LETTER OF TRANSMITTAL

Parkson™ Treating Water Right

Transmittal Date: 8/8/16

Project Name: Wichita Reuse WSC, KS			**Job #**	**7127**	**Parkson**	
			PO#	**4552**	Project #	P02600585
Customer/Contractor: Wildcat Construction					Description	MaximOS - SCH-100
Address: 3219 W May					Spec Section	46 33 13 / 46 41 17
Wichita KS 67213					Engineer	Chinmay Vaze
					Email	ChinmayV@parkson.com
					Project #	
Attn:	Tyler Dehn		**e-mail**	tyler.dehn@wildcat.net	Description	
Phone:	316 945 9408	**Fax:**			Spec Section	
Engineer					Engineer	
Address:					Email	
					Project #	
					Description	
					Spec Section	
					Engineer	
Attn:			**e-mail**		Email	
Phone:		**Fax:**				

We are transmitting the following:

	No. Copies	Approval	Your Use	Review & Comment	As Requested
Submittal Package					
Re-Submittal	1 (Electronic)	X		X	
Certified Drawings					
IOM Manuals					
Other:					

REMARKS/COMMENTS

RETURN (1) COPY of this TRANSMITTAL TO:

Project Manager: **Julie Davis**
JDavis@parkson.com

Parkson Address: **Parkson Corporation**
1401 W Cypress Creek Rd, Suite 100
Fort Lauderdale, FL 33309-1721
(954) 974-6610

APPROVAL REQUIRED NO LATER THAN:

Estimated Shipping date _____ **weeks After Drawing Approval (ADA)**

PLEASE NOTE: Although every attempt will be made to ship within our quoted lead times, our estimated ship date is subject to final approval and fabricator workload at the time final approval is received by Parkson. Commencement of performance, including this submittal transmission, shall not constitute acceptance of the order. Only a signed contract, containing mutually agreeable terms and conditions, shall act as an acceptance.

MKEC ENGINEERING, INC.
411 North Webb Road – Wichita, KS 67206

☐ **Reviewed** ☑ **Reviewed As Noted**
☐ **Revise and Resubmit** ☐ **Rejected**
☐ **Not Required by the Contract Documents**

Reviewed for conformance with the design concept of the project and compliance with the information given in the contract documents. Contractor is responsible for: dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication process or to techniques of construction; and coordination of work of all other trades. If "Resubmit" or "Rejected" are not checked resubmission is neither desired or required.

By: Keith Scarberry Date: 08/23/2016

DISTRIBUTION

	Contractor	Fluid Equipment (Dave McClure)	**Rep 1**		**File**
	Engineer		**Rep 2**		**Service**

Rev Date 7/16/2014.
CC: Project Manager

1401 West Cypress Creek Road Suite 100
Fort Lauderdale FL 33309-1969

Phone 1.888.PARKSON
Fax 954.974.6182

Letter of Response – Wichita Reuse WSC, KS

August 8, 2016

Dear Tyler Dehn:

Reference: Submittal Review comments dated July 22, 2016

1. *Comment: Hayward true union valves are specified. Spears was not requested as an "Engineer approved equal" (Typical 5 places)*
   Response: Noted, Hayward true union valves will be supplied.

2. *Spears utility ball valves are not allowed. Hayward true union valves are specified.*
   Response: Noted, Hayward true union valves will be supplied.
   Hayward ball valves in bleach service shall be True Union Z-Ball Valves per the specifications.
3. *Incorrect ion exchange resin highlighted on NSF resin list.*
   Response: Noted, modified cut sheets included.

4. *Can the Brine pump be located under the salt transfer auger?*
   Response: Yes, but pump should be covered for any salt dust from salt transfer auger.
   Pump cover is not by Parkson.

5. *How does staff check salt level in brinemaker? No inspection port has been supplied.*
   Response: Brine tank is Translucent (for visible content level).

6. *Can the softener be changed to a Culligan softener be used instead of the Kenetico unit submitted?*
   Response: Yes, Culligan softener can be used over Kinetico but note - Culligan softeners are electrical. If Culligan softener is preferred over Kinetico, please let us know. We will send a change order for the same.

7. *Provide 208V, 3-phase tankless water heater. Provide with 60A disconnect switch and wire with (3)-#4, #8 ground, in 1" conduit. Provide 70 amp, 3 pole circuit breaker in panel PSL.*
   Response:
   - Noted, 208 V, 3-phase tankless heater will be supplied.
   - Disconnect for the water heater not by Parkson.
     Please refer to electrical installation instructions for wiring diagram and wire sizes.

8. *Coordinate with Electrical Contractor to provide 15 amp circuit breaker for brine pump and NEMA 4x disconnect switch at brine pump.*
   Response: Note to Contractor.

9. *Coordinate with Electrical Contractor to provide 120 volt, 20 amp circuit to pressure sensor control box.*
   Response: Note to Contractor.

   Please note: OSG Alternator Control Panel is included in this submittal booklet.

Please feel free to contact me or Luc LaHaie (LLahaie@parkson.com, 873-200-1408) directly with any questions or concerns.

Chinmay Vaze
Chinmayv@parkson.com
O: +91-20-40147770
Project Engineer
Parkson Corporation

TB Series
True Union Ball Valves

1/4″ TO 3/8″ PVC AND
1/2″ TO 2″ PVC, CPVC AND GFPP

NSF
PVC and CPVC

Now Available in Platinum GFPP!

KEY FEATURES

- PVC, CPVC and GFPP
- Full Port Design
- Reversible PTFE Seats
- Double O-Ring Stem Seals
- Easily Actuated
- NSF/ANSI 61 Listed (PVC and CPVC)

OPTIONS

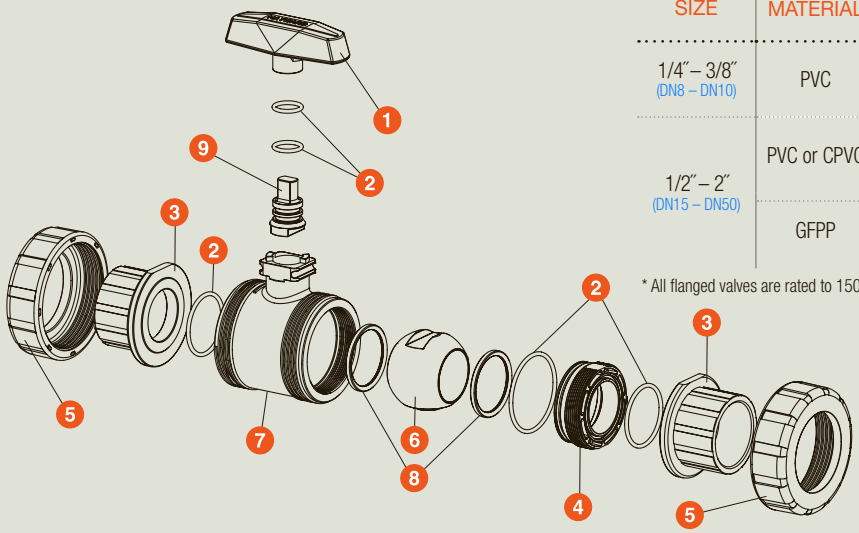
- Lockouts Available
- 2″ Square Operating Nut
- Stem Extensions
- Pneumatic and Electric Actuators
- Spring Return Handle

MATERIALS

- PVC Cell Class 12454 per ASTM D1784
- CPVC Cell Class 23447 per ASTM D1784
- GFPP Cell Class 85580 per ASTM D4101
- FPM and EPDM O-Ring Seals

TECHNICAL INFORMATION

EXPLODED VIEW



SELECTION CHART

SIZE	MATERIAL	END CONNECTION	SEALS	PRESSURE RATING
1/4″ – 3/8″ (DN8 – DN10)	PVC	Socket or Threaded	FPM or EPDM	250 PSI @ 70°F Non-Shock
1/2″ – 2″ (DN15 – DN50)	PVC or CPVC	Socket and Threaded or Flanged*		
	GFPP	Threaded or Flanged		150 PSI @ 70°F Non-Shock

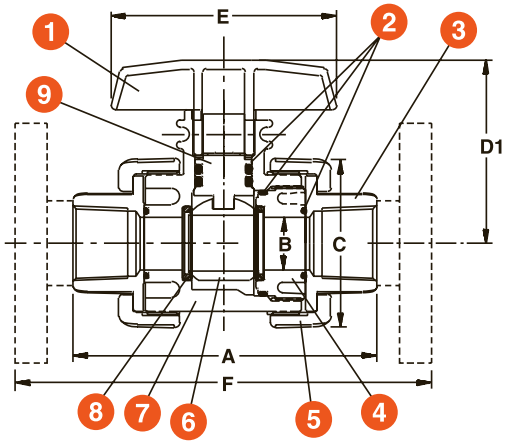
* All flanged valves are rated to 150 PSI @ 70°F Non-Shock

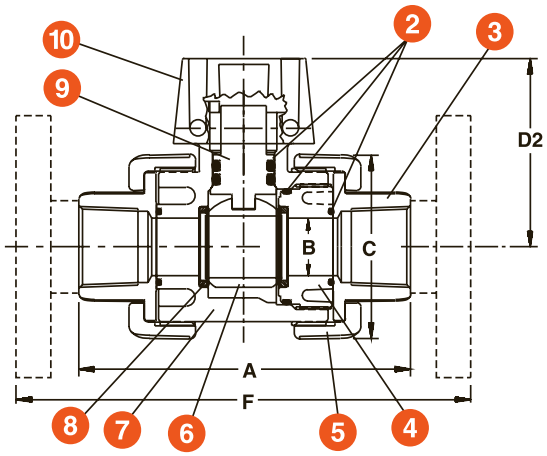
TB Series
True Union Ball Valves
1/4″ TO 2″ PVC, CPVC AND GFPP

TECHNICAL INFORMATION, *CONTINUED*

PARTS LIST

1. Handle
2. O-Ring Seals
3. End Connector
4. Seal Retainer
5. Union Nut
6. Ball
7. Body
8. PTFE Seat
9. Stem
10. Actuator Mounting Pad





DIMENSIONS

SIZE in/DN	A in/mm	B in/mm	C in/mm	D1 in/mm	D2 in/mm	E in/mm	F in/mm	WEIGHT lbs/kg SOC/THD	WEIGHT lbs/kg FLANGED
1/4/8	4.77/121	.50/13	2.25/57	2.81/71	2.63/67	3.50/89	N/A	.75/.34	N/A
3/8/10	4.77/121	.50/13	2.25/57	2.81/71	2.63/67	3.50/89	N/A	.75/.34	N/A
1/2/15*	4.77/121	.50/13	2.25/57	2.81/71	2.63/67	3.50/89	6.75/171	.75/.34	1.00/.45
3/4/20*	4.85/123	.75/19	2.63/67	3.02/77	2.81/71	3.50/89	7.13/181	.75/.34	1.00/.45
1/25*	5.44/138	.93/24	3.00/76	3.26/83	3.05/77	4.00/102	8.09/205	1.15/.52	2.15/.98
1-1/4/32*	6.30/160	1.50/38	4.00/102	3.92/100	3.48/88	5.00/127	9.19/233	2.15/.98	3.50/1.59
1-1/2/40*	6.85/174	1.50/38	4.00/102	3.92/100	3.48/88	5.00/127	9.88/251	2.15/.98	3.75/1.70
2/50*	8.00/203	1.94/49	4.75/121	4.43/113	4.00/102	5.00/127	11.4/290	3.80/1.72	6.30/2.86

Dimensions are subject to change without notice – consult factory for installation information

* Metric End Connections Available In: BSP – Straight Thread, BSP TR – Tapered Thread and Metric Socket

Cv VALUES

SIZE in/DN	Cv VALUES	SIZE in/DN	Cv VALUES
1/4/8	1.0	1/25	29.0
3/8/10	2.8	1-1/4/32	75.0
1/2/15	8.0	1-1/2/40	90.0
3/4/20	16.0	2/50	150.0

PRESSURE LOSS CALCULATION FORMULA

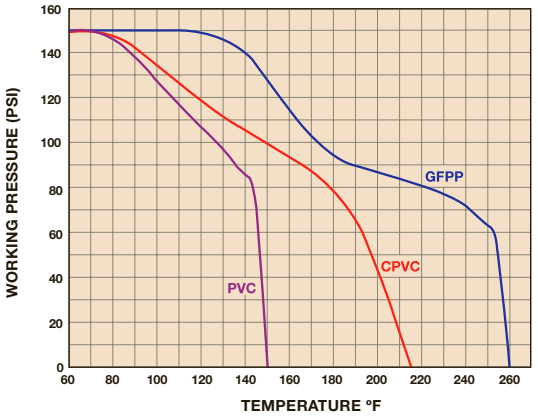
$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop

Q = Flow in GPM

Cv = Flow Coefficient

OPERATING TEMPERATURE/PRESSURE



Contact Hayward Flow Control with questions: **USA:** 1-888-429-4635 • Fax: 1-888-778-8410 • One Hayward Industrial Drive • Clemmons, NC 27012 USA
Canada: 1.888.238.7665 • Fax: 1.905.829.3636 • 2880 Plymouth Drive • Oakville, ON L6H 5R4 Canada • Email: hflowcanada@haywardnet.com
Visit us at: www.haywardflowcontrol.com • E-mail: hflow@haywardnet.com

TC Series True Union Ball Check Valves

1/4″ TO 3/8″ PVC, 1/2″ TO 2″ PVC, CPVC AND PP AND 2-1/2″ TO 6″ PVC AND CPVC

NSF
1/4″ – 4″
PVC and CPVC

Ball check valve with foot valve screen installed

KEY FEATURES

- PVC, CPVC and PP
- For Horizontal or Vertical Installation*
- 1/2″ to 6″ are Sure Block Design
- Square Cut Seat for Positive Sealing
- Seats with Minimum Back Pressure
- 1/4″ and 3/8″ are Trim Check Design

OPTIONS

- Foot Valve Screens

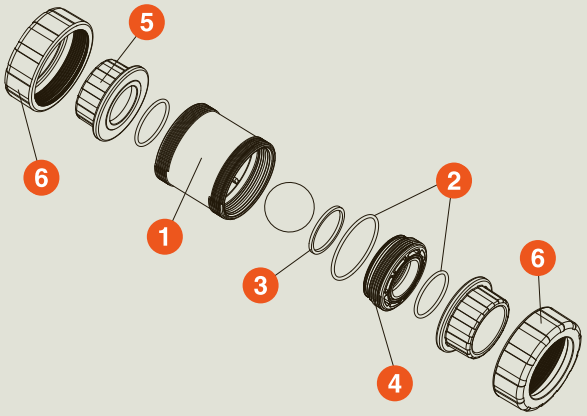
MATERIALS

- PVC Cell Class 12454 per ASTM D1784
- CPVC Cell Class 23447 per ASTM D1784
- PP per ASTM D4101
- FPM and EPDM O-Ring Seals

* For installation information, see IOM manual

TECHNICAL INFORMATION

EXPLODED VIEW



SELECTION CHART

SIZE	MATERIAL	END CONNECTION	SEALS	PRESSURE RATING
1/4″ – 3/8″ * (DN8 – DN10)	PVC	Socket or Threaded	FPM	150 PSI @ 70°F Non-Shock
1/2″ – 2″ (DN15 – DN50)	PVC or CPVC	Socket and Threaded or Flanged****	FPM or EPDM	235 PSI @ 70°F Non-Shock
	PP**	Threaded		150 PSI @ 70°F Non-Shock
2-1/2″ – 4″ (DN65 – DN100)	PVC or CPVC	Socket, Threaded or Flanged		
6″ *** (DN150)		Flanged		

* Trim Checks ** 2″ PP is rated to 100 PSI @ 70°F Non-Shock *** 4″ valve venturied to 6″
**** All flanged valves are rated to 150 PSI @ 70°F Non-Shock

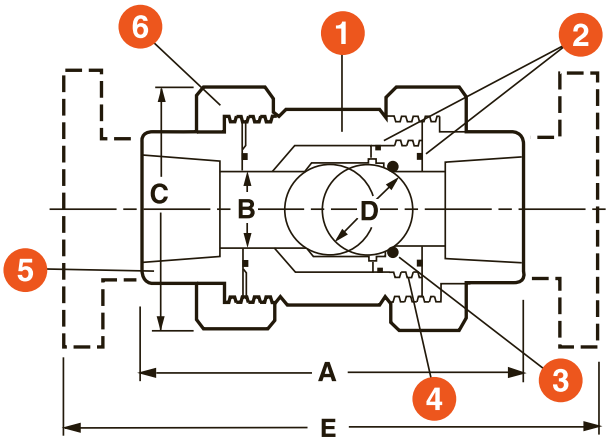
TC Series True Union Ball Check Valves

1/4″ TO 3/8″ PVC, 1/2″ TO 2″ PVC, CPVC AND PP AND 2-1/2″ TO 6″ PVC AND CPVC

TECHNICAL INFORMATION, *CONTINUED*

PARTS LIST

1. Body
2. O-Ring Seals
3. Square Cut O-Ring Seat
4. Seal Retainer
5. End Connector
6. Union Nut



Ball check valve with foot valve screen installed

DIMENSIONS

SIZE in/DN	A in/mm	B in/mm	C in/mm	D in/mm	E in/mm	F in/mm	G in/mm	WEIGHT lbs/kg SOC/THD	WEIGHT lbs/kg FLANGED
1/4/8	3.06/78	.31/8	1.38/35	.50/13	N/A	N/A	N/A	.13/.06	N/A
3/8/10	3.06/78	.31/8	1.38/35	.50/13	N/A	N/A	N/A	.13/.06	N/A
1/2/15	4.63/118	.50/13	2.25/57	.75/19	6.75/171	4.88/124	2.32/59	.75/.34	1.00/.45
3/4/20*	4.75/121	.75/19	2.63/67	1.00/25	7.13/181	5.00/127	2.60/66	.75/.34	1.38/.63
1/25*	5.25/133	1.00/25	3.00/76	1.25/32	7.75/197	5.88/149	2.88/73	1.25/.57	2.13/.97
1-1/4/32*	6.30/160	1.25/32	4.00/102	1.75/44	9.19/233	6.94/176	3.75/95	2.00/.91	3.75/1.70
1-1/2/40*	6.75/171	1.50/38	4.00/102	1.75/44	9.75/248	7.06/179	3.75/95	2.00/.91	3.75/1.70
2/50*	8.00/203	1.94/49	4.75/121	2.25/57	11.25/286	8.56/217	4.50/114	3.75/1.70	5.75/2.61
2-1/2/65*	10.68/271	2.88/73	6.56/167	3.25/83	14.38/365	11.25/286	2.50/64	10.00/4.54	14.00/6.35
3/80	10.56/268	2.88/73	6.56/167	3.25/83	14.38/365	11.25/286	2.50/64	10.00/4.54	14.00/6.35
4/100	12.94/329	4.00/102	8.56/217	4.25/108	17.00/432	14.63/372	4.25/108	17.00/7.71	25.00/11.34
6/150	N/A	4.00/102	N/A	4.25/108	19.19/487	N/A	N/A	N/A	30.20/13.70

Dimensions are subject to change without notice – consult factory for installation information

Hayward TC Ball Check Valves require a minimum of 2 PSI to seat and 1-1/2 PSI cracking pressure to open

* Metric End Connections Available In: BSP – Straight Thread, BSP TR – Tapered Thread and Metric Socket for PVC and CPVC Valves Only

Cv VALUES

SIZE in/DN	Cv VALUES	SIZE in/DN	Cv VALUES
1/4/8	1.0	1-1/2/40	45.0
3/8/10	3.0	2/50	130.0
1/2/15	4.8	2-1/2/65	170.0
3/4/20	7.7	3/80	250.0
1/25	11.0	4/100	400.0
1-1/4/32	25.0	6/150	340.0

PRESSURE LOSS CALCULATION FORMULA

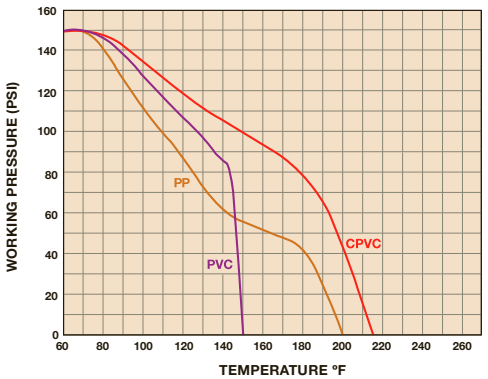
$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop

Q = Flow in GPM

Cv = Flow Coefficient

OPERATING TEMPERATURE/PRESSURE



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Visit us at: www.haywardflowcontrol.com • E-mail: hflow@haywardnet.com

LA Series Lateral Three-Way True Union Ball Valves

1/2″ TO 6″ PVC AND CPVC

KEY FEATURES

- PVC and CPVC
- PTFE Seats
- FPM or EPDM O-Rings
- Double O-Ring Stem Seal
- Simplifies Lateral Connections
- Replaces Valve/Tee Connection Combinations
- Quick, Easy to Install
- Replacement for Zero Dead-Leg Valves

OPTIONS

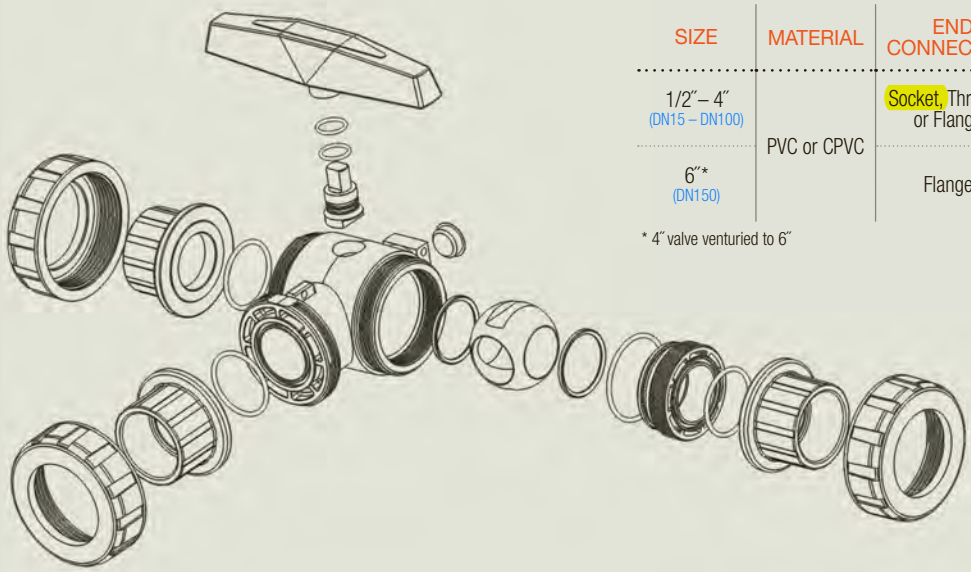
- Lockouts Available
- Pneumatic and Electric Actuators
- 90º Ball

MATERIALS

- PVC Cell Class 12454 per ASTM D1784
- CPVC Cell Class 23447 per ASTM D1784
- FPM and EPDM O-Ring Seals

TECHNICAL INFORMATION

EXPLODED VIEW



SELECTION CHART

SIZE	MATERIAL	END CONNECTION	SEALS	PRESSURE RATING
1/2″– 4″ (DN15 – DN100)	PVC or CPVC	Socket, Threaded or Flanged	FPM or EPDM	150 PSI @ 70°F Non-Shock
6″* (DN150)		Flanged		

* 4″ valve venturied to 6″

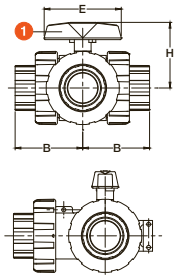
LA Series Lateral Three-Way True Union Ball Valves

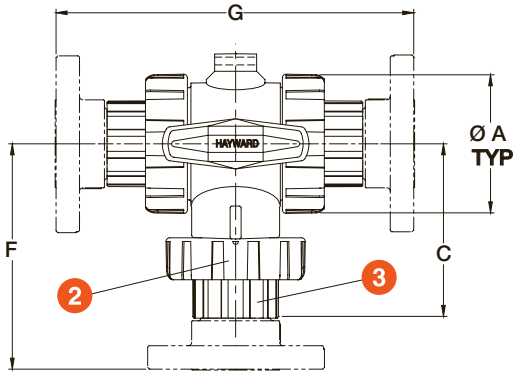
1/2″ TO 6″ PVC AND CPVC

TECHNICAL INFORMATION, *CONTINUED*

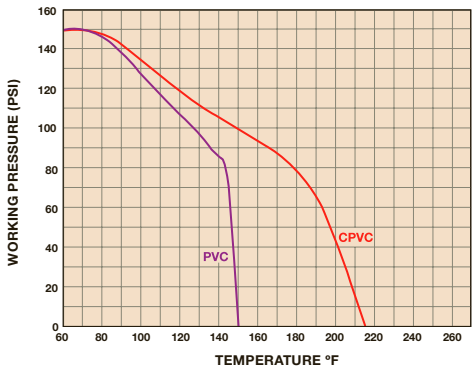
PARTS LIST

1. Handle
2. Assembly Nut
3. End Connector





OPERATING TEMPERATURE/PRESSURE



DIMENSIONS

SIZE in/DN	A in/mm	B in/mm	C in/mm	E in/mm	F in/mm	G in/mm	H in/mm
1/2/15	2.25/57	2.30/58	3.29/84	3.50/89	3.87/98	6.72/170	1.70/43
3/4/20	2.63/67	2.56/65	3.57/91	3.50/89	4.60/117	7.50/191	2.93/74
1/25	3.00/76	2.98/76	4.14/105	4.00/102	4.77/121	8.50/216	3.23/82
1-1/4/32	4.75/121	4.39/112	5.94/151	4.00/102	5.19/132	11.54/293	4.19/106
1-1/2/40	4.75/121	4.30/109	5.87/149	4.00/102	6.00/152	11.85/301	4.19/106
2/50	4.75/121	4.38/111	6.00/152	5.00/127	6.75/171	12.25/311	4.19/106
2-1/2/65	6.40/163	5.90/150	7.59/193	10.50/267	8.68/220	15.92/404	5.35/136
3/80	6.40/163	5.90/150	7.59/193	10.50/267	8.72/221	16.00/406	5.35/136
4/100	8.56/217	7.00/178	9.33/237	10.50/267	10.44/265	18.88/480	6.85/174
6/150	8.56/217	N/A	N/A	10.50/267	11.25/286	20.25/514	6.85/174

Dimensions are subject to change without notice – consult factory for installation information

Cv VALUES

SIZE in/DN	Cv VALUES	SIZE in/DN	Cv VALUES
1/2/15	3.0	2/50	58.0
3/4/20	7.0	3/80	190.0
1/25	10.0	4/100	450.0
1-1/2/40	30.0	6/150	340.0

PRESSURE LOSS CALCULATION FORMULA

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop

Q = Flow in GPM

Cv = Flow Coefficient

FLOW SCHEMATICS – TOP VIEW

FLOW AT	STANDARD BALL	FLOW AT	90° BALL TYPICALLY USED IN ACTUATION
0°	Port A — Port B, Port C	0°	Port A — Port B, Port C
90°	Port A — Port B, Port C	45°	Port A — Port B, Port C
180°	Port A — Port B, Port C	90°	Port A — Port B, Port C

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Visit us at: www.haywardflowcontrol.com • E-mail: hflow@haywardnet.com

Requirements for POE Water Softeners under *NSF/ANSI 44*

By Rick Andrew

Cation exchange water softening is a well-known, well-understood technology that is successfully employed in many hard-water regions of North America as well as internationally. There is an American National Standard for testing and certification of these products—*NSF/ANSI 44*. Many readers may be familiar with the concepts of softening capacity, pressure drop, accuracy of the brining system and other requirements of this standard. But do you know the details?

This column will help to provide those details, including the conservative testing requirements and nuances of scope present in the standard. As you will see, the requirements are well thought out based on the considerations involved with the safety and operation of residential water softeners.

A question of scope

NSF/ANSI 44 defines a residential softener as a regenerable cation exchange system with conventional plumbing fittings not exceeding 1.25-inch (31.75 mm) NPS (nominal pipe size). Any softener with an inlet exceeding 1.25 inches is not considered residential, at least for purposes of *NSF/ANSI 44* and falls outside the scope of the standard.

Notice that the definition is not related to resin tank size, amount of cation exchange resin or system salt settings, but is based solely on the inlet size of the control valve. Also note that any physical or magnetic water conditioning systems are outside the scope of *NSF/ANSI 44*, because the standard is limited to cation exchange systems.

Disposable cartridge filters containing cation exchange resin fall outside the scope of the standard. This is because, although some do use cation exchange technology, they are not regenerable.

POE systems under NSF/ANSI 61

In late 2007, the scope of *NSF/ANSI 61* was revised to include POE systems and components. This means that water softeners can be certified either to *NSF/ANSI 44*, *NSF/ANSI 61* or both.

The main difference is that *NSF/ANSI 61* requires only conformance to the material safety requirements. *NSF/ANSI 44* requires conformance to material safety, structural integrity, pressure drop, softening capacity, softening performance, brine accuracy and product literature requirements.

Obviously, *NSF/ANSI 44* is a much more comprehensive standard for POE water softeners than *NSF/ANSI 61*. For this reason, NSF recommends that POE softeners be certified to *NSF/ANSI 44*.

A multitude of tests

A summary of the testing requirements of *NSF/ANSI 44* is included in Figure 1. A formulation review for all materials in contact with drinking water and material extraction test is required to establish that no contaminants leach from the softener at concentrations of toxicological concern.

A total of 100,000 cyclic and 15-minute hydrostatic tests are required to establish the long-term durability of the system as well as its resistance to pressure spikes. A pressure drop test confirms that the softener will not cause a drop of more than 15 psi in line pressure when operated at the manufacturer's rated service flow.

Softener capacity is determined by testing at one half of the manufacturer's rated service flow. The feed water must have a hardness of 20 ± two grains per gallon. Capacity testing is required at the lowest and highest salt settings and the setting closest to the midpoint of the range of salt settings.

Capacity for other non-tested salt settings is interpolated from the three measured capacities. Extrapolation is not allowed, so testing at the low and high salt settings is critical. Each test of capacity is conducted by first regenerating with a precisely measured amount of saturated brine. The softener's brine system is not utilized due to potential variation in the amount of regenerant salt.

The endpoint of the test is defined as one grain per gallon breakthrough in the softened water. The hardness leakage

Figure 1. NSF/ANSI 44 test descriptions

Requirement	Test description
Material safety	Formulation review for all wetted materials + extraction testing
Structural integrity	100,000 cyclic and 15-minute hydrostatic pressure testing
Pressure drop	Differential pressure between inlet and outlet may not exceed 15 psig at rated service flow
Exchange capacity	Softener challenged at one half of rated service flow with 20 grain per gallon feed water, endpoint when treated water reaches one grain per gallon
Rinse effectiveness	Net chloride in softened water must not exceed 100 mg/L after regeneration
Softening performance	System must produce soft water at rated service flow for 10 minutes after regeneration
Accuracy of the brine system	Salt used for regeneration must be within 15 percent of nominal salt setting

throughout the run is subtracted off when the capacity is determined, so that capacity is reflective of the exact amount of hardness removed. Three successive runs within 10 percent of the average of the three runs are required, with the average value being considered the official capacity at that salt setting. See Figure 2 for a graph of an example capacity run.

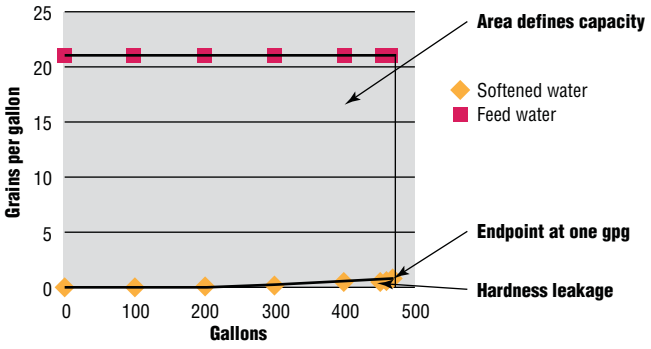
During capacity testing, the amount of residual chloride in the softened water is measured after regeneration. The net increase in chloride concentration from the softener may not exceed 100 mg/L. This indicates that the rinse is sufficient to rid the softened water of excess salt.

A separate test known as 'softening performance' is required. This test involves regeneration of the softener at the lowest salt setting and operation at the manufacturer's rated service flow. Samples of product water are taken each minute for 10 minutes and the hardness of the water may not exceed one grain per gallon for any of these samples.

Because the brine system is not used when conducting capacity testing, accuracy of the brine system must be determined through a separate test. This testing is conducted at the lowest and highest salt settings and the setting closest to the midpoint of the range. It involves weighing the brine tank before and after regenerations and three successive runs within 15 percent of the nominal salt setting must be achieved.

For example, a 10-pound salt setting successful brine accuracy test would require the weight of the brine tank to decrease by 8.5 to 11.5 pounds after each regeneration, for a series of three regenerations. There is an alternate procedure that may be used for time-controlled brine systems, involving calculations based on saturated brine.

Figure 2. Typical capacity test



Softener efficiency

In this day and age of potential bans on water softeners due to concerns about salinity, efficiency is a very hot topic. Although efficiency is not required for certification to *Standard 44*, it may be required by state or local regulations.

This is true especially in western states like California that have water salinity problems. And states that currently do not have efficiency requirements for softeners may be moving in that direction.

Efficiency is based on the amount of hardness capacity per amount of regenerant salt and per volume of regenerant water. Efficient softeners require less salt and/or regenerant water to achieve the same amount of softening capacity as less efficient softeners. This results in less water consumption and less salinity added to the environment.

The efficiency of softeners varies with the amount of salt used for regeneration. The higher the salt dosage, the lower the salt efficiency. There are diminishing returns in terms of softening capacity for regenerating with more and more salt. In fact, there is a point at which additional salt used in regeneration will not achieve any more softening

capacity and will simply be rinsed out of the system.

Efficiency is calculated from data measured and recorded during capacity testing. The requirements for efficiency are included in Figure 3. Only demand initiated regeneration (DIR) softeners may claim efficiency. A softener must achieve both salt efficiency and water efficiency in order to be 'efficiency rated.'

Figure 3. NSF/ANSI 44 efficiency requirements for DIR softeners only

Parameter	Efficiency requirement
Salt efficiency	At least 3,350 grains of capacity per pound of regenerant salt
Water efficiency	At least 1,000 grains of capacity per five gallons of regeneration water

Also any efficiency specifications or statements must refer to the salt setting at which the efficiency was achieved. The State of California has a more stringent requirement for salt efficiency ratings than does *Standard 44*, requiring at least 4,000 grains of capacity per pound of regenerant salt.

Conformance by calculation—certification of families of softeners

Standard 44 includes procedures to calculate pressure drop, capacity and efficiency for softeners that are similar to the test unit. There are specific requirements for softeners to be considered 'similar,' including:

- same control valve
- same distributor (length of distributor tube can vary with size of resin tank)
- limitations on variation in cation exchange resin specifications
- limitations on amounts of resin
- limitations on resin tank size
- limitations on regeneration volumes
- limitations on flow rates
- limitations on salt dosages

The concept is that a line of softeners built with the same control valve can be certified based on testing one or a few of them and then using calculations included in the standard to calculate pressure drop, capacity and efficiency for the non-tested models. The limitations are designed to keep only softeners that function similarly in the same family.

The equations used for calculations have proven accurate in practice. Conformance by calculation allows manufacturers to certify broad lines without unnecessarily testing each one of many very similar softeners.

A comprehensive standard

As you can see from this brief overview, *Standard 44* requires testing all relevant aspects of water softeners, from material safety to accuracy of the brine system. This means that a number of tests are required, each one designed to evaluate different aspects.

This is in contrast to *Standard 61*, which requires an evaluation for material safety only. Although POE softeners may be evaluated under and certified to either one, the comprehensiveness of *Standard 44* makes it the clear choice.

About the author

Rick Andrew is the Operations Manager of the NSF Drinking Water Treatment Units Program for certification of POE and POU systems and components. Prior to joining NSF, his previous experience was in the area of analytical and environmental chemistry consulting. Andrew has a Bachelor's Degree in chemistry and an MBA from the University of Michigan. He can be reached by phone at 1-800-NSF-MARK or by email at Andrew@nsf.org.

DOWEX™ HCR-S

A High Capacity Cation Exchange Resin for Softening and Demineralization Applications

Product	Type	Matrix	Functional group
DOWEX™ HCR-S	Strong acid cation	Styrene-DVB gel	Sulfonic acid

Guaranteed Sales Specifications		Na^+ form	H^+ form
Total exchange capacity, min.	eq/L	2.0	1.8
	kgr/ft³ as $CaCO_3$	43.7	39.3
Bead size distribution range† 300 - 1,200 µm, min. (50 mesh - 16 mesh)	%	90	90
Acidity range	pH	7.0 - 10.5	—
Color throw, as packaged, max.	APHA	20	—

Typical Physical and Chemical Properties		Na^+ form	H^+ form
Water content	%	44 - 48	50 - 56
Whole uncracked beads	%	90 - 100	90 - 100
Total swelling ($Na^+ \rightarrow H^+$)	%	8	8
Particle density	g/mL	1.28	1.22
Shipping weight	g/L	820	780
	lbs/ft³	51	49

Recommended Operating Conditions

- Maximum operating temperature: 120°C (250°F)
- pH range 0 - 14
- Bed depth, min. 800 mm (2.6 ft)
- Flow rates:
  - Service/fast rinse 5-50 m/h (2-20 gpm/ft²)
  - Backwash See figure 1
  - Co-current regeneration/displacement rinse 1-10 m/h (0.4-4 gpm /ft²)
- Total rinse requirement 3 - 6 Bed volumes
- Regenerant: 1-8% H_2SO_4, 4-8% HCl or 8-12% NaCl

† For additional particle size information, please refer to Particle Size Distribution Cross Reference Chart (Form No. 177-01775).

Typical Properties and Applications

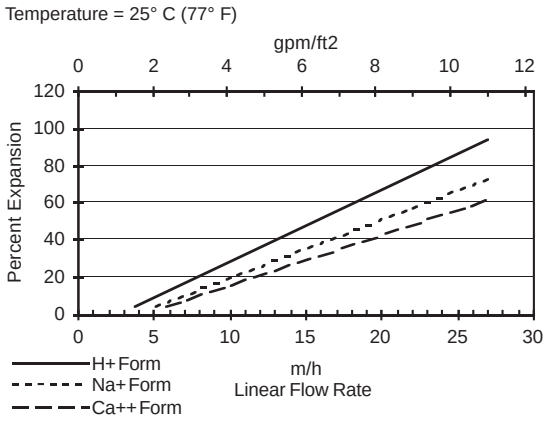
DOWEX™ HCR-S cation exchange resin is a high capacity resin with excellent kinetics and good physical, chemical and thermal stability.

DOWEX HCR-S cation exchange resin is well suited for industrial water softening and demineralization in the co-current mode of regeneration.

Packaging

25 liter bags or 5 cubic feet fiber drums

Figure 1. Backwash Expansion Data

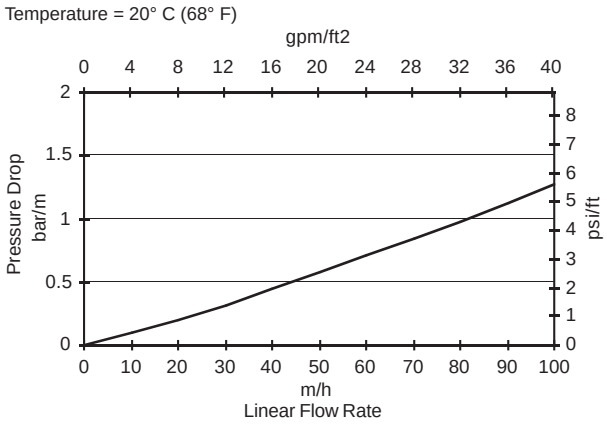


For other temperatures use:

$F_T = F_{77°F}$ [1+ 0.008 ($T_{°F}$ -77)], where F ≡ gpm/ft^2

$F_T = F_{25°C}$ [1+ 0.008 (1.8$T_{°C}$ - 45)], where F ≡ m/h

Figure 2. Pressure Drop Data



For other temperatures use:

$P_T = P_{20°C}$ / (0.026 $T_{°C}$ + 0.48), where P ≡ bar/m

$P_T = P_{68°F}$ / (0.014 $T_{°F}$ + 0.05), where P ≡ psi/ft

Note: These resins may be subject to drinking water application restrictions in some countries: please check the application status before use and sale.

DOWEX™ Ion Exchange Resins
For more information about DOWEX resins, call the Dow Water Solutions business:

North America:	1-800-447-4369
Latin America:	(+55) 11-5188-9222
Europe:	(+32) 3-450-2240
Pacific:	+60 3 7958 3392
Japan:	+813 5460 2100
China:	+86 21 2301 9000

http://www.dowex.com

Form No. 177-01583-0407

The Dow Chemical Company
U.S.A.

Effective Date: December 20, 2007
Supersedes: August 28, 2007

FOOD ADDITIVE STATUS

Product	**Product Code**
DOWEX™ 50WX4 20-50 Mesh (Na) Cation Exchange Resin	23030
DOWEX 88 (Na) Cation Exchange Resin	37067
DOWEX 88MB (Na) Cation Exchange Resin	23073
DOWEX CM-15 (Na) Cation Exchange Resin	03780
DOWEX HCR-S (Na) Cation Exchange Resin	63145
DOWEX HCR-SL (Na) Cation Exchange Resin	10193
DOWEX HCR-S/S (Na) Cation Exchange Resin	03789
DOWEX HCR-S/S CR (Na) Cation Exchange Resin	05305
DOWEX HGR (Na) Cation Exchange Resin	63151
DOWEX MARATHON™ C (Na) Cation Exchange Resin	39935
DOWEX MARATHON C-10 (Na) Cation Exchange Resin	69048
DOWEX MARATHON MSC (Na) Cation Exchange Resin	63028
DOWEX MONOSPHERE™ C-350 Cation Exchange Resin	08530
DOWEX MONOSPHERE C-400 Cation Exchange Resin	08531
DOWEX MONOSPHERE 88 (Na) Cation Exchange Resin	30267
DOWEX MONOSPHERE C-600 B Cation Exchange Resin	43966
DOWEX N278 (Na) Cation Exchange Resin	52155
DOWEX N279 (Na) Cation Exchange Resin	52156
DOWEX UPCORE™ Mono C-600 (Na) Cation Exchange Resin	52221
XUS 43595.00 Developmental Cation Exchange Resin	80065
XUS 43598.00 Developmental Cation Exchange Resin	148757

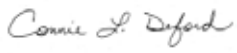
Food and Drug Administration (FDA)

These products comply with the U.S. Food and Drug Administration's Food Additive Regulation 21 CFR § 173.25(a)(1).

Use of this product is subject to good manufacturing practices and any limitations which are part of the regulations. The regulations should be consulted for complete details.

If you have any questions or require further information, please contact us via our web site at www.dow.com/perfchem.

Sincerely,



Connie Deford
Global Director for Product Regulatory Management
The Dow Chemical Company
www.dow.com/perfchem (Dow Answer Center)

Hubbell™

Model HX/TX Tankless

Tankless Electric Water Heater

Available up to 54 KW in Single or Three Phase Voltages

Features

- **Heavy Duty Construction**
  - √ Constructed with high grade materials to ensure long operating life
  - √ Simple to specify and easy to install and operate
  - √ Factory packaged heater provides trouble-free installation and operation
- **Reliability**
  - √ Engineered for your specific application to ensure reliable operation
  - √ Wide selection of sizes to meet the needs of even the most demanding application
- **High Efficiency**
  - √ On demand heating eliminates costly and cumbersome storage tanks
  - √ Instantaneous design reduces stand-by heat loss and significantly lowers operating costs compared to traditional storage systems

Applications

- Process Systems
- Wash Downs
- Heat Pump Back-Up
- Boiler Systems
- Emergency Safety Wash Systems
- Freeze Protection
- Heat Transfer Systems
- Supplemental Heat
- Point-of-Use Hot Water

Model HX/TX Tankless

CLASSIFIED UL EPH ANSI/NSF 5

c UL us LISTED

The Model HX / TX Tankless is a compact wall mounted electric tankless water heater that is 98% + efficient and is easily installed and operated.

Tankless Water Heater For Commercial and Industrial Use

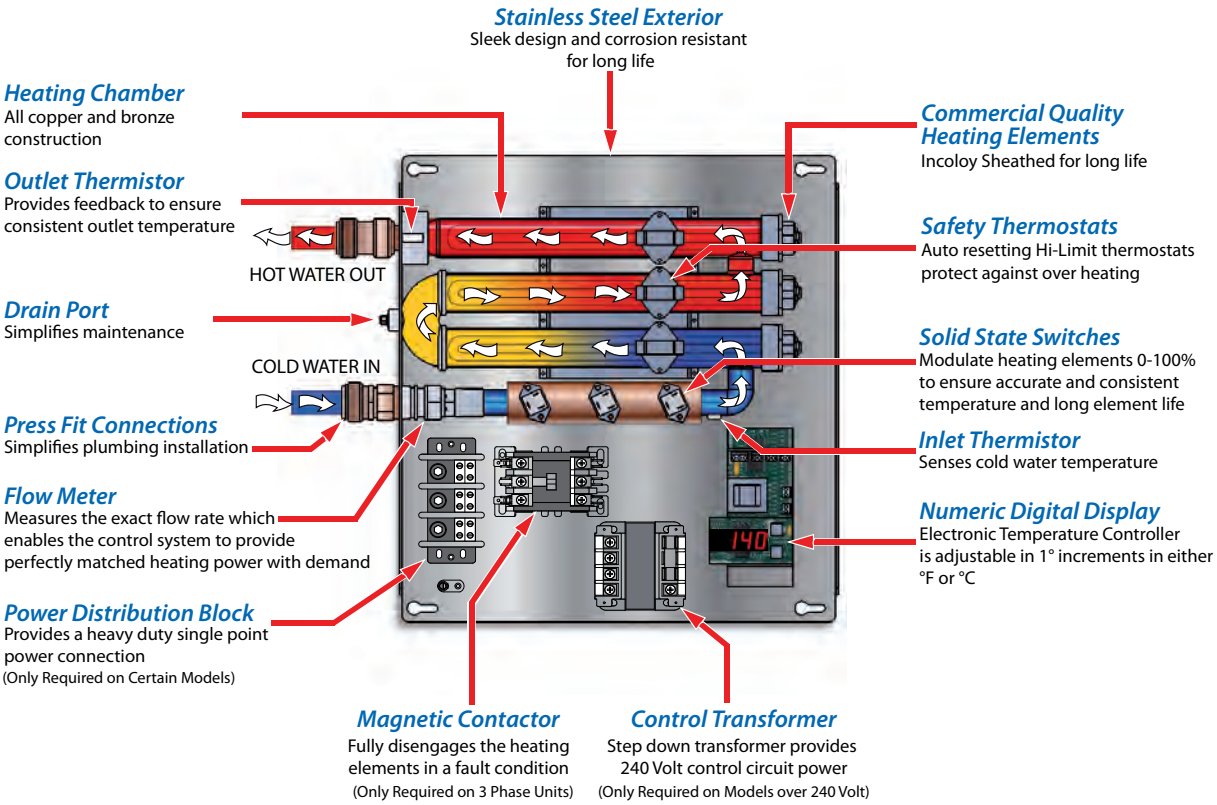
The Hubbell model HX / TX Tankless electric water heater is a highly reliable and easily maintained heater designed for operation in a commercial or industrial application. The Hubbell HX / TX Tankless heater is compact, extremely efficient, takes up minimal space, and reduces operating costs. Hubbell's vast experience, meticulous engineering, and advanced technology ensure that you can rely on the model HX / TX for your water heating needs in even the most demanding and critical applications. The Hubbell Tankless is the right choice for your water heating requirements, as you will be providing your customer with a quality product that is long lasting, trouble-free, and energy efficient.

Hubbell Tankless Features

How It Works

The Hubbell Model HX / TX electric tankless water heater contains high powered heating elements that heat water only when there is demand for hot water. When hot water is needed, a built in flow sensor measures the exact flow rate, and that data combined with temperature readings at the heater's inlet and outlet are processed by the electronic temperature controller. This data is continuously transmitted to the temperature controller, which constantly calculates the precise amount of power (kW) needed to achieve the desired temperature. A zero cross over firing signal is sent to the fast acting triacs in order to modulate the heating elements to the precise level needed to meet demand. The Hubbell tankless heater uses only as much power as is needed, while delivering accurate and consistent hot water temperature.

Heater Overview - *3 Element Model Shown*



Tankless Model HX/TX Standard Specifications

Heating Chamber:	Copper and Bronze	**Thermostat Range:**	32 -194°F / 0-90°C
Capacities:	8 thru 54 kW	**Hi-Limit:**	200°F (Fixed Temperature)
Orientation:	Wall Mounted	**Design WP:**	150 psi
Voltages:	208 thru 600 Volt 50/60 Hz	**Design TP:**	300 psi
Phase:	1 Φ and 3 Φ (balanced)	**Elements:**	Incoloy 800
Power Factor:	0.999	**Standby Power:**	< 3 Watts
Thermal Efficiency:	98% +	**Heating Chamber Warranty:**	5 Year
Inlet/Outlet Size:		**Electrical Warranty:**	1 Year
TX:	3/4" Press Fit		
HX:	1" ~~Press Fit~~ NPT		
Min/Max Flow:		**Enclosure:**	304 Stainless Steel Brushed Finish
TX:	0.2 GPM Min, 8.0 GPM Max		
HX:	0.5 GPM Min, 40 GPM Max	**Approvals:**	cULus, UL EPH ANSI/NSF 5

Technical Features

Temperature Controller

A sophisticated electronic temperature controller with LED digital display provides the user interface. The temperature controller processes all flow and temperature data and calculates the precise amount of power needed to meet demand.

Operator Control Capabilities		
✓	***Power Limiting:***	Allows the operator to reduce the power consumption by any percentage to provide installation and operational flexibility and savings.
✓	***Diagnostics:***	Display inlet and outlet temperatures, flow rate and error codes to assist in troubleshooting.
✓	***Cost Calculator:***	Determine the exact cost of operating the heater. Input your cost per KW·Hr and the controller displays total KW·HRs consumed, total cost of operation, and total hot water usage (shown in gallons or liters).
✓	***Temperature Control:***	Set the digital display to the desired water temperature in °F or °C. Fully adjustable in 1° increments from 32-194°F (0-90°C). A user adjustable +/- 3° calibration feature provides additional control for superior accuracy.

Full Heater Modulation

Each heating element is switched on/off using a fast acting solid state triac with zero cross over firing control. This switching schema provides full modulation of each heating element, ensuring that the precise amount of heat is added to meet demand. To improve operating efficiency and component longevity, each triac is mounted to a heat sink located on the incoming supply piping so that heat generated by the triac during the switching process is dissipated into the water.

Proper Power Integrity

All Hubbell tankless water heaters, including all 3 phase models, are engineered to operate as a balanced load and operate at 0.999 Power Factor. All Hubbell 3 phase models are designed for 3 wire (3 live, 1 ground) and 4 wire power systems and draw equal current across all conductors to maintain the power integrity of the users electrical system. Hubbell does not recommend the use of heaters that operate as an unbalanced load, as is common with staged heaters designed for star systems (3 live, 1 neutral, 1 ground) that require use of the neutral leg. All load switching in Hubbell tankless models is performed as zero cross over, eliminating phase angle firing interference and associated EMI issues.

Full Resource Staging

The Hubbell tankless control schema ensures that usage is equalized across all heating circuits. To achieve this, once the controller has calculated the precise amount of kW required, all circuits are energized in a staggered fashion such that each circuit is proportionally and independently energized and then time staggered between circuits. This Full Resource Staging Schema reduces EMI output, increases component longevity, and provides highly accurate and consistent hot water temperatures. For three phase models, all circuits are fully modulated and synchronized to operate as a balanced load.

Building Management Integration

Remote Control: Ability to remotely enable or inhibit the heating operation of the unit using one of the following two methods:

1. Customer supplied 24VDC signal is user configured for either Inhibit Mode or Normal Operation Mode.
2. Customer supplied volt free contact is user configured for either Inhibit Mode or Normal Operation Mode.

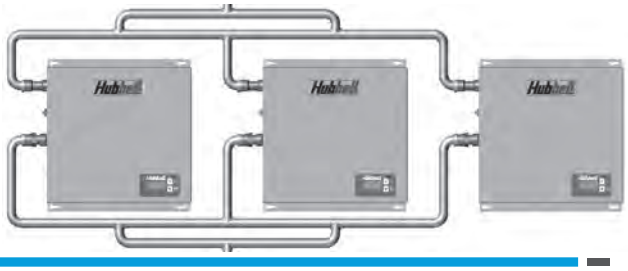
Priority Control: An integrated SPDT potential free dry contact (NO/NC 10A @ 240VAC) energizes when the unit is heating and de-energizes when not heating. This feature is useful when it is desirable to give the water heater priority over another electrical load to ensure that both are not operational at the same time.

Options

- ☐ A. High flow construction specify model HX for up to 40 GPM flow (min 0.5 GPM actuation).
- ☐ B. Type 316L stainless steel heating chamber for added corrosion resistance.
- ☐ C. Special construction features. Please consult factory.
- ☐ D. Inlet and Outlet Valve assembly simplifies installation and includes unions, shut offs, check valve,drain ports and relief valve port.
- ☐ E. Heating chamber built to ASME Section VIII and "UM" stamped.
- ☐ F. Remote Control Display allows the heater to be installed in a remote location. The 3" x 5" NEMA 4 display enclosure can be located up to 250' from the heater and gives the operator full remote control and monitoring capabilities.
- ☐ G. NEMA 4x construction when heater is located in a wet environment. Overall dimensions 24" x 20" x 6"
- ☐ H. Additional heater control features to meet UL834 Electric Boiler requirements. Please specify base model CR.
- ☐ I. Factory supplied manifold single point connection for redundancy and high demand applications.

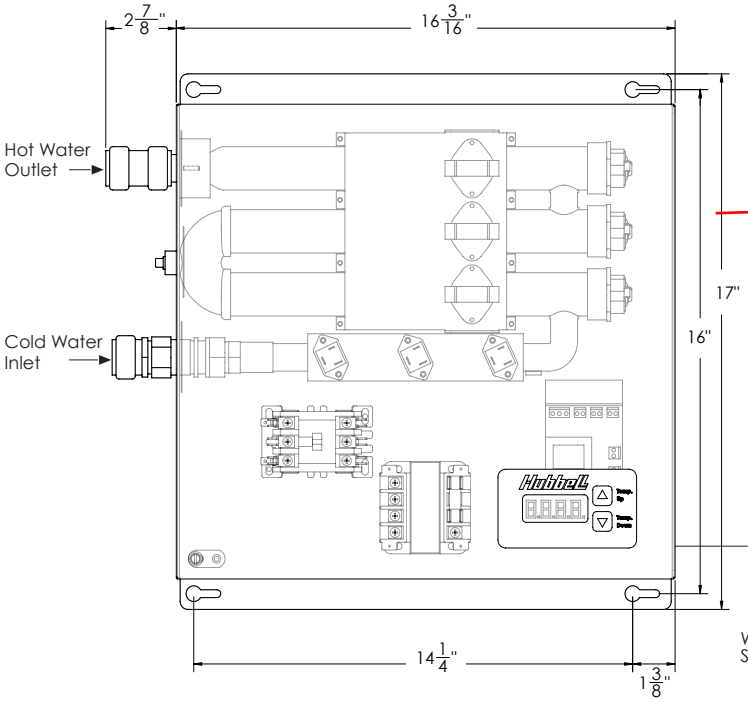
Manifold Assembly Option

Single point connection for redundancy and high demand applications.



Outline Dimensions and Model Selection

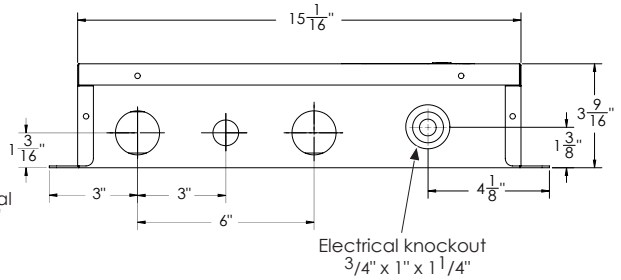
8-27 KW Models (2 and 3 Element)



KW Selection Chart						
KW	3 Phase Voltages				1 Phase Voltages	
	208V	240V	480V	600V	208V	240V
8					✓ (2)	
11	✓ (3)					✓ (2)
12	✓ (3)				✓ (2)	
14		✓ (3)			✓ (2)	✓ (2)
16	✓ (3)	✓ (3)			✓ (3)	✓ (2)
18	✓ (3)		✓ (3)		✓ (3)	✓ (2)
20	✓ (3)				✓ (3)	
21		✓ (3)	✓ (3)	✓ (3)		✓ (3)
24		✓ (3)	✓ (3)	✓ (3)		✓ (3)
27		✓ (3)	✓ (3)	✓ (3)		✓ (3)

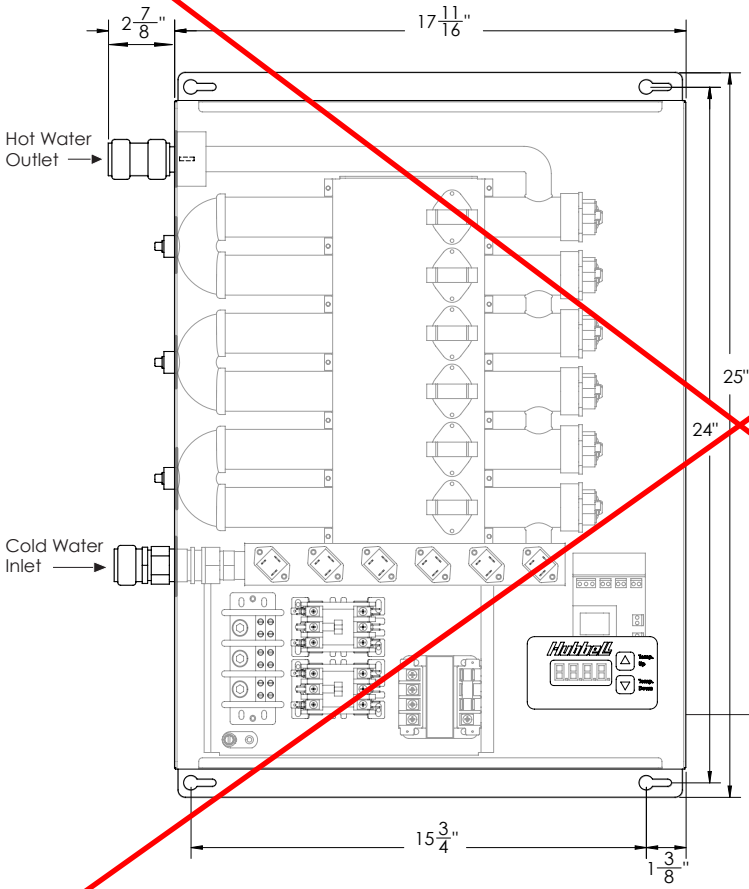
Note: Chart indicates three element (3) and two element (2) model types

Side View



Pressure Drop: 3 psi @ 8 GPM *Dry Weight: 21 Lbs* *Wet Weight: 21.5 Lbs* *Shipping Weight: 24 Lbs*

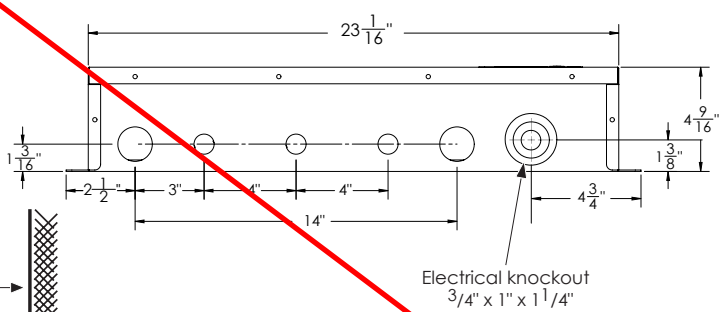
24-54 KW Models (6 Element)



KW Selection Chart						
KW	3 Phase Voltages				1 Phase Voltages	
	208V	240V	480V	600V	208V	240V
24	✓ (6)				✓ (6)	
31	✓ (6)				✓ (6)	
33		✓ (6)				✓ (6)
36	✓ (6)		✓ (6)		✓ (6)	
40	✓ (6)				✓ (6)	
42		✓ (6)	✓ (6)	✓ (6)		✓ (6)
48	✓ (6)	✓ (6)	✓ (6)	✓ (6)	✓ (6)	✓ (6)
54		✓ (6)	✓ (6)	✓ (6)		✓ (6)

Note: All models shown in this chart are six element (6) model types

Side View



Pressure Drop: 4 psi @ 8 GPM *Dry Weight: 38 Lbs* *Wet Weight: 39 Lbs* *Shipping Weight: 42 Lbs*

Heating Capacity and Amperage Chart

KW Rating	Heating Capability in GPM at °F Temperature Rise (°FΔT)										MAX Amps (at 100% heater output)					
											3 Phase Voltages				1 Phase Voltages	
	20° ΔT	30° ΔT	40° ΔT	60° ΔT	70° ΔT	80° ΔT	100° ΔT	110° ΔT	120° ΔT	140° ΔT	208V	240V	480V	600V	208V	240V
8	2.73	1.82	1.36	0.91	0.78	0.68	0.55	0.50	0.45	0.39	–	–	–	–	38	–
11	3.75	2.50	1.88	1.25	1.07	0.94	0.75	0.68	0.63	0.54	31	–	–	–	–	46
12	4.09	2.73	2.05	1.36	1.17	1.02	0.82	0.74	0.68	0.58	33	–	–	–	58	–
14	4.78	3.18	2.39	1.59	1.36	1.19	0.96	0.87	0.80	0.68	–	34	–	–	67	58
16	5.46	3.64	2.73	1.82	1.56	1.36	1.09	0.99	0.91	0.78	44	39	–	–	77	67
18	6.14	4.09	3.07	2.05	1.75	1.54	1.23	1.12	1.02	0.88	50	–	22	–	87	75
20	6.82	4.55	3.41	2.27	1.95	1.71	1.36	1.24	1.14	0.97	56	–	–	–	96	–
21	7.17	4.78	3.58	2.39	2.05	1.79	1.43	1.30	1.19	1.02	–	51	25	20	–	88
24	8.19	5.46	4.09	2.73	2.34	2.05	1.64	1.49	1.36	1.17	67	58	29	23	115	100
27	9.21	6.14	4.61	3.07	2.63	2.30	1.84	1.67	1.54	1.32	–	65	33	26	–	113
31	10.58	7.05	5.29	3.53	3.02	2.64	2.12	1.92	1.76	1.51	86	–	–	–	149	–
33	11.26	7.51	5.63	3.75	3.22	2.81	2.25	2.05	1.88	1.61	–	79	–	–	–	138
36	12.28	8.19	6.14	4.09	3.51	3.07	2.46	2.23	2.05	1.75	100	–	43	–	173	–
40	13.65	9.10	6.82	4.55	3.90	3.41	2.73	2.48	2.27	1.95	111	–	–	–	192	–
42	14.33	9.55	7.17	4.78	4.09	3.58	2.87	2.61	2.39	2.05	–	101	51	41	–	175
48	16.38	10.92	8.19	5.46	4.68	4.09	3.28	2.98	2.73	2.34	133	116	58	46	230	200
54	18.42	12.28	9.21	6.14	5.26	4.61	3.68	3.35	3.07	2.63	–	130	65	52	–	225

Note: *• Unshaded flows specify Base Model TX, shaded flows must specify Base Model HX due to high flow rate.*
• Alternate voltages including 277, 380, 415, 440 and 575 volt available. Please consult factory for exact KW availability in these voltages.

Sizing Formulas

Step 1
Solve for the unknown using formulas below.

Variables To Solve For:

KW Requirement:

_____ GPM x _____ °FΔT x 0.1465 = _____ KW

Temperature Rise:

_____ KW x 6.824 ÷ _____ GPM = _____ °FΔT

Flow Rate:

_____ KW x 6.824 ÷ _____ °FΔT = _____ GPM

Step 2
Choose the Tankless model with the KW rating which meets the peak demand (GPM) and required temperature rise (°FΔT) for your application.

Step 3
Choose the voltage and phase power supply available. Note the total amperage draw of the unit and verify availability.

Voltage De-Rating Factors

Rated Voltage	Applied Voltage	De-Rating Factor
600 V	575 V	92%
600 V	550 V	84%
480 V	460 V	92%
480 V	440 V	84%
240 V	230 V	92%
240 V	220 V	84%
240 V	208 V	75%

When the actual supply voltage (applied voltage) is different than the design voltage (rated voltage) the resulting KW output will be affected. Please see the chart for typical voltage de-rating factors, or use the following formula.

$$\frac{\text{Applied Voltage}^2}{\text{Rated Voltage}^2} \text{ X Rated KW = KW output at applied voltage}$$

Model Number Designation

~~TX~~ | **018** | – | **3** | **R**

Step 1
Base Model No.
TX = 8 GPM Max
HX = 40 GPM Max

Step 2
KW Rating:
8 thru 54KW
(008 - 054)

Step 3
Number of Heating Elements:
2
3
6

Step 4
Voltage / Phase / Hz:
RS = 208-1-60
R = 208-3-60
S = 240-1-60
T = 240-3-60
T3 = 380-3-50/60
T7 = 415-3-50/60
T5 = 440-3-60
T4 = 480-3-60
T6 = 600-3-60

Example: TX024-3T4

A Hubbell tankless electric water heater rated at 24 KW with 3 heating elements and powered with 480 volt, three phase, 60 Hz.

Option Note
Any and all optional equipment for a tankless model heater must be called out in the written specifications. A model number in and of itself does not reflect any optional equipment selected.

Electrical Installation Instructions:

IMPORTANT INFORMATION:

- *The unit must be wired in accordance* with the current version of the National Electrical Code (US) or Canadian Electric Code (Canada).
- The unit must have its own independent circuits.
- When the heater is not within sight of the electrical circuit breakers, an additional local means of disconnection of all ungrounded conductors must be provided that is within sight of the appliance or a circuit breaker lockout must be used. (Ref. NEC 422.31)
- Wire entry must be through the electrical KO provided in the bottom of the unit.
- For Canada, per Canadian Electric Code, C22.1-02, the unit must be wired by a single feed installation with one (1) double-pole circuit breaker.
- For US, the unit may be wired by a single feed installation with one (1) double-pole circuit breaker or by a multiple feed installation with multiple double-pole circuit breakers.

Wiring to the water heater:

- Connect the power wire from the main panel to the power distribution block or magnetic contactor as applicable.
- Connect the main ground wire to the ground lug in the heater.
- Make sure the connections are securely tightened.

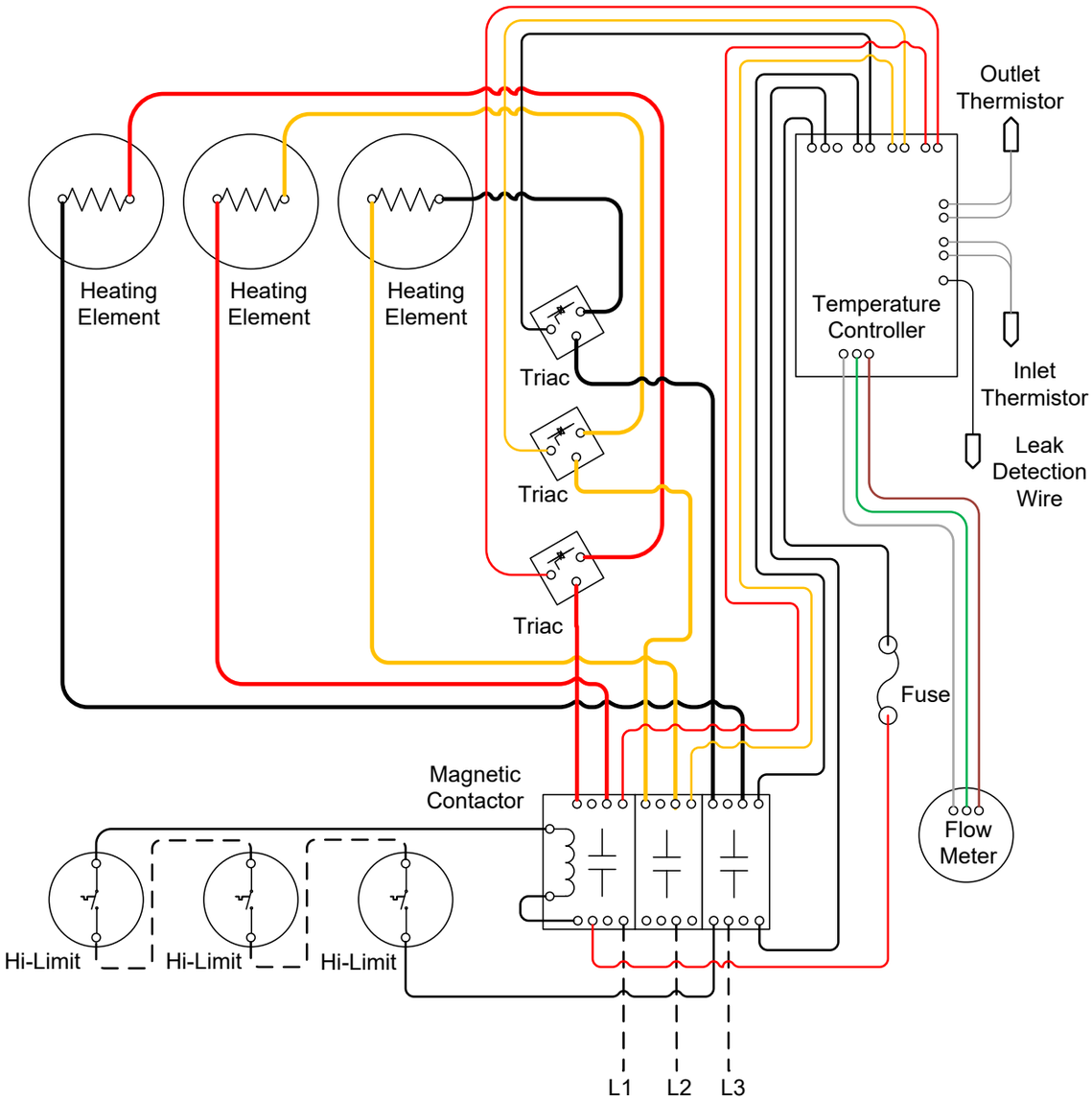
Electrical Specifications:

Listed in the following tables are the electrical specifications for each tankless water heater model.

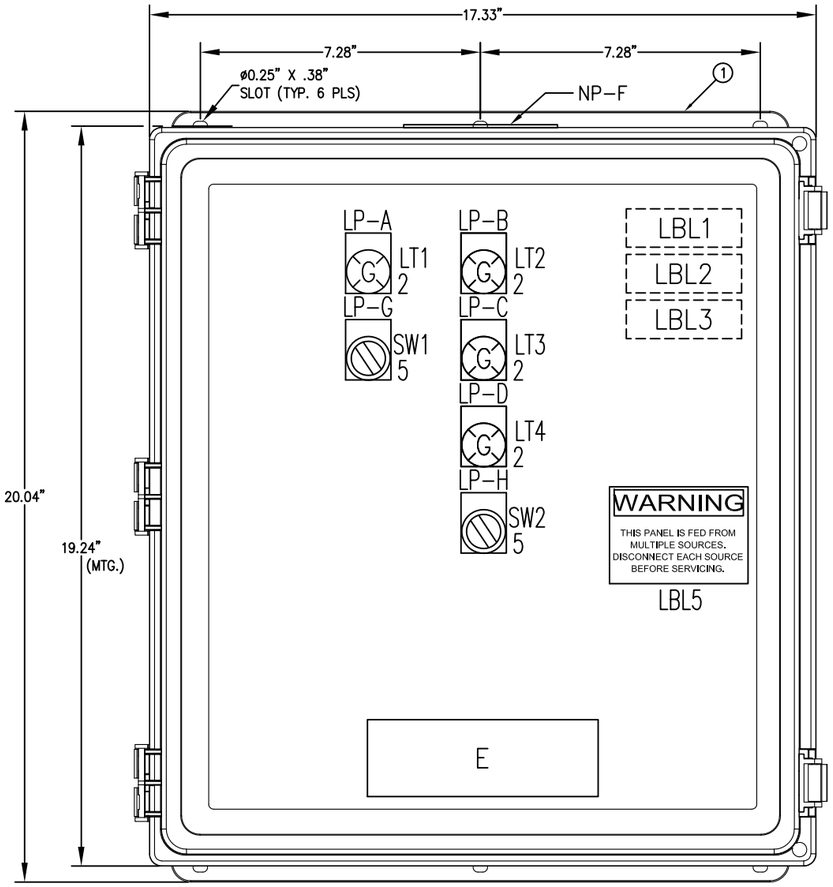
- □ Tankless water heaters are considered a non-continuous load.
- □ If a multiple feed installation is used, it is acceptable to install up to two conductors in one line side port. Additionally, when a power distribution block is supplied, additional conductors may be installed in an open load side port of the power distribution block.
- □ Wiring sizing listed is for 75°C THHN. 60°C or 90°C wire may be used. Refer to NEC table 310.16 for sizing.
- □ Conductors should be sized to maintain a voltage drop of less than 3% under load.
- □ Electrical specifications for the High Flow (HX) models are the same as listed for the Low Flow (TX) models.
- □ For the following models, for installation in Canada per CSA requirements, a single feed is required sized as follows:
  - TX036-6RS: 3/0
  - TX040-6RS: 4/0
  - TX042-6S: 3/0
  - TX048-6RS: 250
  - TX048-64S: 4/0
  - TX054-6S: 250
- □ * These models indicated require that a supplementary protection assembly be installed (supplied by Hubbell).

Model	kW	Volts / Phase	Amps	Min. Breaker Size	Wire Size	Conduit Size	Wiring Diagram	Element Amp Draw
TX008-2RS	8	208 / 1	38.5	45	8	¾"	1	19.9
TX011-3R	11	208 / 3	30.5	35	8	¾"	3	16.3
TX011-2S	11	240 / 1	45.8	50	8	¾"	1	22.9
TX011-3T3	11	380 / 3	16.7	20	8	¾"	4	9.9
TX012-2RS	12	208 / 1	57.7	70	6	¾"	1	28.9
TX012-3R	12	208 / 3	33.3	35	8	¾"	3	19.9
TX013-3T3	13	380 / 3	19.8	25	8	¾"	4	11.5
TX013-3T7	13	415 / 3	18.1	20	8	¾"	4	10.8
TX014-2RS	14	208 / 1	67.3	80	4	1"	1	32.5
TX014-2S	14	240 / 1	58.3	70	6	¾"	1	29.2
TX014-3T	14	240 / 3	33.7	40	8	¾"	3	18.8
TX015-3T3	15	380 / 3	22.8	25	8	¾"	4	13.2
TX016-3RS	16	208 / 1	76.9	90	4	1"	2	25.3
TX016-3R	16	208 / 3	44.4	50	8	¾"	3	25.3
TX016-2S	16	240 / 1	66.7	80	4	1"	1	33.3
TX016-3T	16	240 / 3	38.5	45	8	¾"	3	22.9
TX016-3T7	16	415 / 3	22.3	25	8	¾"	4	12.6
TX018-3RS	18	208 / 1	86.5	90	3	1"	2	28.9
TX018-3R	18	208 / 3	50.0	60	6	¾"	3	28.9
TX018-2S	18	240 / 1	75.0	80	4	1"	1	37.5
TX018-3T3	18	380 / 3	27.3	30	8	¾"	4	15.7
TX018-3T7	18	415 / 3	25.0	30	8	¾"	4	14.4
TX018-3T4	18	480 / 3	21.7	25	8	¾"	4	12.5
TX020-3RS	20	208 / 1	96.2	110	2	1"	2	32.5
TX020-3R	20	208 / 3	55.5	60	6	¾"	3	32.5
TX020-3T3	20	380 / 3	30.4	35	8	¾"	4	17.7
TX020-3T7	20	415 / 3	27.8	30	8	¾"	4	16.2
TX021-3S	21	240 / 1	87.5	90	3	1"	2	29.2
TX021-3T	21	240 / 3	50.5	60	6	¾"	3	29.2
TX021-3T4	21	480 / 3	25.3	30	8	¾"	4	14.6
TX021-3T6	21	600 / 3	20.2	25	8	¾"	5	20.2
TX024-6RS	24	208 / 1	115.4	125*	1	2"	6	19.9
TX024-6R	24	208 / 3	66.6	70	4	1"	7	19.9
TX024-3S	24	240 / 1	100.0	110	2	1"	2	33.3
TX024-3T	24	240 / 3	57.7	70	6	¾"	3	33.3
TX024-3T7	24	415 / 3	33.4	40	8	¾"	4	19.3
TX024-3T4	24	480 / 3	28.9	35	8	¾"	4	16.7
TX024-3T6	24	600 / 3	23.1	25	8	¾"	5	23.1
TX025-3T3	25	380 / 3	38.0	40	8	¾"	4	22.2
TX027-3S	27	240 / 1	112.5	125	1	2"	2	37.5
TX027-3T	27	240 / 3	65.0	70	4	1"	3	37.5
TX027-6T3	27	380 / 3	41.0	45	8	¾"	9	11.5
TX027-6T7	27	415 / 3	37.6	40	8	¾"	9	10.8
TX027-3T4	27	480 / 3	32.5	35	8	¾"	4	18.8

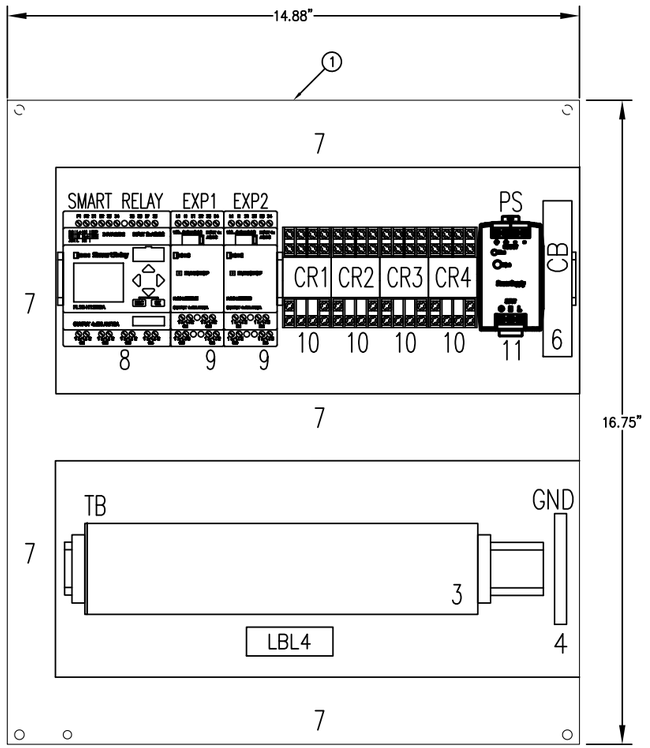
Tankless Wiring Diagram 3



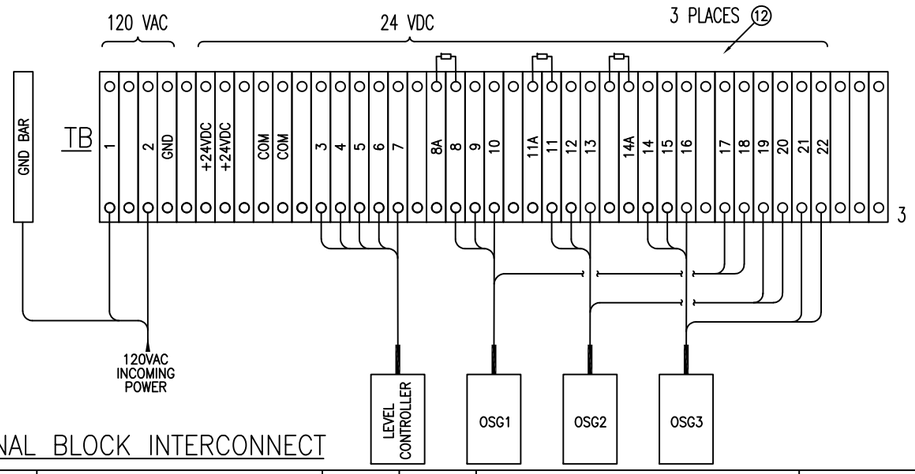
OSG ALTERNATOR CONTROL PANEL



FRONT VIEW
(10" DEEP)



SUBPANEL LAYOUT



TERMINAL BLOCK INTERCONNECT

BILL OF MATERIAL

ITEM	QTY.	MANUFACTURER	CATALOG	LINE DESIGNATION
1	1	HOFFMAN	A181610PHC	ENCLOSURE, NEMA 4X, POLYESTER, WALL-MOUNT, 18"H X 16"W X 10D"
	1	HOFFMAN	A18P16	SUBPANEL, 16.75" X 14.88", PAINTED STEEL
2	4	SQUARE D	XB5AVB3	PILOT LIGHT, 22 mm, GREEN, 24 VDC, LED TYPE, NEMA 4X
3	40	WEIDMULLER	1020100000	TERMINAL BLOCK, FEED THROUGH, WDU 4, BEIGE, 600V, 22-10 AWG
4	1	SQUARE D	PK7GTA	GROUND BAR, 7-GANG, ALUMINUM
5	2	SQUARE D	XB5AD25	SELECTOR SWITCH, 22 mm, 2-POSITION MAINTAINED, WITH CONTACT BLOCKS
6	1	SQUARE D	QOU110	CIRCUIT BREAKER, 1-POLE, 10 AMP, 120/240 VAC RATED
7	A/R	PANDUIT	TYPE F	WIRING DUCT, LIGHT GRAY, NARROW SLOT
8	1	IDEC	FL1E-H12RCE	PROGRAMMABLE RELAY. 12/24 VDC, (8) INPUTS, (4) RELAY OUTPUTS
9	2	IDEC	FL1B-M08B2R2	EXPANSION MODULE, 12/24 VCDC, (4) INPUTS, (4) RELAY OUTPUTS
10	4	IDEC	RY4S-ULC-DC24V	CONTROL RELAY, 4PDT, 24 VDC COIL, WITH INDICATOR AND TEST BUTTON
	4	IDEC	SY4S-05C	FINGER-SAFE RELAY SOCKET
11	1	PULS	ML60.241	POWER SUPPLY, 24 VDC OUTPUT, 60 WATT, 100-240 VAC POWER
12	2	ANY	1N4001	DIODE, 50V, 1 AMP

ENGRAVING SCHEDULE (ATTACH WITH ADHESIVE)

I.D. No.	QTY.	SIZE	PLATE COLOR	LETTER COLOR	LINE DESIGNATION
A	1	2" SQ LEGEND	WHITE	BLACK	POWER ON
B	1	2" SQ LEGEND	WHITE	BLACK	OSG #1 ON
C	1	2" SQ LEGEND	WHITE	BLACK	OSG #2 ON
D	1	2" SQ LEGEND	WHITE	BLACK	OSG #3 ON
E	1	2" x 6" x 1/16"	BLUE	WHITE	(PARKSON LOGO) / OSG ALTERNATOR PANEL / PROJECT P02600585
F	1	3" x 4" x 1/16"	WHITE	BLACK	TOP ENTRY IS NOT RECOMMENDED. IF TOP ENTRY IS REQUIRED, USE AN APPROVED MYERS HUB.
G	1	2" SQ LEGEND	WHITE	BLACK	POWER / OFF- ON
H	1	2" SQ LEGEND	WHITE	BLACK	ALTERNATOR / NORMAL - AUTO

LABEL SCHEDULE

LBL-1 RCS INFORMATION LABEL:
SERIAL NO. V0586 CUSTOMER ID: P02600585
LINE VOLTAGE ___, ___PHASE, ___WIRE, 60 Hz.
CONTROL VOLTAGE 120V LARGEST MOTOR HP ___ TOTAL FLA 10
RCS CONTACT R. BRADDOCK
REF. DWG. NO. P0260058525 TYPE 4X ENCLOSURE
SHORT CIRCUIT CURRENT RATING 10K RMS SYMMETRICAL AMPERES

LBL2 TO MAINTAIN ENCLOSURE RATING, USE HUBS OR FITTINGS WITH THE SAME ENVIRONMENTAL RATING AS THE ENCLOSURE.
O-Z/GEDNEY CHMG SERIES HUBS
APPLETON HUBG SERIES HUBS
CROUSE HINDS STG SERIES HUBS
CAUTION! NONMETALLIC ENCLOSURE DOES NOT PROVIDE GROUNDING BETWEEN CONDUIT CONNECTIONS. USE GROUNDING BUSHINGS AND JUMPER WIRES.

LBL3 U.L. 508A LABEL

LBL4 USE COPPER CONDUCTORS ONLY.
RECOMMENDED TORQUE: 8.9 LBF-IN

LBL5 WARNING
THIS PANEL IS FED FROM MULTIPLE SOURCES.
DISCONNECT EACH SOURCE BEFORE SERVICING.

NOTE: FUSE LABELS TO BE LOCATED NEAR EACH RESPECTIVE FUSEHOLDER.

NOTES:

1. ALL INTERNAL WIRING TO BE BETWEEN #18-#14 AWG MTW.
2. ASSEMBLED CONTROL PANEL TO HAVE UL508A LABEL.
3. ASSEMBLED CONTROL PANEL RATED NEMA 4X.

RCS #: V0586

REV	DESCRIPTION	DATE	BY

__PRELIMINARY __APPROVAL
__INFORMATION X CERTIFIED

THIS DRAWING IS LIMITED TO FUNCTIONAL DESIGN, GENERAL ARRANGEMENT AND CLEARANCE. NO RESPONSIBILITY IS ACCEPTED BY PARKSON CORPORATION FOR OTHER DIMENSIONS, QUANTITIES, OR COORDINATION WITH OTHER EQUIPMENT OR DRAWINGS EXCEPT AS STATED IN PURCHASE ORDER.

DRAWN BY TRB	DATE 08/01/16
CHECKED BY TRB	DATE 08/02/16
SCALE	SIZE B

Parkson™

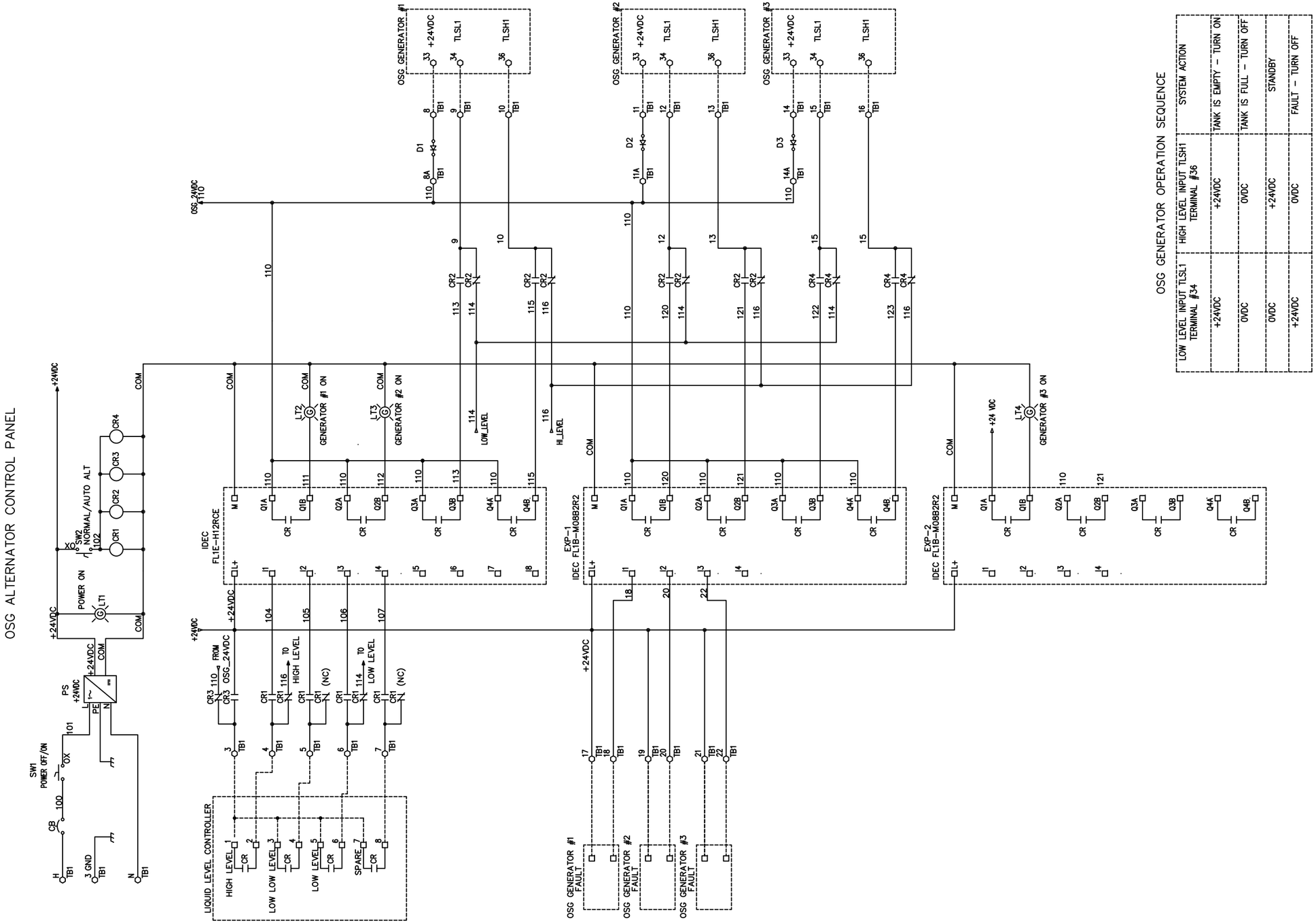
PROJECT NAME
P02600585
WICHITA REUSE, KS

TITLE
OSG ISOLATED TRIPLEX ALTERNATOR CONTROL PANEL
PANEL LAYOUT AND BILL OF MATERIAL

REFERENCE INFORMATION

DRAWING NO P0260058525-01
SHEET 1 OF 2

REV



OSG GENERATOR OPERATION SEQUENCE

LOW LEVEL INPUT TLSL1 TERMINAL #34	HIGH LEVEL INPUT TLSH1 TERMINAL #36	SYSTEM ACTION
+24VDC	+24VDC	TANK IS EMPTY – TURN ON
0VDC	0VDC	TANK IS FULL – TURN OFF
0VDC	+24VDC	STANDBY
+24VDC	0VDC	FAULT – TURN OFF

LIQUID LEVEL CONTROLLER PROGRAMMING CONSTRAINTS

1. LOW LOW LEVEL MUST BE PROGRAMMED TO CLOSE OUTPUT CONTACTS WHEN A LOW LOW LEVEL IS REACHED. HYSTERISIS REQUIRED
2. LOW LEVEL MUST BE PROGRAMMED TO CLOSE OUTPUT CONTACTS WHEN A LOW LEVEL IS REACHED. HYSTERISIS REQUIRED
3. HIGH LEVEL MUST BE PROGRAMMED TO OPEN OUTPUT CONTACTS WHEN A HIGH LEVEL IS REACHED. HYSTERISIS REQUIRED

RCS #: V0568

REV	DESCRIPTION	DATE	BY

__PRELIMINARY X APPROVAL

__INFORMATION __CERTIFIED

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DRAWN BY	DATE
TRB	08/01/16
CHECKED BY	DATE
TRB	08/02/16
SCALE	SIZE
	B

Parkson™

PROJECT NAME
P02600585
WICHITA REUSE, KS

REFERENCE INFORMATION

TITLE
OSG ISOLATED TRIPLEX ALTERNATOR CONTROL PANEL
CONTROL PANEL WIRING DIAGRAM

DRAWING NO P0260058525-02
SHEET 1 OF 2

REV

POLYPRO™, TYPE 4X

POLYPRO™ ENCLOSURES

Item 1

INDUSTRY STANDARDS

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A Listed; Type 4, 4X, 12, 13; File No. E61997 cUL Listed per CSA C22.2 No 94; Type 4, 4X, 12, 13; File No. E61997 Enclosure flammability evaluated per UL 508A Window flammability evaluated per UL 508A

NEMA/EEMAC Type 4, 4X, 12, 13
CSA File No. 42186; Type 4, 4X, 12, 13 (solid covers only)
IEC 60529, IP66

APPLICATION

POLYPRO™ polyester enclosures perform exceptionally well in applications where harsh chemicals, weather extremes and corrosive environments demand toughness from a lightweight enclosure. Providing excellent ultraviolet protection and a tight environmental seal, these versatile, feature-rich enclosures are also recyclable.

SPECIFICATIONS

- Non-glass-filled polyester material offers superior UV resistance; eliminates fiberbloom associated with fiberglass
- Provides excellent chemical resistance to a broad range of solvents, alkalis and acids
- Resists cracking and provides excellent impact resistance
- Lighter-weight than fiberglass
- Recyclable
- Easy, dustless in-field modifications using standard tools
- Overlapping tongue-and-groove raised cover and gasket provide a secure Type 4X seal
- Removable snap-hinge cover allows for easy access to cover and body for modifications
- Molded layout grid on inside of body and solid covers assists with component mounting
- Molded-in embosses for rear panel mounting
- Optional cover screws included with all models
- Internal rail system and adjustable panel blocks allow for panel height adjustment and installation of multiple panels
- Scratch-resistant polycarbonate windows
- Standard models include body and cover, two mounting feet, two latch assemblies with optional cover screws and hardware (adjustable panel blocks and panels sold separately)

FINISH

RAL 7035 light-gray textured finish inside and out

ACCESSORIES

See also Accessories.
Adjustable Panel Block Kit
Panels for Junction Boxes
HOL-SEALERS™ Non-Metallic Hole Seals
Aluminum Swing-Out Panels
Stainless Steel Latches (Padlockable)
Hinge Retainers

MODIFICATION AND CUSTOMIZATION

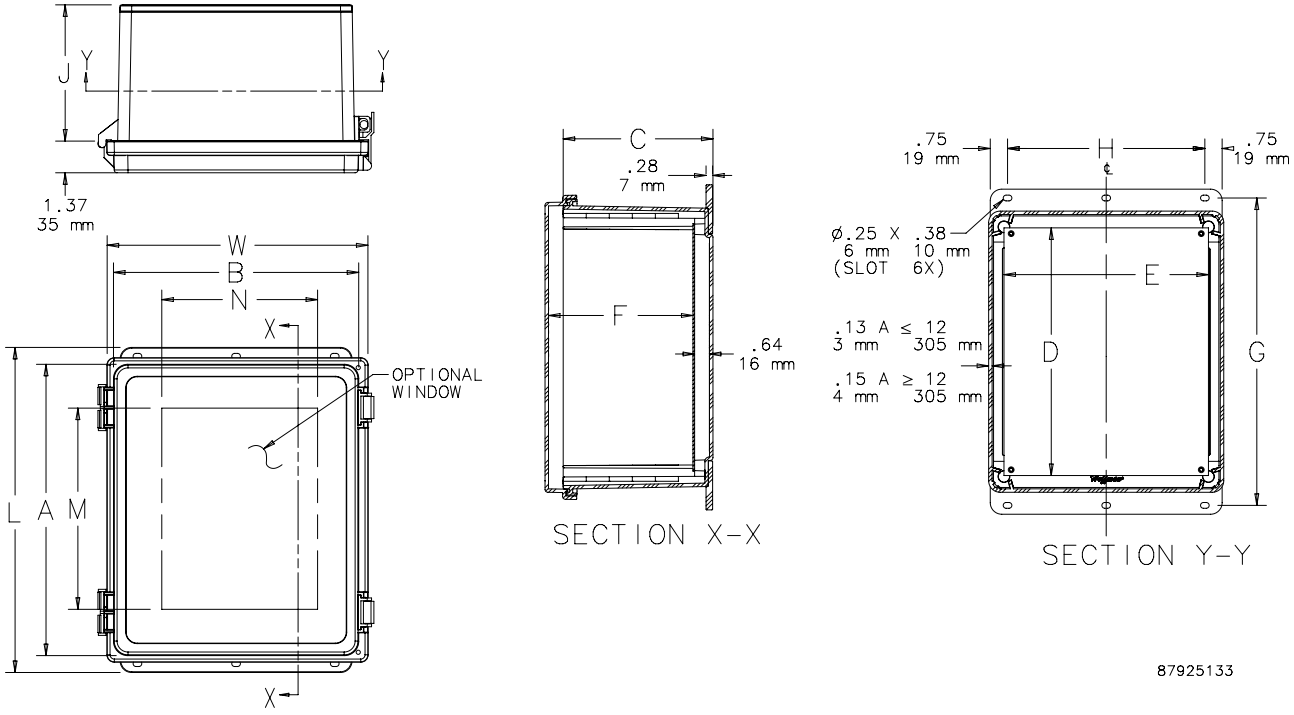
Hoffman excels at modifying and customizing products to your specifications. Contact your local Hoffman sales office or distributor for complete information.

BULLETIN: PCR

Standard Product

Catalog Number	AxBxC in./mm	Cover Type	Steel Panel	Aluminum Panel	Panel Size D x E in./mm	F in./mm	G in./mm	H in./mm	J in./mm	L in./mm	M in./mm	N in./mm	W in./mm
A644PHC	6.12 x 4.12 x 4.38 155 x 105 x 111	Solid	A6P4	A6P4AL	4.88 x 2.88 124 x 73	4.32 110	7.38 187	2.56 65	3.91 99	8.15 207	— —	— —	5.23 133
A644PHCW	6.12 x 4.12 x 4.38 155 x 105 x 111	Window	A6P4	A6P4AL	4.88 x 2.88 124 x 73	4.32 110	7.38 187	2.56 65	3.91 99	8.15 207	4.25 108	2.25 57	5.23 133
A664PHC	6.12 x 6.12 x 4.38 155 x 155 x 111	Solid	A6P6	A6P6AL	4.88 x 4.88 124 x 124	4.32 110	7.38 187	4.56 116	3.91 99	8.15 207	— —	— —	7.23 184
A664PHCW	6.12 x 6.12 x 4.38 155 x 155 x 111	Window	A6P6	A6P6AL	4.88 x 4.88 124 x 124	4.32 110	7.38 187	4.56 116	3.91 99	8.15 207	4.25 108	4.25 108	7.23 184
A864PHC	8.12 x 6.12 x 4.38 206 x 155 x 111	Solid	A8P6	A8P6AL	6.75 x 4.88 171 x 124	4.32 110	9.38 238	4.56 116	3.91 99	10.15 258	— —	— —	7.23 184
A864PHCW	8.12 x 6.12 x 4.38 206 x 155 x 111	Window	A8P6	A8P6AL	6.75 x 4.88 171 x 124	4.32 110	9.38 238	4.56 116	3.91 99	10.15 258	6.25 159	4.25 108	7.23 184
A884PHC	8.12 x 8.12 x 4.38 206 x 206 x 111	Solid	A8P8	A8P8AL	6.75 x 6.88 171 x 175	4.32 110	9.38 238	6.56 167	3.91 99	10.15 258	— —	— —	9.23 234
A884PHCW	8.12 x 8.12 x 4.38 206 x 206 x 111	Window	A8P8	A8P8AL	6.75 x 6.88 171 x 175	4.32 110	9.38 238	6.56 167	3.91 99	10.15 258	6.25 159	6.25 159	9.23 234
A1084PHC	10.12 x 8.12 x 4.38 257 x 155 x 111	Solid	A10P8	A10P8AL	8.75 x 6.88 222 x 175	4.32 110	11.38 289	6.56 167	3.91 99	12.15 309	— —	— —	9.23 234
A1084PHCW	10.12 x 8.12 x 4.38 257 x 155 x 111	Window	A10P8	A10P8AL	8.75 x 6.88 222 x 175	4.32 110	11.38 289	6.56 167	3.91 99	12.15 309	8.25 210	6.25 159	9.23 234
A10106PHC	10.04 x 10.04 x 6.38 255 x 255 x 162	Solid	A10P10	A10P10AL	8.75 x 8.88 222 x 226	6.32 161	11.31 287	8.56 217	5.91 150	12.08 307	— —	— —	11.23 285
A10106PHCW	10.04 x 10.04 x 6.38 255 x 255 x 162	Window	A10P10	A10P10AL	8.75 x 8.88 222 x 226	6.32 161	11.31 287	8.56 217	5.91 150	12.08 307	8.25 210	8.25 210	11.23 285
A12106PHC	12.08 x 10.09 x 6.38 307 x 256 x 162	Solid	A12P10	A12P10AL	10.75 x 8.88 273 x 226	6.32 161	13.34 339	8.56 217	5.91 150	14.08 358	— —	— —	11.23 285
A12106PHCW	12.08 x 10.09 x 6.38 307 x 256 x 162	Window	A12P10	A12P10AL	10.75 x 8.88 273 x 226	6.32 161	13.34 339	8.56 217	5.91 150	14.08 358	10.25 260	8.25 210	11.23 285
A14128PHC	14.02 x 12.01 x 8.35 356 x 305 x 212	Solid	A14P12	A14P12AL	12.75 x 10.88 324 x 276	8.27 210	15.27 388	10.56 268	7.91 201	16.04 407	— —	— —	13.32 338
A14128PHCW	14.02 x 12.01 x 8.35 356 x 305 x 212	Window	A14P12	A14P12AL	12.75 x 10.88 324 x 276	8.27 210	15.27 388	10.56 268	7.91 201	16.04 407	12.25 311	10.25 260	13.32 338
A16148PHC	16.02 x 14.01 x 8.35 407 x 356 x 212	Solid	A16P14	A16P14AL	14.75 x 12.88 375 x 327	8.27 210	17.27 439	12.56 319	7.91 201	18.04 458	— —	— —	15.32 389
A16148PHCW	16.02 x 14.01 x 8.35 407 x 356 x 212	Window	A16P14	A16P14AL	14.75 x 12.88 375 x 327	8.27 210	17.27 439	12.56 319	7.91 201	18.04 458	14.25 362	12.25 311	15.32 389
A181610PHC	17.95 x 15.94 x 10.35 456 x 405 x 263	Solid	A18P16	A18P16AL	16.75 x 14.88 425 x 378	10.27 261	19.20 488	14.56 370	9.91 252	19.97 507	— —	— —	17.32 440
A181610PHCW	17.95 x 15.94 x 10.35 456 x 405 x 263	Window	A18P16	A18P16AL	16.75 x 14.88 425 x 378	10.27 261	19.20 488	14.56 370	9.91 252	19.97 507	16.25 413	14.25 362	17.32 440

Purchase panels separately. Panels are available in aluminum, mild steel, stainless steel, conductive and composite materials.



Product data sheet
Characteristics

XB5AVB3
green complete pilot light Ø22 plain lens with integral LED 24V

Product availability: Stock - Normally stocked in distribution facility

Item 2

Price*: 72.00 USD

Main

Commercial Status	Commercialised
Range of product	Harmony XB5
Product or component type	Complete pilot light
Device short name	XB5
Bezel material	Plastic
Fixing collar material	Plastic
Mounting diameter	0.87 in (22 mm)
Sale per indivisible quantity	1
Shape of signaling unit head	Round
Cap/Operator or lens colour	Green
Operator additional information	With plain lens
Light source	Protected LED
Bulb base	Integral LED
Light source colour	Green
[Us] rated supply voltage	24 V AC/DC, 50/60 Hz

Complementary

Height	1.65 in (42 mm)
Width	1.18 in (30 mm)
Depth	2.13 in (54 mm)
Terminals description ISO n°1	(X1-X2)PL
Product weight	0.08 lb(US) (0.038 kg)
Resistance to high pressure washer	1015.26 psi (7000000 Pa) at 131 °F (55 °C),distance: 0.1 m
Connections - terminals	Screw clamp terminals: 1 x 0.22...2 x 2.5 mm² without cable end conforming to EN/IEC 60947-1 Screw clamp terminals: <= 2 x 1.5 mm² with cable end conforming to EN/IEC 60947-1
[Ui] rated insulation voltage	250 V (degree of pollution: 3) conforming to EN 60947-1
[Uimp] rated impulse withstand voltage	4 kV conforming to EN 60947-1
Signalling type	Steady
Supply voltage limits	21.6...26.4 V AC 19.2...30 V DC
Current consumption	18 mA
Service life	100000 h at rated voltage and 25 °C
Surge withstand	1 kV conforming to IEC 61000-4-5

Environment

Protective treatment	TH
Ambient air temperature for storage	-40...158 °F (-40...70 °C)
Ambient air temperature for operation	-13...158 °F (-25...70 °C)
Class of protection against electric shock	Class II conforming to IEC 60536
IP degree of protection	IP66 conforming to IEC 60529
NEMA degree of protection	NEMA 4X NEMA 13
IK degree of protection	IK05 conforming to IEC 50102
Standards	EN/IEC 60947-1 EN/IEC 60947-5-1 EN/IEC 60947-5-4 JIS C 4520 UL 508 CSA C22.2 No 14
Product certifications	CSA UL listed
Vibration resistance	5 gn (f = 12...500 Hz) conforming to IEC 60068-2-6
Shock resistance	50 gn for 11 ms half sine wave acceleration conforming to IEC 60068-2-27 30 gn for 18 ms half sine wave acceleration conforming to IEC 60068-2-27
Resistance to fast transients	2 kV conforming to IEC 61000-4-4
Resistance to electromagnetic fields	9.14 V/yd (10 V/m) conforming to IEC 61000-4-3
Resistance to electrostatic discharge	8 kV in free air (in insulating parts) conforming to IEC 61000-4-2 6 kV on contact (on metal parts) conforming to IEC 61000-4-2
Electromagnetic emission	Class B conforming to IEC 55011

Ordering and shipping details

Category	22467 - PUSHBUTTONS,22MM(PLASTIC) NEW
Discount Schedule	CS2
GTIN	00785901383994
Nbr. of units in pkg.	1
Package weight(Lbs)	0.08
Product availability	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	FR

Contractual warranty

Period	18 months

W-Series
WDU 4

Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 16
D-32758 Detmold
Germany
Fon: +49 5231 14-0
Fax: +49 5231 14-292083
www.weidmueller.com

Item 3

The versatile and extensive range of products - from 0.05 mm² to 300 mm² - means that you have diverse options for your applications at your disposal.
Hardened steel for mechanical strength and high-quality tinned copper for optimum conductivity. All materials comply with RoHS requirements and have been tested to current environment guidelines.

General ordering data

Order No.	1020100000
Type	WDU 4
Version	W-Series, Feed-through terminal, Rated cross-section: 4 mm², Screw connection, Direct mounting
GTIN (EAN)	4008190150617
Qty.	100 pc(s).

Creation date November 14, 2012 11:59:50 AM CET

Weidmüller

W-Series
WDU 4

Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 16
D-32758 Detmold
Germany
Fon: +49 5231 14-0
Fax: +49 5231 14-292083
www.weidmueller.com

Technical data

Dimensions and weights

Length	60 mm	Width	6.1 mm
Height	46.5 mm	Height of lowest version	47 mm
Weight	10.4 g	Net weight	9.57 g

Temperatures

Operating temperature		Storage temperature	
Continuous operating temp., min.	-50 °C	Continuous operating temp., max.	120 °C

Rated data IECEx/ATEX

Certificate No. (ATEX)	KEMA98ATEX1683U	ATEX certificate	KEMA98ATEX1683U_d.pdf
ATEX certificate	KEMA98ATEX1683U_e.pdf	IEC Ex certificate	IECEXULD05.0008U_e.pdf
Max. voltage (ATEX)	690 V	Current (ATEX)	28 A
Wire cross section max. (ATEX)	4 mm²	Voltage, cross-connection	CrossConnectionGuide.pdf
Operating temperature range	For operating temperature range see EC Design Test Certificate / IEC Ex-Certificate of Conformity	Marking EN 60079-7	Ex e II
Marking ATEX Directive 94/9/EC	II 2 G D		

2 clampable wires (H05V/H07V) same cross-section (rated connection)

Wire connection cross section, finely stranded, two clampable wires, min.	0.5 mm²	Wire cross-section, finely stranded, two clampable wires, max.	1.5 mm²
Wire connection cross section, finely stranded with wire-end ferrules DIN 46228/1, 2 clampable wires, min.	0.5 mm²	Wire connection cross section, finely stranded with wire-end ferrules DIN 46228/1, 2 clampable wires, max.	1.5 mm²

Additional technical data

Explosion-tested version	Yes	Installation advice	Direct mounting
Number of similar terminals	1	Open sides	right
Type of mounting	Snap-on	Version	Double terminal

CSA ratings data

Certificate No. (CSA)	200039-1057876	Voltage size C (CSA)	600 V
Current size B (CSA)	35 A	Current size C (CSA)	35 A
Wire cross section max. (CSA)	10 AWG	Wire cross section min. (CSA)	26 AWG

Weidmüller

W-Series
WDU 4

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www.weidmueller.com

Technical data

Clampable wires (rated connection)

Type of connection	Screw connection	Stripping length	10 mm
Blade size	0.6 x 3.5 mm	Connection direction	on side
Number of connections	2	Clamping range, rated connection, min.	0.13 mm²
Clamping range, rated connection, max.	6 mm²	Clamping screw	M 3
Tightening torque, min.	0.5 Nm	Tightening torque, max.	1 Nm
Torque level with DMS electric screwdriver	2	Gauge to IEC 60947-1	A4
Wire connection cross section, solid core, max. rated connection	0.5 mm²	Wire connection cross section, solid core max. rated connection	6 mm²
Wire connection cross section, stranded, rated connection, min.	1.5 mm²	Wire connection cross section, stranded, rated connection, max.	6 mm²
Wire connection cross section, finely stranded, max.	6 mm²	Wire connection cross-section, finely stranded, min.	0.5 mm²
Wire connection cross section, finely stranded with wire-end ferrules DIN 46228/1, rated connection, min.	0.5 mm²	Wire connection cross section, finely stranded with wire-end ferrules DIN 46228/1, rated connection, max.	4 mm²
Cross-section for connected conductor, finely stranded with wire-end ferrules and plastic collars DIN 46228/4, rated connection, min.	0.5 mm²	Wire connection cross-section, finely stranded with wire-end ferrules and plastic collars DIN 46228/4, rated connection, max.	4 mm²
Twin wire-end ferrules, min.	0.5 mm²	Twin wire-end ferrules, max.	2.5 mm²
Wire connection cross section AWG, min.	AWG 26	Wire connection cross section AWG, max.	AWG 10

Rated data

Rated cross-section	4 mm²	Rated voltage	800 V
Rated impulse withstand voltage	8 kV	Rated current	32 A
Current at maximum wires	41 A	Standards	IEC 60947-7-1
Pollution severity	3		

UL ratings data

Certificate No. (UR)	E60693VOL1SEC38	Voltage size C (UR)	600 V
Current size C (UR)	35 A	Conductor size Factory wiring max. (UR)	10 AWG
Conductor size Factory wiring min. (UR)	26 AWG	Conductor size Field wiring max. (UR)	10 AWG

Material data

Material	Wemid	Colour	Beige
UL 94 flammability rating	V-0		

System specifications

Product family	W-Series	Type of connection	Screw connection
Connection direction	on side	Number of levels	1
Number of connections	2	No. of clamping points per level	2
Levels cross-connected internally	No	Mounting rail	TS 35
End cover plate required	Yes		

Classifications

ETIM 2.0	EC000897	ETIM 3.0	EC000897
UNSPSC	30-21-18-11	eClass 4.1	27-14-11-20
eClass 5.1	27-14-11-20	eClass 6.0	27-14-11-20
eClass 7.0	27-14-11-20		

W-Series
WDU 4

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Technical data

Product information

Descriptive text ordering data	1000 V DC rated voltage tested. Refer to the W-Series Accessories section for colour versions.
Descriptive text technical data	Rated voltage is 400 V when using the ZQV cross-connector. Note max. current of terminal (41 A) when using WQV!
Descriptive text accessories	Socket and test plug refer to W-series Accessories section Only 400 V when using the shielding rail LS 2,8 1056400000.
Product description	

Approvals

Approvals

W-Series
WDU 4

Weidmüller Interface GmbH & Co. KG
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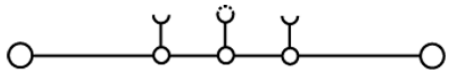
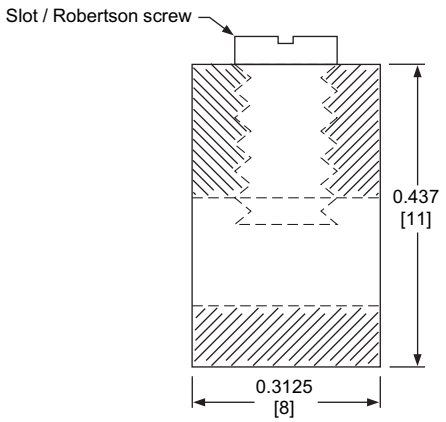
Drawings





Cross Section of Size 1 Ground Bar

Dimensions: in. [mm]

TECHNICAL INFORMATION

Item 4

Grounding Bar Kits

All PK equipment grounding kits are supplied with mounting screws, necessary installation instructions, and an Equipment Grounding Terminal self-adhesive label.

Catalog Number	Total Qty.	Terminals						Approximate Overall Length		Distance Between Mounting Holes		Mounting
		Quantity Each Size See "Wire Range Table" below.										
		I	II	III	IV	V	VI	in.	mm	in.	mm	
PK0GTA2[1]	2						2	1.75	44	One hole	One hole	Top
PK0GTA6[2]	6					6		4.61	117	1.69	43	Top
PK3GTA1[3]	3	3						1.38	35	One hole	One hole	Top
PK4GTA[3]	4	4						1.63	41	One hole	One hole	Top
PK5GTA[4]	5	5						2.25	57	1.25	32	Top
PK7GTA[3]	7	7						2.88	73	1.25	32	Top or side
PK9GTA1[3]	9	9						3.25	83	One hole	One hole	Top
PK9GTA[3]	9	9						3.78	96	3.13	80	Top
PK12GTA[3]	12	12						4.70	119	3.13	80	Top
PK15GTA[3]	15	15						5.63	143	3.13	80	Top
PK15GTAL[5]	16	15	1					8.13	207	3.13	80	Top
PK15GTA6[6]	21	15			6			5.88	149	[7]	[7]	Top
PK18GTA[3]	18	18						6.56	167	3.13	80	Top
PK18GTAL[5]	19	18	1					8.81	224	3.13	80	Top
PK23GTA[3]	23	23						8.11	206	3.13	80	Top
PK23GTAL[5]	24	23	1					9.44	240	3.13	80	Top
PK27GTA[3][8]	27 or 26	27 26		1				9.36	238	3.13	80	Top

1 Mounting screw 40205-065-01 (one required).

2 Mounting screw 21922-18360 (two required).

3 Mounting screw 21594-14220 (two required).

4 Mounting screw 21594-14241 (two required).

5 Mounting screw 21594-14302 (two required).

6 Mounting screws 21594-14241(two required) and 21594-17121(two required).

7 3.13 in. (80 mm) on small terminals; 5.25 in. (133 mm) on large terminals.

8 PK27GTA includes one main grounding lug that mounts with two terminal screws and requires three terminals for mounting.

Size	Cu (AWG)	Al (AWG)
I	(1) #14 # 4 or (2) #14 or #12	(1) #12 #4 or (2) #12 or #10
II	(1) #1 4/ 0	(1) #1 4/0
III	(1) #6 2/ 0	(1) #6 2/0
IV	(1) #6 3/ 0	(1) #6 3/0
V	(1) #14 1 /0	(1) #14 1/0
VI	(1) #10 2/0	(1) #6 2 /0

Fişă tehnică produs
Caracteristici

XB5AD25
selector Ø 22 - 2 poziţii, oprire în poz. - mâner std. - negru - 1 NO + 1 NC

Item 5

Caracteristici Principale

Gama de produse	Harmony XB5
Tip produs sau componenta	Selector complet
Nume scurt al dispozitivului	XB5
Material rama	Plastic
Diametrul de montaj	22 mm
Vânzare în cantitate indivizibilă	1
Forma a capului unitatii de semnalizare	Rotund
Tip de operator	Fără revenire
Profil operator	Negru mâner standard
Informatii de pozitie operator	2 pozitii 90°
Tip si compozitie contacte	1 NO + 1 NC
Operare contacte	Decuplare lenta
Conexiuni - borne	Borne cu şurub: <= 2 x 1.5 mm² cu pini conformitate cu EN/IEC 60947-1 Borne cu şurub: >= 1 x 0.22 mm² fără terminale de cablu conformitate cu EN/IEC 60947-1

Complementare

Înălţime	42 mm
Lăţime	30 mm
Adâncime	70 mm
Descriere borne ISO nr. 1	(13-14)NO
Greutate produs	0.043 kg
Rezistenţă la spălare cu presiune inaltă	7000000 Pa la 55 °C,distanţa: 0.1 m
Utilizare contacte	Contacte standard
Deschidere pozitiva	Cu deschidere pozitivă conformitate cu EN/IEC 60947-5-1 anexa K
Cuplul de funcţionare	0.14 N.m (modificarea stării electrice NO)
Durabilitate mecanică	1000000 cic
Cuplu de strângere	0.8...1.2 N.m conformitate cu EN 60947-1
Forma a capului surubului	Cruce cap compatibil cu Philips nr. 1 şurubelniţă Cruce cap compatibil cu pozidriv No 1 şurubelniţă Perforat cap compatibil cu plat Ø 4 mm şurubelniţă Perforat cap compatibil cu plat Ø 5.5 mm şurubelniţă
Material contacte	Aliaj de argint (Ag/Ni)
Protecţie la scurtcircuit	10 A cartuş fuzibil tip gG conformitate cu SR EN 60947-5-1
[Ith] curent termic convenţional în aer liber	10 A conformitate cu SR EN 60947-5-1
[Ui] tensiune nominală de izolaţie	600 V (grad de poluare: 3) conformitate cu EN 60947-1
[Uimp] tensiune de ţinere la impuls	6 kV conformitate cu EN 60947-1
[Ie] curent nominal de utilizare	1.2 A 600 V AC-15 A600 SR EN 60947-5-1 0.27 A 250 V DC-13 Q600 SR EN 60947-5-1 0.1 A 600 V DC-13 Q600 SR EN 60947-5-1 3 A 240 V AC-15 A600 SR EN 60947-5-1 0.55 A 125 V DC-13 Q600 SR EN 60947-5-1 6 A 120 V AC-15 A600 SR EN 60947-5-1
Durabilitate electrică	1000000 cic, AC-15, 2 A la 230 V, rata de funcţionare: 3600 cic/h, factor de sarcină: 0.5 conformitate cu EN/IEC 60947-5-1 anexa C 1000000 cic, AC-15, 3 A la 120 V, rata de funcţionare: 3600 cic/h, factor de sarcină: 0.5 conformitate cu EN/IEC 60947-5-1 anexa C 1000000 cic, AC-15, 4 A la 24 V, rata de funcţionare: 3600 cic/h, factor de sarcină: 0.5 conformitate cu EN/IEC 60947-5-1 anexa C 1000000 cic, DC-13, 0.2 A la 110 V, rata de funcţionare: 3600 cic/h, factor de sarcină: 0.5 conformitate cu EN/IEC 60947-5-1 anexa C

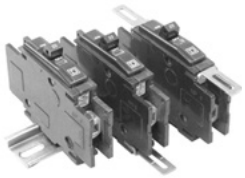
	1000000 cic, DC-13, 0.5 A la 24 V, rata de funcţionare: 3600 cic/h, factor de sarcină: 0.5 conformitate cu EN/IEC 60947-5-1 anexa C
Securitatea electrică IEC 60947-5-4	Λ < 10exp(-6) la 5 V, 1 mA în mediu curat conformitate cu EN/IEC 60947-5-4 Λ < 10exp(-8) la 17 V, 5 mA în mediu curat conformitate cu EN/IEC 60947-5-4

Mediu

tratament protector	TH
temperatura de depozitare	-40...70 °C
temperatura ambiantă pentru utilizare	-25...70 °C
clasa de protecţie la electrocutare	Clasa II conformitate cu IEC 60536
grad de protectie IP	IP69K conformitate cu SR EN 60529
grad de protectie NEMA	NEMA 13 NEMA 4X
grad de protectie IK	IK06 conformitate cu IEC 50102
standarde	EN/IEC 60947-1 SR EN 60947-5-1 EN/IEC 60947-5-4 JIS C 4520 UL 508 CSA C22.2 No 15
certificari produs	BV CSA DNV GL LROS (Lloyds register of shipping) RINA UL
rezistenta la vibratii	5 gn (f = 2...500 Hz) conformitate cu IEC 60068-2-6
rezistenta la socuri	30 gn (durata = 18 ms) pentru half sine wave acceleration conformitate cu IEC 60068-2-27 50 gn (durata = 11 ms) pentru half sine wave acceleration conformitate cu IEC 60068-2-27

Contractual warranty

Perioada	18 months



Low Ampere QOU

Low Ampere QOU Miniature Circuit Breakers

QOU unit mount miniature circuit breakers (cable-in/cable-out) are ideal for OEM applications. They have the Square D™ circuit breaker's unique Visi-Trip™ feature and can be DIN rail-mounted or surface- or flush-mounted using mounting feet.

General Specifications Common to All Low Ampere QOU Circuit Breakers

- For convenient flush mount, surface mount or DIN mount (symmetrical rail 35 x 7.5 DIN/EN 50 022)
- Single handle with internal common trip
- Terminal lug wire size (1) 14–2 AWG Cu or Al
- Reversible line and load lugs
- Field-installable quick connectors
- UL Listed 48 Vdc (5 k AIR)
- UL Listed as HACR Type: 10–70 A
- High magnetic trip circuit breakers (QOU-HM) are recommended for applications where high initial inrush may occur and for individual dimmer applications.
- For DIN mounting rails, see IEC Starters and Relays, Section 18.

Table 7.20: QOU Low Ampere Miniature Circuit Breakers

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.▲	$ Price	Cat. No.	$ Price
10 k AIR								
10 A	QOU110		QOU210		—		QOU310	
15 A	QOU115		QOU215		QOU215H		QOU315	
20 A	QOU120		QOU220		QOU220H	**168.00**	QOU320	
25 A	QOU125		QOU225		QOU225H		QOU325	
30 A	QOU130	**40.20**	QOU230	**87.00**	QOU230H		QOU330	**285.00**
35 A	QOU135		QOU235		—	—	QOU335	
40 A	QOU140		QOU240		—	—	QOU340	
45 A	QOU145		QOU245		—	—	QOU345	
50 A	QOU150		QOU250		—	—	QOU350	
60 A	QOU160		QOU260		—	—	QOU360	
70 A	QOU170	**78.00**	QOU270	**171.00**	—	—	QOU370	**363.00**
22 k AIR								
15 A	QOU115VH		QOU215VH		—	—	QOU315VH	
20 A	QOU120VH		QOU220VH		—	—	QOU320VH	**426.00**
25 A	QOU125VH		QOU225VH		—	—	QOU325VH	
30 A	QOU130VH		QOU230VH		—	—	QOU330VH	
35 A	QOU135VH	**101.00**	QOU235VH	**189.00**	—	—	—	—
40 A	QOU140VH		QOU240VH		—	—	—	—
45 A	QOU145VH		QOU245VH		—	—	—	—
50 A	QOU150VH		QOU250VH		—	—	—	—
60 A	QOU160VH		QOU260VH		—	—	—	—

▲ QOU-H interrupting rating is 10 kA at 240 Vac.

Table 7.21: QOU-HM Miniature Circuit Breakers (10 k AIR)

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
15 A	QOU115HM	**40.20**	—	—	—	—	—	—
20 A	QOU120HM		—	—	—	—	—	—

High Ampere QOU

Table 7.22: QYU UL1077 Recognized Supplementary Protectors (5 k AIR)

Ampere Rating	1P 277 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
10 A	QYU110		—	—	—	—	—	—
15 A	QYU115		—	—	—	—	—	—
20 A	QYU120	**122.00**	—	—	—	—	—	—
25 A	QYU125		—	—	—	—	—	—
30 A	QYU130		—	—	—	—	—	—

High Ampere QOU Circuit Breakers

General Specifications Common to All High Ampere QOU Circuit Breakers

- Flush mount, surface mount, and DIN rail mount.
- Internal common trip.
- Non-reversible line and load lugs.
- Terminal lug wire size (1) 12– 2/0 AWG Cu or Al.
- UL Listed 60 Vdc per pole (5 k AIR). (**Note:** except switches)
- UL Listed as HACR type, 80–125 A.
- Non-automatic switches have the same physical packaging as miniature circuit breakers, but provide no overcurrent or short circuit protection. They are UL Listed per UL1087 and are CSA certified.

Table 7.23: QOU High Ampere Miniature Circuit Breakers (10 k AIR)

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
80 A	QOU180		QOU280		—	—	QOU380	
90 A	QOU190	**176.00**	QOU290	**246.00**	—	—	QOU390	**416.00**
100 A	QOU1100		QOU2100		—	—	QOU3100	
125 A	—	—	QOU2125	**452.00**	—	—	—	—

Table 7.24: QOU Non-Automatic Switches

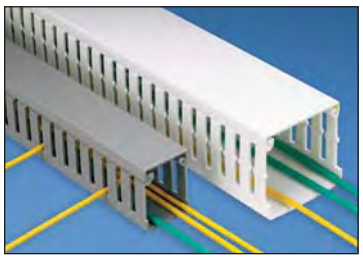
Ampere Rating	1P 120 Vac	$ Price	2P 120/240 Vac	$ Price	2P 240 Vac	$ Price	3P 240 Vac	$ Price
	Cat. No.		Cat. No.		Cat. No.		Cat. No.	
60 A	—	—	—	—	QOU200	**87.00**	QOU300	**285.00**
100 A	—	—	—	—	QOU2000	**246.00**	QOU3000	**416.00**
125 A	—	—	—	—	QOU20001	**452.00**	QOU30001	**716.00**

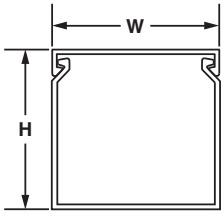
Interrupting Ratings . . . . . Page 7-3
Accessories . . . . . Page 7-12, 7-15
Dimensions. . . . . Page 7-54

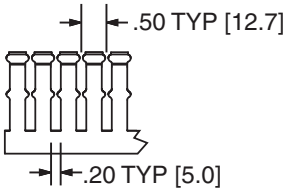
Item 7

Panduct® Type F Narrow Slot Wiring Duct

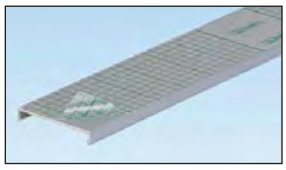
- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Multiple slot restrictors present with 2" and greater duct wall height.



To order cover with protective film add "-F" to part number. 6" cover not available with film.

NEW!

Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

FL1E IDEC SmartRelay

Features

- **New** Remote text display panel
- **New** Extended retentive data memory
- **New** Arithmetic functions
- **New** Controllable backlit LCD display
- **New** 4 built-in 5kHz fast inputs
- **New** 4 built-in analog inputs
- **New** 3 memory cartridges
- **New** USB programming cable
- **New** Brighter & higher LCD contrast
- **New** 50% more memory
- EEPROM memory
- Password protection
- Universal voltages
- DIN rail or surface mountable
- Max. 50 message blocks

Specifications

Base Modules

Base Module Part Number		with LCD Display	FL1E-H12SND	FL1E-H12RCE	FL1E-H12RCA	FL1E-H12RCC
		without Display	—	FL1E-B12RCE	FL1E-B12RCA	FL1E-B12RCC
Power Supply	Rated Power Voltage		24V DC	12/24V DC	24V AC/DC	100 to 240V AC/DC
	Allowable Voltage Range		20.4 to 28.8V DC	10.8 to 28.8V DC	20.4 to 26.4V AC, 20.4 to 28.8V DC	85 to 265V AC, 100 to 253V DC
	Rated Frequency		—	—	47 to 63Hz	47 to 63Hz
	Current Draw		40 to 75mA (24V DC)	60 to 175mA (12V DC) 40 to 100mA (24V DC)	76 to 182mA (24V AC) 40 to 100mA (24V DC)	25 to 40mA (100V AC), 20 to 30mA (240V AC) 10 to 25mA (100V DC), 6 to 15mA (240V DC)
	Allowable Momentary Power Interruption		—	2ms (Typ.) (12V DC) 5ms (Typ.) (24V DC)	5ms (Typ.) (24V AC/DC)	10ms (Typ.) (100V AC/DC) 20ms (Typ.) (240V AC/DC)
	Power Consumption		0.7 to 1.3W (24V DC)	0.3 to 1.7W (12V DC) 0.4 to 1.8W (24V DC)	0.9 to 2.7VA (24V AC) 0.4 to 1.8W (24V DC)	1.1 to 4.6VA (100V AC), 2.4 to 6.0VA (240V AC) 0.5 to 2.9W (100V DC), 1.2 to 3.6W (240V DC)
	Reverse Polarity Protection		Yes	Yes	—	—
Clock	Backup Duration		—	80 hours (25°C) Note 1	80 hours (25°C) Note 1	80 hours (25°C) Note 1
	Clock Accuracy		—	±2 sec/day maximum	±2 sec/day maximum	±2 sec/day maximum
Input	Input Signal		DC		AC/DC	AC/DC
	Input Points		8 (I1 to I8)		8 (I1 to I8)	8 (I1 to I8)
	Analog Input Points		4 (I1, I2, I7, I8)		—	—
	High-speed Input Note 2		4 (I3, I4, I5, I6), 5Khz maximum		—	—
	Analog	Input Range	0 to 10V DC (max. rated input: 28.8V DC)		—	—
		Input Error	±1.5 (of full scale)		—	—
		Input Resolution	10 bits (0 to 1000)		—	—
		Allowable Voltage Range	0 to 28.8V DC		—	—
	Input Impedance	Digital Input	3.5kΩ		4.8kΩ	840kΩ
		Analog Input	72kΩ		—	—
	Isolation		—	—	—	—
	Operating Range	OFF Voltage	< 5V DC		< 5V AC/DC	< 40V AC, < 30V DC
		ON Voltage	≥ 12V DC		≥ 12V AC/DC	≥ 79V AC, ≥ 79V DC
		OFF Current	< 0.85mA (I1 to I6), < 0.05mA (I1, I2, I7, I8)		< 1.0mA	< 0.03mA
		ON Current	≥ 2mA (I3 to I6) ≥ 0.15mA (I1, I2, I7, I8)	≥ 1.5mA (I3 to I6) ≥ 0.1mA (I1, I2, I7, I8)	≥ 2.5mA	≥ 0.08mA, 100V AC: 50ms (Typ.)
	Turn ON Time		1.5ms (Typ.) ≤ 1.0ms (I3, I6)		1.5ms (Typ.)	100V AC: 50ms (Typ.), 240V AC: 30ms (Typ.) 100V DC: 25ms (Typ.) 240V DC: 15ms (Typ.
	Turn OFF Time		1.5ms (Typ.) ≤ 1.0ms (I3, I6)		15ms (Typ.)	100V AC: 65ms (Typ.), 240V AC: 105ms (Typ.) 100V DC: 95ms (Typ.), 240V DC: 125ms (Typ.)
	Wire Length		100m Note 3		100m Note 3	100m

1. Two year backup duration (typ.) when bettery cartridge or memory/battery cartridge used.
2. When selecting frequency trigger function and up/down counter function.
3. 10m when connected to analog input (twisted pair cable).

Specifications con't on following page

Specifications con't

Base Module Part Number		with LCD Display	FL1E-H12SND	FL1E-H12RCE	FL1E-H12RCA	FL1E-H12RCC
		without Display	—	FL1E-B12RCE	FL1E-B12RCA	FL1E-B12RCC
Output	Output		Transistor source	Relay		
	Output Points/ Contact Configuration		4 points (separate)	4NO contacts		
	Isolation		—	Isolated		
	Dielectric Strength (between power/input terminals and output terminals)		—	2500V AC, 1 minute, 500V DC, 1 minute		
	Output Voltage		External power voltage	—		
	Maximum Load Current		0.3A	Resistive load: 10A at 12/24V AC/DC, 10A at 100/120V AC, 10A at 230/240V AC Inductive load: 2A at 12/24V AC/DC, 3A at 100/120V AC, 3A at 230/240V AC		
	Surge Current		—	30A maximum		
	Short-circuit Protection		Built-in current limiting resistor: Approx. 1A	External fuse required: 16A maximum		
	Minimum Switching Load		—	10mA, 2V DC	10mA, 12V DC	
	Initial Contact Resistance		—	100 mΩ maximum (at 1A, 24V DC)		
	Mechanical Life		—	10 million operations (no load, 10Hz)		
	Electrical Life		—	100,000 operations (rated resistive load) 1800 operations/hour		
Switching Rate	Mechanical Load		—	10Hz		
	Electrical Load		10Hz	—		
	Resistive Load/Lamp Load [1]		10Hz	2Hz		
	Inductive Load		0.5Hz	0.5Hz		

1. For fluorescent lamps, if the inrush current exceeds the allowable value, use an appropriate relay.

General

Item		Specification	Standard
Operating Temperature	Horizontal Mounting	0 to 55°C	Cold: IEC60068-2-1 Hot: IEC60068-2-2
	Vertical Mounting	0 to 55°C	
Storage/Transportation Temperature		–40 to +70°C (no freezing)	—
Relative Humidity		10 to 95% RH (no condensation)	IEC60068-2-30
Atmospheric Pressure		795 to 1080 hPa	—
Operating Condition		No corrosive gas	—
Degree of Protection		IP20	—
Vibration Resistance		5 to 8.4Hz, amplitude 3.5mm 8.4 to 150Hz, acceleration 9.8m/s^2	IEC60068-2-6
Shock Resistance		147m/s^2	IEC60068-2-27
Drop Test		0.3m	IEC60068-2-31
Drop Test (packaged)		1m	IEC60068-2-32
Emission		Class B Group 1 Note 1	EN55011
Electrostatic Discharge		8kV air discharge, 6kV contact discharge Note 2	IEC61000-4-2
Radiation Field Immunity		Field Strength: 1V/m and 10V/m	IEC61000-4-3
Burst Pulses		2kV (power line), 1kV (I/O signal line) Note 3	IEC61000-4-4
Energy Carriers Single Pulse (Surge) Note 4 (FL1E-H12RCC, FL1E-B12RCC only)		1kV (power line) normal 2kV (power line) common	IEC61000-4-5
Communication Cable		0.5 to 2.5mm^2 (one wire), 0.5 to 1.5mm^2 (two wires)	—
Terminal Style		Finger-safe type Note 5	—

1. Class A for AS-Interface communication module.
2. 8kV (air discharge), 4kV (contact discharge) for AS-Interface communication module.
3. 1kV (criteria A), 2kV (criteria B) for AS-Interface communication module.
4. For protection against surge noise on DC power supply types (FL1E-H12RCE/B12RCE, FL1E-H12SND, FL1E-H12RCA/B12RCA), use surge absorbers, noise cut transformers, or noise filters. Use of surge protection device (DEHN + SOHNE GmbH + Co. VVT AD 24 Part No. 918 402) is recommended.
5. Tightening torque 0.4 to 0.5 N-m.

Function Blocks

General

AND	Series connection of normally open contacts
AND (Edge)	Edge detection with edge evaluation (pos. edge)
NAND	Parallel connection of normally closed contacts
NAND (Edge)	Edge detection with edge evaluation (pos. edge)
OR	Parallel connection of normally open contacts
NOR	Series connection of normally closed contacts
XOR	Double changeover contact
NOT	Connection of closed contact

Special

On-delay	
Off-delay	
On-/Off-delay	
Retentive on-delay	
Latching Relay	
Current impulse relay	
Interval time-delay relay/Pulse output	
Edge-triggered interval time-delay relay	
Seven-day time switch	
Twelve-month time switch	
Up/down counter	
Analog differential trigger	
Analog value monitor	
Operating hours counter	
Asynchro-nous pulse generator	
Random generator	
Frequency trigger	
Analog trigger	
Analog compara-tor	
Stairwell light switch	
Dual-function switch	
Message texts	
Softkey	
Analog amplifier	
Shift register	
PI control	
Analog ramp control	
Analog multiplexer	
New Pulse width modulator (PWM)	
New Analog math	
New Analog math error detection	

Wide variety of modules for various combinations provides for flexibility and versatility.

Items 8 & 9

FL1E Base Modules

	FL1E-H12SND	FL1E-H12RCE	FL1E-H12RCA	FL1E-H12RCC
Power Voltage	24V DC	12/24V DC	24V AC/DC	100 to 240V AC/DC
Input	DC input: 8 points (PNP) (Analog 4 points)	DC input: 8 points (PNP) (Analog 4 points)	AC/DC input: 8 points (PNP/NPN input)	AC/DC input: 8 points (PNP input)
Output	Transistor output: 4 points	Relay output: 4 points	Relay output: 4 points	Relay output: 4 points
Programming Function	With	With	With	With
Clock Function	With (Note)	With	With	With

Note: FL1E-H12SND of Ver. 4 and before does not have clock function.

	FL1E-B12RCE	FL1E-B12RCA	FL1E-B12RCC
Power Voltage	12/24V DC	24V AC/DC	100 to 240V AC/DC
Input	DC input: 8 points (PNP) (Analog 4 points)	AC/DC input: 8 points (PNP/NPN input)	AC/DC input: 8 points (PNP input)
Output	Relay output: 4 points	Relay output: 4 points	Relay output: 4 points
Programming Function	Without	Without	Without
Clock Function	With	With	With

Initialization Time: After power-up, the FL1E takes a maximum of 10 seconds (when using a memory cartridge or memory/battery cartridge) or 9 seconds (without using any cartridges or when using a battery cartridge) for initialization. When initialization is complete, the FL1E is automatically set to RUN mode.

Expansion I/O Modules

Combination I/O Modules

	FL1B-M08B1S2	FL1B-M08B2R2	FL1B-M08D2R2	FL1B-M08C2R2
Power Voltage	24V DC	12/24V DC	24V AC/DC	100 to 240V AC/DC
Input	DC input: 4 points (PNP input)	DC input: 4 points (PNP input)	AC/DC input: 4 points (PNP/NPN input)	AC/DC input: 4 points (PNP input)
Output	Transistor output: 4 points	Relay output: 4 points	Relay output: 4 points	Relay output: 4 points
Max. Expansion Modules	4	4	4	4

Analog Modules

	FL1B-J2B2 Analog Input Module	FL1D-K2BM2 Analog Output Module
Power Voltage	12/24V DC	24V DC
Analog I/O Points	Analog input: 2 points	Analog output: 2 points
Analog I/O Range	Voltage input: 0-10V DC Current input: 0-20 mA	Voltage output: 0-10V DC Current output: 0-20, 4-20 mA
Resolution	10 bits	10 bits
Max. Expansion Modules	4	1

Module Combination and Allocation Numbers

1. Maximum configuration when using a base module without analog inputs

	FL1E-H12RCA								FL1B-M08B2R2																FL1B-J2B2						FL1D-K2BM2	
Digial Input: I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24								
Analog Input: AI																									3	4	5	6	7	8		
Analog Output: AQ																															1	2
Digital Output: Q	1	2	3	4					5	6	7	8	9	10	11	12	13	14	15	16												

Note 1: Digital inputs: 24, analog inputs: 6, digital outputs, 16, analog outputs: 2
Note 2: AI3 to AI8 are allocated to the analog input module.

2. Maximum configuration when using two analog inputs on the base module

	FL1E-H12RCE								FL1B-M08B2R2																FL1B-J2B2						FL1D-K2BM2	
Digial Input: I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24								
Analog Input: AI							1	2																	3	4	5	6	7	8		
Analog Output: AQ																															1	2
Digital Output: Q	1	2	3	4					5	6	7	8	9	10	11	12	13	14	15	16												

Note 1: Digital inputs: 22, analog inputs: 8, digital outputs: 16, analog outputs: 2
Note 2: Analog inputs AI3 and AI4 are allocated to the analog input module.
Note 3: When using two analog inputs on the FL1E base module, allocation of I/O numbers has a compatibility with the FL1D series.

3. Maximum configuration when using four analog inputs on the base module

	FL1E-H12RCE								FL1B-M08B2R2																FL1B-J2B2						FL1D-K2BM2	
Digial Input: I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24								
Analog Input: AI	3	4					1	2																	5	6	7	8				
Analog Output: AQ																															1	2
Digital Output: Q	1	2	3	4					5	6	7	8	9	10	11	12	13	14	15	16												

Note 1: Digital inputs: 20, analog inputs: 8, digital outputs: 16, analog outputs: 2
Note 2: Using WindLGC Ver. 6.*, allocate AI3 and AI4 to the base module. AI5 to AI8 are allocated to the analog input module.

Max. Expansion Modules

Use of a base module and expansion I/O modules of the same power voltage rating is recommended, with power supplied to all modules using one power supply.

Maximum number of connectable modules per base module:

- 4 combination I/O modules
- 4 analog input modules
- 1 analog output module

Maximum number of I/O points*

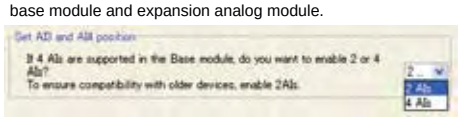
Digital input: 24
Digital output: 16
Analog input: 8
Analog output: 2

* The maximum number includes the I/O points of the base module and the expansion I/O modules.

Base module | Combination I/O module | Analog input module | Analog output module

For users using analog inputs:

By setting the embedded analog input number using the WindLGC Ver. 6.*, I/O numbers can be allocated to the base module and expansion analog module.



IDEC

RY/RM Series Miniature Relays

Item 10

RY2 (3A), RY4 (5A), RM2 (5A)
Bifurcated contacts are also available

The RY/RM series are general purpose miniature relays with a 3A or 5A contact capacity. A wide variety of terminal styles and coil voltages meet a wide range of applications. All 4PDT types have arc barriers.

Part Number Selection

Contact	Model	Part Number: Plug-in Terminal	Part Number: PC Board Terminal	Coil Voltage Code
DPDT (Slim) 3A 	Basic	RY2S-U	RY2V-U	AC6V, AC12V, AC24V, AC110V, AC120V, AC220V, AC240V DC6V, DC12V, D24V, DC48V, DC110V
	With Indicator	RY2S-UL	RY2V-UL	
	With Check Button	RY2S-UC		
	With Indicator and Check Button	RY2S-ULC		
	Top Bracket Mounting	RY2S-UT		
	With Diode (DC coil only)	RY2S-UD	RY2V-UD	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	—		
DPDT (Wide) 5A 	Basic	RM2S-U	RM2V-U	AC6V, AC12V, AC24V, AC110-120V, AC220-240V DC6V, DC12V, DC24V, DC48V, DC100-110V
	With Indicator	RM2S-UL	RM2V-UL	
	With Check Button	RM2S-UC		
	With Indicator and Check Button	RM2S-ULC		
	Top Bracket Mounting	RM2S-UT		
	With Diode (DC coil only)	RM2S-UD		DC6V, DC12V, DC24V, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RM2S-ULD		
4PDT 5A 	Basic	RY4S-U	RY4V-U	AC6V, AC12V, AC24V, AC110-120V, AC220-240V DC6V, DC12V, DC24V, DC48V, DC100-110V
	With Indicator	RY4S-UL	RY4V-UL	
	With Check Button	RY4S-UC		
	With Indicator and Check Button	RY4S-ULC		
	Top Bracket Mounting	RY4S-UT		
	With Diode (DC coil only)	RY4S-UD	—	DC6V, DC12V, DC24V, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RY4S-ULD		
DPDT (Slim) 1A Bifurcated 	Basic	RY22S-U	RY22V-U	AC6V, AC12V, AC24V, AC110V, AC120V, AC220V, AC240V DC6V, DC12V, D24V, DC48V, DC110V
	With Indicator	RY22S-UL	RY22V-UL	
	Top Bracket Mounting	RY22S-UT		
	With Diode (DC coil only)	RY22S-UD	RY22V-UD	DC6V, DC12V, DC24V, DC48V, DC110V
4PDT 1A Bifurcated 	Basic	RY42S-U	RY42V-U	AC6V, AC12V, AC24V, AC110-120V, AC220-240V DC6V, DC12V, DC24V, DC48V, DC100-110V
	With Indicator	RY42S-UL	RY42V-UL	
	Top Bracket Mounting	RY42S-UT		

Ordering Information
When ordering, specify the Part No. and coil voltage code:
(example) **RY4S-U** **AC110-120V**
Part No. — Coil Voltage Code

Sockets

Relays	Standard DIN Rail Mount	Finger-safe DIN Rail Mount	Through Panel Mount	PCB Mount
RY2S RY22S	SY2S-05	SY2S-05C	SY2S-51	SY2S-61
RM2	SM2S-05	SM2S-05C	SM2S-51	SY4S-61 SY4S-62
RY4S RY42S	SY4S-05	SY4S-05C	SY4S-51	
				

Hold Down Springs & Clips

Appearance	Description	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket	Min Order Qty
	Pullover Wire Spring	RY2S	SY2S-02F1	SY4S-51F1	10
		RY22S			
		RM2	SY4S-51F1	SY4S-51F1	
		RY4S			
		RY42S			
	Leaf Spring* (side latch)	RY2S, RY22S	SFA-202	SFA-302	20
		RM2, RY4S, RY42S			
	Leaf Spring* (top latch)	RY2S, RY22S	SFA-101	SFA-301	
		RM2			
		RY4S, RY42S			

*Not available for PCB mount socket SY4S-62.

Accessories

Description	Appearance	Use with	Part No.	Remarks
Aluminum DIN Rail (1 meter length)		All DIN rail sockets	BNDN1000	IDEC offers a low-profile DIN rail (BNDN1000). The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm).
DIN Rail End Stop		DIN rail	BNL5	9.1 mm wide.
Replacement Hold-Down Spring Anchor		Horseshoe clip for all DIN rail sockets	Y778-011	For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket.

Specifications

Contact Model	Standard Contact			Bifurcated Contact
	RY2 - DPDT Slim	RM2 - DPDT Wide	RY4 - 4PDT	RY22 - DPDT / RY42 - 4PDT
Contact Material	Gold-plated silver	Silver	Gold-plated silver	Silver-palladium alloy
Contact Resistance [1]	50 mΩ maximum	30 mΩ maximum	50 mΩ maximum	100 mΩ minimum
Minimum Applicable Load	24V DC, 5 mA; 5V DC, 10 mA (reference value)	24V DC, 10 mA; 5V DC, 20 mA (reference value)	24V DC, 5 mA; 5V DC, 10 mA (reference value)	1V DC, 100 µA (reference value)
Operate Time [2]	20 ms maximum			
Release Time [2]	20 ms maximum			
Power Consumption (approx.)	AC: 1.1 VA (50 Hz), 1 VA (60 Hz) DC: 0.8W	AC: 1.4 VA (50 Hz), 1.2 VA (60 Hz) DC: 0.9W	AC: 1.4 VA (50 Hz), 1.2 VA (60 Hz) DC: 0.9W	AC: 1.1 VA (50 Hz), 1 VA (60 Hz) DC: 0.8W
Insulation Resistance	100 MΩ minimum (500V DC megger)			
Dielectric Strength [3]	Between live and dead parts:			
	1500V AC, 1 minute	2000V AC, 1 minute	2000V AC, 1 minute	1500V AC, 1 minute [3]
	Between contact and coil:			
	1500V AC, 1 minute	2000V AC, 1 minute	2000V AC, 1 minute	1500V AC, 1 minute
	Between contacts of different poles:			
	1500V AC, 1 minute	2000V AC, 1 minute	2000V AC, 1 minute	1500V AC, 1 minute
	Between contacts of the same pole:			
	1000V AC, 1 minute	1000V AC, 1 minute	1000V AC, 1 minute	1000V AC, 1 minute
Operating Frequency	Electrical: 1800 operations/h maximum Mechanical: 18,000 operations/h maximum			
Vibration Resistance	Damage limits: 10 to 55 Hz, amplitude 0.5 mm Operating extremes: 10 to 55 Hz, amplitude 0.5 mm			
Shock Resistance	Damage limits: 1000 m/s^2 Operating extremes: 100 m/s^2 (DPDT Slim), 200 m/s^2 (4PDT, DPDT Wide)			
Mechanical Life	50,000,000 operations			
Electrical Life	200,000 operations (220V AC, 3A)	500,000 operations (220V AC, 5A)	100,000 operations (220V AC, 5A) 200,000 operations (220V AC, 3A)	200,000 operations (110V AC, 1A)
Operating Temperature [4]	–25 to +55°C (no freezing)	–25 to +45°C (no freezing)	–25 to +55°C (no freezing) [5]	–25 to +55°C (no freezing)
Operating Humidity	45 to 85% RH (no condensation)			
Weight (approx.)	23g	35g	34g	RY22: 23g / RY42: 34g

Note: Above values are initial values.

1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
   Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000V AC, 1 minute
4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve.
   The operating temperature range of relays with indicator or diode is –25 to +40°C.
5. When the total current of 4 contacts is less than 15A, the operating temperature range is –25 to +70°C.

AC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C				Coil Resistance (Ω) ±10% at 20°C		Operation Characteristics (against rated values at 20°C)		
	AC 50Hz		AC 60Hz						
	DPDT Slim	DPDT Wide & 4PDT	DPDT Slim	DPDT Wide & 4PDT	DPDT Slim	DPDT Wide & 4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	170	240	150	200	18.8	9.4	110%	80% maximum	30% minimum
12	86	121	75	100	76.8	39.3			
24	42	60.5	37	50	300	153			
110	9.6	—	8.4	—	6,950	—			
110-120	—	9.4-10.8	—	8.0-9.2	—	4,290			
120	8.6	—	7.5	—	8,100	—			
220	4.7	—	4.1	—	25,892	—			
220-240	—	4.7-5.4	—	4.0-4.6	—	18,820			
240	4.9	—	4.3	—	26,710	—			

DC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C		Coil Resistance (Ω) ±10% at 20°C		Operation Characteristics (against rated values at 20°C)		
	DPDT Slim	DPDT Wide & 4PDT	DPDT Slim	DPDT Wide & 4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	128	150	47	40	110%	80% maximum	10% minimum
12	64	75	188	160			
24	32	36.9	750	650			
48	18	18.5	2,660	2,600			
100-110	—	8.2-9.0	—	12,250			
110	8	—	13,800	—			

Contact Ratings

Contact	Continuous Current	Maximum Contact Capacity: Allowable Contact Power		Rated Load		
		Resistive Load	Inductive Load	Voltage (V)	Res. Load	Ind. Load
DPDT Slim (RY2)	3A	660 VA AC 90W DC	176 VA AC 45W DC	110V AC	3A	1.5A
				220V AC	3A	0.8A
				30V DC	3A	1.5A
DPDT Wide (RM2)	5A	1100VA AC 150W DC	440VA AC 75W DC	110V AC	5A	2.5A
				220V AC	5A	2A
				30V DC	5A	2.5A
4PDT (RY4)	5A	1200 VA AC 150W DC	288 VA AC 60W DC	240V AC	5A	1.2A
				30V DC	5A	2A
Bifurcated Contact (RY22/ RY42)	1A	176 VA AC 30W DC	88 VA AC 15W DC	110V AC	1A	0.5A
				220V AC	0.8A	0.4A
				30V DC	1A	0.5A

Note: Inductive load for the rated load — cos ø = 0.3, L/R = 7 ms

UL Ratings (Standard Contact)

Voltage	Resistive			General use		
	DPDT Slim	DPDT Wide	4PDT	DPDT Slim	DPDT Wide	4PDT
240V AC	3A	5A	5A	0.8A	2A	5A
120V AC	—	—	—	1.5A	2.5A	—
100V DC	0.2A	0.4A	0.2A	0.2A	—	0.2A
30V DC	3A	5A	5A	3A	—	5A

CSA Ratings (Standard Contact)

Voltage	Resistive			General use		
	DPDT Slim	DPDT Wide	4PDT	DPDT Slim	DPDT Wide	4PDT
240V AC	3A	5A	5A	0.8A	2A	5A
120V AC	3A	5A	—	1.5A	2.5A	—
100V DC	—	—	—	0.2A	0.4A	0.2A
30V DC	3A	5A	5A	1.5A	2.5A	1.5A

TÜV Ratings (Standard Contact)

Voltage	DPDT Slim	DPDT Wide	4PDT
240V AC	3A	5A	5A
30V DC	3A	5A	5A

AC: cos ø = 1.0, DC: L/R = 0 ms

UL Ratings (Bifurcated Contact)

Voltage	Resistive	General use
240V AC	0.8A	0.4A
120V AC	1A	0.5A
30V DC	1A	0.5A

CSA Ratings (Bifurcated Contact)

Voltage	Resistive	General use
240V AC	0.8A	0.4A
120V AC	1A	0.5A
30V DC	1A	—

Socket Specifications

	Sockets	Terminal	Electrical Rating	Wire Size	Torque
DIN Rail Mount Sockets	SY2S-05	M3 screws with captive wire clamp	300V, 7A	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
	SM2S-05	M3 screw with captive wire clamp	300V, 10A	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
	SY4S-05	M3 screw with captive wire clamp	300V, 7A*	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
Finger-safe DIN Rail Mount	SY2S-05C	M3 screws with captive wire clamp, fingersafe	300V, 7A	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
	SM2S-05C	M3 screw with captive wire clamp, fingersafe	300V, 10A	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
	SY4S-05C	M3 screw with captive wire clamp, fingersafe	300V, 7A*	Maximum up to 2–#14AWG	5.5 - 9 in•lbs
Through Panel Mount Socket	SY2S-51	Solder	250V, 7A	—	—
	SM2S-51	Solder	250V, 10A	—	—
	SY4S-51	Solder	250V, 7A*	—	—
PCB Mount Socket	SY2S-61	PCB Mount	300V, 7A	—	—
	SY4S-61	PCB Mount	300V, 7A	—	—
	SY4S-62	PCB Mount	250V, 7A	—	—

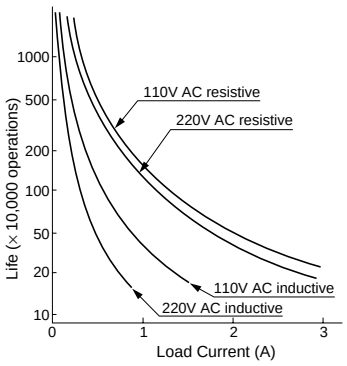
* When using only 2 poles of the 4-poles, the UL recognized current is 10A.

Characteristics (Reference Data)

Electrical Life Curves

AC Load

(RY2)



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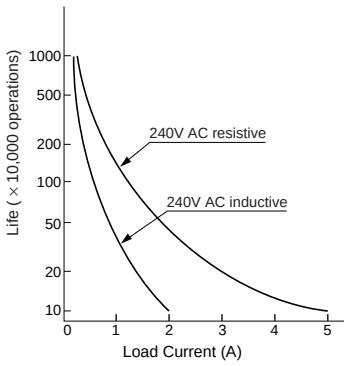
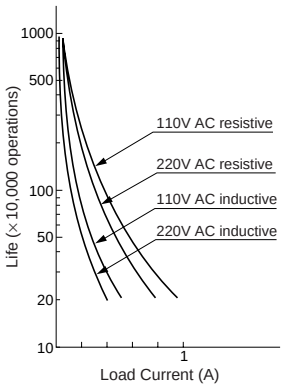
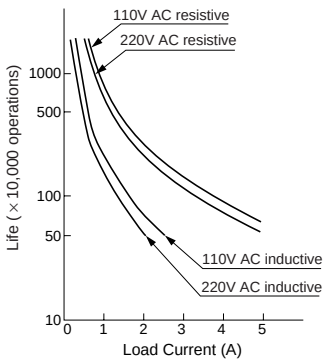


(RY42/ RY22)

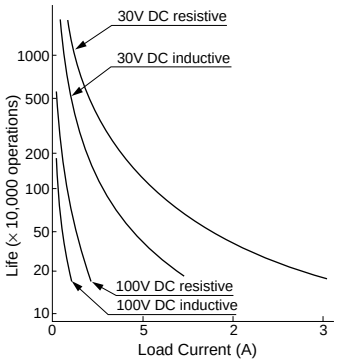


(RM2)



DC Load

(RY2)



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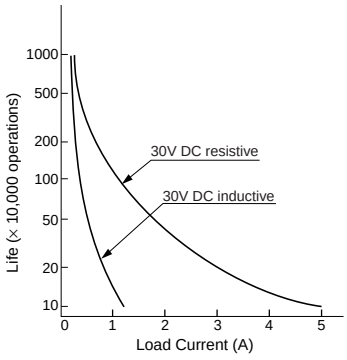
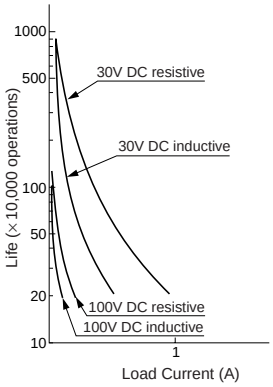
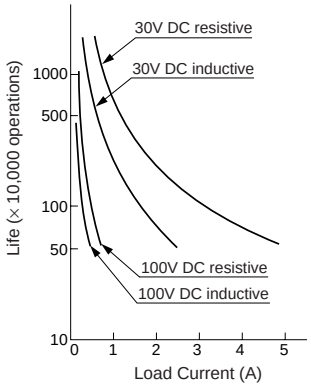


(RY42/ RY22)

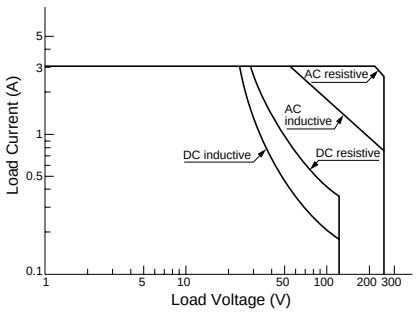


(RM2)



Maximum Switching Capacity

(RY2)



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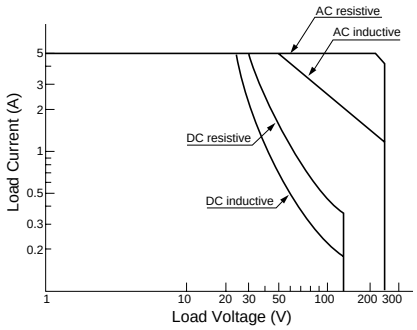
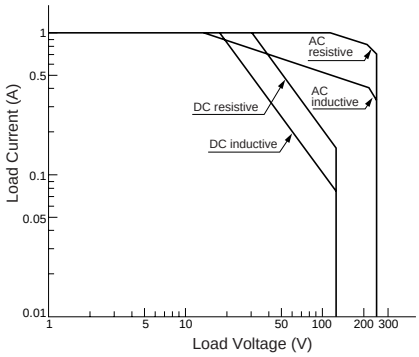
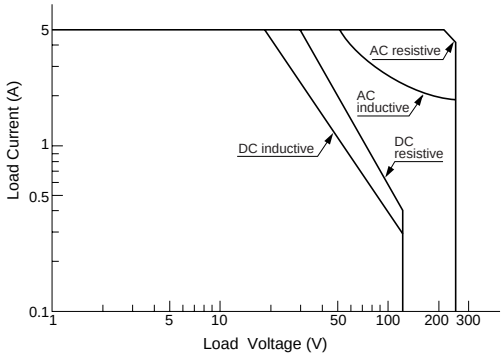


(RY42/ RY22)

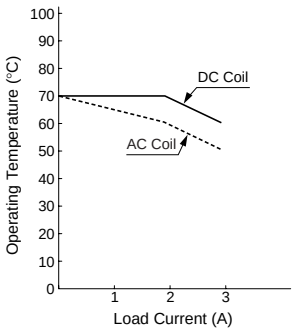


(RM2)

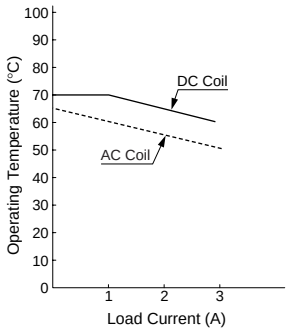


Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

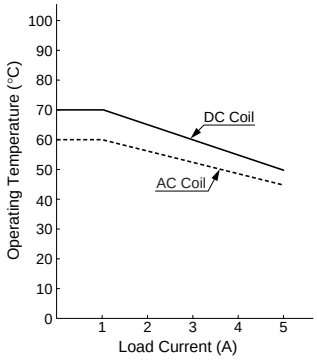
(RY2)



(RY4)



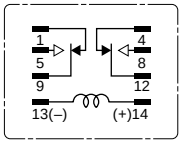
(RM2)



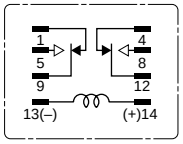
Internal Connection (View from Bottom)

Basic Type

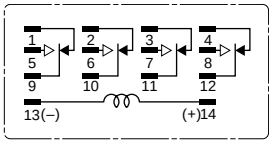
DPDT Slim (RY2/RY22)



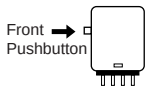
DPDT Wide (RM2)



4PDT (RY4/RY42)

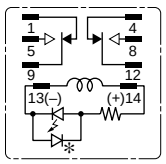
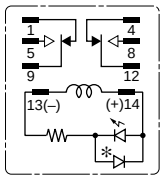
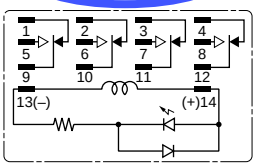
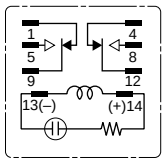
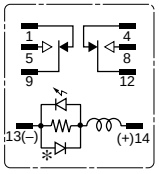
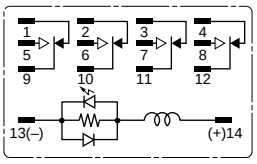


With Check Button



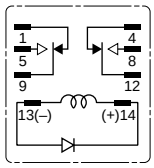
Contacts can be operated by pressing the check button.

With Indicator (-L type)

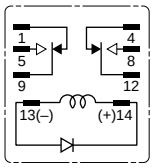
	DPDT Slim (RY2/RY22)		DPDT Wide (RM2)	4PDT (RY4/RY42)	
Coil Below 100V AC/DC		Coil Below 24V AC/DC			When the relay is energized, the indicator goes on. • The LED protection diode is not contained in DPDT relays for coils below 100V DC. • If coil polarity is reversed LED will not light.
Coil 100V AC/DC and over		Coil 24V AC/DC and over			

With Diode (-D type)

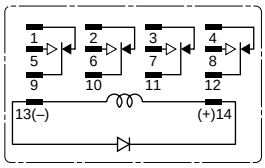
DPDT Slim (RY2/RY22)



DPDT Wide (RM2)



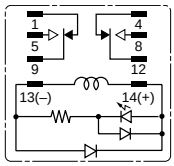
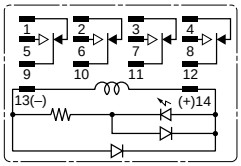
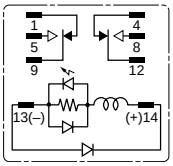
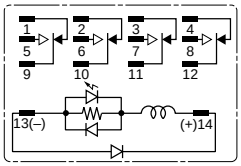
4PDT (RY4)



Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer.

- Diode Characteristics
  Reverse withstand voltage: 1,000V
  Forward current: 1A

With Indicator and Diode (-LD type)

	DPDT Wide (RM2)	4PDT (RY4)		DPDT Wide (RM2)	4PDT (RY4)	
Coil Below 24V DC			Coil 24V DC and over			Contains LED indicator and a surge absorber.

PULS

ML60.241

MiniLine-2

24V, 2.5A, SINGLE PHASE INPUT

POWER SUPPLY

- 100-240V Wide Range Input
- NEC Class 2 Compliant
- Adjustable Output Voltage
- Efficiency up to 89.7%
- Low No-load Losses and Excellent Partial-load Efficiency
- Compact Design, Width only 45mm
- Full Power between -10°C and +60°C
- Large International Approval Package
- 3 Year Warranty

GENERAL DESCRIPTION

A compact size, light weight, simple mounting onto the DIN-rail and the utilization of only quality components are what makes the MiniLine power supplies so easy to use and install within seconds.

A rugged electrical and mechanical design as well as a high immunity against electrical disturbances on the mains provides reliable output power. This offers superior protection for equipment which is connected to the public mains network or is exposed to a critical industrial environment.

The MiniLine series offers output voltages from 5 to 56Vdc and a power rating from 15W to 120W.

The supplementary MiniLine decoupling diode module MLY10.241 allows building of redundant systems or to protect against back-feeding voltages.

SHORT-FORM DATA

Output voltage	DC 24V	
Adjustment range	24 - 28V	
Output current	2.5A at 24V 2.1A at 28V	
Output power	60W	
Output ripple	< 50mVpp	20Hz to 20MHz
Input voltage	AC 100-240V	-15% / +10%
Mains frequency	50-60Hz	±6%
AC Input current	0.98 / 0.58A	at 120 / 230Vac
Power factor	0.58 / 0.5	at 120 / 230Vac
AC Inrush current	typ. 16 / 32A	peak value at 120 / 230Vac 40°C and cold start
DC Input	88-375Vdc	below 110Vdc derating required
Efficiency	87.8 / 89.7%	at 120 / 230Vac
Losses	8.3 / 6.7W	at 120 / 230Vac
Temperature range	-10°C to +70°C	operational
Derating	1.5W/°C	+60 to +70°C
Hold-up time	typ. 24 / 107ms	at 120 / 230Vac
Dimensions	45x75x91mm	WxHxD
Weight	250g / 0.55lb	

ORDER NUMBERS

Power Supply	**ML60.241**	24-28V Standard unit
Accessory	MLY10.241	Redundancy Module
	UF20.241	Buffer Module
	ZM3.WALL	Wall mount bracket

MARKINGS

c UL us LISTED
Ind. Cont. Eq. UL 508

c TÜV us
UL 60950-1

GL
Marine

c SP us
Class I Div 2

NEC Class 2

CE
EMC, LVD

INDEX

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term "earth" which is the same as the U.S. term "ground".
T.B.D.	To be defined, value or description will follow later.
AC 230V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
230Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50Hz vs. 60Hz	As long as not otherwise stated, AC 100V and AC 230V parameters are valid at 50Hz and AC 120V parameters are valid at 60Hz mains frequency.
may	A key word indicating flexibility of choice with no implied preference.
shall	A key word indicating a mandatory requirement.
should	A key word indicating flexibility of choice with a strongly preferred implementation.

1. INTENDED USE

This device is designed for installation in an enclosure and is intended for the general use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this power supply in equipment, where malfunction may cause severe personal injury or threaten human life.

2. INSTALLATION REQUIREMENTS

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Mount the unit on a DIN-rail so that the output terminals are located on top and input terminal on the bottom. For other mounting orientations see de-rating requirements in this document.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 30%!

Keep the following installation clearances:
40mm on top, 20mm on the bottom
Left / right: 0mm (or 15mm in case the adjacent device is a heat source; in example another power supply….).

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Do not use the power supply without proper grounding (Protective Earth). Use the terminal on the input block for earth connection.
- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Notes for use in hazardous location areas:

The power supply is suitable for use in Class I Division 2 Groups A, B, C, D locations.

WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment. Do not disconnect the unit or operate the voltage adjustment unless power has been switched off or the area is known to be non-hazardous.

A suitable enclosure must be provided for the end product which has a minimum protection of IP54 and fulfils the requirements of the EN 60079-15:2010.

3. AC-INPUT

AC input	nom.	AC 100-240V	-15% / +10%, TN/TT/IT-mains
AC input range		85-264Vac	continuous operation, reduce output power linearly to 50W between 90Vac and 85Vac at ambient temperatures above +45°C, see Fig. 3-5
		264–300Vac	< 0.5s
Allowed voltage L or N to earth	max.	264Vac or 375Vdc	
Input frequency	nom.	50–60Hz	±6%
Turn-on voltage	typ.	65Vac	
Shut-down voltage	typ.	see Fig. 3-1	

		AC 100V	AC 120V	AC 230V	
Input current (rms)	typ.	1.14A	0.98A	0.58A	at 24V, 2.5A see Fig. 3-3
Power factor *)	typ.	0.61	0.58	0.50	at 24V, 2.5A see Fig. 3-4
Crest factor **)	typ.	3.2	3.3	3.7	at 24V, 2.5A
Start-up delay	typ.	170ms ***)	110ms ***)	90ms	see Fig. 3-2
Rise time	typ.	50ms	50ms	60ms	at 24V, 2.5A, 0mF, see Fig. 3-2
		120ms	110ms	140ms	at 24V, 2.5A, 2.5mF
Turn-on overshoot	max.	200mV	200mV	200mV	see Fig. 3-2

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.
**) The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
***) At low temperatures, start-up attempts may occur which extends the start-up delay

Fig. 3-1 **Input voltage range**

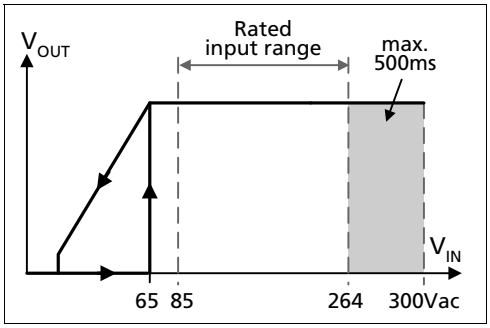


Fig. 3-2 **Turn-on behavior, definitions**

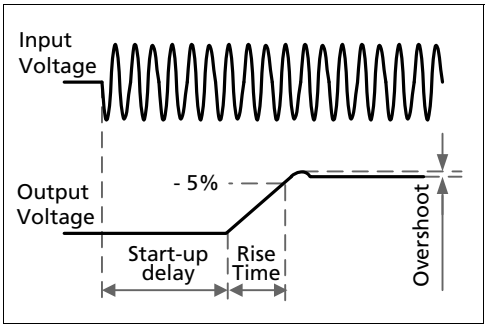


Fig. 3-3 **Input current vs. output load at 24V**

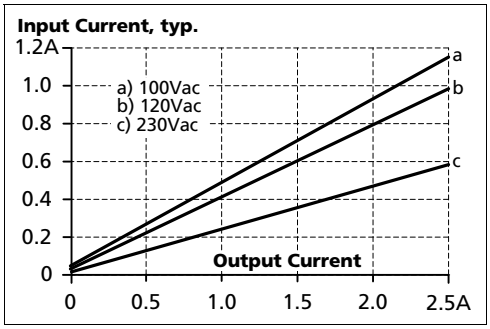


Fig. 3-4 **Power factor vs. output load at 24V**

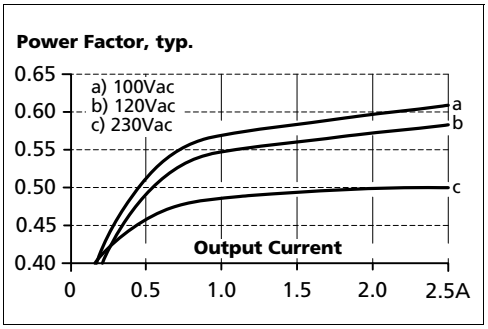
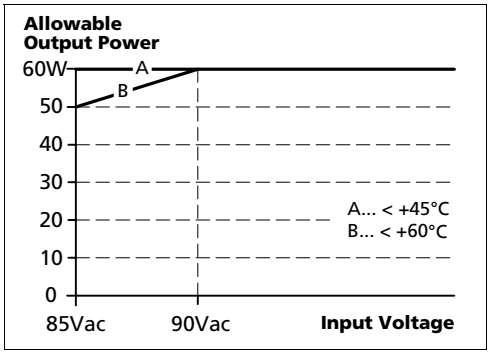


Fig. 3-5 **De-rating requirements for low input voltages**



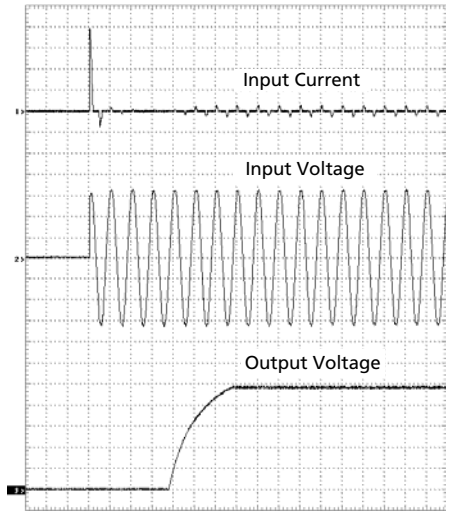
4. INPUT INRUSH CURRENT

A NTC limits the input inrush current after turn-on of the input voltage. The inrush current is input voltage and ambient temperature dependent.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

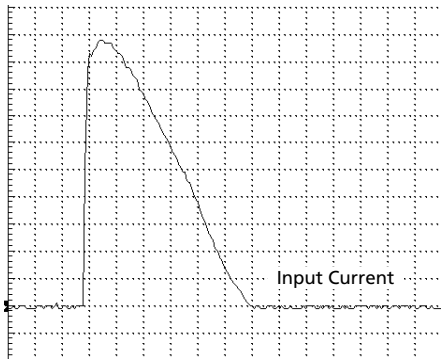
		AC 100V	AC 120V	AC 230V	
Inrush current	max.	$17A_{peak}$	$21A_{peak}$	$40A_{peak}$	40°C ambient, cold start
	typ.	$14A_{peak}$	$16A_{peak}$	$32A_{peak}$	40°C ambient, cold start
Inrush energy	typ.	$0.15A^2s$	$0.2A^2s$	$1.0A^2s$	40°C ambient, cold start

Fig. 4-1 **Input inrush current, typical behavior**



Input: 230Vac
Output: 24V, 2.5A
Ambient: 25°C
Upper curve: Input current 5A/DIV
Middle curve: Input voltage 100V/DIV
Lower curve: Output voltage 5V/DIV
Time basis: 20ms / DIV

Fig. 4-2 **Input inrush current, zoom into first peak**



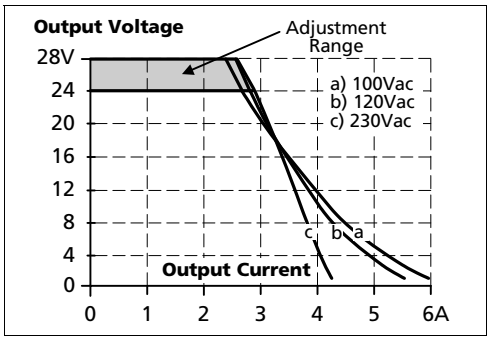
Input: 230Vac
Output: 24V, 2.5A
Ambient: 25°C
Input current 2A/DIV
Time basis: 0.5ms / DIV

5. OUTPUT

Output voltage	nom.	24V	
Adjustment range	min.	24-28V	guaranteed
	max.	30V *)	at clockwise end position of potentiometer
Factory setting		24.5V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	85-264Vac
Load regulation	max.	100mV	static value, 0A → 2.5A
Ripple and noise voltage	max.	50mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	1 600µF	
Output current	nom.	2.5A	at 24V, see Fig. 5-1
	nom.	2.1A	at 28V, see Fig. 5-1
Output power	nom.	60W	
Short-circuit current	min.	3.6A	load impedance 400mOhm, see Fig. 5-1
	max.	6.2A	load impedance 400mOhm, see Fig. 5-1

*) This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not guaranteed value which can be achieved. The typical value is about 28.6V.

Fig. 5-1 **Output voltage vs. output current, typ.**



Peak current capability (up to several milliseconds)

The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 22.1.

Peak current voltage dips	typ.	from 24V to 16V	at 5A for 50ms, resistive load
	typ.	from 24V to 15V	at 12.5A for 2ms, resistive load
	typ.	from 24V to 10.5V	at 12.5A for 5ms, resistive load

6. HOLD-UP TIME

		AC 100V	AC 120V	AC 230V	
Hold-up Time	typ.	36ms	54ms	218ms	at 24V, 1.25A, see Fig. 6-1
	typ.	15ms	24ms	107ms	at 24V, 2.5A, see Fig. 6-1

Note: At no load, the hold-up time can be up to several seconds. The green DC-ok lamp is also on during this time

Fig. 6-1 **Hold-up time vs. input voltage**

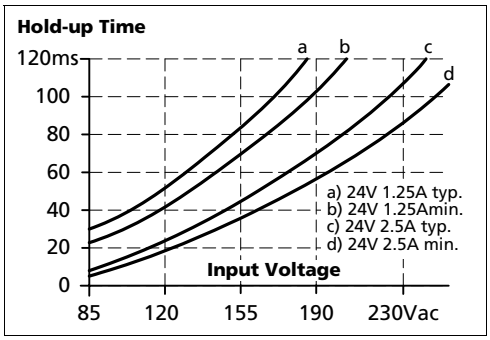
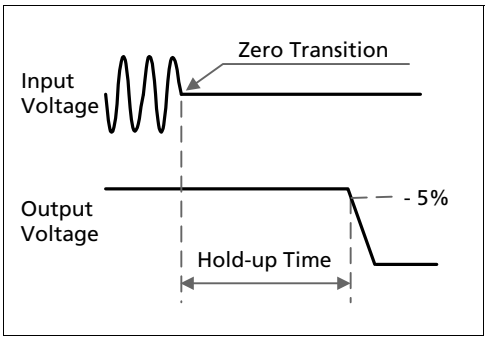


Fig. 6-2 **Shut-down behavior, definitions**



7. DC-INPUT

The power supply can also be supplied from a DC source. Use a battery or similar DC source. For other sources contact PULS. Connect the + pole to L and the – pole to N. Connect the PE terminal to an earth wire or to the machine ground.

DC input	nom.	DC 110-300V	-20%/+25%
DC input range	min.	88-375Vdc	continuous operation, reduce output power according Fig. 7-2 at voltages below 110Vdc
Allowed Voltage L/N to Earth	max.	375Vdc	IEC 62103
DC input current	typ.	0.62A / 0.22A	110Vdc / 300Vdc, at 24V, 2.5A
Turn-on voltage	typ.	80Vdc	steady state value
Shut-down voltage	typ.	30-70Vdc	depending on output load

Fig. 7-1 **Wiring for DC Input**

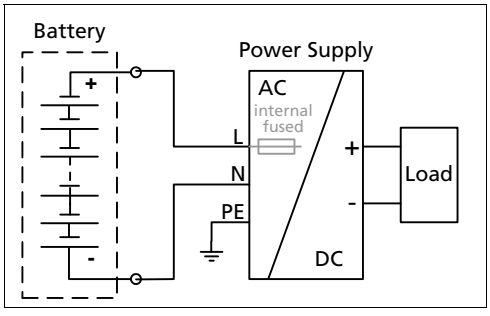
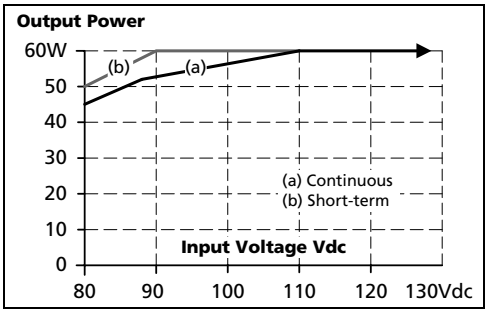


Fig. 7-2 **Allowable output current below 110Vdc input voltage**



8. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	86.5%	87.8%	89.7%	at 24V, 2.5A (full load)
Power losses	typ.	0.45W	0.5W	0.85W	at 0A
	typ.	4.0W	3.8W	4.0W	at 24V, 1.25A (half load)
	typ.	9.4W	8.3W	6.9W	at 24V, 2.5A (full load)

Fig. 8-1 **Efficiency vs. output current at 24V, typ.**

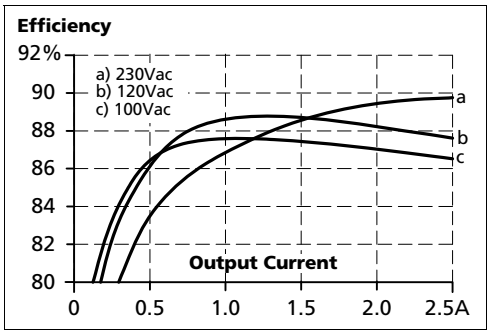


Fig. 8-2 **Losses vs. output current at 24V, typ.**

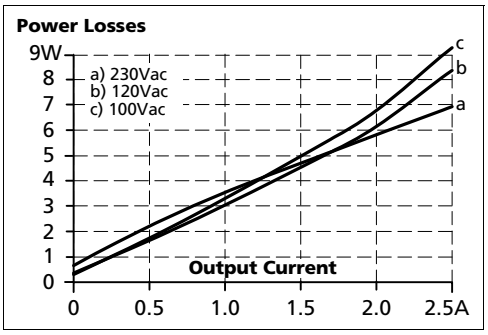


Fig. 8-3 **Efficiency vs. input voltage at 24V, 2.5A, typ.**

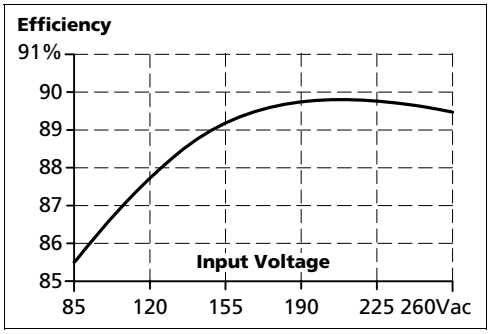
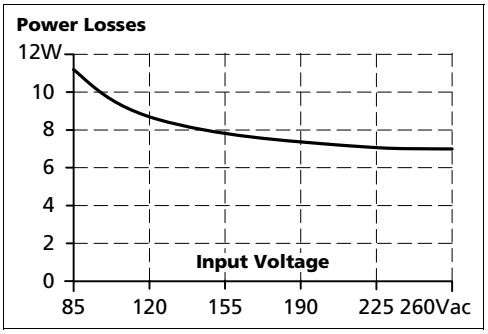
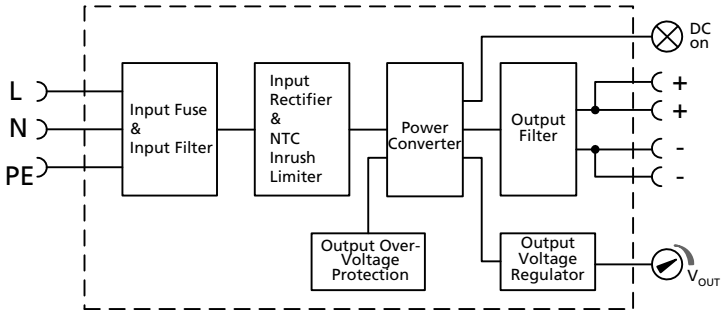


Fig. 8-4 **Losses vs. input voltage at 24V, 2.5A, typ.**



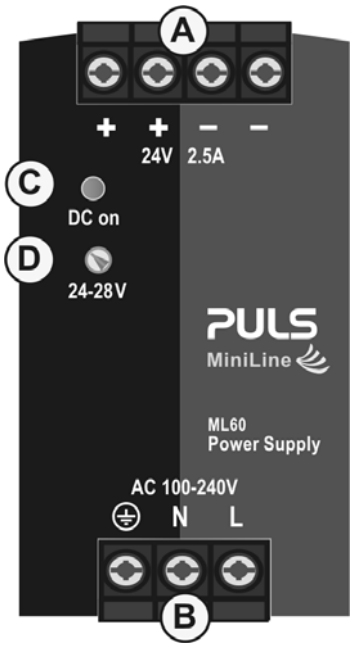
9. FUNCTIONAL DIAGRAM

Fig. 9-1 **Functional diagram**



10. FRONT SIDE AND USER ELEMENTS

Fig. 10-1 **Front side**



A **Output Terminals**
Screw terminals,
Dual terminals for the negative and positive pole. Both poles are equal
+ Positive output
- Negative (return) output

B **Input Terminals**
Screw terminals
L Phase (Line) input
N Neutral conductor input
⏚ PE (Protective Earth) input

C **DC-on LED** (green)
On, when the voltage on the output terminals is > 17V

D **Output voltage potentiometer**
(single turn potentiometer)
Turn to set the output voltage. Factory set: 24.5V

11. TERMINALS AND WIRING

All terminals are easy to access when mounted on the panel. Input and output terminals are separated from each other (input below, output above) to help in error-free wiring.

	Input	Output
Type	screw terminals	screw terminals
Solid wire	max. 6mm²	max. 6mm²
Stranded wire	max. 4mm²	max. 4mm²
American Wire Gauge	max. AWG10	max. AWG10
Wire stripping length	7mm / 0.275inch	7mm / 0.275inch
Screwdriver	3.5mm slotted or Pozidrive No 2	3.5mm slotted or Pozidrive No 2
Recommended tightening torque	1Nm, 9lb.in	1Nm, 9lb.in

Instructions:

a) Use appropriate copper cables that are designed for an operating temperature of:
60°C for ambient up to 45°C and 75°C for ambient up to 60°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
e) Do not use the unit without PE connection.
f) Screws of unused terminal compartments should be securely tightened.
g) Ferrules are allowed.

12. LIFETIME EXPECTANCY AND MTBF

These units are extremely reliable and use only the highest quality materials. The number of critical components such as electrolytic capacitors has been reduced.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy *)	71 000h	93 000h	128 000h	at 24V, 2.5A and 40°C
	200 000h *)	264 000h *)	363 000h *)	at 24V, 1.25A and 40°C
	162 000h *)	233 000h *)	327 000h *)	at 24V, 2.5A and 25°C
MTBF **) SN 29500, IEC 61709	1 391 000h	1 667 000h	1 916 000h	at 24V, 2.5A and 40°C
	2 541 000h	2 964 000h	3 345 000h	at 24V, 2.5A and 25°C
MTBF **) MIL HDBK 217F	1 038 000h	1 112 000h	1 060 000h	at 24V, 2.5A , 40°C; Ground Benign GB40
	1 414 000h	1 517 000h	1 450 000h	at 24V, 2.5A , 25°C; Ground Benign GB25
	269 000h	295 000h	291 000h	at 24V, 2.5A , 40°C; Ground Fixed GF40
	355 000h	389 000h	384 000h	at 24V, 2.5A , 25°C; Ground Fixed GF25

*) The **Lifetime expectancy** shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor's manufacturer specification. The manufacturer of the electrolytic capacitors only guarantees a maximum life of up to 15 years (131 400h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

) **MTBF stands for **M**ean **T**ime **B**etween **F**ailure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.
The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

14. ENVIRONMENT

Operational temperature *)	-10°C to +70°C (14°F to 158°F)	reduce output power according Fig. 14-1
Storage temperature	-40°C to +85°C (-40°F to 185°F)	for storage and transportation
Output de-rating	1.5W/°C	60-70°C (140°F to 158°F)
Humidity **)	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock	15g 6ms, 10g 11ms 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 2000m (0 to 6 560ft)	without any restrictions
	2000 to 6000m (6 560 to 20 000ft)	reduce output power or ambient temperature see Fig. 14-2 IEC 62103, EN 50178, overvoltage category II
Altitude de-rating	4W/1000m or 5°C/1000m	> 2000m (6500ft), see Fig. 14-2
Over-voltage category	III	IEC 62103, EN 50178, altitudes up to 2000m
	II	altitudes from 2000m to 6000m
Degree of pollution	2	IEC 62103, EN 50178, not conductive
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	

*) Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.
**) Do not energize while condensation is present

Fig. 14-1 **Output power vs. ambient temp.**

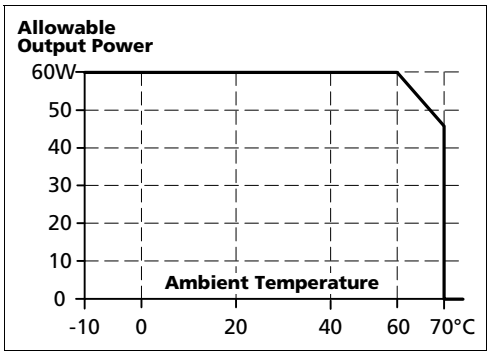
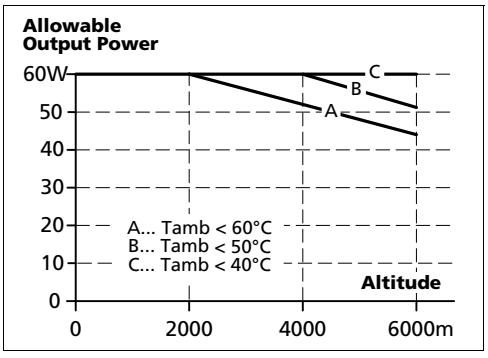


Fig. 14-2 **Output power vs. altitude**



15. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits *)	
Output over-voltage protection	typ. 31Vdc max. 32.5Vdc	In case of an internal power supply fault, a redundant circuit limits the maximum output voltage. In such a case, the output shuts down and stays down until the input voltage is turned off and on again.
Output over-current protection	electronically limited	see Fig. 5-1
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	> 2.5mm in diameter	e.g. screws, small parts
Over-temperature protection	not included	
Input transient protection	MOV	Metal Oxide Varistor
Internal input fuse	T3.15A H.B.C.	not user replaceable

*) In case of a protection event, audible noise may occur.

16. SAFETY FEATURES

Input / output separation *)	SELV	IEC/EN 60950-1
	PELV	IEC/EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
	II (with restrictions)	for use without PE connection contact PULS
Isolation resistance	> 5MOhm	Input to output, 500Vdc
Touch current (leakage current)	typ. 0.13mA / 0.29mA	100Vac, 50Hz, TN-,TT-mains / IT-mains
	typ. 0.19mA / 0.40mA	120Vac, 60Hz, TN-,TT-mains / IT-mains
	typ. 0.30mA / 0.63mA	230Vac, 50Hz, TN-,TT-mains / IT-mains
	< 0.17mA / 0.38mA	110Vac, 50Hz, TN-,TT-mains / IT-mains
	< 0.25mA / 0.53mA	132Vac, 60Hz, TN-,TT-mains / IT-mains
	< 0.41mA / 0.85mA	264Vac, 50Hz, TN-,TT-mains / IT-mains

*) Double or reinforced insulation

22. APPLICATION NOTES

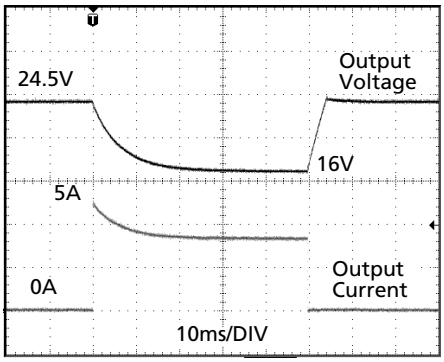
22.1. PEAK CURRENT CAPABILITY

Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current. The same situation applies when starting a motor or switching-on a capacitive load.

In many cases, the peak current capability also ensures a safe operation of subsequent circuit breakers. Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in a branch circuit, the fuse needs a certain amount of over-current to trip or to blow.

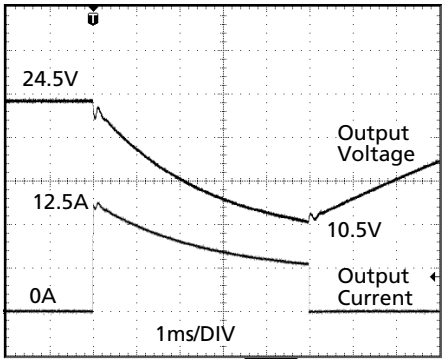
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 22-1 **Peak loading with 2x the nominal current for 50ms, typ.**



Peak load 5A (resistive load) for 50ms
Output voltage dips from 24V to 16V.

Fig. 22-2 **Peak loading with 5x the nominal current for 5ms, typ.**



Peak load 12.5A (resistive load) for 5ms
Output voltage dips from 24V to 10.5V.

22.2. BACK-FEEDING LOADS

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

This power supply is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off.

The maximum allowed feed-back-voltage is 35Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 5.

22.3. CHARGING OF BATTERIES

The power supply can be used to charge lead-acid or maintenance free batteries. (Two 12V batteries in series)

Instructions for charging batteries (float charging):

a) Ensure that the ambient temperature of the power supply is below 45°C

b) Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage.

End-of-charge voltage	27.8V	27.5V	27.15V	26.8V
Battery temperature	10°C	20°C	30°C	40°C

c) Use a 4A circuit breaker (or blocking diode) between the power supply and the battery.

d) Ensure that the output current of the power supply is below the allowed charging current of the battery.

e) Use only matched batteries when putting 12V types in series.

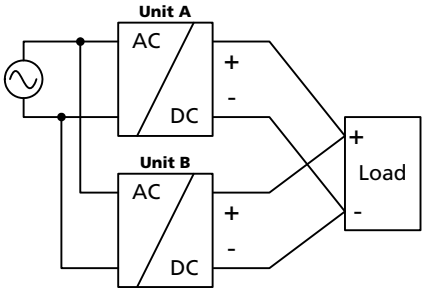
f) The return current to the power supply (battery discharge current) is typical 7.3mA when the power supply is switched off (except in case a blocking diode is utilized).

22.4. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 20A. An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 10A B- or 6A C-Characteristic breaker should be used.

22.5. PARALLEL USE TO INCREASE OUTPUT POWER



ML60.241 power supplies can be paralleled to increase the output power. This power supply has no feature included which balances the load current between the power supplies. Usually the power supply with the higher adjusted output voltage draws current until it goes into current limitation. This means no harm to this power supply as long as the ambient temperature stays below 45°C. The ML60.241 can also be paralleled with other power supplies from MiniLine series with 24V output voltage. The output voltages of all power supplies shall be adjusted to the same value (±100mV).

A fuse or diode on the output of each unit is only required if more than three units are connected in parallel. If a fuse (or circuit breaker) is used, choose one with approximately 150% of the rated output current of one power supply.

Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in parallel in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit).

Be aware that leakage current, EMI, inrush current and harmonics will increase when using multiple power supplies in parallel.