



# Specifications Volume 1

Penn State Solar Decathlon Team  
MorningStar: Under.One.Sun  
Penn State

Faculty Advisor: David Riley

August 7, 2007



# Specifications

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## Summary of Changes

Since the March 6, 2007 Penn State Construction Documents submission, the following has been updated and revised:

### Site:

- Finalized planter details
- Finalized handicap accessibility requirements for site drawings

### Architectural:

- Updated Architectural Details (A-400 series)

### Structural

- Finalized foundation plan for National Mall with donation of 2' x 2' concrete pads from High Concrete Group. (The cribbing will interface with the trailer beams similar to that of an historic Pennsylvanian barn.)
- Received approval of the Murus SIP panel system as required by NREL. (See Appendix 5.03 for Thomas Meyers' approval letter.)
- All site elements and enclosures have been checked in accordance with Solar Decathlon Code Section 3.8 "Impact on Turf". (All elements bear less than 1500psf on the mall.)

### Mechanical and Plumbing:

- Added controls drawings to set
- Finalized equipment selections and schedules

### Electrical:

- Located disconnects on floor plans
- Further developed electrical design, including submission of required one-line and wiring diagrams for both AC and DC LED systems.
- Developed grounding design
- Developed design for battery bank enclosures

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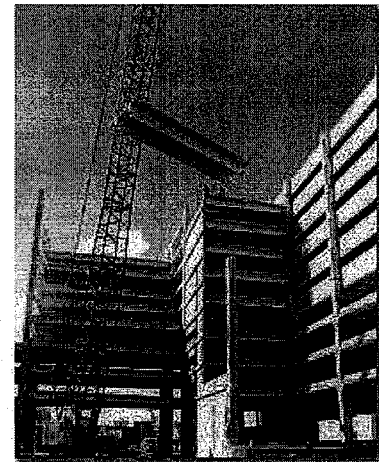
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A precast/prestressed 15-foot MEGA-TEE, produced by High Concrete Structures, is shown being erected at Trump Taj Mahal in Atlantic City, NJ

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This section is an excellent resource for useful information, including:

**Technical Data**

- Architectural Facade Systems Technical Data
- Precast Concrete Parking Structures Technical Data **NEW**
- Industrial/Commercial Wall Systems Technical Data
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- Prison Systems Technical Data

**Precast Specifications**

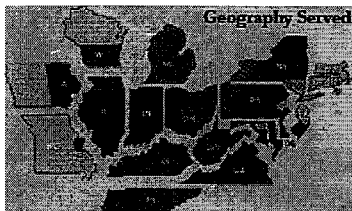
- Section 3410 - Precast/Prestressed Concrete Products
- Section 3450 - Precast Architectural Concrete Products

**Load Test Data**

- Inverted Tee Beams
- 12 ft. Tees
- 15 ft. Tees

**UL Certifications**

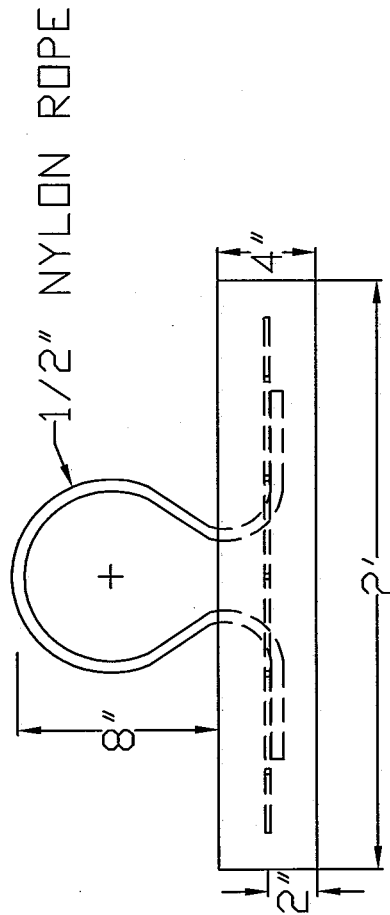
- UL File No. R9270

**Typical Loading Scheme****More Engineering Tips and Info**

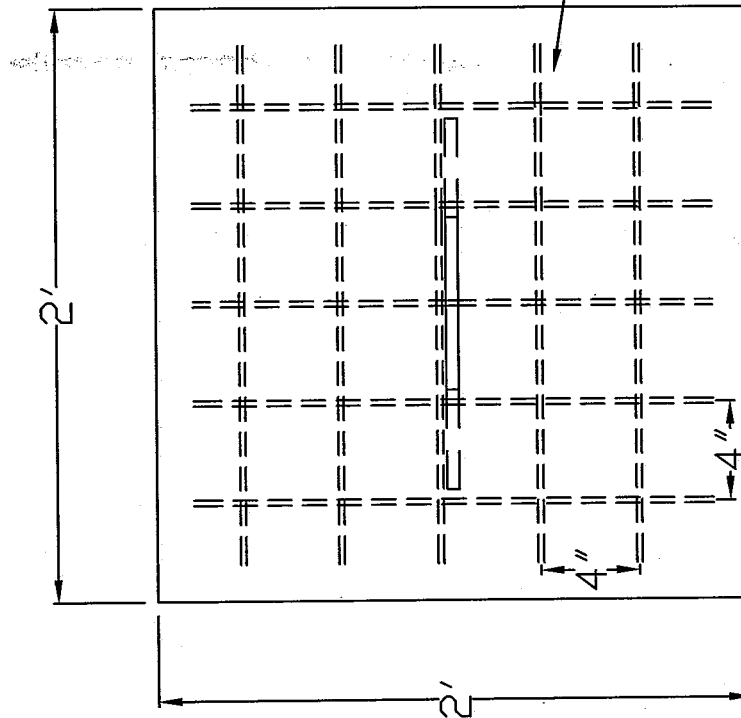
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	CHECKED	-		
	ENGINEER	-		
PROJECT	PENN STATE FOUNDATION BASE			
DRAWING	PSU-001	JOB	07-343	

## Division 04 - Masonry

04 0000	Masonry
04 4000	Stone Assemblies
04 5000	Refractory Masonry
04 6000	Corrosion-Resistant Masonry
04 7000	Manufactured Masonry

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## Division 05 - Metals

- 05 0000 Metals
- 05 1000 Structural Metal Framing
- 05 2000 Metal Joists
- 05 3000 Metal Decking
- 05 4000 Cold-Formed Metal Framing
- 05 5000 Metal Fabrications
- 05 7000 Decorative Metal

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THE STANDARD IN PV MOUNTING STRUCTURES

## SOLARMOUNT

U.S. and other patents pending

### Minimum Requirements

The user is solely responsible for the soundness of his or her Estimator inputs. To ensure a sound, code-compliant installation, install your array in accordance with the SolarMount Code-Compliant Planning and Assembly manual applicable to your building code. Download it from [www.unirac.com](http://www.unirac.com).

#### Design Parameters

Module manufacturer	BP Solar	Module model number	BP4175
Total modules in the array	3	Number of modules per row	1
Clamps / Clips	Top mounting clamps dark	Mounting system	Low profile
Footing	Raised flange standoffs steel	Standoff height	3
Flashing	Oatey 12 1/2" X 8 3/4" galv	Rail Type	Standard rail

#### Quote

Part number	Qty	Description	List price (each)	Extended price
300201	3	SM RAIL KIT, STD, 48"	\$ 108.00	\$ 324.00
320095	3	SM CLAMP E KIT, DRK, 2 MODULES	\$ 25.00	\$ 75.00
310121	6	LEG KIT, LOW-PROF, CLR, 1 @ 12"	\$ 30.00	\$ 180.00
310047	1	STANDOFFS, FLANGE, 3" @ 12	\$ 192.00	\$ 192.00
990101	1	GALV FLASH, 12 @ 1.25"-1.5"	\$ 75.50	\$ 75.50

<b>Total list price</b>	<b>\$846.50</b>
<b>Price per watt</b>	<b>\$1.61</b>

Most prices are suggested list price per individual item. If purchased in bulk, unit prices for all items will be lower.

Consult the SolarMount Price List for details. Prices and specifications are subject to change without notice.

Spacing between the rails equals spacing between L-feet on the ground/roof, which equals two-thirds the module length.

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505.242.6412 Fx



THE STANDARD IN PV MOUNTING STRUCTURES™



U.S. and other patents pending

## Minimum Requirements

Users are solely responsible for determining their inputs. To ensure a proper installation, assemble your array in accordance with Installation Manual 808.1: SunFrame Planning and Assembly for Threaded Slot Rail. Download it from [www.unirac.com](http://www.unirac.com).

### Design Parameters

Module manufacturer	BP Solar	Module model number	BP4175
Module orientation	Landscape	Total modules in the array	15
Number of rows in array	5	Number of modules per row	3
Foot spacing	24 inches	Finish	Dark anodized

### Quote

Part number	Qty	Description	List price (each)	Extended price
302013	1	SF THREADED RAIL, DRK, 8 @ 96"	680.00	680.00
302014	4	SF THREADED RAIL, DRK, 1 @ 96"	93.50	374.00
321116	1	SF CAPSTRIP, E, DRK, 8 @ 96"	250.00	250.00
321117	4	SF CAPSTRIP, E, DRK, 96"	34.50	138.00
321155	1	SF CAPSCREWS, 1-1/4" DRK @100	45.00	45.00
321158	6	SF CAPSCREWS, 1-1/4" DRK @ 10	5.20	31.20
310065	2	L-FOOT, SERR, DRK W/HDW @20	79.00	158.00
310066	14	L-FOOT, SERR, DRK W/HDW @1	4.55	63.70
310228	6	SPLICE BAR, SERRATED, DRK @ 1	6.10	36.60
310225	6	SF ENDCAPS, THREADED, @ 2	5.55	33.30

**Total list price** \$1,809.80

**Price per watt** \$0.69

Most prices are suggested list price per individual item. If purchased in bulk, unit prices for all items will be lower. Consult the SunFrame Price List for details. Prices and specifications are subject to change without notice.

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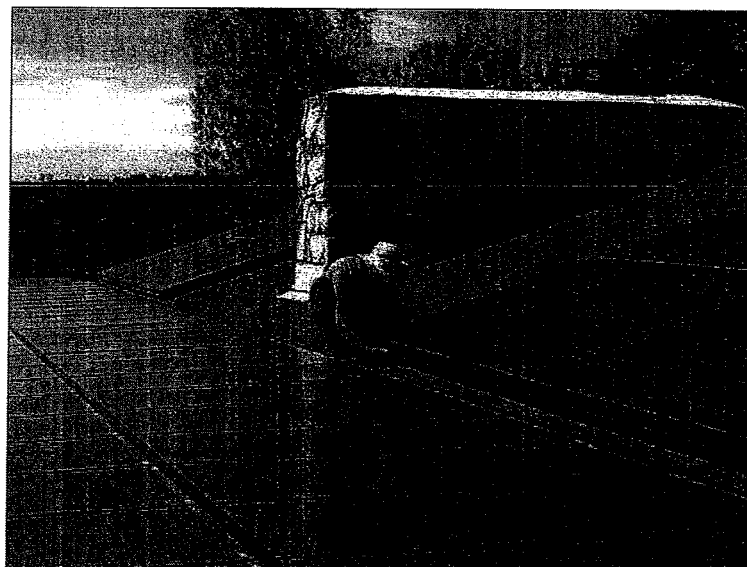
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THE STANDARD IN PV MOUNTING STRUCTURES™

## SUNFRAME®

### Planning and Assembly for Threaded Slot Rail *Installation Manual 808.1*



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June 2006



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## Scope and installer responsibility

Please review this manual thoroughly before installing SunFrame Systems using threaded slot rails.

The installer is solely responsible for:

- Complying with all applicable local or national building codes, including any that may supersede this manual;
- Ensuring that UniRac and other products are appropriate for the particular installations and are designed for the installation environment;
- Ensuring that the roof, its rafters, connections and other structural support members can support the array under live load conditions;
- Ensuring that lag screws have adequate pull-out strength and shear capacities;
- Maintaining the waterproof integrity of the roof including selection of appropriate flashing; and
- Ensuring safe installation of all electrical aspects of the PV array.

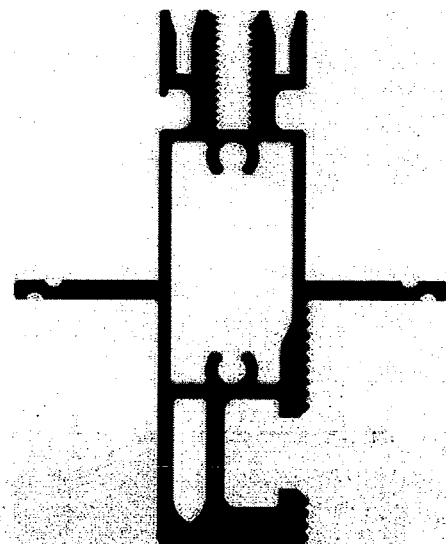


Figure 1. SunFrame threaded slot rail, cross section, actual size.



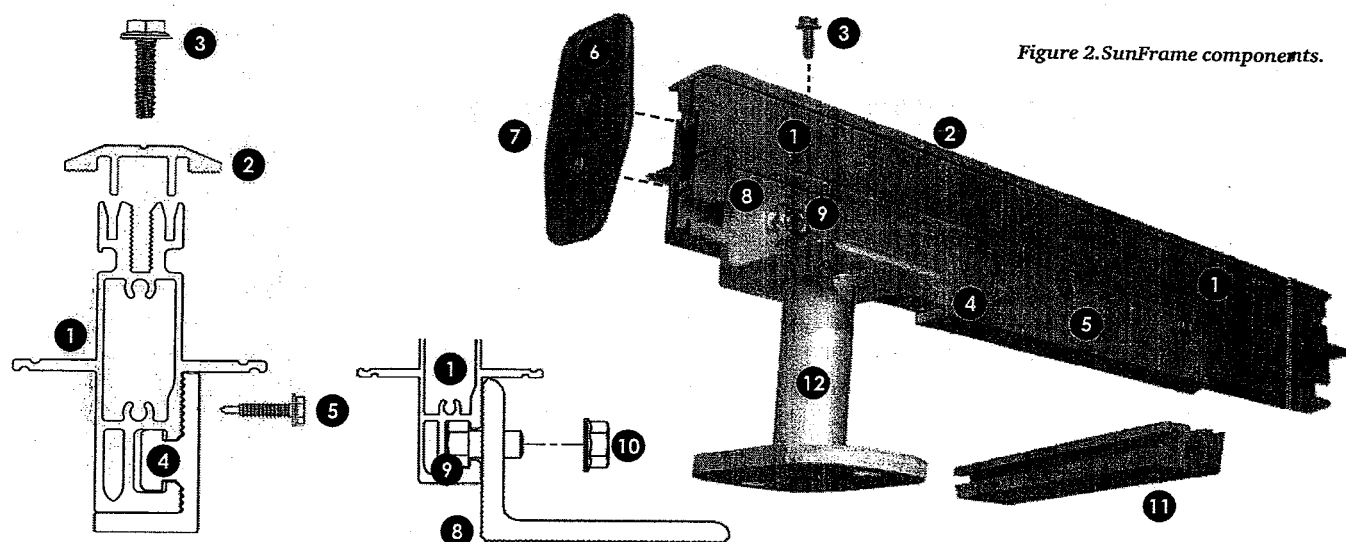


Figure 2. SunFrame components.

## SunFrame® components

1. **Rail**—Supports PV modules. Use one per row of modules plus one. Shipped in 8- or 16-foot lengths. 6105-T5 aluminum extrusion, anodized (clear or dark bronze) to match PV module frame.
2. **Cap strip**—Secures PV modules to rails and neatly frames top of array. Lengths equals rail lengths. Cap strips are sized for specific PV modules. Shipped in 8- or 16-foot lengths. Predrilled every 8 inches. 6105-T5 aluminum extrusion, anodized (clear or dark bronze) to match PV module frame.
3. **Cap strip screw** ( $\frac{1}{4}$ -20, Type F thread cutting)—Use to secure each cap strip (and PV modules) to rail, one per predrilled hole. Use an additional end screw wherever a predrilled hole does not fall within 4 inches of the end of any cap strip segment. 18-8 stainless steel, clear or dark to match cap strip.
4. **Rail splice**—Joins rail sections into single length of rail. It can form either a rigid or thermal expansion joint. 8 inches long, predrilled. 6105-T5 aluminum extrusion, anodized (clear or dark bronze) to match PV module frame.
5. **Self-drilling screw** (No. 10 x  $\frac{3}{4}$ ")—Use 4 per rigid splice or 2 per expansion joint. Galvanized steel.
6. **End caps**—Use one to neatly close each rail end. UV resistant black plastic.
7. **Truss-head sheet metal screw** (No. 8 x  $\frac{5}{8}$ ")—Use 2 per end cap to secure end cap to rail. 18-8 stainless steel; with black oxide coating to match end caps.
8. **L-foot**—Use to secure rails either through roofing material to rafters, to L-foot adjusting sliders, or to standoffs. Use no less than one L-foot per 4 feet of rail. 6105-T5 aluminum extrusion, anodized (clear or dark bronze) to match PV module frame.
9. **L-foot bolt** ( $\frac{3}{8}$ " x  $1\frac{1}{4}$ ")—Use one per L-foot to secure rail to L-foot. 304 stainless steel.
10. **Flange nut** ( $\frac{3}{8}$ ")—Use one per L-foot bolt. 304 stainless steel. Required torque: 30 to 35 foot-pounds.
11. **L-foot adjusting slider** (optional)—Use one beneath each L-foot or aluminum two-piece standoff, except in lowest row. 6105-T5 aluminum extrusion. Sliders allow easier alignment of rails and better snugging of PV modules between rails. Includes  $\frac{3}{8}$ " x  $1\frac{1}{4}$ " bolt with flange nut for attaching L-foot or standoff shaft, and two  $\frac{5}{16}$ " x  $2\frac{1}{2}$ " lag bolts with flat washers for securing sliders to rafters.
12. **Flattop standoff** (optional)—Use if L-foot cannot be secured directly to rafter (with tile or shake roofs, for example). Sized to minimize roof to rail spacing. Use one per L-foot. **Two-piece** (pictured): 6105-T5 aluminum extrusion. Includes  $\frac{3}{8}$ " x  $\frac{3}{4}$ " bolt with lock washer for attaching L-foot, and two  $\frac{5}{16}$ " x  $3\frac{1}{2}$ " lag bolts. **One-piece**: Service Condition 4 (very severe) zinc-plated welded steel. Includes  $\frac{3}{8}$ " x  $1\frac{1}{4}$ " bolt with lock washer for attaching L-foot. **Flashings**: Use one per standoff. UniRac offers appropriate flashings for both standoff types.

**Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood, (1) apply lubricant to bolts, preferably an anti-seize lubricant, available at auto parts stores, (2) shade hardware prior to installation, and (3) avoid spinning on nuts at high speed. See Installation Supplement 910, Galling and Its Prevention, at [www.unirac.com](http://www.unirac.com).**



## Installer supplied materials

**Lag screw for L-foot**—Attaches L-foot or standoff to rafter. Determine length and diameter based on pull-out values in Table 3 (page 8). If lag screw head is exposed to elements, use stainless steel. Under flashings, zinc plated hardware is adequate. *Note: Lag screws are provided with L-foot adjusting sliders and standoffs.*

**Waterproof roofing sealant**—Use a sealant appropriate to your roofing material.

**Clamps for standing seam metal roof**—See "Frequently Asked Questions . . ." (p. 16).

## Planning your SunFrame® installations

When installing SunFrame threaded rail installations, note the following:

- This bulletin addresses only wind loads. Wind generally produces the maximum load factor affecting an installation. However, verify that other local conditions, such as snow loads and earthquake effects, do not exceed the wind loads. If any loading type does exceed wind loads, give precedence to that factor and consult a local professional engineer or your local building authority.
- The roof on which the SunFrame will be installed must be capable of withstanding the design dead load and design live load per footing, listed in Table 2 on pages 7–8.

### 1. Determine basic wind speed at your installation site.

For the United States, The Uniform Building Code (1997) supplies wind speeds in its chart, "Minimum Basic Wind Speeds in Miles per Hour," reproduced on page 5 on this manual. The International Building Code (2003) includes a similar chart, also reproduced on page 5.

If you need clarifications or further assistance or if your installation is outside the United States, consult a local professional engineer or your local building authority.

### 2. Determine exposure category of your installation site.

The Uniform Building Code\* defines wind exposure categories as follows:

**EXPOSURE B** has terrain with buildings, forests or surface irregularities, covering at least 20 percent of the ground level area extending 1 mile (1.61 km) or more from the site.

**EXPOSURE C** has terrain that is flat and generally open extending ½ mile (0.81 km) or more from the site in any quadrant.

**EXPOSURE D** represents the most severe exposure in areas with basic wind speeds of 80 miles per hour (mph) (129 km/h) or greater and has terrain that is flat and

unobstructed facing large bodies of water over 1 mile (1.61 km) in width relative to any quadrant of the building site. Exposure D extends inland from the shoreline ¼ mile (0.40 km) or 10 times the building height, whichever is greater.

The *International Building Code*† defines wind exposure categories as follows:

**EXPOSURE B.** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type of exposure.

**EXPOSURE C.** Open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet (9144 mm) extending more than 1,500 feet (457.2 m) from the building site in any quadrant. This exposure shall also apply to any building located within Exposure B-type terrain where the building is directly adjacent to open areas of Exposure C-type terrain in any quadrant for a distance of more than 600 feet (182.9 m). This category includes flat open country, grasslands and shorelines in hurricane-prone regions.

**EXPOSURE D.** Flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane-prone regions) for a distance of at least 1 mile (1.61 km). Shoreline in Exposure D include inland waterways, the Great Lakes and coastal areas of California, Oregon, Washington and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet (460 m) or 10 times the height of the building or structure, whichever is greater.

\* *Uniform Building Code 1997, Vol. 2, Structural Engineering Design Provisions, chap. 16, div. III, Wind Design, p. 7. The 2001 California Building Code uses the same definitions.*

† *International Building Code 2003, chap. 16, "Structural Design," p. 290.*

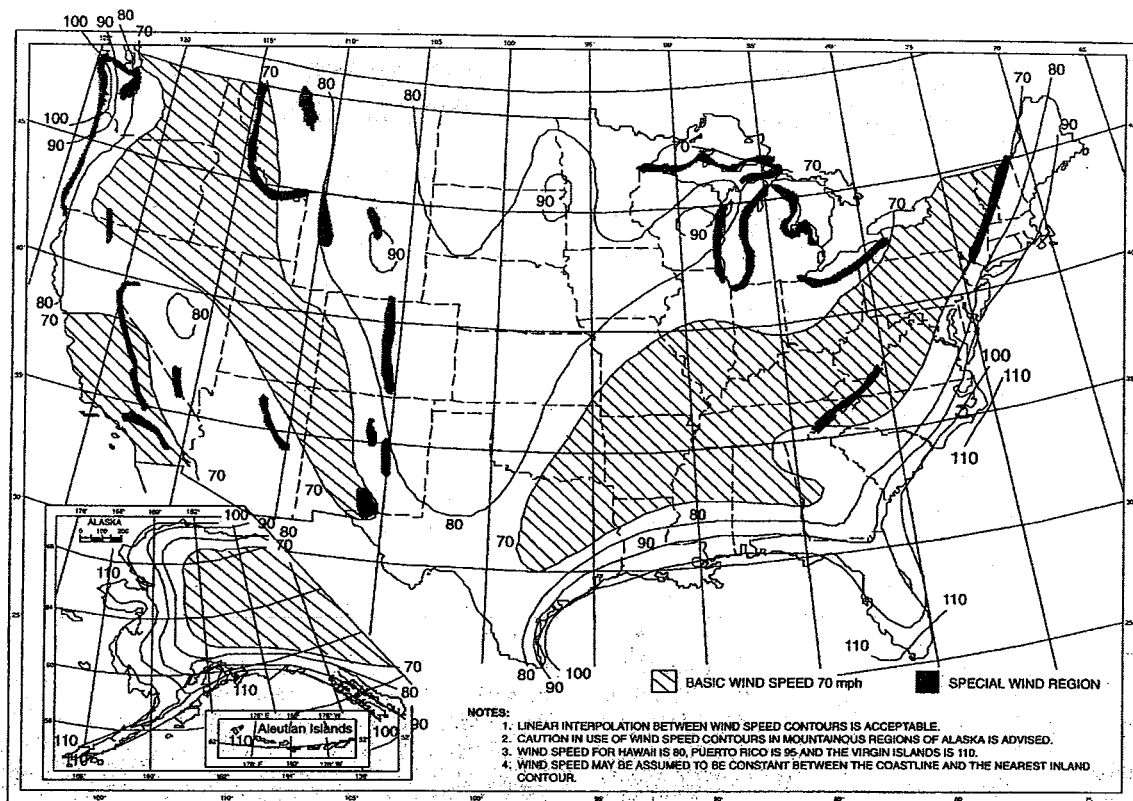


Figure 3. Minimum Basic Wind Speeds. Reproduced from Uniform Building Code 1997, Vol. 2, Structural Engineering Design Provisions, chap. 16, Div. III, Wind Design, Fig. 16.1, "Minimum Basic Wind Speeds in Miles per Hour," p. 36. The 2001 California Building code refers to the same map.

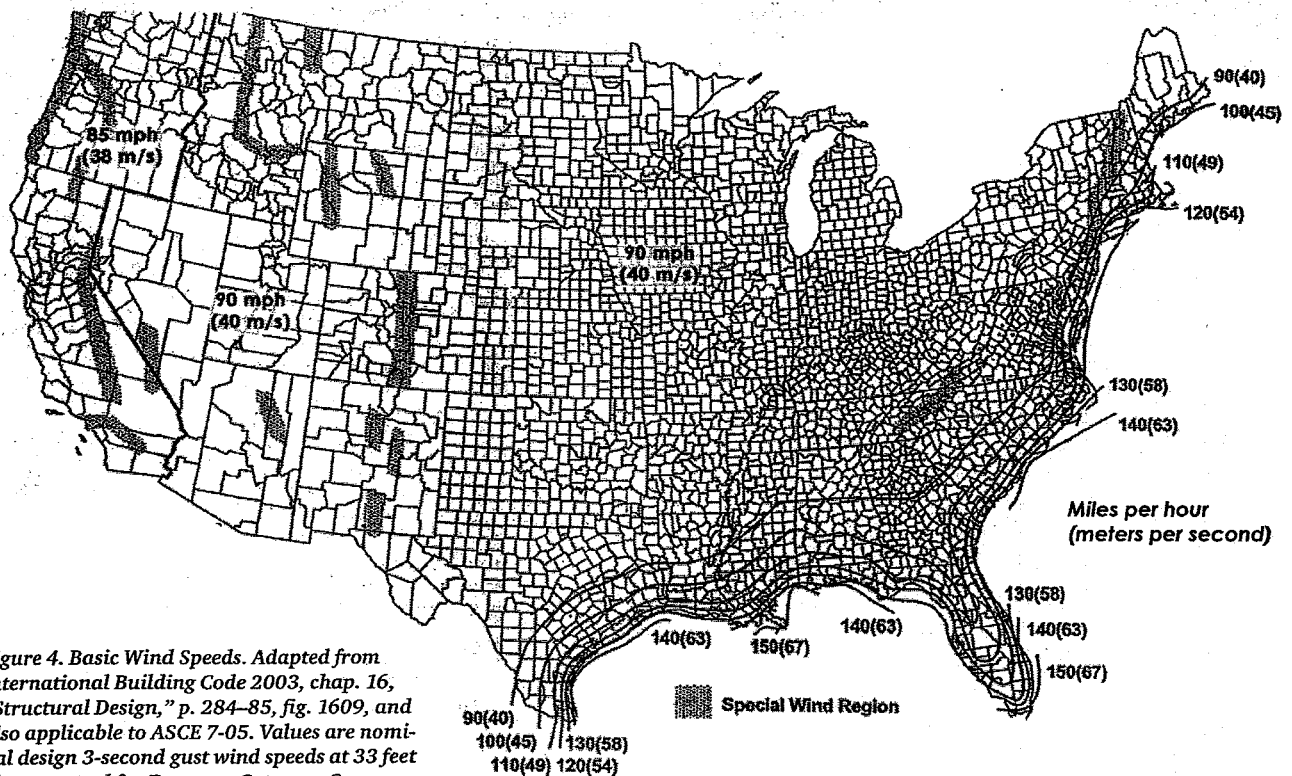


Figure 4. Basic Wind Speeds. Adapted from International Building Code 2003, chap. 16, "Structural Design," p. 284-85, fig. 1609, and also applicable to ASCE 7-05. Values are nominal design 3-second gust wind speeds at 33 feet above ground for Exposure Category C.



### 3. Determine the design wind pressure required for your installation.

Design wind pressure is the amount of wind pressure that a structure is designed to withstand, expressed here in pounds per square foot (psf). To determine the design wind pressure required for your installation, apply the following factors using Table 1:

- your basic wind speed (determined in step 1),
- your exposure category (determined in step 2), and
- the height of your roof above the ground.

If your values fall outside the range of the table, or if your design wind pressure exceeds 50 psf, consult UniRac, a professional engineer, or your local building authority.



**Module manufacturers provide wind pressure rating for their modules. Confirm that they meet or exceed the wind speed rating for your installation. If in doubt, contact the module manufacturer.**

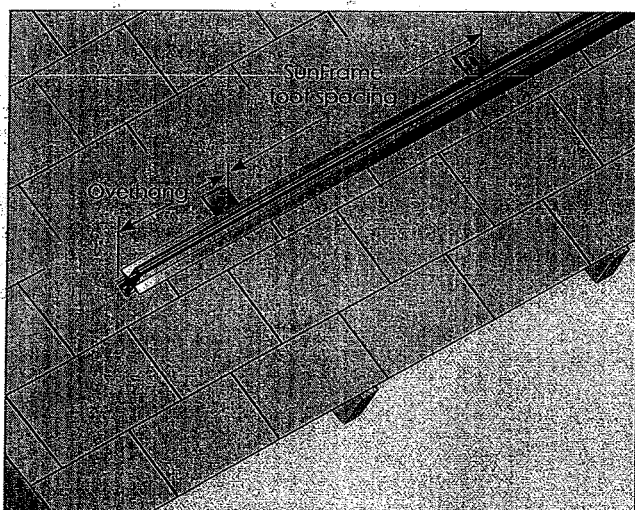


Figure 5. Foot spacing and overhang defined.

Table 1. Design wind pressure (psf) by wind speed and exposure category

	Basic wind speed (mph)						
	70	80	90	100	110	120	130
<b>Category B</b>							
15' roof height	10	13	17	21	25	30	35
20' roof height	11	14	18	22	27	32	38
25' roof height	12	15	19	24	29	35	41
30' roof height	12	16	21	25	31	36	43
<b>Category C</b>							
15' roof height	17	23	29	35	43	51	60
20' roof height	19	24	31	38	46	54	64
25' roof height	19	25	32	40	48	57	67
30' roof height	20	26	33	41	50	59	69
<b>Category D</b>							
15' roof height	23	30	38	46	56	67	78
20' roof height	24	31	39	48	58	70	82
25' roof height	25	32	41	50	60	72	84
30' roof height	25	33	42	51	62	74	87

Source: These design wind pressure (P) values are based on the formula  $P = C_e * C_q * q_s * I_w$  (UBC, 1997, Vol. 2, Structural Engineering Design Provisions, Chapter 16, Div. III, Wind Design, p. 7). Assumptions:  $I_w = 1$  and  $C_q = 1.3$ .

### 4. Determine minimum design dead and live loads for standard rafter spacing.

Foot spacing refers to the space between L-feet (or stand-offs, if used) along the same SunFrame rail (Fig. 5). Footing spacing may not exceed 48 inches. For the rafter spacing at your installation, consult Table 2 to determine your minimum design live loads and design dead loads per footing. Locate the manufacturer and model of the PV module that you plan to install and the rafter spacing at your installation site.

Read or interpolate live loads for the design wind pressure you determined in Step 3. For assistance on this point, consult a local professional engineer.

**Verify that roof framing members have adequate capacity to support these design loads. If they do not, try a closer footing spacing. If the result is still not acceptable, relocate the array to a stronger area of the roof or strengthen the inadequate framing elements.**



### 5. Verify acceptable rail end overhang.

Rail overhang (Fig. 5) must not exceed 50 percent of footing spacing. For example, if footing spacing is 48 inches, the rail overhang cannot be more than 24 inches. In this case, two footings can support a rail as long as 96 inches (48 inches between the footings and 24 inches of overhang at each end).



Table 2. SunFrame Loads (pounds per footing) at Standard Rafter Spacings

Your design point loads (capacity per footing) must be at or above the loads listed here. The installer is solely responsible for verifying that the roof can withstand these design point loads. For specifications based on design wind pressure values greater

than 50 pounds per square foot, contact UniRac. In general, the minimum design live load equals the footing spacing (in feet) times the rail spacing (in feet) times the design wind pressure from Table 1.

	Minimum design dead load	Minimum design live load as a function of design wind pressure			
		20 psf	30 psf	40 psf	50 psf
<b>BP Solar BP3125</b>					
Rafter/footing spacing: 24"	29	276	375	474	573
32"	39	392	524	656	788
48"	59	661	NA	NA	NA
<b>BP Solar BP3150, -3160; -4175; BPSX160, -170</b>					
Rafter/footing spacing: 24"	31	289	394	498	603
32"	41	410	549	689	NA
48"	61	687	NA	NA	NA
<b>Evergreen EC102, EC110, EC115</b>					
Rafter/footing spacing: 24"	30	288	392	496	600
32"	41	408	546	685	NA
48"	61	684	NA	NA	NA
<b>GE Energy GEPIV100M, -110M</b>					
Rafter/footing spacing: 24"	30	272	369	466	563
32"	40	387	516	645	774
48"	59	653	NA	NA	NA
<b>GE Energy GEPIV173M</b>					
Rafter/footing spacing: 24"	30	272	369	466	563
32"	40	387	516	645	775
48"	60	653	NA	NA	NA
<b>Isofoton I-100</b>					
Rafter/footing spacing: 24"	30	250	336	422	508
32"	40	357	472	586	701
48"	60	608	780	NA	NA
<b>Isofoton I-150S</b>					
Rafter/footing spacing: 24"	30	250	336	422	508
32"	40	357	472	586	701
48"	60	608	780	NA	NA
<b>Kyocera KC130GT</b>					
Rafter/footing spacing: 24"	31	266	360	453	547
32"	41	379	504	629	753
48"	62	641	NA	NA	NA
<b>Kyocera KC170GT</b>					
Rafter/footing spacing: 24"	28	245	330	415	499
32"	38	351	464	577	690
48"	56	599	768	NA	NA
<b>Kyocera KC200GT</b>					
Rafter/footing spacing: 24"	31	266	360	453	547
32"	41	379	504	628	753
48"	62	641	NA	NA	NA
<b>Mitsubishi MFI10EC3, MFI20EC3</b>					
Rafter/footing spacing: 24"	30	265	359	452	546
32"	40	378	502	627	752
48"	60	639	NA	NA	NA
<b>Mitsubishi MFI25A2LF, MFI30EA2LF</b>					
Rafter/footing spacing: 24"	28	239	321	403	484
32"	37	343	452	561	670
48"	55	586	750	NA	NA
<b>Mitsubishi MFI60B3, -165B3, -170EB3</b>					
Rafter/footing spacing: 24"	31	288	391	495	599
32"	42	408	546	684	NA
48"	63	684	NA	NA	NA
<b>Photowatt PW1650</b>					
Rafter/footing spacing: 24"	29	239	320	401	482
32"	39	343	451	559	667
48"	58	586	749	NA	NA
<b>Sanyo HIP-180BA3, -185BA3, -190BA3, -196BA3, -200BA3</b>					
Rafter/footing spacing: 24"	27	248	335	421	508
32"	36	355	470	586	701
48"	55	605	778	NA	NA
<b>Schott Solar ASE285, ASE300, ASE315</b>					
Rafter/footing spacing: 24"	58	356	480	604	728
32"	77	499	664	NA	NA
48"	NOT APPLICABLE				
<b>Sharp ND-072ERU/LU (72W nonrectangular end module), and ND-N2ECU (142W)</b>					
Rafter/footing spacing: 24"	24	224	300	377	453
32"	32	322	424	526	628
48"	47	556	709	NA	NA
<b>Sharp ND-L3EJEA (123W), ND-L5E1U (125W)</b>					
Rafter/footing spacing: 24"	34	279	378	476	575
32"	45	397	528	659	790
48"	68	667	NA	NA	NA
<b>Sharp ND-162U1, ND-167U3A</b>					
Rafter/footing spacing: 24"	29	250	336	423	509
32"	38	357	472	588	703
48"	57	608	781	NA	NA
<b>Sharp NE-170U1</b>					
Rafter/footing spacing: 24"	33	289	392	495	599
32"	44	409	547	685	NA
48"	66	686	NA	NA	NA
<b>Sharp ND-200U1, ND-208U1</b>					
Rafter/footing spacing: 24"	33	298	406	513	621
32"	45	421	565	709	NA
48"	67	704	NA	NA	NA
<b>Shell 165P, -PC, 175P, -PC</b>					
Rafter/footing spacing: 24"	35	297	404	510	617
32"	47	420	562	704	NA
48"	70	703	NA	NA	NA

NA = not applicable. Never allow total load (live load plus dead load) to exceed 800 pounds per footing.

Continued on page 8

Table 2 (continued from p. 7). SunFrame Loads (pounds per footing) at Standard Rafter Spacings

Your design point loads (capacity per footing) must be at or above the loads listed here. The installer is solely responsible for verifying that the roof can withstand these design point loads. For specifications based on design wind pressure values greater

than 50 pounds per square foot, contact UniRac. In general, the minimum design live load equals the footing spacing (in feet) times the rail spacing (in feet) times the design wind pressure from Table 1.

	Minimum design dead load	Minimum design live load as a function of design wind pressure					Minimum design dead load	Minimum design live load as a function of design wind pressure			
		20 psf	30 psf	40 psf	50 psf			20 psf	30 psf	40 psf	50 psf
<b>SunPower SPR200, SPR210</b>											
Rafter/footing spacing: 24"	32	286	388	490	593						
32"	43	405	542	678	NA						
48"	64	680	NA	NA	NA						
<b>SunWize SW115, SW120</b>											
Rafter/footing spacing: 24"	30	269	363	458	553						
32"	40	382	509	635	762						
48"	61	646	NA	NA	NA						
<b>SunWize SW155L, SW165L</b>											
Rafter/footing spacing: 24"	30	301	412	523	634						
32"	40	425	573	721	NA						
48"	60	710	NA	NA	NA						
<b>UniSolar ES62T</b>											
Rafter/footing spacing: 24"	15	228	310	393	475						
32"	20	328	438	548	658						
48"	30	564	729	NA	NA						
<b>UniSolar US64</b>											
Rafter/footing spacing: 24"	23	250	340	429	519						
32"	30	358	477	597	716						
48"	45	609	788	NA	NA						
<b>Yingli YL80, YL85</b>											
Rafter/footing spacing: 24"	26	227	304	381	458						
32"	35	327	430	532	635						
48"	52	563	717	NA	NA						

NA = not applicable. Never allow total load (live load plus dead load) to exceed 800 pounds per footing.

#### 6. Ensure that live loads do not exceed pull-out limits.

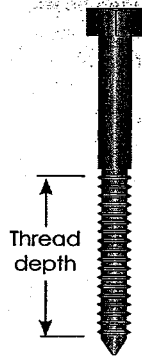
Based on the characteristics of your roof truss lumber and the lag screws, consult Table 3 to determine the lag pull-out value per 1-inch thread depth. Compare that value to the minimum design live load per footing determined in step 4. Based on these values, determine the length of the lag-screw thread depth you require to resist the design live load. The lag pull-out value per footing must be greater than the footing design live load.

If your SunFrame rails require splices, see also "Footing and splicing requirements" (p. 11), before beginning your installation.

If your SunFrame requires standoffs, always use at least two lag screws to secure each standoff to the structural member. Bolt the L-foot to the standoff through the slot nearest the bend in the L-foot.

Table 3. Lag screw design pull-out values (pounds per embedded 1" thread depth) in typical roof truss lumber

	Specific gravity	Lag screw	
		5/16"	3/8"
Douglas Fir—Larch	0.50	266	304
Douglas Fir—South	0.46	235	269
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	0.46	235	269
Hem—Fir	0.43	212	243
Hem—Fir (North)	0.46	235	269
Southern Pine	0.55	307	352
Spruce, Pine, Fir	0.42	205	235
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	0.50	266	304



Sources: Uniform Building Code 1997, American Wood Council.

Notes: (1) Thread must be embedded in a rafter or other structural roof member. (2) Pull-out values incorporate a 1.6 safety factor recommended by the American Wood Council. (3) See Uniform Building Code for required edge distances.

## Installing the array

Safe, efficient SunFrame installation involves three principal tasks:

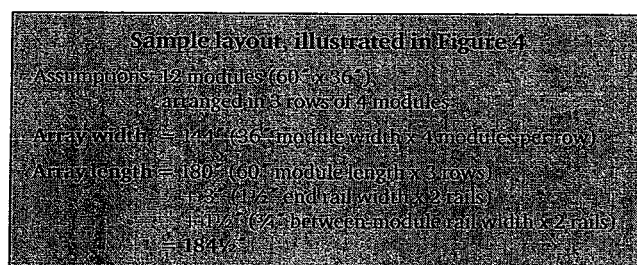
- Laying out the installation area and planning for material conservation.
- Installing footings and rails, beginning with the *lowest* row and moving up the roof.
- Placing modules and cap strips, beginning with the *highest* row and moving down the roof.

The following illustrated steps describe the procedure in detail. Before beginning, please note these important considerations.

**Footings must be lagged into structural members. Never attach them to the decking alone, which leaves both the array and roof susceptible to severe damage.**



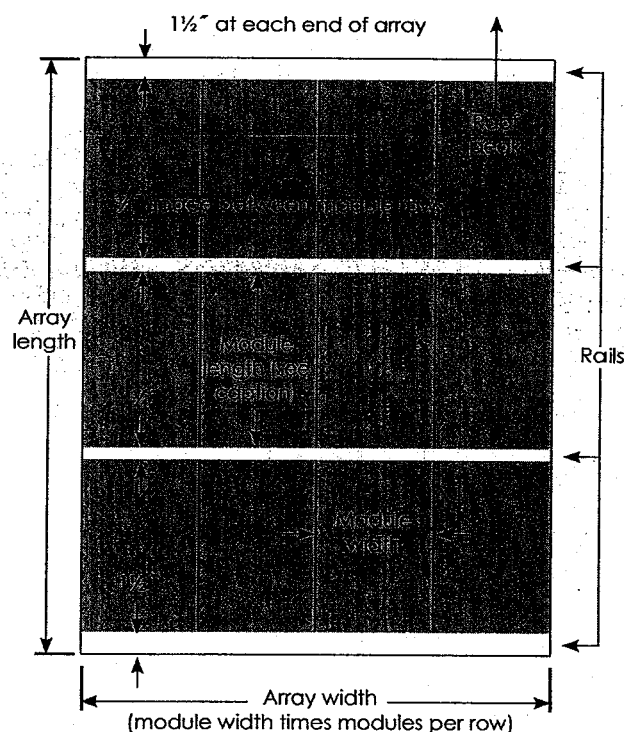
**For array widths or lengths greater than 32 feet, contact UniRac concerning thermal expansion issues.**



### 1. Laying out the installation area

Always install SunFrame rails perpendicular to rafters. (These instructions assume typical rafters that run from the gutter to the peak of the roof. If this is not the case, contact UniRac.) Rails are typically mounted horizontally (parallel to the lower edge of the roof), and *must* be mounted within 10 degrees of horizontal.

Leave adequate room to move safely around the array during installation. During module installation, you will need to slide one module in each row about a foot beyond the end of the rails on one side. Using the number of rows and the number of modules per row in your installation, determine the size of your array area following Figure 6.



**Figure 6. Installation area layout. Note: Module length is not necessarily measured from the edges of the frame. Some frames have lips. Others are assembled with pan-head screws. All such features must be included in module length.**



## 2. Installing the lowest row of L-feet and rail

In the lowest row, it is not necessary to use L-foot adjusting sliders, even if you plan to use them in subsequent rows. Install L-feet directly onto low profile roofing material such as asphalt shingles or sheet metal. (For high profile roofs, such as tile or shake, use optional standoffs with flashing to raise L-feet. L-feet must be flush with or above the highest point of the roof surface.)

L-feet can be placed with the double-slotted side against the roof surface (as in Fig. 7) or with the single-slotted side against the roof (which increases air circulation beneath modules). Module-to-roof dimensions are listed on page 15 for both arrangements.



**If you are using L-foot adjusting sliders, you must use the short side of the the L-foot against the roof in the first row. See Figure 9 below.**

**If you are using both L-foot adjusting sliders and standoffs, see the upper box on page 11.**

Install the first row of L-feet at the lower edge of the installation area (Fig. 8). Ensure feet are aligned by using a chalk line. (A SunFrame rail can also be used as a straight edge.) Position the L-feet with respect to the lower edge of the roof as illustrated in Figures 7 and 8.

Drill a pilot hole through roof into the center of rafter at each

L-foot lag screw hole location. Apply weatherproof sealant into the hole and onto shafts of the lag screws. Seal the underside of the L-feet with a suitable weatherproof sealant.

Fasten the L-feet to the roof with the lag screws. **If the double slotted sides of the L-feet are against the roof, lag through the slot nearest the bend in the L-foot (Figs. 7 and 8).**

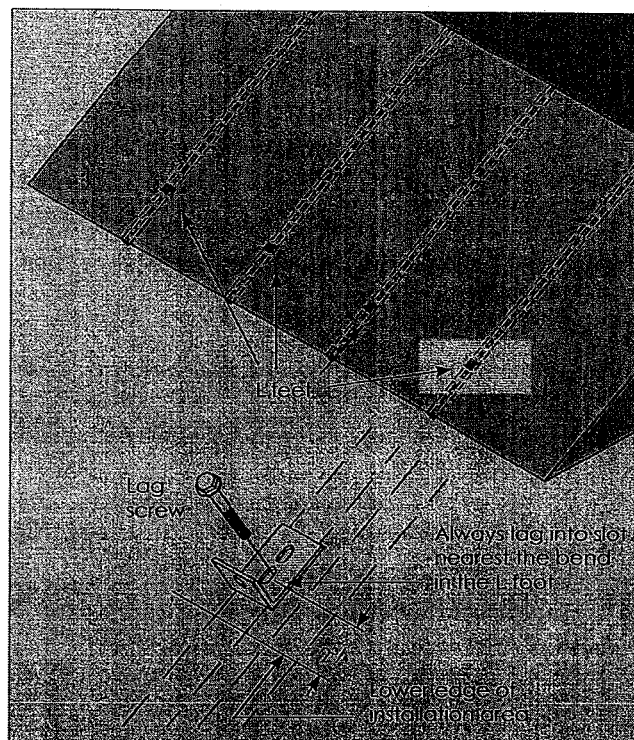


Figure 7. Placement of first L-foot row.

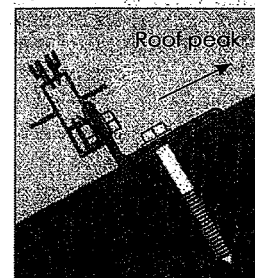
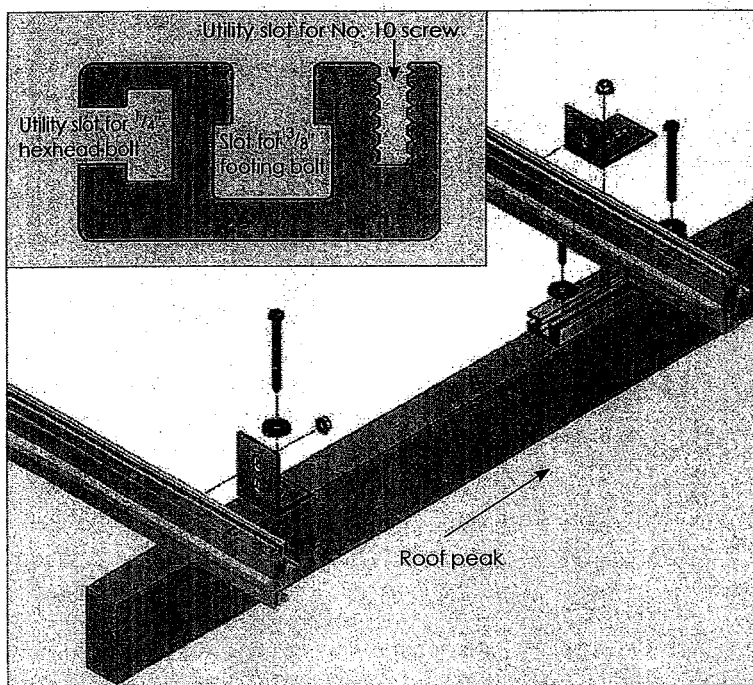


Figure 8. L-Foot orientation.



Cut the rails to your array width, being sure to keep rail slots free of roofing grit or other debris. If your installation requires splices, assemble them prior to attaching L-feet (see "Footings and splicing requirements," p. 11, and "Material planning for rails and cap strips," p. 13). Slide the  $\frac{3}{8}$ -inch mounting bolts into the footing slots. **If more than one splice is used on a rail, slide L-foot bolt(s) into the footing slot(s) of the interior rail segment(s) before splicing.**

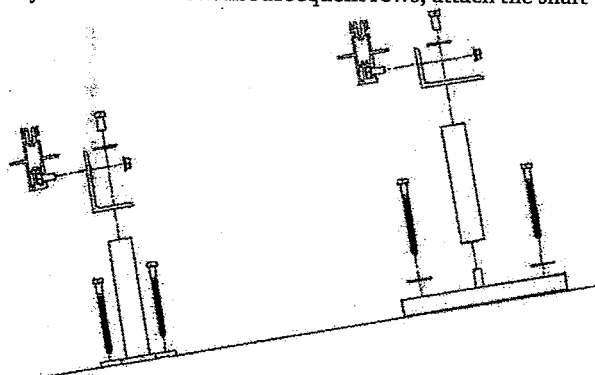
Loosely attach the rails to the L-feet with the flange nuts. Ensure that rails are oriented with respect to the L-feet as shown in Figure 9. Align the ends of the rail to the edge of the installation area. Ensure that the rail is straight and parallel to the edge of the roof. Securely tighten the lag screws.

Figure 9. L-foot orientation in conjunction with L-foot adjusting sliders. The sliders include two utility slots to secure module wiring, combiner boxes, and other system components.

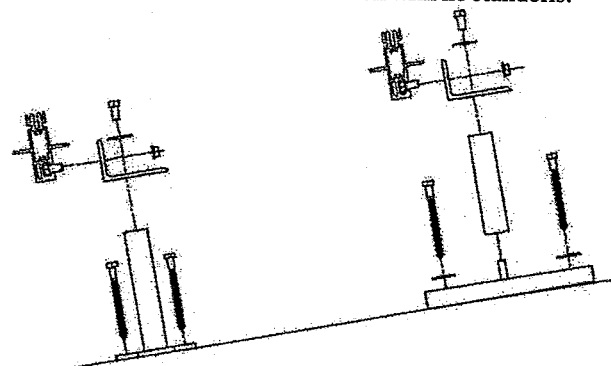
## Using standoffs with L-foot adjusting sliders

Two-piece aluminum standoffs may be used with footing sliders, although flashings may not be available to cover the entire length of the slider. Use the bases of the standoffs only in the lowest row. In subsequent rows, attach the shaft

of each standoff to the slider using the slider's  $\frac{3}{8}$ -inch hex-head bolt. Note that L-feet are positioned long side up on the lowest rows and with long side down in subsequent rows—in the same manner as an installation with no standoffs.



With standoffs of equal length, orient L-foot to compensate for height difference.



If the standoff supporting the lowest rail is 1 inch taller than the standoffs on the footing sliders, place both L-feet in the same orientation—either both long side up or both short side up.



This example assumes a rail seven times the length of the footing spacing (A). A splice may be located in any of the

shaded areas. If more than one splice is used, be sure the combination does not violate Requirements 5, 6, or 7.

## Footing and splicing requirements

The following criteria are required for sound installations.

While short sections of rail are structurally permissible, they can usually be avoided by effective planning, which also promotes superior aesthetics. See "Material planning for rails and cap strips" (p. 13).

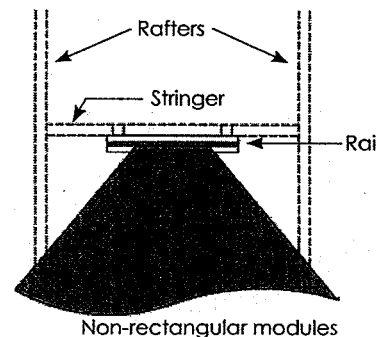
*The installer is solely responsible for ensuring that the roof and its structural members can support the array and its live loads.*

*For rail lengths exceeding 48 feet, thermal expansion joints may be necessary. Please contact UniRac.*

1. Footing spacing along the rail (A in illustration above) is determined by wind loading (see pp. 5–8, especially step 4). Foot spacing must never exceed 48 inches.
2. Overhang (B) must be no more than half the length of the maximum footing spacing (A). For example, if Span A is 32 inches, Overhang B should not exceed 16 inches.

3. Do not locate a splice in the center third of the span between two adjacent feet.
4. In a spliced length of rail, all end sections must be supported by no less than two L-feet.
5. All interior rail sections must be supported by no less than one L-foot.
6. Interior rail sections supported by only one L-foot must be adjacent, on at least one side, to a rail section supported by no less than two L-feet.
7. Rail sections longer than half the footing spacing require no fewer than two L-feet.

*Modules should always be fully supported by rails. In other words, modules should never overhang rails. This is especially critical when supporting the short side of a non-rectangular module. When a rail supports a pair of non-rectangular modules by themselves (right), it must be supported by at least two L-feet. The rail should be at least 14 and no more than 24 inches long, which will likely require a stringer between rafters to ensure proper footings.*





### 3. Laying out and installing the next row of L-feet

**With L-feet only:** Position the second row of L-feet in accordance with Figure 10. Ensure that you measure between the lower bolt hole centers of each row of L-feet. Install the second row of L-feet in the same manner and orientation as the first row, but leave the lag screws a half turn loose. Be aware of the set-up time of your sealant; the L-feet will not be fully tightened until Step. 4.

**With L-foot adjusting sliders:** Use a chalk line to mark the position of the slider center holes of the next row. The illustration below provides spacing guidelines. The length of the module (A in Fig. 11) includes any protrusions, such as lips or pan-head screws in its frame.

Attach and seal L-foot adjusting slider: Install lower lag first, footing bolt next, and upper lag last. Attach an L-foot with its short side up to each slider.

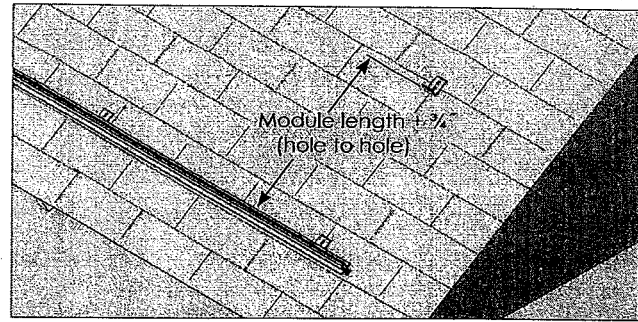


Figure 10. L-foot separation. See the note on module length in the caption of Figure 4 (p. 9).

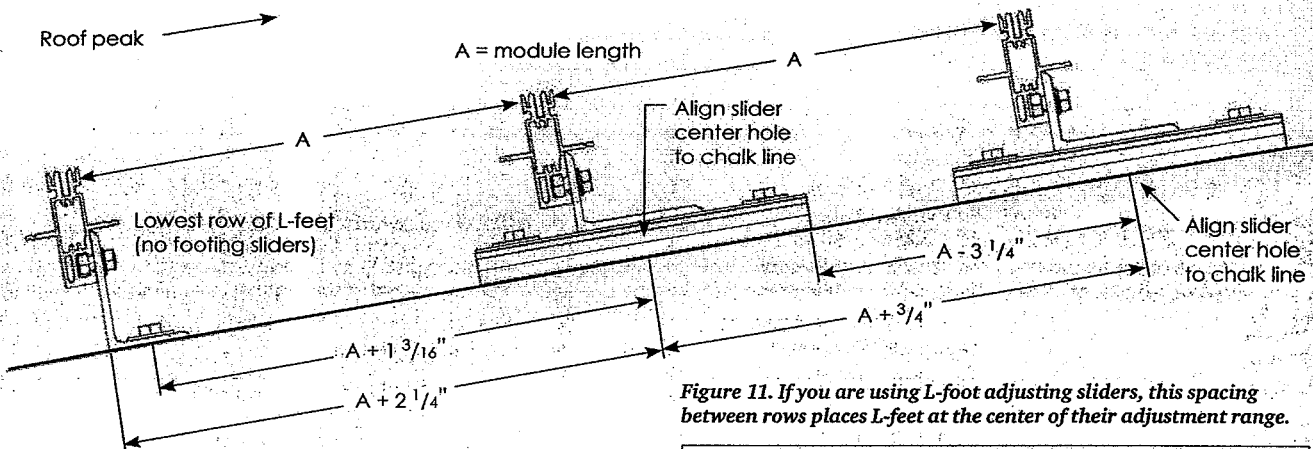


Figure 11. If you are using L-foot adjusting sliders, this spacing between rows places L-feet at the center of their adjustment range.

### 4. Installing the second rails

**With L-feet only** (Fig. 12): Install and align the second rail in the same manner and orientation as the first rail. After rail alignment, securely tighten the rail mounting bolts to between 30 and 35 foot-pounds.

Lay one module in place at one end of the rails, and snug the upper rail (Fig. 12) toward the lower rail, leaving no gap between the ends of the modules and either rail. (If pan-head screw heads represent the true end of the modules, be sure the screw heads touch the rails on both ends.) Securely tighten the lag screw on that end. Slide the module down the rails, snugging the rails and tightening the remaining lag screws as you go.

**With L-foot adjusting sliders:** Install rails on first and second rows of L-feet. Verify spacing by placing a module onto the rails at several points along the row. Adjust L-foot positions as needed.

### 5. Installing remaining L-feet and rails

Install the L-feet and the rails for the remaining rows, following Steps 3 and 4. You may use the same module to space all the rows. When complete, confirm that:

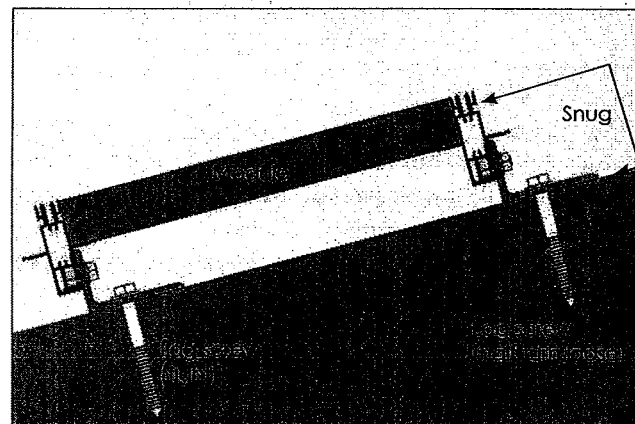


Figure 12. Position and secure top rail.

- All rails are fitted and aligned.
- All footing bolts and lag screws are secure.
- The module used for fitting is resting (but not secured) in the highest row.

## Material planning for rails and cap strips

*Preplanning material use for your particular array can prevent structural or aesthetic problems, particularly those caused by very short lengths of rail or cap strip. This example illustrates one approach.*

Structural requirements for rails are detailed in "Footings and splicing requirements" (p.11). Structurally, cap strips require:

- A screw in every prepunched hole (which occur every 8 inches, beginning 4 inches from the ends of the rails).
- One screw 4 inches or less from the each end of every rail segment. Wherever there is no prepunched hole within 4 inches of an end of a segment, drill a  $\frac{1}{4}$ -inch hole 2 inches from the end of the segment and install a cap strip screw. (In most cases, you can avoid this situation with good material planning.)

Structural requirements always take precedence, but usually good planning can also achieve both material conservation and superior aesthetics. This example conserves material and achieves two specific aesthetic goals:

- Cap strip screws must align across the rails.
- End screws must be equidistant from both sides of the array.

The example assumes an array of three rows, each holding five modules 41 inches wide. Thus, four 205-inch rail

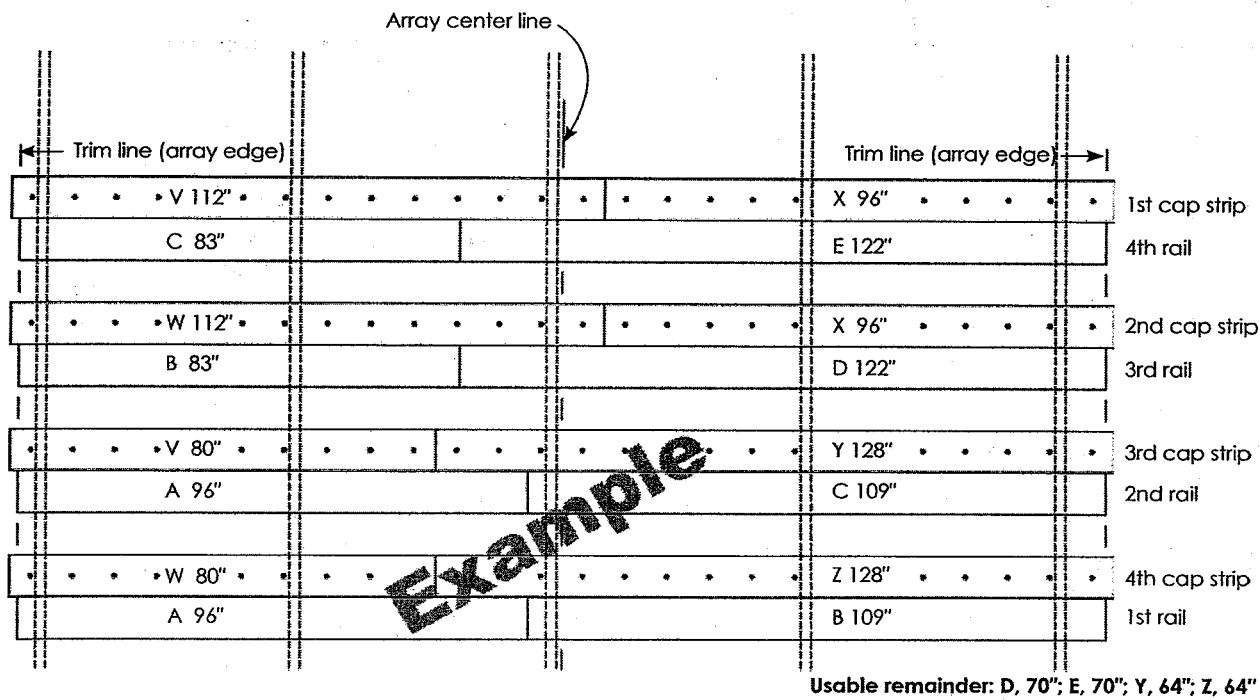
assemblies and cap strip assemblies need to be cut and spliced from 192-inch sections of rail and cap strip. The example illustrates one means of doing so, without violating structural requirements or aesthetic goals.

Rail segments come from five 192-inch lengths, lettered A thru E. Rail A, for example, is cut into two 96-inch segments, with one segment spliced into each of the first two rails. Similarly, five 192-inch cap strips are designated V through Z.

All cap strip segments are cut at the midpoint between prepunched screw holes. For each rail, start with the cap strip segment that crosses the array center line, and position over the center line so that the appropriate holes are spaced equally on either side.

Position each cap strip onto its rail and mark its trim point. Remove and trim before final mounting.

*Preliminary footing and splice positions must be checked against structural requirements in "Footings and splicing requirements" (p.11). In this example, the center of the array is offset 2 inches from the center rafter. This prevents rail splices BD (3rd rail) and CE (4th rail) from falling too close to the center of the spans between footings (Requirement 3, p. 11). Because footings are not visible from ground level, there is negligible aesthetic loss.*



## 6. Securing the first module

Gather sufficient lengths of cap strip to cover the length of the first rail. For maximum visual appeal and material conservation see "Material planning for rails and cap strips" (p. 13).

Slide the first module into final position at one end of the array. Lay the remaining modules in the top row, leaving a gap about a foot wide between the first and second modules (Fig. 13).

The temporary gap allows the installer to place one of his feet between the modules. He can access the section of the cap strip he needs to secure while leaning toward the peak of the roof. For the time being, the last module may overhang the rail by up to one third its width.

Attach the end of the cap strip with the cap strip screws (Fig. 13, inset), so that the upper end of the first module is secure.

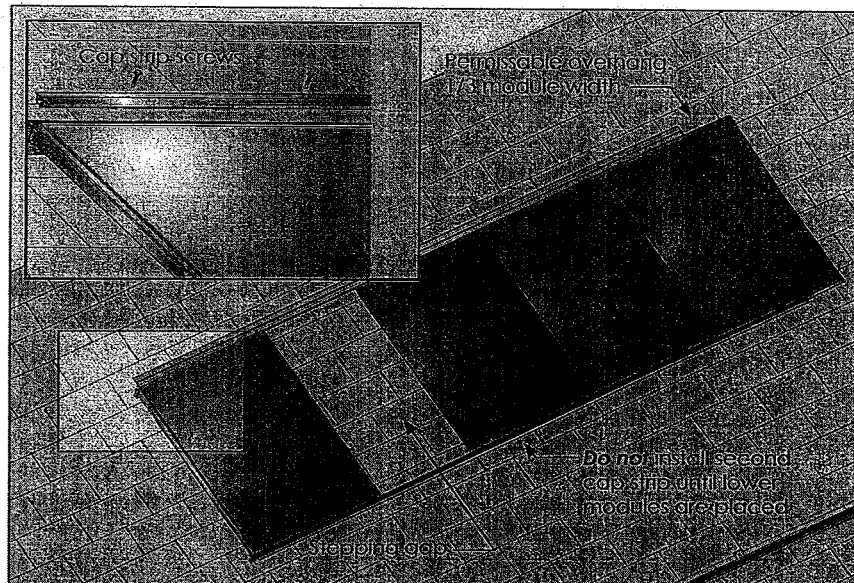


Figure 13. Begin cap strip installation.



**The structural integrity of your array requires that cap strip screws fully engage the threaded rail. Use the cap strip screws supplied with your cap strips. Any substitute screws must be 1/4-20 Type F thread cutting (18-8 stainless steel) and the correct length. See Table 4 (pg. 15) to match screw length to the size cap strip in your installation.**



**Every cap strip segment must have a cap strip screw 4 inches or less from each end. If the nearest predrilled hole falls more than 4 inches from any end, drill a 1/4-inch hole 2 inches from the end and install an additional screw.**



**Wherever it is necessary to make a new cap strip hole, drill a 1/4-inch hole before installing the cap strip screw.**

## 7. Installing the remaining modules in the top row

Slide the next module into final position and install the screws to secure it (Fig. 14). For a neat installation, use cable ties to attach excess wiring to the rail beneath the flanges. UniRac's cable ties can be attached to the SunFrame rail by drilling a 1/4-inch hole in the rail and pushing the end of the tie into the hole.

Continue the process until all modules in the top row are in final place and secured from the top. When complete, every pre-punched hole in the cap strip will be secured by a screw, and the top end of the first row of modules will be secure.

## 8. Installing the remaining modules row by row

Repeat Steps 6 and 7 for the remaining rows (Fig. 15). Each subsequent cap strip will secure the tops to the modules being installed and the bottoms of the modules in the row above.

Place the final cap strip in the lowest rail, securing the bottom of the lowest module row.

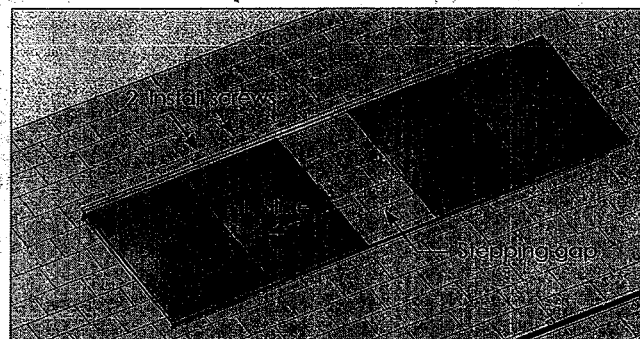


Figure 14. Position and secure modules one by one.

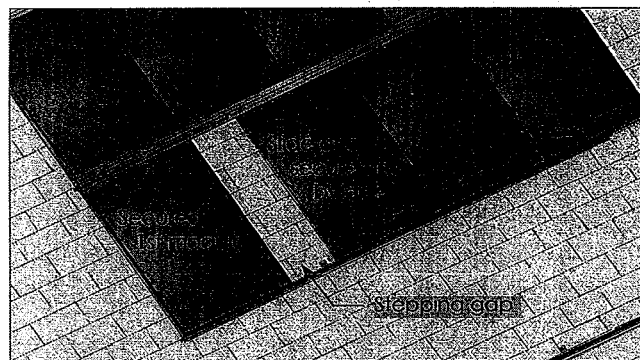


Figure 15. As modules slide into place, the stepping gap shifts, always allowing access to the section of cap strip being secured.



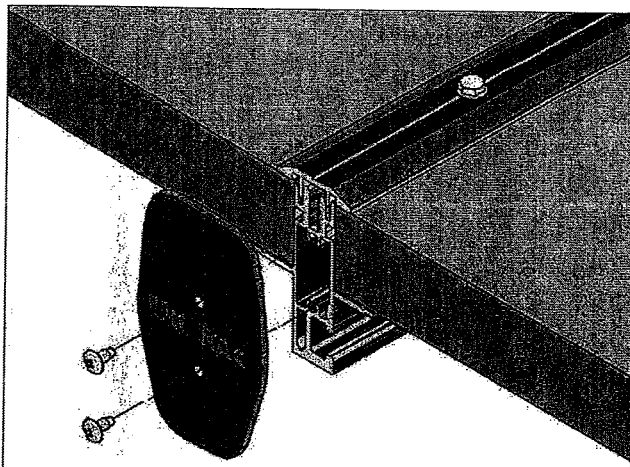


Figure 16. End cap installation.

**9. Installing the end caps**

Attach the end caps to the ends of the rails by securing with the truss head sheet metal screws provided (Fig. 16).

**Table 4: PV module, cap strip, and cap strip screw compatibility**

To ensure code compliance and a structurally sound array, cap strip sizes and cap strip screw lengths must be compatible with the PV modules in your installation. All cap strip screws must be ¼-20 Type F thread cutting (18-8 stainless steel).

Module thickness or type		Cap strip cross section	Cap strip size	Required screw length (inches)
inches	mm			
1.34–1.42	34–36		C	¾"
1.50–1.57	38–40		D	¾"
1.77–1.85	45–47		F	1¼"
1.93–2.01	49–51		E	1¼"
Sharp lipped modules			G	1"
Sanyo lipped modules			H	¾"

## Frequently asked questions about standoffs and roof variations

### How high above the roof is a SunFrame array?

The answer depends on the orientation of your L-feet and the length of your standoffs, if used. See the illustration appropriate to your installation.

### How can I seal the roof penetration required when standoffs are lagged below the roofing material?

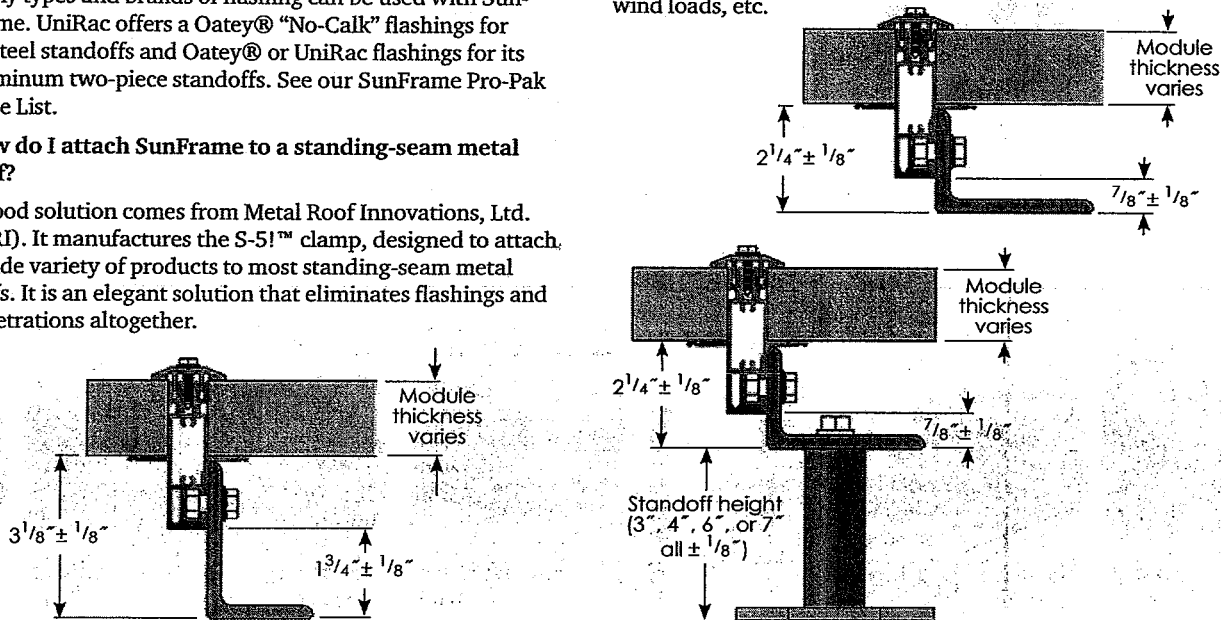
Many types and brands of flashing can be used with SunFrame. UniRac offers a Oatey® "No-Calk" flashings for its steel standoffs and Oatey® or UniRac flashings for its aluminum two-piece standoffs. See our SunFrame Pro-Pak Price List.

### How do I attach SunFrame to a standing-seam metal roof?

A good solution comes from Metal Roof Innovations, Ltd. (MRI). It manufactures the S-5!™ clamp, designed to attach a wide variety of products to most standing-seam metal roofs. It is an elegant solution that eliminates flashings and penetrations altogether.

SunFrame L-feet will mount to the top of the S-5! clamps with the  $\frac{3}{8}$ -inch stainless steel bolt provided with the S-5! See [www.s-5solutions.com](http://www.s-5solutions.com) for different clamp models and details regarding installation.

When using S-5! clamps, make sure that there are enough clamp/L-feet attachments to the metal roof to meet the Metal Roof Manufacturers' and MRI specifications regarding wind loads, etc.



## 10 year limited Product Warranty, 5 year limited Finish Warranty

UniRac, Inc., warrants to the original purchaser ("Purchaser") of product(s) that it manufactures ("Product") at the original installation site that the Product shall be free from defects in material and workmanship for a period of ten (10) years, except for the anodized finish, which finish shall be free from visible peeling, or cracking or chalking under normal atmospheric conditions for a period of five (5) years, from the earlier of 1) the date the installation of the Product is completed, or 2) 30 days after the purchase of the Product by the original Purchaser ("Finish Warranty").

The Finish Warranty does not apply to any foreign residue deposited on the finish. All installations in corrosive atmospheric conditions are excluded. The Finish Warranty is VOID if

the practices specified by AAMA 609 & 610-02 -- "Cleaning and Maintenance for Architecturally Finished Aluminum" ([www.aamanet.org](http://www.aamanet.org)) are not followed by Purchaser. This Warranty does not cover damage to the Product that occurs during its shipment, storage, or installation.

This Warranty shall be VOID if installation of the Product is not performed in accordance with UniRac's written installation instructions, or if the Product has been modified, repaired, or reworked in a manner not previously authorized by UniRac IN WRITING, or if the Product is installed in an environment for which it was not designed. UniRac shall not be liable for consequential, contingent or incidental damages arising out of the use of the Product by Purchaser under any circumstances.

If within the specified Warranty periods the Product shall be reasonably proven to be defective, then UniRac shall repair or replace the defective Product, or any part thereof, in UniRac's sole discretion. Such repair or replacement shall completely satisfy and discharge all of UniRac's liability with respect to this limited Warranty. Under no circumstances shall UniRac be liable for special, indirect or consequential damages arising out of or related to use by Purchaser of the Product.

Manufacturers of related items, such as PV modules and flashings, may provide written warranties of their own. UniRac's limited Warranty covers only its Product, and not any related items.



THE STANDARD IN PV MOUNTING STRUCTURES™

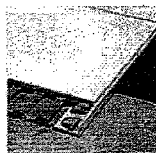


Innovative Installation Systems for Tile and Stone

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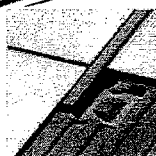
## Edge Protection & Transition Profiles for Floors



### Schluter®-SCHIENE

Schluter-SCHIENE finishes and protects the edges of tiled surfaces at transitions to other surface coverings of the same height, such as tile bordered by carpet.

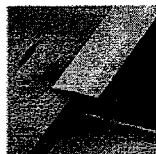
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### Schluter®-DECO

Schluter-DECO finishes and protects the edges of tiled surfaces at transitions to other surface coverings of the same height, such as wood or carpet. The exposed surface of the Schluter-DECO is wider than the Schluter-SCHIENE and can also be used to create decorative lines within tile fields.

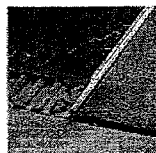
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### Schluter®-RENO-T

Schluter-RENO-T overlaps the edges of adjoining floor covering surfaces of the same height (e.g., ceramic tile or natural stone, parquet flooring, concrete pavers, laminate, etc.). Schluter-RENO-T can be installed during the tile installation or retrofit an existing installation.

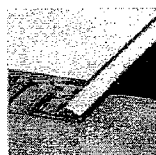
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### Schluter®-RENO-TK

Schluter-RENO-TK provides a sloped transition between tiled surfaces and lower adjoining floor coverings, typically carpet. The sloped flange of the profile hides and protects the cut edge of the lower adjoining surface covering.

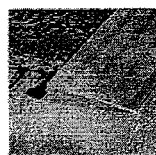
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### Schluter®-RENO-U

Schluter-RENO-U is designed to provide a smooth transition from tile to lower floor coverings with a 4 mm edge that abuts the lower surface covering.

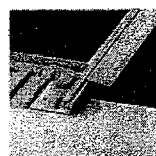
[Read more](#)



### Schluter®-RENO-RAMP

Schluter-RENO-RAMP provides a gradual transition between tiled surfaces and lower adjoining floor coverings. Ideal for commercial applications where wheel carts are used (e.g., bakeries, hospitals, etc.).

[Read more](#)



### Schluter®-RENO-V

Schluter-RENO-V is an adjustable transition profile designed to provide a sloped transition between tiled and lower adjoining floor coverings. The movable transition arm allows the profile to adjust to the height of the lower adjacent floor covering.

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[Schluter-RENO-TK](#)

[Schluter-RENO-U](#)

[Schluter-RENO-RAMP](#)

[Schluter-RENO-V](#)

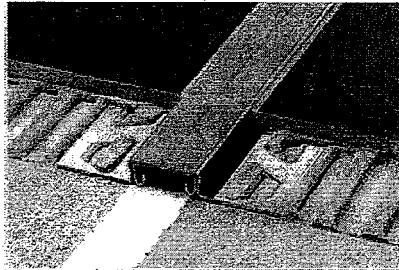
exterior



## Innovative Installation Systems for Tile and Stone

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## Schluter®-DILEX-KSBT

Schluter-DILEX-KSBT 20			
H = Tile Thickness	Stainless steel 304 (E)	Solid brass (M)	Aluminum (A)
5/16" - 8 mm	KS V2A 80 BT 20 ...*	MKS 80 BT 20 ...*	AKS 80 BT 20 ...*
3/8" - 10 mm	KS V2A 100 BT 20 ...*	MKS 100 BT 20 ...*	AKS 100 BT 20 ...*
1/2" - 12.5 mm	KS V2A 125 BT 20 ...*	MKS 125 BT 20 ...*	AKS 125 BT 20 ...*
17/32" - 14 mm	KS V2A 140 BT 20 ...*	MKS 140 BT 20 ...*	AKS 140 BT 20 ...*
5/8" - 16 mm	KS V2A 160 BT 20 ...*	MKS 160 BT 20 ...*	---
23/32" - 18.5 mm	KS V2A 185 BT 20 ...*	MKS 185 BT 20 ...*	---
13/16" - 21 mm	KS V2A 210 BT 20 ...*	MKS 210 BT 20 ...*	---
7/8" - 23 mm	---	MKS 230 BT 20 ...*	---
1" - 25 mm	KS V2A 250 BT 20 ...*	MKS 250 BT 20 ...*	---
1-3/16" - 30 mm	KS V2A 300 BT 20 ...*	MKS 300 BT 20 ...*	---

Length supplied: 8' 2-1/2" - 2.50 m

\*To complete the item number, add the color code (e.g., MKS 80 BT 20 G)

Schluter-DILEX-KSBT 30			
H = Tile Thickness	Stainless steel 304 (E)	Solid brass (M)	Aluminum (A)
5/16" - 8 mm	KS V2A 80 BT 30 ...*	MKS 80 BT 30 ...*	AKS 80 BT 30 ...*
3/8" - 10 mm	KS V2A 100 BT 30 ...*	MKS 100 BT 30 ...*	AKS 100 BT 30 ...*
1/2" - 12.5 mm	KS V2A 125 BT 30 ...*	MKS 125 BT 30 ...*	AKS 125 BT 30 ...*
17/32" - 14 mm	KS V2A 140 BT 30 ...*	MKS 140 BT 30 ...*	AKS 140 BT 30 ...*
5/8" - 16 mm	KS V2A 160 BT 30 ...*	MKS 160 BT 30 ...*	---
23/32" - 18.5 mm	KS V2A 185 BT 30 ...*	MKS 185 BT 30 ...*	---
13/16" - 21 mm	KS V2A 210 BT 30 ...*	MKS 210 BT 30 ...*	---
15/16" - 23 mm	---	MKS 230 BT 30 ...*	---
1" - 25 mm	KS V2A 250 BT 30 ...*	MKS 250 BT 30 ...*	---
1-3/16" - 30 mm	KS V2A 300 BT 30 ...*	MKS 300 BT 30 ...*	---

Length supplied: 8' 2-1/2" - 2.50 m

\*To complete the item number, add the color code (e.g., MKS 80 BT 30 G)

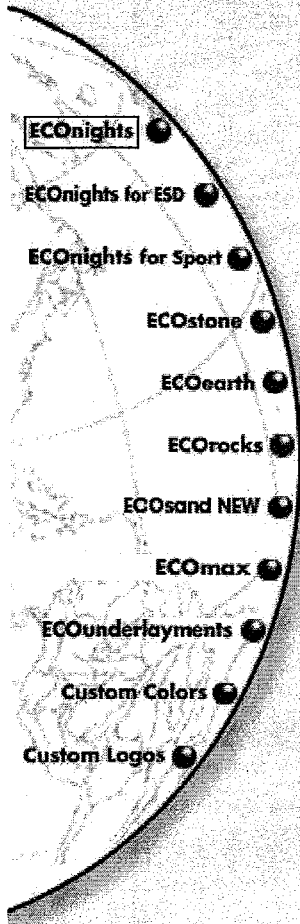
## Schluter-DILEX-KSBT

Schluter-DILEX-KSBT		
Accessories	Item No. (3/4" - 20 mm)	Item No. (1-3/16" - 30 mm)
Rubber insert replacement	KS 20 ...*	KS 30 ...*

06 0000	Wood, Plastics, and Composites
06 1000	Rough Carpentry
06 2000	Finish Carpentry
06 4000	Architectural Woodwork
06 5000	Structural Plastics
06 6000	Plastic Fabrications
06 7000	Structural Composites
06 8000	Composite Fabrications

[illegible]



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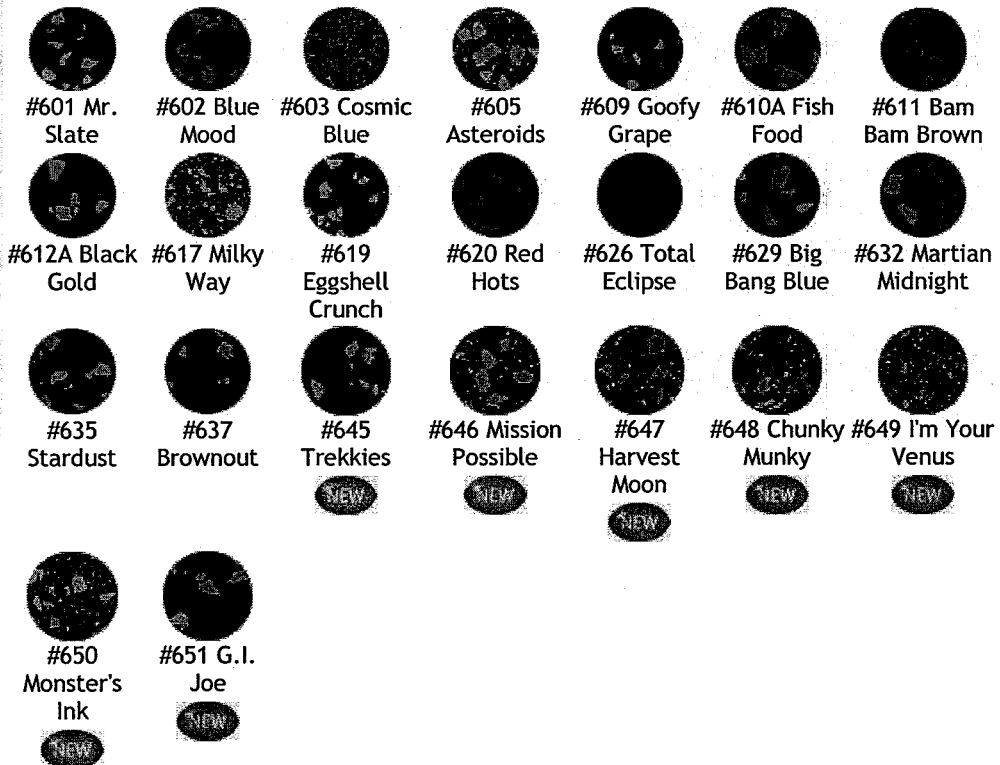
## ECONights® Recycled Rubber Flooring

### Product Specification

#### Performance Attributes

- Complies with new ASTM Sustainability Assessment
- Electrostatic dissipative
- Single-ply, non-laminated
- Indoor and outdoor
- Outstanding slip-resistance
- Unbelievable durability
- Cushioned resilience
- Stain resistance
- Consistent color (no wear layer)
- Low VOC emissions
- Custom colors
- Logo/graphic inlays
- Easy installation/maintenance

#### Colors



#### Product Presentation

- ECOsurfaces recycled rubber flooring: The single-ply rubber surface furnished under this specification shall be Dodge-Regupol, Inc.'s: ECONights as specified.
- The material ECONights is a non-laminated, single-ply surface made from recycled high-quality SBR tire rubber, with bright reprocessed EPDM color flecks that create a glowing effect. The color and thickness shall be as specified.

#### Physical Properties

##### ECONights Rubber Rolls

Width:	48"	
Thickness:	4mm (5/32")	standard
	6mm (1/4")	special
Weight:	4mm	1.1lbs/sq.ft.

Length:	6mm	1.7lbs/sq.ft.
ECONights Rubber Tiles	200 sq/ft (50 l/ft) per roll	
Size:	36" x 36"	
	18" x 18"	
Thickness:	4mm (5/32")	standard
	6mm (1/4")	special

Test	ASTM	Results
Tensile Strength	D412	200 lb/in <sup>2</sup> min
Flexibility	F137	Pass ¼ inch mandrel
Static Dissipation	F150/ESD S7.1	10 <sup>6</sup> to 10 <sup>9</sup> Ohms
Coefficient of Friction	D2047	>0.9
McBurney Indentation	F142, 1 min	0.1120 inches
Thermal Conductivity	C518	0.406 Btu-in/hr-ft <sup>2</sup> -°F
Static Load Limit	F970, 400 lbs	<0.005 in
Electrostatic Propensity	AATCC Test method 134	-0.8 kv
Static Decay	FTM 4046 of FS 101B	0.01 seconds
Chemical Resistance	F925	no change
Impact Insulation Class	E492	49
Sound Transmission Coefficient	E413	51
Noise Reduction Coefficient	C423	0.10 sabine/ft <sup>2</sup>
Sustainability	E2129-01	data collected
VOC Washington State IAQ Test	n/a	24hr=0.39; 1wk=0.056

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## sustainable features of 3form

AS A MEMBER OF THE UNITED STATES GREEN BUILDING COUNCIL, 3FORM RECOGNIZES THE IMPORTANCE OF LEED® RATING SYSTEM TO SUSTAINABLE DESIGN. IN FACT, 3FORM PANELS AND OUR INNOVATIVE RECLAIM PROGRAM CAN HELP ACHIEVE LEED® CREDITS. CONTACT YOUR 3FORM REPRESENTATIVE FOR SPECIFIC INFORMATION.

### Material Credit #2: Construction waste management

3form is the only resin manufacturer with a closed-loop recycling program. Old 3form panels from renovation projects are efficiently reclaimed and reused.

### Material Credit #4: Recycled content

3form materials contain high levels of recycled content, either post-industrial waste or post-consumer product. The amount of recycled content varies by product — 3form ecoresin™: 40% post-industrial recycled content, 100 Percent: 100% post-consumer recycled content.

### GREENGUARD Certification for 3form ecoresin™

3form ecoresin™ is GREENGUARD Certified for indoor air quality. The GREENGUARD Certification Program is an industry independent, third-party testing program for low-emitting products and materials. GREENGUARD Certification is a valuable tool for architects, designers, product specifiers, and purchasing organizations that want to locate, specify, and purchase off-the-shelf, low-emitting products for indoor environments.



MATERIALSOLUTIONS

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**CSI# 06650**

Product: **3-Form**  
[www.3-form.com](http://www.3-form.com)

**3form®**

Manufacturer: **3-Form Inc.**  
2300 South 2300 West  
Suite B  
Salt Lake City, Utah 84119

phone: 801.649.2500  
fax: 801.649.2699  
e-mail: [info@3-form.com](mailto:info@3-form.com)

Contact: **Anathea Kirk, Sales Rep.**  
752 Washington Dr.  
Pittsburg, PA 15229  
phone: 412.608.9765  
fax: 412.367.2997  
e-mail: [akirk@3-form.com](mailto:akirk@3-form.com)

Description: 3form is a material for the mind and the eye. From the lightness of translucency to the fascination of interlayers, 3form materials engage one's senses—and one's sensibility thanks to its eco-consciousness. 3form can add to your projects with a stunning array of materials.

Project Location: Green Screen Sliding Panels & Canopy; Entry Kiosks; Build and Play  
material: Bear Grass Fade

Specifications:  
gauges (in.): 1/4, 3/8, 1/2, 3/4, 1  
gauges (mm.): 6, 10, 12, 19, 25  
price group: C  
  
pattern: parallel to 8'/10'  
avail. colors: all stock colors  
width: 48" / 1219mm  
length: 96" / 2438mm or  
120" / 3048mm  
surface area: 32-40 sq.ft. / 3-3.7 sq.m



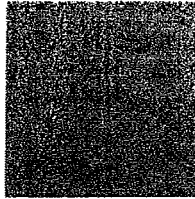
Project Location: Green Screen Sliding Panels & Canopy; Entry Kiosks; Build and Play  
material: Bear Grass Lite

Specifications:  
gauges (in.): 1/8, 3/16, 1/4, 3/8, 1/2, 3/4, 1  
gauges (mm.): 3, 5, 6, 10, 12, 19, 25  
price group: B  
  
pattern: parallel to 8'/10'  
avail. colors: all stock colors  
width: 48" / 1219mm



#### 4. REFINED FINISHES

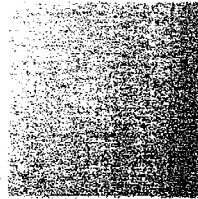
The satin anodized finish on the aluminum extrusions eliminates the need for any type of track valance.



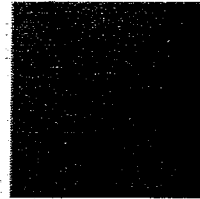
satin natural



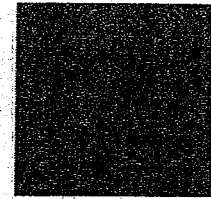
buffed brite black



brushed brite stainless



brushed brite black



buffed satin brown

#### 5. COMPATIBLE WITH VARIETY OF 3FORM MATERIALS

Depending on your panel configuration, you may choose from a variety of 3form materials. The chart below summarizes these possibilities.

Materials:

ecoresin™ 1/4" & 3/8"

DUO 16mm (coming soon)

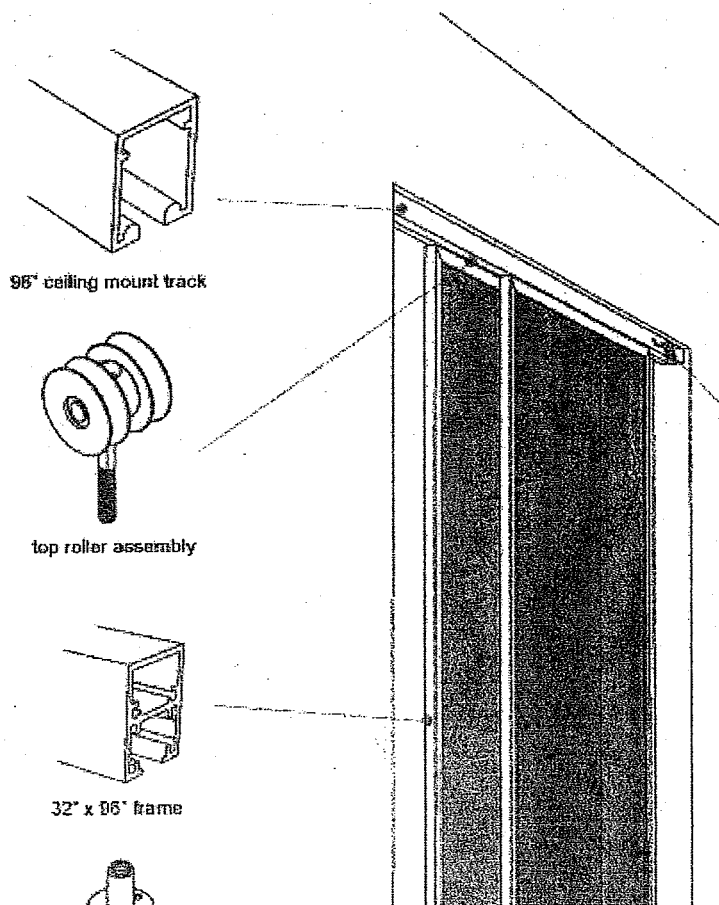
pep 3/4" (19mm) (coming soon)

glass 1/4"

alabaster 3/8"

chroma 3/8"

Note: When using ecoresin™ in a door width greater than 32", 3form recommends using a 3/8" gauge panel for best performance.



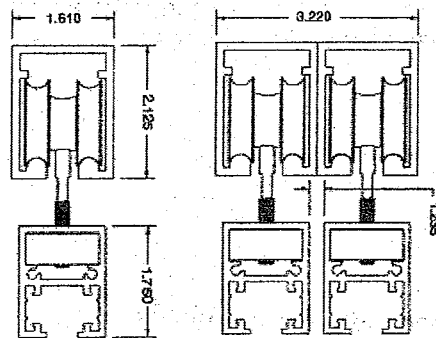
length: 96" / 2438mm or  
120" / 3048mm  
surface area: 32-40 sq.ft. / 3-3.7 sq.m

Other: -Specifications Sheet Follow  
-Hardware Specifications Follow  
-We have product samples available

### 3-Form Hardware

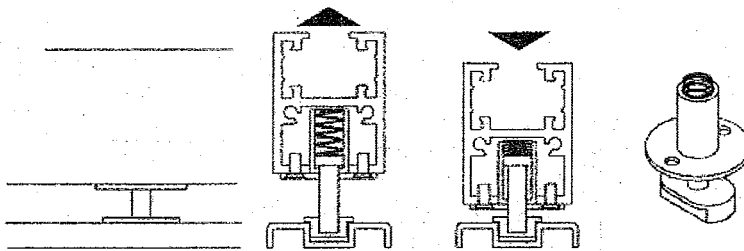
#### 1. CEILING MOUNT TRACK ALLOWING FOR MULTIPLE BYPASSING DOORS

The ceiling mounted track may be fastened directly to an overhead substrate. For multiple bypassing doors, the tracks may simply be placed directly next to one another without fear of the framed panels interfering with one another. The resulting gap between framed panels is 1/4".



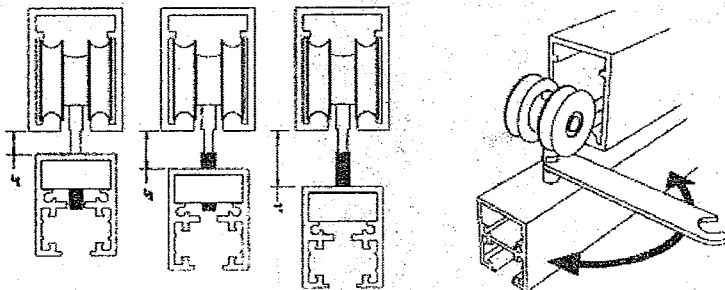
#### 2. FLOOR TRACK WITH SPRING LOADED FLOOR GUIDE

The spring loaded floor guide and track ensures that even when your floor is not perfectly level, the sliding panel still performs as though it is.



#### 3. ADJUSTABLE ROLLER

The roller mechanism can be adjusted to minimize the gap between the track and the top of the panel and also to ensure the framed panel is hung level.





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 Mechanical Ventilation Information  
 Murus Brochure (PDF)

### Builders

### Architects & Engineers

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THE MURUS OSB-2100PUR STRUCTURAL INSULATING PANEL (OSB/PUR Foam Core/OSB)			
#	2145	2155	2165
Overall Thickness:	4-5/8"	5-5/8"	6-5/8"
Thickness Tolerance:	+/- 1/8"	*	*
Width:	48"	*	*
Width Tolerance: (Finish Size)	+0/-1/8"	*	*
Standard Lengths: (Feet)	4', 6', 8', 9', 10', 12', 14', 16', 18', 20', 22', 24'	*	*
Length Tolerance:	+/- 1/4"	*	*
Weight:	3.95 lb/sf	4.15 lb/sf	4.35 lb/sf
Insulating Core			
Type:	Polyurethane closed cell foam		
Thickness:	3-11/16"	4-11/16"	5-11/16"
Density:	2.2 lb/cu.ft.	*	*
R-value	6.76 per inch thickness	*	*
Insulating Core Properties	<sup>4</sup> Design Values		
K Factor: (aged foam)	.14	ASTM C-518	
Compressive Strength:	26 psi	ASTM D1621-94	
Compressive <sup>1</sup> MOE:	936 psi	ASTM D1621-94	
Shear Strength:	22 psi	ASTM C-273	
Shear Modulus:	192 psi	ASTM C-273	
Flexure <sup>2</sup> MOR ( <sup>3</sup> MD):	39 psi	ASTM C203-92	
Flexure Modulus ( <sup>3</sup> MD):	794 psi	ASTM C203-92	
Tensile Strength:	43 psi	ASTM D1623-78	
Tensile Modulus:	1133 psi	ASTM D1623-78	
MVT/ Perm Inches:	<2.0	ASTM E-96	
Foam Fire Rating:	Class 1	**ASTM E-84	
Flame Spread:	18	**ASTM E-84	
Smoke Developed	270	**ASTM E-84	
<sup>1</sup> MOE: Modulus of Elasticity <sup>2</sup> MOR: Modulus of Rupture <sup>3</sup> MD: Machine Direction <sup>4</sup> Design Values are mean derived from multiple specimens *Specification or value is the same as the OSB 2145 Panel **ASTM E-84 is not necessarily a representation of performance in an actual fire. Class 1 is the highest rating available for combustible materials.			
Outside Skins			
Type: APA or equivalent rated oriented strand board (OSB)			
Grade: Exposure-1			
Thickness: 7/16"			

### PUR Technical Specifications

THE MURUS OSB-2100PUR  
STRUCTURAL INSULATING PANEL  
(OSB/PUR Foam Core/OSB)

THE MURUS PTP-2100PUR  
STRUCTURAL INSULATING PANEL  
(PTP/PUR Foam Core/PTP)

THE MURUS CLAD-2100PUR  
STRUCTURAL INSULATING PANEL  
(OSB/PUR Foam Core/OSB/Pine Cladding)

THE MURUS T-1-11-2100PUR  
INSULATING PANEL  
(OSB/PUR Foam Core/OSB/T-1-11)

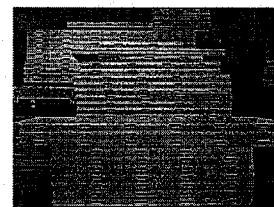
THE MURUS BB-2100PUR  
INSULATING PANEL  
(OSB/PUR Foam Core/Blueboard)

THE MURUS CB-2100PUR  
INSULATING PANEL  
(Cement Board/PUR Foam Core/Cement Board)

THE MURUS CP-2100PUR  
INSULATING PANEL  
(OSB/PUR Foam Core/Sound Board)

THE MURUS PTP/FB-2100PUR  
INSULATING PANEL  
(PTP/PUR Foam Core/FB)

THE MURUS FB-2100PUR  
INSULATING PANEL  
(OSB/PUR Foam Core/FB)



The Murus Company  
PO Box 220 . 3234 Route 549 . Mansfield, PA . 16933  
Phone: 570-549-2100 Fax: 570-549-2101  
Email: [info@murus.com](mailto:info@murus.com)

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**SPECIFICATION:****Part 1 – General***1.01 Description of Work*

- A. Provide all materials, labor, and equipment to install Murus Polyurethane SIPs.
- B. Murus Polyurethane Structural Insulating Panels (SIPs) are engineered products consisting of approved oriented strand board (OSB) and third party certified rigid polyurethane foam insulation core.
- C. Murus polyurethane SIPs are installed using patented cam lock connectors and approved fasteners supplied by the manufacturer, combined with dimensional plates, nailers, headers and sills, supplied by contractor, as detailed in manufacturer's installation details.

*1.02 Related Documents*

The general provisions of the contract and Division 1, General Supplementary and Special Conditions apply to the work specified in this section.

*1.03 Submittals*

- A. Provide evidence of compliance with code requirements as an alternate method of construction.
- B. Each Murus Polyurethane SIP installation drawing shall be reviewed by and sealed by a registered professional engineer qualified to perform such work.

Manufacturer shall verify that panels have been tested in accordance with ASTM E72, ASTM E84, and any other applicable tests.

*1.04 Quality Assurance*

- A. Provide evidence of third party inspection and labeling of all insulation used in the manufacture of panels. Manufacturer's listing programs shall cover both flame and physical properties.
- B. Panel manufacturer will provide lamination and R-value warranty documents for building owner acceptance and execution upon request. Manufacturer's standard forms will be submitted.

*1.05 Product Delivery, Storage and Handling*

- A. All panels shall be stored in manufacturer's original packaging in a protected area and elevated to prevent ground contact.
- B. Prior to installation, panels shall be covered and protected from exposure to sunlight and moisture.
- C. After installation, panels shall be covered to prevent contact with water and /or moisture on all exposed panel edges and faces.

**Part 2 – Products***2.01 Description of Work*

- A. Murus Polyurethane Structural Insulating Panel (SIP) - A stress skin panel manufactured using the proprietary manufacturing method of Uniform Dispersion Molding (UDM) consisting of the following:

1. Polyurethane closed cell foam – minimum of 2.2 pcf insulation meeting manufacturer quality standards
2. OSB – an APA performance rating mark shall be identified on the panel, with an Exposure 1 durability rating; minimum physical properties shall be tested and described in APA PRP-108. 7/16" thickness is standard.
3. Cam locks – if required, shall be installed in the panel during the manufacturing process.
4. Wiring chases – if required, shall be formed into the panel during the manufacturing process.

B. Fasteners – shall be galvanized ring shank panel nails, or panel screws, as specified by panel manufacturer, for attachment of panel to frames, roofs, and corners. All fasteners to be sized and provided by manufacturer and installed per manufacturer's requirements.

C. Foam sealant – a sealant compatible with all components of the panel and adjacent materials, provided by manufacturer.

D. Construction adhesive – adhesive for installing dimensional lumber to be supplied by contractor.

E. Install foam sealant and adhesive per manufacturer's instructions.

F. Dimensional Lumber – SPF #2 kiln-dried or better, or pre-engineered equivalent supplied by contractor.

## 2.02 Performance Characteristics

A. Sizes – Murus polyurethane SIPs are available in sizes from 4' x 4' to 4' x 24'.

B. Thermal characteristics

Typical R-values	
Murus polyurethane SIP thickness (inches)	R-value
4 5/8"	26
5 5/8"	33
6 5/8"	40

C. Panel Dimensional Tolerances – shall comply with values listed in the manufacturer's Quality Control Manual.

D. Structural Testing – Each panel type shown on the drawings shall meet or exceed performance standards, values, manufacturer's load design charts, and applicable technical data reports when tested in accordance with:

1. Transverse Load – Test method: ASTM E72
2. Combined Axial and Bending – Test method: ASTM E72
3. ASTM E84 Surface burning characteristics for the rigid insulation core.
4. ASTM E84 Surface burning characteristics conducted for the interior and exterior surfaces of the finished panel.

## 2.03 Manufacturers/Contractors

A. All components called for in this section to be supplied by the panel manufacturer shall be obtained from the selected manufacturer.



## **Part 3 – Installation**

### **3.01 General**

- A. The contractor shall inspect conditions of substrate, grade and other conditions, which may affect the proper installation of panels. *Any* adverse conditions are to be reported in writing to the construction manager. Do not proceed with the installation until adverse conditions are corrected.
- B. Installation shall be in strict accordance with manufacturer's published instructions, details, and the drawings that are part of the contract documents for this project. Any conflicts between these documents shall be resolved in writing. All plans shall be reviewed by a registered professional engineer and shall be signed and sealed. Deviations from standard detail and load design values shall be calculated and signed and sealed by a registered professional engineer.

### **3.02 Protection**

- A. When storing panels, do not allow them to come into contact with the ground. Stored panels must remain dry and in the manufacturer's original packaging. Do not allow panels to be stored in an unsupported manner. Improper storage may cause tolerance problems in the field.
- B. Roof panels must be fully protected from weather by roofing materials or other means to provide temporary protection at the end of the day, or when rain or snow is imminent.
- C. Remove and replace Insulating wall or roof panels, which have become excessively wet or damaged before proceeding with installation of additional panels or other work.
- D. The construction manager, or his designee, shall remove all refuse created by the installation of work in this section.





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## Legacy report on the BOCA® National Building Code/1999

**DIVISION: 06—WOOD AND Plastics**

**Section: 06120—Structural Panels**

**EVALUATION SUBJECT:**

**MURUS PANELS**

**MANUFACTURER:**

**THE MURUS COMPANY**  
**P.O. BOX 220**  
**MANSFIELD, PA 16933**

**EVALUATION SCOPE**

**Compliance with the following code:**

BOCA® National Building Code/1999

- Section 1603.1 General
- Section 1708.1 Where required
- Section 1710.3.1 Test procedure
- Section 2305.7 Wind bracing
- Section 1404.2 Durability
- Section 2603.2 Labeling
- Section 2603.3 Surface burning characteristics
- Section 2313.2 Sandwich panels
- Section 1704.3 Labeling

## DESCRIPTION

The Murus Panel is a composite panel used for exterior wall and roof applications. The Murus Panel, when used as an exterior wall panel, is used either as a curtain wall panel, which resists transverse loads only, or an exterior wall panel, which resists axial and transverse loads. The composite panel is 4 1/2 inches thick, 4 feet wide and is available in various lengths. See Figure 1 of this report for a diagram of the Murus Panel.

- Table 1 of this report contains allowable transverse loads and spans for the Murus Panel.
- Table 2 of this report contains allowable loads and spans for Murus Panels subjected to uniform transverse and concentric axial loads.
- Table 3 of this report contains allowable loads and spans for Murus Panels subjected to uniform transverse and axial loads with an eccentricity of 3/4 in.

- Table 4 of this report contains the allowable horizontal racking load of the Murus Panel, with and without openings.

## ■ Panel Components

- **Core:** The foam plastic core consists of one of two available foam plastic systems which are as follows: Flexible Products CIP 1416-HC#2 and Flexible Products PPG 442-22D. The Flexible Products CIP 1416-HC#2 core is made up of a rigid urethane foam which consists of an isocyanurate and polyol catalyst blend. The Flexible Products PPG 442-22D core is made up of a rigid urethane foam which consists of an isocyanurate and a resin component blend. The foam plastic cores have a density of 2.2 pounds per cubic feet.
- **Exterior skins:** Each face of the Murus Panel consists of 7/16-inch exterior grade, Exposure 1, Oriented Strand Board (OSB) complying with the United States Department of Commerce PS 2-95 (DOC PS 2-95).
- **Joinery:** The Murus Panel has a tongue-and-groove edge. The connection between the panels is made with a cam lock system, which consists of two parts, as shown in Figure 2 of this report. The cam lock is located along the vertical edge of the Murus Panel at 2-foot intervals, beginning 1 foot from the top or bottom of the panel. Two Murus panels are secured together by aligning two Murus Panels with cam locks next to each other, with spray foam applied to the tongue (or groove) of one panel, and rotating the cam turning gear in the cam lock with a hex head wrench. After the connection is completed, spray foam is applied in the exterior channel between the two panel skins. The excess foam is removed prior to the application of the exterior wall covering.

## CONDITIONS OF USE

This report is limited to the applications and products as stated in this report. The ICC-ES Subcommittee on National Codes intends that the report be used by the code official to determine that the report subject complies with the code requirements specifically addressed, provided that this product is installed in accordance with the following conditions:

- Murus Panels shall be installed in accordance with this report and the manufacturer's instructions. Where the manufacturer's installation instructions differ from this report, this report shall be null and void.
- Murus Panels shall be limited to use as an exterior wall or roof panel in Type 5 construction.
- The use of Murus Panels in fire-resistance rated wall or roof assemblies is beyond the scope of this report.

*ICC-ES legacy reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, Inc., express or implied, as to any finding or other matter in this report, or as to any product covered by the report.*

- The design loads on the system shall not exceed those given in Tables 1, 2, 3 and 4 of this report. Design values are for normal duration under dry use conditions and temperatures less than 160°F.
- Openings in the Murus Panels shall be limited to the sizes given in Figures 6 and 7 of this report. Openings larger than those shown in Figures 6 and 7 are beyond the scope of this report.
- The routing of chaseways into the Murus Panel wall for electrical, plumbing, HVAC or other purposes is beyond the scope of this report.
- A top in-let plate, as shown in Figure 3 of this report, shall be provided along the top edge of all Murus wall panels. The top in-let plate shall be installed in such a manner as to be continuous through the vertical panel joints. The top in-let plate shall consist of 2-inch by 4-inch dimension lumber. The plate shall be located in a 1 1/2-inch-deep routed channel at the top of the panel with spray foam applied between the foam core and the in-let plate. The OSB faces of the Murus Panel shall be secured to the top plate with 8d nails at 4 inches on center. The fasteners on the OSB faces shall be staggered from each other.
- A bottom in-let plate, as shown in Figure 4 of this report, shall be provided along the bottom edge of all Murus wall panels. The bottom in-let plate shall consist of 2-inch by 4-inch dimension lumber. The foam core of the panel shall be routed to completely embed the in-let plate in the panel, so that the OSB faces of the panel will bear completely on the surface which supports the Murus Panels. The in-let plate is to be fastened securely to the supporting structure as required by the approved construction documents. The void in the Murus Panel is sprayed with foam, as described above, prior to placing the panel over the in-let plate. The Murus Panel is then secured to the in-let plate on both faces with 8d nails at 4 inches on center. The fasteners on the OSB faces shall be staggered from each other.
- Openings in the Murus Panels for door and windows shall be rough framed with 2-inch by 4-inch dimension lumber embedded into the foam core of the panel in the same manner as the top and bottom in-let plates. The lumber framing shall be provided on all sides of the opening, as shown in Figure 5 of this report, and shall be secured to the OSB faces of the panel on both sides with 6d nails at 8 inches on center, staggered.
- The manufacturer shall provide the user of this report with instructions for the erection of Murus Panels. These instructions shall include, but not be limited to, details of panel to panel and panel to other building components interfaces.
- This report is subject to periodic re-examination. For information on the current status of this report, contact the ICC-ES.

#### ITEMS REQUIRING VERIFICATION

The following items are related to the use of the report subject, but are not within the scope of this evaluation. However, these items are related to the determination of code compliance:

- ✓ Product identification consistent with this report.
- ✓ Special inspections in accordance with Section 1705.0 of the BOCA® *National Building Code/1999*, and consistent with the following:

#### • SPECIAL INSPECTIONS

Special inspections are required for the installation of Murus Panels, in that it is work which is of an unusual design wherein installation, fabrication, erection and placement of components requires special expertise to ensure adequacy.

Therefore, the Committee's evaluation of Murus Panels is based upon monitoring and control of the installation of Murus Panels through the use of special inspections in accordance with Section 1705.0 of the BOCA® *National Building Code/1999*. The following items shall be inspected:

- **Bottom in-let plates, top in-let plates and preparation of rough openings for doors and windows**
  - Foam core of panel properly routed (not over routed) to receive 2-in by 4-in nailer
  - Condition of foam core (clean and dry)
- **Application of foam spray**
  - Sufficient quantity of spray applied
  - Ambient temperature/substrate temperature
  - Appropriate mix proportions of foam
  - Label on ingredients
- **Framing of door and window openings**
  - Framing full length on all sides of the opening
  - Framing properly lapped
- **Fastening of panel to in-let plates and opening framing**
  - Size of fasteners
  - Spacing of fasteners
  - Fasteners on both sides of panel
- **Cam locks**
  - Properly secured, as required by the manufacturer's installation instructions
- ✓ Thermal barrier separation, when required, in accordance with Section 2603.4 of the BOCA® *National Building Code/1999*.
- ✓ Where installed in roofing applications, roof covering complies with the applicable provisions of Chapter 15 of the BOCA® *National Building Code/1999*.
- ✓ Where installed in exterior wall applications, exterior wall covering complies with the applicable provisions of Chapter 14 of the BOCA® *National Building Code/1999*.

#### INFORMATION SUBMITTED

##### STRUCTURAL

- "Structural Evaluation of the Murus Stress-Skin Urethane Sandwich Panel," by Harvey B. Manbeck, P.E., Ph.D, of the NAHB/NRC Designated Housing Research Center at Penn State, dated August 1991, containing the following:
  - Results of adhesion testing of the OSB facers and the foam plastic core material when subjected to ASTM Standard C481-62 Aging Cycle A.
  - Results of flatwise tension testing in accordance with ASTM C297.
  - Results of edgewise compression testing in accordance with ASTM C364.
  - Results of flatwise compression testing in accordance with ASTM C365.
  - Results of flexural testing in accordance with ASTM C393.
  - Results of transverse and compression testing in accordance with ASTM E72.

The results of the above test are the basis for Tables 1 through 3 of this report.

- Results of horizontal racking testing in accordance with a modified version of ASTM E72 performed on Murus Panels with and without door and window openings. The modification was that no stud framing was provided, and the panels were 10 feet high rather than 8 feet high. The panels were secured to the base beam and top beam of the test assembly with #6 sheetrock screws at 8 inches on center. The results of the testing are given in Table 4 of this report. The door and window openings tested are shown in Figures 6 and 7 of this report.
- Report No. 30, "Creep Behavior of the Murus Stress-Skin Urethane Composite Sandwich Panel," by Harvey B. Manbeck, P.E., Ph.D, of the NAHB/NRC Designated Housing Research Center at Penn State, dated January 1993, containing results of testing in accordance with Section 1710.3.1 of the BOCA® *National Building Code*/1999.
- Celotex Corporation Testing Services, MTS Job No. 258498, dated June 3, 1998 and June 29, 1998, containing results of tensile, compressive, flexural and shear testing of the CIP 14-8557 (PPG 442-22D) foam plastic in accordance with ASTM D1623, ASTM D1621, ASTM C203 and ASTM C273. The results indicate that the CIP 14-8557 (PPG 442-22D) foam plastic has structural properties at least equivalent to the CIP 1416-HC#2 foam plastic.

#### FOAM PLASTIC

- Omega Point Laboratories, Report No. 8926-98159, dated March 2, 1995, containing results of testing of the Flexible Products CIP 1416-HC#2 foam plastic in accordance with ASTM E84 at a thickness of 1 in and 5 3/4 in.
- Omega Point Laboratories, Report Nos. 9056-103120 and 9056-103121, dated May 11, 1998, containing results of testing of the Flexible Products CIP 14-8557 (PPG 442-22D) foam plastic in accordance with ASTM E84 at a thickness of 5 3/4 in.

#### LABELING

- The Murus Company, *Quality Control Manual*, dated March 1999, Revision D, signed by representatives of the Murus Company and PFS Corporation, containing procedures for the manufacture of the Murus Panel, in-house plant inspections, and product labeling.

#### APPLICATION FOR PERMIT

To aid in the determination of compliance with this report, the following represents the minimum level of information to accompany the application for permit:

- The language "See ICC-ES Legacy Report No. 97-36" or a copy of this report;
- Manufacturer's name.
- Product model name and number.
- Design calculations and details for construction utilizing Murus Panels shall be furnished to the code official verifying compliance with this report. The individual preparing such documents shall be competent and qualified in the application of the structural design principals involved, and shall possess the registration or license in accordance with the professional registration laws of the state in which the project is constructed. The calculations shall include, but not be limited to, the following:

- The minimum required design loads for the building for the building system, consistent with the requirements of Chapter 16 of the BOCA® *National Building Code*/1999.
- The allowable design loads of the panels, consistent with this report.
- The ability of all connections between the panel and adjacent building components to transfer all the imposed design loads to the building foundation and footing system.
- Details of panel openings, consistent with this report.
- Statement of Special Inspections

#### PRODUCT IDENTIFICATION

- Murus Panels or product packaging shall be marked at the plant with the identifying language "See ICC-ES Legacy Report No. 97-36."
- Additionally, each panel shall bear a label containing the manufacturer name, product name, and identification of the inspection agency, PFS Corporation.

*This report is subject to re-examination in one year.*

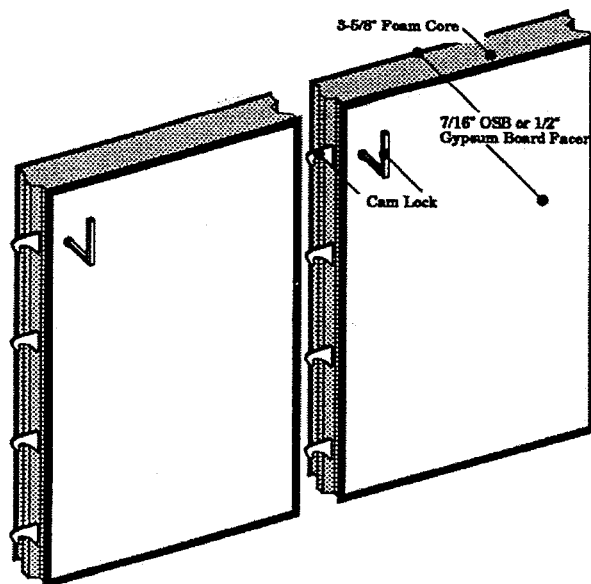


FIGURE 1—\*MURUS PANELS

The panels are 48 inches wide. Cam Locks, if provided, are located 1 ft. from the top and bottom and at 2 ft. intervals in between.

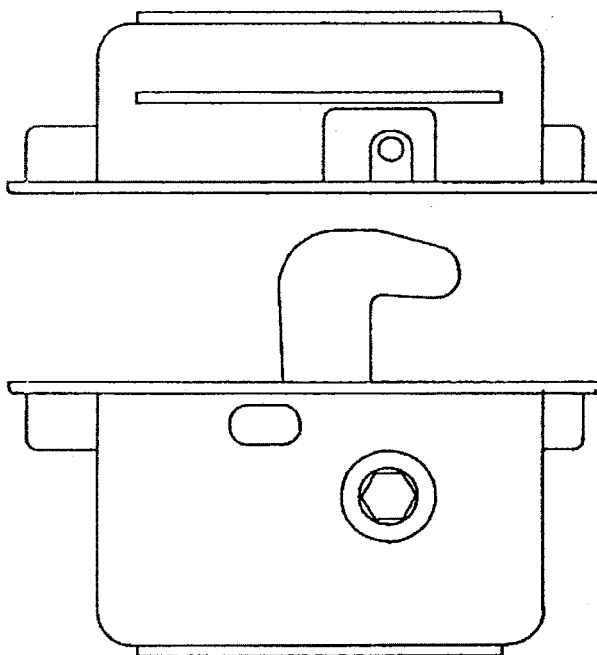


FIGURE 2\*—CAM LOCK

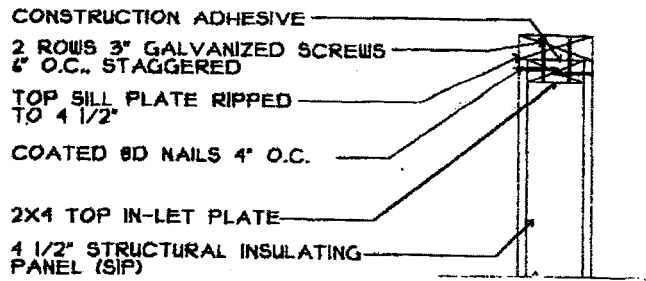


FIGURE 3\*—TOP IN-LET PLATE

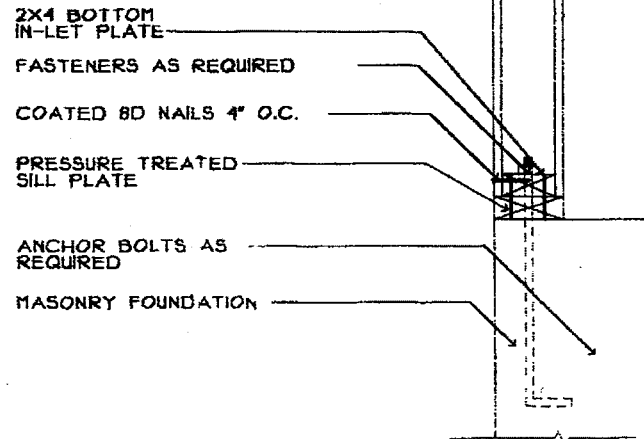


FIGURE 4\*—BOTTOM IN-LET PLATE

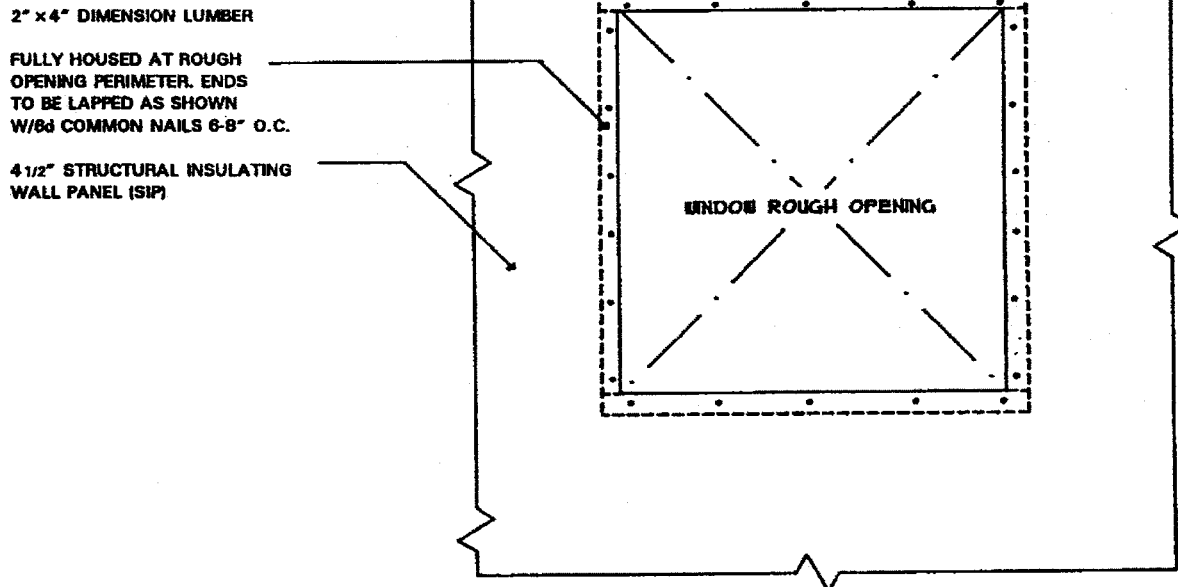


FIGURE 5\*—FRAMING AT ROUGH OPENINGS FOR WINDOWS AND DOORS



**TABLE 1**  
**TRANSVERSE LOAD-SPAN TABLE FOR THE MURUS PANEL**  
**(Customary Units)**

UNIFORM TRANSVERSE LOAD <sup>1</sup> (psf)	ALLOWABLE PANEL SPAN <sup>2,3,4</sup> (ft - in)			
	DEFLECTION LIMITS			
	L/180	L/240	L/360	L/480
5	20'-8"	18'-9"	16'-4"	14'-9"
10	16'-4"	14'-9"	13'-0"	11'-9"
15	14'-3"	13'-0"	11'-4"	10'-3"
20	13'-0"	11'-9"	10'-3"	9'-4"
25	12'-1"	11'-0"	9'-7"	8'-8"
30	11'-4"	10'-3"	9'-0"	8'-2"
35	10'-9"	9'-9"	8'-7"	7'-9"
40	10'-3"	9'-4"	8'-2"	7'-6"
45	9'-11"	9'-0"	7'-10"	7'-2"
50	9'-7"	8'-8"	7'-7"	6'-11"
55	9'-3"	8'-4"	7'-4"	6'-8"
60	9'-0"	8'-2"	7'-2"	6'-6"
65	8'-9"	8'-0"	7'-0"	6'-3"
70	8'-7"	7'-9"	6'-9"	6'-2"
75	8'-4"	7'-7"	6'-8"	6'-0"
80	8'-2"	7'-5"	6'-9"	5'-11"

1. Uniform load for normal load durations only.
2. Values given are for full (four foot) panel widths with facing strands oriented parallel to the panel span assuming proper end support and connections. The transverse load-carrying capacity of panels that contain openings is beyond the scope of this report.
3. Values given are computed from the continuous span uniform deflection equation using the flexural stiffness parameter  $(EI)_g$  developed from the full scale transverse panel assembly test of the Murus Panel (ASTM E72-80).
4. Design values are for normal load duration under dry use conditions and temperatures less than 160°F.

**TABLE 2**  
**ALLOWABLE AXIAL LOAD/UNIT WIDTH FOR THE MURUS PANEL WITH NO ECCENTRICITY**  
**(Customary Units)**

TRANSVERSE LOAD <sup>1</sup> psf	ALLOWABLE AXIAL LOAD <sup>*1,2,3,4</sup> lb/ft										
	PANEL LENGTHS ft										
	4	5	6	7	8	9	10	11	12	13	14
0	9025	8720	8165	7250	5870	4640	3755	3105	2610	2220	1915
2	8975	8630	8030	7075	5690	4470	3600	2955	2460	2080	1775
4	8920	8540	7900	6905	5510	4310	3445	2805	2315	1940	1635
6	8865	8455	7765	6740	5340	4150	3295	2660	2175	1800	1500
8	8815	8365	7640	6575	5170	3990	3145	2515	2035	1660	1365
10	8760	8275	7510	6415	5005	3840	3000	2375	1900	1530	900*
12	8710	8190	7380	6255	4840	3690	2855	2235	1765	1240*	35*
14	8655	8100	7255	6100	4685	3540	2715	2100	1630	435*	NP
16	8600	8015	7130	5950	4530	3395	2575	1965	1180*	NP	NP
18	8550	7925	7010	5800	4375	3250	2440	1835	440*	NP	NP
20	8495	7840	6885	5650	4230	3110	2305	1665*	NP	NP	NP
22	8445	7755	6765	5505	4080	2975	2170	990*	NP	NP	NP
24	8390	7670	6645	5365	3940	2835	2040	310*	NP	NP	NP
26	8340	7585	6525	5220	3795	2705	1910	NP	NP	NP	NP
28	8285	7500	6410	5085	3655	2570	1590*	NP	NP	NP	NP
30	8235	7415	6295	4945	3520	2440	975*	NP	NP	NP	NP

\* Load limited by L/240 deflection criterion

NP = Not Permitted

1. Uniform transverse and axial loads are for normal load durations only.
2. Values given are for full (four foot) panel widths with facing strands oriented parallel to the panel span assuming proper end support and connections. The load-carrying capacity of panels that contain openings is beyond the scope of this report.
3. Values given are computed from the combined load case and limiting deflection criterion using the flexural stiffness parameter ( $EI$ )<sub>g</sub> developed from the full-scale transverse panel assembly test of the Murus Panel (ASTM E72-80),  $F_c$  developed from the compression edgewise test of the Murus Panel (ASTM C364-61),  $F_b$  from published data for Oriented Strand Board.
4. Design values are for dry end use conditions and temperatures less than 160°F.

**TABLE 3**  
**ALLOWABLE AXIAL LOAD/UNIT WIDTH FOR THE MURUS PANEL WITH A 0.75-IN. ECCENTRICITY**

TRANSVERSE LOAD <sup>1</sup> psf	ALLOWABLE AXIAL LOAD* <sup>1,2,3,4</sup> lb/ft										
	PANEL LENGTHS ft										
	4	5	6	7	8	9	10	11	12	13	14
0	4925	4605	4245	3835	3340	2930	2570	2260	1990	1765	1565
2	4895	4560	4190	3765	3260	2840	2475	2155	1885	1655	1455
4	4870	4520	4135	3695	3180	2755	2380	2055	1780	1545	1345
6	4845	4482	4080	3625	3100	2665	2285	1955	1680	1440	1130*
8	4815	4440	4025	3555	3020	2575	2190	1860	1575	1170*	760*
10	4790	4400	3970	3490	2945	2490	2095	1760	1335*	840*	385*
12	4760	4355	3915	3420	2865	2405	2005	1630*	1045*	510*	NP
14	4735	4315	3860	3350	2785	2320	1915	1380*	755*	180*	NP
16	4705	4275	3805	3280	2710	2235	1820	1128*	460*	NP	NP
18	4680	4235	3750	3215	2630	2150	1640*	875*	170*	NP	NP
20	4650	4195	3695	3145	2555	2065	1420*	620*	NP	NP	NP
22	4625	4155	3640	3080	2480	1980	1205*	365*	NP	NP	NP
24	4595	4115	3585	3010	2400	1895	990*	115*	NP	NP	NP
26	4570	4070	3530	2945	2325	1770*	775*	NP	NP	NP	NP
28	4540	4030	3475	2880	2250	1585*	555*	NP	NP	NP	NP
30	4515	3990	3420	2810	2175	1405*	340*	NP	NP	NP	NP

\* Load limited by L/240 deflection criterion

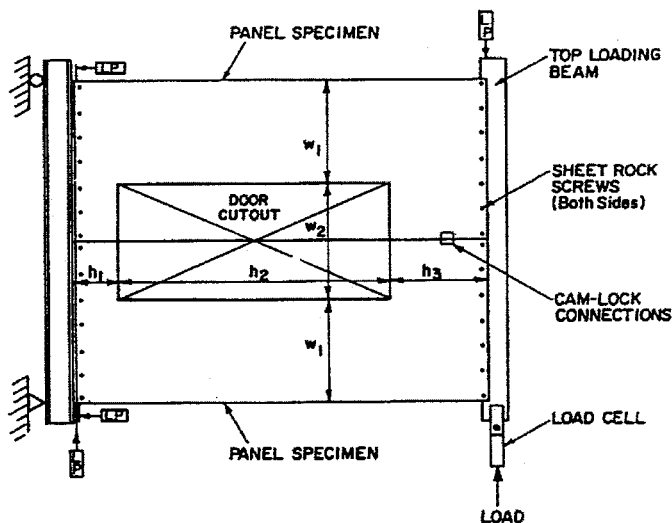
NP = Not Permitted

1. Uniform transverse and axial loads are for normal load durations only.
2. Values given are for full (four foot) panel widths with facing strands oriented parallel to the panel span assuming proper end support and connections. The load-carrying capacity of panels that contain openings is beyond the scope of this report.
3. Values given are computed from the combined load case and limiting deflection criterion using the flexural stiffness parameter ( $EI$ ), developed from the full-scale transverse panel assembly test of the Murus Panel (ASTM E72-80),  $F_c$  developed from the compression edgewise test of the Murus Panel (ASTM C364-61),  $F_b$  from published data for Oriented Strand Board, and an eccentricity of 0.75 inch, the same as required in the compression test of the Murus Panel (ASTM E72-80).
4. Design values are for dry end use conditions and temperatures less than 160°F.

**TABLE 4**  
**HORIZONTAL RACKING RESISTANCE OF MURUS PANELS**

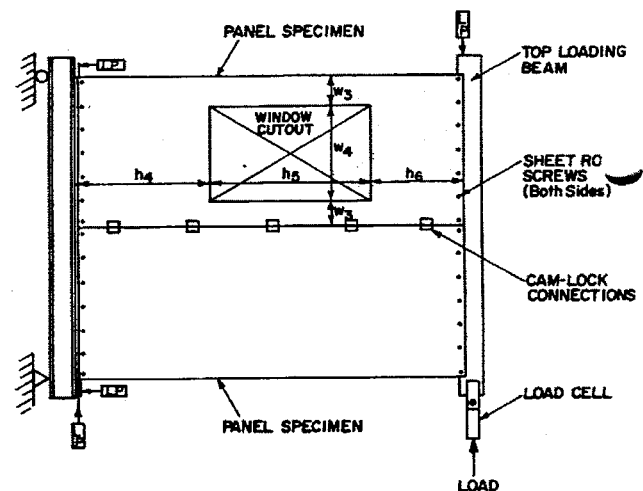
Panel Assembly	Allowable Racking Resistance <sup>1</sup>	
	lbs	plf
Full Panel Assemblies	430	53.75
Panel with Door Opening <sup>2</sup>	400	50
Panel with Window Opening <sup>2</sup>	430	53.75

1. The connection at the head and sill of the panel shall conform to Figures 3 and 4 of this report.
2. The size of the door and window openings shall not exceed those shown in Figures 6 and 7 of this report, and the opening shall be rough framing with 2x4 dimension lumber, as shown in Figure 5 of this report.
3. The values in this table were obtained from panels attached with sheet rock screws at 8 inch on center.



**FIGURE 6\***  
**PANEL TESTED WITH DOOR OPENING**

$h_1 = 12$  inches (30 cm)  
 $h_2 = 84$  inches (210 cm)  
 $h_3 = 24$  inches (60 cm)  
 $w_1 = 29 \frac{1}{4}$  inches (74 cm)  
 $w_2 = 37 \frac{1}{2}$  inches (95 cm)



**FIGURE 7\***  
**PANEL TESTED WITH WINDOW OPENING**

$h_4 = 42$  inches (107 cm)  
 $h_5 = 54$  inches (137 cm)  
 $h_6 = 24$  inches (60 cm)  
 $w_3 = 8$  inches (20 cm)  
 $w_4 = 32$  inches (81 cm)

\*THESE DRAWINGS ARE FOR ILLUSTRATION PURPOSES ONLY. THEY ARE NOT INTENDED FOR USE AS CONSTRUCTION DOCUMENTS FOR THE PURPOSE OF DESIGN, FABRICATION OR ERECTION.



## LIMITED WARRANTY

### MURUS PUR (POLYURETHANE) STRUCTURAL INSULATING PANELS (SIPs)

OSB-2100PUR ~ CLAD-2100PUR ~ PTP-2100PUR ~ T-1-11-2100PUR ~ CB-2100PUR

**Delamination:** Murus PUR SIPs are warranted not to delaminate for the life of the panel provided said SIPs were specified, utilized and installed in a correct and proper manner, in accordance with 1) the standards and specifications established by The Murus Company's Installation Manual and 2) standard building practices, and: wherein said delamination interferes with and/or impairs the ability of the SIPs to perform as intended by The Murus Company.

**Materials and Workmanship:** Murus PUR SIPs are warranted against defects in materials and/or workmanship for a period of ten (10) years from the date of manufacture provided said SIPs were specified, utilized and installed in a correct and proper manner, in accordance with 1) the standards and specifications established by The Murus Company's Installation Manual, and 2) standard building practices, and: wherein said defects interfere with and/or impair the ability of the SIPs to perform as intended by The Murus Company.

This warranty is extended only to the original purchaser or the original property owner where Murus SIPs were installed, and is otherwise non-transferable.

**Definitions:** Delamination is defined as visible separation of the bond of the foam core from the surface of the panel skin. Life is defined as a period of time while the building structure is in good condition and sound, and the SIP is in good condition and is still useful.

**Exceptions:** This warranty does not cover delamination or defects due to:

- Fire, floods, natural disaster or any acts of God.
- Improper handling, storage, use or installation.
- Water or moisture damage.
- Faulty construction, settling of the building foundation, or movement of the structure.

**The Murus Company's Commitment:** If Murus PUR SIPs are found to delaminate or be defective in materials and/or workmanship during the warranty period(s) as listed above, The Murus Company will provide to the purchaser or original property owner, replacement SIPs as originally purchased.

Notification of claims to The Murus Company must be made in writing immediately upon detection or perception of defective SIPs. The Murus Company reserves the right to inspect the said defective SIPs by an authorized representative prior to the settlement of any claim.

The Murus Company's sole responsibility for delamination and/or defects in materials or workmanship is as set forth in this warranty and The Murus Company will not be responsible for incidental, indirect or consequential damages.

For questions concerning this warranty, contact The Murus Company Customer Service at (570) 549-2100; P.O. Box 220, 3234 Route 549, Mansfield, PA 16933.

This warranty is subject to local, state, federal and statutes, regulations and alike.



07 0000	Thermal and Moisture Protection
07 1000	Dampproofing and Waterproofing
07 2000	Thermal Protection
07 3000	Steep Slope Roofing
07 4000	Roofing and Siding Panels
07 5000	Membrane Roofing
07 6000	Flashing and Sheet Metal
07 7000	Roofing and Wall Specialties and Accessories
07 8000	Fire and Smoke Protection
07 9000	Joint Protection

MORNINGSTAR  
50 of 353

## Perm-A-Barrier® Wall Membrane

Self-adhesive, rubberized asphalt/polyethylene waterproofing membrane for air and vapor barrier applications

### Advantages

- Fully bonded – transmits wind loads directly to the substrate
- Waterproof and virtually impermeable to moisture – virtually impermeable to the passage of liquid water and vapor
- Air tight – exceeds CCMC requirements for air barrier membranes and complies with Massachusetts State Energy Code
- Cross laminated film – provides dimensional stability, high tear strength, puncture and impact resistance
- Cold applied – no flame hazard; self-adhesive overlaps ensure continuity
- Flexible – accommodates minor settlement and shrinkage movement
- Controlled thickness – factory made sheet ensures constant, non-variable site application
- Aggressive, conformable adhesive – allows self-sealing around mechanical fasteners
- Wide application window –
  - Perm-A-Barrier® Wall Membrane surface and ambient temperatures at 5°C (40°F) and above

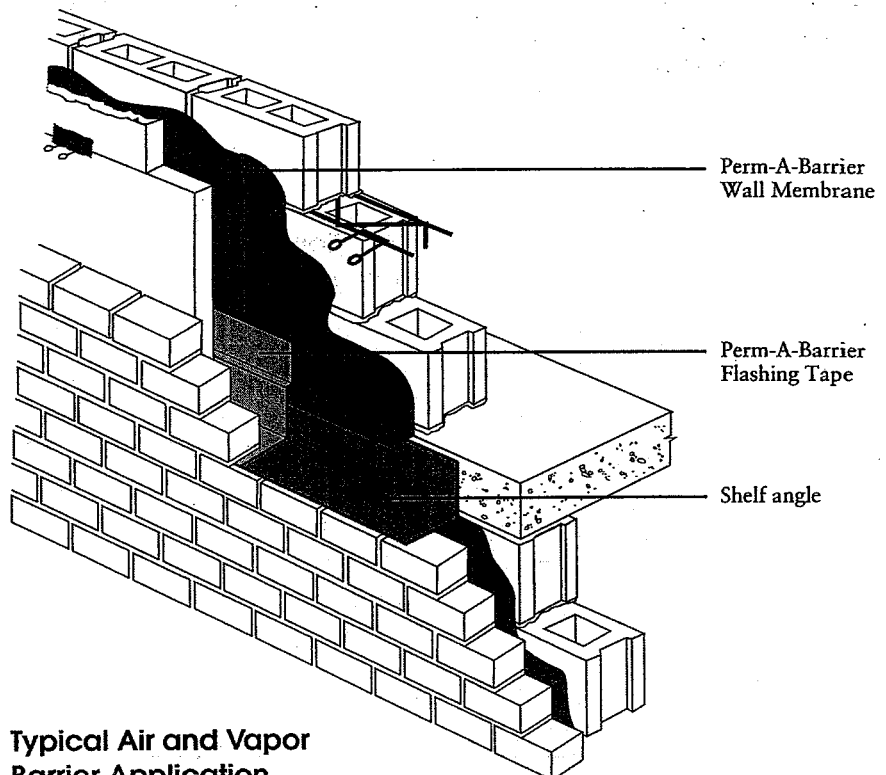
- Perm-A-Barrier System 4000 Wall Membrane surface and ambient temperatures at -4°C (25°F) and above
- Perm-A-Barrier Low Temperature Wall Membrane surface and ambient temperatures between -4°C (25°F) and 16°C (60°F)

### Description

Perm-A-Barrier wall membranes are ideal for protecting the building superstructure from the damaging effects of the elements.

By minimizing air and water vapor flow through the building exterior, Perm-A-Barrier wall membranes:

- Prevent premature deterioration of the building envelope
- Enhance thermal performance of the structure and save energy costs
- Improve comfort for the building occupants



Typical Air and Vapor Barrier Application

## System Components

- **Perm-A-Barrier System 4000 Wall Membrane** – extended temperature range system for use at all temperatures above -4°C (25°F), conveniently packaged with a unique water-based surface conditioner
- **Perm-A-Barrier Wall Membrane** – standard grade for use at temperatures above 5°C (40°F)
- **Perm-A-Barrier Low Temperature Wall Membrane** – low temperature grade for use at temperatures between -4°C (25°F) and 16°C (60°F)
- **Perm-A-Barrier Surface Conditioner** – water-based surface treatment for use with System 4000 on cementitious substrates
- **Perm-A-Barrier WB Primer** – high tack, water-based primer for use with Perm-A-Barrier Wall Membrane and Perm-A-Barrier Low Temperature Wall Membrane on cementitious and exterior gypsum wallboards
- **Bituthene® Primer B2** – used to prime green concrete or damp substrates
- **Bituthene Mastic Trowel Grade** – rubberized asphalt mastic for sealing patches, terminations, brick ties, etc.

## Installation

### Safety

Perm-A-Barrier products must be handled properly. Vapors from the mastic and solvent-based primer are harmful and flammable. For these products, the best available information on safe handling, storage, personal protection, health and environmental considerations has been gathered. Refer to product label and Material Safety Data Sheet before use. All users should acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and MSDS before use. MSDSs can be

obtained from our web site at [www.graceconstruction.com](http://www.graceconstruction.com) or by contacting us toll free at 866-333-3SBM (3726).

### Surface Preparation

Surface must be smooth, clean, dry and free of voids, spalled areas, loose aggregate, loose nails, sharp protrusions or other matter that will hinder the adhesion or regularity of the wall membrane installation. Clean loose dust or dirt from the surface to which the wall membrane is to be applied by wiping with a clean, dry cloth or brush.

If the substrate is damp, allow to dry or use Bituthene Primer B2 to prepare the area to receive the membrane.

### Temperature

Perm-A-Barrier System 4000 Membrane and Bituthene Surface Conditioner may be applied only in dry weather when air and surface temperatures are above -4°C (25°F). Perm-A-Barrier Low Temperature Membrane may be applied only in dry weather when air and surface temperatures are between -4°C (25°F) and 16°C (60°F). Perm-A-Barrier Wall Membrane may be applied only in dry weather when air and surface temperatures are above 5°C (40°F).

### Application

**Conditioning and Priming:** Bituthene System 4000 Surface Conditioner is supplied ready to use. It should not be diluted with water or solvent. Mix and apply a light coating with a portable spray unit, brush or roller. Conditioner will cover 6-8 m<sup>2</sup>/L (250-350 ft<sup>2</sup>/gal) when applied with a low pressure, portable sprayer. Allow surface conditioner to dry completely before membrane application. The surface conditioner is considered dry when the substrate returns to its original color (minimum 1 hour). To test for dryness, rub small conditioned area by hand. Wet conditioner will ball

up under the fingertips. Let dry until conditioner cannot be rubbed off. Condition only areas that can be covered the same day.

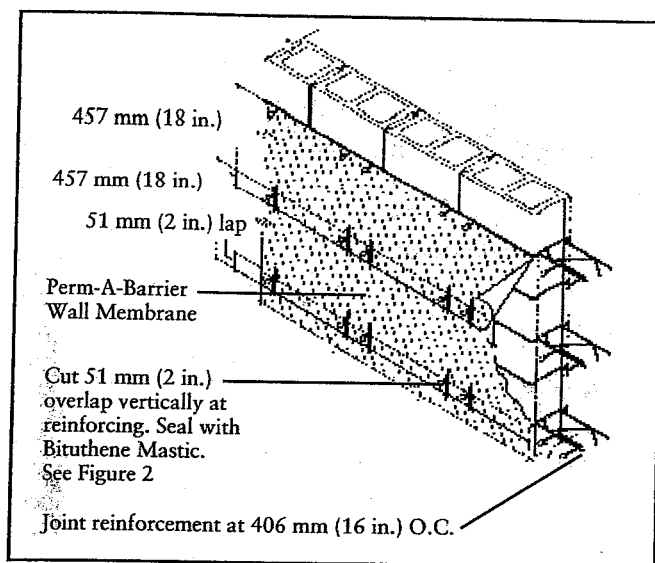
Conditioned areas not covered the same day should be reconditioned.

Perm-A-Barrier WB Primer is a water-based primer which imparts an aggressive, high tack finish on the treated substrate. It is packaged ready to use and is specifically designed to facilitate tenacious adhesion of Perm-A-Barrier flashing tapes and wall membranes to glass mat surfaces and exterior gypsum boards such as Dens-Glass Gold®. Apply Perm-A-Barrier WB Primer by roller at a coverage rate of 6-8 m<sup>2</sup>/L (250-350 ft<sup>2</sup> gal). Allow to dry for a minimum of 1 hour (longer at low temperatures).

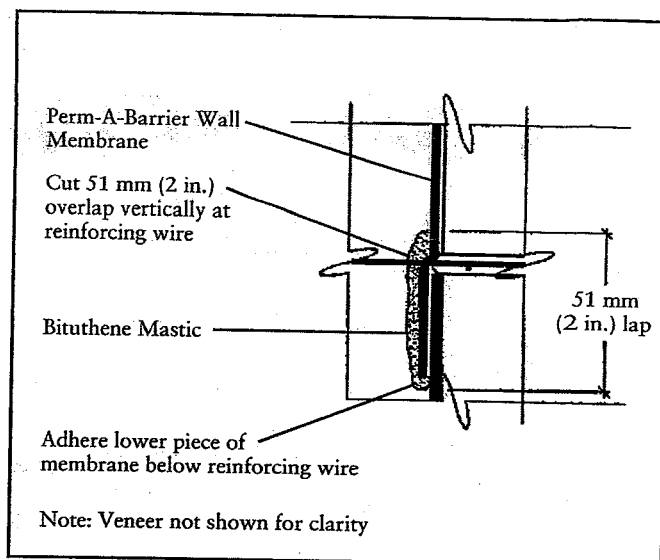
### Membrane Application

Cut membrane into easily handled lengths. Apply membrane horizontally or vertically to primed substrates receiving post-applied masonry anchors (ties), such as gypsum sheathing.

Apply wall membranes horizontally to the primed blockwork with projecting masonry anchors (ties), beginning at the base of the wall. Each length of the membrane must be installed so that the upper edge runs continuously along the underside of the line of masonry anchors (ties). Subsequent sheets applied above must overlap the sheet below by 51 mm (2 in.) immediately below the line of anchors (ties). Since the membrane width appropriate for this application of 457 mm (18 in.) is wider than the typical spacing between the lines of anchors (ties) 406 mm (16 in.), it will be necessary to cut the membrane at the location of the tie wires projecting from the wall to enable the sheet to be laid in place. End laps that occur in subsequent lengths that follow should maintain a minimum overlap of 51 mm (2 in.). See Figures 1 and 2.



**Figure 1: Membrane System Detail**



**Figure 2: Horizontal Reinforcing**

The membrane must be pressed firmly into place with a hand roller or the back of a utility knife as soon as possible, ensuring continuous and intimate contact with the substrate to prevent water from migrating under the membrane.

In certain applications such as on soffits, ceilings or substrates such as oriented strand board (OSB), backnail the membrane along the side lap prior to installing the next sheet of membrane to ensure positive contact to the substrate.

Apply Bituthene Mastic to seal around the tie wire projections. Fit the Perm-A-Barrier wall membrane tightly around all penetrations through the membrane and seal using Bituthene Mastic.

Continue the membrane into all openings in the wall area, such as windows, doors, etc., and terminate at points that will prevent interior visibility. The installation must be made continuous at all framed openings. Coordinate installation of the Perm-A-Barrier wall membrane with the roofing trade to ensure continuity with the roofing system at this critical transition area.

At the end of each working day, if the wall has been only partially covered, apply a bead of Bituthene

Mastic along the top edge of the membrane at its termination to prevent vertical drainage of precipitation from penetrating the end and undermining the membrane adhesion. Tool the Bituthene Mastic to ensure it is worked into the surface. Inspect the membrane before covering and repair any punctures, damaged areas or inadequately lapped seams.

### Membrane Repairs

Repairs must be made using Perm-A-Barrier wall membrane sized to extend 150 mm (6 in.) in all directions from the perimeter of the affected area. If repairs are required, carefully cut out affected areas and replace in similar procedure as outlined above. The repair piece must be pressed into place with a hand roller as soon as possible to ensure continuous and intimate contact with the substrate.

### Membrane Protection

Perm-A-Barrier wall membranes must be protected from damage by other trades or construction materials.

### Storage and Handling Information

All materials must be protected from rain and physical damage. Pallets of Perm-A-Barrier wall

membrane must not be double stacked on the job site. Provide cover on top and all sides, allowing for adequate ventilation. Store membrane where temperatures will not exceed 32°C (90°F) for extended periods. All products must be stored in a dry area away from high heat, flames or sparks. Store only as much material at point of use as is required for each day's work.

### Limitations

Perm-A-Barrier wall membrane systems must not be applied in areas where they will be permanently exposed to UV light and must be covered within a reasonable amount of time, not to exceed 30 days.

### Warranty

Perm-A-Barrier products are warranted to be free of defects in manufacture for a period of 5 years. Material will be provided at no charge to replace any defective product.

### Technical Service

Support is provided by full-time technically trained Grace field sales representatives and technical service personnel, backed by a central research and development technical services staff.



## Supply

Product	Unit of Sale	Approximate Coverage	Weight	Palletization
Perm-A-Barrier System 4000 Wall Membrane (includes surface conditioner)	1 roll	20.9 m <sup>2</sup> (225 ft <sup>2</sup> ) per roll 0.9 x 25 m (3 x 75 ft) roll	23 lbs/roll	25 cartons (25 rolls) per pallet
Perm-A-Barrier Wall Membrane	1 roll	20.9 m <sup>2</sup> (225 ft <sup>2</sup> ) per roll 0.9 x 25 m (3 x 75 ft) roll	17 lbs/roll	25 cartons (25 rolls) per pallet
Perm-A-Barrier Low Temperature Wall Membrane	1 roll	20.9 m <sup>2</sup> (225 ft <sup>2</sup> ) per roll 0.9 x 25 m (3 x 75 ft) roll	17 lbs/roll	25 cartons (25 rolls) per pallet
Perm-A-Barrier Wall Flashing				
- 305 mm (12 in.)	1 roll	7.5 linear ft per roll	13 lbs/roll	15 cartons (75 rolls) per pallet
- 457 mm (18 in.)	1 roll	7.5 linear ft per roll	17.5 lbs/roll	15 cartons (75 rolls) per pallet
- 610 mm (24 in.)	1 roll	7.5 linear ft per roll	18 lbs/roll	15 cartons (75 rolls) per pallet
- 914 mm (36 in.)	1 roll	7.5 linear ft per roll	24 lbs/roll	15 cartons (75 rolls) per pallet
Buttane Mastic - 5 gal pail	1 pail	approx. 1.0 m <sup>2</sup> at 60 mils	14 lbs/pail	15 pails per pallet
Buttane Mastic - 30 oz tube	12 tubes	approx. 30 linear ft at 4 mils	32 lbs/carton	72 cartons (864 tubes) per pallet
Perm-A-Barrier Surface Conditioner - 1 gal pail	4 pails	6-8 m <sup>2</sup> (150-350 ft <sup>2</sup> )	1 lbs/pail	36 cartons (144 pails) per pallet
Perm-A-Barrier WB Adhesive - 5 gal pail	1 pail	3-5 m <sup>2</sup> (350-550 ft <sup>2</sup> )	48 lbs/pail	14 pails per pallet
Buttane Primer B2 - 5 gal pail	1 pail	3-5 m <sup>2</sup> (350-550 ft <sup>2</sup> )	48 lbs/pail	14 pails per pallet


## Physical Properties

Property and Test Method	Perm-A-Barrier System 4000	Perm-A-Barrier Wall Membrane	Perm-A-Barrier Low Temperature	Test Method
Thickness	1 mm (3/64 in.)	1 mm (3/64 in.)	1 mm (3/64 in.)	ASTM D3767 Method A
Minimum tensile strength, membranes	2.8 MPa (400 psi)	2.8 MPa (400 psi)	2.8 MPa (400 psi)	ASTM D412 Die C Modified
Minimum tensile strength, film	34.5 MPa (5000 psi)	34.5 MPa (5000 psi)	34.5 MPa (5000 psi)	ASTM D412 Die C Modified
Minimum elongation, to failure of rubberized asphalt	200%	200%	200%	ASTM D412 Die C Modified
Pliability, at 180° bend over 2.5 mm (1 in.) mandrel	Pass at -43°C (-45°F)	Pass at -32°C (-25°F)	Pass at -43°C (-45°F)	ASTM D1970
Crack cycling, 3.2 mm (1/8 in.) at -32°C (-25°F)	Unaffected	Unaffected	Unaffected	ASTM C836
Minimum puncture resistance, membrane	178 N (40 lbs)	178 N (40 lbs)	178 N (40 lbs)	ASTM E154
Lap peel adhesion at minimum application temperature	1100 N/m width (6.3 lbs/in.)	700 N/m width (4 lbs/in.)	875 N/m width (5 lbs/in.)	ASTM D1876 Modified
Maximum permeance to water vapor transmission	2.9 ng (0.05 perms/(Pa.s.m <sup>2</sup> ))	2.9 ng (0.05 perms/(Pa.s.m <sup>2</sup> ))	2.9 ng (0.05 perms/(Pa.s.m <sup>2</sup> ))	ASTM E96 Method B
Air permeance of in-place membrane <sup>1</sup>	8x10 <sup>-5</sup> L/s/m <sup>2</sup> (4x10 <sup>-6</sup> cf/min/ft <sup>2</sup> )	1.7x10 <sup>-4</sup> L/s/m <sup>2</sup> (8.5x10 <sup>-5</sup> cf/min/ft <sup>2</sup> )	1.7x10 <sup>-4</sup> L/s/m <sup>2</sup> (8.5x10 <sup>-5</sup> cf/min/ft <sup>2</sup> )	ASTM E283
Air permeance of in-place membrane <sup>2</sup>	No change in air permeance value	No change in air permeance value	No change in air permeance value	ASTM E330
Water absorption (weight gain at 24 hours)	0.1%	0.1%	0.1%	ASTM D570

### Footnote:

- Air permeance measured at a pressure differential of 68 Pa (1/4 in.) Hg.
- Air permeance measured at a pressure differential of 68 Pa (1/4 in.) Hg after wall being subjected to a negative 3014 Pa (5 1/4 in.) Hg pressure difference for 10 seconds.

For Technical Assistance call toll free at 866-333-3SBM (3726).

 Visit our web site at [www.graceconstruction.com](http://www.graceconstruction.com)

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W. R. Grace & Co.-Conn.

62 Whittemore Avenue

Cambridge, MA 02140

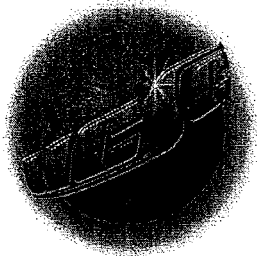
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Dens-Glass Gold is a registered trademark of G-P Gypsum Corporation

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DAP 0400 Printed in USA 4105 EAH 1/04

 MORNINGSTAR  
Construction Products





# MATERIAL SAFETY DATA SHEET

UCSC Rigid Polyurethane Spray Foam  
Includes: Duraseal, Durazone, Duraseal, Durafill and ProForm Products  
Page 1 of 4

## Rigid Polyurethane Spray Foam

Distributed by:  
UCSC  
3010 W. LINCOLN ST.  
PHOENIX, AZ 85009

0

### EMERGENCY PHONE NUMBERS

CHEMTREC 800-424-9300  
UCSC 888-289-8272

### SECTION 1. MATERIAL IDENTIFICATION

Trade Name: UCSC Durafoam, Durazone, Duraseal,  
ProForm, Durafill Systems  
Chemical Family: Rigid Urethane Foam Plastic – Closed Cell,  
Open Cell  
Chemical Name: Rigid Polyurethane Cellular Plastic  
CAS: N/A – Finished Good  
Current Issue Date: September 2006  
WHMIS Classification: Not Regulated

### SECTION 2. INGREDIENTS AND HAZARDS

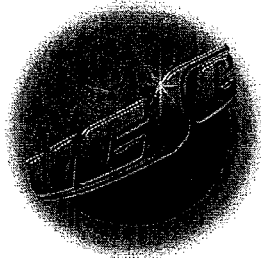
<u>Ingredient Name:</u>	<u>Approx.%</u>	<u>Exposure Limits</u>
Urethane Plastic	100	Not Established

### SECTION 3. PHYSICAL DATA

Physical State:	Rigid Cellular Plastic
Odor:	Neutral
Density:	0.5 to 20 pcf
Melt Point/Freeze Point:	N/A, Thermoset
Decomposition Temperature:	> 250°F
Max Service Temperature:	180°F
Water Solubility:	None

### SECTION 4. FIRE AND EXPLOSION DATA

State:	Combustible
Flash Point:	Not Established
Auto-Ignition Temperature:	650-800°F



# MATERIAL SAFETY DATA SHEET

UCSC Rigid Polyurethane Spray Foam  
Includes: Duraseal, Durazone, Duraseal, Durafill and ProForm Products  
Page 2 of 4

## SECTION 4. FIRE AND EXPLOSION DATA (continued)

Extinguishing Media:	Use water, dry chemical, carbon dioxide, or chemical foam
Special Fire Fighting Equipment:	Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus with a positive pressure.
Hazardous Decomposition:	Under fire conditions, carbon monoxide, carbon dioxide hydrogen products halides and nitrogen oxides.

Rigid Polyurethane foam like other organic materials such as paper, wood and cotton, can present unreasonable fire risks in certain misapplication when exposed to ignition sources in air. Once ignited, fires can burn rapidly and produce rapid flame spread, quick flashover, toxic or flammable gases, dense smoke and intense heat. In no event should the polyurethane foam remain exposed or unprotected.

### Precautions

1. Make no application of foam to interior wall and ceilings or other space enclosures without prompt and subsequent application of approved thermal barriers.
2. Do no welding or flame cutting until proper surface protection has been provided.
3. Avoid the confined storage of large urethane foam buns.

## SECTION 5. HEALTH HAZARDS DATA

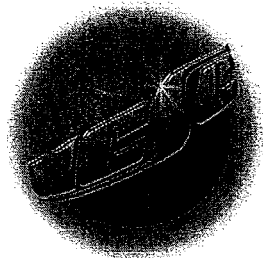
Routes of entry for solids:	Inhalation, skin contact, only if dust is created during cutting.
Routes of entry for gasses:	N/A
Eye and skin contact with dust:	May cause mechanical irritant to skin and eyes.
Dust Inhalation:	May cause mechanical irritant to skin and eyes.
Dust Ingestion:	May cause choking if swallowed.

## SECTION 6. EMERGENCY & FIRST AID PROCEDURES

Eye Contact:	Irrigate with water for 15 minutes.
Skin Contact:	Wash with soap and water thoroughly.
Inhalation:	Evacuate the area and move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, assist with oxygen. Consult a physician immediately.

## SECTION 7. SPECIAL PROTECTION INFORMATION

Eye Protection:	Safety glasses during cutting.
Skin Protection:	Protective clothing not necessary.
Respiratory Protection:	Dust mask during cutting.
Ventilation:	Use sufficient ventilation to keep exposure to dust to minimum (below 5-



# MATERIAL SAFETY DATA SHEET

UCSC Rigid Polyurethane Spray Foam  
Includes: Duraseal, Durazone, Duraseal, Durafill and ProForm Products  
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mg/m<sup>3</sup> breathable nuisance dust).

## SECTION 8. REACTIVITY DATA

Stability:	Stable under normal conditions.
Polymerization:	None
Incompatibility (Materials To Avoid):	None Known
Hazardous Decomposition Products:	Under fire conditions; carbon monoxide and dioxide, hydrogen products halides and nitrogen oxides.
Corrosive Properties:	None
Oxidizer Properties:	None
Chemical Resistance:	Stable in the presence of most solvents found in binders, bituminous materials, wood preservatives and sealers. Resistant to facers containing plasticizer, fuel, mineral oil, weak acids and weak bases. Resistant to fungi and microbes. UV rays cause a darkening of the foam surface and with time an embrittlement of the surface.

## SECTION 9. DISPOSAL CONSIDERATIONS

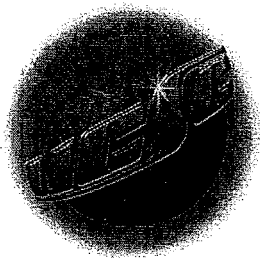
Waste Disposal: In accordance with Federal, Provincial and local regulations.

## SECTION 10. STORAGE INFORMATION

General:	Keep away from open flame, electrical or mechanical sparks, electric heaters, high-powered lights, flame sources and flammable liquids and gases.
Storage Requirements:	Protect all indoor bun and sheet storage areas with fusible sprinklers.

## SECTION 11. SHIPPING DATA

Technical Shipping Name:	Rigid Urethane Foam Plastic
Primary hazard Class:	N/A
Secondary hazard class:	N/A
Label required:	None
Placard required:	None
Poison constituent:	N/A
UN Code:	N/A
EPA Registration #:	N/A
TDG Classification:	Non-regulated



## MATERIAL SAFETY DATA SHEET

UCSC Rigid Polyurethane Spray Foam  
Includes: Duraseal, Durazone, Duraseal, Durafill and ProForm Products  
Page 4 of 4

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Renewable Roof Systems  
Wall Coatings

## ***Application Guidelines PR20***

### ***Partially Reinforced Coating Membrane***

The AcryLabs PR20 Elastomeric Coating System is a fluid applied partially reinforced membrane for metal panel, standing seam and low slope roofs. Combining our Mesh 2000 with multiple coats of our 2100 series 100% Acrylic/Elastomeric coating provides a fully adhered, seamless membrane system with superior weatherability. The PR20 is a monolithic, sustainable coating system that will yield a final minimum membrane thickness of 20 mils throughout the field of the roof and 45 mils at the reinforced areas. AcryLabs coatings are waterborne and meet or exceed all V.O.C. regulatory requirements.

#### **Integral Components of the PR20 System**

2100B    Elastomeric Base Coat  
2100     Elastomeric Finish Coat  
Mesh 2000 Polyester Reinforcement

#### **Primers and Accessory Items**

2400            Brush Grade Acrylic Sealant  
2500            Trowel Grade Acrylic Sealant  
3200            Rust Inhibitive Primer  
3600            Corroaseal Rust Converter

### ***Installation:***

#### **1.) Preparation**

AcryLabs coatings are adhesive and require a clean dry surface to insure proper adhesion. The key to successful coating application is preparation. Pressure washing is the preferred method in removing all oxidation, dirt and contaminants. When pressure washing is not appropriate, consult AcryLabs Inc. Technical department for additional information.

#### **2.) Repair**

The applicator needs to provide a sound substrate for the PR20 System. All repairs should be made following industry guidelines. These materials should not be applied over rust or corrosion. All rust and corrosion should be removed following SSPC guidelines and primed with 3200 RIP. If any unusual conditions exist consult Acrylabs, Inc. technical department.



### 3.) Fasteners

Make sure all fasteners are properly tightened and washers are in good condition. Tighten all loose fasteners; replace missing and stripped fasteners with oversized fasteners. Dab all fasteners heads with 2400 Brushable Caulk/Sealant to create a water-tight seal.

### 4.) Flashings & Penetrations

All flashings, terminations, penetrations and any other areas deemed necessary should be reinforced using the following guidelines:

- A.) Apply a generous coating of 2100B Elastomeric Base Coat to the area to be reinforced.
- B.) Embed appropriate width Mesh 2000 into wet coating, removing all wrinkles and fishmouths.
- C.) Apply a saturation coat of 2100B Elastomeric Base Coat.

\*These areas must be coated when applying finish coats to insure minimum membrane thickness.

### 5.) Field Application

Apply 2100 Elastomeric Finish Coat to all areas at a minimum rate of 1.25 gallons per 100 square feet, allow too dry. Apply final coat 2100 Elastomeric Finish Coat to all areas at a minimum rate of 1.25 gallons per 100 square feet.

\*When embedding Mesh 2000 into wet coating a 3" inch overlap is recommended.

### 6.) Inspection

Inspect roof and apply additional AcryLabs coating as necessary to insure a final membrane thickness of 20 mils DFT (dry film thickness) throughout the field of the roof and 45 mils at the reinforced areas.

This is a general guideline, minimum material requirements may change based on project specific requirements. Consult AcryLabs technical department for additional information. Failure of the substrate or roofing systems does not constitute AcryLabs coating or system failure.

### Application:

AcryLabs coatings can be brushed, rolled or sprayed utilizing airless spray equipment.

### Spray Equipment:

 The following are guidelines for airless equipment.

2500PSI                      2 gallons per minute                      Tips: 427-433

**Warranty:** Acrylabs responsibility under this limited warranty is for defective material. Acrylabs, Inc. only obligation is to either replace or refund the price of materials to be proven defective.

730 Commercial Lane \* Honey Brook, PA 19344  
P.O. Box 82585 \* Tampa, FL 33682-2585  
Toll free 866.273.1355 Fax 610.273.1357

## Division 08 - Openings

08 0000 Openings  
 08 1000 Doors and Frames  
 08 3000 Specialty Doors and Frames  
 08 4000 Entrances, Storefronts, and Curtain Walls  
 08 5000 Windows  
 08 6000 Roof Windows and Skylights  
 08 7000 Hardware  
 08 8000 Glazing  
 08 9000 Louvers and Vents

CSI #	Product Type	Product Name/Model #	Manufacturer	Sample Spec Product Data	
08 1000	Sliding Glass Door	WP2 2424 OF (96"x96")	Loewen		
08 1000	Terrace Door	TD1 0904	Loewen		
08 1000	Transom window	TD1 0904	Loewen		
08 1000	Sidelite	16"x96"	Loewen		
08 4000	Exterior Curtain wall System	Illumawall - Series 3000 BPC	Duo-gard		X
08 4000	Interior Curtain Wall System	Illumawall - Series 1500	Duo-gard		
08 5000	Access Window/Fixed Window Assembly	48"x96"	Loewen		
08 5000	Casement Window/Fixed Window Assembly	24"x96"	Loewen		
08 5000	Awning Window (bathroom)	48"x24"	Loewen		
08 5000	Awning Window (kitchen)	24"x30"	Loewen		
08 5000	Fixed Window (kitchen)	96"x13"	Loewen		
08 5000	Transom Window (Awning)	16"x36"	Loewen		
08 6000	Skylight (kitchen)	FCM White Laminated Glass 2222	Velux		X
08 6000	Skylight (Breezeway)	FCM Comfort 1430	Velux		X
08 6000	Skylight (Living Space)	Custom	Duo-Gard		
08 8000	Exterior Curtain Wall Glazing	16 mm Nanogel filled Polycarbonate	Duo-Gard	X	X
08 8000	Interior Curtain Wall Glazing	10 mm Polycarbonate (opal)	Duo-Gard		
08 8000	Living Space Skylight Glazing	16 mm RFX	Duo-Gard		
08 8000	Door Glazing	Heat Smart Plus 1 Argon Filled (R=4.0)	Loewen		
08 8000	Transom Glazing	Heat Smart Plus 1 Argon Filled (R=4.0)	Loewen		
08 8000	Sidelite Glazing	Heat Smart Plus 3 Argon Filled (R=7.9)	Loewen		
08 8000	Window Glazing	Heat Smart Plus 3 Argon filled (R=7.9)	Loewen		

## TERRACE DOORS, SIDELITES AND TRANSOMS

Rough Opening	inches	37 1/2		72		106 1/2		141 1/4	
		mm		1830		2706		3583	
Unit O.S.M.	inches	36 3/8		70 7/8		105 3/8		139 7/8	
		mm		1800		2676		3553	
15 3/4	400								
15 3/4	400	TDT1 0904		TDT2 1804		TDT3 2704		TDT4 3604	
23 5/8	600								
23 5/8	600	TDT1 0906		TDT2 1806		TDT3 2706		TDT4 3606	
79 1/2	2020								
79 1/2	2020	TD1 0920 R, L or F		TD2 1820 *RF or *FL		TD3 2720 *FRF or *FLF		TD4 3620 *FRFF or *FFLF	
82	2085								
82	2085	TD1 0921 R, L or F		TD2 1821 *RF or *FL		TD3 2721 *FRF or *FLF		TD4 3621 *FRFF or *FFLF	
86 3/4	2184								
86 3/4	2184	TD1 0970 R, L or F		TD2 1870 *RF or *FL		TD3 2770 *FRF or *FLF		TD4 3670 *FRFF or *FFLF	
95 1/4	2420								
95 1/4	2420	TD1 0924 R, L or F		TD2 1824 *RF or *FL		TD3 2724 *FRF or *FLF		TD4 3624 *FRFF or *FFLF	
107 1/16	2720								
107 1/16	2720	TD1 0927 R, L or F		TD2 1827 *RF or *FL		TD3 2727 *FRF or *FLF		TD4 3627 *FRFF or *FFLF	

\* Complete with optional screen.

Note: Operation as viewed from outside.

# Duo-Gard Interior Systems

## TRANSLUCENT INTERIOR WALLS

Light – Privacy – Versatility – Economy

### System Summary

- Polycarbonate glazing technology
- Contemporary appearance
- Dramatic backlighting appeal
- CC1 – Class A fire-rated
- Demountable as desired
- 3 distinct system series provide wide range of design options
- High-end solutions at a reasonable price
- Aluminum framing
- Project diffused daylight deeply into space
- Project light inside wall's interior flutes
- Configurations for sound blocking
- Design/build around your creative ideas

### Design / Structural Options

- Seamless expanses-no mullions
- Standard panels up to 24 ft. long
- Elegant curved walls
- Install vertically or horizontally
- Mount to steel or wood studs
- Aluminum tube wall & partition structure designed and fabricated to your design
- Aluminum mullions
- Custom panels up to 39 ft. long
- Unusual curved corners
- Grid patterns to uniquely manipulate light
- Relocate systems as needed

### Ideal Applications

- Walls
- Partitions
- Panels
- Ceilings
- Light filters
- Skylight light baffles
- Moveable dividers
- Your idea here

### Glazing Options

- Opal, crystal, blue, green, bronze
- Custom colors for large orders
- Prismatic panels
- Block images with total diffusion
- Combine panels to create unique designs
- Aluminum frame colors to suit your specs
- Run flutes vertically or horizontally
- Add crystal panels to enhance visibility

### Finish Options

- Kynar finishes
- Anodized finishes
- Electrostatically painted finishes
- Custom architectural colors

### Technical / Installation Support

- Complete specifications for each system
- Superior technical assistance from design concept through installation
- Systems specifically designed for installation ease
- Field-fabricated to ensure accuracy, reduce dependency on installation measurements, reduce errors
- Exceptional technical support for installers in the field

### Pricing

- Drawings, details required. E-mail [Info@duo-gard.com](mailto:Info@duo-gard.com); fax 734-207-7995.

# **Duo-Gard Structural Framing Systems**

## **SERIES 3000 – BPC SYSTEM**

### **Flexibility with Aesthetic Appeal in Single-Glazed Option**

#### **System Summary**

- Engineered with a base plate, pressure plate and cap system
- Highly aesthetic profile with a smooth flowing face and no visible screws
- Structural integrity with light weight
- Houses all glazing types
- Water-tight system with multiple seals
- Spans large walls and window areas
- Available in Series 3000 Double-Glaze (See additional performance data)

#### **Ideal Applications**

- Large, high-profile glazing areas where aesthetics are paramount
- Buildings with multiple glazing angle requirements
- Interior walls and partitions
- Sloped areas and skylight retrofit
- For all industrial, institutional, commercial, government buildings
- Pre-engineered metal buildings

#### **Glazing Options**

- All translucent panels 8mm, 10mm, 16mm, 20mm, 25mm, 40mm
- All types of glass, including insulated
- Integrated multiple glazing types

#### **Finish Options**

- Satin anodized aluminum
- Electrostatically painted aluminum
- Custom architectural colors

#### **System Options**

- Multiple opener combinations when integrated with Series 1000 System
- Custom configurations for complex engineered solutions
- Visibility and ventilation as desired



# FCM FIXED (NON-VENTING) CURB MOUNTED SKYLIGHTS

Quality VELUX Skylight Designed for Curb Mount Installations

VELUX®

Size Code	1430	1446	2222	2230	2234	2246	3030	3046	3434	4646
Inside Curb Dimension	14 1/4" x 30"	14 1/4" x 46 1/2"	22 1/4" x 22 1/4"	22 1/4" x 30"	22 1/4" x 34 1/2"	22 1/4" x 46 1/2"	30 1/4" x 30"	30 1/4" x 46 1/2"	34 1/4" x 34 1/2"	46 1/4" x 46 1/2"
Outside Curb Dimension	17 1/4" x 33 1/2"	17 1/4" x 49 1/2"	25 1/4" x 25 1/2"	25 1/4" x 33 1/2"	25 1/4" x 37 1/2"	25 1/4" x 49 1/2"	33 1/4" x 33 1/2"	33 1/4" x 49 1/2"	37 1/4" x 37 1/2"	49 1/4" x 49 1/2"
Maximum Skylight Clearance	18 1/4" x 34 1/2"	18 1/4" x 49 1/2"	26 1/4" x 26 1/2"	26 1/4" x 34 1/2"	26 1/4" x 38 1/2"	26 1/4" x 50 1/2"	34 1/4" x 34 1/2"	34 1/4" x 50 1/2"	38 1/4" x 38 1/2"	50 1/4" x 50 1/2"
GLAZINGS/CLADDINGS	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
FCM Comfortplus Laminated, Low-E	115	132	115	139	149	163	176	248	254	305
FCM Impact Glass Laminated, Low-E	*	*	138	*	171	182	206	276	254	305
FCM White Laminated Glass Laminated, Low-E	*	*	152	*	*	205	*	*	*	338
FCM SageGlass®	N/A	N/A	1036	N/A	N/A	1859	N/A	N/A	N/A	N/A

Note: FCM custom sizes are available. Model FCM can be installed horizontally.  
Call 1-800-888-3589 for more information and pricing.

## FLASHING SYSTEMS

BLINDS (Electric blinds require control systems sold separately. See CONTROLS section below.)	1430	1446	2222	2230	2234	2246	3030	3046	3434	4646
FHG Manual	N/A	102	102	110	113	118	122	126	124	152
MMC Electric	N/A	N/A	304	307	309	315	326	337	332	358

## CONTROLS

CONTROLS	\$
Manual Rod, ZST 300, 6' - 10' Telescopic	31
Power Supply and Keypad, KES 160, for 1 Electric Blind	88
SmartGlass Control System, ZST 186	325

## FCM CUSTOM SIZE SKYLIGHTS

Skylights available to fit **outside curb dimensions including flashing** of 17 1/4" to 49 1/4" wide by 17 1/4" to 70 1/4" long with 14 working day lead-time.

Laminated glass is limited to 17 1/4" to 49 1/4" wide by 17 1/4" to 49 1/4" long for a 14 working day lead-time. Larger units will have a 24 working day lead-time.

VELUX requires outside curb dimensions, then builds an FCM to the closest 1/2" increment. Therefore, spacing between the outside curb dimension, including flashing and the skylight dimension, can range from 1/8" to 3/4" overall.

Call 1-800-888-3589 for more information and pricing.

NEW FCM can be installed **completely flat** onto any type of curb.



\*Special order only. Call for price and availability.

Retail prices are not valid in Alaska, Hawaii or Mexico due to additional freight cost.

### \*National Delivery Guideline

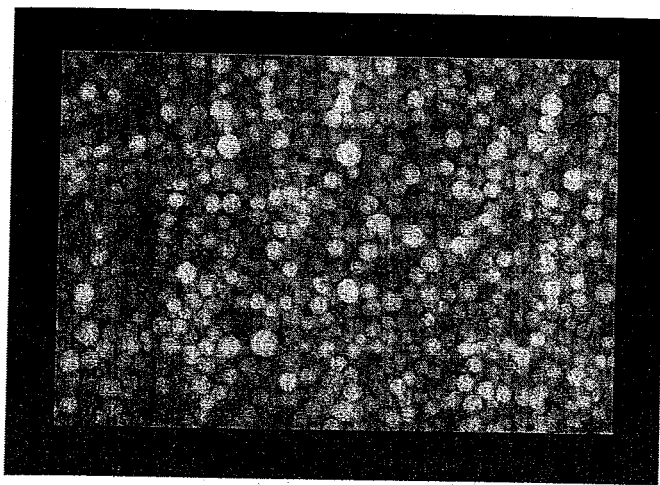


- S - In-stock at regional warehouses - Allow 2 to 4 days for shipment
- T - Trans-shipped from central warehouse - Allow 10 to 14 days for shipment
- N - Not stocked; Manufactured on demand - Allow Approximately 30 working days for shipment

ROOF PITCH  
0:12-20:12

SLOPE  
0°-60°

MORNINGSTAR



**nanogel**™  
AEROGEL  
BEADS



## Product Features

Particle Size Range:	≈ 1.0 mm (0.04 in)
Pore Diameter:	≈ 20 nm
Porosity:	> 90%
Bulk Density:	90 to 100 kg/m <sup>3</sup> (5.6 – 6.2 lb/ft <sup>3</sup> )
Surface Chemistry:	Fully Hydrophobic
Thermal Conductivity:	0.018 W/m-K at 25°C (0.125 Btu-in/hr-ft <sup>2</sup> -°F)
CAS RN:	126877-03-0

## Nanogel® Aerogel Flammability Testing

Flammability of solids – burning rate (fire train test)  
(Chilworth Technologies)

Result: not readily combustible substance of Division 4.1  
(DOT); No smoke

Standard Test Method for Ignition Properties of Plastics –  
Test Method: ASTM D-1929 (Vtech)

Flash Ignition Temp	Self Ignition Temp
395°C (750°F)	395°C (750°F)

Minimum Ignition Energy of Dust:  
US Bureau of Mines Report of Investigations 5624

Temperature	Minimum Ignition Energy
RT	>500 mJ

## Nanogel® Aerogel Beads Information

The Nanogel® Aerogel Beads are white, free flowing, spherical particles. The size distribution of beads is narrow and centered around 1mm. The pore volume exceeds 90%. It is this high porosity, in conjunction with the associated fine structure of the aerogel that insures excellent performance in a variety of applications. These particles can be used as is or milled to smaller sizes for applications such as:

- Reinforcement
- Rheological control
- Thermal insulation
- Acoustic insulation
- Free Flow
- Anti-caking
- Water repellency
- Fluidization
- Corrosion resistance
- Matting
- Anti-foaming



## The Benefits of Utilizing Nanogel® Aerogel Beads

These Nanogel® Aerogel Beads represent a new class of hydrophobic silica particles distinguished by its:

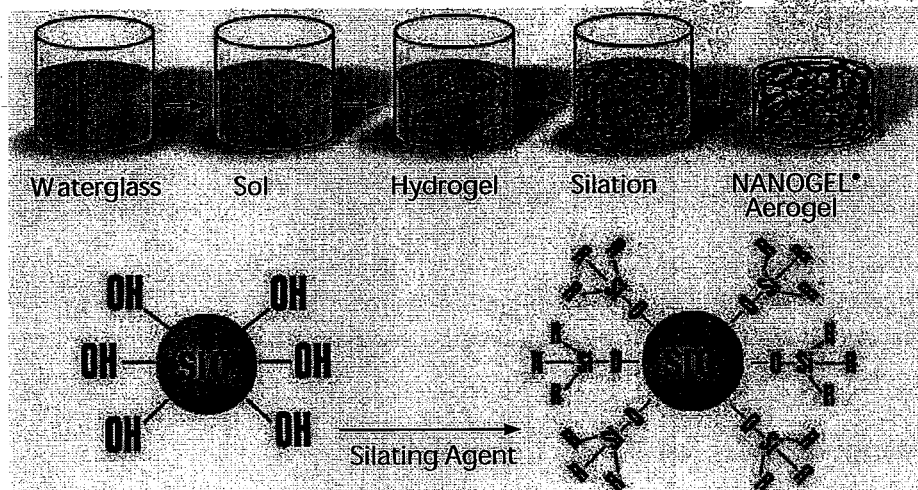
- porosity
- hydrophobicity
- level of extractable materials
- range of particle sizes
- transparency

Unique combinations of these characteristics create opportunities to expand Cabot's product offerings, develop new applications and set new standards among existing technologies.

### State-of-the-Art Nanogel® Aerogel Technology Direct Silation of the Hydrogel



Nanogel® Aerogel Beads



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Tuscola, IL 61953-9643  
U.S.A.  
T: (217) 253-3370  
F: (217) 253-4334

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GmbH and Co. KG  
Kronenstrasse 2  
79618 Rheinfelden  
Germany  
T: (49) 7623-707-0  
F: (49) 7623-707-53

#### Asia Pacific

Cabot Specialty Chemicals Inc.  
Level 21, MNI Tower 2  
11, Jalan Pinang  
50450 Kuala Lumpur,  
Malaysia  
T: (60-3) 2164-8352  
F: (60-3) 2162-0253

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American Division  
Av. João, Castaldi, 88  
04517-900, São Paulo, SP,  
Brazil  
T: (55-11) 5536-0388  
F: (55-11) 5542-6037



**CABOT**

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E-mail: [nanogel@cabot-corp.com](mailto:nanogel@cabot-corp.com)

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# Working Safely With Nanogel® Aerogel Beads

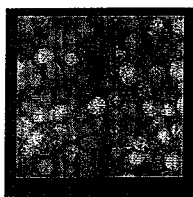


## Purpose

This guide provides users information on the safe handling of NANOGEL® Aerogel Beads. Safety, health and environmental issues associated with the use of NANOGEL® Aerogel Beads can be easily managed by the application of standard occupational safety, health and environmental practices, as provided in this guide.

Please note that this guide is not a substitute for the information provided in NANOGEL® Aerogel Beads' material safety data sheet (MSDS) and users should refer to the MSDS prior to working with NANOGEL® Aerogel Beads.

## General Information



NANOGEL® Aerogel Beads [CAS No.: Not Assigned] is a surface treated precipitated synthetic amorphous silica gel that is chemically very similar to other commercially available surface treated precipitated synthetic amorphous silica products. It consists of greater than 97% treated precipitated amorphous silica gel and less than 3% water. **NANOGEL® Aerogel Beads does not contain crystalline silica.** As shipped, its physical appearance is that of white, friable beads of approximately one millimeter (mm) diameter. During transportation, a small amount of smaller particles, capable of entering the respiratory tract, may be generated due to abrasion.

## Fire and Explosion



NANOGEL® Aerogel Beads is not a readily combustible substance and presents a low risk of fire or explosion. Dust clouds of fine material generated from NANOGEL® Aerogel Beads have been shown to be explosive. Refer to the MSDS for the minimum ignition energy and the maximum explosion concentration of fine NANOGEL® Aerogel Beads.

If a fire involving NANOGEL® Aerogel Beads does occur, direct water spray or stream may spread the fire due to the burning powder floating on the water or due to the generation of dust clouds. A fog spray is recommended when water is used as an extinguishing agent. Foam is also a suitable extinguishing agent. Areas where hot work, such as welding, occurs should be free from the dust of settled and airborne NANOGEL® Aerogel Beads.

The product may build up static electrical charges when subjected to friction and may present an ignition source in the presence of flammable vapors or gases. All metal elements that come in contact with NANOGEL® Aerogel Beads must be grounded.

## Occupational Hygiene



Avoid exposure of skin and eyes to the dust of NANOGEL® Aerogel Beads. Use personal protective equipment, including protective gloves and clothing, safety goggles or safety glasses with eyeshields. Have an emergency eyewash and safety shower in close proximity. An occupational exposure limit (OEL) has not been established for this product or for any other surface treated precipitated synthetic amorphous silica. It is recommended that dust levels be maintained below the current OEL for precipitated synthetic amorphous silica and silica gel. Where this is not practical using engineering controls, use appropriate respiratory protection. Refer to NANOGEL® Aerogel Beads' MSDS for OEL and additional personnel protection equipment information.



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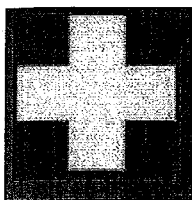
Cabot Corporation

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**MORNINGSTAR**

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## First Aid



### Inhalation:

The dust of NANOGEL® Aerogel Beads, like many dusts, may initiate a bronchial response among individuals with pre-existing lung conditions. Exposures above the current OEL for precipitated synthetic amorphous silica may produce temporary discomfort to the upper respiratory tract that may result in coughing. Removal from dust exposure normally is sufficient to cause symptoms to subside with no lasting effects.

### Skin:

Repeated exposure to the dust of NANOGEL® Aerogel Beads may cause drying of the skin. Wash dust from the skin with mild soap and water. Barrier cream application prior to skin exposure may assist in the removal of dust from the skin.

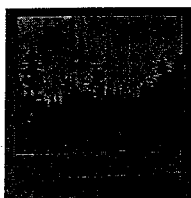
### Ingestion:

No adverse effects are expected if NANOGEL® Aerogel Beads is ingested.

### Eyes:

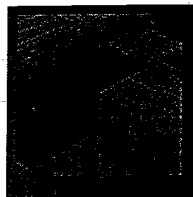
The dust of NANOGEL® Aerogel Beads may cause mechanical irritation. Flush gently with clean water to remove dust.

## Environment



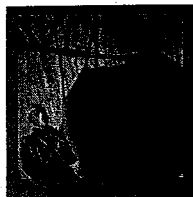
Avoid the release of NANOGEL® Aerogel Beads to the environment. Spills should be collected immediately, preferably by dry vacuuming and then placed in sealed containers. Waste product should be disposed of in accordance with local regulations.

## Storage



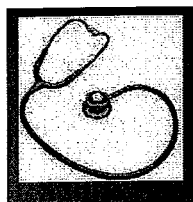
NANOGEL® Aerogel Beads should be stored in a clean, dry uncontaminated area away from volatile chemicals.

## Housekeeping



Avoid the production of any dust. Dry vacuuming is the preferred method for removing surface dust and cleaning up spills of NANOGEL® Aerogel Beads. Dry sweeping should be avoided but may be performed when using dust suppression.

## Health



Surface treated precipitated synthetic amorphous silica products are not carcinogenic or mutagenic. Chemically similar products have not been demonstrated to be skin sensitizers, skin or eye irritants, or toxic when ingested.





WINDOWS DOORS ENVIRONMENT CONTACT US LOEWEN HOME

home « architect main « glazing « heatsmart



## PRODUCTS

Windows

Doors

## SERVICES

Photo Gallery

CAD Details Catalog

Find an Architectural Representative

Intro to LAS

Product Literature & Samples

AIA Continuing Education

## ARCHITECTURAL BENEFITS

Environment

Douglas Fir

Mahogany

Colors & Cladding

Hardware

StormForce™ Series

Glazing

HeatSmart®

Tranquility®

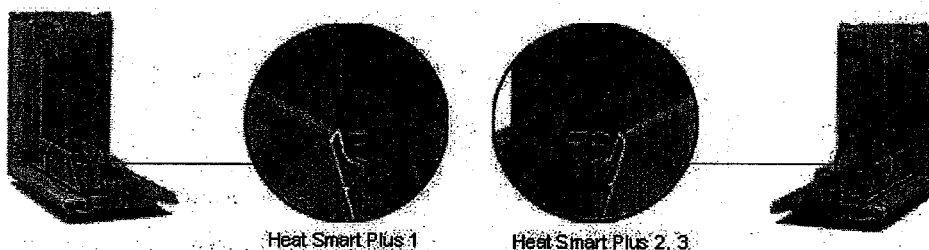
Grilles & Divided Lites

## ARCHITECTURAL SERVICES GLAZING

### HEAT SMART® PLUS WINDOW SYSTEMS

Heat Smart® Plus Window Systems offer three levels of thermal protection. The charts below show the comparative performance of each Loewen window system and will help you better understand their benefits.

[Learn more about thermal design.](#)



### HEAT SMART® PLUS 1

Good. Double glazed, with one layer of Low E<sup>2</sup> coating and one 1/2" air space filled with argon gas\*.

### HEAT SMART® PLUS 2

Better. Triple glazed, with one layer of Low E<sup>2</sup> coating and one 1/2" air space filled with argon gas\*.

### HEAT SMART® PLUS 3

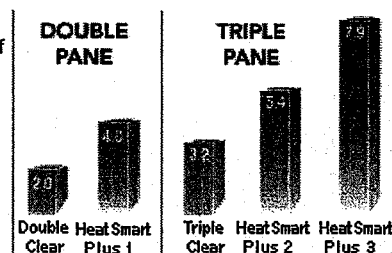
Best. Triple glazed, with two layers of Low E<sup>2</sup> coatings and two 1/2" air spaces filled with argon gas\*.

Heat Smart® Plus Window Systems also protect furnishings by screening out much of the damaging ultraviolet rays that enter the home. This reduces fading and related damage.

### R VALUE

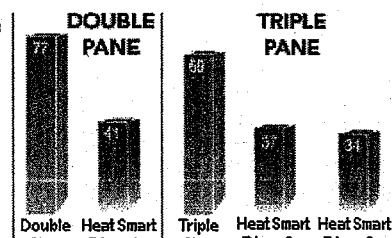
This chart compares Heat Smart® Plus with clear double and triple pane glass units by measuring the resistance of heat transfer through glass.

The higher the number, the better the window insulates. R-Value measured at center of glass.



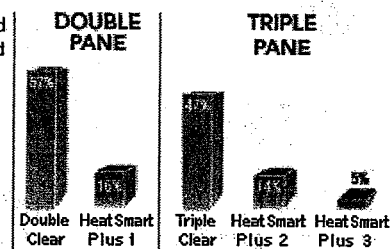
### SOLAR HEAT GAIN

This chart measures the ratio of solar heat gain through a window system compared to an unobstructed opening. Heat Smart® Plus compared with clear double and triple pane glass units.



**UV TRANSMITTANCE**

This chart measures the percentage of ultraviolet radiated wavelengths allowed to be transmitted through the glazed product. Heat Smart® Plus compared with clear double and triple pane glass units.

**ADDITIONAL GLAZING STANDARDS**

Loewen uses 1/8" double strength glass, giving vast improvement to strength, durability and clarity over thinner glass.

All standard sealed units feature machine applied butyl primary sealant and polyisobutyl secondary sealant. This reduces the chance of seal failure, improves argon gas retention and increases strength.

Minimal use of exposed exterior caulking on glass surface for a clean, aesthetically pleasing appearance.

All standard Loewen sealed units are argon gas filled with no spacer bar piercing\*.

Glazing fabrication is automated.

Our automated glazing assembly line allows robots to excel at what they do best — precise, repetitive tasks — and lets our skilled operators concentrate on issues of quality and performance. The robotic line creates Loewen sealed units with the glass in a vertical position, which prevents the irregularity caused by deflection (glass sagging during production) that can rob units of their hermetic seal over time.

Specially treated glass designed for southern exposures and hot climates is available. Sun 140 glass helps to provide comfort and shading from strong sunlight.

\*\*\*Ashrae calculated values Window 4.1. 12mm airspace (0.5 inches). Does not apply to sealed units with capillary tubes installed.

## GUIDE SPECIFICATIONS

### GUIDE SPECIFICATIONS FOR DOORS BY LOEWEN

#### SECTION 08215

##### ALUMINUM CLAD: SWINGING TERRACE AND FRENCH TERRACE DOOR UNITS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Work Included: Furnish and install factory-assembled, aluminum clad swinging Terrace and French Terrace door units, including glass and glazing, hardware and accessories; as indicated on Drawings and as specified herein.
- B. Related Sections: Other Specification sections that directly relate to the work of this Section include, but are not limited to, the following:
  - 1. Section 06100, Rough Carpentry: Wood framing.
  - 2. Section 07210, Building Insulation: Batt and blanket insulation.
  - 3. Section 07900, Joint Sealers: Perimeter sealants.
  - 4. Section 09900, Painting: Painting and finishing.

##### 1.02 PERFORMANCE REQUIREMENTS

- A. General: Perform testing in accordance with AAMA/WDMA 101 I.S.2-97, or CSA-A440-00.

##### 1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, test reports and installation instructions.
- B. Shop Drawings: Submit shop drawings for approval. Include detailed plans, elevations, details, required rough openings, anchors and accessories. Include relationship with adjacent materials. Provide installation templates for work installed by others.
- C. Samples: Submit representative samples of each material that is to be exposed in the completed work. Show full color ranges and finish variations expected.

##### 1.04 QUALITY ASSURANCE:

- A. Manufacturer: For each material type required for the work of this section, provide primary materials, which are the product of one manufacturer. Provide secondary or accessory materials that are acceptable to the manufacturer of the primary materials.
- B. Installer: A firm with a minimum of three years experience in the type of work required by this Section.
- C. Mock-Up: Prior to commencing the primary work of this section, provide a mock-up of each unit type at locations acceptable to Architect. Obtain Architect's acceptance of visual qualities. Remove and replace units that are not approved. Approved mock-ups built in place may be incorporated into the finished work.

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

ALUMINUM CLAD: SWINGING TERRACE AND FRENCH TERRACE DOOR UNITS

08215-1

Swinging/French Terrace Doors

*Loewen*

K63

www.loewen.com

## GUIDE SPECIFICATIONS

### GUIDE SPECIFICATIONS FOR DOORS BY LOEWEN

#### 1.06 WARRANTY

- A. Provide manufacturer's standard limited warranty covering the following:
1. Structural members and operating hardware are warranted against defects in material and workmanship for a period of ten years.
  2. Insulating glass is warranted against material obstruction of transparency resulting from film formation or dust collection on the interior surfaces for a period of ten years and 20 years on qualifying Heat-Smart Systems.

#### PART 2 PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURER

- A. Provide units manufactured by Loewen (Loewen Inc. in the U.S.A. and C.P. Loewen Enterprises Ltd. in Canada and internationally; 77 Highway 52 West, Steinbach, Manitoba R5G 1B2; 204-326-6446; 800-563-9367; www.loewen.com).

##### 2.02 ALUMINUM CLAD: SWINGING TERRACE AND FRENCH TERRACE DOOR UNITS

- A. Swinging Terrace and French Terrace door units: Swinging doors, Transoms, Tidelites, and preglazed with insulating glass and as follows:
1. Glass and Glazing Type:
    - a. Double-glazed [and Heat-Smart Plus System 1].
    - b. Special Glass Designs: \_\_\_\_\_.
  2. Hardware Options:
    - a. Keyed alike locks.
    - b. Finish: painted [Black] and plated [Antique Brass, Polished Brass, Brushed Chrome, Brushed Nickel and Oil Rubbed Bronze] and solid bronze [Rustic Bronze] finishes.
  3. Grilles:
    - a. Style: [Colonial][Heritage][Craftsman][\_\_\_\_\_].
    - b. Between Glass Grilles: [White Metal][Square Brass][Pewter].
    - c. Simulated Divided Lites: [3/4"][1 1/8"][2"] Grille bars permanently applied to the interior and exterior, with or without airspace grilles.

##### 2.03 MATERIALS AND COMPONENTS

- A. Frame and Door: Coastal Douglas Fir [Mahogany (*Swietenia macrophylla*)] kiln-dried lumber, preservative-treated in accordance with NAFS 1 /WDMA 101 I.S.-2/CSA-A440. Interior exposed surfaces are clear Fir; exterior surfaces factory primed. Jamb width [4 9/16" (116 mm)][6 9/16" (166 mm)][other].
- B. Glass and Glazing: Factory sealed units of 4 mm clear tempered glass with 1/2" (12 mm) airspace; wood stop at interior face and foam tape gasket at exterior face.
- C. Weatherstrip: Operating doors are sealed with flexible bubble and fin at head and jambs.
1. Inswing Doors: Pile dust plugs at door bottom.
- D. Hardware: Multi-point locking hardware with brass handle set, escutcheon and dead bolt.
- E. Door Sill: Wood clad with bronze anodized aluminum, thermally broken with rigid vinyl extrusion.
- F. Grilles: Manufacturer's standard, unfinished clear wood grilles, interior mounted.

#### ALUMINUM CLAD: SWINGING TERRACE AND FRENCH TERRACE DOOR UNITS

08215-2

Swinging/French Terrace Doors™

K64

*Loewen*

1.800.563.9367

## GUIDE SPECIFICATIONS

### GUIDE SPECIFICATIONS FOR DOORS BY LOEWEN

#### G. Finishes:

1. Exterior Aluminum Finish: Manufacturer's [Standard][Architectural] palette; colors as selected from manufacturer's clad color spectrum.
2. Interior wood finish: Unfinished, ready for site finishing. Refer to Section 09900, Painting.

#### PART 3 EXECUTION

##### 3.01 PREPARATION

- A. Examine substrates and conditions in which units will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

##### 3.02 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Coordinate installation with adjacent work to ensure proper sequence of construction, clearances and support.
- B. Apply caulking underneath sill, install units plumb, level, complete with drip flashing and in proper relationship with adjacent work. Install without twisting, bowing or springing. Anchor units securely in place.

##### 3.03 ADJUSTING AND CLEANING

- A. Adjust hardware and operating parts for proper operation.
- B. Clean exposed surfaces using manufacturer recommended materials and methods. Remove labels and visible markings. Remove and replace work that cannot be successfully cleaned.
- C. Touch-up damaged coatings and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

#### ALUMINUM CLAD: SWINGING TERRACE AND FRENCH TERRACE DOOR UNITS

08215-3

*Loewen*

K65

#### END OF SECTION

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MORNINGSTAR

74 of 353

Swinging/French Terrace Doors



GUIDE SPECIFICATIONS

GUIDE SPECIFICATIONS FOR WINDOWS BY LOEWEN

SECTION 08555

ALUMINUM CLAD: HUNG WINDOW UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Work Included: Furnish and install factory-assembled aluminum-clad Hung window units, including glass and glazing, hardware, and accessories; as indicated on Drawings and as specified herein.
- B. Related Sections: Other Specification sections that directly relate to the work of this Section include, but are not limited to, the following:
  - 1. Section 06100, Rough Carpentry: Wood framing.
  - 2. Section 07210, Building Insulation: Batt and blanket insulation.
  - 3. Section 07900, Joint Sealers: Perimeter sealants.
  - 4. Section 09900, Painting: Painting and finishing.

1.02 PERFORMANCE REQUIREMENTS

- A. General: Perform testing in accordance with AAMA/WDMA 101 I.S.2-97, or CSA-A440-00.
- B. Forced Entry: When tested in accordance with ASTM F588, shall be Grade 20/F-2 where applicable.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, test reports and installation instructions.
- B. Shop Drawings: Submit shop drawings for approval. Include detailed plans, elevations, details, required rough openings, anchors and accessories. Include relationship with adjacent materials. Provide installation templates for work installed by others.
- C. Samples: Submit representative samples of each material that is to be exposed in the completed work. Show full color ranges and finish variations expected.

1.04 QUALITY ASSURANCE:

- A. Manufacturer: For each material type required for the work of this section, provide primary materials that are the product of one manufacturer. Provide secondary or accessory materials that are acceptable to the manufacturer of the primary materials.
- B. Installer: A firm with a minimum of three years experience in the type of work required by this Section.
- C. Mock-Up: Prior to commencing the primary work of this section, provide a mock-up of each unit type at locations acceptable to Architect. Obtain Architect's acceptance of visual qualities. Remove and replace units that are not approved. Approved mock-ups built in place may be incorporated into the finished work.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

ALUMINUM CLAD: HUNG WINDOW UNITS

08555-1

Double/Single Hung Windows

*Loewen*

C43

www.loewen.com



## GUIDE SPECIFICATIONS

## GUIDE SPECIFICATIONS FOR WINDOWS BY LOEWEN

## 1.06 WARRANTY

- A. Provide manufacturer's standard limited warranty covering the following:
1. Structural members and operating hardware are warranted against defects in material and workmanship for a period of ten years.
  2. Insulating glass is warranted against material obstruction of transparency resulting from film formation or dust collection on the interior surfaces for a period of ten years and 20 years on qualifying Heat-Smart Systems.

## PART 2 PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURER

- A. Provide units manufactured by Loewen (Loewen Inc. in the U.S.A. and C.P. Loewen Enterprises Ltd. in Canada and internationally; 77 Highway 52 West, Steinbach, Manitoba R5G 1B2; 204-326-6446; 800-563-9367; www.loewen.com).

## 2.02 ALUMINUM-CLAD: HUNG WINDOW UNITS

- A. Aluminum-clad hung window units: Preglazed with insulating glass; [Single Hung][Double Hung] window meeting AAMA/WDMA 101 I.S.2-97, and CSA-A440-00. [Single Hung] window tested for Air Leakage PASS/A-2, Water Leakage DP75/B-5, Wind Resistance/Load DP70/C-5; [Double Hung] windows tested for Air Leakage PASS/A-2, Water Leakage DP40/B-3, Wind Resistance/Load DP50/C-3 and as follows:

1. Glass and Glazing Type:
  - a. Double-glazed [and Heat Smart-Plus System 1].
  - b. Special Glass Designs: \_\_\_\_\_.
2. Hardware: Heavy duty cam-lock and tilt latches.
  - a. [Sash lift].
  - b. Finish: painted [Bronze][White][Sandstone][Black], plated [Antique Brass][Bright Brass][Oil Rubbed Bronze] and [Brushed Chrome].
3. Grilles:
  - a. Style: [Colonial][Heritage][Craftsman][\_\_\_\_\_].
  - b. Between Glass Grilles: [White Metal][Square Brass][Pewter].
  - c. Simulated Divided Lites: [3/4"] [1 1/8"] [2"] Grille bars permanently applied to the interior and exterior, with or without airspace grilles.
4. Insect Screen: Full-size; [Bronze][White][Sandstone] frame color.
5. Weatherstrip: Flexible bubble and foam filled leaf.

## 2.03 MATERIALS AND COMPONENTS

- A. Frame and Sash: Coastal Douglas Fir [Mahogany (*Swietenia macrophylla*)] kiln-dried lumber, preservative-treated in accordance with NAFS 1/WDMA 101 I.S.-2/CSA-A440. Interior exposed surfaces are clear Fir [Mahogany]; exterior surfaces aluminum clad. Jamb width [4 9/16" (116 mm)] [6 9/16" (166 mm)] [other].
- B. Glass and Glazing: Factory sealed units of 3 mm clear glass with 1/2" (12 mm) airspace; wood stop at interior face and foam tape gasket at exterior face. Subject to Change Without Notice
- C. Hardware: Steel components with Truth E-Gard coating.
- D. Grilles: Manufacturer's standard, unfinished clear wood grilles, interior mounted.

ALUMINUM CLAD: HUNG WINDOW UNITS

08555-2

## GUIDE SPECIFICATIONS

### GUIDE SPECIFICATIONS FOR WINDOWS BY LOEWEN

- E. Insect Screen: Black anti-glare fiberglass cloth, set in aluminum frame fitted to outside of window, supplied complete with necessary hardware. Screen frame finish shall be baked enamel.
- F. Finishes:
  - 1. Exterior Aluminum Finish: Manufacturer's [Standard][Architectural] palette; colors as selected from manufacturers clad color spectrum.
  - 2. Interior Wood Finish: Unfinished, ready for site finishing. Refer to Section 09900, Painting.

#### PART 3 EXECUTION

##### 3.01 PREPARATION

- A. Examine substrates and conditions in which units will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

##### 3.02 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Coordinate installation with adjacent work to ensure proper sequence of construction, clearances and support.
- B. Apply caulking underneath sill, install units plumb, level, complete with drip flashing and in proper relationship with adjacent work. Install without twisting, bowing or springing. Anchor units securely in place.

##### 3.03 ADJUSTING AND CLEANING

- A. Adjust hardware and operating parts for proper operation.
- B. Clean exposed surfaces using manufacturer recommended materials and methods. Remove labels and visible markings. Remove and replace work that cannot be successfully cleaned.
- C. Touch-up damaged coatings and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

#### ALUMINUM CLAD: HUNG WINDOW UNITS

08555-3

#### END OF SECTION

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Double/Single Hung Windows

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C45

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- 09 0000 Finishes
- 09 2000 Plaster and Gypsum Board
- 09 3000 Tiling
- 09 5000 Ceilings
- 09 6000 Flooring
- 09 7000 Wall Finishes
- 09 8000 Acoustic Treatment
- 09 9000 Painting and Coating

MSDS  
Product Data

B5W951  
07 00

MATERIAL SAFETY DATA SHEET

MSDS FOR Sherwin Williams  
White Paint

Section 1 -- PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER

B5W951

HMIS CODES

Health	1
Flammability	0
Reactivity	0

PRODUCT NAME

HARMONY\* Interior Flat Finish, Extra White

MANUFACTURER'S NAME

THE SHERWIN-WILLIAMS COMPANY  
101 Prospect Avenue N.W.  
Cleveland, OH 44115

EMERGENCY TELEPHONE NO.  
(216) 566-2917

DATE OF PREPARATION

06-APR-06

INFORMATION TELEPHONE NO.  
(216) 566-2902

Section 2 -- COMPOSITION/INFORMATION ON INGREDIENTS

% by WT	CAS No.	INGREDIENT	UNITS	VAPOR PRESSURE
4	1332-58-7	Kaolin		
		ACGIH TLV	2 mg/m3 as Resp. Dust	
		OSHA PEL	10 mg/m3 Total Dust	
		OSHA PEL	5 mg/m3 Respirable Fraction	
3	12001-26-2	Mica		
		ACGIH TLV	3 mg/m3 as Resp. Dust	
		OSHA PEL	3 mg/m3 as Resp. Dust	
6	471-34-1	Calcium Carbonate		
		ACGIH TLV	10 mg/m3 as Dust	
		OSHA PEL	15 mg/m3 Total Dust	
		OSHA PEL	5 mg/m3 Respirable Fraction	
15	13463-67-7	Titanium Dioxide		
		ACGIH TLV	10 mg/m3 as Dust	
		OSHA PEL	10 mg/m3 Total Dust	
		OSHA PEL	5 mg/m3 Respirable Fraction	

Section 3 -- HAZARDS IDENTIFICATION

ROUTES OF EXPOSURE

INHALATION of vapor or spray mist.

EYE or SKIN contact with the product, vapor or spray mist.

EFFECTS OF OVEREXPOSURE

EYES: Irritation.

SKIN: Prolonged or repeated exposure may cause irritation.

INHALATION: Irritation of the upper respiratory system.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

Redness and itching or burning sensation may indicate eye or excessive skin exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

None generally recognized.

CANCER INFORMATION

For complete discussion of toxicology data refer to Section 11.

Continued on page 2



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Section 4 -- FIRST AID MEASURES

---

EYES: Flush eyes with large amounts of water for 15 minutes.  
Get medical attention.  
SKIN: Wash affected area thoroughly with soap and water.  
INHALATION: If affected, remove from exposure. Restore breathing.  
Keep warm and quiet.  
INGESTION: Do not induce vomiting.  
Get medical attention immediately.

---

---

Section 5 -- FIRE FIGHTING MEASURES

---

FLASH POINT	LEL	UEL
Not Applicable	N.A.	N.A.

## FLAMMABILITY CLASSIFICATION

Not Applicable

## EXTINGUISHING MEDIA

Carbon Dioxide, Dry Chemical, Alcohol Foam

## UNUSUAL FIRE AND EXPLOSION HAZARDS

Closed containers may explode (due to the build-up of pressure) when exposed to extreme heat.

During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

## SPECIAL FIRE FIGHTING PROCEDURES

Full protective equipment including self-contained breathing apparatus should be used.

Water spray may be ineffective. If water is used, fog nozzles are preferable. Water may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat.

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Section 6 -- ACCIDENTAL RELEASE MEASURES

---

## STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Remove all sources of ignition. Ventilate the area.

Remove with inert absorbent.

---

Section 7 -- HANDLING AND STORAGE

---

## STORAGE CATEGORY

Not Applicable

## PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Keep container closed when not in use. Transfer only to approved containers with complete and appropriate labeling. Do not take internally. Keep out of the reach of children.

Continued on page 3

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Section 8 -- EXPOSURE CONTROLS/PERSONAL PROTECTION

---

## PRECAUTIONS TO BE TAKEN IN USE

Use only with adequate ventilation.

Avoid contact with skin and eyes. Avoid breathing vapor and spray mist.

Wash hands after using.

This coating may contain materials classified as nuisance particulates (listed "as Dust" in Section 2) which may be present at hazardous levels only during sanding or abrading of the dried film. If no specific dusts are listed in Section 2, the applicable limits for nuisance dusts are ACGIH TLV 10 mg/m<sup>3</sup> (total dust), 3 mg/m<sup>3</sup> (respirable fraction), OSHA PEL 15 mg/m<sup>3</sup> (total dust), 5 mg/m<sup>3</sup> (respirable fraction).

Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

## VENTILATION

Local exhaust preferable. General exhaust acceptable if the exposure to materials in Section 2 is maintained below applicable exposure limits. Refer to OSHA Standards 1910.94, 1910.107, 1910.108.

## RESPIRATORY PROTECTION

If personal exposure cannot be controlled below applicable limits by ventilation, wear a properly fitted organic vapor/particulate respirator approved by NIOSH/MSHA for protection against materials in Section 2.

When sanding or abrading the dried film, wear a dust/mist respirator approved by NIOSH/MSHA for dust which may be generated from this product, underlying paint, or the abrasive.

## PROTECTIVE GLOVES

Required for long or repeated contact.

## EYE PROTECTION

Wear safety spectacles with unperforated sideshields.

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Section 9 -- PHYSICAL AND CHEMICAL PROPERTIES

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PRODUCT WEIGHT	12.12 lb/gal	1451 g/l
SPECIFIC GRAVITY	1.46	
BOILING POINT	212 - 213 F	100 - 100 C
MELTING POINT	Not Available	
VOLATILE VOLUME	58 %	
EVAPORATION RATE	Slower than ether	
VAPOR DENSITY	Heavier than air	
SOLUBILITY IN WATER	N.A.	
pH	9.5	
VOLATILE ORGANIC COMPOUNDS	(VOC Theoretical)	
0.05 lb/gal	6 g/l	Less Water and Federally Exempt Solvents
0.02 lb/gal	2 g/l	Emitted VOC

Continued on page 4

## Section 10 -- STABILITY AND REACTIVITY

STABILITY -- Stable

CONDITIONS TO AVOID

None known.

INCOMPATIBILITY

None known.

HAZARDOUS DECOMPOSITION PRODUCTS

By fire: Carbon Dioxide, Carbon Monoxide

HAZARDOUS POLYMERIZATION

Will not occur

## Section 11 -- TOXICOLOGICAL INFORMATION

CHRONIC HEALTH HAZARDS

No ingredient in this product is an IARC, NTP or OSHA listed carcinogen.

Rats exposed to titanium dioxide dust at 250 mg./m3 developed lung cancer, however, such exposure levels are not attainable in the workplace.

TOXICOLOGY DATA

CAS No.	Ingredient Name				
1332-58-7	Kaolin	LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
12001-26-2	Mica	LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
471-34-1	Calcium Carbonate	LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available
13463-67-7	Titanium Dioxide	LC50	RAT	4HR	Not Available
		LD50	RAT		Not Available

## Section 12 -- ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

No data available.

## Section 13 -- DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Waste from this product is not hazardous as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.

Incinerate in approved facility. Do not incinerate closed container. Dispose of in accordance with Federal, State/Provincial, and Local regulations regarding pollution.

## Section 14 -- TRANSPORT INFORMATION

No data available.

Continued on page 5

=====  
Section 15 -- REGULATORY INFORMATION  
=====SARA 313 (40 CFR 372.65C) SUPPLIER NOTIFICATION  
-----

CAS No.	CHEMICAL/COMPOUND	% by WT	% Element
---------	-------------------	---------	-----------

  
-----

No ingredients in this product are subject to SARA 313 (40 CFR 372.65C) Supplier Notification.

## CALIFORNIA PROPOSITION 65

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.  
TSCA CERTIFICATION

All chemicals in this product are listed, or are exempt from listing, on the TSCA Inventory.

=====  
Section 16 -- OTHER INFORMATION  
=====

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

# Material Safety Data Sheet

24 Hour Assistance:  
1-847-367-7700  
Rust-Oleum Corp.  
www.rustoleum.com

## Section 1 - Chemical Product / Company Information

Product Name: EPOXY 1-GL EPOXY PREMIUM  
CLEAR ACTIVATOR  
Revision Date: 02/28/2006  
Identification Number: 225238  
Product Use/Class: Activator/Epoxy Shield Kit #225225  
Supplier: Rust-Oleum Corporation  
11 Hawthorn Parkway  
Vernon Hills, IL 60061  
USA  
Manufacturer: Rust-Oleum Corporation  
11 Hawthorn Parkway  
Vernon Hills, IL 60061  
USA  
Preparer: Regulatory Department

## Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-CEILING
4,4'-Methylene-bis-cyclohexylamine	1761-71-3	40.0	N.E.	N.E.	N.E.	N.E.
Benzyl Alcohol	100-51-6	40.0	N.E.	N.E.	N.E.	N.E.
Cycloaliphatic Amine	PROPRIETARY	35.0	N.E.	N.E.	N.E.	N.E.

## Section 3 - Hazards Identification

\*\*\* Emergency Overview \*\*\*: Harmful if swallowed. Causes eye burns. Causes skin irritation. May cause allergic skin reaction.

Effects Of Overexposure - Eye Contact: Causes eye burns.

Effects Of Overexposure - Skin Contact: May cause skin sensitization, an allergic reaction, which becomes evident on re-exposure to this material. Contact causes skin irritation.

Effects Of Overexposure - Inhalation: High vapor concentrations are irritating to the eyes, nose, throat and lungs.

Effects Of Overexposure - Ingestion: Aspiration hazard if swallowed; can enter lungs and cause damage. Can burn mouth, throat and stomach.

Effects Of Overexposure - Chronic Hazards: High concentrations may lead to central nervous system effects (drowsiness, dizziness, nausea, headaches, paralysis, and blurred vision) and/or damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Eye Contact

## Section 4 - First Aid Measures

First Aid - Eye Contact: Hold eyelids apart and flush with plenty of water for at least 15 minutes. Get medical



attention.

First Aid - Skin Contact: Remove contaminated clothing. Wash skin with soap and water. Get medical attention.

First Aid - Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

First Aid - Ingestion: If swallowed, do not induce vomiting. Give victim a glass of water or milk. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

## **Section 5 - Fire Fighting Measures**

Flash Point: 234 F  
(Setaflash)

Lower Explosive Limit: N.A. %  
Upper Explosive Limit : N.A. %

Extinguishing Media: Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Combustion generates toxic fumes of carbon monoxide, carbon dioxide and other gases.

Special Firefighting Procedures: Evacuate area and fight fire from a safe distance.

## **Section 6 - Accidental Release Measures**

Steps To Be Taken If Material Is Released Or Spilled: Contain spilled liquid with sand or earth. DO NOT use combustible materials such as sawdust. Isolate the hazard area and deny entry to unnecessary and unprotected personnel.

## **Section 7 - Handling And Storage**

Handling: Avoid prolonged or repeated contact with skin. Use with adequate ventilation. Wash thoroughly after handling.

Storage: Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame.

## **Section 8 - Exposure Controls / Personal Protection**

Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation.

Respiratory Protection: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Skin Protection: Nitrile or Neoprene gloves may afford adequate skin protection. Use impervious gloves to prevent skin contact and absorption of this material through the skin.

Eye Protection: Use safety eyewear designed to protect against splash of liquids.

Other protective equipment: Refer to safety supervisor or industrial hygienist for further information regarding personal protective equipment and its application.

Hygienic Practices: Remove contaminated clothing immediately and launder before reuse. Wash thoroughly with soap and water before eating, drinking or smoking.

## Section 9 - Physical And Chemical Properties

Boiling Range:	401 - 405 F	Vapor Density:	Heavier than Air
Odor:	Solvent like	Odor Threshold:	ND
Appearance:	Liquid	Evaporation Rate:	Slower than Ether
Solubility in H <sub>2</sub> O:	Slight		
Freeze Point:	ND	Specific Gravity:	1.030
Vapor Pressure:	ND	PH:	NE
Physical State:	Liquid		

(See section 16 for abbreviation legend)

## Section 10 - Stability And Reactivity

Conditions To Avoid: Avoid all possible sources of ignition.

Incompatibility: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

Hazardous Decomposition: When heated to decomposition, it emits acrid smoke and irritating fumes. By open flame, carbon monoxide and carbon dioxide.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

## Section 11 - Toxicological Information

Product LD50: ND

Product LC50: ND

### Chemical Name

4,4'-Methylene-bis-cyclohexylamine  
Benzyl Alcohol  
Cycloaliphatic Amine

### LD50

625 mg/kg (ORAL, RAT)  
1230 MG/KG (ORAL, RAT)  
RAT >2000MG/KG

### LC50

N.D.  
1000 PPM (8HR, RAT)  
N.D.

## Section 12 - Ecological Information

Ecological Information: Product is a mixture of listed components.

## Section 13 - Disposal Information

Disposal Information: Dispose of material in accordance to local, state and federal regulations and ordinances. Do not allow to enter storm drains or sewer systems.

## Section 14 - Transportation Information

DOT Proper Shipping Name:	Paint Related Material	Packing Group:	—
DOT Technical Name:	—	Hazard Subclass:	Not Regulated
DOT Hazard Class:	—	Resp. Guide Page:	—
DOT UN/NA Number:	—		

## Section 15 - Regulatory Information

### CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD

### SARA Section 313:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

### Toxic Substances Control Act:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of TSCA 12(B) if exported from the United States:

### U.S. State Regulations: As follows -

#### New Jersey Right-to-Know:

The following materials are non-hazardous, but are among the top five components in this product.

None

#### Pennsylvania Right-to-Know:

The following non-hazardous ingredients are present in the product at greater than 3%.

None

#### California Proposition 65:

This product contains no known chemicals known by the State of California to cause cancer

This product contains no known chemicals known by the State of California to cause birth defects or other reproductive harm

### International Regulations: As follows -

#### CANADIAN WHMIS:

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16

headings.

**CANADIAN WHMIS CLASS:** D2B

## **Section 16 - Other Information**

**HMIS Ratings:**

Health: 3

Flammability: 1

Reactivity: 1

Personal Protection: X

**VOLATILE ORGANIC COMPOUNDS, g/l:** 272

**REASON FOR REVISION:** Regulatory Update

**Legend:** N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained on this MSDS has been checked and should be accurate. However, it is the responsibility of the user to comply with all Federal, State, and Local laws and regulations.



BioPreserve  
1001 State Street, Suite 806  
Erie, Pennsylvania 16501  
Information Phone 814-454-0328

Ver. 1.1 Revised 02/03/2005  
Prepared by: Brad Davis

## MATERIAL SAFETY DATA SHEET

### Section 1 - Material Identity

Trade/Product Name: SoyGuard® Pressure Treating Formula  
Chemicals/Ingredients: Methyl Esters CAS # 67784-80-9  
Polystyrene CAS # 009003-53-6  
SAFRA Hazards: None noted (Section 311/312) Info III Section 313 - Not Listed

### Section 2 - Hazardous Ingredients

Contains no hazardous ingredients as defined under the U.S. OSHA Hazard Communication Standard (29 CFR 1910.1200).

### Section 3 - Physical/Chemical Characteristics

Boiling Point: 301° F (150° C) (ASTM D86)  
Vapor Pressure: Less Than 1mm Hg at 176° F (80° C) (ASTM D2879)  
Specific Gravity: 0.92 at 77° F (25° C) (ASTM D1298)  
Solubility in Water: Negligible at room temperature  
Appearance and Color: Light Yellow  
Evaporation Rate: 0.01 (1 = n-butyl acetate) (ASTM D3539)

### Section 4 - Fire and Explosion Hazard Data

Flash Point and Method Used: 360° F (182° C) (ASTM D93)  
Flammable Limits in Air, % by Volume - Lower: Not Applicable  
Flammable Limits in Air, % by Volume - Upper: Not Applicable  
Extinguishing Media: Carbon Dioxide, Dry Chemical for small fires, foam for large fires.  
Special Fire Fighting Procedures: Fire fighters should be equipped with self contained breathing apparatus and protective clothing. (Individuals should perform only those fire fighting procedures for which they have been trained). Use water spray, dry chemical, foam, or carbon dioxide. Water may be ineffective but should be used to keep fire-exposed containers cool. If a spill or leak has not ignited, use water spray to disperse the vapors. Water spray may be used to flush spills away from fire.  
Unusual Fire/Explosion Hazards: Rags soaked with any solvent will cause spontaneous combustion if not handled properly. Soaked rags should be stored in an approved safety container. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion.

### Section 5 - Reactivity Data

Stability: Generally Stable  
Conditions to Avoid: Heat, sparks, open flame and other ignition sources.  
Materials to Avoid: Rags soaked with other solvents or chemicals, and strong oxidizing agents/strong reducing agents/strong acids/ strong bases/ strong mineral acids.  
Hazardous Decomposition Products: Decomposition may produce carbon monoxide and carbon dioxide, and various other hydrocarbons.  
Polymerization Conditions to Avoid: None Likely

### Sections 6 - Health Hazard Data

Route of Entry: Inhalation, eye, skin contact  
Health Hazards: None Known



Carcinogenity: Not listed by NTP, IARC, OSHA  
Eye Contact: May cause eye irritation  
Skin Contact: Not classified as a primary skin irritant or corrosive material.

#### Emergency/First Aid Procedures

In case of eye contact: Immediately irrigate eyes with plenty of water for at least 15 to 20 minutes. Do not let victim rub eyes. Seek medical attention if symptoms persist.  
In case of skin contact: Wash exposed areas of the body with soap and water. Remove contaminated clothing and wash before reuse. If irritation persists, get medical attention.  
If swallowed: Do not induce vomiting. Call a physician immediately.  
Inhalation: Immediately leave the area to obtain fresh air. Seek medical attention if symptoms persist.

#### Section 7 - Precautions for Safe Handling and Use

Spill or Leak: Remove all sources of ignition. Contain the spill and transfer to secure containers. Ventilate the area. Wear appropriate respiratory protection and protective clothing. Where necessary, collect using absorbent media.  
Waste Disposal Method: All recovered material should be packaged, labeled, transported and disposed or reclaimed in conformance with all applicable local, state and federal regulations.  
Other Precautions: Avoid uncontrolled releases of this material. Where spills are possible, a comprehensive plan should be developed and implemented. Prevent run-off to sewers or other bodies of water. If run-off occurs, notify proper authorities, as required.

#### Section 8 - Special Control Measures

Respiratory Protection: None required for normal usage. Recommended exposure limits have not been established for this material. Handle in the presence of adequate ventilation. Avoid prolonged breathing of vapors.  
Protective Gloves: No need anticipated.  
Eye Protection: Wear safety glasses meeting OSHA specifications.  
Work Hygienic Practices: Practice reasonable care and cleanliness.

#### Section 9 - Special Hazard Precaution

Methyl ester soaked rags should be stored in an approved safety container or dried individually in a well ventilated area to avoid spontaneous combustion.

#### Section 10 - Transportation Information

DOT Classification: Class 65  
DOT Proper Shipping Name: Fatty Acid Ester

#### Section 11 - Ingredients/Identity Information

Ingredient #: 01  
Ingredient Name: Methyl Esters  
CAS Number: 67784-80-9  
Flash point: >300° F (149° C)  
HMIS: Health 1, Flammability 1, Reactivity 0.  
Ingredient #: 02  
Ingredient Name: Polystyrene  
CAS Number: 009003-53-6  
Flash point: 670° F (354° C)  
HMIS: Health 0, Flammability 1, Reactivity 0.

#### Manufacturer's Statement

The Material Safety Information is correct to the best of our knowledge at the date of its publication. This information is based on tests and experience believed to be factual and has been derived from the works and opinions of persons believed to be qualified experts. We cannot accept liability for any loss, injury or damage that may result from its use. Information in this Data Sheet is designed only as guidance for safe handling, storage and use of the product. It does not constitute a warranty, express or implied, or product guarantee.

## Division 11 - Equipment

11 0000	Equipment
11 1000	Vehicle and Pedestrian Equipment
11 2000	Commercial Equipment
11 3000	Residential Equipment
11 6000	Entertainment Equipment
11 9000	Other Equipment

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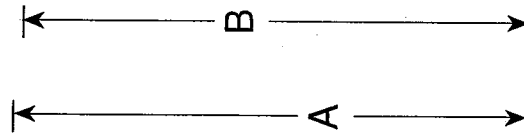
# GDS20SBS

## GE® ENERGY STAR® 19.5 Cu. Ft. Stainless Bottom-Freezer Door Refrigerator

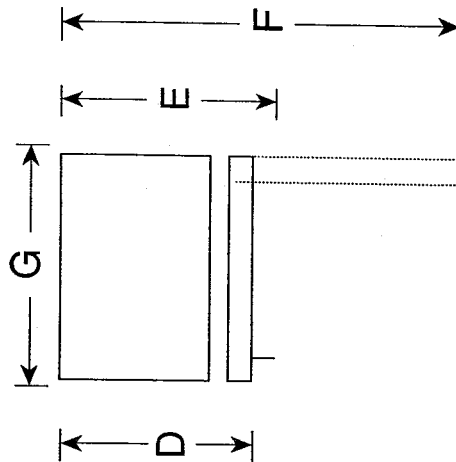
### Dimensions and Installation Information (in inches)

Overall Dimensions	Height to top of hinge (in.) A	68
	Height to top of case (in.) B	67-1/4
	Case depth without door (in.) C	28-1/4
	Case depth less door handle (in.) D	31-3/4
	Case depth with door handle (in.) E	33-7/8
	Depth with fresh food door open 90° (in.) F	59
	Width (in.) G	29-7/8
	Width with door open 90° inc. door handle (in.) H	33-1/2
Air Clearances	Each side (in.)	1/8
	Top (in.)	1
	Back (in.)	1

Front View



Top View



For answers to your Monogram®, GE Profile™ or GE® appliance questions, visit our website at [ge.com](http://ge.com) or call GE Answer Center® service, 800.626.2000.



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Listed by Underwriters Laboratories



As an ENERGY STAR® partner, GE has determined that this product meets the ENERGY STAR® guidelines for energy efficiency.

Specification Created 1/05

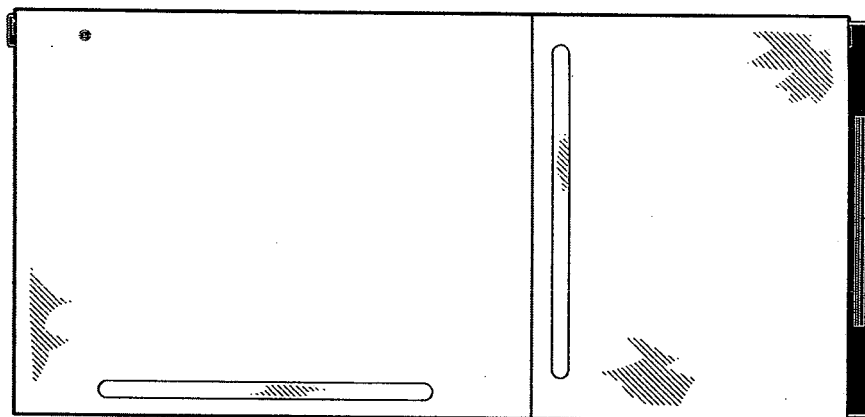
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## GDS20SBS

### GE® ENERGY STAR® 19.5 Cu. Ft. Stainless Bottom-Freezer Door Refrigerator

#### Features and Benefits

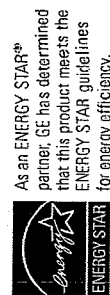
- Stainless Finish - Conveys the look of utmost polish and sophistication
- Upfront Illuminated Temperature Controls - Is easy to see and set
- Slide 'n Store™ Freezer Basket - Offers easy access and flexible storage
- BrightSpace™ Interior with GE Reveal™ Lighting - Cast a clear natural-looking glow throughout the refrigerator
- Adjustable Spill Proof Glass Shelves - Helps to contain spills for ease of cleaning
- Adjustable Humidity Vegetable/Fruit Crisper - Provides the ideal storage environment for fruits and vegetables
- Adjustable Gallon Door Bins - Make room for milk and other gallon-size containers
- Snack Pan - Helps keep everyday foods like muffins and carrot sticks fresh
- NeverClean™ Condenser - Condenser coils are encased, so they don't require cleaning in normal operating environments
- Deluxe Quiet Design - Significantly reduces operating noise
- Model GDS20SBSSS - Stainless steel



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Specification Created 1/05

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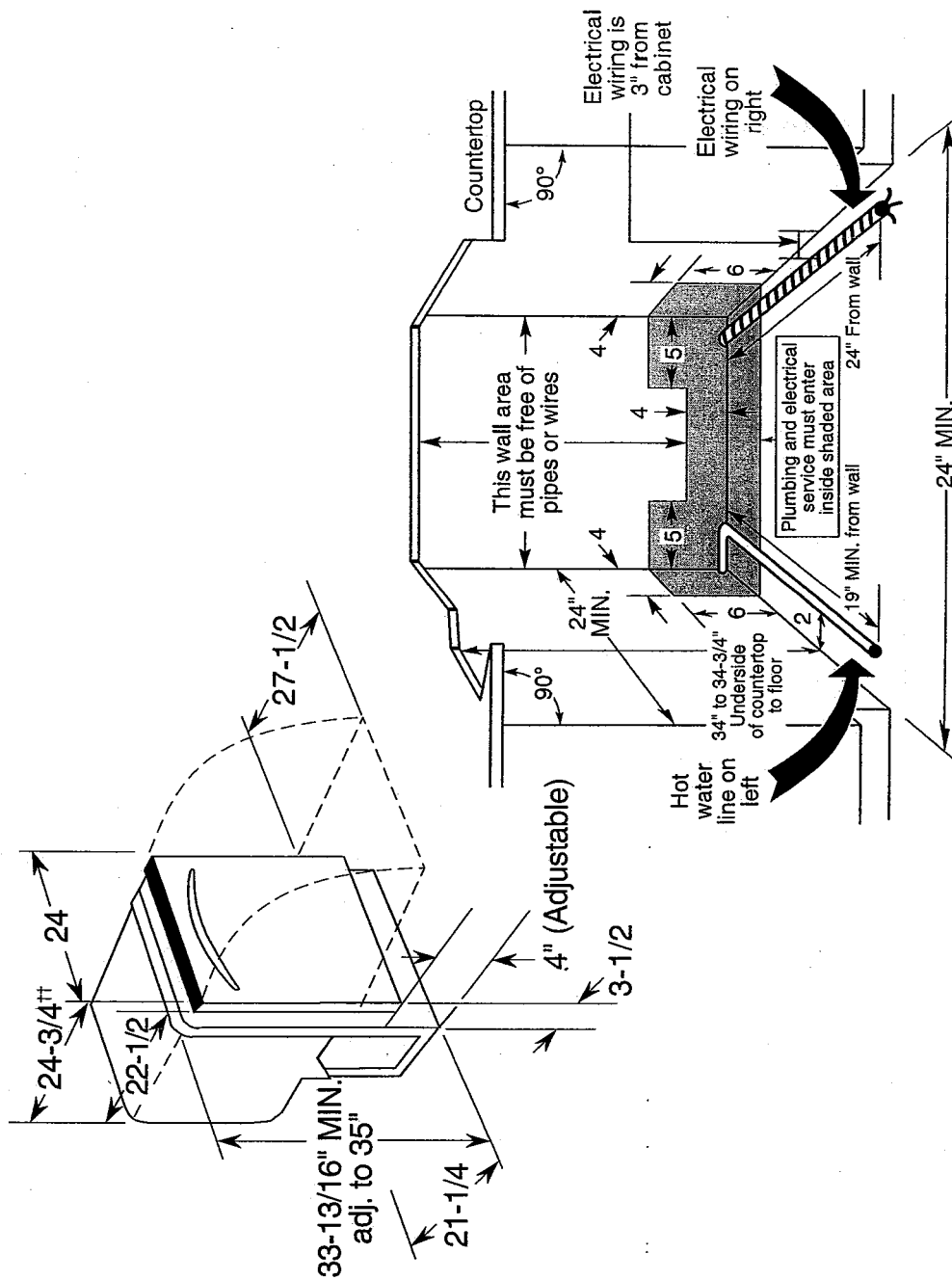
GE Profile™ Dishwasher with SmartDispense™ Technology

## Electrical Rating

Voltage AC.....	120
Hertz.....	60
Total connected load amperage.....	9.1
Calrod® heater watts max.....	875

**Installation Information:** Before installing, consult installation instructions packed with product for current dimensional data.

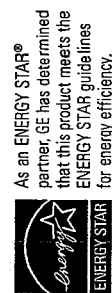
†† Add 1/2" for deepest part of contour door.  
Allow an additional 2" for the handle on  
PDW9900/9200 Series models.



For answers to your Monogram® GE Profile™ or GE® appliance questions, visit our website at [ge.com](http://ge.com) or call GE Answer Center® service, 800.626.2000.



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Specification Created 6/06

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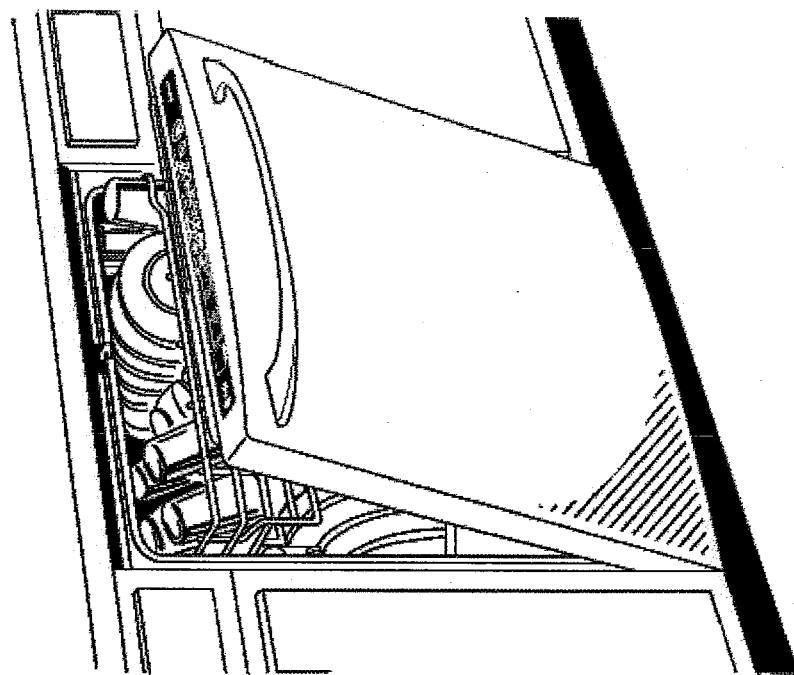


## PDW9900/9980N

### GE Profile™ Dishwasher with SmartDispense™ Technology

#### Features and Benefits

- SmartDispense™ Technology - Holds an entire bottle of liquid automatic dishwasher detergent, dispensing the right amount based on water hardness and soil levels to get dishes incredibly clean
- Angled Rack Dry™ System - Features tines that gently angle cups, mugs and dessert glasses so water runs right off
- Single Rack Wash™ Selection - Perfect for smaller loads or for cleaning glasses only, washing just the upper rack of dishes using less water and energy
- QuietPower™ 7 Sound Package - Our quietest dishwasher ever with extremely quiet components and a hidden vent that seals in sound during the wash cycle
- Countdown Display with 1-24 Hour Delay Start - Signals remaining cycle time and starts the dishwasher when no one's home or during off peak hours when utilities are at reduced rates
- 100% Fold-Down Tines and Adaptable Bowl Tines in Lower Rack - Flip up to hold bowls, or flip down to provide maximum loading flexibility in the lower rack
- SpeedCycle™ Selection - Cuts the length of the normal cycle in half, effectively washing and drying lightly soiled dishes in about 45 minutes or less
- Model PDW9980NSS - Stainless steel (shown)
- Model PDW9900NWW - White on white
- Model PDW9900NBB - Black on black



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MORNINGSTAR

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# JVM1790BK/CK/SK/WK GE Profile™ 1.7 Cu. Ft. Capacity Over-the-Range Microwave Oven

## Dimensions and Installation Information (in inches)

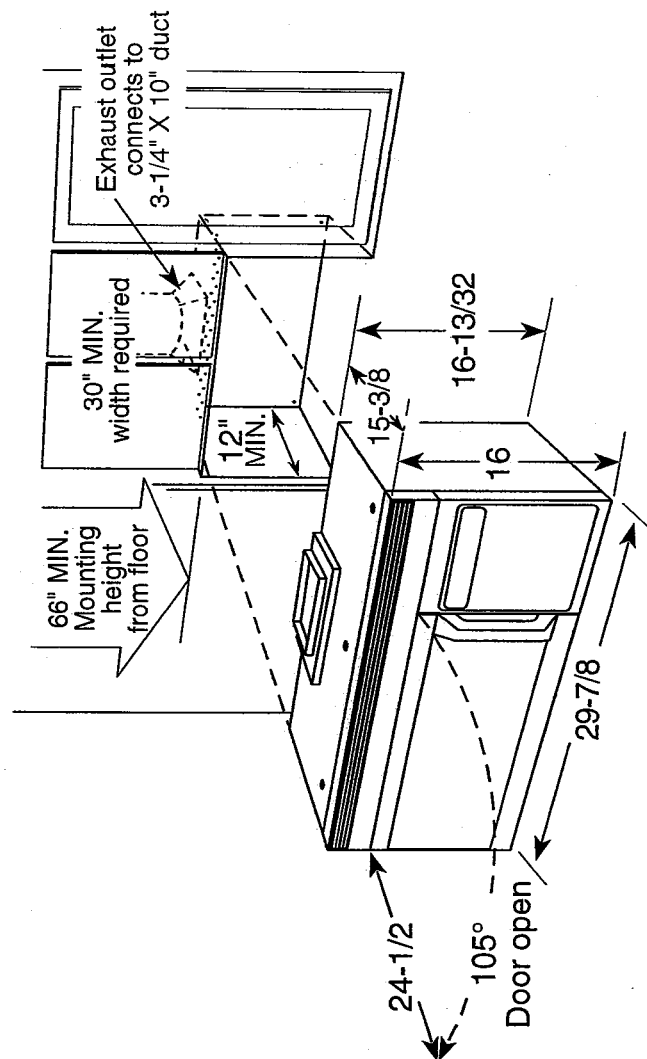
**Note:** Requires 120V grounded outlet. Electrical receptacle must be located in cabinet above Spacemaker microwave oven. No additional wiring, venting or cabinet rebuilding necessary in many cases. Complete detailed, easy-to-follow installation instructions and convenient full-size templates are packed with the Spacemaker microwave oven.

**Important Information:** When installing the Spacemaker microwave oven over a range, allow minimum of 2" from bottom of Spacemaker microwave oven to top of range backguard to allow for removal of light covers.

**Ventilation Options:** The Spacemaker microwave ovens and Spacemaker convection/microwave ovens are designed for adaptation to the following three types of ventilation:

- Outside exhaust (Vertical – as shown)
- Outside exhaust (horizontal)
- Recirculating (non-vented ductless – see Filter Kit drawing, order JX81, JX81A or JX81B)r

**Installation Information:** This information is not intended to be used for installing unit described. Before installing, consult installation instructions packed with product/kit for current dimensional data.



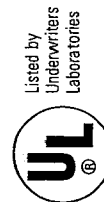
For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at [ge.com](http://ge.com) or call GE Answer Center® service, 800.626.2000.



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Specification Created 3/05

240260

# JVM1790BK/CK/SK/WK

## GE Profile™ 1.7 Cu. Ft. Capacity Over-the-Range Microwave Oven

### Optional Accessories (Available at additional cost)

**Hood Exhaust Duct:** Outside ventilation requires a HOOD EXHAUST DUCT. Read the following carefully.

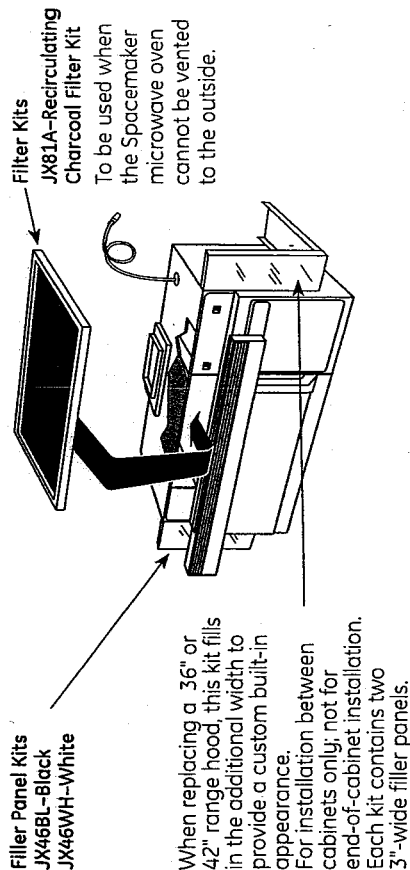
**Exhaust Connection:** The hood exhaust has been designed to mate with a standard 3-1/4" x 1" rectangular duct. If a round duct is required, a rectangular-to-round transition adaptor must be used. Do not use less than a 6" diameter duct.

**Rear Exhaust:** If a rear or horizontal exhaust is to be used, care should be taken to align exhaust with space between studs, or wall should be prepared at the time it is constructed by leaving enough space between the wall studs to accommodate exhaust.

**Maximum Duct Length:** For satisfactory air movement, the total duct length of 3-1/4" x 10" rectangular or 6" diameter round duct should not exceed 140 equivalent feet.

**ELBOWS, TRANSITIONS, WALL AND ROOF CAPS:** etc., present additional resistance to airflow and are equivalent to a section of straight duct which is longer than their actual physical size. When calculating the total duct length, add the equivalent length of all transitions and adaptors plus the lengths of all straight duct sections. The chart below shows the approximate feet of equivalent length of some typical ducts.

Duct	Equivalent Feet
A. Rectangular-To-round Transition Adaptor	5 ft.
B. Wall Cap	40 ft.
C. 90° Elbow	10 ft.
D. 45° Elbow	5 ft.
E. 90° Elbow	25 ft.
F. 45° Elbow	5 ft.
G. Roof Cap	24 ft.

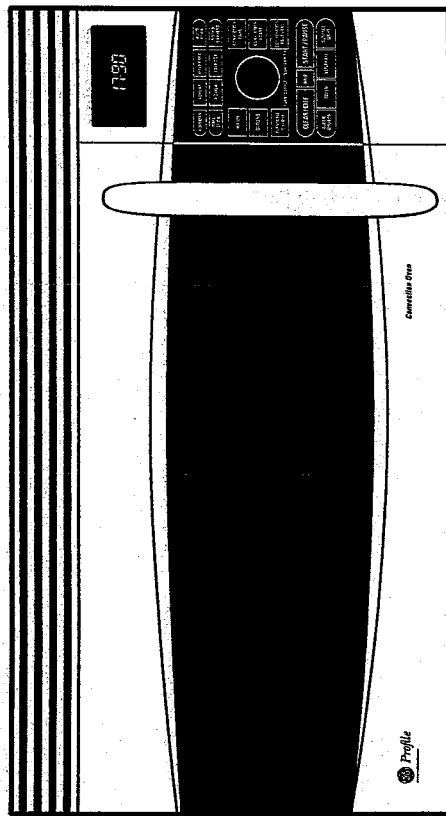


# JVM1790BK/CK/SK/WK

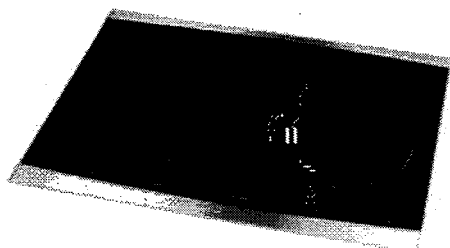
## GE Profile™ 1.7 Cu. Ft. Capacity Over-the-Range Microwave Oven

### Features and Benefits

- 1.7 cu. ft. capacity - 1000 microwave watts (IEC test procedure) and 1500 convection watts
- Convection Cooking - Produces flavorful, beautifully browned results
- Fast Bake - Delivers oven-quality results up to 25% faster than conventional cooking
- Sensor Microwave Oven - Uses built-in sensors to automatically set power and time based on food moisture levels
- Warming Oven - Keeps prepared foods perfectly warm and fresh
- Auto Recipe™ Conversion - Automatically converts standard recipe temperatures to proper convection settings, eliminating the guesswork
- Bilingual Scrolling Display - Provides helpful cooking tips and oven use instructions in easy-to-read English or Spanish
- Three-speed, 300 CFM Venting - Allows adjustment of ventilation levels according to your needs
- Easy Set Control Dial - Allows quick and easy adjustment of time and temperature settings
- Stainless Steel Interior - Reflects heat and surface cleans quickly and easily
- Model JVM1790WK - White
- Model JVM1790CK - Bisque
- Model JVM1790BK - Black
- Model JVM1790SK - Stainless steel



imagination at work



### Stainless Steel w/Black Kenmore Elite 30 in. Electric Induction Cooktop

Sears Item #02242800000 Mfr. model #42800

**\$1,619.99**

~~\$1,799.99~~

Save \$180.00  
thru 03/03/07

Product images may differ from actual product appearance. Items cannot be shipped to APO / FPO addresses. Not all products are available at every Sears store. Online prices and promotions are for the continental U.S. only.

#### Product Overview:

Item Weight	46.0 lbs.
General Warranty	1 year parts and labor
Type of Item	Large appliances

#### Electric Configuration:

No. of Elements/Cooking Zones	4
Element Configuration	Standard: 1-6 in. radiant, 1500/1200 watts 1-10 in. 2400/3200 watts nominal power/PowerBoost
Element Type	Induction (magnetic)
Safety Features	Automatic 18-hour shut off
<b>Type:</b>	
Cooking Surface	Electric: induction glass surface
Cooking Zone	None, fixed elements/burners
Size	30 in.
Venting System	-
<b>Controls:</b>	
Control Type(s)	Electronic touch pad controls
Control(s) Location	Front
Ease of Use	Built-in timer



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Electronic Type	17 button electronic
Fan	Automatic
Light(s)	Power on light
Safety/In-Use Indicator(s)	Hot surface indicator(s) ON indicator(s)
Styling	Glass touch controls

**Color:**

Control Dials/Knobs	Black
Overall	Stainless Steel w/Black
Top Surface	Black
Trim	Stainless Steel

**Materials & Finishes:**

Control Panel	Ceramic-glass
Elements	Ceramic-glass
Frame	Stainless Steel
Subtop	Galvanized steel
Surface	Ceramic glass with stainless trim
Vent Air Channel	Steel

**Dimensions:**

Depth, Burner Box	19-7/8 in.
Depth, Overall	21-1/2 in.
Height	2 in.
Maximum Width	30-3/4 in.

**Cutouts:**

Clearance, above Cooktop	30 in. min.
Clearance, below Cooktop	4-1/2 in.
Clearance, Left Wall	7-1/2 in.
Clearance, Rear Wall	1-1/2 in.
Clearance, Right Wall	7-1/2 in.
Considerations	Never cut/modify cabinets w/o merchandise
Depth, Opening	20-1/4 in.

Height of Cooktop	1/2 in.
Min. to Front Edge of Counter	2-1/2 in.
Width, Opening	29-1/2 in.

**Power Source:**

Electric Supply	240V/208V, 60Hz AC
Max. Amp Load	40
Power Cable Location	Right rear
Total Connected Load	7.4 kW @ 240V / 6.7 kW @ 208V
Power Source	Electric

**Installation Options & Tips:**

Considerations	Requires a 3-wire w/ground circuit
Required Parts, Included	Mounting hardware

**Included with Item:**

Other	Non-stick stainless steel skillet
-------	-----------------------------------



## WASHER/DRYER COMBO



**WM3431HW**

**WM3431HS**

All-In-One Washer and Dryer

### Performance

- NeveRust Stainless Steel Drum
- 2.44 Cu.Ft. Capacity (IEC)
- Direct Drive Motor is Highly Reliable, Durable and Quiet
- 1400 RPM Maximum Spin Speed
- Ventless Condensing Drying System
- 115V Power Source

### Intelligent Fabric Care

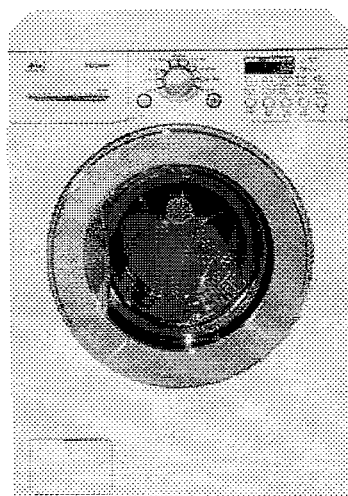
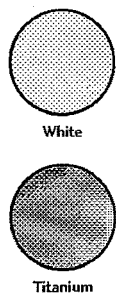
- SenseClean System Automatically Adjusts Water and Wash Time for Optimal Care
- Sensor Dry System Measures Moisture in the Drum and Automatically Adjusts Drying Time and Temperature for Optimal Care
- Flexibility of Wash to Dry, Wash Only or Dry Only
- 9 Wash Programs
- 5 Rinse Temperatures
- Sanitary Cycle
- Delay Wash up to 19 hours

### Style and Design

- 24" Installation Under Counter
- Premium Finishes in Titanium and White
- Upfront Electronic Controls with Dial-A-Cycle
- Chrome Trimmed Door with Clear Glass

### Environmentally Friendly

- Energy Star Rated
- LoDecibel Quiet Operation

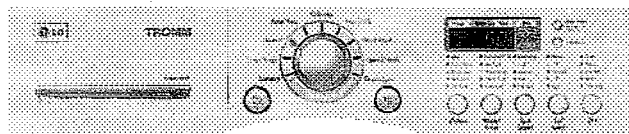


LG front load washers exceed Energy Star® classification a minimum of 39%.





# WASHER/DRYER COMBO



## All-in-One Washer and Dryer

This laundry dream washes and dries all in one machine.

## Who Is It for?

People who want to be able to do laundry at home but don't have an external venting source which conventional dryers require. It's great for busy people who want to start a load and return to clean clothes. The Delay Start feature allows convenient completion of laundry to fit your schedule. Homes, apartments, businesses and vacation homes where there may be space constraints.

## What Are The Advantages?

No outside venting is required because it is ventless condensing. It runs on a standard 115V electricity and not gas. No need to wait to transfer from the washer to the dryer.

## What Else Should I Know?

Ventless condensing dries from within the drum so the water that is extracted from the clothes drains through the drum and out the water pump. This drying process takes longer than conventional drying.

It requires installation where a water hook-up is available.

WM3431HW  
WM3431HS

<b>TYPE</b>	
Front Loader	
Design Look	Front Panel
Intelligent Electronic Controls with Dial-A-Cycle	
Drying System	Ventless Condensing
<b>CAPACITY</b>	
Total Capacity	2.44 cu.ft. (IEC)
Maximum Dry Capacity	8.8 lbs.
<b>ENERGY</b>	
Energy Star Compliant	
<b>PROGRAMS</b>	
9 Wash Programs	Sanitary, Cotton/Towels, Normal, Permanent Press, Delicates, Wool/Silk, Hand Wash, Speed Wash, Drain & Spin
5 Wash/Rinse Temperature Levels	Extra Hot/Cold, Hot/Cold, Warm/Warm, Warm/Cold, Cold/Cold
Spin Speeds	1400 RPM, Extra High, High, Medium, Low, No Spin
5 Dry Times	150 min, 120 min, 90 min, 60 min, 30 min
Temperature Options	Normal, Low Temperature
Water Level	Automatic
No. of Soil Levels	5
Options	Extra Rinse, Rinse & Spin, Soak, Extra Wash, Spin Only, Dry Only, Delay Wash up to 19 Hours
<b>FABRIC CARE FEATURES</b>	
SenseClean	
Sensor Dry	
<b>CONVENIENCE FEATURES</b>	
3 Tray Dispenser (Main Wash, Bleach, Softener)	
End of Cycle Beeper	
Child Lock	
Self Diagnosis	
Auto-Balancing	
Auto Suds Removal	
Forced Drain System	
Remaining Time Display/Status Indicator	
Water Heater	
Leveling Legs	4 Adjustable
LoDecibel Quiet Operation	
<b>MOTOR AND AGITATOR</b>	
Motor Type / Motor Speed	Direct Drive / Variable
Agitator Type	Horizontal Axis
<b>MATERIALS AND FINISHES</b>	
NeveRust Stainless Steel Drum	
Transparent Glass Window Door	
Door Rim	Chrome
Cabinet	Painted Steel
Cabinet Top	Premium Plastic
Control Panel	Plastic
Colors	White, Titanium
<b>POWER SOURCE</b>	
Ratings/Requirements	UL Listed/120V, 60Hz, 10 Amps
Type	Electric
<b>DIMENSIONS</b>	
Product (WxHxD)	23 5/8" x 33 1/4" x 23 13/16" (25"D including door)
Weight (lbs): Net / Gross	147 / 163
<b>WARRANTY</b>	
	1 year parts and labor 2 years on the control board 7 years on the motor Lifetime on the drum
<b>UPC CODE</b>	
White	048231 008594
Titanium	048231 008600

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Design and specifications are subject to change without notice.

LG ELECTRONICS INC.

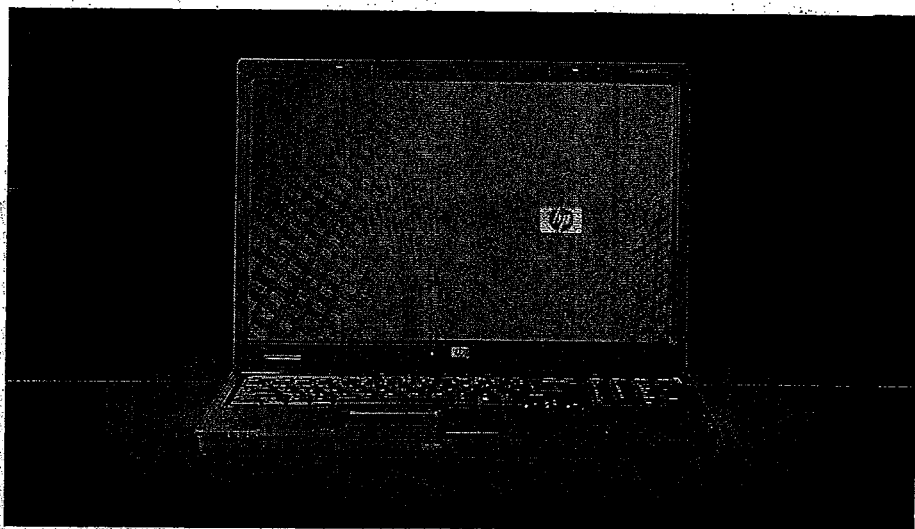
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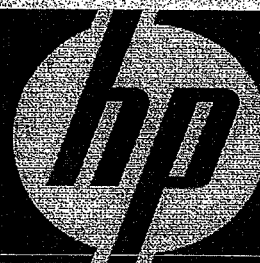
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Printed in March 2005 SS-WM3431HW/WM3431HS



## HP Compaq nx9420 Notebook PC

Go Powerful. Extreme Performance and Functionality: 17" widescreen display, high performance discrete graphics and full sized keyboard with integrated numeric keypad



HP recommends Windows Vista™ Business

The HP nx9420 Notebook PC is designed for power users looking for the most robust notebook in HP's Business Notebook line. It combines cutting-edge mobile computing technologies, high-end graphics, and excellent battery life into a thin and light package.

### Performance on the move

- High-resolution 17-inch widescreen display with wide-viewing angle technology.
- New Intel® Core™2 Duo<sup>7</sup> processors allow simultaneous use of multiple applications so you accomplish more in less time.
- Large, fast hard drives let you store complex files, while the HP Mobile Data Protection System 3D helps protect data during normal use from shock and vibration while on the go.
- Powerful graphics solutions from ATI and NVIDIA quickly render complex 3D drawings and presentations with stunning visual clarity and realism.

### Power and connectivity on the go

- A variety of wired and wireless<sup>4</sup> communication solutions help you stay connected.
- The HP Wireless Assistant provides power control and device status information allowing you to easily check your device and quickly enable or disable it to enhance battery life.

- Up to 4 hours of battery life using the primary system battery and up to 8 hours with optional HP Extended Life Battery<sup>6,8</sup>. HP Fast Charge Technology<sup>9</sup> allows you to quickly recharge your primary battery while you are working.

### Desktop in motion

- The full-sized keyboard with separate numeric keypad delivers desktop equivalent familiarity and functionality.
- An integrated 7-in-1 media reader supports the most popular media card formats allowing you to quickly share data with different devices or other users.<sup>10</sup>

### HP Professional Innovations

- Security – HP ProtectTools, an integrated suite of security solutions, helps protect your notebook, data, and network connections.
- Ease-of-use – Boost productivity with HP comfort-focused designs and innovative features that provide easy access to frequently used tools. Compatible with all of the notebook accessory solutions<sup>7</sup> (docking stations, travel batteries, etc.) shared across HP's Business Notebook line.
- Reliability – HP delivers products built to perform and proven to last through expert engineering and dedication to quality.



Shipping options ok

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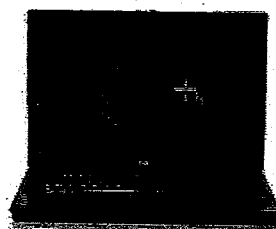
## HP Compaq nx9420 Notebook PC (RB549UT) - specifications and warranty

HP recommends Windows Vista™ Business.

» Small & Medium Business

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### Specifications

### » Accessories, Supplies & Services

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#### System features

See detailed specs

US QuickSpecs » [html](#) » [pdf](#)

Operating system

Genuine Windows® XP Professional (Windows Vista Capable†)

Processors available

Intel® Core™ 2 Duo Processor T7200 2.0 GHz 4 MB L2 cache 667 MHz front side bus

Memory

Memory

1 GB 667 MHz DDR2 SDRAM

Storage

Hard drives

100 GB 5400 rpm SATA

Optical Drives

DVD+/-RW SuperMulti with Double Layer

Audio, Slots, and Ports

Audio

ADI High Definition CODEC; Integrated 16-bit Sound Blaster Pro compatible audio; Integrated stereo speakers, External volume up and down, and mute buttons; Stereo headphone/line out, Stereo microphone in, Integrated directional microphone

Ports

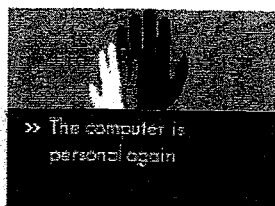
**Standard:**  
4 USB 2.0  
1 IEEE 1394  
1 AC power  
1 external VGA monitor  
1 RJ-45  
1 S-video  
1 headphone/line-out  
1 microphone in  
1 battery connector



» Even the Biggest Idea started small. Now HP Business Notebooks with AMD processors!

Did you know? HP is the #1 provider of PCs, servers and printers to small and mid-sized businesses worldwide (based on combined unit shipments)\*\*





	1 docking connector
	<b>Rear:</b>
	1 RJ-11
<b>Slots</b>	1 Type I/II PC card 1 Smart Card Reader 1 7-in-1 media reader
<b>Graphics and Input/Output devices</b>	
Graphics cards	ATI Mobility Radeon X1600
Display size	17 in WSXGA+ wide viewing angle BrightView
Input devices	Touchpad
Keyboard	101/102-key compatible keyboard
Docking Solutions	HP Docking Station; HP Advanced Docking Station
<b>Communication features</b>	
Network	10/100/1000 NIC
Modem	56K modem
Wireless	802.11a/b/g Bluetooth
<b>Manageability</b>	
Security management	HP ProtectTools Security Manager; Configuration Control Hardware; Memory Change Alert; Ownership Tag; Setup Password; Power-On Password; Drivelock; TPM Enhanced Drivelock (disabled where use is restricted by law); HP Disk Sanitizer; Kensington Lock Slot; Integrated Smart Card Reader; TPM Embedded Security Chip (disabled where use is restricted by law)
<b>Product specifications</b>	
Dimensions (w x d x h)	15.5 x 10.8 x 1.3 in (393 x 275 x 33 mm)
Weight	7.5 lb (3.36 kg)
<b>Power and Battery</b>	
Battery	8-Cell Lithium-Ion
Power supply	External 90-watt AC adapter, 6-foot (1.8-meter) power cord included. Total length including External AC adapter is 12 feet (3.66 meter). HP Fast Charge Technology
<b>Service and Support</b>	
Warranty - year(s)	HP Services includes a one-year standard parts and labor warranty, pick-up or carry-in, and toll-free 7 x 24 hardware technical phone support (depending on model). On-site service and warranty upgrades are also available.

\*Except where noted, all prices are estimated U.S. HP prices. Actual prices from other locations or websites may vary.

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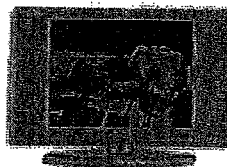
\*\* Sources: IDC Worldwide PC & HCP Trackers 1Q06 Final..

† Not all Windows Vista features are available for use on all Windows Vista Capable PCs. All Windows Vista Capable PCs will run the core experiences of Windows Vista, such as innovations in organizing and finding information, security, and reliability. Some features available in premium editions of Windows Vista -- like the new Windows Aero™ user interface -- require advanced or additional hardware. Check [www.windowsvista.com/getready](http://www.windowsvista.com/getready) for details.

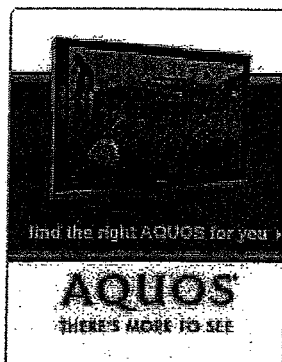
Certain Windows Vista product features require advanced or additional hardware. See <http://www.microsoft.com/windowsvista/getready/hardwarereqs.mspx> and <http://www.microsoft.com/windowsvista/getready/capable.mspx> for details. Windows Vista Upgrade Advisor can help you determine which features of Windows Vista will run on your computer. To download the tool, visit [www.windowsvista.com/upgradeadvisor](http://www.windowsvista.com/upgradeadvisor).

**SHARP**

Traditional LCD TV : LC-20SH4U : Detailed Specs



Enlarge

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**LC-20SH4U | Televisions****Specifications**

Panel Type (Diagonally Measured)	20" Active Matrix (a-si TFT) LCD <sup>1</sup>
Pixel Resolution	921,600 dots (640 x 480 x R/G/B=VGA)
Video System	NTSC
Brightness	430 cd/m <sup>2</sup>
Lamp Life	60,000 hours <sup>2</sup>
Viewing Angles	170° H / 170° V
Audio System	1.0W + 1.0W
Tuner Type	NTSC-M
Aspect Ratio	4:3
Contrast Ratio	500:1
Color Temperature	Variable (High/Medium/Low)

Accessories

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Mac mini  
Mac Pro

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iPod nano  
iPod shuffle  
U2 iPod  
Apple TV

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Speakers

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AppleCare & .Mac  
Audio & Speakers  
Digital Cameras & Video  
Displays  
Memory  
Mice & Keyboards  
Notebook Cases  
Printers  
Printer Supplies  
Software  
Storage  
More Accessories...

## Servers

Xserve  
Xserve RAID

## Special Deals

Refurbished Mac  
Refurbished iPod

## Apple iPod AV Cable

The iPod AV Cable provides composite video and audio output for viewing photo slideshows with music on a TV. Compatible with iPod with color display. This cable is made specifically for iPod with color display (other AV cables are not compatible with iPod with color display).

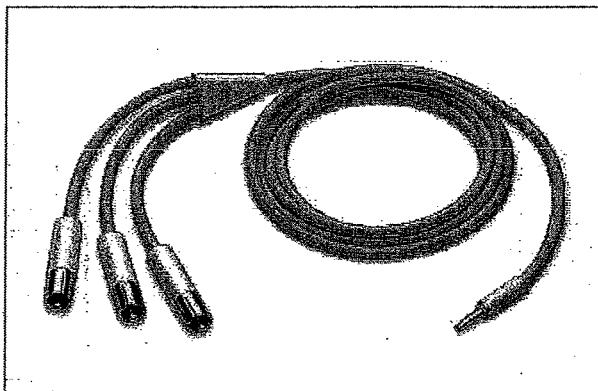
**Price: \$19.00****Estimated Ship:**  
**Within 24 hours**

Save for later

Sign up for 1-Click

Add to cart

Connect iPod to your television set with the iPod AV Cable, gather up your friends, and watch slideshows together on the big screen. You can also hook the AV Cable to your stereo or powered speakers for a room-filling audio experience. The AV Cable connects to the headphone port of the iPod or the line-out port on the iPod Universal Dock.



This accessory is compatible with the following iPods:

iPod with  
color  
displayiPod with  
video

Based on 226 reviews

## Customer Rating

★★★★★  
Based on 226 reviews

Read the reviews

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## Customer Reviews

See all reviews &gt;

Sort by Newest

&lt;&lt; first &lt; prev | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | next &gt; last &gt;&gt;

★★★★★

**Great**Written by SW from Wirral  
February 18, 2007

Thanks to EM from Plainview, it was simple to set up and I'm really impressed with the sound quality. I don't think that it will replace my i-trip for music though as my stereo system has a far better sound system than my T.V. Movie quality was good ... Read more >

(5 of 5 people found this review useful)

Was this useful?

Yes

No

Report this as inappropriate &gt;

★★★★★

**Great Product !**Written by MR from San Diego  
February 10, 2007

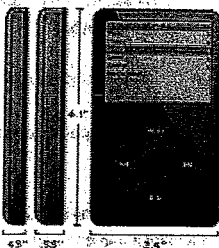
I got this cable at an Apple Store, and when I tried it out, it was great! It's cheap, and it still does the job that some other products do for many times as much. If you want to easily watch/listen to your iPod's contents over a TV, this is the ... Read more >

(7 of 7 people found this review useful)

## Technical Specifications

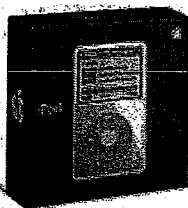
## Size and weight (30GB)

- Height: 4.1 inches
- Width: 2.4 inches
- Depth: 0.43 inch
- Weight: 4.8 ounces



## Size and weight (80GB)

- Height: 4.1 inches
- Width: 2.4 inches
- Depth: 0.55 inch
- Weight: 5.5 ounces



## In the box

- iPod
- Earphones
- USB 2.0 cable
- Dock adapter for use with Universal Dock
- Case
- Quick Start guide

## Capacity

- 30GB or 80GB hard drive<sup>1</sup>
- Holds up to 7,500 (30GB) or 20,000 songs (80GB) in 128-Kbps AAC format<sup>2</sup>
- Holds up to 25,000 iPod-viewable photos<sup>3</sup>
- Holds up to 40 hours (30GB) or up to 100 hours (80GB) of video<sup>4</sup>
- Stores data via USB hard drive

## Display

- 2.5-inch (diagonal) QVGA transfective, over 65,000-color liquid crystal display with white LED backlight
- 320 by 240 pixel resolution, .156-mm dot pitch
- Support for display of multiple languages and characters simultaneously

## Audio

- Frequency response: 20Hz to 20,000Hz
- Audio formats supported: AAC (16 to 320 Kbps), Protected AAC (from iTunes Store), MP3 (16 to 320 Kbps), MP3 VBR, Audible (formats 2, 3 and 4), Apple Lossless, AIFF and WAV
- User-configurable maximum volume limit

## Video

- Video formats supported: H.264 video, up to 1.5 Mbps, 640 by 480 pixels, 30 frames per sec., Low-Complexity version of the H.264 Baseline Profile with AAC-LC audio up to 160 Kbps, 48 kHz, stereo audio in .m4v, .mp4, and .mov file formats; H.264 video, up to 768 Kbps, 320 by 240 pixels, 30 frames per sec., Baseline Profile up to Level 1.3 with AAC-LC audio up to 160 Kbps, 48 kHz, stereo audio in .m4v, .mp4, and .mov file formats; MPEG-4 video, up to 2.5 Mbps, 640 by 480 pixels, 30 frames per sec., Simple Profile with AAC-LC audio up to 160 Kbps, 48 kHz, stereo audio in .m4v, .mp4, and .mov file formats

## Headphones

- Earphones
- Frequency response: 20Hz to 20,000Hz
- Impedance: 32 ohms



## Mac system requirements

- Macintosh computer with USB 2.0 port
- Mac OS X v10.3.9 or later
- iTunes 7 or later<sup>5</sup>

## Windows system requirements

- PC with USB 2.0
- Windows 2000 with Service Pack 4 or later, or Windows XP Home or Professional with Service Pack 2 or later
- iTunes 7 or later<sup>5</sup>

## Languages

- Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hungarian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Russian, Simplified Chinese, Spanish, Swedish, Traditional Chinese, and Turkish
- Additional language support for display of song, album and artist information: Bulgarian, Croatian, Romanian, Serbian, Slovak, Slovenian, and Ukrainian

## Environmental requirements

- Operating temperature: 32° to 95° F (0° to 35° C)
- Nonoperating temperature: -4° to 113° F (-20° to 45° C)
- Relative humidity: 5% to 95% noncondensing
- Maximum operating altitude: 10,000 feet (3000 m)

## Input and output




- iPod
  - Dock connector
  - 3.5-mm stereo headphone minijack
- iPod Universal Dock
  - Dock connector
  - Audio and composite video output
  - S-video output

Power and battery<sup>6</sup>

- Built-in rechargeable lithium ion battery
- Playback time (30GB model)
  - Music playback time: Up to 14 hours when fully charged
  - Photo slideshow with music viewing time: Up to 4 hours when fully charged
  - Video playback time: Up to 3.5 hours when fully charged
- Playback time (80GB model)
  - Music playback time: Up to 20 hours when fully charged
  - Photo slideshow with music viewing time: Up to 6 hours when fully charged
  - Video playback time: Up to 6.5 hours when fully charged
- Charging via USB or FireWire to computer system or power adapter (sold separately)
  - Fast-charge time: about 2 hours (charges up to 80% of battery capacity)
  - Full-charge time: about 4 hours

## Design for the Environment

## Comparison Chart

	 iPod shuffle	 iPod nano	 iPod
Storage/capacity	1GB (240 songs)	2GB 4GB 8GB	30GB (7,500 songs) 80GB (20,000 songs)

## Division 12 - Furnishings

- 12 0000 Furnishings
- 12 1000 Art
- 12 2000 Window Treatments
- 12 3000 Casework
- 12 4000 Furnishings and Accessories
- 12 5000 Furniture
- 12 6000 Multiple Seating

[illegible]





## DEL MOTORIZED SOLUTIONS

(866) 44MOTOR - (215) 639.3880

WWW.MOTORIZEDSOLUTIONS.COM

### Application Notes:

- Compact AC motor control module for ONE or TWO, 115VAC or 230VAC motors.
- Surface mount allows for placement in many locations and allows for maximum job site flexibility. Installations could range from under a panel of drapery, a location under a Roman Shade headrail or even large central panels that are custom built for a project.
- 60 Programmable channels: provides one-touch control of individual motors, sub-groups of motors and ALL motors.
- System programming is achieved from many different devices. Programmable action features include:
  - Maintained or Momentary motor action
  - Intermediate stops that are user defined via load sensing can be customized for each motor
  - Deadbeat feature
  - Wind features for any application
  - Lamp Control mode (if enabled applies to both motor connections)
- Commands can be sent to an RP60ABM from many sources. Command Sources could be:
  - IR Remote Transmitters
  - RF Remote Transmitters
  - IR Key Pads
  - RF Key Pads
  - Low Voltage Trigger rated 6-24VDC
  - Standard Wall Switches and Dry Contacts (any type) via use of PSI60
  - Sun and Wind
  - RS232 systems such as Crestron®, Vantage™, LiteTouch®, Lutron® or AMX®
  - IP source

### Electrical Specifications:

#### Input:

Line Voltage: 115VAC +/- 20%

Low Voltage Trigger: 6-24VDC

#### Output:

115VAC 6FLA Max per motor

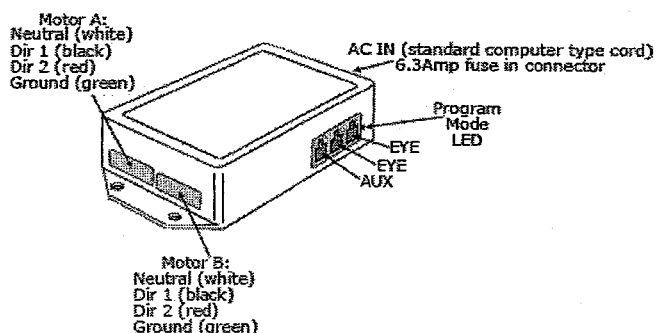
6FLA Max Total 1/3 HP

### Mechanical Specifications:

L: 5.5" W: 3.25" H: 2.0"

(L: 140mm W: 82.5mm H: 50.8mm)

### Connection Diagram:



# DEL Motorized Solutions

(866) 44MOTOR - (215) 639.3880

www.motorizedsolutions.com

Customer Penn State

Receiver Type RP60ABM

Main Channel	Momentary	Group 1	Group 2	Group 3	Group 4	Misc
1	NA					1 <sup>st</sup> ABM2
2	NA					1 <sup>st</sup> ABM2
3	NA					2 <sup>nd</sup> ABM2
4	NA					2 <sup>nd</sup> ABM2
5	NA					1 <sup>st</sup> ABM1

Accessory	Quantity	Description
Remote		
Batteries		
Eyes		
Timer		
Sun Sensor		
Splitter		
RJ11 wires	3	
R2D7		
12V Trigger		
Keypads	1	
Plastic Boxes		
R2D7	1	
Power cords	3	

Ship to:

Notes

Showroom:  
2075 Byberry Road  
The Atrium, Suite 108  
Bensalem, PA 19020

Factory:  
111 Buck Road  
Unit #900  
Huntingdon Valley, PA 19006





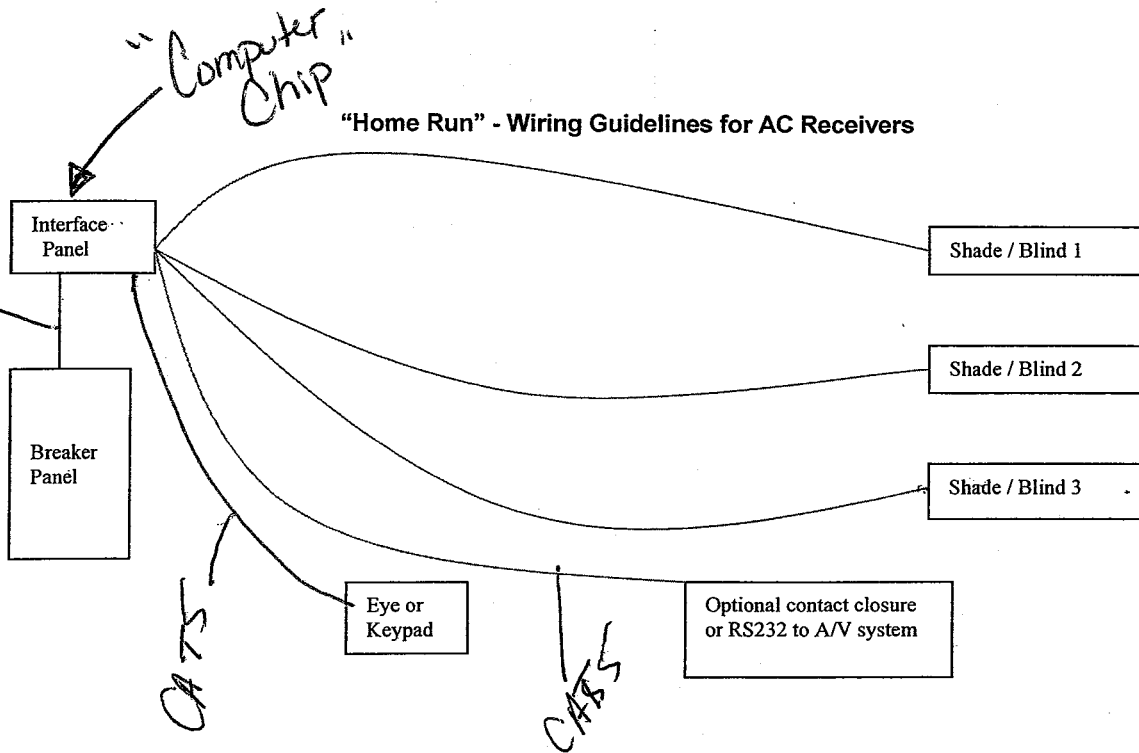
## DEL MOTORIZED SOLUTIONS

(866) 44MOTOR - (215) 639.3880

WWW.MOTORIZEDSOLUTIONS.COM

Dennis Lister  
#

### "Home Run" - Wiring Guidelines for AC Receivers



Each interface has a built-in fuse for itself, but not for the motor. The breaker must be rated for all the motors plus 2 Watts for each receiver it is connected to, in addition to conforming to the motor manufacturer's recommendation and prevailing electrical codes.

Black wire connects power to the interface panel and should be between 14 AWG and 12 AWG (solid or stranded) 2 conductors with ground. Size of wire must be sufficient to carry the motor load. The ground connection on the receiver is optional and may be used if useful for connecting the case to ground.

Red wire connects the motor to the interface. It must be between 14 AWG and 12 AWG 3 conductors with ground. Red and Black wires are the "open" and "close" leads from the motor. Note that the motor connection can be reversed by remote programming.

Yellow wire is low voltage modular telephone cord, or CAT 5 wire and is isolated from the AC power line.

Pink wire is low voltage modular telephone cord, or CAT 5 wire and is isolated from the AC power line.

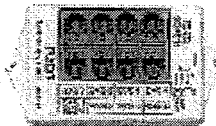
Note that ALL receivers must be powered for any of them to work in this configuration.



## DEL MOTORIZED SOLUTIONS

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- RS232 control has become a very efficient method of motor control integration.
- Using an RD7 in bus mode, you can integrate up to 7 systems of interface modules. With each system supporting up to 60 motors, you can control a total of 420 motors. Bus mode is a factory default setting for RD7.
- Using an RD7 in RF mode, you can integrate up to 99 systems of interface modules. With each system supporting up to 60 motors, you can control a total of 5940 motors on a wireless RS232 bus system.
- Should motors be added to an area of a project that were not planned on originally, Bus mode and RF mode can be combined.
- RS232 is adaptable in many ways and when combined with the addressing capacity of our motor control system, you have a tremendously powerful system to command motors with.
- The "Time to Send" option allows for manipulating the starting, stopping and run duration of motors. This can create scenes, set intermediate stops and invent drama.
- Combined with DEL's new Shade Commander, you will be able to program and save system files, allowing for future interface system programming.
- Communication settings for RD7 are industry standards: 9600 8 N 1.

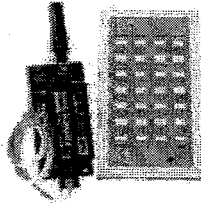
*Check w/ Steve Tom  
to see if these  
can be integrated  
w/ ACL system*

Showroom:  
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The Atrium, Suite 108  
Bensalem, PA 19020

Factory:  
111 Buck Road  
Unit #900  
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## Wireless and Hardwired Keypads

*Control by keypad*

Key Pads are a simple and efficient method to deliver a wall mounted control solution for multiple motors. The alternative would be a row of switches, which are not as visually pleasant, or cost effective.

- \* this is an estimate*
- IR Key Pads have an IR eye at the lower right corner allowing them to receive a command from a transmitter.
  - K24 comes with a "Shift" button. This button when pressed will flash the LED in the upper left corner for 5 seconds, indicating that the Key Pad is shifted into the upper bracket of numbers displayed on the overlay of the Key Pad. When shifted, a K24 will operate channels 13 through 24.
  - K24 is a programming device, it can program an RP motor controls operational features to its full potential, motor addresses up to channel 24.
  - Should a project have fewer than 24 motors, the unused channels could be programmed as a Sub Group or Master Group channel, making a K24 a clean and simple solution for larger projects.

*\* sample programming on website  
↳ may need to do programming?*

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The Atrium, Suite 108  
Bensalem, PA 19020

*Factory:*  
111 Buck Road  
Unit #900  
Huntingdon Valley, PA 19006



## Division 13 - Special Construction

13 0000	Special Construction
13 1000	Special Facility Components
13 2000	Special Purpose Rooms
13 3000	Special Structures
13 4000	Integrated Construction
13 5000	Special Instrumentation

[illegible]

21 0000	Fire Suppression
21 1000	Water Based Fire-Suppression Systems
21 2000	Fire Extinguishing Systems

## Sample Spec Product Data

Residential Series  
Garage/Workshop Fire Extinguisher (Primary Protection)

Part Number 21005765      Garage/Workshop use      Single use

UL Rated 3-A:40-B:C



Meets NFPA recommendations  
for the garage and workshop

Description

Due to the volume of flammable liquids normally present in garages & workshops, a higher rated fire extinguisher is recommended.

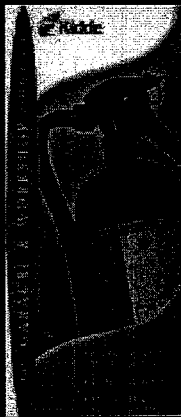
Fights fires common to the garage and workshop such as paint, wood, gasoline & energized electrical equipment. This unit is easy to use and has a 10 year warranty.

Features bilingual nameplate and carton

Red finish.

Features

- Pressure gauge allows for immediate pressure status check
- Easy-to-pull safety pin
- Rust and impact resistant nylon handle
- 5 lb. of fire extinguishing agent (Average)
- 10 year limited warranty
- UL approved wall hanger
- Powder coated cylinder for corrosion protection



UPC: 0-47871-05765-8

For use on the following types of fire:



At a Glance

- Model FX340GW
- Multipurpose Dry Chemical
- UL listed
- UL rated 3-A:40-B:C
- Supplied with wall hanger
- Monoammonium Phosphate
- 10 year limited warranty

Product Specification

Net agent weight (Average)	5.0 lb.
Unit weight (Average)	7.75 lb.
Diameter	4.5 inches
Height	16.07 inches
Discharge time	13-15 seconds
Discharge range	12-18 feet
Operating pressure	195 psi
Cylinder	Seamless aluminum
Valve, handle, lever	Nylon
Wall hanger	UL Listed

Packaging Options

Master Pack (2)	21005765
Master Pack (4)	21005766
Cut Case (8)	21005767



MASTER PACK



MASTER PACK



CUT CASE

## Residential Series

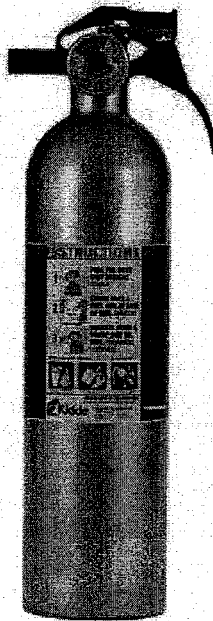
### Electrical Fire Extinguisher (Secondary Protection)

Part Number 21005744

Electrical use

Single use

UL Rated 1-A:10-B:C



#### Description

The Kidde Electrical Fire Extinguisher is suitable for fires involving energized electrical equipment. The unit is easy to use and has a 10 year warranty.

Features bilingual nameplate and carton.

Metallic Silver finish.

#### Features

- Pressure gauge allows for immediate pressure status check
- Easy-to-pull safety pin
- Rust and impact resistant nylon handle
- 2.5 lb. of fire extinguishing agent (Average)
- 10 year limited warranty
- UL approved wall hanger
- Powder coated cylinder for corrosion protection

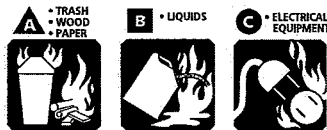


UPC: 0-47871-05744-3

#### At a Glance

- Model FX110E
- Multipurpose Dry Chemical
- UL listed
- UL rated 1-A:10-B:C
- Supplied with wall hanger
- Monoammonium Phosphate
- 10 year limited warranty

For use on the following types of fire:



#### Product Specification

Net agent weight (Average)	2.5 lb.
Unit weight (Average)	3.9 lb.
Diameter	3.25 inches
Height	13.75 inches
Discharge time	8-12 seconds
Discharge range	6-8 feet
Operating pressure	100 psi
Cylinder	Seamless aluminum
Valve, handle, lever	Nylon
Wall hanger	UL Listed

#### Packaging Options

Master Pack (6)	21005744
Cut Case (12)	21005745



MASTER PACK



CUT CASE

## Division 22 - Plumbing

22 0000	Plumbing
22 1000	Plumbing, Piping and Pumps
22 3000	Plumbing Equipment
22 4000	Plumbing Fixtures
22 5000	Pool and Fountain Plumbing Systems

[illegible]



## GRUNDFOS PRODUCT GUIDE

• will need an enclosure & base  
• may want a pressure gauge  
• need to coord. w/ electrician!

Can this pump be installed outside?

Yes

- needs to be covered & have a 'base' to sit on  
\* need a power cord to plug the pump into

Self-priming multistage pumps  
60 Hz

DOMESTIC PRESSURIZATION  
PUMP

(P-1)  
MQ



BE > THINK > INNOVATE >

GRUNDFOS

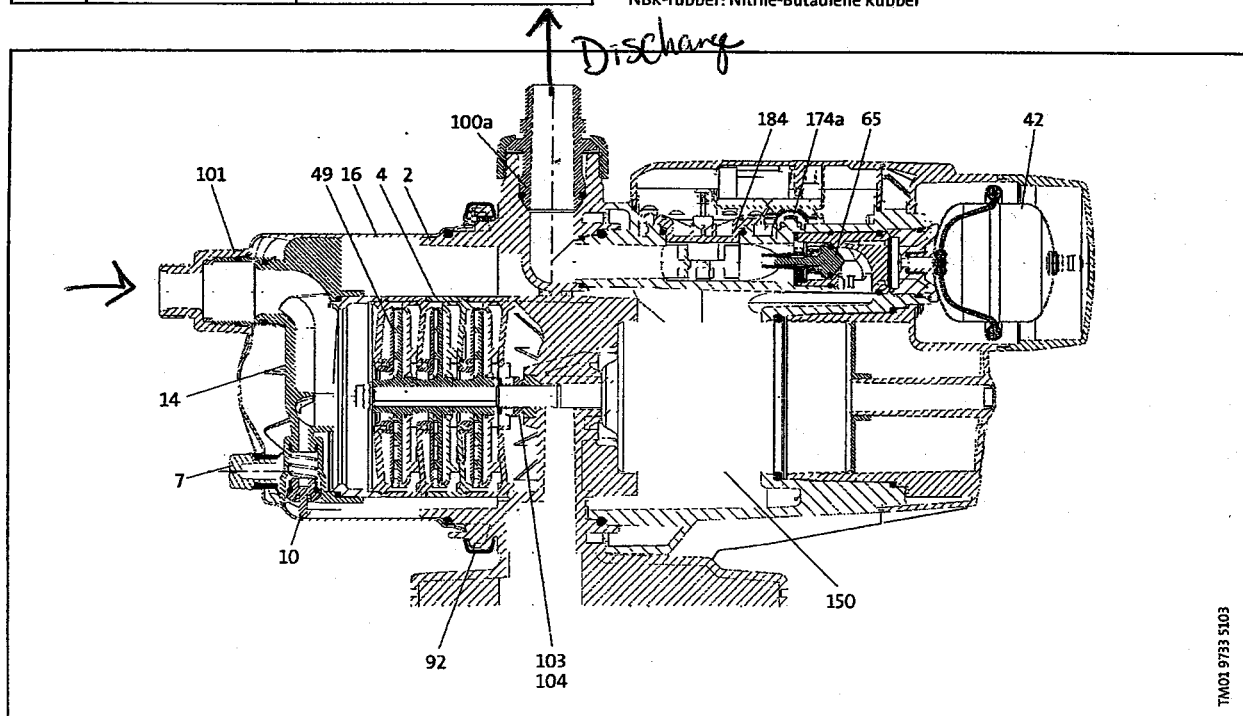




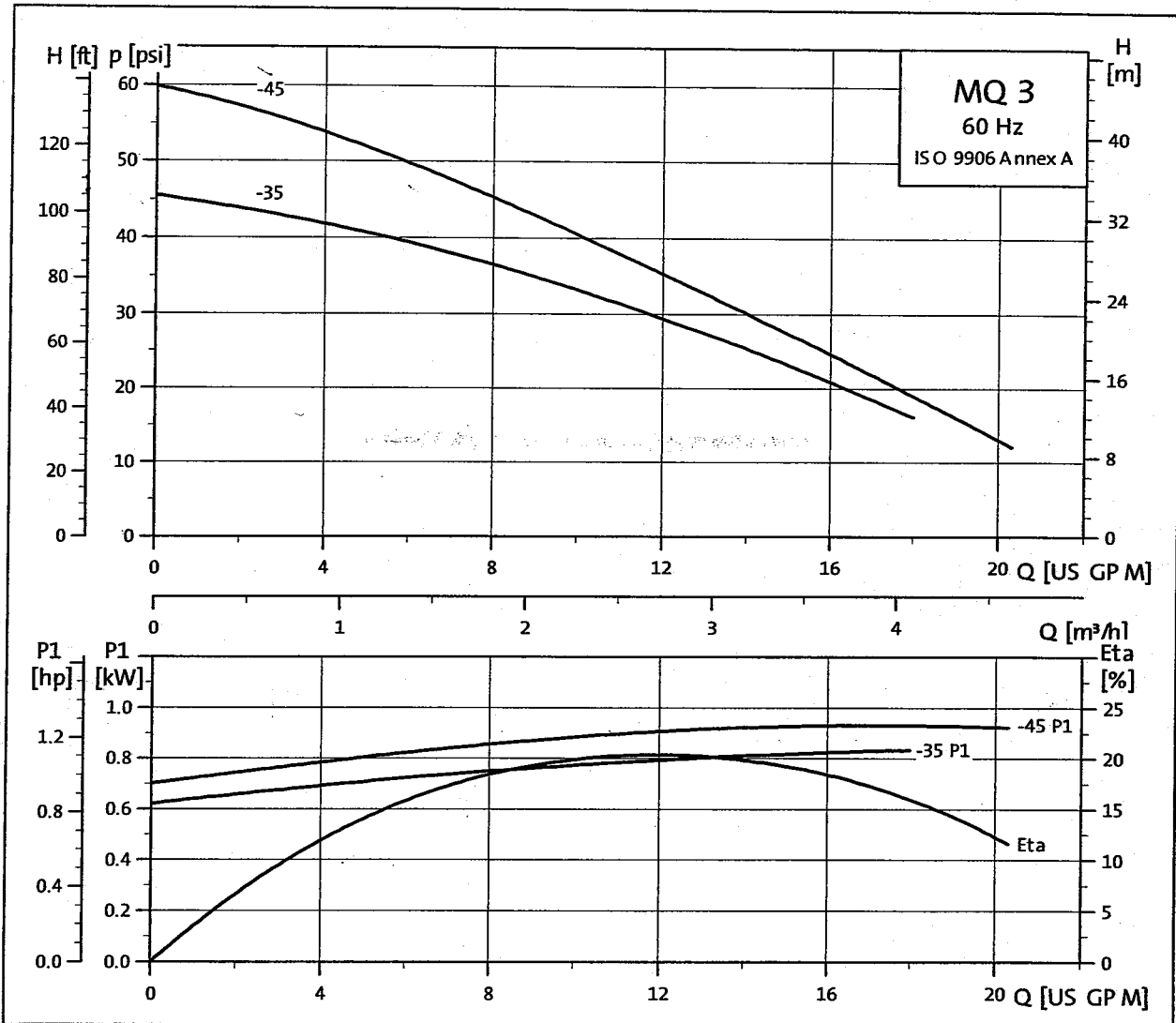
## Material specification

Pos.	Components	Material
2	Motor stool with base plate	POM + 25% glass fiber
4	Chamber	PPO + 20% glass fiber
7	Drain and priming plug	POM + 25% glass fiber
10	Self-priming valve	PP + 30% glass fiber
14	Self-priming part	PPE/PS + 20 % glass fiber
16	Pump sleeve	Stainless steel, DIN W.-Nr. 1.4301, AISI 304
42	Pressure tank	Butyl (diaphragm)
49	Impeller	PPO + 20% glass fiber-PTFE
65	Non-return valve	POM + 25% glass fiber
92	Clamp	Stainless steel, DIN W.-Nr. 1.4301, AISI 304
100a	Discharge port	POM + 25% glass fiber
101	Suction port	POM + 25% glass fiber
103 104	Shaft seal: Stationary and rotating part	Carbon/ceramics/NBR rubber
150	Shaft	Stainless steel, DIN W.-Nr. 1.4005, AISI 416
	Motor sleeve	Stainless steel, DIN W.-Nr. 1.4301, AISI 304
174a	Pressure switch	
184	Flow sensor	
	O-rings	NBR-rubber

POM: Polyoximetylen  
 NR-rubber: Natural Rubber  
 PPO: Polyphenylene Oxides  
 PP: Polypropylene  
 PPE/PS: Polyphenylene Oxides (the same as PPO but from different supplier)  
 NBR-rubber: Nitrile-Butadiene Rubber

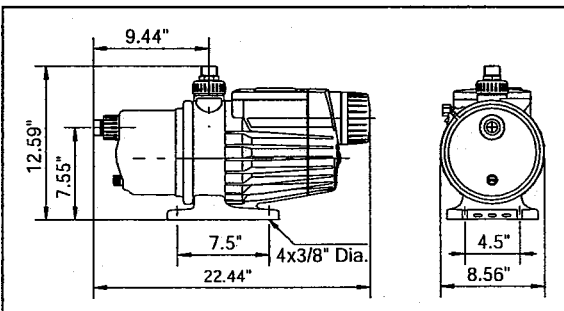


## Flooded suction (0 PSI inlet) performance curves\*



\*See suction lift performance curves (page 8) for installations with water level below intake.

## Dimensions



## Technical data

Pump type	Voltage	I <sub>n</sub> [A]	I <sub>start</sub> [A]	P <sub>2</sub>		Net weight [pounds]
				[W]	[hp]	
MQ 3-35	1 X 110-120 V	7.2	12.5	580	0.79	29
MQ 3-45	1 X 110-120 V	9.2	12.5	680	0.92	29
MQ 3-35	1 X 220-240 V	3.7	8.6	580	0.79	29
MQ 3-45	1 X 220-240 V	4.5	8.6	680	0.92	29

# PUMP Selection

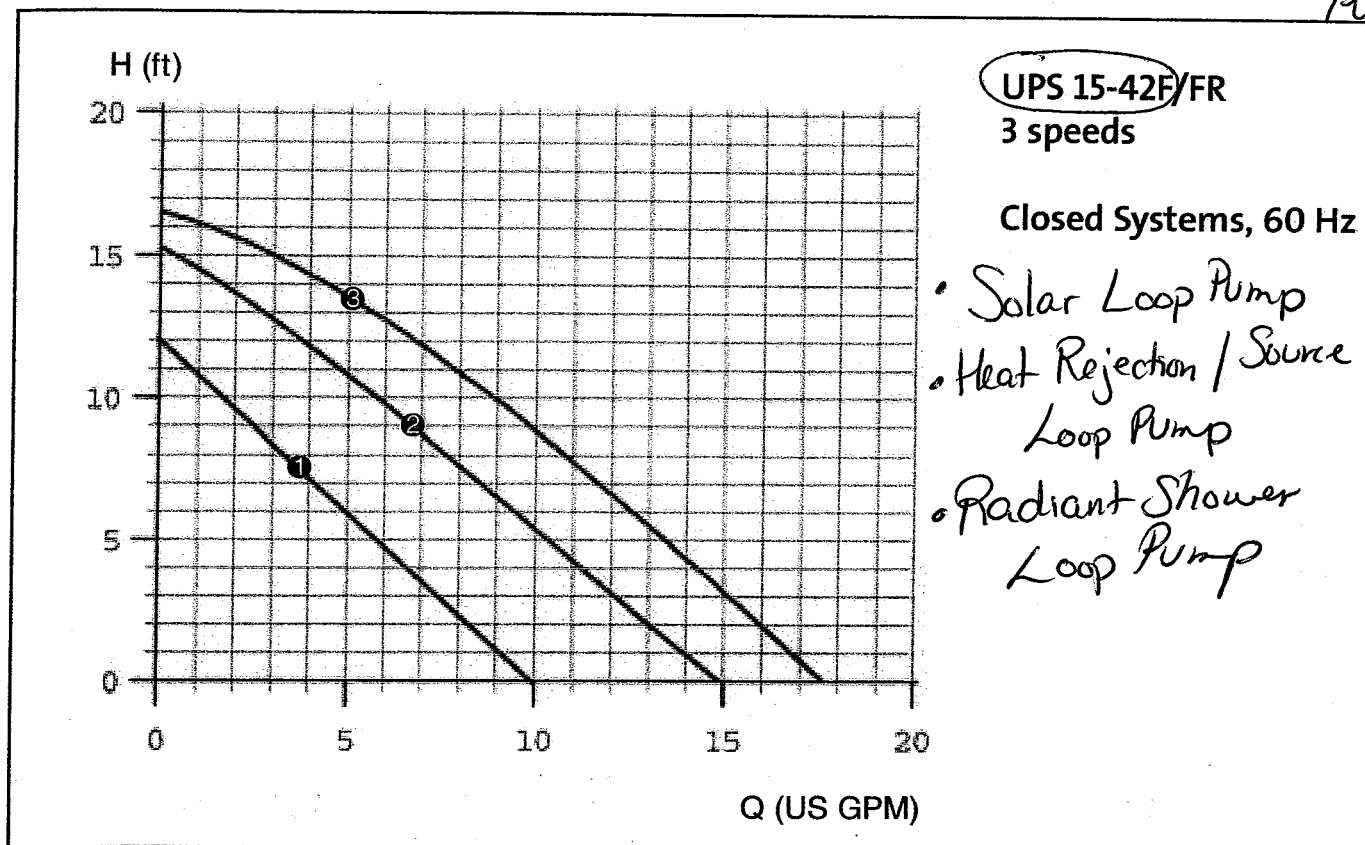
\* Pump recommendation from Chris

## TECHNICAL DATA

## GRUNDFOS SERIES UP

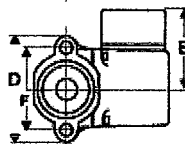
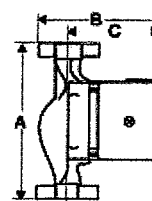
### UPS 15-42F/FR

\* Check if Bill can order Grundfos Pumps

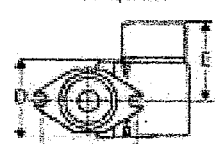
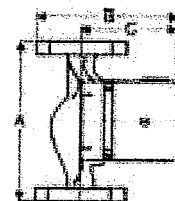


Flow range: 0 - 17.5 U.S. GPM  
Head range: 0 - 17 FEET  
Motors: 2 Pole, Single Phase  
Maximum fluid temperature: 230°F (110°C)  
Min. fluid temperature: 36°F (2°C)  
Maximum working pressure: 145 PSI

MODEL	Spd.	VOLTS	AMPS	WATTS	HP	CAPACITOR
UPS15-42F/FR	3	115	0.74	85	1/25	10mF/180V
	2		0.57	65	—	—
	1		0.4	45	—	—
UPS15-42F/FR	3	230	0.41	92	1/25	2mF/400V
	2		0.19	40	—	—
	1		0.14	30	—	—



UP 15-42F



UP 15-42FR

Model Type	A	B	C	D	E	F	Connection Type and Size	Shipping Wt. (Lbs.)
UPS15-42F	6 1/2	5 1/4	4	4 3/16	3 1/4	3 5/32	GF 15/26 Flange - (2) 1/2" Dia. Bolt Holes	7 1/4
UPS15-42FR	6 1/2	5 15/16	4	3 3/4	3 1/4	3 5/32		7 1/4

## Taco Radiant Made Easy Application Guide

# Variable Speed Variable Voltage "00" Circulator (00-VV)

## Products & Applications

PA08

EFFECTIVE: March 1, 2004

SUPERSEDES: New

## OVERVIEW

### Variable Speed Variable Voltage "00" Circulator (00-VV)

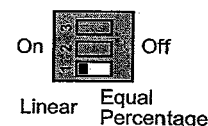
The Variable Voltage version of the Variable Speed "00" Circulator is a microprocessor-based pump designed to operate at different speeds based on an externally generated analog voltage signal input. Its reliable operation, ease of installation and integration to BDC or building management systems allows for a wide variety of HVAC applications such as maintaining a pressure differential or a setpoint temperature. The control accepts a 0-10 V(dc), 0-20 mA, 2-10 V(dc), or 4-20 mA signal.

## 00-VV Operation

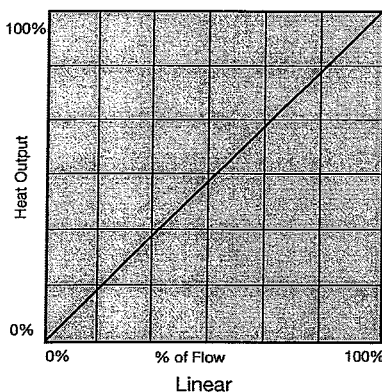
Whenever the 00-VV is powered up, the green power LED turns on and the pump operates based on an analog input signal. The percent output (% OUT) LED flashes at different rates based on the speed of the pump. As the % OUT LED flashes faster it indicates a faster speed of the pump. A fully on LED indicates the pump is at 100% capacity.

### Output Characteristic (DIP switch 1)

The 00-VV accepts an analog signal in order to drive the pump at different speeds. The pump speed may be selected to change linearly or based on equal percentage characteristic. The output characteristic is selected via DIP switch 1.

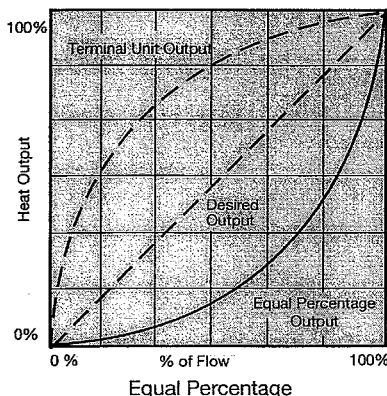


### Linear Characteristic



The linear output characteristic assumes there is a linear relationship between percent of flow of the pump and heat output of the terminal unit. Linear operation is typically used in applications in which the pump injects into a constant circulating loop, which includes the terminal unit.

### Equal Percentage Characteristic



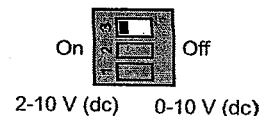
The equal percentage output characteristic assumes there is a non-linear relationship between percent of flow of the pump and heat output of the terminal unit. In order to achieve the desired linear output, the 00-VV provides an equal percentage output. Equal percentage operation is typically used in applications in which the pump injects directly into the terminal unit.

### Features:

- Available in all styles of "00" or "LM" pumps
- All-in-one pump / control
- Easy to wire
- UL approved
- Snap-in PC board
- Integral flow check
  - prevents gravity circulation
  - specially designed for variable speed systems
  - easy to service
  - patented
- 4 signal voltage ranges (0-10 V dc, 0-20 mA, 2-10 V dc, or 4-20 mA)
- Internal LED's
- Manual operation switch
- Linear or logarithmic output
- Pump exercise (10 seconds after 3 days of no operation)

### Analog Signal (DIP switch 3)

The control accepts either a 0-10 V (dc) or 2-10 V (dc) signal. The signal range is selectable via the DIP switch number 3. Once a signal is applied, the pump speed varies based on the selected output characteristic.



#### 0-10 V (dc) / 0-20 mA

Whenever the signal is 0 V (dc), the percent speed output of the pump is 0%, and it increases to 100% when a 10 V (dc) signal is present.

If a 0-20 mA signal is used, install the 500 ohm 1/4 W resistor across the (+) and (-) terminals as shown in Figure 2. Whenever the signal is 0 mA, the percent speed output of the pump is 0%, and it increases to 100% when a 20 mA signal is present.

#### 2-10 V (dc) / 4-20 mA

Whenever 2 V (dc) is present, the control operates the pump at 0% and it increases to 100% whenever a 10 V (dc) signal is present.

If a 4-20 mA input signal is used, install the 500 ohm 1/4 W resistor across the (+) and (-) terminals as shown in figure 2. Whenever a 4 mA signal is present the pump operates at 0% output and it increases to 100% whenever a 20 mA signal is present.

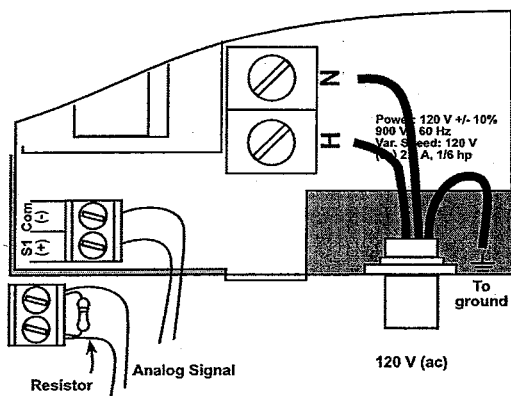


Figure 2

### Manual/Automatic Operation (DIP switch 2)

The 00-VV allows the user to manually turn on the pump at full flow without an analog signal. This function is enabled by switching the DIP switch number 2 on.

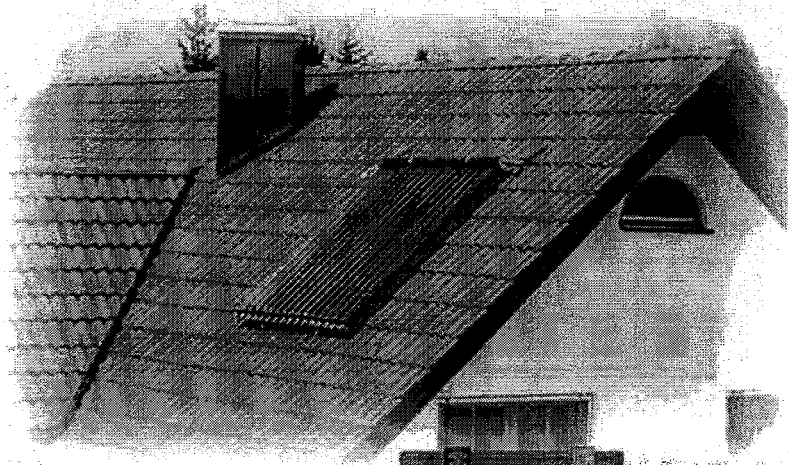


### Exercising

During long periods of no operation, the 00-VV is designed to exercise the pump for 10 seconds every 3 days of no operation in order to prevent precipitate build-up in the pump. The % OUT LED turns on during the exercising function.

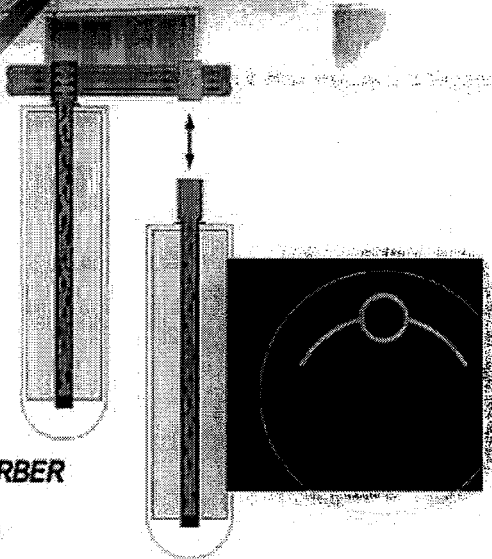


ETA-1  
Evacuated  
Tube  
Array



### SEIDO - 5 VACUUM TUBE SOLAR COLLECTOR

- ~ HEAT PIPE TECHNOLOGY  
(dry connection to manifold)
- ~ HIGH EFFICIENCY CURVED ABSORBER  
SELECTIVELY COATED  
(ideal for South facing installations)
- ~ FAST & EASY INSTALLATION
- ~ MAINTENANCE FREE
- ~ LONG SERVICE LIFE (20+ YEARS)
- ~ 5 YEAR COLLECTOR GUARANTEE



**SUNDA**  
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\*\*\* DEALER INQUIRIES WELCOME \*\*\*

Seido 5 Technical Data	Seido 5-8	Seido 5-16
Design	Evacuated Tube with Heat Pipe	Evacuated Tube with Heat Pipe
Dimensions (LxWxH)	2110 x 960 x 180 mm 83 x 38 x 7 inches	2110 x 1920 x 180 mm 83 x 76 x 7 inches
No of Tubes	8	16
Vacuum Tube Glass Material	high quality borosilicate	high quality borosilicate
Wall Thickness	0.098 inches (2.5mm)	0.098 inches (2.5mm)
Tube Outside Diameter	4 inches (100 mm)	4 inches (100 mm)
Tube Length	78.74 inches (2000 mm)	78.74 inches (2000 mm)
Tube Weight	10.14 lbs (4.6 kg)	10.36 lbs (4.7 kg)
Hailstone Resistant to	1.378 in (35mm) dia	1.378 in (35mm) dia
Vacuum	< 75 <sup>-7</sup> torr (10 <sup>-5</sup> mbar)	< 75 <sup>-7</sup> torr (10 <sup>-5</sup> mbar)
Collector Surface Area	22.28 ft <sup>2</sup> (2.07 m <sup>2</sup> )	44.67 ft <sup>2</sup> (4.15 m <sup>2</sup> )
Absorber Surface Area	19.38 ft <sup>2</sup> (1.8 m <sup>2</sup> )	38.75 ft <sup>2</sup> (3.6 m <sup>2</sup> )
Angle of Inclination	25-90°	25-90°
Module Weight	110 lbs (50 kg)	220 lbs (100 kg)
Pressure drop per module @ 0.44 gpm (100 L/h)	0.17 ft H <sub>2</sub> O (5 mbar)	0.34 ft H <sub>2</sub> O (10 mbar)
Test Pressure	145 psi (10 bar)	145 psi (10 bar)
Operating Pressure to	87 psi (6 bar)	87 psi (6 bar)
Fluid Content	0.13 gal (0.48 L)	0.25 gal (0.96 L)
Absorber Material	Aluminum	Aluminum
Coating	Aluminumnitride	Aluminumnitride
Absorption Coefficient	> 92%	> 92%
Emission Coefficient	< 8%	< 8%
Max Temperature (module)	374 F (190 C)	374 F (190 C)
Typical Operating Temperature	158-248 °F (70-120 °C)	158-248 °F (70-120 °C)
Stagnation Temperature (pipe)	477 F (247 °C)	477 F (247 °C)

### Basic Sizing Guidelines

Typically 1 m<sup>2</sup> (10.76 ft<sup>2</sup>) of absorber surface for every 100 Liters (26.42 US gallons) of water storage, or 0.7 m<sup>2</sup> (7.5 ft<sup>2</sup>) or 4 tubes per person. The following factors must be considered when sizing a system:

- Number of persons and water consumption habits
- Desired temperature
- Deviation of the collector from true South
- Deviation of roof inclination from optimum 35-45
- Total length of piping (to and from collector)
- Hot water circulation circuit

Contact us for detailed information and pricing.

See the components breakdown (171 KB Adobe PDF)



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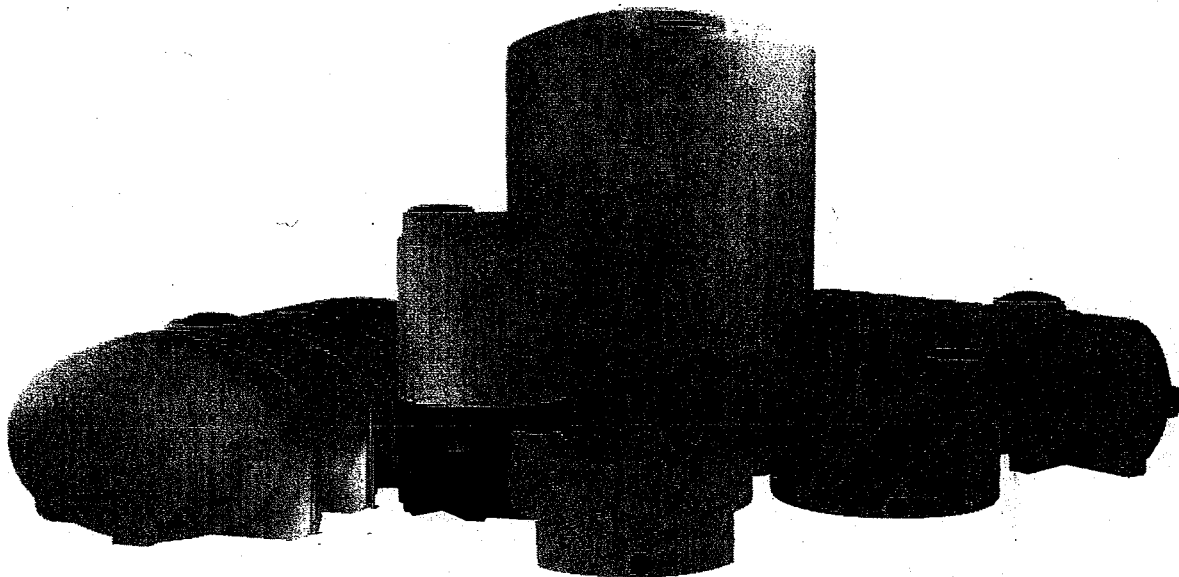


Water  
Supply  
Tanks

T-1A

T-1B

~~Talk w/ Heather  
about PIPE  
Connections for  
DPT & pump~~



## Liquid Storage Tanks

*Think Tanks. Think Norwesco.*

*2004 Edition*

## Horizontal Leg Tanks

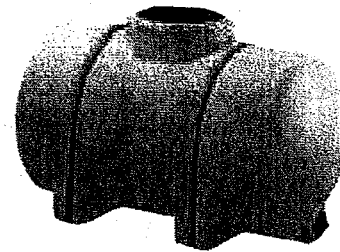
With the broadest leg tank line available, NORWESCO manufactures a size that will fit your needs. Used primarily for transport and nursing applications, NORWESCO's leg tanks feature molded-in legs that act as "baffles" to reduce sloshing. Please refer to page 4 for support bands.

Gallon Capacity	Diameter	Length	Fill Opening	Outlet/Drain Specification	No. of Bands	Premium Weight Part No. White	Heavy Weight Part No. Blue
35 ∞	20"	29"	5"	3/4"	2 optional	45223	—
55 ∞	23"	33"	5"	3/4"	2 optional	41873	—
65 ∞	23"	43"	5"	3/4"	2 optional	45191	—
125	32"	41"	8"	2"	2 optional	40298	—
225	38"	49"	8"	2"	2 optional	40299	—
325	38"	68"	16"	2"	2 optional	40217	—
525	49"	71"	16"	2"	2 optional	40181	40193
725 *	49"	101"	16"	2"	3 required	40180	40194
1025 *	49"	139"	16"	2"	4 required	40089	40131
1325 *	66"	99"	16"	2"	4 required	41875	41877
5025 *	92"	190"	16" **	3 1/2"	4 required	41879	41881

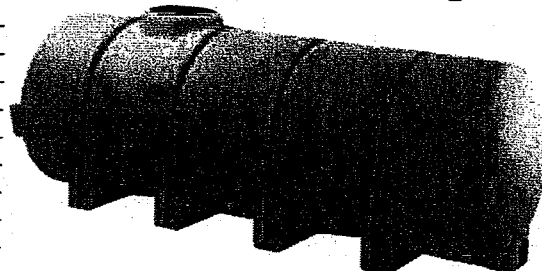
∞ Within UPS dimensional limits

\*Require full length support and bands

\*\*16" hinged lid



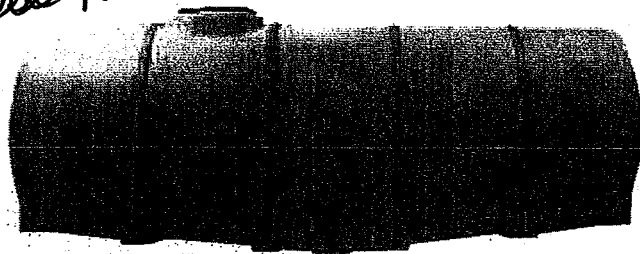
325 Gallon Horizontal Leg



1025 Gallon Horizontal Leg

## Drainable Leg Tanks

When complete drainage is necessary, these are the tanks of choice. They are designed primarily for use on fertilizer and chemical nurse trailers. All NORWESCO drainable tanks require full length bottom support as well as support bands. Please refer to page 4 for support bands.



Sloped For Complete Drainage 1010 Gallon Drainable Leg

Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	No. of Bands	Premium Weight Part No. White	Heavy Weight Part No. Blue
710 (horizontal)	47"	47"	104"	16"	2"	3 required	40655	40657
1010 (horizontal)	47"	47"	140"	16"	2"	4 required	40393	40395
1310 (horizontal)	66"	76"	99"	16"	—	4 required	41871	41872
1610 (elliptical)	69"	63"	140"	16"	—	4 required	40806	40808
2610 (elliptical)	90"	70"	140"	16"	—	4 required	41382	41383
3210 (elliptical)	92"	74"	178"	16"	—	4 required	40822	40824

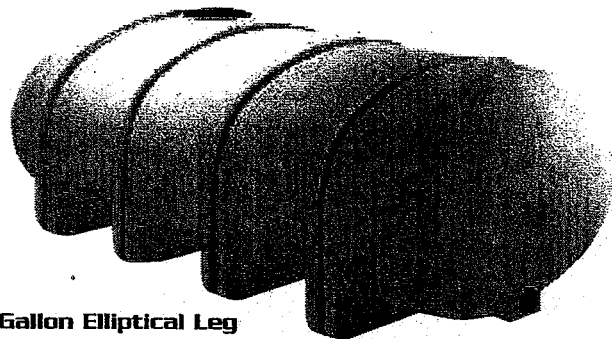
\*16" hinged lid

## Elliptical Leg Tanks

This elliptical tank style is designed to provide the greatest capacity with the lowest center of gravity, making it the best design available for transporting larger volumes. NORWESCO elliptical tanks feature molded-in legs and flow-through baffles which work together to reduce sloshing and provide increased stability during transport. All NORWESCO elliptical leg tanks require full length bottom support as well as support bands. Please refer to page 4 for support bands.

Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White	Heavy Weight Part No. Blue
1035	79"	53"	89"	16"	2"	40191	—
1235	65"	52"	128"	16"	2"	40239	—
1635	71"	57"	142"	16"	2"	40387	40388
2035	84"	55"	142"	16"	2"	40618	40623
2635	90"	71"	140"	16"	3 1/2"	40547	40283
3135	88"	76"	151"	16"	3 1/2"	40686	40688
4035	92"	77"	192"	16" *	3 1/2"	41267	41269

\*16" hinged lid



2035 Gallon Elliptical Leg



# Weiste Water Tanks

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Quality Environmental Solutions

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Home > Flexible Tanks > Water Bladders

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## HOW TO ORDER

## WATER BLADDERS



Our pillow tanks are collapsible tanks that provide temporary as well as long term liquid storage. They are useful for potable water, grey water, chemical, fuel and oil spill recovery operations, bulk liquid transport and storage of bilge slops. They are designed for land based operations but can be used on decks of vessels with proper support. Standard sizes range from 100 gallons to 50,000 gallons and larger custom tanks are available.

### Camp Anaconda



(Click to Enlarge)

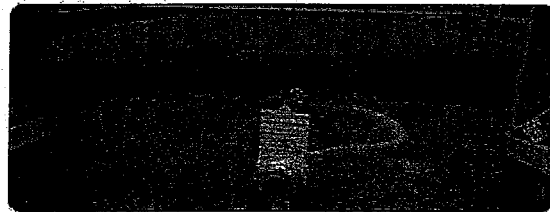
Special services are available for relief situations and/or military use. Call 1-800-238-4259 or 1-800-472-3392 for after hours or emergency information. Our general call in number is 1-800-474-7294 for day time or normal business hours. South Florida shipping location at 941-377-8610

We currently have in stock and ready for shipment 50,000, 25,000, 2,000, 1,000, 500 and 100 gallon potable water tanks. We can build relief tanks, custom tanks, grey water, fuel tanks or to mil specifications. Interstate Products, Inc. is always

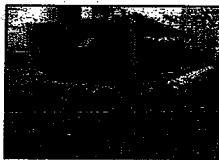
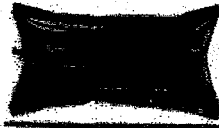
ready to accept the challenges of customizing your tank storage needs in case our large stock of ready to ship inventory just won't do. Please call us at 1-800-474-7294 and find out why our clients keep coming back for more

Standard flexible tanks are fabricated with top quality materials and fabric which provides ultra-violet light and chemical resistance. Many fabrics and connections available.

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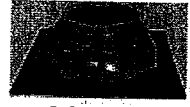


Custom Logos Available!

## RELATED PAGE



Fuel Bladders



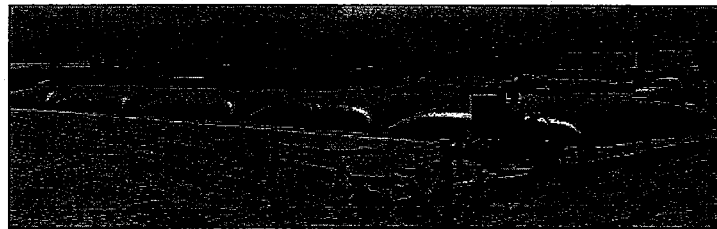
Union Tanks

**FREE CATALOG**

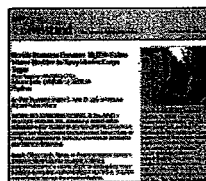
• What type of connection to this tank?  
• Do the tanks come w/ a standard connection size? / Can a size be requested when ordered?

T2 + T5

Temporary Water Storage • Decontamination • Fuel Storage  
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We use NSF 61 approved fabrics for potable water use.  
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## News - Naval Support

### "Florida Business Donates 10,000-Gallon Water Bladder to Navy Marine Corps Team"

Release Date: 1/7/2005 11:35:00 AM

"ABOARD USS BONHOMME RICHARD, At Sea (MNS) — Interstate Products, Inc. donated a 10,000-gallon collapsible water bladder to the Navy/Marine Corps team aboard San Diego-based USS Bonhomme Richard (LHD 6) (BHR) as it prepared to conduct humanitarian assistance operations in Indonesia."

## Pillow Tank Common Size / Capacities

Pillow Tank Capacity	Pillow Tank Shipping Weight	Pallet Shipping Dimensions	Maximum height of filled tank	Maximum Dimensions Empty (L x W)
			Inches	



T-2

T-5

Use 3 of these tanks

US Gal.	Imp Gal.	Liters	Lbs	Kg	Inches	Cm	(mm)	Feet	Meters
100	83	379	100	46	36 x 38 x 17	92 x 97 x 43	12 (305)	4.5 x 4.8	1.4 x 1.5
120	100	455	110	50	36 x 38 x 17	92 x 97 x 43	12 (305)	5.2 x 4.8	1.6 x 1.5
200	208	946	130	59	36 x 38 x 17	92 x 97 x 43	13 (330)	5 x 7.0	1.6 x 2.2
250	250	1136	135	52	36 x 38 x 17	92 x 97 x 43	15 (381)	5.9 x 7.0	1.8 x 2.2
500	416	1893	140	64	36 x 38 x 17	92 x 97 x 43	21 (533)	9.0 x 7.0	2.8 x 2.2
600	500	2271	145	66	36 x 38 x 17	92 x 97 x 43	21 (533)	10.6 x 7.0	3.3 x 2.2
750	625	2835	155	71	36 x 38 x 17	92 x 97 x 43	21 (533)	8.4 x 9.4	2.6 x 2.9
900	749	3400	160	73	36 x 38 x 17	92 x 97 x 43	22 (559)	9.6 x 9.4	3.0 x 2.9
1000	833	3785	185	84	36 x 38 x 17	92 x 97 x 43	22 (559)	10.6 x 9.4	3.3 x 2.9
1200	1000	4542	195	89	36 x 38 x 17	92 x 97 x 43	24 (610)	12.4 x 9.4	3.8 x 2.9
1500	1250	5678	220	100	48 x 48 x 12	122 x 122 x 26	25 (635)	14.9 x 9.4	4.6 x 2.9
1800	1500	6814	230	105	48 x 48 x 12	122 x 122 x 26	28 (711)	15 x 9.4	4.6 x 2.9
2000	1665	7571	240	109	48 x 48 x 12	122 x 122 x 26	31 (787)	10.6 x 14.0	3.3 x 4.3
2400	1998	9085	260	118	48 x 48 x 12	122 x 122 x 26	32 (813)	11.7 x 14.0	3.6 x 4.3
2500	2082	9464	265	121	48 x 48 x 12	122 x 122 x 26	33 (838)	12.6 x 14.0	3.9 x 4.3
3000	2498	11356	350	158.76	48 x 48 x 18	122 x 122 x 46	36 (914)	14 x 14	4.27 x 4.27
3600	2998	13627	310	141	48 x 48 x 18	122 x 122 x 46	38 (965)	17.0 x 14.0	5.2 x 4.3
4000	3331	15142	315	143	48 x 48 x 18	122 x 122 x 46	39 (991)	18.0 x 14.0	5.5 x 4.3
4800	3997	18170	325	148	48 x 48 x 18	122 x 122 x 46	40 (1016)	20 x 14	6.1 x 4.3
5000	4164	18927	357	162	48 x 48 x 24	122 x 122 x 61	43 (1092)	14.6 x 18.8	4.5 x 5.8
6000	4996	27712	373	170	48 x 48 x 24	122 x 122 x 61	45 (1143)	16 x 18.8	4.9 x 5.8
7500	6245	28391	412	187	48 x 48 x 36	122 x 122 x 92	47 (1194)	19.9 x 18.8	6.1 x 5.8
9000	7494	34069	489	222	48 x 48 x 40	122 x 122 x 102	52 (1321)	23.4 x 18.8	7.2 x 5.8
10000	8327	37854	600	272.16	48 x 48 x 36	122 x 122 x 92	60 (1524)	22 x 22	6.71 x 6.71
12000	9992	45425	560	255	48 x 48 x 40	122 x 122 x 102	60 (1524)	21.6 x 23.4	6.6 x 7.2
15000	12491	56781	575	261	48 x 48 x 48	122 x 122 x 122	60 (1524)	26.7 x 23.4	8.2 x 7.2
18000	14989	68137	630	286	48 x 48 x 48	122 x 122 x 122	60 (1524)	30 x 23.4	9.2 x 7.2
20000	16654	75708	850	385.55	48 x 48 x 48	122 x 122 x 122	60 (1524)	28 x 24	8.53 x 7.32
24000	19985	90850	850	386	48 x 48 x 48	122 x 122 x 122	60 (1524)	33.11 x 28.0	10.1 x 8.6
25000	20817	94635	895	406	48 x 48 x 48	122 x 122 x 125	60 (1524)	39.11 x 33	11.9 x 10
48000	39970	181699	1350	613	48 x 84 x 36	122 x 213 x 91	60 (1524)	50 x 32.8	15.3 x 10.0
50000	41635	189270	2000	907.18	48 x 84 x 40	122 x 213 x 102	60 (1524)	65 x 24	19.81 x 7.32

**Notes:**

The empty dimensions tank sizes can vary a little depending on application, fabric used and/or military spec.

**Options:**

For use on rough terrain areas. Ground Mats are waterproof and available for under the tank for protection from rocks and sharp objects. Extra matting extends life of the tank and is made wider and longer than the tank to fully cushion it.

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Water Heater Tank →

**A.O. Smith**

*Residential Electric Water Heaters*

**ProMax®**

Heat Pump Water  
Heater Tanks

**PROMAX® FEATURES**

**TALL, SHORT AND LOWBOY (TOP CONNECT) MODELS AVAILABLE.**

**A. O. SMITH DYNACLEAN™ DIFFUSER DIP TUBE**

Helps reduce lime and sediment buildup, maximizes hot water output.  
Made from long-lasting PEX cross-link polymer.

**COREGARD™ ANODE ROD**

Aluminum anode with stainless steel core protects tank  
against corrosion longer than ordinary mild steel anodes.

**DURABLE TAMPER-RESISTANT BRASS DRAIN VALVE**

**A. O. SMITH PERMAGLAS® GLASS COATING**

Protects steel tank from rust.

**FACTORY-INSTALLED SIDE-MOUNTED TEMPERATURE  
AND PRESSURE (T&P) RELIEF VALVE**

Top-mounted T&P valve available as option on some models.

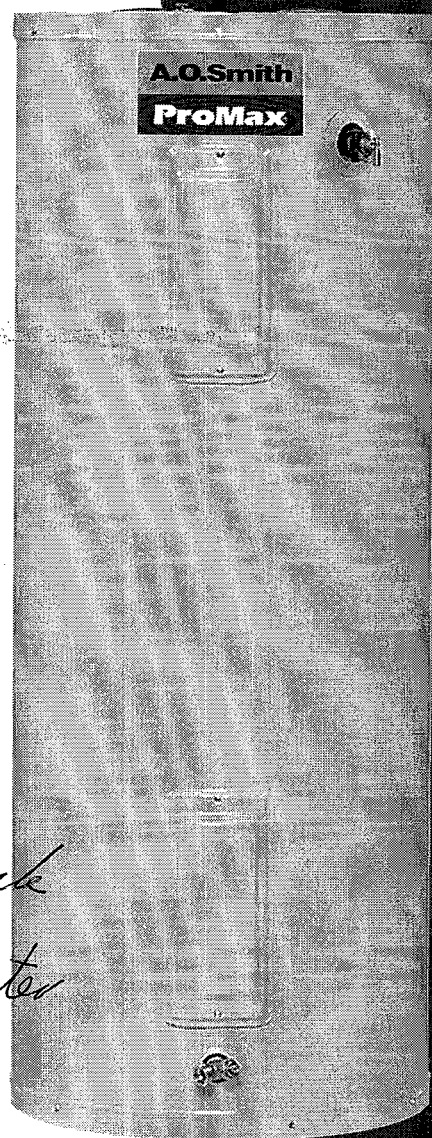
**6-YEAR LIMITED TANK AND PARTS WARRANTY**

For complete information consult written warranty or A. O. Smith Water  
Products Company.

**UPGRADE TANK WARRANTY TO 10 YEARS** (see details on page 2).

**CODE COMPLIANCE: CEC, CABO, HUD, BOCA NATIONAL  
CODES, ASHRAE/IES 90.1-1999 AND 2004 NAECA**

**CERTIFIED TO UL 174 FOR HOUSEHOLD ELECTRIC  
WATER HEATERS**



T-3: ELJC-20 : Heat Storage Tank

WH-1: ECL-30 : Heat Pump Water  
Heater Tank



**A.O. Smith**  
**Water Heaters**

[www.hotwater.com](http://www.hotwater.com)

# RESIDENTIAL

# Electric Water Heaters

# ProMax®

MODEL NUMBER	FIRST HOUR RATING GALLONS	ENERGY FACTOR	GAL. CAP.	ELEMENT WATTAGE 240 VAC		RECOVERY 90°F RISE GALLON PER HOUR	R VALUE	DIMENSIONS IN INCHES			APPROX. SHIPPING WEIGHT (LBS)
				STANDARD	MAXIMUM			A	B	C	
TALL MODELS											
ECT-30**	43	.93	30	4500	6000	21	16	46-1/2	18	39-1/2	95
ECT-40	52	.92	40	4500	6000	21	16	59-1/2	18	53-1/2	115
ECT-52	62	.91	50	4500	6000	21	16	54	20-1/2	47-1/2	125
ECT-55	67	.90	55	4500	6000	21	16	60-1/4	20-1/2	52-3/4	135
ECT-66	72	.88	66	4500	6000	21	16	60-1/4	22	53	170
ECT-80	81	.86	80	4500	6000	21	16	60-1/2	24	52	200
ECT-120*	116	.81	119	4500	6000	21	16	64-1/4	28	54-1/4	320
SHORT MODELS											
ECS-30**	43	.93	30	4500	6000	21	16	36-1/2	20-1/2	28	100
ECS-40**	52	.92	40	4500	6000	21	16	44	20-1/2	37-3/4	115
ECS-50**	60	.90	50	4500	6000	21	16	48	22	40-1/2	150
LOWBOY MODELS											
ELJC-6	N/A	N/A	6	1500 @ 120V	2500 @ 120V	7	8	15-1/2	14-1/4	10-1/2	35
ELJC-15	N/A	N/A	15	1500 @ 120V	2500 @ 120V	7	16	32-1/4	14-1/4	20-3/4	58
ELJC-20	N/A	N/A	19	2500 @ 120V	6000 @ 240V	11	16	32-1/4	18	15-3/4	73
ECL-30**	42	.93	29	4500	6000	21	16	30	22	22-1/2	105
ECLN-40**	48	.92	38	4500	6000	21	12	31-1/4	23	24-5/8	125
ECL-50**	58	.91	50	4500	6000	21	16	34	26-1/2	25	170

Recovery capacity is based on actual performance tests.

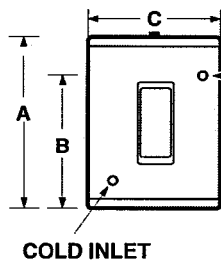
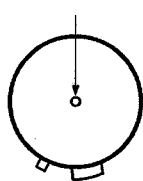
For 10-year tank warranty, change "E" to "P" in model number (PCT-40).

\* This model is not available with top T&P valve.

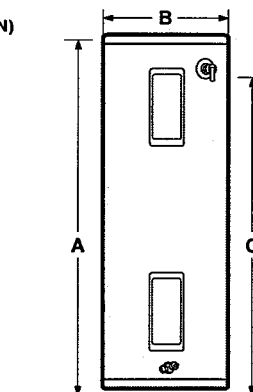
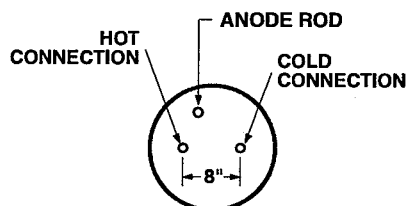
\*\* Models supplied with Heat Trap Nipples.

10-year tank warranty and top T&P option combo not available on ECLN-40 and ECL-50.

**TOP T&P CONNECTION**  
(OR OPTIONAL TOP HOT OUTLET)



ELJC-6 and ELJC-15



ECT, ECS, ECL(N) and ELJC-20

**A.O. Smith**  
Water Heaters  
[www.hotwater.com](http://www.hotwater.com)

500 Tennessee Waltz Parkway, Ashland City, TN 37015

For Technical Information and Automated Fax Service, call 800-527-1953.  
A. O. Smith Corporation reserves the right to make product changes or improvements without prior notice.



1/2" hePEX tubing  
for  
Radiant  
Floor  
System



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## Wirsbo hePEX™ plus Tubing

Uponor's Wirsbo hePEX™ plus tubing is designed specifically for radiant heating systems.

The Wirsbo hePEX plus tubing is made from PEX (crosslinked polyethylene), a unique plastic tubing made stronger through the hot crosslinking process. It's a product you can trust.

- Tested and proven for over 30 years
- Durable, flexible and extremely reliable
- Maintenance-free
- 100-year life expectancy
- More than 11 billion feet of Uponor PEX tubing currently installed worldwide
- Backed by a [25-year warranty](#)

For those who want to know a little more:

- There are several different kinds of PEX tubing on the market and they are not created equal.
- Wirsbo hePEX plus has an oxygen diffusion barrier<sup>1</sup> so it can be used in radiant heating systems that contain ferrous components.
- Uponor's exclusive [ProPEX® fittings](#) take advantage of the tubing's unique shape memory to make solid, permanent connections, minimizing the risks of leaks.

For those who want to know a lot more, review the hePEX plus technical data below<sup>2</sup>.

### 1. Oxygen Diffusion Barrier

Wirsbo hePEX plus is sealed with a special polymer barrier to prevent oxygen diffusion and to protect the corrodible components of closed loop hydronic heating systems.

The barrier consists of an EVOH layer laminated onto the tube. The hePEX plus barrier meets the requirements of the German DIN Standard 4726 for oxygen diffusion prevention, as endorsed by the Radiant Panel Association.

The amount of oxygen that enters the system is less than 0.10 grams per cubic meter (volume) per day for all hePEX plus dimensions. The Wirsbo hePEX plus barrier is not affected by water temperatures up to 200°F.

### 2. Wirsbo hePEX plus Technical Data

Wirsbo hePEX plus is an oxygen diffusion barrier tubing and is designed for use in closed loop hydronic systems operating at temperatures up to 200°F. Corrosive or ferrous components may be used in Wirsbo hePEXplus circulating loops.

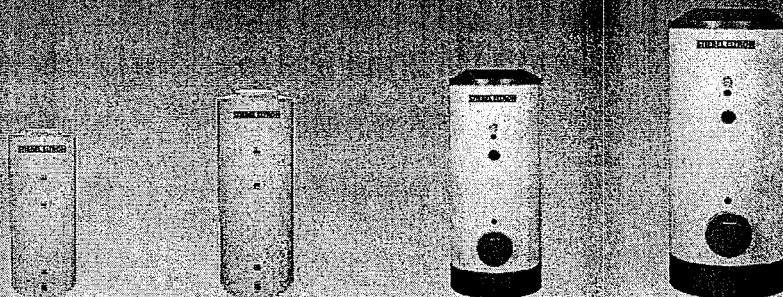
Brand Name:	Wirsbo hePEX™ plus
Dimensions:	5/16", 3/8", <u>1/2"</u> , 5/8", 3/4", 1"
Wall Thickness:	SDR 9
ASTM Standard:	ASTM F876/F877/F1960
Temp & Pressure Ratings:	200°F at 80 psi, 180°F at 100 psi, and 73.4°F at 160 psi
Approvals:	ICBO, NSF-rfh
Codes:	2000 Uniform Mechanical Code (UMC)

5925 W. 148th Street • Apple Valley, MN 55124  
Tel 800 321 4739 • Fax 952 891 2008  
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# THE POWER OF THE SUN

## Storage Tanks for Solar Applications

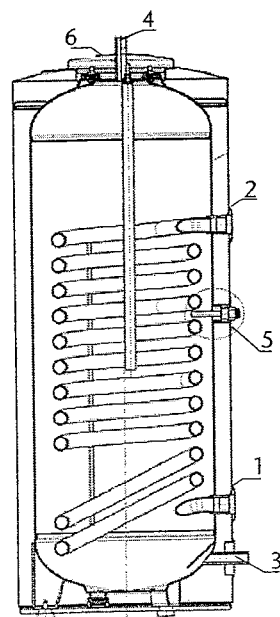
### Single Heat Exchanger Models



#### Technical Data

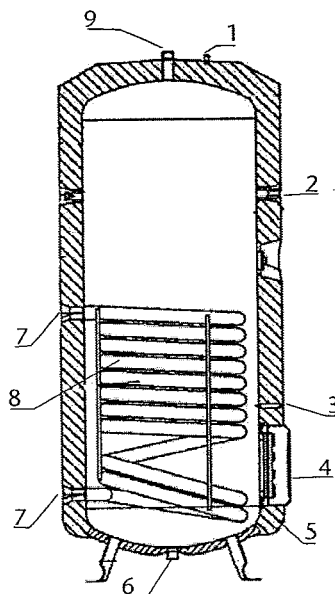
Type		SB 150 S	SB 200 S	SBB 300 S	SBB 400 S
Contents					
Storage capacity	Gal / ltr	39.0 / 147.63	52 / 196.84	80.6 / 305	108.6 / 411
Volume of heat exchanger, top	Gal / ltr	NA	NA	NA	NA
Volume of heat exchanger, bottom	Gal / ltr	1.9 / 7.2	2.7 / 9.1	2.7 / 10.1	2.9 / 11.3
Pressure					
Working pressure	PSI / bar	150 / 10	150 / 10	150 / 10	150 / 10
Tested to pressure	PSI / bar	217 / 15	217 / 15	217 / 15	217 / 15
Max. pressure of boiler loop	PSI / bar	150 / 10	150 / 10	150 / 10	150 / 10
Temperature					
Max. temperature solar loop	°F / °C	203 / 95	203 / 95	203 / 95	203 / 95
Max. temperature of boiler loop	°F / °C	203 / 95	203 / 95	203 / 95	203 / 95
Heat exchanger					
Surface area heat exchanger top	sq. inch / m <sup>2</sup>	NA	NA	NA	NA
Surface area heat exchanger bottom	sq. inch / m <sup>2</sup>	1742	2059	2325 / 1.5	2635 / 1.7
Weights					
Tank weight empty	lb. / kg	190 / 86.18	226 / 102.5	292 / 133	371 / 169
Tank weight full	lb. / kg	523 / 237.2	658 / 298.4	988 / 448	1304 / 591
Other					
Standby losses in 24 hours	BTU / kWh	6500 / 1.9	4434 / 1.3	6500 / 1.9	7500 / 2.2
Cold/hot water connection		3/4" Male NPT		for 1" copper pipe with adapters, provided with unit	
Dimensions					
Height with insulation	in. / mm	50.5 /	62.75 /	66.1 / 1679	72.7 / 1848
Width with insulation	in. / mm	20.5 /	20.5 /	27.55 / 700	29.52 / 750

### SB 150 S & SB 200 S models



- 1 Heat exchanger out
- 2 Heat exchanger in
- 3 Cold water inlet
- 4 Hot water outlet
- 5 Well for thermostat
- 6 T & P valve

### SBB 300 S & ~~SBB 400 S~~ models



- 1 Sacrificial anode indicator
- 2 Thermometer
- 3 Well for temperature sensor (solar)
- 4 Clean-out port
- 5 Foam insulation
- 6 Cold water inlet
- 7 Heat exchanger ports (solar)
- 8 Exchanger coil (solar)
- 9 Hot water outlet

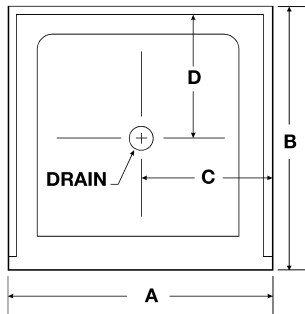
Note: heat exchangers are steel with porcelain enamel coating



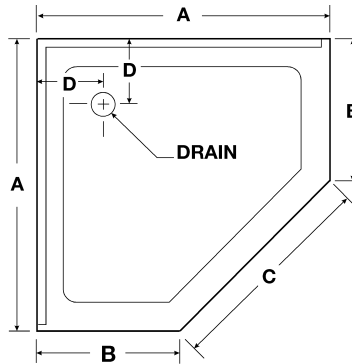
# Shower Floors Installation Instructions

## Swanstone Solid Surface and Veritek™ Shower Floors

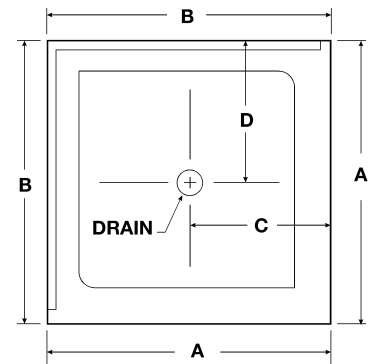
**NOTE:** If installing a Swanstone Shower Alcove SA-3232, SA-3448, SA-3636 or SA-38 NEO, please disregard this installation form and reference the Shower Alcove Wall installation form #465 included in the shower alcove carton.



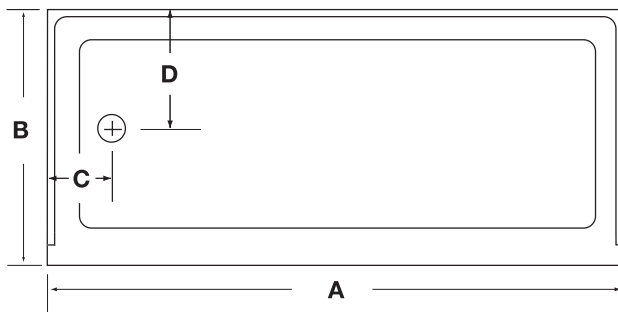
**SINGLE THRESHOLD**



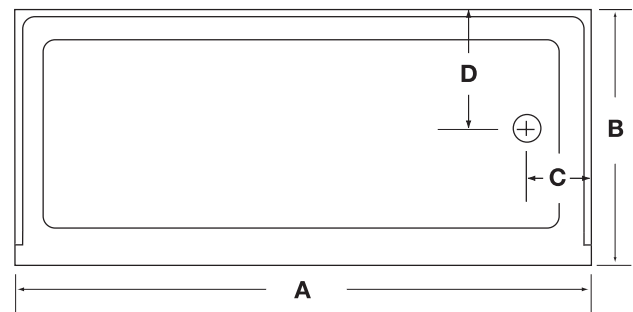
**NEO ANGLE THRESHOLD**



**DOUBLE THRESHOLD**



**RETROFIT THRESHOLD  
(LEFT SIDE DRAIN)**



**RETROFIT THRESHOLD  
(RIGHT SIDE DRAIN)**

MODELS	NOMINAL SIZE	*ROUGH-IN DIMENSIONS			
		A	B	C	D
R-3232 & SS-3232	32" x 32"	32 3/8"	32 3/16"	16 3/16"	16 3/16"
R-3248 & SS-3248	32" x 48"	48 3/8"	32 3/16"	24 3/16"	16 3/16"
R-3260 & SS-3260	32" x 60"	60 3/8"	32 3/16"	30 3/16"	16 3/16"
R-3260 L & SS-3260 L - Retrofit (left drain)	32" x 60"	60 3/8"	32 3/16"	8 3/16"	15 3/16"
R-3260 R & SS-3260 R - Retrofit (right drain)	32" x 60"	60 3/8"	32 3/16"	8 3/16"	15 3/16"
R-3442 & SS-3442	34" x 42"	42 3/8"	34 3/16"	21 3/16"	17 3/16"
R-3448 & SS-3448	34" x 48"	48 3/8"	34 3/16"	24 3/16"	17 3/16"
R-3454 & SS-3454	34" x 54"	54 3/8"	34 3/16"	27 3/16"	17 3/16"
R-3460 & SS-3460	34" x 60"	60 3/8"	34 3/16"	30 3/16"	17 3/16"
R-3636 & SS-3636	36" x 36"	36 3/8"	36 3/16"	18 3/16"	18 3/16"
R-4236 & SS-4236	42" x 36"	36 3/8"	42 3/16"	18 3/16"	21 3/16"
R-4242 & SS-4242	42" x 42"	42 3/8"	42 3/16"	21 3/16"	21 3/16"
R-DTF & SS-DTF Double Threshold	36" x 36"	36 1/16"	36 1/16"	18 3/16"	18 3/16"
R-36NEO & SS-36NEO Neo Angle	36" x 36"	36 1/8"	18 3/16"	25 1/8"	12 3/16"
R-38NEO & SS-38NEO Neo Angle	38" x 38"	38 1/8"	20 3/16"	25 1/8"	12 3/16"
FTS-3738 & STS-3738 - Transfer Shower	37" x 38"	38 3/8"	37 3/16"	19"	18 1/2"

\*IMPORTANT: Rough-in dimensions are provided for reference only. You must measure the actual shower floor and check local building code requirements before construction of the stud wall.

### INSTALLATION TIPS

- Read instructions carefully and familiarize yourself with the parts.
- Be certain shower floor is correct size and in good condition before beginning installation.
- Make sure hole in subfloor or slab is large enough to accommodate drain and will coincide with the hole in the shower floor. Hole should be 6" in diameter.
- Make sure shower floor is level and all feet of the shower floor are making firm contact with the subfloor. It may be necessary to shim under the shower floor for best overall subfloor contact. For a more stable installation, it is suggested that the shims be nested in a bed of mortar-type material (Quikrete). Improper installation will void the warranty.
- Finished walls may be tiled-in over integral flanges of shower floor.

LIMITED **Lifetime**  
WARRANTY

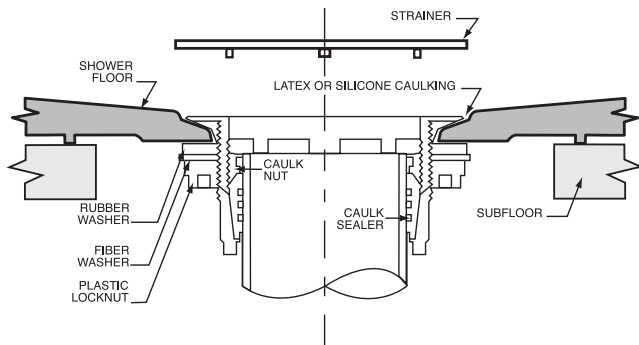
# Shower Floors Installation Instructions

## Swanstone Solid Surface and Veritek™ Shower Floors

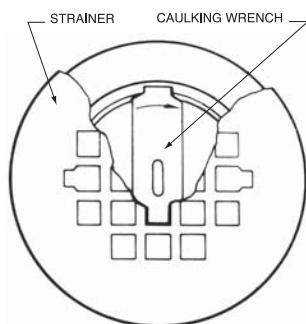
**NOTE:** If installing a Swanstone Shower Alcove SA-3232, SA-3448, SA-3636 or SA-38 NEO, please disregard this installation form and reference the Shower Alcove Wall installation form #465 included in the shower alcove carton.

### Plastic Self-Caulking Type Drain

Install drain to the shower floor. Make sure latex or silicone caulking (not provided) is applied to the underside of drain body flanges and secure it as shown. Do not use oil base caulking for any plastic type drain. May cause drain to break or distort.

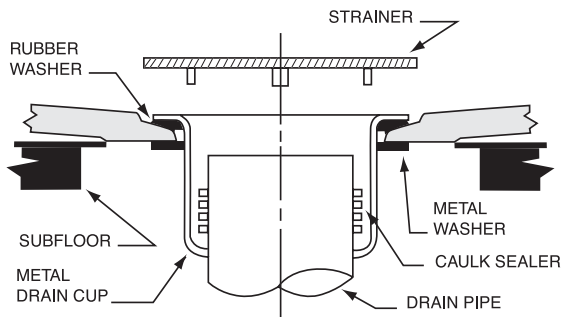


**FOR SELF-CAULKING (SPEEDY SEAL) —** Using the caulking wrench provided, screw in caulking nut (clockwise) until it is tight enough to compress sealer. Install strainer by snapping it in the drain body.

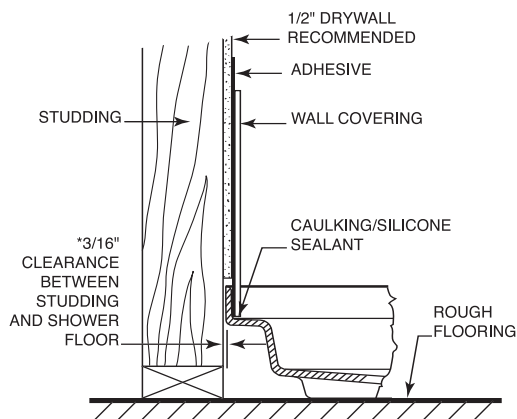


### Pressed-In Drain

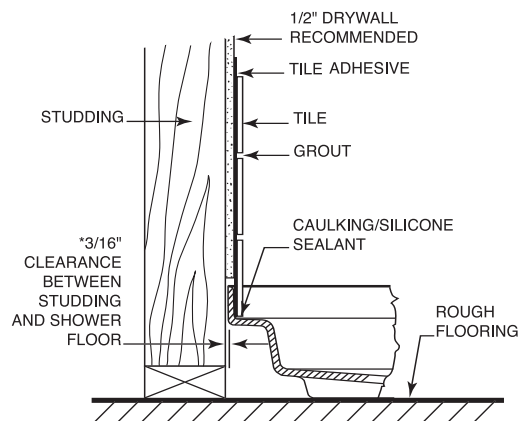
Install shower floor by sliding metal drain cup over drain pipe. If installing over no-hub or cast iron drain pipe, make sure the area that is accepting the shower floor drain is free of nicks, cuts, or burrs. To ensure proper seal, lightly sand drain pipe with emery paper or "0000" steel wool. For ease of installation, lubricate both the caulk sealer, drain cup and the drain pipe with either liquid hand soap or dish washing liquid. Slide caulk sealer over drain pipe. Complete installation by snapping strainer into place.



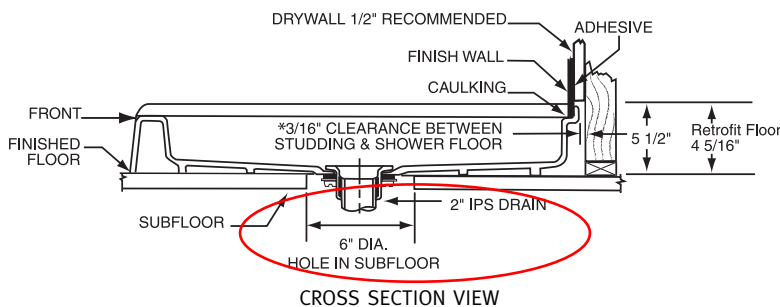
Swanstone produces many decorative wall systems that are designed to install perfectly over Swanstone/Veritek shower floors. Wall systems other than Swanstone brand wall systems can also be installed over Swanstone/Veritek shower floors. However, you must first check with the manufacturer of those wall systems, as well as checking state and local plumbing codes for proper installation.



TYPICAL THROUGH THE WALL DETAIL  
WITH A SWANSTONE PANEL SYSTEM



TYPICAL THROUGH THE WALL DETAIL  
WITH AN ALTERNATIVE WALL COVERING APPLICATION



\*Rough-In Dimensions Are Suggested. Conditions May Vary For Each Installation.

### Care and Cleaning

Swanstone and Veritek floors are uniquely impervious throughout their entire thickness. They maintain their beauty in the most active environments and resist stress, thermal cracking and peeling. However, they do require reasonable care.

Everyday cleaning should consist of liquid cleaners such as Dow or Lysol foaming bubbles, Top Job,

Mr. Clean or liquid Lysol along with a sponge.

Remove hard water stains, mineral or soap build-up with scale removers such as Lime-Away.

If necessary, you may use an abrasive cleaner such as Ajax or Comet with a nylon brush or pad to remove build up in between the pebble surface. Do not use steel wool or a wire brush.

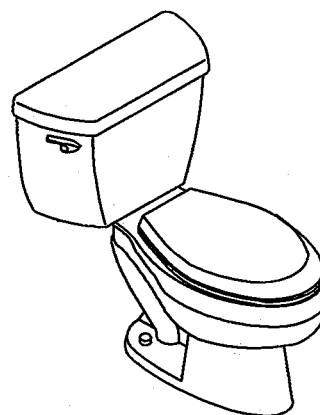
An abrasive cleaner, brush or pad will not remove the finish because the color is molded throughout. However, it is best to avoid the higher sheen surface around the pebbles. The higher sheen is a feature that deters soap build up. Prolonged scrubbing of this area could cause it to look dull, and promote soap build up.

### Features

- 12" (30.5 cm) rough-in
- Includes polished chrome trip lever
- Less seat and supply
- Vitreous china
- Elongated bowl
- 1.1 gpf (4.2 lpf)
- Equipped with Sloan Flushmate® - Sloan Valve Company
- Combination toilet
- Optional bedpan lugs or tank cover locks
- Available with right-hand or left-hand trip lever
- 17-1/8" (43.5 cm) high bowl is ADA compliant
- 11-1/2" (29.2 cm) x 9-1/2" (24.1 cm) water area
- 30-1/8" (76.5 cm) x 21-1/4" (54 cm) x 31-1/4" (79.4 cm)

### PRESSURE-LITE™ 1.1 TOILET K-3519

ADA



### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.19.2
- Energy Policy Act of 1992 (EPACT)
- IAPMO/UPC
- ADA
- CSA B45

### Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

### Accessories:

- 0: White
- CP: Polished Chrome
- PB: Polished Brass
- Other: Refer to Price Book for additional colors/finishes

### Specified Model

Model	Description	Colors/Finishes	
K-3519	Elongated bowl toilet (left-hand trip lever) (-RA right-hand trip lever)	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____
K-3519-T/TR	Toilet with tank cover locks (left/right-hand trip lever)	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____
K-4304	Toilet bowl (-L with bedpan lugs)	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____
K-4484	Tank (left-hand trip lever) (-RA right-hand trip lever)	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____

### Recommended Accessories

K-4650	French Curve™ seat with cover	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____
K-4664	Brevia™ seat with cover	<input type="checkbox"/> 0 White	<input type="checkbox"/> Other _____
K-7637	Angle supply with stop	<input type="checkbox"/> CP	<input type="checkbox"/> PB <input type="checkbox"/> Other _____

### Product Specification:

The elongated combination toilet shall be 12" (30.5 cm) rough-in. Toilet shall include a polished chrome trip lever and be less seat and supply. Toilet shall be made of vitreous china and 1.1 gpf (4.2 lpf). Toilet shall be equipped with Sloan Flushmate® - Sloan Valve Company. Toilet shall have optional bedpan lugs or tank cover locks and with right or left hand trip lever. Toilet shall have 11-1/2" (29.2 cm) x 9-1/2" (24.1 cm) water area. 17-1/8" (43.5 cm) high bowl is ADA compliant. Toilet shall be Kohler Model K-3519-\_\_\_\_\_.

# HIGHLINE™

## Optional Accessories

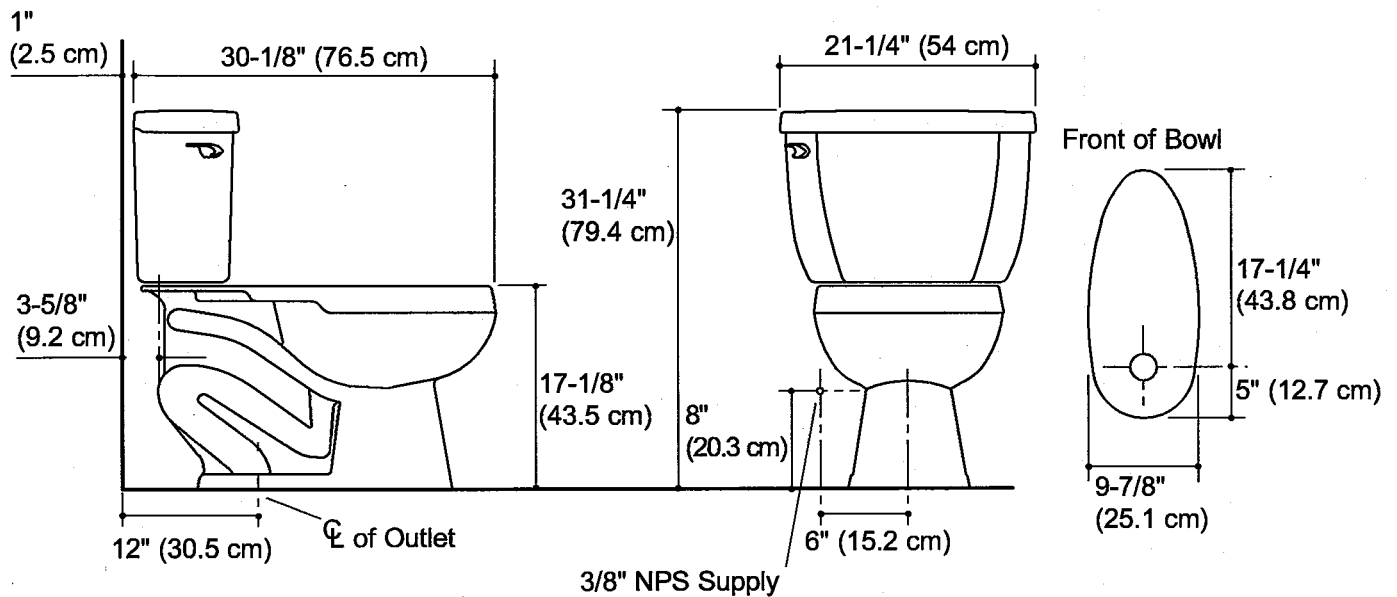
K-9481-L	Trip lever, left-hand (non-CP)	<input type="checkbox"/> PB	<input type="checkbox"/> Other _____
K-9481-R	Trip lever, right-hand (non-CP)	<input type="checkbox"/> PB	

## Technical Information

Fixture:	
Elongated bowl toilet	2-piece, elongated
Water per flush	1.1 gpf (4.2 lpf)
Passageway	2-1/4" (5.7 cm)
Water area	11-1/2" (29.2 cm) x 9-1/2" (24.1 cm)
Water depth from rim	5-3/4" (14.6 cm)
Seat post hole centers	5-1/2" (14 cm)
Maximum static pressure required	35 psi (241 kPa)
Maximum static pressure	80 psi (551.6 kPa)

## Installation Notes

Install this product according to the installation guide.



## Product Diagram

### Features

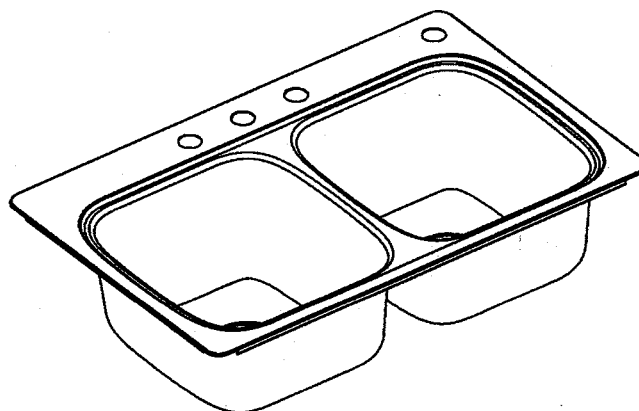
- 18 gauge stainless steel
- Self-rimming
- Double (equal) compartment
- Includes installation hardware
- 4-hole (-4), 3-hole (-3), or single-hole (-1)
- 33" (83.8 cm) x 22" (55.9 cm) x 8" (20.3 cm)

### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.19.3
- IAPMO/UPC

### SELF-RIMMING KITCHEN SINK K-3371



### Colors/Finishes

- NA: None applicable

### Accessories:

- CP: Polished Chrome
- ST: Stainless Steel
- NA: None applicable
- Other: Refer to Price Book for additional colors/finishes

### Specified Model

Model	Description	Colors/Finishes
K-3371-4	4-hole sink	<input type="checkbox"/> NA
K-3371-3	3-hole sink	<input type="checkbox"/> NA
K-3371-1	Single-hole sink	<input type="checkbox"/> NA

Optional Accessories		
K-3119	Hardwood cutting board (for either basin)	<input type="checkbox"/> NA
K-3129	Stainless steel bottom basin rack (for either basin)	<input type="checkbox"/> ST
K-8801	Duostrainer® sink strainer	<input type="checkbox"/> CP <input type="checkbox"/> Other _____
K-8813	Stainless steel sink strainer with tailpiece	<input type="checkbox"/> CP
K-8814	Stainless steel sink strainer less tailpiece	<input type="checkbox"/> CP

### Product Specification:

The self-rimming kitchen sink shall be 33" (83.8 cm) in length, 22" (55.9 cm) in width, and 8" (20.3 cm) in depth. Sink shall be made of 18 gauge stainless steel. Sink shall be double (equal) compartment. Sink shall be 4-hole (-4), 3-hole (-3), or single-hole (-1). Sink shall include installation hardware. Sink shall be Kohler Model K-3371-\_\_\_\_\_.



**VERSE™**

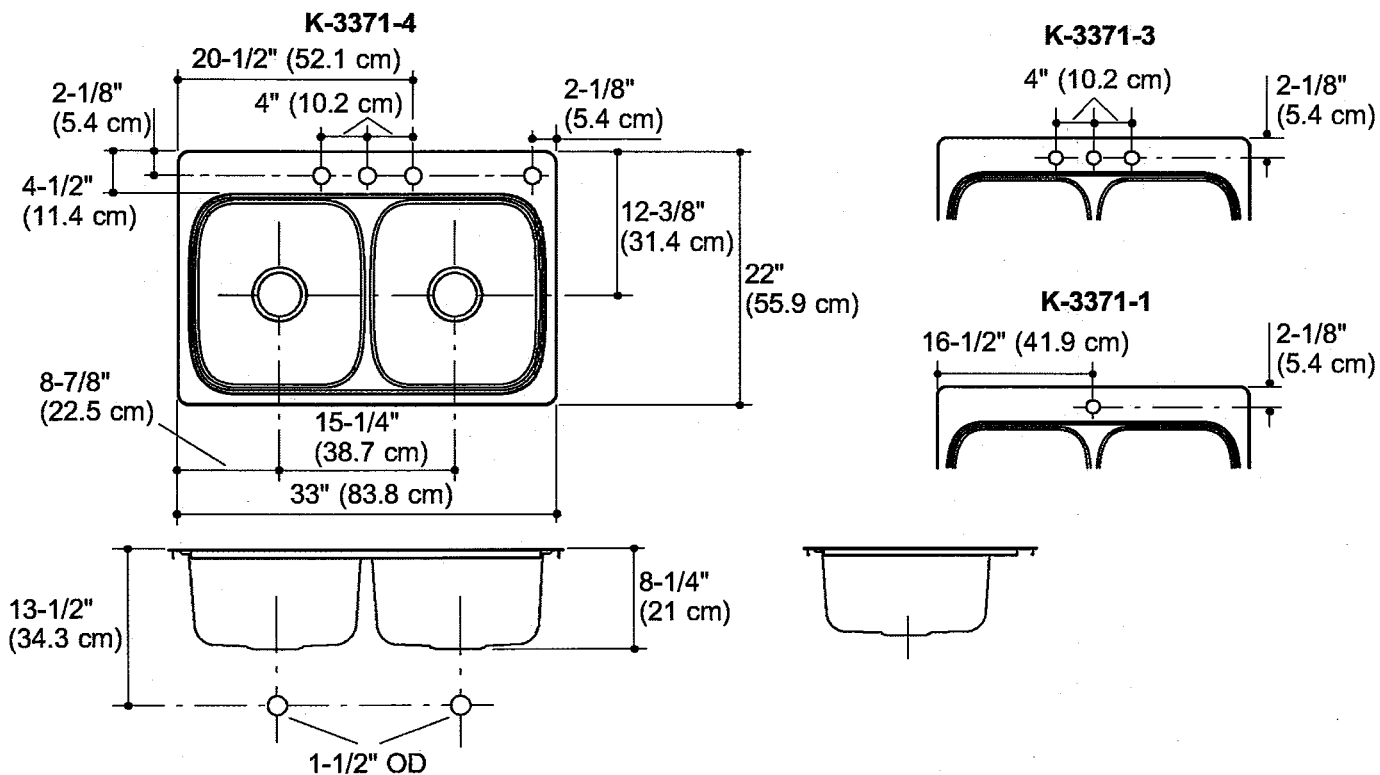
## Technical Information

Fixture*:	Basin area	Water depth
Sink	14-1/4" (36.2 cm) x 15-3/4" (40 cm)	8" (20.3 cm)
Drain holes	3-5/8" (9.2 cm) D.	
Faucet holes	1-7/16" (3.7 cm) D.	
* Approximate measurements for comparison only.		
Included component:		
Fastener pack	1023180	

## Installation Notes

**Install this product according to the installation guide.**

Cutout is 32-1/2" (82.6 cm) x 21-1/2" (54.6 cm) with 3/4" (1.9 cm) radius corners.



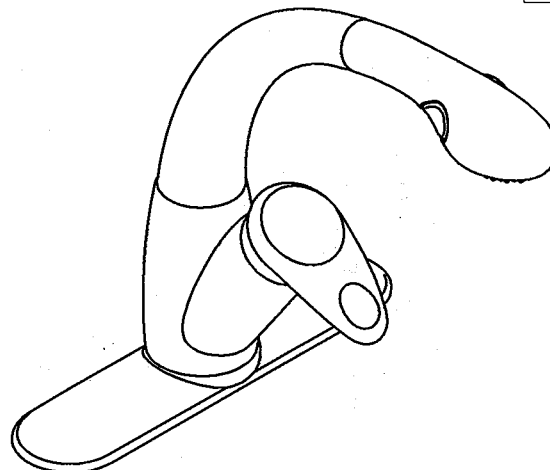
## Product Diagram

### Features

- Brass construction
- One-piece, self-contained ceramic disc valve allows both volume and temperature control
- Temperature memory allows faucet to be turned on and off at any temperature setting
- High-temperature limit stop for added safety
- 9-1/4" (23.5 cm) high-arch swing spout with integral spray and retractable hose
- Integral vacuum breaker
- Touch control for stream-to-spray water flow
- Sprayhead is available in a variety of colors
- Single-hole or three-hole installation options
- 2.2 gallons (8.3 L) per minute [max at 60 psi (4.14 bar)]
- Front lever handle

### KITCHEN SINK FAUCET K-6350

ADA



### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.18.1
- CSA B125
- IAPMO/UPC
- NSF 61
- Energy Policy Act of 1992 (EPACT)
- Listed in the States of Michigan, New York, and Wisconsin
- ADA

### Colors/Finishes

- CP: Polished Chrome
- PB: Polished Brass
- Other: Refer to Price Book for additional colors/finishes

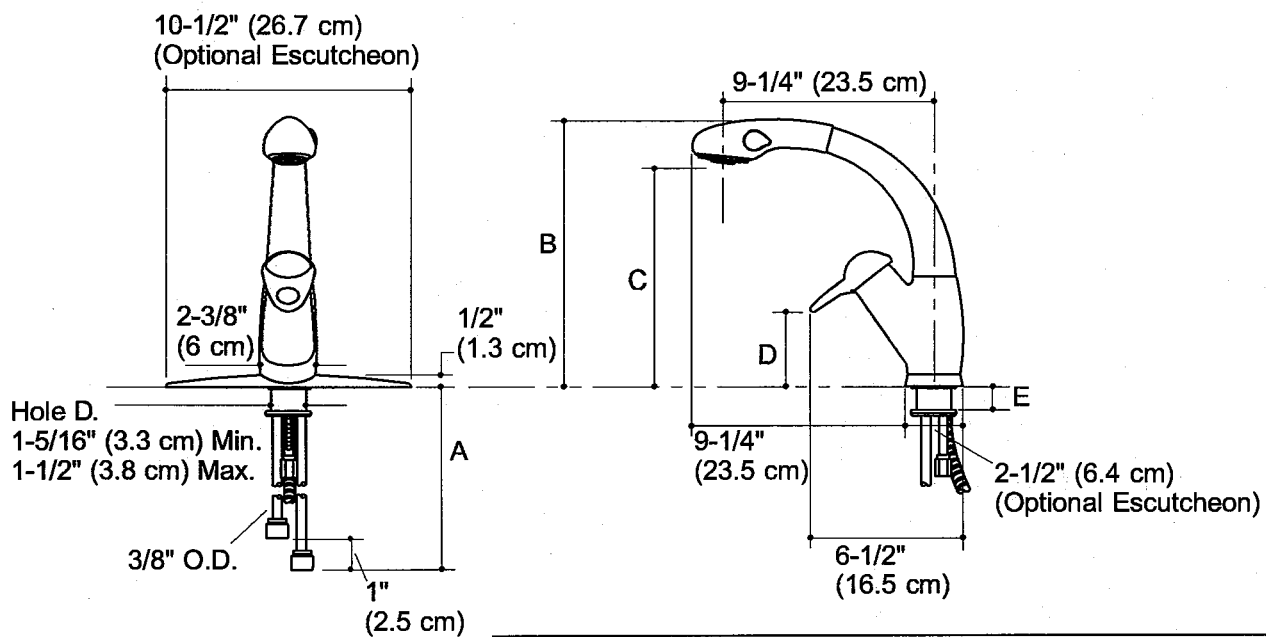
### Specified Model:

Model	Description		
K-6350	With Matching Color sprayhead	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-6350-AP	With Polished Chrome Body and White sprayhead	<input type="checkbox"/> CP	
K-6350-MP	With Polished Chrome Body and Almond sprayhead	<input type="checkbox"/> CP	
K-6350-BP	With Black sprayhead	<input type="checkbox"/> CP	<input type="checkbox"/> PB

### PRODUCT SPECIFICATION

Single-control pull-out spray kitchen sink faucet shall be of brass construction. The valve shall be a one-piece, self-contained ceramic disc valve, and allows both volume and temperature control. The valve shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting, and includes a high-temperature limit stop. Product shall include 9-1/4" (23.5 cm) high-arc swing spout with integral sprayhead, retractable hose, integral vacuum breaker, 10-1/2" (26.7 cm) escutcheon for three-hole installations, and front lever handle. Faucet shall be Kohler Model K-6350-\_\_\_\_-\_\_\_\_.

# AVATAR™



## Roughing-In Notes

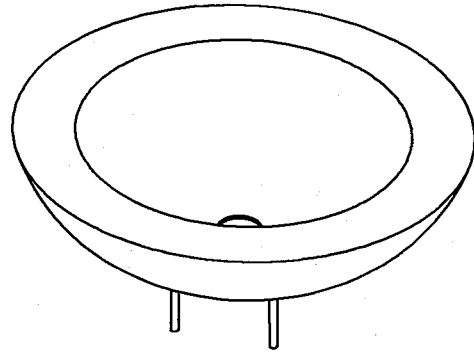
	A	B	C	D	E
With escutcheon	11-1/8" (28.3 cm)	11-5/8" (29.5 cm)	9-3/8" (23.8 cm)	3-1/8" (7.9 cm)	2-5/8" (6.7 cm)
Without escutcheon	11-5/8" (29.5 cm)	11-1/8" (28.3 cm)	8-7/8" (22.5 cm)	2-5/8" (6.7 cm)	3-1/8" (7.9 cm)

## Product Diagram

### Features

- 19-1/4" (48.9 cm) D.
- 18 gauge stainless steel
- Above-the-counter installation
- Satin finish (-S)
- Mirror finish (-M)
- Installation hardware included
- Without overflow
- PVC tube and drain gasket included to cover the overflow hole in the faucet drain assembly
- Internal sound proofing
- Sealant included

### TIMPANI™ LAVATORY K-2277



### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.19.3
- CSA B45

### Colors/Finishes

- NA: None applicable

#### Accessories:

- CP: Polished Chrome
- NA: None applicable
- Other: Refer to Price Book for additional colors/finishes

### Specified Model

Model	Description	Colors/Finishes
K-2277-M	Lavatory with mirror finish	<input type="checkbox"/> NA
K-2277-S	Lavatory with satin finish	<input type="checkbox"/> NA

#### Recommended Accessories

K-9018	P-trap	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-T196	Falling Water faucet trim with 8-1/4" (21 cm) spout OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-T197	Falling Water faucet trim with 9" (22.9 cm) spout OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-T198	Falling Water faucet trim with 10-1/4" (26 cm) spout OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-T199	Falling Water faucet trim with 10" (25.4 cm) spout OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-307-K	Single control ceramic valve*	<input type="checkbox"/> NA	
K-7710	Drain OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-7715	Grid drain OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-7702	Pop-up drain OR	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____

\*Valve must be ordered to complete Falling Water faucet.

### Product Specification

The round lavatory shall be 19-1/4" (48.9 cm) in diameter. Lavatory shall be made of 18 gauge stainless steel. Lavatory shall be above-the-counter installation. Lavatory shall have a satin finish (-S), or mirror finish (-M). Lavatory shall include installation hardware. Lavatory shall have a PVC tube and drain gasket to cover overflow hole in the faucet drain assembly. Lavatory shall have internal sound proofing. Lavatory shall include sealant. Lavatory shall be Kohler model K-2277-\_\_\_\_-NA.

# VESSELS™

## Technical Information

Fixture:*	basin area	water depth
Lavatory	15-3/4" (40 cm) D.	4-1/2" (11.4 cm)
Drain	1 5/8" (4.1 cm) D.	
* Approximate measurements for comparison only.		

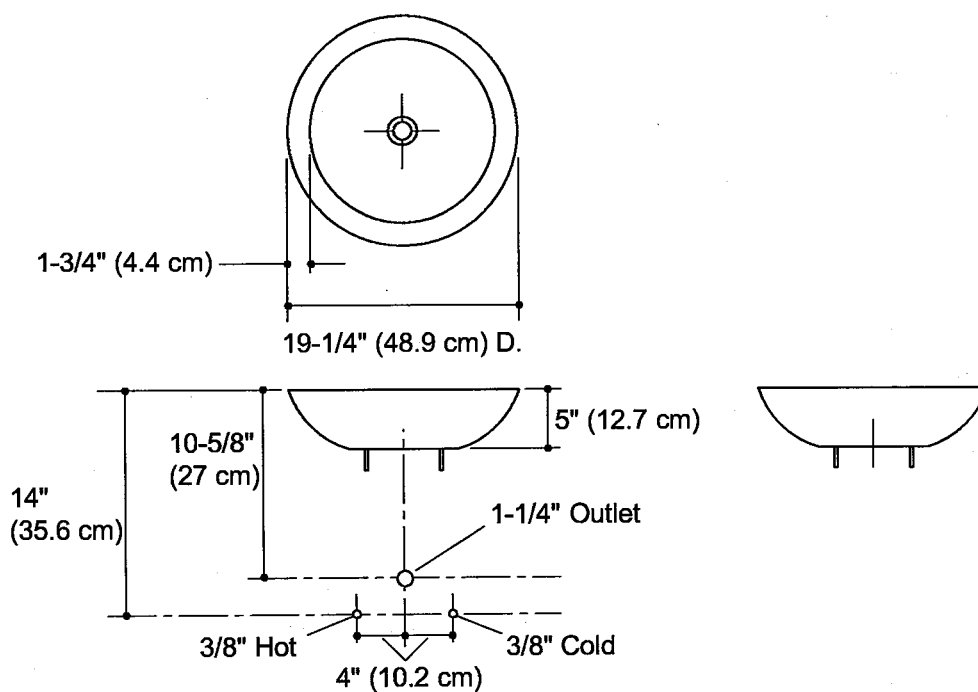
Included components:	
Drain gasket	33507
Tube	1011037-CP
Basin clamp assembly	88007
Cut-out template	1002988-7

## Installation Notes

Install this product according to the installation guide.

**IMPORTANT!** This product rests on the countertop. Consider the height of the product when designing the installation.

**NOTICE:** The countertop manufacturer or cutter **must** use the cut-out template provided with the product, or a current one provided by Kohler Co. (call 1-800-43 FOCUS). Kohler Co. is not responsible for cut-out errors when the incorrect cut-out template is used.



## Product Diagram



## Division 23 - HVAC

23 0000 Heating, Ventilating, and Air-Conditioning  
 23 2000 HVAC Piping and Pumps  
 23 3000 HVAC Air Distribution  
 23 4000 HVAC Air Cleaning Devices  
 23 6000 Central Cooling Equipment  
 23 7000 Central HVAC Equipment

CSI #	Product Type	Product Name/Model #	Manufacturer	Sample Spec Product Data	
23 2000	Air Eliminator	PV Series	Honeywell		X
23 2000	Thermostatic Mixing Valve	AM Series	Honeywell		X
23 3000	Louver	ELM90	Ruskin		X
23 3000	Toilet Exhaust Fan	QTXE080	Broan		X
23 3000	Exhaust Fan for Battery Bank Enclosures	ST48B7	ComAir RotRon		x
23 3000	Supply Registers	272FL	Titus		X
23 3000	Return Grill	55FFL	Titus		X
23 3000	Floor Supply Grills	CT-480	Titus		X
23 3000	Return Air Filter	FC40R	Honeywell		X
23 7000	Radiant Floor Supply/Return Manifolds	TruFlow	Wirsbo		X
23 7000	Heat Pump - Heating/Cooling Systems	50RWS036CCC3--1H	Carrier		
23 7000	Heat Pump Water Heater	R-060	E-Tech		X
23 7000	Air-Cooled Fluid Cooler	FSL101	Witt		X
23 7000	Energy Recovery Ventilator	ERVCCSHA1100	Carrier		X
23 7000	Over Temp-Over Pressurization Device	OTP	Bulter Sun Solutions		X
23 7000	Expansion Tanks	Extrol-15, Extrol RX-15	Amtrol		X
23 7000	Fin Tube Radiators	Design Line	Sterling		X
23 7000	Reheat Coil	F58 108	US Coil & Air		X
23 7000	Refrigerant	Genetron AZ-20 (R-410A)	Honeywell	X	

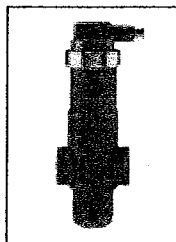
## PV Series SuperVent™ Air Eliminator

**Honeywell**

*This should work -  
need to determine  
how many we  
need  
\*need one for  
each closed  
loop*

*OLARD*  
            
*# CLOSED*  
*LOOPS =*

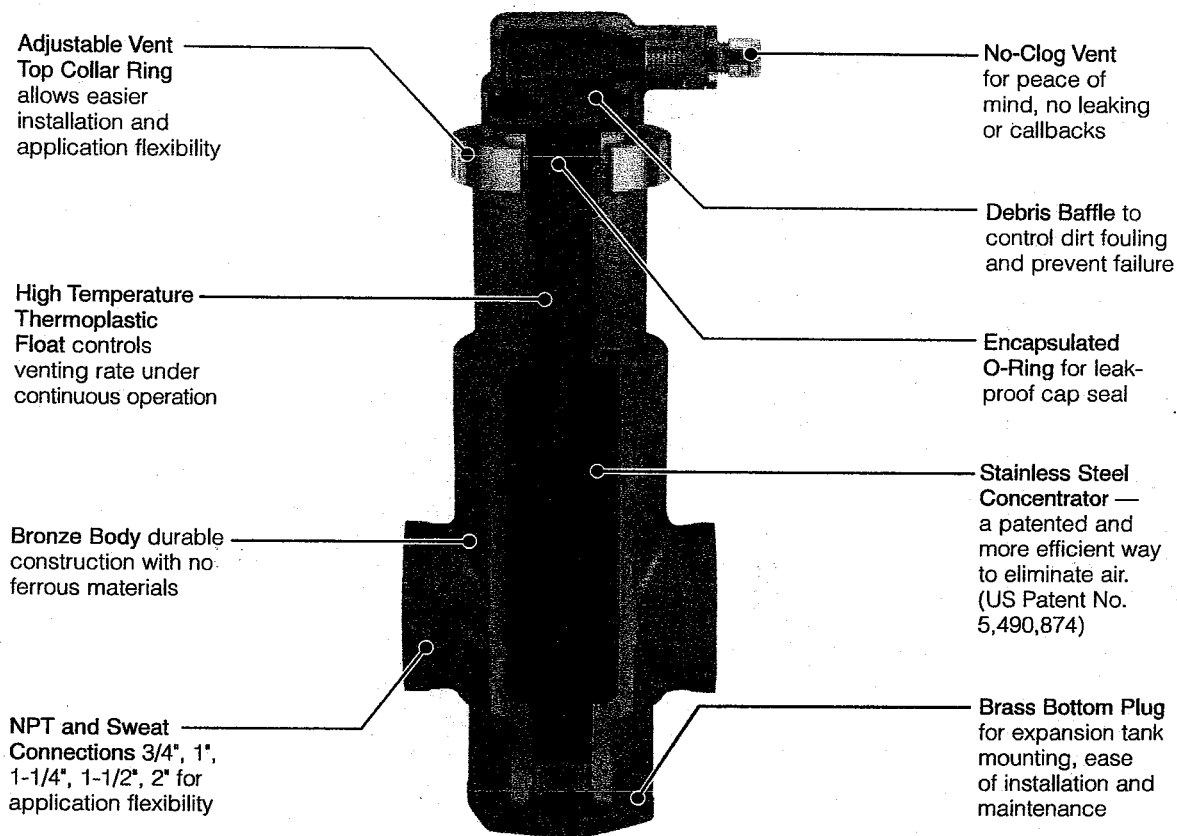
*MT*  
        
*#CLOSED*  
*LOOPS =*



The unique design of the Honeywell PV Series SuperVent™ breaks apart air bubbles, absorbs stagnant air pockets and eliminates troublesome air from hydronic heating systems. This results in the elimination of annoying gurgling and sometimes-costly maintenance. Its rugged design stands up to tough conditions and continuous service, providing you with leak-proof operation, reduced service intervals and the elimination of callbacks.

# PV Series SuperVent™ Air Eliminator

EFFECTIVELY ELIMINATES AIR AND NOISE FROM HYDRONIC HEATING SYSTEMS



## Automation and Control Solutions

In the US:

Honeywell

1985 Douglas Drive North

Golden Valley, MN 55422

In Canada:

Honeywell Limited

35 Dynamic Drive

Toronto, Ontario M1V 4Z9

Phone: (800) 328-5111

Email: [info@honeywell.com](mailto:info@honeywell.com)

[customer.honeywell.com](http://customer.honeywell.com)

MODEL #	SIZE	CV	CONNECTION TYPE
PV075	3/4"	13 Cv	NPT
PV075S	3/4"	13 Cv	Sweat
PV100	1"	22 Cv	NPT
PV100S	1"	22 Cv	Sweat
PV125	1-1/4"	38 Cv	NPT
PV125S	1-1/4"	38 Cv	Sweat
PV150	1-1/2"	53 Cv	NPT
PV200	2"	95 Cv	NPT
PVU	Universal models available for vertical risers.		

What is NPT?  
↳ threaded?

**Honeywell**

50-9142

July 2005

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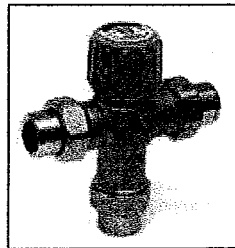
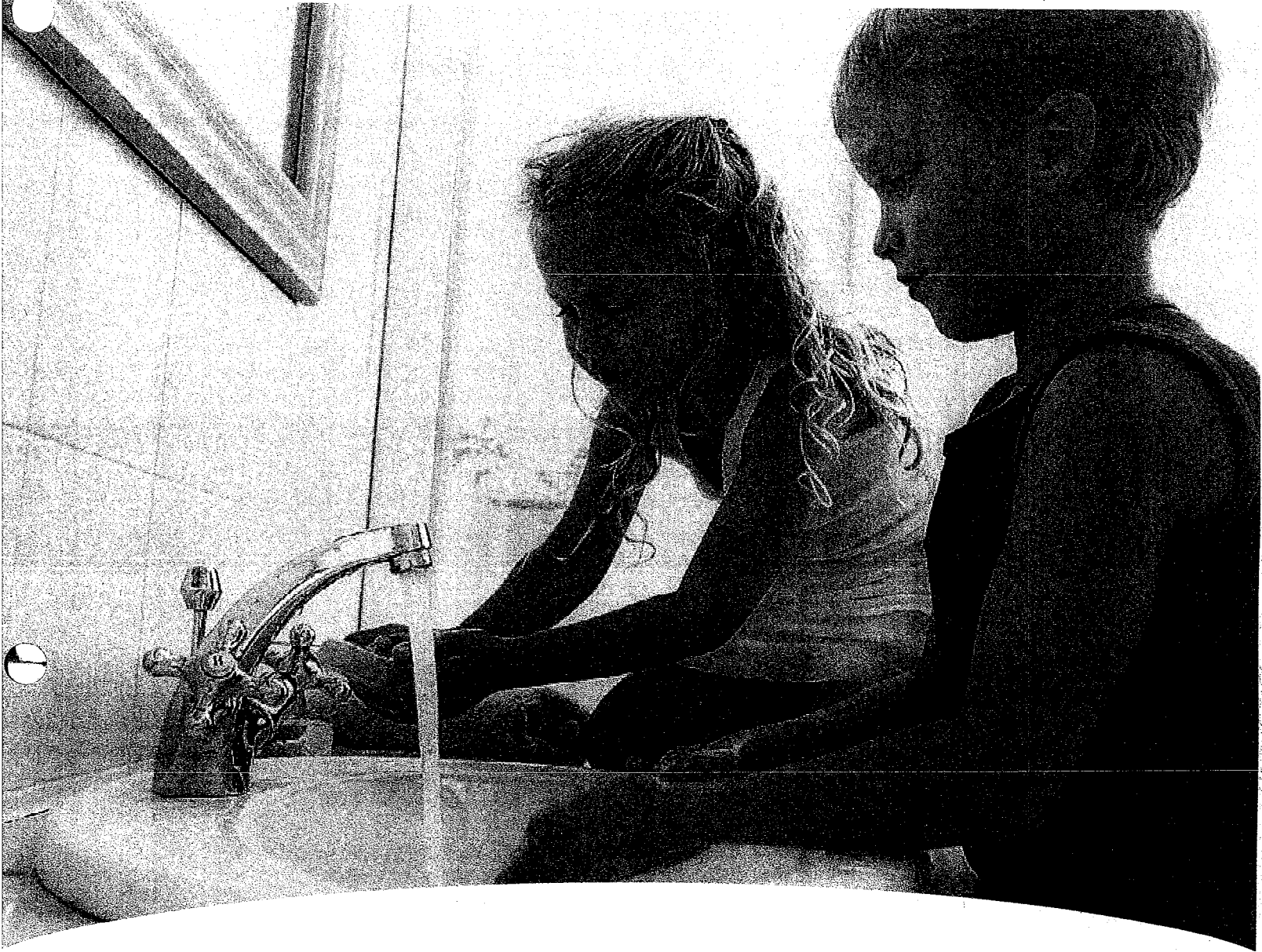
MORNINGSTAR

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## AM-1 Series Thermostatic Mixing Valves

# Honeywell



Add a Honeywell Mixing Valve for added safety and more available hot water. When you're having a water heater installed, be sure to add a Honeywell mixing valve. A Honeywell mixing valve is designed to prevent scalding and the growth of bacteria, so you'll be improving your family's safety. As an added bonus, the mixing action of hot and cold water increases the amount of usable hot water available in your home. You can get up to 60-gallon performance

from a 40-gallon tank, so even the last person in the shower can enjoy hot water.

*This should work for our system*

*• 1 for MT*

*• At least one for Solar D*

*Ref Question*

*Are these  
adjusted manually?*

*(The Control Valves will be used @ other points in the system)*

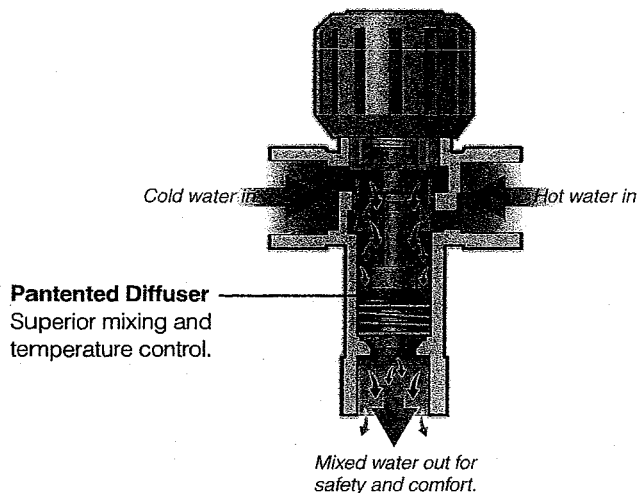
MORNINGSTAR

112 of 353

# AM-1 Series Thermostatic Mixing Valves

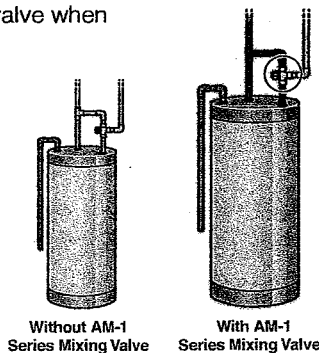
IMPROVING HOT WATER SAFETY AS WELL AS PERFORMANCE.

A Honeywell mixing valve allows you to set your water heater to a higher temperature to reduce the threat of bacteria growth, yet the mixing action helps prevent scalding. Plus, you'll increase your available hot water supply, because you're mixing hot water with cold.



## MORE HOT WATER

Adding a Honeywell mixing valve when you have a new water heater installed helps ensure more available hot water. The mixing action gives you up to 60-gallon performance from a 40-gallon tank, perfect for meeting the water demands of busy families.



### To learn more:

#### Automation and Control Solutions

In the US:

Honeywell

1985 Douglas Drive North

Golden Valley, MN 55422

In Canada:

Honeywell Limited

35 Dynamic Drive

Toronto, Ontario M1V 4Z9

Phone: (800) 328-5110

Email: [info@honeywell.com](mailto:info@honeywell.com)

[www.honeywell.com](http://www.honeywell.com)

*Does the mixing valve need to be installed @ this location?*

## PROTECTION FOR YOUR FAMILY

### Helps Prevent Bacteria

Deadly Legionella bacteria can grow in water heaters where the temperature is set too low. The Honeywell mixing valve is designed to prevent the growth of bacteria by allowing you to set your water heater at 140° F, the temperature where the Legionella bacteria can not survive.



### Helps Increase Safety

At the same time, the mixing action reduces the temperature at the faucet to help prevent scalding, so your family can enjoy hot water worry-free. Use your sink, shower or tub without fear of scalding, because Honeywell mixing valves meet the most stringent industry safety and reliability standards (ASSE 1016 and ASSE 1017).

### Approximate Times And Temperatures Causing A Third-Degree Burn

TEMPERATURE	ADULTS skin thickness of 2.5 mm	CHILDREN 0-5 YEARS skin thickness of 0.56 mm
160°F	1 second	0.5 seconds
155°F	1.5 seconds	1 second
150°F	2 seconds	1.5 seconds
145°F	3 seconds	2 seconds
140°F	5 seconds	3 seconds
135°F	15 seconds	4 seconds
130°F	35 seconds	10 seconds
125°F	3 minutes	2 minutes
120°F	10 minutes	5 minutes
100°F	Safest Water Temperature for Bathing	

For better performance and increased safety, ask your water heater contractor to add a Honeywell mixing valve.

# Honeywell

50-9141  
August 2005  
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MORNINGSTAR



# Thermostatic Mixing Valves

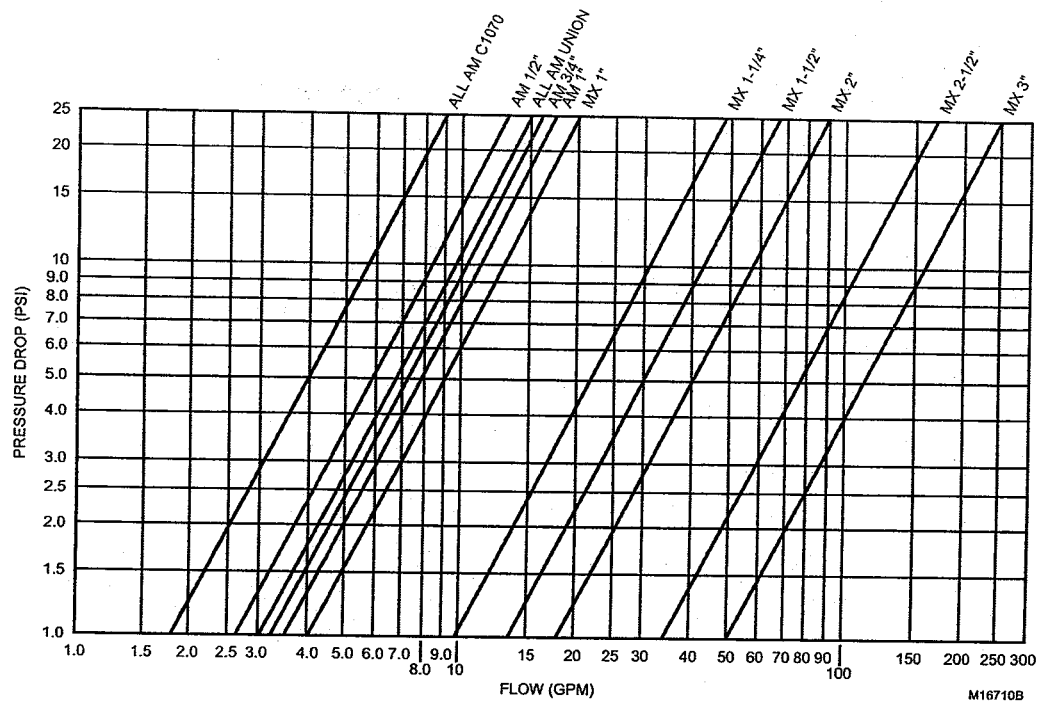
Added to  
Procurement list  
5/29/07

for Honeywell

Product Number	Pipe Size		Connection Type	Capacity (Cv)	Operating Temperature Range		ASSE	Comments
	(inch)	DN			(F)	(C)		
AM101-UCPVC-1	3/4 in.	DN20	Union CPVC	3.8	100 F to 145 F	38 C to 63 C	1017	
AM101-UPEX-1	3/4 in.	DN20	Union PEX	3.9	100 F to 145 F	38 C to 63 C	1017	
AM101-US-1	3/4 in.	DN20	Union Sweat	3.9	100 F to 145 F	38 C to 63 C	1017	
AM101-UT-1	3/4 in.	DN20	Union NPT	3.9	100 F to 145 F	38 C to 63 C	1017	
AM101B-1	3/4 in.	DN20	NPT	3.8	60 F to 100 F	16 C to 38 C	No Approval	
AM101B-UCPVC-1	3/4 in.	DN20	Union CPVC	3.8	60 F to 100 F	16 C to 38 C	No Approval	
AM101B-US-1	3/4 in.	DN20	Union Sweat	3.9	60 F to 100 F	16 C to 38 C	No Approval	
AM101B-UT-1	3/4 in.	DN20	Union NPT	3.9	60 F to 100 F	16 C to 38 C	No Approval	
AM101C-1	3/4 in.	DN20	NPT	3.8	80 F to 120 F	27 C to 49 C	1017	
AM101C-UCPVC-1	3/4 in.	DN20	Union CPVC	2.4	80 F to 120 F	27 C to 49 C	1017	
AM101C-UPEX-1	3/4 in.	DN20	Union PEX	3.9	80 F to 120 F	27 C to 49 C	1017	
AM101C-US-1	3/4 in.	DN20	Union Sweat	3.9	80 F to 120 F	27 C to 49 C	1017	
AM101C-UT-1	3/4 in.	DN20	Union NPT	3.9	80 F to 120 F	27 C to 49 C	1017	
AM101C1070-UC-1	3/4 in.	DN20	Union Compression	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM101C1070-UCPVC-1	3/4 in.	DN20	CPVC Union Coupling	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM101C1070-UPEX-1	3/4 in.	DN20	Union PEX	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM101C1070-US-1	3/4 in.	DN20	Union Sweat	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM101C1070-UT-1	3/4 in.	DN20	Union NPT	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM101R-UPEX-1	3/4 in.	DN20	Union PEX	3.9	80 F to 180 F	27 C to 82 C	No Approval	Heating Only
AM101R-US-1	3/4 in.	DN20	Union Sweat	3.9	80 F to 180 F	27 C to 82 C	No Approval	Heating Only
AM101R-UT-1	3/4 in.	DN20	Union NPT	3.9	80 F to 180 F	27 C to 82 C	No Approval	Heating Only
AM102-1	1 in.	DN25	NPT	4.3	100 F to 145 F	38 C to 63 C	1017	
AM102-US-1	1 in.	DN25	Union Sweat	3.9	100 F to 145 F	38 C to 63 C	1017	
AM102-UT-1	1 in.	DN25	Union NPT	3.9	100 F to 145 F	38 C to 63 C	1017	
AM102B-1	1 in.	DN25	NPT	4.3	60 F to 100 F	16 C to 38 C	No Approval	
AM102B-US-1	1 in.	DN25	Union Sweat	3.9	60 F to 100 F	16 C to 38 C	No Approval	
AM102B-UT-1	1 in.	DN25	Union NPT	4.3	60 F to 100 F	16 C to 38 C	No Approval	
AM102C-1	1 in.	DN25	NPT	3.9	80 F to 120 F	27 C to 49 C	1017	
AM102C-US-1	1 in.	DN25	Union Sweat	3.9	80 F to 120 F	27 C to 49 C	1017	
AM102C-UT-1	1 in.	DN25	Union NPT	3.9	80 F to 120 F	27 C to 49 C	1017	
AM102C1070-US-1	1 in.	DN25	Union Sweat	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM102C1070-UT-1	1 in.	DN25	Union NPT	1.8	70 F to 120 F	21 C to 49 C	1070 1017	
AM102R-US-1	1 in.	DN25	Union Sweat	3.9	80 F to 180 F	27 C to 82 C	No Approval	Heating Only
AM102R-UT-1	1 in.	DN25	Union NPT	3.9	80 F to 180 F	27 C to 82 C	No Approval	Heating Only

# Thermostatic Mixing Valves

Pressure Drop Chart



## Replacement Parts AM Series (Old Style)

Application: "Old Style" series AM valves  
Includes: Element, sprint, and plug assembly

Product Number	Operating Temperature Range		Description
	(F)	(C)	
AM100-001RP	90 F to 120 F	32 C to 49 C	C element, spring, plug assembly (Does not fit AM-1 Series)
AM100-002RP	110 F to 145 F	43 C to 63 C	Standard element, spring, plug assembly (Does not fit AM-1 Series)
AM100-003RP	130 F to 170 F	54 C to 77 C	H element, spring, plug assembly (Does not fit AM-1 Series)
AM100-000RP	60 F to 100 F 70 F to 100 F	16 C to 38 C 21 C to 38 C	B element, spring, plug assembly (Does not fit AM-1 Series)
AM100-010RP	70 F to 100 F	21 C to 38 C	R element, spring, plug assembly (Does not fit AM-1 Series)

## AM-1 Series Replacement Parts

Product Number	Operating Temperature Range		Description	Application
	(F)	(C)		
AM-1-025RP	100 F to 145 F 80 to 180 F	38 F to 63 C 27 C to 49 C	Replacement Part AM-1 Series	AM Series Standard and R range mixing valves
AM-1-020RP	80 F to 120 F (B range) 60 F to 100 F (C range)	27 C to 49 C (B range) 16 C to 38 C (C range)	Replacement Part AM-1 Series	AM Series B and C range mixing valves
AMU200-RP	—	—	Gasket Kit for AM-1	AM Series Union models
AM-1-030RP	70 F to 120 F	21 C to 49 C	Replacement Part AM-1 1070 Series	AM-1 1070 models

*Check previous sales of China Contract Ed*

# RUSKIN®

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Kansas City, MO 64030

(816) 761-7476

FAX (816) 765-8955

## ELM90 and ELM811 ADJUSTABLE LOUVER EXTRUDED ALUMINUM

### STANDARD CONSTRUCTION

#### FRAME

ELM811 - 4" (102) deep, 6063T5 extruded aluminum with .081" (2.1) nominal wall thickness. Caulking surfaces provided.

ELM90 - 6" (152) deep, 6063T5 extruded aluminum with .125" (3.2) nominal wall thickness. Caulking surfaces provided.

#### BLADES

6063T5 extruded aluminum with .081" (2.1) nominal wall thickness. J-style blades are adjustable to 45° angle on ELM811 and 70° angle on ELM90. Blade spacing is approximately 4 3/4" (121) center to center.

#### SCREEN

3/4" x .051" (19 x 1.3) expanded, flattened aluminum bird screen in removable frame. Screen adds approximately 1/2" (13) to louver depth.

#### BEARINGS

Stainless steel sleeve pressed into frame.

#### AXLES

1/2" (13) plated steel hex.

#### FINISH

Mill.

#### LINKAGE

Concealed in frame.

#### ACTUATOR

Locking louver quadrant.

#### MINIMUM SIZE

12" w x 12" h (305 x 305).

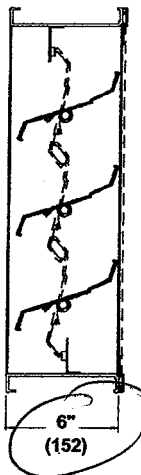
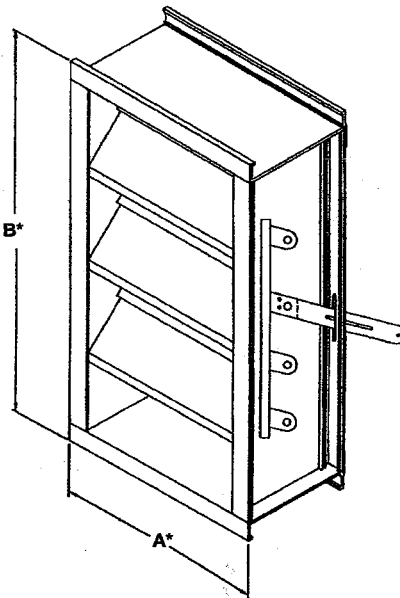
#### APPROXIMATE SHIPPING WEIGHT

ELM811 - 4 lbs. per sq. ft.

ELM90 - 4.5 lbs. per sq. ft.

#### MAXIMUM FACTORY ASSEMBLY SIZE

Shall be 60" x 96" (1524 x 2438). Louvers with optional blade and jamb seals shall be 48" x 96" (1219 x 2438). Louvers larger than the maximum factory assembly size will require field assembly of smaller sections.



### FEATURES

The ELM811 and ELM90 offer:

- Low torque operation and architecturally pleasing appearance with low leakage performance.
- Hexagonal shaped axles assure positive blade alignment and low operating torque.
- Concealed blade linkage is protected from weather exposure and reduces required installation depth.
- Blade and jamb seal options provide tight blade-to-blade and blade-to-frame closure, allowing less than 4 cfm per sq. ft. at 1/2" pressure differential.

### VARIATIONS

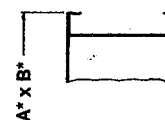
Variations to the basic design of this louver are available at additional cost. They include:

- Extended sill
- Front or rear security bars
- A variety of bird and insect screens
- Filter racks
- Selection of finishes: prime coat, baked enamel (modified fluoropolymer), epoxy, Pearledize 50 & 70, Kynar, clear and color anodize. (Some variation in anodize color consistency is possible.)
- Blade edge and jamb seals.
- Manual, electric or pneumatic actuators.

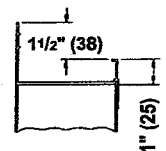
Available with .125" (3.2) construction throughout, refer to as ELM811H and ELM90H.

Consult Ruskin for other special requirements.

### FRAME CONSTRUCTION



STANDARD



INTEGRAL  
FLANGE

Dimensions in inches, parenthesis ( ) indicate millimeters.

Units furnished 1/4" (6) smaller than given opening dimensions.

TAG	QTY.	SIZE		FRAME	VARIATIONS
		A*-WIDE	B*-HIGH		
PROJECT ARCH./ENGR. REPRESENTATIVE			LOCATION CONTRACTOR DATE		

24"x12"  
will work  
Architecturally

## FREE AREA GUIDE

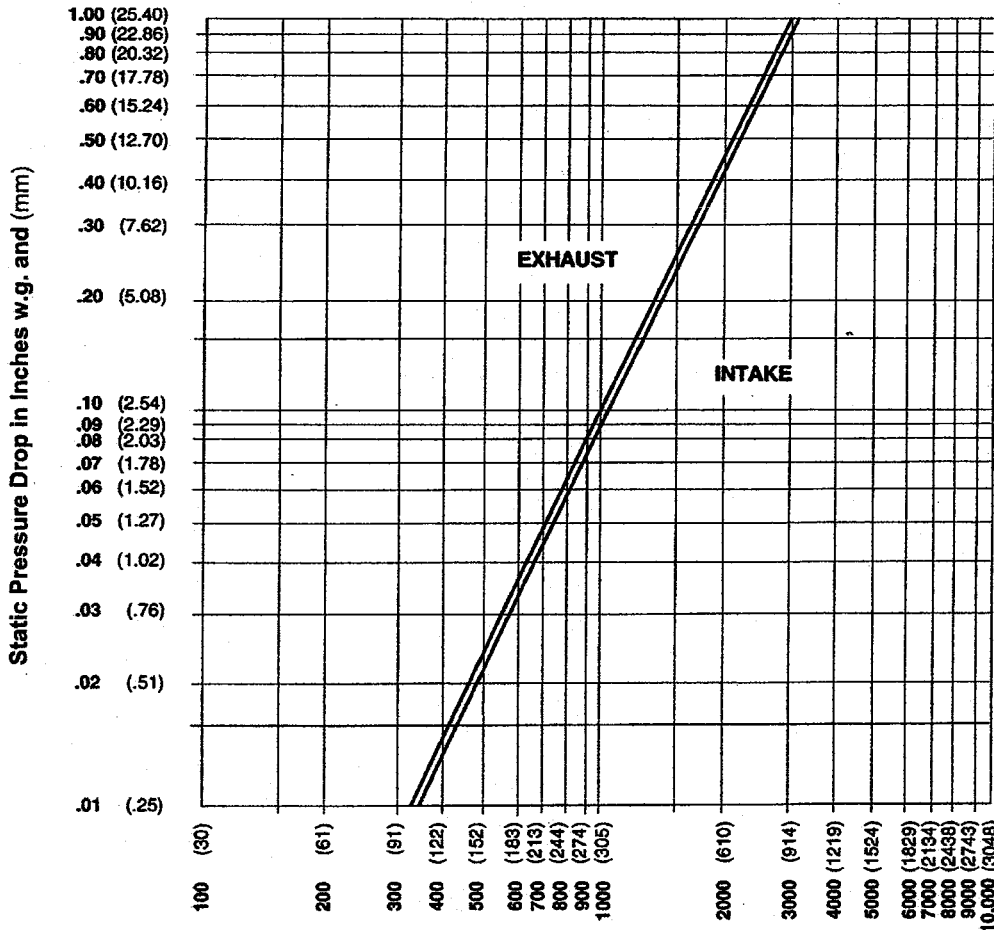
Free Area Guide shows free area in ft<sup>2</sup> and m<sup>2</sup> for various sizes of ELM90.

Width - Inches and Meters

Height - Inches and Meters

	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
12	.30	.46	.62	.76	.91	1.07	1.22	1.37	1.52	1.68	1.83	1.96	2.13	2.29	2.44
30	.32	.52	.72	.91	1.11	1.31	1.51	1.70	1.90	2.10	2.30	2.49	2.69	2.89	3.08
18	.59	.95	1.32	1.68	2.04	2.40	2.77	3.14	3.49	3.85	4.21	4.58	4.94	5.30	5.66
46	.06	.09	.12	.16	.19	.22	.26	.29	.32	.36	.39	.43	.46	.49	.53
24	.81	1.30	1.79	2.28	2.77	3.26	3.76	4.25	4.74	5.23	5.72	6.22	6.71	7.20	7.69
61	.07	.12	.17	.21	.26	.30	.35	.39	.44	.49	.53	.58	.62	.67	.71
30	1.11	1.78	2.46	3.13	3.81	4.48	5.16	5.83	6.51	7.18	7.86	8.53	9.21	9.88	10.56
76	.10	.17	.23	.29	.35	.42	.48	.54	.60	.67	.73	.79	.86	.92	.98
36	1.36	2.18	3.01	3.84	4.67	5.50	6.33	7.15	7.98	8.81	9.64	10.47	11.30	12.12	12.95
91	.13	.20	.28	.36	.43	.51	.59	.66	.74	.82	.90	.97	1.05	1.13	1.20
42	1.71	2.76	3.81	4.85	5.90	6.95	8.00	9.04	10.09	11.14	12.18	13.23	14.28	15.33	16.37
107	.16	.26	.35	.45	.55	.65	.74	.84	.94	1.03	1.13	1.23	1.33	1.42	1.52
48	1.98	3.20	4.41	5.62	6.83	8.04	9.25	10.47	11.68	12.89	14.10	15.31	16.53	17.74	18.95
122	.18	.30	.41	.52	.63	.75	.86	.97	1.08	1.20	1.31	1.42	1.54	1.65	1.76
54	2.20	3.54	4.88	6.22	7.56	8.90	10.25	11.59	12.93	14.27	15.61	16.95	18.30	19.64	20.98
137	.20	.33	.45	.58	.70	.83	.95	1.08	1.20	1.33	1.45	1.58	1.70	1.82	1.95
60	2.50	4.02	5.55	7.07	8.60	10.12	11.65	13.17	14.70	16.22	17.75	19.27	20.80	22.32	23.85
152	.23	.37	.52	.66	.80	.94	1.08	1.22	1.37	1.51	1.65	1.79	1.93	2.07	2.22
66	2.75	4.42	6.10	7.78	9.46	11.14	12.81	14.49	16.17	17.85	19.53	21.21	22.88	24.56	26.24
168	.26	.41	.57	.72	.88	1.03	1.19	1.35	1.50	1.66	1.81	1.97	2.13	2.28	2.44
72	3.10	5.00	6.90	8.79	10.69	12.59	14.49	16.38	18.28	20.18	22.07	23.97	25.87	27.76	29.66
183	.29	.46	.64	.82	.99	1.17	1.35	1.52	1.70	1.87	2.05	2.23	2.40	2.58	2.76
78	3.37	5.44	7.50	9.56	11.62	13.68	15.74	17.81	19.87	21.93	23.99	26.05	28.11	30.17	32.24
196	.31	.50	.70	.89	1.08	1.27	1.46	1.65	1.85	2.04	2.23	2.42	2.61	2.80	2.99
84	3.59	5.78	7.97	10.16	12.35	14.54	16.74	18.93	21.12	23.31	25.50	27.69	29.88	32.08	34.27
213	.33	.54	.74	.94	1.15	1.35	1.55	1.76	1.96	2.17	2.37	2.57	2.78	2.98	3.18
90	3.89	6.26	8.64	11.01	13.39	15.76	18.13	20.51	22.88	25.26	27.63	30.01	32.38	34.76	37.13
229	.36	.58	.80	1.02	1.24	1.46	1.68	1.91	2.13	2.35	2.57	2.79	3.01	3.23	3.45
96	4.14	6.67	9.19	11.72	14.25	16.78	19.30	21.83	24.36	26.89	29.42	31.94	34.47	37.00	39.53
244	.38	.62	.85	1.09	1.32	1.56	1.79	2.03	2.26	2.50	2.73	2.97	3.20	3.44	3.67

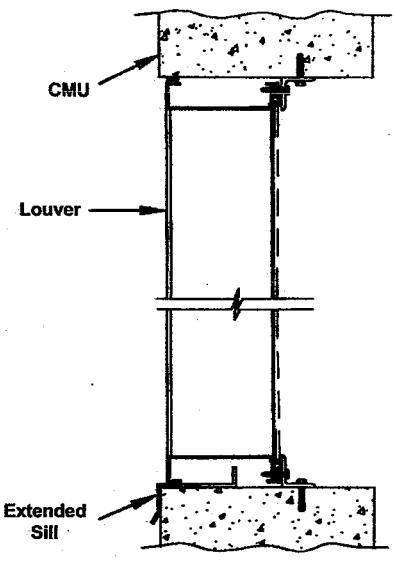
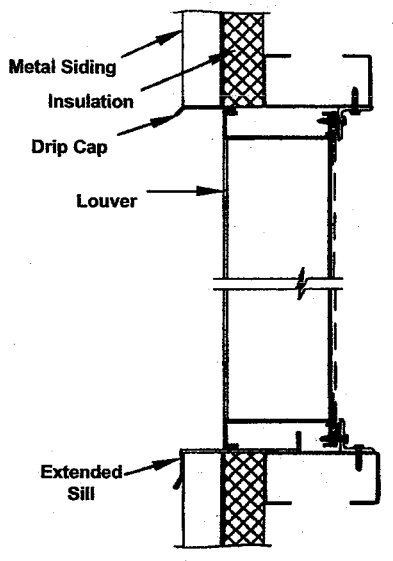
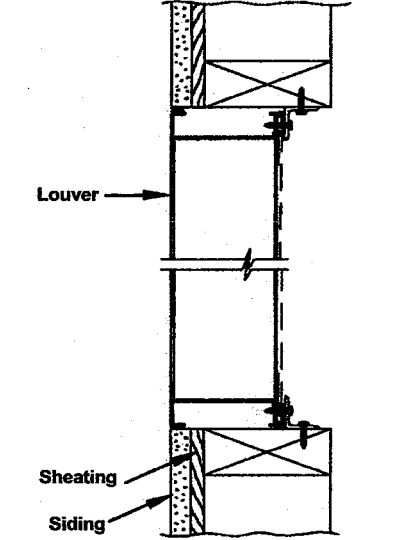
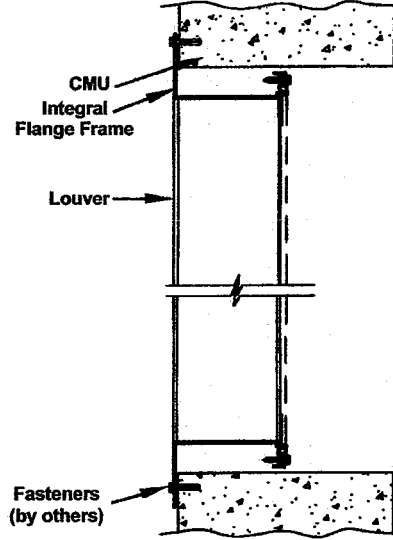
## PRESSURE DROP



Ratings do not include the effect of a bird screen.

Air Velocity in feet and (meters) per minute through Free Area

## TYPICAL INSTALLATION DETAILS

Masonry Wall	Metal Panel Wall
	
Wood Installation	Flange Mount
	

## SUGGESTED SPECIFICATION

Accessories at additional cost.

Furnish and install louvers as hereinafter specified where shown on plans or as described in schedules. Louvers shall be adjustable type entirely contained within a 4" (102) or 6" (152) frame. Louver components (heads, jambs, sills, blades & mullions) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 5 ft. (1530) and shall incorporate structural supports required to withstand a wind load of 20 lbs. per sq. ft. (.96kPa, equivalent of a 90 mph wind [145 KPH] - specifier may substitute any loading required).

Louvers shall be Ruskin Model ELM90 or ELM811 6063T5 extruded aluminum alloy construction as follows:

- Frame: .081" (2.1) extruded aluminum (ELM811).  
.125" (3.2) extruded aluminum (ELM90).
- Blades: .081" (2.1) wall thickness on approximately 43/4" (121) centers.
- Screen: 3/4" x .051" (19 x 1.3) expanded, flattened aluminum bird screen in removable frame.
- Finish: Select finish specification from Ruskin Finishes Brochure.

# RUSKIN®

3900 Dr. Greaves Rd.  
Kansas City, MO 64030  
(816) 761-7476  
FAX (816) 765-8955

MORNINGSTAR



# PERFORMANCE RATINGS

## QTXE SERIES FAN / LIGHT / NIGHT LIGHTS

### HVI PERFORMANCE

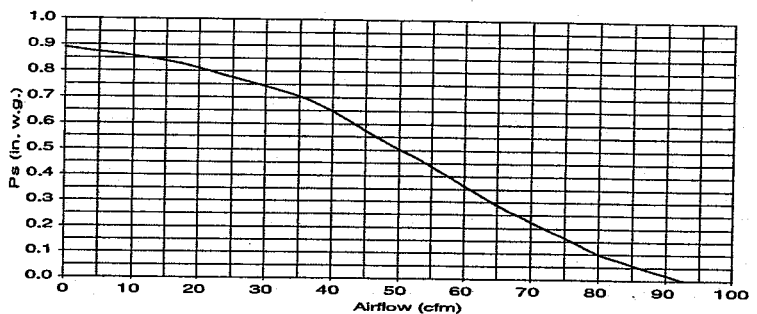
Model	Sones @0.1" Ps	CFM @0.1" Ps
QTXE080FLT	0.3	80
QTXE110FLT	0.9	110
QTXE150FLT	1.4	150



HVI-2100 CERTIFIED RATINGS comply with new testing technologies and procedures prescribed by the Home Ventilating Institute, for off-the-shelf products, as they are available to consumers. Product performance is rated at 0.1 in. static pressure, based on tests conducted in AMCA's state-of-the-art test laboratory. Sones are a measure of humanly-perceived loudness, based on laboratory measurements.

### AIR FLOW PERFORMANCE

MODEL QTXE080FLT



### AMPS

Model	Amps*
QTXE080FLT	1.0
QTXE110FLT	1.1
QTXE150FLT	1.0

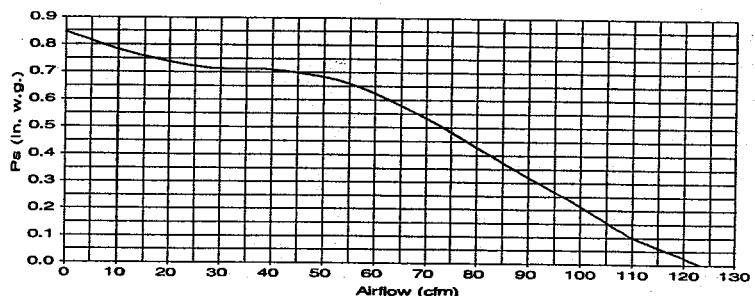
\* Total connected load

### WEIGHT

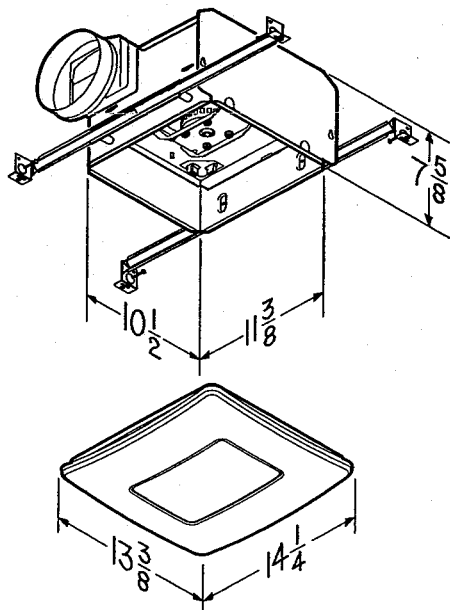
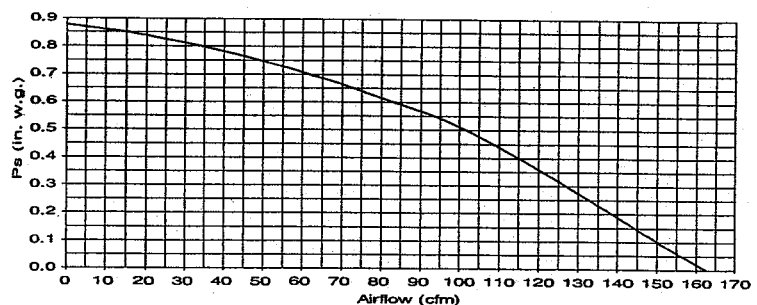
Model	Shipping Weight
QTXE080FLT	16.2 lbs.
QTXE110FLT	15.8 lbs.
QTXE150FLT	16.2 lbs.



MODEL QTXE110FLT



MODEL QTXE150FLT



# BROAN

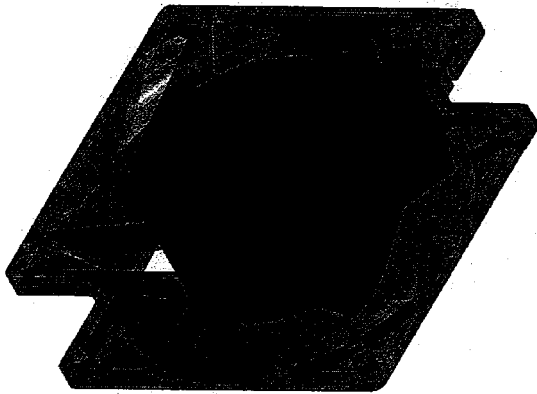
Broan-NuTone LLC, 926 West State Street, Hartford, Wisconsin 53027 (1-800-637-1453)



Scheduled

delivery date  
7/30/07

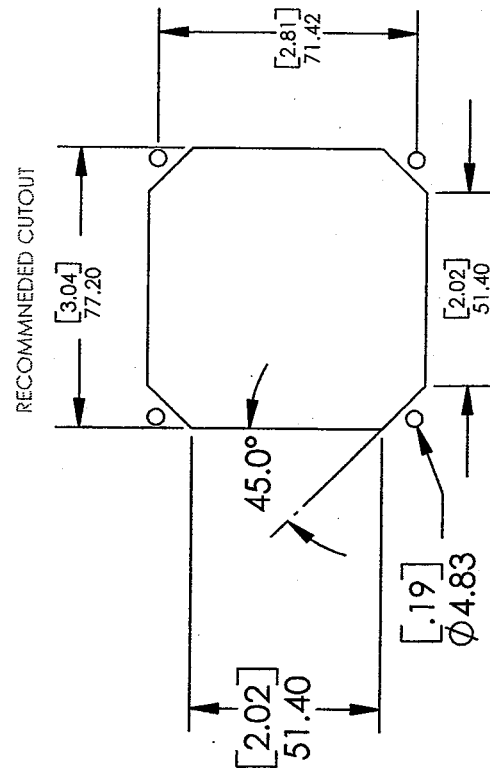
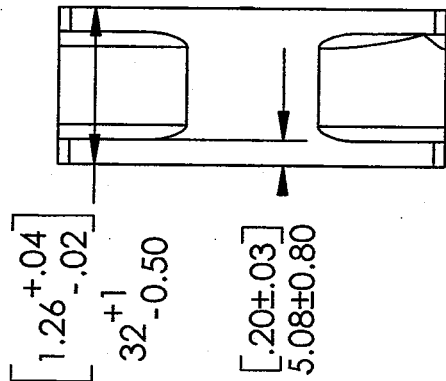
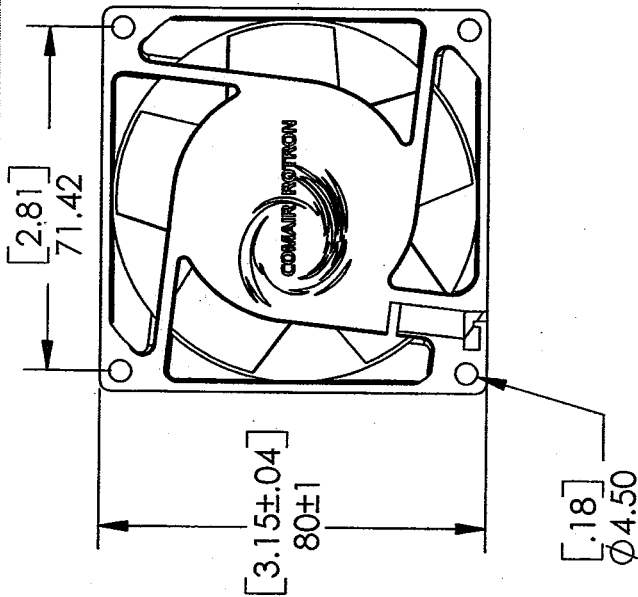
EF-2a/EF-2b



Battery  
Bank  
Enclosure Fan



CONTACT INFO: WWW.COMAIRROTRON.COM   SALES@COMAIRROTRON.COM		AMERICAN PROJECTION 1 PL. DEC. 1/32 (1/32) ANGULAR ± 30°	
TOLERANCE UNLESS OTHERWISE SPECIFIED		3D MODEL FOUND AT..	
[2.81] 71.42		[619] 661 - 6688	
[3.15±.04] 80±1		SPRINT	





**Sprint - ST48B7 - 031862 - Yes**  
 (Family) (Model) (Part #) (In Stock)

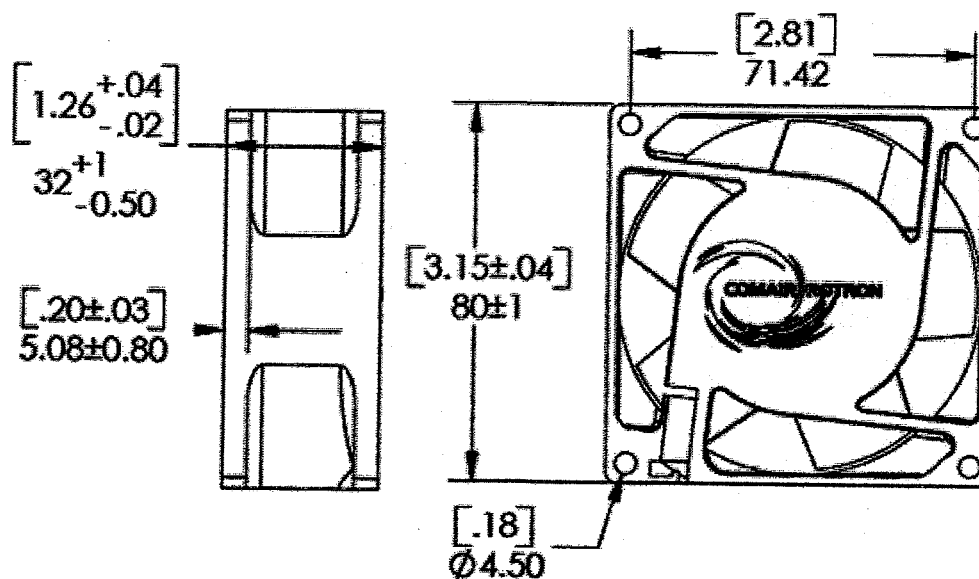
## Electrical Specifications

Operating Voltage:	48 Volts
Voltage Range:	24 - 56 Volts
Power Supply:	3.6 Watts
Line Current:	0.07 Amps
Locked Rotor Current	0.25 Amps
Nominal Speed:	3300 RPM

## Mechanical Specifications

Dimensions:	3.1 x 3.1 x 1.3 in
Weight	6.4 oz
Max Airflow @ 0 in H <sub>2</sub> O	34.0 CFM
Max Pressure @ 0 CFM	0.225 in H <sub>2</sub> O
Noise	40.9 dBA

## Mechanical Drawing



Comair Rotron, Inc.  
 Phone: 858.348.6200  
 FAX: 858.566.4577  
 sales@comairrotron.com

ThermaFlo, Inc.  
 Phone: 972.312.8609  
 FAX: 972.312.8617  
 info@thermaflo.com

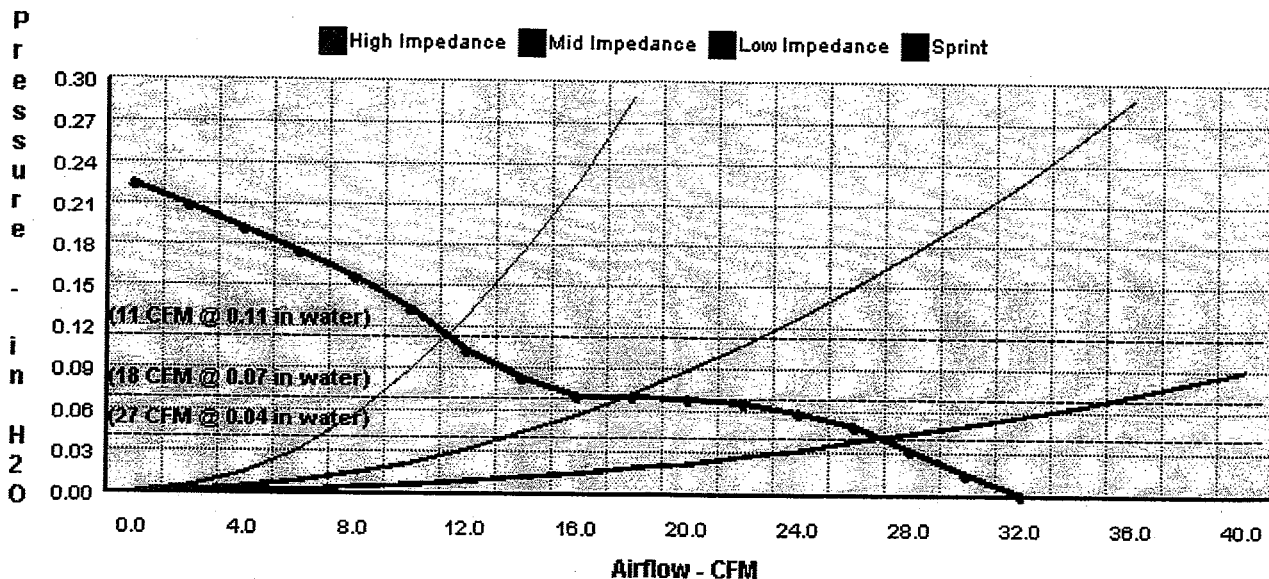
Comair Rotron Europe, Ltd.  
 Phone: +44.1527.520525  
 FAX: +44.1527.520565  
 saleseurope@comairrotron.com

Comair Rotron Fan Company Ltd.  
 Phone: +86.21.52260581  
 FAX: +86.21.52260597  
 salesasia@comairrotron.com

Print Date: Thursday, July 26, 2007 at 08:30:32 - DC Fan Datasheet - Web Version 1.0 Rev. B



## Fan Performance Curve



## Fan Configuration Options

**Sprint**      **ST48B7**      /      **031862**      **Yes**      305 mm [12 inch] Leads  
 (Family)      (Model)      (Part #)      (In Stock)      (Features)

Fan Speed: 3300 RPM      Fan Bearings: Ball Bearings  
 Fan Airflow Direction: Flow R (CCW Rotation)      Fan Termination: Leads

Fan Monitoring Options: TTL (+5V) Tachometer Output

Fan Speed Control Option: No ThermaPro-V Fan Speed Control Options Selected

Environmental Protection Options: No Enviroshield Options Selected

Comair Rotron, Inc. Phone: 858.348.6200 FAX: 858.566.4577 sales@comairrotron.com	ThermaFlo, Inc. Phone: 972.312.8609 FAX: 972.312.8617 info@thermaflo.com	Comair Rotron Europe, Ltd. Phone: +44.1527.520525 FAX: +44.1527.520565 saleseurope@comairrotron.com	Comair Rotron Fan Company Ltd. Phone: +86.21.52260581 FAX: +86.21.52260597 salesasia@comairrotron.com
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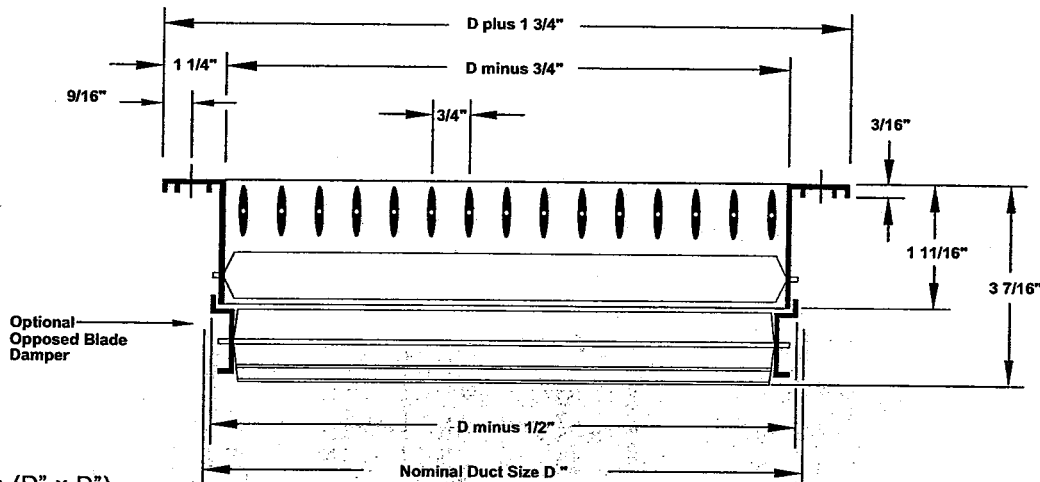
Print Date: Thursday, July 26, 2007 at 08:30:32 - DC Fan Datasheet - Web Version 1.0 Rev. B

## TITUS® Submittal

ABG-272F 12-1-98

Louvered Supply Grilles and Registers • Aero-Blade Series  
Aluminum Border • Aluminum Airfoil Blades

Models: ☐ 272FL • Double Deflection • Long Front Blades •  $\frac{3}{4}$ " Blade Spacing  
☐ 272FS • Double Deflection • Short Front Blades •  $\frac{3}{4}$ " Blade Spacing

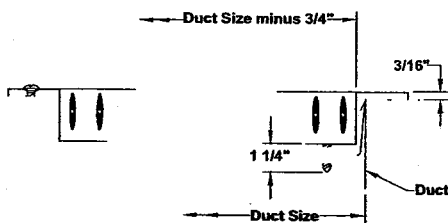
SR-1, SR-2,  
SR-3, SR-4☐ Border Type 1 • Surface Mount

## Available Sizes (D" x D")

Border Type 1 is available in sizes 6" x 4" through 48" x 48" in one piece construction. Sizes larger than 48" x 48" are shipped in multiple sections with joining strips for field assembly. Odd and fractional sizes are available at additional cost.

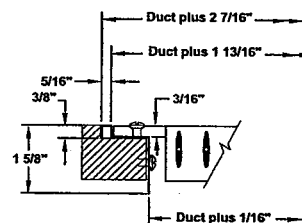
Note: Dimensions are in inches. Wall or duct opening should be duct size  $\pm \frac{1}{8}$ ".

## Fastenings

☐ Type A • External Screw☐ Type C • Concealed Screw

Available with Border Type 1 only.

## Mounting Frames

☐ PFAP • Aluminum Plaster Frame

## Recessed Mounted Example

Note: Wall opening should be listed duct size +  $\frac{1}{8}$ " to listed duct size +  $\frac{1}{4}$ ".  
 Model PFAP Plaster Frame can be installed as either surface mount or recessed.

Accessories (Optional) Check ☒ if provided☐ Opposed blade damper (galvanized steel)☐ EQT • Earthquake Tabs☐ IS • Insect Screen ( $\frac{1}{16}$ " square mesh – galvanized steel)☐ DS • Debris Screen ( $\frac{1}{4}$ " square mesh – galvanized steel)☐ Other: \_\_\_\_\_

## Standard Finish: #26 White

☐ Other Finish: \_\_\_\_\_

## General Description

• Aerodynamically shaped blades are individually adjustable.

• Optional opposed blade damper has screw-driver adjustment accessible through face of register.

• Material is heavy extruded aluminum for blades and border.

• #8 x  $1\frac{1}{4}$ " lg. Phillip's flat head sheet metal screws painted white.

• All dimensions are  $\pm \frac{1}{16}$ ".

TITUS®

Note: This submittal is meant to demonstrate general dimensions of this product. The drawings on this submittal are not meant to detail every aspect of the product with exactness. Drawings are not to scale. TITUS reserves the right to make changes without written notice.

ABC 100  
MORNINGSTAR







## AeroBlade Options and Accessories

See below

### Supply Options

Model #	Type Grille	Type Deflection	Deflection Degrees	Blade Spacing	Border Type	OS	FR	#01	#04	#20	#21	#26	#34	#84	#94	#95	#96	C	DS		FG	PFAP	
271	St-Supply	Single	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
272	St-Supply	Double	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
271	Al-Supply	Single	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
272	Al-Supply	Double	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
111	St-Supply	Single	Adjustable	1 1/2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
112	St-Supply	Double	Adjustable	1 1/2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
121	St-Supply	Single	Adjustable	2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
122	St-Supply	Double	Adjustable	2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
131	St-Supply	Single	Adjustable	3"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
132	St-Supply	Double	Adjustable	3"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y

### Return Options RG-1

Model #	Type Grille	Type Deflection	Deflection Degrees	Blade Spacing	Border Type	OS	FR	#01	#04	#20	#21	#26	#34	#84	#94	#95	#96	C	DS	IS	FG	PFAP	EQT
3	Al-Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Al-Return	Fixed	45	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3FF	Al-Filter Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
3FF	Al-Filter Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
4	Al-Return	Fixed	45	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
4	Al-Return	Fixed	45	1/2"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4FF	Al-Filter Return	Fixed	45	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
4FF	Al-Filter Return	Fixed	45	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
23	St-Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
23	St-Return	Fixed	45	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
23	St-Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
23	St-Return	Fixed	45	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
23	St-Return	Fixed	45	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
23RF	St-Filter Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N
25	St-Return	Fixed	30	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
25	St-Return	Fixed	30	1/2"	2	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
25	St-Return	Fixed	30	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
25	St-Return	Fixed	30	1/2"	4	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
25	St-Return	Fixed	30	1/2"	7	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
25RF	St-Filter Return	Fixed	30	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N
55	Al-Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
55	Al-Return	Fixed	0	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55FF	Al-Filter Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
55FF	Al-Filter Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
56	Al-Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
56	Al-Return	Fixed	0	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56FF	Al-Filter Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
56FF	Al-Filter Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N

Caution: All options are not available in all combinations. Check with your TITUS representative for details.  
TITUS reserves the right to discontinue or add options at any time without notice.

### Series Finishes, Options and Accessories

Finishes:	Options And Accessories:
#01 Aluminum Colored Paint	OS Oversize
#04 Mill Finish	FR Fractional Size
#20 Envirotherm Color To Match Sample	DS Concealed Fasteners
#21 Envirothane Color To Match Sample	IS Insect Screen 1/16" Square Mesh
#25 Off White	FG Galvanized Steel Screen
#26 White (standard on most models)	PFAP Galvanized Steel Screen
#34 Clear Anodized*	EQT Foam Gasket On Back Side of Border
#84 Black*	Aluminum Plaster Frame
#94 Light Bronze Anodized*	Earthquake Tab For Safety Wiring
#95 Medium Bronze Anodized*	to Support Structure
#96 Dark Bronze Anodized*	

Note: An asterisk (\*) indicates additional cost.



DIV 233000

# TITUS® Submittal

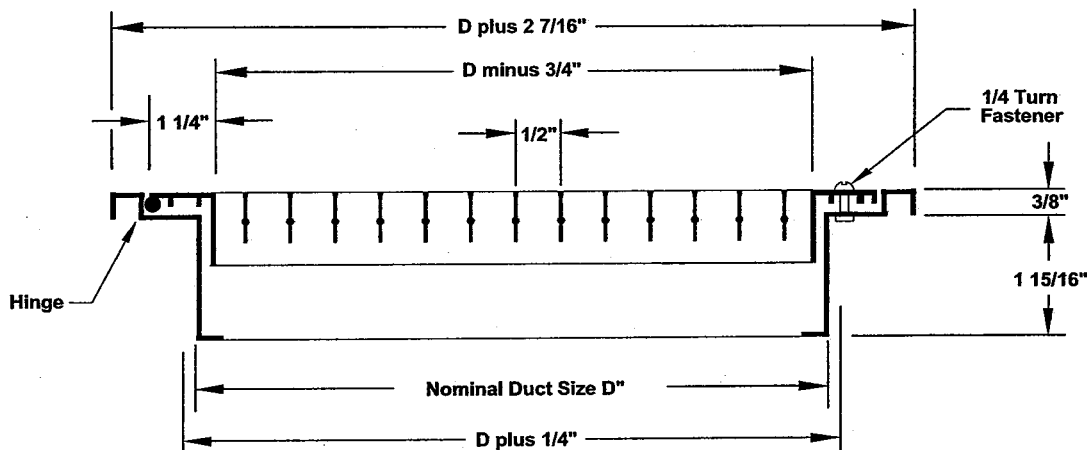
ABG-55FF 12-1-98

## Filter Louvered Return Grilles • Aero-Blade Series All Aluminum

RG-1

Models: 55FFL • 0° Deflection • Long Blades • 1/2" Spacing  
55FFS • 0° Deflection • Short Blades • 1/2" Spacing

☒ Border Type 1 (Surface Mount)



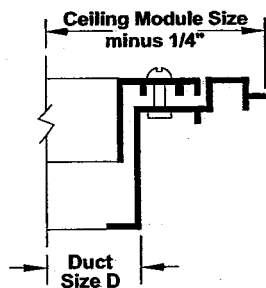
Available Sizes ( $D" \times D"$ )

Sizes 6" x 4" through 36" x 24" in 1" increments. Border Type 3 is available in module sizes 24" x 12", 24" x 24", 36" x 12", 36" x 24" and 48" x 24".

Note: Dimensions are in inches.

### Additional Border Type

☐ Border Type 3 (Lay-in)



### Accessories (Optional)

Check ☒ if provided.

- ☐ Model AG-35-B • Duct Mounted Opposed Blade Damper • Galvanized Steel
- ☐ Model AG-35B-AA • Duct Mounted Opposed Blade Damper • Aluminum

Standard Finish: #26 White

☐ Optional Finish \_\_\_\_\_

Other

Specify \_\_\_\_\_

### General Description

• Model 55FF filter louvered return grille belongs to the premium quality Aero-Blade Series.

- Provision for 1" filter cell.
- Core hinged parallel to long dimension.

• Material is heavy extruded aluminum for blades, border and filter frame.

TITUS®

Note: This submittal is meant to demonstrate general dimensions of this product. The drawings on this submittal are not meant to detail every aspect of the product with exactness. Drawings are not to scale. TITUS reserves the right to make changes without written notice. ABG-28.0-S

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MORNINGSTAR



Performance Data (continued)

**55F, 56F • 0° Deflection (continued)**

Performance based on nominal sizes shown in bold.

RG-1

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Pressure Neg. Static Pressure	NC-10	NC20	NC-30		NC-40		NC-50		
				300 0.006 0.013	400 0.010 0.023	500 0.016 0.036	600 0.022 0.052	700 0.031 0.071	800 0.040 0.094	1000 0.062 0.144	1200 0.090 0.208	1400 0.122 0.283
RG-1 → 48x12 24x24	4.00	3.75	Airflow, cfm NC	1125	1500	1875	2250	2625	3000	3750	4500	5250
36x18	4.50	4.22	Airflow, cfm NC	1266	1688	2110	2532	2954	3376	4220	5064	5908
36x20 30x24	5.00	4.71	Airflow, cfm NC	1413	1884	2355	2826	3297	3768	4710	5652	6594
42x18	5.25	4.94	Airflow, cfm NC	1482	1976	2470	2964	3458	3952	4940	5928	6916
28x28	5.44	5.16	Airflow, cfm NC	1548	2064	2580	3096	3612	4128	5160	6192	7224
42x20 30x28	5.83	5.51	Airflow, cfm NC	1653	2204	2755	3306	3857	4408	5510	6612	7714
48x18 36x24	6.00	5.66	Airflow, cfm NC	1698	2264	2830	3396	3962	4528	5660	6792	7924
30x30	6.25	5.94	Airflow, cfm NC	1782	2376	2970	3564	4158	4752	5940	7128	8316
42x24 36x28	7.00	6.66	Airflow, cfm NC	1998	2664	3330	3996	4662	5328	6660	7992	9324
46x22	7.03	6.68	Airflow, cfm NC	2004	2672	3340	4008	4676	5344	6680	8016	9352
32x32	7.11	6.78	Airflow, cfm NC	2034	2712	3390	4068	4746	5424	6780	8136	9492
36x30	7.50	7.16	Airflow, cfm NC	2148	2864	3580	4296	5012	5728	7160	8592	10024
48x24 36x32	8.00	7.63	Airflow, cfm NC	2289	3052	3815	4578	5341	6104	7630	9156	10682
34x34	8.03	7.68	Airflow, cfm NC	2304	3072	3840	4608	5376	6144	7680	9216	10752
36x34	8.50	8.14	Airflow, cfm NC	2442	3256	4070	4884	5698	6512	8140	9768	11396
42x30	8.75	8.38	Airflow, cfm NC	2514	3352	4190	5028	5866	6704	8380	10056	11732
36x36	9.00	8.63	Airflow, cfm NC	2589	3452	4315	5178	6041	6904	8630	10356	12082
42x34 48x30	10.00	9.6	Airflow, cfm NC	2880	3840	4800	5760	6720	7680	9600	11520	13440
38x38	10.03	9.64	Airflow, cfm NC	2892	3856	4820	5784	6748	7712	9640	11568	13496
42x36	10.50	10.1	Airflow, cfm NC	3030	4040	5050	6060	7070	8080	10100	12120	14140
46x34	10.86	10.45	Airflow, cfm NC	3135	4180	5225	6270	7315	8360	10450	12540	14630
42x38	11.08	10.67	Airflow, cfm NC	3201	4268	5335	6402	7469	8536	10670	12804	14938
40x40	11.11	10.7	Airflow, cfm NC	3210	4280	5350	6420	7490	8560	10700	12840	14980
48x36	12.00	11.57	Airflow, cfm NC	3471	4628	5785	6942	8099	9256	11570	13884	16198
42x42	12.25	11.82	Airflow, cfm NC	3546	4728	5910	7092	8274	9456	11820	14184	16548
44x44	13.44	12.99	Airflow, cfm NC	3897	5196	6495	7794	9093	10392	12990	15588	18186
48x42	14.00	13.54	Airflow, cfm NC	4062	5416	6770	8124	9478	10832	13540	16248	18956
46x46	14.69	14.22	Airflow, cfm NC	4266	5688	7110	8532	9954	11376	14220	17064	19908
48x46	15.33	14.85	Airflow, cfm NC	4455	5940	7425	8910	10395	11880	14850	17820	20790
48x48	16.00	15.50	Airflow, cfm NC	4650	6200	7750	9300	10850	12400	15500	18600	21700

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-91.

- NC based on room absorption of 10 dB, re 10<sup>-12</sup> w measured per ANSI/ASHRAE Standard 70-91.





## AeroBlade Options and Accessories

### Supply Options

*See below*

Model #	Type Grille	Type Deflection	Deflection Degrees	Blade Spacing	Border Type	OS	FR	#01	#04	#20	#21	#26	#34	#84	#94	#95	#96	C	DS	IS	FG	PFAP	EQT
271	Stl-Supply	Single	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
272	Stl-Supply	Double	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
271	Al-Supply	Single	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
272	Al-Supply	Double	Adjustable	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
111	Stl-Supply	Single	Adjustable	1 1/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
112	Stl-Supply	Double	Adjustable	1 1/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
121	Stl-Supply	Single	Adjustable	2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
122	Stl-Supply	Double	Adjustable	2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
131	Stl-Supply	Single	Adjustable	3"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y
132	Stl-Supply	Double	Adjustable	3"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y

### Return Options RG-1

Model #	Type Grille	Type Deflection	Deflection Degrees	Blade Spacing	Border Type	OS	FR	#01	#04	#20	#21	#26	#34	#84	#94	#95	#96	C	DS	IS	FG	PFAP	EQT
3	Al-Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Al-Return	Fixed	45	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3	Al-Return	Fixed	45	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
3FF	Al-Filter Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
3FF	Al-Filter Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
4	Al-Return	Fixed	45	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
4	Al-Return	Fixed	45	1/2"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4	Al-Return	Fixed	45	1/2"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
4FF	Al-Filter Return	Fixed	45	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
4FF	Al-Filter Return	Fixed	45	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
23	Stl-Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	Y
23	Stl-Return	Fixed	45	3/4"	2	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
23	Stl-Return	Fixed	45	3/4"	3	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
23	Stl-Return	Fixed	45	3/4"	4	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
23	Stl-Return	Fixed	45	3/4"	7	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
23RF	Stl. Filter Return	Fixed	45	3/4"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	N
25	Stl-Return	Fixed	30	1/2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	Y
25	Stl-Return	Fixed	30	1/2"	2	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
25	Stl-Return	Fixed	30	1/2"	3	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
25	Stl-Return	Fixed	30	1/2"	4	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
25	Stl-Return	Fixed	30	1/2"	7	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	Y
25RF	Stl. Filter Return	Fixed	30	1/2"	1	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	N
55	Al-Return	Fixed	0	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
55	Al-Return	Fixed	0	1/2"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	1/2"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55	Al-Return	Fixed	0	1/2"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
55FF	Al-Filter Return	Fixed	0	1/2"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
55FF	Al-Filter Return	Fixed	0	1/2"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
56	Al-Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
56	Al-Return	Fixed	0	3/4"	2	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	4	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56	Al-Return	Fixed	0	3/4"	7	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
56FF	Al-Filter Return	Fixed	0	3/4"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
56FF	Al-Filter Return	Fixed	0	3/4"	3	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N

**Caution:** All options are not available in all combinations. Check with your TITUS representative for details.  
TITUS reserves the right to discontinue or add options at any time without notice.

### Series Finishes, Options and Accessories

#### Finishes:

- #01 Aluminum Colored Paint
- #04 Mill Finish
- #20 Envirothane Color To Match Sample\*
- #21 Envirothane Color To Match Sample\*
- #25 Off White\*
- #26 White (standard on most models)
- #34 Clear Anodized\*
- #84 Black\*
- #94 Light Bronze Anodized\*
- #95 Medium Bronze Anodized\*
- #96 Dark Bronze Anodized\*

#### Options And Accessories:

- OS Oversize
- FR Fractional Size
- C Concealed Fasteners
- DS Debris Screen 1/4" Square Mesh
- IS Galvanized Steel Screen
- IS Insect Screen 1/16" Square Mesh
- FG Galvanized Steel Screen
- FG Foam Gasket On Back Side of Border
- PFAP Aluminum Plaster Frame
- EQT Earthquake Tab For Safety Wiring to Support Structure

**Note:** An asterisk (\*) indicates additional cost.



# **Linear Bar**

## **Aluminum Fixed Bars**

### Models:

#### 1/4" Spacing:

- CT-480 • 1/8" Bars
- 0° Deflection
- CT-481 • 1/8" Bars
- 15° Deflection

#### 1/2" Spacing:

- CT-580 • 1/8" Bars
- 0° Deflection
- CT-581 • 1/8" Bars
- 15° Deflection
- CT-540 • 1/4" Bars
- 0° Deflection
- CT-541 • 1/4" Bars
- 15° Deflection

### Pencil Proof Models:

#### 7/16" Spacing:

- CT-PP-0 • 7/32" Bars
- 0° Deflection
- CT-PP-3 • 7/32" Bars
- 30° Deflection

- When both appearance and performance are of prime importance in an air distribution system, TITUS linear bar diffusers are a logical choice.
- Designed for both heating and cooling applications, supply as well as return.
- Available in eight different core styles plus a wide selection of frames and borders.
- Can be selected for ceiling, side wall, or sill installations. Heavy duty models (Frames 5, 6, and 15) are designed especially for typical floor installations.
- Accessories such as directional blades, dampers, blank-offs, access doors, and mitered corners make these diffusers even more versatile.

- Ideal for continuous length applications. Multiple sections are shipped with required alignment strips or pins for field installation.
- Maximum one piece section is 6 feet. Lengths greater than 6 feet are furnished in multiple sections.
- Sections can be joined together end-to-end for continuous appearance, using standard alignment strips or alignment wires.
- All deflection bars are fixed and parallel to the long dimension.
- Fixed bars and support bars are extruded aluminum.
- Optional curving to a 6 feet minimum radius on most models, available for architectural enhancement.

F35

SR-5  
SR-6

F

• Spec

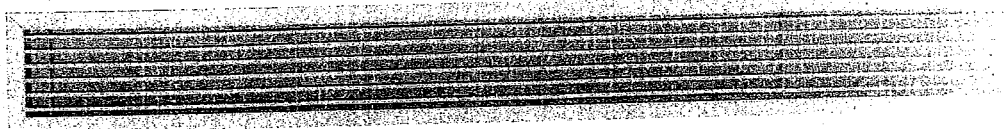
**CT-480 • 1/4" Spacing, 1/8" Bars**



### These Products Include:

- Standard Finish:  
#26 White
- Optional Finishes:  
#01 Aluminum  
#34 Clear Anodized

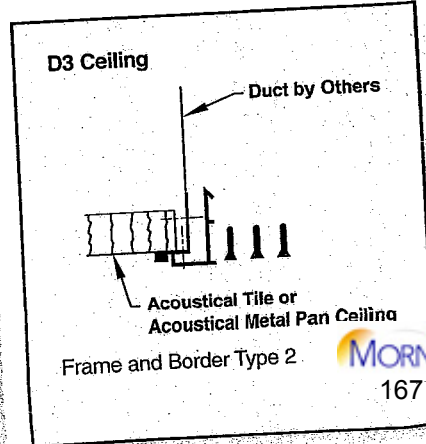
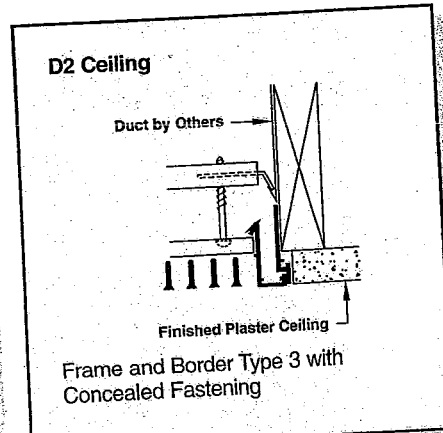
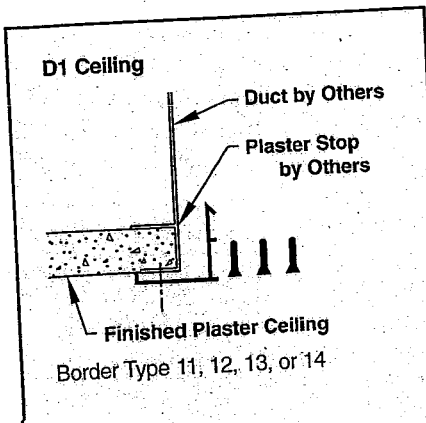
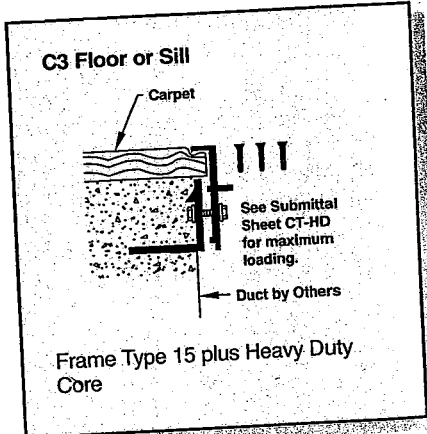
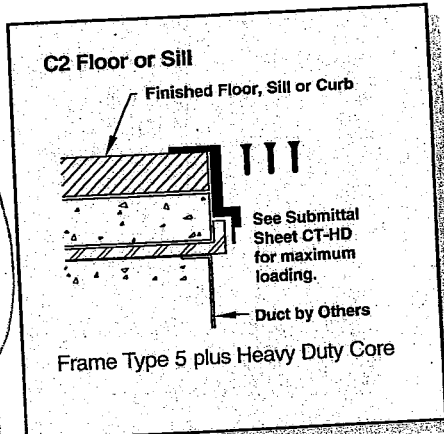
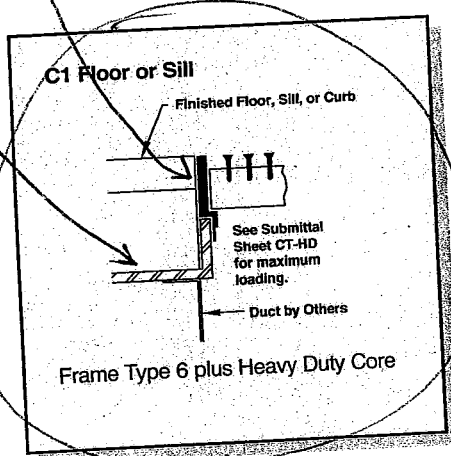
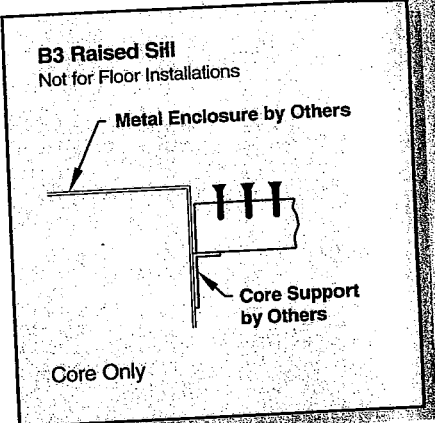
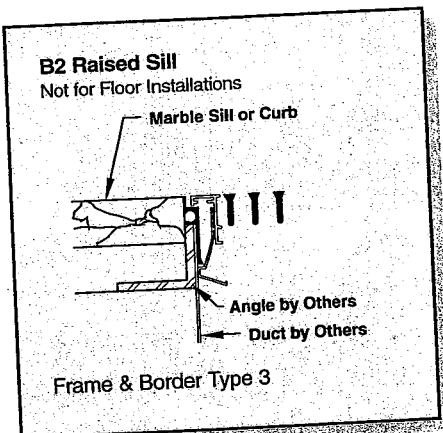
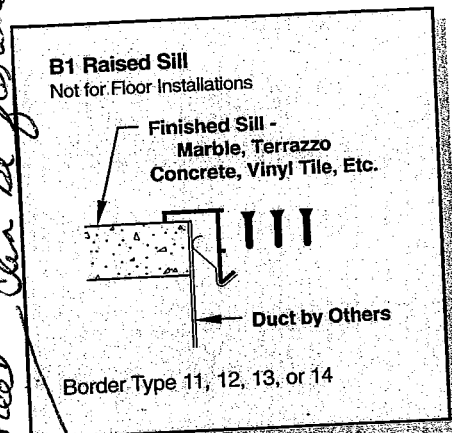
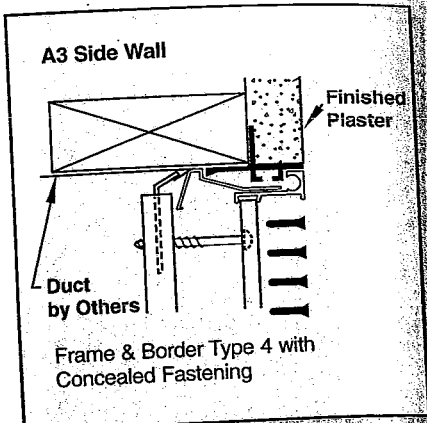
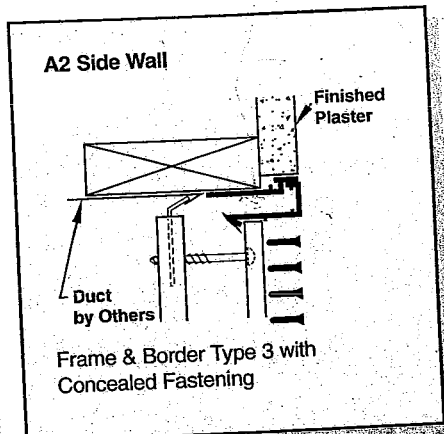
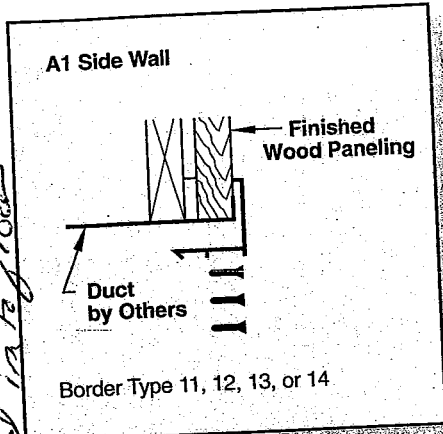
**CT-540 • 1/2" Spacing, 1/4" Bars**



Frames and Borders	...F36
Accessories	.....F39
Installation Details	.....F40
Performance Data	
CT-480, CT-481	.....F41
CT-580, CT-581	.....F42
CT-540, CT-541	.....F43
CT-PP-0, CT-PP-3	...F44
Specifications	
All Models	.....F45



Angled Steel can be fastened into floor



## Overall Lengths and Widths of Various Frame & Border Types

**Border Types (Type 11 Shown)**

Type	F Border Length	O Overall Length	C Core Opening Length
5	D	D plus 1"	D - 3/4"
6	D	D	D - 3/4"
7	D minus 3/4"	D minus 3/4"	D minus 3/4"
11	D minus 3/4"	D plus 3/4"	D minus 3/4"
12	D minus 3/4"	D plus 3/4"	D minus 3/4"
13	D minus 3/4"	D plus 1"	D minus 3/4"
14	D minus 3/4"	D plus 1"	D minus 3/4"

**Frame & Border Type (Type 1A & 1B Shown)**

Type	F Frame Length	O Overall Length	C Core Opening Length
1A	D	D plus 2"	D minus 3/4"
1B	D	D plus 2 1/2"	D minus 3/4"
2	D	D plus 1 1/4"	D minus 3/4"
3	D	D plus 7/16"	D minus 3/4"
4	D	D	D minus 3/4"
15	D	D plus 1/4"	D minus 3/4"

Dimensions are for length or width.

### Standard Core Width Information

Number of Bars per Width	Border 1A, 1B, 2, 3, 4, 7, 11, 12, 13, 14			Border 5, 6, 15		
	CT480, 481 1/4" spacing	CT540, 541, CT580, 581 1/2" spacing	CTPPO, CTPP3 3/4" spacing	CT480, 481 1/4" spacing	CT540, 541, CT580, 581 1/2" spacing	CTPPO, CTPP3 3/4" spacing
2"	3	2	2	6	3	3
2 1/2"	5	3	3	8	4	4
3"	7	4	4	10	5	5
3 1/2"	9	5	5	12	6	7
4"	11	6	7	14	7	8
5"	15	8	9	18	9	10
6"	19	10	11	22	11	12

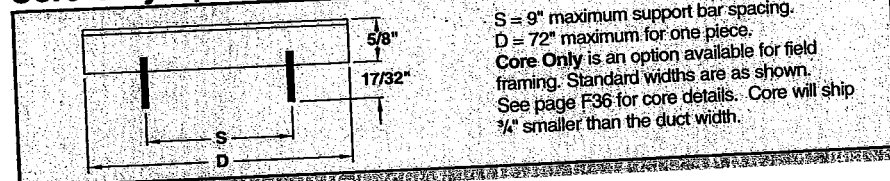
### Maximum Floor Loading

(Frames 5, 6, and 15 with standard support bars on 6" centers)

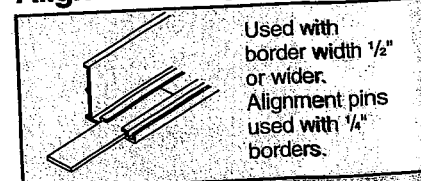
Model	Max. Vertical Distributed Load (lbs./in. <sup>2</sup> )	Max. Vertical Live Load (lbs./ft. <sup>2</sup> )	Max. Horizontal Load (lbs.)
CT-480/CT-481	300	300	50
CT-580/CT-581	200	200	50
CT-540/CT-541	250	250	50
CT-PP-0/CT-PP-3	250	250	50

**Note:** If placing furniture on cores, furniture legs should be a minimum of core spacing plus two bars wide to avoid placing a horizontal load on cores. Maximum duct width available is 12".

### Core Only Option



### Alignment Strips



### Available Fastenings

#### Type A

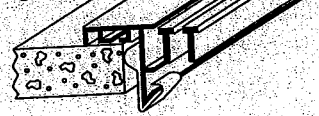
- Screw Holes



For ceiling, side wall, sill, or floor. Used with Frame & Border Types 1B, 5, 11, 12, 13, 14.

#### Type B

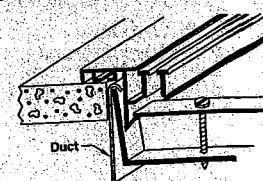
- Spring Clip



For sill installations. Used with Frame & Border Types 11, 12, 13, 14. Must use AG-35B Damper instead of AG-35.

#### Type C

- Concealed Fastening



For ceiling, side wall, or sill. Used with Frame & Border Types 1A, 1B, 2, 3, 4, 7, 11, 12, 13, 14.

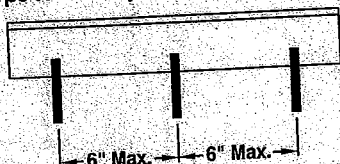
#### Notes:

- Used without spring latch in Frame & Border Types 3 and 4.
- Not for use with Cores CT-480 and CT-481 (1/4" bar spacing). Screwdriver will not fit between bars.

### Additional Reinforcing (Optional) (Except frame types 5, 6, and 15)\*

#### Type H

- Optional Heavy Duty Core (Note)



Optional Heavy Duty Core has support bars on 6" maximum centers. (Standard core has 9" maximum centers.) See maximum floor loading shown above.

**Note:** Frame types 5, 6, and 15 have support bars on 6-inch centers as standard.

All dimensions are in inches.



**CT-480 • 1/8-inch Thick Fixed Bars • 0° Deflection • 1/4-inch Spacing Width**

Effective Area, Square Feet	Nominal Duct Width, Inches										
0.048	2"	Total Pressure	0.011	0.024	0.042	0.068	0.097	0.134	0.173	0.217	0.272
		CFM per foot	19	28	37	47	56	66	75	84	94
		Noise Criteria (NC)	-	9	17	24	29	34	37	41	44
		Throw, Side Wall	3-5-10	5-8-15	7-10-18	8-13-20	10-15-22	12-17-23	14-18-25	15-19-26	16-20-28
		Throw, End Wall	3-6-12	6-9-18	8-12-21	10-15-23	12-18-25	14-19-27	16-21-29	18-22-31	19-23-33
0.066	2 1/2"	Total Pressure	0.011	0.024	0.043	0.066	0.096	0.13	0.17	0.215	0.266
		CFM per foot	26	39	52	65	78	91	104	117	130
		Noise Criteria (NC)	-	11	19	25	30	35	39	42	45
		Throw, Side Wall	3-6-12	6-9-18	8-12-21	10-15-23	12-18-25	14-19-27	16-21-29	18-22-31	19-23-33
		Throw, End Wall	3-7-13	7-10-20	9-13-23	11-17-26	14-20-29	16-22-31	18-23-33	20-25-35	21-26-37
0.084	3"	Total Pressure	0.01	0.024	0.041	0.066	0.095	0.128	0.168	0.211	0.262
		CFM per foot	33	50	66	83	100	116	133	149	166
		Noise Criteria (NC)	-	12	20	26	31	36	40	43	46
		Throw, Side Wall	3-7-13	7-10-20	9-13-23	11-17-26	14-20-29	16-22-31	18-23-33	20-25-35	21-26-37
		Throw, End Wall	3-8-14	8-11-22	10-15-26	13-19-29	15-22-32	18-24-34	20-26-37	23-28-39	24-29-41
0.103	3 1/2"	Total Pressure	0.011	0.024	0.043	0.066	0.095	0.13	0.169	0.216	0.263
		CFM per foot	41	61	82	102	122	143	163	184	204
		Noise Criteria (NC)	-	12	21	27	32	37	40	44	47
		Throw, Side Wall	4-8-15	8-11-22	10-15-26	13-19-29	15-22-32	18-24-34	20-26-37	23-28-39	24-29-41
		Throw, End Wall	4-9-16	9-14-28	12-19-32	16-23-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
0.121	4"	Total Pressure	0.011	0.024	0.044	0.068	0.097	0.133	0.173	0.221	0.271
		CFM per foot	49	73	98	122	146	171	195	220	244
		Noise Criteria (NC)	-	14	22	28	33	38	42	45	48
		Throw, Side Wall	4-8-17	8-12-25	11-17-28	14-21-32	17-25-35	19-27-38	22-28-40	25-30-43	26-32-45
		Throw, End Wall	4-9-18	9-14-28	12-19-32	16-23-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
0.157	5"	Total Pressure	0.011	0.024	0.042	0.066	0.094	0.129	0.168	0.212	0.263
		CFM per foot	63	94	125	157	188	220	251	282	314
		Noise Criteria (NC)	-	14	22	29	34	39	42	46	49
		Throw, Side Wall	5-9-19	9-14-28	12-19-32	16-23-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
		Throw, End Wall	5-10-20	10-16-31	14-21-36	17-26-40	21-31-44	24-34-47	28-36-51	31-38-54	33-40-57
0.194	6"	Total Pressure	0.011	0.024	0.042	0.066	0.095	0.129	0.168	0.213	0.263
		CFM per foot	78	116	155	194	233	272	310	349	388
		Noise Criteria (NC)	-	15	23	30	35	40	43	47	50
		Throw, Side Wall	6-10-21	10-16-31	14-21-36	17-26-40	21-31-44	24-34-47	28-36-51	31-38-54	33-40-57
		Throw, End Wall	6-11-22	11-17-33	15-22-38	19-28-43	23-30-47	27-34-51	31-38-54	35-42-58	38-46-61

**CT-481 • 1/8-inch Thick Fixed Bars • 15° Deflection • 1/4-inch Spacing Width**

Effective Area, Square Feet	Nominal Duct Width, Inches										
0.049	2"	Total Pressure	0.011	0.024	0.042	0.068	0.096	0.133	0.172	0.216	0.271
		CFM per foot	19	28	37	47	56	66	75	84	94
		Noise Criteria (NC)	-	16	24	31	36	41	44	48	51
		Throw, Side Wall	3-5-10	5-7-15	7-10-18	8-13-20	10-15-22	12-17-23	13-18-25	15-19-26	16-20-28
		Throw, End Wall	3-6-12	6-9-18	8-12-21	10-15-23	12-18-25	14-19-27	16-21-29	18-22-31	19-23-33
0.066	2 1/2"	Total Pressure	0.011	0.024	0.042	0.066	0.095	0.129	0.169	0.214	0.264
		CFM per foot	26	39	52	65	78	91	104	117	130
		Noise Criteria (NC)	-	17	26	32	37	41	45	49	52
		Throw, Side Wall	3-6-12	6-9-18	8-12-21	10-15-23	12-18-25	14-19-27	16-21-29	18-22-31	19-23-33
		Throw, End Wall	3-7-13	7-10-20	9-13-23	11-17-26	14-20-29	16-22-31	18-23-33	20-25-35	21-26-37
0.083	3"	Total Pressure	0.01	0.024	0.041	0.065	0.095	0.127	0.167	0.21	0.26
		CFM per foot	33	50	66	83	100	116	133	149	166
		Noise Criteria (NC)	-	18	26	33	38	42	46	49	52
		Throw, Side Wall	4-7-14	7-10-20	9-13-23	11-17-26	14-20-29	16-22-31	18-23-33	20-25-35	21-26-37
		Throw, End Wall	4-8-15	8-11-22	10-15-26	13-19-29	15-22-32	18-24-34	20-26-37	23-28-39	24-29-41
0.1	3 1/2"	Total Pressure	0.011	0.024	0.043	0.066	0.094	0.129	0.168	0.212	0.263
		CFM per foot	41	61	82	102	122	143	163	184	204
		Noise Criteria (NC)	-	19	27	34	39	43	47	50	53
		Throw, Side Wall	4-8-15	8-11-22	10-15-26	13-19-29	15-22-32	18-24-34	20-26-37	23-28-39	24-29-41
		Throw, End Wall	4-9-16	9-14-28	12-19-32	16-23-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
0.117	4"	Total Pressure	0.011	0.024	0.044	0.067	0.097	0.132	0.172	0.219	0.27
		CFM per foot	49	73	98	122	146	171	195	220	244
		Noise Criteria (NC)	-	20	28	35	40	44	48	51	54
		Throw, Side Wall	5-8-17	8-13-25	11-17-28	14-21-32	17-25-35	20-27-38	22-28-40	25-30-43	26-32-45
		Throw, End Wall	5-9-18	9-14-28	12-19-32	16-23-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
0.151	5"	Total Pressure	0.011	0.023	0.041	0.065	0.094	0.128	0.167	0.211	0.261
		CFM per foot	63	94	125	157	188	220	251	282	314
		Noise Criteria (NC)	-	20	29	35	40	45	49	52	55
		Throw, Side Wall	5-10-19	10-14-28	13-19-32	16-24-36	19-28-39	22-30-43	25-32-46	28-34-48	29-36-51
		Throw, End Wall	5-11-20	11-16-31	14-21-36	17-26-40	21-31-44	24-34-47	28-36-51	31-38-54	33-40-57
0.186	6"	Total Pressure	0.011	0.023	0.042	0.065	0.094	0.128	0.167	0.211	0.261
		CFM per foot	78	116	155	194	233	272	310	349	388
		Noise Criteria (NC)	-	21	30	36	41	46	49	53	56
		Throw, Side Wall	6-11-21	11-16-31	14-21-36	17-26-40	21-31-44	24-34-47	28-36-51	31-38-54	33-40-57
		Throw, End Wall	6-12-22	12-17-33	16-22-38	20-28-43	24-31-47	28-35-51	32-39-54	36-43-58	39-47-61

Difusers

### Performance Notes: Linear Bar

- All pressures are in inches of water.
- Throw velocities are given for terminal velocities of 150, 100, and 50 fpm. For an explanation of catalog throw data, see the *Engineering Guidelines* section.
- Throw values are based on an active section 4 feet long. Multipliers for correcting the throw for other lengths are shown in the table below.

### Throw Correction for Length (multiply)

Active Length (ft)	2	4	8	10
Throw Correction	0.72	1	1.5	1.7

**Note:** Throw values based on applications with surface effect. Use the multiplier of 0.7 for free jet applications.

- NC values are based on a room absorption of 10 dB, re 10<sup>-12</sup> watts, with a 4-foot active diffuser section. Corrections for other lengths are shown in the table below.

### NC Correction for Length (add)

Active Length (ft)	2	4	6	8	10
NC Correction	-3	0	2	3	5

- When the diffuser is used as a return intake, the NC value is increased by 4, and the negative static pressure is 0.8 times the listed total pressure.
- Dash (-) in space denotes an NC value less than 10.
- For continuous lengths, the selection for NC is usually based on a 10-foot section.
- These products have been tested per ANSI/ASHRAE 70-91. Actual performance, with flexible duct inlet

and supply plenums, may vary in the field. See the *Engineering Guidelines* section of this catalog for additional information.

- Maximum available width 24 inches except frames 5, 6, and 15 (12-inch width). Consult your TITUS representative for performance data.
- For continuous lengths it is recommended that maximum active lengths are no longer than 10 feet.

## Suggested Division 15 Specification

### Linear Bar Diffusers

#### Aluminum Fixed Bars

Models:

- |         |                  |
|---------|------------------|
| CT-480  | • 1/4" spacing   |
|         | • 1/8" Bars      |
| CT-481  | • 0° deflection  |
|         | • 1/4" spacing   |
|         | • 1/8" Bars      |
| CT-580  | • 15° deflection |
|         | • 1/2" spacing   |
|         | • 1/8" Bars      |
| CT-581  | • 0° deflection  |
|         | • 1/2" spacing   |
|         | • 1/8" Bars      |
| CT-540  | • 15° deflection |
|         | • 1/2" spacing   |
|         | • 1/4" Bars      |
| CT-541  | • 0° deflection  |
|         | • 1/2" spacing   |
|         | • 1/4" Bars      |
| CT-PP-0 | • 15° deflection |
|         | • 7/16" spacing  |
|         | • 7/32" Bars     |
| CT-PP-3 | • 0° deflection  |
|         | • 7/16" spacing  |
|         | • 7/32" Bars     |
|         | • 30° deflection |

Linear bar diffusers shall be TITUS model CT with 1/8- or 1/4-inch thick fixed bars at 0° or 15° deflection, spaced 1/4 or 1/2 inch on center. Model CT-PP shall also be available with 7/32 inch thick fixed bars at 0° or 30° deflection, spaced 7/16 inch on center. Linear bar diffusers shall be available in standard one-piece lengths up to 6 feet and shall have the sizes and mounting types shown on the plans and outlet schedule. Diffuser lengths greater than 6 feet shall be furnished in multiple sections and will be joined together end-to-end with alignment strips or pins to form a continuous appearance. All alignment components to be provided by the manufacturer.

The diffuser core shall have extruded aluminum bars locked into a heavy extruded aluminum border. The deflection bars must be fixed and parallel to the long dimension. The core must have support bars located no more than 9 inches apart and shall be parallel to the short dimension.

Floor models of the diffuser shall have heavy duty mounting frames (frames 5, 6, or 15) and removable cores for easy access. The core support bars shall be located no more than 6 inches apart and shall be parallel to the short dimension for added strength.

The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

Heavy gauge extruded aluminum end borders and mitered corners shall be available to close off the ends of the diffusers. Optional opposed blade damper shall be constructed of heavy gauge steel (aluminum also available). Damper must be operable from the face of the diffuser. Optional directional blades and blank-offs shall also be available. Optional diffuser curving to a 6-foot minimum radius on most models shall be available as required.

The manufacturer shall provide published performance data for the linear bar diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.



# FC40R

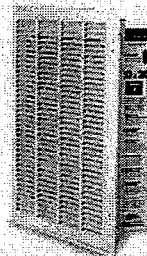
## High-Performance Return Grille Filters

# Honeywell



\*get one of these  
for Solar D

\*Check if 20x20  
is correct size



When installed into your home's ceiling or wall return grille(s), Honeywell's FC40R High-Performance Return Grille Filters provide air filtration equivalent to typical four-inch media filters in a one-inch return grille space. The FC40R is up to 15 times more effective\* than standard one-inch filters at trapping and filtering dust, as well as reducing pollen, mold spores, bacteria and other allergens passing through your HVAC system. This ensures that cleaner air is distributed throughout your home. Additionally, FC40R Return Grille Filters from Honeywell last three times longer than standard one-inch filters, which mean less maintenance for improved indoor air quality.

\*Based on initial efficiency analysis of new filters tested at 3-10 micron particles at 492 feet per minute of airflow.

Check size

20x20 size



# High-Performance Return Grille Filter

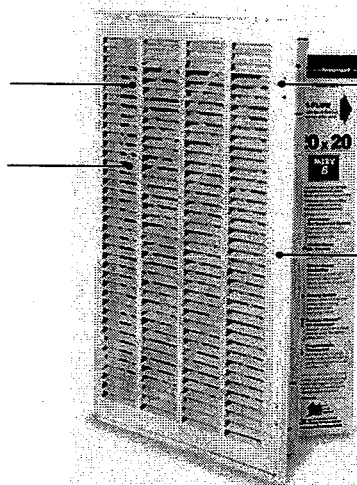
CLEANER AIR WITH LESS EFFORT.

**Longer Lasting** – Three times the life of a standard one-inch filter. Only replace every 6-12 months, versus monthly or quarterly.

**Superior Performance** – Up to 15 times more effective and 40% efficient compared to a standard one-inch filter at reducing airborne particles like dust, mold spores and bacteria.



**Helpful Reminder** – The optional wireless AirWatch™ System reminds you when to change your filter. (Sold separately)



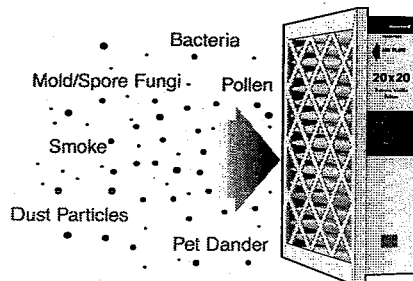
**Perfect Fit** – Fits most one-inch ceiling or wall mount return grilles.

**Increases Efficiency** – Filtered air puts less strain on your heating and cooling equipment, allowing it to run more efficiently.

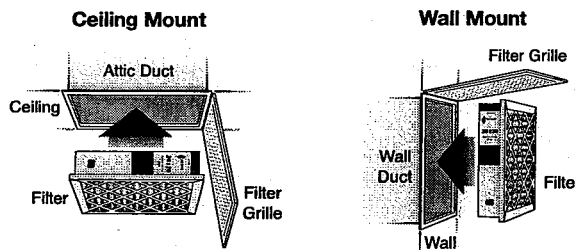
*This should fit our filter rack!*

## TYPICAL HOUSEHOLD PARTICLES

FC40R air filters capture 15 times more 0.3-micron particles than typical one-inch fiberglass filters.



## INSTALLATION



### GENERAL SPECIFICATIONS

FC40R air filters fit most common brands of return grilles. Air filters are available in 5-pack cartons.

Size	Part #	Size	Part #
12" x 12"	FC40R1094	16" x 25"	FC40R1060
12" x 24"	FC40R1037	18" x 24"	FC40R1136
14" x 14"	FC40R1102	20" x 20"	FC40R1003
14" x 20"	FC40R1110	20" x 24"	FC40R1144
14" x 24"	FC40R1128	20" x 25"	FC40R1011
14" x 25"	FC40R1045	20" x 30"	FC40R1029
14" x 30"	FC40R1169	20" x 36"	FC40R1151
16" x 20"	FC40R1052	24" x 24"	FC40R1078
		24" x 30"	FC40R1177

\*Based on initial efficiency analysis of new filters tested at 3-10 micron particles at 492 feet per minute of airflow.

\*Relative performance rating based on initial fractional efficiency analysis of new filters against 0.3-micron to 0.4-micron air particles when tested in accordance with ASHRAE standard 52.2.

### Learn More

Call toll-free 1-800-328-5111

E-mail [info@honeywell.com](mailto:info@honeywell.com)

### Automation and Control Solutions

Honeywell

1985 Douglas Drive North,

Golden Valley, MN 55422-3992

[www.honeywell.com](http://www.honeywell.com)

50-8985 RL 11/05  
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# Honeywell

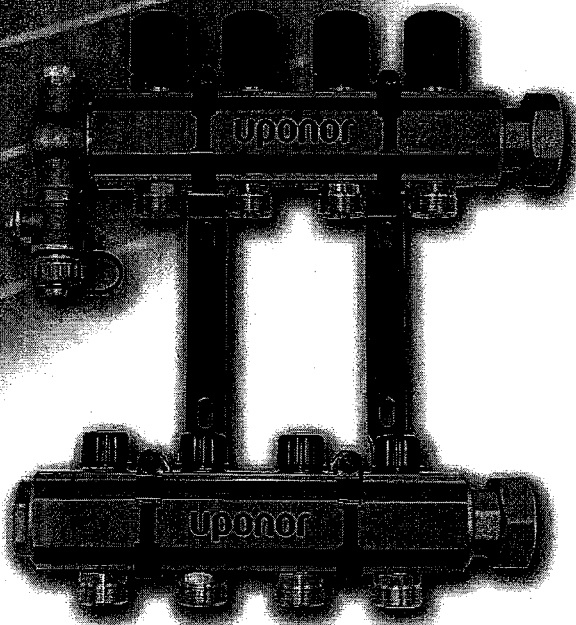


# Uponor

RADIANT HEATING SYSTEMS

## TruFLOW™ CLASSIC MANIFOLD ASSEMBLY

CUT SHEET



## TruFLOW™ Classic Manifold Assembly

The TruFLOW™ Classic Manifold Assembly offers the ultimate in convenience and usability. It comes completely assembled on a durable metal bracket for easy installation — simply take it out of the box and mount it on the wall.

The extruded-brass manifold assembly features a basic end cap on the supply and an end cap with vent and drain on the return, and comes in 2- through 12-loop configurations (with the exception of 9 and 11 loops).

The manifold body features a 1½" internal diameter (i.d.), which allows up to 21 gallons per minute (gpm) of flow. The loop outlets have a flow coefficient ( $C_v$ ) of 1.9 gpm.

For supply and return connections, the manifold is equipped with R32 unions to accommodate any Uponor manifold adapters. It also features o-ring sealed manifold connections to ensure a leak-resistant and secure fit.

The loop connection features an R20 thread to accommodate ⅝" to ¾" PEX or ½" and ⅝" Uponor multi-layer composite (MLC) tubing (formerly MultiCor®) fitting assemblies.

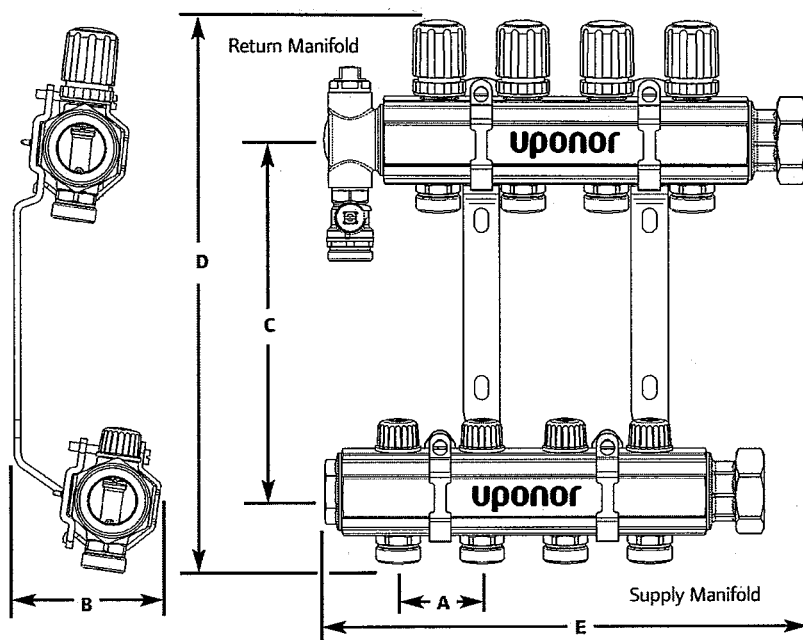


The supply manifold body features calibrated balancing valves, and the return manifold with isolation valves allows connection to either the Uponor Thermal Actuator or Motorized Valve Actuator.

### Features and Benefits

- Highly reliable extruded brass manifold system
- No assembly required — makes installation quick and easy
- R32 unions accommodate any Uponor manifold adapters
- Heavy-duty bracket off-set (front to back and side-to-side)
- 1½" i.d. for superior flow characteristics
- Loop isolation capability with more accurate balancing
- Calibrated balancing valves on supply with isolation valves on return
- Electronic balancing system reading both temperature and flow per loop
- O-ring sealed connections
- Manifold extension kit for jobsite surprises
- Full line of accessories
- Uponor-exclusive design

# TruFLOW Classic Manifold Assemblies



**TruFLOW Classic Manifold Assemblies Dimensions** (in inches)

Part No.	Part Description	A	B	C	D	E
A2610200	TruFLOW Classic Manifold Assembly, 2-loop S&R	1.94	3.46	8.25	12.60	8.40
A2610300	TruFLOW Classic Manifold Assembly, 3-loop S&R	1.94	3.46	8.25	12.60	10.34
A2610400	TruFLOW Classic Manifold Assembly, 4-loop S&R	1.94	3.46	8.25	12.60	12.28
A2610500	TruFLOW Classic Manifold Assembly, 5-loop S&R	1.94	3.46	8.25	12.60	14.22
A2610600	TruFLOW Classic Manifold Assembly, 6-loop S&R	1.94	3.46	8.25	12.60	16.16
A2610700	TruFLOW Classic Manifold Assembly, 7-loop S&R	1.94	3.46	8.25	12.60	18.10
A2610800	TruFLOW Classic Manifold Assembly, 8-loop S&R	1.94	3.46	8.25	12.60	20.04
A2611000	TruFLOW Classic Manifold Assembly, 10-loop S&R	1.94	3.46	8.25	12.60	23.92
A2611200	TruFLOW Classic Manifold Assembly, 12-loop S&R	1.94	3.46	8.25	12.60	27.80



**Uponor, Inc**  
 5925 148th Street West  
 Apple Valley, MN 55124  
 Tel: (800) 321-4739  
 Fax: (952) 891-1409  
 Web: [www.uponor-usa.com](http://www.uponor-usa.com)  
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**Uponor Ltd.**  
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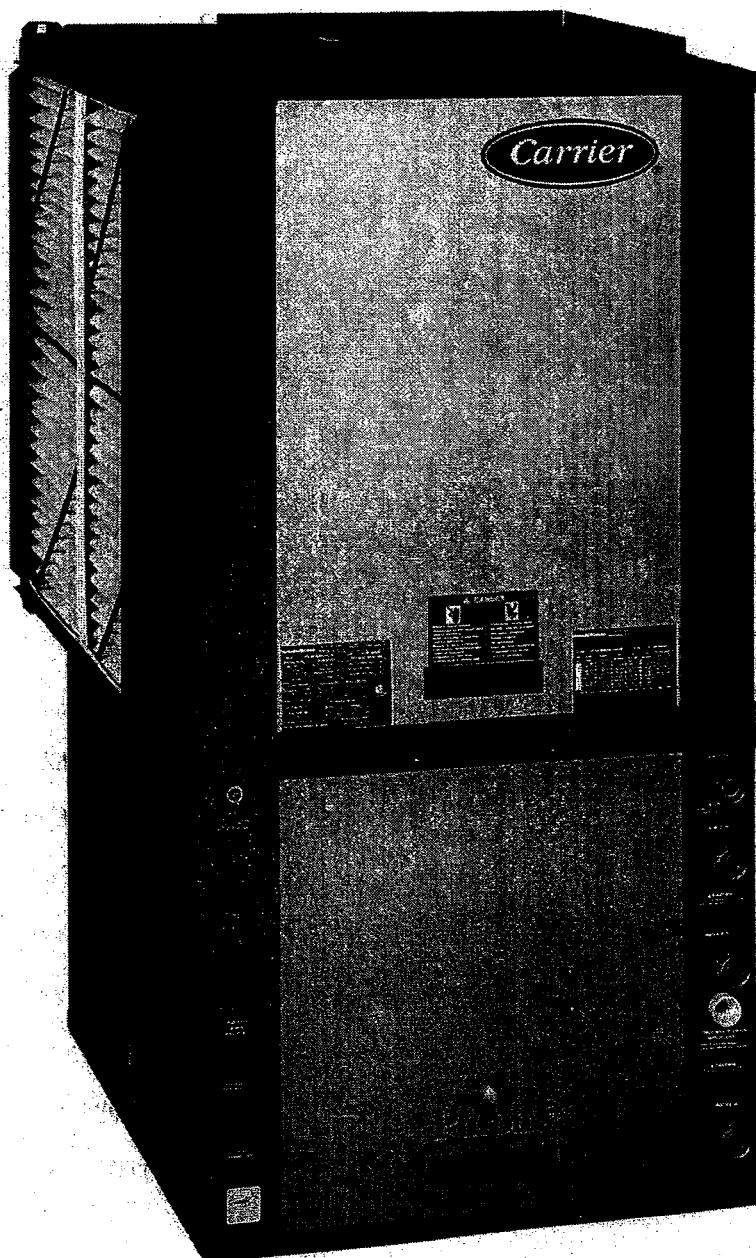
**uponor**

**MORNINGSTAR**



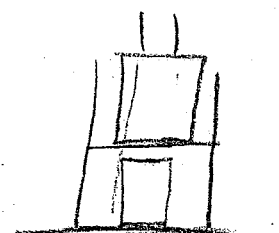
# Unit Specifications

Vertical and Horizontal Single-Stage Puron® Systems



**GT-PG 50YE Series  
Geothermal Heating  
and Cooling System  
Sizes 018-070**



~~14 2~~  
~~7 2~~  
~~1 2~~

Vertical Upflow Model	Overall Cabinet			Water Connections					Electrical Knockouts			Discharge Connection					Return Connection					
				1	2	3	4	5	J 1/2" Cond Voltage	K 1/2" Ext Port	L 3/4" Cond Power Supply	M (LH/rtn)	N	O Supply Width	P Supply Depth	Q (FH/rtn)	R	S Return Depth	T Return Height	U		
	Width	Depth	C Height	D In	E Out	F HWG In	G HWG Out	H Cond- ensate	Loop Water IPT	HWG IPT	net Torque Inlets (+0.10 to +0.25mm)					Std. Discharge Inlets (+0.10 to +0.25mm)						
018	in.	22.4	25.6	44.8	2.1	10.0	13.9	18.9	7.8	1" Swivel	3.8	6.1	8.6	7.2	5.8	14.0	14.0	4.9	1.7	22.2	26.2	3.5
	cm.	58.6	65.1	123.2	5.2	25.4	35.2	42.9	19.8	1" Swivel	9.2	15.6	21.9	18.3	14.8	35.6	35.6	12.4	4.2	56.4	66.4	3.9
034-030	in.	22.4	25.6	49.5	2.1	10.0	13.9	18.9	7.8	1" Swivel	3.8	6.1	8.6	7.2	5.8	14.0	14.0	4.9	1.7	22.2	26.2	1.5
	cm.	58.6	65.1	123.2	5.2	25.4	35.2	42.9	19.8	1" Swivel	9.2	15.6	21.9	18.3	14.8	35.6	35.6	12.4	4.2	56.4	66.4	3.9
038	in.	25.4	30.6	50.5	3.4	10.8	15.6	18.9	7.8	1" Swivel	3.8	6.1	8.6	6.4	6.3	18.0	18.0	5.3	2.1	27.1	28.1	1.5
	cm.	64.5	77.8	128.3	8.6	27.5	39.7	47.9	19.8	1" Swivel	9.2	15.6	21.9	16.1	16.0	45.7	45.7	13.5	5.3	68.9	68.4	3.9
042-048	in.	25.4	30.6	54.5	3.4	10.8	15.6	18.9	7.8	1" Swivel	3.8	6.1	8.6	6.4	6.3	18.0	18.0	5.3	2.1	27.1	30.1	1.5
	cm.	64.5	77.8	139.3	8.6	27.5	39.7	47.9	19.8	1" Swivel	9.2	15.6	21.9	16.1	16.0	45.7	45.7	13.5	5.4	68.9	76.5	3.9
090-070	in.	25.4	30.6	58.5	3.4	10.8	15.6	18.9	7.8	1" Swivel	3.8	6.1	8.6	6.4	6.3	18.0	18.0	5.3	2.1	27.1	34.1	1.5
	cm.	64.5	77.8	148.6	8.6	27.5	39.7	47.9	19.8	1" Swivel	9.2	15.6	21.9	16.1	16.0	45.7	45.7	13.5	5.4	68.9	86.7	3.9

State of CA



## Performance Summary For 2 Ton

Project: ~Untitled3  
Prepared By:

OCTOBER D.C. PERFORMANCE

02/23/2007  
10:33AM

MUST  
PROVIDE  
SINGLE  
PHASE  
POWER

## Unit Parameters

Tag Name: ..... 2 Ton  
Quantity: ..... 1  
Part Number: ..... 50PSV024JCA3-20  
Unit Size: ..... 2 Tons, 850 CFM  
Fluid Type: ..... Water  
Fluid Concentration: ..... 0 %  
Fluid Flow Rate: ..... 8. gpm  
Fluid Pressure Drop: ..... 11.1 ft wg  
Altitude: ..... 0 ft  
External Static Pressure: ..... .30 in wg  
Fan Speed: ..... ECM HI

## Cooling

Airflow: ..... 950.0 CFM  
Loop Temp Cooling: ..... 95.0 F  
Cooling Ent. Air DB Temp: ..... 74.0 F  
Cooling Ent. Air WB Temp: ..... 61.5 F  
Total Cooling: ..... 22.7 MBH  
Sensible Cooling: ..... 17.7 MBH  
Cooling EER: ..... 13.1  
Cooling KW: ..... 1.7 kW  
Heat of Rejection: ..... 28.6 MBH  
Cooling LAT DB: ..... 56.7 F  
Cooling LAT WB: ..... 53.0 F  
Cooling LWT: ..... 102.2 F  
ARI/ISO 13256-1 WLHP Cooling: ..... 25.0 MBH  
ARI/ISO 13256-1 WLHP EER: ..... 17.0  
ARI/ISO 13256-1 GWHP Cooling: ..... 28.1 MBH  
ARI/ISO 13256-1 GWHP EER: ..... 27.4  
ARI/ISO 13256-1 GLHP Cooling: ..... 26.0 MBH  
ARI/ISO 13256-1 GLHP EER: ..... 20.0

## Heating

Airflow: ..... 1,060.0 CFM  
Loop Temp Heating: ..... 35.0 F  
Heating Ent. Air DB Temp: ..... 68.0 F  
Heating LAT: ..... 87.3 F  
Total Heating: ..... 22.1 MBH  
Heating COP: ..... 4.6  
Heating KW: ..... 1.4 kW  
Heat of Absorption: ..... 17.3 MBH  
Heating LWT: ..... 30.7 F  
ARI/ISO 13256-1 WLHP Heating: ..... 30.0 MBH  
ARI/ISO 13256-1 WLHP COP: ..... 5.3  
ARI/ISO 13256-1 GWHP Heating: ..... 25.1 MBH  
ARI/ISO 13256-1 GWHP COP: ..... 4.6  
ARI/ISO 13256-1 GLHP Heating: ..... 19.4 MBH  
ARI/ISO 13256-1 GLHP COP: ..... 3.8

## Electrical

Voltage: ..... 208/230-1-60 V-Ph-Hz  
Compressor LRA: ..... 60 Amps  
Compressor RLA: ..... 12.8 Amps  
Fan FLA: ..... 4.3 Amps  
Total FLA: ..... 17.1 Amps  
Max fuse amps: ..... 30 Amps  
Min Circuit Amps: ..... 20.3 Amps  
Min/Max Voltage: ..... 197-254 Volts

What do WLHP  
GWHP  
GLHP stand for?  
Need to be added to  
schedule  
Need to spec this  
as an option  
Need to sch. this

## Dehumidification

Airflow: ..... 740.0 CFM  
Total Cooling: ..... 22.2 MBH  
Sensible Cooling: ..... 15.6 MBH  
Cooling EER: ..... 13.7  
Cooling KW: ..... 1.6 kW  
Heat of Rejection: ..... 27.8 MBH  
Cooling LAT DB: ..... 54.5 F  
Cooling LAT WB: ..... 50.5 F  
Cooling LWT: ..... 101.9 F

## R060

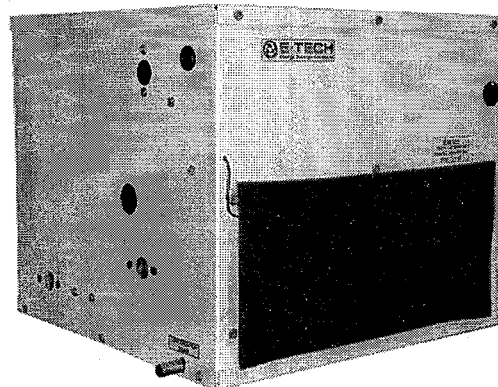
### Residential High Efficiency Heat Pump Water Heater

#### Description:

The R060 "Hot Water Cube" is an add-on heat pump water heater, designed to be mounted on a wall or shelf near a standard electric hot water heater. It is a medium capacity machine intended for the typical 1-4 person home, or where hot water demand is lower.

The R060 uses 40-70% less electricity than standard electric hot water heaters and provides cool dehumidified air as it operates. It uses an environmentally friendly refrigerant. When installed to replace a fossil fuel heater it eliminates harmful fossil fuel emissions.

The R060 is typically installed in basements, garages, workshops or large utility closets.



#### Features

- Selector switch for three modes of operation - heat pump, off (vacation mode), or electric resistance heater.
- Automatic conversion to electric heating (using storage tank elements) in a fault condition.
- Heat pump can be removed for servicing without a long interruption of the hot water supply. (The water heating is then performed by the resistive elements.)
- High refrigerant pressure protection. Unit will turn off and switch to electric resistance heating in a high pressure condition.
- Low ambient temperature protection. Unit will turn off and switch to electric resistance heating to prevent evaporator freezing.

#### Options

- **Duct Kit**  
This option allows the conditioned air to be vented to another room or into the existing ductwork. It provides higher air flow, a duct collar, 6 feet of flexible duct and a grill.
- **Freeze Protection.**  
When the ambient temperature approaches freezing, this option circulates hot water from the tank through the R060 to prevent bursting (freezing) of the water lines inside the unit. (The heat pump will still not operate below 46°F.)
- **High Ambient Protection**  
With this option, the unit will turn off and switch to resistance heating prior to a high pressure trip. It will return to heat pump mode when ambient temperatures drop.
- **Connection Kit**  
All of the accessories needed to install the R060 up to 8 feet away from the electric hot water heater.

#### Performance Data (Based on the DOE efficiency testing ambient conditions of: 67.5°F, 50% RH and 58°F entering water temperature.)

C.O.P.: 3.3 (Avg. when going from a 58°F tank to a 125°F tank.)	Recovery Rate: 9.4 gph at 135°F tank temp. 12.6 gph at 115°F tank temp.
Heating Output: 5,900 Btu/hr (nominal)	Water flow rate (internal): 1.7 gpm
Cooling Capacity: 4,100 Btu/hr	Sound level: Less than 60 db(A) at 5 feet
Dehumidification Capacity: 0.75 Pints/hr	Maximum tank temperature: 135°F

#### Components

Compressor: ½ ton (nominal) rotary hermetic with external overload protection.	Fan: 240 cfm
Condenser: Double wall - suitable for potable water, with copper water and steel refrigerant passages.	Pump: Wet rotor, 1/40 hp (nominal)
	Refrigerant: R-134a
	Filter: Washable foam

#### Ambient Operating Range

Minimum Operating Temp: 48°F +/- 2°F (Areas with high humidity may cut out at higher temperatures.)
Maximum Operating Temp: 100°F

### Electrical Data

Power: 230/208 VAC, 1 ph, 60 Hz.  
The unit is wired to the storage tank, a separate circuit is not required

FL Current: 7 Amps

### Weight & Dimensions

Weight (empty): 60 lbs.  
Shipping weight: 65 lbs.  
Dimensions: 16" w x 16" d x 14" h  
Shipping Dimensions: 20" w x 20" d x 18.5" h

### Installation Requirements

**Water Heater:** The R060 works in conjunction with a standard electric water heater and uses the water heater thermostats and storage tank. It also uses the upper heating element for backup operation.

The requirements of the electric water heater are:

- Minimum 40 gallon storage tank, larger is generally better.
- Maximum tank element size of 6000 Watts.
- Operate on 230/208 VAC, 1 ph, 60 Hz power.
- Hot and cold water connections should be 3/4" pipe thread.

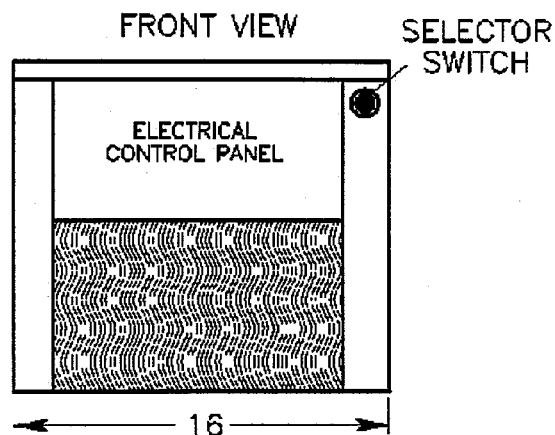
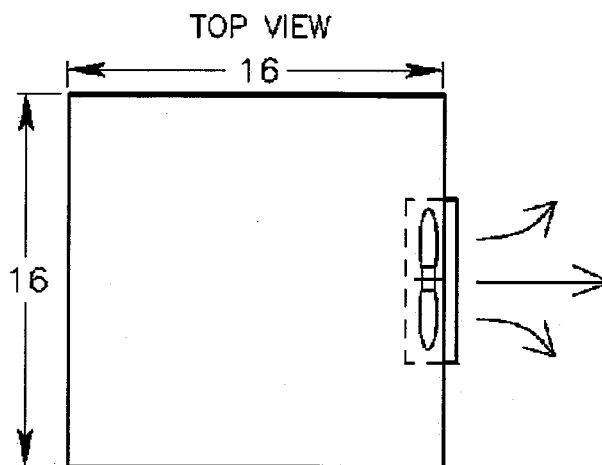
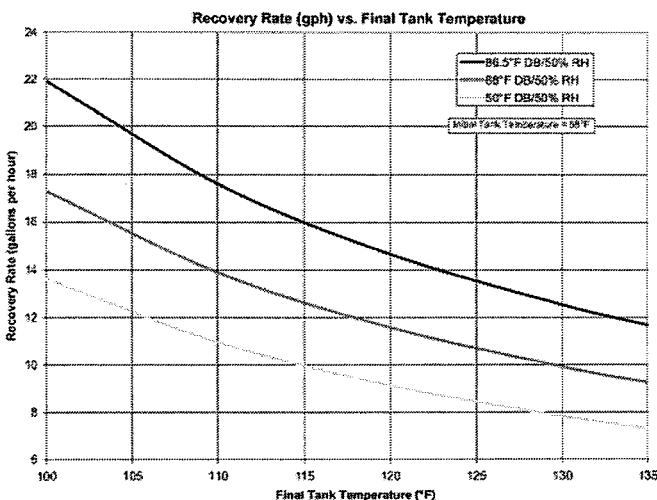
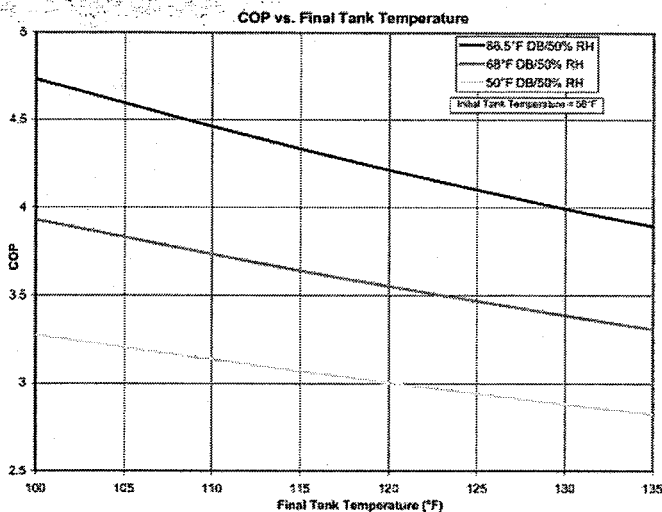
**Clearances:** Minimum clearances for proper air flow are:

- 24" in front of fan, 24" in front of evaporator. Allow adequate clearance on top for servicing.

**Location:** The R060 must be sheltered from the weather.

A minimum of 1,000 cubic feet of space is recommended - smaller spaces will require vents or ducting.  
A condensate drain or pump is required.

### Operating Curves & Dimension Drawing



Specifications are subject to change without notice.

(R060 10-06)

Applied Energy Recovery Systems, Inc.-6670A Corners Industrial Court - Norcross GA 30092

Phone: (770) 734-9696 Fax: (770) 453-9323 www.aers.com

MORNINGSTAR

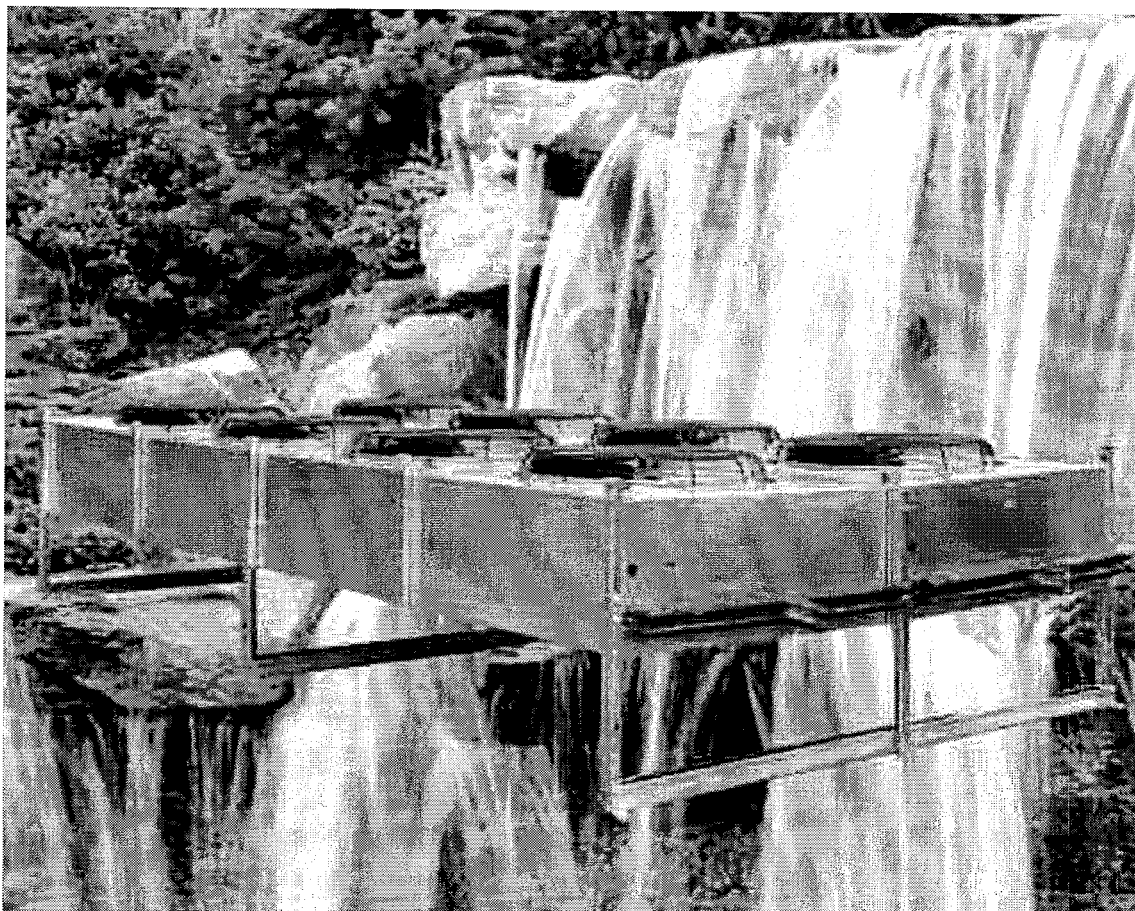


**FS/FD**

## Air-Cooled Fluid Cooler

Catalog 710.1

\*More info to be  
provided after final  
selection



### **Consider The Possibilities ...**

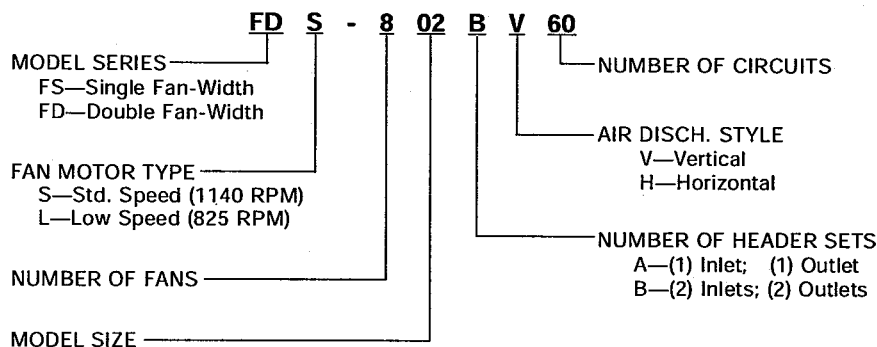
- Cools most any non-corrosive fluid
- Closed-circuit cooling avoids contamination
- Cold weather economizer for interior cooling loads
- HVAC and computer room air conditioning
- Industrial cooling applications
  - Cutting fluids
  - Machinery cooling jackets
  - Electrical gear



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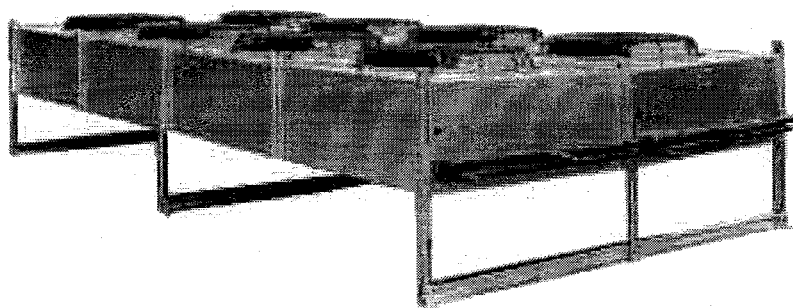
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## NOMENCLATURE





# FS/FD

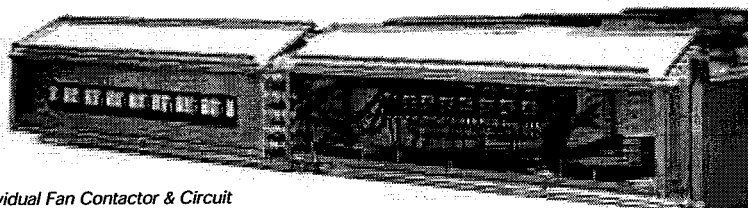


## STANDARD FEATURES

- Direct Drive Fans  
1140 RPM—Model FSS/FDS  
825 RPM—Model FSL/FDL
- Horizontal Air Discharge available
- Single and Double Fan-Width models
- 45 Model Sizes
- Shipped in operating position (Vertical Discharge)
- Hoisting Eyes for easy rigging
- Galvanized Steel Casing and Frame

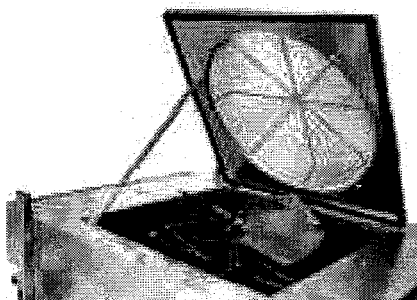
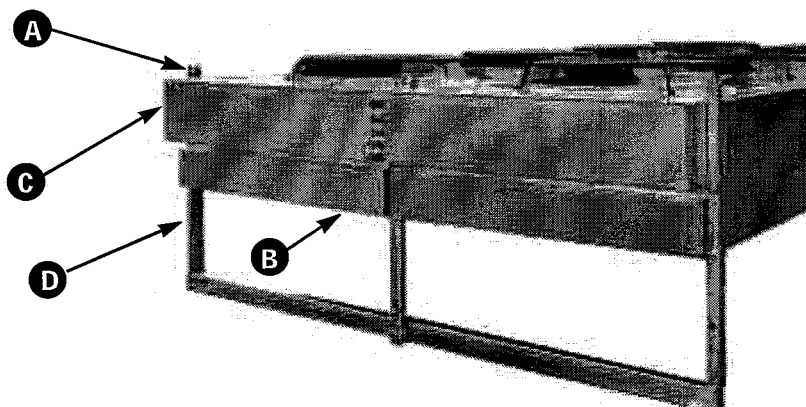
## TYPICAL FAN CYCLING CONTROL PANEL

- Standard Location — Header End. (Side or Opposite-to-Header-End Mount available)
- Weather-Tight Enclosure
- Options:
  - Temperature Controls
  - Variable Speed Control (Lead Fans)
  - Custom Wiring and Logic
  - Motor Fusing or Circuit Breakers
  - Motor Contactors
  - Control Transformers



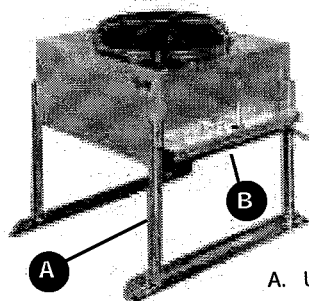
Individual Fan Contactor & Circuit Breaker option shown

- A. Hoisting Eye
- B. Return Bend Cover (UL required)
- C. Hinged Control Panel Cover
- D. 10 Ga. Legs and Cross-supports



## 'FLIP-TOP' VENTURI PANELS

- Makes Coil Cleaning Quick & Thorough  
Dirt can be flushed back thru the coil to avoid coil plugging.
- Permits Easy Fan and Motor Service



- A. Universal Mounting Legs  
Horizontal or Vertical
- B. Header Guard (UL Required)

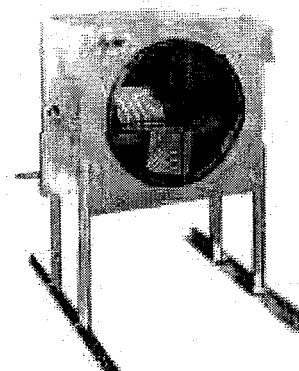
## Small Frame Models

### DUAL FAN UNITS

- 8 thru 12 Tons — Standard Fan-Speed Models
- 6 thru 9 Tons — Low Fan-Speed Models

### SINGLE FAN UNITS

- 1 thru 5 Tons — Standard Fan-Speed Models
- 1 thru 4 Tons — Low Fan-Speed Models



Heavy Gauge Galvanized Steel Casing & Legs

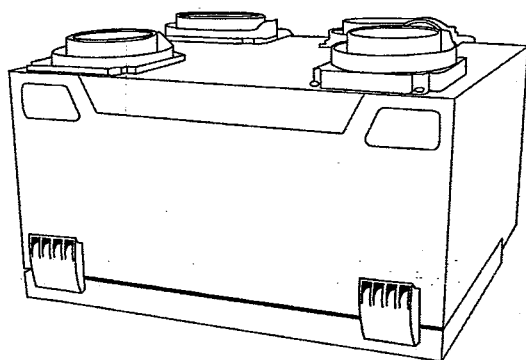
# ERVCCSVA, ERVCCSHA Energy Recovery Ventilators



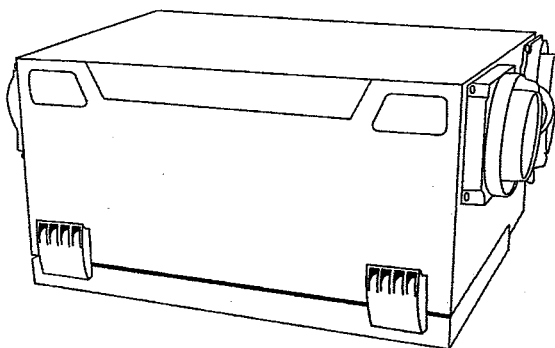
Turn to the Experts.

ERV-1

## Product Data



ERVCCSVA



ERVCCSHA

The Energy Recovery Ventilation (ERV) system offered by Carrier is the finest on the market today. The ERV provides efficient and cost effective heat recovery during the heating season when needed most.

As temperatures drop below 23°F (-5°C), indoor air is recirculated periodically through the heat exchanger core to prevent frost from forming. Competitors' methods of supplementary electric defrost waste energy. Unlike rotary wheel heat exchangers which mix air streams, these cross-flow or counterflow heat exchangers ensure that there is no mixing of the stale air stream with the fresh outdoor air stream.

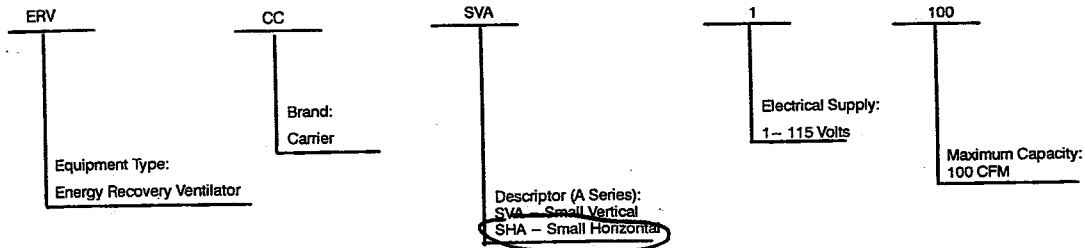
A filter installed on the incoming outdoor air stream removes large airborne particles from the intake air stream before they enter the heat exchanger and reduces the maintenance required. The units' acoustically engineered design makes the Carrier ERV the quietest on the market and ensures that comfort is felt, not heard.

Unlatching two (2) suitcase style latches allows easy removal of the filters and core for cleaning.

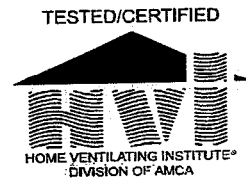
### STANDARD FEATURES

- Drainless design
- Integrated airflow balancing points
- Integrated furnace interlock
- High pressure blowers
- Onboard control for continuous high/low ventilator operation
- Energy saving defrost cycle
- Cross-flow, counterflow heat exchangers
- One filter on incoming air; one filter on outgoing air to protect core
- No-tools maintenance
- Enthalpic heat exchanger core

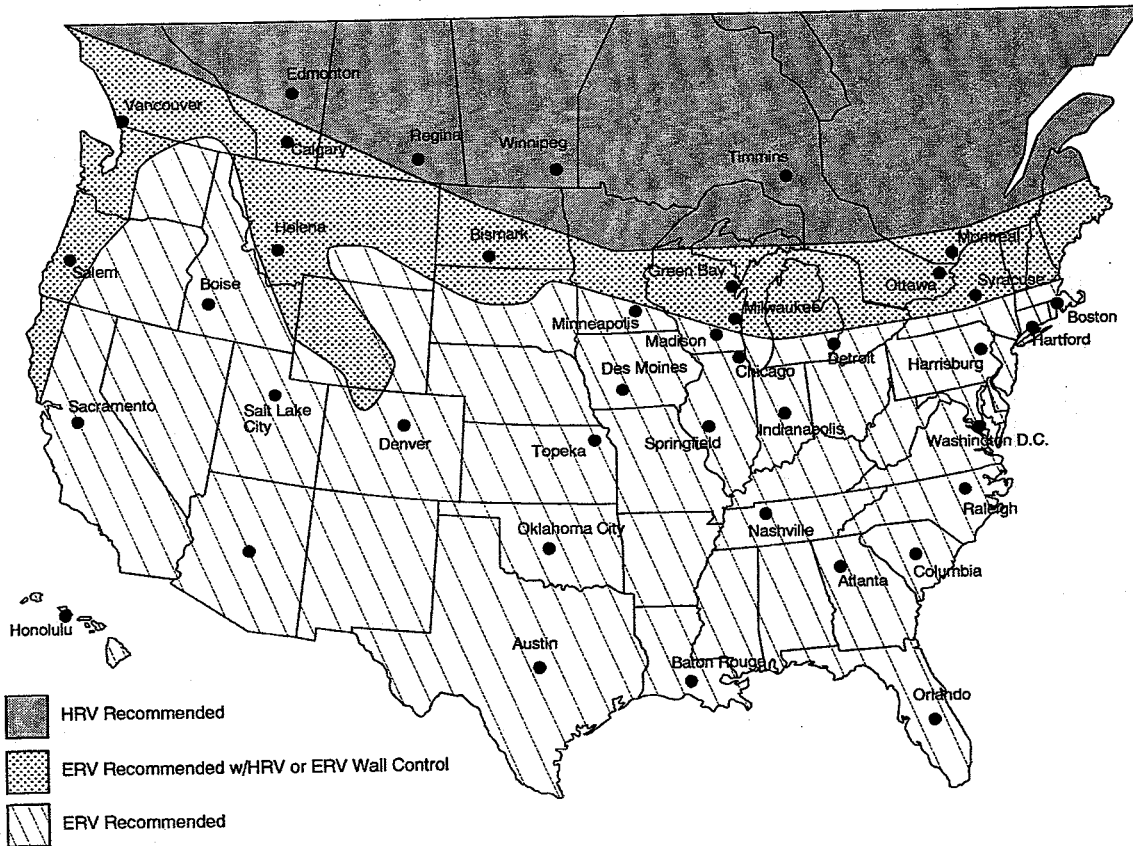
## Model number nomenclature



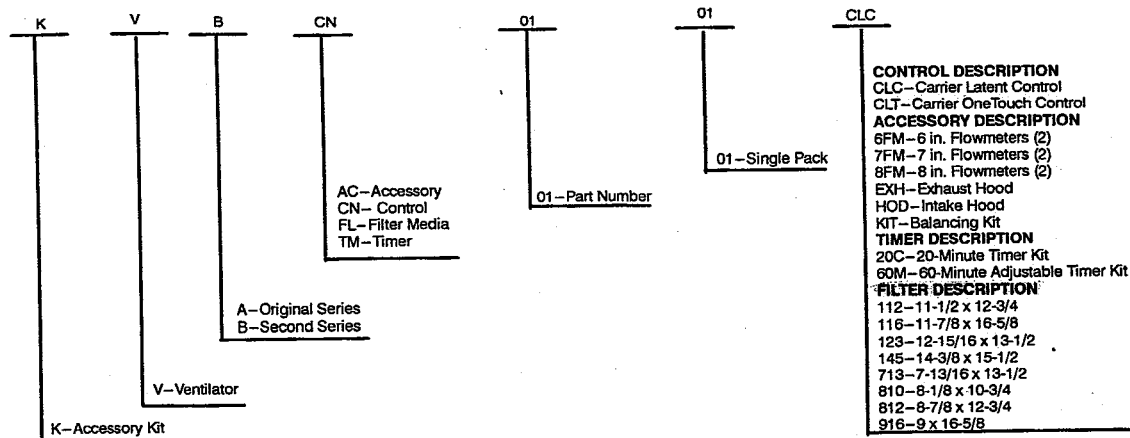
ERV



## Climate Map for Energy and Heat Recovery Ventilators



## Controls and accessories part number nomenclature



ERV

Kit Number	Description	Where Used
KVBCN0101CLT	Carrier OneTouch Control	Used with all ERVs as a main wall control <i>only to turn on</i>
KVACN0101CLC	Latent Control	Used with all ERVs
KVAAC0101HCO	Intake and Exhaust Hood	Used as a single intake/exhaust for ERVCCSVA1100, ERVCCSHA1100 only.
KVAAC0101HOD	Exterior Intake and Exhaust Hood	2 Required
KVATM010120C	20 Minute Push Button Timer	Used with all ERVs when 20 minute manual operation is required
KVATM010160M	60 Minute Timer	Used with all ERVs, time is adjustable between 10 and 60 minutes
KVAAC0101KIT	Start-Up Balancing Kit	Start up Balancing Kit, includes (2) 6 in. Flow Meter Collars & Magnehelic Gage
KVAFK0101100	Internal Filter	Used with ERVCCSHA1100, ERVCCSVA1100 Unit 10 1/2 in. x 6 3/4 in. x 1/2 in.

Control Description	Fan Speed Control	Humidistat Control	Continuous Mode	Intermittent Mode
OneTouch	Yes	No	Yes	Yes
Latent	Yes	Yes	Yes	Yes

## Control features

### OneTouch Control:

Allows control of ventilator with the touch of a button. This control will operate as a main wall control. The OneTouch will operate the unit in Intermittent Mode (20 minutes per hour), continuous low speed, continuous high speed, and off.

### Latent Control:

**Low Exchange Mode**—If the relative humidity inside the building is lower than selected, air exchange would occur with the outside at high speed. If the relative humidity inside the building is higher than selected, air exchange would occur with the outside at low speed. This ensures continuous air exchange for constant air quality.

**Intermittent Mode**—If the relative humidity inside the building is higher than selected, no air exchange would occur and the system

would turn off. If the relative humidity inside the building is lower than selected, air exchange would occur with outside at high speed. This mode is ideal for maintaining the proper humidity level when the continuous mode cannot.

## Automatic Defrost Cycle Features

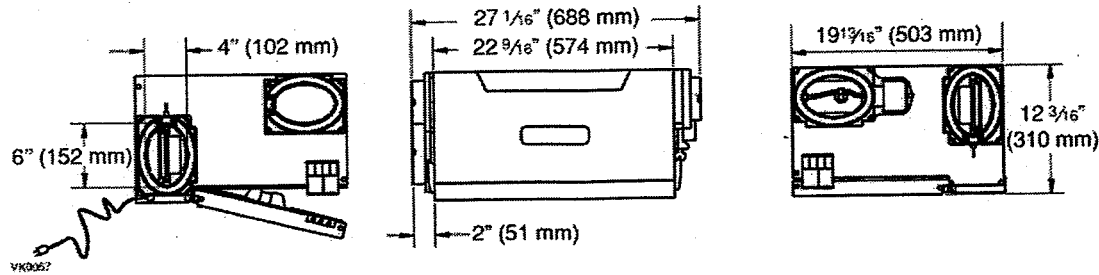
All models offer a non-electric defrost cycle feature which prevents frost and ice buildup within the heat recovery core. When the outside air temperature falls below 23°F (-5°C) it is electronically sensed and the dampers close the outside air ports. This allows warm indoor air to recirculate within the heat recovery core. The frequency of this cycle increases as the outside air temperature decreases.



Model	25°F TO 55°F (-5°C TO -15°C)		4°F TO -17°F (-15.6°C TO -27.3°C)		BELOW -18°F (-27.8°C)	
	DEFROST*	EXCHANGE†	DEFROST*	EXCHANGE†	DEFROST*	EXCHANGE†
ERVCCSHA	6 Minutes	60 Minutes	6 Minutes	32 Minutes	6 Minutes	20 Minutes
ERVCCSVA	6 Minutes	60 Minutes	6 Minutes	32 Minutes	6 Minutes	20 Minutes

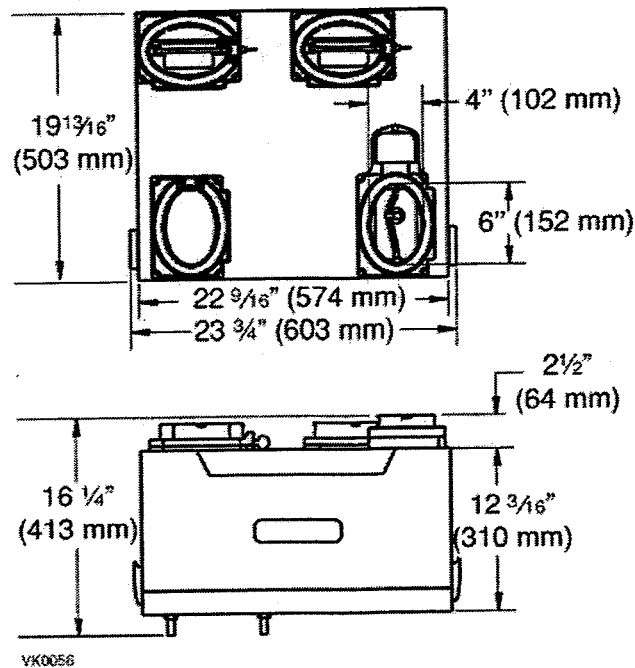
\* All defrost times are in the standard mode (as shipped)

† Time between defrost when within specified temperature range



A05426

Fig. 1 - ERVCCSHA Unit Dimensions



A05425

Fig. 2 - ERVCCSVA Unit Dimensions

# Physical data

HORIZONTAL  
UNIT

Model	ERVCCSVA1100	ERVCCSHA1100
Port Locations	Top	Side
Core Type	Enthalpic transfer media with plastic stack	Enthalpic transfer media with plastic stack
Weight — lb (kg)	42	42
Shipping Weight — lb (kg)	48	48
Shipping Dimensions (in.)		
Height	25.5	30.0
Width	17.5	15.0
Depth	23.0	23.0

Model	ERVCCSVA1100	ERVCCSHA1100
Capacity—CFM @ 0.5-0.3ESP (in. wc)	99-107	99-107
Efficiency (Sensible)—Percent 32°F (0° C) -13°F (-25° C)	67	67
Efficiency (Latent)—Percent @ all temperatures	60	60
Heat Core Exchange Area— cu ft (cu m)	56 (5.2)	56 (5.2)

Model	ERVCCSVA1100	ERVCCSVA1100
Voltage	120	120
Max Power — watts	150	150
Max Amps	1.3	1.3

ERV

1- 858-259-8895

2(a,b,c)

Butler Sun Solutions

• HOME • SYSTEM COMPONENTS • SYSTEM INSTALLATIONS • FEATURED PRODUCTS •

SYSTEM DOCUMENTATION • TO ORDER • What's New •

\$240

OTP-1

# Integrated Over-temperature/Over-pressure Radiator System

## Integrated Over-temperature / Over-pressure system (Patent Pending)

Standard Automotive Radiator Cap

Fluid Overflow Recovery Reservoir Tube

Finned Copper Radiator Housing

**A Butler Sun Solutions Exclusive Product!**

The unit includes its own radiator and fluid overflow and recovery tank.

Compression 3/8-inch tube fitting to the collector is on the left end. Finned Copper radiator provides for heat removal from collector if pump stops. A standard automotive radiator cap is used to vent into and recover fluid from the bottom of the fluid overflow recovery reservoir tube on the right end. A filler plug in the reservoir allows the fluid level to be checked and filled if needed.

Integrated Over-temperature/Over-pressure radiator system (Patent Pending) shown here.

Jeff Mearns  
5/31/07 H&W

\* Need to determine location

\* device must be located @ the highest point in the loop

\* must be on high point of roof

\* See pg 27

What are the dimensions of the device?

• get one of these? - to test?

→ Could retrofit on Child Care Center in MT

→ Check w/ DR

• this may work better w/ MT OR better than FTR on roof of Solar

• definitely MT  
→ get 2 - one for Solar D also

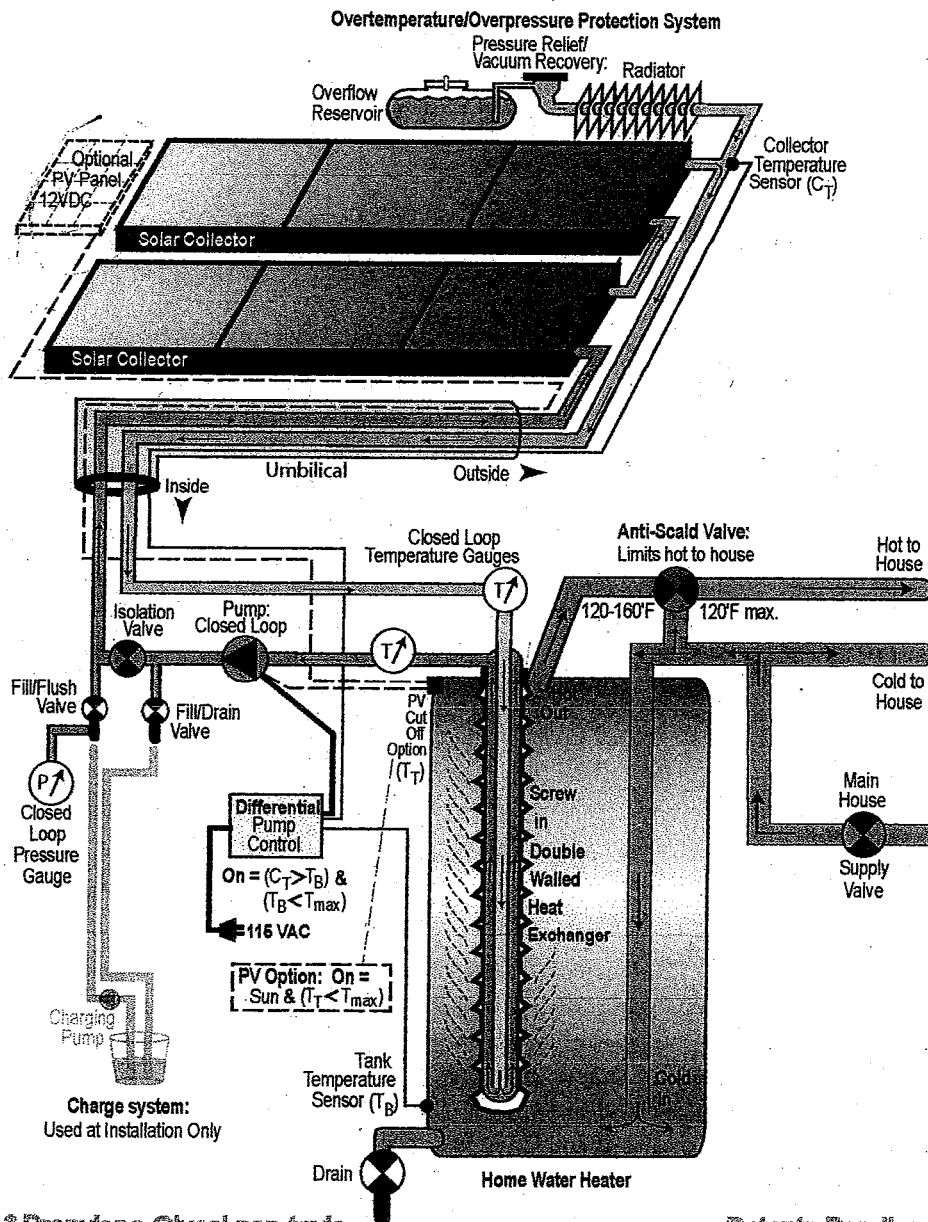
Close Window

\* need to forward info to Leidy Autumn

\* get 2 of these

→ put into Solar D design instead of FTR

# CLOSED LOOP ANTIFREEZE\* SOLAR ASSIST FOR HOME HOT WATER HEATERS



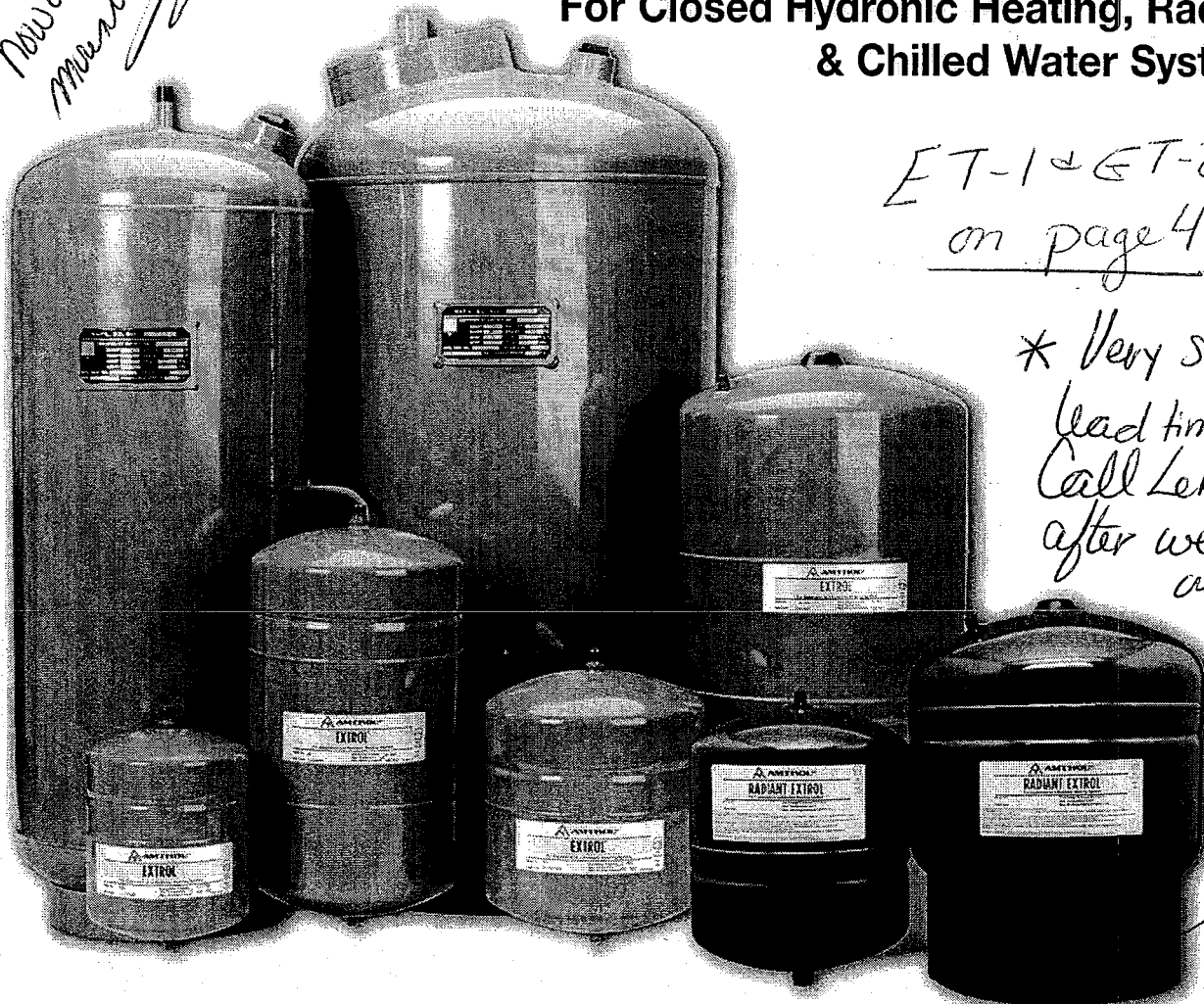
\* Propylene Glycol non-toxic

Patents Pending



# EXTROL® EXPANSION TANKS

For Closed Hydronic Heating, Radiant  
& Chilled Water Systems



*How are these  
mounted / supply  
\* Will have ET-1 & 2  
donated by  
LeRoy*

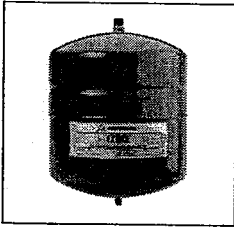
*ET-1 & ET-2  
on page 4*

*\* Very short  
lead time —  
Call LeRoy  
after we have  
our system  
built*

*that way  
tanks are  
sized  
properly!*

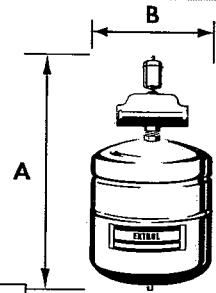
*→ For final  
selections  
of tanks*

# Residential Models and Packages



## EXTROL®

- Factory pre-charged to 12 psig
- Maximum working pressure: 100 psig
- Maximum operating temperature: 240°F



EXTROL Package

### EXTROL Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Height (Inches)	B Diameter (Inches)	System Conn. <sup>1</sup> (Inches)	Shipping Weight (lbs.)
15	2.0	0.9	12 1/2	8	1/2	5
30	4.4	2.5	15 1/2	11	1/2	9
60	7.6	2.5	23	11	1/2	14
90	14.0	11.3	21	15 1/2	1/2	23

### EXTROL Combination Packages

Model Number	Extrol Model	Purger Model	Vent Model	Ship. Wt. (lbs.)
1500/1 or 1 1/4	15	443 or 444	700-C	9
3000/1 or 1 1/4	30	443 or 444	700-C	14
6000/1 1/4	60	444	700-C	19
6000/1 1/2	60	445	700-C	19

<sup>1</sup> System Connection is NPTM

## Sizing the EXTROL

Sizing Based on BTU's

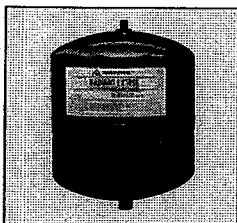
BOILER Net Output in 1000'S of BTU/Hr.	TYPE OF RADIATION			
	Finned Tube Baseboard or Radiant Panel	Convectors or Unit Heaters	Radiators Cast Iron	Baseboard Cast Iron
MBH	Use Model	Use Model	Use Model	Use Model
25	15	15	15	15
50	15	15	30	30
75	30	30	30	60
100	30	30	60	60
125	30	60	60	90
150	30	60	90	90
175	60	60	SX-30V	SX-30V
200	60	60	SX-30V	SX-30V
250	60	90	SX-30V	SX-40V
300	90	SX-30V	SX-30V	SX-40V
350	SX-30V	SX-30V	SX-40V	SX-60V
400	SX-30V	SX-40V	SX-40V	SX-60V

Sizing based on: • Fill Pressure 12 psig • Relief Pressure 30 psig • Average System Temp. 200°F  
• System filled with water • Consult factory for compatibility and sizing for other fluids.

### Sizing Based on Maximum System Temperature

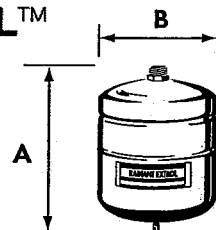
Max. System Temp. °F	System Water Content in Gallons			
	Model 15	Model 30	Model 60	Model 90
100	125	275	417	876
110	93	205	311	653
120	72	158	239	502
130	58	128	194	407
140	48	105	160	336
150	40	89	134	282
160	34	76	115	241
170	30	65	99	208
180	26	57	87	182
190	23	51	77	161
200	20	45	68	143
210	18	40	61	129
220	17	37	55	116
230	15	33	50	106
240	14	30	46	96

Sizing by system temp. based on: • Max. Operating Temperature 240°F • Fill Pressure 12 psig • Relief Pressure 30 psig • Water Fill Temperature 40°F



## For Radiant Systems, Use RADIANT EXTROL™

- Specifically designed for high-efficiency radiant systems
- Plastic liner compatible with barrier and non-barrier systems
- Suitable for use in glycol applications
- Non-ferrous system connection for corrosion resistance
- Maximum working pressure: 100 psig
- Maximum operating temperature: 200°F



RADIANT EXTROL

### RADIANT EXTROL Tanks for Radiant Systems

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Height (Inches)	B Diameter (Inches)	System Conn. <sup>1</sup> (Inches)	Shipping Weight (lbs.)
RX-15	2.0	0.9	12 1/2	8	3/4	5
RX-30	4.4	3.2	15 1/2	11	3/4	9
RX-60	10.3	10.3	19 1/4	15 1/2	1	23

<sup>1</sup> System Connection is NPTM

### Radiant Extrol Quick Sizing Chart

Feet of Tubing	Nominal Pex Tubing Size				
	3/8"	1/2"	5/8"	3/4"	1"
1000	RX-15	RX-15	RX-15	RX-15	RX-15
5000	RX-15	RX-15	RX-15	RX-30	RX-30
7500	RX-15	RX-15	RX-30	RX-30	RX-30
10000	RX-15	RX-30	RX-30	RX-60	RX-60
14000	RX-15	RX-30	RX-60	RX-60	
18000	RX-30	RX-60	RX-60	RX-60	
22000	RX-30	RX-60	RX-60		
30000	RX-30	RX-60			

Based on 120°F operating temp. with 12psi fill and 30psi relief valve.  
For glycol applications, consult AMTROL Technical Support.



order from Krentzman

Sterling Hydronics  
413-568-9571

Just order there  
also?

PTD-2

# DESIGNLINE

11  
11  
8

Lori  
Castello  
↳ left message 4/20/67

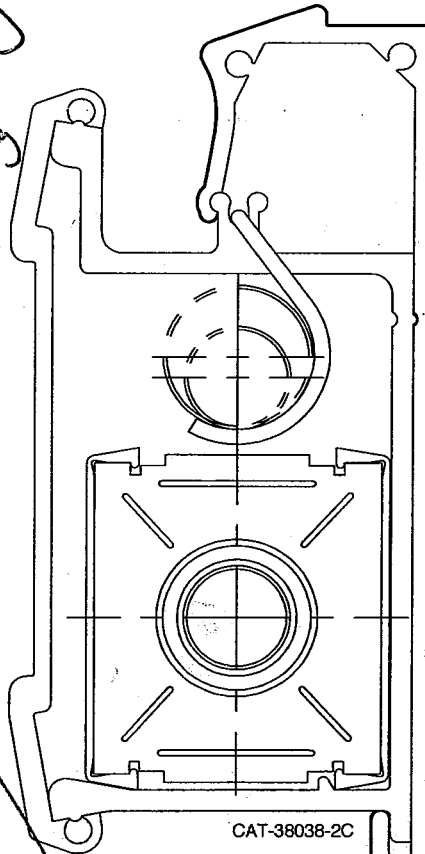
DESIGNED TO LAST FOREVER

~~Call  
PR Day~~

## Performance and Technical Data

### Bathrooms

Local Rep  
Economy Plumbing Heating  
1-215-848-5600  
↳ not in stock - is checking on \$ for me



### Kitchens

ONLY  
ELEMENT AND  
CLIP TO  
BE USED,  
• NOT ENCLOSURE

• 4-5FT elements  
• Cost between w/ or w/o enclosure?

• each 5FT w/ enclosure  
\$40 per piece  
↳ Germantown

↳ need the physical card  
\* try Local plumbing supply co.

2- 5FT elements  
↳ will allow  $\approx 6"$  on each side  $\approx 5"$  between

Can be  
butted right  
up to  
each other

"Everywhere Baseboard Takes a Beating"

## SPECIFICATION AND SUBMITTAL

### MATERIAL AND CONSTRUCTION

#### Enclosure Assembly

The entire enclosure assembly components are made of heavy gauge extruded 6063T5 clear anodized aluminum.

#### Finish

The standard finish supplied on all of the enclosure assembly and accessories is a high solid baked enamel. White and Sand Dunes (tan) are the standard colors. Consult factory for special or custom colors.

#### Backplate

The backplate is designed to provide the basic backbone to the entire assembly. Its form is extruded, providing a minimum thickness of 10 gauge (.100) throughout. Incorporated in its design are alignment slots that will receive lock-pins which will interlock with the adjoining piece of backplate or terminating end cap and/or 90° inside corner accessory. The backplate also provides mounting tracks in which the element/face plate support brackets locate and interlock.

#### Brackets

The brackets are designed to integrate with the backplate and support the element while providing a pressure lock fit with the face plate. ~~The bracket extrusion maintains a minimum thickness of 10 gauge (.100).~~ *USE this bracket to connect to steel*

#### Fronts

The extruded insert front is designed to maintain a minimum thickness of 10 gauge (.100). Its design provides a pressure lock along the length of the backplate mounted brackets.

#### 90° Inside Corner

The 90° inside corner accessory is made of die cast 380 aluminum material. The minimum wall thickness will not be less than 10 gauge (.100). Each end will fit over the enclosure assembly. Lock-pin receiver holes are provided to inter lock with the adjoining pieces of enclosure to ensure tight and positive attachment.

#### Wall Trim

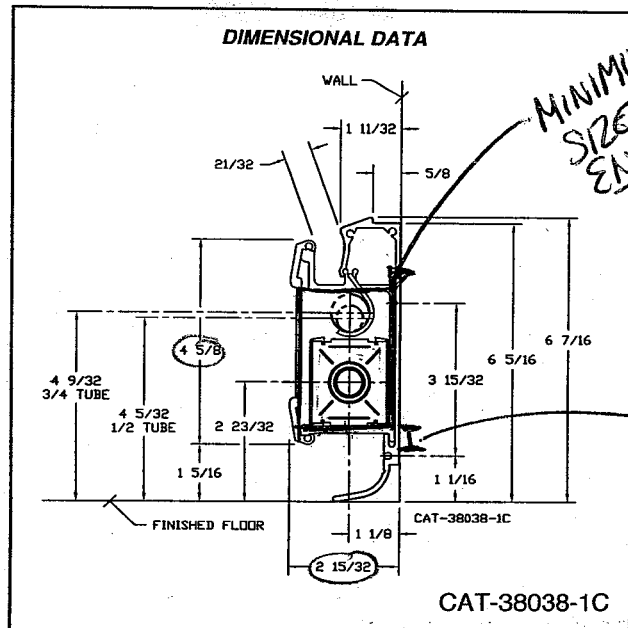
The wall piece is designed to snap fit over the enclosure assembly. It is intended to be used to start or finish the run of enclosure when terminating at a wall. The bottom of the wall trim returns back to the backplate and is secured into position with a drill point fastener supplied by Designline. The material thickness is to be no less than 12 gauge (.075) extruded aluminum.

#### End Cap

The end cap accessory is made of die cast 380 aluminum material. The minimum wall this thickness will not be less than 10 gauge (.100) thick. It overlaps the enclosure assembly and is provided with lock-pin receiver holes for tight and positive attachment. Up to 3/8" lateral adjustment can be obtained.

#### Element

The copper tube aluminum finned element is mechanically expanded to provide maximum fin contact. ~~The aluminum fin is of full collared design so that consistent spacing is provided along with maximum heat transfer. The copper tube will be~~



~~1/2" nominal O.D. with the aluminum fins shall be 1 13/16 x 1 31/32 x .009" thick.~~ There are 64 fins per foot. The fin will have air turbulence impressions over the vertical stiffening edges on the front and back.

#### Slide Shoe

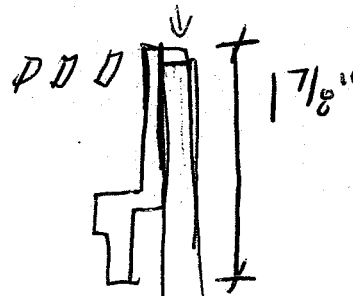
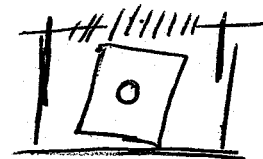
The element will be provided with two vertically mounted plastic slide shoes occurring at each bracket. These slide shoes are designed to snap into pre-cut notches in the element fins. The slide shoes provide a noise isolation effect between the element and bracket and eliminate metal to metal contact.

#### Supply/Return Hanger

The supply/return hanger provides extra support to the supply or return tube inside of the enclosure assembly. The dual loop design is made of no. 13 wire. It snaps into the lock groove formed in the bracket and allows lateral movement due to expansion and contraction to take place. Movement front to back is eliminated. The hanger will accommodate 1/2" and 3/4" copper tube.

#### Access Panel

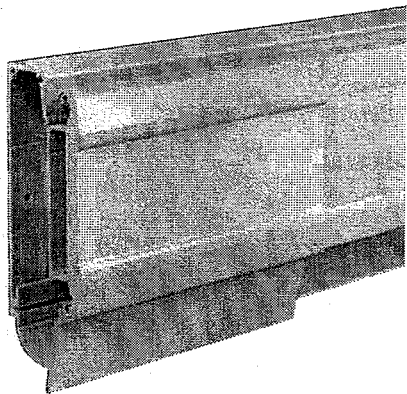
The access panel is designed to slide over the front panel and provide access to the interior area where valves or air vents are located. The material thickness is to be no less than 12 gauge (.075) extruded aluminum.



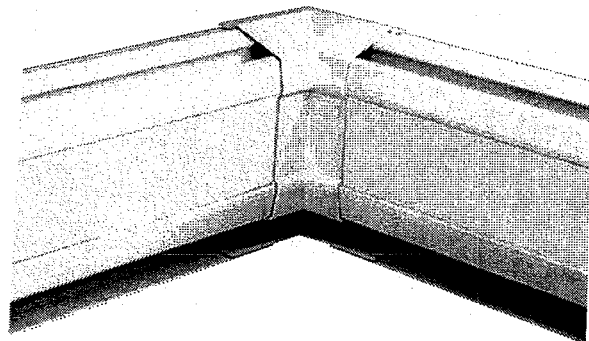


## BTU PERFORMANCE DATA

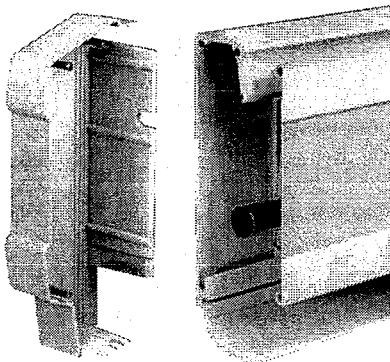
BASEBOARD RATINGS <span style="float: right;">I = B = R HOT WATER RATINGS—FORCED CIRCULATION    Based on 65°F Entering Air Temperatures</span>											
FLOW RATE	BTUH PER LINEAL FOOT OF ACTIVE LENGTH AT AVERAGE WATER TEMPERATURES INDICATED °F										
	DL-500 Assembled with 1/2" Element										
GPM	150°	160°	170°	180°	190°	200°	210°	215°	220°	230°	240°
4	270	320	370	420	470	520	560	590	610	660	710
1	260	300	350	400	440	490	530	560	580	620	670
RATING AND PRESSURE DROPS AT VARIOUS FLOW RATES											
GPM	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	
Lb. per Hr.	500	750	1,000	1,250	1,500	1,750	2,000	2,250	2,500	3,000	
I = B = R Factor to Obtain Rating at Given Flow	1,000	1,016	1,028	1,038	1,045	1,051	1,057	1,062	1,067	1,074	
DL-500 Element — P.D. Milinches Per Ft.	260	520	850	1,270	1,730	2,290	2,880	3,600	4,300	5,900	
<b>NOTES:</b> 1. The Hot Water Ratings shown are based on an active length of 7.75 ft.—The total length is 3 inches longer or 8 ft. 2. The Hot Water Capacities are obtained by actual test at 500 lbs./hr. water flow rate to which 15% has been added to obtained I = B = R. 3. The heating element P5E is 1/2" nominal diameter copper tubing with unpainted aluminum fins 1-11/16" x 1-31/32" x .009", 64 fins per foot. 4. The I = B = R Ratings at 4 gpm should not be used unless the flow rate is known to be equal to or greater than 4 gpm. Where the flow rate is unknown, the I = B = R Rating at 1 gpm (500 lb. hr.) must be used.											



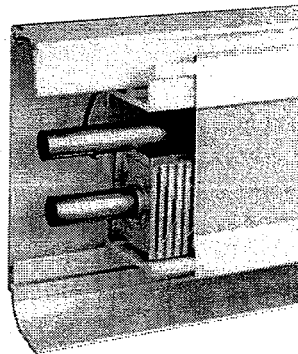
**ENCLOSURE WITH  
ACCESS PANEL**



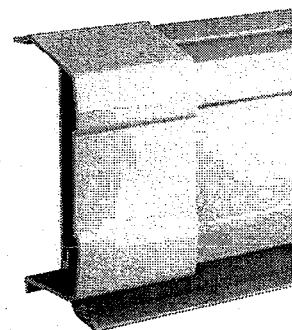
**ENCLOSURE  
WITH INSIDE CORNER**



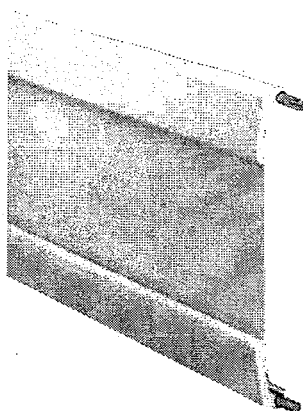
**ENCLOSURE ASSEMBLY  
WITH END CAP**



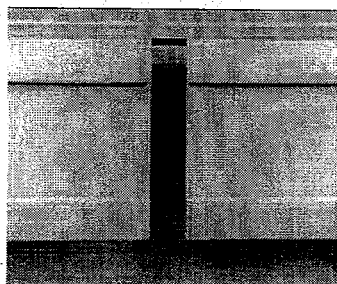
**RETURN PIPE HANGER  
IN BRACKET**



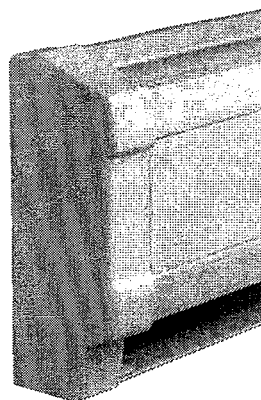
**ENCLOSURE WITH  
WALL TRIM**



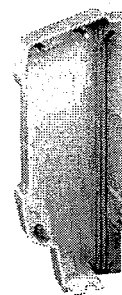
**INTERLOCKING  
FRONT PANEL**



**FRONT PANEL WITH  
PIN INSERTED**



**INTERLOCKING  
ACCESSORIES**



**END CAP WITH  
PIN INSERTED**

BASEBOARD ENCLOSURE OPTIONS	
<b>Model D-500</b>	Complete with 1/2" element with standard baked enamel paint. Available lengths 2', 3', 4', 5', 6', 7' & 8'.
<del><b>Model D</b></del>	<del>Enclosure only with standard baked enamel paint. Available lengths 2', 3', 4', 5', 6', 7' &amp; 8'.</del>
<b>Model DE-500</b>	Single 1/2" heating elements. Available lengths 2', 3', 4', 5', 6', 7' & 8'.

2  
 4

bracket is part of  
 enclosure  
 \* Can be easily cut

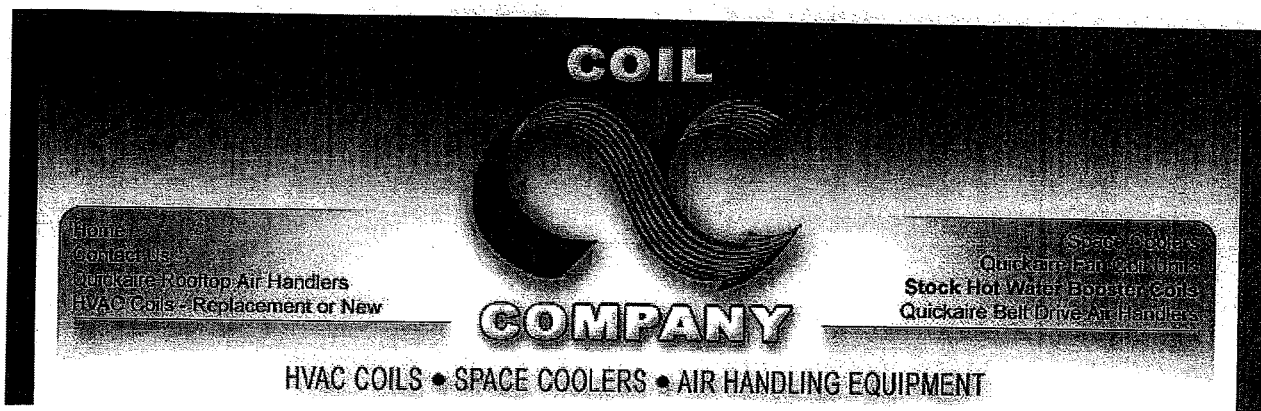
2-4' FTR-2  
 FTR-3  
 4-6'

# DESIGNLINE

DESIGNED TO LAST FOREVER

260 North Elm Street, Westfield, MA 01085  
 Tel: (413) 564-5545 Fax: (413) 562-8437

RH-1



## Stock Hot Water Booster Coils

F.H. x F.L.		Rows	Fins/Inch	
15X15		1	10	

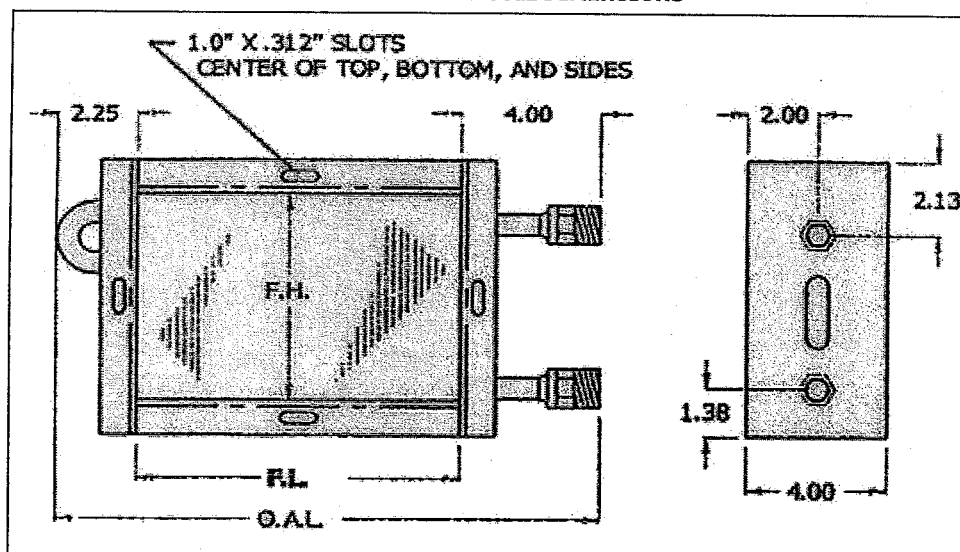
  

CFM @ 750 FPM	G.P.M. @ 180° ENT H <sub>2</sub> O	60°F EAT MBH	Water FT. Pressure Drop	CFM @ 750 FPM Steam MBH @ 2 psig
1172	3.5000	36.9000	6.2000	
1172	4.3000	38.2000	8.5200	
1172	5.1000	39.2000	11.2000	40.0000

MBH = 38.0

3 to 5 Day Shipment

### STOCK HEATING COIL DIMENSIONS



Some coils feed more than (1) tube and are header type coils.  
 THESE DIMENSIONS DO NOT SHOW HEADERS.

Coil Company, LLC  
 3223 Phoenixville Pike  
 Malvern, PA 19355

800.523.7590 [toll free]  
 610.251.0257 [local]  
 610.251.0805 [fax]

## Material Safety Data Sheet

### Genetron® AZ-20 (R-410A)

#### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** Genetron® AZ-20 (R-410A)  
**OTHER/GENERIC NAMES:** R-410A  
**PRODUCT USE:** Refrigerant  
**MANUFACTURER:** Honeywell  
 101 Columbia Road  
 Box 1053  
 Morristown, New Jersey 07962-1053

**FOR MORE INFORMATION CALL:**  
 (Monday-Friday, 9:00am-5:00pm)  
 1-800-522-8001

**IN CASE OF EMERGENCY CALL:**  
 (24 Hours/Day, 7 Days/Week)  
**Medical:** 1-800-498-5701  
**Transportation:** 1-800-424-9300

#### 2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Difluoromethane	175-10-5	50
Pentafluoroethane	354-33-6	50

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

#### 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW:** Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides

#### POTENTIAL HEALTH HAZARDS

**SKIN:** Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

**EYES:** Liquid contact can cause severe irritation and frostbite. Mist may irritate.

**INHALATION:** Genetron AZ-20 (R-410A) is low in acute toxicity in animals. When oxygen levels in air are reduced to 12-14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.



## MATERIAL SAFETY DATA SHEET

### Genetron® AZ-20 (R-410A)

**INGESTION:** Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

**DELAYED EFFECTS:** None known

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
No ingredients listed in this section			

#### 4. FIRST AID MEASURES

**SKIN:** Promptly flush skin with water until all chemical is removed. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Get medical attention if symptoms persist.

**EYES:** Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation. Get medical attention if symptoms persist.

**INHALATION:** Immediately remove to fresh air. If breathing has stopped, give artificial respiration. Use oxygen as required, provided a qualified operator is available. Get medical attention. Do not give epinephrine (adrenaline).

**INGESTION:** Ingestion is unlikely because of the physical properties and is not expected to be hazardous. Do not induce vomiting unless instructed to do so by a physician.

**ADVICE TO PHYSICIAN:** Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions.

#### 5. FIRE FIGHTING MEASURES

##### FLAMMABLE PROPERTIES

**FLASH POINT:** Gas, not applicable per DOT regulations

**FLASH POINT METHOD:** Not applicable

**AUTOIGNITION TEMPERATURE:** >750°C

**UPPER FLAME LIMIT (volume % in air):** None by ASTM D-56-82

**LOWER FLAME LIMIT (volume % in air):** None by ASTM E-681

**FLAME PROPAGATION RATE (solids):** Not applicable

**OSHA FLAMMABILITY CLASS:** Not applicable

##### EXTINGUISHING MEDIA:

Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable)

## MATERIAL SAFETY DATA SHEET

### Genetron® AZ-20 (R-410A)

#### **UNUSUAL FIRE AND EXPLOSION HAZARDS:**

Genetron AZ-20 (R-410A) is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources.

Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

#### **SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:**

Firefighters should wear self-contained, NIOSH-approved breathing apparatus for protection against possible toxic decomposition products. Proper eye and skin protection should be provided. Use water spray to keep fire-exposed containers cool.

## **6. ACCIDENTAL RELEASE MEASURES**

#### **IN CASE OF SPILL OR OTHER RELEASE:**

(Always wear recommended personal protective equipment.)

Evacuate unprotected personnel. Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation. Unprotected personnel should not return until air has been tested and determined safe, including low-lying areas.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

## **7. HANDLING AND STORAGE**

#### **NORMAL HANDLING:**

(Always wear recommended personal protective equipment.)

Avoid breathing vapors and liquid contact with eyes, skin or clothing. Do not puncture or drop cylinders, expose them to open flame or excessive heat. Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.

Genetron AZ-20 (R-410A) should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

#### **STORAGE RECOMMENDATIONS:**

Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

## **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **ENGINEERING CONTROLS:**

Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

#### **PERSONAL PROTECTIVE EQUIPMENT**

##### **SKIN PROTECTION:**

Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse.

## MATERIAL SAFETY DATA SHEET

### Genetron® AZ-20 (R-410A)

#### EYE PROTECTION:

For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear chemical safety goggles.

#### RESPIRATORY PROTECTION:

None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH - approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.

#### ADDITIONAL RECOMMENDATIONS:

Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.

#### EXPOSURE GUIDELINES

##### INGREDIENT NAME

Difluoromethane

Pentafluoroethane

##### ACGIH TLV

None

None

##### OSHA PEL

None

None

##### OTHER LIMIT

\*1000 ppm TWA

(8hr)

\*\*1000 ppm TWA

(8hr)

\* = Limit established by AlliedSignal.

\*\* = Workplace Environmental Exposure Level (AIHA).

\*\*\* = Biological Exposure Index (ACGIH).

#### OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

Hydrogen Fluoride: ACGIH TLV: 2 ppm ceiling, 0.5ppm TLV-TWA

#### 9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Clear, colorless liquid and vapor

PHYSICAL STATE: Gas at ambient temperatures

MOLECULAR WEIGHT: 72.6

CHEMICAL FORMULA: CH<sub>2</sub>F<sub>2</sub>  
CHF<sub>2</sub>CF<sub>3</sub>

ODOR: Faint ethereal odor

SPECIFIC GRAVITY (water = 1.0): 1.08 @ 21.1°C (70°F)

SOLUBILITY IN WATER (weight %): Unknown

pH: Neutral

BOILING POINT: -48.5°C (-55.4°F)

FREEZING POINT: Not Determined

VAPOR PRESSURE: 215.3 psia @ 70°F  
490.2 psia @ 130°F

VAPOR DENSITY (air = 1.0): 3.0

EVAPORATION RATE: >1

COMPARED TO: CCl<sub>4</sub> = 1

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> AZ-20 (R-410A)

**% VOLATILES:** 100  
**FLASH POINT:** Not applicable  
(Flash point method and additional flammability data are found in Section 5.)

#### 10. STABILITY AND REACTIVITY

##### NORMALLY STABLE? (CONDITIONS TO AVOID):

The product is stable.

Do not mix with oxygen or air above atmospheric pressure. Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

##### INCOMPATIBILITIES:

(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction). Chemically active metals: potassium, calcium, and powdered aluminum, magnesium and zinc.

##### HAZARDOUS DECOMPOSITION PRODUCTS:

Halogens, halogen acids and possibly carbonyl halides.

##### HAZARDOUS POLYMERIZATION:

Will not occur.

#### 11. TOXICOLOGICAL INFORMATION

##### IMMEDIATE (ACUTE) EFFECTS:

LC<sub>50</sub> : 4 hr. (rat) -  $\geq 520,000$  ppm (difluoromethane)

Cardiac Sensitization threshold (dog)  $\geq 100,000$  ppm (pentafluoroethane)

##### DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:

Teratology - negative

Subchronic inhalation (rat) NOEL - 50,000 ppm

##### OTHER DATA:

Not active in four genetic studies

#### 12. ECOLOGICAL INFORMATION

**Degradability (BOD):** Genetron AZ-20 (R-410A) is a gas at room temperature; therefore, it is unlikely to remain in water.

**Octanol Water Partition Coefficient:** Log P<sub>ow</sub> = 1.48 (pentafluoroethane), 0.21 (difluoromethane)

#### 13. DISPOSAL CONSIDERATIONS

##### RCRA

Is the unused product a RCRA hazardous waste if discarded?

Not a hazardous waste

If yes, the RCRA ID number is: Not applicable



## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> AZ-20 (R-410A)

#### OTHER DISPOSAL CONSIDERATIONS:

Disposal must comply with federal, state, and local disposal or discharge laws. Genetron AZ-20 (R-410A) is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

#### 14. TRANSPORT INFORMATION

US DOT HAZARD CLASS: US DOT PROPER SHIPPING NAME: Liquified gas, n.o.s. (Pentafluoroethane, Difluoromethane)  
US DOT HAZARD CLASS: 2.2  
US DOT PACKING GROUP: Not applicable

US DOT ID NUMBER: UN3163

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

#### 15. REGULATORY INFORMATION

##### TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: Components listed on the TSCA inventory

OTHER TSCA ISSUES: Subject to Section 12(b) export notification. May contain 0-10 ppm Ethane, 2-chloro-1,1,1-trifluoro, CAS# 75-88-7

##### SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

##### INGREDIENT NAME

No ingredients listed in this section

##### SARA/CERCLA RQ (lb.)

##### SARA EHS TPQ (lb.)

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: IMMEDIATE  
PRESSURE

##### SARA 313 TOXIC CHEMICALS:

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

##### INGREDIENT NAME

No ingredients listed in this section

##### COMMENT

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> AZ-20 (R-410A)

#### STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

#### INGREDIENT NAME

No ingredients listed in this section

#### WEIGHT %    COMMENT

#### ADDITIONAL REGULATORY INFORMATION:

Genetron AZ-20 (R-410A) is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

**WARNING:** Contains pentafluoroethane (HFC-125) and difluoromethane (HFC-32), greenhouse gases which may contribute to global warming

**Do Not vent** to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered.

#### WHMIS CLASSIFICATION (CANADA):

This product has been evaluated in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

#### FOREIGN INVENTORY STATUS:

EU - EINECS # 2065578 (HFC-125)

#### 16. OTHER INFORMATION

**CURRENT ISSUE DATE:** December, 2005

**PREVIOUS ISSUE DATE:** February, 2003

#### **CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:**

- Section 1: Updated medical emergency number
- Section 8: Updated ACGIH-TLV for HF decomposition product
- Section 15: Updated TSCA information

#### **OTHER INFORMATION:**

HMIS Classification: Health - 1, Flammability - 1, Reactivity - 0  
NFPA Classification: Health - 2, Flammability - 1, Reactivity - 0  
ANSI/ASHRAE 34 Safety Group - A1

#### Regulatory Standards:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
2. DOT classification per 49 CFR 172.101

Toxicity information per PAFT Testing

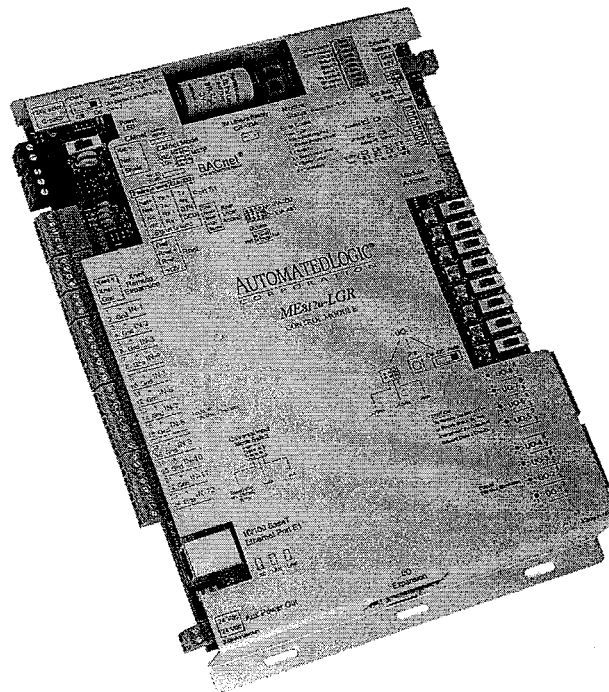
## Division 25 - Integrated Automation

25 0000 Integrated Automation  
 25 1000 Integrated Automation Network Equipment  
 25 3000 Integrated Automation Instrumentation and Terminal Devices  
 25 5000 Integrated Automation Facility Controls  
 25 9000 Integration Automation Control Sequences

CSI #	Product Type	Product Name/Model #	Manufacturer	Sample Spec Product Data	
25 3000	Mechanical Controller	ME812U-LGR	ALC		X
25 3000	Mechanical Equipment Expander	MEx88U	ALC		X
25 3000	Zone Controller	Zn551	ALC		X
25 3000	ARCNet Diagnostics Board	Diag485	ALC		
25 3000	Protection Board for ARCNet	PROT485	ALC		
25 3000	Temperature Sensors	RSP	ALC		X
25 3000	Enterprise Integration Software	N/A	ALC		
25 3000	Advanced Reporting Software	N/A	ALC		
25 3000	Web CTRL Software	Part #WC	ALC		
25 3000	Router		Linksys		
25 3000	Transformer(s)				
25 3000	Temperature Probes w/ FEP jacketed cable: Loop flow AFC-1	Remote Probe w/ Plenum Cable BA/10K-2-RPP-15'	BAPI		X
25 3000	Temperature Probes w/ FEP jacketed cable: ETA-1 outlet temp	Remote Probe w/ Plenum Cable BA/10K-2-RPP-20'-BB	BAPI		X
25 3000	Temperature Probes w/ FEP jacketed cable: Loop discharge temp at HWG	Remote Probe w/ Plenum Cable BA/10K-2-RPP-10'	BAPI		X
25 3000	Temperature Probes w/ FEP jacketed cable: Fluid outlet temp at WH-1	Remote Probe w/ Plenum Cable BA/10K-2-RPP-10'	BAPI		X
25 3000	Temperature Probes w/ FEP jacketed cable: Fluid outlet temp at HPWH-1	Remote Probe w/ Plenum Cable BA/10K-2-RPP-10'	BAPI		X
25 3000	Temperature Probes w/ FEP jacketed cable: Fluid supply temp for radiant floor (after P-5)	Remote Probe w/ Plenum Cable BA/10K-2-RPP-5'	BAPI		X
25 3000	Temperature Sensor for Solar Heat Storage Tank	Remote Probe w/ Plenum Cable	BAPI		X
25 3000	Relays				
25 3000	Discharge Air Temp/RH Sensor for ERV	J-Box, BA/10K-2-200H-D-BB	BAPI		X
25 3000	Discharge Air Temp Sensor for HP	J-Box BA/10K-2-200-D-BB, 12" length	BAPI		X
25 3000	Enclosure for controllers		Hoffman		
25 3000	Actuators for Radiant Floor System		Honeywell		
25 3000	Relative Humidity Sensor	BA/H200-RD	BAPI		X
25 3000	Carbon Dioxide Sensor	C7232A	Honeywell		X
25 3000	Actuator		Johnson Controls		
25 3000	Mixing Valve		Honeywell		
25 3000	Outdoor Air Temperature Sensor	BA/10K-2-0-BB	BAPI		X
25 3000	Weather Shield for OA Sensor	DTR-503B	Vaisala		X
25 3000	Two-position valve		Johnson Controls		
25 3000	Tempering Valves for radiant floor		Johnson Controls		
25 3000	Flow meter for ETA-1 loop	F45500 (LHN)12	Utilities Supply Co		X
25 3000	Flow meter for Solar heat Storage loop	F45500 (LHN)12	Utilities Supply Co		X
25 3000	Flow meter for HPWH loop	F45500 (LHN)12	Utilities Supply Co		X
25 3000	Flow meter for radiant floor loop	F45500 (LHN)12	Utilities Supply Co		X
25 3000	Thermal Epoxy				
25 3000	Control for Reheat Coil				
25 3000	Current Transducer for AFC-1 Fan	H822-10	Hawkeye		X
25 3000	Current Transducer for P-5	H822-10	Hawkeye		X
25 3000	Current Transducer for ERV-1	H822-10	Hawkeye		X
25 3000	Current Transducer for AFC-1 Pump	H822-10	Hawkeye		X
25 3000	Current Transducer HP-1 Fan	H822-10	Hawkeye		X
25 3000	Current Transducer to monitor status of domestic pressure pump	H822-20	Hawkeye		X
25 3000	Current Transducer to monitor status of HPWH	H8222-20	Hawkeye		X
25 3000	Connectors for OA Sensor	BA/SFC2000	BAPI		
25 3000	Temp. Gauge				
25 3000	Pressure Gauge				

# ME812u, ME812u-E, ME812u-LGR Router/Controller

Powerful Multi-Equipment Controllers



The ME812u series of controllers have the speed, power, memory and I/O flexibility to handle the most demanding control applications in the industry. Capable of controlling multiple pieces of HVAC equipment simultaneously, this robust BACnet controller can support complex control strategies with plenty of memory for trends, and is capable of third party integration using other communication protocols.

## Key Features and Benefits

- Multi-equipment capabilities for general and custom HVAC applications.
- Native BACnet communications to field devices over TCP/IP, Ethernet, high-speed ARCNET 156 Kbps or BACnet MS/TP networks.
- Universal Inputs and Outputs with Hand-Off-Auto override.
- Flexible communication port configurations are available for communications to field controllers and routing to other BACnet and non-BACnet devices.
- Easy third-party integration using Automated Logic's extensive library of integration drivers.
- Easy expansion of I/O using up to five MEx I/O expansion modules in a stack panel configuration or remote mounted up to 100ft away for scalable solutions.
- First MEx I/O expander can be mounted directly on top of the ME812u controller, reducing control panel space.
- 16 MByte of battery backed SDRAM memory for control and extensive trending, providing plant diagnostics and historical reports.
- 8 MByte Flash memory (32 bit wide) for easy field upgrades over the network.
- Battery backed real-time clock provides true standalone capabilities allowing complete recovery from power outages.
- Rnet port supports Automated Logic's line of RS room sensors and BACview<sup>®</sup> local operator interface, and provides local access to the system.
- ME812u controllers are fully graphically programmable and offer full peer-to-peer communications with other ME line, SE line or ZN line controllers. Graphical programs are universally understood and provide self-documenting control sequences.
- Tough construction delivers superior performance and reliability. Modules are constructed with a rugged aluminum cover which provides optimum electrical protection and noise immunity.

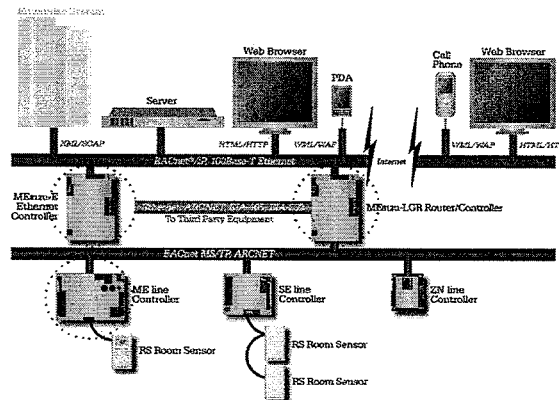
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# ME812u, ME812u-E, ME812u-LGR Router/Controller

## Specifications



BACnet Support:	Conforms to the BACnet Advanced Application Controller (B-AAC) Standard Device as defined in BACnet 135-2001 Annex L.	
Communication Ports:	ME812u: EIA-485 port for ARCNET 156 Kbps or BACnet MS/Tp (9600 baud to 76.8 Kbps). Rnet port for RS room sensors and local BACview <sup>®</sup> operator displays. Xnet (500 Kbps) port for MEx I/O expansion modules. Local access port. ME812u-E: Ethernet port (10/100Mbps) only for BACnet over Ethernet or BACnet/IP communications. Rnet port for RS room sensors and local BACview <sup>®</sup> operator displays. Xnet (500Kbps) port for MEx I/O expansion modules. Local access port. ME812u-LGR: Ethernet port* (10/100Mbps) for BACnet over Ethernet or BACnet/IP communications. EIA-485 port for ARCNET 156 Kbps or BACnet MS/TP (9600 baud to 76.8 Kbps). EIA-232/485* configurable port for BACnet PTP. Rnet port for RS room sensors and local BACview <sup>®</sup> operator displays. Xnet (500 Kbps) port for MEx I/O expansion modules. Local access port. *Third-Party integration drivers available through Ethernet and (1) EIA-232/485 configurable port.	
Universal Inputs:	Twelve configurable universal inputs with 14-bit A/D resolution. Supported input types include: 0-5 Vdc, 0-10 Vdc, 0-20 mA, Thermistor (10k Ohm Type II), 1k Ohm RTD (Platinum, Nickel or Balco), and Dry Contact. All inputs support pulse counting up to 40 cycles per second (25mSec minimum pulse).	
Universal Outputs:	Eight universal outputs that are jumper configurable as 0-10Vdc, or 0-20mA with 12-bit A/D or 24Vdc @ 50mA relay drive. HOA (hand/off/auto) switches for all outputs, including potentiometer for manual adjustment of analog outputs.	
Expansion:	Five MEx I/O expansion modules can be connected - one mounted directly on top of the controller, mounted locally in a stack configuration or remote mounted up to 100ft away. Compatible with legacy MX I/O expanders using the 9-pin Sub-D connector only.	
Microprocessor:	Powerful 32-bit Motorola Power PC microprocessor. High performance 32-bit communication co-processor. I/O expansion CAN co-processor.	
Memory:	32-bit memory bus structure, 8 Mbyte FLASH memory, 16 Mbyte SDRAM battery backed. Battery CR123A has life of 10 years with 720 hours of cumulative power outage.	
Real-time Clock:	Battery-backed real-time clock.	
Status Indicators:	LED status indicators for EIA-232/485 communication, and low battery status. Seven segment status display for running, error, and power status.	
Module Addressing:	Rotary dip switches for intuitive network addressing of modules.	
Protection:	Built-in surge and transient protection circuitry for power, communications and I/O.	
Listed by:	UL916 (Canadian Std C22.2 No. 205-M1983), CE, FCC Part 15 - Subpart B - Class A.	
Environmental Operating Range:	-20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing.	
Power Requirements:	24 Vac $\pm$ 10%, 50-60Hz, 50VA, or 26 Vdc $\pm$ 10%, 23W. NOTE: Power consumption will increase when BACview <sup>®</sup> or other accessories are attached.	
Physical:	Rugged aluminum cover. Removable screw terminal blocks.	
Weight:	1.4 lb. (45.5 kg)	
Dimensions:	<div> <div>Overall</div> <div>Width: 7-1/2" (190mm)</div> <div>Height: 11-5/16" (287mm)</div> <div>Depth: 1-1/4" (32mm) min. panel depth</div> </div> <div> <div>Mounting Holes</div> <div>Width: 5" (127mm)</div> <div>Height: 10-7/8" (276mm)</div> </div>	

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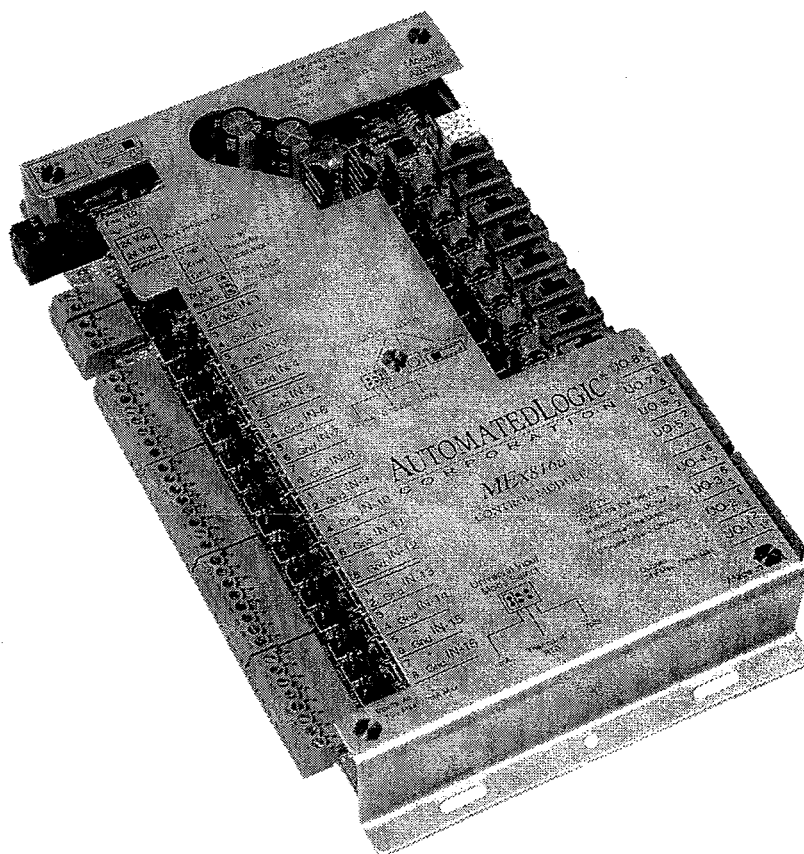
CSME812urev3

MORNINGSTAR

two of these

# MEx I/O Expander

Superior Performance and Reliability



The MEx series of I/O expanders are designed for the powerful ME series of controllers and for the most demanding control applications in the industry. The MEx I/O expanders can be remote mounted or directly mounted on the ME Controllers.

## Key Features and Benefits

- High resolution Universal Inputs and Outputs for accuracy.
- Easy expansion of I/O using up to five MEx I/O expansion modules in a stack panel configuration or remote mounted up to 100ft away for scalable solutions.
- First MEx I/O expander can be mounted directly on top of the ME812u controller, reducing control panel space.
- Removable screw connectors for easy wiring, termination and service.
- Tough construction delivers superior performance and reliability. Modules are constructed with a rugged aluminum cover which provides optimum electrical protection and noise immunity.

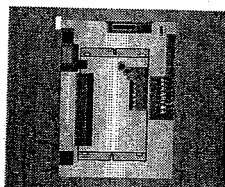
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# MEx I/O Expander

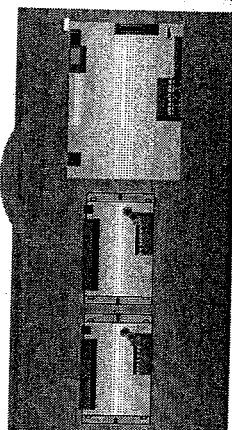
## Specifications

### Flexible Panel Configurations

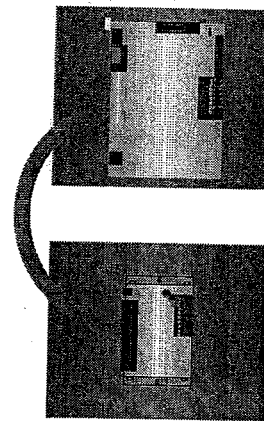


Direct Mounting

Easy expansion of I/O using up to five MEx816u expanders.



Stack Panel Mounting

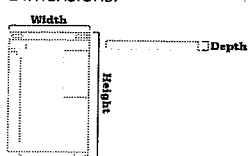


Remote Panel Mounting

Product	Universal Outputs	Universal Inputs
MEx48u	4	8
MEx88u	8	8
MEx016u	0	16
MEx816u	8	16

Communication:	Xnet I/O Expander bus for 500 Kbps communications between ME controller and I/O Expanders.
Universal Inputs:	Configurable universal inputs with 14-bit A/D resolution. Supported input types include: 0-5 Vdc, 0-10 Vdc, 0-20 mA, Thermistor (10k Ohm Type II), 1k Ohm RTD (Platinum, Nickel or Balco), and Dry Contact. All inputs support pulse counting up to 40 cycles per second (12.5mSec minimum pulse duration).
Universal Outputs:	Universal outputs that are jumper configurable as 0-10Vdc, or 0-20mAdc with 12-bit D/A or 24Vdc @ 50mA relay drive. HOA (hand/off/auto) switches for all outputs, including potentiometer for manual adjustment of analog outputs.
Expansion:	Five MEx I/O expansion modules can be connected: one mounted directly on top of the controller, mounted locally in a stack configuration, or remote mounted up to 100ft away. Compatible with legacy Mx I/O expanders using the 9-pin Sub-D connector only.
Status Indicators:	LED status indicators for Power, Run, Error, Xnet TX and Xnet Rx.
Addressing:	Rotary dip switches for intuitive network addressing of modules.
Protection:	Built-in surge and transient protection circuitry for power, communications and I/O.
Listed by:	UL916 (Canadian Std C22.2 No. 205-M1983), CE, FCC Part 15 - Subpart B - Class A.
Environmental Operating Range:	-20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing.
Power Requirements:	24 Vac $\pm$ 10%, 50-60Hz, 24VA, or 26 Vdc $\pm$ 10%, 10W. NOTE: Power consumption will increase when BACview <sup>®</sup> or other accessories are attached.
Physical:	Rugged aluminum cover. Removable screw terminal blocks.
Weight:	1.4 lb. (45.5 kg)

#### Dimensions:



Overall		Mounting Holes
Width:	4-3/4" (121mm)	Width: 2-3/4" (70mm)
Height:	9" (229mm)	Height: 8-1/2" (216mm)
Depth:	1-1/2" (38mm)	

\*two of these

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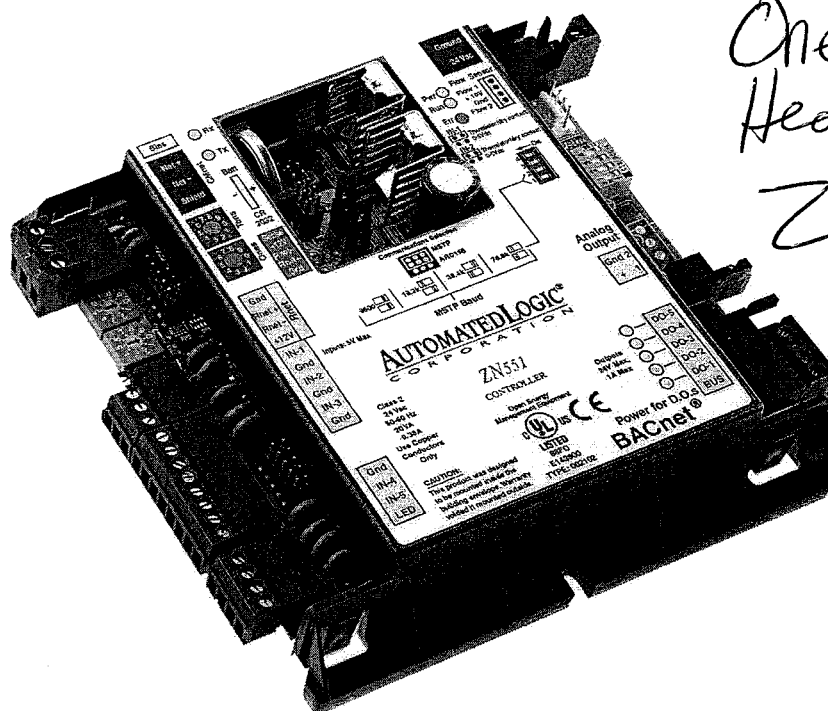
CSMEXrev1

MORNINGSTAR



# ZN551

## Zone Controller



One per  
Heating  
Zone

Automated Logic's ZN551 provides unprecedented power and flexibility through fully programmable networked controllers. The ZN551 controllers connect to the Building Automation System (BAS) network using BACnet over ARCNET 156 Kbps or MS/TP. The ZN551 supports a line of RS room sensors using Rnet port.

### Key Features and Benefits

- Powerful zone controller for VAV, heat pump, unit ventilator and other packaged HVAC applications.
- Native BACnet communications to field devices over a high speed ARCNET 156 Kbps or BACnet MS/TP network.
- Uses a high speed 16-bit microprocessor with 1 MByte Flash memory and 512 KByte of RAM for unparalleled programmability. Firmware upgrades can be downloaded remotely – no chip replacement necessary.
- The ZN551 is part of a full line of ZN controllers which include a variety of Universal Inputs, Binary Outputs and 0-10VDC Analog Outputs. Other ZN models with built-in flow sensors and/or integral damper actuators are available as well as optional single/dual air flow sensors for pressure independent VAV applications.
- Rnet port supports Automated Logic's line of RS room sensors and provides local access to the system.
- The ZN551 controller is fully graphically programmable and offers full peer-to-peer communications with other ZN-line, ME-line or SE-line controllers. Graphical programs are universally understood and provide self-documenting control sequences.
- An extensive library of pre-engineered control routines provides proven solutions for most zone control applications. Custom programs can be easily written in EIKON®, ALC's legendary graphic programming language.
- Compact and rugged plastic enclosure for easy mounting.

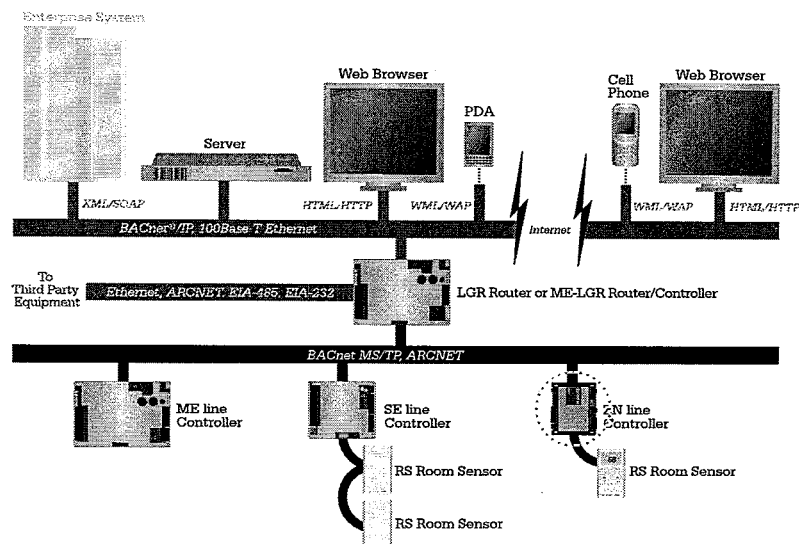
**AUTOMATED LOGIC**  
CORPORATION

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Kennesaw, Georgia 30144  
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# ZN551

## Specifications



BIBB Support:	Supports BACnet Interoperability Building Blocks (BIBBs) from the following groups: Data Sharing, and Device and Network Management.
Communication:	The following ports are available on the ZN551 module: EIA-485 port for ARCNET 156 Kbps or MS/TP (9600 bps – 76.8 Kbps). Local access port for system start-up and troubleshooting. Rnet port for RS room sensors. The Rnet port supports up to four RS sensors and one RS Pro sensor for averaging or high/low select control. NOTE: Local operator interface (BACview®) is not supported. LogiStat port for LogiStat room sensors. Two Analog Inputs are used by the LogiStat port. NOTE: The LogiStat Pro is not supported on the ZN-line (use RS Pro on the Rnet port instead).
Digital Outputs:	Five digital outputs, relay contact rated at 1A max @ 24VAC, configured normally open
Universal Inputs:	Five inputs with 10 bit A/D resolution. Two inputs are configurable for dry contact, type 2 thermistors, or 0 - 5 VDC. Inputs 4 and 5 are taken when a LogiStat sensor is connected – these inputs are available if RS sensors are used.
Analog Outputs:	One analog output, 0-10VDC with 8-bit resolution.
Microprocessor:	High speed 16-bit microprocessor with ARCNET communication co-processor.
Memory:	512 KByte non-volatile battery-backed RAM, 1 MByte Flash memory, 16-bit memory bus. (Shelf life of the battery is 10 years with 10,000 hours of continuous operation.)
Status Indicators:	LED status indicators for EIA-485 communication, running, error, power and all digital outputs.
Module Addressing:	Rotary dip switches for intuitive network addressing of modules.
Protection:	Built in surge and transient protection circuitry for power and communications.
Listed by:	UL916 (Canadian Std C22.2 No. 205-M1983), CE, FCC Part 15 – Subpart B – Class A
Environmental Operating Range:	0°F to 130°F (-17.8°C to 54.4°C); 10 -90% relative humidity, non-condensing. NOTE: Control modules should be installed within the building.
Power Requirements:	24VAC ± 10%, 50-60Hz, 20VA
Physical:	Rugged GE C2950 Cyclopol plastic.
Weight:	0.6 lb. (0.27 kg)

#### Dimensions:



Mounting hole spacing 5-9/16".

#### Overall

Width: 5-1/16" (129mm)  
Height: 5-11/16" (144mm)  
Depth: 1-1/2" (38mm) min. panel depth

#### Mounting\*

Two mounting holes center line as at left with 5-9/16" (141mm) spacing (height).

\*For indoor use only.

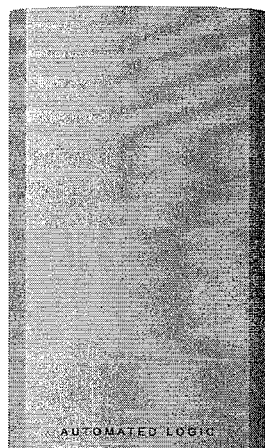
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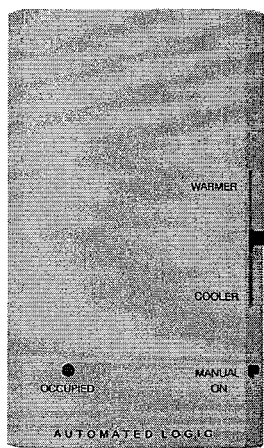
CSZN551rev5

# RS

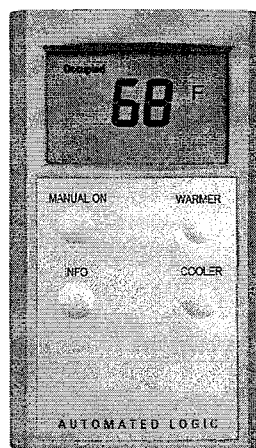
## Intelligent Room Sensors



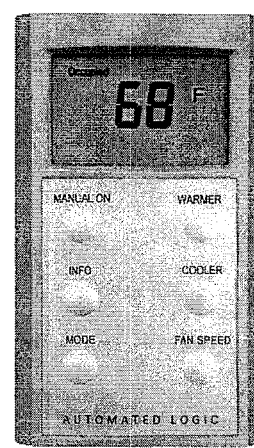
**RS Standard**



**RS Plus**



**RS Pro**



**RS Pro F**

Automated Logic's line of intelligent sensors includes the RS Standard, RS Plus, RS Pro and RS Pro F and is designed for use with the ZN, SE and ME line controllers. The RS Plus offers a local set point adjustment and override to an occupied mode and LED indication of current status. The RS Pro has a large LCD display and easy-to-use occupant controls. The RS Pro F includes additional functions ideal for fan coil units operating with multiple fan speeds. All sensors provide precision measurement and communication capabilities in attractive low profile enclosures. A hidden communications jack provides local access to the HVAC control system for commissioning and maintenance.

### Key Features and Benefits

#### All Room Sensors:

- Attractive, low profile enclosure in a neutral color complements any room.
- Precise 10K ohm thermistor with  $+ 0.36^{\circ}\text{F}$  ( $0.2^{\circ}\text{C}$ ) standard accuracy and less than  $0.18^{\circ}\text{F}$  ( $0.01^{\circ}\text{C}$ ) drift over a ten year span – requires no maintenance or re-calibration.
- A hidden communication port allows a laptop computer to be connected to the HVAC Control System.
- Multiple RS room sensors can be daisy-chained to one controller for temperature averaging or high/low select control. (One RS Plus, RS Pro or RS Pro F with up to four RS Standards.)
- Mounts on a standard 2" by 4" electrical box for easy installation.

#### RS Plus:

- Features a convenient local setpoint adjustment through an easy to use slide potentiometer.
- Occupancy override is simple using the momentary push button on the RS Plus with a bright LED for immediate indication of status. When the override button is pressed during an unoccupied mode, the zone reverts to an occupied setpoint for a predetermined period of time.

#### RS Pro/RS Pro F:

- Large, easy-to-read LCD on the RS Pro displays zone temperature, outside air temperature, heating setpoint, cooling setpoint, and local override (after-hours occupancy) time.
- Occupancy override is easy using the "Manual On" momentary pushbutton on the RS Pro. A single push switches the zone to an Occupied mode for a preset period of time. Multiple pushes increase the override time, and the LCD displays precisely how long the zone will stay occupied. The occupied time per push and maximum override time are fully programmable in EIKON®.
- Zone setpoints can be easily changed on the RS Pro by pressing the "Warmer" or "Cooler" button. How much each push affects the setpoint and the maximum total adjustments are fully programmable in EIKON.
- Pressing the "Fan Speed" button on the RS Pro F incrementally adjusts the fan speed of the fan coil unit. The "Mode" button can be used to select among several zone operation modes as programmed in EIKON.

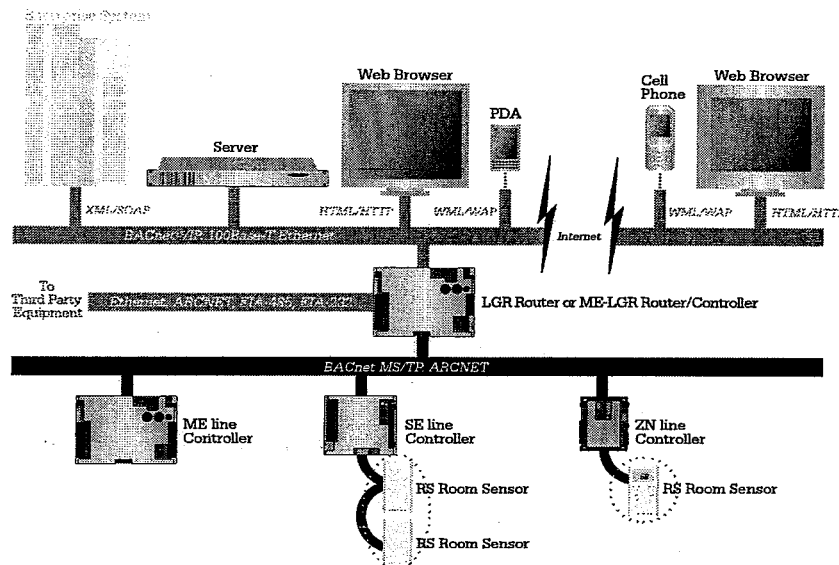
## AUTOMATED LOGIC<sup>®</sup>

C O R P O R A T I O N

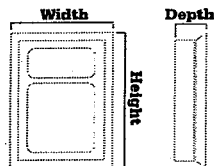
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# RS

## Specifications



Communication:	115 kbaud Rnet
Power:	ZN, SE, or ME line Controllers
Sensing Element:	Precision Thermistor. Standard accuracy $\pm 0.35^{\circ}\text{F}$ ( $0.2^{\circ}\text{C}$ ). Less than $\pm 0.18^{\circ}\text{F}$ ( $0.1^{\circ}\text{C}$ ) drift over a 10 year period.
Wiring:	Remote mounting up to 500 ft. is via four conductor shielded cables - 18 AWG if using BACview on the Rnet, 20 AWG if using only RS sensors on the Rnet.
Local Access Port:	5 pin port for commissioning and maintenance.
Mounting:	Standard 2" by 4" electrical box using 6-32 by 1/2" mounting screws provided.
Overall Dimensions:	2-3/4" (width) by 4-3/4" (height) by 5/8" (depth) (depth is a maximum 15/16"). 70mm (width) by 120mm (height) by 16mm (depth) (depth is a maximum 24mm).



Features*	RS Standard	RS Plus	RS Pro	RS Pro F
Low profile design, neutral color	✓	✓	✓	✓
Precise 10K ohm thermistor	✓	✓	✓	✓
Requires no maintenance or re-calibration	✓	✓	✓	✓
Hidden communication port	✓	✓	✓	✓
Can be daisy-chained to one controller	✓	✓	✓	✓
Mounts on a standard 2" by 4" electrical box	✓	✓	✓	✓
Convenient local setpoint adjustment		✓	✓	✓
Simple occupancy override		✓	✓	✓
Large, easy-to-read LCD			✓	✓
Easily changed zone setpoints			✓	✓
Fan speed control				✓

\*See Key Features and Benefits for specific details.

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CSRSrev7



## Features &amp; Options

- Etched Teflons Leads on the Remote Sensors
- Plenum Cable or FEP Cable on the Remote Probes
- Double Encapsulated Sensors on the Remote Probes
- Wide Selection of Temperature Sensing Elements
- Limited Lifetime Warranty

BAPI Remote Sensors feature a .85" long encapsulation shell and come with etched Teflon leads in lengths of 6", 18", 40", 5', 10', 15', 20', and 25'. Because of their small size, Remote Sensors are perfect for tight locations. Additional cable options, lead lengths and probe styles are available upon request.

Remote Probes feature a 1.75" long stainless steel probe with either Plenum-Rated Cable or FEP-Jacketed Cable. Lead lengths are 18", 5', 10', 15', 20', and 25'. Remote Probes are commonly used in refrigerated case or strap-on applications. They are ideal for hard-to-access areas or for applications where the usual Immersion or Duct Sensors do not fit well. Additional cable options, lead lengths and probe styles are available upon request.

Remote Sensors and Probes are available with a Weatherproof (WP), Weather Tight (EU) or BAPI-Box (BB) Enclosure to protect the terminations.

**For detailed specifications on the individual Sensors & Transmitters, turn to the "Sensors" Section.**

\*Some items may not be CE compliant, call BAPI for additional information.

Probe with BB Enclosure

Probe with EU Enclosure

Probe with WP Enclosure

## Specifications

## Environmental Operation Range:

-40 °C to 105 °C (Etched Teflon, Plenum-Rated & FEP Jacketed Cable)

-40 °C to 150 °C (FEP2 Jacketed Cable)

Humidity: 0 to 100%, non-condensing

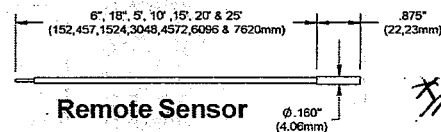
**Encl. Material:** WP Model: Cast Aluminum

EU Model: ABS Plastic, UL94, V-0

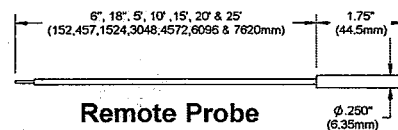
BB Model: UV-resistant polycarbonate, UL94, V-0

**Encl. Rating:** WP Model: NEMA 3R

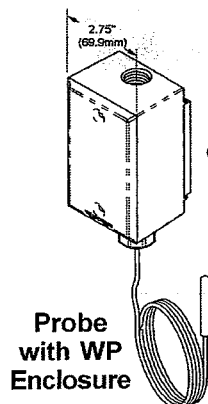
EU & BB Model: IP66



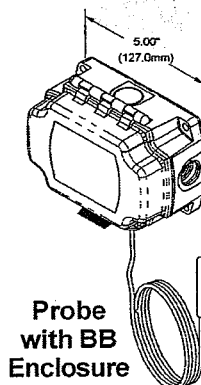
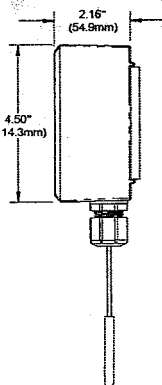
Remote Sensor



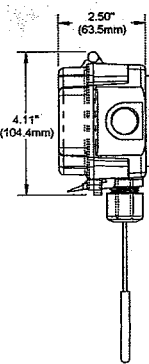
Remote Probe



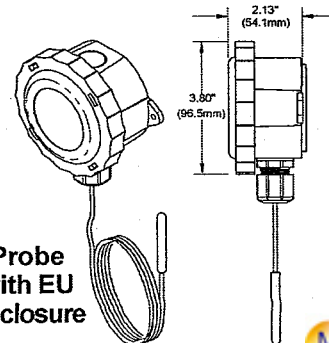
Probe with WP Enclosure



Probe with BB Enclosure



Probe with EU Enclosure





**A38**

# Duct Units

**Temperature Sensors**

Rev. 05/01/07

## Features & Options

- Mounting Tabs for Easy Installation
- Probe Lengths: 4", 8", 12" and 18"
- Series 304 Stainless Steel Probes
- Double Encapsulated Sensors
- Medical-Grade Foam Padding
- Etched Teflon Leadwires
- Several Enclosure Styles
- Wide Selection of Temperature Sensing Elements
- Limited Lifetime Warranty



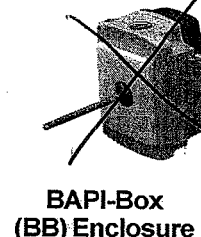
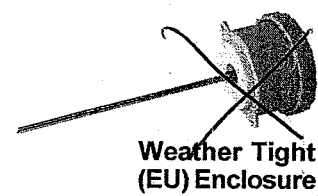
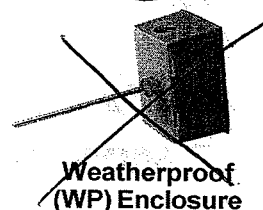
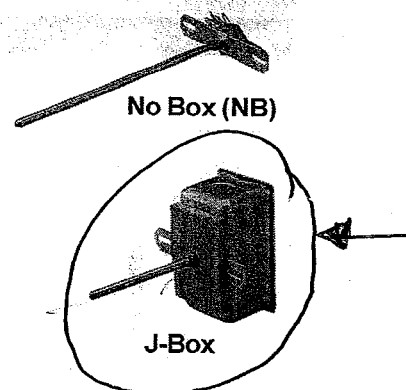
Single Point Duct Units feature medical-grade closed cell foam to seal the probe insertion hole and to absorb vibration. Mounting tabs allow for easy installation directly to the wall of the duct. All Duct Units have etched Teflon leadwires and double encapsulated sensors to create a watertight package that can withstand high humidity and condensation and perform under real world conditions. Duct Units have probe lengths from 4" to 18" to accommodate most duct shapes and sizes. Custom probe lengths are also available.

### Enclosure Styles

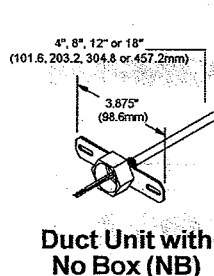
Duct Units come standard with a 2"x4" steel J-Box but are also available with no box or three styles of enclosure: Weatherproof (WP), Weather Tight (EU) or BAPI-Box (BB). The metal WP enclosure carries a NEMA 3R rating, while the ABS polymer EU carries an IP66 rating and is available in a UV-resistant material (EUO). The BAPI-Box (BB) is made of UV-resistant polycarbonate and carries an IP66 rating. BAPI also offers optional liquid-tight fittings. For a comparison of the enclosure styles, please see the App. Notes section.

**For detailed specs on the individual Sensors & Transmitters, turn to the "Sensors" section.**

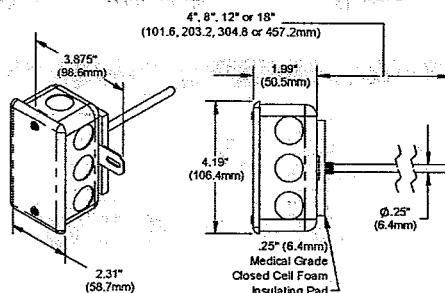
\*Some items may not be CE compliant, call BAPI for additional info.



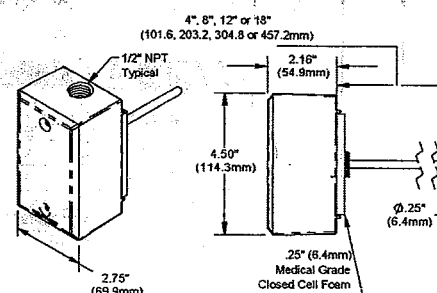
## Specifications



**Duct Unit with No Box (NB)**



**Duct Unit with J-Box**



**Weatherproof (WP) Duct Unit**

### Enclosure Material:

WP Model: Cast Aluminum  
BB Model: Polycarbonate  
EU Model: ABS Plastic  
J-Box Model: Galv. Steel

### Enclosure Rating:

WP Model: NEMA 3R  
EU Model: IP66  
BB Model: IP66

### Environmental Operation Range:

Temperature: -40 °C to 100 °C  
Humidity: 0 to 100%, non-condensing

### Enclosure Material Rating:

BB & EU Models: UL94, V-0

B4

# Delta Style Room Units

Humidity & Combination Temp/Humidity Sensors

Rev. 06/05/07

## Features & Options

- Low Profile Delta Style Enclosure
- Humidity Only or Temp./Humidity Combo
- LCD Readout (optional)
- 2% and 3% RH Accuracies
- Communications Jack (optional)
- User Adjustable Toggle Rate Between Temperature and Humidity
- Wide Selection of Temperature Sensing Elements
- Full-range Temperature Compensation of RH Signal
- Two Year Warranty

The Delta Style room units are available as Humidity Only sensors or as Combination temperature and humidity sensors. The Delta Style enclosure features an optional LCD display with a user adjustable toggle rate between humidity and temperature and can display in either °C or °F.

The unit is available with the entire line of BAPI temperature sensors. In addition, these units save time and money by allowing for field replacement of humidity elements without recalibration. If a temperature transmitter and humidity transmitter are desired, then see the "X-Combo" Unit on page B8-9 of this section.

**For detailed specs on the individual Sensors & Transmitters, turn to the "Sensors" section.**

\*Some items may not be CE compliant, call BAPI for additional information.

## Specifications

**Power:** 15 to 35 VDC (0 - 5 VDC or 4 - 20 mA Outputs)  
 15 to 40 VDC (0 - 10 VDC Output)  
 12 to 24 VAC (0 - 5 VDC Output)  
 15 to 28 VAC (0 - 10 VDC Output)

**Power Consumption:**  
 22 mA max. DC (0 - 5 VDC or 4 - 20 mA Outputs)  
 6 mA max DC (0 - 10 VDC Output)  
 0.53 VA max. AC (0 - 5 VDC Output)  
 0.14 VA max. AC (0 - 10 VDC Output)

**Sensing Elements:**  
 Temperature - Thermistor, RTD or Semiconductor  
 Humidity - Impedance Type, ±2% or ±3% RH

**Wiring:** 2 to 3 pair of 16 to 22 AWG\*

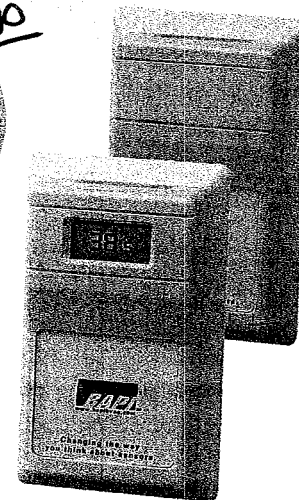
**Mounting:** Standard 2"x4" J-box or drywall mount - screws provided

### Environmental Operation Range:

Temperature: 32 to 122 °F (0 to 50 °C)  
 Humidity: 0 to 95%, non-condensing

**Material:** ABS Plastic

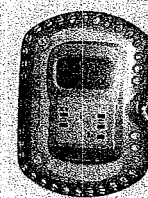
**Material Rating:** UL 94, V-0



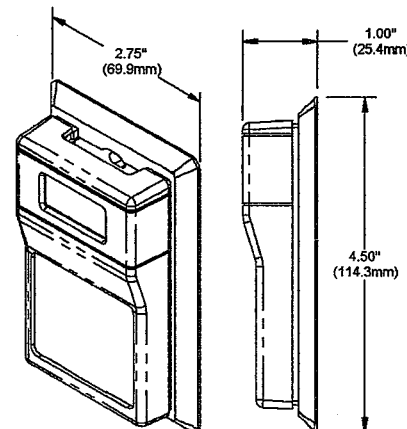
Delta Style Enclosures with and without LCD Display

### The BAPI-Guard™

- Prevents Tampering, Physical Damage and Unauthorized Adjustment
- Exceptional Airflow for Proper Thermostat Operation
- Two Sizes to Fit Most Thermostats



BAPI-Guard Mounted Over a Thermostat  
 (See Accessories for more info.)



Delta Style Enclosure

\*BAPI recommends that you do not run wiring for the room units in the same conduit as line voltage wiring or with wiring used to supply highly inductive loads such as motors, generators, and coils.

\* Use Shielded Cable w/ ground Connected to Controller

Mike → Should I also get the Voltage Converter (pg2)?

Humidity Sensor



Approved by Mike Prinkey



# Delta Style Room Units

**B5**

## Humidity & Combination Temp/Humidity Sensors

Rev. 06/05/07

Ordering Information		Delta Style Room Unit, Humidity only or Temp./Humidity Combo	
<b>BA/</b>			
<b>Temperature Sensor</b> Use the designator number, shown to the left in bold. Omit if ordering humidity unit only			
<b>##-</b>	<b>THERMISTORS</b>	<b>RTDs</b>	
1.8K	1.8K $\Omega$ @ 25 °C	100	100 $\Omega$ Platinum @ 0 °C, .385 $\Omega$ /°C temp. coeff.
3K	3K $\Omega$ @ 25 °C	100(3W)	3 Wire 100 $\Omega$ Plat. @ 0 °C, .385 $\Omega$ /°C temp. coeff.
3.3K	3.3K $\Omega$ @ 25 °C	1K (375)	1K $\Omega$ Platinum @ 0 °C, 3.75 $\Omega$ /°C temp. coeff.
10K-2	10K $\Omega$ @ 25 °C	1K(Ni)	1K $\Omega$ Nickel @ 21°C, 5 $\Omega$ /°C temp. coeff.
10K-3	10K $\Omega$ @ 25 °C	1K	1K $\Omega$ Platinum @ 0 °C, 3.85 $\Omega$ /°C temp. coeff.
10K-3(11K)	5,238 $\Omega$ @ 25 °C	2K	2K $\Omega$ Silicon @ 20 °C, 8 $\Omega$ /°C temp. coeff.
20K	20K $\Omega$ @ 25 °C		
50K	50K $\Omega$ @ 25 °C		
100K	100K $\Omega$ @ 25 °C		
		<b>SEMICONDUCTORS</b>	
		334	LM334 Semiconductor
		592	AD592 Semiconductor, 273 $\mu$ A @ 0 °C
	<b>TEMPERATURE TRANSMITTERS</b>		
	<b>T10K - Note</b> See T10K Specific ordering grid on page B27		
	<b>Humidity Transmitter</b>		
	<b>H200</b>	$\pm$ 2% Humidity Transmitter with Interchangeable Output of 0 to 5 V or 4 to 20 mA*	
	<b>H210</b>	$\pm$ 2% Humidity Transmitter with 0 to 10 V Output	
	<b>H300</b>	$\pm$ 3% Humidity Transmitter with Interchangeable Output of 0 to 5 V or 4 to 20 mA*	
	<b>H310</b>	$\pm$ 3% Humidity Transmitter with 0 to 10 V Output	
	<b>Delta Style Enclosure</b>		
		Delta Style Room Enclosure	
		LCD Display Omit if ordering a unit without display	
		LCD Display	
		Optional Comm. Jack Mounted in unit's base	
		<b>-C35L</b> 3.5 mm Phono Jack w/ Leads Attached	
		<b>-C35LT</b> 3.5 mm Phono Style Jack with Leads and	
<b>EXAMPLE</b>			
<b>BA/</b>	<b>10K-2</b>	<b>H200</b>	<b>-R</b>
			<b>D</b>
			<b>-C35L</b>
Example Part Number: BA/10K-2-H200-RD-35L			
Your Part Number:			

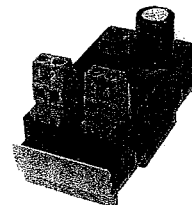
\*DC input voltage is required for current output.

See the "X-Combo" Unit on page B8-9 for more Temperature Transmitter &amp; Humidity Transmitter combination options.

Call BAPI if you have questions about the above ordering grid or the configuration of the product you are ordering.

## VC75 - AC to DC Voltage Converter

BAPI recommends using DC voltage on room sensors for a more stable reading. With its compact size and rugged design, BAPI's VC75 is the perfect AC to DC converter. Besides the 75 mA model (VC75), BAPI also offers 100 mA and 350 mA models, all of which are snaptrack mountable. For more info, see the Accessories section.



VC75 mounted in optional snaptrack

CO<sub>2</sub> Sensor

# Honeywell

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    - > Valves
    - > Variable Frequency Drives
- Training Materials & Product Literature

## Quick Links

- Tradeline Catalog Printed Version (114 MB)
- Tradeline Catalog CD-ROM version (50 MB)

## Locators

- ACI Contractor
- Residential Contractor
- Distributor

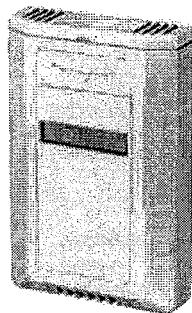
## Environmental & Combustion Controls

[> CO2 Sensors](#) [> C7232](#)

### C7232A1008

Wall mounted Non-dispersive Infrared (NDIR) Carbon Dioxide Sensor with LCD Display and Honeywell logo

- [Locate Distributors](#)
- [Product Specifications](#)



### Overview

The Carbon Dioxide (CO<sub>2</sub>) Sensors and Controllers are stand-alone carbon dioxide (CO<sub>2</sub>) sensors for use in determining ventilation necessity with HVAC controllers. The sensor measures the CO<sub>2</sub> concentration in the ventilated space or duct. The sensors are used in ventilation and air conditioning systems to control the amount of fresh outdoor air supplied to maintain acceptable levels of CO<sub>2</sub> in the space.

### Features

- Models available with LCD that provides sensor readings and status information.
- Non-Dispersion-Infrared (NDIR) technology used to measure carbon dioxide gas.
- Gold-plated sensor provides long-term calibration stability.
- C7232 provides voltage or current output based on CO<sub>2</sub> levels.
- SPST relay output.
- Used for CO<sub>2</sub> based ventilation control (Demand Control Ventilation (DCV)).
- Automatic Background Calibration (ABC) algorithm based on long-term evaluation reduces required typical zero-drift check maintenance.

### Product Specifications

[→ Back To Top](#)

Description	Carbon Dioxide Sensor, Non-dispersive Infrared (NDIR), Wall Mount, LCD Display, Honeywell Logo
Mounting	Wall mount
Display	Yes
Carbon Dioxide Range	0 to 2000 ppm, adjustable
Analog Current Output	0/2 - 10 Vdc or 0/4 - 20 mA selectable, w/ one relay output
Relay Output	One: Normally Open SPST
Electrical Connections	Six leadwires, 20-gauge, 8 in. long
Voltage	24 Vac (±20%)
Frequency	60 Hz
Frequency	50 Hz
Operating Temperature Range (F)	32 F to 122 F
Operating Temperature Range (C)	0 C to 50 C
Timing (response)	2 minutes
Sensor Type	Non-dispersive Infrared (NDIR)
Accuracy	5% full scale

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[Product Search](#)
[Cross Reference Search](#)
[Search](#)
[→ Advanced Search](#)
[Literature / Image Search](#)
[All Literature](#)
[Model / Part Number](#)



Dimensions (in.)	5 1/16 in. high x 3 11/16 in. wide x 2 1/8 in. deep
Dimensions (mm)	128 mm high x 80 mm wide x 25 mm deep
Includes	Honeywell Logo
Contact Ratings	1 A @ 50 Vac/24 Vdc

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Choose Your Region/Country **United States English**

v1.0.2650

© Copyright Honeywell International Inc 2004-2007

## Features &amp; Options

- Etched Teflon Leadwires & Double Encapsulated Sensors
- Three Enclosure Styles
- Humidity Only or Temp./Humidity Combination
- Replaceable Filter & Humidity Probe
- 2% and 3% RH Accuracies
- Wide Selection of Temp. Sensing Elements
- Two Year Warranty



Humidity control is an important aspect of any climate control system. Therefore, humidity sensors must be both accurate and dependable. BAPI's humidity sensors are prescreened for accuracy, eliminating field calibration even when replacing a sensor or probe. The Outside Air Units are also extremely dependable, featuring three of the most watertight enclosures available today.

The Weather Tight (EU) enclosure is made from a flame-retardant polymer that carries an IP66 rating. Outside air units are also available in a cast aluminum Weatherproof (WP) enclosure that carries a NEMA 3R or the BAPI-Box (BB) which is made of UV-resistant polycarbonate and carries an IP66 rating. Optional liquid-tight fittings are available.

All Outside Air Units have etched Teflon leadwires and are built to withstand high humidity and condensation and perform under real world conditions. This is especially important in an Outside Air Unit which can be exposed to rain, snow and large temperature swings.

*For detailed specs on the individual Sensors & Transmitters, turn to the "Sensors" section.*

Outside Air Unit with Weather Tight (EU) Enclosure

Outside Air Unit with Weatherproof (WP) Enclosure

Outside Air Unit with BAPI-Box (BB) Enclosure

## Specifications

## Power:

10 to 35 VDC (0 - 5 VDC or 4 - 20 mA Outputs)  
15 to 35 VDC (0 - 10 VDC Output)  
12 to 24 VAC (0 - 5 VDC Outputs)  
15 to 24 VAC (0 - 10 VDC Output)

## Power Consumption:

22 mA max. DC (0 - 5 VDC or 4 - 20 mA Outputs)  
6 mA max. DC (0 - 10 VDC Output)  
0.53 VA max. AC (0 - 5 VDC Output)  
0.14 VA max. AC (0 - 10 VDC Output)

## Enclosure Rating:

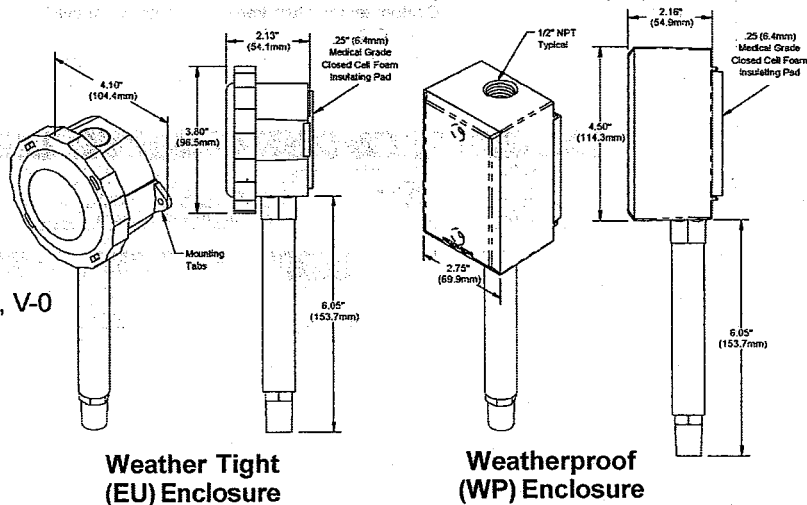
WP Model: NEMA 3R  
EU Model: IP66  
BB Model: IP66

## Encl. Material:

WP Model: Cast Aluminum  
EU Model: ABS Plastic, UL 94, V-0  
BB Model: UV-resistant Polycarbonate, UL 94, V-0

## Environmental Operation Range:

Temp: -30 °C to 70 °C  
Humidity: 0% to 100% RH



Weather Tight (EU) Enclosure

Weatherproof (WP) Enclosure



# VAISALA

use w/ OA sensor

\* install on north side of the home

Get from ALPS

P.O. Box 26, FIN-00421 Helsinki, FINLAND

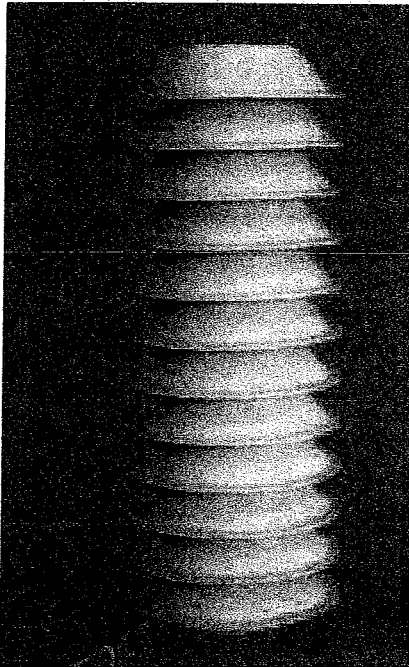
Tel: +358 9 894 91

Fax: +358 9 8949 2485

Email: [industrialsales@vaisala.com](mailto:industrialsales@vaisala.com)

[www.vaisala.com](http://www.vaisala.com)

## DTR Solar Radiation and Precipitation Shields



The DTR Series of solar radiation and precipitation shields support humidity probe installations in outdoor applications.

### Shield protects sensor

The maintenance-free DTR Shields protect the humidity and temperature sensors from solar radiation and precipitation. They provide excellent ventilation while blocking both direct and reflected solar radiation.

The special plastic used in the plates has excellent thermal characteristics; the white outer surface reflects radiation; the black inside absorbs accumulated heat. The shields can be easily installed on either a vertical pole, horizontal beam, or a flat surface.

DTR50 Solar Radiation and Precipitation Shields are available in either a 9 or 12-plate model.

The DTR Shields can be used with the following Vaisala probes:

HMP45A/D  
HMP233/237  
HMD40/50  
HMD60/70

### Choice of models and Installation accessories

Two models are available:

Nine-plate shield:  
DTR502A for HMP45A/D  
DTR502B for HMP233, 237

Twelve plate shield:  
DTR503A for HMP45A/D  
DTR503B for HMD60/70  
DTR503C for HMD40/50

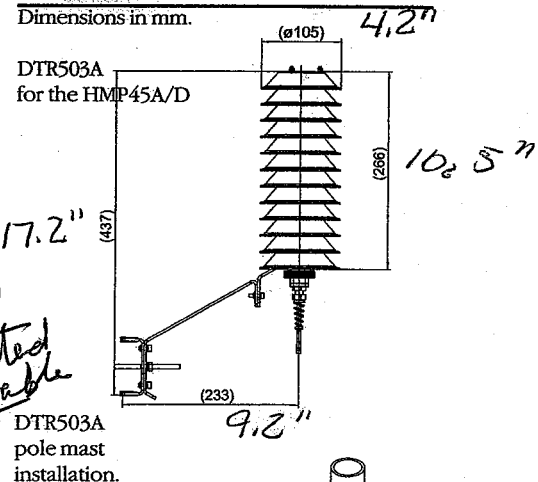
recommended by  
BAP1 website

### Features/Benefits

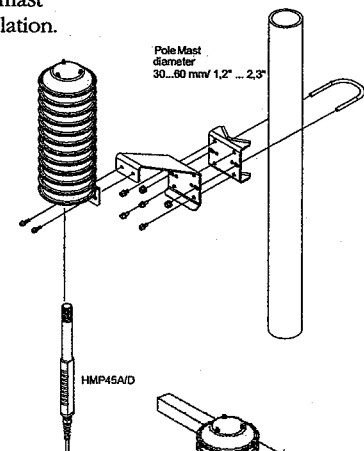
- Protects temperature and humidity probes from scattered, as well as, direct solar radiation and rain.
- Maintenance-free
- Naturally ventilated
- Installs easily on a vertical pole, horizontal beam or flat surface
- Suitable for a wide range of applications
- Choice of shields and mounting accessories

### Dimensions

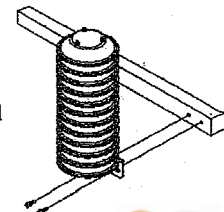
Dimensions in mm.



DTR503A pole mast installation.



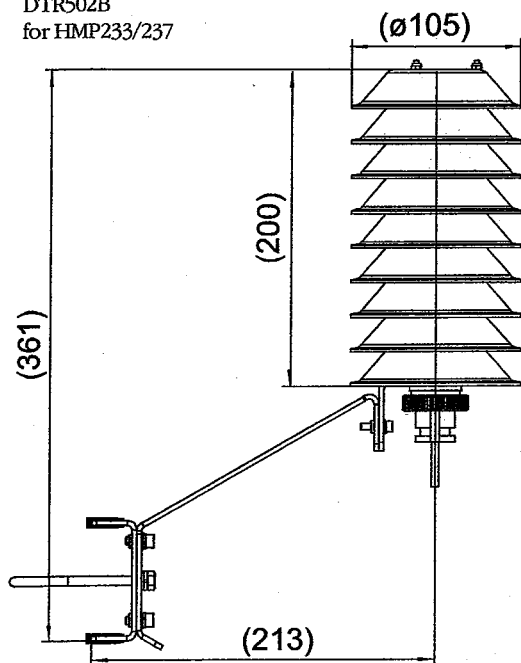
DTR503A horizontal beam installation.



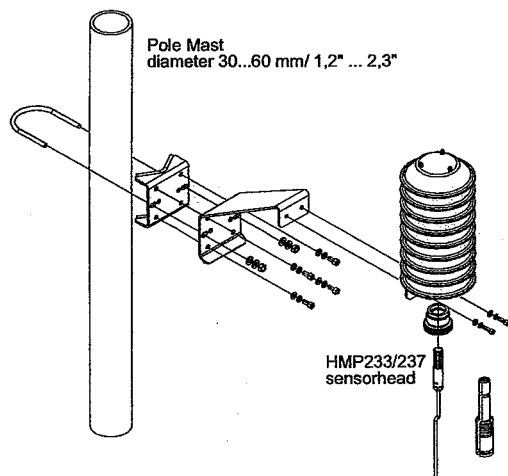
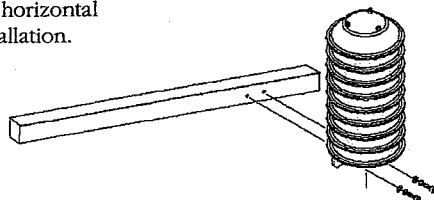
# Technical Data

## Dimensions

Dimensions in mm.

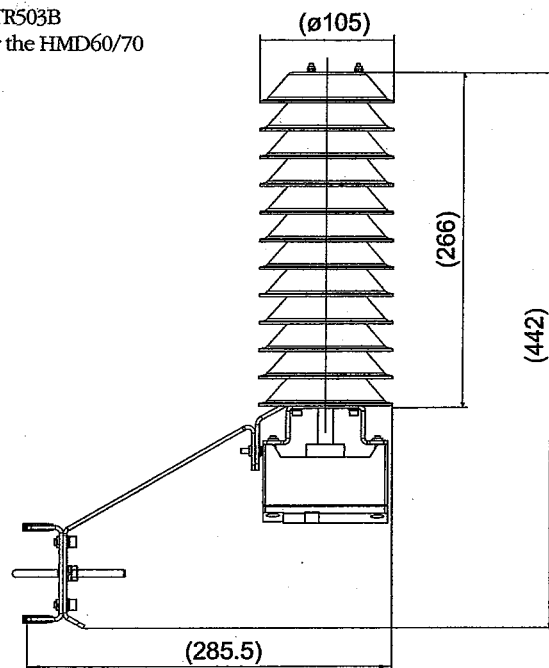
DTR502B  
for HMP233/237

DTR502B pole mast installation.

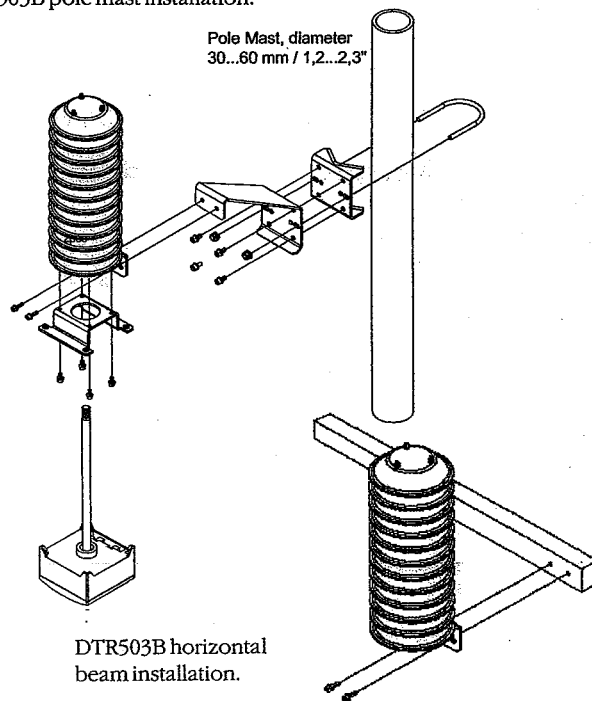
DTR502B horizontal  
beam installation.

## Dimensions

Dimensions in mm.

DTR503B  
for the HMD60/70

DTR503B pole mast installation.

DTR503B horizontal  
beam installation.

Specifications subject to change without prior notice.  
©Vaisala Oyj



F-1: 2gpm, 180°F

F-2: 2gpm, < 120°F → Order 1 of these + one Dwyer?

F-3: 1.7gpm, 130°F

F-4: 130°F, 2.3gpm (0.1, 0.7, 1.5gpm)  
per ea. loop

Utilities Supply Company

50 Everberg Road, Woburn MA 01801

Toll Free: (800) 343-7555 &bull; Telephone: (781) 395-9023 &bull; Fax: (781) 395-2329

E-Mail: uscosales@fwwebb.com &bull; Website: www.uscosupply.com

Item # F45500(LHN)12, Series F-440 & F-450 Flowmeters

\$56.81

Ordered 4 of these



### Series F-440 & F-450 Flowmeters

High performance Polysulfone meter body and adapters. Viton O-ring seals. Corrosion and wear resistant internal parts. Configurations for both in-line and panel mount installation requirements. Optional integral flow adjustment valve. Permanent screen printed scales. Not recommended for direct sunlight applications. Dual scale: gallons per minute and liters per minute (GPM/LPM). Single scale for gallons per hour (GPH).

Temperature: 212°F/100°C at 0 pressure

Pressure: 150 psi/10.3 Bar at 70&#176F/21&#176C

Full Scale Accuracy: &plusmn; 5%

Meter Body material: Polysulfone

Adapters material: Polysulfone

O-rings: Viton

Float material: #316 SS (Hastelloy C, Teflon & PVC materials available depending on calibration)

Max. Pressure drop: 2 psi

\* Can these be  
turned side-ways?  
↳

### SPECIFICATIONS

Calibration	0.5 to 5.0 GPM
Calibration	2.0 to 20 LPM
Adapter Size	3/4 inches
End Connections	M/NPT
Max. Pressure Drop	2 psi
Temperature (at zero pressure)	212 °F
Temperature (at zero pressure)	100 °C
Pressure at 70°F	150 psi
Pressure at 21°C	10.3 bar
Full Scale Accuracy	&plusmn; 5 %
Float Material	#316 SS
Meter Body Material	Polysulfone
Adapter Material	Polysulfone

*requested to order 7/5/07*

**Hawkeye® Solid-Core 0-5VDC Output Self-Powered Current Transducer**

**822-10/822-20**

*wrap to improve reading*

*\*Put info on dwgs*



FIVE-YEAR  
5  
WARRANTY

No More Wrapping! Designed specifically to handle low current loads and reduce the need to make multiple passes with the conductor, the self-powered Hawkeye 822 provides accurate load trending information in factory calibrated 0-10 or 0-20Amp models. The output is an 0-5VDC analog signal proportional to the input current (see graphs).

**Self-powered analog current sensor**

- Reduces the number of installed components... saves time and space
- No jumpers on unit...reduces installation errors
- No external power required for sensor
- Adjustable mounting bracket for installation flexibility
- 5-year limited warranty

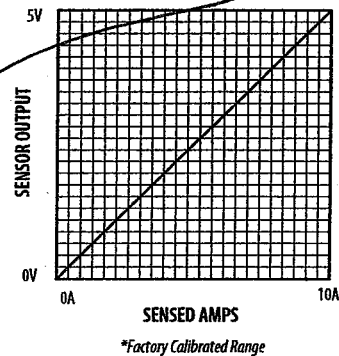
**APPLICATIONS**

- Load trending
- Motor control

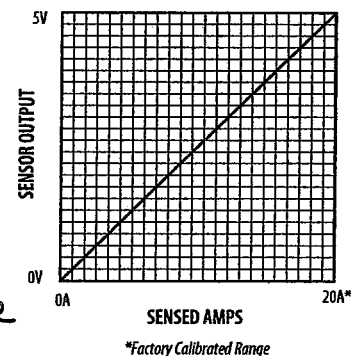


Control Tag	Equipt Tag	Amps
CTR-1	AFC-1 Fan	1.4A
CTR-2	P-5 (rad. floor)	0.74A (max)
CTR-3	ERV-1 Fan	1.3A
CTR-4	AFC PUMP	0.74A (max)
CTR-5	P-1	12.5A-start 7.2A running
CTR-6	HP-1 Fan	4.3A
CTR-7	HPWH	7A

**H822-10 LINEAR OUTPUT**  
Scale software as shown



**H822-20 LINEAR OUTPUT**  
Scale software as shown



**ORDERING INFORMATION**

MODEL	AMPERAGE RANGE	OUTPUT
H822-10	10 Amp	0-5VDC
H822-20	20 Amp	0-5VDC

**ACCESSORIES**

MODEL	DESCRIPTION
AH01	DIN Rail Mounting Clip Set

*works for anything between 0-10A?*

*CTR-7 HPWH running? → add -7A*

*transmitter is a transducer*

**MOD-TRONIC**  
INSTRUMENTS LIMITED

1 Delta Park Blvd, #12 Brampton, ON L6T 5G1

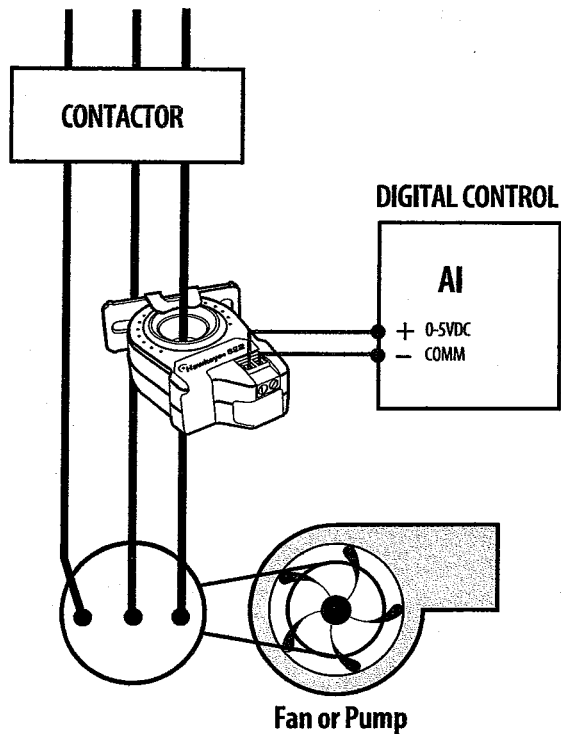
Tel 905-457-6322 or 1-800-794-5777

Fax 905-457-4716 or 1-800-830-7

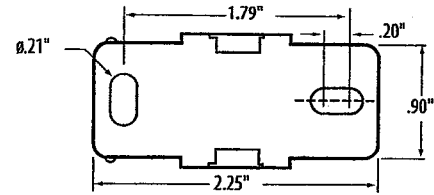
sales@mod-tronic.com www.mod-tronic.com 223 of 353

**MORNINGSTAR**

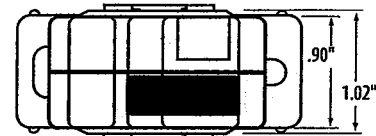
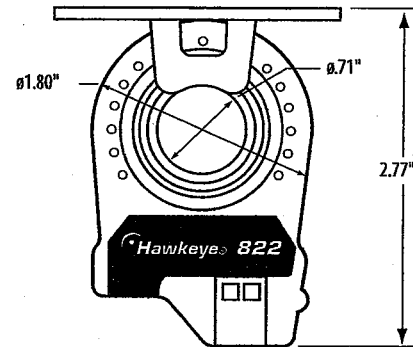
## APPLICATIONS/WIRING EXAMPLE



## DIMENSIONAL DRAWINGS



Removable/Adjustable Mounting Bracket



## SPECIFICATIONS

Amperage Range	See ordering table
Output	0-5VDC Self-powered
Insulation Class	600VAC rms
Frequency Range	60Hz. nominal
Temperature Range	-15° to 60°C
Humidity Range	0-95% non-condensing
Accuracy	±2% H822-20, ±3% H822-10
Response Time	2 sec.
Dimensions (H822)...(L x W x H)	2.77" x 1.80" x 1.02"
Sensor Hole Size	0.71" Diameter

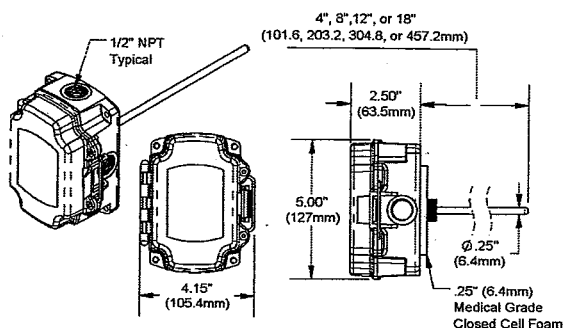
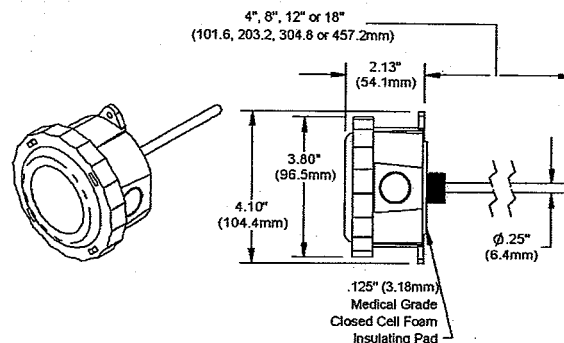


Rev. 05/01/07

**Specifications**

# Duct Units

## Temperature Sensors

**A39****BAPI-Box (BB) Duct Unit****Weather Tight Enclosure (EU) Duct Unit**

Ordering Information		Duct Units - Temperature		
<b>BAI</b>				
<b>Sensor Type</b> Use the designator number (shown to the left in bold) to indicate the sensor				
# 2	<b>THERMISTORS</b>			
	1.8K	1.8K $\Omega$ @ 25 °C	100	100 $\Omega$ Platinum @ 0 °C, .385 $\Omega$ /°C temp. coeff.
	3K	3K $\Omega$ @ 25 °C	100(3W)	3 Wire 100 $\Omega$ Plat. @ 0 °C, .385 $\Omega$ /°C temp. coeff.
	3.3K	3.3K $\Omega$ @ 25 °C	1K(375)	1K $\Omega$ Platinum @ 0 °C, 3.75 $\Omega$ /°C temp. coeff.
	10K-2	10K $\Omega$ @ 25 °C	1K(Ni)	1K $\Omega$ Nickel @ 21°C, 5 $\Omega$ /°C temp. coeff.
	10K-3	10K $\Omega$ @ 25 °C	1K	1K $\Omega$ Platinum @ 0 °C, 3.85 $\Omega$ /°C temp. coeff.
	10K-3(11K)	5,238 $\Omega$ @ 25 °C	2K	2K $\Omega$ Silicon @ 20°C, 8 $\Omega$ /°C temp. coeff.
	20K	20K $\Omega$ @ 25 °C	<b>SEMICONDUCTORS</b>	
	50K	50K $\Omega$ @ 25 °C	334	LM334 Semiconductor
	100K	100K $\Omega$ @ 25 °C	592	AD592 Semiconductor, 273 $\mu$ A @ 0C
592-10K AD592 Semicond. w/ 10 k $\Omega$ shunt resistor, 2.73 V @ 0C				
<b>TEMPERATURE TRANSMITTERS</b> Must include a "range" figure				
T100[range]	100 Platinum RTD, 100 $\Omega$ @ 0 °C with 4 to 20 mA Output			
T100M[range]	100 Platinum RTD, 100 $\Omega$ @ 0 °C with MATCHED 4 to 20 mA Output			
T1K[range]	1K Platinum RTD, 1,000 $\Omega$ @ 0 °C with 4 to 20 mA Output			
T1KM[range]	1K Platinum RTD, 1,000 $\Omega$ @ 0 °C with MATCHED 4 to 20 mA Output			
T10K[range]	10K Thermistor, 10,000 $\Omega$ @ 25 °C with 4 to 20 mA Output			
<b>TEMPERATURE TRANSMITTER RANGES</b>				
Custom temperature transmitter ranges are available. Common ranges are listed below				
40 TO 90F	4 TO 32C	-30 TO 130F	-34 TO 54C	
0 TO 100F	-18 TO 38C	32 TO 212F	0 TO 100C	
20 TO 120F	-7 TO 48C	30 TO 234F	-1 TO 112C	
32 TO 134F	0 TO 57C			
<b>Probe Length</b>				
-D-4"	4" length of 1/4" Diameter, Stainless Steel Probe			
-D-8"	8" length of 1/4" Diameter, Stainless Steel Probe			
-D-12"	12" length of 1/4" Diameter, Stainless Steel Probe			
-D-18"	18" length of 1/4" Diameter, Stainless Steel Probe			
-D-XX"	Custom lengths of 1/4" Dia, Stainless Steel Probe are available. Call for details.			
<b>Enclosure Type</b> 2"x4" Steel J-Box comes standard				
-BB	BAPI-Box Enclosure - IP66 rated, UV-resistant polycarbonate			
-WP	Weatherproof Enclosure - NEMA 3R rated metal enclosure			
-EU	Weather Tight Enclosure - IP66 rated ABS polymer enclosure			
-EUO	Weather Tight Enclosure - IP66 rated UV-resistant enclosure			
-NB-18"	No Junction Box, 18" Lead Length, Plenum Rated Cable			
-NB-5'	No Junction Box, 5' Lead Length, Plenum Rated Cable			
-NB-10'	No Junction Box, 10' Lead Length, Plenum Rated Cable			
-NB-15'	No Junction Box, 15' Lead Length, Plenum Rated Cable			
-NB-XX	Custom lead lengths (Plenum Rated cable) are available. Call for details.			
<b>EXAMPLE</b>				
BAI	10K-2	-D-8"	-NB-5'	
Example Part Number: BAI/10K-2-D-8"-NB-5'				
<b>Your Part Number</b>				

Call BAPI if you have questions about the above ordering grid or the configuration of the product you are ordering.



## Division 26 - Electrical

26 0000	Electrical
26 0933	Remote Controlled Dimmers: Radio Frequency Light Control System
26 2000	Low-Voltage Electrical Distribution
26 2726	Wiring Devices: Wallbox Dimmers and Accessories
26 3000	Facility Electrical Power Generating and Storage Equipment
26 4000	Electrical and Cathodic Protection
26 5000	Lighting
26 6000	24V DC LED Lighting System

CSI #	Product Type	Product Name/Model #	Manufacturer	MSDS	Product Data
26 0933	Control System Interface	RadioRA: RA-NET-120	Lutron		X
26 0933	System Bridge and Timeclock	RadioRA: RA-SBT-CHR	Lutron		X
26 0933	Cordless Tabletop Master Controls	RadioRA: RAMC-10C-RL-BL	Lutron		X
26 0933	Multi-location dimmers for low-voltage	RadioRA: RA-5NE-MN	Lutron		X
26 0933	Lamp Dimmer	RadioRA: RA-3LD-MN	Lutron		X
26 0933	Wall-mounted Master Control Switch	RadioRA: RALB-5W-RL-MN-P	Lutron		X
26 0933	Multi-location switches for permanent lighting	RadioRA: RAS-8LM-MN	Lutron		X
26 2000	Safety Switches and Electric Meter	(see attached materials list)	Square D		X
26 2000	AC Panel Board	(see attached materials list)	Square D		X
26 2000	DC Panel Board	(see attached materials list)	Square D		X
26 2000	Terminal Blocks	9080 LBA 161101	Square D		X
26 2000	Inverter	SB1800U	SMA America		X
26 2000	Inverter	SB6000U	SMA America		X
26 2000	Inverter	SI4248U	SMA America		X
26 2000	PV Data Collect System	WebBox	SMA America		X
26 2726	Electronic Switch	Maestro, Satin Colors: MSC-S8AM-MN	Lutron		X
26 2726	Electronic Switch	Maestro, Satin Colors: MSC-S8AM-SW	Lutron		X
26 2726	GFI Receptacle	Satin Colors: SCR-20-GFCI-MN	Lutron		X
26 2726	Duplex Receptacle	Satin Colors: SCR-20-MN	Lutron		X
26 2726	Cable TV Jack	Satin Colors: SC-CJ-MN	Lutron		X
26 2726	Telephone Jack	Satin Colors: SC-PJ-MN	Lutron		X
26 2726	Single-gang wallplate	Claro: CW-1-SS	Lutron		X
26 2726	Two-gang wallplate	Claro: CW-2-SS	Lutron		X
26 2726	Combination opening 2-gang wallplate	Fassada, Claro: FW-2-TD-SS	Lutron		
26 3000	Batteries & Quote for AC System	24 M100-27	Deka	X	X
26 3000	Batteries for DC LED System	UB12900	Universal Battery	X	X
26 3000	Photovoltaics & Quote	Saturn 7190	BP Solar		X
26 3000	Photovoltaics	Sunslates Q Cell- 5" poly	Atlantis Energy Systems		X
26 5000	Smoke Detector	Dual sensor, 120VAC w/ battery backup	Kidde		X
26 5000	Interior Luminaires and Accessories	(see attached luminaire schedule)	(see attached luminaire		X
26 5000	Cable System hardware	Cable System hardware	Alfa Lighting		X
26 5000	Transformer Accessories	Transformer Accessories	Alfa Lighting		X
26 5113	Fluorescent Electronic Dimming Ballast	Eco-10: E 3 T514 C 120 2	Lutron		
26 6000	DC LED Power Data Module	PDM-201	Color Kinetics		X
26 6000	DC LED Controller	Smart Jack 3	Color Kinetics		X
26 6000	LED Fixtures (Breezeway)	Color Cove QL	Color Kinetics		X
26 6000	Charge Controller	Tristar 30A, 60A	Morningstar		X

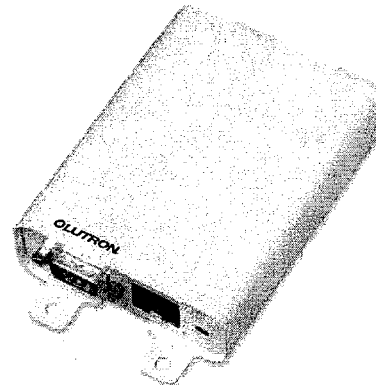
## RadioRA Network Control Interface

Network

The *RadioRA* Network Control Interface (NCI) allows you to control lighting throughout your home—via any popular web browser—while utilizing an existing home network.

### Features

- Provides web-based control of the *RadioRA* system.
- 8 customizable control pages each with 5, 10, or 15 buttons.
- Works with popular web browsers.
- Control via popular devices (PC, PDA, touch screen, etc.).
- Can integrate with Microsoft® Windows® XP Media Center Edition 2005.
- Firmware upgradable over the internet.
- Simple connection to the *RadioRA* system and home network.
- Easy to configure via web-based setup utility.
- DHCP enabled—automatically attaches to the home network.



Job Name: Penn State  
Solar Decathlon

Model Numbers: RA-NET-120

Job Number:

## Specifications

### Standards

- UL Listed (Adapter).

### Power

- AC Adapter:  
Input power: 120 V~ 60 Hz  
Output power: 12 V= 300 mA
- Use only the Adapter provided by Lutron with the RA-NET-120.

### Data Retention

- Configuration is saved to non-volatile flash memory.

### Key Design Features

- Provides web-based control of the *RadioRA* system.
- 8 customizable control pages each with 5, 10, or 15 buttons.
- Works with popular web browsers.
- Control via popular devices (PC, PDA, touch screen, etc.).

- Can integrate with Microsoft® Windows® XP Media Center Edition 2005.
- Firmware upgradable over the internet.
- Simple connection to the *RadioRA* system and home network.
- Easy to configure via web-based setup utility.
- DHCP enabled—automatically attaches to the home network.

### Required Components

- RS232 Interface or ChronoS™ System Bridge and Timeclock.
- PC or other web browser-enabled device capable of browsing the NCI setup pages.
- Available ethernet port on a home or office network with a DHCP server (commonly found in routers, but not in hubs or switches).

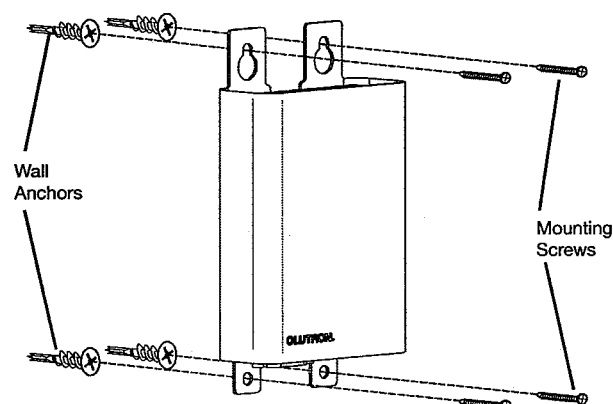
### Environment

- Ambient operating temperature: 0-40 °C, 32-104 °F
- 0-90% humidity, non-condensing.
- Indoor use only.

### Warranty

- 1-year Limited Warranty.

## Mounting

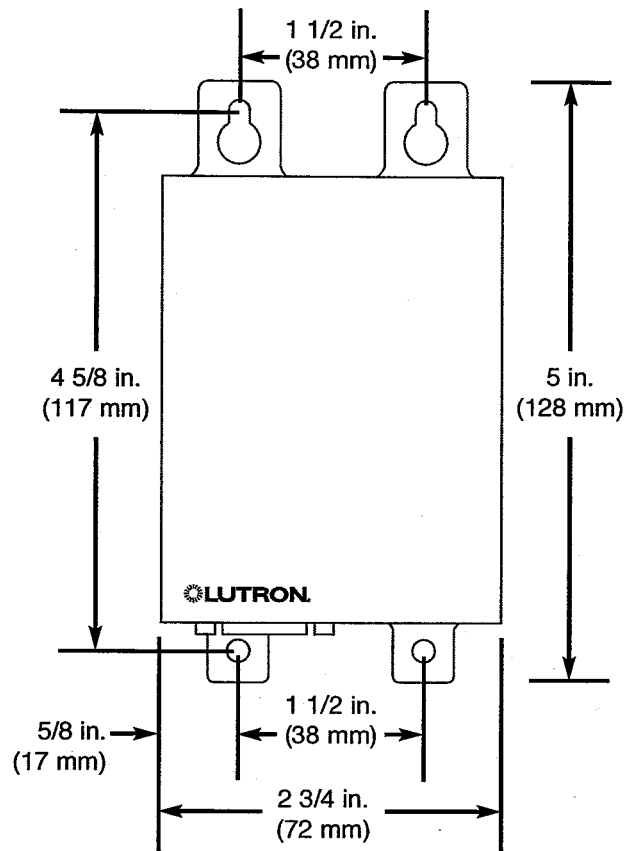
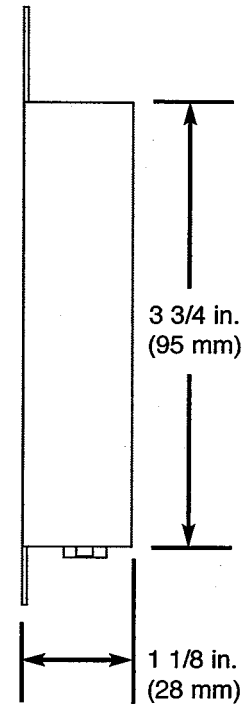


Microsoft and Windows are registered trademarks of the Microsoft Corporation, Redmond, Washington.

Job Name: Penn State  
Solar Decathlon

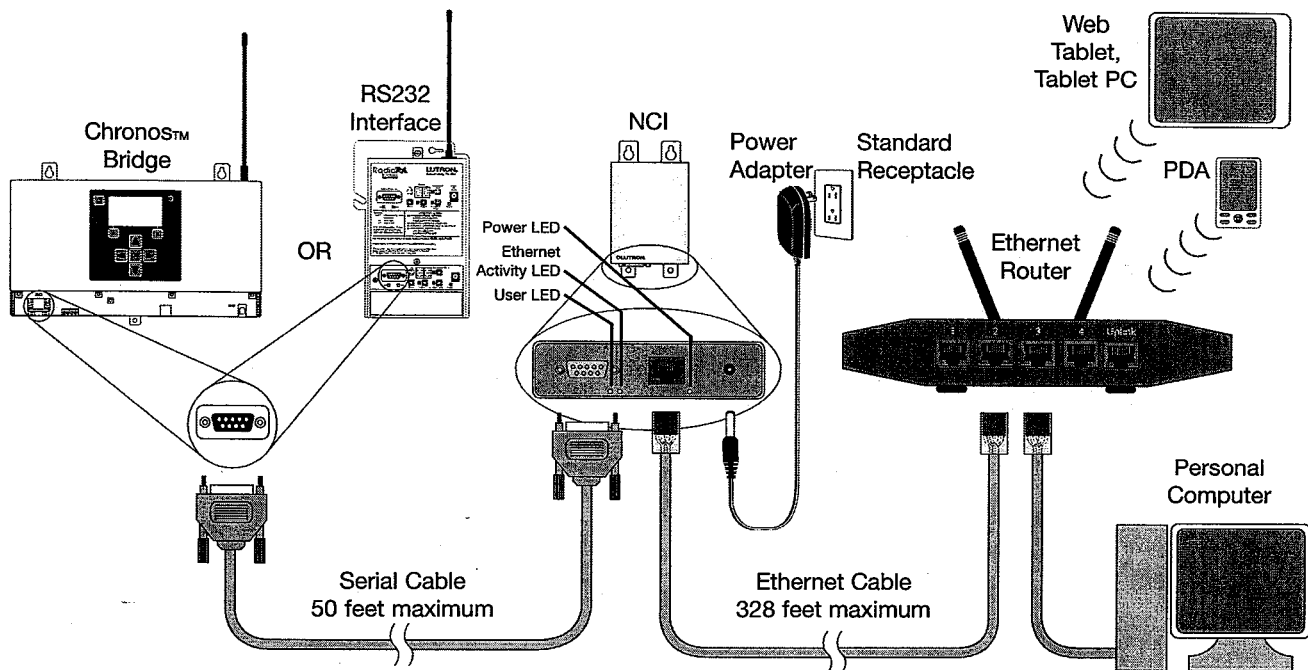
Model Numbers: RA-NET-120

Job Number:

**Dimensions****Front View****Side View**



## Connections



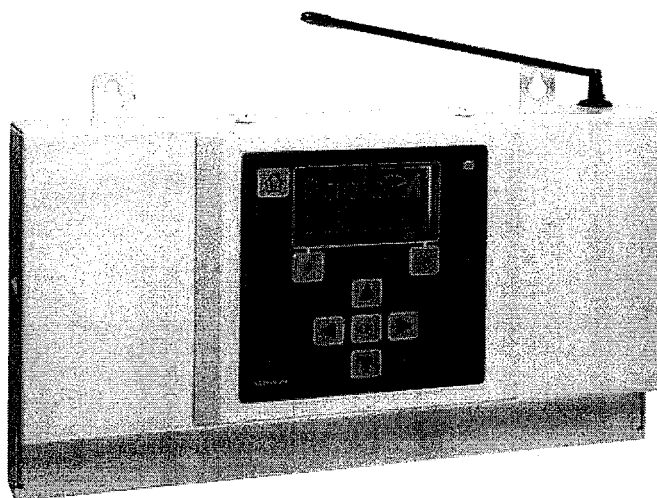
## Chronos™ System Bridge and Timeclock

The *RadioRA Chronos* System Bridge and Timeclock can serve as the main communication hub of up to two *RadioRA* systems. Devices in a *RadioRA* system communicate with the *Chronos* via Radio Frequency (RF). Each *Chronos* supports up to 64 *RadioRA* Lighting Zone Controls and 24 *RadioRA* Master Controls.

In addition, *Chronos* provides an astronomical timeclock for scheduling lighting changes based on time of day or astronomic events, an RS-232 port for serial communications to other systems, and contact closures for integration with other systems in the home.

### Features

- Can be added to an existing *RadioRA* system, or serve as the main system control in a new *RadioRA* system.
- Built-in astronomical timeclock.
- RS-232 port for serial communication to other systems.
- Three contact closure inputs for interfacing to other systems.
- Graphical LCD with user friendly menus for system setup and diagnostics.
- Durable membrane touchpad for user interface.
- Main Repeater Functions.
- Manages one or two systems.
- Provides a unique house code to eliminate interference by neighboring systems.
- Works with a network of repeaters for increased system reliability.
- Covers 2500 square feet of living space.



Job Name:

Model Numbers: RA-SBT-CHR

Job Number:

## Specifications

### Standards

- UL Listed (Adapter).
- NOM Certified.
- FCC Approved. Complies with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.
- Industry Canada Registered.

### Power

- AC Adapter:  
Input power: 120 V~ 60 Hz  
Output power: 18 V~ 300 mA
- Use only the Adapter provided by Lutron with the Chronos™.

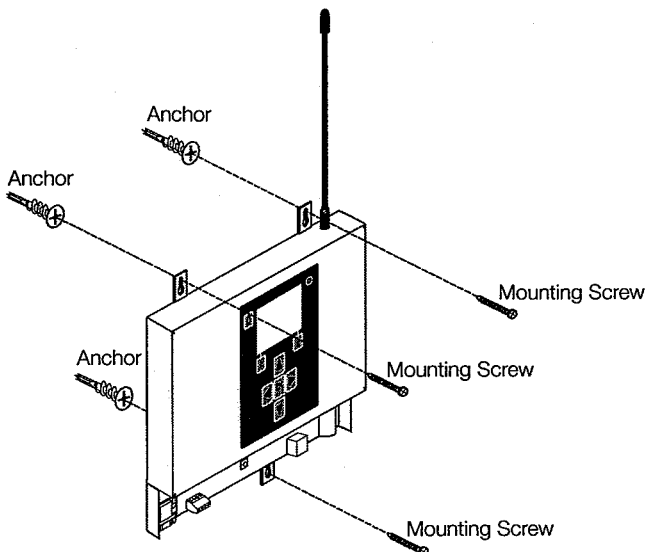
### Data Retention

- 10-year battery backup.

### Timeclock

- Up to 13 Timeclock Scenes.
- Up to 100 Timeclock Events.

### Mounting



- Home and Away Modes.
- Events can be activated based on time of day or in relation to sunrise/sunset times (astronomical).

### System Communications

- RF coverage of up to 2500 square feet. Up to 3 auxiliary repeaters may be added (per system) to expand RF coverage.

### Inputs/Outputs

- Contact Closure Inputs for Security Mode, Home/Away Mode, or scene activation.
- RS-232 port for integration with other systems.
- Standard PS/2 keyboard port for navigation and data entry.

### System Maximums

- Single System (*Chronos* used as a Master Control or a Main Repeater):

32 Lighting Zone Controls  
12 Master Controls  
4 RF Signal Repeater  
(3 Repeaters if Chronos used as Main Repeater)

- Bridged System (*Chronos* used as a Main Repeater):  
64 Lighting Zone Controls  
24 Master Controls  
6 RF Signal Repeaters  
(3 per system)

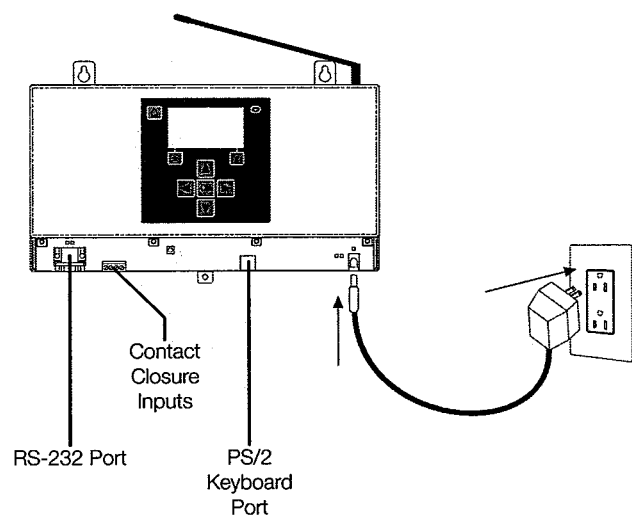
### Environment

- Ambient operating temperature: 0-40°C, 32-104°F
- 0-90% humidity, non-condensing.
- Indoor use only.

### Warranty

- 1-year Limited Warranty.

### Connections



Job Name: Penn State

Solar Decathlon

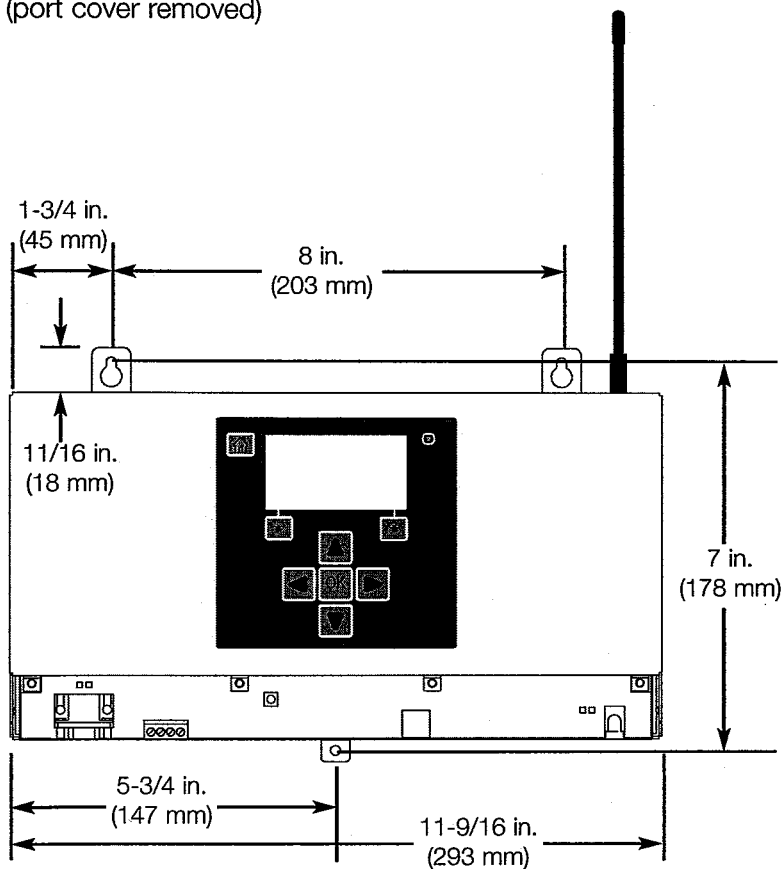
Job Number:

Model Numbers: RA-SBT-CHR

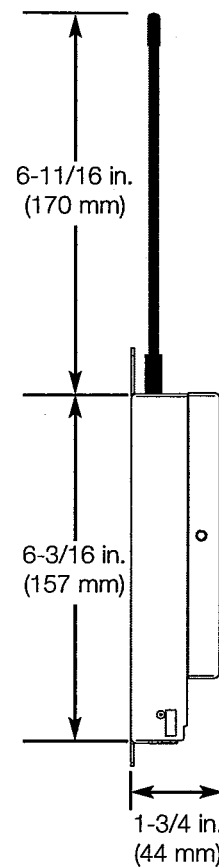
## Dimensions

### Front View

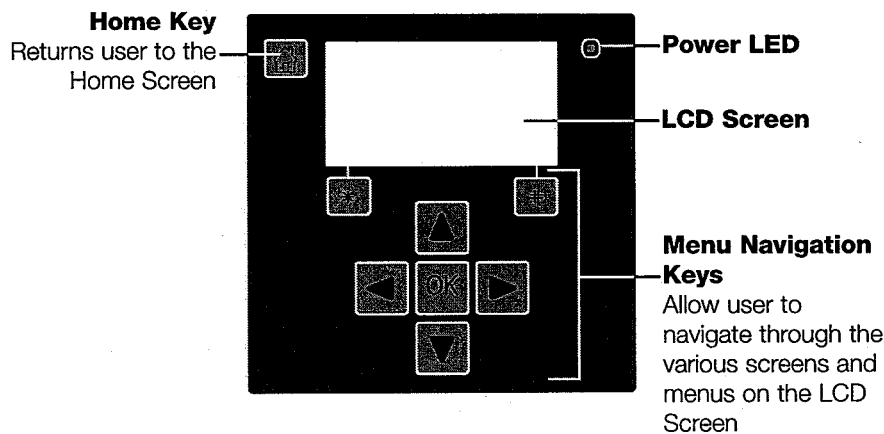
(port cover removed)



### Side View



## Touchpad



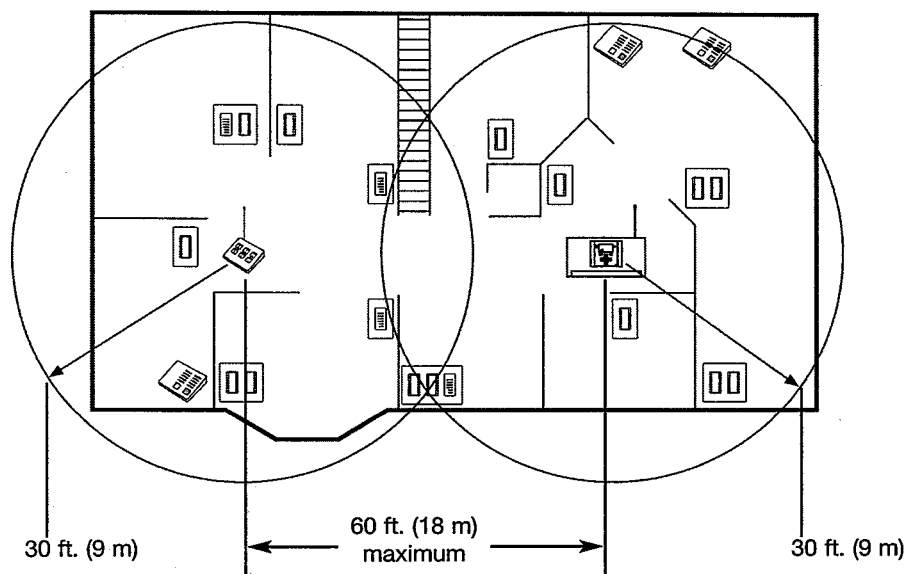
Job Name: Penn State  
Solar Decathlon  
Job Number:

Model Numbers: RA-SBT-CHR



## System Overview

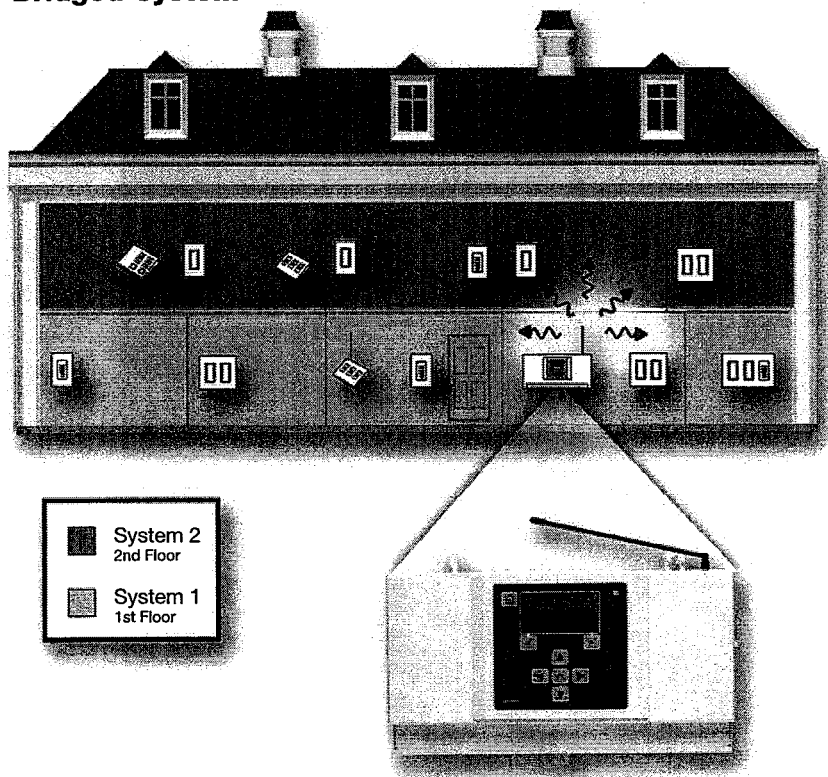
### Single System



### System Communication Notes

- RadioRA Lighting Zone Controls and Master Controls must be located within 30 ft. (9 m) of Chronos or a Repeater. Multiple repeaters may be necessary to provide adequate coverage.
- Additional repeaters must be within 60 ft. of Chronos or another repeater.
- RadioRA Lighting Zone Controls cannot be controlled and RadioRA Master Controls will not function until they are addressed and programmed.
- Chronos and Repeaters each provide RF coverage for an area of approximately 2500 sq. ft.
- One (1) Chronos with three (3) Auxiliary Repeaters will cover an area of approximately 10,000 sq. ft.

### Bridged System



Job Name: Penn State

Model Numbers: RA-SBT-CHR

Solar Decathlon

Job Number:

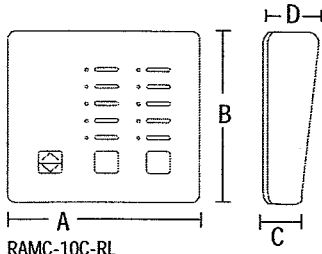
# Lutron Specification Submittal

## RadioRA Cordless Tabletop Master Controls *Cordless Tabletop Control*

RAMC-10C, RAMC-10C-RL

Model No.: ☐ RAMC-10C- ☐ RAMC-10C-RL-\* (\*features raise/lower function)

Colors: ☐ White ☐ Black

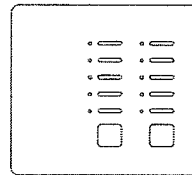


RAMC-10C-RL

Master Control shown with raise/lower option.

### Dimensions

	in	mm
A	3.57	91
B	3.23	82
C	.70	18
D	.98	25



RAMC-10C

### ► Specifications

<b>POWER</b>	Input: 3V DC (2 "AAA" Batteries Included) The Cordless Master Control is for use in 60Hz countries only. Consult factory for 50Hz applications.
<b>BATTERY LIFE</b>	1 year with typical use
<b>MOUNTING</b>	Tabletop or wall mount bracket (provided)
<b>TEMPERATURE</b>	32-104°F (0-40°C)
<b>SYSTEM MAX.</b>	12 Master Controls

### ► Features

- Central control for up to 32 Dimmers/Switches/GRAFIK Eye Preset Lighting Controls.
- Controls are field-programmable to select whole-house or single-room preset light levels.
- LEDs show status of lighting after unit has been activated.

### ► Function

Allows master control of up to 32 circuits of lights in a RadioRA system to:

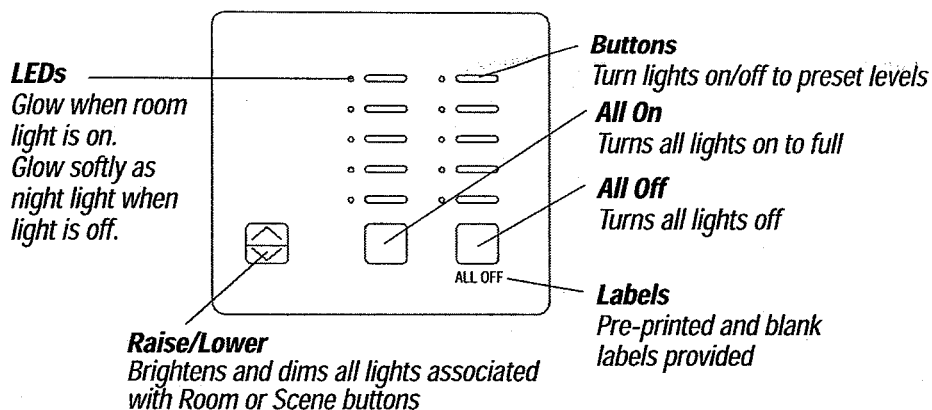
- turn a light or group of lights on to preset levels
- monitor the status of a light or group of lights
- turn all lights on to full
- turn all lights off
- raise and lower room/scene lighting (-RL models only)

### ► Flexibility

- Completely portable.
- No line-of-sight limitations.
- Master Control button columns may be set up to monitor lights (Room buttons) or to select presets (Scene buttons).

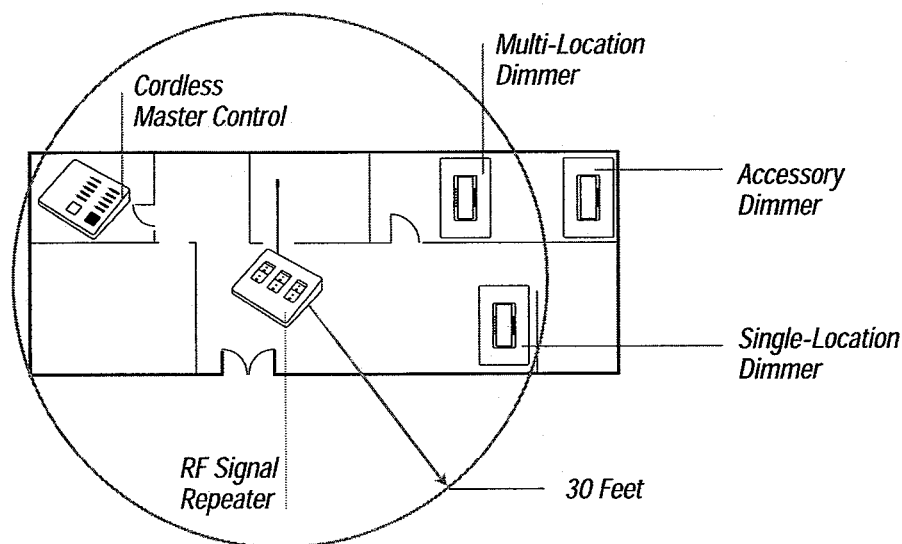
Have Questions? Call the Lutron Hotline 24/7 at 800-523-9466, or visit the Lutron website at [www.lutron.com](http://www.lutron.com)

### ► Cordless Tabletop Master Control Operation



1. Press any button to activate the unit.
2. LEDs will travel up and down during activation cycle.
3. Unit will show status of ROOMS and SCENES.
4. Select desired ROOM or SCENE setting.
5. Unit will go to "sleep" after 10 seconds without any button presses.  
LEDs will be off until reactivated.

### ► RadioRA System Overview



#### Notes:

- RadioRA Master Controls must be located within 30 feet of an RF Signal Repeater.

### ► Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO ONE YEAR FROM PURCHASE. THIS WARRANTY DOES NOT COVER THE COST OF INSTALLATION, REMOVAL OR REINSTALLATION, OR DAMAGE RESULTING FROM MISUSE, ABUSE, OR IMPROPER OR INCORRECT REPAIR, OR DAMAGE FROM IMPROPER WIRING OR INSTALLATION. THIS WARRANTY DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES. LUTRON'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE MANUFACTURE, SALE, INSTALLATION, DELIVERY, OR USE OF THE UNIT SHALL NEVER EXCEED THE PURCHASE PRICE OF THE UNIT.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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# Lutron Specification Submittal

## RadioRA Multi-Location Dimmers for Electronic Low-Voltage Lighting Loads

*Dimmer for Elec. LoV*

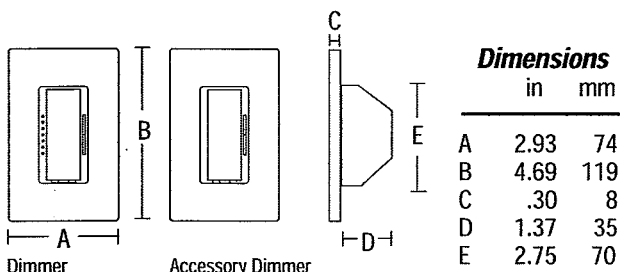
RAELV-500LM, RA-AD

Model No.: ☐ RAELV-500LM- ☐ RA-AD-

Gloss Colors: ☐ White ☐ Ivory ☐ Almond ☐ Light Almond ☐ Gray ☐ Brown ☐ Black

Satin Colors: ☐ Ivory ☐ Kiwi ☐ Ochre ☐ Lilac ☐ TerraCotta ☐ Desert Stone ☐ Stone ☐ Limestone

☐ Blue Mist ☐ Sea Glass ☐ Midnight ☐ Taupe ☐ Eggshell ☐ Biscuit ☐ Snow



Note: Dimmer shown with Lutron Designer Wallplate

### ► Specifications

<b>POWER</b>	Input: 120/127VAC, 50/60Hz
<b>MOUNTING</b>	1-gang US wallbox
<b>TEMPERATURE</b>	32-104°F (0-40°C)
<b>DESIGN</b>	Use Lutron Claro® or Satin Colors™ wallplates or standard decorator-style wallplates
<b>SYSTEM MAX.</b>	32 Dimmers/Switches/GRAFIK Eye Interfaces (does not include RA-AD Accessory Dimmers or RA-AS Accessory Switches)
<b>LOAD TYPE</b>	Electronic Low-Voltage and Incandescent
<b>MIN. LOAD</b>	40W
<b>MAX. LOAD</b>	500W
<b>AUXILIARY CONTROLS</b>	Use up to nine RA-AD (Accessory Dimmers) for 3-way and 4-way applications

For multi-gang installations, derate load capacities as follows:

Model No.	End of Gang (1 side section removed)	Middle of Gang (2 side sections removed)
RAELV-500LM	450W	400W
RA-AD	no derating required	no derating required

### ► Features

- Multi-location dimming from Dimmer and Accessory Dimmer
- Lights fade up or down over 3 seconds when turned on or off
- Double tap instantly brings lights to full on
- Long tap (press and hold for 1/2 second) fades lights to off over 10 seconds
- Light levels can be fine-tuned by pressing and holding the dimming rocker until the desired light level is reached

### ► Function

- Allows local control of one circuit of lights in a RadioRA system to:
- turn lights on or off
  - adjust light intensity

### ► Flexibility

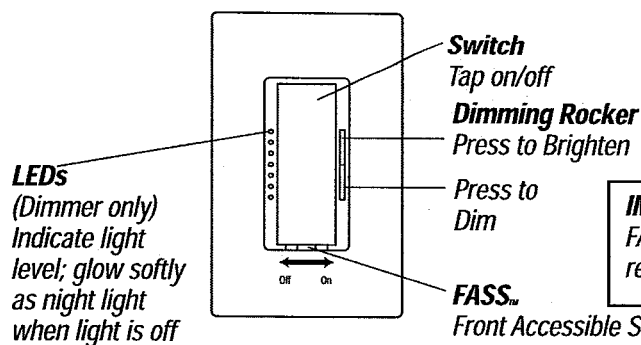
- Uses conventional 3-way and 4-way wiring.

### ► Reliability

- Dimmers always operate locally and do not require central system control.



## ► Dimmer Operation

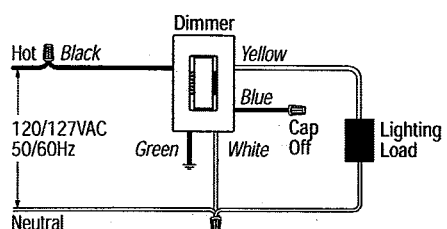


### IMPORTANT NOTICE:

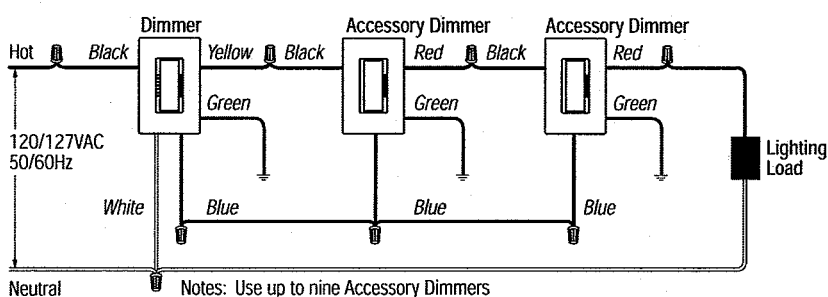
FASS™ - Front Accessible Service Switch - to replace bulb, remove power by sliding FASS switch to the left.

## ► Wiring Diagrams

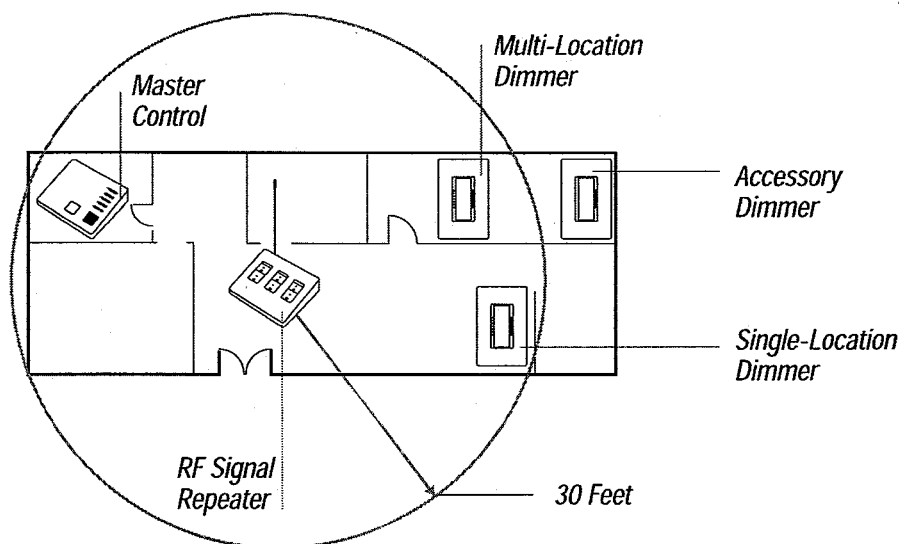
### Single-Location Installation



### Multi-Location Installation



## ► RadioRA System Overview



### Notes:

- RadioRA Dimmers must be located within 30 feet of an RF Signal Repeater.
- RadioRA Accessory Dimmers (RA-AD) are not required to be within any specific range of an RF Signal Repeater.

## ► Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO ONE YEAR FROM PURCHASE. THIS WARRANTY DOES NOT COVER THE COST OF INSTALLATION, REMOVAL OR REINSTALLATION, OR DAMAGE RESULTING FROM MISUSE, ABUSE, OR IMPROPER OR INCORRECT REPAIR, OR DAMAGE FROM IMPROPER WIRING OR INSTALLATION. THIS WARRANTY DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES. LUTRON'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE MANUFACTURE, SALE, INSTALLATION, DELIVERY, OR USE OF THE UNIT SHALL NEVER EXCEED THE PURCHASE PRICE OF THE UNIT. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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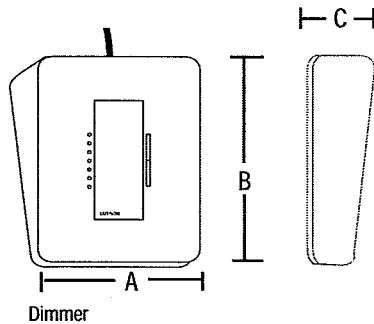
# Lutron Specification Submittal

## RadioRA Table Lamp Dimmer Controls for Table and Floor Lamps

Lamp Dimmer

RA-300TL, RALV-300TL

Model No.:	<input type="checkbox"/> RA-300TL -	<input type="checkbox"/> RALV-300TL -
Colors:	<input type="checkbox"/> White	<input type="checkbox"/> Royal Plum
	<input type="checkbox"/> MidNight	



	Dimensions	
	in	mm
A	2.45	62
B	3.23	82
C	.96	24

### ► Specifications

<b>POWER</b>	Plugs into standard 120/127VAC (50/60Hz) wall receptacle Features a 6-foot cord		
<b>TEMPERATURE</b>	32-104°F (0-40°C)		
<b>MAX CAPACITY</b>	RA-300TL-WH	300W	Incandescent
	RALV-300TL-WH	300VA (240W)	Magnetic Low-Voltage
<b>SYSTEM MAX.</b>	RadioRA Table Lamp Dimmers count toward the system maximum of 32 Dimmers/Switches/GRAFIK Eye® Interfaces		
<b>MIN LOAD</b>	10W		

*\*Magnetic low-voltage dimmers can also control incandescent loads.*

### ► Features

- Lights fade up or down over 3 seconds when turned on or off.
- Double tap instantly brings lights to full on.
- Long tap (press and hold for 1/2 second) fades lights to off over 10 seconds.
- Light levels can be fine-tuned by pressing and holding the dimming rocker until the desired light level is reached.
- Royal Plum color matches black Master Controls.

### ► Function

- Allows local control of table or floor lamps in a RadioRA system to:
- turn lights on or off
  - adjust light intensity

### ► Flexibility

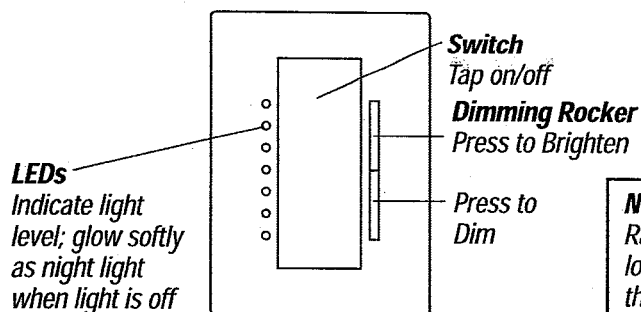
- Can be moved from room to room quickly and easily.
- Plug lamp into Dimmer and plug the Dimmer into the receptacle.

### ► Reliability

- Dimmers always operate locally and do not require central system control.

Have Questions? Call the Lutron Hotline 24/7 at 800-523-9466, or visit the Lutron website at [www.lutron.com](http://www.lutron.com)

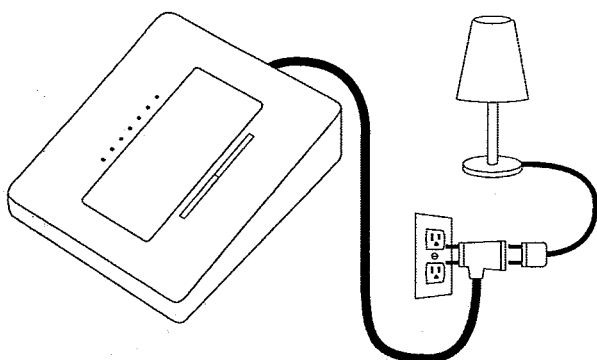
## ► Table Lamp Dimmer Operation



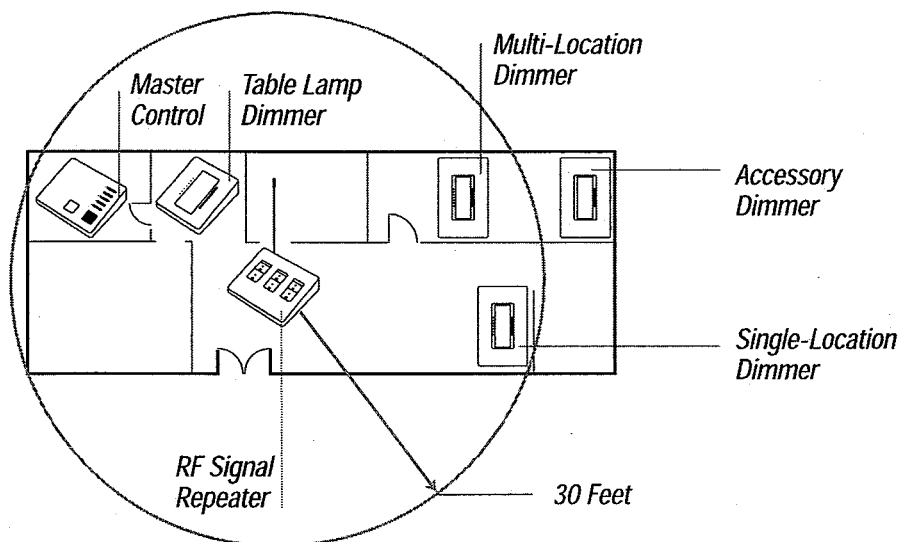
### NOTE:

RadioRA Table Lamp Controls not intended for use with motor loads, other non-lighting loads, or with table and floor lamps that contain integral dimmers.

## ► Installation



## ► RadioRA System Overview



### Notes:

- RadioRA Dimmers must be located within 30 feet of an RF Signal Repeater.

## ► Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO ONE YEAR FROM PURCHASE. THIS WARRANTY DOES NOT COVER THE COST OF INSTALLATION, REMOVAL OR REINSTALLATION, OR DAMAGE RESULTING FROM MISUSE, ABUSE, OR IMPROPER OR INCORRECT REPAIR, OR DAMAGE FROM IMPROPER WIRING OR INSTALLATION. THIS WARRANTY DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES. LUTRON'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE MANUFACTURE, SALE, INSTALLATION, DELIVERY, OR USE OF THE UNIT SHALL NEVER EXCEED THE PURCHASE PRICE OF THE UNIT. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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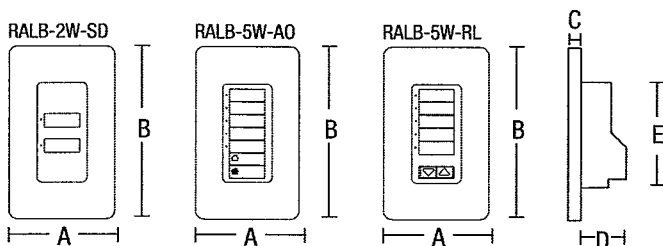
# Lutron Specification Submittal

## RadioRA Large Button Master Controls (Wall-mounted)

*Large Button Ctrl*

RALB-2W-SD, RALB-5W-AO, RALB-5W-RL

Model No.:	<input type="checkbox"/> RALB-2W-SD-	<input type="checkbox"/> RALB-5W-AO-	<input type="checkbox"/> RALB-5W-RL-
Gloss Colors:	<input type="checkbox"/> White	<input type="checkbox"/> Ivory	<input type="checkbox"/> Almond
	<input type="checkbox"/> Light Almond	<input type="checkbox"/> Gray	<input type="checkbox"/> Brown
	<input type="checkbox"/> Black		
Satin Colors™:	<input type="checkbox"/> HoI	<input type="checkbox"/> Ochre	<input type="checkbox"/> TerraCotta
	<input type="checkbox"/> Desert Stone	<input type="checkbox"/> STone	<input type="checkbox"/> LimeStone
	<input type="checkbox"/> Blue MisI	<input type="checkbox"/> MidNight	<input type="checkbox"/> TauPe
	<input type="checkbox"/> EggShell	<input type="checkbox"/> Blscuit	<input type="checkbox"/> SnoW
Engraving:	<input type="checkbox"/> -Prepaid (engrave later) <input type="checkbox"/> -Engrave now		



### Dimensions

	in	mm
A	2.93	74
B	4.69	119
C	.30	8
D	1.26	32
E	2.75	70

Note: Master Controls shown with Lutron Designer Wallplates

### ► Specifications

<b>POWER</b>	Input: 120/127 V~, 50/60 Hz
<b>MOUNTING</b>	1-gang US wallbox
<b>TEMPERATURE</b>	32-104°F (0-40°C)
<b>DESIGN</b>	Use Lutron Claro® or Satin Colors™ wallplates
<b>SYSTEM MAX.</b>	14 Master Controls (24 with Chronos™ system bridge and timeclock)

### ► Features

- Central control for RadioRA local lighting controls
- Controls are field-programmable to select whole-house or single-room preset light levels
- One custom-engraved button kit included
- Large, easy-to-press buttons
- LEDs show status of lighting

### ► Function

Central control of RadioRA local lighting control system to:

- turn a light or group of lights on to preset levels
- monitor the status of a light or group of lights
- turn all lights on to full
- turn all lights off
- raise and lower room/scene lighting (-RL model only)

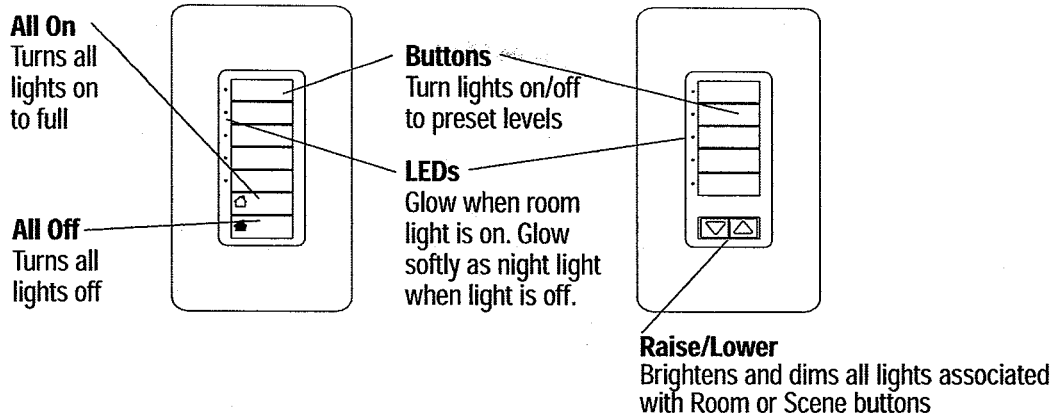
### ► Flexibility

- Master Control button columns may be set up to monitor lights (Room buttons) or to select presets (Scene buttons).

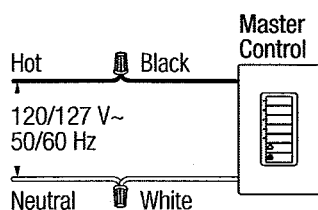
Have Questions? Call the Lutron Hotline 24/7 at 800-523-9466, or visit the Lutron website at [www.lutron.com](http://www.lutron.com)



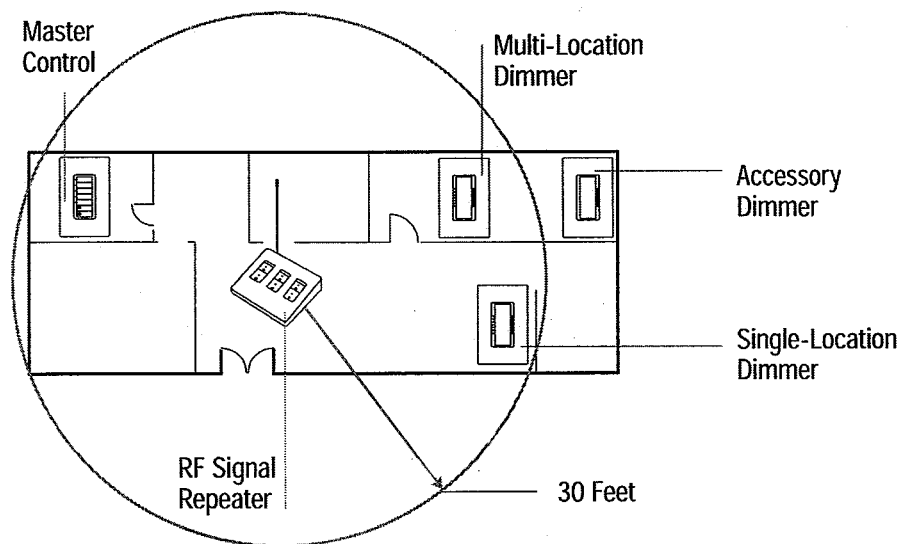
## ► Master Control Operation



## ► Wiring Diagram



## ► RadioRA System Overview



### Notes:

- RadioRA Master Controls must be located within 30 feet of an RF Signal Repeater.

## ► Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO ONE YEAR FROM PURCHASE. THIS WARRANTY DOES NOT COVER THE COST OF INSTALLATION, REMOVAL OR REINSTALLATION, OR DAMAGE RESULTING FROM MISUSE, ABUSE, OR IMPROPER OR INCORRECT REPAIR, OR DAMAGE FROM IMPROPER WIRING OR INSTALLATION. THIS WARRANTY DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES. LUTRON'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE MANUFACTURE, SALE, INSTALLATION, DELIVERY, OR USE OF THE UNIT SHALL NEVER EXCEED THE PURCHASE PRICE OF THE UNIT.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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# Lutron Specification Submittal

## RadioRA Multi-Location Switches for Permanently Installed Lighting Loads

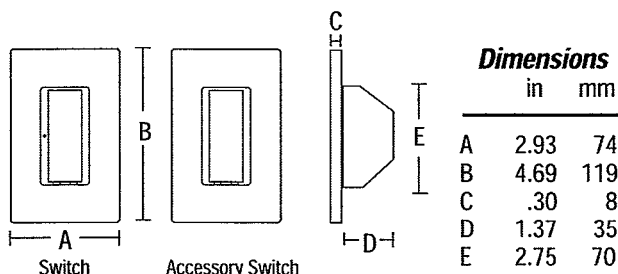
RadioRA - Multi-Location Switches

RAS-8LM, RA-AS

Model No.: ☐ RAS-8LM- ☐ RA-AS-

Gloss Colors: ☐ White ☐ Ivory ☐ Almond ☐ Light Almond ☐ Gray ☐ Brown ☐ Black

Satin Colors: ☐ Hoi ☐ Kiwi ☐ Ochre ☐ Lilac ☐ TerraCotta ☐ Desert Stone ☐ Stone ☐ Limestone  
☐ Blue Mist ☐ Sea Glass ☐ Midnight ☐ Taupe ☐ Eggshell ☐ Biscuit ☐ Snow



Note: Switches shown with Lutron Designer Wallplates

### ► Specifications

<b>POWER</b>	Input: 120/127VAC, 50/60Hz (requires a neutral wire connection)
<b>MOUNTING</b>	1-gang US wallbox
<b>TEMPERATURE</b>	32-104°F (0-40°C)
<b>DESIGN</b>	Use Lutron Claro® or Satin Colors™ wallplates or standard decorator-style wallplates
<b>SYSTEM MAX.</b>	32 Dimmers/Switches/GRAFIK Eye® Interfaces (does not include RA-AD Accessory Dimmers or RA-AS Accessory Switches)
<b>LOAD TYPE</b>	Incandescent, fluorescent, magnetic low-voltage, electronic low-voltage, high intensity discharge
<b>MAX. CAPACITY</b>	8A
<b>MIN. LOAD</b>	5W
<b>AUXILIARY CONTROLS</b>	Use up to 9 RA-AS Accessory Switches for 3-way and 4-way applications

For multi-gang installations, derate load capacities as follows:

Model No.	End of Gang (1 side section removed)	Middle of Gang (2 side sections removed)
RAS-8LM	6.5A	5A
RA-AS	Does not require derating	Does not require derating

### ► Features

- Multi-location switching
- Single tap brings lights instantly to full on.
- LED indicates status of lighting load (on RAS-8LM only).

### ► Function

- Allows local control of one circuit of lights in a RadioRA System to:
  - turn lights on or off

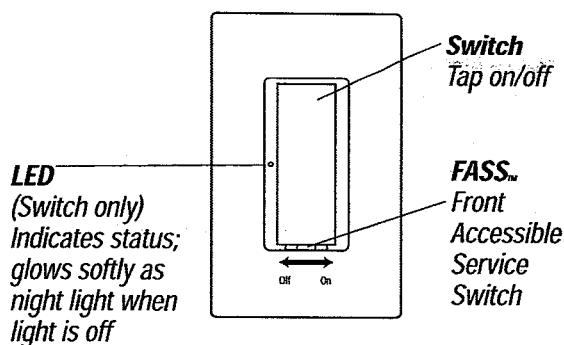
### ► Flexibility

- Uses conventional 3-way and 4-way wiring.

### ► Reliability

- Switches always operate locally and do not require central system control.

## ► Switch Operation

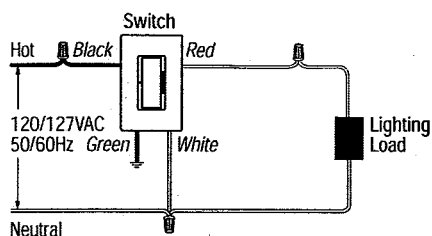


### IMPORTANT NOTICE:

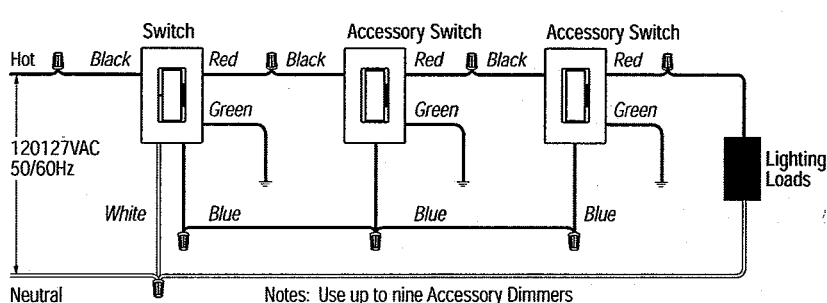
FASS™ - Front Accessible Service Switch - to replace bulb, remove power by sliding FASS switch to the left on either the RadioRA Switch or Accessory Switch.

## ► Wiring Diagram

### Single-Location Installation



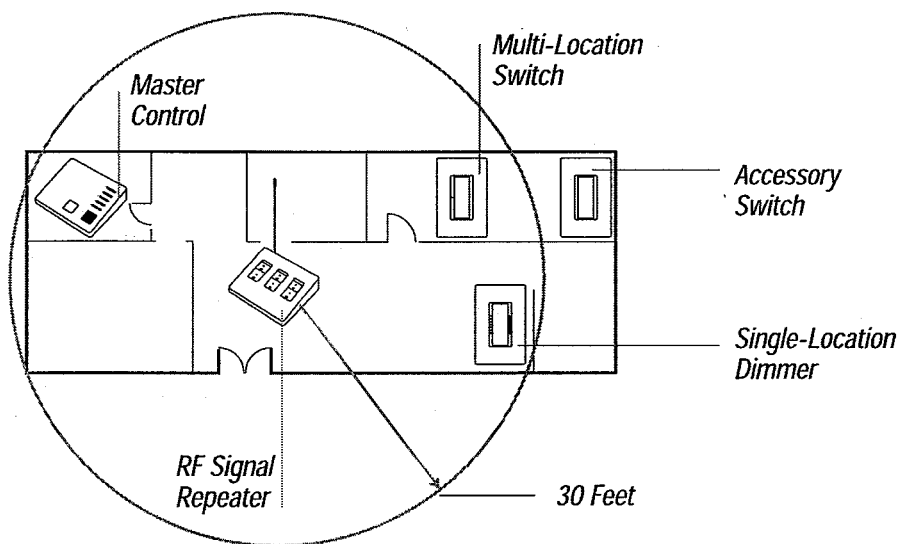
### Multi-Location Installation



Notes: Use up to nine Accessory Dimmers  
Maximum wire run length on blue wire is 250 feet.



## ► RadioRA System Overview



### Notes:

- RadioRA Switches must be located within 30 feet of an RF Signal Repeater.
- RadioRA Accessory Switches (RA-AS) are not required to be within any specific range of an RF Signal Repeater.

## ► Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO ONE YEAR FROM PURCHASE. THIS WARRANTY DOES NOT COVER THE COST OF INSTALLATION, REMOVAL OR REINSTALLATION, OR DAMAGE RESULTING FROM MISUSE, ABUSE, OR IMPROPER OR INCORRECT REPAIR, OR DAMAGE FROM IMPROPER WIRING OR INSTALLATION. THIS WARRANTY DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES. LUTRON'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE MANUFACTURE, SALE, INSTALLATION, DELIVERY, OR USE OF THE UNIT SHALL NEVER EXCEED THE PURCHASE PRICE OF THE UNIT. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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Order P/N 366-416 for a complete set of RadioRA specification submittals.  
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# LUMINAIRE SCHEDULE

TYPE	DESCRIPTION	MFR/CATALOG #	ALTERNATE	LAMPING PER FIXTURE		VOLTS	LOCATION	QTY	NOTES
				#	WATTS TYPE				
L1	Color-changing 12" LED striplight; connected to standalone PV system.	Color Kinetics iColorCove QL #101-000051-00  PDM-201 #118-000062-00  Smart Jack 3 Adapter #104-000007-00			3 W LED, RGB	24 VDC	Breezeway clerestories		1. To be installed with Duogard wall system. 2. Three 12" fixtures to be mounted per translucent glazing module. 3. North facing clerestories to have one fixture centered and mounted at top of module, remaining two fixtures to be mounted 6" from each side at bottom of module; all three fixtures to be centered and mounted on bottom of East/West facing modules.
L2R	LED spot light, Color: red	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W LED, red	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L2G	LED spot light, Color: green	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W LED, green	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L2B	LED spot light, Color: blue	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W LED, blue	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L3	12" warm-white L.E.D. striplight.	Lightwild LW-LIN-W-3K-12-LFR  Controller: LW-LIN-GCU-OUTD-40-ONOFF			3.5 W LED, warm white	24 VDC	Site ramps		
L4	Submersible L.E.D.				LED, cool white	24 VDC	Site Rainwater garden basin		To be aimed on-site by lighting designer during installation.
L5	Cool-white L.E.D. small round recessed uplight.				1.5 W LED	24 VDC	Site tree; kiosks		To be aimed on-site by lighting designer during installation.
L6	Exterior cool white LED striplight with 82" beam spread; 48" long.	Lightwild LW-LIN-W-3K-12-LFR			3.5 W LED, cool white	24 VDC	Site green-screen		
P1	Surface-mounted 3' linear fluorescent uplight with 2-lamp electronic dimming ballast.	Ellipair F305-T239-S-00-T-000 Lutron 1% Hi-Lume FDB-T539-120-2		1	39 W F39T5HO	120 VAC	Living Space/Bedroom fixed cabinets	4	1. Install a strip of GWB in front of the luminaire to block direct view of lamp. Paint to match the wall color. 2. Controlled by RadioRA.
P2	Low-voltage accent light surface mounted underneath cabinet with remote transformer.			1	20 W MR11	12 VAC	Living Space fixed cabinets	3	1. Coordinate with architects for exact mounting locations. 2. 120VAC/12VAC transformer required. 3. To be aimed by lighting designers after installation as necessary.
P3	Low-voltage decorative pendant on cable system with remote transformer; lamps included.	Alfa Lighting G68PK-Frosted-801-JC 35W G6.35-Cable System-Satin Nickel		1	35 W T4 halogen bi-pin (included)	12 VAC	Dining Space Dining Table		Low voltage transformer required.
P4	LED desk lamp; manually switchable; connected to on/off photosensor to maintain a minimum 50 fc on workplane at all times.	FineLite			9 W LED		Movable Wall desk		Test to determine best location for photosensor and lamp on desk.
P5	Low-voltage bedside reading light fixture.						Bedroom bedside		Low voltage transformer required.
P6	Surface mounted mirror with integral lighting; on-off pull chain included. Dimensions: 17.7" W x 31.5" H x 1.6" D	Lightology 0103ML-IMOLA-018F1-OOMI  Lutron Eco-10 Ballast FDB-T539-120-2	Lightology 0743ME-TWINSUM-020F1-OOMI (ballast and two (2) F24T5HO/830 lamps included)	2	14 W F14T5, 3000K	120 VAC	Bathroom mirror		Center above sink so that top edge is in line with top edge of cabinet, or coordinate with architects for exact mounting location.
P7	12" linear fluorescent undercabinet fixture; integral electronic ballast; high-efficiency (HE) T5 lamp included.	SIMKAR	Alfa Lighting UFL12-SL	1	8 W T5 HE, 3000K (included)	120 VAC	Kitchen under cabinets		Connect to wallswitch to override individual fixture switches.
P8	Surface mounted compact fluorescent downlight.	LUCEPLAN METROPOLI D20/17P-PW + D20/17.2		1	9 W CFQ9W/G23/830	120 VAC	Kitchen over sink		
P9	Recessed linear fluorescent T5HO downlight with integral electronic ballast; lamp included.		Focal Point FAVE-F1-T5HO-C-120-CF-CRWH-2	1	24 W F24T5/830/HO/ALTO	120 VAC	Kitchen by skylight		1. Must be IC-rated.
P10	Surface mounted compact fluorescent downlight with integral magnetic ballast.	Bega 2839P SLV	Bega 2839P SLV	1	9 W CFQ9W/G23/830	120 VAC	Mechanical Room		
P11	Decorative wall-mounted compact fluorescent fixture with photocell; rated for wet locations.	Insight Lighting	ICP Inc. 51018BPC	1	18 W springlamp (NPF CFL, GX base)	120 VAC	Exterior East/West entrance doors		
P12	In-ground mounted asymmetric narrow beam L.E.D. strip with integral driver; UL listed for wet locations. Dimensions: 49.0" L x 2.56" W x 4.25" D	Designplan C2L-L-AF-4-SS-0-G-R-00 C2L-L-BF-4-SS-0-G-R-00			3 W LED, 3150K/5500K	120 VAC	Exterior Deck at south-wall	8	1. Mount 3150K LEDs at glazing and 5500K LEDs at slates, at least 9" away from façade. 2. Fixtures at glazing to be switched separately from those at slates.



# PSU SOLAR DECATHLON MATERIAL LIST

MATERIAL:

SQUARE D MASTER LIST - SUMMARY LIST

DRAWING:

X These items  
are listed on  
separate sheets

LIST:

Added  
to List

✓ H222NRB	2 - Safety Switch	} These are all Safety switches
✓ H222N	2	
✓ H221N	1	
✓ H221NRB	4	
✓ H321NRB	1 - Safety Switch	
✓ PM850RD	1	
✓ PM8G	1	

MAIN AC PANEL:

\*\*SEE ATTACHED BILL OF MATERIAL FROM SQUARE D\*\*

DC LIGHTING PANEL:

\*\*SEE ATTACHED BILL OF MATERIAL FROM SQUARE D\*\*

## PSU SOLAR DECATHLON MATERIAL LIST

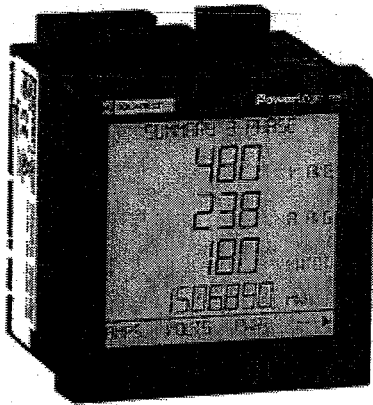
SYSTEM: MAIN METERING

DRAWING: N/A

### MATERIAL LIST:

Meter:	PM850RD	POWERLOGIC METER WITH REMOTE DISPLAY	→ already have!
Socket:	Milbank U3939-X	320A Underground Meter Socket	<u>**NOT SQUARE D**</u>
Adapter:	PM8G	Socket adapter for PM850RD	↓ add to HITE LIST make sure underground meter socket

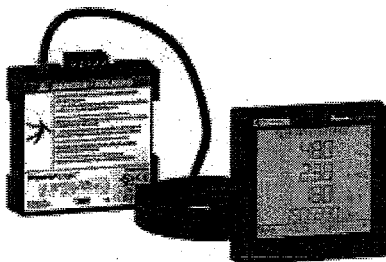
# PowerLogic® Series 800 Power Meters



*Series 800 Power Meters with unique, easy to read backlit display that lets you view multiple values at one time (e.g. all three phases, plus neutral, for current or voltage)*

## Applications

- Remote monitoring of an electrical installation
- Panel instrumentation
- Cost allocation
- Power Sensitive Processes



*Optional remote display for Series 800 power meters is the perfect choice for installations when local regulations do not permit over 120V on panel doors*

Today, the balance between the cost and reliability of power remains a priority. We're all working harder these days to reduce costs and increase productivity. But it takes the right equipment to achieve those goals and that's why we developed PowerLogic Series 800 Power Meters.

Designed for basic monitoring and electrical installations with power-sensitive processes, there are three Power Meter models available that combine accurate energy, power measurement and power quality capabilities not typically found in a compact power meter. These 96x96mm units are equipped with advanced functionality such as sag/swell disturbance detection, waveform capture, 128 samples per cycle plus offer an easy to use display for local viewing that can be read in extreme lighting conditions or viewing angles.

## Advantages

### Model PM870 — Ideal for Mains and Feeders

- Disturbance sag/swell detection for troubleshooting and resolving anomalies that can affect manufacturing production or sensitive processes such as semiconductor fabrication, pharmaceuticals, petrochemical facilities.
- Configurable Waveform Capture, with flexible resolution, permits you to adapt the waveform captures according to the type of event/disturbance or even channel—185 cycles in one channel at 16 samples/cycle up to 3 cycles on six channels at 128 samples/cycle. Waveforms plotted in PowerLogic® System Manager Software give a graphical representation of what's happening with your power at a particular instant.

### Model PM850 — Ideal for Feeders

- Boolean Alarms increase Flexibility and Logic for Alarming by allowing the combination of up to four other alarms with NAND, AND, OR, NOR and XOR.
- Additional Power Quality capabilities—EN50160 Evaluation, individual harmonics up to 63rd and Waveform Capture.
- Trending & Forecasting—Combining data collection capabilities with its unique firmware, Series 800 Power Meters "look into the future" to automatically forecasting power usage. Coupled with the ability to access information—such as onboard statistical calculations, real time trend plots, min/max and averages, demand metering—the power meter provides answers instead of just raw data that is ideal for intelligent power control, load curtailments and load preservation programs that can perform to drive down energy costs and improve system reliability.

### Model PM820 — Ideal for Basic Monitoring

- Accurate demand and energy measurements (meeting both IEC 62053-22 and ANSI C12.20 Class 0.5S standards) help facility managers track costs, allocate energy expenses, and sub-bill by department, area or individual process.
- Onboard data logging—another capability that is usually only found in higher end meters—stores Power Meter information in the meter's non volatile memory, allowing the most reliable data, is collected and data gaps, due to network downtime are eliminated.
- Standard Modbus® communications—allow Power Meter to be used as part of a PowerLogic power and energy management system. Data logs stored onboard are automatically retrieved on a scheduled basis by system software and made accessible for usage pattern analysis, cost allocation reporting and essential for making other fact based decisions.
- Installation—the Power Meter's compact size and mounting depth of 70 mm make it suitable for installation in low voltage switchboards (even in shallow cable compartments), standalone machines, and a wide range of commercial and industrial applications. Series 800 Power Meter mounts with only two clips; no tools are required.
- Field Installable Modules—optionally, a remote display or input/output modules can be added at any time to evolve as your needs require thus allowing monitoring of status points, energy monitoring of water, air, gas, electric, or steam pulses (WAGES) or other new functions.
- Downloadable Firmware—update your meters with the latest features by simply downloading them from [www.powerlogic.com](http://www.powerlogic.com).
- Voltage Inputs 600 Vac Direct Connect—power Meter can connect directly with up to 600V inputs as opposed to traditional 120V, eliminating the need for potential transformers (PTs).



## On-Board Logging

Extensive on-board memory to handle advanced alarm and logging functions

- Custom data logs, one in PM820, three in PM850 and PM870
- Minimum/maximum logging
- Energy billing log
- Default logging set at factory, logging starts as soon as meter is powered up
- Multiple alarms with up to four priority classes

## Mounting Options

### Compact design

- Optional Remote Display includes configurable 2-4 wire RS485/RS232 port
- Panel mount with a 92x92mm cutout
- Retro fit existing analog meters with 4" round cutouts
- Din rail mounting without display
- Option modules available for field installation

## Harmonic Measurements

### Power Quality Features

- Voltage and current magnitudes and angles to the 31st harmonic; 63rd harmonic on PM850 and PM870
- Disturbance sag/swell detection, configurable waveform on PM870

### Metering Values

Current, per phase and neutral
Current demand—maximum per phase & neutral
Voltage, per phase (L-L, L-N)
Power, per phase, 3-ph total (kW, kVA, kVAR)
Power factor, 3 phase total
Power demand (kWd) present & peak
Power demand, (kVARd, kVA d) present & peak
Real energy (kWh)
Energy, IN and OUT (kWh, kVARh, kVAh)
Minimum/maximum readings, I, V, F, PF, THD
THD, voltage and current per phase
Trending and forecasting (PM850/PM870)

## Technical Specifications

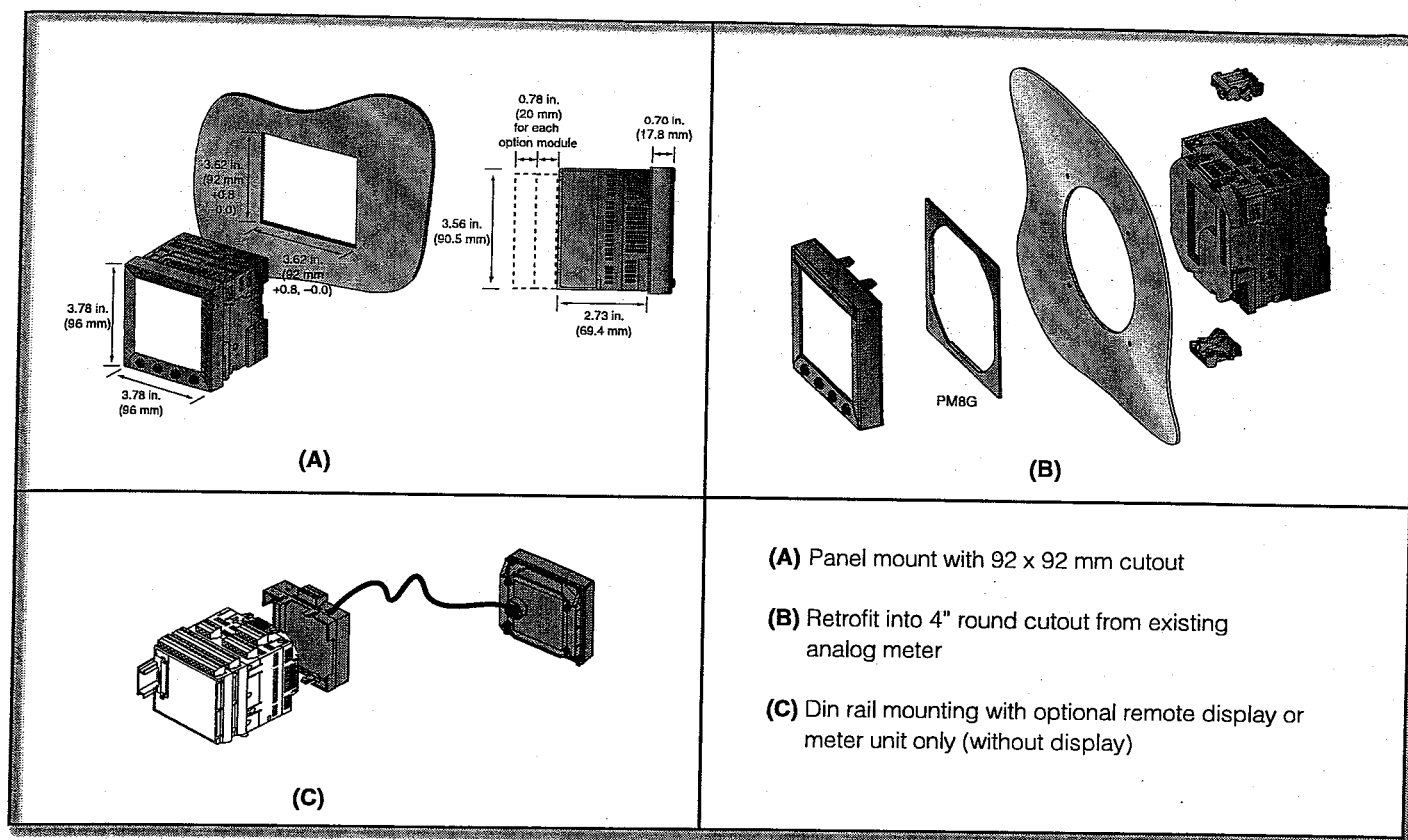
<b>Current Inputs (Each Channel)</b>	
Nominal Current	5 A ac
Metering Range	0-10 A ac
Withstand	15 A continuous
	50 A 10 sec per hour
	500 A 1 sec per hour
Burden	Less than 0.15 VA
Input Impedance	Less than 0.1 Ohm
<b>Voltage Inputs (Each Channel)</b>	
Nominal Full Scale	347 Vac L-N 600 Vac L-L
Metering Over-range	50%
Input Impedance	5 Mohm
Metering Frequency	
Range	45-67 Hz 350-450 Hz
Metering Category III	
<b>Accuracy</b>	
IEC 62053-22 0.5S (Real Energy)	
ANSI C12.20 0.5S	
<b>Current</b>	
±(0.075% Reading + 0.025% full scale) <sup>1</sup>	
<b>Voltage</b>	
±(0.075% Reading + 0.025% full scale) <sup>2</sup>	
<b>Power</b>	
±(0.15% Reading + 0.025% full scale) <sup>3</sup>	
True Power Factor ±0.002 to 0.500 leading and -0.002 to 0.500 lagging	
<b>Frequency</b>	
±0.01 Hz at 45-67 Hz	
±0.01 Hz at 350-450 Hz	
<b>Sampling</b>	
• Zero blind	
• 128 samples/cycle	
<b>Harmonic Resolution</b>	
Metered Values	63rd harmonic
<b>Waveform Capture and Disturbance Detection</b>	
Manual or alarm initiation (PM85/PM870)	
3 Cycles @ 128 samples/cycle (PM850)	
Configurable waveform (PM870)	
Sag/swell disturbances (PM870)	
<b>I/O</b>	
• Standard KV output 3 Vac/dc to 240 Vac or 300 Vdc	
—1350 Vrms isolation	
—100 mA maximum @ 25°C <sup>4</sup>	
• Standard digital input	
—Turn on voltage 20-138 Vac/dc	
—5mA burden	
• I/O Option modules	
—2 digital out, 2 digital in, 2 analog out, 2 analog in	
—2 digital out, 6 digital in	
<b>Onboard Logging</b>	
<b>PM820</b>	
• 80Kb non-volatile memory for onboard logging	
• 1 custom data log	
• 1 billing log	
• Event log date/time stamps to seconds	
• Min/max log of worst phase with date and time stamp	
• Alarm log, maintenance log	
• Default logging loaded at factory, begins on device power up	
<b>PM850/PM870</b>	
• 800Kb non-volatile memory for onboard logging	
• 3 custom data logs	
• 1 billing log	
• Trending and forecasting log (phase 2, firmware)	
• Event log date/time stamps to seconds	
• Min/max log of worst phase with date and time stamp	
• Alarm log, maintenance log	
• Default logging loaded at factory, begins on device power up	
<b>Onboard Trending and Forecasting</b>	
• Average, minimum and maximum values by minute, hour, day and month	
• Forecasted average, minimum and maximum values by hour and day	
• Statistical summaries for hours and weeks	
<b>Alarming</b>	
• Each alarm, individually configured with pickup and dropout setpoints and delays	
• Each alarm can be assigned one of four priority classes	
• Supports multiple alarms for a single quantity to create alarm levels	
• Assign different actions based on the severity level of the alarm	
<b>Response time: 1 sec</b>	
<b>Boolean alarms (PM850 only) combine up to four other alarms with AND, NAND, NOT, OR, and XOR</b>	
<b>Firmware upgrade</b>	
<b>Platform can be updated with new features by firmware download via RS 485</b>	
<b>Control Power</b>	
Universal	AC or DC
AC Control Power	
Operating Range	115-415
Burden	15 VA max
Frequency	45-67 Hz 350-450 Hz
Ride through	45 ms at 120 Vac
DC Control Power	
Operating range	125-250 V ± 20%
Burden	10W max
Ride through	45 ms at 125 Vdc
<b>Operating temperature</b>	
Meter	-25°C to +70°C <sup>4</sup>
Display	10°C to +50°C
<b>Operating Environment</b>	
Relative humidity	5-95% (non-condensing)
Maximum elevation	3,000 m
Pollution degree	2
<b>Physical Specifications</b>	
Weight (w/o options)	1.1 lb. (0.5 kg)
Dimensions LxWxH	96x96x98mm
<b>Regulatory/Standards Compliance</b>	
<b>Emissions</b>	
• Radiated FCC part 15 Class A, EN55011	
• Conducted FCC part 15 Class A, EN55011	
• Harmonics IEC 1000-3-2	
• Flicker IEC 1000-3-3	
<b>Immunity</b>	
• ESD IEC 1000-4-2 Level 3	
• Radiated IEC 1000-4-3 Level 3	
• EFT IEC 1000-4-4 Level 3	
• Surges IEC 1000-4-5 Level 3	
• Conducted IEC 1000-4-6 Level 3	
• Magnetic field IEC 1000-4-8 Level 3	
• Voltage dips IEC 1000-4-11	
<b>Accuracy</b>	
IEC 62053-22 0.5S (Real Energy)	
ANSI C12.20 0.5S	
<b>Regulatory Compliance</b>	
USA <sup>1</sup>	UL 508
Canada	cUL 508
Europe	CE per EN 61010
<b>Communications</b>	
<b>RS-485 (Standard)</b>	
• Modbus <sup>®</sup> or JBUS protocol	
• 2-wire connection	
• Up to 38.4K baud	
• 2nd RS-485/232 port with remote display adapter (optional)	
<b>Mounting Options</b>	
• Panel mount	
• 96x96mm cutout or 4" round hole	
• Din rail without display or with remote display	
<b>Specifications (based on 50/60 Hz nominal systems)</b>	
<sup>1</sup> Full scale = 10A. Add 0.006% (Temperature [°C]-25) to the upper limit error for temperatures below 25°C	
<sup>2</sup> Full scale = 600V. Add 0.001% (Temperature [°C]-25) to the upper limit error for temperatures above 50°C	
<sup>3</sup> Full scale = 120 V x 10A. Add 0.006% (Temperature [°C]-25) to the upper limit error for temperatures below 25°C	
<sup>4</sup> Requires 5°C derating when using display and control power above 305V	
<sup>5</sup> Derate load current 0.56 mA/°C above 25°C	



## Product Selection Guide

		PM870	PM850	PM820
<b>General selection criteria</b>				
Installation				
Use on LV distribution systems		▼	▼	▼
Use on LV and HV distribution systems		▼	▼	▼
Current / voltage accuracy		0.1%	0.1%	0.1%
Power / energy accuracy		0.5%	0.5%	0.5%
<b>Power quality measurements</b>				
Total harmonic distortion	▼ Phases	▼	▼	▼
	▼ Neutral	▼	▼	▼
Voltage per phase	(L-L, L-N)	▼	▼	▼
Frequency		▼	▼	▼
Total power	▼ Active	▼	▼	▼
	▼ Reactive	▼	▼	▼
	▼ Apparent	▼	▼	▼
	▼ Active	▼	▼	▼
Power per phase	▼ Reactive	▼	▼	▼
	▼ Reactive	▼	▼	▼
	▼ Total	▼	▼	▼
Power factor	▼ Total	▼	▼	▼
	▼ Per phase	▼	▼	▼
<b>Energy values</b>				
Real energy		▼	▼	▼
Apparent energy		▼	▼	▼
User-set accumulation mode		▼	▼	▼
<b>Demand values</b>				
Current	Present and max. values	▼	▼	▼
Total active power	Present and max. values	▼	▼	▼
Total reactive power	Present and max. values	▼	▼	▼
Total apparent power	Present and max. values	▼	▼	▼
Total predicted demand	kW, kVAR, kVA	▼	▼	▼
Synchronization of calculation window		▼	▼	▼
User-set calculation mode		▼	▼	▼
<b>Power quality measurements</b>				
Total harmonic distortion	Voltage	▼	▼	▼
	Current	▼	▼	▼
Individual harmonic magnitude and angles		63	63	31
Waveform capture		up to 185 cycles	3 cycles	—
Detection of voltage sags and swells		▼	—	—
Programmable (logic and mathematical functions)		▼	—	—
EN50160 compliance checking		▼	▼	—
True ms measurement	Max. harmonic number	63	63	63
Sampling rate	Points per cycle	128	128	128
<b>Logging</b>				
Min/max of instantaneous values		▼	▼	▼
Data logging		▼	▼	▼
Event logging		▼	▼	▼
Trend curves		▼	▼	▼
Alarms		▼	▼	▼
Storage capacity		800 kB	800 kB	80 kB
<b>Display, sensors, input/outputs</b>				
Front panel display		▼	▼	▼
Pulse output		▼	▼	▼
Digital or analog inputs (max. number)		13	13	13
Digital or analog outputs (max. number, including pulse outputs)		9	9	9
Direct voltage connections without external VT		600V	600V	600V
Input Metering Capability, number of channels		18	18	5
<b>Power supply</b>				
AC/DC version		AC DC	AC DC	AC DC
<b>Communication</b>				
RS-485 port		▼	▼	▼
RS-232 port		▼	▼	▼
Modbus protocol		▼	▼	▼
Transparency/Ready compatible		▼	▼	▼

## Mounting Options



## Ordering Information

Description	Part Number
<b>Meter with Integrated Display</b>	
PM with integrated display, basic instrumentation, THD, Alarming, 80 kb Logging	PM820
PM with integrated display, basic instrumentation, THD, Alarming, 800 kb Logging, Waveform Capture	PM850
PM with integrated display, basic instrumentation, THD, Alarming, 800 kb Logging, Configurable Waveform, Sag Swell Detection	PM870
<b>Meter with Remote Display</b>	
PM with remote display, basic instrumentation, THD, Alarming, 80kb Logging	PM820RD
PM with remote display, basic instrumentation, THD, Alarming, 800kb Logging, Waveform Capture	PM850RD
PM with integrated display, basic instrumentation, THD, Alarming, 800 kb Logging, Configurable Waveform, Sag Swell Detection	PM870RD
<b>Meter without Display</b>	
PM without display, basic instrumentation, THD, Alarming, 80kb Logging	PM820U
PM without display, basic instrumentation, THD, Alarming, 800kb Logging, Waveform Capture	PM850U
PM with integrated display, basic instrumentation, THD, Alarming, 800 kb Logging, Configurable Waveform, Sag Swell Detection	PM870U
<b>Remote Display, Adapter and Accessories</b>	
PM8 remote display and adapter with 12' (3.66m) cable	PM8RD
PM8 remote display adapter	PM8RDA
RJ-11 thru-door 12' display cable extender for PM600/800 and CM3000/4000	RJ11EXT
PM800 mounting adapter for CM2000	PM8MA
PM800 gasket for analog meter retrofit (4" round cutout)	PM8G
<b>Options and Accessories</b>	
2 relay outputs / 2 digital inputs, 2 analog outputs, 2 analog inputs	PM8M2222
2 relay outputs / 6 digital inputs	PM8M26



## Customer Quotation

## The Hite Company

1245 Benner Pike

State College, PA 16801

Phone: (814)237-7649 Fax: (814)237-7935

**SQUARE D**

Project Name: PSU SOLAR DEC

Project Location: STATE COLLEGE

Customer Name: PENN STATE UNIVERSITY

Q2C Number:

Quote Number: 1

**Accessories**

Fuses NOT Included

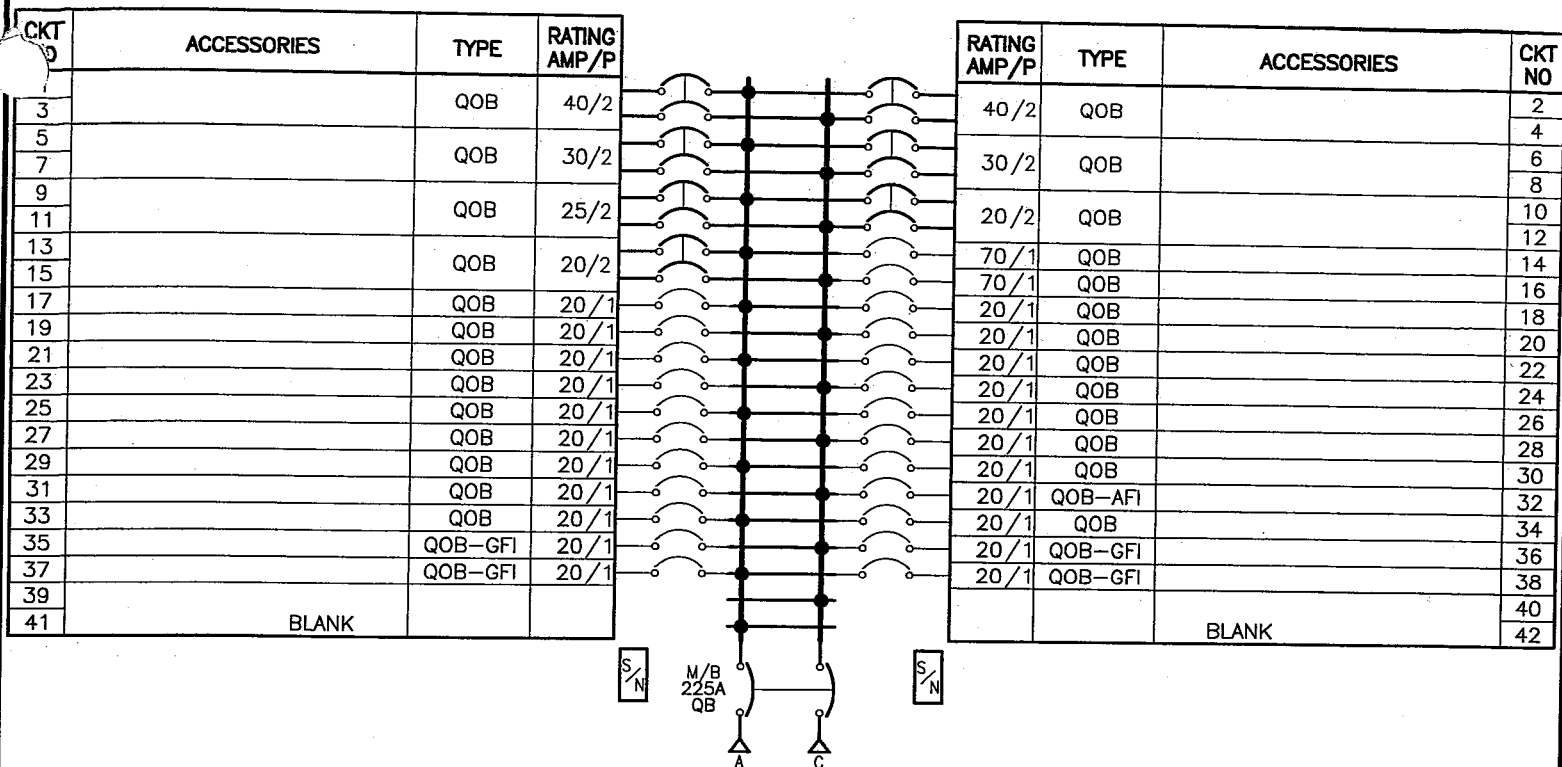
Overloads NOT Included

Lamps NOT Included

Lug Kits NOT Included

Item Number	Quantity	Catalog Number / Details	Unit Price	Extended Price
001-00	1	NQOD MB PANELBOARD (INTERIOR) NQOD PANELBOARD CONSISTING OF 120/240 VAC 1PH 3W 60 HZ      SCCR:10K MAIN: 225A QB CIRCUIT BREAKER INCOMING CONDUCTOR(S): (1)#4-300 kcmil Al/Cu BUS: COPPER      SILVER/TIN PLATING GROUND BAR TYPE 1      50"H X 32"W X 5.75"D INCOMING : BOTTOM      SURFACE W/DOOR BOX CAT#: SPECIAL      FRONT CAT#:MHC50SSP BRANCHES: (2) 40A/2P QOB (2) 30A/2P QOB (1) 25A/2P QOB (2) 20A/2P QOB (17) 20A/1P QOB (4) 20A/1P QOB-GFI (2) 70A/1P QOB (1) 20A/1P QOB-AFI SPECIAL: STANDARD SOLID NEUTRAL, INCREASE LEFT SIDE GUTTER 12"		
		* MAIN AC PANEL *		
002-00	1	Estimated Ship Days (ARO): 15 Working Days (SPECIAL PANELBOARD ENCLOSURE) → 71" x 20" LEFT SIDE GUTTER EXT 12" SPECIAL BOX		
003-00	1	Estimated Ship Days (ARO): 15 Working Days MHC50SSPL (FRONT) NQOD TYPE 1 SURFACE TRIM FRT HGT 50  Estimated Ship Days (ARO): 15 Working Days		

REV	DESCRIPTION	BY	DATE	--	----	---	---	---	---
--	----	--	---/---/---	--	----	--	---	---	---



## PHYSICAL DATA

- ENCLOSURE: TYPE 1  
SURFACE WITH DOOR FRONT  
FRONT CAT#: MHC50SSPL  
BOX CAT#: SPECIAL  
DIMENSIONS:  
50"H X 32"W X 5.75"D  
WIRE BENDING SPACE:  
TOP 5.0"  
BOTTOM 12.1"  
LEFT SIDE 18.1"  
RIGHT SIDE 6.1"
- BUSSING: COPPER BUS  
STANDARD PLATING
- SPECIAL:  
STANDARD SOLID NEUTRAL  
INCREASE LEFT SIDE GUTTER 12"  
GROUND BAR

## ELECTRICAL DATA

- SYSTEM: 120/240 VAC 1PH 3W 60 HZ  
10,000 AMPS SYMS. SCCR
- MAIN: MAIN BREAKER: QB 225A  
BOTTOM FEED  
10K AIC  
INCOMING CONDUCTOR(S) PER PHASE:  
(1)#4-300 kcmil Al/Cu (PER NEC)
- BRANCH MOUNTING TYPE: BOLT-ON

BRANCH SUMMATION	
2-40A/2P QOB	2-30A/2P QOB
1-25A/2P QOB	2-20A/2P QOB
17-20A/1P QOB	4-20A/1P QOB-GFI
2-70A/1P QOB	1-20A/1P QOB-AFI

JOB NAME:	PSU SOLAR DEC	EQUIPMENT DESIGNATION:	
JOB LOCATION:	STATE COLLEGE PA	EQUIPMENT TYPE:	NQOD
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:	---		
DATE:	JUNE 22 2007		
DRAWING STATUS:	QUOTE NOT FOR CONSTRUCTION	DWG# 023861590	PG 1 OF 1 REV 000



**SQUARE D**  
Schneider Electric

**MORNINGSTAR**

253 of 353



PSU SOLAR DECATHLON  
MATERIAL LIST

\*need to  
make sure  
loc. on design

SYSTEM: PV SYSTEMS SCHEMATIC

DRAWING: E-60X1 AC System

MATERIAL LIST:

1. DC DISCONNECT (SB1800U)

Switch: ~~H~~221NRB (1) SIZE (in): 3.81 x 6.72 x 3.00  
Fuses: FRN-R-15 (2) \*\*NOT SQUARE D\*\*

3  
H  
3

2. AC DISCONNECT (SB1800U)

Switch: ~~H~~221NRB (1) SIZE (in): 3.81 x 6.72 x 3.00  
Fuses: FRN-R-15 (1) \*\*NOT SQUARE D\*\*

inside  
mech  
room

3. DC DISCONNECT (SB6000U)

Switch: ~~H~~321NRB (1) SIZE (in): 3.81 x 6.72 x 3.00  
Fuses: FRN-R-15 (3) \*\*NOT SQUARE D\*\*

4. AC DISCONNECT (SB6000U)

Switch: ~~H~~221NRB (1) SIZE (in): 3.81 x 6.72 x 3.00  
Fuses: FRN-R-15 (2) \*\*NOT SQUARE D\*\*

disconnects or  
internal  
to SB6000-not  
needed

\* need  
to make sure  
these are needed-  
may be  
included in  
the SB6000U

5. AC DISCONNECT (GENERATOR CONNECTION)

Switch: ~~H~~221NRB (1) SIZE (in): 14.88 x 6.63 x 7.55  
Fuses: FRN-R-30 (2) \*\*NOT A SQUARE D ITEM\*\*

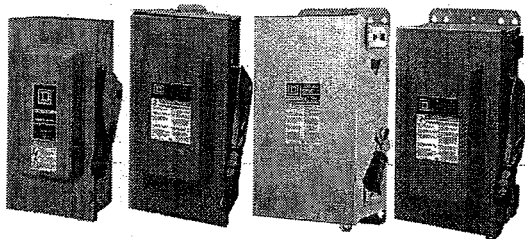
\* 175 Amp Fuses -  
Need to know  
what ty  
enclosure

# Heavy Duty Safety Switches

240 Volt

Class 3110






**SQUARE D**  
www.us.schneider-electric.com  
FOR CURRENT INFORMATION



NEMA 1      NEMA 3R      NEMA 4, 4X and 5  
                                 Stainless Steel      NEMA 12

Visible blade heavy duty safety switches are designed for application where maximum performance and continuity of service are required. All heavy duty safety switches feature quick-make, quick-break operating mechanism, a dual cover interlock and a color coded indicator handle. They are suitable for use as service equipment when equipped with a field- or factory-installed neutral assembly or equipment grounding kit, unless a 600Y/347 V or 480 Y/277 V, 1000 A or greater, solidly grounded WYE system is used, per NEC 215-10. Heavy duty safety switches are UL Listed (except as noted), File E2875 & 154828 and meet or exceed the NEMA Standard KS1. For UL Listed short circuit current ratings, see page 3-6.

**Table 3.10: 240 Volt—Single Throw Fusible**

System	Amperes	NEMA 1 Indoor		NEMA 3R Rainproof (Bolt-on Hubs, page 3-9)		NEMA 4, 4X, 5, ▲ 304 Stainless Steel (for 316 stainless, see page 3-7) Dust tight, Watertight, Corrosion Resistant (Watertight Hubs, page 3-9)		NEMA 12K With Knockouts (Watertight Hubs, page 3-9)		NEMA 12, 3R ■ Without Knockouts (Watertight Hubs, page 3-9)		Horsepower Ratings ♦				250 Vdc★				
												240 Vac								
		Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	1Ø	3Ø	1Ø	3Ø					
2 Wire (2 Blades and Fuseholders)—240 Vac, 250 Vdc																				
	30	Use 3 Wire Devices For 2 Wire Applications				H221DS	1298.00	H221A	336.00	H221AWK	315.00	1-1/2	3 ▼	3	7-1/2 ▼	5				
	60									H222DS	1558.00	—	—	H222AWK	392.00	1-1/2	—	3	—	5
	100									H223DS	3396.00	H223A	672.00	H223AWK	431.00	3	7-1/2 ▼	10	15 ▼	10
	200									H224DS	4640.00	H224A	1158.00	H224AWK	632.00	7-1/2	15 ▼	15	30 ▼	20
	400	H225	1819.00	H225R	2589.00	H225DS	9654.00	—	—	H225AWK	1095.00	15	25 ▼	—	60 ▼	40				
	600	H226	3616.00	H226R	4854.00	H226DS	13848.00	—	—	H226AWK	2775.00	—	—	—	—	50				
	800	H227	5639.00	H227R	7655.00	—	—	—	—	H227AWK	4362.00	—	75 ▼	—	200 ▼	50				
	1200	H228	7788.00	H228R	10324.00	—	—	—	—	H228AWK	6883.00	50	—	50	—	50				
3 Wire (2 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc																				
	30	H221N	157.00	H221NRB	298.00	Use 2 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately See page 3-10.				H221NAWK	2869.00	1-1/2	3 ▼	3	7-1/2 ▼	5				
	60	H222N	314.00	H222NRB	561.00					H222NAWK	4624.00	3	7-1/2 ▼	10	15 ▼	10				
	100	H223N	477.00	H223NRB	724.00					H223NAWK	8225.00	7-1/2	15 ▼	15	30 ▼	20				
	200	H224N	859.00	H224NRB	1041.00					H224NAWK	11458.00	15	25 ▼	—	60 ▼	40				
	400	H225N	2061.00	H225NR	2830.00	H225NDS	9858.00	—	—	H225NAWK	2869.00	—	50 ▼	—	125 ▼	50				
	600	H226N	3879.00	H226NR	5118.00	H226NDS	14054.00	—	—	H226NAWK	4624.00	—	75 ▼	—	200 ▼	50				
	800	H227N	6711.00	H227NR	8144.00	—	—	—	—	H227NAWK	8225.00	50	—	50	—	50				
	1200	H228N	8281.00	H228NR	11110.00	—	—	—	—	H228NAWK	11456.00	50	—	50	—	50				
3 Wire (3 Blades and Fuseholders)—240 Vac, 250 Vdc																				
	30	Use 4 Wire Devices For 3 Wire Applications				H321DS	1366.00	H321A	426.00	H321AWK	403.00	1-1/2	3	3	7-1/2	5				
	60									H322DS	1688.00	H322A	609.00	H322AWK	576.00	3	7-1/2	10	15	10
	100									H323DS	3564.00	H323A	941.00	H323AWK	887.00	7-1/2	15	15	30	20
	200									H324DS	4997.00	H324A	1360.00	H324AWK	1284.00	15	25	—	60	40
	400	H325	2283.00	H325R	2650.00	H325DS	9974.00	—	—	H325AWK	2835.00	—	50	—	125	50				
	600	H326	4113.00	H326R	5524.00	H326DS	14266.00	—	—	H326AWK	4910.00	—	75	—	200	50				
	800	H327	7637.00	H327R	9899.00	—	—	—	—	H327AWK	9685.00	50	100	50	250	50				
	1200	H328	9678.00	H328R	12485.00	—	—	—	—	H328AWK	11633.00	50	100	50	250	50				
4 Wire (3 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc																				
	30	H321N	209.00	H321NRB	370.00	Use 3 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately. See page 3-10				H321NAWK	3090.00	1-1/2	3	3	7-1/2	5				
	60	H322N	352.00	H322NRB	594.00					H322NAWK	5171.00	3	7-1/2	10	15	10				
	100	H323N	561.00	H323NRB	852.00					H323NAWK	10586.00	7-1/2	15	15	30	20				
	200	H324N	967.00	H324NRB	1165.00					H324NAWK	13343.00	15	25	—	60	40				
	400	H325N	2525.00	H325NR	2881.00	H325NDS	10214.00	—	—	H325NAWK	3090.00	—	50	—	125	50				
	600	H326N	4346.00	H326NR	5748.00	H326NDS	14506.00	—	—	H326NAWK	5171.00	—	75	—	200	50				
	800	H327N	8126.00	H327NR	10375.00	—	—	—	—	H327NAWK	10586.00	50	100	50	250	50				
	1200	H328N	10209.00	H328NR	13139.00	—	—	—	—	H328NAWK	13343.00	50	100	50	250	50				
4 Wire (4 Blades and Fuseholders)																				
	30	Use 600 Vac Devices. See page 3-5.																		
	60																			
	100																			
	200																			
	400																			

- ▲ Complete rating is NEMA 3, 3R, 4, 4X, 5 and 12. For NEMA 3R applications, remove drain screw from bottom endwall.
- Also suitable for NEMA 3R application by removing drain screw from bottom endwall.
- ♦ Refer to page 7-31 for additional motor application data. The starting current of motors of more than standard horsepower may require the use of fuses with appropriate time delay characteristics.
- ▼ For switching dc, use two switching poles.
- ★ For corner grounded delta systems only and with neutral assembly installed. Use switching poles for ungrounded conductors.
- △ 60 ampere switch with 30 ampere fuse spacing and clips. Must use 60 A enclosure accessories including electrical interlocks.
- Suitable for NEMA 5 applications with drain screw installed.

Dimensions: NEMA 1 and 3R ..... page 3-12  
Dimensions: NEMA 4, 4X and 5 Stainless and NEMA 12 ..... page 3-13  
Accessories: ..... pages 3-9 through 3-11

Table 3.34: Terminal Lug Data (NEMA 1, 3R, 4, 4X, 5, 7, 9, 12)▲

Rating (A)	Conductors Per Phase and Neutral	Wire Range Wire Bending Space Per NEC Table 312.6 AWG/kcmil	Lug Wire Range AWG/kcmil	Optional Versa-Crimp® Compression Lug Field-Installable■
30♦	1	12-6 (Al) or 14-6 (Cu)	12-2 (Al) or 14-2 (Cu)	—
	2	14-10 (Cu) solid or 14-10 (Cu) stranded		
60★	1	14-3 (Al) or 14-3 (Cu)	12-2 (Al) or 14-2 (Cu)	—
100	1	12-1/0 (Al) or 14-1/0 (Cu)	12-1/0 (Al) or 14-1/0 (Cu)	VCEL02114S1
200▼	1	6-250 (Al/Cu)	6-300 (Al/Cu)	VCEL030516H1
400	1 or 2	1/0-750 (Al/Cu)▲ or 1/0-300 (Al/Cu)	1/0-750 (Al/Cu) and 1/0-300 (Al/Cu)	VCEL07512H1 or VCEL030516H1□ and VCEL05012H1
	2	3/0-500 (Al/Cu)	3/0-500 (Al/Cu)	VCEL05012H1
600	3	3/0-750 (Al/Cu)	3/0-750 (Al/Cu)	H8LKE2♦
800	4	3/0-750 (Al/Cu)	3/0-750 (Al/Cu)	H12LKE2♦

▲ 30-100 A switches suitable for 60°C or 75°C conductors. 200-1200 A switches suitable for 75°C conductors.

■ For NEMA 1 and R3 only.

♦ HU461AWK—14-6 AWG (Cu).

★ H60XFA—14-6 AWG (Cu).

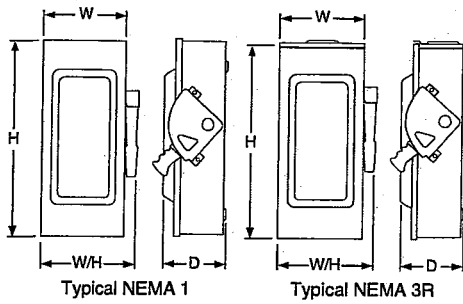
▼ H225XKA—4 AWG-300 kcmil (Cu).

▲ Max. wire range 600 Al/Cu on NEMA 4-4X Stainless and NEMA 12.

□ Order two PK516KN mounting kits (\$5.80 each, Lexington Order Point) when installing VCEL030516H1 lugs.

Only one kit is required on 2-Pole switches.

♦ See page 3-11, 800 and 1200 A compression lug kits for additional information.



Typical NEMA 1

Typical NEMA 3R

Cat. No.	Approximate Dimensions									Cat. No.	Approximate Dimensions								
	Series	H		W		D		W/H			Series	H		W		D		W/H	
		in.	mm	in.	mm	in.	mm	in.	mm			in.	mm	in.	mm	in.	mm		
H221N	F5	14.60	371	6.50	165	4.88	124	7.55	192	H364, N	F5	29.00	737	17.13	435	8.25	210	18.50	470
H221NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	H364RB, NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473
H222N	F5	14.60	371	6.50	165	4.88	124	7.55	192	H365, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H222NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	H365R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H223N	F5	21.25	540	8.50	216	6.38	162	10.50	267	H366, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H223NRB	F5	21.25	540	8.50	216	6.38	162	10.50	267	H366NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H224N	F5	29.00	737	17.13	435	8.25	210	18.50	470	H367, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H224NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473	H367NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H225, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	H368, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H225NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	H368NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H226, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	H461	F5	20.50	521	14.75	375	6.85	174	16.13	410
H226NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	H462	F5	20.50	521	14.75	375	6.85	174	16.13	410
H227, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H463	F5	20.50	521	14.75	375	6.85	174	16.13	410
H227NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H464	F5	29.00	737	23.25	591	8.75	222	24.88	632
H228, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H465	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H228NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H466	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H265	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU265	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H265R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU265R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H266	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU266	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H266R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU266R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H267	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU267	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H267R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU267R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H268	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU268	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H268R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU268R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H321N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU361	F5	14.60	371	6.50	165	4.88	124	7.55	192
H321NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU361RB	F5	14.88	378	6.63	168	4.88	124	7.55	192
H322N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU361WA	F6	18.19	462	9.00	229	6.81	173	10.50	267
H322NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU361WC	F6	18.19	462	9.00	229	6.81	173	10.50	267
H323N	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU362	F5	17.50	445	9.00	229	6.38	162	10.50	267
H323NRB	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU362RB	F5	17.50	445	9.00	229	6.38	162	10.50	267
H324N	F5	29.00	737	17.13	435	8.25	210	18.50	470	HU362WA	F6	18.19	462	9.00	229	6.81	173	10.50	267
H324NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473	HU362WC	F6	16.75	425	9.00	229	7.00	178	10.50	267
H325, N	E4	50.25	1276	27.88	708	10.13	257	27.88	708	HU362WH	F5	18.19	462	9.00	229	6.81	173	10.50	267
H325R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU363	F5	21.25	540	8.50	216	6.38	162	10.50	267
H326, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU363RB	F5	21.25	540	8.50	216	6.38	162	10.50	267
H326R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU363WA	F6	21.85	462	9.00	229	6.81	173	10.50	267
H327, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU363WC	F6	21.85	555	9.00	229	6.81	173	10.50	267
H327R, NR	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU364	F5	29.00	737	17.13	435	8.25	210	18.50	470
H328, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU364RB	F5	29.25	743	17.25	438	8.50	216	18.63	473
H328R, NR	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU365	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H361, N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU365R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H361-2	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU366	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H361NRB, RB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU366R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H361WA	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU367	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H361WC	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU367R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362, N	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU368	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362NRB, RB	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU368R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362WA	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU461	F5	20.50	521	14.75	375	6.85	174	16.13	410
H362WC	F6	16.75	425	9.00	229	7.00	178	10.50	267	HU462	F5	20.50	521	14.75	375	6.85	174	16.13	410
H362WH	F5	18.19	462	9.00	229	6.81	173	10.50	267	HU463	F5	20.50	521	14.75	375	6.85	174	16.13	410
H363, N	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU464	F5	29.00	737	23.25	591	8.75	222	24.88	632
H363NRB, RB	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU465	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H363WA	F6	21.85	462	9.00	229	6.81	173	10.50	267	HU466	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H363WC	F6	21.85	555	9.00	229	6.81	173	10.50	267										

~~\*add Fuses to  
MTE LIST\*~~

## PSU SOLAR DECATHLON MATERIAL LIST

\*need to  
make sure this  
is all located  
on dwg\*

SYSTEM: PV / DC SCHEMATIC

DRAWING: E-602

### MATERIAL LIST:

1. 40A DC DISCONNECT (rainproof) QTY = 2

✓SWITCH: H222NRB (2) SIZE: 14.88in X 7.55in X 4.88in  
✓FUSES: FRN-R-40 (4) \*\*NOT A SQUARE D ITEM\*\*

2. 40A DC DISCONNECT (indoor) QTY = 2

SWITCH: H222N (2) SIZE: 14.60in X 7.55in X 4.88in  
FUSES: FRN-R-40 (4) \*\*NOT A SQUARE D ITEM\*\*

3. 20A DC DISCONNECT (indoor) QTY = 1

SWITCH: H221N (1) SIZE: 14.60in X 7.55in X 4.88in  
FUSES: FRN-R-20 (2) \*\*NOT A SQUARE D ITEM\*\*

4. DC BREAKER PANEL (indoor)

\*\*SEE ATTACHED BILL OF MATERIAL FROM SQUARE D\*\*



BOM Number: 17364

BOM Name: DC LIGHTING PANEL

BOM Sub Name: Panel

Item Number	Quantity	Catalog Number / Details
-------------	----------	--------------------------

1-00	1	NQOD MB PANELBOARD (INTERIOR) NQOD PANELBOARD CONSISTING OF 48 VDC 2W                      SCCR:5K MAIN: 20A QOB CIRCUIT BREAKER INCOMING CONDUCTOR(S): (1)#14-#8 Al/Cu BUS: COPPER                      SILVER/TIN PLATING GROUND BAR TYPE 1                      23"H X 20"W X 5.75"D INCOMING : BOTTOM      SURFACE W/DOOR BOX CAT#: MH23              FRONT CAT#:MHC23S REF. DRAWING: PBA 503A BRANCHES: (4) 10A/2P QOB SPECIAL: BLCK FACE/WHT LET NAMEPLATE
------	---	---

Estimated Ship Days (ARO): 15 Working Days

2-00	1	MH23              (BOX) STANDARD TYPE 1 BOX HGT 23"
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Estimated Ship Days (ARO): 4 Working Days

3-00	1	MHC23S              (FRONT) NQOD TYPE 1 SURFACE TRIM FRT HGT 23
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Estimated Ship Days (ARO): 15 Working Days



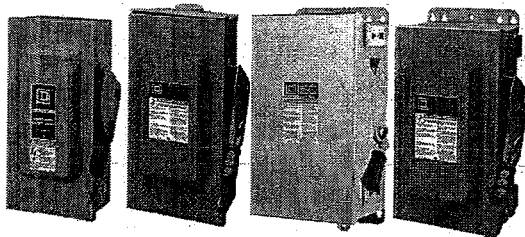
# Heavy Duty Safety Switches

240 Volt



Class 3110






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NEMA 1    NEMA 3R    NEMA 4, 4X and 5 Stainless Steel    NEMA 12

Visible blade heavy duty safety switches are designed for application where maximum performance and continuity of service are required. All heavy duty safety switches feature quick-make, quick-break operating mechanism, a dual cover interlock and a color coded indicator handle. They are suitable for use as service equipment when equipped with a field- or factory-installed neutral assembly or equipment grounding kit, unless a 600Y/347 V or 480 Y/277 V, 1000 A or greater, solidly grounded WYE system is used, per NEC 215-10. Heavy duty safety switches are UL Listed (except as noted), File E2875 & 154828 and meet or exceed the NEMA Standard KS1. For UL Listed short circuit current ratings, see page 3-6.

Table 3.10: 240 Volt—Single Throw Fusible

System	Amperes	NEMA 1 Indoor		NEMA 3R Rainproof (Bolt-on Hubs, page 3-9)		NEMA 4, 4X, 5, 304 Stainless Steel (for 316 stainless, see page 3-7) Dust tight, Watertight, Corrosion Resistant (Watertight Hubs, page 3-9)		NEMA 12K With Knockouts (Watertight Hubs, page 3-9)		NEMA 12, 3R Without Knockouts (Watertight Hubs, page 3-9)		Horsepower Ratings ♦				250 Vdc★				
												240 Vac								
		Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	1Ø	3Ø	1Ø	3Ø					
2 Wire (2 Blades and Fuseholders)—240 Vac, 250 Vdc																				
	30	Use 3 Wire Devices For 2 Wire Applications				H221DS	1298.00	H221A	336.00	H221AWK	315.00	1-1/2	3 ▼	3	7-1/2 ▼	5				
	60									—	—	—	—	H2212AWKΔ	392.00	1-1/2	—	3	—	5
	100									H222DS	1558.00	—	—	H222AWK	431.00	3	7-1/2 ▼	10	15 ▼	10
	200									H223DS	3396.00	H223A	672.00	H223AWK	632.00	7-1/2	15 ▼	15	30 ▼	20
	400	H225	1819.00	H225R	2589.00	H224DS	4640.00	H224A	1158.00	H224AWK	1095.00	15	25 ▼	—	60 ▼	40				
	600	H226	3616.00	H226R	4854.00	H225DS	9654.00	—	—	H225AWK	2775.00	—	—	—	—	50				
	800	H227	5639.00	H227R□	7655.00	H226DS	13848.00	—	—	H226AWK	4362.00	—	75 ▼	—	200 ▼	50				
1200	H228	7788.00	H228R□	10324.00	—	—	—	—	H227AWK	6883.00	50	—	50	—	50					
3 Wire (2 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc																				
	30	H221N	157.00	H221NRB	298.00	Use 2 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately See page 3-10.				—	—	1-1/2	3 ▼	3	7-1/2 ▼	5				
	60	H222N	314.00	H222NRB	561.00					—	—	3	7-1/2 ▼	10	15 ▼	10				
	100	H223N	477.00	H223NRB	724.00					—	—	7-1/2	15 ▼	15	30 ▼	20				
	200	H224N	859.00	H224NRB	1041.00					—	—	15	25 ▼	—	60 ▼	40				
	400	H225N	2061.00	H225NR	2830.00	H225NDS	9858.00	—	—	H225NAWK	2869.00	—	50 ▼	—	125 ▼	50				
	600	H226N	3879.00	H226NR	5118.00	H226NDS	14054.00	—	—	H226NAWK	4624.00	—	75 ▼	—	200 ▼	50				
	800	H227N	6711.00	H227NR□	8144.00	—	—	—	—	H227NAWK	8225.00	50	—	50	—	50				
1200	H228N	8281.00	H228NR□	11110.00	—	—	—	—	H228NAWK	11456.00	50	—	50	—	50					
3 Wire (3 Blades and Fuseholders)—240 Vac, 250 Vdc																				
	30	Use 4 Wire Devices For 3 Wire Applications				H321DS	1366.00	H321A	426.00	H321AWK	403.00	1-1/2	3	3	7-1/2	5				
	60					H322DS	1688.00	H322A	609.00	H322AWK	576.00	3	7-1/2	10	15	10				
	100					H323DS	3564.00	H323A	941.00	H323AWK	887.00	7-1/2	15	15	30	20				
	200					H324DS	4997.00	H324A	1360.00	H324AWK	1284.00	15	25	—	60	40				
	400	H325	2283.00	H325R	2650.00	H325DS	9974.00	—	—	H325AWK	2835.00	—	50	—	125	50				
	600	H326	4113.00	H326R	5524.00	H326DS	14266.00	—	—	H326AWK	4910.00	—	75	—	200	50				
	800	H327	7637.00	H327R□	9899.00	—	—	—	—	H327AWK	9685.00	50	100	50	250	50				
1200	H328	9678.00	H328R□	12485.00	—	—	—	—	H328AWK	11633.00	50	100	50	250	50					
4 Wire (3 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc																				
	30	H321N	209.00	H321NRB	370.00	Use 3 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately See page 3-10				—	—	1-1/2	3	3	7-1/2	5				
	60	H322N	352.00	H322NRB	594.00					—	—	3	7-1/2	10	15	10				
	100	H323N	561.00	H323NRB	852.00					—	—	7-1/2	15	15	30	20				
	200	H324N	967.00	H324NRB	1165.00					—	—	15	25	—	60	40				
	400	H325N	2525.00	H325NR	2881.00	H325NDS	10214.00	—	—	H325NAWK	3090.00	—	50	—	125	50				
	600	H326N	4346.00	H326NR	5748.00	H326NDS	14506.00	—	—	H326NAWK	5171.00	—	75	—	200	50				
	800	H327N	8126.00	H327NR□	10375.00	—	—	—	—	H327NAWK	10586.00	50	100	50	250	50				
1200	H328N	10209.00	H328NR□	13139.00	—	—	—	—	H328NAWK	13343.00	50	100	50	250	50					
4 Wire (4 Blades and Fuseholders)																				
	30	Use 600 Vac Devices. See page 3-5.																		
	60																			
	100																			
	200																			
	400																			

- ▲ Complete rating is NEMA 3, 3R, 4, 4X, 5 and 12. For NEMA 3R applications, remove drain screw from bottom endwall.
- Also suitable for NEMA 3R application by removing drain screw from bottom endwall.
- ♦ Refer to page 7-31 for additional motor application data. The starting current of motors of more than standard horsepower may require the use of fuses with appropriate time delay characteristics.
- ★ For switching dc, use two switching poles.
- ▼ For corner grounded delta systems only and with neutral assembly installed. Use switching poles for ungrounded conductors.
- Δ 60 ampere switch with 30 ampere fuse spacing and clips. Must use 60 A enclosure accessories including electrical interlocks.
- Suitable for NEMA 5 applications with drain screw installed.

Dimensions: NEMA 1 and 3R ..... page 3-12  
Dimensions: NEMA 4, 4X and 5 Stainless and NEMA 12 ..... page 3-13  
Accessories: ..... pages 3-9 through 3-11

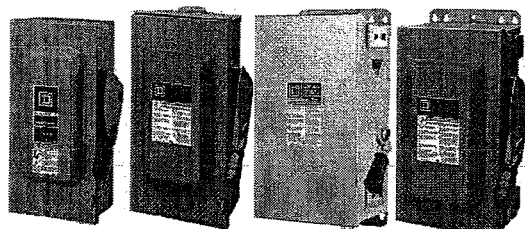
# Heavy Duty Safety Switches

240 Volt



Class 3110






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NEMA 1    NEMA 3R    NEMA 4, 4X and 5 Stainless Steel    NEMA 12

Visible blade heavy duty safety switches are designed for application where maximum performance and continuity of service are required. All heavy duty safety switches feature quick-make, quick-break operating mechanism, a dual cover interlock and a color coded indicator handle. They are suitable for use as service equipment when equipped with a field- or factory-installed neutral assembly or equipment grounding kit, unless a 600Y/347 V or 480 Y/277 V, 1000 A or greater, solidly grounded WYE system is used, per NEC 215-10. Heavy duty safety switches are UL Listed (except as noted), File E2875 & 154828 and meet or exceed the NEMA Standard KS1. For UL Listed short circuit current ratings, see page 3-6.

Table 3.10: 240 Volt—Single Throw Fusible

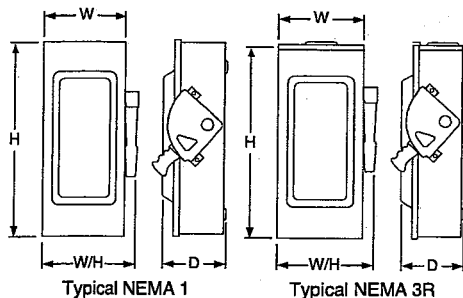
System	Amperes	NEMA 1 Indoor		NEMA 3R Rainproof (Bolt-on Hubs, page 3-9)		NEMA 4, 4X, 5, 304 Stainless Steel (for 316 stainless, see page 3-7) Dust tight, Watertight, Corrosion Resistant (Watertight Hubs, page 3-9)		NEMA 12K With Knockouts (Watertight Hubs, page 3-9)		NEMA 12, 3R Without Knockouts (Watertight Hubs, page 3-9)		Horsepower Ratings ♦				250 Vdc★
												240 Vac				
		Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Std. (Using Fast Acting, One Time Fuses)		Max. (Using Dual Element, Time Delay Fuses)		
												1Ø	3Ø	1Ø	3Ø	
<b>2 Wire (2 Blades and Fuseholders)—240 Vac, 250 Vdc</b>																
	30	Use 3 Wire Devices For 2 Wire Applications				H221DS	1298.00	H221A	336.00	H221AWK	315.00	1-1/2	3 ▼	3	7-1/2 ▼	5
	60					H222DS	1558.00			H222AWK	392.00	1-1/2		3		5
	100					H223DS	3396.00	H223A	672.00	H223AWK	431.00	3	7-1/2 ▼	10	15 ▼	10
	200					H224DS	4640.00	H224A	1158.00	H224AWK	1095.00	15	25 ▼		60 ▼	40
	400					H225DS	9654.00			H225AWK	2775.00					50
	600	H226	3616.00	H226R	4854.00	H226DS	13848.00			H226AWK	4362.00		75 ▼		200 ▼	50
	800	H227	5639.00	H227R□	7655.00					H227AWK	6883.00	50		50		50
	1200	H228	7788.00	H228R□	10324.00					H228AWK	10543.00	50		50		50
<b>3 Wire (2 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc</b>																
	30	H221N	157.00	H221NRB	298.00	Use 2 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately See page 3-10.						1-1/2	3 ▼	3	7-1/2 ▼	5
	60	H222N	314.00	H222NRB	561.00							3	7-1/2 ▼	10	15 ▼	10
	100	H223N	477.00	H223NRB	724.00							7-1/2	15 ▼	15	30 ▼	20
	200	H224N	859.00	H224NRB	1041.00							15	25 ▼		60 ▼	40
	400	H225N	2061.00	H225NR	2830.00								50 ▼		125 ▼	50
	600	H226N	3879.00	H226NR	5118.00	H226NDS	9858.00			H226NAWK	2869.00		75 ▼		200 ▼	50
	800	H227N	6711.00	H227NR□	8144.00					H227NAWK	8225.00	50		50		50
	1200	H228N	8281.00	H228NR□	11110.00					H228NAWK	11456.00	50		50		50
<b>3 Wire (3 Blades and Fuseholders)—240 Vac, 250 Vdc</b>																
	30	Use 4 Wire Devices For 3 Wire Applications				H321DS	1366.00	H321A	426.00	H321AWK	403.00	1-1/2	3	3	7-1/2	5
	60					H322DS	1688.00	H322A	609.00	H322AWK	576.00	3	7-1/2	10	15	10
	100					H323DS	3564.00	H323A	941.00	H323AWK	887.00	7-1/2	15	15	30	20
	200					H324DS	4997.00	H324A	1360.00	H324AWK	1284.00	15	25		60	40
	400					H325DS	9974.00			H325AWK	2835.00		50		125	50
	600	H326	2283.00	H326R	2650.00	H326DS	14266.00			H326AWK	4910.00		75		200	50
	800	H327	7637.00	H327R□	9899.00					H327AWK	9685.00	50	100	50	250	50
	1200	H328	9678.00	H328R□	12485.00					H328AWK	11633.00	50	100	50	250	50
<b>4 Wire (3 Blades and Fuseholders, 1 Neutral)—240 Vac, 250 Vdc</b>																
	30	H321N	209.00	H321NRB	370.00	Use 3 Wire Devices, Field-Installable Solid Neutral Assemblies Order Separately. See page 3-10.						1-1/2	3	3	7-1/2	5
	60	H322N	352.00	H322NRB	594.00							3	7-1/2	10	15	10
	100	H323N	561.00	H323NRB	852.00							7-1/2	15	15	30	20
	200	H324N	967.00	H324NRB	1165.00							15	25		60	40
	400	H325N	2525.00	H325NR	2881.00								50		125	50
	600	H326N	4346.00	H326NR	5748.00	H326NDS	10214.00			H326NAWK	3090.00		75		200	50
	800	H327N	8126.00	H327NR□	10375.00					H327NAWK	10586.00	50	100	50	250	50
	1200	H328N	10209.00	H328NR□	13139.00					H328NAWK	13343.00	50	100	50	250	50
<b>4 Wire (4 Blades and Fuseholders)</b>																
	30	Use 600 Vac Devices. See page 3-5.														
	60															
	100															
	200															
	600															

- ▲ Complete rating is NEMA 3, 3R, 4, 4X, 5 and 12. For NEMA 3R applications, remove drain screw from bottom endwall.
- Also suitable for NEMA 3R application by removing drain screw from bottom endwall.
- ♦ Refer to page 7-31 for additional motor application data. The starting current of motors of more than standard horsepower may require the use of fuses with appropriate time delay characteristics.
- ★ For switching dc, use two switching poles.
- ▼ For corner grounded delta systems only and with neutral assembly installed. Use switching poles for ungrounded conductors.
- ▲ 60 ampere switch with 30 ampere fuse spacing and clips. Must use 60 A enclosure accessories including electrical interlocks.
- Suitable for NEMA 5 applications with drain screw installed.

Dimensions: NEMA 1 and 3R ..... page 3-12  
Dimensions: NEMA 4, 4X and 5 Stainless and NEMA 12 ..... page 3-13  
Accessories: ..... pages 3-9 through 3-11



Table 3.34: Terminal Lug Data (NEMA 1, 3R, 4, 4X, 5, 7, 9, 12)▲



Rating (A)	Conductors Per Phase and Neutral	Wire Range Wire Bending Space Per NEC Table 312.6 AWG/kcmil	Lug Wire Range AWG/kcmil	Optional Versa-Crimp® Compression Lug Field-Installable■
30▲	1	12-6 (Al) or 14-6 (Cu)	12-2 (Al) or 14-2 (Cu)	—
	2	14-10 (Cu) solid or 14-10 (Cu) stranded		
60★	1	14-3 (Al) or 14-3 (Cu)	12-2 (Al) or 14-2 (Cu)	—
100	1	12-1/0 (Al) or 14-1/0 (Cu)	12-1/0 (Al) or 14-1/0 (Cu)	VCEL02114S1
200▼	1	6-250 (Al/Cu)	6-300 (Al/Cu)	VCEL030516H1
400	1 or 2	1/0-750 (Al/Cu)▲ or 1/0-300 (Al/Cu)	1/0-750 (Al/Cu) and 1/0-300 (Al/Cu)	VCEL07512H1 or VCEL030516H1□ and VCEL05012H1
600	2	3/0-500 (Al/Cu)	3/0-500 (Al/Cu)	VCEL05012H1
800	3	3/0-750 (Al/Cu)	3/0-750 (Al/Cu)	H8LKE2◇
1200	4	3/0-750 (Al/Cu)	3/0-750 (Al/Cu)	H12LKE2◇

▲ 30-100 A switches suitable for 60°C or 75°C conductors. 200-1200 A switches suitable for 75°C conductors.

■ For NEMA 1 and 3R only.

◇ HU461AWK—14-6 AWG (Cu).

★ H60XFA—14-6 AWG (Cu).

▼ H225XKA—4 AWG-300 kcmil (Cu).

▲ Max. wire range 600 Al/Cu on NEMA 4-4X Stainless and NEMA 12.

□ Order two PK516KN mounting kits (\$5.80 each, Lexington Order Point) when installing VCEL030516H1 lugs.



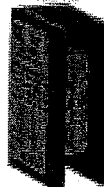



Only one kit is required on 2-Pole switches.

◇ See page 3-11, 800 and 1200 A compression lug kits for additional information.

Cat. No.	Approximate Dimensions									Cat. No.	Approximate Dimensions								
	Series	H		W		D		W/H			Series	H		W		D		W/H	
		in.	mm	in.	mm	in.	mm	in.	mm			in.	mm	in.	mm	in.	mm		
H221N	F5	14.60	371	6.50	165	4.88	124	7.55	192	H364, N	F5	29.00	737	17.13	435	8.25	210	18.50	470
H221NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	H364RB, NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473
H222N	F5	14.60	371	6.50	165	4.88	124	7.55	192	H365, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H222NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	H365R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H223N	F5	21.25	540	8.50	216	6.38	162	10.50	267	H366, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H223NRB	F5	21.25	540	8.50	216	6.38	162	10.50	267	H366NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H224N	F5	29.00	737	17.13	435	8.25	210	18.50	470	H367, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H224NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473	H367NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H225, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	H368, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H225NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	H368NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H226, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	H461	F5	20.50	521	14.75	375	6.85	174	16.13	410
H226NR, R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	H462	F5	20.50	521	14.75	375	6.85	174	16.13	410
H227, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H463	F5	20.50	521	14.75	375	6.85	174	16.13	410
H227NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H464	F5	29.00	737	23.25	591	8.75	222	24.88	632
H228, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H465	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H228NR, R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	H466	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H265	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU265	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H265R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU265R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H266	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU266	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H266R	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU266R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H267	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU267	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H267R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU267R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H268	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU268	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H268R	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU268R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H321N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU361	F5	14.60	371	6.50	165	4.88	124	7.55	192
H321NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU361RB	F5	14.88	378	6.63	168	4.88	124	7.55	192
H322N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU361WA	F6	18.19	462	9.00	229	6.81	173	10.50	267
H322NRB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU361WC	F6	18.19	462	9.00	229	6.81	173	10.50	267
H323N	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU362	F5	17.50	445	9.00	229	6.38	162	10.50	267
H323NRB	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU362RB	F5	17.50	445	9.00	229	6.38	162	10.50	267
H324N	F5	29.00	737	17.13	435	8.25	210	18.50	470	HU362WA	F6	18.19	462	9.00	229	6.81	173	10.50	267
H324NRB	F5	29.25	743	17.25	438	8.50	216	18.63	473	HU362WC	F6	16.75	425	9.00	229	7.00	178	10.50	267
H325, N	E4	50.25	1276	27.88	708	10.13	257	27.88	708	HU362WH	F5	18.19	462	9.00	229	6.81	173	10.50	267
H325R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU363	F5	21.25	540	8.50	216	6.38	162	10.50	267
H326, N	E4	50.25	1276	27.63	702	10.13	257	27.63	702	HU363RB	F5	21.25	540	8.50	216	6.38	162	10.50	267
H326R, NR	E4	50.31	1278	27.88	708	10.13	257	27.88	708	HU363WA	F6	21.85	462	9.00	229	6.81	173	10.50	267
H327, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU363WC	F6	21.85	555	9.00	229	6.81	173	10.50	267
H327R, NR	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU364	F5	29.00	737	17.13	435	8.25	210	18.50	470
H328, N	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU364RB	F5	29.25	743	17.25	438	8.50	216	18.63	473
H328R, NR	E4	69.13	1756	36.62	930	17.75	451	36.62	930	HU365	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H361, N	F5	14.60	371	6.50	165	4.88	124	7.55	192	HU365R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H361-2	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU366	E4	50.25	1276	27.63	702	10.13	257	27.63	702
H361NRB, RB	F5	14.88	378	6.63	168	4.88	124	7.55	192	HU366R	E4	50.31	1278	27.88	708	10.13	257	27.88	708
H361WA	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU367	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H361WC	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU367R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362, N	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU368	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362NRB, RB	F5	17.50	445	9.00	229	6.38	162	10.50	267	HU368R	E4	69.13	1756	36.62	930	17.75	451	36.62	930
H362WA	F6	18.19	462	9.00	229	6.81	173	10.50	267	HU461	F5	20.50	521	14.75	375	6.85	174	16.13	410
H362WC	F6	16.75	425	9.00	229	7.00	178	10.50	267	HU462	F5	20.50	521	14.75	375	6.85	174	16.13	410
H362WH	F5	18.19	462	9.00	229	6.81	173	10.50	267	HU463	F6	20.50	521	14.75	375	6.85	174	16.13	410
H363, N	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU464	F5	29.00	737	23.25	591	8.75	222	24.88	632
H363NRB, RB	F5	21.25	540	8.50	216	6.38	162	10.50	267	HU465	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H363WA	F6	21.85	462	9.00	229	6.81	173	10.50	267	HU466	E4	50.25	1276	33.88	861	10.13	257	33.88	861
H363WC	F6	21.85	555	9.00	229	6.81	173	10.50	267										

# Order 2 - For Phase & Neutral Bus on AC PV system

## Terminal Blocks Power Distribution Blocks Copper or Aluminum Wire

CLASS 9080	MINIATURE		STANDARD	
				
Maximum Voltage Rating	600	600	600	600
Service Class	B & C	B & C	B & C	B & C
Amperage Rating - CU Wire	115 amp.	115 amp.	175 amp.	175 amp.
Amperage Rating - AL Wire	90 amp.	90 amp.	135 amp.	135 amp.
Wire Range Lugs suitable for use with 75° C Conductors.	MAIN (1) #14-2 AWG BRANCH (1) #14-2 AWG	MAIN (1) #14-2 AWG BRANCH (4) #18-10 AWG	MAIN (1) #14-2/0 AWG BRANCH (1) #14-2/0 AWG	MAIN (1) #14-2/0 AWG BRANCH (4) #14-4 AWG
Tightening Torque	MAIN #3-#2 50 lbf-in (5.6 N-m) #6-#4 45 lbf-in (5.1 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m) BRANCH #3-#2 50 lbf-in (5.6 N-m) #6-#4 45 lbf-in (5.1 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m)	MAIN #3-#2 50 lbf-in (5.6 N-m) #6-#4 45 lbf-in (5.1 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m) BRANCH #18-#10 7 lbf-in (0.8 N-m)	MAIN #6-2/0 120 lbf-in (13.5 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m) BRANCH #6-2/0 120 lbf-in (13.5 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m)	MAIN #6-2/0 120 lbf-in (13.5 N-m) #8 40 lbf-in (4.5 N-m) #14-#10 35 lbf-in (4.0 N-m) BRANCH #14-#4 35 lbf-in (4.0 N-m)
Lug Material	Tin Plated High Conductive AL	Tin Plated High Conductive AL	Tin Plated High Conductive AL	Tin Plated High Conductive AL
Base Material	High Impact Thermoplastic	High Impact Thermoplastic	General Purpose Phenolic	General Purpose Phenolic
Temperature Rating	-40 to 257° F -40 to 125° C	-40 to 257° F -40 to 125° C	-40 to 302° F -40 to 150° C	-40 to 302° F -40 to 150° C
Listings	 File E60616 Guide XCFR2		 File LR70361	
Flammability Rating	UL94V-0	UL94V-0	UL94V-0	UL94V-0
<b>ONE POLE BLOCKS</b>				
Block Catalog Number	9080 LBA161101	9080 LBA161104	9080 LBA162101	9080 LBA162104
Block Dimensions (D) x(H)x(W)	1.62x2.29x0.76 in. 41.1x58.2x19.3 mm	1.62x2.29x0.76 in. 41.1x58.2x19.3 mm	1.78x2.88x1.13 in. 45.2x73.2x28.7 mm	1.78x2.88x1.13 in. 45.2x73.2x28.7 mm
<b>TWO POLE BLOCKS</b>				
Block Catalog Number	N/A	9080 LBA261104	9080 LBA262101	9080 LBA262104
Clear Plastic covers	N/A	N/A	9080 LB22	9080 LB22
Block Dimensions (D) x(H)x(W)	N/A	1.62x2.29x1.40 in. 41.1x58.2x35.6 mm	1.78x2.88x1.94 in. 45.2x73.2x49.3 mm	1.78x2.88x1.94 in. 45.2x73.2x49.3 mm
<b>THREE POLE BLOCKS</b>				
Block Catalog Number	9080 LBA361101	9080 LBA361104	9080 LBA362101	9080 LBA362104
Clear Plastic covers	N/A	N/A	9080 LB23	9080 LB23
Block Dimensions (D) x(H)x(W)	1.62x2.29x2.03 in. 41.1x58.2x51.6 mm	1.62x2.29x2.03 in. 41.1x58.2x51.6 mm	1.78x2.88x2.75 in. 45.2x73.2x69.9 mm	1.78x2.88x2.75 in. 45.2x73.2x69.9 mm

\*added to  
Square D  
Procurement  
List  
6/20/07



# Sunny Boy 1800U



*The leading grid-tied photovoltaic inverters in Europe and America*

UL 1741 Listed for grid  
interactive inverters

5-year comprehensive  
warranty standard

Rugged NEMA 4X stainless  
steel enclosure standard

Exceptional reliability and  
energy capture ratio

Easy to install three-point  
mounting system

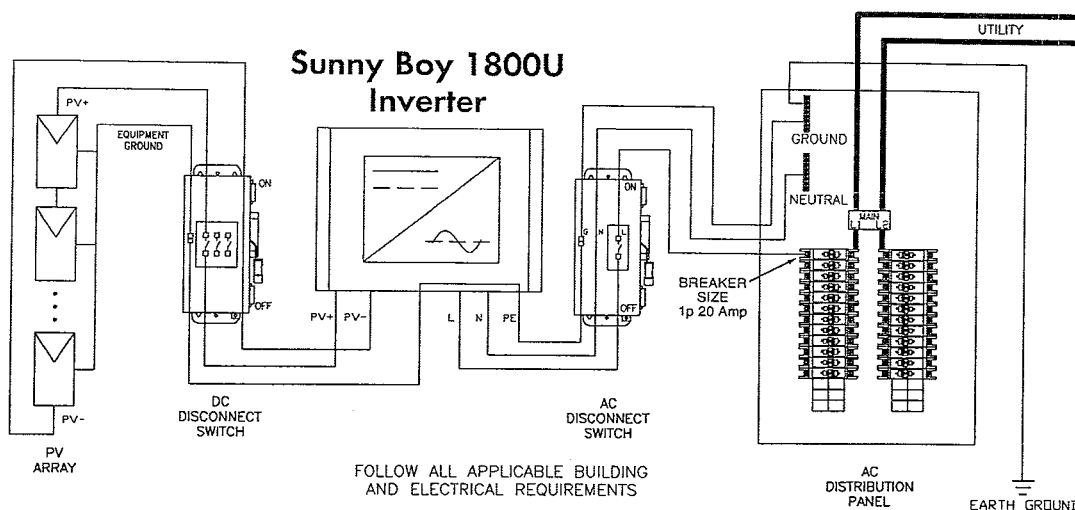
Comprehensive communications  
and data collection options

SMA's modular string inverter  
design is expandable to  
virtually any size system

The SMA Sunny Boy inverter, the most popular grid-tied photovoltaic inverter in Europe, is now UL 1741 Listed and available in North America. Sunny Boy's extensive track record in some of the world's most demanding markets has made it a favorite among PV professionals everywhere. Over 250,000 Sunny Boy inverters have been installed worldwide. Superior design, rock-solid German engineering and exceptional real-world efficiency have made Sunny Boy the top choice for American solar designers.







Sunny Boy's unsurpassed reliability and efficiency are the result of SMA's manufacturing philosophy that combines simple design with robust execution. SMA's state-of-the-art maximum power point tracking performance results in greater real-world energy capture than any other grid-tied inverter. Sunny Boy's safety and reliability record is also exceptional due, in part, to the inverter's redundant grid monitoring and built-in ground fault detection and interruption protection. The inverter's IGBT power stage generates a nearly perfect sine wave with the lowest harmonic distortion in the industry and meets ultra-strict FCC EMC standards. SMA's unique String Inverter technology makes future system expansion simple. SMA advanced communication options are available to satisfy almost any application.

## Specifications

Inverter Technology	Real sine-wave, current source, high frequency PWM	Enclosure	NEMA 4X (IP65) Stainless Steel
AC Input Voltage	106 - 132 (120V AC)	Dimensions	17.10W x 11.60H x 8.40D in 434W x 295H x 214D mm
AC Input Frequency	59.3 - 60.5 (60Hz) (50Hz also available)	Weight	59.4 lbs (27 kg)
DC Input Voltage	156 - 400V DC	Compliance	United States UL 1741, E210376, UL 1998, IEEE 519, IEEE 929, ANSI C62.41 C1 & C3, FCC part 15 A & B International DIN EN50082 Part 1, 61000-32, 50081, 50014, 600055 Part 2 55011 Group 1 Class B, 50178, 60146 Part 1-1
Peak Power Tracking Voltage	156 - 350V DC		
Minimum DC Input Voltage	139 - 170V DC		
Maximum Array Input Power	2200W (DC @ STC)		
Maximum AC Power Output	1800W		
Current THD	< 4%		
Power Factor	Unity		
Peak Inverter Efficiency	93.6%		
Cooling	* Convection cooling (no fan)		
PV Start Voltage	180V DC		
Maximum AC Output Current	15.0A		
Maximum DC Input Current	12.0A		
DC Voltage Ripple	< 5%		
Power Consumption	0.25W nighttime, < 7W standby		
Ambient Temperature Rating	45°C		

Distributed by:

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**Solar Today...  
Energy Tomorrow**





# Sunny Boy 6000U



*The leading grid-tied photovoltaic inverters in Europe and America*

Exceptional reliability,  
efficiency and energy  
capture ratio

5-year comprehensive  
warranty

Rugged stainless steel  
outdoor enclosure standard

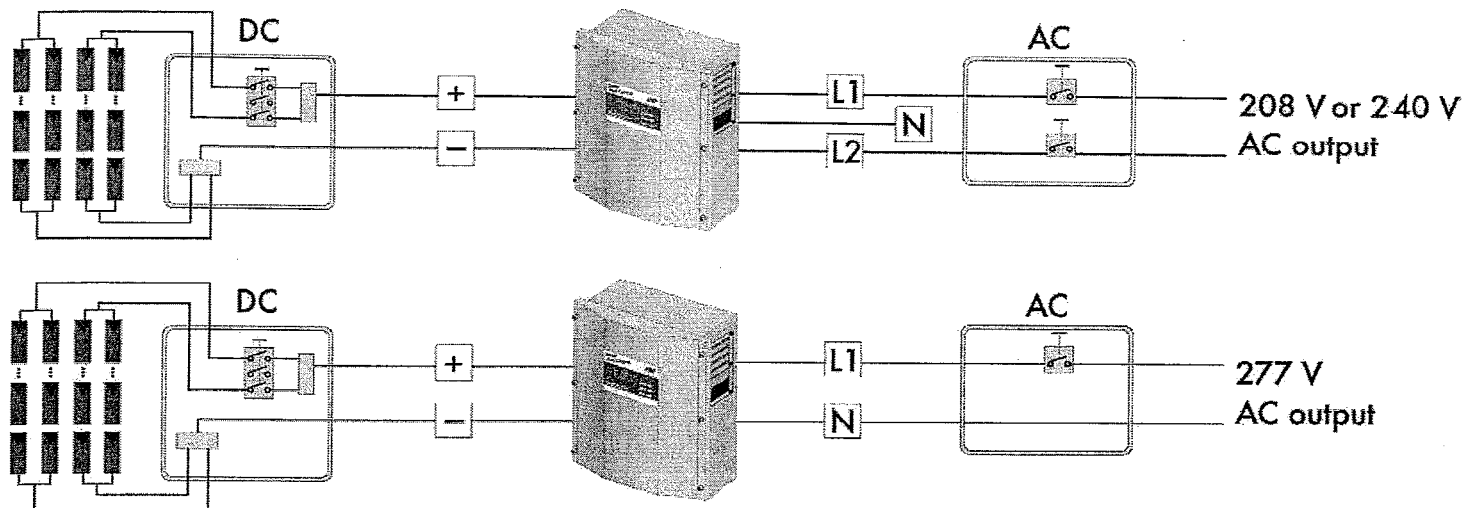
Easy to install wall  
mount bracket system

Comprehensive SMA  
communications and  
data collection options

SMA's modular  
commercial inverter  
design is expandable  
to virtually any size system

The most popular grid-tied photovoltaic inverter in Europe, is now available in North America. Sunny Boy's extensive track record in some of the world's most demanding markets has made it the favorite among PV professionals everywhere. Over 250,000 Sunny Boy inverters have been installed throughout the world. Superior design, rock-solid German engineering and exceptional real-world efficiency have made Sunny Boy inverters the top choice for American solar designers.





The SB6000U is SMA's latest addition to the Sunny Boy family of utility interactive inverters. The SB6000U is designed for use with PV, fuel cell, wind-turbine, hydro-turbine and micro-turbine technologies. The SB6000U follows SMA's modular system design philosophy for utility, commercial and residential PV installations from 6kW and up. Automatic sensing of the site utility voltage makes installation on almost any utility system trouble-free. Just wire the inverter into any 208, 277 or 240 VAC system, make one internal jumper setting and the SB6000U does the rest. The wide DC input voltage range allows connection to almost any type or model of PV module. Our proven peak-power-point tracker results in maximum energy capture. The SB6000U uses the same SMA communication accessories as every other inverter in the Sunny Boy family. Choose the system package that best suits your needs. SMA offers a variety of hardware and software solutions from low cost wireless monitoring, to complex data acquisition systems that integrate large numbers of inverters with external sensors to networked PC's and the internet.

## Specifications

Inverter Technology	PWM true sine-wave, current source	Power Factor	Fixed, unity
AC Input Voltage	Automatic sensing	Peak Inverter Efficiency	> 95%
	277 VAC Nominal (244-305 VAC)	Cooling	Temperature regulated fan cooling
	240 VAC Nominal (211-264 VAC)	Power Consumption	0.1W nighttime
	208 VAC Nominal (183-229 VAC)		7W standby
AC Input Frequency	59.3-60.5 (60Hz)	Ambient Temperature Rating	-25° to +45° C
AC Maximum Output Power	6000W (at 277 or 240 VAC)	Enclosure	NEMA 3R
	5200W (at 208 VAC)	Dimensions	16.9 W x 23.6 H x 9.8 D (in)
AC Maximum Output Current	25A (22A at 277 VAC)		430 W x 600 H x 250 D (mm)
DC Input Voltage	234-600 VDC	Weight	137 lbs
DC Minimum Input Voltage	207-256 VDC		62 kg
	(dependent on AC line voltage)		
DC Voltage Ripple	Less than 5%	Compliance	Meets requirements of
DC Maximum Current	25A		IEEE-519, IEEE-929,
Peak Power Tracking Voltage	250-480 VDC		IEEE-1547
PV Start Voltage (adjustable)	300 VDC (277 or 240 VAC)		UL 1741
	270 VDC (208 VAC)		
Maximum Recommended PV Power	7500W (STC)		
Current THD	Less than 4%		

Available From:

SMA America, Inc  
Grass Valley, CA USA  
info@sma-america.com  
www.sma-america.com

Solar Today...  
Energy Tomorrow

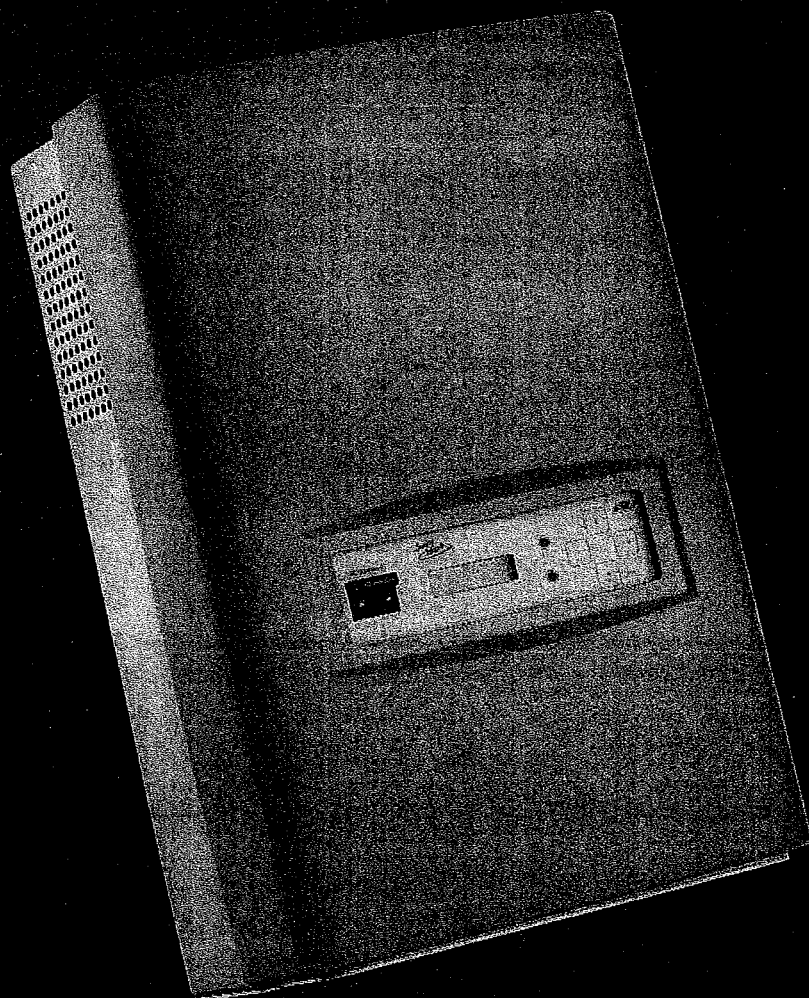




# Sunny Island 4248U



*SMA's new off grid inverter - A technological leap into the future*



Optimized for high ambient temperatures

Very high overload capability

High efficiency

Integrated DC breaker

Intuitive user interface

Output load shedding

DC and AC coupling of energy sources

Nearly silent operation

Automatic generator start

Battery protection

Insect proof

Easy installation and commissioning

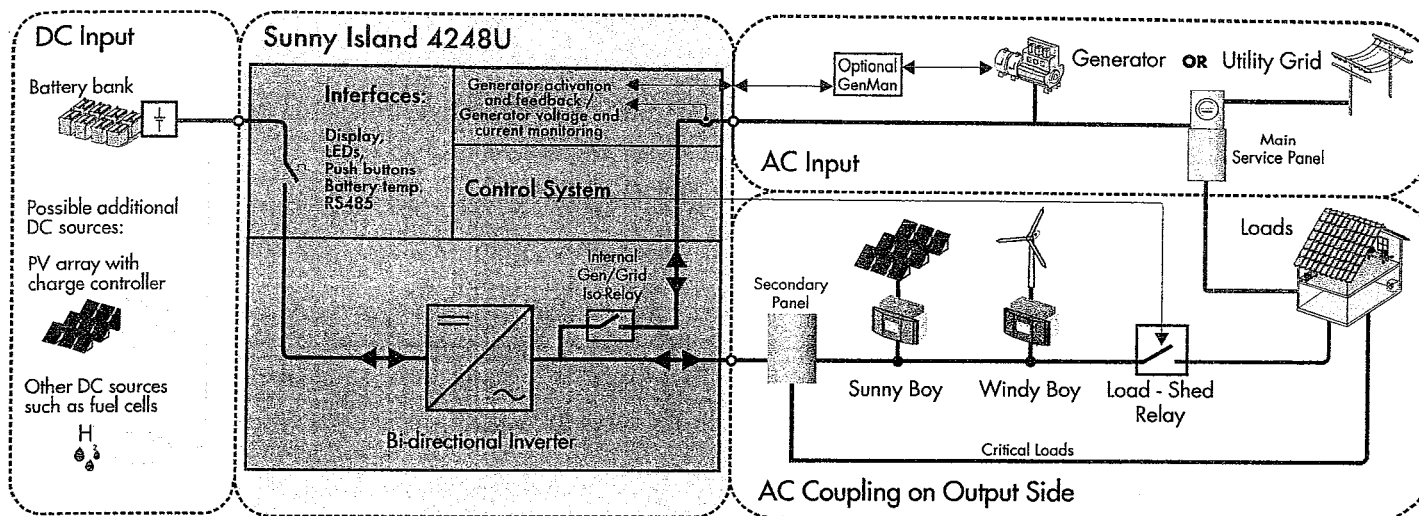
Non volatile parameter settings

Compatible with the Sunny Family of products

The new Sunny Island 4248U battery based inverter is the first off-grid inverter from SMA for use in the U.S. Perfect sine wave off-grid electricity is now available with high efficiency, robust power and outstanding reliability. Simple to install and use, yet loaded with powerful and advanced features, the Sunny Island 4248U is designed to meet the needs of off-grid as well as back-up power system applications.

Whenever and wherever electric power is needed, the new Sunny Island 4248U will perform!





The Sunny Island 4248U provides a continuous power output of 4200 watts at 25°C and 3400 watts even at scorching temperatures up to 45°C. That's enough power to comfortably energize most household appliances with power to spare. Large critical loads such as water pumps and refrigerators can be easily powered by the Sunny Island 4248U. This inverter operates silently and can be powered from multiple sources: wind, utility grid (for back-up power), hydro, solar electric and is even compatible with fuel cells. A number of communication options provide flexible remote system monitoring. The optional SMA "GenMan" (Generator Management Box) provides advanced control of even the most basic generators. The Sunny Island 4248U also works in conjunction with grid tied Sunny Boy solar systems to provide a powerful and efficient back up power solution.

The internal battery charger can supply up to 100A to the battery when in charge mode. Transition from charge to invert mode is a lightning fast 20ms, so even your computers will stay on-line. A pass-through relay with a rating of 60A at 120V is also included. Two Sunny Island 4248's may be paralleled to support 240VAC split-phase load centers. Once installed, the Sunny Island 4248U will run with basically no maintenance for years to come. With its state-of-the-art software and non-volatile memory, just set it and forget it.

## Technical Data

### Electrical / Mechanical data

Nom. Battery Voltage:	V <sub>DC,nom</sub>	48 V
Battery Voltage Range:	V <sub>DC</sub>	41 - 63 V
Nom. AC Voltage:	V <sub>AC,nom</sub>	120 V
AC Voltage Range:	V <sub>AC</sub>	105 - 132 V
Nom. AC Frequency:	f <sub>AC,nom</sub>	60 Hz
AC Input Charge Current:	I <sub>AC,chg</sub>	40A @ 25°C 28A @ 45°C

Max. AC pass through current (transfer relay):	60 A
Consumption (no load operation):	<22 W
Consumption (standby):	<4 W
Total harmonic distortion:	<3 %

### Temperature Range

-20°C to +45°C / -4.0°F to +113.0°F

**Enclosure:** IP30

**Weight:** 39 kg / 86 lbs

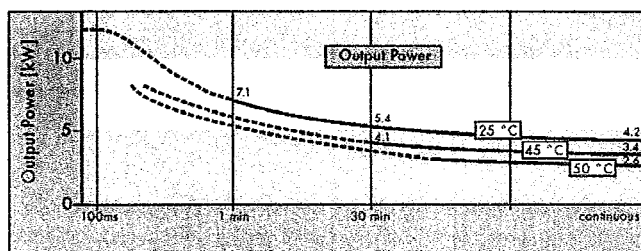
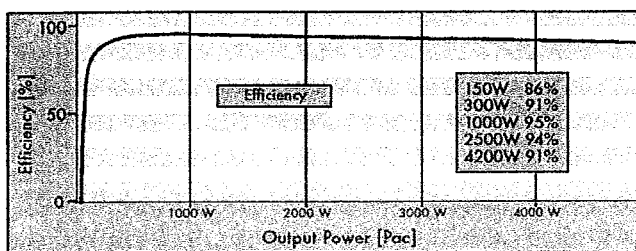
**Size:** W 390 x L 590 x H 245 millimeters  
W 15.35 x L 23.22 x H 9.64 inches

### Interfaces

- 2 LEDs; 2-line LCD; 4 push buttons
- 1 dry contact output for load shedding
- 1 dry contact for generator start
- 1 generator-ready opto isolated input

### Accessories

- Remote battery temperature sensor (included)
- Generator Management Box (optional)
- 1 RS232/485 galvanic isolated for communication(optional)



### SMA America, Inc.

12438 Loma Rica Drive  
Grass Valley, CA 95945  
phone: 530.273.4895  
email: info@sma-america.com  
www.sma-america.com

Solar Today ...  
Energy Tomorrow

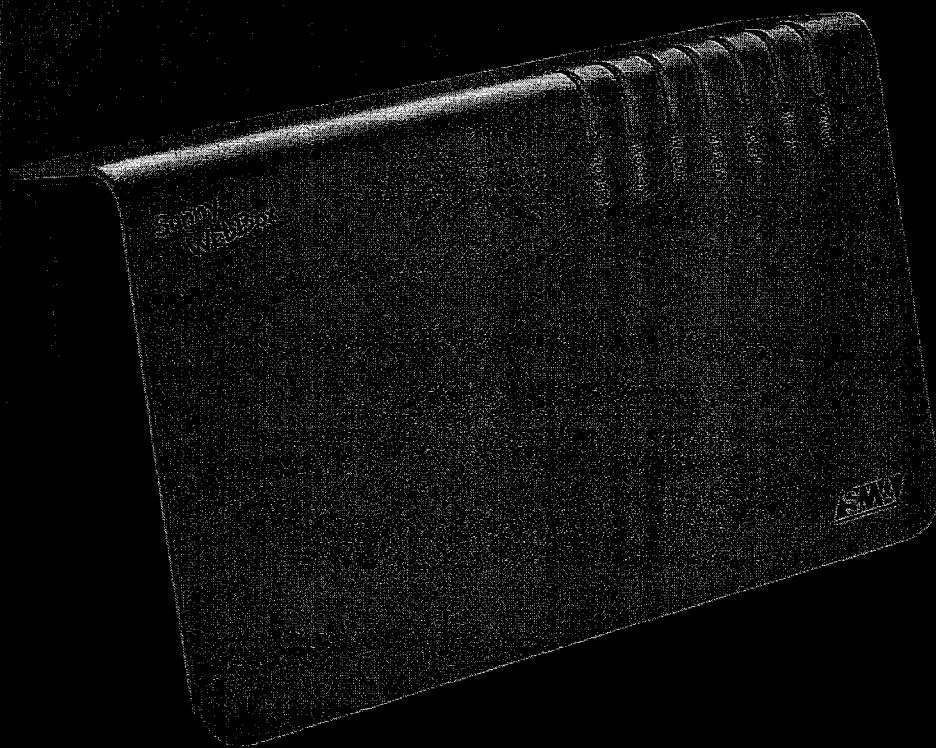




# Sunny WebBox™



Web enabled data logging and control for alternative energy systems



System access from any  
Web browser - anywhere  
in the world

Recording of daily, monthly  
and annual energy yield  
via Sunny Portal™

Remote plant diagnosis

Remote system configuration

Automatic data transfer  
at chosen intervals

Data storage and display  
via Ethernet

Compatible with all  
SMA utility interactive  
inverters

Low power consumption

Automated communication  
with Sunny Portal™

The new Sunny WebBox from SMA is a powerful communications tool that allows the operating data of your solar system to be logged and easily transmitted via modem or Ethernet to the Web or directly to your PC. It can also send the data to SMA's new internet portal (Sunny Portal) which provides free long-term data storage and graphical display of your system data. Collected information is stored in common file formats so that you can use it in various spreadsheets, graphs or your own web site. The Sunny WebBox is extremely versatile, making the storage, transmission, management and display of your system data easier than ever before.

# The new way to monitor your system

## A new standard in communication

The Sunny WebBox provides complete plant monitoring, remote diagnosis, data storage and display at an affordable price. It features an integrated HTTP web interface that allows you to access plant information via a PC, regardless of operating system or browser type.

The Sunny WebBox is the link between the Sunny Boy PV plant and its owner. It combines computing power, storage capacity, and versatile communication interfaces in a compact enclosure. Networked with the Sunny Portal, the data-logger offers up-to-date display and control options on the internet.

The Sunny WebBox supports RS232 or RS485 protocols for data transfer to and from all SMA utility interactive inverters.

Data transfer and plant configuration via

the internet is handled either by Ethernet connection or telephone modem. Data transfer is automatic - all you have to do is to set the desired intervals. A single WebBox can monitor up to 50 Sunny Boy inverters, saving even more costs when used in larger Sunny Boy solar systems.

## Around the clock, around the world

Check the status of your PV plant - from your home, your office or anywhere you may be. A PC with an internet browser is all that is needed to access the WebBox.

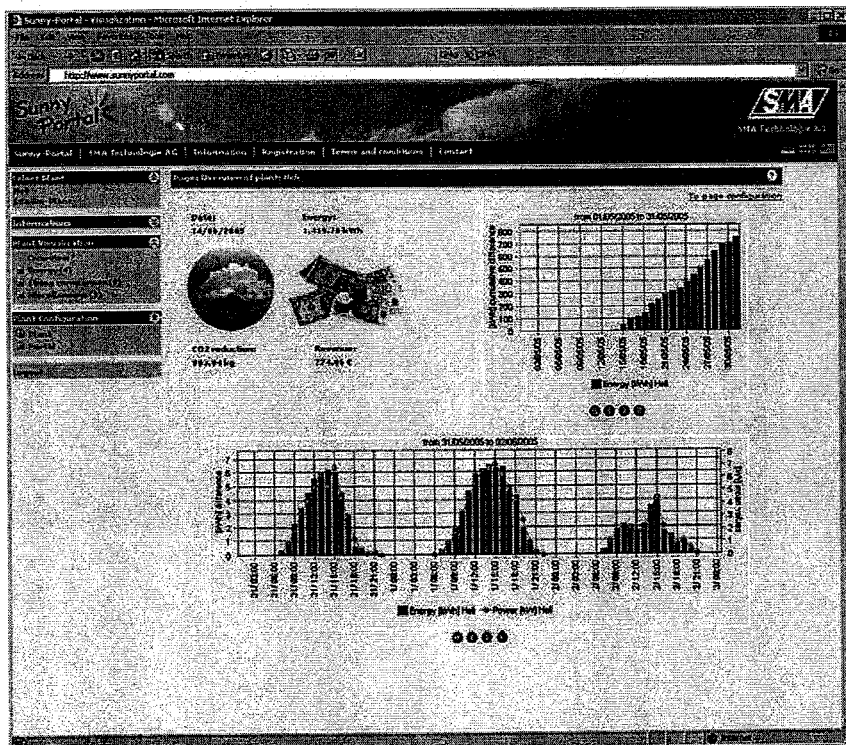
The Sunny WebBox is equipped with its own web server that is preconfigured to work with your internet browser. This allows you to view the output of your plant and the operating channels of each inverter. You can also adjust the parameters of the Sunny WebBox via your web browser.

The Sunny WebBox can also be used in combination with SMA's Sunny Portal Web site ([www.sunnyportal.com](http://www.sunnyportal.com)). Our internet portal offers free graphical presentation of your plant data in charts and diagrams. The Sunny Portal is WebBox ready, simply set up an account and connect the WebBox to the internet.

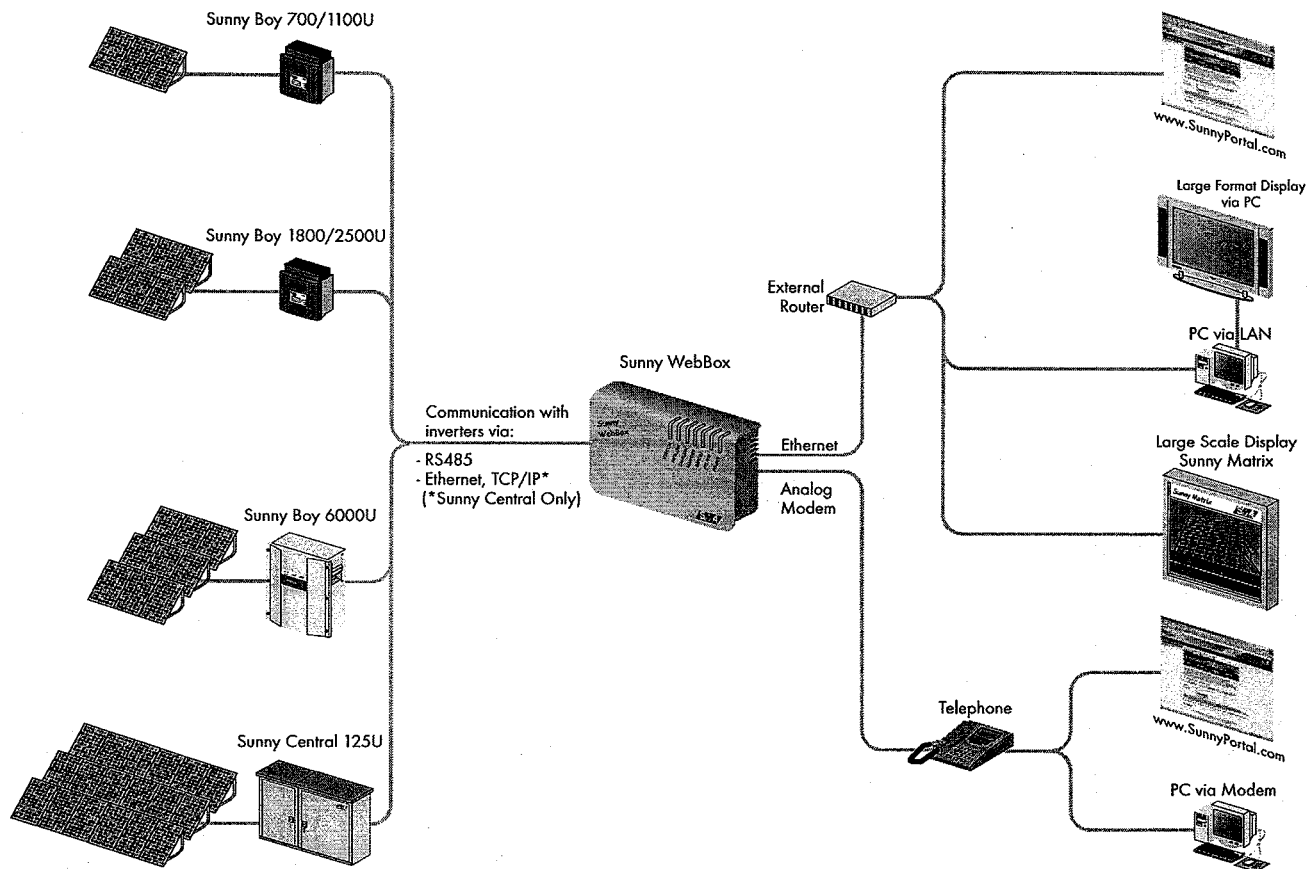
## A perfect match

Sunny WebBox and Sunny Portal are a perfectly matched team. They offer you long-term storage of your solar power plant data, inform you about changes in plant performance, and let you review the performance of your investment at any time, from anywhere.

To learn more about this new method of plant monitoring visit [www.SunnyPortal.com](http://www.SunnyPortal.com). We have set up demonstration accounts that allow you to view actual PV plants. Visit [www.sunnyportal.com](http://www.sunnyportal.com) and see for yourself what the Sunny WebBox and Sunny Portal has to offer.



Customer plant in Sunny Portal, 10.4 kWp



## Specifications

### Interfaces

SMACOM RS485  
(up to 50 inverters, max. 4000 ft. cable)

Ethernet 10Mb / 100 Mb auto sensing

### External Data Storage

SD-Card from 16 MB upwards  
USB-Stick USB 2.0 Host

### Dimensions

Size 8.85 x 2.25 x 5.11 in. (w x d x h)  
Weight 1.65 lb.

### Power Requirements

Wall Transformer Typ. 300 mA @ 12 V  
(120 VAC 60Hz) Max. 1 A @ 12 V  
Power Consumption Max. 12W

### Ambient Temperature Rating

Ambient Temperature Range 0°C to 55°C  
Relative Humidity Range 5 % to 95 %, non-condensing

### Miscellaneous

Operating System Windows CE.NET  
Status Display 7 LED's  
Mounting Options Wall mount, DIN rail mount, desktop

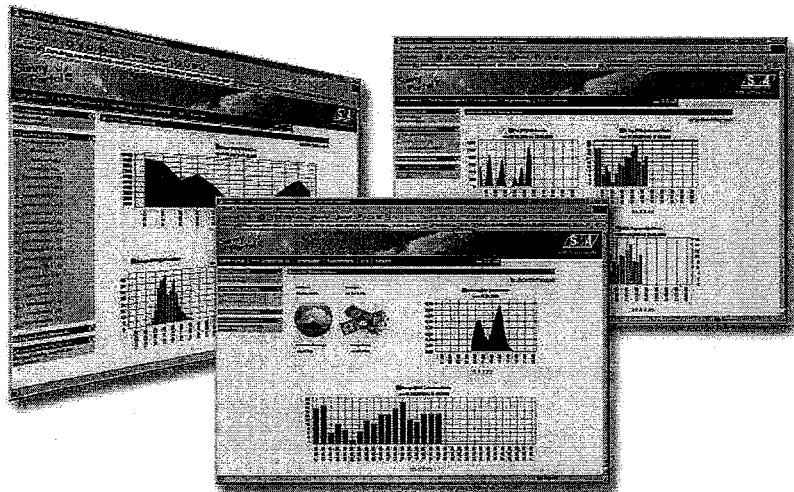
### Options

Integrated Analog Modem



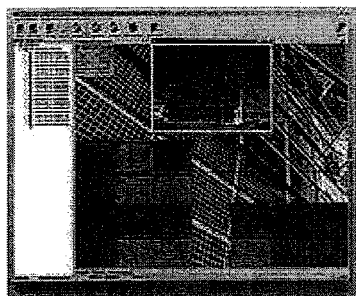
# The SMA family of data technology products

SMA America offers a wide range of data and communication related products to suit any application and budget. From the affordable Sunny Beam wireless system monitor for both home and commercial use, to the advanced data handling ability of the Web Box, SMA has the right product to meet your communication needs.



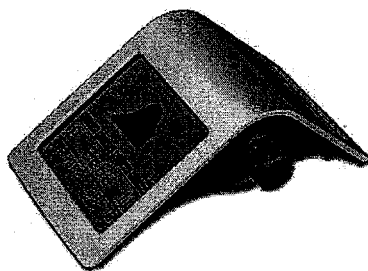
## Sunny Portal

- Free interactive access to your PV plant
- Storage and individual display of your system data
- Remote monitoring and service via internet
- Free registration at [www.SunnyPortal.com](http://www.SunnyPortal.com)



## Sunny Data Control

- Total plant overview display
- Access system parameters
- Download stored data to PC
- View individual inverter performance



## Sunny Beam

- Monitor and record inverter data
- Wireless operation
- USB for data transfer to PC
- Data storage and individual display via Sunny Data Control
- Power supplied by integrated solar cell



## SMA America Web Site

- For more information and document downloads visit [www.sma-america.com](http://www.sma-america.com)

WebBox Flyer 010506 - Specifications subject to change without notice. SMA does not assume any liability for errors or misprints.

Supplied by:



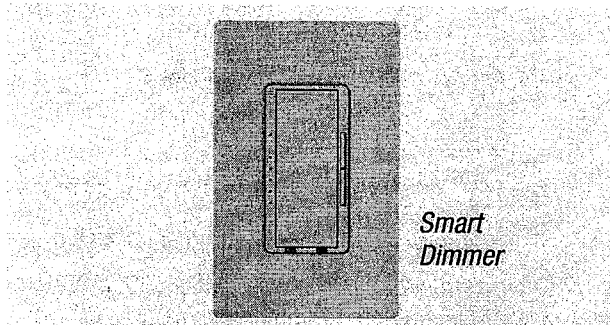


# SPECIFICATION SUBMITTAL

## MAESTRO® Satin Colors

www.lutron.com/satincolors

### The High-Tech Multi-Location Dimmer



#### PRODUCT FAMILY FEATURES

- High-tech "Smart Dimmer" with microprocessor technology for a standard designer wallplate opening
- Features a clean, flush, stylish appearance
- Two taps on the switch brings lights on to full brightness; press and hold the switch to slowly fade lights to off over 10 seconds
- LED's indicate light level and glow softly as a locator light in the dark
- Multi-location dimming from up to 10 locations
- Uses standard single-pole and 3-way wiring for easy installation in any home
- Raise from off

#### SPECIFICATION FEATURES

- Power- failure memory
- Frequency compensation
- Includes Radio Frequency Interference suppression
- Front accessible service switch (FASS™) to disconnect load power
- Electrostatic discharge tested
- Precise color matching across all controls

#### MAESTRO CONTROLS

##### Smart Dimmers

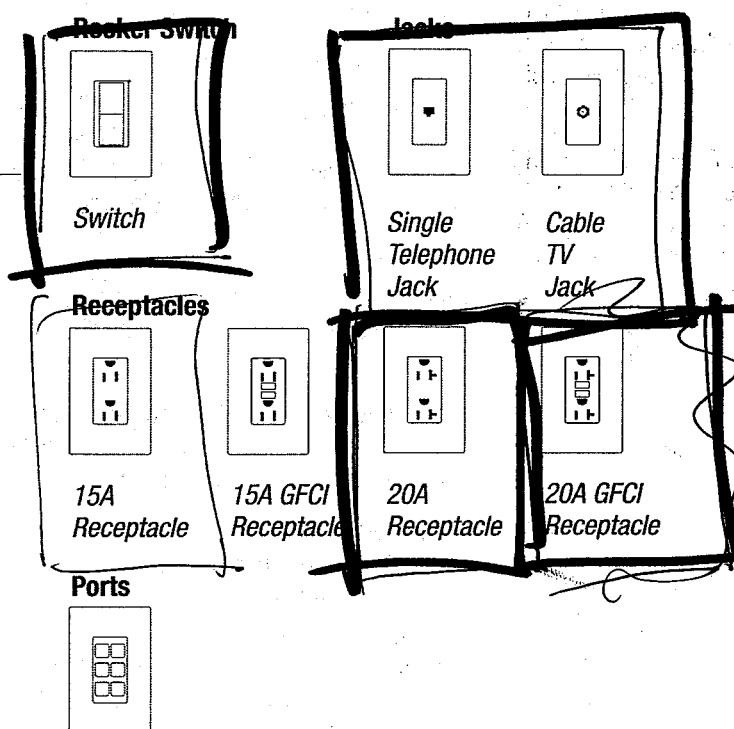
- One tap on to selected light level/off; two taps full bright; press & hold for 10-second fade off
- Press rocker to adjust light level
- Front accessible service switch (FASS™)
- LED'S indicate light level, glow softly

##### Accessory Dimmers

SCR-20-MN  
SC-PJ

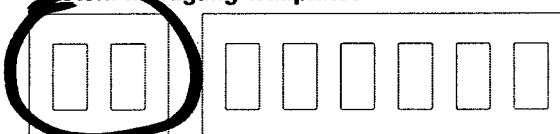
Note: For multi-location dimming only-use one Smart Dimmer (left) with up to nine Accessory Dimmers

#### SATIN COLOR ACCESSORIES



#### 6-Port Frame

#### Custom Multigang Wallplates



#### 2-gang to 6-gang wallplates

STANDARDS	
JOB NAME	AREA CONTROLLED
LOCATION	JOB NUMBER
TITLE	PAGE NO.





# SOLAR

AC System Batteries

## PHOTOVOLTAIC BATTERIES



### FLOODED MAINTENANCE SAVER SYSTEM

Higher voltage systems naturally  
have greater power requirements.

The **DEKA SOLAR FLOODED SYSTEM**

is designed to offer reliable,  
low maintenance power for  
renewable energy applications  
where frequent deep cycles  
are required and minimum  
maintenance is desirable.

#### FEATURES & BENEFITS

Jar and Cover	Molded high impact polypropylene.
Separators	Microporous polyethylene material
Retainers	Vertically and horizontally wrapped glass mat, folded perforated envelope, molded plastic bottom shield
Positive and Negative Plate	Antimony flat plate
Specific Gravity (fully charged)	1.250 @ 25°C (77°F).
Self discharge	1% per week
Cycle life	1500 cycles @ 80% DOD, 4000 cycles @ 20% DOD [Number of cycles based on 6-hr. rate @ 25°C (77°F)]

#### INNOVATIVE FEATURES

- High capacity flat plate cells • Long life: 12 to 14 years in shallow cycle service
- Extended watering interval - up to six months because of a large reservoir for electrolyte
  - Thermally sealed cover to container • Long-lasting epoxy coated steel trays
- Special mounting brackets on tray for enhanced stability • Custom design modules

#### OPTIONS AVAILABLE

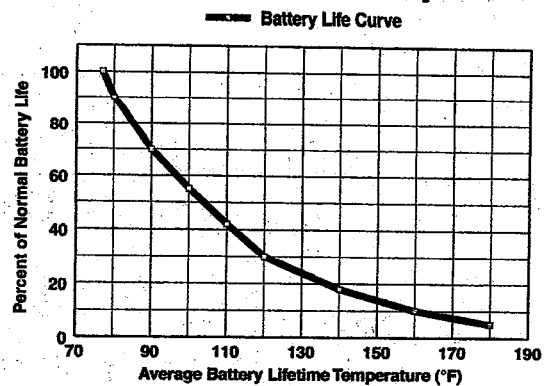
- Jars and covers constructed of LOI material • Single point watering system
- Design variations based on specific application needs • Cone and thimble bolt-on terminals
  - EZ Link bolt-on connections • High Density Polyethylene plastic trays

## Flooded System Discharge Ratings\*

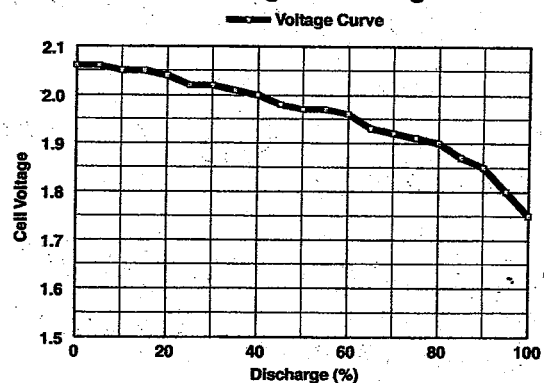
\*Cut-Off Voltage at 1.75 VPC

Cell Type	6 Hr.	8 Hr.	20 Hr.	24 Hr.	48 Hr.	100 Hr.
M75	Height:	No Cover - 25"	Dome Cover - 26"	Flat Cover - 26"		
M75-5	143	151	178	182	198	218
M75-7	215	226	267	273	297	327
M75-9	287	302	356	365	396	437
M75-11	358	377	444	456	495	546
M75-13	430	452	533	547	594	655
M75-15	501	528	622	638	693	764
M75-17	573	603	711	729	792	873
M75-19	645	678	800	820	891	982
M75-21	716	754	889	911	990	1091
M75-23	788	829	978	1002	1089	1200
M75-25	860	905	1067	1094	1188	1310
M75-27	931	980	1155	1185	1287	1419
M75-29	1003	1055	1244	1276	1386	1528
M75-31	1074	1131	1333	1367	1485	1637
M75-33	1146	1206	1422	1458	1584	1746
M85	Height:	No Cover - 25"	Dome Cover - 26"	Flat Cover - 26"		
M85-5	162	171	202	206	224	247
M85-7	243	256	302	310	337	371
M85-9	325	342	403	413	449	494
M85-11	406	427	504	516	561	618
M85-13	487	513	605	619	673	742
M85-15	568	598	705	723	785	865
M85-17	649	684	806	826	898	989
M85-19	730	769	907	929	1010	1113
M85-21	811	855	1008	1032	1122	1236
M85-23	893	940	1109	1135	1234	1360
M85-25	974	1025	1209	1239	1346	1483
M85-27	1055	1111	1310	1342	1459	1607
M85-29	1136	1196	1411	1445	1571	1731
M85-31	1217	1282	1512	1548	1683	1854
M85-33	1298	1367	1612	1652	1795	1978
M100	Height:	No Cover - 30"	Dome Cover - 31"	Flat Cover - 31"		
M100-5	191	201	237	243	264	291
M100-7	286	301	355	364	395	436
M100-9	382	402	474	486	528	582
M100-11	477	502	592	607	660	727
M100-13	573	603	712	729	792	873
M100-15	668	704	830	850	924	1018
M100-17	764	805	949	972	1056	1164
M100-19	859	905	1067	1093	1188	1309
M100-21	955	1006	1186	1215	1321	1455
M100-23	1050	1106	1304	1336	1452	1600
M100-25	1146	1207	1423	1458	1585	1746
M100-27	1241	1307	1541	1579	1716	1891
M100-29	1336	1407	1659	1700	1847	2035
M100-31	1432	1508	1779	1822	1980	2182
M100-33	1527	1608	1896	1942	2111	2326

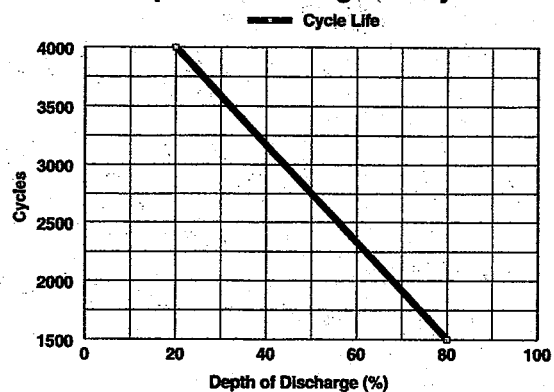
## Temperature vs. Battery Life



## Discharge vs. Voltage



## Depth of Discharge vs. Cycles



QUALITY SYSTEM  
CERTIFIED TO  
**ISO 9001**  
**ISO/TS 16949**

**UL**  
UL Recognized Component

## EAST PENN manufacturing co., inc.

Lyon Station, PA 19536-0147 • Phone: 610-682-6361 • Fax: 610-682-4781

Order Department Hotline: 610-682-4231

www.eastpennunigy.com

E-mail: sales@eastpennunigy.com

E.P.M. Form No. 0919A 5/03  
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MORNINGSTAR

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Print

Message 315 of 321

Read

~~Prepare PO~~

inbox

**From** "David R. Riley" <DRiley@engr.psu.edu>  
 "David R. Riley" <DRiley@engr.psu.edu>  
**To** Rennie Santangelo <rsantangelo@eastpennuniggy.com>  
 Rennie Santangelo <rsantangelo@eastpennuniggy.com>  
**Subject** RE: Penn State Solar Decathlon  
**Date** Wed, 30 May 2007 07:57:43 -0400  
 Angela Lewis <ama259@psu.edu>, Seth Wilberding  
 <sethwilberding@yahoo.com>, "Lisa D. Iulo" <ldi1@psu.edu>, Nick Rotondi  
 <nar153@psu.edu>  
**CC** Angela Lewis <ama259@psu.edu>, Seth Wilberding  
 <sethwilberding@yahoo.com>, "Lisa D. Iulo" <ldi1@psu.edu>, Nick Rotondi  
 <nar153@psu.edu>  
 multipart/mixed  
 multipart/alternative  
**Parts/Attachments** text/plain (printable)  
 text/html (printable)  
 text/x-vcard (printable)

7 Contact for  
 Deka Batteries  
 @ East Penn

Thank you Rennie,  
 We will prepare a purchase order for these batteries.

DR

David R. Riley, Assoc. Prof. of Architectural Engineering

**Executive Director:** Center for Sustainability  
 Penn State Dept. of Architectural Engineering  
 104 Engineering Unit A  
 University Park, PA 16802  
 814-863-2079  
 driley@engr.psu.edu  
 www.engr.psu.edu/ae/faculty/riley

We can't solve problems by using the same kind of thinking we used when we created them.  
 -Albert Einstein, physicist, Nobel laureate (1879-1955)

**From:** Rennie Santangelo [mailto:rsantangelo@eastpennuniggy.com]  
**Sent:** Tuesday, May 29, 2007 4:54 PM  
**To:** Jeff Park  
**Cc:** David R. Riley; kreitenauer@eastpennuniggy.com; Staci Eckhart  
**Subject:** Re: Penn State Solar Decathlon

Jeff,  
 East Penn has some information that you were looking for on the 24M100-27 batteries.

The dimensions will be L 41 13/16 x W 38 5/16 x H 33 1/8 Weight 5,332 lbs per 24 cell battery  
 Acid volume 106 .56 gal of electrolyte ( pure acid and water make up electrolyte ) per 24 cell





battery

24 gal of pure acid per 24 cells

4.44 gallons per cell electrolyte

1 gal pure acid pre cell

Hydrogen calculator for both batteries:

92.2 cu. ft. or H<sub>2</sub> gas

Recommended Air Make Up:

51.2 cu. ft. per min. forced air

Battery Price:

Penn State Cost

24 M100-27 \$4,197.60 ea. Delivery is 10 weeks after receipt of order. Delivery is included to State College, PA.

Street value \$8,879.00

Retail value \$6,830.00

If you have any further questions please get back to me.

Sincerely,

Rennie Santangelo

Hello Rennie-

After discussing the batteries with the one of the Solar Decathlon faculty advisors Dr. David Riley, we have decided that we would like to use the (2) M100-27 batteries in the home. Can we get a written quote ASAP and a time estimate for receiving batteries once our order is placed.

Thank you

Jeff Park

Graduate Student

Solar Decathlon Team  
Pennsylvania State University

Dept. Architectural Engineering  
104 Engineering Unit A  
University Park, PA 16802  
Phone: (970) 846-7991

---

David R. Riley.vcf

David R. Riley.vcf

**– Material Safety Data Sheet –****Lead Acid Battery Wet, Filled with Acid****SECTION I****Manufacturer's Name:**

East Penn Manufacturing Co., Inc.

Deka Road, Lyon Station, PA 19536

**Telephone Number for Information:** (610) 682-6361**Emergency Telephone Number:** CHEMTREC: 1-800-424-9300,

In Washington D.C. or outside continental U.S., call 1-202-483-7616

**Date:** March 16, 2005**Trade Name:** Electric Storage battery, SLI or Industrial battery**Classification:** Battery wet, filled with acid, electric storage  
UN2794**SECTION II****HAZARDOUS INGREDIENTS/IDENTITY INFORMATION**

Hazardous Components Specific Chemical Identity (Common Name (s))	OSHA PEL	ACGIH TLV	Range Percent By Weight	Average
Lead, CAS #7439921	0.05 mg/m <sup>3</sup>	0.05 mg/m <sup>3</sup>	43-70	65
Sulfuric Acid, CAS #7664939	1.00 mg/m <sup>3</sup>	1.00 mg/m <sup>3</sup>	20-44	25
Antimony, CAS #7440360	0.50 mg/m <sup>3</sup>	0.50 mg/m <sup>3</sup>	0-4	<1
Arsenic, CAS #7440382	0.01 mg/m <sup>3</sup>	0.01 mg/m <sup>3</sup>	<.01	-
Polypropylene, CAS #9003070	-	-	5-10	8
Calcium, CAS #7440702	1.0 mg/m <sup>3</sup>	1.0 mg/m <sup>3</sup>	<1	<1

**SECTION III****PHYSICAL/CHEMICAL CHARACTERISTICS****Electrolyte (Sulfuric Acid):****Appearance and Odor:** Clear, Odorless, Colorless**Boiling Point:** approximately 235° F**Evaporation Rate (Butyl Acetate=1):** less than 1.0**Melting Point:** N/A**Solubility in Water:** Completely**Specific Gravity (H<sub>2</sub>O=1):** 1.220 – 1.325**Vapor Density (AIR=1):** N/A**Vapor Pressure (mm Hg):** 13**SECTION IV****FIRE AND EXPLOSION HAZARD DATA****Flash Point (Method Used):** Non-Flammable**Flammable Limits:** \*Hydrogen Gas**Extinguishing Media:** Class ABC extinguisher, CO<sub>2</sub>

LEL: 4%

UEL 74%

**Special Fire Fighting Procedures:** Cool exterior of battery if exposed to fire to prevent rupture. The acid mist and vapors in a fire situation are corrosive. Wear special respiratory protection (SCBA) and clothing.**Unusual Fire and Explosion Hazards:** \*Hydrogen gas, which may explode if ignited, is produced by this battery, especially when charging. Use adequate ventilation; avoid open flames, sparks, or other sources of ignition.**SECTION V****REACTIVITY DATA****Stability:** Stable**Condition to Avoid:** Prolonged overcharging, sources of ignition**Incompatibility (Materials to Avoid):** Sulfuric Acid: Contact with combustibles and organic materials may cause fire and explosion. Also reacts violently with strong reducing agents, metals, strong oxidizers and water. Contact with metals may produce toxic sulfur dioxide fumes and may release flammable hydrogen gas.**Hazardous Decomposition of By-Products:** Sulfuric Acid: Excessive overcharging or fire may create Sulfur trioxide, carbon monoxide, sulfuric acid mist, sulfur dioxide, and hydrogen.**Lead Compounds:** Contact with strong acid or base or presence of nascent hydrogen may generate highly toxic arsine gas.

## SECTION VI HEALTH HAZARD DATA

**Route(s) of Entry:** Not Applicable under normal use. (Inhalation, skin contact, and ingestion)

**Health Hazards (Acute and Chronic):** Do not open battery, avoid contact with internal components. Internal components are Oxide lead and electrolyte. Short term exposure: Sulfuric acid may cause irritation of eyes, nose, and throat. Prolonged contact may cause severe burns. Long term exposure: Repeated contact causes irritation and skin burns. Repeated exposure to mist may cause erosion of teeth, chronic eye irritation and/or chronic inflammation of the nose, throat, and bronchial tubes.

**TARGET ORGAN:** (Electrolyte) respiratory system, eyes, skin, and teeth

### **Carcinogenicity:**

Sulfuric Acid: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid contained within a battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product such as overcharging, may result in the generation of sulfuric acid mist.

Lead Compounds: Lead is listed as a 2B carcinogen, likely in animals at extreme doses. Proof of carcinogenicity in humans is lacking at present.

Arsenic: Listed by National Toxicology Program (NTP), IARC, OSHA and NIOSH as a carcinogen only after prolonged exposure at high levels.

**Signs and Symptoms of Exposure:** Acid contact may cause irritation of eyes, nose and throat. Breathing of mist may produce respiratory difficulty. Contact with eyes and skin causes irritation and skin burns. Sulfuric acid is a CORROSIVE chemical.

**Medical Conditions Generally Aggravated by Exposure:** Sulfuric Acid Mist exposure may aggravate medical conditions such as, pulmonary edema, bronchitis, emphysema, dental erosion, and tracheobronchitis. Pregnant women and children must be protected from lead exposure.

### **Emergency and First Aid Procedures:** (Sulfuric Acid)

- 1) Flush contacted area with large amounts of water for at least 15 minutes. Remove contaminated clothing and obtain medical attention if necessary. Eye wash and/or emergency shower should be readily available.
- 2) If swallowed, give large volumes of water. **DO NOT** induce vomiting, obtain medical treatment.

## SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

**Steps to be Taken in Case Material is Released or Spilled:** *SULFURIC ACID:* Dilute spill cautiously with five to six volumes of water and gradually neutralize with sodium bicarbonate, soda ash or lime. When exposure level is not known, wear NIOSH approved positive pressure self-contained breathing apparatus. Reference North American Emergency Response Guidebook, #154.

**Waste Disposal Method:** Lead-acid batteries are completely recyclable. For information on returning batteries to East Penn for recycling, contact your East Penn Representative. Dispose of any collected material in accordance with local, state or applicable federal regulations.

**Precautions to be Taken in Handling and Storing:** Store away from reactive material as defined in Section V, Reactivity Data. Place cardboard between layers of stacked batteries to avoid damage and short circuit. Do not allow metallic materials to simultaneously contact both terminals.

**Other Precautions:** Sodium bicarbonate, soda ash, sand, or lime should be kept in same general area for emergency use. Keep away from sources of ignition during charging see Section IV on generation of hydrogen gas. If battery case is broken, avoid direct contact with internal components.

## SECTION VIII CONTROL MEASURES

**Respiratory Protection (Specific Type):** Respirator required when PEL is exceeded or employee witnesses respiratory irritation. (see Section VI, Health Hazard Data).

**Ventilation:** Must be provided when charging in an enclosed area. (29CFR1910.178(g) and .305(j)(7))

Mechanical (general): Acceptable at 1 to 4 air exchanges/hour or to maintain air concentrations below the PEL.

Local Exhaust: Preferred

Other: Local building/fire codes may require explosion proof fans and equipment

**Protective Gloves:** Acid resistant

**Eye Protection:** Preferred, safety glasses, goggles, face shield

**Other Protective Clothing or Equipment:** Acid resistant aprons, boots, and protective clothing

**Work Hygienic Practices:** Good Personal hygiene and work practices are mandatory.



## SECTION IX OTHER REGULATORY INFORMATION

### NFPA Hazard Rating

Health(Blue)

Flammability (Red)

Reactivity (Yellow)

### Sulfuric Acid

3

0

2

### Lead

3

0

0

Note: Sulfuric acid is water-reactive if concentrated.

### **U.S. DOT: Battery Wet, Filled with Acid**

Hazard Class/Division

8

ID Number

UN2794

Packing Group

III

Label Requirement

Corrosive

**RCRA:** Spent lead-acid batteries are not regulated as hazardous waste when recycled. Spilled sulfuric acid is a characteristic hazardous waste, EPA hazardous waste number D002 (corrosivity).

### **CERCLA (Superfund) and EPCRA (Emergency Planning and Community Right to Know ACT)**

- a) Reportable Quantity (RQ) for spilled 100% sulfuric acid is 1000 lbs.
- b) Sulfuric acid is a listed "Extremely Hazardous Substance" under EPCRA with a Threshold Planning Quantity (TPQ) of 1000 lbs.
- c) EPCRA Section 312 Tier II reporting required for batteries if sulfuric acid is present in quantities of 500 lbs or more and/or lead is present in quantities of 10,000 lbs or more.

**California Prop 65:** Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. **WASH HANDS AFTER HANDLING.**

For additional information concerning East Penn Manufacturing Co., Inc. products or questions concerning the content of this MSDS please contact your East Penn representative.

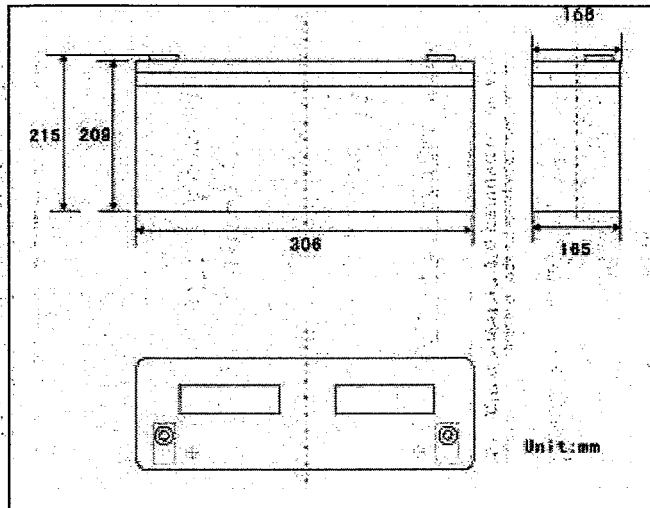
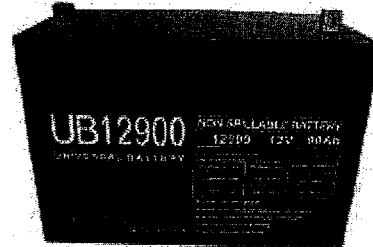
This information is accurate to the best of East Penn Mfg. Co.'s knowledge or obtained from sources believed by East Penn to be accurate. Before using any product, read all warnings and directions on the label.



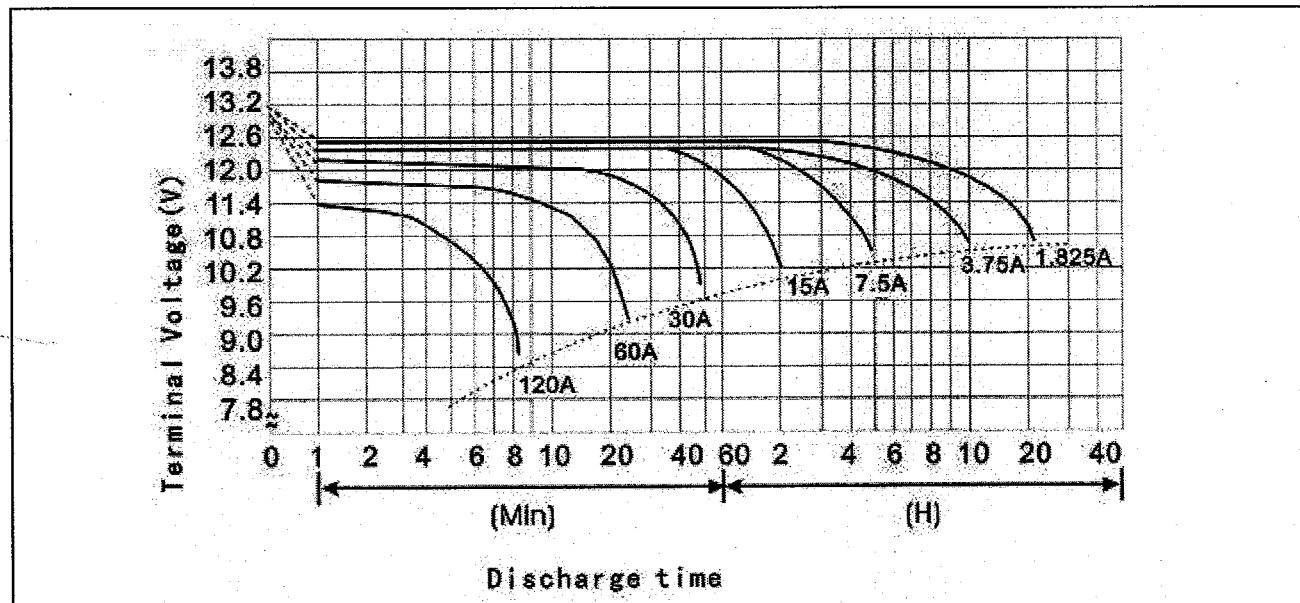


# Midstate UB12900 Batteries (LED LIGHTING SYS) UB12900

Specifications		
Nominal Voltage		12V
Rated Capacity (20 hour rate)		90Ah
Dimensions	Tot. Height (with terminal)	8.46 in (215 mm)
	Height	8.23 in (209 mm)
	Length	12.05 in (306 mm)
	Width	6.49 in (165 mm)
Weight		Approx. 62.61 lbs



Characteristics		
Capacity 77°F (25°C)	20 hr. rate 20	90Ah
	10 hr. rate 10	83.7Ah
	5 hr. rate 5	76.5Ah
	4 hr. rate 4	75Ah
	1 hr. rate 1	54Ah
Internal resistance. Full charged battery 77°F (25°C)		6.7 milliohms
Capacity affected by Temperature (20 hour rate)	104° F (40°C)	102%
	77°F (25°C)	100%
	32°F (0°C)	85%
	5°F (-15°C)	65%
Self Discharge 77°F (25°C)	Capacity after 3 months storage	90%
	Capacity after 6 months storage	80%
	Capacity after 12 months storage	60%
Watts per cell @ 1 hour		36
Run time @ 25A		3 hr. 32 min.
Discharge rate @ 4 hours		18A
Charge (Constant- Voltage)	Cycle	Initial charging current less than 27A. Voltage 14.5~14.9V/12V 77°F (25°C)
	Float	Voltage 13.6~13.8V/12V 77°F (25°C)



**MID-STATE BATTERY, LLC.**

167 North Main Street

Pleasant Gap PA 16823

(814) 238-2828

DC-LED  
System  
Batteries**INVOICE # 1094**

Invoice Date 6/5/2007

Pick Date 6/5/2007

Route/Stop LOCAL

Label Code/Price Sheet

Company#/Salesman#129+

3

243+

**SOLD TO:**

PSU-AED

104 ENGINEERING UNIT A

UNIVERSITY PARK PA 16802

**SHIP TO:**

PSU-AED

104 ENGINEERING UNIT A

UNIVERSITY PARK PA 16802

Ship Via

NAN

Cust. P/O #

VERBAL

Company Phone #

How Paid

VISA

Sold By:

JP

ORDR	SHIP	PART #	PART DESCRIPTION	PRICE	TOT
8	8	WB12900	12V 90AH SLA BATTERY	149.95	1,19
	8	Core A	Core A DEPOSITS	.00	
			TOTAL INVOICE AMOUNT		1,19
			PAID BY VISA		-1,19

**PLEASE PAY: \$0.00**

4 MONTHS FREE REPLACEMENT \_\_\_\_\_ MONTHS PRO RATED WARRANTY

12 MONTHS FREE REPLACEMENT \_\_\_\_\_ MONTHS PRO RATED WARRANTY

24 MONTHS FREE REPLACEMENT \_\_\_\_\_ MONTHS PRO RATED WARRANTY

Received By \_\_\_\_\_

Date: \_\_\_\_\_

MORNINGSTAR



**UPG**

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CARROLLTON, TX 75006  
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AUTOMOTIVE

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MARINE

MEDICAL

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OEM

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UPS

## MATERIAL SAFETY DATA SHEET

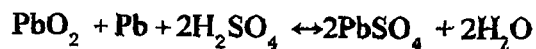
Material Safety Data Sheets (MSDS) are a sub requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to the various subcategories including anything defined by OSHA as an "article" as an manufacturing item other than a fluid or particle: 1.) Which is formed to a specific shape or design during manufacture 2.) Which has end functions(s) dependent in the whole or in part upon its shape or design during end use 3.) Which under normal conditions of use does not more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees.

Because all of our batteries are defined as "articles", they are exempt from the requirements of Hazard Communication Standard, 29 CFR 1910.1200; hence a MSDS is not required.

The following components are found in a Universal Battery sealed lead acid battery:

		Weight Range:
Sulfuric Acid-Electrolyte	$H_2SO_4$	10-20%
Lead-Negative Electrode	Pb	30-60%
Lead Dioxide-Positive Electrode	$PbO_2$	5-25%
Lead Sulfate- Positive Electrode	$PbSO_4$	1-25%

The overall reaction is:



Concentration of components depends on the state of charge and discharge and the battery size. The hazardous waste code for the lead acid batteries is D008. At the end of its useful life, please recycle this battery.

*\* SEALED LEAD ACID BATTERIES \**

ATTN: ANGELA

MORNINGSTAR  
284 of 353

## 190 Watt Photovoltaic Module – Saturn Technology

BP 7190

3033E-1 07/06

The BP 7190S forms part of the high efficiency Saturn 7 Series "real power" range of solar modules. Our industry leading warranty is based on nominal power output, meaning more power for a longer period of time. The bypass diodes use the IntegraBus™ technology, which limits the loss of energy in the event of partial shadowing affecting the module. Being one of the largest, most powerful modules manufactured by BP Solar, the BP 7190S is ideal for installations where high power is needed in a limited area.

The BP 7190S has been especially designed for grid connect applications such as large commercial roofs, residential systems and photovoltaic power plants.

### Performance

Rated power	190W
Tolerance	-0/+2.5%
Module efficiency	15.1%
Nominal voltage	24V
Warranty:	90% power output over 12 years 80% power output over 25 years Free from defects in materials and workmanship for 5 years

### Configuration

BP 7190S	Clear Universal Frame, sealed junction box, cables with Multi-Contact connectors.
----------	---

### Qualification Test Parameters

Temperature cycling range	-40°C to +85°C for 200 cycles
Damp heat test	85°C and 85% relative humidity for 1000h
Front & rear load test (eg: wind)	2400Pa
Front load test (eg: snow and wind)	5400Pa
Hailstone impact test	25mm hail at 23m/s from 1m distance

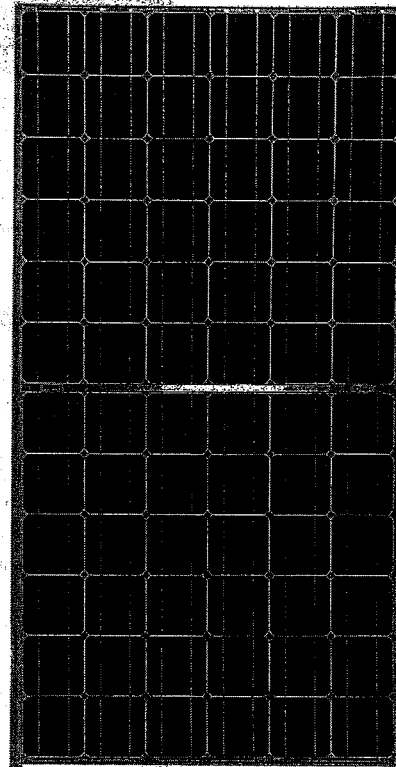
### Quality and Safety

- Manufactured in ISO 9001 and ISO 14003 certified factories
- Conforms to European Community Directive 89/33/EEC, 73/23/EEC, 93/68/EEC
- Certified to IEC 61215

Module power measurements calibrated to World Radiometric Reference from ESTI (European Solar Test Installation) at Ispra, Italy.

Framed modules certified by TÜV Rheinland as Safety Class II (IEC 60364) equipment for use in systems up to 1000V.

Framed modules listed by Underwriters Laboratories for electrical and fire safety (Class C fire rating).

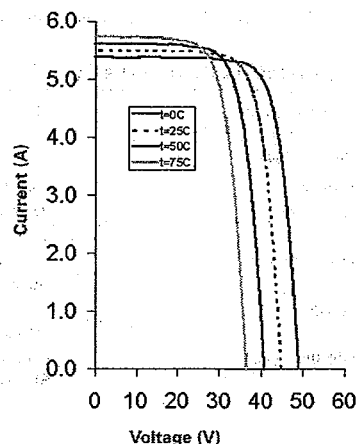


BP 7190S scale 1:14

### Efficiency (%)

9-11	11-12	12-13	13-14	14-15
------	-------	-------	-------	-------

### BP 7190S I-V Curves





BP Solar

BP 7190 - Contact Information

Jeff Park

---

**From:** Golofski, Julie A [Julie.Golofski@bp.com]  
**Sent:** Friday, February 16, 2007 12:29 PM  
**To:** David R. Riley; Jeff Park  
**Subject:** Product Information

Hi David and Jeff -

We are expecting the modules to ship from Spain next week by air freight, the cost of which BP Solar will incur. To start the order, I will need a purchase order from Penn State for the (42) Saturn 7190 modules quoted at \$23,940; \$3/watt. Also, I will need bill to and ship to addresses, in addition to contact name, telephone number, fax number and a copy of the university's tax exempt certificate.

Please let me know if you have any other questions or concerns via e-mail or phone at 412.398.3143.

Kind regards,

Julie Golofski

BP Solar



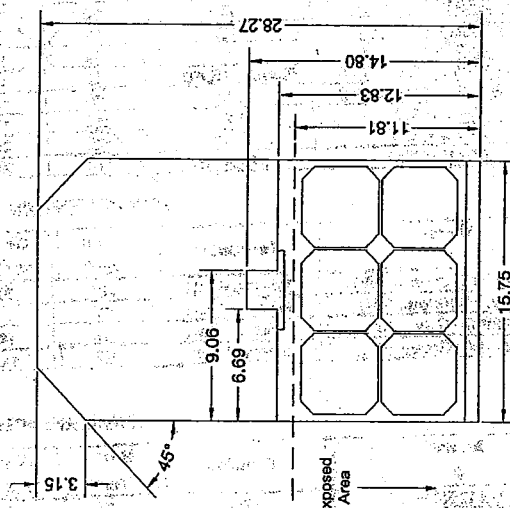
# Atlantis Energy Systems, Inc. Sunslates® Product Information

All Specifications at Standard Test Conditions (STC): 1000W/m<sup>2</sup> Irradiation, 25°C Cell Temp, 1.5 Air Mass  
Each Sunslate has six crystalline photovoltaic cells connected in series

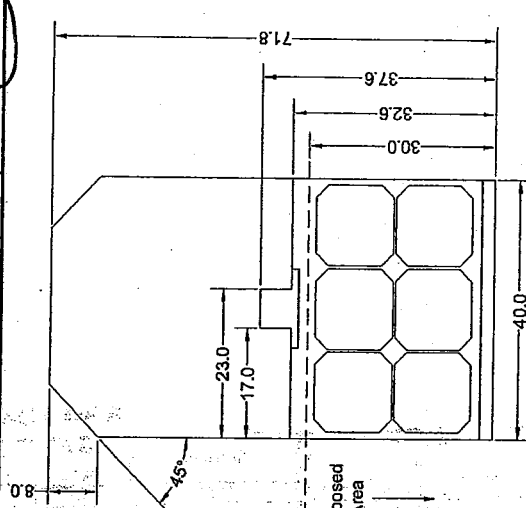
Model	Pmax Watts @ Max Power Point	Vmax Volts @ Max Power Point	Voc Open Circuit Voltage	Imax Amps @ Max Power Point	Isc Short Circuit Amps
Q Cell - 5" Poly	14.26	2.98	3.70	4.78	5.14

NOTE: Voltage, Current and Power Output Numbers are Estimated and Will Be Confirmed by a Qualified Testing Facility

American Units			Metric Units		
Exposed Area Per Sunslate	1.29 ft <sup>2</sup>		Exposed Area Per Sunslate	0.120m <sup>2</sup>	Module Area Performance
Used Area Per Sunslate	1.32 ft <sup>2</sup>		Used Area Per Sunslate	0.123m <sup>2</sup>	
Pounds Per Roofers Square (100 ft <sup>2</sup> )	750		Pounds Per Roofers Square (100 ft <sup>2</sup> )	36.6	
Slates per Roofers Square (100ft <sup>2</sup> )	75.75		Slates per m <sup>2</sup>	8.13	
Watts per Roofers Square (100ft <sup>2</sup> )	1080.1		Watts per m <sup>2</sup>	115.9	



Dimensions in Inches



Dimensions in Centimeters



# ATLANTIS ENERGY, INC.

9275 Beatty Drive  
Sacramento, Ca 95826  
PH: (916) 438-2930  
FX: (916) 438-2935

## Budgetary Estimate

Contact: Art Rivera  
(916) 869-6784

Manufacturer  
Contact Info

Dr. David Riley  
Architectural Engineering Department  
Pennsylvania State University  
104 Engineering Unit A  
University Park, PA 16802  
Solar Decathlon 07/Jyotsna Bhamidipati

F.O.B.  
TERMS  
DELIVERY  
Ref #

Poughkeepsie, NY
50%order/ship

We are pleased to quote you the following:

ITEM	QUANTITY	DESCRIPTION	UNIT PRICE	Extension
SP-A	89	Sharp A SUNSLATES/w cables & shields	\$101.00	\$ 8,989.00
	8	No-power half SUNSLATE, left+ type	\$35.00	\$ 280.00
	8	No-power half SUNSLATE, right+ type	\$35.00	\$ 280.00
	14	Eternit Slates (starter course)	7.00	\$ 98.00
	14	Twister cables, (row to row connector)	9.60	\$ 134.40
	2	Bridge cables	2.80	\$ 5.60
	2	50 Ft. Home Run field cables, (.80/ft.)	40.00	\$80.00
	30	Hooks	0.20	\$ 6.00
	1	Sunslates Tool	17.35	17.35
This quotation is for Sunslates siding materials only and does not include BOS, shipping or installation support.				
Total:				\$ 9,890.35

Atlantis Energy Systems Inc.  
5432 Bayside Road, Exmore, VA 23350  
Attn: Carolyn Courtney - (757) 442-3509

$$\frac{\$101}{\text{slate}} \times \frac{\text{slate}}{1.29 \text{ SF}} \times \frac{\text{SF}}{10.8 \text{ W}} = \$7.25/\text{W}$$

Cost Per W#  
for each cell

Authorization

Date



## Dual Sensor, 120VAC with Battery Backup Smoke Alarm

• PI2000 • Item Number 442006

### Dual Sensor

Contains both a photoelectric and ionization sensor, providing the best protection for your home.

### Hush® Feature

Temporarily silences nuisance alarms.

### Battery Backup

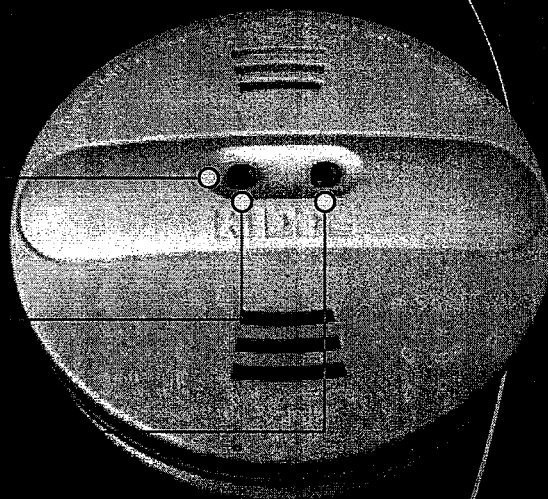
Provides protection even during a power outage.

### Red LED

Flashes every 30-40 seconds to indicate that the smoke alarm is operating properly.

### Test/Reset Button

Tests unit's electronic circuitry and horn.



## Description

The Kidde PI2000 is a 120VAC, wire-in smoke alarm with 9V battery backup. This smoke alarm combines both photoelectric and an ionization sensors in a single alarm, providing the best overall protection. This smoke alarm functions as a stand alone unit or in an interconnected system. The Kidde PI2000 features Hush®, allowing you to quickly silence nuisance alarms and also includes a tamper resist features that deters tampering and theft. The PI2000 includes a quick connect power harness that allows for quick and easy installation.

## Consumer Benefits

The Kidde PI2000, 120VAC, wire-in smoke alarm with 9V battery back up provides continuous protection against smoke and fire hazards, even during power outages. The combination of ionization and photoelectric sensors offer the best protection against both fast flaming and slow smoldering fires. The Kidde PI2000 interconnects with up to 24 Kidde devices including smoke alarms, CO alarms, heat detectors, strobe lights and relay modules on one wiring system. This unit also includes flashing LEDs to signal the alarm is functioning properly, a low battery warning and a loud 85dB alarm. The Kidde PI2000 is UL Listed and includes a 5-year limited warranty.

## Features and Benefits

- **Ionization Sensor** – Protects best against fast flaming fires.
- **Photoelectric Sensor** – Protects best against slow smoldering fires.
- **Interconnect** – Interconnects with up to 24 Kidde devices on one wiring network.
- **Battery Backup (9V battery included)** – Provides continuous protection even during power outages.
- **Tamper Resistant** – Deters from tampering or theft.
- **Hush® Feature** – Temporarily silences nuisance alarms.
- **Red LED** – Flashes every 30-40 seconds to indicate that the smoke alarm is operating properly.
- **Test/Reset Button** – Tests smoke alarm circuitry and horn.
- **Alarm Memory** – Indicates the originating alarm in an interconnected system.





**Dual Sensor, 120VAC with Battery Backup  
Smoke Alarm**Unit Number PI2000  
Item Number 442006**Architectural and Engineering  
Specifications**

The smoke alarm shall be Kidde Unit PI2000 or approved equal. It shall be powered by a 120VAC, 60Hz, 80mA source along with a 9V battery backup. The unit shall incorporate both an ionization smoke sensor and a photoelectric smoke sensor with a nominal alarm sensitivity of 1.99%/ft. The temperature operating range shall be between 40°F and 100°F (4°C and 38°C) and the humidity operating range shall be 5% - 95% relative humidity.

The smoke alarm can be installed on any standard single gang electrical box, up to a 4" octagon junction box. The electrical connection (to the alarm) shall be made with a plug-in connector. A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiation devices, of which 12 can be smoke alarms. With 18 initiation devices (smoke, heat, CO, etc.) interconnected, it is still possible to interconnect 6 strobe lights and or relay modules. The unit shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling.

The alarm shall include a test button that will electronically simulate the presence of smoke and cause the unit to go into alarm. This sequence tests the unit's electronics, battery and horn to ensure proper operation.

The unit shall include a piezoelectric horn that is rated at 85 decibels at 10 feet. In a smoke incident, the horn will sound in the repetitive manner – three (3) beeps, a pause, three (3) beeps, a pause.

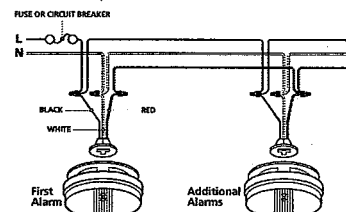
The unit shall include the Hush® feature that silences the unit. By pressing the Hush® button, it will desensitize the unit for approximately 7 minutes if a nuisance condition occurs. The alarm will chirp every 30-40 seconds during this time and will automatically reset after approximately 7 minutes and sound the alarm if particles of combustion are still present. The Hush® feature shall be overridden and the unit will alarm if the smoke is too dense.

The unit shall also include a low battery warning utilizing a brief alarm chirp every 30-40 seconds for a minimum of seven (7) days. The alarm will utilize a red LED that shall flash once every 30-40 seconds to indicate the alarm is receiving power.

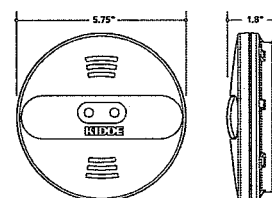
The unit shall at a minimum meet the requirements of UL2034, UL217, NFPA72, (chapter 11, 2002 edition) The State of California Fire Marshall, NFPA101 (One and two family dwellings) Federal Housing Authority (FHA), Housing and Urban Development (HUD). It shall also include a 5-year manufacturer's limited warranty.

**Installation of Smoke Alarm**

The smoke alarm should be installed to comply with all local codes having jurisdiction in your area, Article 760 of the National Electric Code, and NFPA 72. Make certain all alarms are wired to a single, continuous (non-switched) power line, which is not protected by a ground fault interrupter. A maximum of 1000 ft. of wire can be used in the interconnect system. Use standard UL listed household wire (18 gauge or larger as required by local codes).

**Technical Specifications**

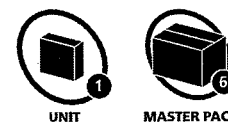
Unit Number:	PI2000
UPC Number:	0-25417-12000-4
Power Source:	120VAC with 9V battery backup
Sensor:	Dual Ionization and Photoelectric
Audio Alarm:	85dB at 10ft
Temperature Range:	40°F (4.4°C) to 100°F (37.8°C)
Humidity Range:	5%-95% relative humidity (RH)
Size:	5.75" in diameter x 1.8" depth
Weight:	1lb
Interconnects:	Up to 24 Kidde devices (of which 18 can be initiating)
LED:	Red, normal operation Green - AC power present
Warranty:	5 year limited

**Ordering Information**

UPC: 0-25417-12000-4

Part Number	I 2 of 5	Pack Quantity	Dimensions (w x d x h inches)	Weight	Case/Skid	Layers/Skid	Skid Weight
442006**	N/A	Individual	5.75 x 1.5 x 5.75	1lb	N/A	N/A	N/A
442006-006	200 25417 12000 8	Master Pack (6 units)	6 x 12.5 x 6	6.5lbs	105	5	682.5lbs

\*\*Not for sale by individual unit

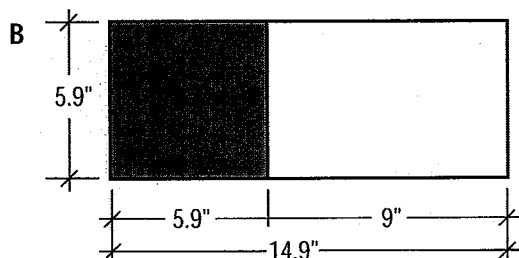
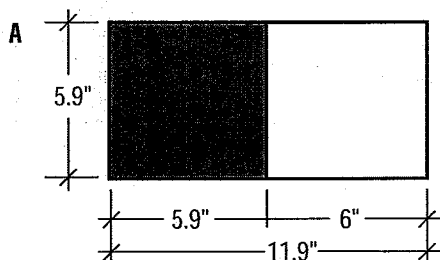
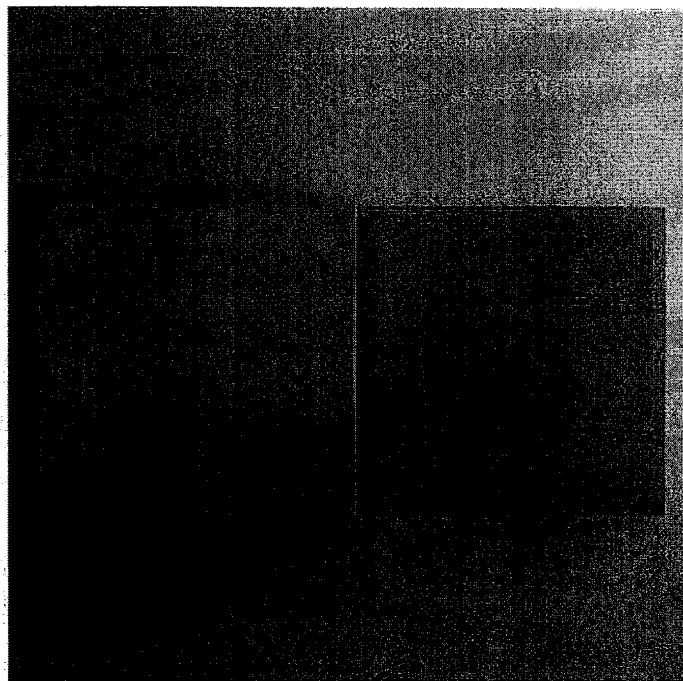
1394 South Third Street, Mebane NC 27302  
1-800-880-6788 • www.kiddeus.com**Distributed by:**

# LUMINAIRES + ACCESSORIES

TYPE	DESCRIPTION	MFR/CATALOG #	ALTERNATE	#	WATTS	TYPE	VOLTS	LOCATION	QTY	NOTES
L1	Color-changing 12" LED strip light; connected to standalone PV system.	Color Kinetics iColorCove QL #101-000051-00  PDM-201 #118-000062-00  Smart Jack 3 Adapter #104-000007-00			3 W	LED, RGB	24 VDC	Breezeway clerestories		1. To be installed with Duogard wall system. 2. Three 12" fixtures to be mounted per translucent glazing module. 3. North facing clerestories to have one fixture centered and mounted at top of module, remaining two fixtures to be mounted 6" from each side at bottom of module; all three fixtures to be centered and mounted on bottom of East/West facing modules.
L2R	LED spot light, Color: red	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W	LED, red	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L2G	LED spot light, Color: green	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W	LED, green	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L2B	LED spot light, Color: blue	Color Kinetics 116-000014-02 Base: 116-000005-00			8.4 W	LED, blue	24 VDC	Mechanical Room	1	1. Coordinate exact mounting location with other trades to avoid conflict. 2. To be aimed by lighting designers after fixtures are installed.
L3	12" warm-white L.E.D. strip light.	Lightwild LW-LIN-W-3K-12-LFR  Controller: LW-LIN-GCU-OUTD-40-ONOFF			3.5 W	LED, warm white	24 VDC	Site ramps		
L4	Submersible L.E.D.					LED, cool white	24 VDC	Site Rainwater garden basin		To be aimed on-site by lighting designer during installation.
L5	Cool-white L.E.D. small round recessed uplight.				1.5 W	LED	24 VDC	Site tree; kiosks		To be aimed on-site by lighting designer during installation.
L6	Exterior cool white LED strip light with 82" beam spread; 48" long.	Lightwild LW-LIN-W-3K-12-LFR			3.5 W	LED, cool white	24 VDC	Site green-screen		
P1	Surface-mounted 3" linear fluorescent uplight with 2-lamp electronic dimming ballast.	Ellipsoar F305-T239-S-00-T-000 Lutron 1% Hi-Lume FDB-T539-120-2		1	39 W	F39T5HO	120 VAC	Living Space/Bedroom fixed cabinets	4	1. Install a strip of GWB in front of the luminaire to block direct view of lamp. Paint to match the wall color. 2. Controlled by RadioRA.
P2	Low-voltage accent light surface mounted underneath cabinet with remote transformer.			1	20 W	MR11	12 VAC	Living Space fixed cabinets	3	1. Coordinate with architects for exact mounting locations. 2. 120VAC/12VAC transformer required. 3. To be aimed by lighting designers after installation as necessary.
P3	Low-voltage decorative pendant on cable system with remote transformer lamps included.	Alfa Lighting G68PK-Frosted-801-JC 35W G6.35-Cable System-Satin Nickel		1	35 W	T4 halogen bi-pin (included)	12 VAC	Dining Space Dining Table		Low voltage transformer required.
P4	LED desk lamp; manually switchable; connected to on/off photosensor to maintain a minimum 50 fc on workplane at all times.	FineLife			9 W	LED		Movable Wall desk		Test to determine best location for photosensor and lamp on desk.
P5	Low-voltage bedside reading light fixture.							Bedroom bedside		Low voltage transformer required.
P6	Surface mounted mirror with integral lighting; on-off pull chain included. Dimensions: 17.7" W x 31.5" H x 1.6" D	Lightology 0103ML-IMOLA-018F1-OOMI  Lutron Eco-10 Ballast FDB-T539-120-2	Lightology 0213ML-TWINSLM-0205L-OOMI (ballast and two (2) F24T5HO/830 lamps included)	2	14 W	F14T5, 3000K	120 VAC	Bathroom mirror		Center above sink so that top edge is in line with top edge of cabinet, or coordinate with architects for exact mounting location.
P7	12" linear fluorescent undercabinet fixture; integral electronic ballast; high-efficiency (HE) T5 lamp included.	SIMKAR	Junco Lighting JUF12-SL	1	8 W	T5 HE, 3000K (included)	120 VAC	Kitchen under cabinets		Connect to wallswitch to override individual fixture switches.
P8	Surface mounted compact fluorescent downlight.	LUCEPLAN METROPOLI D20/17P-PW + D20/17.2		1	9 W	CFQ9W/G23/830	120 VAC	Kitchen over sink		
P9	Recessed linear fluorescent T5HO downlight with integral electronic ballast; lamp included.		Focal Point FAVB-F14T5HO-1C-120-S-P-CP-WH-22	1	24 W	F24T5/830/HO/ALTO	120 VAC	Kitchen by skylight		1. Must be IC-rated.
P10	Surface mounted compact fluorescent downlight with integral magnetic ballast.	Bega 2839P SLV	Bega 2839P SLV	1	9 W	CFQ9W/G23/830	120 VAC	Mechanical Room		
P11	Decorative wall-mounted compact fluorescent fixture with photocell; rated for wet locations.	Insight Lighting	TCP Inc. 51013BPC	1	18 W	springlamp (NPF CFL, GX base)	120 VAC	Exterior East/West entrance doors		
P12	In-ground mounted asymmetric narrow beam L.E.D. strip with integral driver; UL listed for wet locations. Dimensions: 49.0" L x 2.56" W x 4.25" D	Designplan C2L-L-AF-4-SS-0-G-R-00 C2L-L-BF-4-SS-0-G-R-00			3 W	LED, 3150K/5500K	120 VAC	Exterior Deck at south-wall	8	1. Mount 3150K LEDs at glazing and 5500K LEDs at slates, at least 9" away from façade. 2. Fixtures at glazing to be switched separately from those at slates.

# plane

custom signage



## Application

This configuration of plane offers custom signage solutions for exterior and interior architectural applications. Numeric addresses and/or logos are easily created exploiting the finest details.

- plane mounts directly to a junction box for either ceiling or wall mount applications. UL Listed for wet / damp locations. Refer to page 14 for mounting details.

## Sign Graphic Requirements

To ensure the best possible reproduction, vector based files in the PC format are preferred. The following file types are acceptable: Adobe Illustrator (.pdf), Corel Draw (.cdr), encapsulated postscript (.eps). File resolution must be 300 dpi or greater.

All files (room numbers, text or logos) require a separate file which defines the location of the object within the acrylic sign template. For room numbers; each room number must be submitted as a separate file. Standard acrylic sign sizes are 6" x 6" and 6" x 9". Custom acrylic sign sizes are available upon request.

io lighting's creative department may assist in the graphic design and production for a fee over and above the production cost.

## Light Output

plane signage may be used for interior or exterior applications. Numerals and logos are very legible in both light and dark environments. Samples are available for mock-ups.

## Construction

Environmentally sealed enclosed and gasketed 5.9" sq. corrosion resistant zinc casting (stainless steel optional). Mounts directly to a UV stable optically clear, high strength polycarbonate housing. Acrylic sign is laser etched for custom sign configuration. LED luminaire module contained within the housing is replaceable. Customer to provide camera ready art. Contact your local io representative for signage order placement.

## Electrical

120V or 277V energy saving current limiting Class 2 power supply (driver) is located within a 1 1/2" or 2 1/8" deep, 4" octagonal junction box.

## Power Consumption

- standard: 2.2 w

## Finish

Zinc face plate may be polyester powder coated or plated. Plated finishes are for interior applications only. Face plate may also be specified in stainless steel.

## TYPE L2-1

Project Title MorningStar Home

Agent Contact \_\_\_\_\_

Art Work Supplied N/A

Format required: Adobe Illustrator 7.0 & Encapsulated Postscript (eps)

Specify Font Century Gothic

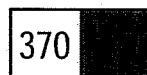
Description	Acrylic Face Size	Quantity
i.e. Logo (see attached artwork)	(A) or B	1
i.e. Addresses (see attached file)	A or (B)	30
Address Number: 15	A or B	1
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	
	A or B	

### Orientation Options

Right Horizontal



Left Horizontal



Bottom Vertical



Top Vertical



### Order Code

<u>0</u> io	<u>01</u> Plane	<u>512</u> Orientation Options	<u>999</u> Mounting	<u>8</u> Finish	<u>0</u> Voltage	<u>1</u> Application
		48 Right Horizontal Red	100 J-Box	Zinc Casting (Painted)	0 120v	0 Interior
		49 Right Horizontal Green	999 Custom	1 Black	1 277v	1 Exterior
		50 Right Horizontal Blue		2 Bronze	<i>Note: Dimming not available</i>	
		51 Right Horizontal Amber		3 Satin aluminum		
		52 Right Horizontal White		4 White		
		53 Left Horizontal Red		Zinc Casting (Plated)		
		54 Left Horizontal Green		<i>Interior Applications Only</i>		
		55 Left Horizontal Blue		5 Satin Nickel		
		56 Left Horizontal Amber		6 Chrome		
		57 Left Horizontal White		7 Satin brass		
		58 Bottom Vertical Red		Stainless Steel		
		59 Bottom Vertical Green		8 Brushed		
		60 Bottom Vertical Blue		Custom Color		
		61 Bottom Vertical Amber		9 Custom		
		62 Bottom Vertical White				
		63 Top Vertical Red				
		64 Top Vertical Green				
		65 Top Vertical Blue				
		66 Top Vertical Amber				
		67 Top Vertical White				
		95 Custom				

### Project Information *To be completed by Agent*

Agent Name \_\_\_\_\_

Project Name \_\_\_\_\_





## COLORBURST 6



The ColorBurst® 6 fixture is a Chromacore®-powered product designed to meet the needs of lighting professionals, providing them with a small, sleek solution for spotlighting and wall-washing with rich, saturated colors and color-changing effects.

Projecting a soft-edge beam of light, ColorBurst 6 is a sealed product designed for both indoor and outdoor installations. The fixture is fully enclosed in a stylish and rugged die-cast aluminum housing and meets or exceeds specifications for use in wet locations. Enclosed wiring gives ColorBurst 6 a neat appearance and optimum positioning. The housing is equipped with a three-screw accessory ring to affix spread lenses, louvers, and other attachments and is available in either a black or white finish to match its environment and prevent oxidation. ColorBurst 6 has three 18AWG wire leads and attaches to a standard junction box or an optional mounting base, which has a 60-foot (18.3 m) three-conductor cable. The 350° locking base swivel, with 350° locking fixture rotation, offers a versatile range of light positioning.

ColorBurst 6 can be controlled by a Color Kinetics® controller or a third-party controller. Each fixture comes pre-addressed to light number one. With a Color Kinetics controller, simple effects, such as fixed color and color wash, require no additional addressing. Other effects across multiple lights, including Chasing Rainbow or Color Sweep, require further addressing using one of the following Color Kinetics addressing tools: Serialized Addressing Software (SAS) or Zapi. For protection from extreme temperatures, ColorBurst 6 has been designed with a temperature monitoring feature. If operating temperatures rise to an unsafe level, a compensation circuit is triggered and ColorBurst 6 operation is interrupted causing the light to turn dull red. After 30 minutes the light will auto-cycle and return to full intensity.

### COLORBURST 6 SPECIFICATIONS

<b>COLOR RANGE</b>	16.7 million (24 bit) additive RGB colors; continuously variable intensity output range
<b>SOURCE</b>	High intensity power light emitting diodes (LEDs)
<b>BEAM ANGLE</b>	12° clear lens, 22° ground lens
<b>HOUSING</b>	Die cast aluminum in black or white
<b>LISTINGS</b>	UL/cUL Listed
<b>COMMUNICATION SPECIFICATIONS</b>	
<b>DATA INTERFACE</b>	Color Kinetics full interface system
<b>CONTROL</b>	Color Kinetics data line of controllers or DMX512 (RS485) compatible when using Color Kinetics power/data supply

### ELECTRICAL SPECIFICATIONS

<b>POWER REQUIREMENT</b>	24VDC
<b>POWER CONSUMPTION</b>	25W Max. at full intensity (full RGB)
<b>POWER SUPPLY</b>	PDS-150e (ITEM# 109-000008-01) - Maximum of 6 fixtures/supply PDS-60 24V (ITEM# 109-000017-00/03) - Maximum of 2 fixtures/supply

### ENVIRONMENTAL SPECIFICATIONS

<b>TEMPERATURE RANGE</b>	-40°F to 122°F (-40°C to 50°C) operating temperature -4°F to 122°F (-20°C to 50°C) starting temperature
--------------------------	--

<b>PROTECTION RATING</b>	IP66
--------------------------	------

### LED SOURCE LIFE

In traditional lamp sources, lifetime is defined as the point at which 50% of the lamps fail. This is also termed Mean Time Between Failure (MTBF). LEDs are semiconductor devices and have a much longer MTBF than conventional sources. However, MTBF is not the only consideration in determining useful life. Color Kinetics uses the concept of useful light output for rating source lifetimes. Like traditional sources, LED output degrades over time (lumen depreciation) and this is the metric for SSL lifetime.

LED lumen depreciation is affected by numerous environmental conditions such as ambient temperature, humidity and ventilation. Lumen depreciation is also affected by means of control, thermal management, current levels, and a host of other electrical design considerations. Color Kinetics systems are expertly engineered to optimize LED life when used under normal operating conditions. Lumen depreciation information is based on LED manufacturers' source life data as well as other third party testing. Low temperatures and controlled effects have a beneficial effect on lumen depreciation. Overall system lifetime could vary substantially based on usage and the environment in which the system is installed.

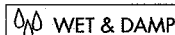
Temperature and effects will affect lifetime. Color Kinetics rates product lifetime using lumen depreciation to 50% of original light output. When the fixture is running at room temperature using a color wash effect, the lifetime is in the range of 80,000-100,000 hours. This is based on LED manufacturers' test data. High output is defined as any LED device that is 1/2 watt or above. For more detailed information on source life, please see [www.colorkinetics.com/lifetime](http://www.colorkinetics.com/lifetime).

### OPTIBIN®

There are inherent variations in the fabrication processes of all semiconductor materials. For LEDs, this variance results in differences in the color and intensity of light output as well as electrical characteristics. Due to these differences, LED manufacturers sort production into "bins," but insuring the availability of a single bin is very difficult. To minimize this issue and achieve optimal color consistency in its products, Color Kinetics has developed and uses a proprietary technology called Optibin. Optibin is an advanced production binning optimization process that minimizes the effects of LED variance for the best possible output uniformity in the final product. Color Kinetics Optibin technology gives you the most consistent control of color and intensity from product to product.

CHROMACORE®  
BY COLOR KINETICS

OPTIBIN®  
BY COLOR KINETICS



ColorBurst 6 ITEM# 116-000014-00 (White, Frosted)  
116-000014-01 (Black, Frosted)  
116-000014-02 (White, Clear)  
116-000014-03 (Black, Clear)  
ColorBurst Base ITEM# 116-000005-00 (White)  
116-000005-01 (Black)

This product is protected by one or more of the following U.S. Patents and their foreign counterparts: 6,016,038, 6,150,774, 6,292,901, 6,340,868, 6,777,891, 6,788,011, 6,806,659, 6,969,954, and 6,975,079. Other patents pending.

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All other brand or product names are trademarks or registered trademarks of their respective owners.

BRO100 Rev 08

Specifications subject to change without notice. Refer to [www.colorkinetics.com](http://www.colorkinetics.com) for the most recent version.

## COLORBURST 6 - CLEAR LENS

### PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

#### SOURCE SPECIFICATIONS

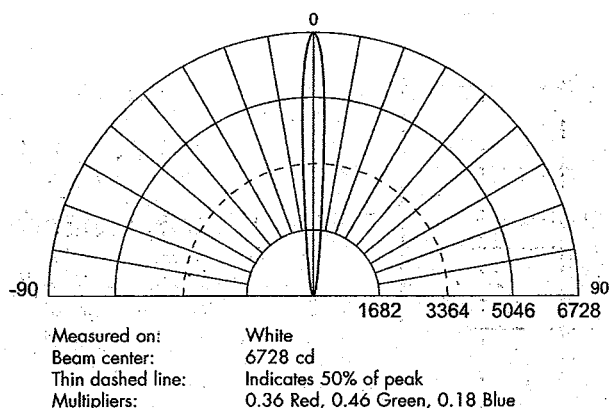
Optics: Clear tempered glass  
 Source: 18 LEDs (6 Red, 6 Green, 6 Blue)  
 Beam Angle: 12°  
 Distribution: Symmetric direct illumination  
 CCT: Adjustable 1,000K-10,000K  
 CRI: Not measureable (CIE 13.3-1995)

#### ILLUMINANCE DISTRIBUTION

1.2 12.9	4.0 43.1	6.6 71.0	4.7 50.6	1.9 20.5	1.0 10.8	6.0'/2.0m
1.6 17.2	14.4 155.0	28.5 306.8	19.1 205.6	4.6 49.5	1.2 12.9	5.0'/1.5m
1.6 17.2	15.0 161.5	39.2 421.9	39.0 419.8	14.7 158.2	1.5 16.1	4.0'/1.2m
1.0 10.8	4.9 52.7	20.1 216.4	29.5 317.5	14.6 157.2	1.4 15.1	3.0'/1.0m
0.4 4.3	1.4 15.1	4.7 50.6	6.9 74.3	4.0 43.1	0.8 8.6	2.0'/0.6m
0.3 3.2	0.4 4.3	0.8 8.6	1.2 12.9	0.8 8.6	0.4 4.3	1.0'/0.3m
3.0'/1.0m	0'/0m	0'/0m	0'/0m	3.0'/1.0m	3.0'/1.0m	

Units: Footcandles (top)/Lux (bottom)  
 10.8 lux = 1 fc  
 Measured on: All, reflectance model 80/50/20%  
 Distance from surface: Bottom center of grid, 3' (1.0 m) from surface, light at a 45° angle off horizontal

#### CANDLE POWER DISTRIBUTION



#### ILLUMINANCE

COLOR	3' 1m	6' 2m	9' 3m	15' 5m
WHITE	750.0 8073.0	187.0 2012.9	83.2 895.6	29.9 321.8
RED	269.3 2899.0	67.2 722.8	29.9 321.6	10.7 115.6
GREEN	345.0 3713.6	86.0 925.9	38.3 412.0	13.8 148.0
BLUE	134.3 1445.1	33.5 360.3	14.9 160.3	5.4 57.6

Measured in Footcandles (top)/Lux (bottom) on axis.  
 Measured on: All, reflectance 0.

#### LIGHT OUTPUT

COLOR	TOTAL OUTPUT (lumens)	POWER (Watts)	EFFICACY (lm/w)
WHITE	295	24.7	11.9
RED	105.9	8.4	12.6
GREEN	135.7	8.4	16.2
BLUE	52.8	8.4	6.3

## COLORBURST 6 - GROUND LENS

### PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

#### SOURCE SPECIFICATIONS

Optics:	Tempered soft focus glass diffuser
Source:	18 LEDs (6 Red, 6 Green, 6 Blue)
Beam Angle:	22°
Distribution:	Symmetric direct illumination
CCT:	Adjustable 1,000K-10,000K
CRI:	Not measureable (CIE 13.3-1995)

#### ILLUMINANCE DISTRIBUTION

2.2 23.7	4.8 51.7	7.0 75.3	5.9 63.5	3.4 36.6	1.8 19.4	6.0'/2.0m
2.9 31.2	9.0 96.9	15.1 162.5	12.6 135.6	6.0 64.6	2.4 25.8	5.0'/1.5m
3.1 33.4	10.9 117.3	21.1 227.1	20.0 215.3	9.7 104.4	3.0 32.3	4.0'/1.2m
2.4 25.8	7.7 82.9	16.9 181.9	19.1 205.6	10.4 111.9	3.0 32.3	3.0'/1.0m
1.5 16.1	3.7 39.8	8.1 87.2	10.2 109.8	6.3 67.8	2.1 22.6	2.0'/0.6m
1.0 10.8	1.9 20.5	3.2 34.4	3.7 39.8	2.6 28.0	1.2 12.9	1.0'/0.3m
3.0'/1.0m	0'/0m	3.0'/1.0m				

Units:

Footcandles (top)/Lux (bottom)  
10.8 lux = 1 fc

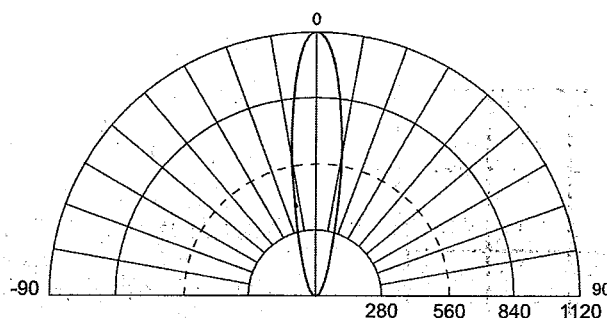
Measured on:

All, reflectance model 80/50/20%

Distance from surface:

Bottom center of grid, 3' (1.0 m) from surface, light at a 45° angle off horizontal

#### CANDLE POWER DISTRIBUTION



Measured on:  
Beam center:  
Thin dashed line:  
Multipliers:

White  
1120 cd  
Indicates 50% of peak  
0.35 Red, 0.46 Green, 0.18 Blue

#### ILLUMINANCE

COLOR	3' 1m	6' 2m	9' 3m	15' 5m
WHITE	124.0 1334.7	31.2 335.8	13.8 148.5	5.0 53.8
RED	43.9 472.5	11.0 118.9	4.9 52.6	1.8 19.1
GREEN	57.2 615.3	14.4 154.8	6.4 68.5	2.3 24.8
BLUE	21.9 236.2	5.5 59.4	2.4 26.3	0.9 9.5

Measured in Footcandles (top)/Lux (bottom) on axis.

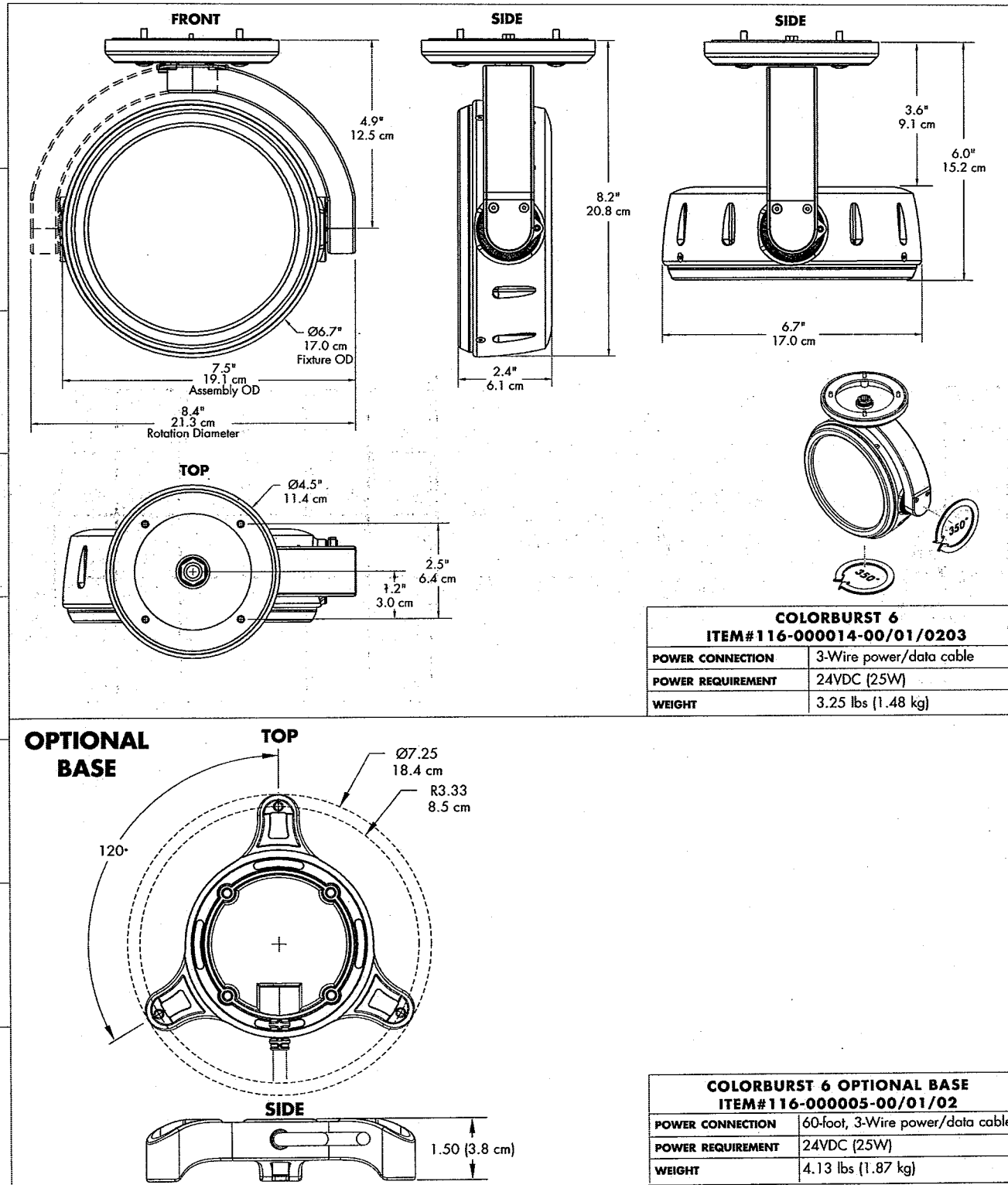
Measured on: All, reflectance 0.

#### LIGHT OUTPUT

COLOR	TOTAL OUTPUT (lumens)	POWER (Watts)	EFFICACY (lm/w)
WHITE	291	24.7	11.8
RED	103.0	8.4	12.3
GREEN	134.2	8.4	16.0
BLUE	51.5	8.4	6.1

## COLORBURST 6

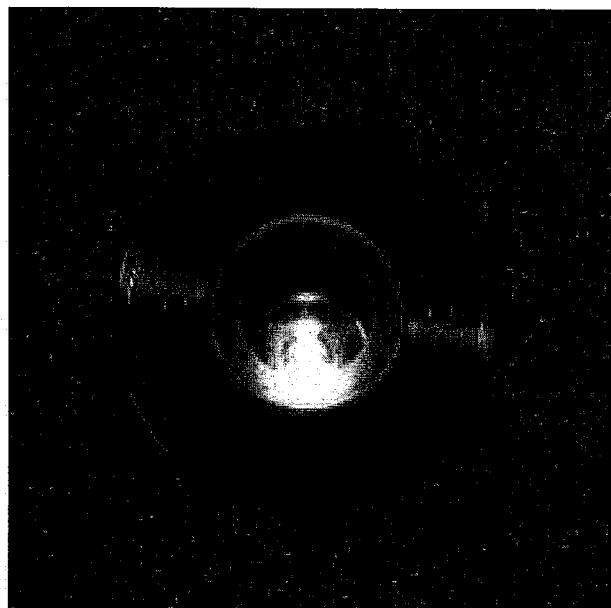
### PHYSICAL DIMENSIONS



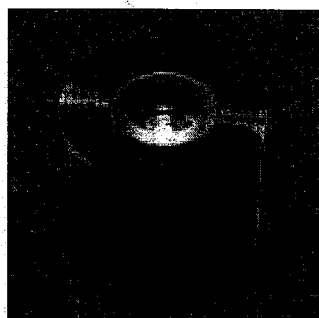


L↑\_south/north/upright

## TYPE L4



CE2 FULLY  
RECESSED



CE2 SEMI  
RECESSED

# ce2 centaur

**submersible, concrete pour, vandal resistant**

- Stainless steel body, suitable for surface mounting, semi recessed or fully recessed mounting. **Suitable for concrete pour**
- UL, cUL listed submersible label IP68 and combustible surfaces
- .400" thick tempered glass lens
- Stainless steel trim ring
- LED uses remote driver
- Supplied with 2 conduit entries
- Suitable for walkover or driveover for 11,000 pounds at 30 mph

### Note:

**Body style 1** with SJOW cord is suitable for use in fountains.

**Body style 4** with "UF" cable is suitable for recessing in sand, gravel or dirt.

**Body style V** is supplied with one 1/2" conduit entry and is suitable for concrete pour or for indoor in floor applications.

# designplan

79 Trenton Avenue  
Frenchtown, NJ 08825

Tel: (908) 996-7710  
Fax: (908) 996-7042

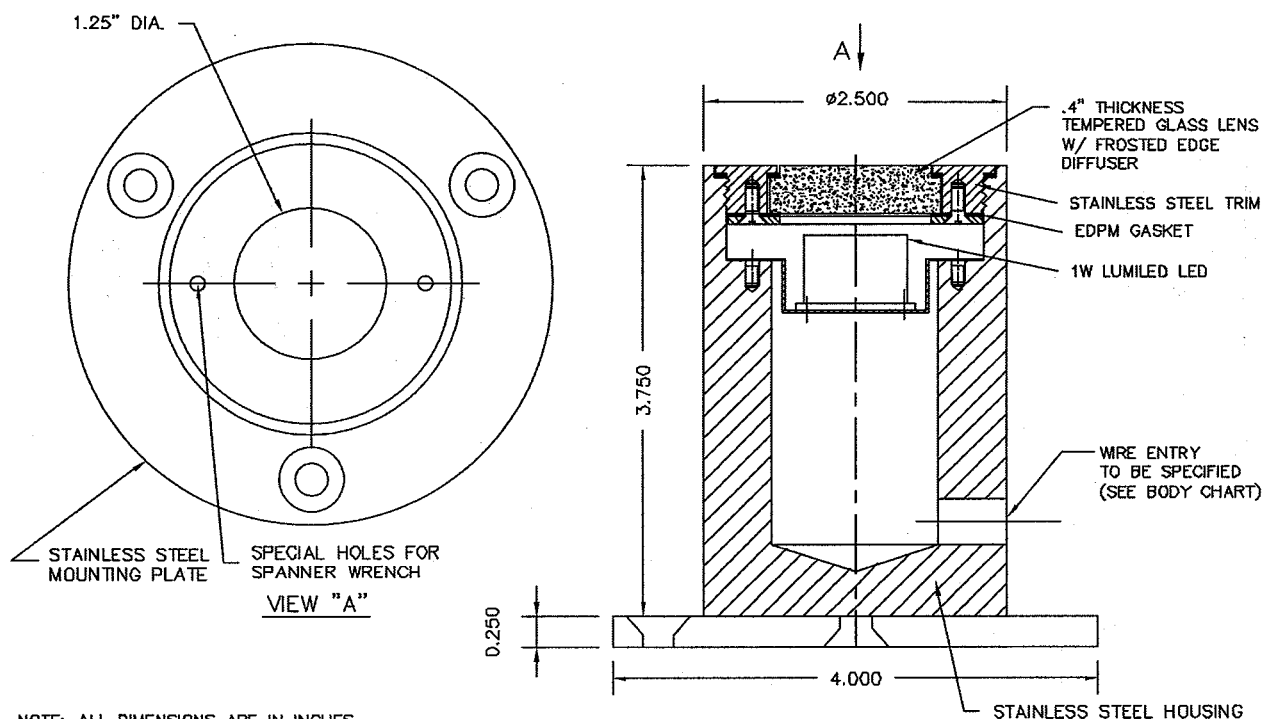
  
CE2 or 298 or 355

**centaur**

## ORDERING CHART

## CE2 REMOTE DRIVER

SERIES	PROD. ID	LAMP TYPE	WATTAGE	BODY	FINISH	GRILL	BALLAST	LENS	OPTIONS
	XXX	X	XX	X	XX	X	X	X	XX
CENTAUR	CE2	L-LED	1P-1X1W- WHITE LED 10 DEGREE SPOT 2P-1X1W- GREEN LED 10 DEGREE SPOT 4P-1X1W- BLUE LED 10 DEGREE SPOT 6P-1X1W- RED LED 10 DEGREE SPOT	1- SURFACE MOUNT WITH 25' OF SJOW CORD 4- RECESSED MOUNT WITH 25' OF UF CABLE V- RECESSED MOUNT WITH (1) 1/2" CONDUIT ENTRY	SS-STAINLESS STEEL	1- STD	X-120V REMOTE DRIVER	T- CLEAR TOUGHENED GLASS	0- NONE



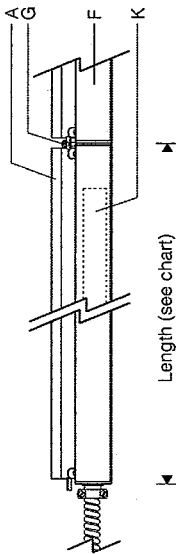
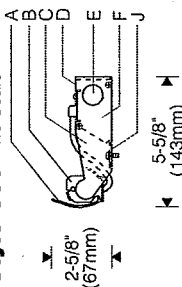
designplan 

79 Trenton Avenue  
Frenchtown, NJ 08825

Tel: (908) 996-7710  
Fax: (908) 996-7042

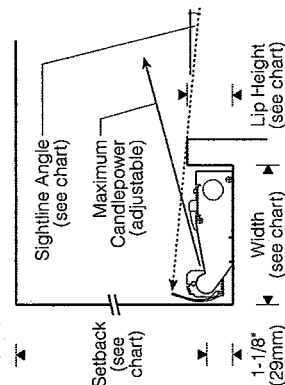
 MORNINGSTAR

Style 305 1:8 Scale



Lamp Length	Luminaire Length
1 x 2'	23-1/16" (586mm)
1 x 3'	34-7/8" (886mm)
1 x 4'	46-11/16" (1186mm)
1 x 5'	58-1/2" (1486mm)
2 x 3'	69-1/2" (1765mm)
2 x 4'	93-1/8" (2365mm)
2 x 5'	116-5/8" (2963mm)

Cove



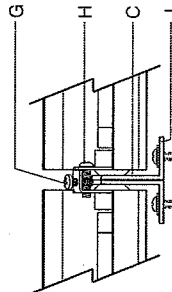
Cove Dimensions

Sightline	0° (horiz. cutoff)	5°	10°
Width (inside)	6-1/2" (165mm)	5-7/8" (150mm)	5-7/8" (150mm)
Lip (inside)	2-5/8" (67mm)	2-1/8" (54mm)	1-5/8" (41mm)
Setback (varies)	Recommended minimum: 12" T5, 18" T5HO		

Note: Finish interior of cove matte white for best results.

Joint

1:4 Scale  
(Ballast compartment not shown for clarity.)



Specifications

- A** Specular extruded aluminum reflector
- B** Stainless steel lamp holder/support brackets
- C** Aluminum sidearm with mounting tab
- D** Extruded aluminum ballast/wireway channel cover
- E** Conduit entry (one each end, conduit and connector by others)
- F** Extruded aluminum ballast/wireway compartment
- G** Rotation locking screw
- H** Joiner/alignment screw
- I** Mounting tab (fastener by others)
- J** Integral electronic ballast

Finish:

Reflector - extruded high purity aluminum with clear anodized specular finish. Sidearms and ballast/wireway compartment - mill finish aluminum. All luminaire hardware - stainless steel.

Mounting:

Lay-in installation requires only one fastener per joint (by others). Sidearms with mounting tabs can be base or wall mounted. Luminaires can be mounted individually or joined together to form a continuous row.

Reflector aiming is adjustable and is fixed in position by rotation locking screws at each sidearm. When mounted in a continuous row, joiner screws lock reflectors together allowing all in the row to be aimed together.

Standard:

UL listed or CSA certified for damp locations.  
(Style 164 painted model with gasketed lens recommended for damp location use, see Outdoor Section.)

Electrical:

Use 90°C wire for supply connections.

Integral electronic HPF thermally protected class P ballast with end-of-life protection. Ballast/wireway compartment includes one conduit entry at each end. Channel cover removes for access to ballast and wiring. Luminaires may be butted end-to-end (connectors by others) for through wiring.

Master/satellite combination is available (Configuration 3, see ordering information). Master supplied with 2-lamp ballast. (Wiring, conduit and connectors between master and satellite units by others.)

Optional electronic dimming ballast dims to 1% of full light output. Compatible dimming control is required (by others). Consult sales representative for specifications.

Optional integral emergency battery operates one lamp. Separate unswitched supply is required.

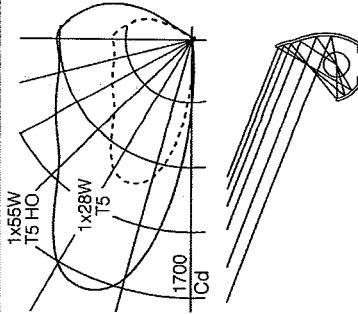
For complete ballast specifications, see Accessories Section.

Features

- T5 fluorescent - precise optical control for unequaled projection of light from perimeter covers
- Adjustable - all reflectors in a row join and aim together; rotation locking screws secure joint position\*
- Only 2-5/8" high - fits in low profile covers
- Integral electronic ballast, thru wiring for easy installation

Performance

Two parabolic reflector sections drive light across the ceiling from one edge. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



For complete photometrics, visit [www.elliptipar.com](http://www.elliptipar.com)

elliptipar

To Order

To form a Catalog Number

F 3 0 5 - T 239 - S - 0 0 - T 00 0  
1 2 3 4 5 6 7 8

1 Source

F = Linear fluorescent

2 Style

305 = Xtra small concealed, integral ballast

3 Lamp

Note: To order by overall row length, enter ROW CODE in place of Lamp Code below (see Row Charts on page C-12.6). Row Code specifies a row complete with all necessary reflectors and ballasts.

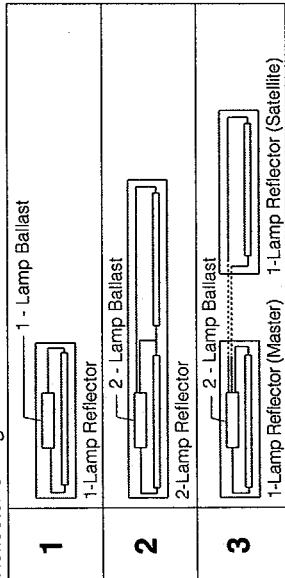
T   = Lamp Code (to specify individual units)

Lamp Wattage (see chart below)

Reflector Configuration, specify 1, 2 or 3 (see chart below)

Example: T228 = two 28W T5 lamps in nominal 8' reflector; one 2-lamp ballast

Reflector Configuration



Lamp Wattage	Lamp Length	Lamp Number
T5 Fluorescent		
14	2'	F14T5
21	3'	F21T5
28	4'	F28T5
35	5'	F35T5

T5 HO Fluorescent *		
24	2'	F24T5/HO
39	3'	F39T5/HO
55	4'	F55T5/HO
80	5'	F80T5/HO

For complete lamp and ballast information, see Accessories Section. Standard T5 and T5HO lamp color is 3000K / 80+ CRI.

Project: PSU Solar Decathlon

Type: P1

4 Mounting

S = Sidearms with mounting tabs

5 Finish

00 = Bright anodized reflector with mill finish ballast compartment

6 Voltage/Ballast

Electronic Dimming\*  
1 = 120V T = 120V  
2 = 277V V = 277V  
3 = 347V (Canada)

\* Dimming available for 4' F55T5HO (lamp codes T155 and T255). For other T5HO lamp lengths or for T5 standard lamps, consult sales representative. Dimming not available for Reflector Configuration 3.

7 Option (See Accessories Section for specifications)

00 = No options  
0E = Integral emergency battery pack with indicator lamp and test button. Operates one lamp. Available in nominal 4', 6' and 8' units only (lamp codes T128, T221, T228, T328, T155, T239, T255 and T355).  
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories  
J = CSA, Canadian Standards Association

Example

F305 - T221 - S - 00 - 1 - 000

Xtra small concealed fluorescent unit consisting of one nominal 6' reflector with two 21W T5 lamps. Integral 120V electronic 2-lamp ballast. Sidearms with mounting tabs. UL.

elliptipar

114 Boston Post Road, West Haven, Connecticut 06516, USA  
Voice 203.931.4455 • Fax 203.931.4464 • www.elliptipar.com

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## To order by Row Code - T5 lamps

When the Style 305 extra small concealed T5 fluorescent is run continuously in **straight** coves, **elliptipar** offers the option of specifying and ordering the entire row as one catalog number. Ordering by row eliminates the need to calculate length, type and quantity of reflectors.

Steps to specify Row Code:

1. Determine clear inside length of cove.
2. Round up to nearest foot and find the nominal row length in chart.
3. Determine what lengths/wattages of lamps will be used and select the corresponding lamp combination codes.  
**Example:** if only 3' and 4' lamps are to be used on the project, specify row codes ending with **A**, **B** and/or **D** only.
4. If for a given nominal row length a preferred lamp combination is not listed, select the next shorter row that is available in the desired lamp combination.
5. Once the nominal row length and lamp combination has been found in the chart, note the actual overall row length (last column).
6. Consider the unlighted length at each end of the row. (Subtract the overall row length from the clear inside length, and divide the remainder by two.) It is generally recommended that the unlighted length at each end be between 6" and 12".
7. Enter the four character Row Code in place of the Lamp Code described on page C-12.5. The remainder of the catalog number is formed as shown on page C-12.5.

## Features

- Time saving - simplifies specification and ordering
- One catalog number - includes all necessary reflectors to install row
- Assured fit - all you need is the clear inside length of the cove

## 3 Row Code

**Note:** Enter row code in place of Lamp Code described on page C-12.5.

= Row Code

## Lamp Combination\*

- A** = All nominal 3' lamps
- B** = All nominal 4' lamps
- C** = All nominal 5' lamps
- D** = Nominal 3' and 4' lamps
- F** = Nominal 3' and 5' lamps
- G** = Nominal 4' and 5' lamps

**Nominal Row Length** in feet, between 3' and 50' \*\*

**S** = T5 fluorescent

**V** = T5/HO fluorescent

\* Not all lamp combinations are available for each nominal row length (see chart)

\*\* Nominal row lengths over 50' can be formed by combining shorter row lengths. (Example: a nominal 60' row can be ordered as two nominal 30' rows.)

## Example

**F305 - S15A - S - 00 - 2 - 000**

Nominal 15' long row of Style 305 extra small concealed T5 fluorescent using only nominal 3' (21W) lamps. Row includes two nominal 6' luminaires for use with two 3' lamps each, one nominal 3' luminaire for use with one 3' lamp and integral 277V electronic ballasts. Overall row length is 14' 5-7/8".

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
3	A	1						2' 10-7/8"
4	B							3' 10-1/16"
5	C			1				4' 10-1/2"
6	A				1			5' 9-1/2"
7	D	1	1					6' 9-9/16"
8	B					1		7' 9-1/8"
9	F	1	1					7' 9-3/8"
9	A	1			1			8' 8-3/8"
9	G		1	1				8' 9-3/16"
10	C							9' 8-5/8"
10	D					1		9' 8-3/16"
11	D	1					1	10' 8"
11	F			1	1			10' 8"
12	A				2			11' 7"
12	B					1		11' 7-13/16"
13	D	1	1					12' 7-1/16"
13	F	1					1	12' 7-1/2"
13	G			1	1			12' 7-5/8"
14	D							13' 6-5/8"
14	F	1						13' 6-7/8"
14	G			1			1	13' 7-5/16"
15	A	1			2			14' 5-7/8"
15	C			1				14' 7-1/8"
15	D	1	1			1		14' 6-11/16"
16	B					2		15' 6-1/4"
16	F						1	15' 6-1/8"
17	D	1			1	1		16' 5-1/2"
17	F			1	2			16' 5-1/2"
17	G		1	1		1		16' 6-5/16"
18	A				3			17' 4-1/2"
18	D					1		17' 5-9/16"
18	F	1					1	17' 6"
18	G						1	17' 5-3/4"
19	D	1				2		18' 5-1/8"
19	F	1			1		1	18' 5"
19	G		1	1			1	18' 5-13/16"

elliptipar



Project:

Type:

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
20	B	1	1			2		19' 4-1/16"
20	C						2	19' 5-1/4"
21	A	1			3			20' 3-3/8"
21	D	1	1		1	1		20' 4-3/16"
21	F			1	1		1	20' 4-5/8"
21	G					2		20' 4-3/4"
22	D				3			21' 3-3/16"
22	F				2		1	21' 3-5/8"
22	G					1	1	21' 4-1/16"
23	D	1	1			2		22' 3-13/16"
23	F	1					2	22' 4-1/8"
23	G		1		1	1	1	22' 4-1/4"
24	A				4			23' 2"
24	B					3		23' 3-3/8"
24	F	1	1		1		1	23' 3-1/2"
24	G						2	23' 3-15/16"
25	C		1				2	24' 3-3/4"
25	D	1			1	2		24' 2-5/8"
26	D				1	2		25' 2-7/16"
26	F						2	25' 2-3/4"
26	G					2	1	25' 2-5/8"
27	A	1			4			26' 0-7/8"
27	D	1				3		26' 2-1/4"
27	F		1	2			1	26' 2-1/8"
27	G	1	1			1	1	26' 2-15/16"
28	B					3		27' 2-1/16"
28	F	1	1				2	27' 2-5/8"
28	G					1	2	27' 2-3/8"
29	D	1	1		1	2		28' 1-5/16"
29	F	1			1		2	28' 1-5/8"
29	G	1	1				2	28' 2-7/16"
30	A				5			28' 1-1/2"
30	C						3	29' 1-7/8"
30	D					3		29' 0-7/8"

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
31	D	1				3		30' 0-13/16"
31	F						2	30' 1-1/4"
31	G					2	1	30' 1-3/8"
32	A	1			5			31' 10-3/8"
32	B					4		31' 0-1/2"
32	D	1			1	3		31' 11-3/4"
32	F				2		2	31' 0-1/4"
32	G		1			1	2	31' 1-1/16"
33	D					3		32' 1-9/16"
33	F						3	32' 0-3/4"
33	G					1	2	32' 0-7/8"
34	D	1				4		33' 11-3/8"
34	F	1			1		2	33' 0-1/8"
34	G					3	1	33' 0"
35	A				6			34' 9"
35	B					4		34' 11-3/16"
35	C						3	34' 0-3/8"
36	D	1	1		1	3		35' 10-7/16"
36	G			1		4		35' 11"
37	D					4		36' 10"
37	F						2	36' 9-3/4"
37	G					1	3	36' 11"
38	A	1			6			37' 7-7/8"
38	D	1	1			4		37' 10-1/16"
38	G		1	1			3	37' 11-1/16"
39	B					5		38' 9-5/8"
39	C						4	38' 10-1/2"
40	D	1			1	4		39' 8-7/8"
40	F			1	1		3	39' 9-7/8"
40	G			1		2	2	39' 10"
41	A				7			40' 6-1/2"
41	D		1			4		40' 8-1/4"
41	F				2		3	40' 8-7/8"
41	G		1			1	3	40' 9-1/16"

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
42	D	1				5		41' 8-1/2"
42	F						4	41' 9-3/8"
42	G					3	1	41' 9-3/16"
43	B		1			5		42' 8-5/16"
43	F				4		2	42' 7-1/4"
43	G		1				4	42' 9-3/16"
44	A	1			7			43' 5-3/8"
44	C						4	43' 9"
44	D					1	4	43' 7-9/16"
45	D				1	5		44' 7-1/8"
45	F				1		4	44' 8"
45	G					2	3	44' 8-1/8"
46	D					5		45' 7-3/16"
46	F				2		3	45' 7-3/8"
46	G					1	3	45' 8-3/16"
47	A				8			46' 4"
47	B					6		46' 6-3/4"
47	F	1		1			4	46' 7-7/8"
47	G					1	4	46' 7-5/8"
48	D				1	5		47' 6"
48	F				1		4	47' 6-7/8"
48	G						4	47' 7-1/16"
49	C						5	48' 7-1/8"
49	D				3	4		48' 5"
50	A	1			8			49' 2-7/8"
50	D					6		49' 5-5/8"
50	F				1		4	49' 6-1/2"
50	G					2	3	49' 6-5/8"

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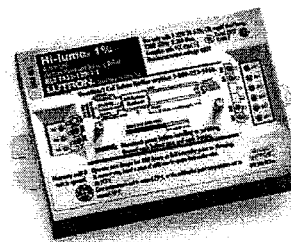
REV. 6/04

## Hi-lume Overview

Hi-lume architectural electronic dimming ballasts are designed to meet the most demanding lighting requirements. By providing industry-leading performance with true full-range 100% to 1% fluorescent dimming, Hi-lume ballasts enable you to provide the ideal visual environment for any application.

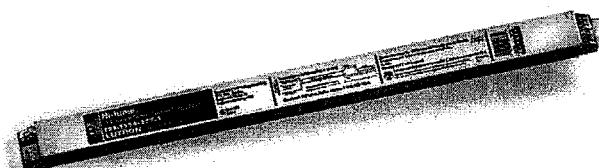
### Features

- Continuous, flicker-free dimming from 100% to 1%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T4 triple-tube compact, T5-HO linear, and T8 lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T4 and T5-HO models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring fixture uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead, or from lamp leads to each other and/or ground
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase



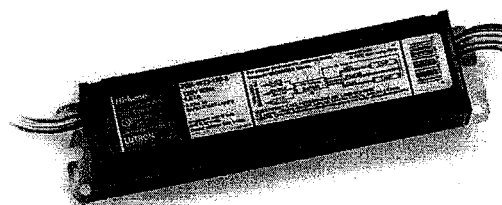
### Hi-lume, case type A

3.00 in. w (76 mm) x 1.00 in. h (25 mm) x 4.90 in. l (124 mm)



### Hi-lume, case type C

1.18 in. w (30 mm) x 1.00 in. h (25 mm) x 18.00 in. l (457 mm)



### Hi-lume, case type F

2.38 in. w (60 mm) x 1.50 in. h (38 mm) x 9.50 in. l (241 mm)

Job Name:  
PSU Solar Decathlon

Job Number:

Model Numbers:  
FDB-T539-120-2



## Specifications

### Performance

- Dimming Range: Hi-lume 100% to 1% measured relative light output (RLO).
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10 °C (50 °F)
- Ambient Temperature Operating Range: 10 °C (50 °F) to 60 °C (140 °F)
- Relative Humidity: maximum 90% noncondensing
- Operating Voltage: 120 V or 277 V at 60 Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant  $\pm 2\%$  light output for line voltage variations of  $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor - Hi-lume: greater than .85 for T8 lamps, greater than .95 for T4 lamps, equal to 1.0 for T5-HO lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 10%
- Maximum Inrush Current: 7 amps per ballast at 120 V, 3 amps per ballast at 277 V
- Sound Rating: Inaudible in a 27 dBA ambient
- Maximum Ballast Case Temperature: 75 °C (167 °F)

### Hi-lume 3D:

-Operating Voltage: Universal input 120 V / 277 V

-Ballast Factor - 1.0/1.17 for T8 lamps

Dimming Range:

BF	Dimming Range (Max/Min (BF))	Dimming Ratio
1.17	1.17 / 0.0085	138:1
1.0	1.00 / 0.0085	118:1

### Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Temperature operating range: 50-140 °F (10-60 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: inaudible in a 27 dB ambient
- Maximum ballast case temperature: 75 °C (167 °F)

### Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- T4 and T5-HO ballasts are MIL Std. 461E compliant (meets the requirements of CE101, RE101 and RE102)
- Meets ANSI C62.41 Category A surge protection standards up to and including 6 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

### Ballast Wiring & Mounting

- Ballast is grounded by a mounting screw to the fixture
- Terminal blocks on the ballast accept the following wire gauges:  
Power Wiring, Lamp Wiring, and EcoSystem Bus:  
only one #18 AWG solid  
Class 2 Sensors:  
only one #22 AWG solid
- Only one wire per terminal
- Class 2 sensor wiring must be separated from all power and Class 1 wiring, consult all applicable local and national codes.
- See Class 2 Sensor Wiring Details page
- Ballast mounts using two screws (or sheet metal feature and one screw) within a fluorescent fixture.




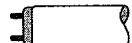
### Lamp Seasoning

Refer to your lamp company for lamp seasoning requirements prior to dimming.

<b>Job Name:</b> PSU Solar Decathlon	<b>Model Numbers:</b> FDB-T539-120-2
<b>Job Number:</b>	



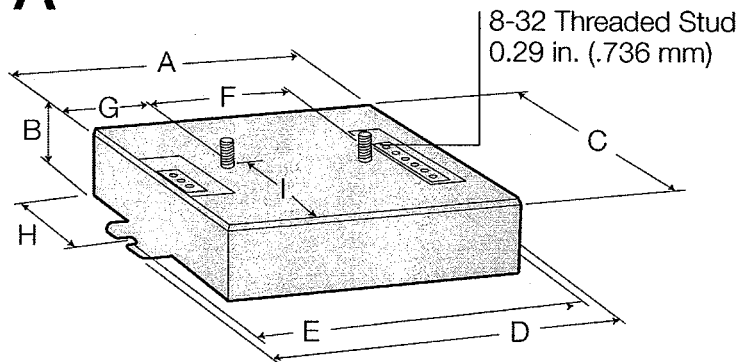
## Hi-lume Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Hi-lume Model Number <sup>1</sup>	Ballast Current (amps)	Hi-lume Model Number <sup>1</sup>
<b>T4 triple-tube 4-pin</b>  1/2 in. diameter	26 W	1	A	.26	HL3-T426-120-1-S	.12	HL3-T426-277-1-S
	32 W	1	A	.31	HL3-T432-120-1-S	.13	HL3-T432-277-1-S
<b>T5-HO linear high output</b>  5/8 in. diameter	24 W (21.5 in.)	1 2	C C	.26 .45	FDB-T524-120-1 FDB-T524-120-2	.13 .20	FDB-T524-277-1 FDB-T524-277-2
	39 W (33.4 in.)	1 2	C C	.38 .76	FDB-T539-120-1 FDB-T539-120-2	.17 .31	FDB-T539-277-1 FDB-T539-277-2
	54 W (45.3 in.)	1 2	C C	.58 1.1	FDB-T554-120-1 FDB-T554-120-2	.25 .45	FDB-T554-277-1 FDB-T554-277-2
	17 W (24 in.)	1 2 3	F F F	.19 .31 .43	FDB-2427-120-1 FDB-2427-120-2 FDB-2427-120-3	.08 .15 .20	FDB-2427-277-1 FDB-2427-277-2 FDB-2427-277-3
	25 W (36 in.)	1 2 3	F F F	.24 .43 .62	FDB-3627-120-1 FDB-3627-120-2 FDB-3627-120-3	.12 .19 .28	FDB-3627-277-1 FDB-3627-277-2 FDB-3627-277-3
	32 W (48 in.)	1 2 3	F F F	.30 .57 .82	FDB-4827-120-1 FDB-4827-120-2 FDB-4827-120-3	.14 .25 .35	FDB-4827-277-1 FDB-4827-277-2 FDB-4827-277-3
<b>T8 linear and U-Bent</b>  1 in. diameter	40 W (60 in.)	1 2	F F	.36 .64	FDB-6027-120-1 FDB-6027-120-2	.16 .30	FDB-6027-277-1 FDB-6027-277-2
	<b>T12 linear HO (800 mA)</b>						
	85 W (72 in.)	1	F	.75	FDB-7280-120-1	--	--
 1 1/2 in. diameter	95 W (84 in.)	1	F	.83	FDB-8480-120-1	--	--
	110 W (96 in.)	1	F	.88	FDB-9680-120-1	--	--

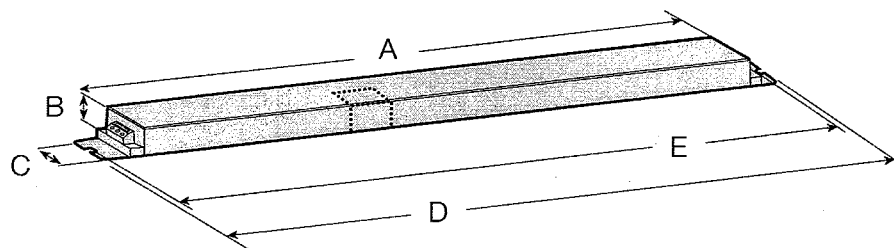
<sup>1</sup> Mounting studs standard for T4 ballasts. Delete suffix -S in the model number if mounting studs not needed.

<b>Job Name:</b> PSU Solar Decathlon	<b>Model Numbers:</b> FDB-T539-120-2
<b>Job Number:</b>	

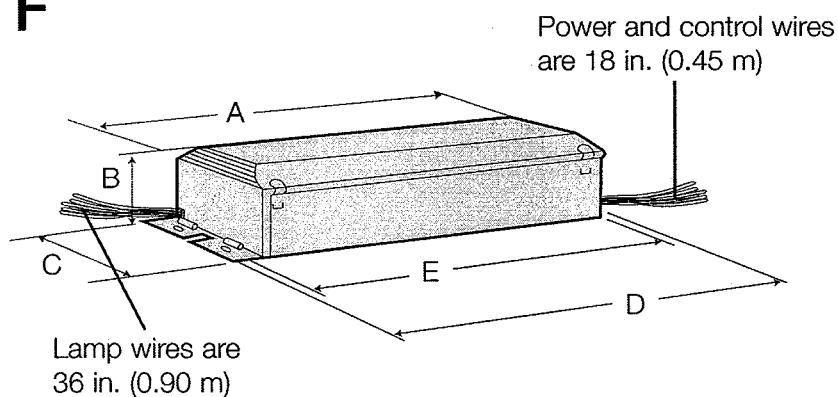
## Case Dimensions

**A<sup>1</sup>**

A	4.20 in. (107 mm)
B	1.00 in. (25 mm)
C	3.00 in. (76 mm)
D	4.90 in. (124 mm)
E	4.60 in. (117 mm)
	(mounting centers)
F	2.00 in. (51 mm)
G	1.08 in. (27 mm)
H	1.60 in. (41 mm)
I	1.39 in. (35 mm)

**C**

A	16.12 in. (409 mm)
B	1.00 in. (25 mm)
C	1.18 in. (30 mm)
D	18.00 in. (457 mm)
E	17.70 in. (450 mm)
	(mounting centers)

**F**

A	8.30 in. (211 mm)
B	1.50 in. (38 mm)
C	2.38 in. (60 mm)
D	9.50 in. (241 mm)
E	8.91 in. (226 mm)
	(slot mounting centers)

If using four hole mount,  
mounting centers are 9.21 in.  
(234 mm) x 1.70 in. (43 mm).

<sup>1</sup> Mounting studs standard. When ordering, delete suffix -S in the ballast model number if mounting studs not needed.

Job Name:  
PSU Solar Decathlon

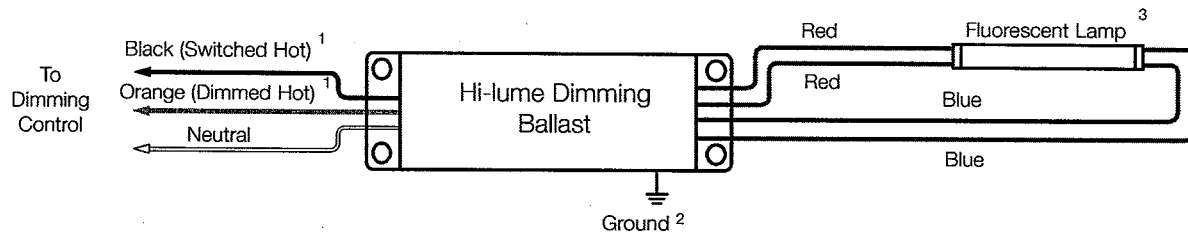
Job Number:

Model Numbers:

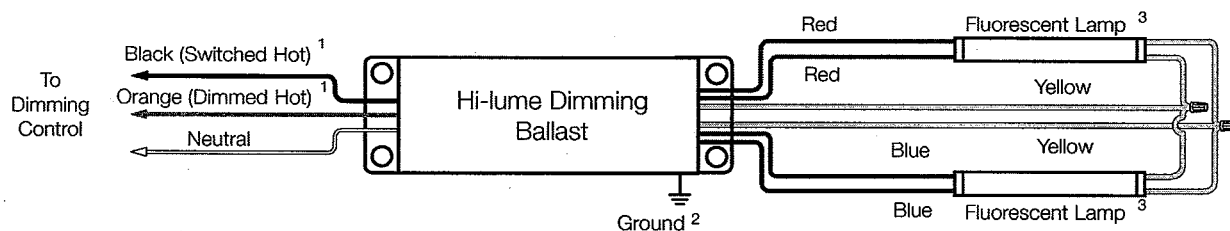
FDB-T539-120-2

## Hi-lume Wiring Diagrams

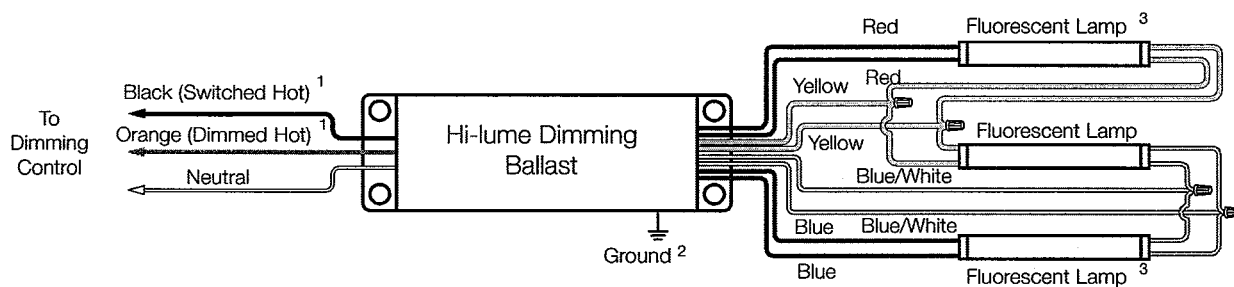
## One T-5-HO or T8 lamp



## Two T-5-HO or T8 lamps



## Three T8 lamps



<sup>1</sup> Dimming control wire colors do not necessarily match ballast wire colors (e.g. control 'dimmed hot' may be yellow, and ballast 'dimmed hot' may be orange. Wire colors shown are for Lutron ballasts and controls only.

<sup>2</sup> Ballast and lighting fixture must be effectively grounded.

<sup>3</sup> Includes 6 in. T8 U-bent lamps

Note: For T5-HO and T8 lamps, maximum lamp-to-ballast wire length is 7 feet (2 m).

Job Name:

PSU Solar Decathlon

Model Numbers:

FDB-T539-120-2

Job Number:



## ATTENTION ELECTRICIANS AND CONTRACTORS



## ATTENTION FACILITIES MANAGERS

### Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 7 ft. (2 m) for T5-HO and T8 linear lamps, and 3 ft. (1 m) for T4 compact lamps.

### Lamp Sockets

Lamp sockets as per IEC 60400 are required to ensure positive lamp-pin to socket contact. T5 linear lamps require rotary locking sockets.

### Lamp Mounting for T8

Many fluorescent lamp sockets are available with mounting slots to vary the height of the lamp away from the grounded metal surface. Use these slots to get the lamp glass to be 1/2 in.  $\pm$  1/4 in. away from the grounded metal surface.

Having a fluorescent lamp too close to the grounded metal will make the minimum intensity too low and will reduce lamp life. Having a fluorescent lamp too far away from the grounded metal will make the lamp flicker or not turn on at all.

### Lamp Mounting for T5 and T5-HO

Keep lamps 3/8 in.  $\pm$  1/8 in. away from the grounded metal surface. Having a T5-HO lamp too close to the grounded metal will not reduce lamp life but may cause a visible difference in brightness along the length of the lamp.

### Ballast Operating Temperature

Ballast case temperature must not exceed 75 °C at any point on ballast.

### Wiring and Grounding

Ballast and lighting fixture must be effectively grounded. Ballasts must be installed per national and local electrical codes.

### PERFORMANCE

#### Lamp Seasoning

Consult lamp manufacturer's recommendations on lamp seasoning prior to dimming

### SERVICE

#### Replacement Parts

Use replacement parts with exact Lutron model numbers. Consult Lutron if you have any questions.

#### Further Information

For further information, please visit us at [www.lutron.com/ballasts](http://www.lutron.com/ballasts) or contact our 24-hour Technical Support Center at 1-800-523-9466.

Job Name:

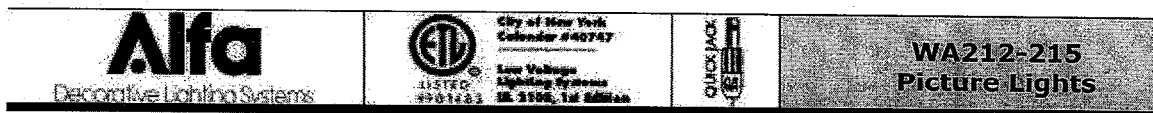
PSU Solar Decathlon

Job Number:

Model Numbers:

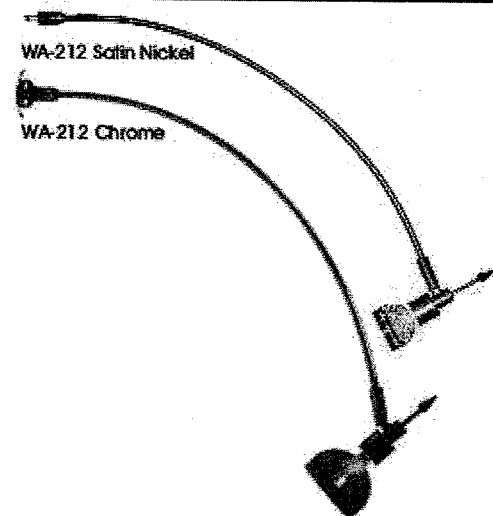
FDB-T539-120-2





WA-212 Satin Nickel

WA-212 Chrome

**WA-212 Chrome**

Arched Quick Jack display light shown with 903QJ 1.5" Monopoint. Complete w/ 2" deep wiring compartment and 3/4" threaded hole in rear of unit for mounting to conduit.  
Projection = 14" Displacement = 11".

**902-QJ**

Quick Jack monopoint for use with remote transformer. Covers a standard 4" junction box. Available in chrome, copper, gold, matte gold, matte nickel, black and white finishes. max. 50W W=4-1/2" H=1/2"

**907-QJ**

New Refit Quick Jack monopoint for use with remote transformer. Available in chrome, copper, gold, matte gold, matte nickel, black and white finishes. max. 50W W=4-1/2" H=1/2"

**WA-213 Chrome**

Arched Quick Jack display light fully adjustable fixture head, use with all QJS system, for mounting to a vertical surface.  
Projection=18" Height =3.5"

**WA-215 Chrome**

Arched Quick Jack display light fully adjustable fixture head, use with all QJS system, for mounting to QJS track or 904 monopoint.

**903-QJ**


Quick Jack 1.5" Monopoint. Complete w/ 2" deep wiring compartment and 3/4" threaded hole in rear of unit for mounting to conduit. Max. ceiling (gyp. board) thickness of 3/4" for sandwich mounting. Rated for a max. of 50 Watts. Requires a remote transformer. Compatible with all QJS fixtures and pendants. Available in chrome, copper, gold, matte nickel, black and white finishes.

<input type="checkbox"/>	Project Name:		Fixture Type:
<input type="checkbox"/>	Item No	Finish	Lamping
<input type="checkbox"/>		Accessories	
		Track System	
		Picture monopoint	


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P3-table-pendant


TYPE P3



Decorative Lighting Systems



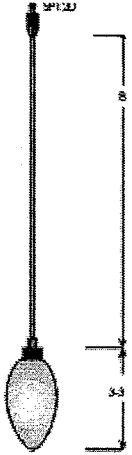
City of New York  
Columbian #469747  
Low Voltage  
Lighting Systems  
UL 2106, 1st Edition  
LISTED  
990143



QUICK JACK





G68

**G68 TEARDROP  
Pendant Cord Set  
Quick Jack System**

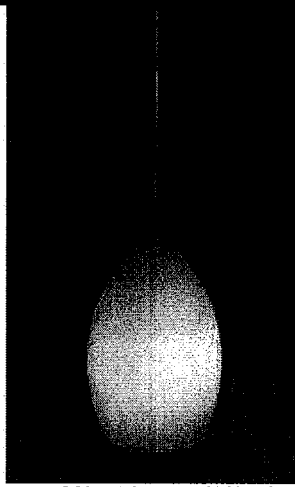


**G68PK TEARDROP** glass with opal white lining. Glass available in amber, cobalt blue, frosted, and red. Complete with Pt 82 coaxial pendant cord set.

Max. 50W JC included.  
W = 4" H = 7"







Frosted    Cobalt Blue    Amber    Red




G68 PK Satin Nickel/Amber

Project Name:				Fixture Type:	
Item No	Glass Colors	Connector	Lamping	System Type	PT82 Cord Sets
G68PK	Amber Frosted Cobalt Blue Red	CTE01 (12V track) CTT21 (120V track) RP2, RP4 (Rail system) ARE01 (Monotrack) 801 (Cable system)	JC 35-50W G6.35	Monopoint system Monorail system Monotrack system Cable system Track system <u>*12V &amp; 120V track system</u>	Satin Nickel Only
Specification:					



ARE01 single circuit  
QJS fixture adapter  
75W max.  
Monotrack system



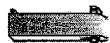
RP2 / RP4(1& 2-circuit)  
Rail QJS fixture adapter  
75W max. per circuit  
Monorail system



801 Cable QJS  
fixture adapter  
75W max.  
Cable system



CTE01 Low voltage  
track  
QJS fixture adapter  
50W max.  
Track system



CTT21 Line voltage  
track power pack /  
QJS fixture adapter  
120-12V, 50W max.  
CTT21 3wire / 1circuit  
CTT21-2 4wire / 2circuit  
CTT21J 2wire / 1 circuit  
Track system



99014QJ  
Triple monopoint  
200W transformer  
included in base  
Monopoint system



901-905QJ  
Monopoint  
60W transformer  
included in base  
Monopoint system



902-907QJ  
Monopoint  
50W max.  
Monopoint system

\*QJS: Quick Jack System

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99210  
99211  
99212



99210 - slim line conductive wall stop set  
Dia=0.5" L=2"



99210, 99211, 99212

99211 - slim line conductive turnbuckle set  
Dia=0.5" L=4"

99212 - slim line base plate for use with 99210 and 99211, Dia =1.25" available in Chrome, Copper, Gold and Nickel finishes.

99235



99235 - Slim line extended pulley, Chrome, Copper, Gold and Nickel finishes. L=3-1/2"



99235

99607  
99608



99607 - In line non-conductive cable turnbuckle joiner. Used to insulate cable run, for more than one transformer.



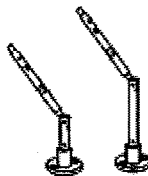
99607

99608 - In line conductive cable turnbuckle joiner, Chrome, Copper, Gold and Nickel finishes. L=4-1/2"

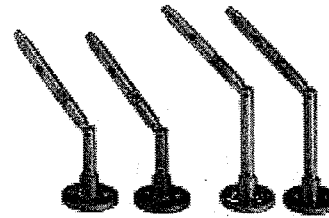


99608

99200  
99201  
99205  
99206



99200 - Conductive turnbuckle set for wall or ceiling 99201 - Non conductive turnbuckle set for wall or ceiling Chrome, Copper, Gold and Nickel finishes, L=6.5"



99200/99201

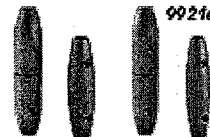
99205/99206

99205 - Conductive turnbuckle set for wall or ceiling 99206 - Non conductive turnbuckle set for wall or ceiling Chrome, Copper, Gold and Nickel finishes, L=7.5"

99216



99216 - In line non-conductive cable joiner. For use with more than one transformer, Copper and Nickel finishes. L=2"



99216

99218



99218 - In line conductive cable joiner. For use to join and extend cable run, Copper and Nickel finishes. L=1 1/2"



99218

801



Quick Jack Cable adapter for use with all QJS fixtures and pendants. use with 10ga. non insulated cable. For connection to insulated or #9ga. cable, the 800 power taps must be ordered in addition. Chrome, Gold and Nickel finishes.



802



Quick Jack Cable adapter for use with all QJS fixtures and pendants. use with both insulated and non insulated cable., the 800 power taps must be ordered in addition. Chrome, Copper, Gold and Nickel finishes.

801

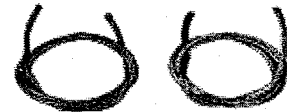


99520  
99530  
99540  
99550  
99560  
99570  
99580



Finest grade copper with tin or gold plated cable. Insulated or non-insulated.

99520 - 10 ga non-insulated.  
99530 - 10 ga kevlar non-insulated.  
99540 - 10 ga kevlar insulated.  
99550 - 9 ga kevlar non-insulated.  
99560 - 9 ga kevlar insulated.  
99570 - 10 ga gold kevlar non-insulated.  
99580 - 10 ga copper insulated.  
Finest grade copper with tin or gold plated cable.  
Insulated or non-insulated.



Gold plated cable Tin plated cable

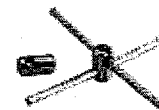


Kevlar core tin plated cable Insulated tin plated cable

99190



99190 - Conductive cross connector. Chrome, Copper or Gold finishes. L=1"



99190

99191



99191 - Non-conductive cross connector. Black finish. L=3/4"



99191

99215



99215 - In line non-conductive cable joiner. For use with more than one transformer. Chrome or gold finishes. L=1-1/2"



99215 99217 99215

99217



99217 - In line conductive cable joiner. Used to join and extend cable run. Chrome or Gold finishes. L=1-1/2"

500



500 - Secondary power tap. For non-insulated cable up to 4mm in diameter (#10 ga.) Chrome, Copper, Gold or Nickel finishes. L=3/4"



999 800 500

800



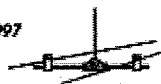
800 - Secondary power tap. For insulated & non - insulated cable up to 6mm in diameter (#9 ga.) Chrome, copper, Gold or nickel finishes. L=1"

999

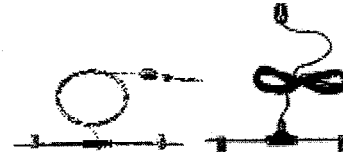


999 - Secondary power tap. For insulated and non - insulated cable up to 8mm in diameter (#8 ga.) Chrome, Copper, Gold or Nickel finishes. L=1-1/2"

997



997 Cable support. For use on long runs or runs with heavy fixtures. Chrome finish with aircraft cable. W=5-1/2" L=6'-6"

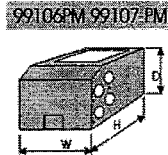
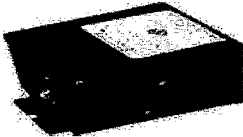


997S 997

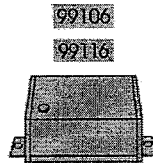
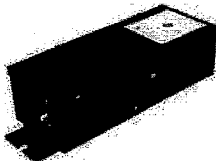




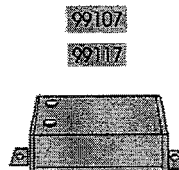
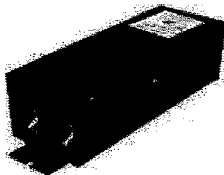
**8060**-12 Volt / 60 Watt electronic solid state transformer, w/ thermal protection. Equipped with ESP (Electronic Short Circuit Protection).



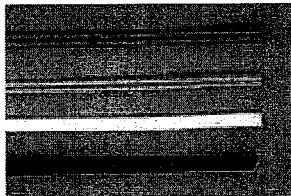
**C-300 and 600PM Series 12V 300VA (99106PM) 2 x 300VA (99107PM) remote mount, transformer.** Each secondary circuit derated at 300VA. Equipped with a wiring block on the secondary and a power monitoring (PM) protection system. PM protects against overload and short circuits, and also allows soft starts for extended lamp life. Fully loaded secondary voltage=2 x 11.5V Open circuit voltage=12.3V  
D= 3 W=3 1/2 H= 6 1/2 (99106PM)  
D=4-3/8" W=4-3/4" H=7" (99107PM)



**99106 & 99116**-Remote mount 12V and 24V magnetic transformer. 99106 is a 12V, 300W remote mount transformer with boost tap. 99116 is a 24V, 600W remote mount transformer with boost tap. One circuit magnetic transformer with secondary protection, no derating required. For use with all ALFA systems. E.T.L. and U.L. Listed 99106 L=8-3/4" W=4-1/4" H=3-3/4" 99116 L=9" W=5-1/4" H=4-3/4"



**99107 & 99117**-Remote mount 12V and 24V magnetic transformer 99107 is a 12V, 300W X 2 remote mount transformer with boost tap. 99117 is a 24V, 600W X 2 remote mount transformer with boost tap. Two circuit magnetic transformer with secondary protection, no derating required. For use with all ALFA systems. E.T.L. and U.L. Listed 99107 L=9-1/2" W=5-3/8" H=5" 99117 L=16" W=6" H=5-3/8"



**995** - Secondary power feed wire 12V and 24V For use with all magnetic transformers. 10 gauge 40 amp power feed wire available in copper, tin plated clear, black and white.

Tin plated clear

White

black

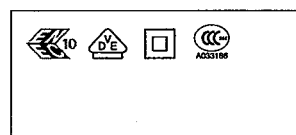
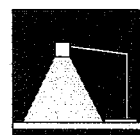
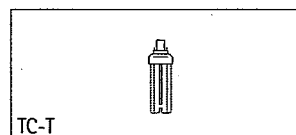
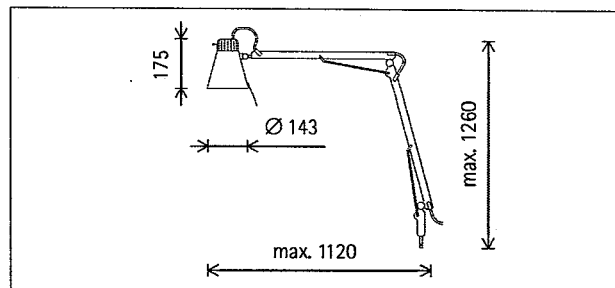
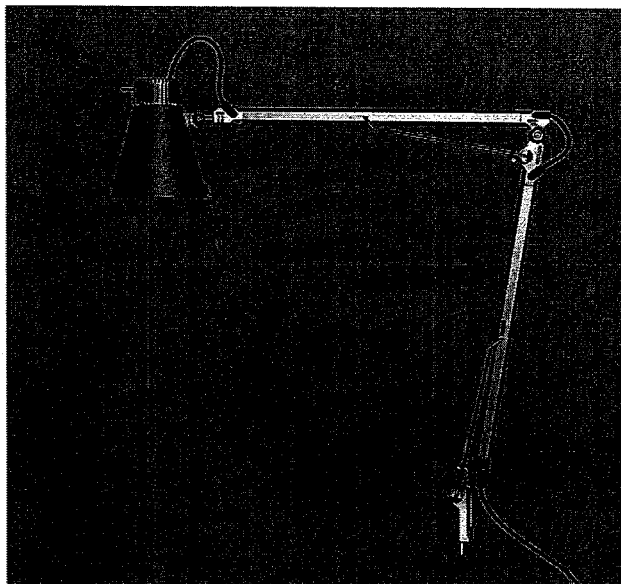
<input type="checkbox"/>	Project Name:		Fixture Type:	
<input type="checkbox"/>	Item No	Finish	System Type:	995 Color / Length:
			Monopoint system Rail system Cable system Track system *12V track system	12V or 24V 24V available in limited models

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# ERCO

## Pf. Desk lamp Lucy Task light for compact fluorescent lamps

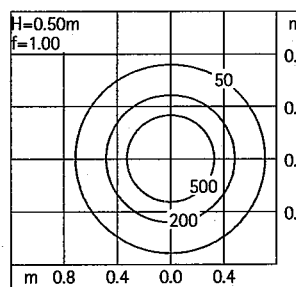
### TYPE P4



33176.000 Silver  
TC-T 18W GX24d-2 1200lm

#### Product description

Light head: aluminium, anodised.  
Switch. Cast aluminium lampholder carrier, designed as heat sink.  
Articulated arm: aluminium profile, anodised. Stabilising of forces by means of visible steel connecting struts with internal springs.  
Hinges: cast aluminium. Plastics elements for optimum conductor routing visible within range of joints, however otherwise concealed.  
Mounting stud with mounting and safety ring for mounting to base, to be ordered separately.  
Cable with 3-pin plug and low-loss control gear, L 2,500mm.  
Reflector: plastic, silver. Fresnel lens.  
Weight 1.70kg



ERCO Leuchten GmbH  
Postfach 2460  
58505 Lüdenscheid  
Germany  
Tel.: +49 2351 551 0  
Fax: +49 2351 551 300  
info@erco.com

Technical Region: 230V/50Hz  
Edition: 16.11.2006  
Please download the current version from  
[www.erco.com/33176.000](http://www.erco.com/33176.000)

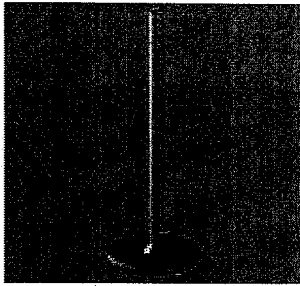
## Planning data

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.88	0.82	0.77	0.89	0.83	0.77	0.71	0.85	0.79	0.73	0.65
RSMF	0.99	0.98	0.96	0.95	0.97	0.96	0.95	0.94	0.97	0.96	0.95	0.94

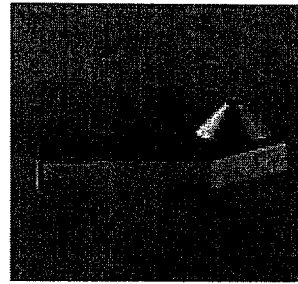
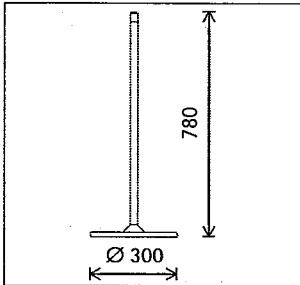
Hours of operation (h)	2000	6000	10000	1000	4000	8000
LLMF	0.92	0.85	0.83	0.97	0.88	0.83
LSF	1	1	1	1	1	1

MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Luminaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

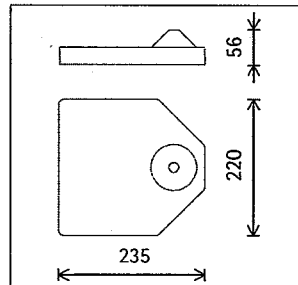
## Accessories



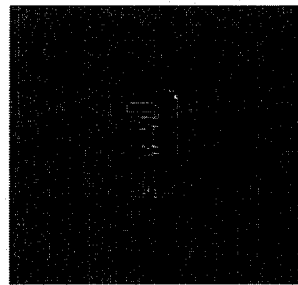
**33190.000**  
Lucy Floor standing base  
Plate: steel, silver powder-coated,  
Ø 300mm.  
Tube: steel, silver powder-coated,  
Ø 25mm, L 780mm.  
Weight 8.50kg



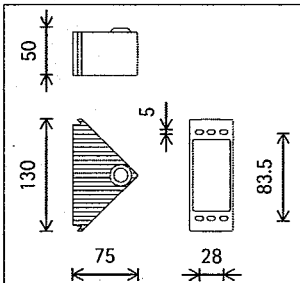
**33193.000**  
Lucy Desk top base  
Cast aluminium, silver powder-  
coated.  
Weight 6.40kg



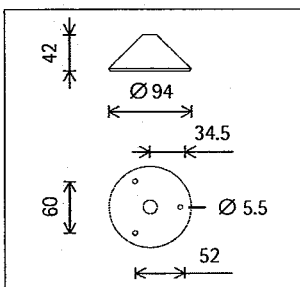
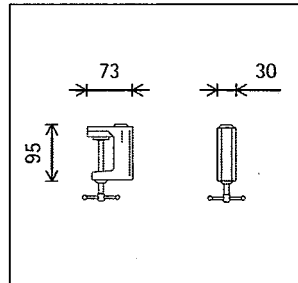
**33191.000**  
Lucy Wall bracket  
Cast aluminium, silver powder-  
coated.  
Weight 0.20kg



**33194.000**  
Lucy Table clamp  
Cast aluminium, silver powder-  
coated. Clamp extension up to  
50mm.  
Weight 0.25kg



**33192.000**  
Lucy Table base  
Cast aluminium, silver powder-  
coated.  
To be screwed on table-top.  
Weight 0.35kg










## LOW-VOLTAGE ELEMENTS

## Curly Raindrop

## ARCHITECTURAL HEAD

FreeJack	MonoRail	Two-Circuit MonoRail	Wall MonoRail	Kable Lite	TwinRail	T-trak™
			N/A	N/A		

## DESCRIPTION

Raindrop glass on a hand-bendable stem.

## SYSTEM

Available for FreeJack, MonoRail, Two-Circuit MonoRail, and TwinRail. For use on T-trak, order FreeJack version and T-trak FreeJack Connector (sold separately).

## COLOR

Amber, apricot, cobalt, frost, red.

## FINISH

Chrome, satin nickel.

TwinRail available in chrome only.

## LAMP

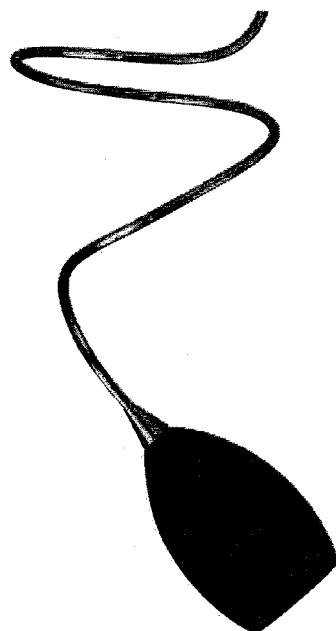
Low-voltage 12 or 24 volt Halogen bi-pin up to 50 watts with Pyrex glass shield (included).

## ACCESSORIES AND OPTICAL CONTROLS

None.

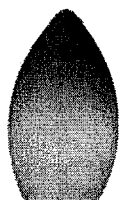
## WEIGHT

0.94-2.28 lb./0.42-1.04 kg. ±



COBALT

Shown approximately  
30% actual size.



AMBER



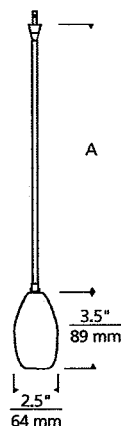
APRICOT



FROST



RED



Socket terminates with FreeJack male connector, which may be installed into a system connector. Elements ordered with a system prefix include a connector for that system.



**TECH LIGHTING®**

7400 Linder Avenue T 847.410.4400  
Skokie, Illinois 60077 F 847.410.4500  
www.techlighting.com

## ORDERING INFORMATION

700	SYSTEM	CRD	COLOR	LENGTH (A)	FINISH	VOLTAGE
FJ	FREEJACK	M	AMBER	06 6"	C CHROME	12 VOLT
MO	MONORAIL	A	APRICOT	12 12"	S SATIN	24 24 VOLT
MO2	TWO-CIRCUIT MONORAIL	B	COBALT	18 18"	NICKEL	
		F	FROST	24 24"		
TW	TWIN RAIL	R	RED	36 36"		

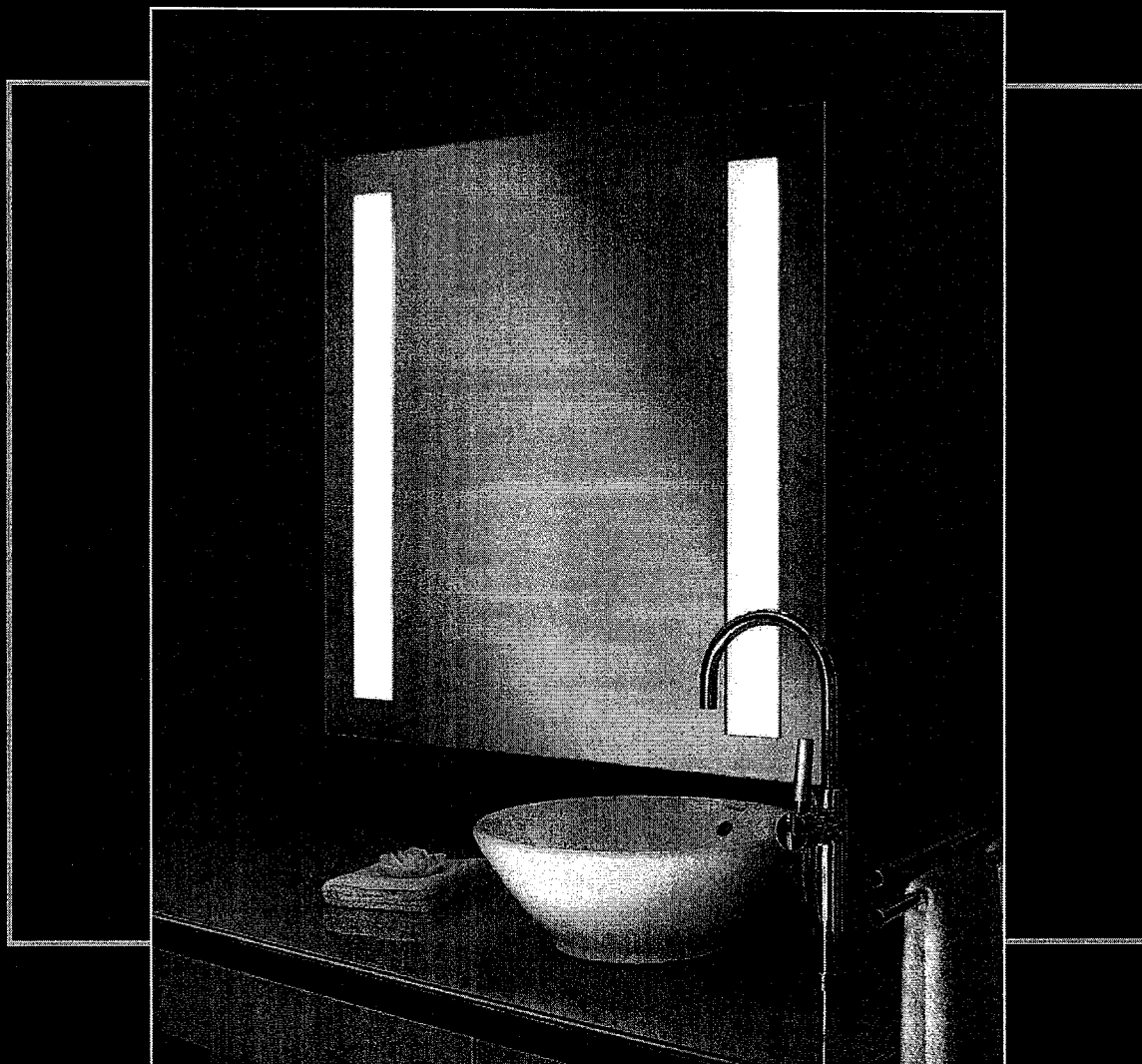
700 FJ CRD F 24 S

FIXTURE TYPE: P5

JOB NAME: MorningStar Home

# MIRROR-LUX® 6002

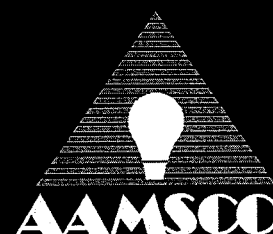
NEW GENERATION



Introducing the MIRROR-LUX® 6002 - New Generation - the newest version of AAMSCO LIGHTING'S collection of energy saving bath and vanity luminaires. The MIRROR-LUX® 6002 - New Generation - replaces our original 6002 with easier relamping and more efficient HE type T-5 fluorescent lamps.

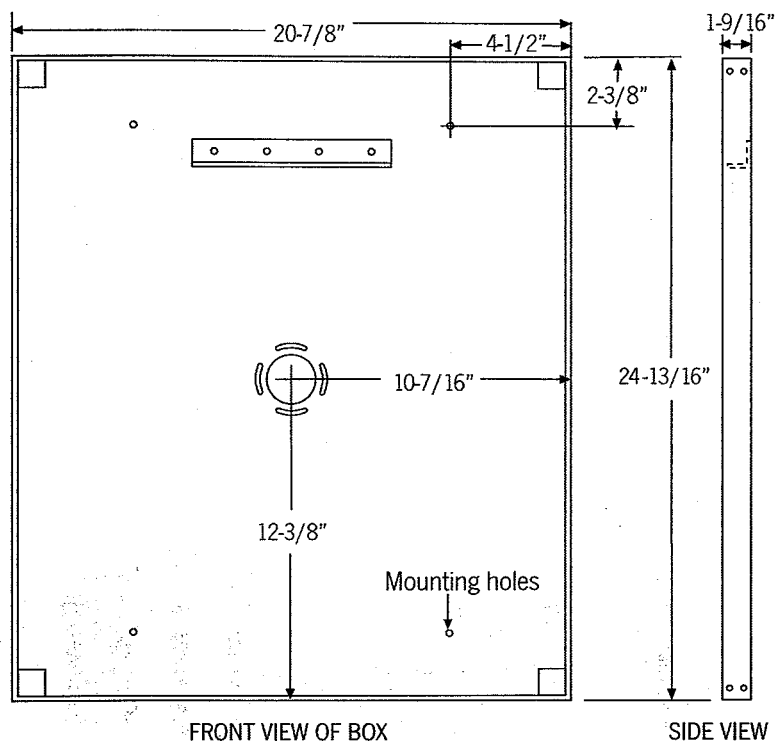
## AAMSCO LIGHTING, INC.

100 Lamp Light Circle • Summerville, SC 29483  
Toll Free: 1-800-221-9092 • Fax: 843-278-0001  
[www.aamsco.com](http://www.aamsco.com)



# MIRROR-LUX® 6002

NEW GENERATION



## TECHNICAL AND ORDERING DATA

### Standard Specifications

- **Voltage:** 120 (220 available, consult factory)
- **Ballast:** Electronic high power factor
- **2-Lamp and 4-lamp versions available** (only 2 lamps operate at a time). On 4-Lamp version, you have a choice of 2 available Kelvin temps.
- **Mounting:** Mounting holes (four) provided for mounting to mechanically sound surface.
- Recessed mounting kit offered as an available option.
- **ETL Listed** for damp locations.
- **ADA:** Conforms to the regulations of all the Americans with Disabilities Act.
- \* For custom shapes and sizes, please consult factory.

### Catalog #

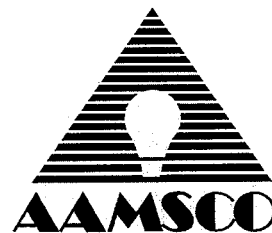
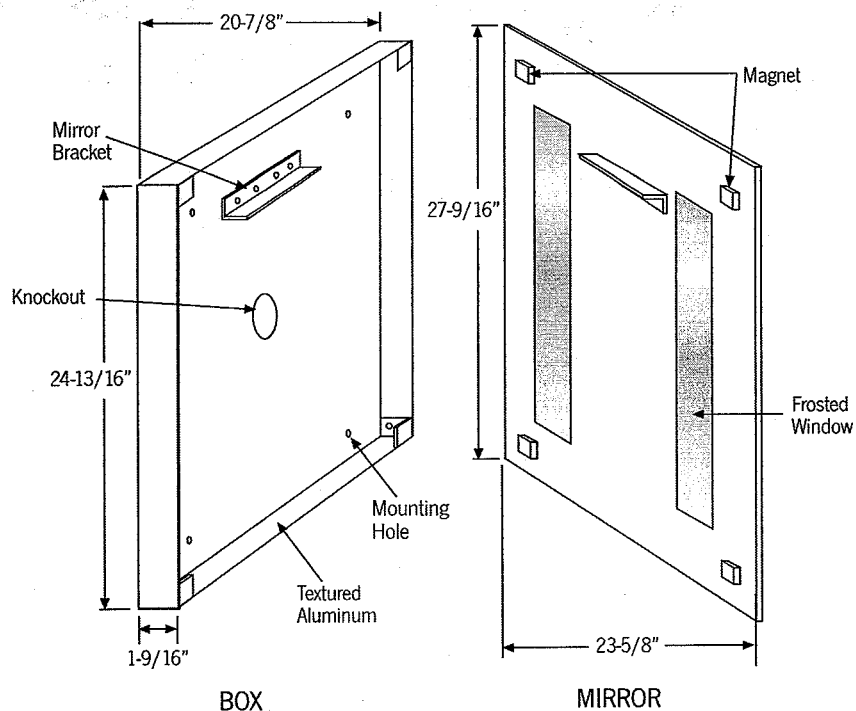
MIRROR-LUX 6002 New Generation

### Lamp Type

F14T5

### Available Kelvin Temps

2700, 3000, 4000, 5350, 6500



## AAMSCO LIGHTING, INC.

100 Lamp Light Circle • Summerville, SC 29483

Toll Free: 1-800-221-9092 • Fax: 843-278-0001 • [www.aam스코.com](http://www.aam스코.com)

## LAMP COLOR DATA

<b>/82 Extra Warm White Special</b>	has a Color Rendering Index of 83 and a Color Temperature of 2700K. Characteristics : high efficacy (90 lm/W) - good color rendering (creates warm atmosphere). Applications : living rooms.
<b>/83 Warm White Special</b>	has a Color Rendering Index of 85 and a Color Temperature of 3000K. Characteristics : high efficacy (90 lm/W) - good color rendering. Applications : offices/indoor sports.
<b>/84 White Special</b>	has a Color Rendering Index of 85 and a Color Temperature of 4000K. Characteristics : high efficacy (90 lm/W) - good color rendering. Applications : offices, shops.
<b>/86 Cool Daylight Special</b>	has a Color Rendering Index of 85 and a Color Temperature of 6500K. Characteristics : high efficacy (90 lm/W) - very good color rendering. Applications : in those areas (especially warm areas) where a cool atmosphere should be created and a good color impression is very important..
<b>/92 Extra Warm White de Luxe</b>	has a Color Rendering Index of 95 and a Color Temperature of 2700K. Characteristics : moderate efficacy (55 lm/W) - excellent color rendering. Applications : Catering Establishments, Homes.
<b>/93 Warm White de Luxe</b>	has a Color Rendering Index of 95 and a Color Temperature of 3000K. Characteristics : moderate efficacy (65 lm/W) - excellent color rendering. Applications : shops where a true color impression is important, such as florists, textile shops.
<b>/95 Cool White de Luxe</b>	has a Color Rendering Index of 98 and a Color Temperature of 5000K. Characteristics : moderate efficacy (65 lm/W) - excellent color rendering. Applications : in those areas where excellent color impression is very important, such as the printing industry, the paint industry and graphic studios.
<b>/96 Cool Daylight de Luxe</b>	has a Color Rendering Index of 98 and a Color Temperature of 6500K. Characteristics : moderate efficacy (65 lm/W) excellent color rendering. Applications : where true color rendition is important.

Color Suffix	Color Temperature (K)	Color Rendering Index (CRI)	lm/W
/82	2700	83	90
/83	3000	85	90
/92	2700	95	55
/84	4000	85	90
/93	3000	95	65
/86	6500	85	90
/95	5000	98	65
/96	6500	98	65

The higher the Color Temperature the cooler the lighting effect.  
The higher the Color Rendering Index the better the color impression.  
The higher the average efficacy (lm/W) the higher the lumen output.

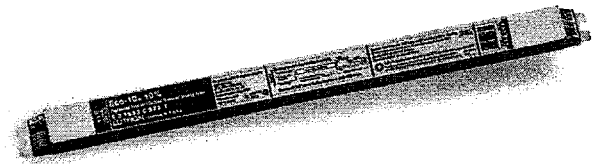


## Eco-10 Overview

Eco-10 lighting management electronic dimming ballasts are designed to maximize the benefits of a lighting management system. Eco-10 offers 100% to 10% dimming, and is ideal for use in any space where saving energy is the primary goal of the design.

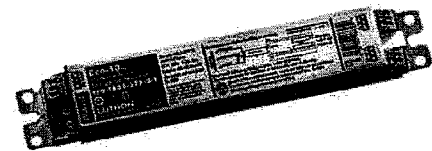
### Features

- Continuous, flicker-free dimming from 100% to 10%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T5 and T5-HO linear, T8 linear and U-bent, and T5 twin-tube lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T5 and T5-HO linear models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase



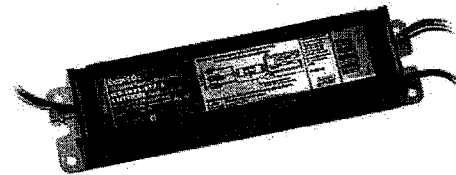
**Eco-10, case type C**

1.18"w (30mm) x 1.00"h (25mm) x 18.00"l (457mm)



**Eco-10, case type D**

1.58"w (40mm) x 1.00"h (25mm) x 9.50"l (241mm)



**Eco-10, case type F**

2.38"w (60mm) x 1.50"h (38mm) x 9.50"l (241mm)

<b>Job Name:</b> Penn State Solar Decathlon	<b>Model Numbers:</b> E-3-T514-C-120-2
<b>Job Number:</b>	

## Specifications

### Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant  $\pm 2\%$  light output for line voltage variations of  $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

### Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Job Name:




Penn State Solar Decathlon

Job Number:

Model Numbers:

E-3-T514-C-120-2

## Eco-10 Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
 5/8" diameter	14W (22")	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
		2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
	21W (34")	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
		2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W (45.3")	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
		2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
 5/8" diameter	24W (21.5")	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
		2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
	39W (33.4")	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
		2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W (45.3")	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
		2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
 5/8" diameter	36/39W (16")	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
		2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
	40W (22")	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
		2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W (22")	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
		2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2



Job Name:

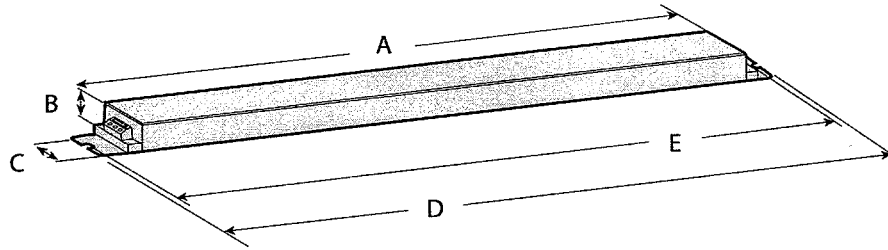
Penn State Solar Decathlon

Job Number:

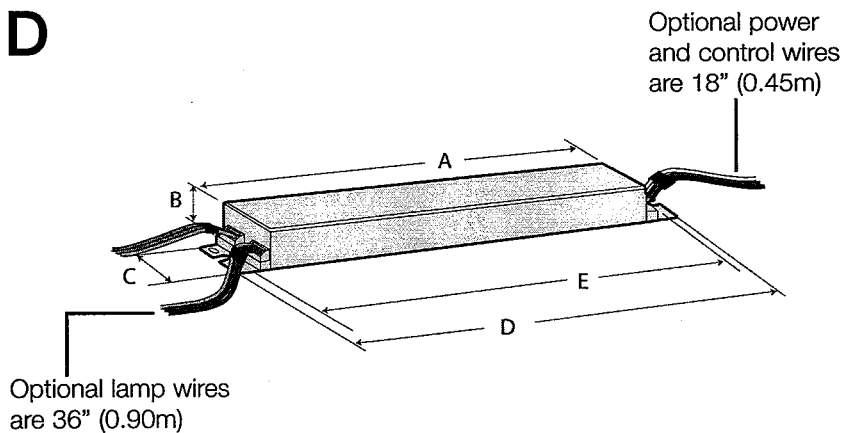
Model Numbers:

E-3-T514-C-120-2

## Eco-10 Case Dimensions

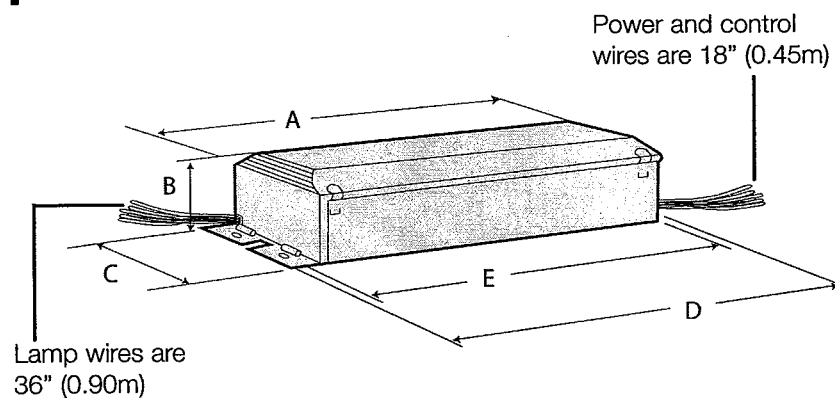
**C**

A	16.12" (409 mm)
B	1.00" (25 mm)
C	1.18" (30 mm)
D	18.00" (457 mm)
E	17.70" (450 mm) (mounting centers)

**D**

A	7.13" (181 mm)
B	1.00" (25 mm)
C	1.58" (40 mm)
D	9.50" (241 mm)
E	8.91" (226 mm) (slot mounting centers)

If using four hole mount,  
mounting centers are 9.00"  
(229 mm) x 1.06" (27 mm).

**F**

A	8.30" (211 mm)
B	1.50" (38 mm)
C	2.38" (60 mm)
D	9.50" (241 mm)
E	8.91" (226 mm) (slot mounting centers)

If using four hole mount,  
mounting centers are 9.21"  
(234 mm) x 1.70" (43 mm).

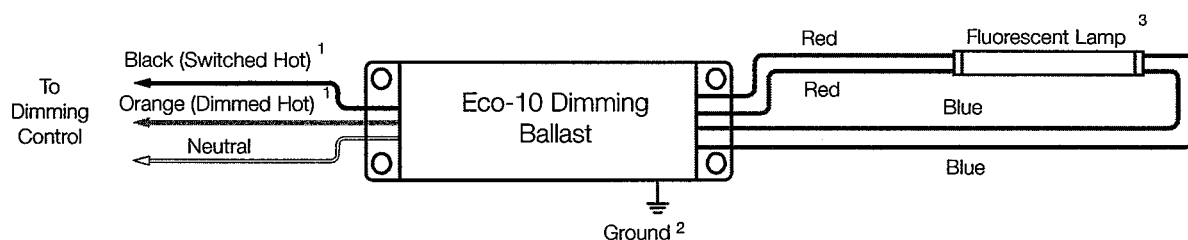
Job Name:  
Penn State Solar Decathlon  
Job Number:

Model Numbers:  
E-3-T514-C-120-2

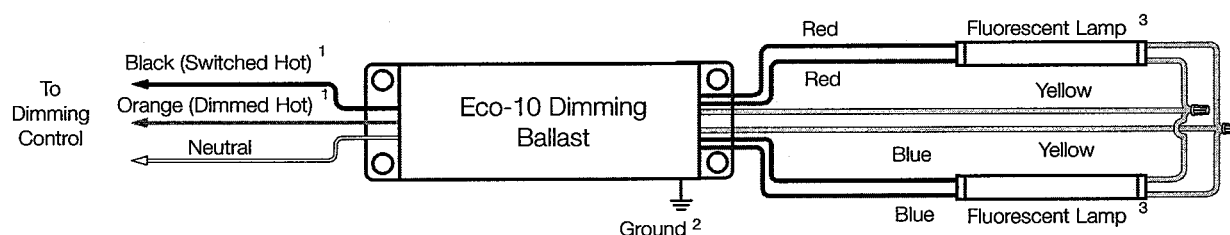


## Eco-10 Wiring Diagrams

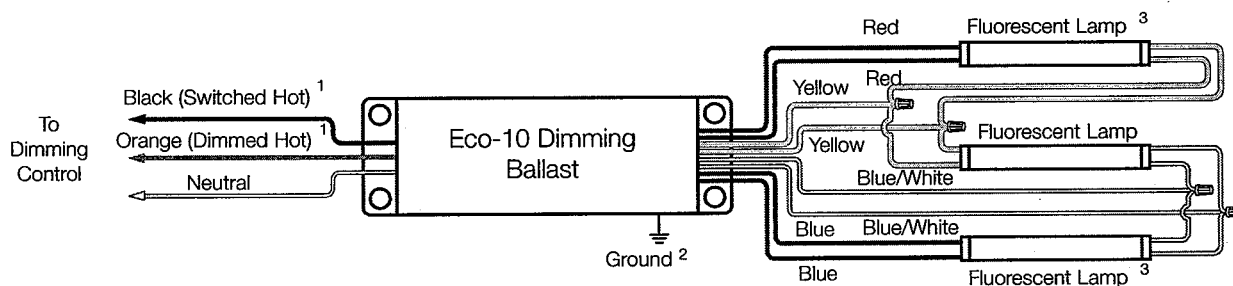
## One T5 or T8 lamp



## Two T5 or T8 lamps



## Three T8 lamps



<sup>1</sup> Dimming control wire colors do not necessarily match ballast wire colors (e.g. control 'dimmed hot' may be yellow, and ballast 'dimmed hot' may be orange. Wire colors shown are for Lutron ballasts and controls only.

<sup>2</sup> Ballast and lighting fixture must be effectively grounded.

<sup>3</sup> Includes 6" T8 U-bent lamps

Note: For T5 and T8 lamps, maximum lamp-to-ballast wire length is 7 feet (2m).

Job Name:

Penn State Solar Decathlon

Job Number:

Model Numbers:

E-3-T514-C-120-2



### ATTENTION ELECTRICIANS AND CONTRACTORS

#### Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 7' (2m) for T5 and T8 lamps, and 3' (1m) for T5 twin-tube lamps.

#### Lamp Sockets

Quality lamp sockets are required to ensure positive lamp-pin to socket contact. T5 linear lamps require rotary locking sockets. T8 lamps require knife-edge sockets. U-bent lamps require locking sockets and proper lamp support to hold lamp pins in full contact with the socket. T5 twin-tube lamps require sockets that lock into the lamp base and provide proper lamp support to hold lamp pins in full contact with socket.

#### Lamp Mounting for T5 Twin-Tube and T8

Many fluorescent lamp sockets are available with mounting slots to vary the height of the lamp away from the grounded metal surface. Use these slots to get the outside edge of the lamp to be  $1/2" \pm 1/4"$  away from the grounded metal surface.

Having a fluorescent lamp too close to the grounded metal will make the minimum intensity too low and will reduce lamp life. Having a fluorescent lamp too far away from the grounded metal will make the lamp flicker or not turn on at all.

#### Lamp Mounting for T5

Keep lamp at least  $3/8" \pm 1/8"$  away from the grounded metal surface. Having a lamp too close to the grounded metal will not reduce lamp life but may cause a visible difference in brightness along the length of the lamp.

#### Wiring and Grounding

All wiring from the dimming control to the Eco-10 ballasts is line voltage wiring and may be run together in the same conduit.

Ballast and lighting fixture must be effectively grounded. Ballasts must be installed per national and local electrical codes.

#### Ballast Operating Temperature

Ballast case temperature must not exceed 75°C at any point on ballast.

#### Number of Ballasts Per Control

To calculate the maximum number of ballasts allowed per control, divide control's current capacity by individual ballast current. Certain controls allow a specific maximum number of ballasts.



### ATTENTION FACILITIES MANAGERS

#### PERFORMANCE

##### Lamps Must Be Seasoned

New fluorescent lamps must be operated for 100 hours at full output ("seasoned") to render lamp impurities inert, so as to achieve proper dimming performance and average rated lamp life.

#### SERVICE

##### Replacement Parts

Use replacement parts with exact Lutron model numbers. Consult Lutron if there are questions.

##### Further Information

For further information, please visit <http://www.lutron.com/ballasts> or contact our 24-hour Technical Support Center at 1-800-523-9466.

Job Name:

Penn State Solar Decathlon

Job Number:

Model Numbers:

E-3-T514-C-120-2

JUNO® lighting

## UNDERCABINET LIGHTING

DIRECT WIRE FLUORESCENT

8W, 14W, 21W &amp; 28W

T5 HE Fluorescent Lamps

UFL12, UFL22, UFL34 and UFL46

Project: MorningStar Home

Fixture Type: P7

Location: Kitchen

Contact/Phone:

## PRODUCT DESCRIPTION

Direct Wire Fluorescent luminaires offer highly efficient illumination in a shallow, easy-to-conceal profile. Ideal for undercabinet, undershelf, and task lighting, where maximum energy efficiency, long lamp life, and cool operation are desired.

## PRODUCT SPECIFICATIONS

**Lamp** Latest generation of high-efficiency (HE), high color rendering 3000K T5 tri-phosphor fluorescent lamps • 20,000 hour rated lamp life.\*

**Ballast** State of the art electronic ballast instantly starts lamp and operates without flicker or hum.

**Housing** Formed steel fixture body for maximum strength, painted appliance white or silver.

**Switch** Convenient on/off switch.

**Diffuser** Extruded non-yellowing clear UV/impact resistant acrylic lens.

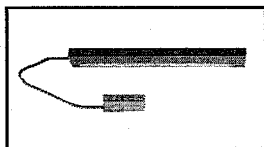
**Labels** UL Listed and Energy Star compliant.

## INSTALLATION

UFL fixtures may be direct-wired with non-metallic cable or flexible metal conduit using the 3/8" die-cast fitting supplied with the fixture. Connect at knockouts located at rear and ends of fixture.

**Portable** To install as a portable fixture, use the 3-wire grounded cord & plug (ULH-CP sold separately).

**Optional Direct Wire** Optional direct wire module (ULH-DWM sold separately) facilitates code-compliant installation of fixture at front edge of cabinetry. Supplied with 36" field-shortenable jumper cord to bring power to fixture.



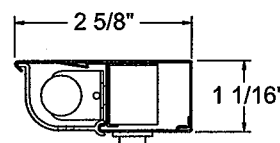
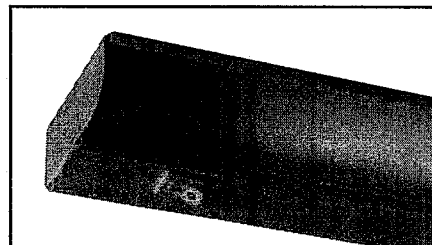
## PRODUCT CODES

Catalog Number	Finish	Overall Length	Lamp
UFL12-WH	Appliance White	12 3/16"	8W T5
UFL12-SL	Silver	12 3/16"	8W T5
UFL22-WH	Appliance White	22 3/4"	14W T5 HE
UFL22-SL	Silver	22 3/4"	14W T5 HE
UFL34-WH	Appliance White	34 1/2"	21W T5 HE
UFL34-SL	Silver	34 1/2"	21W T5 HE
UFL46-WH	Appliance White	46 5/16"	28W T5 HE
UFL46-SL	Silver	46 5/16"	28W T5 HE

\* 8W T5 tri-phosphor lamp rated at 7,500 hours.

REV-2/04

## DIMENSIONS



## ENGINEERING DATA

	UFL12	UFL22	UFL34	UFL46
Total input power (watts)	8.4	15.3	22.1	30.3
Total Operating AMPS	.13	.23	.32	.45
Power Factor	.52	.53	.57	.56

## MAXIMUM ENERGY EFFICIENCY:

8 watts = 40 watts halogen

14 watts = 75 watts halogen

21 watts = 100 watts halogen

28 watts = 150 watts halogen

## ACCESSORIES

Catalog No.	Description
ULH-CONN	3/8" Miniature Die-Cast Electrical Connector
ULH-CP-WH,-BL	3-Wire Grounded Cord & Plug
ULH-DWM-WH,-BL	Direct Wire Module

# UNDERCABINET LIGHTING

DIRECT WIRE FLUORESCENT

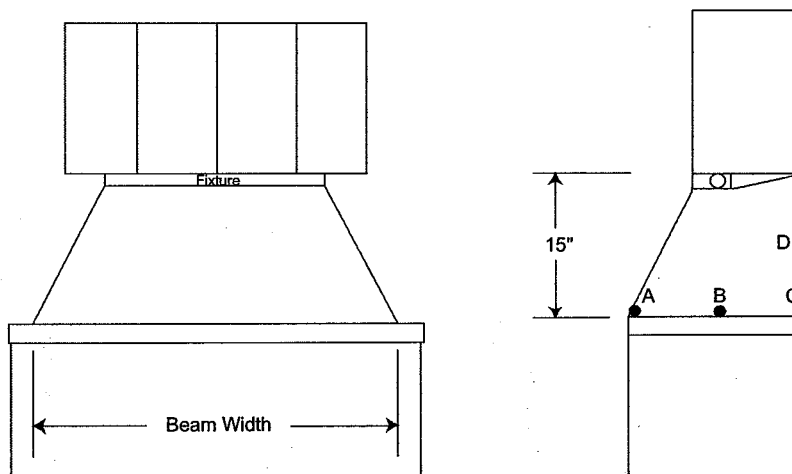
8W, 14W, 21W & 28W

T5 HE Fluorescent Lamps

## LIGHTING APPLICATION DATA

## UFL12, UFL22, UFL34 and UFL46

### FOOTCANDLES ON HORIZONTAL WORK SURFACE



Footcandles						
Cat #	Lamp	*Beam Width	A	B	C	D
UFL12	8-watt T5	24"	32	77	68	93
UFL22	14-watt T5 HE	31"	64	135	130	157
UFL34	21-watt T5 HE	41"	66	140	131	140
UFL46	28-watt T5 HE	50"	83	171	166	170

\*Beam width defined as 50% of maximum footcandles

Rear wall reflectance 50%

Counter Surface Reflectance 20%

8 watts equivalent to 40 watts of halogen

14 watts equivalent to 75 watts of halogen

21 watts equivalent to 100 watts of halogen

28 watts equivalent to 150 watts of halogen



**Juno** lighting

1300 S. Wolf Road, P.O. Box 5065, Des Plaines, IL 60017-5065 Phone 847.827.9880 FAX 847.827.2925  
220 Chrysler Dr., Brampton, Ontario, Canada, L6S 6B6 Phone 905.792.7335 FAX 905.792.0064

Visit us at [www.junolighting.com](http://www.junolighting.com)

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P8 - kirschendownlight - round

# METROPOLI

Alberto Meda, Paolo Rizzato, Riccardo Sarfatti 1992

1994

Ceppas d'Oro

TYPE P8

CEILING/WALL

D20

Die-cast aluminum body:  
white, anthracite, alu, polished aluminum.  
Moulded glass or polycarbonate diffuser.  
Each of the four dimensions provides a specific  
range of interchangeable optics for fluorescent,  
incandescent, halogen lighting.

**D20/56**



1,2" / 3,5 cm.

4,8" / 12,5 cm.

Ø 22"  
Ø 56 cm.

**D20/38**



1" / 2,5 cm.

4" / 9,5 cm.

Ø 15"  
Ø 38 cm.

**D20/27**



0,8" / 1,5 cm.

3,4" / 8,5 cm.

Ø 10,6"  
Ø 27 cm.

**D20/17**



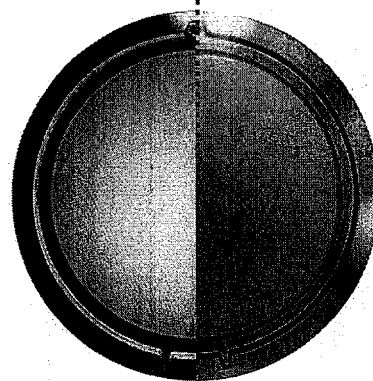
0,8" / 1,5 cm.

2,4" / 6,5 cm.

Ø 6,7"  
Ø 17 cm.

MOULDED GLASS  
code G

POLYCARBONATE  
code P-PW



60W G16<sup>1/2</sup>  
candelabra base

60/100W A-19  
soft white  
medium base

150W A-21  
soft white  
medium base

75/100W  
T-10 halogen  
medium base

15/23W  
EL Fluo  
medium base

9W DTT  
G23-2

13W DTT  
GX23-2

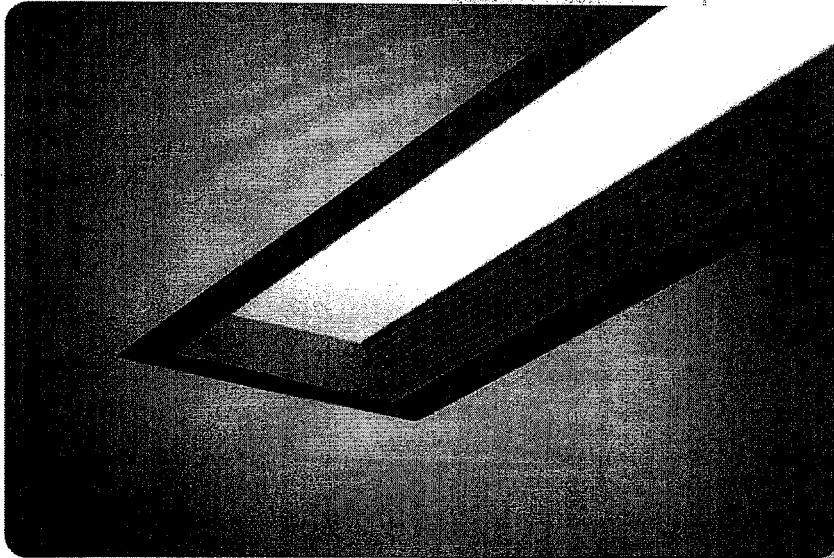
26W DTT  
G24d-3



For more detailed  
information on listed  
products refer  
to the price list.

MORNINGSTAR

# avenue® b



## FEATURES

Narrow 3" slot T5 fluorescent with opaque satin lens.

Shielding options include corrugated, solid regressed trim, concave louver as well as flush lens.

Universal mounting allows compatibility for multiple grid types.

Drywall installation is available, which allows for both individual or continuous row mount capability.

Avenue® B is a great solution for general illumination in a narrow aperture.

## shielding options



corrugated regressed trim

solid regressed trim

concave louver



flush lens

## companion luminaire

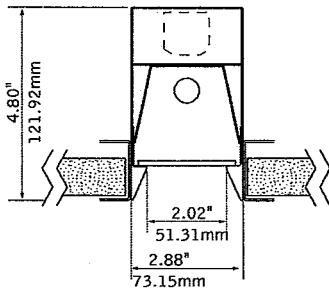


mr16

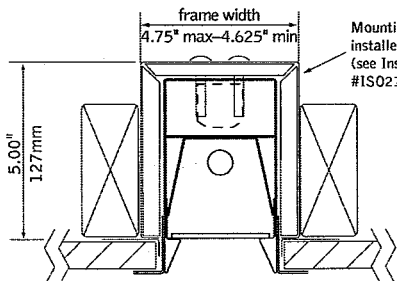
linear

## DIMENSIONAL DATA

### Grid Mount (Regress Trim Shown)

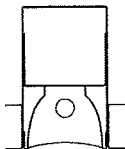


### Drywall Flange (Regress Trim Shown)

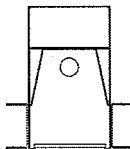


Mounting yoke must be installed before drywall. (see Instruction Sheet #IS0217 for details)

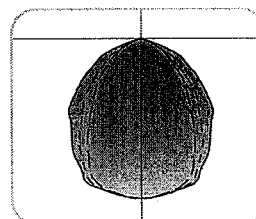
Louver



Flush Lens



## PERFORMANCE



1-Lamp T5  
62% Efficiency  
1466 cd @ 0°

See Photometric section for additional performance data.

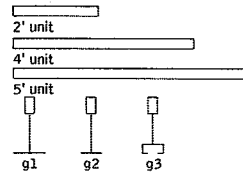


fixture type: P9  
project name: MorningStar Home

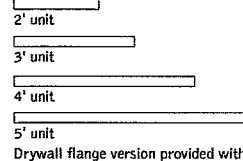
TYPE P9

## DETAILS

### grid



### drywall



## SPECIFICATIONS

### construction

One-piece 20 Ga. steel housing  
Corrugated and solid regress trim constructed of 6063-T5 extruded aluminum finished in Matte Satin White.  
Grid luminaires include 20 Ga. steel, .5" wide universal flange rail finished in Matte Satin White.  
Drywall flange option is provided with 20 Ga. steel, .5" wide flange kit and 20 Ga. galvanized steel mounting yoke.  
Surface mount 20 Ga. housing is also available.

2' unit weight:	5 lbs.
3' unit weight:	6 lbs.
4' unit weight:	7 lbs.
5' unit weight:	8 lbs.

### optic

22 Ga. steel reflectors finished in High Reflectance White powder coat.  
Acrylic lens diffuser .118" thick, frosted clear.  
Concave parabolic louver: 1"H x 1" frequency fabricated of low iridescent, semi-specular premium grade aluminum.  
Louvers can be specified with matte white finish.

### electrical

Luminaires are individually wired for specified circuits.  
Thru-wiring not available.  
Electronic ballasts are thermally protected and have a Class "P" rating.  
Optional DALI and other dimming ballasts available.  
Consult factory for dimming specifications and availability.  
UL and cUL listed.

### emergency

Emergency battery packs provide 90 minutes of illumination.  
Initial lumen output for lamp types are as follows:

T5 Lamp:	Up to 550 lumens
T5H0 Lamps:	Up to 825 lumens

Battery pack requires unswitched hot from same branch circuit as AC ballast.

### finish

Polyester powder coat applied over a 5-stage pre-treatment.  
Standard luminaire housing finished in Matte Satin White.

## ORDERING

luminaire series FAVB  
Avenue B FAVB

shielding FL  
Corrugated Regressed Trim with Lens CR  
Solid Regressed Trim with Lens SR  
Flush Lens FL  
Concave Parabolic Louver PL  
White Concave Parabolic Louver PW

lampping 1T5H0  
One Lamp T5 1T5  
One Lamp T5H0 1T5H0

circuits 1C  
Single Circuit 1C

voltage 120  
120 Volt 120  
277 Volt 277  
347 Volt 347  
(Consult factory for availability)

ballast S  
Electronic Program Start <10% THD S  
Electronic Dimming Ballast D  
(Consult factory for dimming availability)

mounting F  
15/16" Grid G1  
9/16" Grid G2  
9/16" Slot Tee G3  
Drywall Flange F  
Out out dimensions:  
2' 3.5" x 23.6"  
3' 3.5" x 35.6"  
4' 3.5" x 47.6"  
5' 3.5" x 59.6"

factory options CP  
Chicago Plenum CP  
Emergency Circuit EC  
Emergency Battery Pack EM  
(3' & 4' Luminaires Only)  
Seismic Brackets EQ  
HLR/GLR Fuse FU  
Include 3000K Lamp L830  
Include 3500K Lamp L835  
Include 4100K Lamp L841

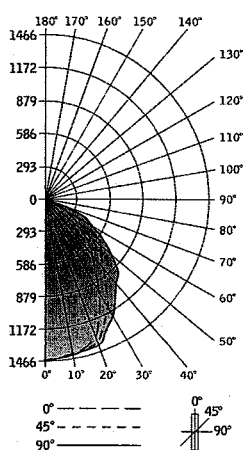
finish WH  
Matte White Housing WH

luminaire length 2'  
2' Nominal Housing 2'  
3' Nominal Housing 3'  
4' Nominal Housing 4'  
5' Nominal Housing 5'  
(Dimming not available with 5' lamps)  
(For continuous row mount in drywall ceiling, specify luminaire run length, ie 24')



regress with lens  
avenue® b

## CANDLEPOWER DISTRIBUTION



Spacing 1.2  
Criterion: 1.1

Vertical Angle	0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1466	1466	1466	1466	1466	
5°	1457	1457	1456	1456	139	
15°	1432	1428	1417	1399	1393	401
25°	1311	1299	1254	1187	1150	575
35°	1102	1073	958	837	793	599
45°	934	866	701	586	553	565
55°	649	578	426	357	335	416
65°	404	328	232	187	174	257
75°	184	133	77	60	58	103
85°	39	21	19	18	17	24
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	0

## LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt
0°-30°	1115	22.3	36.2
0°-40°	1714	34.3	55.7
0°-60°	2695	53.9	87.5
0°-90°	3078	61.6	100.0
Total Luminaire	3078	62	100.0

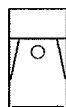
## LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	16467	12359	9750
55°	14106	9259	7281
65°	11918	6844	5133
75°	8863	3709	2794
85°	5579	2718	2432

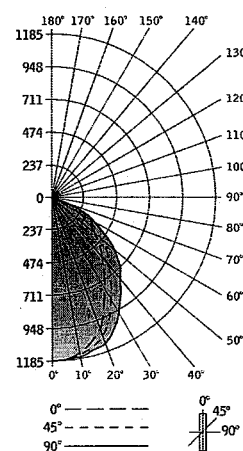
## CO-EFFICIENTS OF UTILIZATION

Floor	80	70	20	30	10	00
Ceiling	70	50	30	10	50	10
Wall	70	50	30	10	50	10
RCR 0	73	73	73	73	72	72
1	68	66	64	62	67	65
2	63	59	56	53	62	58
3	59	53	49	46	56	51
4	54	48	43	40	51	45
5	50	43	38	35	46	39
6	46	39	34	31	41	34
7	43	35	31	27	37	30
8	40	32	27	24	34	27
9	37	29	24	21	30	23
10	34	26	22	19	28	21

Numbers indicate percentage values of reflectivity.

flush lens  
avenue® b

## CANDLEPOWER DISTRIBUTION



Spacing 1.2  
Criterion: 1.0

Vertical Angle	0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1187	1187	1187	1187	1187	
5°	1182	1182	1178	1176	1113	
15°	1158	1150	1126	1102	1091	319
25°	1053	1030	696	914	891	450
35°	870	835	749	684	660	476
45°	706	660	571	516	498	455
55°	478	444	383	349	338	355
65°	291	269	234	218	213	242
75°	133	124	111	106	105	122
85°	28	29	28	28	28	31
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	0

## LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt
0°-30°	881	17.6	34.4
0°-40°	1357	27.1	53.0
0°-60°	2168	43.4	84.6
0°-90°	2561	51.2	100.0
Total Luminaire	2561	51	100.0

## LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	12448	10067	8780
55°	10390	8325	7347
65°	8584	6903	6283
75°	6406	5347	5058
85°	4005	4005	4005

## CO-EFFICIENTS OF UTILIZATION

Floor	80	70	20	30	10	00
Ceiling	70	50	30	10	50	10
Wall	70	50	30	10	50	10
RCR 0	61	61	61	61	57	57
1	57	55	53	51	54	49
2	52	49	46	43	46	42
3	48	44	40	37	41	36
4	45	39	35	32	37	32
5	41	35	31	28	33	27
6	38	32	28	25	30	24
7	35	29	25	22	27	21
8	33	26	22	19	25	19
9	30	23	19	17	22	16
10	28	21	17	15	21	15

Numbers indicate percentage values of reflectivity.

Go to [www.focalpointlights.com](http://www.focalpointlights.com) for additional photometric data.



## Wall and ceiling luminaires

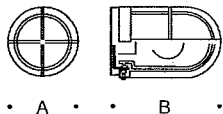
**Housing:** One piece die cast aluminum supplied with universal mounting bracket for direct attachment to 3½" or 4" octagonal wiring box.

**Enclosure:** Hand blown three-ply opal glass with screw thread neck, fully gasketed for weather tight operation using a molded silicone rubber O-ring. One piece die cast aluminum guard, secured by captive socket head, stainless steel screws threaded into stainless steel inserts. Interior of lamp compartment painted gloss white.

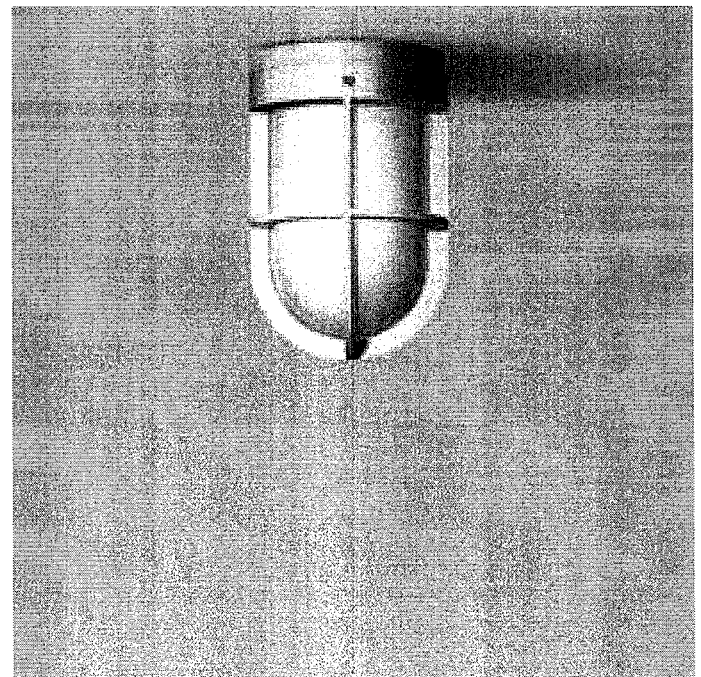
**Electrical:** Lampholder: Fluorescent is type G23-2 (9W), rated 75W, 250V. Ballast: Compact fluorescent is magnetic available in 120V, HPF or 277V, NPF - specify.

**Finish:** These luminaires are available in five standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV); Eurocoat™ (URO). To specify, add appropriate suffix to catalog number. For complete description of BEGA finishing process, refer to technical information section at end of catalog. Custom colors supplied on special order. U.L. listed, suitable for wet locations. Protection class: IP 65.

Type: P10  
BEGA Product #: 2839P  
Project: MorningStar Home  
Voltage: 120 V  
Color: SLV  
Options:  
Modified:



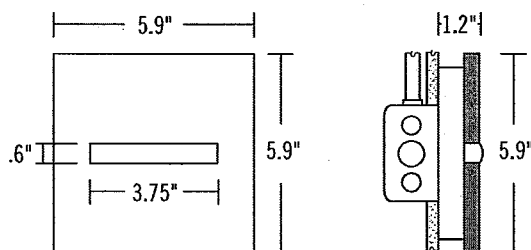
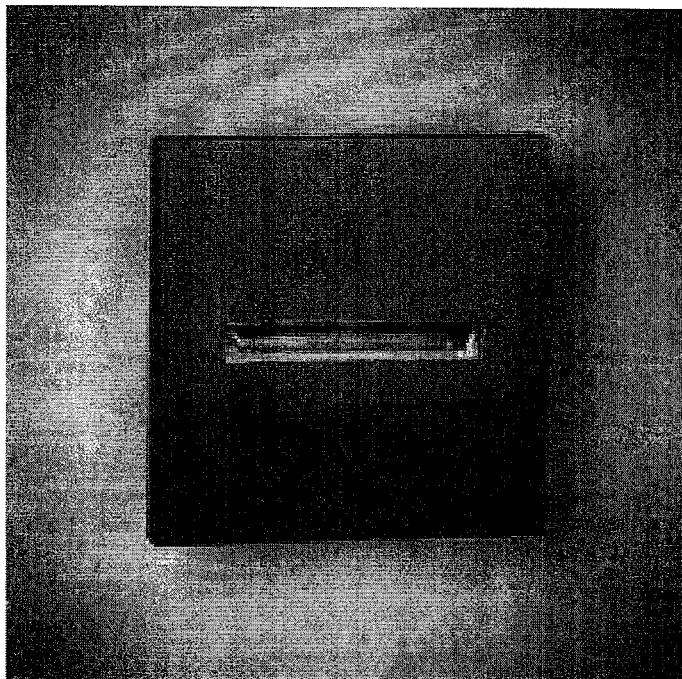
Wall or ceiling luminaires with die cast aluminum guard. Three-ply opal glass with screw neck. U.L. listed, suitable for wet locations. IP 65. Color: Standard BEGA finishes.



	Lamp			Lumen	A	B
<b>2839P</b>	Wall + Ceiling	1	9W CF quad-2p	525	5½	9⅞

# plane

step light



## Application

These configurations of the plane step light offer a variety of different color combinations for edge glow accents and functional pathway lighting. For use in exterior and interior architectural applications.

- plane mounts directly to a junction box for wall mount applications. UL Listed for wet / damp locations. Refer to page 14 for mounting details.

## Light Output

plane delivers illuminance levels that exceed the National Electrical Codes (NEC) requirement for emergency egress. Recommended mounting 18" to 24" A.G. IES format photometric data available on io's website.

## Construction

Environmentally sealed, enclosed and gasketed 5.9" sq. corrosion resistant zinc casting (stainless steel optional). Mounts directly to a UV stable, optically clear, high strength polycarbonate housing. LED luminaire modules contained within the housing are replaceable.

## Electrical

120V or 277V energy saving current limiting Class 2 power supply (driver) is located within a 1 1/2" or 2 1/8" deep, 4" octagonal junction box. Emergency battery back up requires a 4" square, 2 1/8" deep junction box.

## Power Consumption

- standard: 9.75 w

## Step Optic

Precision molded polycarbonate lens with superior optical properties offers a 90° cutoff with a 70% fixture efficiency.

## Finish

Zinc face plate may be polyester powder coated or plated. Plated finishes are for interior applications only. Face plate may also be specified in stainless steel.

## Emergency

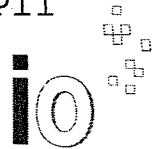
Bodine's AC/Emergency LED driver, "Odyssey," has been designed for the plane step light specifically.

The center portion of the plane step light will illuminate for 90 minutes at full light output during emergency operation. This combination driver/battery back-up must be installed in a standard 4" square, 2 1/8" deep junction box. plane mounts directly to this junction box with an io supplied mounting bracket. A single-pole push-button test switch and LED charging indicator light are also provided. See page 14 for further details.

# plane

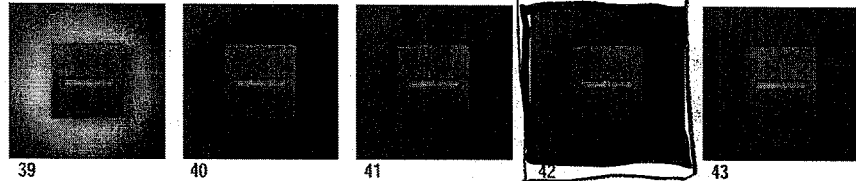
step light

TYPE P11

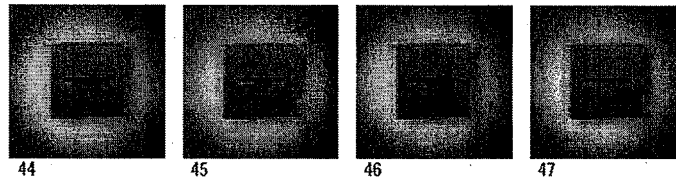


## Color Options

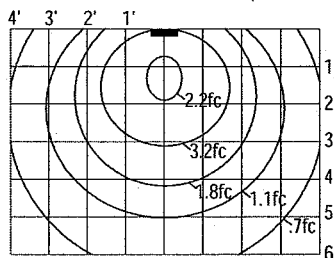
- 39 White 360° | White Step Light  
 40 Red 360° | White Step Light  
 41 Green 360° | White Step Light  
 42 Blue 360° | White Step Light  
 43 Amber 360° | White Step Light



- 44 White 360° | Red Step Light  
 45 White 360° | Green Step Light  
 46 White 360° | Blue Step Light  
 47 White 360° | Amber Step Light



## Light Output



Note: mounting height  
24" above grade.

## Order Code

0 io	01 Plane	42 Configuration	100 Mounting	8 Finish	0 Voltage	Emergency Battery Back-up	Emergency Test Switch Finish
		39 White 360°   White Step Light	100 J-Box	Zinc Casting (Painted)	0 120v	EM	W White (standard)
		40 Red 360°   White Step Light	999 Custom	1 Black	1 277v		B Black
		41 Green 360°   White Step Light		2 Bronze	Note: Dimming not available	Note: leave blank if not applicable	SA Stain Aluminum*
		42 Blue 360°   White Step Light		3 Satin aluminum			SN Plated Satin Nickel*
		43 Amber 360°   White Step Light		4 White			CH Plated Chrome
		44 White 360°   Red Step Light		Zinc Casting (Plated)			* Consult factory for availability
		45 White 360°   Green Step Light		Interior Applications Only			
		46 White 360°   Blue Step Light		5 Satin Nickel			
		47 White 360°   Amber Step Light		6 Chrome			
		94 Custom		7 Satin brass			
				Stainless Steel			
				8 Brushed			
				Custom Color			
				9 Custom			





PIR motion sensor

TYPE P11

# EN Outdoor Motion Sensor

Raintight and weatherproof

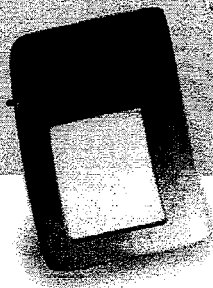
Rated for use in temperature range of -40°-130°F

90 degree or long-range field of view

Operates on line voltage; mounts to standard outdoor junction box

Adjustable light level and time delay settings

Isolated relay enables interface with security systems or other loads



PROJECT	MorningStar Home
LOCATION/TYPE	For use with fixture type P11

## Product Overview

### Description

Watt Stopper/Legrand's EN sensors offer dependable occupancy based lighting control outdoors and under harsh conditions. Indoors, the sensors perform well where damp conditions or line voltage requirements exist. The sensors are raintight and rated for temperatures of -40°F to 130°F.

### Operation

The EN sensors operate at line voltage. Utilizing advanced PIR technology, the sensors detect the difference between infrared energy in motion and the background space, and will turn lighting on when a person or vehicle enters the coverage area. After the area is vacated and the time delay elapses, lighting automatically turns off. A built-in photocell allows the user to set the light level at which motion detection will turn lights on.

### Line Voltage

With their low-profile, aesthetic design, the EN sensors offer a line voltage choice for damp conditions or outdoors, where low voltage may not be practical or desirable. They can be mounted onto a standard, outdoor junction box in a range of locations such as walls, ceilings, eaves, or over doorways.

### Applications

EN sensors are ideal for control of outdoor lighting in areas such as walkways, entryways, or dock lighting, and over doorways. Optimal indoor applications include corridors, doorways, entrances, and warehouses. The 90° coverage pattern is ideal for open work areas in applications such as food processing plants or greenhouses. The narrow long-range coverage pattern is suitable for corridors or aisles.

## Features

- Sensors can be mounted on walls, eaves, or ceilings for installation convenience
- Two coverage patterns for broad applicability
- Precision, double-shot tooling with internal silicon gaskets prevents water and dust contamination
- Optional override-ON to turn lights on remotely for the length of the time delay
- ON/OFF control based on daylight levels via adjustable light level setting
- ASIC enhances reliability and helps to eliminate false triggers
- Zero crossing circuitry reduces stress on the relay and results in increased sensor life
- Pulse Count Processing eliminates false triggers and provide RFI and EMI immunity
- Patented Voltage Drop Protection
- Solid state digital microprocessor offers increased reliability
- User-adjustable time delay from 12 seconds to 16 minutes

www.wattstopper.com  
800.879.8585





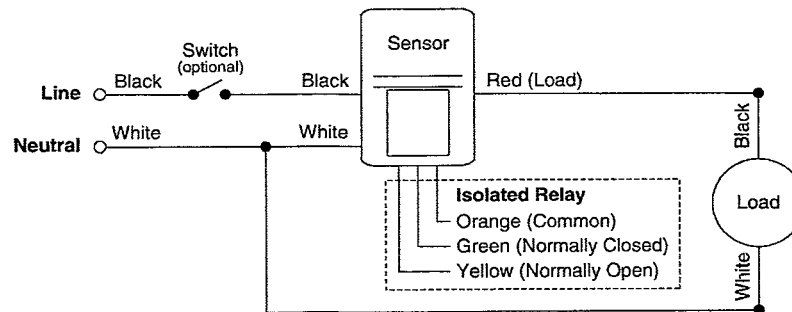
# EN Technical Information

## Specifications

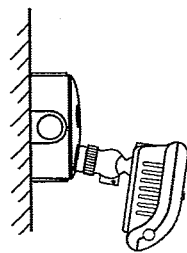
- Operating temperature range -40°F to +130°F
- UL 773A rated raintight
- 120 VAC or 277 VAC, 60 Hz operation
- EN-100 series provides 90° coverage; EN-200 series provides narrow long-range coverage
- Adjustable light level adjustment of .4 to 42 footcandles (4.3 - 452.1 lux)
- 3/4" threaded nipple fits standard NEMA weatherproof fixture fitting
- Single-pole, double throw isolated relay
- Compatible with all electronic ballasts and PL lamp ballast systems for broad applicability
- Dimensions: 4.3" x 3.0" x 2.3" (110mm x 77mm x 58mm)
- UL and CUL listed; Five year warranty

## Wiring & Mounting

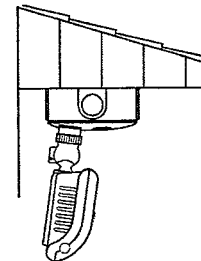
### Wiring Diagram



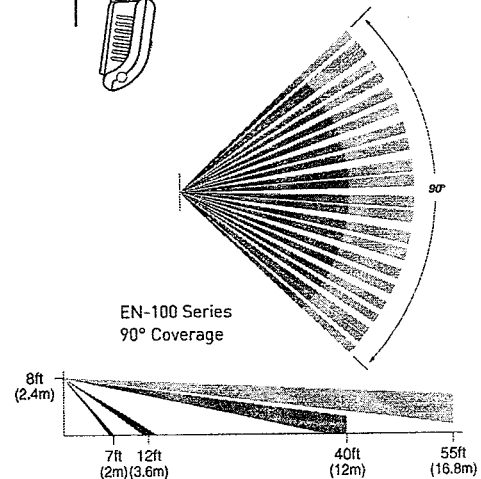
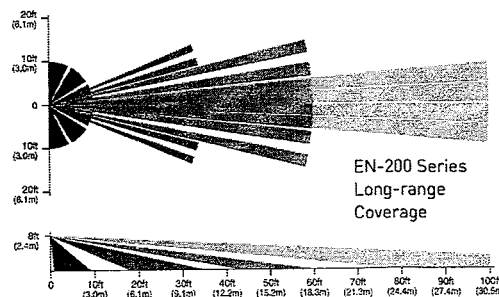
### Wall or Pole Mounting



### Ceiling/Eave Mounting



## Coverage



## Ordering Information

Catalog No.	Color	Voltage	Load Requirement	Coverage
<input type="checkbox"/> EN-100-120-W	Arctic white	120 VAC; 60 Hz	0-1000W ballast or tungsten	90°
<input checked="" type="checkbox"/> EN-100-120-G	Arch. grey			
<input type="checkbox"/> EN-100-277-W	Arctic white	277 VAC; 60 Hz	0-1000W ballast	90°
<input type="checkbox"/> EN-100-277-G	Arch. grey			
<input type="checkbox"/> EN-200-120-W	Arctic white	120 VAC; 60 Hz	0-1000W ballast or tungsten	Long-range
<input type="checkbox"/> EN-200-120-G	Arch. grey			
<input type="checkbox"/> EN-200-277-W	Arctic white	277 VAC; 60 Hz	0-1000W ballast	Long-range
<input type="checkbox"/> EN-200-277-G	Arch. grey			

Watt Stopper/Legrand®  
Pub. No. 8304x

Load ratings 1000W incandescent or halogen, 1000W fluorescent

MORNINGSTAR

P12 ext Southwestern

# WinonaLED

## V-LINE GEN3

Type: **P12**

V-Line Gen3 is a high performance linear luminaire with a small profile suitable for illumination of displays, signage, cabinets, and other small areas.

**Light Output:** Up to 200 lm/ft (cool white)

**Construction:** Extruded aluminum body with molded endcaps. Extruded acrylic optic is UV resistant.

**Finish:** Black anodized only. This product is not available in a painted finish. Painting this product will void all warranties.

**Internal Drivers:** Built-In SmartDrivers by i2Systems ensure constant current to each LED enabling uniform brightness from LED to LED and fixture to fixture over a wide input voltage range. The internal drivers can be controlled by an external dimming module for true 0-100% dimming. Dimming module accepts standard 0V-10V signal.

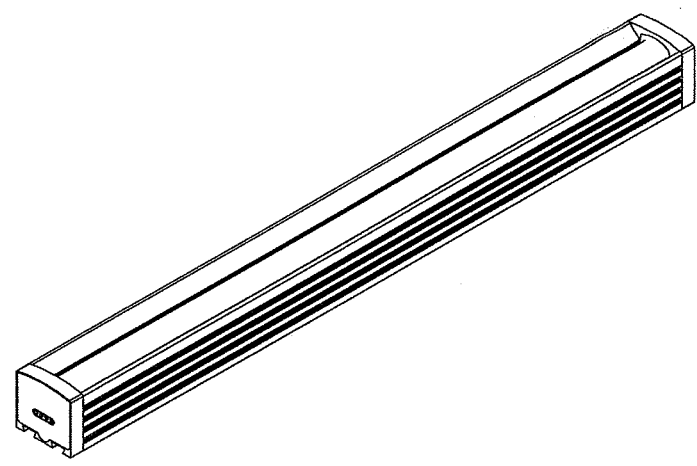
**Available Mounts:** Fixed and adjustable mounting hardware is available.

**Power Requirements:** V-Line Gen3 is powered by a 18V-30V DC power supply sized according to the installation. Power consumption is approximately 8W per linear foot.

**Wiring:** V-Line Gen3 is supplied with 24" long insulated 22GA stranded wire leads.

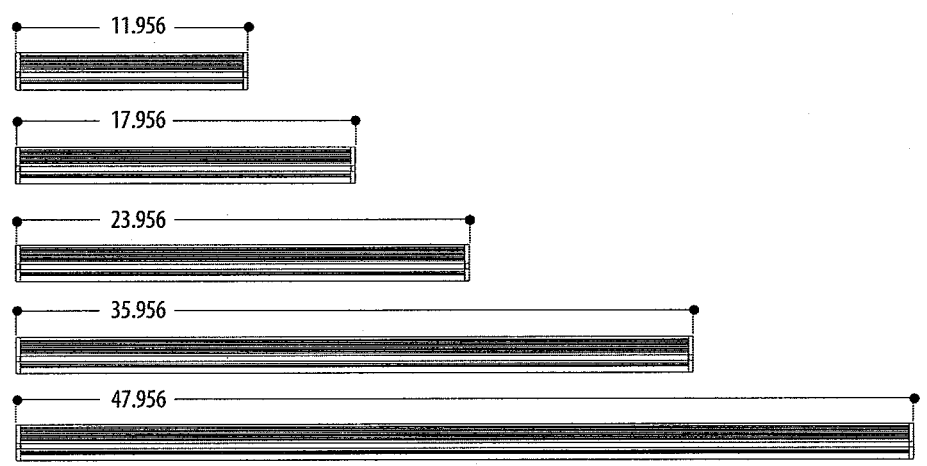
Project Name: **Penn State Solar Decathlon**

Qty: **5**

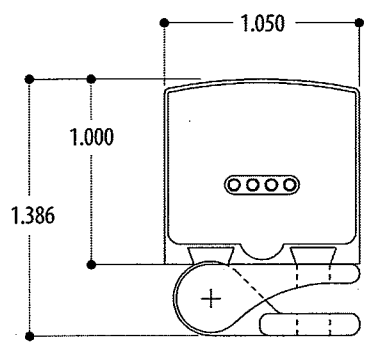


**i2Systems**  
enabLED.

**Available Lengths:** ( 12", 18", 24", 36", 48" )



(UL Listed Dry, Damp, and Wet locations.)

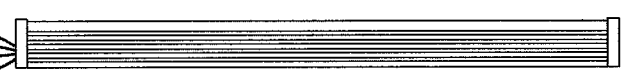


(NOT TO SCALE)

Shown with available **ADJ** adjustable mount.  
**FIX** fixed mount plate is .125" H x 1W" x 2L"

### Wire Codes:

- RED** to power supply 24V positive
- BLACK** to power supply ground
- VIOLET** to dimming module **YELLOW** (if applicable)
- GREY** to dimming module **BLACK** (if applicable)



**LED** — **VL3** — **48** — **30** — **002** — **24V** — **ADJ** — **BLK** — **STD**

**SOURCE** — **MODEL** — **LENGTH** — **BEAM ANGLE** — **LED CODE** — **SUPPLY VOLTAGE** — **MOUNT** — **FINISH** — **SPECIAL**

**MODEL:** VL3 = V-Line Gen3

**LENGTH:**  
12 = 12 INCH  
18 = 18 INCH  
24 = 24 INCH  
36 = 36 INCH  
48 = 48 INCH

**BEAM ANGLE:**  
30 = 30 DEGREE SYMMETRIC  
45 = 45 DEGREE SYMMETRIC  
65 = 65 DEGREE SYMMETRIC  
82 = 82 DEGREE SYMMETRIC

CODE	COLOR	OUTPUT
001	WARM WHITE	NORMAL
002	COOL WHITE	NORMAL
003	AMBER	NORMAL
004	BLUE	NORMAL
005	CYAN	NORMAL
006	GREEN	NORMAL
007	ORANGE	NORMAL
008	RED	NORMAL

**SPECIAL:**  
STD=STANDARD  
MOD=MODIFIED

**FINISH:**  
BLK=BLACK ANODIZED  
(Product cannot be painted. Painting will void warrantee.)

**MOUNT:**  
ADJ=ADJUSTABLE  
FIX=FIXED

**SUPPLY VOLTAGE:**  
24V=24V AC

Modifications: (if any) \_\_\_\_\_

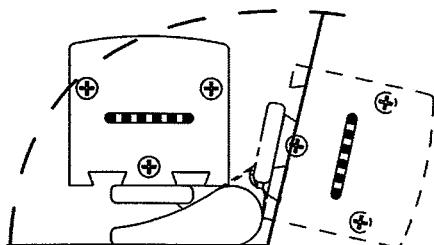
1/16/07

# WinonaLED V-LINE GEN3

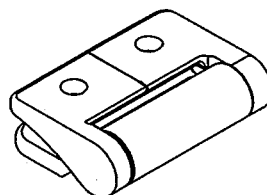
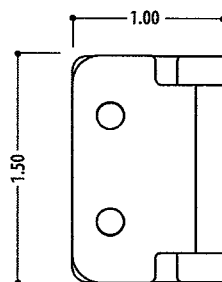
## MOUNTING OPTIONS

V-Line GEN3 is offered with either fixed or adjustable mounts. Both mounts have been engineered for maximum installation flexibility.

### GEN3 ADJUSTABLE MOUNT



95 DEGREES OF  
ADJUSTMENT



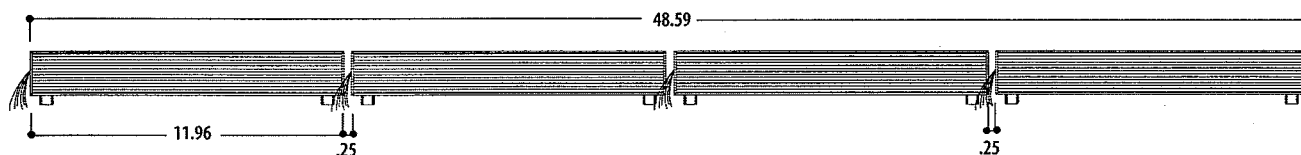
Adjustable mount allows easy installation and adjustment of individual GEN3 luminaires.

1. Die cast aluminum construction.
2. Each hinge rated at eight pounds force.
3. Fastens to GEN3 via 8-32 screws.
4. Mount holes located at six inch o.c. along back of luminaire.
5. Matte black finish.

How to determine headline: "Run Lengths"

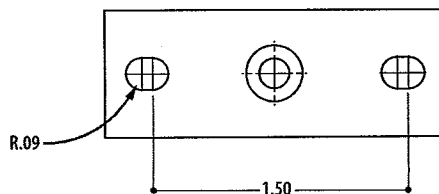
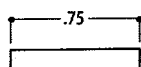
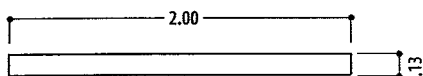
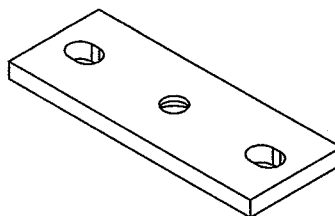
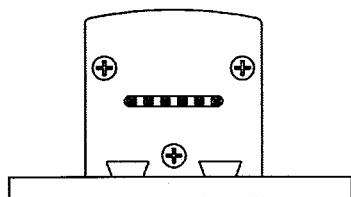
1. Add length of all luminaires.

2. Add an equal number of gaps (.25" each) for wires.



$$11.96 + .25 + 11.96 + .25 + 11.96 + .25 + 11.96 = 48.59$$

### GEN3 FIXED MOUNT



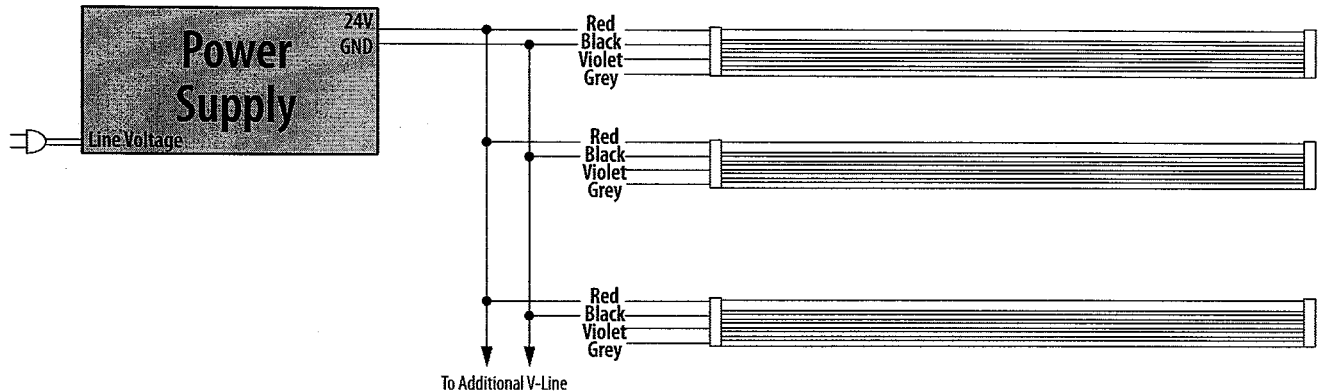
The fixed mount is a quick and easy method of mounting GEN2 to any surface when field adjustment is not required. Features include:

1. Solid aluminum construction.
2. Fastens to GEN3 via 8-32 screws.
3. Holes on back at six inch o.c.
4. Matte black finish.

V-Line Gen3 is optimized for an 18V-30V DC power source only. (Do not connect directly to line voltage under any circumstance.) Connection to line voltage will permanently damage internal components and void manufacturer's warranty.

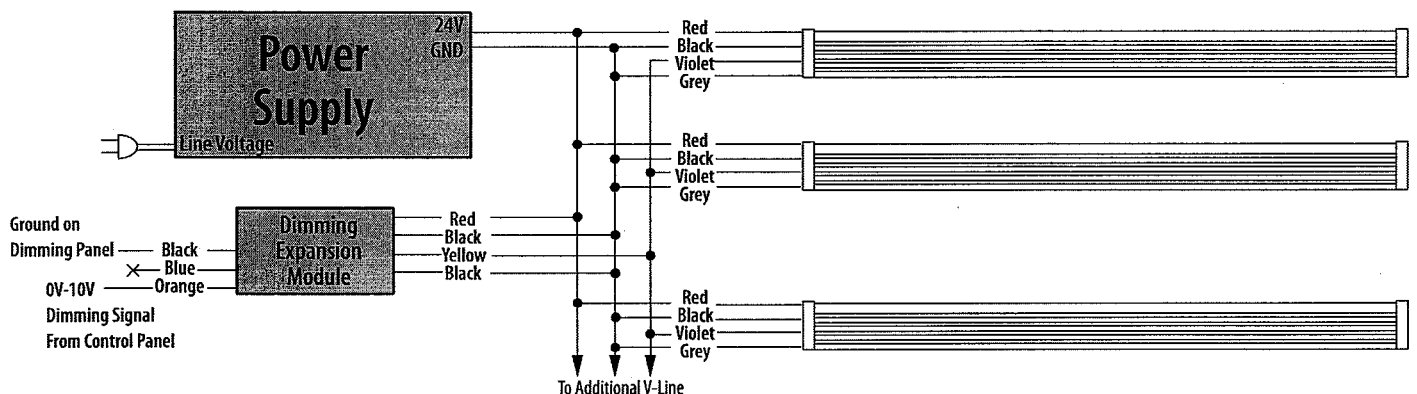
## Wiring Diagram for Non-Dimming Installations

Connect Gen3 RED wire(s) to power supply 24V Positive terminal.  
Connect Gen3 BLACK Wires to power supply GND terminal.  
On non-dimming installations the Violet and Grey wires are not used and can be left unconnected but covered.



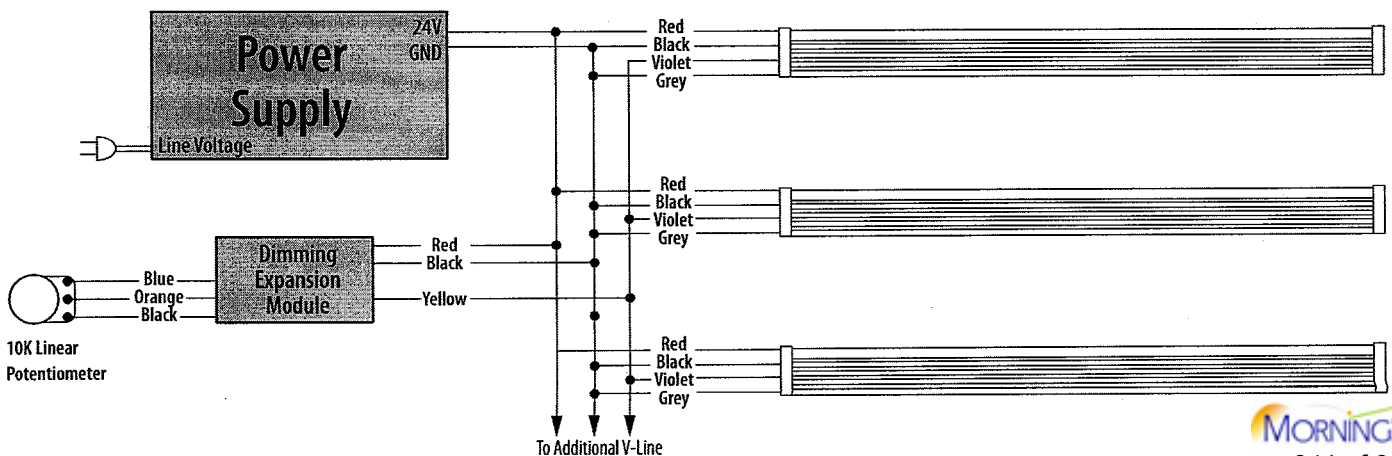
## Wiring Diagram for Panel Controlled Dimming Installations - NOTE! Requires a 0V-10V Source Signal.

Connect Gen3 RED wire(s) to power supply 24V Positive terminal.  
Connect Gen3 BLACK wire(s) to power supply GND terminal.  
Connect Gen3 VIOLET wire to Dimming Expansion Module YELLOW.  
Connect Gen3 GREY wire to Gen3 BLACK wire.  
Connect Dimming Expansion Module ORANGE to 0V-10V dimming signal from control panel.  
Connect Dimming Expansion Module BLACK to Dimming Panel Ground.



## Wiring Diagram for Potentiometer Controlled Dimming Installations

Connect Gen3 RED wire(s) to power supply 24V Positive terminal.  
Connect Gen3 BLACK wire(s) to power supply GND terminal.  
Connect Gen3 VIOLET wire to Dimming Expansion Module YELLOW.  
Connect Gen3 GREY wire to Gen3 BLACK wire.  
Connect Dimming Expansion Module ORANGE to center lug of 10K potentiometer.  
Connect Dimming Expansion Module BLUE to outer lug of 10K potentiometer.  
Connect Dimming Expansion Module BLACK to outer lug of 10K potentiometer.

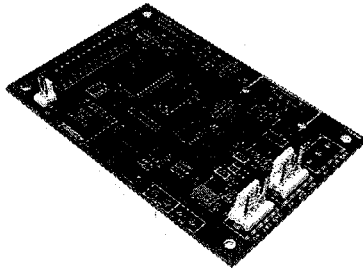




# (LED iColorCoreQL PDM-201 Power Supply)



## PDM-201



Color Kinetics® PDM-201 is a Series 200 power/data module. PDM-201 allows product designers to easily integrate the Series 200 digital light engines (DLEs) and lamps with a variety of available power supplies. By supporting 7.5VDC, 12VDC, or 24VDC power input, the PDM-201 supports standard power supplies in a variety of configurations which allows several power and data distribution options. The simple design allows you to combine it with a power supply or integrate it directly into a light fixture. The total number of DLEs that a single PDM-201 can drive is dependent on the wattage of each DLE.

PDM-201 data circuitry conditions data supplied from standard or differential DMX data inputs or from on-board preprogrammed settings to a format compatible with Series 200 DLEs based on Chromasic™ technology. The Chromasic microchip integrated into each Series 200 DLE integrates power, communication, and control to enable the Series 200 system.

PDM-201 offers a choice of controls including Color Kinetics or third-party controllers, or preprogrammed effects. The preprogrammed effects include fixed color, color wash, rainbow wash, and random color. The 12 dipswitches allows selection the effect mode, and then modification of the effect by setting the speed, color, etc.

### FEATURES

- Economical
- Compact size
- Ease of installation
- DMX ready
- Choice of preprogrammed light effects
- Support automatic and manual configuration of number of lights per output

### PDM-201 ITEM# 118-000062-00

Applications using this technology or product may be covered under one of the following patents:  
U.S. Patent Nos. 6,016,038, 6,150,774 and other patents listed at <http://colorkinetics.com/patents/>.  
Other patents pending.

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BR0164 Rev 01

Specifications subject to change without notice.

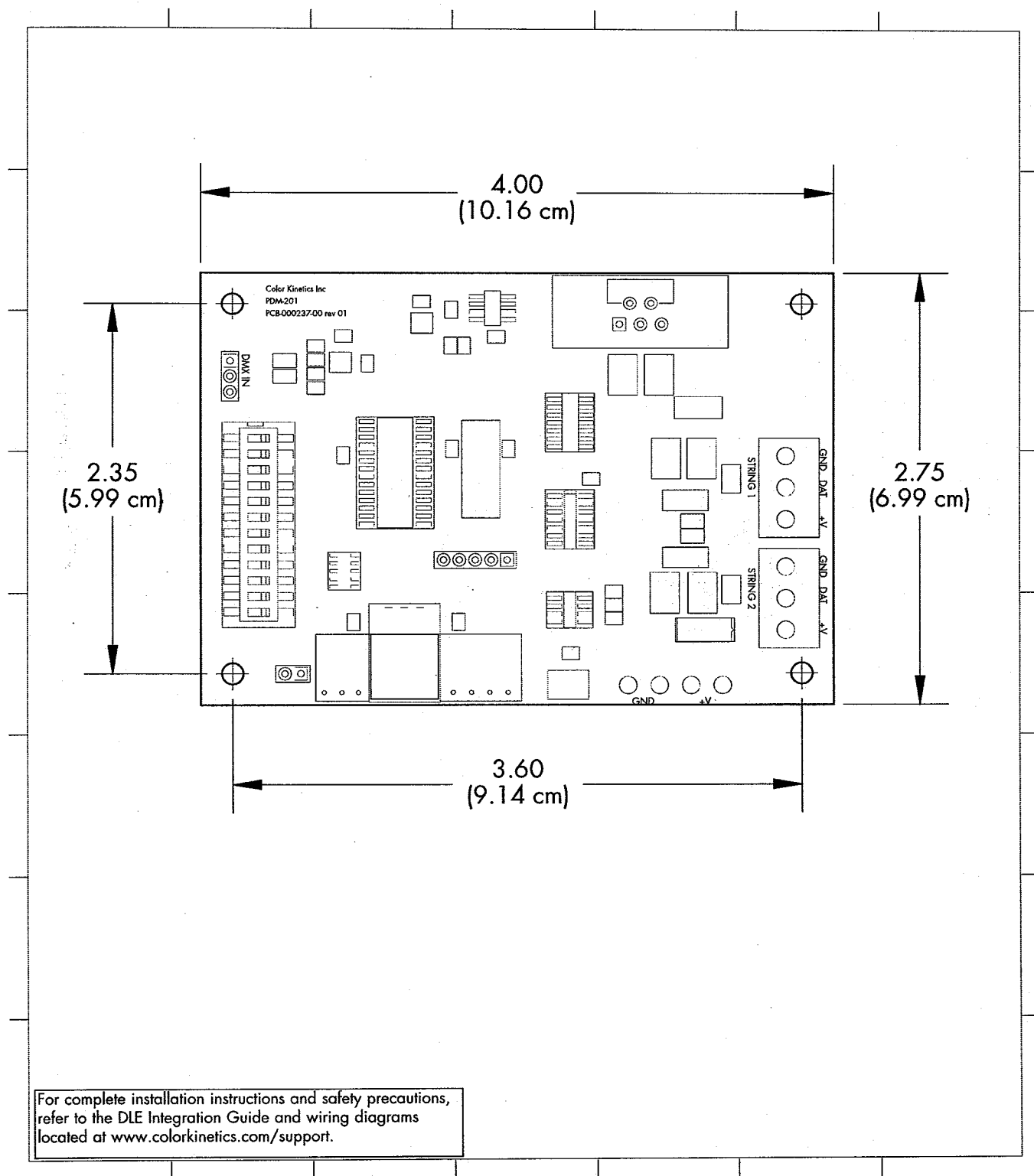
### PDM-201 SPECIFICATIONS

POWER INPUT	7.5VDC, 12VDC, or 24VDC
POWER OUTPUT	7.5VDC, 12VDC, or 24VDC
AMBIENT OPERATING TEMP	14°F to 122°F (-10°C to 50°C)
CONNECTORS	Output: 3-pin vertical header, Power: solder pads
DATA INPUT INTERFACE	DMX512
DATA OUTPUT INTERFACE	Chromasic

### U.S. AND FOREIGN PATENTS AND PATENTS PENDING

# PDM-201

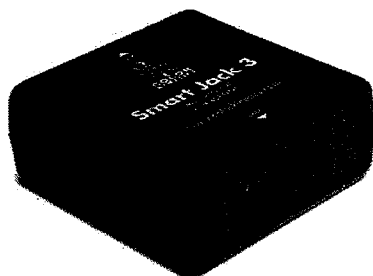
## PHYSICAL DIMENSIONS



# LED Color Kinetics iColor® OverL Controller



## SMART JACK 3 ADAPTER



Color Kinetics® Smart Jack 3 Adapter allows for control of up to 170 Color Kinetics light addresses – a full DMX512 universe from a personal computer. Smart Jack 3 Adapter is ideal for applications that can be controlled via a PC and used in conjunction with customized software. Users can develop customized software with Controller SDK, which can be downloaded from Color Kinetics website at [www.colorkinetics.com/support](http://www.colorkinetics.com/support). Controller SDK requires knowledge of the DMX512 protocol and is primarily intended for use by Color Kinetics partners and software developers.

Additionally, Smart Jack 3 Adapter can be used to simulate shows authored in ColorPlay®, Color Kinetics light show authoring software, live from a PC to the light fixtures. This live play ability is useful for editing and testing light shows on installations or demonstrating ColorPlay and Color Kinetics light system capabilities/possibilities. Because Smart Jack 3 Adapter does not have the ability to record and playback shows, like iPlayer® 2, it's more economical for some applications.

Smart Jack 3 Adapter communicates to the computer via a USB cable. The device draws power through the USB port, therefore no external power supply is required. Data is then converted and sent to the Color Kinetics installation via a CAT5 data cable.

### SMART JACK 3 ADAPTER SPECIFICATIONS

<b>HOUSING</b>	Black plastic
<b>CABLE REQUIREMENTS</b>	Power/Data in: USB; Data Out: CAT5 with RJ45 connector
<b>SYSTEM REQUIREMENTS</b>	Windows 98 2nd Ed, ME, 2000, XP; or Mac OS X or higher

### FEATURES

- High data rate for true DMX
- Compatible with all Color Kinetics products
- Compact size
- No external power supply required

### SMART JACK ADAPTER SPECIFICATIONS

<b>WEIGHT</b>	2.2 oz (68.4 g)
<b>DATA CONNECTORS</b>	USB data in; RJ45 data out
<b>POWER CONNECTOR</b>	USB
<b>POWER REQUIREMENT</b>	none (powered by USB)
<b>HOUSING DIMENSIONS</b>	
HEIGHT	2.6" (6.6 cm)
WIDTH	2.6" (6.6 cm)
DEPTH	1.1" (2.8 cm)

#### ITEM# 104-000007-00

This product is protected by one or more of the following patents:  
U.S. Patent Nos. 6,016,038, 6,150,774 and other patents listed at  
<http://colorkinetics.com/patents/>. Other patents pending.

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All other brand or product names are trademarks or registered trademarks of their respective owners.

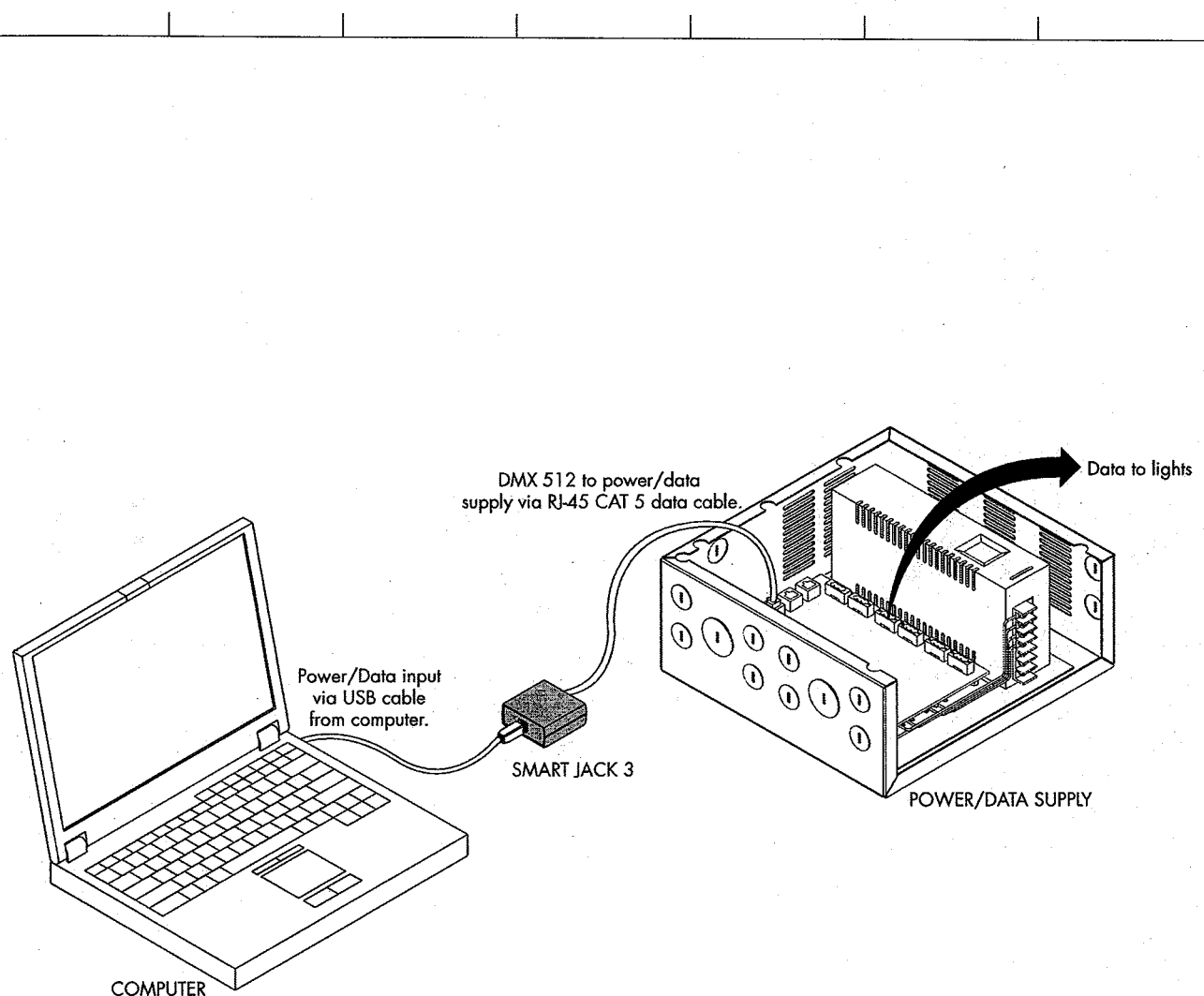
BRO049 Rev 11

Specifications subject to change without notice.

### U.S. AND FOREIGN PATENTS AND PATENTS PENDING

## SMART JACK 3 ADAPTER

### FUNCTIONAL FLOW DIAGRAM



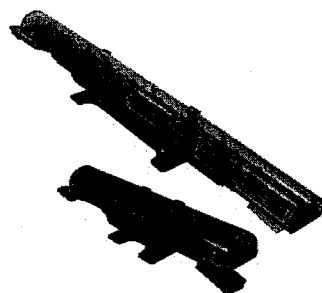
For complete installation instructions and safety precautions, refer to the Smart Jack 3 User Guide and wiring diagrams located at [www.colorkinetics.com/support](http://www.colorkinetics.com/support).



LI



# iCOLOR COVE QL



The iColor® Cove QL fixture is a low-profile LED cove light featuring Chromasic® technology. From large-scale commercial installations to simpler residential applications, iColor Cove QL delivers color-changing illumination and lighting effects to alcoves, task areas, accent areas, and other confined spaces. Employing Chromasic technology, iColor Cove QL has the capability of auto-addressing, which simplifies installation, addressing and programming.

Encased in a vented, molded plastic housing, iColor Cove QL is available in 6" (15cm) and 12" (30cm) lengths with a 100° x 40° beam angle and features in-line power/data connectors that allow a run to turn up to 180°, reducing installation time. The mounting bracket provides 180° aiming rotation.

iColor Cove QL is driven by the Color Kinetics® Chromasic chip, which integrates power, communication, and control. It therefore lowers the overall system cost, making it an affordable alternative for edge and alcove lighting. Each one-foot fixture can be individually controlled or grouped as one address for simplified installation.

Power and data are supplied by sPDS-60ca 24V, a dedicated Color Kinetics power/data supply available for DMX and Ethernet applications, or PDS-60ca 24V for pre-programmed effects. Each power/data supply supports up to 20 12" fixtures or 36 6" fixtures in a single run or divided into two runs. End-to-end is the preferred method of installation. However, jumper cables are available for areas that require spacing.

## iCOLOR COVE QL SPECIFICATIONS

<b>COLOR RANGE</b>	64 billion (36 bit) additive RGB color, continuously variable intensity
<b>SOURCE</b>	High brightness LEDs
<b>BEAM ANGLE</b>	100° x 40°
<b>HOUSING</b>	Rigid, vented plastic housing.

12" L x 1.5" W x 1.4" H (30cm) x (6.8cm) x (3.5cm) (with base)  
6" L x 1.5" W x 1.4" H (15cm) x (6.8cm) x (3.5cm) (with base)

<b>CONNECTORS</b>	Integral 3-pin male/female connectors
<b>LISTINGS</b>	UL/cUL, CE

## COMMUNICATION SPECIFICATIONS

<b>DATA INTERFACE</b>	Color Kinetics Chromasic data interface system
<b>CONTROL</b>	Color Kinetics line of controllers, including Light System Manager, Video System Manager, or other DMX512 (RS485) sources

## ELECTRICAL SPECIFICATIONS

<b>POWER REQUIREMENT</b>	24VDC
<b>POWER CONSUMPTION</b>	3W at full output for 12" fixture; 1.7W at full output for 6" fixture
<b>POWER SUPPLY</b>	sPDS-60ca 24V (Item# 109-000021-02) for DMX/Ethernet applications, PDS-60ca 24V (Item# 109-000016-00) for Preprogrammed applications
<b>LEADER CABLE</b>	30-ft (9m) iColor Cove EC Leader Cable (Item# 108-000015-00)
<b>JUMPER CABLE</b>	1-ft (0.3m) iColor Cove EC/QL Jumper Cable (Item# 108-000020-00) 5-ft (1.5m) iColor Cove EC/QL Jumper Cable (Item# 108-000020-01)

## ENVIRONMENTAL SPECIFICATIONS

<b>TEMPERATURE RANGE</b>	-4°F to 122°F (-20°C to 50°C) based on testing of specific product
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## LED SOURCE LIFE

In traditional lamp sources, lifetime is defined as the point at which 50% of the lamps fail. This is also termed Mean Time Between Failure (MTBF). LEDs are semiconductor devices and have a much longer MTBF than conventional sources. However, MTBF is not the only consideration in determining useful life. Color Kinetics uses the concept of useful light output for rating source lifetimes. Like traditional sources, LED output degrades over time (lumen depreciation) and this is the metric for SSL lifetime.

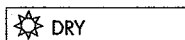
LED lumen depreciation is affected by numerous environmental conditions such as ambient temperature, humidity, and ventilation. Lumen depreciation is also affected by means of control, thermal management, current levels, and a host of other electrical design considerations. Color Kinetics systems are expertly engineered to optimize LED life when used under normal operating conditions. Lumen depreciation information is based on LED manufacturers' source life data as well as other third party testing. Low temperatures and controlled effects have a beneficial effect on lumen depreciation. Overall system lifetime could vary substantially based on usage and the environment in which the system is installed.

Temperature and effects will affect lifetime. Color Kinetics rates product lifetime using lumen depreciation to 50% of original light output. When the fixture is running at room temperature using a color wash effect, the lifetime is in the range of 30,000-50,000 hours. This is based on LED manufacturers' test data. For more detailed information on source life, please see [www.colorkinetics.com/lifetime](http://www.colorkinetics.com/lifetime).

CHROMACORE®  
BY COLOR KINETICS

CHROMASIC®  
BY COLOR KINETICS

OPTIBIN®  
BY COLOR KINETICS



ITEM# 101-000051-00 (12")  
101-000051-01 (6")

This product is protected by one or more of the following U.S. Patents and their foreign counterparts: 6,016,038, 6,150,774, 6,292,901, 6,340,868, 6,777,891, 6,788,011, 6,806,659, 6,969,954, and 6,975,079. Other patents pending.

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BRO152 Rev 05

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## iCOLOR COVE QL 6"

### PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

#### SOURCE SPECIFICATIONS

Optics:	PMMA (Acrylic)
Source:	15 LEDs (5 Red, 5 Green, 5 Blue)
Beam Angle:	100° x 40° (at 50% of peak illuminance)
Distribution:	Asymmetric direct illumination
CCT:	Adjustable 1,000–10,000K
CRI:	Not measurable (CIE 13.3-1995)

#### ILLUMINANCE DISTRIBUTION

0.0 0.0	0.1 1.1	0.1 1.1	0.1 1.1	0.0 0.0	0.0 0.0	3.0'/1.0m
0.1 1.1	0.7 7.5	1.3 14.0	0.7 7.5	0.1 1.1	0.0 0.0	
0.1 1.1	1.3 14.0	3.0 32.3	2.5 26.9	0.7 7.5	0.1 1.1	0'/0m
0.1 1.1	0.7 7.5	2.5 26.9	3.0 32.3	1.3 14.0	0.1 1.1	
0.0 0.0	0.1 1.1	0.7 7.5	1.3 14.0	0.7 7.5	0.1 1.1	3.0'/1.0m
0.0 0.0	0.0 0.0	0.1 1.1	0.1 1.1	0.1 1.1	0.0 0.0	
3.0'/1.0m	0'/0m	3.0'/1.0m				

Units: Footcandles (top)/Lux (bottom)

10.8 lux = 1 fc

Location: Center of grid, 1' (0.3m) from surface, light at perpendicular to surface

Measured on: All, reflectance model: 50%

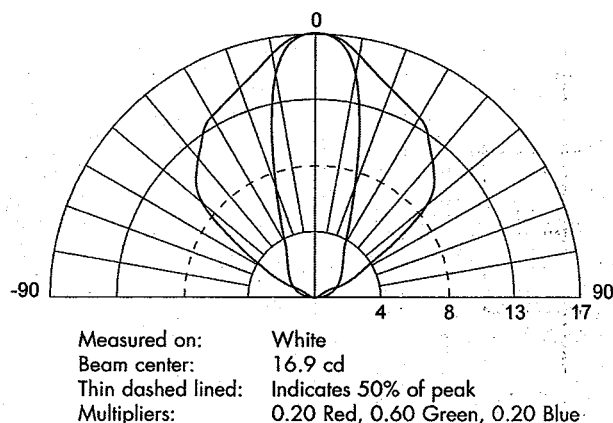
#### ILLUMINANCE

COLOR	1' 0.3m	2' 0.6m	3' 1m	4' 1.2m
WHITE	43.2 465.0	6.4 68.9	2.4 25.8	1.3 14.0
RED	8.6 93.0	1.3 13.8	0.5 5.2	0.3 2.8
GREEN	25.9 279.0	3.8 41.3	1.4 15.5	0.8 8.4
BLUE	8.6 93.0	1.3 13.8	0.5 5.2	0.3 2.8

Measured in Footcandles (top)/Lux (bottom) on axis.

Measured on All, reflectance 0

#### CANDLE POWER DISTRIBUTION



#### LIGHT OUTPUT

COLOR	TOTAL OUTPUT (LUMENS)	POWER (WATTS)	EFFICACY (lm/w)
WHITE	23	1.6	14.4
RED	4.6	0.6	7.7
GREEN	13.8	0.6	23.0
BLUE	4.6	0.6	7.7

Note: Efficacy figures are for a complete tested fixture not simply a lamp source.

## iCOLOR COVE QL 12"

### PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

#### SOURCE SPECIFICATIONS

Optics:	PMMA (Acrylic)
Source:	30 LEDs (10 Red, 10 Green, 10 Blue)
Beam Angle:	100° x 40° (at 50% of peak illuminance)
Distribution:	Asymmetric direct illumination
CCT:	Adjustable 1,000-10,000K
CRI:	Not measurable (CIE 13.3-1995)

#### ILLUMINANCE DISTRIBUTION

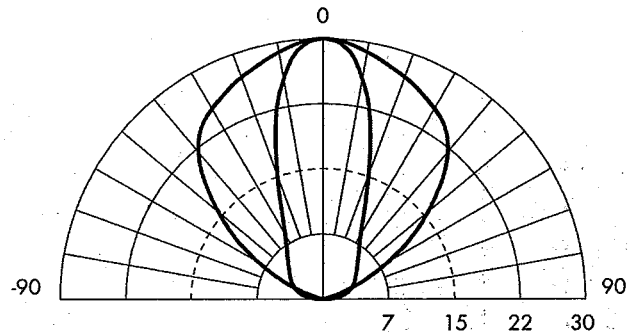
0.3 2.2	0.4 4.3	0.6 6.5	0.4 4.3	0.2 2.2	0.1 1.1	3.0'/1.0m
0.3 3.2	1.6 17.2	2.4 25.8	1.7 18.3	0.5 5.4	0.2 2.2	
0.4 4.3	2.1 22.6	4.6 49.5	4.0 43.1	1.5 16.1	0.3 3.2	0'/0m
0.3 3.2	1.5 16.1	4.0 43.1	4.6 49.5	2.1 22.6	0.4 4.3	
0.2 2.2	0.5 5.4	1.7 18.3	2.4 25.8	1.3 14.0	0.3 3.2	3.0'/1.0m
0.1 1.1	0.2 2.2	0.4 4.3	0.6 6.5	0.4 4.3	0.2 2.2	
3.0'/1.0m	0'/0m	0'/0m	0'/0m	0'/0m	3.0'/1.0m	

Units: Footcandles (top)/Lux (bottom)  
10.8 lux = 1 fc

Location: Center of grid, 1'/0.3m from surface,  
light at perpendicular to surface

Measured on: White, reflectance model: 50%

#### CANDLE POWER DISTRIBUTION



Measured on: White  
Beam center: 30 cd  
Thin dashed lined: Indicates 50% of peak  
Multipliers: 0.24 Red, 0.48 Green, 0.28 Blue

#### ILLUMINANCE

DISTANCE	3'	6'	9'	15'
	1m	2m	3m	5m
WHITE	3.0 32.3	0.8 8.6	0.4 4.3	0.4 4.3
RED	0.8 8.1	0.2 2.2	0.1 1.1	0.1 1.1
GREEN	1.4 15.5	0.4 4.1	0.2 2.1	0.2 2.1
BLUE	0.8 9.0	0.2 2.4	0.1 1.2	0.1 0.2

Measured in Footcandles (top)/Lux (bottom) on axis.  
Measured on white, reflectance 0

#### LIGHT OUTPUT

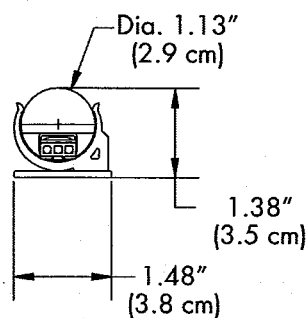
COLOR	TOTAL OUTPUT (LUMENS)	POWER (WATTS)	EFFICACY (lm/w)
WHITE	46	2.9	15.9
RED	11.5	0.7	16.4
GREEN	22.1	1.2	18.4
BLUE	12.9	1.2	10.7

Note: Efficacy figures are for a complete tested fixture not simply a lamp source.

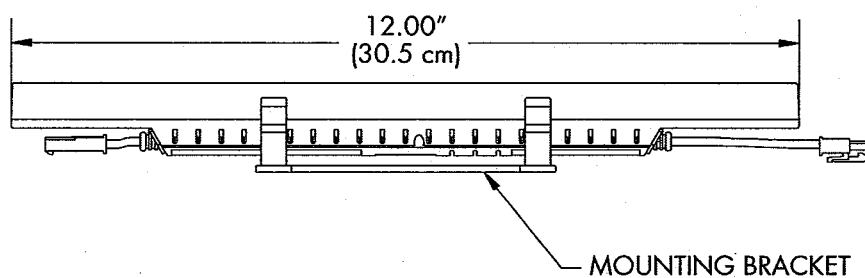
## iColor Cove QL 12"

### PHYSICAL DIMENSIONS

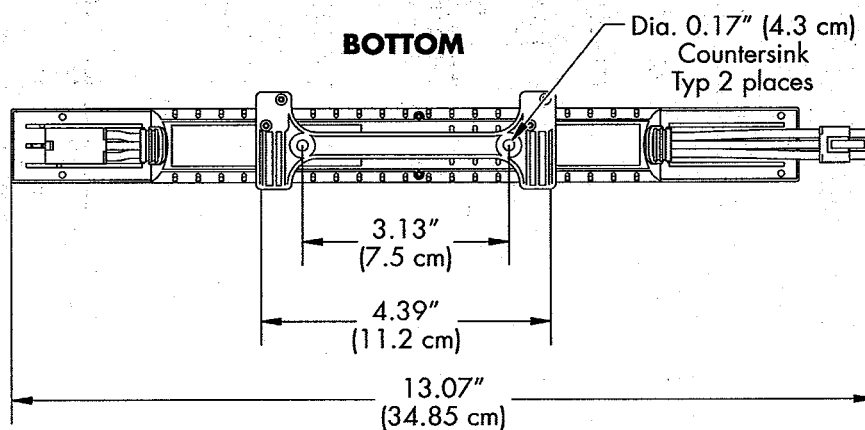
**END**



**SIDE**



**BOTTOM**

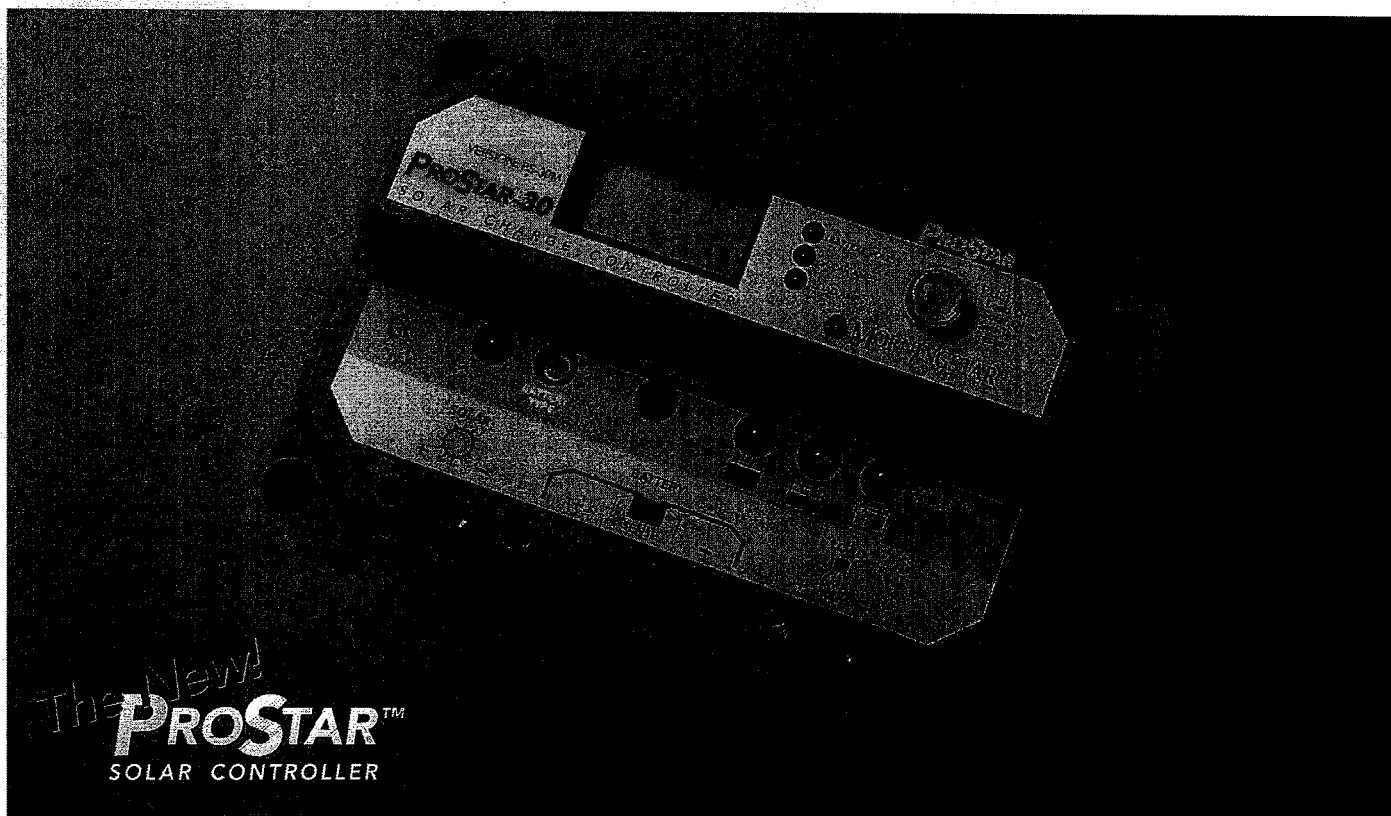


#### iColor Cove QL 12" SPECIFICATIONS

DATA/POWER CONNECTOR	Integral 3-pin male/female connectors
POWER/DATA SUPPLY	sPDS-60ca 24V (Item# 109-000021-02) for DMX/Ethernet applications PDS-60ca 24V (Item# 109-000016-00) for Preprogrammed applications



# Morningstar ProStar 30A



Morningstar's **ProStar** is the world's leading mid-range solar controller for both professional and consumer applications. This second generation ProStar:

- Adds new features and protections using highly advanced technology
- Provides longer battery life and improved system performance
- Sets new standards for reliability and self-diagnostics

#### Standard Features:

- Versions available: 15 or 30 amp  
12 / 24 or 48 volt  
negative or positive ground
- Estimated 15 year life
- PWM series battery charging (not shunt)
- 3-position battery select: gel, sealed or flooded
- Very accurate control and measurement
- Jumper to eliminate telecom noise
- Parallel for up to 300 amps
- Temperature compensation

- Tropicalization: conformal coating, stainless-steel fasteners & anodized aluminum heat sink
- No switching or measurement in the grounded leg
- 100% solid state
- Very low voltage drops
- Current compensated low voltage disconnect (LVD)
- LED's indicate battery status and faults
- Capable of 25% overloads
- Remote battery voltage sense terminals

#### Electronic Protections:

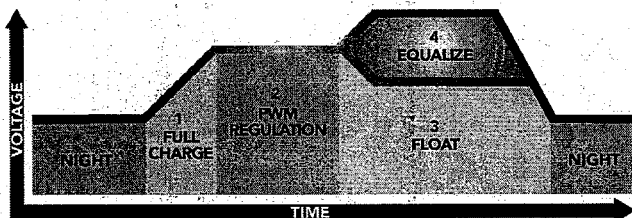
- Short-circuit — solar and load
- Overload — solar and load
- Reverse polarity
- Reverse current at night
- High voltage disconnect
- High temperature disconnect
- Lightning and transient surge protection
- Loads protected from voltage spikes
- Automatic recovery with all protections

### ProStar Options:

- Digital meter
  - Highly accurate voltage and current display
  - Low self-consumption (1 mA)
  - Includes manual disconnect button
  - Displays 5 different protection functions and disconnect conditions
  - Self-Diagnostics (self-test) provides a comprehensive test of the ProStar —
    - Displays 9 different controller status parameters, including temperature
    - Displays detected faults
- Positive ground
- Remote temperature probe

### Optimized Battery Charging:

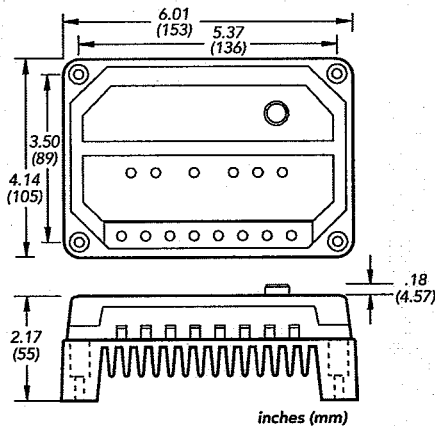
The ProStar has 4 stages of charging to provide increased battery capacity and life.



### Mechanical Specifications:

Weight:  
12 oz  
(0.34 kg)

Wire Size:  
#6 AWG  
(16 mm<sup>2</sup>)



### ProStar Versions:

	PS-15	PS-30	PS15M-48V
Rated Solar Current	15A	30A	15A
Rated Load Current	15A	30A	15A
System Voltage	12/24V	12/24V	48V
Options:			
Digital Meter	yes	yes	standard
Positive Ground	no	yes	yes
Remote Temp. Probe	yes	yes	yes

### Battery Voltage Setpoints\*

	Gel	Sealed	Flooded
Regulation Voltage	14.0	14.15	14.4
Float	13.7	13.7	13.7
Equalization	n/a	14.35	14.9/15.1
Load Disconnect	11.4	11.4	11.4
Load Reconnect	12.6	12.6	12.6

Note: values are for 12V. Use 2X for 24V and 4X for 48V.

### Electrical Specifications:

	12V	24V	48V
Temp. Comp. (mV/°C)*	– 30mV	– 60mV	– 120mV
Accuracy	40mV	60mV	80mV
Min. voltage to operate	8V	8V	15V
Self Consumption	22mA	25mA	28mA
LVD current coefficient**	– 20mV	– 40mV	– 80mV
Charge algorithm	PWM, constant voltage		
Operating temperature	– 40°C to + 60°C		
Digital Display:			
Operating temperature	– 30°C to + 85°C		
Voltage accuracy	0.5%		
Current accuracy	2.0%		
Self-consumption	1 mA		

\* 25°C reference

\*\* per amp of load

**WARRANTY:** Five year warranty period. Contact Morningstar or your authorized distributor for complete terms.

**AUTHORIZED MORNINGSTAR DISTRIBUTOR:**



1098 Washington Crossing Road  
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Website: [www.morningstarcorp.com](http://www.morningstarcorp.com)



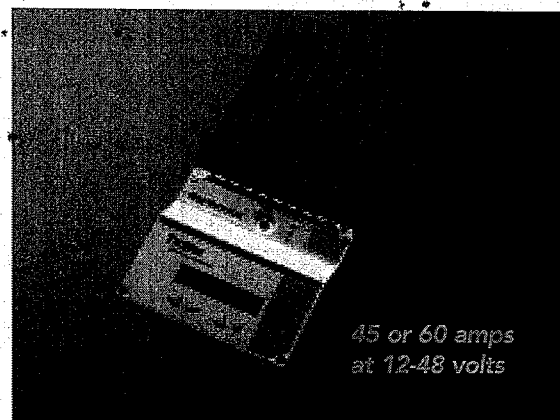
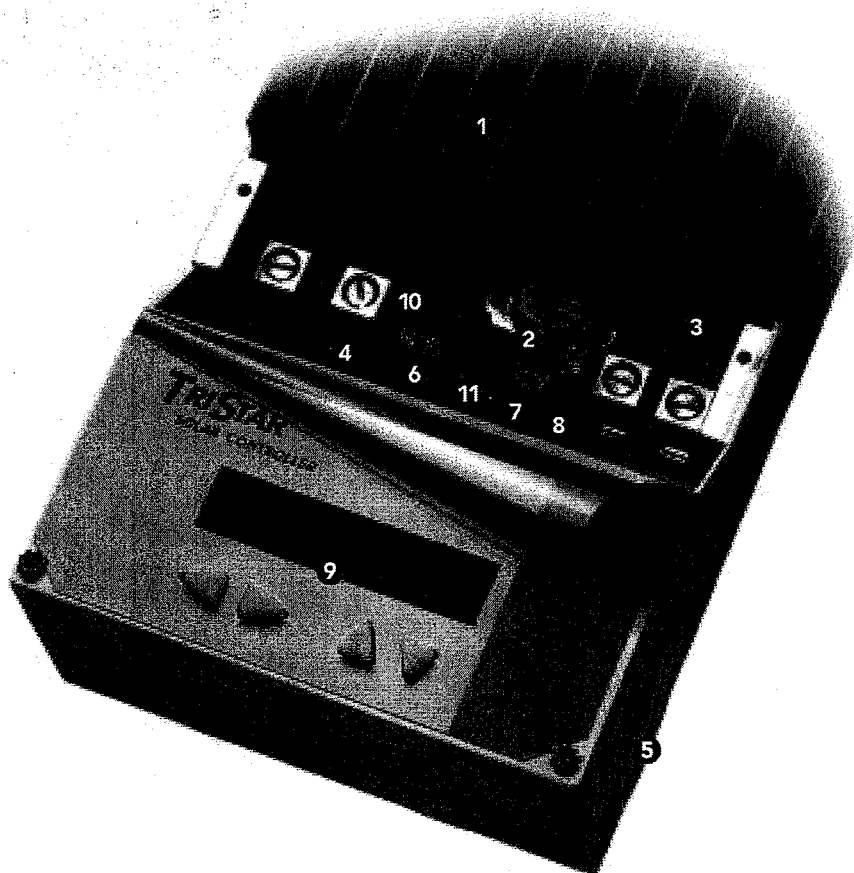
MORNINGSTAR TRISTAR  
~~45A~~  
60A

# TRISTAR™

## THREE-FUNCTION SOLAR CONTROLLER

Morningstar's **TriStar Controller** is a three-function controller that provides reliable solar battery charging, load control or diversion regulation. The controller operates in one of these modes at a time and two or more controllers may be used to provide multiple functions.

The TriStar uses advanced technology and automated production to provide exciting new features at a competitive cost. The optional TriStar meter is the most sophisticated and informative controller meter on the market. The controller is UL listed and is designed for both solar home systems and professional applications.



### Key Features and Benefits

#### Highest Reliability

Large heat sink ① and conservative design enables operating at full ratings to 60°C. No need to de-rate.

#### More Power

Ratings to 60A at 48VDC will handle solar arrays up to 4kW.

#### Communications Capability

RS-232 ② connects to a personal computer for custom settings, data logging and remote monitoring and control.

#### Fully Adjustable

DIP switch ③ provides user with a choice of 7 different digital presets and custom settings via RS-232.

#### Extensive Electronic Protections

Fully protected against reverse polarity, short circuit, overcurrent, high temperature and overvoltage.

#### Simple Mechanical Interface

Larger power terminals ④ and conduit knockouts ⑤. Extra space for wire turns. Fits on power panels.

#### Better Battery Charging

Connecting battery sense wires ⑥ and optional remote temperature sensor ⑦ will improve control accuracy. Constant voltage series PWM algorithm increases battery capacity and life.

#### More Information

3 LEDs ⑧ to indicate status, faults and alarms. Optional meter ⑨ displays extensive system and controller information, automatic self-test and reset capabilities. Meter connection via RJ-11 phone jack ⑩.

#### Easy to Reset

Pushbutton ⑪ provides manual reset and stop/start battery equalization or load disconnect.

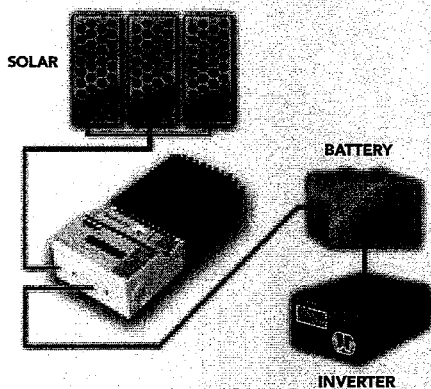
#### Low Telecom Noise

DIP switch setting will change PWM to "On-Off" battery charging.



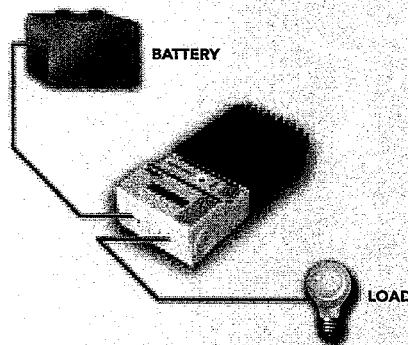


## CHARGE CONTROL



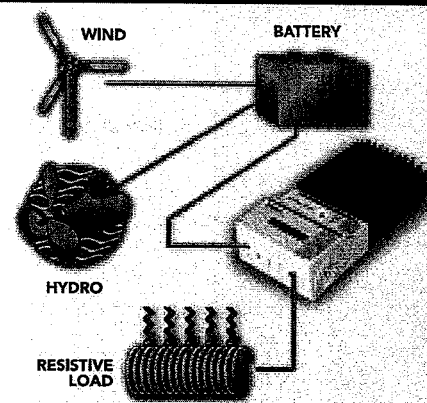
- Constant voltage series PWM design to provide highly efficient battery charging
- 4-stage charging to increase battery capacity and life: bulk charge, PWM regulation, float and equalize
- Parallel for larger solar arrays up to 300 amps or more

## LOAD CONTROL



- Starts large loads including motors and pumps with no damage to controller
- Allows inrush current to 300 amps
- Electronic short-circuit and overload protection with automatic reconnect
- LVD is current compensated and has a delay to avoid false disconnects

## DIVERSION CONTROL



- May be used for solar, wind or hydroelectric
- To protect against battery overcharge, excess energy is diverted from primary battery to a secondary battery or alternate DC resistive load
- PWM reduces power into diversion load during overcurrent conditions

### Electrical Specifications

- Rated solar, load or diversion current:
 

TriStar-45	45A
TriStar-60	60A
- System Voltage 12-48V
- Accuracy
 

12/24V:	≤0.1% ±50mV
48V:	≤0.1% ±100mV
- Min. voltage to operate 9V
- Max. solar voltage (Voc) 125V
- Self-consumption:
 

Controller	<20mA
Meter	7.5mA

### Environmental Specifications

- Operating ambient temperature:
 

Controller	-40°C to +60°C
Meter	-40°C to +60°C
- Storage temperature: -55° to +85°C
- Humidity: 100% (non-condensing)
- Tropicalization: Conformal coating on both sides of all printed circuit boards

### Electronic Protections

- Reverse polarity protection (any combination)
- Short-circuit protection
- Overcurrent protection
- Lightning and transient surge protection using 4500W transient voltage suppressors
- High temperature protection via automatic current reduction or complete shut down
- Prevents reverse current from battery at night

### Mechanical Specifications

- Dimensions: Height: 26.0cm/10.3 inch  
Width: 12.7cm/5.0 inch  
Depth: 7.1cm/2.8 inch
- Weight: 1.6 kg/3.5 lb
- Largest Wire: 35mm<sup>2</sup>/2 AWG
- Conduit knockouts: Eccentric 2.5/3.2cm (1.0/1.25 inch)
- Enclosure: Type 1, indoor rated

### TriStar Options:

- **TriStar Meter** — 2 x 16 display mounts to controller and provides system and controller information, data logging, bar graphs and choice of 5 languages

13.5V	25C	12.3A	V	14.4V	1135 7Ah
1234.5Ah	FL0AT	A		12.3V	11.3 kWh

- **TriStar Remote Meter** — Includes 30 meters of cable for mounting meter away from the controller
- **Remote Temperature Sensor** — Provides temperature compensated charging by measuring temperature at the battery (10 meter cable)

### Certifications

- CE Compliant
- UL Listed (UL 1741)
- cUL (CSA-C22.2 No.107.1-95)
- Complies with U.S. National Electric Code
- Manufactured in a certified ISO 9001 facility



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corporation

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