



PROJECT O&M:  
**2012600120-0-701**

DATE:  
**05/24/12**

DISTRIBUTOR:  
**HENRY P THOMPSON CO.**

PURCHASE ORDER #:  
**20249-001-001**

PROJECT NAME:  
**SALEM IN. WATER  
TREATMENT PLANT**

EQUIPMENT:  
**(QTY 1) PAC METERING  
SKID**

**(QTY 1) VFD CONTROL  
PANEL**

**1**

### GENERAL INFORMATION

PROMINENT WARRANTY  
DELIVERY AND STORAGE CHECKLIST  
PRE-INSTALLATION CHECKLIST  
QUICK START GUIDE  
PUMP SELECTION TIPS  
TROUBLESHOOTING GUIDELINES

**2**

### PAC METERING SKID COMPONENTS

DULCOFLEX IDENT: DFBU0224200G40000001  
DULCOFLEX O&M  
BALDOR IDXM7006: 1/2HP EXP MOTOR  
  
ACCUDRAW PVC CALIBRATION COLUMN  
ACCUDRAW CALIBRATION COLUMN O&M  
ASAHI PVC/VITON TYPE 21 BALL VALVES  
ASAHI BALL VALVE O&M  
BLACOH PVC/VITON PULSATION DAMPENERS  
BLACOH PULSATION DAMPENER O&M  
PFC PVC/PTFE PRESSURE RELIEF VALVES  
PFC PRESSURE RELIEF VALVE O&M  
PRECISION PTFE GAUGE & PTFE ISOLATOR SEAL  
BRAIDFLEX PVC TUBING  
SPEARS SCH.80 PVC PIPING & FITTINGS

**3**

### ELECTRICAL

STAHLIN FRP ENCLOSURE  
C3 CONTROLS MOTOR STARTER  
SQUARE D CIRCUIT BREAKER  
TELEMECANIQUE RELAY  
ALLEN BRADLEY POWERFLEX VFD  
ALLEN BRADLEY POWERFLEX VFD O&M  
DIODES VOLTAGE SUPPRESSOR  
IDEC POWER SUPPLY  
SCHNEIDER SELECTOR SWITCH  
SCHNEIDER PILOT LIGHT  
PHOENIX CONTACT TERMINALS

**4**

### DRAWINGS

PAC METERING SKID GENERAL ARRANGEMENT  
2012600120-0-200  
  
VFD CONTROL PANEL DRAWINGS  
2012600120-A-300, 301, 302, 303

# ProMinent Warranty

1) WARRANTY, REMEDY, DISCLAIMER: The warranties set out in this clause shall be conditional upon fulfillment of the Purchaser's contractual obligations, including all terms of payment. For sales of completed pumps and controllers, the warranty shall be conditional upon the Purchaser completing and returning the attached Warranty Validation Card. Seller warrants that the Drive Units and DULCOMETER Controllers will be of good workmanship and material for two (2) years from the date of purchase by owner of new equipment from an authorized distributor of manufacturer, but no longer than two and one-half (2-1/2) years from the date of shipment by manufacturer. All Dulcotest sensors are warranted for (6) months from the date of shipment by manufacturer. For sales of liquid ends, Bello Zon, Bono Zon, pump accessories, standard engineered products, custom designed items and items not manufactured by ProMinent, Seller warrants that the products will be of good workmanship and material for one (1) year from the date the goods are shipped by Seller. If purchaser claims that the goods are defective, he must permit Seller's personnel at Seller's option to inspect the goods on Purchaser's property. Purchaser shall not return the goods to Seller unless Purchaser obtains prior written approval of such from Seller. If, after inspection, Seller determines that the goods are defective, Seller will repair or replace goods at Seller's option and at Seller's cost. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED AND STATUTORY INCLUDING THE WARRANTIES OF FITNESS FOR PURPOSE AND MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. The warranty provided for herein shall not apply to any goods that become defective for the following reason:

- (a) unsuitable or unreasonable use
- (b) faulty assembly, installation or servicing by the Purchaser or any third party
- (c) faulty or careless handling

2) DISCLAIMER OF TORT LIABILITY: PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT SELLER SHALL NOT BE LIABLE IN TORT, WHETHER BASED ON NEGLIGENCE, STRICT LIABILITY OR ANY OTHER THEORY OF TORT LIABILITY, FOR ANY ACTION OR FAILURE TO ACT IN RESPECT TO THE MANUFACTURE, PREPARATION FOR SALE, OR DELIVERY OF THE GOODS. IT IS THE PARTIES' INTENT AND THE INTENT OF THIS PARAGRAPH TO ABSOLVE AND PROTECT SELLER FROM ANY AND ALL TORT LIABILITY.

3) EXCLUSIVE REMEDY: PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT PURCHASER'S SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST SELLER SHALL BE THE REMEDY PROVIDED IN PARAGRAPH TWO (2) ABOVE.

4) EXCLUSION OF CONSEQUENTIAL DAMAGES: PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT UNDER NO CIRCUMSTANCES WILL SELLER BE LIABLE TO PURCHASER FOR ECONOMIC, SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS AND ANY OTHER LOSS CAUSED BY REASON OF THE NON-OPERATION OF THE GOODS. THIS EXCLUSION IS APPLICABLE TO CLAIMS FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST SELLER.

5) ALL TERMS AND CONDITIONS OF SALE CONTAINED IN SELLER'S ACKNOWLEDGMENT/OFFER TO SELL APPLY AND ARE IN NO WAY ALTERED BY THIS WARRANTY VALIDATION CARD.

**ProMinent Fluid Controls**  
RIDC Park West  
136 Industry Drive  
Pittsburgh, PA 15275-1014  
(412)787-2484

# !!! IMPORTANT – PLEASE READ !!!

ProMinent® SYSTEMS

## SITE DELIVERY AND STORAGE CHECKLIST

1. Check packing list for completeness and note any missing items immediately.
2. The skid may have been jarred during shipping. Inspect equipment and shipping container for damage before accepting delivery. Make note on the carrier's bill-of-lading the extent of the damage, if any, and notify the carrier. Save the shipping container until your system is started up.
3. Store equipment on firm level surface in original packing container. Do not store equipment where it may be exposed to extreme temperatures, precipitation, humidity, or dust. Avoid direct sunlight that could overheat and damage equipment.

**WARNING – PUMPS MAY BE FILLED WITH OIL WHICH COULD LEAK IF TILTED**

**Ambient Conditions for storage and transport:**

**Temperature:**

**14°F to 120°F**

**Air humidity:**

**max. 95% relative humidity, non-condensing**

**Please call if you have questions.**

ProMinent Fluid Controls, Inc.  
RIDC Park West  
136 Industry Drive  
Pittsburgh, PA 15275-1014  
Phone: (412) 787-2484  
Fax: (412) 787-0704

# !!! IMPORTANT – PLEASE READ !!!

ProMinent® SYSTEMS

## PRE-INSTALLATION CHECKLIST

1. Mount equipment on hard flat level surface. Stainless steel or FRP angle may be used to fasten skids down.
2. Do not install equipment in areas of extreme heat, cold, dust or humidity. Avoid areas where objects or fluids can drop from overhead.
3. Install piping so connections properly meet skid termination points. Do not “stretch” field installed piping to meet skid termination points. Stressed plastic piping will fail!
4. Check the tightness on all unions. Hand tighten only - no tools. Unions incorporate an o-ring seal. Ensure that the o-ring is seated properly before tightening.
5. Check the piping for breakage. The skid may have been jarred during shipping.
6. Allow provisions for draining the system piping. Skid components will require maintenance. Ensure that chemicals can be evacuated from skid piping and components.
7. Do not down-size piping to or from system. Piping should be at least equal in diameter to piping on skid and one or two sizes larger for long runs.
8. Install suction line strainer if one was not included with your packaged system
9. Avoid getting dirt in piping during installation. Plug ends of piping with rags if construction activities are underway. All debris must be flushed from piping before system start-up.
10. Check electrical connections to be sure proper voltage is supplied to unit.

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# **!!! IMPORTANT – PLEASE READ !!!**

## **ProMinent® SYSTEMS QUICK START GUIDE**

1. Pressure Relief Valves and Back Pressure Valves (PRV's/BPV's) are NOT pre-adjusted. ProMinent adjusts valves for QC purposes, but valves must be opened before shipping to allow water to be drained out.
2. The PRV's should be set no higher than the lowest rated component – typically the pump. In any case, do not exceed 150 psi with plastic piping. Tighten the PRV only with the a proper sized screwdriver or the furnished adjusting wrench. An improper adjustment tool will damage the valve adjustment screw.

**No extraordinary start-up procedures are required. However, the following steps are recommended. WEAR SAFETY GLASSES WHILE WORKING ON CHEMICAL FEED EQUIPMENT!**

- a. Unions tagged with Red Tape are purposely loosened prior to shipping. Check ALL unions for tightness and insure O-ring is properly seated before tightening. **DO NOT OVERTIGHTEN!** Hand tighten initially, and if necessary, apply one-eighth to one-quarter turn with properly sized wrench. **DO NOT OVERTIGHTEN!**
- b. Start the pumps in manual control mode with water – **DO NOT APPLY SYSTEM PRESSURE. CHECK MOTOR ROTATION!** (clockwise, looking down towards pump). Open oil vent, if applicable. Check for leaks.
- c. Check pulsation dampener fastener bolts' torque and inflate dampeners before applying system pressure (~80% of System Pressure). Set BPV for at least 15 psi pressure. Set PRV for rated pressure of weakest link in system.
- d. Run the system in manual mode with water. Build pressure. Check for leaks! Correct all leaks before introducing chemical into the system.
- e. Familiarize yourself with controls, check functionality of instruments, and verify correct pump output.
- f. Run the system in automatic mode with water. Verify functionality of alarms and safety devices. Verify correct pump output and functionality of instruments.
- g. Run the system in automatic mode with chemicals. Allow system to build pressure and check for leaks.

**Please call if you have questions.**

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# Pump Selection, Accessories and Installation Tips

## WHEN SELECTING, INSTALLING AND OPERATING A PUMP AND ACCESSORIES, THE FOLLOWING GUIDELINES SHOULD BE FOLLOWED:

When selecting a pump, make allowances for extra capacity and working pressure, especially if the *fluid viscosity* is higher than that of water (note: Capacities in manuals pertain specifically to water at fixed pressures).

If in doubt about the *chemical compatibility* of the liquid end materials, valves, valve balls, O-rings, suction and discharge lines and accessories, refer to the Chemical Resistance List (page 8).

For varying, *corrosive media*, the corrosiveness of which is unknown, select the highest rated PTFE (TT) version. For *abrasive fluids*, or for use in the *food processing* industry, select the stainless steel (SS) version if compatible with the media.

The site of the metering pump should be easily accessible. The metering pump should be protected against the risk of being damaged mechanically. *High ambient temperatures, radiating heat and direct sunlight* should be avoided, if possible.

The metering pump should be provided with a *power supply* of its own. If connected in parallel to other equipment, the metering pump should be switched on and off by separate contacts, e.g. by relays or contactors. If the metering pump is paced externally, the maximum input pulse rate should match the maximum stroking rate.

All pumps are *self-priming*. The suction lift varies between 5 and 20 ft. (1.5 and 6 m), depending on the pump type (refer to Technical Data). The reduced suction lift for media having a specific gravity (density) higher than 1 can be evaluated as follows:

$$\begin{array}{lcl} \text{Effective} & & \text{Rated} \\ \text{suction lift} & = & \frac{\text{suction lift, water}}{\text{(f)}} \quad \text{S.G.} \end{array}$$

**Note:** Suction lift decreases with high altitude. Contact factory for pump selection.

## Accessories and tips. . .

### – The suction line should be. . .

- as short as possible.
- sloping upwards to eliminate vapor pockets.

### – The discharge line should have. . .

- a drain valve when corrosive media is to be handled.

#### Installation Tip:

- Draining is achieved by means of a tee and bleed valve, or an adjustable pressure relief valve in the discharge line.

### – A foot valve with ball check valve, ceramic weight and strainer facilitates. . .

- priming.
- prevents loss of prime.
- protects the liquid end against coarse impurities.

#### Installation Tip:

- Must install vertically, slightly above the bottom of the tank; directly under pump taking pump maximum suction lift into account.

**Note:** Pump capacity is effected if not installed properly or if plugged.

### – Postive suction head (flooded suction)

- Recommended with media which tend to develop gases.
- Recommended with media which has high viscosity.

#### Installation Tips:

- Degassing pump must be used on suction lift applications, not flooded suction.
- Metering pump can be located at and fed from the foot of the supply tank.

### – A ball-check-type injection valve

- Prevents back flow.

#### Installation Tip:

- Should be at the end of the discharge line; Teflon injection valves are not spring-loaded and must be oriented vertically into bottom of pipe for ball to seat.

**Note:** Pumps will not give consistent results without backpressure; our injection valve provides minimum backpressure when pumping into atmosphere.

### – Backpressure valve

- Adjustable spring tension on a diaphragm.
- Ensures accurate metering and prevents siphoning.

#### Installation Tips:

- Must be in the discharge line or mounted onto the pump in the following cases:
  - ✓ When the discharge head is negligible (open-end discharge).
  - ✓ The metering pump discharges into a vacuum system or the positive suction head exceeds the discharge head.

**Note:** At least 15 psig differential pressure is required to provide repeatability of metering.

### – Pulsation dampener

- Bladder type cavity with pressure gauge.
- Required for very long discharge lines.
- Required when high-viscosity media are handled.
- Required when a smooth flow profile is required.

# Pump Selection and Installation Tips Cont. . .

## Installation Tips:

- Should be as close to the pump as possible.
- Set pressure at 90% of discharge line pressure.
- No further than 12 inches from the metering pump discharge, in direction of flow.

**Note:** Backpressure valve is required at point of injection, downstream of pulsation dampener. Consult ProMinent for verifications when discharge lines are greater than 100 feet.

## – Pressure relief valve

- In form of an adjustable backpressure valve or 3-port relief valve.
- Protects metering pump against "dead head" (pumping against a closed valve).

## Installation Tip:

- Must be close to the pump, upstream of the backpressure valve, for system protection.

## Application Suggestions:

- Where the discharge line is hard piped.
- When pumping into high pressures.
- Where the discharge line has several check valves installed.

**Note:** Recommended for all motor-driven pumps.

## – Viscous fluids

- Require valve springs to ensure balls seat properly.

## Installation Tips:

- Should be spring-loaded for viscous media.
- Operation at a greater stroke length is better than operation at a higher stroking rate.
- The suction piping should be sized up by one pipe size and a pulsation dampener used.
- Select PP4/PP5 series pumps with special liquid ends for extremely high viscosities. Positive suction recommended.

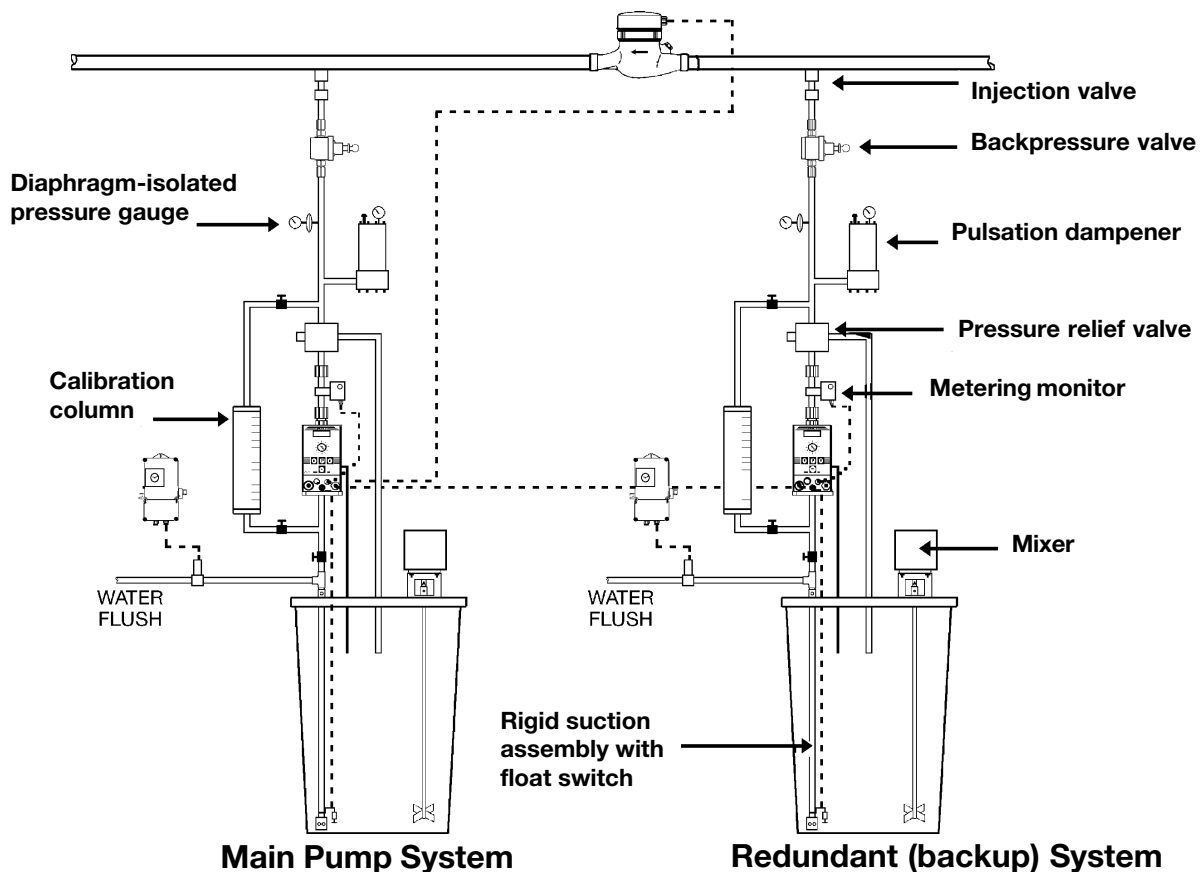
## – Calibration column

- Draw down, graduated cylinder.
- Useful for setting up metering pump to reach desired capacity.
- Single pump dosing package can be equipped with a self-filling calibration assembly for application where the pump is installed above the tank (eliminates chemical handling).

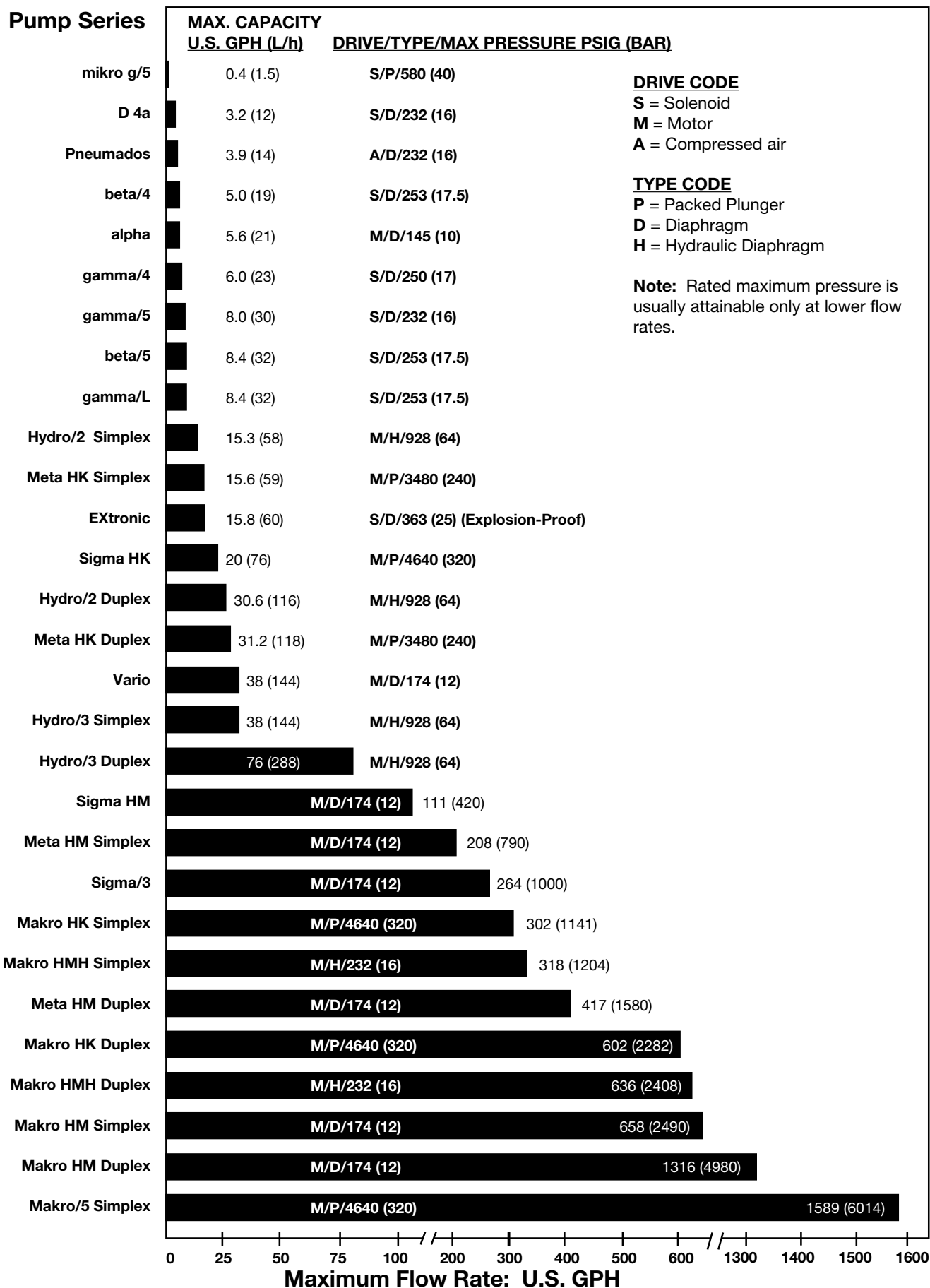
## Installation Tip:

- Easy to install off the suction side of the metering pump with a ball valve to isolate from the tank.

## APPLICATION OF PUMP ACCESSORIES FOR AN OPTIMAL METERING SYSTEM



# ProMinent® Metering Pump Selection Guide



# Data required to size metering pumps and accessories

Complete this data sheet and fax it to ProMinent Pittsburgh at (412) 787-0704 or ProMinent Canada at (519) 836-5226 for a review of the system hydraulics and recommendations on pump and accessory selection.

Desired capacity min./max.	GPH (l/h) _____
Available power supply	_____ V, _____ Hz, _____ phase
Working temperature min./max.	°F (°C) _____
Description of process fluid	_____
Concentration %	_____
Solids content %	_____
Absolute viscosity, cP	_____
Vapor pressure at working temperature	psig (bar) _____
Remarks (e.g. abrasive, developing gases and fumes, flammable, corrosive)	_____ _____

## Suction conditions:

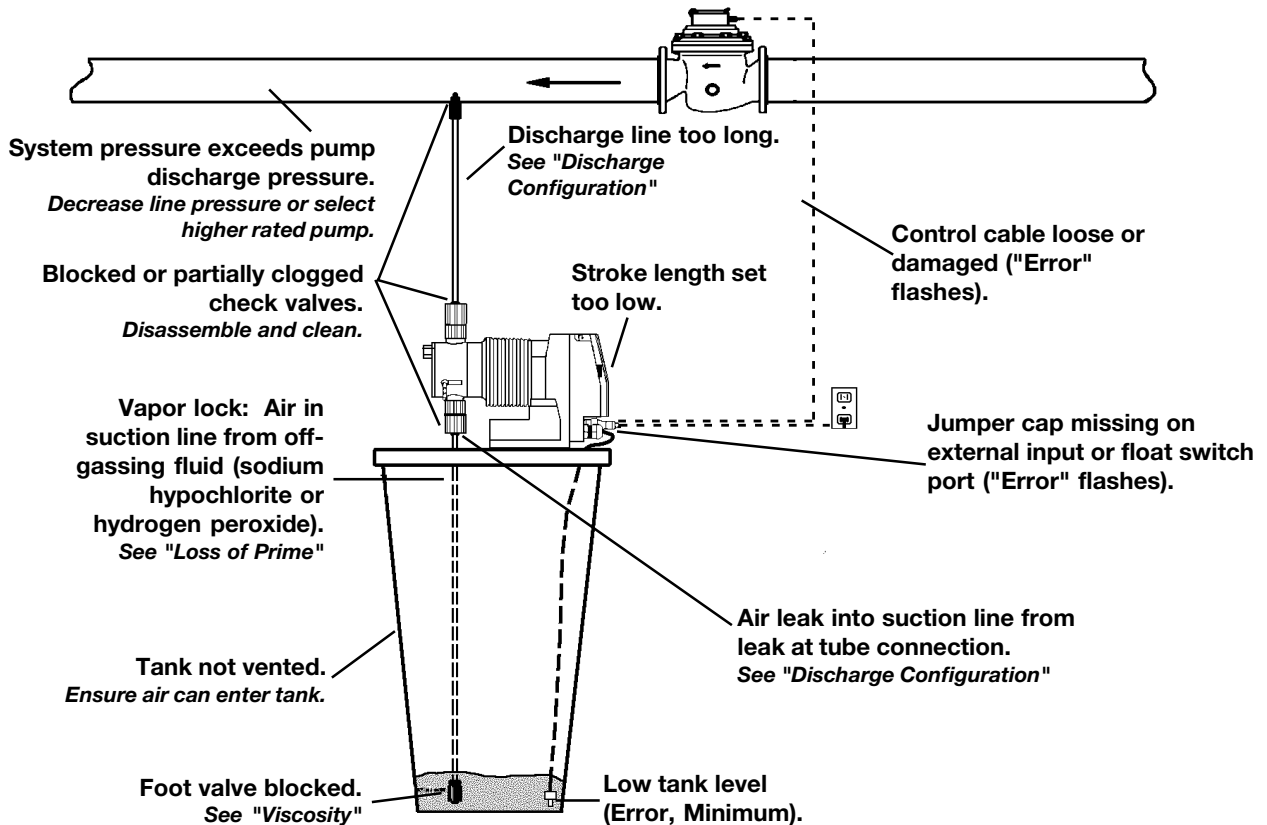
Suction lift min./max., or	ft. (m) _____
Positive suction head min./max., or	ft. (m) _____
Pressure in chemical tank	psig (bar) _____
Length of suction line	ft. (m) _____
Size (I.D.) of suction line	in. (mm) _____
Number of valves and fittings in suction line	_____

## Discharge conditions:

Back-pressure min./max.	psig (bar) _____
Discharge head min./max.	ft. (m) _____
Negative discharge head min./max.	ft. (m) _____
Length of discharge line	ft. (m) _____
Size (I.D.) of discharge line	in. (mm) _____
Number of valves and fittings in discharge line	_____

## System sketch

## TROUBLESHOOTING TYPICAL PROBLEMS



### Metering pumps are affected by:

- Pressure
- Viscosity
- Suction conditions (length, line size, configuration)
- Discharge conditions (length, line size, configuration)

### Take these precautionary measures

- Metering pumps should not be primed against pressure (open the bleed valve on the liquid end, where available, until product appears).
- Ensure all connections on suction side are "leak free," especially at the foot valve.
- If the chemical being pumped is compatible with water, it is helpful to prime the pump with water, if possible - this will help wet the pump seals when the pump is left idle for a long time.
- For metering pumps with high viscosity heads or with standard liquids with light duty springs, priming will take longer. It is sometimes easier to prime the metering pump with water.

### Pressure

#### Problem:

Metering pump capacities are greatly effected by pressure.

#### Solution:

Must be calibrated at your process pressure to determine capacity.

### Viscosity

#### Problem:

Products where viscosity increases with a decrease in temperature or aging are a potential problem for metering pumps. They can block up the foot valve and/or pump valves.

#### Solution:

The best solution is to keep the pump pumping continuously. If the pump will be off for an extended period of time it is best to FLUSH the pump head and foot valve.

#### Tip:

Where possible, install the metering pump in flooded suction (i.e. at the base of the tank).

#### Note:

Metering pumps require valve springs to ensure the valve balls seat properly.

# Troubleshooting Cont. . .

## Loss of Prime

### *Problem:*

Introduction of air on the suction side of the pump caused by missing or blocked foot valve, poor connection at suction valve and/or foot valve or pumping from an empty tank.

*Solution:* Check fittings for air leaks, check chemical tank level.

### *Problem:*

Pumping off-gassing products such as NaOCl, PAA or  $H_2O_2$ .

### *Solution:*

Try to use metering pumps with a manually adjustable bleed valve or, preferably, a self-degassing liquid end.

### *Problem:*

Using teflon tape on pump valves that are sealed by O-rings can prevent the valve from seating properly in pump head and may cause the operator to overtighten the valves thereby over-compressing the seals and causing leaks.

*Solution:* Only use thread type on NPT joints where the threads are the seating mechanism. O-ring sealed joints should not have thread tape or pipe dope.

## Siphoning

### *Problem:*

When installing a metering pump at the base of a tote/bulk tank, the head pressure of the container will force product through the pump - siphoning.

### *Solution:*

The surest way to prevent siphoning is to install a backpressure valve in the discharge line.

### *Note:*

The backpressure valve will also improve the pump consistency.

## Suction Configuration

- <sup>1</sup> Size the piping/tubing no smaller than the metering pump manufacturer's specification.
  - <sup>2</sup> When drawing from the top of a drum, a foot valve must be used.
  - <sup>3</sup> When draining from the base of a tote/bulk tank, a strainer is recommended to prevent sediment from entering the metering pump valves.
  - <sup>4</sup> When draining from the base of tote/bulk tank with the pump mounted mid-way up the tote/tank, a check valve should be installed (foot valve without ceramic weight).
  - <sup>5</sup> As the tank level gets below the pump height, the output capacity of the metering pump will change unless a ball check valve is installed.
- KEEP IT SIMPLE.

## Discharge Configuration

- <sup>1</sup> Size pipe/tubing no smaller than the metering pump manufacturer's specification.
- <sup>2</sup> Piping/tubing should be laid out such that the entire discharge line is full of product. If there are sags in tubing, there will be air at the highest point. As the amount of air varies, so will the capacity coming out of the injection valve.
- <sup>3</sup> Where a pulsation dampener is used, the bladder pressure must be maintained.

# DulcoFlex DFB Series

## One of the most versatile hose pumps ever built!

The **DulcoFlex DFB** is a versatile peristaltic pump, which incorporates both hose and tubing technology. The unique roller design offers a lubricant-free housing unlike typical shoe pumps. With pressures up to **116 psi** and flow rates to **385 gph**, the **DFB** is a great choice for pumping difficult fluid such as slurries and abrasive chemicals.

## Applications

- NaOCl
- Lime dosing
- FeCl<sub>3</sub>
- Mining
- Fruit Juices
- Flavoring
- Wine
- Ink
- Emulsions
- Detergents



## Features & Benefits

- ~~10, 13, 16, 19, 22 mm tubing pumps (30psi)~~
- 10, 13, 16 **22 mm** reinforced hose pumps (116psi)
- Flows to 385 gph (6.5 gpm)
- ~~Halar coating available for the toughest chemicals~~
- Disaster proof hose connections
- Roller Technology - Lower hose Stress
- Easy maintenance
- Reinforced hose
- Can run dry
- Self priming
- Great for solids
- Reversible
- No seals
- No valves

**ProMinent®**

Visit our XTRANET <[www.prominentxtranet.com](http://www.prominentxtranet.com)> to:

- sign up for our electronic newsletter
- download literature and manuals
- validate your product warranty

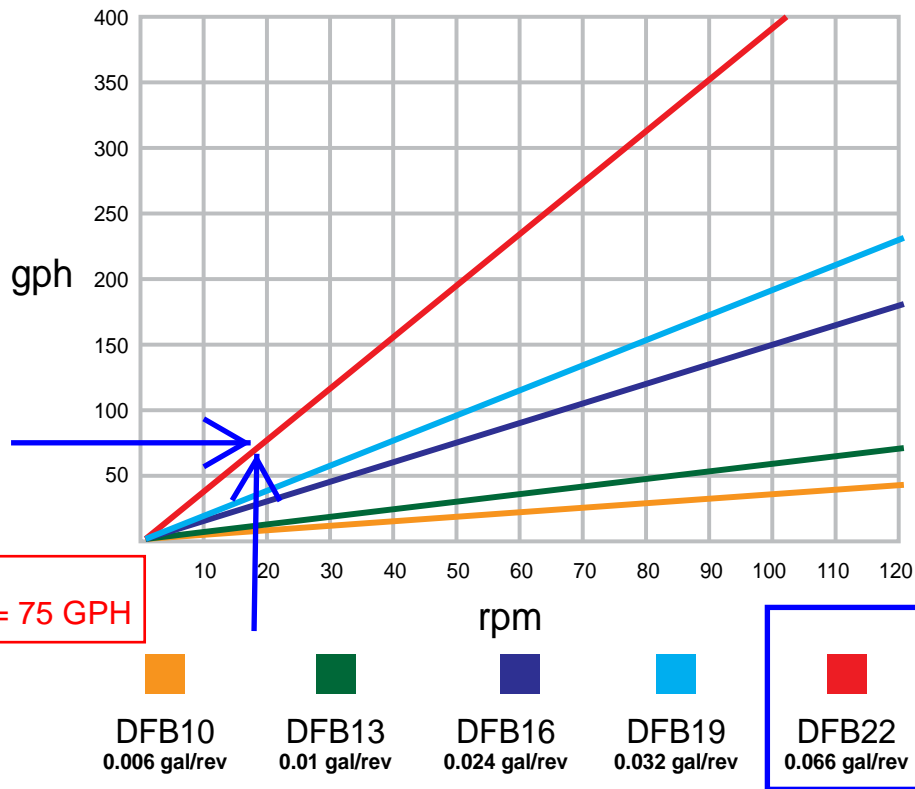
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**ProMinent®**



# DulcoFlex DFB Series

## DFB Series Flow Rates



## Pump Capacities

	DFB10	DFB13	DFB16	DFB19	DFB22
Compression	Roller	Roller	Roller	Roller	Roller
Connection	3/8"	3/8"	3/4"	1"	1"
Capacity gal/rev	0.006	0.01	0.024	0.032	0.066
Max Flow gph	52	84	210	270	385
Reinforced Hoses	Natural Rubber Nitrile EPDM Hypalon Natural Rubber Food Grade Nitrile Food Grade			Not Available in this model.	Same as DFB10-16 models.
Max Pressure Reinforced Hose	116 psi	116 psi	116 psi	N/A	116 psi
Tubing	Norprene	Norprene	Norprene Tygon	Norprene Tygon	<del>Norprene</del>
Max Pressure Tubing	30 psi	30 psi	30 psi	30 psi	<del>30 psi</del>

# ProMinent®

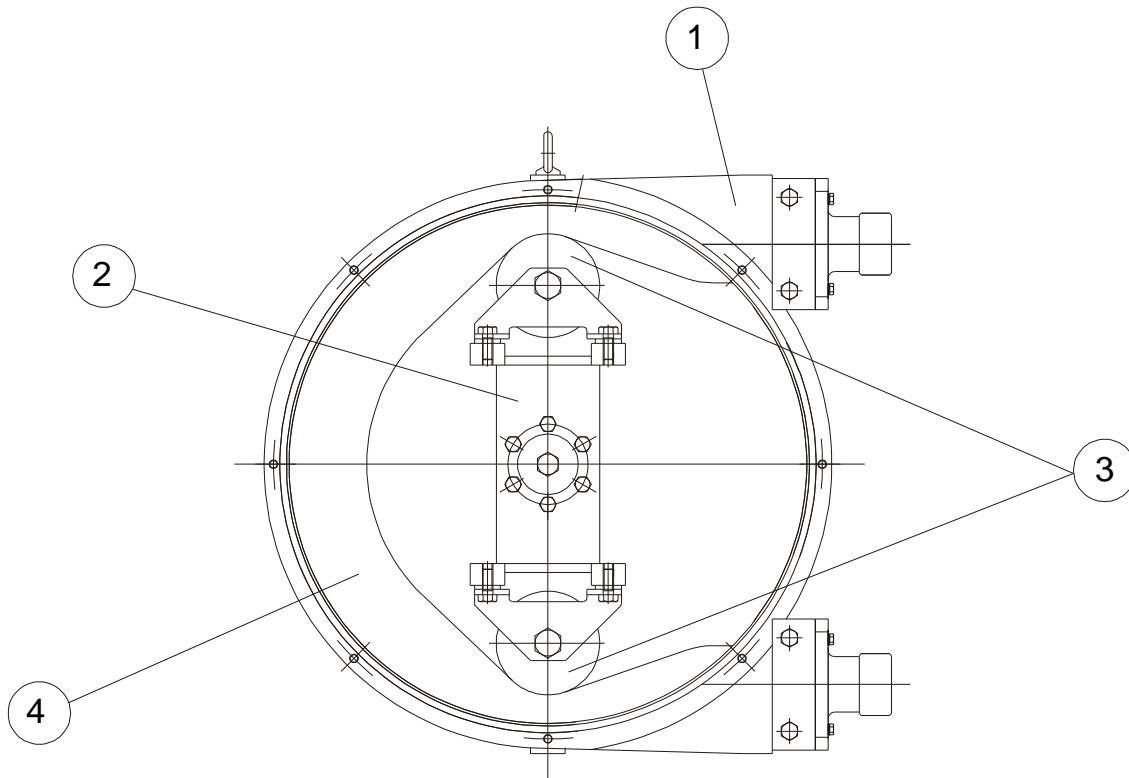
ProMinent Fluid Controls, Inc. (US)  
 136 Industry Drive  
 Pittsburgh, PA 15275-1014  
 Tel: (412) 787-2484  
 Fax: (412) 787-0704  
 eMail: sales@prominent.us  
 www.prominent.us

ProMinent Fluid Controls Ltd. (Canada)  
 490 Southgate Drive  
 Guelph, ON N1G 4P5  
 Tel: 1-888-709-9933 | (519) 836-5692  
 Fax: (519) 836-5226  
 eMail: sales@prominent.ca  
 www.prominent.ca

## PERISTALTIC PUMP

- **Construction of the pump.**

As shown in the figure below, the pump unit is a very simple design, robust and with very few moving parts.

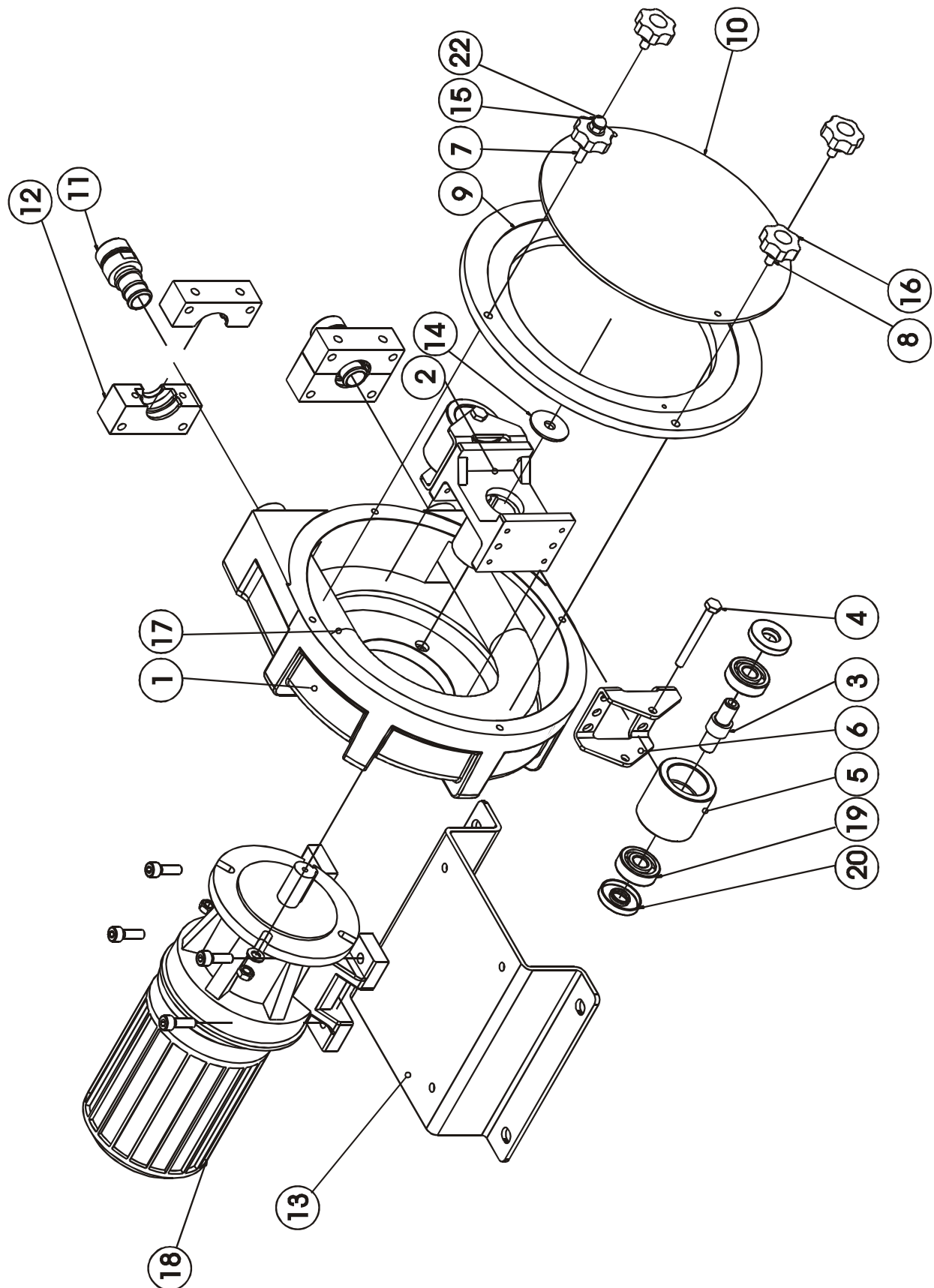


The outer casing (1) terminates with threaded connections. Inside the casing are found the rotor (2), completed with two rollers (3). As this is revolving it compresses the reinforced tube (4) and in this way generates a pumping action. A change in the direction of rotation will give rise to a change in direction of the pumped fluid.

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## INSTALLATION

- Installation should normally be made in a well ventilated area away from heat sources. If it is necessary to place the pump outside it should be provided with a cover to protect it from sunlight and inclement weather.



ITEM	DESCRIPTION	Q	CODE	Prom Part #	MATERIAL
1	Pump casing	1	113.00.01	7761321	
2	Rotor	1	113.00.02	7761322	
3	Shaft roller	2	113.00.03	7761323	
4	Screw roller shaft	2	113.00.04	7761324	
5	Roller standard	2	113.00.05	7761325	
	Roller for thermoplastic hose	2	113.00.06		
6	Roller support	2	113.00.07	7761326	
7	Stud long	1	102.00.07	7761074	
8	Stud short	3	102.00.14	7761077	
9	Cover metallic part	1	113.00.08	7761327	
10	Cover plastic part	1	113.00.09	7761328	
11	Connection INOX-BSP	2	113.00.10	NA	
	Connection PP-BSP	2	113.00.11	NA	
	Connection PVDF-BSP	2	113.00.12	NA	
	Connection SS-NPT	2	113.00.13	7761329	
	Connection PP-NPT	2	113.00.14	7761330	
	Connection PVDF-NPT	2	113.00.15	NA	
	Connection DIN	2	113.00.16	NA	
	Connection SMS	2	113.00.17	NA	
	Connection TRI-CLDFB	2	113.00.18	7761332	
12	Press flange standard	2	113.00.19	7761333	
	Press flange thermoplastic hose	2	113.00.20	7761334	
13	Base plate	1	113.00.21	7761335	
	Base plate S.S.	1	113.00.22	7761336	
14	Washer rotor	1	113.00.23	7761337	
15	Press pommel	1	102.00.25	7761084	
16	Press pommel blind	3	102.00.26	7761085	
17	Hose NR	1	113.00.24	1037175	
	Hose NBR	1	113.00.25	1037176	
	Hose NBR-A	1	113.00.26	1037180	
	Hose EPDM	1	113.00.27	1037178	
	Hose Norprene	1	113.00.28	1037181	
	Hose NR-A	1	113.00.29	1037179	
	Hose HYPALON	1	113.00.30	1037182	
18	Driver	1			
19	Ball bearing roller	4	113.00.31	7761338	
20	Lip seal roller	4	113.00.32	7761339	

## DECLARATION OF CONFORMITY

# INSTRUCTION MANUAL

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## DulcoFlex Peristaltic Pumps: DFB22

This manual forms an integral part of the pump and must accompany it until its demolition. The peristaltic pump is a machine destined to work in industrial areas and as such the instruction manual must form part of the legislative dispositions and the applicable technical standards and does not substitute any installation standard or eventual additional standard.

### GENERAL SAFETY WARNING

Pumps are machines that due to their functioning under pressure and moving parts can present dangers.

- Improper use
- Removing the protections and/or disconnecting the protection device
- The lack of inspections and maintenance

### CAN CAUSE SERIOUS DAMAGE OR INJURY

The person in charge of safety should therefore guarantee that

- The pump is transported, installed, put in service, used, maintained and repaired by qualified personnel who should therefore possess:

- Specific training and sufficient experience.
- Knowledge of the technical standards and applicable laws.
- Knowledge of the general national and local safety standards and also of installation.

Any work carried out on the electrical part of the pump should be authorised by the person responsible for safety. Given that the pump is destined to form part of an installation, it is the responsibility of whoever supervises the installation to guarantee absolute safety, adopting the necessary measures of additional protection.

**INDEX**

	Page N°
Cover	01
Index	02
Identification record of equipment	03
Transport, storage and elevation	04
General safety standards	05
General description	07
Installation	08
Roller pressure adjustment	08
Work conditions	09
Performance curves	10
Checks before starting up the machine	11
Maintenance	11
Reposition of the hose – dismantling	12
Reposition of the hose – mounting	12
Problems, causes and solutions	13
Diagram of components parts	14
Spare parts code	15
Certificate of approval	17
Guarantee	18

**IDENTIFICATION RECORD OF EQUIPMENT**

MANUFACTURER:

IMPORTER / SUPPLIER:

MODEL OF PUMP:

DFB22

SERIAL NUMBER:

DRIVER MARK:

DRIVER POWER / SPEED:

REDUCER MARK &amp; MODEL:

REDUCTION RATIO:

FIXED SPEED MOTOR GEAR REDUCER:

MECHANICAL VARIATOR + GEAR REDUCER:

GEAR REDUCER WITH ELECTRONIC INVERTER:

WORK SPEED:

MAXIMUM SPEED:

MINIMUM SPEED:

WORKING MANOMETRIC PRESSURE:

MAXIMUM DESIGN PRESSURE:

116 PSI

HOSE MATERIAL:

CONNECTIONS MATERIAL:

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## TRANSPORT, STORAGE and ELEVATION

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### TRANSPORT

- The pump is protected by a wood packaging.
- The packaging materials are recyclable.

### STORAGE

- Avoid areas open to inclement weather or excessive humidity.
- For storage periods of longer than 60 days, protect the coupling surfaces ( cIDFBs, reducers, motors ) with adequate anti-oxidant products.
- Spare tubes should be stored in a dry place away from the direct light.

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## GENERAL SAFETY STANDARDS

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- The instructions of this manual, whose inobservance is determined as a failure to meet safety standards, are identified by this symbol



- The instructions of this manual, whose inobservance compromises electrical safety, are identified by this symbol.

WARNING!

- The instructions of this manual, whose inobservance compromises the correct working of the pump, are identified with this symbol.



Do not start the pump without first having installed the front cover.



For any manipulation of the equipment, it is necessary to make certain that the pump is stopped and the electricity supply disconnected.



Changing the hose should be done with the pump stopped.

WARNING!

Do not exceed the nominal pressure, speed or temperature of the pump, or use the pump for applications other than that originally planned without first consulting the manufacturer or distributor.

**WARNING!**

Cleaning the pipe, including the hose, should be done with fluids compatible with the mentioned drive pump and at its maximum temperature recommended.

**WARNING!**

Do not start the pump without it being properly secured to the floor.



Do not carry out any maintenance operations or dismantle the pump without first making sure that the pipes are not under pressure and are empty or isolated.



The start system of the motor should be provided with a direction inverter, stop-go button and emergency stop button (together with the pump), in such a way that the pump can be manipulated with total safety.



The DulcoFlex pump is a positive displacement pump and therefore susceptible to a closed valve (dead headed) condition. Installing a pressure relief valve on the discharge piping can help prevent damage caused by a “dead headed” condition.



Check the turning direction of the pump, as it is reversible it could generate pressure in the suction and compromise the safety of the installation. The circulation of the fluid should be in the same direction as the turning direction of the pump as seen from the inspection plate situated on the front cover.



Since hose/tube life is so unpredictable, it may be necessary to equip the pump with a moisture sensing device that can shut the pump down in the event of a hose/tube failure.



For C.I.P., or S.I.P. process, or similar, it's necessary to contact with the manufacturer, because it's necessary to use a determinate installation, and cleaning conditions.

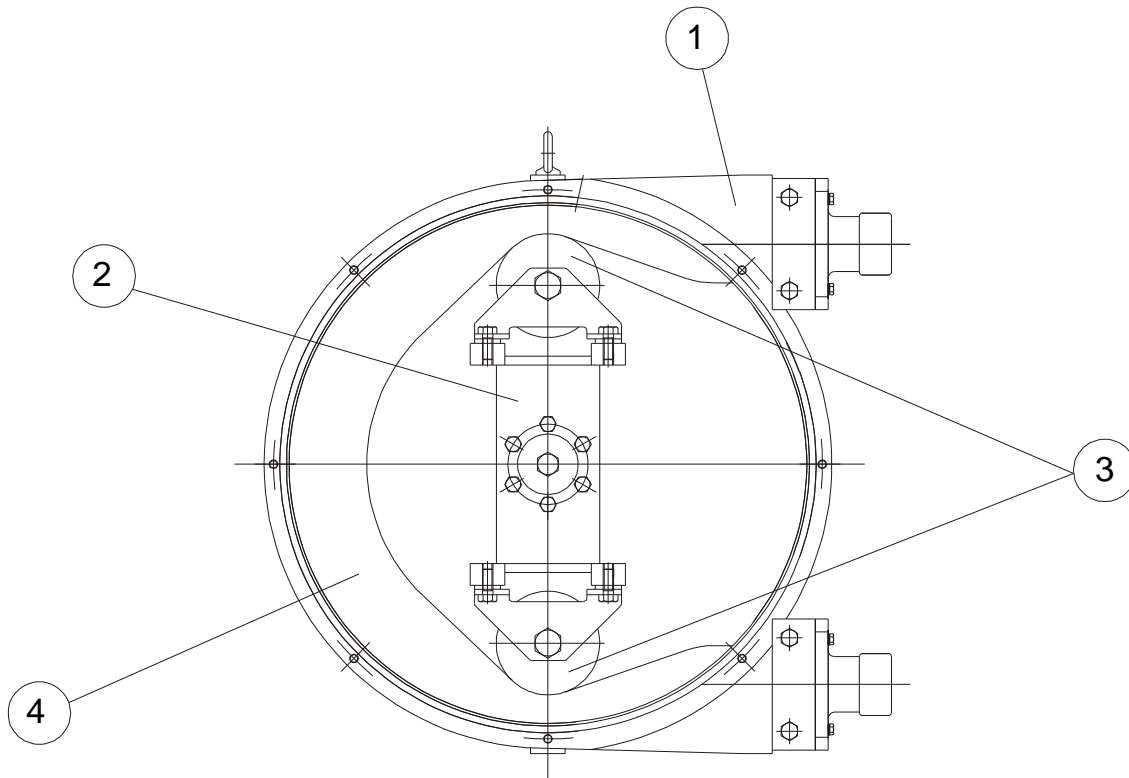
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## GENERAL DESCRIPTION

## PERISTALTIC PUMP

- **Construction of the pump.**

As shown in the figure below, the pump unit is a very simple design, robust and with very few moving parts.



The outer casing (1) terminates with threaded connections. Inside the casing are found the rotor (2), completed with two rollers (3). As this is revolving it compresses the reinforced tube (4) and in this way generates a pumping action. A change in the direction of rotation will give rise to a change in direction of the pumped fluid.

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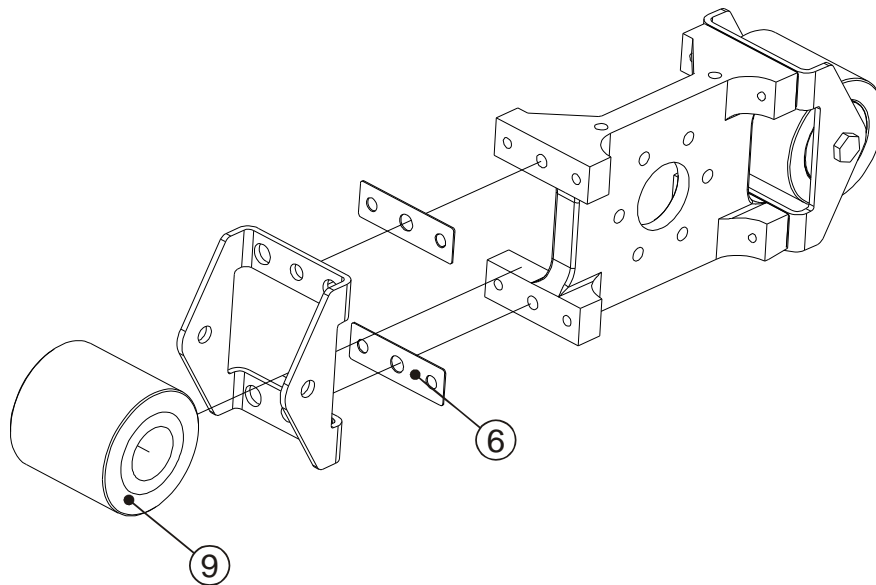
## INSTALLATION

- Installation should normally be made in a well ventilated area away from heat sources. If it is necessary to place the pump outside it should be provided with a cover to protect it from sunlight and inclement weather.

- The positioning of the pump should allow easy access for all kinds of maintenance operations.
- **Suction:** The pump should be as near as possible to the supply of liquid so that the suction pipe is as short and straight as possible. The suction pipe should be perfectly airtight and made of suitable material so that it does not collapse due to the internal drop in vacuum. The minimum diameter should be similar to that of the tubular element. With viscous fluids a larger diameter is recommendable. (Consult manufacturer or distributor). The pump has automatic suction and does not need an inlet. The pump is reversible, and so the suction connection can be either one of the two. (Normally the one which adapts itself physically better to the installation would be chosen). It is recommendable to use a flexible connection between the piping and the collars of the pump in order to avoid the transmission of vibration to the piping.
- **Impulsion:** To reduce power being absorbed, use the straightest and shortest piping possible. The diameter should be the same as the nominal diameter of the pump, excepting precise calculations of load losses. With viscous fluids a bigger diameter is needed. (Consult the manufacturer or distributor). Connecting the fixed piping to the pump with a length of flexible pipe facilitates maintenance and avoids vibrations and loads on the pump. Fix the piping firmly. The impulsion is slightly pulsatory: To avoid such effect, it is advisable to install adequate pulsation dampeners. (See accessories.)

## ROLLER PRESSURE ADJUSTMENT

The peristaltic pump, includes a shims ( Figure 6 ), that are used to adjust the exact pressing distance of the roller ( figure 9 ).



The shims are installed from factory to work at the work conditions indicated ( in function of the speed and the work pressure), and following the next tables:

INSTRUCTION MANUAL	<b>ProMinent®</b>
DFB22	

DFB22 ( Number of shims of 0.5 mm. )

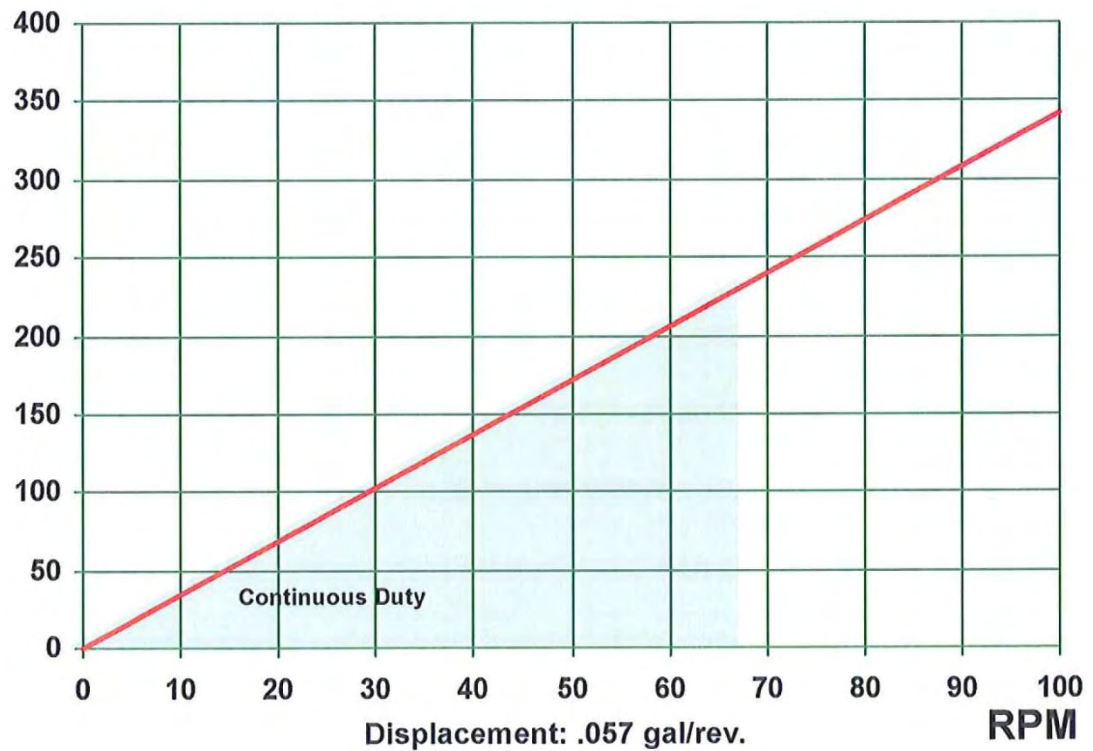
rpm	0-19	20-39	40-59	60-79	80-99
PSI					
7.25	2	2	1	1	1
29	2	2	2	2	2
58	3	3	2	2	2
87	3	3	3	--	--
116	4	3	--	--	--

## WORK CONDITIONS

There are a limits of temperatures and pressures, in function of the hose selected. Those limits are the next:

MATERIAL	TEMPERATURE MIN. (°F)	TEMPERATURE MAX. (°F)	AMBIENT TEMPERATURE MIN. (°F)	PRESSURE MAX. (PSI)
NR	-4	176	-40	116
NBR	14	176	-40	116
EPDM	14	176	-40	116
NR-A	14	176	-40	116
NBR-A	14	176	-40	116

## PERFORMANCE CURVES

**GPH****DFBa22 Performance Curve**

Maximum Pressure for Continuous Duty	
RPM	PSI
28	116
48	58
64	29

**DFB22**

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## CHECKS BEFORE SWITCHING ON THE PUMP

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Check that the pumping equipment has not suffered any damage during transportation or storage, any damage should be notified to the supplier immediately.

Check that the network voltage is suitable for the motor.

Make sure that the hose is suitable for the fluid to be pumped and that it will not be chemically affected, check also that the temperature of the fluid does not exceed that recommended.

If the hose is in a resting position, then the pump has come from storage or transportation; now is the moment to install the second roller. **Do not switch on the pump without the front cover being correctly installed.**

**Lubrication.** Check that the drive pump, the hose and rollers are correctly greased. The specially formulated grease can be obtained from the authorised distributor.

Check that the protectors of the moving parts are correctly assembled.

Check that the thermal protector corresponds with that of the values on the plate on the motor.

Check that the direction of rotation is the desired one. (rotation test).

Check that the optional electrical components are connected to the control panel and test that they function correctly.

In cases of doubt of the valuation of discharge pressure (e.g. high viscosity), mount a pressure gauge on the discharge.

Check in predicted working conditions that the values of flow, pressure and absorbed power of the motor correspond to the project.

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## MAINTENANCE

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Any work carried out on the pump must be done when the pump is stationary and disconnected from the electricity supply.

### Lubrication

Check that the rollers and the hose are correctly greased. Check it every 200 hours of work. Add lubricant as necessary.

Check that the lubricant level in the gear reducer is correct, and carry out periodic changes of lubricant according to the maintenance manual.

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## REPOSITIONING OF HOSE - DISMANTLING

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- First, all valves must be closed to prevent losses of the product.
- Disconnect the suction and discharge pipes.
- Dismantling of the suction/discharge connections. Dismantling one roller. With the front cover mounted, start the pump 180° until the other roller don't compress the hose.
- Dismantling the second roller ( OPTIONAL ).
- Dismantling the connections that are on the top of the hose, and the close rings.
- Dismantling the hose.
- To see repositioning of the hose – mounting.

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## REPOSITIONING OF HOSE - MOUNTING

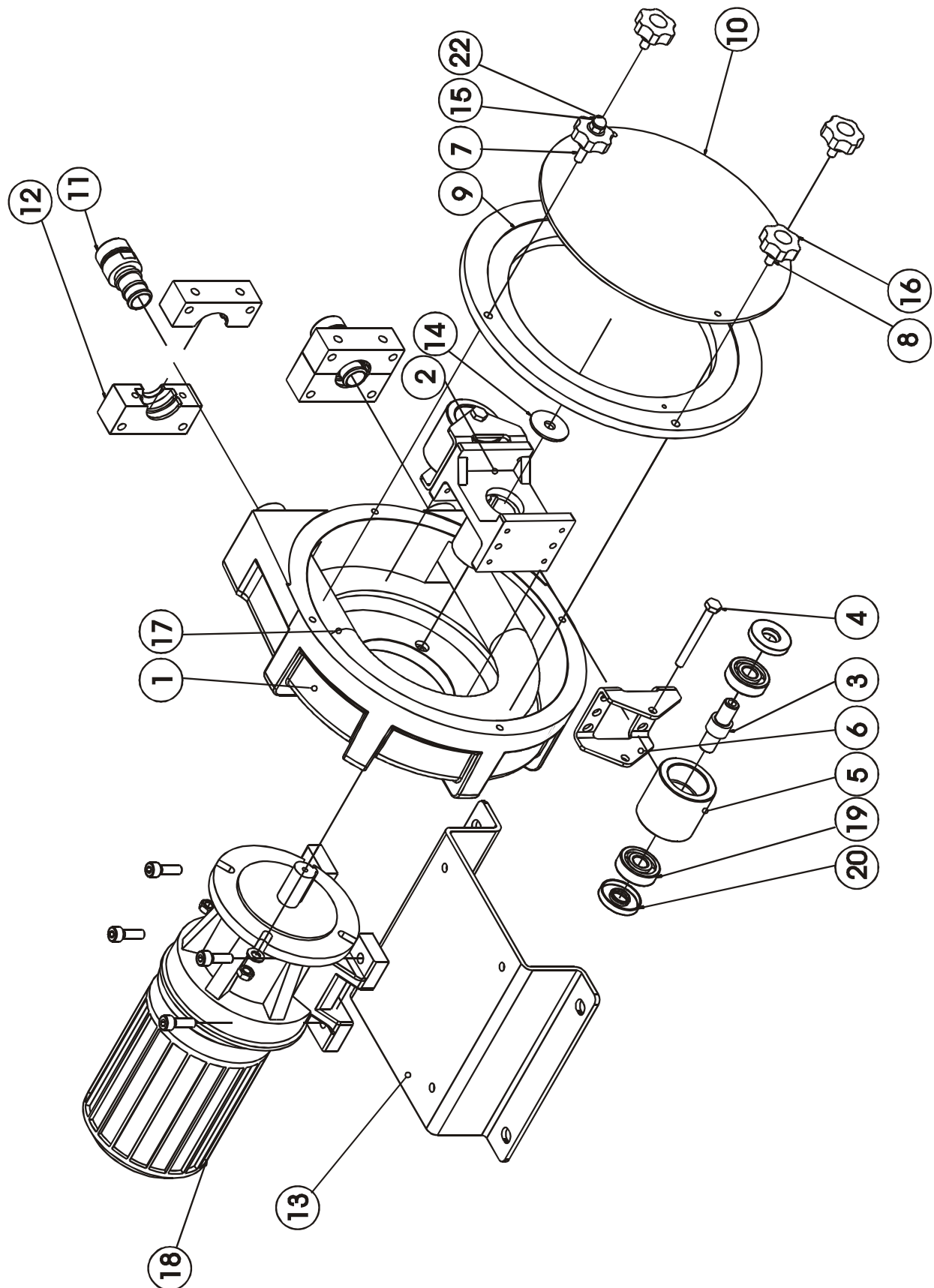
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- Clean the internal surfaces of the pump body. Lubricate the internal faces of the pump body where there could be friction with the hose. To carry out this operation correctly it is necessary to remove the front cover.
- Insert the connections in each hose end.
- Install the hose in the pump body, lubricating with grease the hose and the rollers.
- Mount the tightening collars that fasten the hose and its connections to the pump body.
- Fit the front cover ( only with 2 screws ).
- Start the driver until position the rotor in the correct position to fit the second roller.
- Dismantling the front cover.
- Fit the second roller.
- Fit the front cover.
- Connect suction/discharge pipes.



## PROBLEMS, CAUSES AND SOLUTIONS

PROBLEM	POSSIBLE CAUSE	SOLUCIÓN
<b>Elevated Temperature</b>	Hose with no lubricant Elevated temperature of product Poor or bad suction conditions  Excessive pipe tightening  Excessive pumping speed	Use original lubricant Reduce pumping temperature Check there are no obstructions Recalculate sections and lengths Check roller pressure adjustment  Reduce velocity of pump
<b>Reduction of Capacity/pressure</b>	Suction or impulsion valve closed. Hose insufficiently compressed  Rupture of the hose (the product leaks to the casing) Partial obstruction of suction piping Insufficient product amount in suction reservoir Insufficient diameter of suction piping Excessive length of suction pipe High viscosity of product  Entry of air via the suction connections High pulsation on suction	Open valves Check roller pressure adjustment  Replace drive hose Clean piping Fill or stop Increase section length/reduce pump speed Shorten suction piping Reduce viscosity Increase section length of piping Confirm that the pump is suitable  Tighten connections and accessories Install pulsation dampener to discharge Reconsider application (speed etc.)
<b>Vibrations in pump and piping</b>	The piping is not correctly fixed together Excessive pumping speed  Insufficient diameter of piping Bedplate of pump loose Elevated pulsation of pump	Refix piping Reduce the speed of the pump  Increase pipe diameter Fix the bedplate firmly Install pulsation dampener to discharge
<b>Short life of the hose</b>	Chemical attack  High speed of pump High pumping temperature High working pressure  Abnormal elevation of temperature Unsuitable lubricant Insufficient quantity of grease Cavitation of the pump	Confirm compatibility of the hose with the pumped fluid and the cleaning fluid Reduce speed of pump Reduce temperature of product Reduce speed of pump Increase section diameter of piping Check roller pressure adjustment Use original lubricant Top up lubricant Reconsider suction conditions
<b>Stretching of the hose inside the pump</b>	Insufficient grease High suction pressures (>3 Bar) Hose full of sediment Brackets insufficiently tightened	Top up lubricant Reduce suction pressure Clean hose Retighten brackets
<b>The pump does not start</b>	Insufficient starter power Insufficient power from frequency convertor    Blockage in the pump	Increase starter power Increase power Check that the voltage is adequate Do not drop below a frequency of 10Hz (confirm this point with the distributor) The starting up will occur at at least 10Hz. Check there are no obstructions in the pipe



ITEM	DESCRIPTION	Q	CODE	Prom Part #	MATERIAL
1	Pump casing	1	113.00.01	7761321	
2	Rotor	1	113.00.02	7761322	
3	Shaft roller	2	113.00.03	7761323	
4	Screw roller shaft	2	113.00.04	7761324	
5	Roller standard	2	113.00.05	7761325	
	Roller for thermoplastic hose	2	113.00.06		
6	Roller support	2	113.00.07	7761326	
7	Stud long	1	102.00.07	7761074	
8	Stud short	3	102.00.14	7761077	
9	Cover metallic part	1	113.00.08	7761327	
10	Cover plastic part	1	113.00.09	7761328	
11	Connection INOX-BSP	2	113.00.10	NA	
	Connection PP-BSP	2	113.00.11	NA	
	Connection PVDF-BSP	2	113.00.12	NA	
	Connection SS-NPT	2	113.00.13	7761329	
	Connection PP-NPT	2	113.00.14	7761330	
	Connection PVDF-NPT	2	113.00.15	NA	
	Connection DIN	2	113.00.16	NA	
	Connection SMS	2	113.00.17	NA	
	Connection TRI-CLDFB	2	113.00.18	7761332	
12	Press flange standard	2	113.00.19	7761333	
	Press flange thermoplastic hose	2	113.00.20	7761334	
13	Base plate	1	113.00.21	7761335	
	Base plate S.S.	1	113.00.22	7761336	
14	Washer rotor	1	113.00.23	7761337	
15	Press pommel	1	102.00.25	7761084	
16	Press pommel blind	3	102.00.26	7761085	
17	Hose NR	1	113.00.24	1037175	
	Hose NBR	1	113.00.25	1037176	
	Hose NBR-A	1	113.00.26	1037180	
	Hose EPDM	1	113.00.27	1037178	
	Hose Norprene	1	113.00.28	1037181	
	Hose NR-A	1	113.00.29	1037179	
	Hose HYPALON	1	113.00.30	1037182	
18	Driver	1			
19	Ball bearing roller	4	113.00.31	7761338	
20	Lip seal roller	4	113.00.32	7761339	

## DECLARATION OF CONFORMITY

**The company:**

Declares under its own sole responsibility that the next industrial peristaltic pump:

**Model: DFB22**

**Serial number:**

☐ **CE DECLARATION OF CONFORMITY (Ann. II.A, 98/37/CE)**

The pump is conform to the safety requirements according to the 98/37/CE norms and amendments.

☐ **MANUFACTURER DECLARATION ( Ann. II.B, 98/37/CE )**

The pump cannot be operated before the machine in which is assembled the pump, will be declared in conformity with the safety requirements according to the 98/37/CE norms and amendments.

☐ **FOOD PRODUCTS-CONTACT SUITABILITY DECLARATION**

The pump is made with materials suitable to come in contact with food grade product according to the 89/109/EEC norms and amendments.

**on:**

The technical Director.

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## **GUARANTEE**

- The contractor shall obtain from the manufacturer its warranty that the equipment shall be warranted for a period of one (1) year from the date of start-up or 18 months from signed delivery acknowledgement, whichever comes first, to be free from defects in materials and workmanship. This guarantee does not include the hose or lubricant as these are elements that have normal function wear, irrespective of their duration.
- This guarantee is valid as long as the equipment functions within the parameters indicated in the technical information card supplied with every pump or on subsequent changes authorised.
- This guarantee includes materials and work but not the transportation of materials to or from our warehouses, being necessary to do so arising from the necessities of the client, the corresponding costs of displacement and expenses will be charged.

# **BALDOR® • *RELIANCE***

## **Product Information Packet**

### **IDXM7006**

**.5HP,1750RPM,3PH,60HZ,56C,X3516M,XPFC,F1**

Product Detail										
Revision:	T	Status:	PRD/A	Change #:		Proprietary:	No			
Type:	AC	Prod Type:	3516M	Elec. Spec:	35WGT203	CD Diagram:	CD0005			
Enclosure	XPFC	Mfg Plant:		Mech Spec:	35M998	Layout:	35LYM998			
Frame:	56C	Mounting:	F1	Poles:	04	Created Date:				
Base:	RG	Rotation:	R	Insulation:	F	Eff. Date:	11-08-2007			
Leads:	9#18	Literature:		Elec. Diagram:		Replaced By:				
Nameplate NP0887XP										
NO.		TEMP CODE	T3C							
SPEC.	35M998T203G1	MX RPM	2700							
CAT.NO.	IDXM7006	INV.TYPE	PWM							
HP	.5	C HP FR	60	C HP TO	90					
VOLTS	230/460	CT HZ FROM	6	CT HZ TO	60					
AMPS	1.6/.8	VT HZ FROM	6	VT HZ TO	60					
RPM	1750	DES	B	WK2	.09	PH	3	CL	F	
HZ	60	SER.F.	1.00	NOM.EFF.	82.5	SL HZ	1.8			
MAG CUR	1/.5									
RATING	40C AMB-CONT									
FRAME	56C									
S/N		BLANK								

Parts List			
Product ID	Description	Quantity	List Price
SA028180	SA 35M998T203G1	1.000	617.00
RA024228	RA 35M998T203G1	1.000	486.00
35CB3001A01SP	EXPL CONDUIT BOX, MACH, 1/2" PIPE TAP LE	1.000	36.00
11XT0832G06	8-32 X 3/8 TY 23 TAP GRN. X	1.000	4.00
HW3001A01	D3019 BRASS WASHER(STIMP)	1.000	3.00
35EP3700A01SP	FR ENDPLATE, XPFC	1.000	129.00
HW5100A03SP	WAVY WASHER (W1543-017)	1.000	3.00
35EP3702A01SP	PU EP-205 BRG-35X-56C-143-5TC	1.000	159.00
51XN1032A20	10-32 X 1 1/4 HX WS SL SR	2.000	3.00
HA3013A01	1/2-20X5/8 SPL.HX BOLT (WELKER)	2.000	5.00
HW3021C06	3/32 DI X .625 PIN (F/S)	2.000	3.00
XY3118A12	5/16-18 HEX NUT DIRECTIONAL SERRATION	4.000	3.00
51XB1214A16	12-14X1.00 HXWSSLD SERTYB	1.000	3.00
35FH4005A01SP	IEC FH NO GREASER W/AUTOPHORETIC PRIMER	1.000	28.00
51XW1032A06	10-32 X .38, TAPTITE II, HEX WSHR SLTD S	3.000	4.00
35CB3500A01SP	CONDUIT BOX LID, MACH	1.000	21.00
10XN2520A16	1/4-20 X 1 HEX HEAD CAP SCR, ZINC PLATED	4.000	4.00
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000	3.00
HW2501D13SP	KEY, 3/16 SQ X 1.375	1.000	3.00
HA7000A04	KEY RETAINER 0.625 DIA SHAFTS	1.000	3.00
85XU0407A04	#4-7 X 1/4 DRIVE PIN	8.000	3.00
NP0018	NP- XP CONDUIT BOX	1.000	3.20
MJ1000A02	GREASE, POLYREX EM EXXON	0.050	12.00
35FN3002A05SP	EXTERNAL FAN, PLASTIC, FOR .637 DIA JOUR	1.000	27.00



Parts List (continued)			
Product ID	Description	Quantity	List Price
MG1025Z20	ACTIVATOR WILKOFAS 060.32	0.010	261.00
MG1025G29	PAINT 789.205 DARK GRAY METALLIC (USE W/	0.017	404.00
HA3104A06	THRUBOLT 5/16-18 X 8.50 OHIO ROD	4.000	3.00
LB1119	WARNING LABEL	1.000	3.00
LB1125C01	STD (STOCK) CARTON LABEL BALDOR WITH FLA	1.000	3.00
LC0145B01	CONNECTION LABEL	1.000	3.00
NP0887XP	UL/CSA, CLI GP-D, CLII GP-F&G, INV	1.000	
36PA1000	PACK GROUP W/LB5001	1.000	21.00

## Performance Data at 460V, 60Hz, 0.5HP (Typical performance - Not guaranteed values)

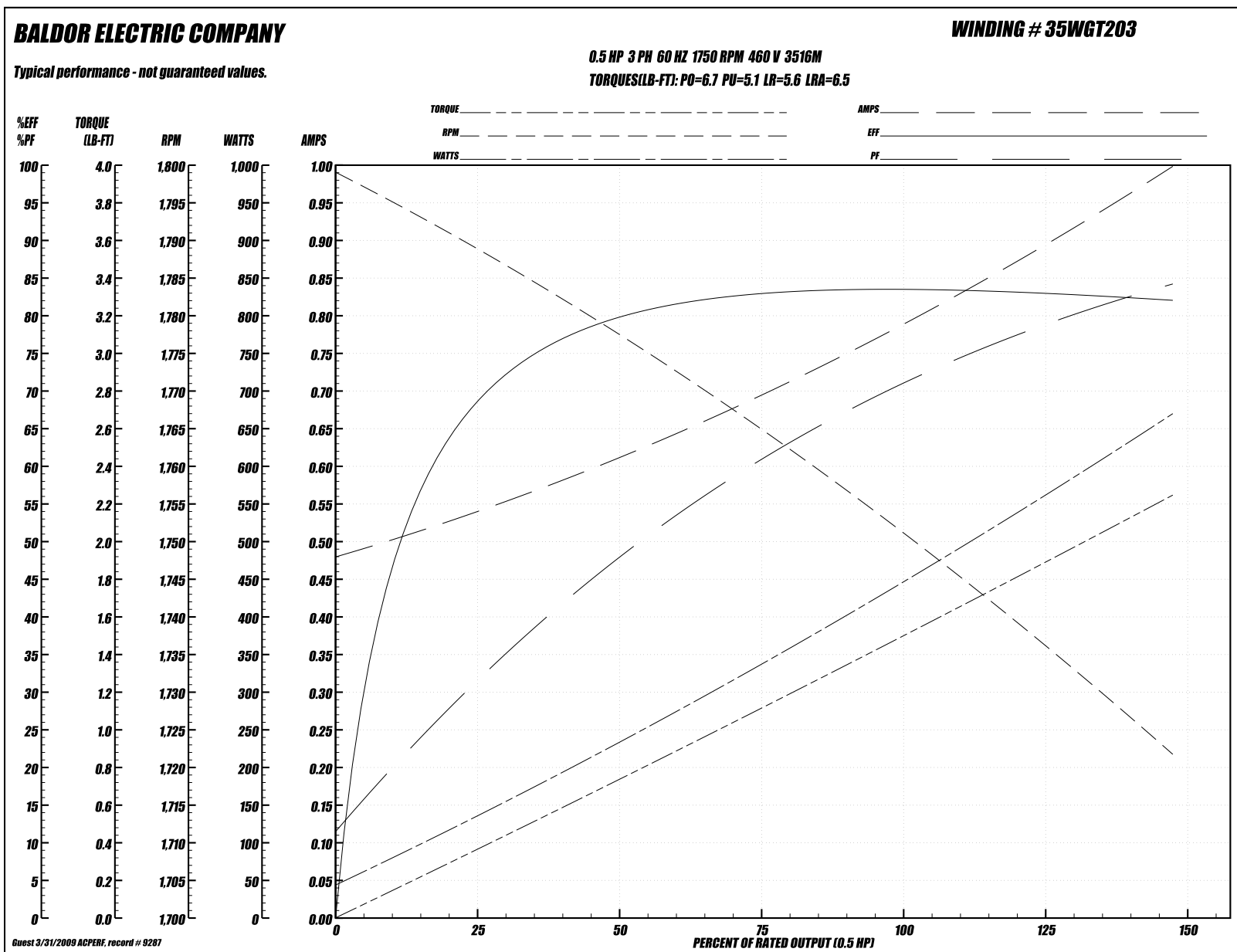
## General Characteristics

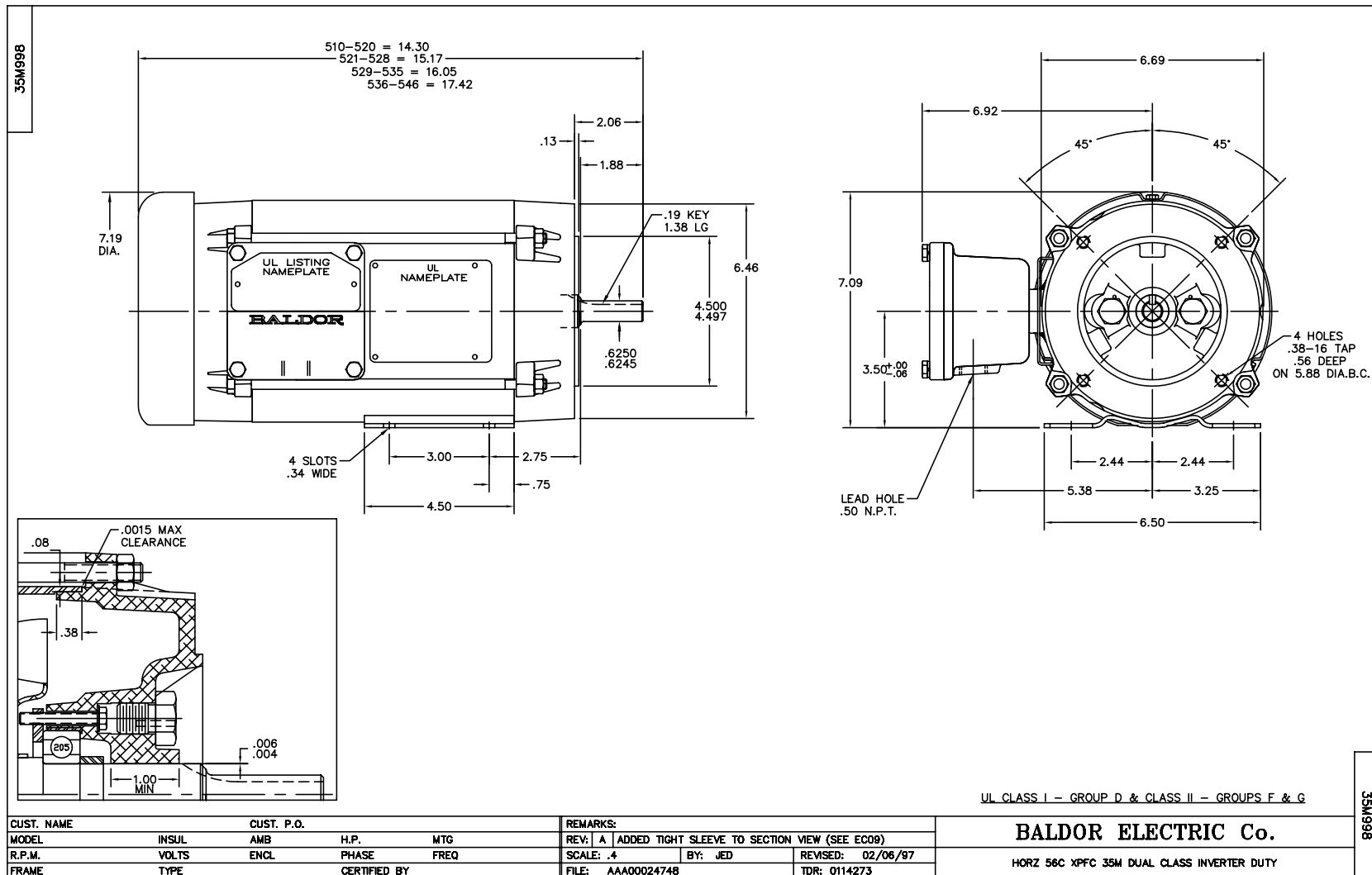
Full Load Torque:	1.5 LB-FT	Start Configuration:	DOL
No-Load Current:	0.5 Amps	Break-Down Torque:	6.7 LB-FT
Line-line Res. @ 25°C.:	34.1 Ohms A Ph / 0.0 Ohms B Ph	Pull-Up Torque:	5.1 LB-FT
Temp. Rise @ Rated Load:	25°C	Locked-Rotor Torque:	5.6 LB-FT
Temp. Rise @ S.F. Load:	0°C	Starting Current:	6.5 Amps

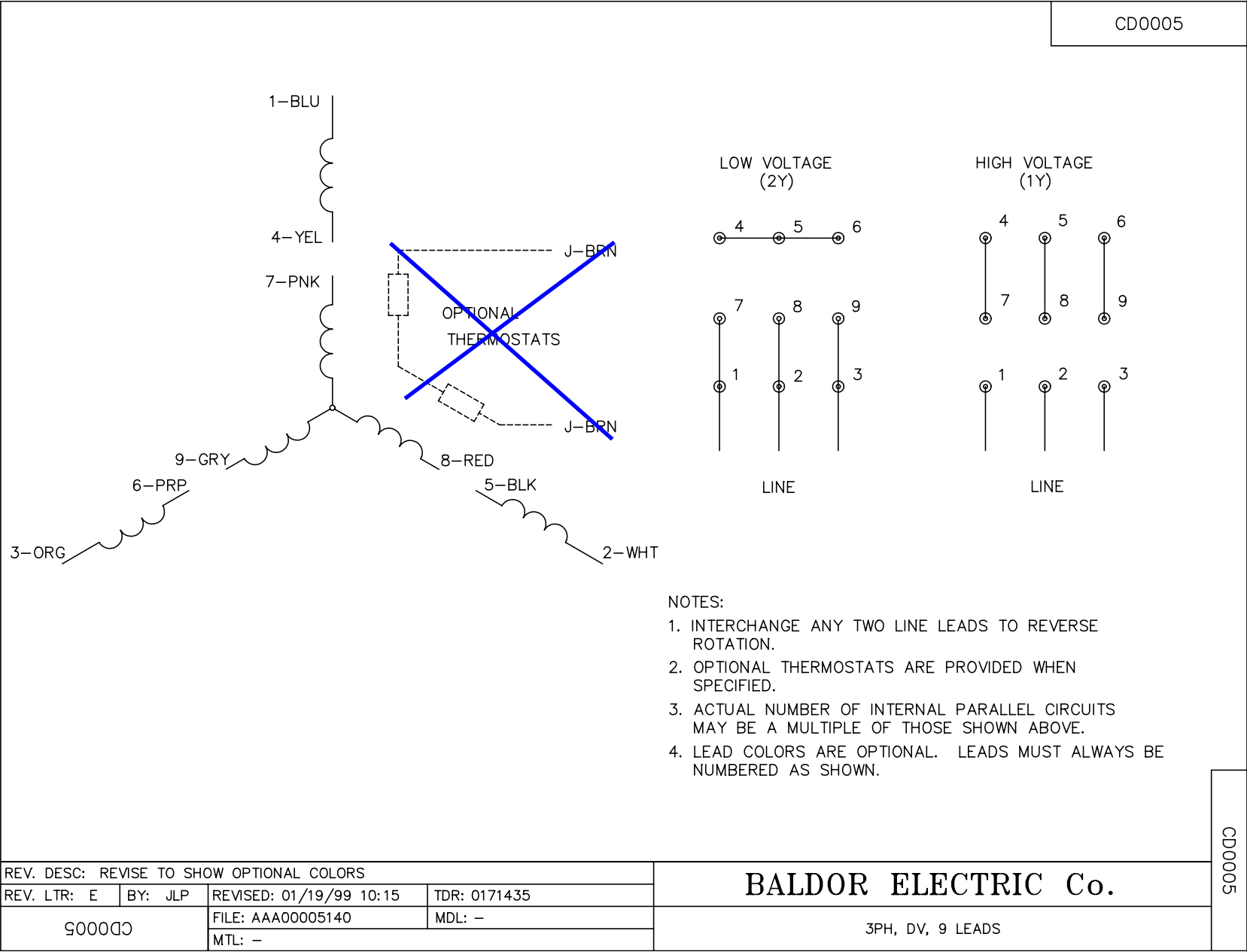
## Load Characteristics

% of Rated Load:	25	50	75	100	125	150	S.F.
Power Factor:	32.0	52.0	65.0	74.0	79.0	83.0	77.0
Efficiency:	69.0	80.0	83.0	83.5	83.0	82.0	83.2
Speed:	1790.0	1775.0	1765.0	1750.0	1740.0	1720.0	1744.0
Line Amperes:	0.52	0.57	0.75	0.8	0.87	1.0	0.84

Performance Graph at 460V, 60Hz, 0.5HP (Typical performance - Not guaranteed values)





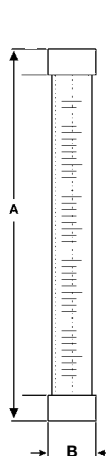


# Pump & Systems Accessories

## Calibration Columns

### Calibration columns

#### Clear PVC calibration columns

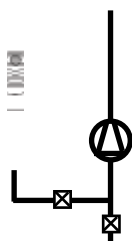


Cylinder size	Fitting size	Dimension (inches)		Threaded base, removable top	Threaded both ends
		A	B		
100 mL	1/2" NPT	10.75	1.39	7500137	7500127
250 mL	1/2" NPT	11.51	1.89	7350138	7500128
500 mL	1/2" NPT	12.75	2.39	7350139	7500129
1000 mL	1/2" NPT	16.75	2.77	7350130	7500135
2000 mL	1" FNPT	20.67	3.52	7500140	7500131
4000 mL	1" FNPT	22.66	4.52	7500141	7500132
10,000 mL	2" FNPT	23.16	6.91	7500134	7500133
20,000 mL	2" FNPT	42.69	6.91	7500142	7500136

#### Typical Application of Calibration Columns

##### Column w/removable top

**Note:** Top must be removed during calibration



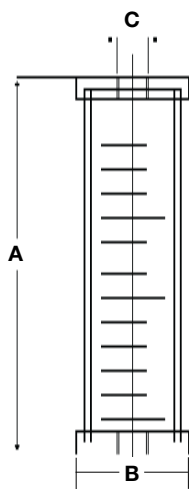
##### Column threaded both ends

**Note:** If plumbed as shown, a vent hole must be drilled into the top of the calibration column



### Borosilicate Glass calibration columns with Viton® o-rings for Sulfuric Acid Applications

Glass cylinder with acrylic outer shield and 1/2" (316 SS) or 3/4" (PVDF, PVC) thick end flanges. All cylinders are bolted together using stainless steel rods with Viton O-rings for the glass seal and Buna N O-rings for the acrylic seal.



Cylinder size	Fitting size	Dimensions (inches)			Part No.
		A	B	C	
100 mL	1/2" CPVC	10.0	3.0	1/2	7500151
100 mL	1/2" PVDF	10.0	3.0	1/2	7500152
100 mL	1/2" SS	9.5	3.0	1/2	7500153
250 mL	1/2" CPVC	12.5	3.5	1/2	7500154
250 mL	1/2" PVDF	12.5	3.5	1/2	7500155
250 mL	1/2" SS	12.0	3.5	1/2	7500156
500 mL	1/2" CPVC	14.5	4.0	1/2	7500157
500 mL	1/2" PVDF	14.5	4.0	1/2	7500158
500 mL	1/2" SS	14.0	4.0	1/2	7500159
1000 mL	1/2" CPVC	16.75	4.75	1/2	7500160
1000 mL	1/2" PVDF	16.75	4.75	1/2	7500161
1000 mL	1/2" SS	16.25	4.75	1/2	7500162
2000 mL	1" CPVC	18.75	5.5	1	7500163
2000 mL	1" PVDF	18.75	5.5	1	7500164
2000 mL	1" SS	18.25	5.5	1	7500165
4000 mL	1" CPVC	22.5	6.5	1	7500166
4000 mL	1" PVDF	22.5	6.5	1	7500167
4000 mL	1" SS	22.0	6.5	1	7500168

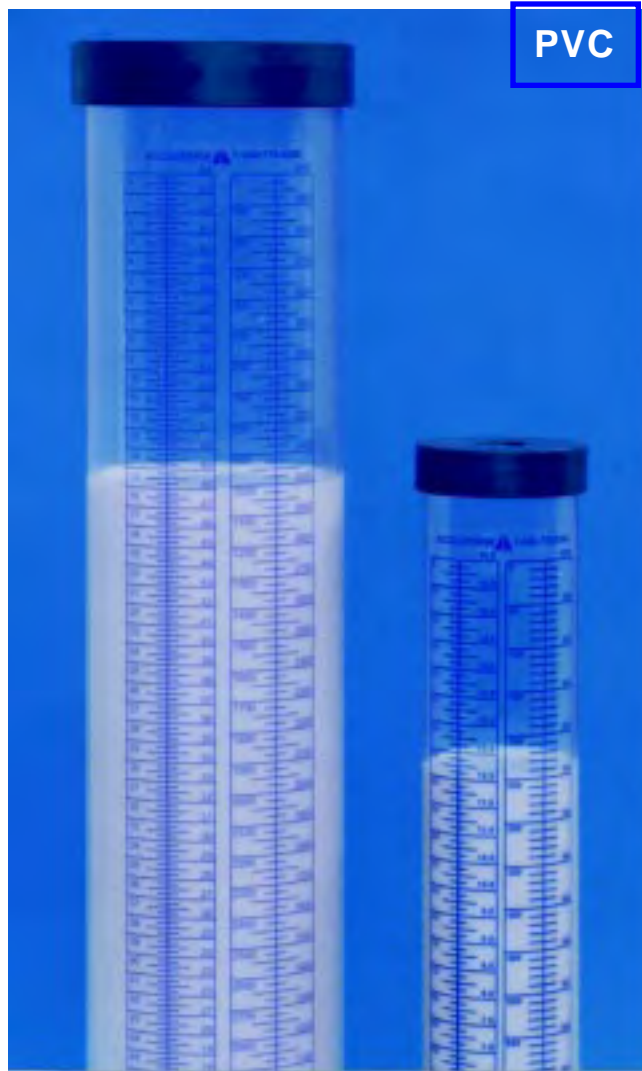


# ACCUDRAW® Calibration Cylinders

**Polypropylene**



**PVC**



**ACCUDRAW®** *has been developed for the accurate calibration of metering pumps. Standard features include:*

- translucent
- chemical resistant
- break resistant
- threaded or socket
- colored graduations and lettering
- PVC has dual scale USGPH & ml
- PVC sizes 100 - 20000 ml
- POLY sizes 100 - 4000 ml
- POLY meets ISO standards
- custom sizes and other materials (acrylic, glass) on request





# ACCUDRAW®

# Calibration Cylinders

## "For Accuracy That Counts"

## Sizing and Ordering Information

### Polypropylene Construction

Size	Conn.	BC	BTC	BDC
100 ml	1/2" NPT	AC#1-100	AC#2-100	AC#3-100
250 ml	1/2" NPT	AC#1-250	AC#2-250	AC#3-250
500 ml	1/2" NPT	AC#1-500	AC#2-500	AC#3-500
1000 ml	1/2" NPT	AC#1-1000	AC#2-1000	AC#3-1000
2000 ml	1.0" NPT	AC#1-2000	AC#2-2000	AC#3-2000
4000 ml	1.0" NPT	AC#1-4000	AC#2-4000	AC#3-4000

BC = bottom connection only, open top

BTC= bottom and top connections

BDC= bottom connection and dust cover top

### PVC Construction

Size/Scale	Conn	BC	BTC	BDC
100 ml/ 1.6 GPH	1/2" NPT	PV#1-100	PV#2-100	PV#3-100
250 ml/ 4 GPH	1/2" NPT	PV#1-250	PV#2-250	PV#3-250
500 ml/ 8 GPH	1/2" NPT	PV#1-500	PV#2-500	PV#3-500
1000 ml/ 16 GPH	1/2" NPT	PV#1-1000	PV#2-1000	PV#3-1000
2000 ml/ 32 GPH	1.0" NPT	PV#1-2000	PV#2-2000	PV#3-2000
4000 ml/ 64 GPH	1.0" NPT	PV#1-4000	PV#2-4000	PV#3-4000
10000 ml/ 160 GPH	2.0" NPT	PV#1-10000	PV#2-10000	PV#3-10000
20000 ml/ 320 GPH	2.0" NPT	PV#1-20000	PV#2-20000	PV#3-20000

Note: PVC cylinders available with socket weld connections.

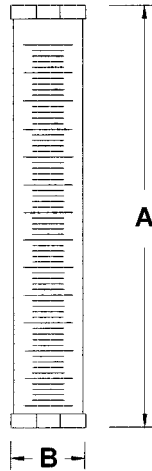
Add suffix "S" to model # e.g. PV#3-100S

For BSP threads, add suffix "B" to model # e.g. PV#3-100B

## Dimensional Information

### Polypropylene Construction

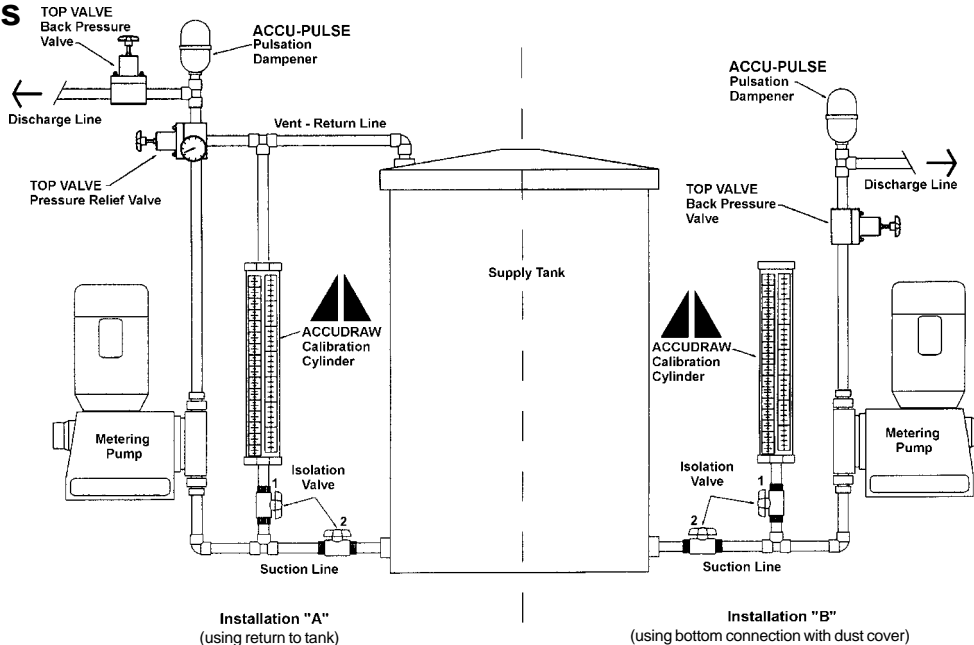
Model	Size (ml)	Dev (ml)	A (inches)	B (inches)
AC#1	100	1	9.88	1.38
AC#1	250	2	12.44	1.75
AC#1	500	5	14.1	2.33
AC#1	1000	10	17.19	2.63
AC#1	2000	20	20.88	3.38
AC#1	4000	50	23.56	4.38
AC#2/AC#3	100	1	9.25	1.38
AC#2/AC#3	250	2	11.63	1.75
AC#2/AC#3	500	5	13	2.32
AC#2/AC#3	1000	10	16.5	2.69
AC#2/AC#3	2000	20	19.5	3.38
AC#2/AC#3	4000	50	22.13	4.38



### PVC Construction

Model	Size (ml)	Divisions (ml)	Size (GPH)	Divisions (GPH)	A (inches)	B (inches)
PV#1	100	1	1.6	0.02	10.24	1.388
PV#1	250	2	4	0.05	11.04	1.888
PV#1	500	5	8	0.05	12.25	2.388
PV#1	1000	10	16	0.125	16.24	2.765
PV#1	2000	20	32	0.25	20.16	3.517
PV#1	4000	25	64	0.25	22.16	4.521
PV#1	10000	200	160	2	22.64	6.906
PV#1	20000	200	320	2	42.19	6.906
PV#2/PV#3	100	1	1.6	0.02	10.75	1.388
PV#2/PV#3	250	2	4	0.05	11.51	1.888
PV#2/PV#3	500	5	8	0.05	12.75	2.388
PV#2/PV#3	1000	10	16	0.125	16.76	2.765
PV#2/PV#3	2000	20	32	0.25	20.67	3.517
PV#2/PV#3	4000	25	64	0.25	22.66	4.521
PV#2/PV#3	10000	200	160	2	23.16	6.906
PV#2/PV#3	20000	200	320	2	42.69	6.906

## Installations



### Conversion Factors

1 ml = 1 cc  
 1000 ml = 1 liter  
 ml/sec X 60 = ml/min  
 1 US gal/min X 0.063 = liters/sec  
 1 US gal = 3.786 liters

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# ▲ ACCUDRAW® PVC Calibration Instructions

**Note:** Before starting either of the calibration procedures below, ensure that the pump is primed and void of any trapped air.

**Using the USGPH scale:** (scale is based on time, in one (1) minute volume discharge)

1. Fill the calibration to the top "0" mark on the USGPH scale.
2. Close isolation valve (#2) from supply tank, open isolation valve (#1) below cylinder and start the pump.
3. Use a stopwatch to measure the time of one (1) minute (60 seconds) and record the volume dispensed by the metering pump, using the draw down scale.
4. Adjust the pump volume control higher or lower to meet with your desired output.
5. Repeat above steps 1 through 4, until the desired output is met.
6. Divide the measured USGPH number by 60 to determine the **USGPM volume**, if required.

If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the measured volume by the same number used to divide the time by.

e.g. 10 USGPH in 1 minute equals  
5 USGPH X 2 in 30 seconds or  
2.5 USGPH X 4 in 15 seconds

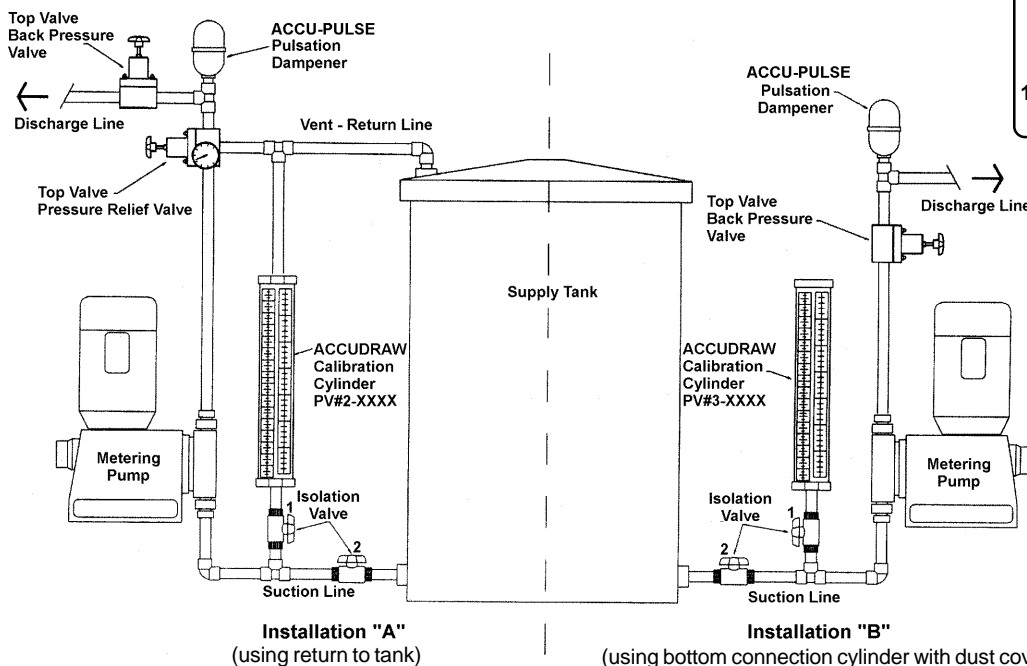
**Using the ml scale:** (scale is based on volume pumped, over any given time)

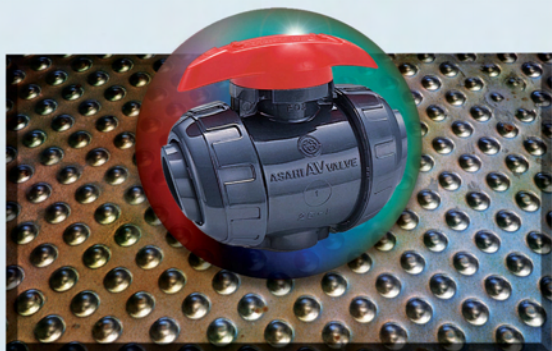
1. Fill the calibration cylinder to the top "0" mark on the ml scale.
2. Close isolation valve (#2) from supply tank, open isolation valve (#1) below cylinder and start the pump.
3. Use a stopwatch to measure the time it takes to pump down a given volume (ml) in 60 seconds.
4. Multiply the volume by 60 to determine the **ml per hour** volume, if required.
5. Adjust the pump volume control higher or lower to meet with your desired output.
6. Repeat above steps 1 through 5, until the desired output is met.

If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the volume by the same number used to divide the time by to determine ml per minute or hour.

e.g. 100 ml in 60 seconds equals  
50 ml X 2 in 30 seconds or  
25 ml X 4 in 15 seconds

## Typical Installations ("A" and "B")





## Type 21 Ball Valve

### Standard Features (Sizes 1/2" – 6")

- Pressure rated up to 230 psi (PVC, CPVC, PVDF)
- Double O-ring seals on stem for an added protection.
- Full bore, sizes 1/2" – 2"
- Full vacuum rated, all sizes
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve
- Integrally molded ISO mounting pad for both manual and actuated operations
- Integrally molded base pad to mount valves securely or panel mounting
- PTFE seats with elastomeric backing cushions ensure bubble-tight shut-off and a low fixed torque, while at the same time compensating for wear
- True Union design for easier installation or repairs without expanding the pipe system
- Built-in spanner wrench on the handle for valve disassembly and assembly
- Two sets of end connectors (socket and threaded) included with all PVC and CPVC valves in sizes 1/2" – 2"
- CPVC threaded end connectors on sizes 1/2" – 1" come with stainless steel reinforcing rings

### Options

- Pneumatic and electric actuators & accessories
- Stem extensions
- 2" square operating nut or "T" nut
- Locking and/or spring return handles
- Limit switches
- Vented Ball

### Specifications

**Sizes:** 1/2" – 6"  
**Models:** PVC & CPVC: Socket, Threaded and Flanged (ANSI)  
 PP & PVDF: IPS and Metric (DIN)  
 Socket, Threaded, Butt and Flanged (ANSI)  
**Bodies:** PVC, CPVC, PP and PVDF  
**Seats:** PTFE backed with EPDM or FKM  
**Seals:** EPDM or FKM or AFLAS®†

**Sizes 1/2" - 4" PVC/EPDM/FKM Models available with NSF-61 Certification**

† Trademark of Asahi Glass Co., Ltd.

### Parts List (Sizes 1/2" – 2")

PARTS			
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Carrier	1	PVC, CPVC, PP, PVDF
4	End Connector	2	PVC, CPVC, PP, PVDF
5	Union Nut	2	PVC, CPVC, PP, PVDF
6	Stem	1	PVC, CPVC, PP, PVDF
7	Seat	2	PTFE
8	O-Ring (A)	2	EPDM, FKM, Others
9	O-Ring (B)	1	EPDM, FKM, Others
10	O-Ring (C)	2	EPDM, FKM, Others
11	O-Ring (D)	1	EPDM, FKM, Others
12	O-Ring (E)	1	EPDM, FKM, Others
13	Stop Ring*	2	PVDF
14	Handle	1	ABS
4a	Ring**	2	304 Stainless Steel

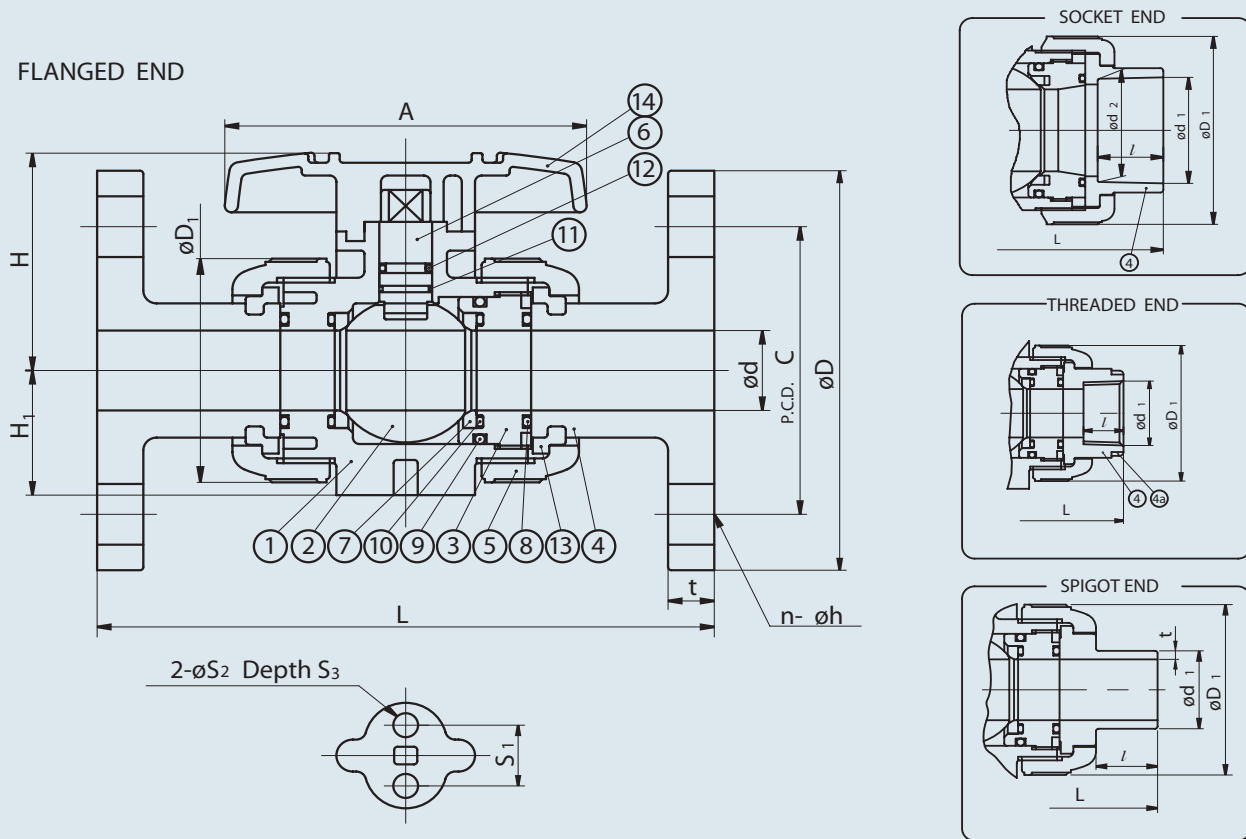
\* Used for flanged end

\*\* Used for CPVC body, threaded end, 1/2" – 1"



**ASAHI/AMERICA**

Rev. C 03-05



## Dimensions (Sizes 1/2" – 2")

NOMINAL SIZE		d	FLANGED						SOCKET										
			ANSI CLASS 150				L	t	PVC CPVC				PP, PVDF (DIN)				PP, PVDF (IPS)		
									ASTM SCH 80		L	DIN 16962			L	d1	l	L	
INCHES	mm	D	C	n	h	d1	d2	l	L	d1		d2	l	L					d1
1/2	15	0.59	3.50	2.38	4	0.62	5.63	0.47	0.848	0.836	0.875	4.45	0.768	0.760	0.57	3.90	0.83	0.87	4.45
3/4	20	0.79	3.88	2.75	4	0.62	6.77	0.55	1.058	1.046	1.000	5.08	0.965	0.957	0.63	4.49	1.03	1.00	5.08
1	25	0.98	4.25	3.12	4	0.62	7.36	0.55	1.325	1.310	1.125	5.75	1.240	1.232	0.71	4.84	1.30	1.13	5.75
1 1/4	32	1.26	4.62	3.50	4	0.62	7.48	0.63	1.670	1.655	1.250	6.46	1.553	1.543	0.81	5.47	1.65	1.25	6.46
1 1/2	40	1.57	5.00	3.88	4	0.62	8.35	0.63	1.912	1.894	1.375	7.24	1.947	1.937	0.93	5.83	1.89	1.37	7.24
2	50	2.01	6.00	4.75	4	0.75	9.21	0.63	2.387	2.369	1.500	8.23	2.461	2.445	1.08	6.93	2.36	1.50	8.23

NOMINAL SIZE		THREADED							SPIGOT (BUTT END)									
									PP, PVDF									
									DIN 3442		PP	PVDF	L					
INCHES	mm	d <sub>1</sub>	l	L	D <sub>1</sub>	H	H <sub>1</sub>	A	d <sub>1</sub>	l	t	t	L	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>		
1/2	15	1/2-14 NPT	0.59	4.02	1.89	2.03	1.14	3.62	0.787	0.728	0.098	0.075	4.882	0.75	0.29	0.43		
3/4	20	3/4-14 NPT	0.67	4.72	2.36	2.34	1.38	3.94	0.984	0.866	0.106	0.075	5.670	0.75	0.29	0.43		
1	25	1-11 1/2 NPT	0.79	5.16	2.76	2.68	1.54	4.33	1.260	0.886	0.118	0.094	6.063	0.75	0.29	0.43		
1 1/4	32	1 1/4-11 1/2 NPT	0.87	5.91	3.23	3.17	1.85	4.76	1.575	1.024	0.146	0.094	6.850	1.18	0.35	0.59		
1 1/2	40	1 1/2-11 1/2 NPT	0.98	6.42	3.94	3.50	2.17	5.16	1.969	1.260	0.181	0.118	7.638	1.18	0.35	0.59		
2	50	2-11 1/2 NPT	1.10	7.76	4.96	4.04	2.60	6.26	2.480	1.417	0.228	0.118	8.819	1.18	0.35	0.59		

## Pressure vs. Temperature (PSI, WATER, NON-SHOCK)

NOMINAL SIZE		PVC				CPVC						PP				PVDF				
		30° F	71° F	106° F	121° F	30° F	71° F	106° F	121° F	141° F	176° F	-5° F	86° F	121° F	141° F	-5° F	71° F	106° F	141° F	176° F
INCHES	mm	70° F	105° F	120° F	140° F	70° F	105° F	120° F	140° F	175° F	195° F	85° F	120° F	140° F	175° F	70° F	105° F	140° F	175° F	210° F
1/2-2	15-50	230	170	150	30	230	170	150	120	75	55	150	110	90	55	230	185	150	115	85
2 1/2	65	230	170	150	NA	230	170	150	120	75	55	150	95	70	40	230	185	150	115	85
3	80	230	170	150	NA	230	170	150	85	55	40	150	95	70	40	230	185	150	100	70
4-6	100-150	150	150	150	NA	150	150	150	85	55	40	150	95	70	40	150	150	150	100	70

## Sample Specification

All TYPE 21 Ball Valves, sizes 1/2" to 4", shall be of true union design with two-way blocking capability. All O-rings shall be EPDM or FKM with PTFE seats. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double O-rings and be of blowout-proof design. The valve handle shall double as carrier removal and/or tightening tool. ISO mounting pad shall be integrally molded to valve body for actuation. PVC conforming to ASTM D1784 Cell Classification 12454-A, CPVC conforming to ASTM D1784 Cell Classification 23567-A, PP Conforming to ASTM D4101 Cell Classification PP0210B67272 and PVDF conforming to ASTM D3222 Cell Classification Type II. The ball valves, except PP, shall have a pressure rating of 230 psi for sizes 1/2" to 3" and 150 psi for 4" (150 psi for PP, all sizes) at 70 ° F. Type 21 Ball Valves must carry a two-year guarantee, as manufactured by Asahi/America, Inc.

## Cv Values

NOMINAL SIZE		Cv
INCHES	mm	
1/2	15	14
3/4	20	29
1	25	47
1 1/4	32	72
1 1/2	40	155
2	50	190
2 1/2	65	365
3	80	410
4	100	680

## Weight (POUNDS)

NOMINAL SIZE		SOCKET THREADED	FLANGED
INCHES	mm		
1/2	15	0.44	1.10
3/4	20	0.66	1.54
1	25	1.10	2.70
1 1/4	32	1.54	3.30
1 1/2	40	2.64	4.40
2	50	4.40	8.15
2 1/2	65	6.17	8.80
3	80	9.70	13.00
4	100	24.00	26.67

## Caution

- Never remove valve from pipeline under pressure.
- Always wear protective gloves and goggles.
- Watch out for trapped fluid in valve. It is safe to close valve before removing it from the pipeline.

## Caution

- Do not use ball valves where media has suspended particles. Use the following valves:  
*Butterfly Valves* – PVDF disc is most abrasion resistant and make sure of chemical compatibility.  
*Diaphragm Valves* – Elastomeric diaphragm is designed for handling suspended particles.
- Volatile fluids such as sodium hypochlorite (NaClO) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) could be trapped and gasified within the valve. We can provide you with a Type 21 ball valve with a *vented ball* to relieve pressure build-up inside the valve.

## Troubleshooting

### What if the fluid still flows when valve is closed?

- Carrier is not properly tightened. Tighten it.
- PTFE seat is damaged or worn. Replace seat.
- Foreign material is caught between ball and PTFE seat. Remove material and clean.
- Ball is damaged or worn. Change ball.

### What if fluid leaks outside of valve?

- Union nut not properly tightened. Retighten.
- Carrier is not properly tightened. Thread it in firmly.
- Carrier or face O-ring is damaged, worn, or missing. Replace O-ring.

### What if handle does not rotate smoothly?

- Foreign material has formed on the ball or seat. Clean both.
- Internal part(s) chemically attacked or swollen. Refer to Asahi/America Chemical Resistance Chart for compatibility. Replace part(s) as required.
- Carrier over-tightened. Retighten properly.

### What if handle rotates too freely?

- Stem is damaged. Replace stem.
- Handle is not engaged with stem. Disassemble and reengage. Inspect.
- Engaging part of stem and/or ball is damaged. Change stem and/or ball.

Serial No.

H – V027 E – 4

## Ball Valve Type 21

### User's Manual



### Contents

(1) General operating instructions .....	1
(2) General instructions for transportation, unpacking and storage .....	1
(3) Name of parts .....	2
(4) Comparison between working temperature and pressure .....	3
(5) Installation procedure .....	4
(6) Operating procedure .....	9
(7) Method of Adjusting face pressure between ball and seat .....	9
(8) Disassembling method for parts replacement .....	10
(9) Mounting actuator, metal Ensert and base(panel) .....	11
(10) Inspection items .....	13
(11) Troubleshooting .....	13
(12) Handling of residual and waste materials .....	13
(13) Inquiries .....	14



ASAHI AV VALVES

## (1) General operating instructions

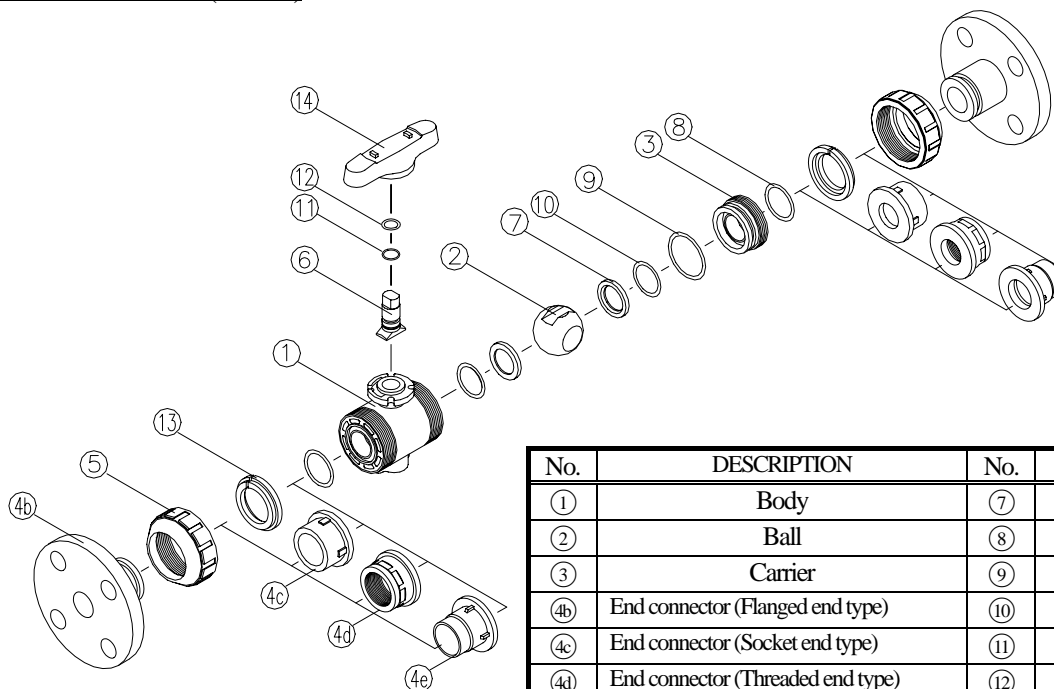
- Operate the valve within the pressure Vs temperature range.  
(The valve can be damaged by operating beyond the allowable range.)
- Select a valve material that is compatible with the media, refer to “CHEMICAL RESISTANCE ON ASAHI AV VALVE”.  
(Some chemicals may damage incompatible valve materials.)
- Do not use the valve to fluid containing slurry. (The valve will not operate properly.)
- Do not use the valve on condition that fluid has crystallized.  
(The valve will not operate properly.)
- Do not step on the valve or apply excessive weight on valve. (It can be damaged.)
- Do not exert excessive force in closing the valve.
- Make sure to consult a waste treatment dealer to dispose of the valves.  
(Poisonous gas is generated when the valve is burned improperly.)
- Allow sufficient space for maintenance and inspection.
- Keep the valve away from excessive heat or fire. (It can be deformed, or destroyed.)
- The valve is not designed to bear any kind of external load. Never stand on or place anything heavy on the valve at anytime.
- Certain liquid such as H<sub>2</sub>O<sub>2</sub>, NaClO, etc may be prone to vaporization which may cause irregular pressure increases, which may destroy the valve.

## (2) General instructions for transportation, unpacking and storage

- Keep the valve packed in the carton or box as delivered until installation.
- Keep the valve away from any coal tar, creosote (antiseptic for wood), termite insecticide, vermicides, and paint.  
(This could cause swelling damage the valve.)
- Do not impact or drop the valve. (It can be damaged.)
- Avoid scratching the valve with any sharp object.

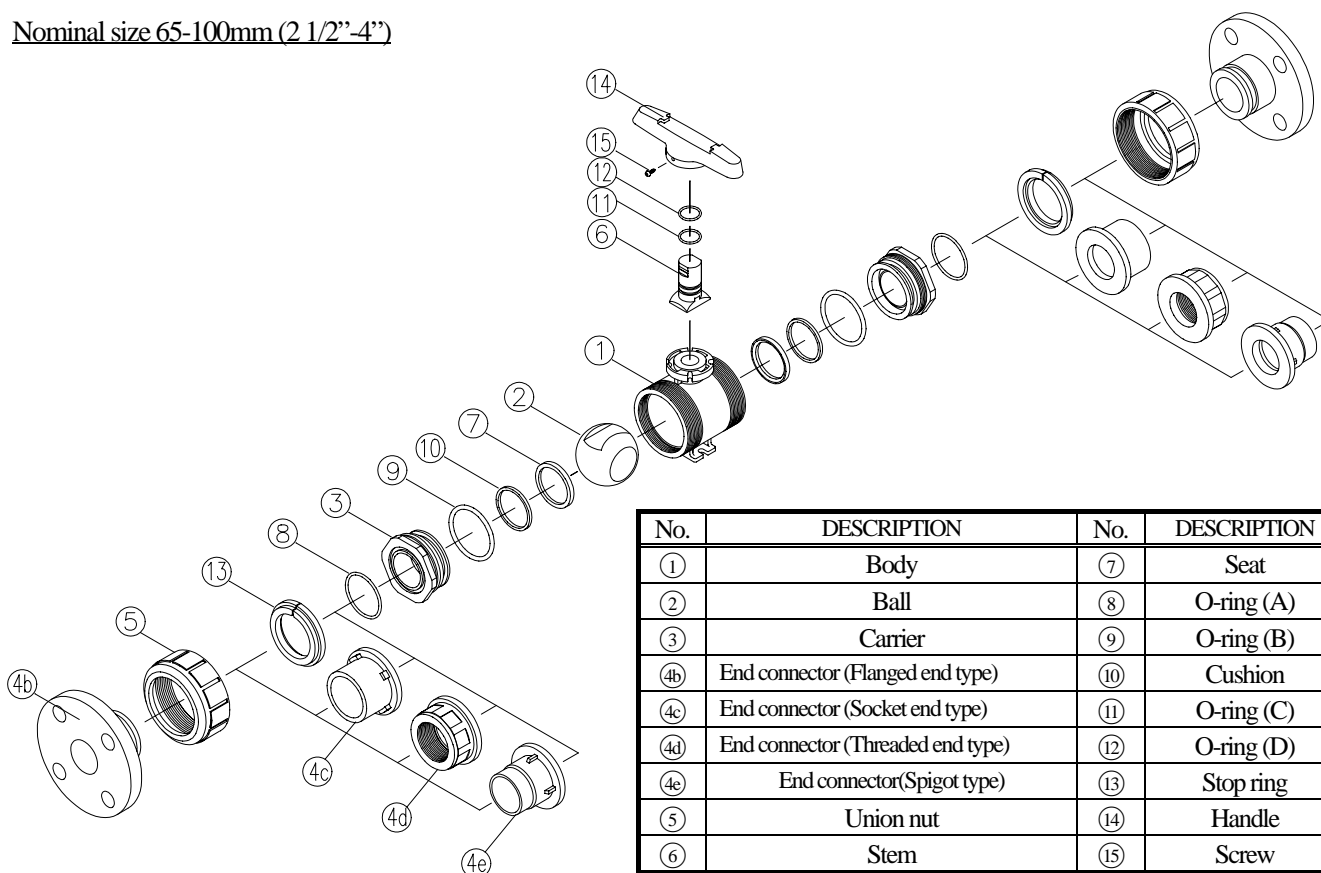
### (3) Name of parts

Nominal size 15-50mm (1/2"-2")



No.	DESCRIPTION	No.	DESCRIPTION
①	Body	⑦	Seat
②	Ball	⑧	O-ring (A)
③	Carrier	⑨	O-ring (B)
④b	End connector (Flanged end type)	⑩	O-ring (C)
④c	End connector (Socket end type)	⑪	O-ring (D)
④d	End connector (Threaded end type)	⑫	O-ring (E)
④e	End connector (Spigot type)	⑬	Stop ring
⑤	Union nut	⑭	Handle
⑥	Stem		

Nominal size 65-100mm (2 1/2"-4")

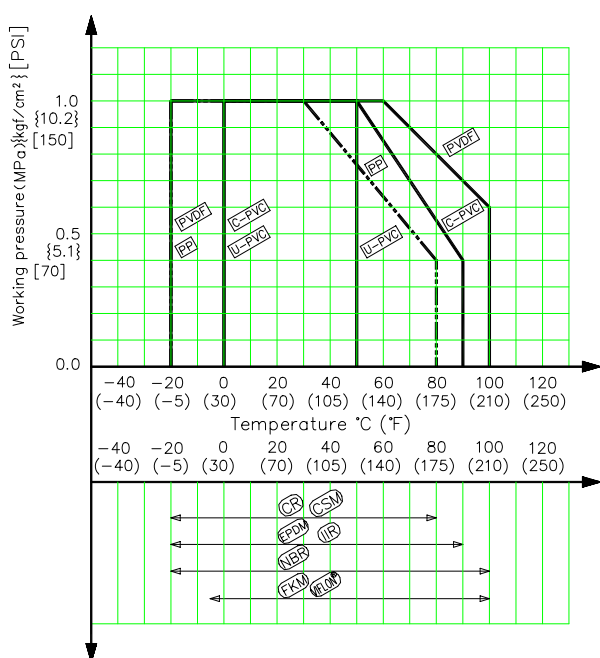


No.	DESCRIPTION	No.	DESCRIPTION
①	Body	⑦	Seat
②	Ball	⑧	O-ring (A)
③	Carrier	⑨	O-ring (B)
④b	End connector (Flanged end type)	⑩	Cushion
④c	End connector (Socket end type)	⑪	O-ring (C)
④d	End connector (Threaded end type)	⑫	O-ring (D)
④e	End connector (Spigot type)	⑬	Stop ring
⑤	Union nut	⑭	Handle
⑥	Stem	⑮	Screw

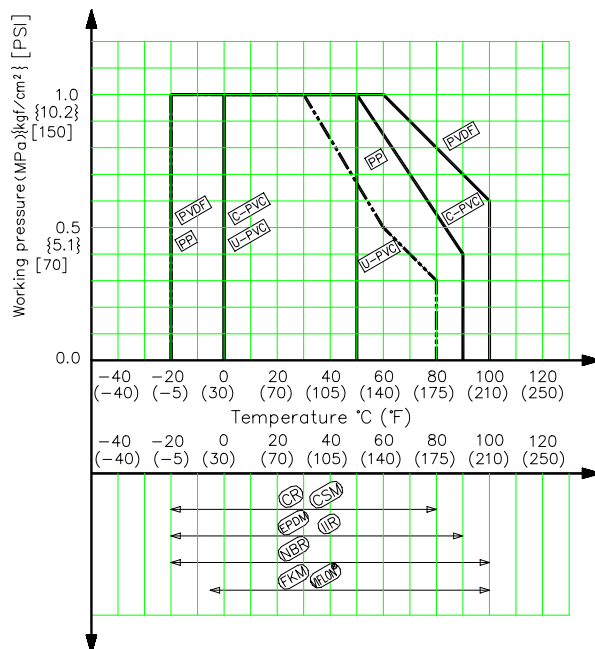


#### (4) Comparison between working temperature and pressure

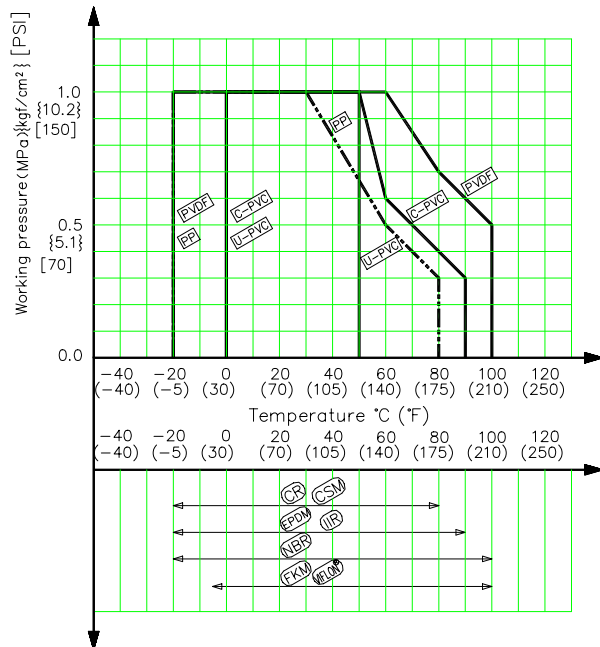
Nominal size: 15mm-50mm (1/2"-2")



Nominal size: 65mm (2 1/2")



Nominal size: 80mm, 100mm (3", 4")



#### Caution

Do not operate the valve beyond the range of working temperature and pressure.  
(The valve can be damaged.)



## (5) Installation procedure

### Flanged type (Material: PVC, C-PVC, PP, PVDF)

#### Necessary items

- Torque wrench
- Spanner wrench
- AV gasket
- Bolt, Nut, Washer (For many flanges specification)

(When a non-AV gasket is used, a different tightening torque specification should be followed.)

#### Procedure

- 1) When the union nut ⑤ flange assembly set was removed or loosen from body ①, O-ring (A) ⑧ should be installed into carrier and body groove. (In either horizontal or vertical installation, if necessary apply a small amount of lubricant to O-ring to hold in place.) Align union nut and end connector with the body. Insure end connector mates with body and O-ring. Make certain union nut threads onto body smoothly. Tighten union nuts on each side valve until hand tight. Then using a strap wrench tighten union nuts uniformly on each side approx 90° -180° turns, 1/4 to 1/2 turns.
- 2) Set the AV gasket between the flanges.
- 3) Insert washers and bolts from the pipe side, insert washers and nuts from the valve side, then temporarily tighten them by hand.



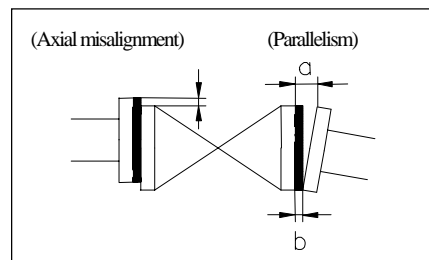
#### Caution

The parallelism and axial misalignment of the flange surface should be under the values shown in the following table to prevent damage the valve.

(A failure to observe them can cause destruction due to stress application to the pipe)

Unit : mm (inch)

Nom. Size	Axial Misalignment	Parallelism (a-b)
15-32mm (1/2"-1 1/4")	1.0mm (0.04")	0.5mm (0.02")
40-80mm (1 1/2"-3")	1.0mm (0.04")	0.8mm (0.03")
100mm (4")	1.0mm (0.04")	1.0mm (0.04")



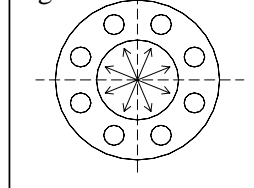
- 4) Tighten the bolts and nuts gradually with a torque wrench to the specified torque level in a diagonal manner. (Refer to fig.1.)

#### Recommended torque value

Unit: N·m [kgf·cm] [lb·inch]

Nom. Size	15-20mm (1/2"-3/4")	25-40mm (1"-1 1/2")	50, 65 mm (2", 2 1/2")	80, 100 mm (3", 4")
Torque value	17.5 { 179 } [155]	20.0 { 204 } [177]	22.5 { 230 } [230]	30.0 { 306 } [266]

Fig. 1



#### Caution

Avoid excessive tightening. (The valve can be damaged.)

**Threaded type** (Material : PVC, C-PVC, PP, PVDF)

## Necessary items

- Sealing tape (A non-sealing tape can cause leakage.)
- Strap wrench (Do not use Pipe wrench.)
- Spanner wrench



## Caution

Make sure that the threaded connections are plastic x plastic.  
(Metallic thread can cause damage.)

Procedure

- 1) Wind a sealing tape around the external thread of joint, leaving the end (about 3mm) free.
- 2) Loosen the union nut (5) with a strap wrench..
- 3) Remove the union nut (5) and the end connector (4d).
- 4) Lead the union nut (5) through the pipe.
- 5) Tighten the external thread of the joint and the end connector (4d) hardly with hand.
- 6) Using a spanner wrench, screw in the end connector (4d) by turning 180° -360° carefully without damaging it.



## Caution

Avoid excessive tightening. (The valve can be damaged.)

- 7) Make sure that the O-ring (A) (8) is mounted.
- 8) Set the end connector (4d) and union nut (5) directly on the body without allowing the O-ring (A) (8) to come off.
- 9) Tighten union nuts (5) on each valve until hand tight.
- 10) Using a strap wrench tighten union nuts uniformly on each on each side approx 90° -180° turns, 1/4 to 1/2 turns.



## Caution

Avoid excessive tightening. (The valve can be damaged.)

Socket type (Material : PVC, C-PVC)

## Necessary items

- Adhesive for hard vinyl chloride pipes
- Strap wrench (Do not use the pipe wrench)



## Caution

Do not install a socket type valve where the atmospheric temperature is 5°C or lower.  
(The valve can be damaged.)

Procedure

- 1) Loosen the union nut ⑤ with a strap wrench.
- 2) Remove the union nut ⑤ and end connector ④c.
- 3) Lead the union nut through the pipe.
- 4) Clean the hub part of the end connector ④c by wiping the waste cloth.
- 5) Apply adhesive evenly to the hub part of the end connector ④c and the pipe spigot.



## Caution

Do not apply more adhesives than necessary.  
(The valve can be damaged due to solvent cracking.)

Adhesive quantity (guideline)

Nom. Size	15mm (1/2")	20mm (3/4")	25mm (1")	32mm (1 1/4")	40mm (1 1/2")	50mm (2")	65mm (2 1/2")	80mm (3")	100mm (4")
Quantity (g)	1.0	1.3	2.0	2.4	3.5	4.8	6.9	9.0	13.0

- 6) After applying adhesive, insert the pipe quickly to the end connector ④c and leave it alone for at least 60 seconds.
- 7) Wipe away overflowing adhesive.
- 8) Make sure that O-ring(A) ⑧ is mounted
- 9) Set the end connector ④c and union nut ⑤ directly on the body without allowing the O-ring (A) ⑧ to come off.
- 10) Tighten union nut ⑤ hardly with hand.
- 11) Using a strap wrench tighten union nuts uniformly on each side approx 90° -180° turns, 1/4 to 1/2 turns.



## Caution

Avoid excessive tightening. (The valve can be damaged.)

**Socket type** (Material : PP, PVDF)

## Necessary items

- Strap wrench (Do not use the pipe wrench.)
- Sleeve welder or automatic welding machine
- User's manual for sleeve welder or automatic welding machine

Procedure

- 1) Loosen the union nut with a strap wrench.
- 2) Remove the union nut ⑤ and the end connector.
- 3) Lead the union nut ⑤ through the pipe.
- 4) For the next step, refer to the user's manual for the sleeve welder or the automatic welding machine.
- 5) After welding, make sure that the O-ring (A) ⑧ is mounted.
- 6) Set the end connector ④c and the union nut ⑤ directly without allowing the O-ring (A) ⑧ to come off.
- 7) Tighten union nut ⑤ hardly with hand.
- 8) Using a strap wrench tighten union nuts uniformly on each side approx 90° -180° turns, 1/4 to 1/2 turns.



## Caution

Avoid excessive tightening. (The valve can be damaged.)

**Spigot type** (Material : PVDF)

## Necessary items

- Strap wrench (Do not use the pipe wrench.)
- Automatic welding machine
- User's manual for automatic welding machine

Procedure

- 1) Loosen the union nut with a strap wrench.
- 2) Remove the union nut ⑤ and the end connector.
- 3) Lead the union nut ⑤ through the pipe.
- 4) For the next step, refer to the user's manual for the sleeve welder or the automatic welding machine.
- 5) After welding, make sure that the O-ring (A) ⑧ is mounted.
- 6) Set the end connector ④c and the union nut ⑤ directly without allowing the O-ring (A) ⑧ to come off.
- 7) Tighten union nut ⑤ hardly with hand.
- 8) Using a strap wrench tighten union nuts uniformly on each side approx 90° -180° turns, 1/4 to 1/2 turns.



## Caution

Avoid excessive tightening. (The valve can be damaged.)

**Caution**

{15mm-50mm(1/2"-2")}

It is recommended to install the valve with the threaded carrier to the upstream side of the system.

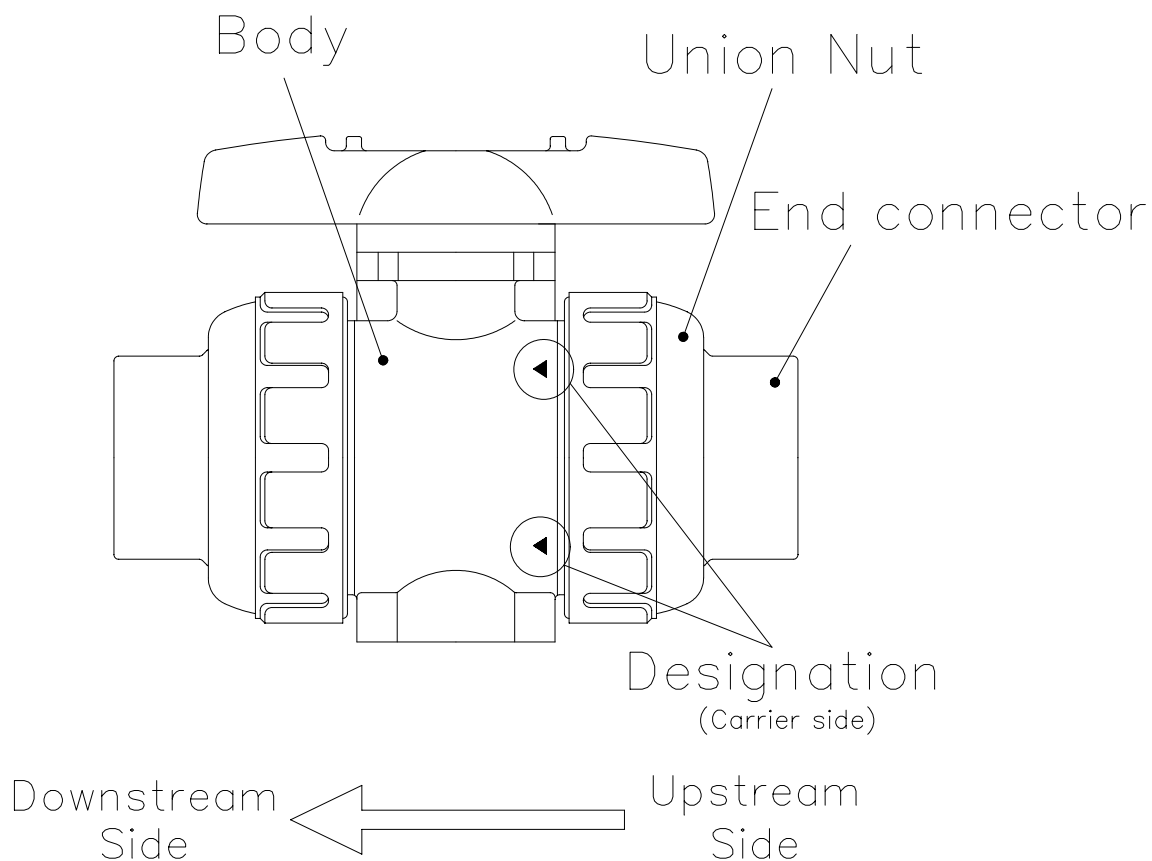
This allows for an increase safety factor and eliminating a threaded connection when used as a blocking valve.

This also allows the down stream union nut and end connector to be removed safely under pressure.

It increases the safety where there is no chance of thread leakage or accidentally removing the carrier.

The designation of the up stream side (non threaded carrier is marked as shown) on the body.

Nominal size 15mm - 50mm (1/2" – 2")



## (6) Operating Procedure



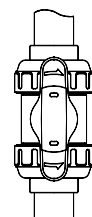
### Caution

Avoid excessive tightening. (The valve can be damaged.)

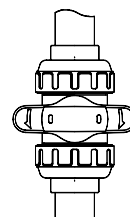
- Turn the handle gently to open or close.  
(Turn the handle clockwise to close and counter clockwise to open.)

Fully closed ..... The position of the handle should be perpendicular to the pipe.

Fully opened ..... The position of the handle should be parallel to the pipe.



Fully opened



Fully closed

## (7) Method of Adjusting Face Pressure between Ball and Seat

### Necessary items

- Strap wrench
- Safety goggles
- Protective gloves
- Screwdriver (+) (only with nominal size 65~100mm)

### Procedure

- 1) Completely discharge fluid from pipes.
- 2) Turn the handle to full close.
- 3) Loosen the right union nut and the left one ⑤ with a strap wrench.
- 4) Remove the body part from piping system.



### Caution

Wear protective gloves and safety goggles as some fluid remains in the valve. (You may be injured.)

- 5) Pull the handle off the body part.



### Caution

As for nominal size 65-100mm (2 1/2"-4"), loosen the screw ⑮ properly with a screwdriver before pulling it off..

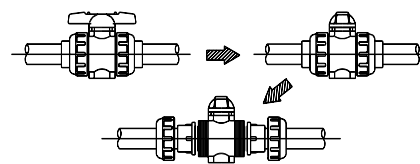
- 6) Engage the upper convex part of the handle with the concave part of the union ③.



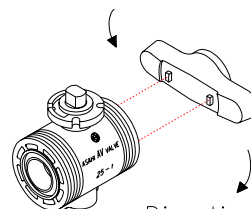
### Caution

As for nominal size 15-50mm  
Only the union ③ on the right side when viewed from the trademark (AV mark) can be adjusted.  
As for nominal size 65-100mm  
adjust the unions on both sides.

- 7) Make an adjustment by turning the union clockwise (to tighten it) or counter clockwise (to loosen it).
- 8) Make sure that the handle can be operated smoothly.
- 9) Assemble the valve by following the above procedure in the reverse order, starting at 6)



Direction where carrier is tightened



Direction where carrier is loosened

## (8) Disassembling Method for Replacing Parts

### Necessary items

- Strap wrench
- Safety goggles
- Protective gloves



### Caution

Wear protective gloves and safety goggles as some fluid remains in the valve.  
(You may be injured.)

### <Disassembly>

#### Procedure

- 1) Completely discharge fluid from pipes.
- 2) Turn the handle to full close.
- 3) Loosen the right union nut and the left one ⑤ with a strap wrench.
- 4) Remove the body part from piping system.
- 5) Pull the handle off the body part.



### Caution

As for nominal size 65-100mm (2 1/2"-4"), loosen the screw ⑮ properly with a screwdriver before pulling it off..

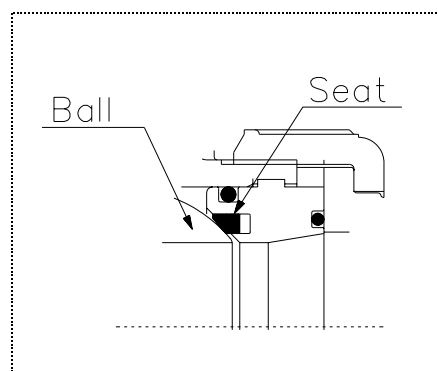
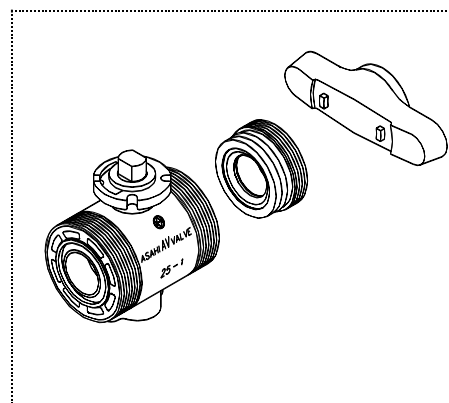
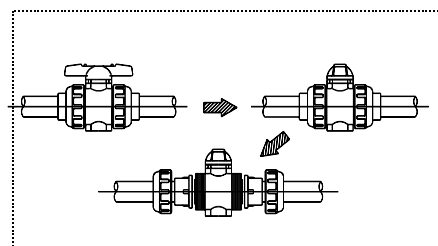
- 6) Engage the upper convex part of the handle with the concave part of the union.



### Caution

As for nominal size 15-50mm  
Only the union ③ on the right side when viewed from the trademark (AV mark) can be adjusted.  
As for nominal size 65-100mm, adjust the unions on both sides.

- 7) In the engaged state, turn the handle ⑭ counter clockwise to loosen it and remove the union ③.
- 8) Remove the seat ⑦ carefully by hand without damaging it.
- 9) Push out the ball ② by hand.
- 10) Push out the stem ⑥ from the top flange side to the body side.



### <Assembly>

#### Procedure

Carry out the assembly work in the reverse procedure from item 10)



### Caution

With regard to item 8), before installing seat ⑦ on the valve, check the seat for its face and back.

## (9) Mounting actuator, Ensaf and base (panel)

### ○ Attach actuator to the top flange

#### Procedure

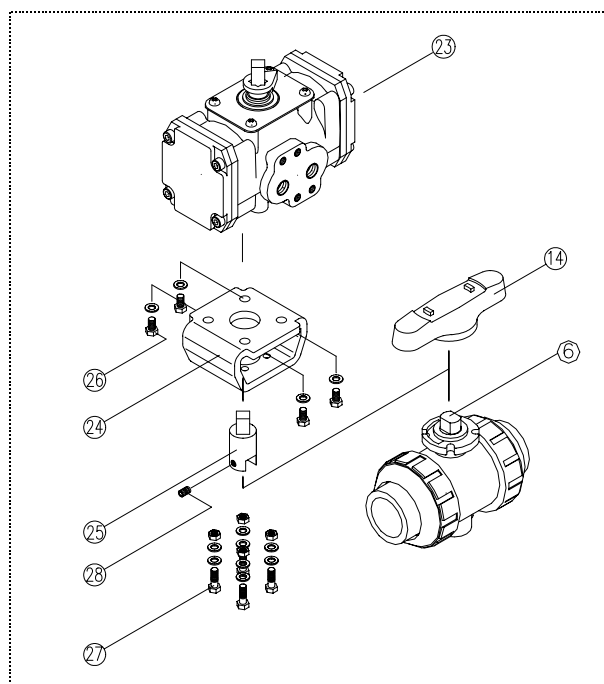
- 1) Remove the handle (14).



#### Caution

As for nominal 65mm-100mm, tighten the screw (15) properly before removing it.

- 2) Fix the stand (24) to actuator (23) with bolt (A).
- 3) Fix the stem (6) to the joint (25) with screw (B) (28).
- 4) Engage the joint (25) with actuator (23).
- 5) Fix the stand (24) to the top flange with bolt-nut (B) (27).
- 6) Make sure that the valve works smoothly, by operating actuator (23) by hand.



### ○ Attach Inserted metal to the bottom stand.

#### Procedure

Refer to the user's manual for the Inserted metal  
(Commercially available.)

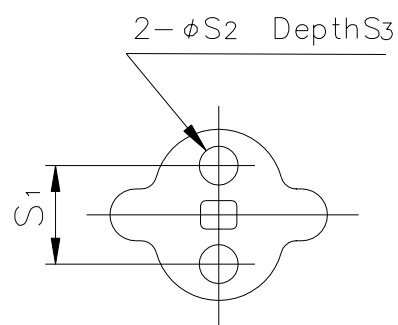
#### Bottom stand dimension

Unit; mm

Nom.Size	S1	S2	S3
15mm (1/2")	19	7.3	11
20mm (3/4")	19	7.3	11
25mm (1")	19	7.3	11
32mm (1 1/4")	30	9	15
40mm (1 1/2")	30	9	15
50mm (2")	30	9	15
65mm (2 1/2")	48	9	6
80mm (3")	55	11	7
100mm (4")	65	11	8

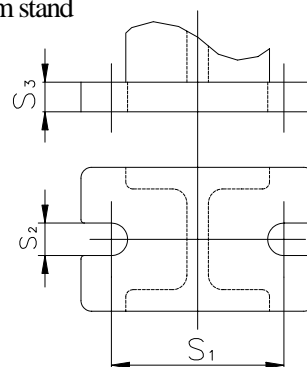
Nominal 15-50mm(1/2"-2")

Bottom stand



Nominal 65-100mm (2 1/2"-4")

Bottom stand

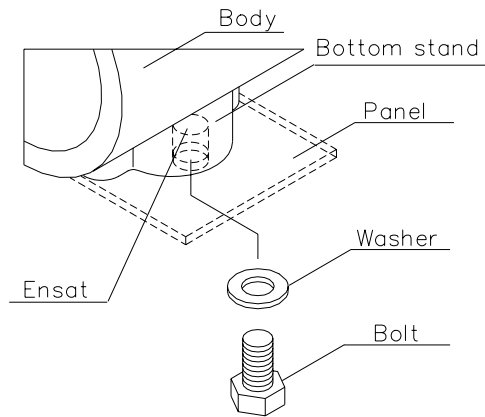




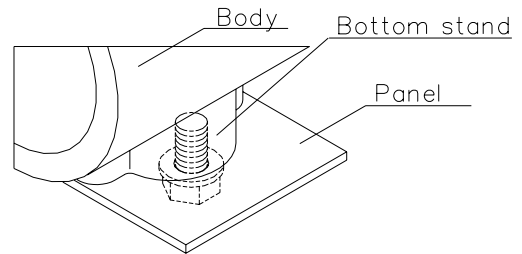
## ○ Fixation of bottom stand with panel

Nominal size: 15mm-50mm (1/2"-2")

Before the fixation

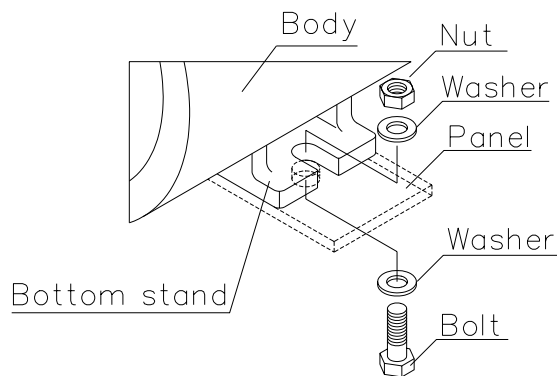


After the fixation

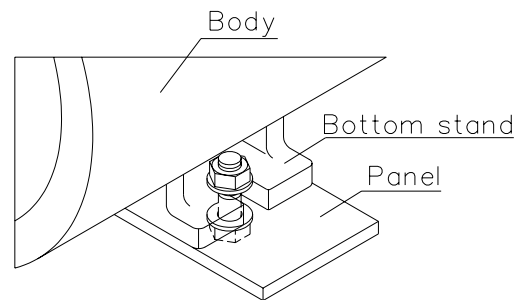


Nominal size: 65mm-100mm (2 1/2"-4")

Before the fixation



After the fixation



**(10) Inspection items**

○Inspect the following items.

(1)	Existence of scratches, cracks, deformation, and discoloring.
(2)	Existence of leakage from the valve to the outside.
(3)	Existence of leakage when the valve is opened fully at right or left.

**(11) Troubleshooting**

Problem	Cause	Treatment
Fluid leaks from the valve even when the valve is closed fully.	The carrier is loosened.	Adjust the face pressure between the ball and the seat. (Refer to page 9)
	The seat is scratched or worn.	Replace the seat with a new one.
	Foreign matter is in the valve.	Clean up.
	The ball is scratched or worn.	Replace the scratched ball with a new one.
Fluid leaks from the valve.	The union nut is loosened.	Tighten up the union nut.
	The carrier is loosened.	Adjust the face pressure between the ball and the seat. (Refer to page 9)
	The O-ring is scratched or worn.	Replace the O-ring with a new one.
The handle can not be turned smoothly.	Foreign matter is in the valve.	Clean up.
	Deformation. (By heat etc.)	Replace the parts.
The handle fails to engage.	The stem is broken.	Replace the stem with a new one.
	The engagement between the stem and the ball is broken.	Replace the stem and ball with new ones.

**(12) Handling of residual and waste materials**

**Caution**

In discarding remaining or waste materials, be sure to ask waste service company.  
(Poisonous gas is generated.)

(13) Inquiries
----------------

**ASAHI ORGANIC CHEMICALS INDUSTRY CO., LTD.**

**Nobeoka Head Office** : 2-5955, Nakanose- Cho, Nobeoka –City, Miyazaki- Pref. , Japan.

Tel : (81) 982-35-0880 Fax : (81) 982-35-9350

**Tokyo Head Office** : (Furukawachiyoda Bldg.) 15-9, Uchikanda 2- Chome, Chiyoda-Ku, Tokyo, Japan.

Tel : (81) 3-3254-8177 Fax : (81) 3-3254-3474

**Singapore Branch Office** : 16 Raffles Quay, #40-03 Hong Leong Building, Singapore 048581.

Tel : (65) 220-4022 Fax : (65) 324-6151

**Europe Representative Office** : Kaiser-Friedrich-Promenade 61 D-61348 Bad Homburg v. d. H. Germany.

Tel : (49) 6172-9175-0 Fax : (49) 6172-9175-25

**Shanghai Branch Office** : Room 1301-P Shanghai Kerry Center, 1515 Nanjing Xi Road, Shanghai China

Tel : (21) 5298-6900 Fax : (21) 5298-6556

**ASAHI /AMERICA Inc.** :35 Green Street P.O.Box 653 , Malden, Massachusetts 02148 U.S.A.

Tel : (1) 781-321-5409 Fax : (1) 781-321-4421

<b><u>Distributor</u></b>
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## Ball Valves Type 21



ASAHI AV VALVES

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# Pump & Systems Accessories

## Pulsation Dampeners

Pulsation dampeners operate on the principle that gas is compressible and fluid is not. The pulsation dampener consists of an air chamber containing compressed air, a fluid chamber connected to the pump's suction or discharge line, and a bladder or bellows which separates the air and fluid.

Some models are flow-through design, with two ports so they can be mounted directly on the pump suction or discharge line. Other models are single port design, to be teed off of the pump suction or discharge line. Flow-through models may also be used in a tee if one port is capped.

All models feature a Schrader (bicycle) valve and pressure gauge for charging the air chamber on-site.

PVDF/Nordel pulsation dampeners are recommended for sodium hydroxide (caustic) applications. Viton® pulsation dampeners are recommended for sodium hypochlorite applications.

### Sizing Pulsation Dampeners

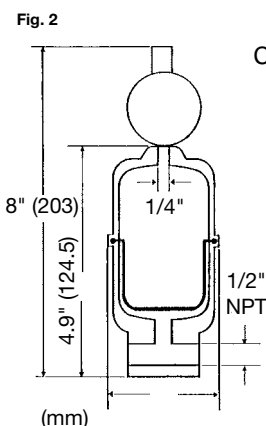
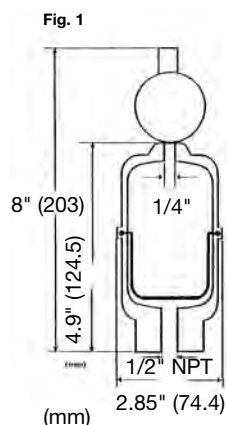
Multiply the pump's displacement per stroke (mL) times 26 to get minimum pulsation dampener volume (mL) to achieve 90% reduction in pulsation.

**Safety Note:** We recommend using pressure relief valves with the pulsation dampeners.

### General Specifications

Maximum pressure:	150 psig (polypro, PVDF and PTFE), 300 psig (SS)
Temperature range:	
Nordel bladder:	-60°F to 280°F (-51°C to 138°C)
Viton® bladder:	30°F to 350°F (-1°C to 177°C)
HYPALON® bladder:	-20°F to 275°F (-29°C to 135°C)
PTFE bellows:	40°F to 220°F (4°C to 104°C)
Polypro housing:	32°F to 175°F (0°C to 79°C)
PVC housing:	32°F to 140°F (0°C to 60°C)
PVDF housing:	10°F to 250°F (-12°C to 121°C)
PTFE housing:	-20°F to 125°F (-29°C to 52°C)
SS housing:	32°F to 200°F (0°C to 93°C)

\*Teflon bellows are smaller in volume



### 131 mL (8 cu. in.) Models

SS housing: 3/8" FNPT, 1 port (not illustrated)				
PTFE bellows	3 (1.4)	CTS1020 T	III	7253205
PVDF housing: 1/2" FNPT, 1 port (Fig. 1)				
PTFE bellows	1 (0.9)	CTK1005 T 5	III	7744101

### 164 mL (10 cu. in.) Models

CPVC housing: 1/2" FNPT, 1 port (Fig. 1)				
Nordel bladder (EPDM)	1 (0.9)	RC-10X-E50	III	7744096
Viton® bladder	1 (0.9)	RC-10X-V50	III	7744097
HYPALON® bladder	1 (0.9)	RC-10X-H50	III	7744098
Polypro housing: 1/2" FNPT, 1 port (Fig. 1)				
Nordel bladder (EPDM)	1 (0.9)	CTP1005 ND 5	III	7744102
PVDF housing: 1/2" FNPT, 1 port (Fig. 1)				
Nordel bladder (EPDM)	1 (0.9)	CTK1005 ND 5	III	7744100
Viton® bladder	1 (0.9)	CTK1005 V 5	III	7744099

Shipping Weight  
lbs (kg)

Model

Size

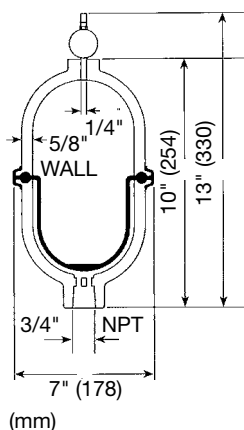
Part No.

# Pump & Systems Accessories

## Pulsation Dampeners

### Pulsation dampeners (cont.)

Fig. 3



#### 262 mL (16 cu. in.) Models

PVC housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	7 (3.2)	CT1311 T	II	7744211
PVDF housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	7 (3.2)	CT1401 T	II	7253234
SS housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	11 (5.0)	CT3120 T	II	7253237

#### 600 mL (36 cu. in.) Models (cont. from pg.15)

PVC housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder	7 (3.2)	CT1311 ND	II	7253232
Viton® bladder	7 (3.2)	CT1311 V	II	7253233
HYPALON® bladder	7 (3.2)	CT1311 H	II	7740946
Polypro housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder	6 (2.7)	CT1301 ND	II	7253230
Viton® bladder	6 (2.7)	CT1301 V	II	7253231
PVDF housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder	7 (3.2)	CT1401 ND	II	7253236
Viton® bladder	7 (3.2)	CT1401 V	II	7253235
SS housing: 3/4" FNPT, 1 port (Fig. 3)				
Viton® bladder	11 (5.0)	CT3120 V	II	7253238

#### 1147 mL (70 cu. in.) Models

PVC housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	10 (4.5)	CT311 T	II	7253229
SS housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	14 (6.4)	CT3020 T	II	7253206
PVDF housing: 3/4" FNPT, 1 port (Fig. 3)				
PTFE bellows	8 (3.6)	CT401 T	II	7253219

#### 1393 mL (85 cu. in.) Models

PVC housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder	6 (2.7)	CT311 ND	II	7253221
Viton® bladder	6 (2.7)	CT311 V	II	7253220
HYPALON® bladder	6 (2.7)	CT311 H	II	7740947
Polypro housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder (EPDM)	6 (2.7)	CT301 ND	II	7253207
Viton® bladder	6 (2.7)	CT301 V	II	7253208
PVDF housing: 3/4" FNPT, 1 port (Fig. 3)				
Nordel bladder (EPDM)	7 (3.2)	CT401 ND	II	7253209
Viton® bladder	8 (3.6)	CT401 V	II	7253210

#### 1998 mL (122 cu. in.) Models

PVC housing: 2" FNPT, 1 port				
PTFE bellows	16 (7.3)	CT911 T	I	7253228
PVDF housing: 2" FNPT, 1 port				
PTFE bellows	15 (6.8)	CT1201 T	I	7253225
SS housing: 2" FNPT, 1 port				
PTFE bellows	30 (13.6)	CT2520 T	I	7253226

#### 2867 mL (175 cu. in.) Models

Polypro housing: 2" FNPT, 1 port				
Nordel bladder	13 (5.9)	CT901 ND	I	7253223
PVC housing: 2" FNPT, 1 port				
Viton® bladder	13 (5.9)	CT911 V	I	7253224
HYPALON® bladder	13 (5.9)	CT911 H	I	7740948

# SENTRY PULSATION DAMPENERS



  
**SENTRY**  
PULSATION DAMPENERS

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# SENTRY PULSATION DAMPENERS

## BENEFITS & FEATURES

Positive Displacement (PD) pumps create pulsation and hydraulic shock due to the reciprocating nature of their stroking action, potentially damaging the entire pumping system. Blacoh's SENTRY® Pulsation Dampeners remove virtually all hydraulic shock, enhancing all-around performance and reliability of fluid handling equipment in industrial and chemical transfer applications.

### SENTRY BENEFITS:

- Produces a near steady fluid flow up to 99%\* pulsation and vibration free.
- Protects pipes, valves, fittings, meters, and in-line instrumentation from destructive pulsations, vibrations, surges, cavitation, thermal expansion, & water hammer
- Creates steady and continuous flow when dosing, blending or proportioning additives
- Insures accuracy, longevity, and repeatability of in-line meters
- Enables uniform application of material in spraying and coating systems
- Reduces product agitation, foaming, splashing and degradation of product
- Provides liquid energy storage for emergency valve closure and equipment shutdown
- Reduces overall energy cost with continuous linear flow, rather than start/ stop turbulent flow
- Operates as a reservoir for make-up fluid

### SENTRY FEATURES:

- Sizes available for all positive displacement pumps with discharge sizes from 1/8" (3.18mm) to 6" (152.4mm)
- Simple, reliable design and quick installation
- Easy in-line maintenance
- Pressure ranges up to 4000 PSI (276 BAR) available from stock
- Temperature ranges from -60°F to +400°F (-51°C to +205°C) available from stock
- Custom models available up to 100 gallons (378L) and 25,000 PSI (1724 BAR)
- Bodies available in a full range of chemically resistant materials
- Bladders available for even the most corrosive application

***Let SENTRY Stand Guard Over Your System.  
Increase productivity, safety, reliability and efficiency.  
Decrease maintenance and operating costs.***

## PROCESSES

- |                   |                    |                   |                    |                  |
|-------------------|--------------------|-------------------|--------------------|------------------|
| • <b>TRANSFER</b> | • <b>FILTERING</b> | • <b>PRINTING</b> | • <b>DOSING</b>    | • <b>FILLING</b> |
| • <b>METERING</b> | • <b>SPRAYING</b>  | • <b>COATING</b>  | • <b>INJECTING</b> | • <b>MIXING</b>  |

## INDUSTRIES SERVED



**Chemical Process**



**Water Treatment**



**Food & Beverage**



**Pulp, Paper & Textile**



**Paint & Coating**



**Biotech/  
Pharmaceutical**



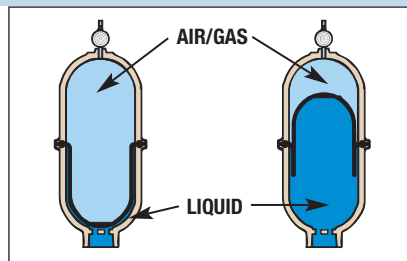
**Gas, Oil, & Petrochemical**



**Consumer Products**

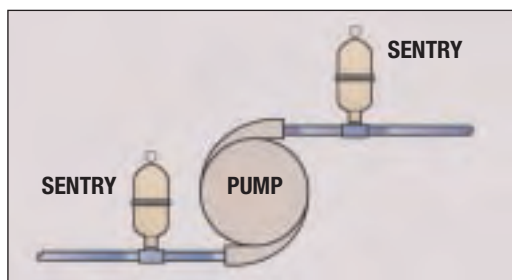
## PRINCIPLES OF OPERATION

SENTRY operates on the principle that volume is inversely proportional to pressure. Compressed air or gas is introduced into the air chamber of the SENTRY Pulsation Dampener to a specified pressure. The gas is entrapped by the elastomeric bladder, which prevents contact between the process fluid and compressed gas. (Without the bladder, the gas would dissolve into the fluid and cause product contamination). During pump discharge, fluid enters the wetted chamber of the SENTRY Pulsation Dampener, displacing the bladder, compressing the gas and absorbing the shock. During pump shift, liquid pressure decreases, the dampener gas expands, pushing fluid back into the process line, eliminating up to 99% of system shock and pulsation.

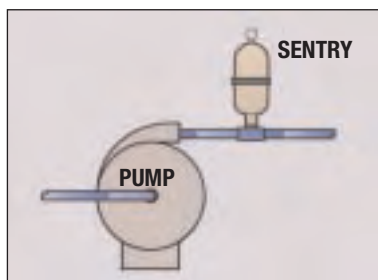


## TYPICAL INSTALLATIONS

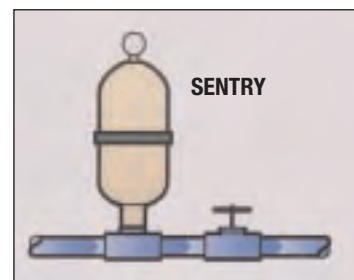
### ADD, METERING, PERISTALTIC, & PISTON PUMPS



### PUMP STARTUP & SHUTDOWN



### QUICK CLOSING VALVES



\*Requires proper sizing.



## SENTRY TECHNICAL SPECIFICATIONS



### SENTRY PLASTIC

Pressure Rating*:	Up to 150 PSI (10 BAR)	Temperature Range**:	-20°F to +250°F (-29°C to +121°C)
Capacities:	4 cubic inches to 5 gallons (.066 – 18L)	Inlet Ports:	Threaded: FNPT and BSP Flanged: ANSI and DIN
Shell Materials:	Polypropylene Conductive Polypropylene PVC and CPVC PVDF Conductive Acetal		



### SENTRY METAL

Pressure Rating*:	Up to 4000 PSI (276 BAR)	Temperature Range**:	-60°F to +400°F (-51°C to +204°C)
Capacities:	4 cubic inches to 100 gallons (.066 - 378L)	Inlet Ports:	Threaded: FNPT and BSP Flanged: ANSI and DIN
Shell Materials:	Aluminum Carbon Steel 316L Stainless Steel Alloy 20 Hastelloy C Epoxy, PVDF and PTFE coated steel		



### SENTRY SANITARY

Pressure Rating*:	Up to 1000 PSI (69 BAR)	Temperature Range**:	-20°F to +350°F (-28°C to +176°C)
Capacities:	4 cubic inches to 10 gallons (.066 - 37L)	Inlet Ports:	Tri-clamp type sanitary fitting
Shell Materials:	30 RA Polished 316L Stainless Steel Bead Blasted 316L Stainless Steel		



### SENTRY PTFE

Pressure Rating*:	Up to 100 PSI (6 BAR)	Temperature Range**:	+40°F to +220°F (+4°C to +104°C)
Capacities:	4 to 370 cubic inches (.066 - 6L)	Inlet Ports:	Threaded: FNPT and BSP Flanged: ANSI and DIN Metric Flare Type
Shell Materials:	Machined PTFE		



### SENTRY XP HIGH PRESSURE

Pressure Rating*:	Up to 4000 PSI (276 BAR)	Temperature Range**:	-60°F to +225°F (-51°C to +107°C)
Capacities:	8 to 24 cubic inches (.13 - .39L)	Inlet Ports:	Threaded: FNPT Flanged: ANSI
Shell Materials:	316L Stainless Steel		



### SENTRY TEF-GUARD HP II

Pressure Rating*:	Up to 2000 PSI (137 BAR)	Temperature Range**:	+40°F to +220°F (+4°C to +104°C)
Capacities:	12 cubic inches (.20L)	Inlet Ports:	Threaded: FNPT Flanged: ANSI
Shell Materials:	316L Stainless Steel Carbon Steel Alloy 20 Hastelloy C		

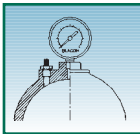
### BLADDER OPTIONS

COMPOUND	TEMPERATURE LIMITS	APPLICATIONS
Neoprene	0°F to +200°F (-18°C to +93°C)	Good abrasion resistance and flex; use with moderate chemicals.
Buna	+10°F to +180°F (+12°C to +82°C)	Good flex life; use with petroleum, solvents and oil-based fluids.
EPDM	-60°F to +280°F (-51°C to +137°C)	Use in extreme cold; good chemical resistance with ketones, caustics.
Hypalon	-20°F to +275°F (-29°C to +135°C)	Excellent abrasion resistance; good in aggressive acid applications.
Viton	-10°F to +350°F (-23°C to +176°C)	Use in hot & aggressive fluids; good with aromatics, solvents, acids & oils.
Aflas	0°F to +400°F (-18°C to +204°C)	High temperature, petroleum based chemicals, strong acids and bases.
FDA Silicone	-20°F to +300°F (-29°C to +149°C)	FDA-approved food grade material; for use in food and pharmaceutical processing.
FDA Buna	+10°F to +180°F (-12°C to +82°C)	FDA-approved food grade. Similar characteristics of Silicone.
FDA Fluorel	-10°F to +350°F (-23°C to +176°C)	Fluorel is a fluorelastomer comparable to Viton.
PTFE	+40°F to +220°F (+4°C to +104°C)	Bellows design; excellent flex life; use with highly aggressive fluids.

\* Maximum PSI rated for ambient temperatures.

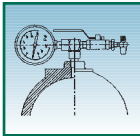
\*\* Reflects entire temperature range for all available materials. Consult Blacoh on specific materials.

## AIR CONTROL OPTIONS



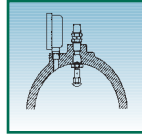
### CHARGEABLE

The chargeable model has a Schrader type charging valve that allows for a predetermined pressure charge to be applied and held in the dampener. No permanent source of compressed gas is required to be attached to the unit. The chargeable models are used primarily with metering, piston and peristaltic pumps for pulsation dampening. Chargeable models are also used for surge suppression to prevent water hammer from quick closing valves, for make-up fluid to prevent pump cycling and for suppression of pump start up or shut down pressure spikes.



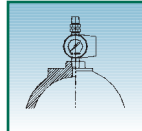
### INLET STABILIZER

The patented inlet stabilizer air control (U.S. Patent No. 6,089,837) consists of a compound pressure gauge, a pressure/vacuum tight ball valve and a venturi valve. When compressed air is passed through the venturi valve at high speed, a low pressure area is created which is used to evacuate the air from the stabilizer, creating a vacuum internally. Conversely, when the flow of air through the venturi valve is diverted into the stabilizer, a pressure charge is obtained. When pump inlet conditions are optimized, pump efficiency is maximized.



### AUTOMATIC

An automatic poppet type valve located in the non-wetted section of the dampener allows for an increase in compressed air pressure to balance an increase in system liquid pressure. As liquid system pressure increases, the bladder is pushed further up into the dampener until it contacts the internal automatic valve. This contact opens the valve and allows an increase of compressed air to enter the dampener. When the air pressure inside the dampener equals the system liquid pressure, the dampener is in balance and pulsations are minimized. If a change in pressure occurs this process is repeated. Automatic units are designed for use on air operated diaphragm pumps in systems with a varying discharge pressure.



### ADJUSTABLE

The adjustable model uses a self-relieving regulator to set dampener pressure. A compressed air line must be permanently attached to the regulator. The regulator allows for an easy, convenient method for readjusting the dampener pressure if the system fluid pressure changes. Adjustable units are designed for use on air operated diaphragm pumps in systems with a constant discharge pressure.

## APPLICATION STORIES

### APPLICATION: PULSATION DAMPENING

**PROBLEM:** A major pulp & paper mill in the Northwest used AODD unloading pumps. The reciprocating action of these air-operated pumps created violent pulsations that caused both pipe stress and mounting fatigue. In fact, these pulsations often caused the pumps to be pulled from their cement foundations. This created significant downtime, costly foundation repair, environmental hazards, and a dangerous working environment.



**SOLUTION:** A Blacoh SENTRY IV Pulsation Dampener was installed in the common discharge of the pumps to dampen these pulsations.

**RESULT:** Pipe stress and mounting fatigue have been eliminated. Not only have the pumps not been ripped from their cement foundations, but the mill has experienced longer life from pump components such as diaphragms and ball valves.

### APPLICATION: WATER HAMMER

**PROBLEM:** A major producer of water treatment chemicals accessed their local water supply through a 3" PVC pipe with quick-closing valves. When the desired quantity had been measured and the valve shut, a water hammer effect with pressure spikes that exceeded the PVC pipe's burst strength was created. The PVC repeatedly broke, causing the entire plant to be shut down for repair. In addition, since pipe failure occurred under a nearby highway, it also had to be closed.



**SOLUTION:** A Blacoh SENTRY 10 gallon Surge Suppressor was installed on the pressure side of each quick closing valve to reduce water hammer pressure spikes.

**RESULT:** The damaging water hammer pressure spikes are now absorbed, no pipes have ruptured, and the plant (and nearby highway) have had no downtime due to water hammer.

### APPLICATION: METERING

**PROBLEM:** A 300 megawatt power plant required a chemical feed system to supply hydrazine to a boiler. The hydrazine acts as an oxygen scavenger, and must be delivered in a precise and consistent quantity. While metering pumps can deliver chemicals in precise amounts, their reciprocating action will not allow delivery in a smooth and consistent flow.



**SOLUTION:** A Blacoh SENTRY III Pulsation Dampener was installed in the common discharge of two metering pumps to create smooth and consistent flow.

**RESULT:** Hydrazine is now delivered to the boiler in a precise and consistent quantity. In addition, pipe vibration has been eliminated, gauge accuracy has been maximized, and pump component stress has been reduced.

### APPLICATION: SPRAYING/ COATING

**PROBLEM:** A decontamination facility pumped acids and water through a series of 15° spray nozzles to rinse radiation from contaminated metals. However, the pulsating action of their reciprocating pumps caused uneven spray into the rinse tanks, and the metals were not rinsed completely.



**SOLUTION:** A Blacoh SENTRY 1 Pulsation Dampener was installed at each pump discharge manifold to eliminate the surging flow of the pumps and ensure complete coverage and thorough cleaning.

**RESULT:** The even flow ensures that the metal product is completely rinsed of radiation. Furthermore, both process time and the amount of acid required have been reduced, which increased productivity and profit.

## UNDERSTANDING PULSATION AND WATER HAMMER CONTROL

### PULSATION DAMPENING

Positive displacement pumps create pulsation and hydraulic shock purely by the reciprocating nature of the pump's stroking action. During the discharge stroke of a pump, fluid pressure takes the line of least resistance, displacing the bladder in the dampener, and compressing the trapped gas. As the pump begins its next cycle, fluid flow stops momentarily allowing the compressed gas to expand, forcing the bladder to push the accumulated

fluid back into the discharge line. This fills the void created in the pipeline by the pump's cycle shift. Whether a piston, plunger, air diaphragm, peristaltic, gear, or diaphragm metering pump, a SENTRY Pulsation Dampener placed at the pump's discharge will produce a steady fluid flow up to 99% pulsation free; protecting the entire pumping system from the damaging effects of shock.

### SURGE SUPPRESSION & WATER HAMMER

When fluid in motion is abruptly stopped, a hydraulic surge is created in the system. Hydraulic surge is often referred to as "water hammer". The kinetic energy, released as pressure, can spike up to six times the system's operating pressure, destroying system instrumentation, pumps, pipes, fittings, and valves. Without a suppression device, the shock wave travels the length of the pipe back to the pump, then reverses again, oscillating back and forth until friction dissipates the pressure spike or a system component fails.

There are several major culprits that produce water hammer; quick closing valves, back surge, pump start up and pump shut down. Quick closing valves can be defined as valves that close within one and one-half seconds. Quick closing valves have the potential of stopping large volumes of energized fluid, producing violent water hammer. The pump start up also stops fluid in motion. During pump start up, fluid in a pipe is static and must be accelerated. The pumped fluid is abruptly stopped when it contacts the static fluid in the pipe, again creating a shock wave. A SENTRY Surge

Suppressor installed at the pump's discharge will provide the accumulation capacity to absorb the rapid fluid acceleration and prevent a pressure spike from occurring. As the surge enters the Suppressor, the gas inside is compressed, the fluid is accumulated and the shock wave is absorbed. When steady system flow rate is achieved, pressure and fluid are slowly released back into the system by the compressed gas.

At pump shut-down, either planned or failure, fluid flow will momentarily continue away from the pump due to momentum. As the flow continues, a void, called column separation can occur at the pump's discharge. When fluid momentum is stopped due to pipe friction, the liquid will usually reverse toward the void area of the pump discharge. The reversing fluid will slam into the check valve usually located at the pump discharge and a water hammer pressure spike will occur. Depending upon the design of the piping system and the fluid involved, the voided area can actually become sub-atmospheric which can significantly increase the pressure spike.

### INLET (SUCTION) STABILIZATION

Without a sufficient supply of fluid a pump will not perform efficiently. Fluid "starvation" is caused by unbalanced hydraulics from friction, acceleration, and head. A reciprocating pump further complicates the issue by emitting high-frequency pressure waves created by the inlet valves opening and closing. In high inlet pressure situations, a pump's inlet valves create water hammer by their opening and closing action; increasing pipe and pump damage, and draining system efficiency.

In suction lift and horizontal suction applications, the pumps' inlet valve action actually decreases inlet fluid pressure. A "starved" or cavitating

pump will be unable to produce specified flow rates due to the incomplete filling of cylinders and liquid chambers. In addition, cavitation will result in the premature failure of pump parts. A SENTRY Suction Stabilizer at the pump's inlet will act as an accumulator, reducing pressure fluctuations and aid in filling the pump head with fluid during each inlet stroke. In high suction lift applications it is also important not to lose the acceleration of the fluid created with each suction stroke of the pump. A Suction Stabilizer will momentarily maintain the flow of the accelerated fluid. The fluid flows into the stabilizer as the pump shifts, and then out as the inlet valve re-opens, maintaining even pressure and steady flow, minimizing cavitation.

### THERMAL EXPANSION

Many fluids change volume due to temperature changes. As the temperature of a fluid rises, the fluid expands. In a closed or loop system a volumetric increase in fluid can create a rise in pressure beyond the limits of safety. The increase in pressure can result in ruptured pipes and fittings,

destroyed in-line instrumentation, burst pressure relief valves and contaminated surroundings. A SENTRY Thermal Expansion Chamber installed in the pipeline will accumulate the expanded fluid, eliminating a dangerous rise in pressure.

### ACCUMULATORS, AUXILIARY ENERGY, FLUID MAKE-UP & TRANSFER BARRIER

Fluids flowing in a system can be accumulated during one part of the process cycle, and then released when needed during another part of the cycle. The release can be based upon the pressure of the system or by the opening/closing of a valve. The SENTRY Accumulator can be used to maintain process line pressure and store fluid for other uses, such as to back flush filters or to draw off sample fluid.

Accumulators can be used as a Transfer Barrier where pressure on one side of a system needs to be transferred to another side without the mixing of the fluids. The accumulator is installed in-line with the two fluids entering at opposite ends, separated by the bladder. As the pressure of one fluid increases, it pushes the bladder against the other fluid, transferring the increase in pressure.

*Please call your local distributor:*

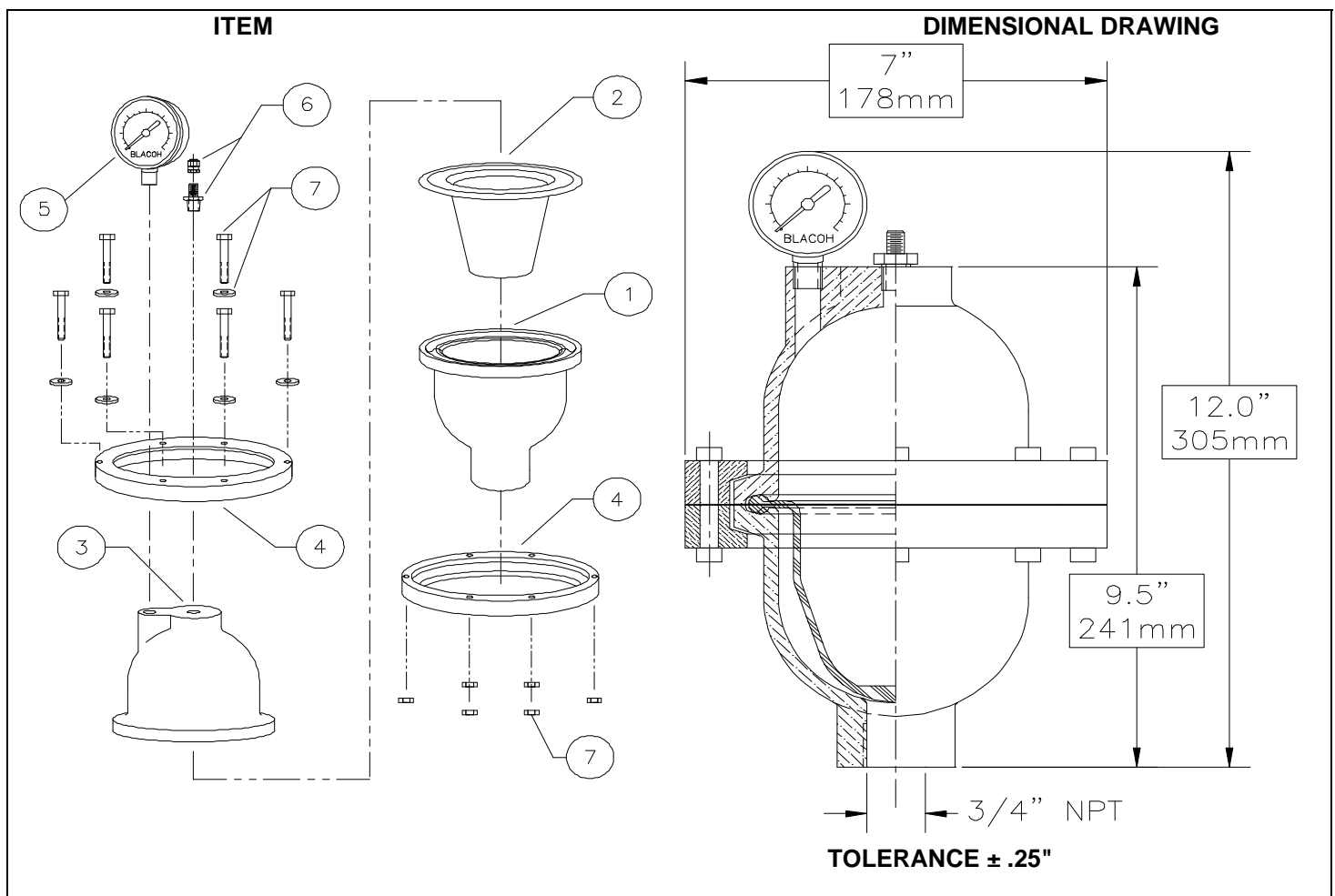
**BLACOH**  
FLUID CONTROL

601 Columbia Ave, Bldg. D, Riverside, CA 92507 • USA  
Tel: (800) 603-7867 or (951) 342-3100 • Fax: (951) 342-3101  
E-mail: sales@blacoh.com • Website: www.blacoh.com

<b>SENTRY MODEL #:</b>	<b>CT311V</b>
<b>MAXIMUM PRESSURE:</b>	<b>150 PSI/10 BAR</b>
<b>CAPACITY:</b>	<b>85 CUBIC INCHES/1.39 LITERS</b>
<b>WETTED HOUSING:</b>	<b>PVC</b>
<b>NONWETTED HOUSING:</b>	<b>PVC</b>
<b>BLADDER:</b>	<b>VITON</b>
<b>INLET:</b>	<b>3/4" FNPT</b>
<b>AIR CONTROL:</b>	<b>CHARGEABLE</b>

DESCRIPTION				
ITEM	PART #	QTY	Component	Material
1	311-27	1	Wetted Housing	PVC
2	401-25	1	Bladder	Viton
3	311-24	1	Nonwetted Housing	PVC
4	102-51	1	Ring Band Assy	Anodized Aluminum (Includes Bolt Assy)
5	101-33	1	Gauge	Plastic, Brass, Bronze
6	101-70	1	Fill Valve	Brass
7	109-51	1	Bolt Assy	Stainless Steel

9/29/2004



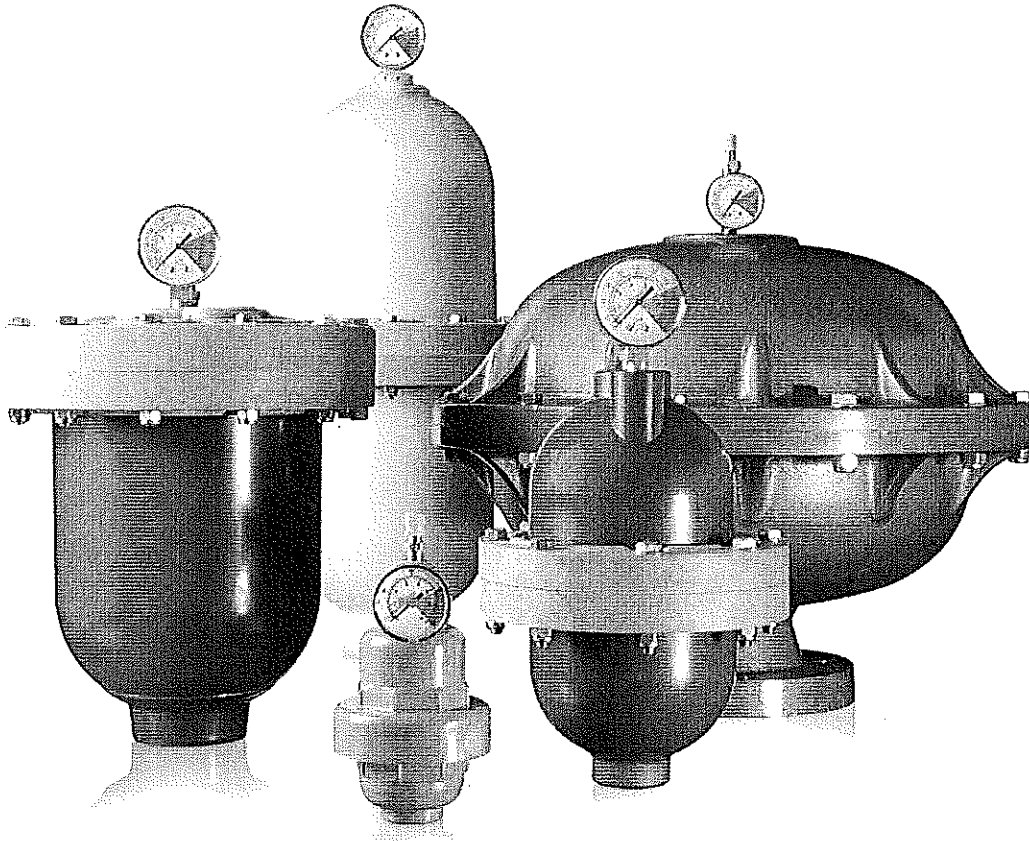
**BLACOH FLUID CONTROL, INC**

RIVERSIDE, CALIFORNIA USA

TEL: 800.603.7867 or 951.342.3100 Fax: 951.342.3101

E-mail: sales@blacoh.com web site: www.blacoh.com

# INSTALLATION & OPERATION MANUAL



## SENTRY™ PULSATION & SURGE CONTROL

### DAMPENER (CHARGEABLE MODEL)

**SENTRY dampeners are pressure vessels** containing a flexible bladder or bellows inside that separates an inert pressurized gas (air or Nitrogen) from a system fluid in the lower chamber. Depending on how dampeners are configured, they are used as PULSATION DAMPENERS, INLET STABILIZERS or SURGE SUPPRESSORS to control pressure fluctuations and spikes in liquid piping systems.

Dampeners work on the principle that volume is inversely proportional to pressure ( $P_1V_1=P_2V_2$ ). Compressed air or Nitrogen (**never** Oxygen) is introduced into the non-wetted side of the dampener. The gas charge is contained by the bladder or bellows preventing contact between the system fluid and the gas.

When the dampener is sized correctly, properly installed and charged according to the instructions provided, it will greatly reduce the damaging effects of pressure variations in piping systems and significantly improve the efficiency of transferring liquids.

All dampeners manufactured by BLACOH use pressure bodies made in the USA to insure quality. Prior to shipment, each and every dampener is factory tested at design pressure or higher to assure proper function and leak-free operation.

Foreign language versions available online at:  
[http://blacoh.com/literature/literature\\_instructions.aspx](http://blacoh.com/literature/literature_instructions.aspx)

**BLACOH™**  
FLUID CONTROL

## TABLE OF CONTENTS

Model Specifications & Installation Information .....	1
SAFETY Warnings .....	2
Safety Symbols .....	2
General Safety .....	2
Equipment Misuse Hazard .....	3
GENERAL Information .....	3
Must Read Before Installation .....	3
Installation Notes .....	4
ATEX Standard .....	4
Maintenance .....	4
Temperature Limits .....	5
Installation & Operation Instructions: Dampener (Chargeable Model) .....	6
Pre-Charge Notes .....	6
Installation for Pump Discharge Pulsation .....	6
Installation for Pump Inlet .....	7
Installation for Surge / Water Hammer .....	8
Manufacturer's Limited Warranty & Return Policy .....	10

## MODEL SPECIFICATIONS & INSTALLATION INFORMATION

Model No.	Serial No.	Installation Date
/		
Body Material: Wetted / Non-wetted	Bladder/Bellows Material	Pump Area and Number
Purchased From	Contact	Phone
		E-Mail

THE WORD "DAMPENER", AS USED IN THIS MANUAL, HAS THE SAME MEANING AS PULSATION DAMPENER, INLET STABILIZER, OR SURGE SUPPRESSOR.

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## SAFETY WARNINGS

Dampeners should only be installed, operated and repaired by experienced and trained professional mechanics. Read and observe all instructions and safety warnings in this Manual before installing, operating or repairing dampeners.

### SAFETY SYMBOLS

The following symbols indicate cautions, warnings and notes that must be observed for safe and satisfactory installation, operation and maintenance of dampener.



**WARNINGS** Danger of serious injury or death could occur if these warnings are ignored.



**CAUTIONS** Equipment damage, injury or death could occur if these cautions are not observed.



**NOTES** Special instructions for safe and satisfactory installation, operation and maintenance.

### GENERAL SAFETY



#### CAUTION!

- Observe all safety symbols in installation and operation instructions.
- The internal dampener pressure will equal the maximum fluid pressure of the system in which it is installed.
- **DO NOT** exceed maximum allowable working pressure (MAWP) specified on dampener serial tag or marked on dampener. If serial tag is missing, **DO NOT** use dampener without consulting distributor or factory for maximum pressure rating.
- Always make sure safety shutoff valves, regulators, pressure relief valves, gauges, etc. are working properly before starting system or assembly.
- Verify dampener model received against purchase order and shipper.
- Before starting a system or assembly make certain the discharge point of the piping system is clear and safe, and all persons have been warned to stand clear.
- **DO NOT** put your face or body near dampener when the system or assembly is operating, or dampener is pressurized.
- **DO NOT** operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.
- **DO NOT** pump incompatible fluids through dampener. Consult distributor or factory if you are not sure of the compatibility of system fluids with dampener materials.
- Dampeners are designed to operate with compressed air or clean dry Nitrogen only. Other compressed gases have not been tested and may be unsafe to use. **DO NOT USE OXYGEN.**
- Always shut off air supply, remove internal dampener pressure, and shut dampener isolation valve before performing dampener maintenance or repair.
- Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.
- Static spark can cause an explosion resulting in severe injury or death. Ground dampeners and pumping system when pumping flammable fluids or operating in flammable environments.
- **NOTE:** EC standard EN-13463-1 and EN-13463-5 (ATEX) require grounding (earthing) on dampeners when the potential for static sparking is present. A grounding point is located and marked on ATEX specific dampener models.

## EQUIPMENT MISUSE HAZARD

### CAUTION!

#### General Safety

**DO NOT** misuse dampener, including but not limited to over-pressurization, modification of parts, using incompatible chemicals, or operating with worn or damaged parts. **DO NOT** use any gases other than compressed air or clean dry Nitrogen to charge dampener. **DO NOT USE OXYGEN.** Any misuse could result in serious bodily injury, death, fire, explosion or property damage.

#### Over-Pressurization

Never exceed the maximum pressure rating for the dampener model being used. Maximum allowable working pressure (MAWP) is specified on dampener serial tag or marked on dampener. Maximum allowable working pressure (MAWP) is rated at 70°F (21°C).

#### Temperature Limits

**DO NOT** exceed the operating temperature limits for the body and/or elastomer materials being used. Excessive temperature will result in dampener failure. For temperature limits, refer to the "Temperature Limits" section of the Manual. Temperature limits are stated at zero psi/bar.

#### Installation and Start-Up Hazards

Install dampener before charging or pressurizing. **DO NOT** start system or assembly without first charging or pressurizing dampener. Failure to charge may result in damage to the elastomeric bladder or PTFE bellows.

#### Temperature & Pressure Hazard

Temperature and pressure reduce the strength and chemical resistance of plastic, metal, elastomers and PTFE.

#### Charging / Pressurization

Charge or pressurize dampener with compressed air or clean dry Nitrogen only. **DO NOT USE OXYGEN.**

#### Dampener Bladder/Bellows Failure

Dampeners utilize an elastomeric membrane (bladder) or PTFE bellows to separate system fluid from the air supply or gas charge. When failure occurs, system fluid may be expelled from the air valve. Always perform preventive maintenance and replace bladder/bellows before excessive wear occurs. O-rings for PTFE bellows cannot be re-used.

#### Maintenance Hazards

Never over-tighten fasteners. This may cause leakage of system fluid and damage to dampener body. Bolts on metal models should not be reused as re-torquing reduces bolt strength. **AFTER MAINTENANCE OR RE-ASSEMBLY OF METAL MODELS, USE NEW FASTENERS AND TORQUE FASTENERS ACCORDING TO SPECIFICATION ON DAMPENER TAG.**

## GENERAL INFORMATION



For safe and satisfactory operation of dampener, read all safety warnings and caution statements, and this complete Manual before installation, startup, operation or maintenance.

### MUST READ BEFORE INSTALLATION



**DO NOT** use Oxygen to charge dampener. Use compressed air or clean dry Nitrogen only.



**DO NOT** exceed maximum allowable working pressure (MAWP) specified on dampener serial tag or marked on dampener.



Turn pump off and remove all pressure from system prior to dampener installation.



Always wear safety glasses and other appropriate safety equipment when installing, charging or repairing dampener.



**Danger of static spark!** Grounding precautions must be considered when dampener is used in flammable or explosive environments.



ATEX Models must be grounded (earthed) before operation.



**DO NOT** operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.



Temperature, pressure and chemicals affect the strength of plastic, elastomer, and metal components.



Many plastics lose strength rapidly as temperature increases. Consult factory if in doubt.



## INSTALLATION NOTES

- △ Dampening of flow pulsations can only be effective if 5 to 10 psi (0.4 to 0.7 bar) back pressure downstream of dampener is available. A BLACOH back pressure valve may be required downstream of dampener.
- △ It is recommended that a BLACOH pressure relief valve be installed in all pump systems to ensure compliance with pressure limits on system equipment.
- △ To avoid possible damage to bladder/bellows from a system pressure test, do the following: **Adjustable and Chargeable models** — charge dampener to 80% of the system test pressure prior to test. **Automatic models** — dampener must be equipped with a constant source of compressed air prior to test; connect a compressed air line and dampener will pressurize itself.
- △ Install dampener in-line, as close to the pump discharge/inlet or quick closing valve as possible. Dampener installation should be no more than ten pipe diameters from pump discharge/inlet or quick closing valve.
- △ It is recommended that an isolation valve be installed between the dampener and system piping.

## ATEX STANDARD

- △ Certain models made for the European market comply with the ATEX standard for use in potentially explosive atmospheres. These models have the AT designation at the end of the part number and comply with EC standard EN-13463-5 with protection degree of II 2GD TXC. AT models have a grounding lug and must be grounded (earthed) before operation.

## MAINTENANCE



Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.

Dampeners require very little maintenance. There is only ONE wear part – the elastomeric bladder or the PTFE bellows. There is no need for lubrication.

Elastomeric bladder replacement should be part of a preventive maintenance program. Dampeners used in conjunction with diaphragm pumps should have the bladders replaced at least every second time the diaphragms in the pump are replaced. As with any pumping system, wear is dependent on many factors including material, temperature, chemicals, fluid abrasiveness and system design. This suggested maintenance program may need to be adjusted according to specific applications.

Periodic inspection of the dampener and fasteners should be conducted to visually check for signs of over-pressurization, fatigue, stress, or corrosion. Body housings and fasteners must be replaced at first indication of deterioration.



**CAUTION!** Replace nut and bolt fasteners on metal models at each re-assembly with fasteners of equal grade/strength value. DO NOT re-use old nuts and bolts.

After the initial torque of fasteners, bolts will usually lose up to 20% of their strength when re-torqued. Failure to replace both nuts and bolts upon each vessel reassembly will void the product warranty given by Blacoh Fluid Control, Inc. and Blacoh Fluid Control, Inc. will have no liability whatsoever for any vessel failure or malfunction.

Where dampeners are used in corrosive environments, nut and bolt fasteners should be regularly inspected and replaced with nut and bolt fasteners of equal grade/strength value if corrosion is observed. Failure to conduct such regular inspections and replacement will void the product warranty given by Blacoh Fluid Control, Inc. and Blacoh Fluid Control, Inc. will have no liability whatsoever for any vessel failure or malfunction.



**IMPORTANT!** AFTER MAINTENANCE OR RE-ASSEMBLY OF METAL MODELS, USE NEW FASTENERS AND TORQUE FASTENERS ACCORDING TO SPECIFICATION ON DAMPENER TAG.



**DO NOT** use dampener if the fasteners (nuts and bolts) are corroded. Check for fastener corrosion frequently, especially in atmospheres containing salt or corrosive chemicals, or if dampener leakage has occurred.

## TEMPERATURE LIMITS

- ① Operating temperatures are based on the maximum temperature of the wetted dampener components only. Non-wetted dampener components may have a lower temperature limit. Temperature and certain chemicals may reduce the maximum allowable working pressure (MAWP) of the dampener.

Elastomer Materials	Temperature Limits	Applications
Aflas	0°F to +400°F (-18°C to +204°C)	High temperature, petroleum based chemicals, strong acids and bases.
Buna	+10°F to +180°F (-12°C to +82°C)	Good flex life; use with petroleum, solvents and oil-based fluids.
FDA Buna	+10°F to +180°F (-12°C to +82°C)	FDA-approved food grade; similar characteristics of Silicone.
EPDM	-60°F to +280°F (-51°C to +138°C)	Use in extreme cold; good chemical resistance with ketones, caustics.
Hypalon	-20°F to +275°F (-29°C to +135°C)	Excellent abrasion resistance; good in aggressive acid applications.
Neoprene	0°F to +200°F (-18°C to +93°C)	Good abrasion resistance and flex; use with moderate chemicals.
PTFE	+40°F to +220°F (+4°C to +104°C)	Bellows design; excellent flex life; use with highly aggressive fluids.
Santoprene	-20°F to +225°F (-29°C to +107°C)	Excellent choice as a low cost alternative for PTFE in many applications.
FDA Silicone	-20°F to +300°F (-29°C to +149°C)	FDA-approved food grade material, for use in food and pharmaceutical processing.
Viton	-10°F to +350°F (-23°C to +177°C)	Use in hot and aggressive fluids; good with aromatics, solvents, acids and oils.

- ① **CAUTION!** Plastic materials lose strength as temperature increases which reduces the maximum pressure sustainable by the material.

Non-Metallic Body Materials	Temperature Limits	Applications
PVC	See chart below.	Good general chemical resistance; loses strength quickly as temperature rises.
CPVC	+32°F to +180°F (0°C to +82°C)	Chlorinated PVC (CPVC) retains strength to higher temperatures.
Acetal*	+32°F to +175°F (0°C to +79°C)	Good flex life; low moisture sensitivity; high resistance to solvents and chemicals.
Noryl	+32°F to +220°F (0°C to +104°C)	Good resistance to acids and bases; good temperature stability.
Polypropylene*	+32°F to +175°F (0°C to +79°C)	Good general purpose plastic; broad chemical compatibility at medium temperatures.
PTFE	+40°F to +220°F (+4°C to +104°C)	Use with highly aggressive fluids.
PVDF	+10°F to +200°F (-12°C to +93°C)	Excellent resistance to most acids and bases; highest temperature plastic available.

\* Conductive Acetal and Conductive Polypropylene available.

- ① **CAUTION!** PVC loses strength more rapidly than other plastic materials as temperature increases. Certain chemicals can also affect material strength reducing maximum pressure ratings. The chart below shows reduced maximum pressure ratings based on temperature for PVC only. Note that these are general guidelines only; selection of dampener materials must be determined by each individual application to avoid equipment damage and unsafe operation.

① PVC Maximum Pressure Guidelines by Temperature							
Temperature	73.4°F (23°C)	80°F (27°C)	90°F (32°C)	100°F (38°C)	110°F (43°C)	120°F (48°C)	130°F (54°C)
Maximum Pressure	150 psi (10.3 bar)	142.5 psi (9.8 bar)	135 psi (9.3 bar)	112.5 psi (7.6 bar)	97.5 psi (6.7 bar)	90 psi (6.2 bar)	75 psi (5.2 bar)

## INSTALLATION & OPERATION INSTRUCTIONS: DAMPENER (CHARGEABLE MODEL)

- ❗ DO NOT USE PLASTIC MODELS AS SURGE SUPPRESSORS AT QUICK CLOSING VALVES. USE METAL SURGE SUPPRESSORS FOR WATER HAMMER OR QUICK CLOSING VALVE APPLICATIONS. CONSULT FACTORY FOR OPTIONS.
- ❗ ATEX MODELS MUST BE GROUNDED (EARTHED) BEFORE OPERATION.
- 🔧 Turn pump off and remove all pressure from system prior to dampener installation.
- 🔧 Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.
- 🔧 Use compressed air or clean dry Nitrogen to charge dampener. **DO NOT USE OXYGEN.**
- 🔧 DO NOT exceed maximum allowable working pressure (MAWP) specified on dampener serial tag.
- 🔧 Always wear safety glasses and other appropriate safety equipment when installing, charging or repairing dampener.
- 🔧 READ ALL SAFETY WARNINGS AND INSTALLATION & OPERATION INSTRUCTIONS IN THE MANUAL BEFORE INSTALLATION.
- 🔧 IMPORTANT! AFTER MAINTENANCE OR RE-ASSEMBLY OF METAL MODELS, USE NEW FASTENERS AND TORQUE FASTENERS ACCORDING TO SPECIFICATION ON DAMPENER TAG.
- ⚠ Before performing a system pressure test, dampener must be charged with 80% of system test pressure to avoid possible damage to bladder/bellows.

### READ BEFORE INSTALLATION

### PRE-CHARGE NOTES

### READ BEFORE INSTALLATION

- ❗ The following pre-charge notes are for plastic dampener models with a maximum pressure rating up to 150 psi (10.3 bar) and metal models with a maximum pressure rating up to 2000 psi (138 bar). **NOTE:** Dampener can be pre-charged with compressed air up to a maximum pressure of 150 psi (10.3 bar). If maximum pressure will exceed 150 psi (10.3 bar), dampener must be pre-charged with Nitrogen only. **DO NOT USE OXYGEN.**

Pre-charge pressure should be checked at least monthly as gas molecules will diffuse through elastomeric bladders, the speed of which depends on the elastomer material, temperature and pressure. Checks must occur when no system pressure is present or inaccurate readings will be recorded. If temperature is above 72°F (22°C) and/or pressure is over 300 psi (20.7 bar), checks should be performed more frequently. To prevent pre-charge loss through the fill valve, always replace the fill valve cap after charging. A proper gas charge is the key to dampener effectiveness and bladder/bellows life.

### READ BEFORE INSTALLATION

### INSTALLATION FOR PUMP DISCHARGE PULSATION

### READ BEFORE INSTALLATION

#### Step 1 — Installation Position

Install the dampener in-line, as close to the pump discharge as possible to absorb the pulse at its source and before any downstream equipment such as risers, valves, elbows, meters, or filters. Dampener installation should be no more than ten pipe diameters from pump discharge. If using a flexible connector on the discharge side of the pump between the pump and system piping, the dampener should be installed at the pump discharge manifold. The flexible connector should be attached to the dampener's tee and system piping (see FIGURE 1). Since pressure is equal in all directions, the dampener can be installed in a vertical, horizontal, or upside-down position. A vertical installation is recommended for better drainage of the dampener. Limitations for horizontal and upside-down mounting include high specific gravity, high viscosity, settling of solid material, or possible air entrapment, which could result in shortened bladder/bellows life and/or reduced dampening performance.

#### Step 2 — Charging and Start-Up (see Pre-Charge Notes)

Chargeable models do not require an air line connection. Dampener can be pre-charged with compressed air up to a maximum pressure of 150 psi (10.3 bar). If maximum pressure will exceed 150 psi (10.3 bar), dampener must be pre-charged with Nitrogen only. Use a hand pump, Nitrogen tank or air compressor to charge dampener. **DO NOT USE OXYGEN.** Charging hose kits are available from BLACOH.

Prior to starting the pump, pre-charge the dampener to approximately 80% of expected system pressure and replace fill valve cap. **DO NOT USE OXYGEN.** The pre-charge pressure in the dampener must always be lower than pump discharge pressure. Generally, pulsation is most effectively minimized when the gas pre-charge is 80% of system pressure. Start the pump to generate system pressure. The dampener charge pressure may need to be adjusted up or down to be most effective in reducing pulsation. **NOTE:** The most effective method to set the proper dampener charge is to install a pressure gauge downstream of the dampener and adjust the dampener to minimize needle movement on the gauge.

Once system pressure is in contact with the bladder/bellows, the gas charge will be compressed to the system pressure and the dampener gauge will read the system pressure, not the initial charge pressure. Once working pressure is achieved, adjustment may be necessary. Gradually increase or decrease the gas charge in the dampener by bleeding or filling through the gas valve. Allow the system to respond to each adjustment (this may take a minute or two) before making further adjustments.

READ BEFORE INSTALLATION

## INSTALLATION FOR PUMP INLET

READ BEFORE INSTALLATION

### Step 1 — Installation Position

Install the dampener in-line, as close to the pump inlet as possible and after any upstream equipment such as risers, valves, elbows, meters, or filters. Dampener installation should be no more than ten pipe diameters from pump inlet. If using a flexible connector on the inlet side of the pump between the system piping and pump, the dampener should be installed on a tee at the pump inlet manifold. The flexible connector should be attached to the dampener's tee and system piping (see FIGURE 1). A compound pressure gauge should be installed upstream of the dampener to aid in proper dampener adjustment.

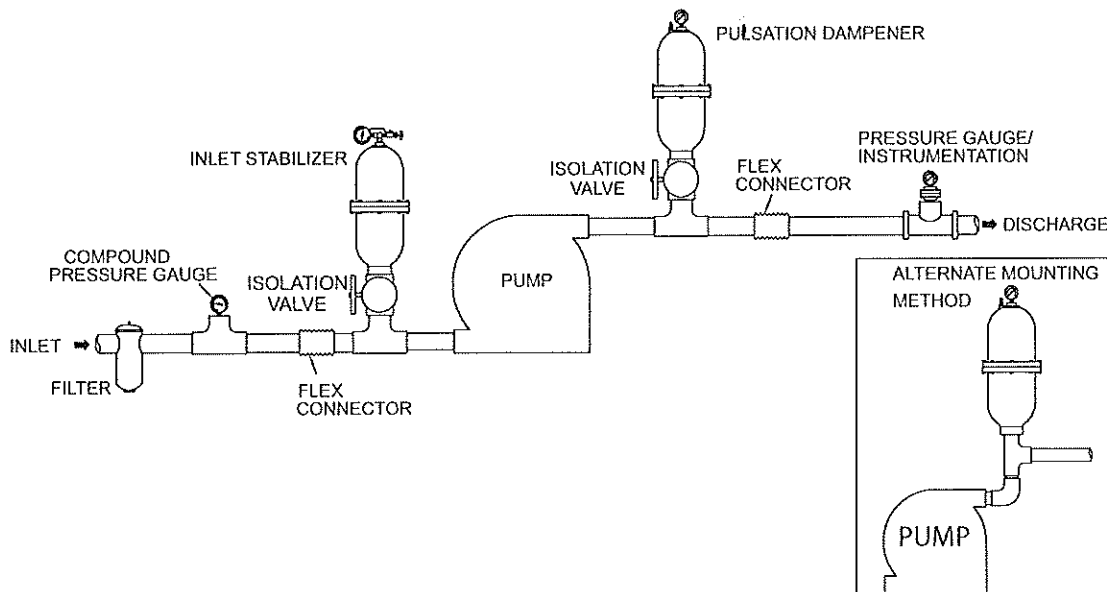
### Step 2 — Charging and Start-Up (see Pre-Charge Notes)

Chargeable models do not require an air line connection. Dampener must be pre-charged with compressed air or Nitrogen, using a hand pump, Nitrogen tank/bottle, or compressor. **DO NOT USE OXYGEN.** Charging hose kits are available from BLACOH.

**A. Suction Lift/Dampener:** When using the dampener in a suction lift application no pre-charge is required. Start the pump to generate working pressure. As system pressure and vacuum is created, the acceleration head created with each suction stroke will compress the air trapped in the bladder/bellows.

**B. Positive Inlet Pressure:** Pre-charge the dampener with 50% of the static system pressure realized at the pump inlet. Start the pump to generate working pressure. Minor pressure adjustments may be required. Allow the system to respond to each adjustment (this may take a minute or two) before making further adjustments.

FIGURE 1



READ BEFORE INSTALLATION

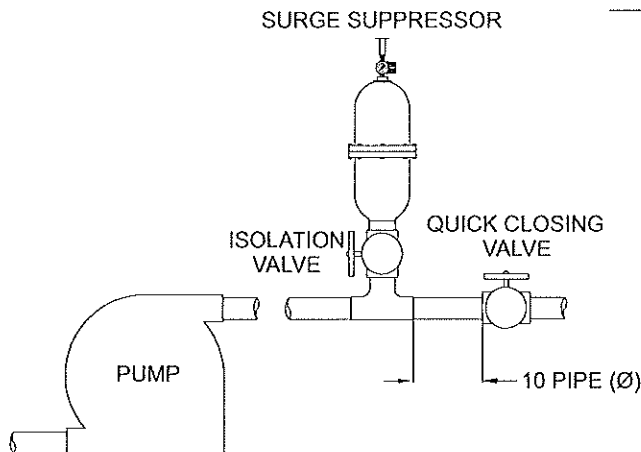
## INSTALLATION FOR SURGE / WATER HAMMER

READ BEFORE INSTALLATION

### Step 1 — Installation Position

Install the dampener in-line, as close as possible to and before the device causing the water hammer pressure spike (see FIGURE 2). For example, if a quick closing valve is causing water hammer, install the dampener on a tee or elbow as close as possible upstream of the valve. Dampener installation should be no more than ten pipe diameters from the valve. It is advisable to install an isolation valve between the dampener inlet and the mounting tee so maintenance and pressure checks can be done while the system is operating.

FIGURE 2



### Step 2 — Charging and Start-Up (see Pre-Charge Notes)

Chargeable models do not require an air line connection. Dampener can be pre-charged with compressed air up to a maximum pressure of 150 psi (10.3 bar). If maximum pressure will exceed 150 psi (10.3 bar), dampener must be pre-charged with Nitrogen only. Use a hand pump, Nitrogen tank or air compressor to charge dampener. **DO NOT USE OXYGEN.** Charging hose kits are available from BLACOH.

The dampener must be pre-charged **after** installation but **prior to** system operation. The only method to get an accurate pressure charge in the dampener is to charge it prior to system start up or with a closed isolation valve at the dampener inlet. Pre-charge the dampener with 90% to 95% of expected system pressure. **DO NOT USE OXYGEN.** A fill valve similar to a Schrader type tire valve but designed for suppressors, is mounted to the top of the dampener. Replace fill valve cap after charging dampener and re-check dampener charge every month.

# SENTRY

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## NOTES

## **MANUFACTURER'S LIMITED WARRANTY & RETURN POLICY**

### **Standard Product Limited Warranty**

Subject to the limitations set forth below, Blacoh Fluid Controls, Inc. ("Blacoh") warrants its products to be free from defects in material and workmanship under normal use, service, and maintenance in accord with Blacoh's published specifications for a period of two years from date of shipment by Blacoh (the "Warranty"). The EXCLUSIVE REMEDY for any product defect covered under this Warranty shall be one of the following, as determined by Blacoh in Blacoh's sole discretion: (a) refund of the purchase price; or (b) replacement or repair of the defective part or parts at Blacoh's facility. This Warranty will be null and void if the product is used in an inappropriate application or if the product has been altered, misapplied, improperly installed, or not properly inspected and maintained. To the maximum extent allowed by applicable law, Blacoh will not be responsible for nor have any liability for any "Damage," which means any of the following, whether the claim sounds in breach of contract, breach of warranty, tort, strict liability, implied contractual indemnity, or otherwise: (i) any damage, loss, or injury of any kind, or destruction, or death, whether or not caused by any defect in a Blacoh product and whether or not the Blacoh product is installed, used, operated, and/or maintained in accord with Blacoh instructions, to other products, machinery, buildings, property, or persons, and (ii) any costs, expenses, losses, or incidental, consequential, or special damages of any kind or nature, including but not limited to loss of profits, arising from or related to any Blacoh product, whether or not caused by any defect in a Blacoh product and whether or not the Blacoh product is installed, used, operated, and/or maintained in accord with Blacoh instructions. Damage resulting from chemical incompatibility or from over-pressurization of a product, whether from gas or fluid, is not covered under this Warranty, nor will Blacoh be responsible in any way for any such Damage. Because Blacoh does not determine and cannot anticipate or control the many different conditions under which its products may be used, Blacoh does not warrant the applicability, suitability, or fitness of any of its products for any particular use or purpose. Statements concerning the possible use of Blacoh products are not intended and shall not be interpreted as warranties of fitness for any specific use of such products. Each user of Blacoh products must conduct its own engineering analysis and tests to determine the suitability of each Blacoh product for the user's intended uses or purposes, including but not limited to chemical compatibility and pressurization, and any written or oral assistance from Blacoh in this regard does not relieve the user from exclusive responsibility for such engineering analysis and testing. Blacoh products are sold with only this limited Warranty, and each buyer assumes all responsibility for Damage (as defined above), including but not limited to, Damage arising from defects in Blacoh products and/or from the handling and use of Blacoh products whether used in accordance with Blacoh's directions or otherwise. Any products sold by Blacoh which are manufactured by and sold under the name of another company are NOT WARRANTED by Blacoh under the foregoing Warranty or otherwise. The buyer must rely exclusively on the product warranty, if any, given by such other company. Products manufactured by Blacoh as an original equipment manufacturer (OEM) to be sold by a customer under the customer's brand and name are warranted by Blacoh only under the above Warranty, and Blacoh shall have no liability whatsoever with respect to any representation or warranty given by such customer (or such customer's representatives, distributors, agents, employees, or independent contractors) to any of its buyers which is different in any respect whatsoever from the foregoing Warranty. EXCEPT FOR THE WARRANTY GIVEN ABOVE, WHICH IS SUBJECT TO THE ADDITIONAL LIMITATIONS STATED ABOVE, AND EXCEPT FOR THE ADDITIONAL LIMITED WARRANTY ON BLACOH'S PTFE BELLOWS STATED BELOW, BLACOH GIVES NO WARRANTY OF ANY NATURE WHATSOEVER, EXPRESS OR IMPLIED, WITH RESPECT TO ANY OF ITS PRODUCTS, INCLUDING WITHOUT LIMITATION NO WARRANTY OF MERCHANTABILITY AND NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. NO COURSE OF DEALING, USAGE OF TRADE, OR OTHER ORAL OR WRITTEN STATEMENTS SHALL MODIFY THE FOREGOING WARRANTY PROVISIONS AND LIMITATIONS IN ANY RESPECT WHATSOEVER. This Warranty shall be governed by and construed in accordance with the laws of the State of California.

### **PTFE Bellows Limited Warranty**

In addition to Blacoh's Standard Product Limited Warranty and subject to the limitations set forth below, Blacoh warrants that its PTFE Bellows equipment ("PTFE Bellows") on Blacoh's PTFE Bellows-fitted pulsation dampener will perform in accordance with Blacoh's written product description for three years from date of shipment ("PTFE Bellows Warranty"). This PTFE Bellows Warranty applies only to PTFE Bellows that are sized, charged, installed, used, operated, and maintained strictly in accordance with all installation, use, operation, and maintenance instructions provided by Blacoh, and failure to properly size, charge, install, use, operate, and maintain the PTFE Bellows (or failure to do any of them) shall make the PTFE Bellows Warranty null and void. This PTFE Bellows Warranty does not include applications where failure of performance is due to an unbalanced pressure load or a transient pressure spike (sometimes called a water hammer). The EXCLUSIVE REMEDY for breach of this PTFE Bellows Warranty is replacement of the PTFE Bellows at Blacoh's facility, and not any other equipment or parts whatsoever, and Blacoh will not be responsible for any Damage or any other loss of any kind, including but not limited to incidental, consequential, or special damages (including but not limited to loss of profits), in any way arising from failure of the PTFE Bellows to perform in accordance with Blacoh's written product description. This PTFE Bellows Warranty shall be governed and construed in accordance with the laws of the State of California.

### **Warranty Claims**

1. Prior to returning any product to Blacoh based on a claim of breach of Warranty or PTFE Bellows Warranty, a Blacoh Return Request form must be completed. The form will be reviewed by Blacoh to determine if a Return Merchandise Authorization (RMA) number will be issued. The issuance of an RMA number does not constitute Blacoh's acknowledgment or agreement that the warranty claim is justified or correct.
2. If an RMA number is issued by Blacoh, customer should then deliver the product in question to the address specified on the RMA, freight prepaid.
3. All products so returned to Blacoh based on a claim of breach of Warranty or of PTFE Bellows Warranty must be cleaned, sanitized and neutralized prior to shipment to Blacoh. Blacoh will not accept any part that contains corrosive chemicals, organic cultures, blood, any harmful residue or air borne materials that might contaminate a breathable atmosphere or put at risk any person or property. Any shipment that does not comply will be returned at the expense of the customer, or the customer will be required to arrange for pickup.
4. **HAZMAT SHIPMENTS WILL BE REMOVED AND PROCESSED AT CUSTOMER'S EXPENSE.**
5. Receipt by Blacoh of a return does not constitute Blacoh's agreement that Blacoh is in breach of its Warranty or PTFE Bellows Warranty.
6. If Blacoh determines that a defect in workmanship or material of a part has occurred, customer is not entitled to a complete unit replacement. In the event of such a defect, Blacoh will repair or replace the defective part or parts or refund the purchase price, as Blacoh determines in Blacoh's sole discretion.

### **New Product Returns**

1. If a customer wishes to return a new, unused product, the customer must first request a Return Merchandise Authorization (RMA) number from Blacoh. Blacoh will determine if the unit can be returned for possible credit.
2. Product to be returned must be new, unused, and of current design and purchased within thirty (30) days of the return request. In addition the product must not have been damaged after original shipment by Blacoh.
3. Product returns must be delivered, freight prepaid.
4. Blacoh has the right to inspect all returned products prior to acceptance or rejection.
5. ALL RETURNS are subject to a minimum \$25.00 or 20% restocking fee, whichever is greater. (Higher restocking fees may be charged on special items and some models may not be eligible for return). Returns accepted by Blacoh will be credited to the customer's account less the re-stocking fee. Refunds will not be issued.
6. Any outsourced product supplied by Blacoh will be subject to the warranty, return policy and re-stock fee charged by the manufacturer of the outsourced product.

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**BLACOH FLUID CONTROL, INC.**

601 Columbia Ave, Bldg D  
Riverside, CA 92507 USA

Phone: 951.342.3100  
800.603.7867

Fax: 951.342.3101

Email: Sales@Blacoh.com

www.blacoh.com

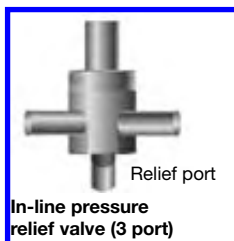


# Pump & Systems Accessories

## Backpressure Valves

### Pressure Relief Valves

#### Backpressure, antisiphon and pressure relief valves



Backpressure (2-port) valves may be used in-line to provide a constant discharge pressure for protection from siphoning, or they may be teed off of the discharge line for pressure relief, discharging back to the source tank or to the pump suction line to create a bypass.

Pressure relief (3-port) valves are mounted in the discharge line, featuring a separate relief port which discharges back to the source tank or to the pump suction line to create a bypass.

Backpressure valves provide several functions: they improve repeatability by providing a constant discharge pressure; they provide antisiphon protection for discharge into pressurized water lines or vacuums, or where suction head exceeds discharge head; and they minimize pulsation when used in conjunction with a pulsation dampener.

#### In-line backpressure/antisiphon and pressure relief valves

These adjustable backpressure (2-port) and pressure relief (3-port) valves have FNPT ports and require tubing adapters for use with flexible tubing.

Can be adjusted with screwdriver.



Backpressure valve on tee for pressure relief

#### Technical data

##### Size:

1"

##### Diaphragm

##### Materials:

PTFE-faced EPDM

##### Liquid Handling

##### Materials:

PP, PVC, PTFE, PVDF  
316 Stainless Steel

##### Pressure Adjustment:

0-150 psig (0-10.3 bar)

##### Flow rates @ 45 psig (3.1 bar):

1/4" - 132 U.S. gph (500 L/h)

1/2" - 132 U.S. gph (500 L/h)

##### Flow rates @ 150 psig:

1/2" (PP, PVC) - 200 U.S. gph (757 L/h)

1/2" (PVDF, TT, SS) - 300 U.S. gph  
(1135 L/h)

3/4" - 300 U.S. gph (1135 L/h)

1" - 500 U.S. gph (1893 L/h)

1-1/2" - 900 U.S. gph (3407 L/h)

2" - 1200 U.S. gph (4542 L/h)

##### Max. Temperature:

PP - 195°F (90°C)

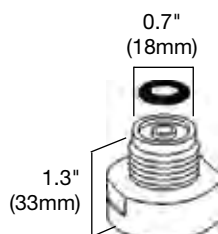
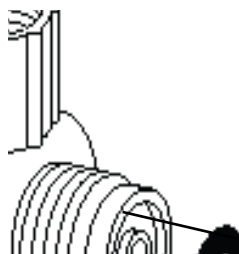
PVC - 140°F (60°C)

PTFE - 250°F (121°C)

PVDF - 250°F (121°C)

316 Stainless - 250°F (121°C)

Max. Pressure Rating 170 psig @ 120°F



Adapter included with all back-pressure/pressure relief valves. Optional use in the event of diaphragm failure.

#### DIMENSIONS: 1/4" to 1/2" valves

D	A (in)	B (in)	C (in)
1/4"	4.90	2.6	1.2
*1/4"	*3.5	*2.375	*0.75
1/2"	4.9	2.6	1.2
*1/2"	*5.5	*3.5	*1.125
3/4"	5.4	3.5	1.1
1"	5.7	3.9	1.4
1-1/2"	8.5	4.6	2.2
2"	8.5	4.6	2.2v

\*Note: Dimensions apply to SS and PTFE valves only.

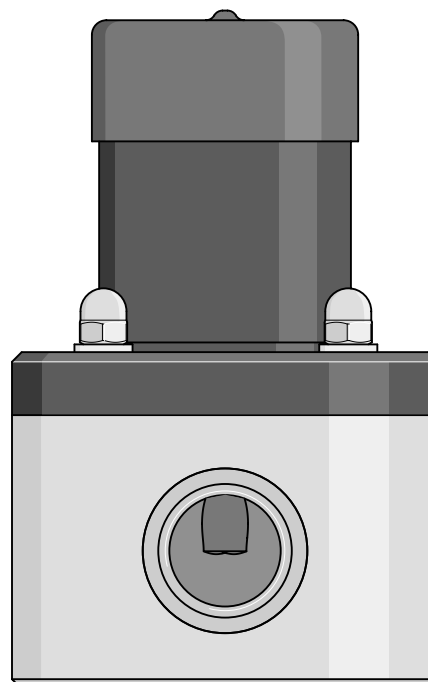
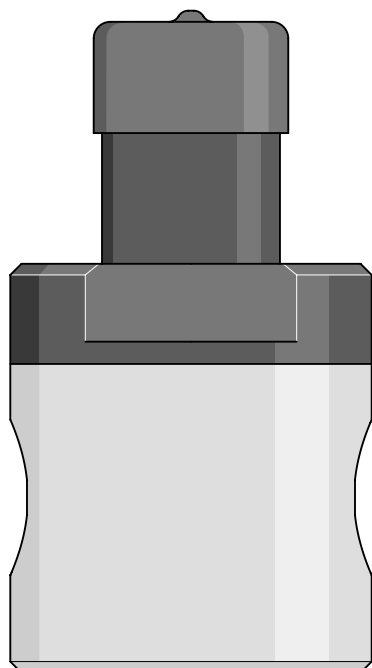
#### DIMENSIONS (for replacement valves only): 1/4" to 1/2" valves - SEE PG. 8

D	A (in)	B (in)	C (in)
1/4"	3.9	2.375	0.75
*1/4"	*3.5	*2.375	*0.75
1/2"	4.6	2.375	1.125
*1/2"	*5.5	*3.5	*1.125
3/4"	5.5	3.5	1.125
1"	5.8	3.5	1.25
1-1/2"	9.0	4.5	2.1
2"	9.0	5.0	2.1

\*Note: Dimensions apply to SS, PVDF and PTFE valves only.

# Operating Instructions

## ProMinent® Backpressure and Pressure Relief Valves



<i>Contents</i>	<i>Page</i>	<i>Contents</i>	<i>Page</i>
Safety Instructions .....	2	Optional Diaphragm Safety Port .....	6
Unpacking .....	2	Part Numbers & Accessories .....	8
Introduction .....	2	Maintenance .....	7
Installation .....	3	Spare Parts .....	7
Description of Controls & Operation .....	5	Repair Service .....	7
Helpful Tips .....	5	Troubleshooting .....	7
Specifications .....	5	Dimensions .....	11

**Read the operating instructions before installation and use. The warranty does not cover damages due to faulty operation. *Keep for reference and replacement information.***

BA B/PRVI 01 1/04 NA

Order no.7750089

### ProMinent Fluid Controls, Inc.

136 Industry Drive, Pittsburgh, PA 15275-1014

### ProMinent Fluid Controls Ltd.

490 Southgate Drive, Guelph, Ontario N1G 4P5

*e-mail: sales@prominent.cc*

Phone: 412/787-2484 Telefax: 412/787-0704

*e-mail: sales@prominent.ca*

Phone: 519/836-5692 Telefax: 519/836-5226

## Operating Instructions for ProMinent® Backpressure and Pressure Relief Valves

### *General Safety Considerations*

### *Safety Operating Procedures*

#### **SAFETY INSTRUCTIONS**

- Wear protective clothing and glasses when working with or near chemicals.
- Refer to the MSDS for all chemicals being used.
- Use only ProMinent® parts. Use of other parts may result in damage to equipment or injury.
- Flush all components that are in contact with chemicals prior to servicing.
- Secure all chemicals and equipment making them inaccessible to children and pets.
- Dispose of all chemicals and waste according to all local, state and federal regulations.
- Stop the flow of sample through the system prior to working on the pump.
- Do not exceed the maximum operating pressure.

#### **UNPACKING**

CHECK ALL EQUIPMENT FOR DAMAGE AND FOR COMPLETENESS AGAINST THE ORDER. REPORT INCORRECT ORDERS OR DAMAGES TO THE SELLER IMMEDIATELY.

The carton should contain:

1 Backpressure or Pressure Relief Valve as ordered  
Accessories as ordered

#### **INTRODUCTION**

ProMinent® diaphragm pressure relief valves are designed to protect chemical feed systems from overpressure caused by defective equipment or by blockage in the chemical line. Chemical flows through the valve via an internal chamber. When the pressure in the chemical line exceeds the preset pressure of the valve, the diaphragm lifts off the seat and the chemical then flows out the bottom port back into the chemical tank. The relief pressure is adjustable from 0-150 psig by the adjuster in the top of the valve.

ProMinent® diaphragm backpressure valves are used to enhance the performance of the chemical feed pumps by providing a constant head pressure. These valves can also be used as an antisiphon valve. The diaphragm is held against the seat by an internal spring. The backpressure is adjustable from 0-150 psig. When the inlet pressure exceeds the preset pressure, the diaphragm lifts off the seat and the chemical flows to the injection point.



## FUNCTION AND DESCRIPTION

The ProMinent® backpressure and pressure relief valves have been modified to include an optional diaphragm safety port to route the chemical in the event of a diaphragm failure. The optional diaphragm safety port fitting must be removed to adjust the backpressure screw. **NOTE: If the optional diaphragm safety port tubing adapter is not installed, upon diaphragm failure, chemical will come out thru the screwdriver adjustment slot.**

## INSTALLATION

### Pressure Relief Valve

Install as close to the chemical pump discharge valve as possible, without any other equipment, especially shut-off valves, between the pressure relief valve and the pump.



The relief port in the bottom of the valve should be vented back to the chemical tank or directly to the drain. No backpressure can be applied to the outlet of the valve. This will impair the valve's ability to relieve at the preset pressure. The valve should not be installed across the pump. That is, the valve should not be connected from the discharge of the pump to the suction side of the pump if there is a check valve in the suction line that could prevent pressure relief.

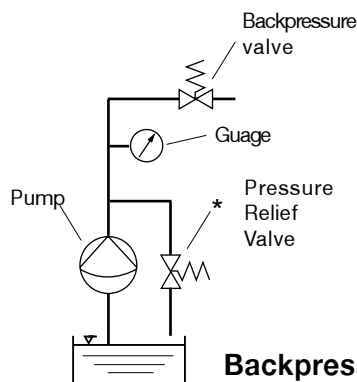
### Back Pressure Valve

The backpressure valve can be installed anywhere in the discharge line, provided there is some downstream pressure at the dosage point via an injection valve or line pressure. If there is no downstream pressure, the backpressure valve should be installed at the dosage point to prevent drainage of the chemical line. The chemical must flow across the valve, in the direction of the arrow.

The performance of the backpressure valve will be enhanced with the installation of a pulsation dampener to smooth out the discharge/ suction cycles of the pump.

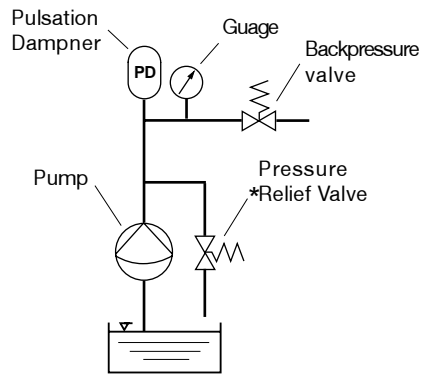
The pulsation dampener should be sized for the dosage volume of the pump head. For most applications, dampeners without diaphragms are acceptable. However some applications require dampeners with diaphragms.

## Typical Installation

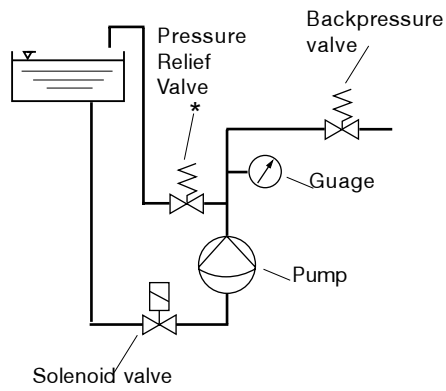


**Backpressure valve to produce a constant pressure to pump against.**

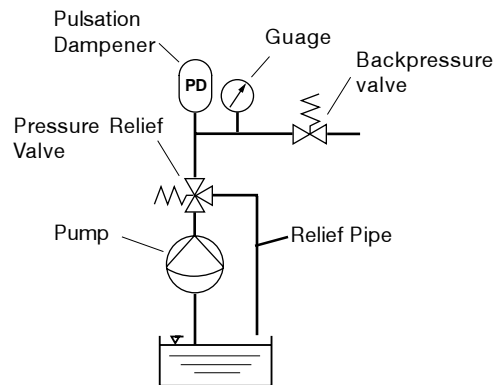
## Backpressure valve in conjunction with a pulsation dampener.



## Backpressure valve used when the suction pressure is high.



## Pressure relief valve to protect pump from overpressure





## DESCRIPTION OF CONTROLS AND OPERATION

Adjust the backpressure and the pressure relief valves by turning the pressure adjuster on the valves to the desired pressure. The valves have a screwdriver slot to adjust the pressure. Turning clockwise increases the pressure and counterclockwise decreases the pressure.

**OR:**

## ADJUSTING THE PRESSURE ON THE VALVES

Remove the optional diaphragm safety port from the top of the valve by unscrewing it from the backpressure/pressure relief valve. The valves have a screwdriver slot to adjust the pressure. Turning clockwise increases the pressure and counterclockwise decreases the pressure. Replace the relief assembly by screwing it onto the backpressure/pressure relief valve.

## HELPFUL TIPS

1L = 0.264 gallon

1000 mL = 1 L

1 bar = 14.5 psig

## SPECIFICATIONS

Size:	1/4", 1/2", 3/4", 1", 1 1/2", 2" NPT or Socket
Diaphragm material:	PTFE-faced EPDM
Liquid handling materials:	PP, PVC, PTFE, PVDF, 316 Stainless Steel
Pressure adjustments:	0-150 psig
Flow rates at 45 psig:	1/4" - 132 gph 1/2" - 132 gph 3/4" - 235 gph 1" - 345 gph 1-1/2" - 740 gph 2" - 740 gph
Max. Temperature:	PP - 122°F PVC - 100°F PTFE - 250°F PVDF - 250°F 316 Stainless - 250°F

## ATTACHING TUBING TO THE OPTIONAL DIAPHRAGM SAFETY PORT

Connector sets connect flexible tubing of different sizes to optional diaphragm safety port fitting. A connector set consists of hose nozzle, grip ring, union nut and gasket. All connector sets fit on optional diaphragm safety port with M20 X 1.5 threads. Part number includes two connector sets. One of the following connector sets are required to attach the tubing to the relief port:

### PART NUMBERS

PP/VITON® for tubing size 1/4" x 3/16" .....	790872
PP/VITON® for tubing size 1/2" x 3/8" .....	740133
PP/EPDM for tubing size 1/4" x 3/16" .....	790885
PP/EPDM for tubing size 1/2" x 3/8" .....	740132
PP/EPDM for tubing size 1/4" x 1/2" .....	817163
PVC/VITON® for tubing size 1/4" x 3/16" .....	817050
PVC/VITON® for tubing size 1/2" x 3/8" .....	817055
PVC/VITON® for tubing size 1/4" x 1/2" .....	817068
PVC/EPDM for tubing size 1/4" x 3/16" .....	790871
PVC/EPDM for tubing size 1/2" x 3/8" .....	740160
PTFE for tubing size 1/4" x 3/16" .....	817201
PTFE for tubing size 1/2" x 3/8" .....	791199

Cut hose ends straight across

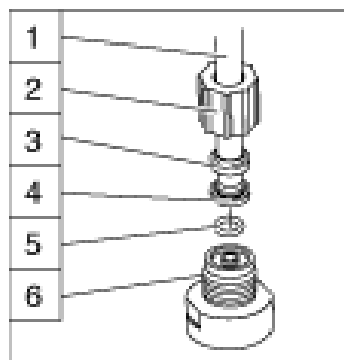
Push Union Nut (2) and clamping ring (3) onto tubing (1)

Push the tubing end (1) over the nozzle (4) to the stop.  
Widen if necessary

Place the hose (1) with the nozzle (4) onto the optional diaphragm safety port fitting (6)

Tighten the union nut (2) while pressing in the tubing (1)

Pull the tubing connected to the optional diaphragm safety port fitting (6); then retighten the union nut



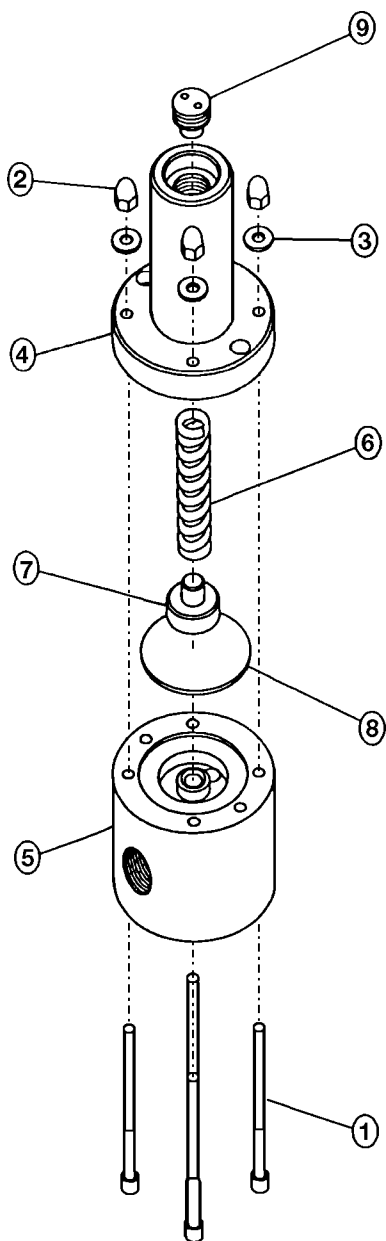
- 1      **Tubing**
- 2      **Union Nut**
- 3      **Clamping Ring**
- 4      **Nozzle**
- 5      **O-ring**
- 6      **Optional diaphragm  
safety port fitting**

## MAINTENANCE

Routinely look for leaks that could indicate a diaphragm rupture. Replacement of the diaphragm can be done without taking the valve out of the chemical line.

### Replacing the diaphragm

- Relieve the pressure from the system.
- Flush the chemical lines prior to disassembling the valve.
- Unscrew the pressure adjuster to relieve the pressure from the diaphragm.
- Unscrew the valve top from the valve bottom **or** Remove the 4 bolts from the top of the valve.
- Lift off the top of the valve.
- Inspect the diaphragm and replace as necessary.
- Inspect the adjustment spring for rust or corrosion and replace if necessary.
- Replace the spring and the spring bumper into the top of the valve.
- Slide the top of the valve back over the bolts and Tighten the screws **or** Screw the valve top to the valve bottom and tighten.
- Screw in the pressure adjuster to approximately the same position it was prior to disassembly.
- Use a pressure gauge to adjust the valve to the desired pressure setting.



Example of a backpressure valve

## SPARE PARTS

1. Bolts
2. Hex Nut
3. 1/4" Flat Washer
4. Valve Lid
5. Valve Body
6. Pressure Spring
7. Spring Plate
8. Diaphragm
9. Pressure Adjustment Screw

## REPAIR SERVICE

Repairs must be done by ProMinent® Fluid Controls. Call your distributor or ProMinent® at (412) 787-2484 for a return goods authorization. DO NOT return any goods without authorization. All items must be free of hazardous chemicals and clean when returned.

## TROUBLESHOOTING

**Leaking:** Check for clogs, diaphragm ruptures or corrosion of the spring.



## Part Numbers and Accessories

## 1/4" FNPT Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PP	1009444	1009452
PVC	1009445	1009453
PVDF	1009446	1009454
316 SS	1009447	1009455



Backpressure  
Valve (2 port)

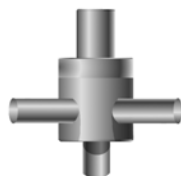
Tubing Adapters

(1 required per valve port): 1/4" x 3/16" tubing x 1/4" MNPT

PP/EPDM (PP1)	7358222
PP/Viton (PP2)	7358226
PVC/Viton (NP6)	7358223
PTFE (TT1)	7358224

## 1/2" FNPT Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PP	1006846	1006858
PVC	1006850	1006862
PVDF	1006854	1006866
316 SS	1008796	1008800



Pressure Relief  
Valve (3 port)

Tubing Adapters

(1 required per valve port): 1/2" x 3/8" tubing x 1/2" MNPT

PP/EPDM (PP1)	7358220
PP/Viton (PP2)	7358227
PVC/Viton (NP6)	7358221
PTFE (TT1)	7358225

## 3/4" FNPT Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PP	1006847	1006959
PVC	1006851	1006863
PVDF	1006855	1006867
316 SS	1008797	1008801

**Part Numbers and Accessories (CONT.)****1" FNPT Valves**

<b>Material</b>	<b>Backpressure Valve (2-port)</b>	<b>Pressure Relief Valve (3-port)</b>
PP	1006848	1006860
PVC	1006852	1006864
PVDF	1006856	1006868
316 SS	1008798	1008802

**1-1/2" FNPT Valves**

<b>Material</b>	<b>Backpressure Valve (2-port)</b>	<b>Pressure Relief Valve (2-port)</b>
PP	1006849	1006865
PVC	1006853	1006865
PVDF	1006857	1006869
316 SS	1008799	1008803

**2" FNPT Valves**

<b>Material</b>	<b>Backpressure Valve (2-port)</b>	<b>Pressure Relief Valve (2-port)</b>
PP	1009448	1009456
PVC	1009449	1009457
PVDF	1009450	1009458
316 SS	1009451	1009459

**Spare Diaphragms**

1/4" - 1/2" valve PTFE/EPDM	1006813	1006813
3/4" - 1" valve PTFE/EPDM	1006814	1006814
1-1/2"-2" valve PTFE/EPDM	1006815	1006815

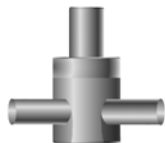
## Part Numbers and Accessories

## 1/4" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PVC	1019891	1019892
PVDF	1019893	1019894

## 1/2" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PVC	1019883	1019884
PVDF	1019895	1019896

Backpressure  
Valve (2 port)

## 3/4" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PVC	1019885	1019886
PVDF	1019897	1019898

Pressure Relief  
Valve (3 port)

## 1" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (3-port)</u>
PVC	1019887	1019888
PVDF	1019899	1019900

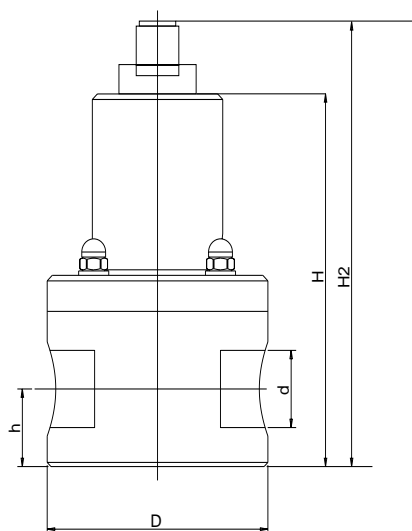
## 1-1/2" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (2-port)</u>
PVC	1019889	1019889
PVDF	1019901	1019901

## 2" Socket Valves

<u>Material</u>	<u>Backpressure Valve (2-port)</u>	<u>Pressure Relief Valve (2-port)</u>
PVC	1019891	1019891
PVDF	1019905	1019905

## Dimensions



Valve size d [inches]	Thread type	h [mm]	h (in.)	D [mm]	D (in.)	H [mm]	H (in.)	H2 (mm)	H2 (in.)
1/4	NPT	31	1.2	65	2.6	125	4.9	158	6.2
1/2	NPT	31	1.2	65	2.6	125	4.9	158	6.2
3/4	NPT	28	1.1	88	3.5	136	5.4	169	6.7
1	NPT	36	1.4	98	3.9	145	5.7	178	7.0
1-1/2	NPT	56	2.2	118	4.6	229.5	9.0	260.5	10.3
2	NPT	56	2.2	118	4.6	229.5	9.0	260.5	10.3



## 701LDS MOLDED GAUGE/SEAL

This innovative new product was developed to solve many common problems associated with polymer type diaphragms seals. Due to the **all molded design** the gauge cannot be removed from the seal, preventing loss of fill – And There is no chance of cracking the upper housing by over tightening the gauge. This product is also molded of a harder blend of polymers – making them more resistant to cracking or breaking during installation.

### Black Body PP Assembly



For filter and pump control on liquid and gases. Housed in all PP material can resist transient overpressure and maintain leak-tight connection. It is also designed to satisfy requirements in corrosive atmosphere & fluids.

Polypropylene Seal Assembly

Injection Molded Polypropylene
2 1/2" Diameter
1/4" or 1/2" FNPT
Viton
Brass
Brass
Glycerine (Others Available upon Request)
Polycarbonate
Dry but Fillable
Dual Scale PSI / Bar / x 100 = kPa
Others Available upon Request
15 PSI to 400 PSI
-4°F to 140°F / -20°C to + 60°C
1.5 % Full Scale

### White Body PTFE Assembly



**TEFLON** anti-impact, all in one Protect from acidification & alkalization excellent stability With its deform temperature is 150°C.

Specialized used in PCB/LCD, high-tech zone, IC equipment, pipe-Line installation and the internal outfit of dust-free chamber with all in one case cover-ed around in order to its unbreakable function and excellent anti-corrosion properties.

PTFE Seal Assembly

#### Specifications:

**Case & Body:**

**Dial Size:**

**Process Conn:**

**Diaphragm:**

**Bourdon Tube:**

**Internals:**

**Fill Fluid:**

**Lens:**

**Case Style:**

**Dial:**

**Max Pressure:**

**Max Temp:**

**Accuracy:**

Injection Molded PTFE

2 1/2" Diameter

1/4" or 1/2" FNPT

PTFE

316SS

316SS

Based upon customer requirements

Polycarbonate

Dry but Fillable

Dual Scale PSI / Bar / x 100 = kPa

Others Available upon Request

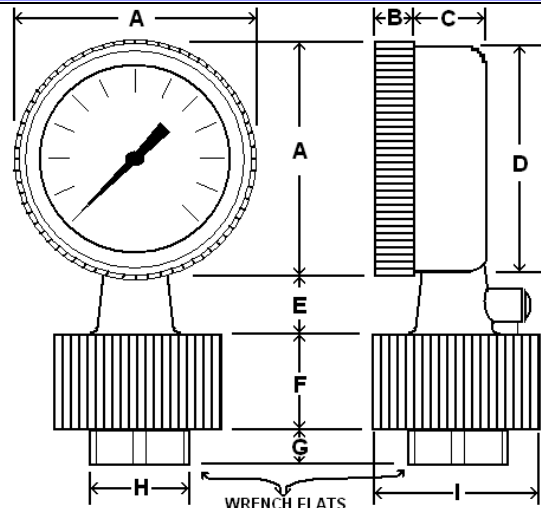
15 PSI to 400 PSI

-4°F to 140°F / -20°C to + 60°C

1.5 % Full Scale

#### Dimensions:

	Inches	MM
A	2.89"	73.44
B	.62"	15.80
C	1.04"	26.47
D	2.61"	66.36
E	.50"	12.82
F	1.19"	30.36
G	.43"	10.99
H	1.23"	31.28
I	2.29"	58.29





## FuelFLEX™ 65 PVC Fuel Tubing

### Features and Benefits:

- Flexible and easy to install (65A durometer)
- Resists swelling and hardening
- Easy-to-identify transparent yellow

### Recommended Applications:

- For intermittent use with petroleum-based products
- Fuel drain lines, vent tubes and overflow tubes
- Transfer of gasoline, heating oils, cutting compounds and coolants
- Lab handling of distillates
- NOT intended for use with foods or beverages

FuelFLEX 65 Cat. No.	Size, in.					Oper. Pressure, psig @ 73°F	Case Qty., ft.
	ID	x	OD	x	Wall		
8365-4230	3/32		3/16		3/64	54	100
8365-4245	1/8		1/4		1/16	62	100
8365-4295	3/16		5/16		1/16	48	100
8365-4335	1/4		3/8		1/16	40	100
8365-4390	5/16		7/16		1/16	36	100
8365-4430	3/8		1/2		1/16	30	100
8365-4465	7/16		5/8		3/32	40	100
8365-4515	1/2		3/4		1/8	40	100
8365-4570	5/8		7/8		1/8	34	100
8365-2605	3/4		1		1/8	30	50

## BraidFLEX™ 70N Braided PVC Tubing

### Features and Benefits:

- Now complies with NSF-51
- Complies with FDA CFR 21 for food packaging
- Embedded braid prevents material entrapment, ensures easy cleaning
- Easy to bend into place
- Flexible; permits tight clamping for leakproof connections
- Maximum working pressure clearly printed on tubing
- Clear tubing allows full visual flow monitoring

### Recommended Applications:

- Transfer lines
- Higher-pressure applications, including lab, food and beverage use
- Pneumatic circuitry
- Cell culture
- Use with insert/barbed fittings
- NOT recommended for vacuum applications

BraidFLEX 70N Cat. No.	Size, in.					Oper. Pressure, psig @ 73°F	Case Qty., ft.
	ID	x	OD	x	Wall		
8470-4300	3/16		3/8		3/32	276	100
8470-7300	3/16		3/8		3/32	276	250
8470-4340	1/4		7/16		3/32	276	100
8470-7340	1/4		7/16		3/32	276	250
8470-4395	5/16		1/2		3/32	276	100
8470-4435	3/8		9/16		3/32	250	100
8470-7435	3/8		9/16		3/32	250	250
8470-4515	1/2		3/4		1/8	230	100
8470-7515	1/2		3/4		1/8	230	250
8470-4570	5/8		7/8		1/8	230	100
8470-7570	5/8		7/8		1/8	230	250
8470-2605	3/4		1		1/8	176	50
8470-7605	3/4		1		1/8	176	250
8470-2680	1		1-5/16		5/32	140	50
8470-7680	1		1-5/16		5/32	140	250
8470-2715	1-1/4		1-5/8		3/16	100	50
8470-2750	1-1/2		1-7/8		3/16	80	50
8470-2790	2		2-1/2		1/4	70	50



# PVC SCHEDULE 80 FITTINGS

80-2-1000

## Performance Engineered & Tested



SPEARS® Schedule 80 PVC fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material reinforcement is uniformly placed in stress concentration areas for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure obtaining the very best PVC fittings available.

### Full 1/4" Through 12" Availability

Spears® comprehensive line of injection molded PVC fittings offers a variety of configurations in molded Schedule 80 sizes 1/4" through 12" conforming to ASTM D 2467 and Spears® exclusive CL150 Flanges in sizes 1/2" through 16".

### Exceptional Chemical & Corrosion Resistance

Unlike metal, PVC fittings never rust, scale, or pit, and will provide many years of maintenance-free service and extended system life.

### High Temperature Ratings

PVC thermoplastic can handle fluids at service temperatures up to 140° F (60°C), allowing a wide range of process applications, including corrosive fluids.

### Lower Installation Costs

Substantially lower material costs than steel alloys or lined steel, combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.

### Higher Flow Capacity

Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.

### Additional Fabricated Configurations through 36"

Extra large, hard-to-find, and custom configurations are fabricated from NSF Certified pipe. Fittings are engineered and tested to provide full pressure handling capabilities according to Spears® specifications.

### Advanced Design Specialty Fittings

Spears® wide range of innovative, improved products include numerous metal-to-plastic transition fittings and unions with Spears® patented special reinforced (SR) plastic threads.

### PVC Valves

SPEARS® PVC Valve products are available for total system compatibility and uniformity; see SPEARS® THERMOPLASTIC VALVES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS (V-4).



### Sample Engineering Specifications

All PVC Schedule 80 fittings shall be produced by Spears® Manufacturing Company from PVC Type I, cell classification 12454, conforming to ASTM Standard D 1784. All injection molded PVC Schedule 80 fittings shall be Certified for potable water service by NSF International and manufactured in strict compliance to ASTM D 2467. All fabricated fittings shall be produced in accordance with Spears® General Specifications for Fabricated Fittings. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

**PROGRESSIVE PRODUCTS FROM SPEARS® INNOVATION & TECHNOLOGY**

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



### PVC Thermoplastic Pipe Temperature Pressure De-Rating

To determine the maximum internal pressure rating at an elevated temperature, simply multiply the pipe pressure rating at 73°F by the percentage specified for the desired temperature.

System Operating Temperature °F (°C)	73 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)
PVC	100%	90%	75%	62%	50%	40%	30%	22%

NOTE: Valves, Unions and Specialty Products have different elevated temperature ratings than pipe.

### Typical Material Properties

Properties	ASTM Test Method	PVC
Mechanical Properties, 73°F		
Specific Gravity, g/cm³	D 792	1.41
Tensile Strength, psi	D 638	7,000
Modulus of Elasticity, psi	D 638	440,000
Compressive Strength, psi	D 695	9,000
Flexural Strength, psi	D 790	13,200
Izod Impact, notched, ft-lb / in	D 256	.65
Thermal Properties		
Heat Deflection Temperature, °F at 66 psi	D 648	165
Thermal Conductivity, BTU / hr / sq ft / °F / in	C 177	1.2
Coefficient of Linear Expansion, in / in / °F	D 696	3.0 x 10 <sup>-5</sup>
Flammability		
Limited Oxygen Index, %	D 2863	43
UL 94 Rating	94V-0	
Other Properties		
Water Absorption, % 24 hr.	D 570	.05
Industry Standard Color	White / Dark Gray	
ASTM Cell Classification	D 1784	12454
NSF Potable Water Approved	YES	

### PVC Chemical Resistance

PVC is generally inert to most mineral acids, bases, salts and paraffinic hydrocarbon solutions. For more information on PVC chemical resistance refer to the Chemical Resistance of Rigid Vinyls Based on Immersion Test, published by the GEON® company.

### NOT FOR USE WITH COMPRESSED AIR OR GASES

Spears® Manufacturing Company DOES NOT RECOMMEND the use of thermoplastic piping products for systems to transport or store compressed air or gases, or the testing of thermoplastic piping systems with compressed air or gases in above and below ground locations. The use of our product in compressed air or gas systems automatically voids any warranty for such products, and its use against our recommendation is entirely the responsibility and liability of the installer.

**WARNING:** DO NOT USE COMPRESSED AIR OR GAS TO TEST ANY PVC OR CPVC THERMOPLASTIC PIPING PRODUCT OR SYSTEM, AND DO NOT USE DEVICES PROPELLED BY COMPRESSED AIR OR GAS TO CLEAR SYSTEMS. THESE PRACTICES MAY RESULT IN EXPLOSIVE FRAGMENTATION OF SYSTEM PIPING COMPONENTS CAUSING SERIOUS OR FATAL BODILY INJURY.



### SPEARS® MANUFACTURING COMPANY • CORPORATE OFFICE

15853 Olden St., Sylmar, CA 91342 • PO Box 9203, Sylmar, CA 91392  
(818) 364-1611 • www.spearsmfg.com



#### PACIFIC SOUTHWEST

15860 Olden St.  
Sylmar (Los Angeles), CA 91342  
(818) 364-1611 • (800) 862-1499  
Fax (818) 367-3014

#### ROCKY MOUNTAIN

4880 Florence St.  
Denver, CO 80238  
(303) 371-9430 • (800) 777-4154  
Fax (303) 375-9546

#### UTAH

5395 West 1520 South  
Salt Lake City, UT 84104  
(303) 371-9430 • (800) 777-4154  
Fax (303) 375-9546

#### SOUTHEAST

4205 Newpoint Pl. Suite 100  
Lawrenceville (Atlanta), GA 30043  
(678) 985-1263 • (800) 662-6326  
Fax (678) 985-5642

#### MIDWEST

1 Gateway Ct. Suite A  
Bolingbrook (Chicago), IL 60440  
(630) 759-7529 • (800) 662-6330  
Fax (630) 759-7515

#### NORTHWEST

4103 C St. NE Suite 200  
Auburn (Seattle), WA 98002  
(253) 939-4433 • (800) 347-7327  
Fax (253) 939-7557

#### SOUTH CENTRAL

4250 Patriot Dr. Suite 300  
Grapevine (Dallas), TX 76051-2317  
(972) 691-4003 • (800) 441-1437  
Fax (972) 691-4404

#### NORTHEAST

590 Industrial Dr. Suite 100  
Lewisberry (Harrisburg), PA 17339-9532  
(717) 938-8844 • (800) 233-0275  
Fax (717) 938-6547

#### FLORIDA

9563 Parksouth Court  
Orlando, FL 32837  
(407) 843-1960 • (800) 327-6390  
Fax (407) 425-3563

#### INTERNATIONAL SALES

15853 Olden St.  
Sylmar (Los Angeles), CA 91342  
(818) 364-1611 • Fax (818) 898-3774  
E-mail: export@spearsmfg.com



# Technical Specifications - Control Enclosures Type 4X

N

*"HWT" configuration - Stainless steel hinged, latched down cover*



## NOTES:

### HWT Construction

<b>Material</b>	Hot compression molded fiberglass reinforced polyester, hand layup FRP
<b>Gasket</b>	Poured polyurethane seamless gasket provides watertight, dust-tight environmental seal
<b>Stainless Steel Hardware</b>	300 Series stainless used on all hardware
<b>Mounting Bosses</b>	Panel mounting capability for fixed rear panel
<b>Metal inserts</b>	All bosses utilize threaded brass inserts accepting 10-32 screws
<b>Soft Edge Design</b>	Rounded edges, minimal protrusions or exposed pocket areas for assembly of dust and debris

### HWT Industry Standards

<b>UL/cUL 50</b>	File E64358 Type 1, 3, 3R, 4X, 12
<b>NEMA 250</b>	Type 1, 3, 3R, 4X, 12
<b>CSA Std C22.2</b>	File LR069014 Type 1, 3, 3R, 4X, 12
<b>Temperature Range</b>	(-40°F to +250°F) (-40°C to +130°C)
<b>Flammability Rating</b>	UL94-5V
<b>Window Flammability</b>	UL94V-0
<b>Self Extinguishing</b>	Non-flame propagating
<b>Chemical Resistance</b>	Full chemical resistance charts listed in appendix

### HWT Accessories

#### Back Panels

	ORDERING INFO	
Aluminum	BP__AL	pg. 331
Carbon Steel	BP__CS	pg. 331
Fiberglass	BP__FG	pg. 331
Stainless Steel	BP__SS	pg. 331

#### Special Accessories

Vent	pg. 323
Louver	pg. 325
Assorted hubs and cord grips	pg. 327, 328
Vapor capsule	pg. 326

### HWT Modifications

See **Special ModRight™ Modification** pg 315 - 322

#### ORDERING INFO

Door brace	pg. 336
Grounding studs	pg. 339
Removable dead front panels	pg. 333
Molded in color	pg. 315 - 322
Custom painting	pg. 315 - 322
Silk screening	pg. 315 - 322
Decals	pg. 315 - 322
EMI/RFI shielding	pg. 315 - 322
Custom windows	pg. 315 - 322
Custom cutouts	pg. 315 - 322
Custom hole drilling	pg. 315 - 322
Custom blending	pg. 315 - 322



Available In These Sizes Only:

N24208HWT	N302410HWT
N242410HWT	N363012HWT

## Control Enclosures Type 4X “HWT” Configuration Technical Charts

**Control Enclosures Type 4X - “HWT” Configuration Dimensions**

CATALOG NUMBER	OVERALL H X W X D	INSIDE A X B X C	MOUNTING E X F	J	K	L	ENCLOSURE OPENING M X N	ENCLOSURE WEIGHT	PANEL NUMBER
N16107HWT	18.75 x 10.96 x 9.03 (476 x 278 x 229)	15.92 x 10.27 x 8.53 (404 x 261 x 217)	17.50 x 7.00 (444 x 178)	7.8 (198)	12 (305)	7.5 (191)	13.14 x 6.00 (334 x 152)	12 lbs.	BP-1610
N20166HWT	22.75 x 16.87 x 7.77 (578 x 429 x 197)	19.70 x 16.04 x 7.24 (500 x 407 x 184)	21.50 x 10.12 (546 x 257)	6.26 (159)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	17 lbs.	BP-2016
N20168HWT	22.75 x 16.87 x 9.77 (578 x 429 x 248)	19.70 x 16.04 x 9.24 (500 x 407 x 235)	21.50 x 10.12 (546 x 257)	8.26 (210)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	22 lbs.	BP-2016
N201610HWT	22.75 x 16.87 x 11.77 (578 x 429 x 299)	19.70 x 16.04 x 11.24 (500 x 407 x 286)	21.50 x 10.12 (546 x 257)	10.26 (261)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	23 lbs.	BP-2016
N201611HWT*	22.75 x 16.87 x 12.77 (578 x 429 x 324)	19.70 x 16.04 x 12.26 (500 x 407 x 311)	21.50 x 10.12 (546 x 257)	11.26 (286)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	23 lbs.	BP-2016
N201612HWT	22.75 x 16.87 x 13.77 (578 x 429 x 350)	19.70 x 16.04 x 13.24 (500 x 407 x 336)	21.50 x 10.12 (546 x 257)	12.26 (312)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	24 lbs.	BP-2016
N201613HWT*	22.75 x 16.87 x 14.52 (578 x 429 x 369)	19.70 x 16.04 x 13.99 (500 x 407 x 355)	21.50 x 10.12 (546 x 257)	13.01 (331)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	24 lbs.	BP-2016
N201614HWT*	22.75 x 16.87 x 15.52 (578 x 429 x 394)	19.70 x 16.04 x 14.99 (500 x 407 x 381)	21.50 x 10.12 (546 x 257)	14.01 (356)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	24 lbs.	BP-2016
N201615HWT*	22.75 x 16.87 x 16.52 (578 x 429 x 420)	19.70 x 16.04 x 15.99 (500 x 407 x 406)	21.50 x 10.12 (546 x 257)	15.01 (381)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	24 lbs.	BP-2016
N201616HWT	22.75 x 16.87 x 17.52 (578 x 429 x 445)	19.70 x 16.04 x 16.99 (500 x 407 x 432)	21.50 x 10.12 (546 x 257)	16.01 (407)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	25 lbs.	BP-2016
N201617HWT*	22.75 x 16.87 x 18.52 (578 x 429 x 470)	19.70 x 16.04 x 17.99 (500 x 407 x 457)	21.50 x 10.12 (546 x 257)	17.01 (432)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	25 lbs.	BP-2016
N201618HWT*	22.75 x 16.87 x 19.52 (578 x 429 x 496)	19.70 x 16.04 x 18.99 (500 x 407 x 482)	21.50 x 10.12 (546 x 257)	18.01 (458)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	25 lbs.	BP-2016
N201619HWT	22.75 x 16.87 x 20.52 (578 x 429 x 521)	19.70 x 16.04 x 19.99 (500 x 407 x 508)	21.50 x 10.12 (546 x 257)	19.01 (483)	15.25 (387)	11.25 (286)	16.75 x 12.19 (425 x 310)	27 lbs.	BP-2016
N20208 HWT*	23.50 x 20.50 x 9.69 (597 x 521 x 246)	20.25 x 20.25 x 8.88 (514 x 514 x 225)	22.25 x 14.50 (565 x 368)	7.88 (200)	15.25 (387)	15.25 (387)	17.00 x 16.00 (432 x 406)	26 lbs.	BP-2020
N202012HWT*	23.50 x 20.50 x 13.69 (597 x 521 x 348)	20.25 x 20.25 x 11.88 (514 x 514 x 302)	22.25 x 14.50 (565 x 368)	11.88 (302)	15.25 (387)	15.25 (387)	17.00 x 16.00 (432 x 406)	28 lbs.	BP-2020
N24126HWT	26.95 x 13.72 x 7.98 (685 x 348 x 203)	24.00 x 12.87 x 7.33 (610 x 327 x 186)	25.75 x 6.25 (654 x 159)	6.33 (161)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	21 lbs.	BP-2412
N241210HWT	26.95 x 13.72 x 11.99 (685 x 348 x 304)	24.00 x 12.87 x 11.33 (610 x 327 x 288)	25.75 x 6.25 (654 x 159)	10.33 (262)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241211HWT*	26.95 x 13.72 x 12.73 (685 x 348 x 323)	24.00 x 12.87 x 12.08 (610 x 327 x 307)	25.75 x 6.25 (654 x 159)	11.08 (281)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241212HWT*	26.95 x 13.72 x 13.73 (685 x 348 x 349)	24.00 x 12.87 x 13.08 (610 x 327 x 332)	25.75 x 6.25 (654 x 159)	12.08 (307)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241213HWT*	26.95 x 13.72 x 14.73 (685 x 348 x 374)	24.00 x 12.87 x 14.08 (610 x 327 x 358)	25.75 x 6.25 (654 x 159)	13.08 (332)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241214HWT*	26.95 x 13.72 x 15.73 (685 x 348 x 400)	24.00 x 12.87 x 15.08 (610 x 327 x 383)	25.75 x 6.25 (654 x 159)	14.08 (358)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241215HWT*	26.95 x 13.72 x 16.73 (685 x 348 x 425)	24.00 x 12.87 x 16.08 (610 x 327 x 408)	25.75 x 6.25 (654 x 159)	15.08 (383)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	25 lbs.	BP-2412
N241216HWT	26.95 x 13.72 x 17.73 (685 x 348 x 450)	24.00 x 12.87 x 17.08 (610 x 327 x 434)	25.75 x 6.25 (654 x 159)	16.08 (408)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	26 lbs.	BP-2412
N241217HWT*	26.95 x 13.72 x 18.73 (685 x 348 x 476)	24.00 x 12.87 x 18.08 (610 x 327 x 459)	25.75 x 6.25 (654 x 159)	17.08 (434)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	26 lbs.	BP-2412
N241218HWT*	26.95 x 13.72 x 19.73 (685 x 348 x 501)	24.00 x 12.87 x 19.08 (610 x 327 x 485)	25.75 x 6.25 (654 x 159)	18.08 (459)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	26 lbs.	BP-2412
N241219HWT*	26.95 x 13.72 x 20.79 (685 x 348 x 527)	24.00 x 12.87 x 20.08 (610 x 327 x 510)	25.75 x 6.25 (654 x 159)	19.08 (485)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	27 lbs.	BP-2412
N241220HWT*	26.95 x 13.72 x 21.73 (685 x 348 x 552)	24.00 x 12.87 x 21.08 (610 x 327 x 535)	25.75 x 6.25 (654 x 159)	20.08 (510)	19.25 (489)	7.25 (184)	21.00 x 8.37 (533 x 213)	32 lbs.	BP-2412

\*Available as made to order.

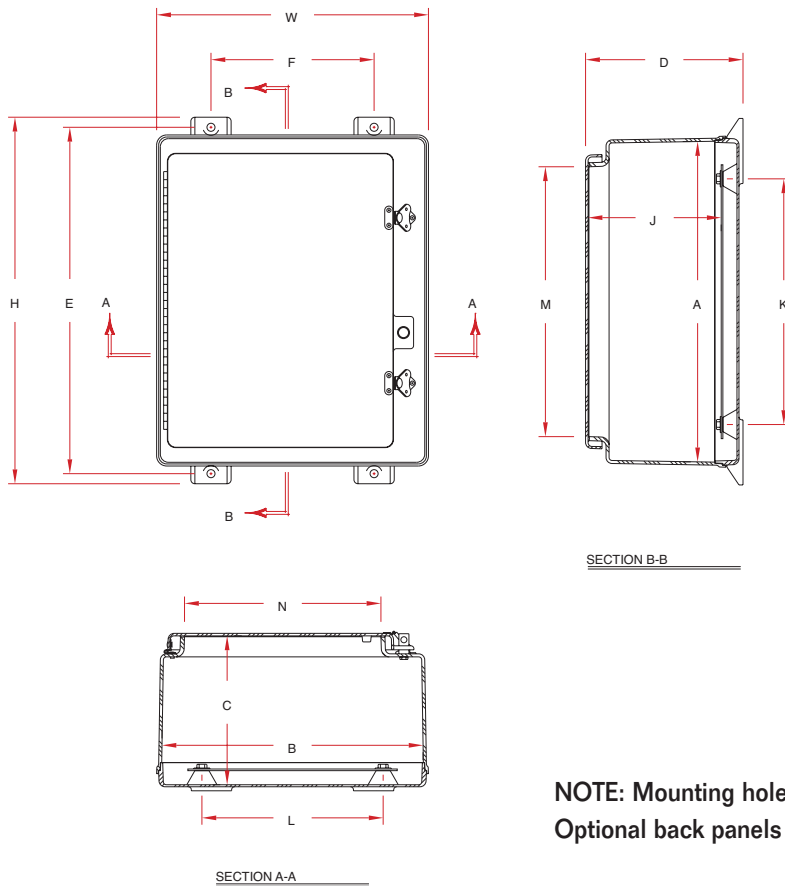
## Control Enclosures Type 4X “HWT” Configuration Technical Charts

**Control Enclosures Type 4X - “HWT” Configuration Dimensions (continued)**

CATALOG NUMBER	OVERALL H X W X D	INSIDE A X B X C	MOUNTING E X F	J	K	L	ENCLOSURE OPENING M X N	ENCLOSURE WEIGHT	PANEL NUMBER
<b>N24208HWT</b>	27.00 x 21.24 x 9.90 (686 x 539 x 252)	24.05 x 20.39 x 9.25 (611 x 518 x 235)	25.75 x 14.00 (654 x 356)	8.25 (209)	19.25 (489)	15.25 (387)	21.25 x 16.00 (540 x 406)	32 lbs.	BP-2420
N242010HWT*	27.00 x 21.24 x 11.90 (686 x 539 x 302)	24.05 x 20.39 x 11.25 (611 x 518 x 286)	25.75 x 14.00 (654 x 356)	8.25 (209)	19.25 (489)	15.25 (387)	21.25 x 16.00 (540 x 406)	37 lbs.	BP-2420
<b>N242410HWT</b>	27.00 x 25.24 x 11.90 (686 x 641 x 302)	24.05 x 24.39 x 11.25 (611 x 619 x 286)	25.75 x 17.87 (654 x 454)	10.25 (260)	19.25 (489)	19.25 (489)	21.25 x 20.00 (540 x 508)	42 lbs.	BP-2424
N242412HWT*	27.00 x 25.24 x 13.90 (686 x 641 x 353)	24.05 x 24.39 x 13.25 (611 x 619 x 336)	25.75 x 17.87 (654 x 454)	12.25 (311)	19.25 (489)	19.25 (489)	21.25 x 20.00 (540 x 508)	43 lbs.	BP-2424
N30206HWT	32.86 x 20.99 x 7.89 (835 x 533 x 200)	29.90 x 20.14 x 7.23 (760 x 511 x 184)	30.75 x 14.25 (806 x 362)	6.23 (158)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	34 lbs.	BP-3020
N30208HWT	32.86 x 20.99 x 9.89 (835 x 533 x 251)	29.90 x 20.14 x 9.23 (760 x 511 x 234)	31.75 x 14.25 (806 x 362)	8.23 (209)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	36 lbs.	BP-3020
N302010HWT	32.86 x 20.99 x 11.89 (835 x 533 x 302)	29.90 x 20.14 x 11.23 (760 x 511 x 285)	31.75 x 14.25 (806 x 362)	10.23 (260)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	39 lbs.	BP-3020
N302011HWT*	32.86 x 20.99 x 12.89 (835 x 533 x 327)	29.90 x 20.14 x 12.23 (760 x 511 x 311)	31.75 x 14.25 (806 x 362)	11.23 (285)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	48 lbs.	BP-3020
N302012HWT	32.86 x 20.99 x 13.89 (835 x 533 x 353)	29.90 x 20.14 x 13.23 (760 x 511 x 336)	31.75 x 14.25 (806 x 362)	12.23 (311)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	48 lbs.	BP-3020
N302013HWT*	32.86 x 20.99 x 14.89 (835 x 533 x 378)	29.90 x 20.14 x 14.23 (760 x 511 x 361)	31.75 x 14.25 (806 x 362)	13.23 (336)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	48 lbs.	BP-3020
N302014HWT	32.86 x 20.99 x 15.89 (835 x 533 x 404)	29.90 x 20.14 x 15.23 (760 x 511 x 387)	31.75 x 14.25 (806 x 362)	14.23 (361)	25.25 (641)	15.25 (387)	27.00 x 16.50 (686 x 419)	49 lbs.	BP-3020
N30247HWT	33.41 x 26.32 x 8.81 (849 x 668 x 224)	30.46 x 25.47 x 8.12 (774 x 647 x 206)	32.25 x 18.50 (819 x 470)	7.12 (181)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	45 lbs.	BP-3024
<b>N302410HWT</b>	33.41 x 26.32 x 11.95 (849 x 668 x 304)	30.46 x 25.47 x 11.27 (774 x 647 x 286)	32.25 x 18.50 (819 x 470)	10.27 (261)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	50 lbs.	BP-3024
N302412HWT	33.41 x 26.32 x 13.79 (849 x 668 x 350)	30.46 x 25.47 x 13.10 (774 x 647 x 333)	32.25 x 18.50 (819 x 470)	12.1 (307)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	54 lbs.	BP-3024
N302413HWT*	33.41 x 26.32 x 14.79 (849 x 668 x 376)	30.46 x 25.47 x 14.10 (774 x 647 x 358)	32.25 x 18.50 (819 x 470)	13.1 (333)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	55 lbs.	BP-3024
N302414HWT	33.41 x 26.32 x 15.79 (849 x 668 x 401)	30.46 x 25.47 x 15.10 (774 x 647 x 384)	32.25 x 18.50 (819 x 470)	14.1 (358)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	56 lbs.	BP-3024
N302415HWT*	33.41 x 26.32 x 16.79 (849 x 668 x 426)	30.46 x 25.47 x 16.10 (774 x 647 x 409)	32.25 x 18.50 (819 x 470)	15.1 (384)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	58 lbs.	BP-3024
N302416HWT	33.41 x 26.32 x 17.79 (849 x 668 x 452)	30.46 x 25.47 x 17.10 (774 x 647 x 434)	32.25 x 18.50 (819 x 470)	16.1 (409)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	62 lbs.	BP-3024
N302417HWT*	33.41 x 26.32 x 18.79 (849 x 668 x 477)	30.46 x 25.47 x 18.10 (774 x 647 x 460)	32.25 x 18.50 (819 x 470)	17.1 (434)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	63 lbs.	BP-3024
N302418HWT*	33.41 x 26.32 x 19.79 (849 x 668 x 503)	30.46 x 25.47 x 19.10 (774 x 647 x 485)	32.25 x 18.50 (819 x 470)	18.1 (460)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	64 lbs.	BP-3024
N302419HWT*	33.41 x 26.32 x 20.79 (849 x 668 x 528)	30.46 x 25.47 x 20.10 (774 x 647 x 511)	32.25 x 18.50 (819 x 470)	19.1 (485)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	65 lbs.	BP-3024
N302421HWT*	33.41 x 26.32 x 21.79 (849 x 668 x 553)	30.46 x 25.47 x 21.10 (774 x 647 x 536)	32.25 x 18.50 (819 x 470)	20.1 (511)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	66 lbs.	BP-3024
N302422HWT	33.41 x 26.32 x 22.79 (849 x 668 x 579)	30.46 x 25.47 x 21.10 (774 x 647 x 536)	32.25 x 18.50 (819 x 470)	21.1 (536)	25.25 (641)	19.25 (489)	27.38 x 21.25 (695 x 540)	67 lbs.	BP-3024
N36308HWT	39.31 x 32.50 x 10.05 (999 x 826 x 255)	36.31 x 31.69 x 9.36 (922 x 805 x 238)	38.13 x 23.88 (968 x 606)	8.36 (212)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	75 lbs.	BP-3630
N363010HWT	39.31 x 32.50 x 12.05 (999 x 826 x 306)	36.31 x 31.69 x 11.36 (922 x 805 x 289)	38.13 x 23.88 (968 x 606)	10.36 (263)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	78 lbs.	BP-3630
<b>N363012HWT</b>	39.31 x 32.50 x 14.05 (999 x 826 x 357)	36.31 x 31.69 x 13.36 (922 x 805 x 339)	38.13 x 23.88 (968 x 606)	12.36 (314)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	81 lbs.	BP-3630
N363013HWT*	39.31 x 32.50 x 15.08 (999 x 826 x 383)	36.31 x 31.69 x 14.39 (922 x 805 x 366)	38.13 x 23.88 (968 x 606)	13.39 (340)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	85 lbs.	BP-3630
N363014HWT*	39.31 x 32.50 x 16.08 (999 x 826 x 408)	36.31 x 31.69 x 15.39 (922 x 805 x 391)	38.13 x 23.88 (968 x 606)	14.39 (366)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	87 lbs.	BP-3630

\*Available as made to order. • Sizes indicated in RED are available in ColorGuard

## Control Enclosures Type 4X “HWT” Configuration Technical Charts & Drawings



### Number of Latches

	HWT STAINLESS STEEL HINGE	WT LIFT OFF COVER	FHLWT FIBERGLASS HINGE
N1610*	2	4	2
N2016	2	4	2
N2412	2	4	2
N2420	4	6	4
N2424	4	6	4
N3020	5	6	5
N3024	5	8	5
N3630	5	8	5
N4836	10	14	10

\*N1610 has no padlock hasp feature

NOTE: Mounting hole dimension is .50 inches.

Optional back panels available in various materials. See Accessories section.

CONTROL  
ENCLOSURES

### Control Enclosures Type 4X - “HWT” Configuration Dimensions (continued)

CATALOG NUMBER	OVERALL H X W X D	INSIDE A X B X C	MOUNTING E X F	J	K	L	ENCLOSURE OPENING M X N	ENCLOSURE WEIGHT	PANEL NUMBER
N363015HWT	31 x 32.50 x 17.08 (999 x 826 x 434)	36.31 x 31.69 x 16.39 (922 x 805 x 416)	38.13 x 23.88 (968 x 606)	15.39 (391)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	88 lbs.	BP-3630
N363016HWT	39.31 x 32.50 x 18.08 (999 x 826 x 459)	36.31 x 31.69 x 17.39 (922 x 805 x 442)	38.13 x 23.88 (968 x 606)	16.39 (416)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	89 lbs.	BP-3630
N363017HWT*	39.31 x 32.50 x 19.08 (999 x 826 x 485)	36.31 x 31.69 x 18.39 (922 x 805 x 467)	38.13 x 23.88 (968 x 606)	17.39 (442)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	90 lbs.	BP-3630
N363018HWT*	39.31 x 32.50 x 20.08 (999 x 826 x 510)	36.31 x 31.69 x 19.39 (922 x 805 x 493)	38.13 x 23.88 (968 x 606)	18.39 (467)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	91 lbs.	BP-3630
N363019HWT*	39.31 x 32.50 x 21.08 (999 x 826 x 535)	36.31 x 31.69 x 20.39 (922 x 805 x 518)	38.13 x 23.88 (968 x 606)	19.39 (492)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	92 lbs.	BP-3630
N363020HWT*	39.31 x 32.50 x 22.08 (999 x 826 x 561)	36.31 x 31.69 x 21.39 (922 x 805 x 543)	38.13 x 23.88 (968 x 606)	20.39 (518)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	93 lbs.	BP-3630
N363021HWT*	39.31 x 32.50 x 23.08 (999 x 826 x 586)	36.31 x 31.69 x 22.39 (922 x 805 x 569)	38.13 x 23.88 (968 x 606)	21.39 (543)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	94 lbs.	BP-3630
N363022HWT*	39.31 x 32.50 x 24.08 (999 x 826 x 612)	36.31 x 31.69 x 23.39 (922 x 805 x 594)	38.13 x 23.88 (968 x 606)	22.39 (569)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	95 lbs.	BP-3630
N363023HWT	39.31 x 32.50 x 25.08 (999 x 826 x 637)	36.31 x 31.69 x 24.39 (922 x 805 x 620)	38.13 x 23.88 (968 x 606)	23.39 (594)	31.25 (794)	25.25 (641)	33.25 x 27.25 (845 x 692)	96 lbs.	BP-3630
N363613HWT*	39.50 x 36.50 x 14.56 (1003 x 927 x 370)	36.25 x 36.25 x 13.88 (921 x 921 x 352)	38.25 x 28.50 (972 x 724)	12.87 (327)	29 (737)	31 (787)	32.00 x 32.00 (813 x 813)	88 lbs.	BP-3636

\*Available as made to order.

All measures are in inches, items in parentheses are in millimeters.





## **IEC MOTOR PROTECTION CIRCUIT BREAKERS Series 330**

c3controls' Series 330 Motor Protection Circuit Breakers provide reliable overload and short circuit protection for all your motor control applications. Our motor protection circuit breakers are ideal for use in multi-motor applications – providing space savings, labor savings, and cost savings. They install on a standard 35mm DIN rail, and they work with a variety of accessories to make wiring as easy as possible.



Motor Protection Circuit Breakers with Thermal and Magnetic Trip Elements	70
Motor Protection Circuit Breakers with Magnetic Trip Elements	71
Accessories	74
Specifications	77
Circuit Diagrams	81
Trip Characteristics	82
Dimensions	83

#### Conformity to Standards:

UL 508  
CSA C22.2 No. 14  
IEC 60947-1, 60947-4-1

#### Certifications:

UL File #: E187641 (Guide NLRV, NLRV7)  
CE Marked (per EU Low Voltage Directive  
73/23/EEC and 93/68/EEC)

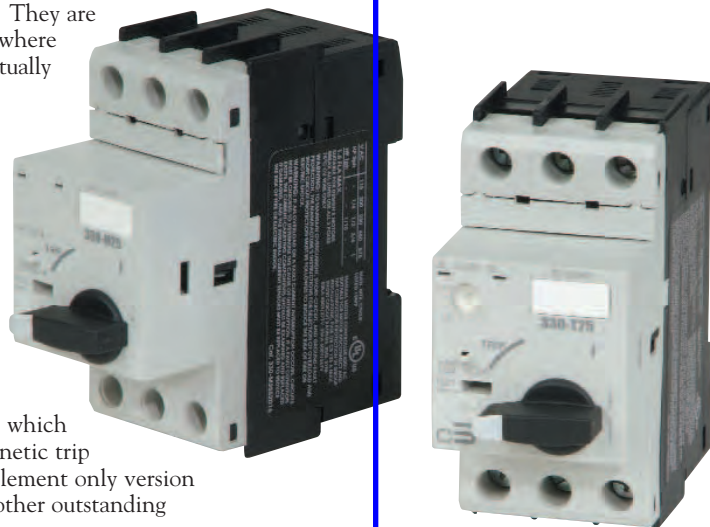


## IEC MOTOR PROTECTION CIRCUIT BREAKERS

c3controls Series 330-T25S Motor Protection Circuit Breakers include both thermal and magnetic trip elements for overload and short circuit protection. They are ideal for use with Series 300 Contactors in group motor installations where panel space is a premium and device modularity is required to satisfy virtually any application requirement. For the simplest applications, they can also be used by themselves as manual motor controllers. cULus and CE Markings make them suitable for use anywhere in the world. Small size, IP20 guarded terminals with dual terminal markings, and shared accessories will help reduce your total installed costs and enhance the features and performance of your equipment. Just look and see what the Series 330-T25S and 330-M25S have to offer.

Product features include:

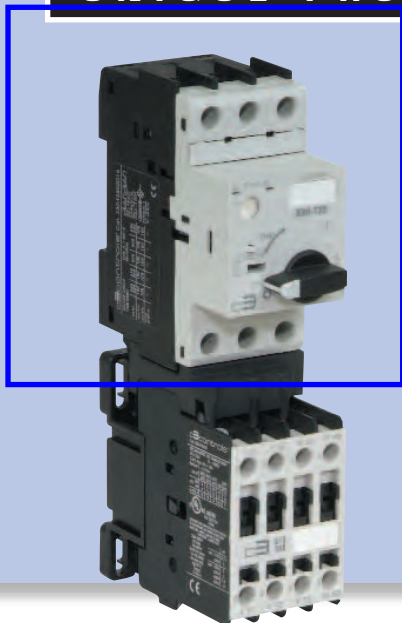
- Certified as Manual Motor Controllers Suitable as Motor Disconnects for use in group motor installations in accordance with the NEC (National Electrical Code).
- Two versions available – with thermal and magnetic trip elements which provide overload protection and short circuit protection, and magnetic trip element only for short circuit protection. Use the magnetic trip element only version with Series 320 Overload Relays for overload protection and the other outstanding features of the Series 320.
- Trip Class 10 for reliable and accurate protection against overload conditions, 330-T25S only.
- Designed for optimum performance with Series 300-S09 to 300-S25 Contactors in group motor installations, and can achieve Type 2 coordination in circuits capable of delivering up to 50kA at 460V.
- Meets IEC 60947 requirements for starters and circuit breakers and provides isolation functionality.
- Modular design and a wide variety of accessories including standard auxiliary contacts, trip indicating auxiliary contacts, shunt and undervoltage release modules, and many wiring accessories such as commoning links and feeder terminals for easy distribution of power to multiple motor protection circuit breakers.
- Snap-on accessories are easily installed without the use of tools, lowering assembly and installation costs.
- Compact size – only 45mm (1.77") wide up to 15HP @ 460V (12.5kW @ 400V) to minimize the amount of panel area required.
- The "ON/OFF" manual operator enables individual motor circuits to be easily isolated without having to disconnect all of the circuits in a control panel.
- Operators can be padlocked in the "OFF" position (max. one 4.9mm [0.193"] padlock) preventing the motor protection circuit breaker from being turned "ON" when the equipment is being serviced.
- Visible trip indication for fast identification of which device tripped in a control panel where multiple motor protection circuit breakers are installed.
- IP20 guarded terminals with dual terminal markings prevent accidental contact with live parts.
- Combination head terminal screws allow the use of "straight", "phillips", or "posidrive" screwdrivers for fast and reliable wiring.
- Device identification marker for labeling motor protection circuit breakers simplifies trouble shooting in panels with many devices.
- Universal ratings and markings: A, kW, and HP ratings as well as applicable 3rd party certification markings.
- Test function to verify the performance of the device and the proper operation of the control circuit and accessories.



# IEC MOTOR PROTECTION CIRCUIT BREAKERS

While Series 330 Motor Protection Circuit Breakers are certified as Manual Motor Controllers Suitable as Motor Disconnects, and can be used to manually control individual motors and protect them against overload and short circuit currents, the greatest benefits can be realized by using the Series 330 Motor Protection Circuit Breakers in conjunction with Series 300 Contactors and Series 330 wiring accessories in Group Motor Installations.

## UNIQUE PRODUCT FEATURES



### SPACE SAVINGS

Control panel sizes can be reduced because the short circuit protection provided by the Series 330 Motor Protection Circuit Breaker enables individual motor branch circuit fuses or circuit breakers and overload relays to be eliminated.

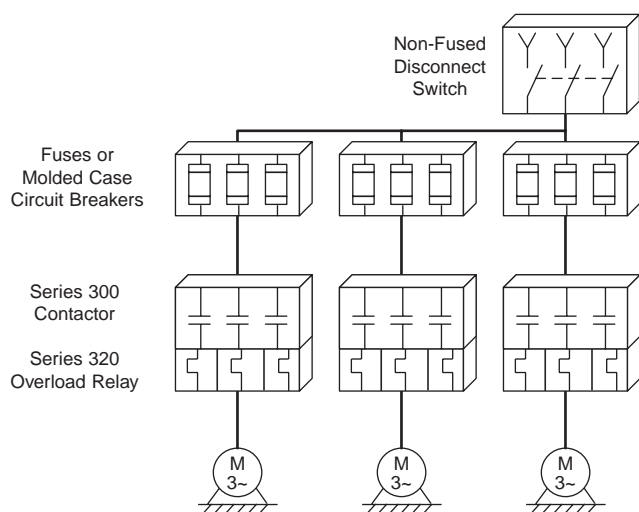
### LABOR SAVINGS

Starter assembly and installation of the starter assemblies in Group Motor Installations is easier and faster with the use of connection modules between the contactor and motor protection circuit breaker and commoning links to conveniently distribute power to multiple starter assemblies. In addition to labor savings, the components look nice too, and provide IP20 protection to guard against accidental contact with live parts.

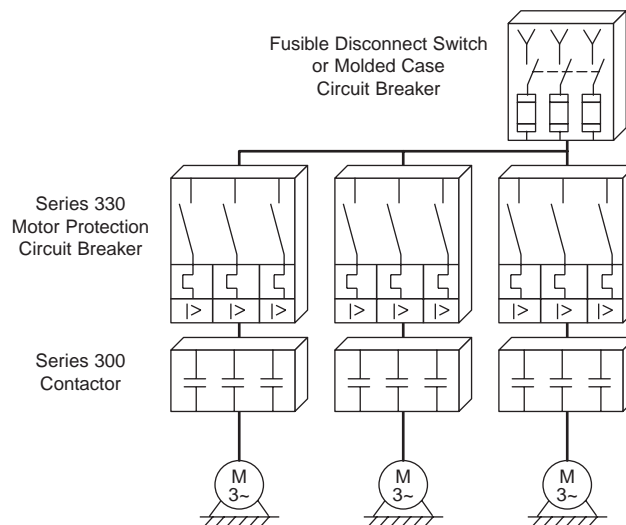
### COST SAVINGS

Smaller size enclosures, reduced wiring, and DIN rail installation all combine to provide a lower cost control panel with superior performance in normal operating conditions as well as in overload or short circuit conditions.

TRADITIONAL MULTI-MOTOR APPLICATION



GROUP MOTOR APPLICATION



## SPECIFICATIONS:

ELECTRICAL SPECIFICATIONS														
CAT. NO. 330-T25S**** AND 330-M25S****														
		2C16	2C25	2C40	2C63	2D10	2D16	2D25	2D40	2D63	2U10	2U16	2U20	2U25
<b>ELECTRICAL GENERAL</b>														
	<b>UNITS</b>													
Rated Operating Current	A	0.16	0.25	0.40	0.63	1.0	1.6	2.5	4.0	6.3	10	16	20	25
Current Setting Range <sup>①</sup>	A	0.1 ~ 0.16	0.16 ~ 0.25	0.25 ~ 0.40	0.40 ~ 0.63	0.63 ~ 1.0	1.0 ~ 1.6	1.6 ~ 2.5	2.5 ~ 4.0	4.0 ~ 6.3	6.3 ~ 10	10 ~ 16	16 ~ 20	20 ~ 25
Magnetic Trip Current	A	1.9	3.0	4.8	7.5	12	19	30	48	75	120	190	240	300
Rated Operating Frequency	Hz	50/60												
Heat Dissipation	W	5	5	5	5	6	6	6	6	6	7	8	8	8
Electrical Life	Ops.	100,000												
Maximum Operating Rate	Ops./Hr.	15												
<b>ELECTRICAL UL/CSA APPLICATIONS</b>														
Rated Operating Voltage, Ue	VAC	600												
<b>RATED 1 PHASE OPERATING POWER, P<sub>e</sub></b>														
115V	HP	—	—	—	—	—	—	—	1/8	1/4	1/2	1	1-1/2	2
230V	HP	—	—	—	—	—	1/10	1/6	1/3	3/4	1-1/2	3	3	3
<b>RATED 3 PHASE OPERATING POWER, P<sub>e</sub></b>														
200V	HP	—	—	—	—	—	1/4	1/2	3/4	1-1/2	3	5	5	7-1/2
230V	HP	—	—	—	—	—	1/3	1/2	1	1-1/2	3	5	7-1/2	7-1/2
460V	HP	—	—	—	—	1/2	3/4	1-1/2	2	5	7-1/2	10	15	15
575V	HP	—	—	—	1/4	1/2	1	1-1/2	3	5	10	15	20	20
<b>MANUAL MOTOR CONTROLLER, MAXIMUM SHORT CIRCUIT CURRENT<sup>②</sup></b>														
@ 480V	kA	50	50	50	50	50	50	50	50	50	50	50	50	50
@ 600V	kA	25	25	25	25	25	25	25	25	25	25	25	25	25
<b>MANUAL MOTOR CONTROLLER IN GROUP INSTALLATIONS, MAXIMUM SHORT CIRCUIT CURRENT<sup>②</sup></b>														
@ 480V	kA	50	50	50	50	50	50	50	50	50	50	50	50	50
Maximum Fuse <sup>③</sup>	A	250	250	250	250	250	250	250	250	250	250	250	250	250
@ 600V	kA	25	25	25	25	25	25	25	25	25	25	25	25	25
Maximum Fuse <sup>③</sup>	A	250	250	250	250	250	250	250	250	250	250	250	250	250
<b>MANUAL MOTOR CONTROLLER SUITABLE FOR TAP CONDUCTOR PROTECTION IN GROUP INSTALLATIONS, MAXIMUM SHORT CIRCUIT CURRENT</b>														
@ 480V	kA	50	50	50	50	50	50	50	50	50	50	50	50	50
Maximum Fuse or Circuit Breaker <sup>③</sup>	kA	125	125	125	125	125	125	125	125	125	125	160	250	250
@ 600V	kA	25	25	25	25	25	25	25	25	25	25	25	25	25
Maximum Fuse or Circuit Breaker <sup>③</sup>	kA	125	125	125	125	125	125	125	125	125	125	160	250	250

① 330-T25S only.

② When protected by Class J fuses.

③ Not to exceed the maximum fuse/circuit breaker size. Per the National Electrical Code.



**ELECTRICAL SPECIFICATIONS**
**CAT. NO. 330-T25S\*\*\*\* AND 330-M25S\*\*\*\***

		2C16	2C25	2C40	2C63	2D10	2D16	2D25	2D40	2D63	2U10	2U16	2U20	2U25
<b>ELECTRICAL IEC APPLICATIONS</b>														
	<b>UNITS</b>													
Rated Insulation Voltage, $U_i$	V	690												
Rated Impulse Voltage, $U_{imp}$	kV	6												
Rated Operating Voltage, $U_e$	VAC	690												
<b>RATED 3 PHASE AC-3 OPERATING POWER, <math>P_e</math></b>														
230V	kW	—	—	—	0.06	0.12	0.18	0.37	0.75	1.1	2.2	3.7	3.7	5.5
400/415V	kW	—	0.06	0.09	0.12	0.25	0.55	0.75	1.5	2.2	4	7.5	9	12.5
500V	kW	—	0.06	0.12	0.25	0.37	0.75	1.1	2.2	3	4	9	12.5	15
690V	kW	0.06	0.12	0.18	0.25	0.55	1.1	1.5	3	4	7.5	12.5	15	22
<b>ULTIMATE SHORT CIRCUIT BREAKING CAPACITY, <math>I_{cu}</math></b>														
230V	kA	100	100	100	100	100	100	100	100	100	100	100	100	100
400/415V	kA	100	100	100	100	100	100	100	100	100	50	50	50	50
440V	kA	100	100	100	100	100	100	100	100	100	50	50	50	50
500V	kA	100	100	100	100	100	100	100	100	100	42	10	10	10
690V	kA	100	100	100	100	100	100	8	6	6	6	4	4	4
<b>RATED SERVICE SHORT CIRCUIT BREAKING CAPACITY, <math>I_{cs}</math></b>														
230V	kA	100	100	100	100	100	100	100	100	100	100	100	100	100
400/415V	kA	100	100	100	100	100	25	25	25	25	25	25	25	25
440V	kA	100	100	100	100	100	100	100	100	100	25	15	15	15
500V	kA	100	100	100	100	100	100	100	100	100	21	8	8	8
690V	kA	100	100	100	100	100	100	8	3	3	3	3	3	3
<b>BACK-UP FUSES, gG/gL<sup>④</sup></b>														
230V	A	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
400/415V	A	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	100	125	125
400V	A	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	80	80	80	100
500V	A	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	63	80	80	80
690V	A	⑤	⑤	⑤	⑤	⑤	⑤	25	32	50	50	63	63	63
<b>MECHANICAL</b>														
Mechanical Life	Ops.	100,000												
<b>ENVIRONMENTAL</b>														
Ambient Operating Temperature		-20 ~ 60° C (-4 to 140° F)												
Ambient Storage Temperature		-50 ~ 80° C (58 to 176° F)												
Altitude		2,000m/6,562ft.												
Shock	g	15												

④ Back-up fuse required only if  $I_{cc} > I_{cu}$ .

⑤ No back-up fuse required.

## CONSTRUCTION SPECIFICATIONS

		CAT. NO. 330-T25S**** AND 330-M25S****												
		2C16	2C25	2C40	2C63	2D10	2D16	2D25	2D40	2D63	2U10	2U16	2U20	2U25
CONSTRUCTION														
	UNITS													
Over Voltage Category	—	III												
Pollution Degree	—	3												
INGRESS PROTECTION														
Main Terminals		IP20												
WEIGHT	kg	330-T25S: 0.322    330-M25S: 0.320												
	lbs	330-T25S: 0.71    330-M25S: 0.70												
CONDUCTOR CROSS SECTION														
Solid Wire	mm²	1 x 1.5 ~ 6 or 2 x 1.5 ~ 6												
Stranded Wire	mm²	2 x 1.5 ~ 6												
Solid or Stranded Wire	AWG	2 x 14 ~ 10												
TIGHTENING TORQUE	Nm	2 ~ 2.5												
	Lb-in.	17.7 ~ 22.1												

## TYPE 2 COORDINATION SPECIFICATIONS<sup>①</sup>

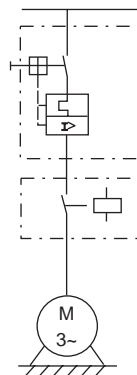
MOTOR PROTECTION CIRCUIT BREAKER		MAXIMUM SHORT CIRCUIT CURRENT @ 480V	MAXIMUM FUSE OR CIRCUIT BREAKER (AMP) <sup>②</sup>	CONTACTOR <sup>③</sup>
WITH THERMAL AND MAGNETIC TRIP ELEMENTS	WITH MAGNETIC TRIP ELEMENT ONLY			
330-T25S-2C16	330-M25S-2C16	50kA	125	300-S09
330-T25S-2C25	330-M25S-2C25	50kA	125	300-S09
330-T25S-2C40	330-M25S-2C40	50kA	125	300-S09
330-T25S-2C63	330-M25S-2C63	50kA	125	300-S09
330-T25S-2D10	330-M25S-2D10	50kA	125	300-S09
330-T25S-2D16	330-M25S-2D16	50kA	125	300-S09
330-T25S-2D25	330-M25S-2D25	50kA	125	300-S09
330-T25S-2D40	330-M25S-2D40	50kA	125	300-S09
330-T25S-2D63	330-M25S-2D63	50kA	125	300-S09
330-T25S-2U10	330-M25S-2U10	50kA	125	300-S09
330-T25S-2U16	330-M25S-2U16	50kA	160	300-S12
330-T25S-2U20	330-M25S-2U20	50kA	250	300-S18
330-T25S-2U25	330-M25S-2U25	50kA	250	300-S25

① Type 2 Coordination requires that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken with regard to the maintenance of the equipment.

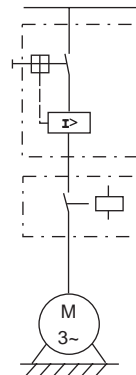
② Per the National Electrical Code.

③ Minimum size contactor shown. Type 2 Coordination can also be achieved with a larger size contactor. For example: a 300-S12 instead of a 300-S09, or a 300-S18 instead of a 300-S12.

330-T25S & 300-S



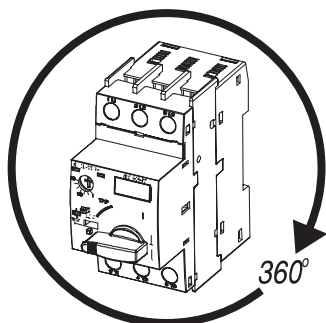
330-M25S & 300-S



**AUXILIARY CONTACTS SPECIFICATIONS**

		<b>SIDE MOUNTED AUXILIARY CONTACT</b>	<b>FRONT MOUNTED AUXILIARY CONTACT</b>
		<b>330-SA</b>	<b>330-FA</b>
<b>ELECTRICAL GENERAL</b>			
	<b>UNITS</b>		
Minimum Switching Capacity		5mA @ 17V	5mA @ 17V
<b>ELECTRICAL UL/CSA APPLICATIONS</b>			
Rated Operating Voltage, Ue	V	600	300
<b>PILOT DUTY RATING</b>			
AC		A600	C300
DC		Q600	R300
General Use		10A @ 600V	2.5A @ 240V
<b>ELECTRICAL IEC APPLICATIONS</b>			
Rated Insulation Voltage, Ui	V	690	250
Rated Operating Voltage, Ue	V	690	250
<b>RATED AC-15 OPERATING CURRENT, Ie</b>			
24V	A	6	2
230V	A	4	0.5
380-415V	A	3	—
440-500V	A	2	—
<b>RATED DC-13 OPERATING CURRENT, Ie</b>			
24V	A	2	0.15
60V	A	0.5	—
110V	A	0.5	—
220V	A	0.25	—
Short Circuit Protection with Fuses (gG/gL)	A	10	10
<b>CONSTRUCTION</b>			
Over Voltage Category		III	III
Pollution Degree		3	3
<b>INGRESS PROTECTION</b>			
Control Circuit Terminals		IP20	IP20
<b>WEIGHT</b>			
	g	20	38
	oz.	0.71	1.34
<b>CONDUCTOR CROSS SECTION</b>			
Solid Wire	mm <sup>2</sup>	1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5	1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5
Stranded Wire	mm <sup>2</sup>	1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5	1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5
Solid or Stranded Wire	AWG	1 x 18 ~ 14 or 2 x 18 ~ 14	1 x 18 ~ 14 or 2 x 18 ~ 14
<b>TIGHTENING TORQUE</b>			
	Nm	1 ~ 1.25	1 ~ 1.25
	Lb-in.	8.9 ~ 11.1	8.9 ~ 11.1

OPERATING POSITION



RELEASE MODULES SPECIFICATIONS

UNDERVOLTAGE RELEASE MODULES

330-UR

ELECTRICAL

	UNITS
Rated Operating Voltage, Ue	V
Pick-Up Voltage	—
Drop-Out Voltage	—

24 ~ 600  
85 ~ 110%  
70 ~ 35%

CONSTRUCTION

INGRESS PROTECTION

Control Circuit Terminals

IP20

WEIGHT

g

115

oz.

4.1

CONDUCTOR CROSS SECTION

Solid Wire	mm <sup>2</sup>
Stranded Wire	mm <sup>2</sup>
Solid or Stranded Wire	AWG

1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5  
1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5  
1 x 18 ~ 14 or 2 x 18 ~ 14

TIGHTENING TORQUE

Nm

1 ~ 1.25

Lb-in.

8.9 ~ 11.1

SHUNT RELEASE MODULES

330-SR

ELECTRICAL

Rated Operating Voltage, Ue	V
Operating Range	—

24 ~ 600  
70 ~ 110%

POWER CONSUMPTION

Pick-Up	VA
Sealed	VA

20.2  
7.2

CONSTRUCTION

INGRESS PROTECTION

Control Circuit Terminals

IP20

WEIGHT

g

115

oz.

4.1

CONDUCTOR CROSS SECTION

Solid Wire	mm <sup>2</sup>
Stranded Wire	mm <sup>2</sup>
Solid or Stranded Wire	AWG

1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5  
1 x 0.5 ~ 2.5 or 2 x 0.5 ~ 2.5  
1 x 18 ~ 14 or 2 x 18 ~ 14

TIGHTENING TORQUE

Nm

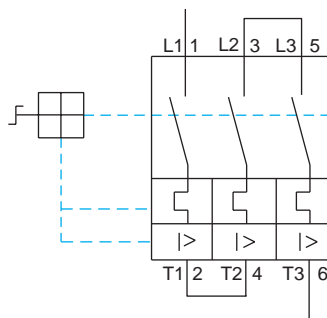
1 ~ 1.25

Lb-in.

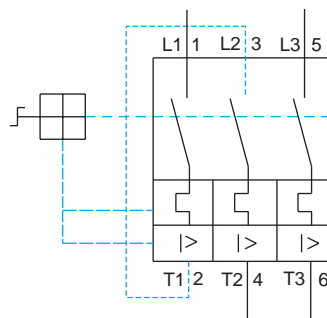
8.9 ~ 11.1

CIRCUIT DIAGRAMS

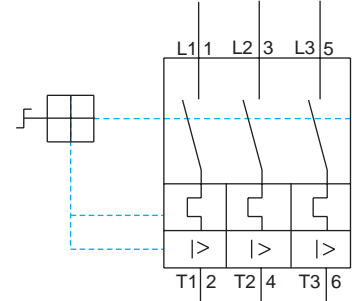
1 PHASE – 1 POLE



1 PHASE – 2 POLE

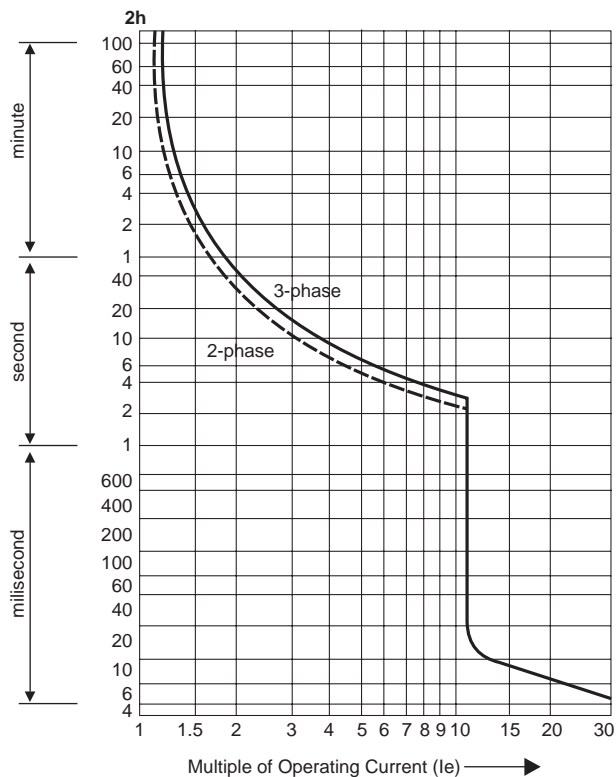


3 PHASE – 3 POLE

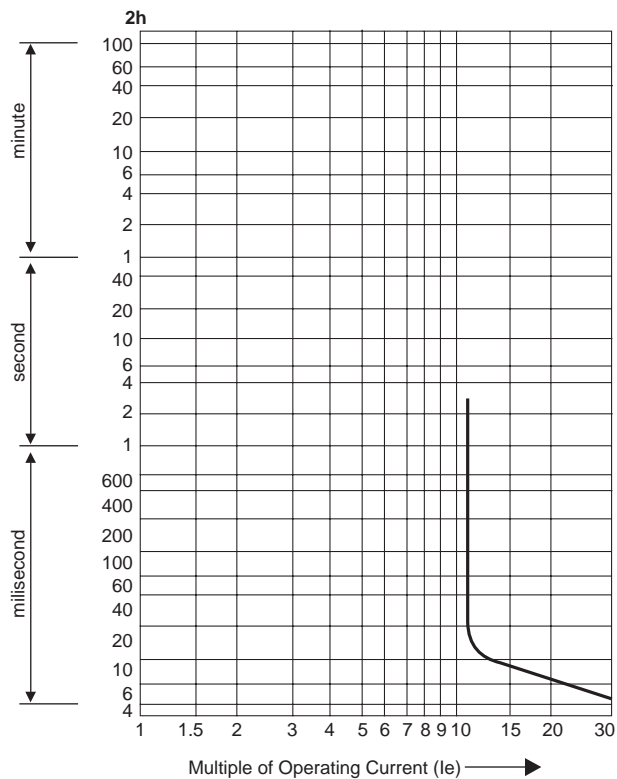


**TRIP CHARACTERISTICS**

330-T25S



330-M25S\*



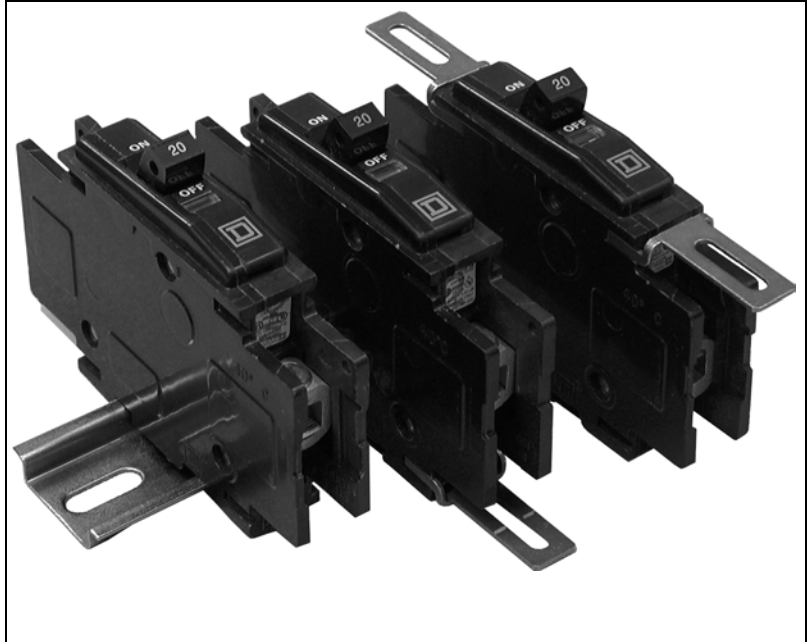
\*Note: Protection below short circuit rating (12x Full Load Current) is provided by an overload protective device (ex. Series 320 or similar function built into the motor).

# QOU Miniature Circuit Breakers and Switches Unit Mount (Cable-in/Cable-out)

Class 720

Catalog  
September

2005



## CONTENTS

Description .....	Page
Application Information .....	page 2
Accessories .....	page 12
UL Requirements .....	page 17
Circuit Breaker Tripping Characteristics (Trip Curves) .....	page 19
Dimensions .....	page 28
QYU One-Pole 277 Vac Supplementary Protectors .....	page 30

# QOU Miniature Circuit Breakers and Switches

## Application Information

### APPLICATION INFORMATION

#### QOU Miniature Circuit Breaker Types

Miniature molded case circuit breakers are intended for use in residential and commercial applications. They are tested and listed according to UL Standard 489 and CSA Standard C22.2 No. 5-02 for molded case circuit breakers and enclosures.

QOU miniature circuit breakers are unit-mount (lug/lug) thermal-magnetic circuit breakers which:

- Provide a means to manually open a circuit.
- Automatically open a circuit under overload or short circuit conditions.
- Feature common tripping of all poles.
- Have a Visi-Trip® trip indicator.
- Can be flush-, surface-, or DIN rail-mounted.
- Has lugs at both ends (cable-in/cable-out construction)
- Operate in any position.
- Are fully tested, UL Listed, and CSA certified for reverse connection without restrictive line/load markings.

#### Non-automatic Switches

QOU non-automatic switches are intended for use as disconnect devices only. UL Standard 489 requires switches to be protected by a thermal-magnetic circuit breaker (or fuse) of equivalent rating. QOU switches are UL Listed for use on circuits capable of delivering not more than 10,000 amperes when protected by an equivalent rated circuit breaker or fuse. QOU switches contain no automatic tripping mechanisms and do not provide overcurrent protection.

#### Description

QOU miniature circuit breakers and switches are available for surface-, flush-, or DIN rail mounted applications in one-, two-, and three-pole constructions. QOU miniature circuit breakers are used for overcurrent protection and switching on both ac and dc electrical systems. QOU circuit breakers and switches measure 0.75 in. (19 mm) wide per pole. Two- and three-pole circuit breakers are both equipped with an internal crossbar for common tripping of all poles. QOU switches are available in one-pole, 60 ampere and two- and three-pole, 60, 100 and 125 ampere construction.

Cases for QOU miniature circuit breakers and switches are constructed of a glass-reinforced insulating material that provides high dielectric strength. Current carrying components are isolated from the handle. The handle position indicates whether the circuit breaker is off, on or tripped.

#### Applications

One-pole QOU miniature circuit breakers rated 120/240 Vac are UL Listed for use on 120/240 Vac single-phase, three-wire or 208Y/120 Vac three-phase, four-wire electrical systems.

Two-pole QOU circuit breakers rated 120/240 Vac are UL Listed for use on 120/240 Vac single-phase, three-wire or 208Y/120 Vac three-phase, four-wire electrical systems. They cannot be used on 240 Vac delta systems. Use QOU-H two-pole circuit breakers rated 240 Vac on 240 Vac delta and 240 Vac single-phase, two wire systems.

Three-pole QOU circuit breakers rated 240 Vac are UL Listed for use on any system where the maximum phase-to-phase or phase-to-ground voltage is 240 Vac or less.

For application information on other systems, contact your local field office

# QOU Miniature Circuit Breakers and Switches

## Application Information

**Table 1: Selection Data**

Rating	Catalog Number						Terminal Lug Wire Size (AWG)
	One-Pole		Two-Pole			Three-Pole	
	120/240 Vac		120/240 Vac	240 Vac	120/240 Vac	240 Vac	
	10K AIR	22K AIR	10 K AIR		22K AIR	10K AIR	
10 A	QOU110	—	QOU210	—	—	QOU310	1—#14—#2 Cu or Al
15 A	QOU115*	QOU115VH	QOU215*	QOU215H*	QOU215VH	QOU315*	
15 A	QOU115HM*†	—	—	—	—	—	
20 A	QOU120*	QOU120VH	QOU220*	QOU220H*	QOU220VH	QOU320*	
20 A	QOU120HM*†	—	—	—	—	—	
25 A	QOU125*	QOU125VH	QOU225*	QOU225H*	QOU225VH	QOU325*	
30 A	QOU130*	QOU130VH	QOU230*	QOU230H*	QOU230VH	QOU330*	
35 A	QOU135*	QOU135VH	QOU235*	—	QOU235VH	QOU335*	
40 A	QOU140*	QOU140VH	QOU240*	—	QOU240VH	QOU340*	
45 A	QOU145*	QOU145VH	QOU245*	—	QOU245VH	QOU345*	
50 A	QOU150*	QOU150VH	QOU250*	—	QOU250VH	QOU350*	
60 A	QOU160*	QOU160VH	QOU260*	—	QOU260VH	QOU360*	
70 A	QOU170*	—	QOU270*	—	—	QOU370‡	1—#12—#2/0 Cu or Al
80 A	QOU180‡	—	QOU280‡	—	—	QOU380‡	
90 A	QOU190‡	—	QOU290‡	—	—	QOU390‡	
100 A	QOU1100‡	—	QOU2100‡	—	—	QOU3100‡	
125 A	—	—	QOU2125‡	—	—	—	
Switch—60 Amperes Max.—240 Vac				QOU200	—	QOU300	1—#14—#2
Switch—100 Amperes Max.—240 Vac				QOU2000‡	—	QOU3000‡	1—#12—#2/0
Switch—125 Amperes Max.—240 Vac				QOU20001‡	—	QOU30001‡	

\* UL Listed as HACR type for use with heating, air conditioning and refrigeration equipment containing motor-group combinations and marked for use with HACR type circuit breakers.

† High-magnetic trip circuit breakers. Recommended for applications where high initial inrush current can occur and for individual dimmer applications.

‡ Available as Series 1 with forward box lugs only. (No optional terminations)

## Tripping Mechanisms

A tripping mechanism is an assembly within the circuit breaker molded case that causes the circuit breaker to open automatically under sustained overload or short circuit conditions.

The tripping mechanisms in two- and three-pole circuit breakers operate such that an overcurrent on any pole of the circuit breaker will cause all poles of the circuit breaker to open simultaneously.

Thermal and magnetic factory calibration (with current) is performed on each pole of every Square D circuit breaker.

These mechanisms operate to trip the circuit breaker:

- Thermal trip
- Magnetic trip
- Optional shunt trip accessory (see Accessories, page 12)

The sensing system is an integral part of a thermal-magnetic circuit breaker. The sensing system continually monitors current flowing through the circuit breaker. It detects abnormal current conditions and, depending on the magnitude of the current, initiates an inverse-time or an instantaneous tripping response. This action causes the tripping mechanism to open the circuit breaker contacts and interrupt current flow. The speed of the tripping process must be controllable and inversely matched to the severity of the overcurrent. QOU miniature circuit breakers have an over-center toggle mechanism for quick-make, quick-break action with positive handle indication. The handle assumes a position between ON (I) and OFF (O) when the circuit breaker has tripped.



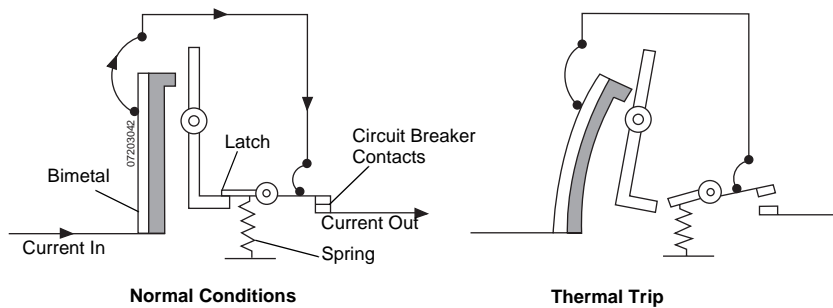
## QOU Miniature Circuit Breakers and Switches

### Application Information

#### Thermal Trip

The thermal trip element of a circuit breaker is a root-mean-squared (rms) current sensing device. The thermal element, or bimetal, is constructed from metals with dissimilar rates of expansion bonded together. The thermal element responds to overloads by reacting to the heat generated both by the current flowing through the circuit breaker and by the heat contribution from ambient conditions. The bending force of the bimetal causes the circuit breaker to trip (see Figure 1). The deflection of the bimetal is predictable as a function of current and time. This is the inverse time tripping characteristic of the thermal element, i.e., the tripping time decreases as the magnitude of the current increases.

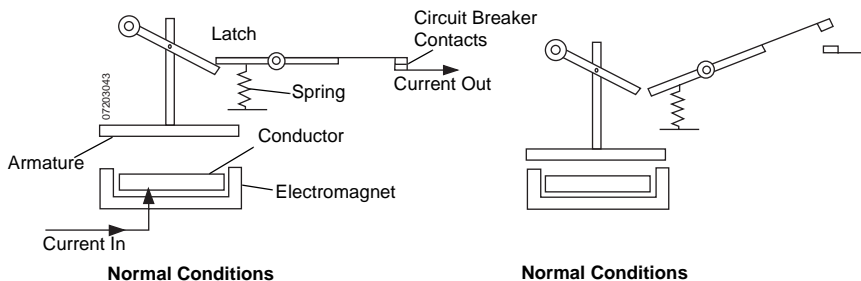
Square D calibrates the thermal elements and they are not field-adjustable. The thermal trip elements are calibrated for 40° C (104° F) ambient temperature, per UL Standard 489 and CSA Standard C22.2 No. 5-02.



**Figure 1: Thermal Tripping**

#### Magnetic Trip

The magnetic (instantaneous) trip element uses an electromagnetic assembly to trip the circuit breaker instantaneously (with no intentional delay) at or above a predetermined current value. During a short circuit of sufficient magnitude, the high-level current passing through the conductor rapidly increases the magnetic field of the electromagnet that attracts the armature. As the armature is drawn toward the electromagnet, it initiates an unlatching action and opens the circuit breaker contact (see Figure 2).



**Figure 2: Magnetic Tripping**

#### Trip Indicator

When the QOU miniature circuit breaker is tripped, the handle assumes a position between ON (I) and OFF (O) and the red Visi-Trip® indicator (A) appears in a window in the circuit breaker case. Reset the circuit breaker and Visi-Trip indicator by pushing the handle to OFF and then to ON.

# QOU Miniature Circuit Breakers and Switches

## Application Information

### Line and Load Connections

QOU miniature circuit breakers are supplied with two types of lug configuration as standard, depending on the continuous current rating:

- 10–70 ampere one- and two-pole; reversible lugs
- 10–60 ampere three-pole; reversible lugs
- Other ampere ratings; forward lugs only

The box-type lugs supplied on QOU miniature circuit breakers are UL Listed and CSA certified to accept solid or stranded, aluminum or copper conductors. These lugs are UL Listed to be used with wire rated at 140° F, 167° F and 194° F (60° C, 75° C and 90° C), sized according to the NEC 176° F (75° C) temperature rating. See the Accessories section for more information on terminations.

Optional terminations, such as quick connectors, are also available. See the Accessories section for more information on terminations.

Ring-tongue terminals can be factory ordered using the following catalog number designations:

- QOU\_\_ \_3100 (ring-tongue terminal wired from front)
- QOUR\_\_ \_5283 (ring-tongue terminal wired from rear)

### Mounting Provisions

QOU miniature circuit breakers are supplied with mounting brackets for both line and load side support. Mounting brackets are field installable and can be attached to the front or back of the circuit breaker molded case. See the Accessories section for more information on mounting brackets. Tapped mounting feet can be ordered using the catalog number designation QOU\_\_ \_3100.

All QOU miniature circuit breakers also come equipped with slots in the molded case for DIN rail mounting.

These miniature circuit breakers are designed for use with a standard 35 mm DIN mounting rail (DIN/EU 50 022, 0.30 x 1.38 in. [7.5 mm x 35 mm]).

### Standards

Square D brand QOU miniature circuit breakers are manufactured and tested according to the following standards:

- UL Standard 489 (File E84967)
- NEMA Standard AB1
- Canadian Standards Association CSA C22.2 No. 5-02
- IEC 60947-2
- CE

Square D brand QOU non-automatic switches comply with:

- UL Standard 489
- Canadian Standards Association CSA C22.2 No. 5-02

*NOTE: Circuit breakers are to be applied by guidelines detailed in the NEC and other applicable electrical codes.*

## QOU Miniature Circuit Breakers and Switches

### Application Information

#### Catalog Numbers

Square D brand circuit breakers are ordered by a catalog number that includes the circuit breaker family, description, number of poles, amperage rating and suffix.

**Table 2: Catalog Numbers**

Typical Catalog Number:						
	QO	U	2	30	H	2100
QO Miniature Circuit Breaker Family						
Description						
U – Unit Mounted (Lugs on Both Ends)						
No. of Poles						
1 – 1-pole						
2 – 2-pole						
3 – 3-pole						
Ampere Rating						
10–125 Ampere Rating						
00 = 60 A, 000 = 100 A, and 0001 = 125 A QOU Switch						
Rating						
1- and 2-pole		2-pole	3-pole			
No Letter-Standard 120/240 Vac Rating		VH - 22,000 AIR	No Letter - 240 Vac Rating			
VH - 22,000 AIR		H-240 Vac Rating	VH - 22,000 AIR			
Suffix						
XXX (i.e., 2100) - Indicates Factory-installed Accessory (See page 12)						

#### Ratings for QOU Miniature Circuit Breakers

When designing an electrical distribution system, overcurrent protective devices are generally selected based on performance requirements. Factors influencing this selection include system voltage, continuous current, interrupting rating and frequency.

QOU circuit breakers are selected by their ratings. A circuit breaker's rating must meet or exceed the parameters of the electrical system on which they are used.

##### Voltage Rating

A circuit breaker can be rated for alternating current (ac) or direct current (dc) or both. The established voltage rating of a circuit breaker is based on design parameters such as clearance of current carrying parts and dielectric withstand tests both through air and over surfaces. Voltage ratings indicate the maximum voltage for the electrical system on which the circuit breaker can be applied.

The circuit breaker must have a voltage rating greater than or equal to the system voltage. When a circuit breaker clears an overcurrent, it does so in two steps: First, the current sensing system identifies the overcurrent and releases the tripping mechanism. This results in a parting of the contacts. Then the circuit breaker must extinguish the voltage arc across the contacts. If the circuit breaker has the correct voltage rating, it can efficiently extinguish this voltage arc. QOU miniature circuit breakers are rated in the following UL 489 voltages, as shown in Table 3:

- 120/240 Vac
- 240 Vac
- 48 Vdc
- 60 Vdc
- 277 Vac for QYU, UL 1077 recognized supplementary protector only (not a branch circuit breaker)

## QOU Miniature Circuit Breakers and Switches

### Application Information

#### Interrupting Rating

The interrupting rating of a circuit breaker is the highest current at rated voltage that the circuit breaker is intended to interrupt under standard test conditions. Circuit breakers must be chosen with interrupting ratings equal to or greater than the maximum available short-circuit current at the point where the circuit breaker is applied in the system (See Table 3).

**Table 3: Interrupting Rating**

Circuit Breaker Type	No. of Poles	Ampere Rating	UL Listed Interrupting Rating—RMS Sym. Amperes				
			AC Volts			DC Volts <sup>1</sup>	
			120/240	240	277	48	60
QOU	1	10–30	NA	NA	5 kA		
		10–70	10 kA	NA	NA	5 kA	NA
		80–100	10 kA	NA	NA	NA	5 kA
	2	10–70	10 kA	NA	NA	5 kA	NA
		80–125	10 kA	NA	NA	NA	5 kA
	3	10–70	NA	10 kA	NA	5 kA	NA
		80–100	NA	10 kA	NA	NA	5 kA
QOU-H	2	15–30	NA	10 kA	NA	5 kA	NA
QOU-VH	2	15–60	22 kA	NA	NA	5 kA	NA

NA = Not Applicable

<sup>1</sup> DC ratings do not apply to circuit breakers rated for 10 A

#### Continuous Current Rating

The continuous current rating of a circuit breaker is defined by the National Electrical Manufacturers Association (NEMA) as: “The maximum direct current or rms current, in amperes, at rated frequency which a device or assembly will carry continuously without exceeding the specified limits of observable temperature rise.” Sometimes referred to as the ampere rating or handle rating of the circuit breaker, the continuous current rating relates to the system current flow under normal conditions.

UL Standard 489 states that circuit breakers must carry 100% of their continuous current rating indefinitely (without tripping) at 104° F (40° C) in free air. QOU circuit breakers should be applied, per the NEC, to carry 80% of their continuous current ratings in the intended enclosure. The continuous current rating is indicated on the handle of each circuit breaker. See Table 1.

#### Switching Duty

The switching duty (SWD) listing applies only to 15 A and 20 A circuit breakers rated at 277 Vac or less. The circuit breakers are subjected to specified temperature rise tests at predetermined periods during the endurance operations.

# Zelio® Plug-In Relays

## RXM, RPM, RUM, RPF, RSB

Class 8501

Catalog  
8501CT0601R1/08

# 08



### CONTENTS

Description .....	Page
Selection Guide .....	3
RXM Miniature Relays .....	4
RPM Miniature Power Relays .....	13
RUM Universal Relays .....	21
RPF Power Relays .....	30
RSB Interface Relays .....	33
General Technical Information .....	38
Catalog Number Index .....	40



#### **RXM Miniature Relays** (page 4)

2 pole relays; 12 A, 1/2 hp (IEC rating = 12 A)  
 3 pole relays; 10 A, 1/3 hp (IEC rating = 10 A)  
 4 pole relays; 8 A, 1/3 hp (IEC rating = 6 A)  
 4 pole relays; 3 A (low level), 1/16 hp (IEC rating = 3 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area



#### **RPM Miniature Power Relays** (page 13)

1 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)  
 2 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)  
 3 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)  
 4 pole relays; 15 A, 1/2 hp (IEC rating = 15 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area



#### **RUM Universal Relays** (page 21)

2 pole relays; 8-pin, tube type; 16 A, 1/3 hp (IEC rating = 10 A)  
 3 pole relays; 11-pin, tube type; 16 A, 1/3 hp (IEC rating = 10 A)  
 2 pole relays; 8 blade type; 16 A, 1/3 hp (IEC rating = 10 A)  
 3 pole relays; 11 blade type; 16 A, 1/3 hp (IEC rating = 10 A)

- Mechanical “relay status” indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area



#### **RPF Power Relays** (page 30)

Two Form C contacts; 30 A  
 Two Normally Open contacts; 30 A

- DIN track mountable
- Can be mounted directly to a panel

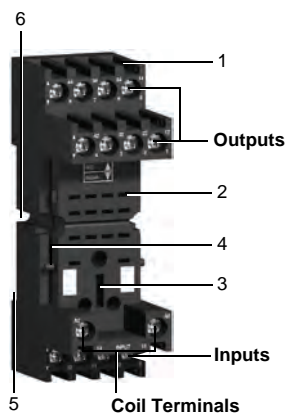
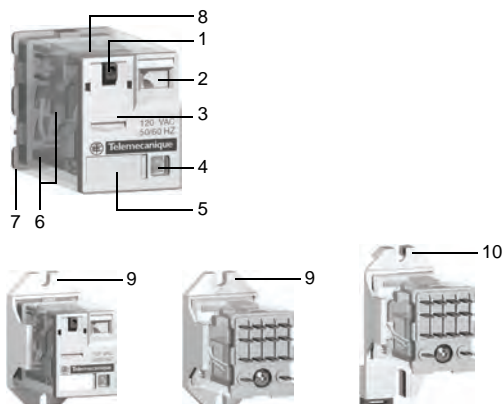
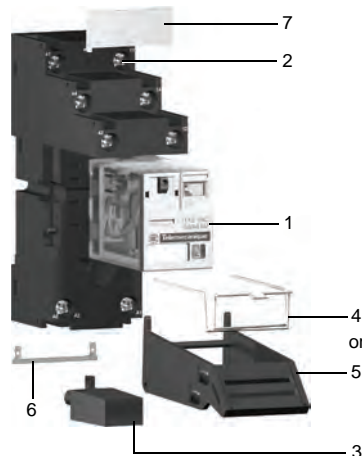


#### **RSB Interface Relays** (page 33)

Two Form C contacts; 8 A  
 One Form C contact; 12 A  
 One Form C contact; 16 A

#### **General Technical Information** (page 38)

Relay contact types  
 Utilization categories  
 Protection categories  
 Protection modules



## Product Description

The RXM miniature relay range consists of:

1. 12 A relays with DPDT contacts, 10 A relays with 3PDT contacts, 6 A relays with 4PDT contacts, and 3 A "low level" relays with 4PDT contacts. All of these relays have the same dimensions.
2. Sockets with mixed or separate contact terminals.
3. Protection modules (diode, RC circuit or varistor). All these modules are common to all sockets.
4. A metal hold-down clip for all sockets.
5. A plastic hold-down clip for all sockets.
6. A 2-pole bus jumper that can be used on sockets with separate contact terminals to simplify wiring when creating a jumper between the coil terminals.
7. Clip-in markers for all the sockets except RXZ E2M114.

## Relay Description

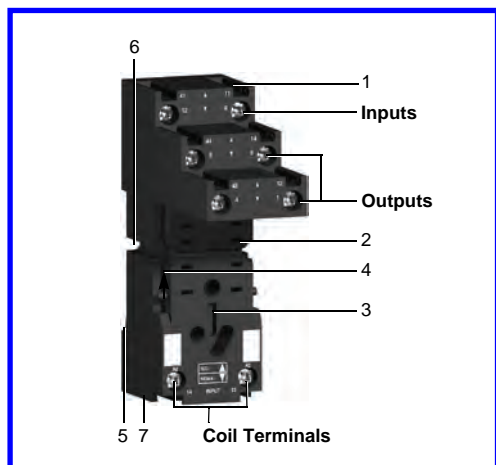
1. Spring return push button for testing the contacts (green: DC, red: AC).
2. Mechanical "relay status" indicator.
3. Optional removable lock-down door and push button, enabling forced maintaining of the contacts for test or maintenance purposes. During operation, this lock-down door must always be in the closed position.
4. Bipolar LED (depending on version) indicating the relay status.
5. Removable marker for relay identification.
6. Four notches for DIN rail mounting adapter or panel mounting adapter.
7. Eight, eleven, or fourteen pins.
8. Area by which the product can be easily gripped.
9. Mounting adapter enabling direct mounting of the relay on a panel.
10. Mounting adapter enabling direct mounting of the relay on a DIN rail.

## Socket Description

### Sockets with Mixed Contact Terminals

1. Connection by screw clamp terminals or box lug connector.
2. Fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two or four mounting holes for panel mounting.

*NOTE: The inputs are mixed with the relay coil terminals, with the outputs being located on the opposite side of the socket.*



## Sockets with Separate Contact Terminals

1. Box lug connector.
2. Eight, eleven, or fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two mounting holes for panel mounting.
7. Location for bus jumpers (see mounting on sockets on page 11).

*NOTE: The inputs and outputs are separated from the relay coil terminals.*

## General characteristics

<b>Conforming to standards</b>		IEC/EN 61810-1 (iss. 2), UL 508, CSA C22-2 n° 14
<b>Product certifications</b>		cULus File E164862 CCN NLDX, NLDX7; cURus File E164862 CCN NLDX2, NLDX8; CSA pending; CE; RoHS compliant
<b>Ambient air temperature</b> around the device	Storage	-40—185 °F (-40—85 °C)
	Operation	-40—131 °F (-40—55 °C)
<b>Vibration resistance</b>	Conforming to IEC/EN 60068-2-6	> 6 gn (10–50 Hz)
<b>Degree of protection</b>	Conforming to IEC/EN 60529	IP 40
<b>Shock resistance</b> conforming to IEC/EN 60068-2-27	Opening	10 gn
	Closing	5 gn
<b>Protection category</b> (see page 38)		RT I
<b>Mounting position</b>		Any

## Insulation characteristics

<b>Rated insulation voltage</b> (Ui)		250 V (IEC), 300 V (UL, CSA)
<b>Rated impulse withstand voltage</b> (Uimp)		3.6 kV (1.2/50 µs)
<b>Dielectric strength</b> (rms voltage)	Between coil and contact	2,500 Vac
	Between poles	2,500 Vac
	Between contacts	1,500 Vac

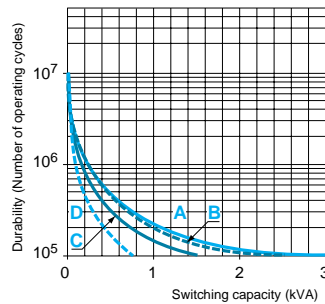
## Contact characteristics

Relay type		RXM2AB●●●	RXM3AB●●●	RXM4AB●●●	RXM4GB●●●
<b>Number and type of contacts</b> (see page 12)		DPDT	3PDT	4PDT	4PDT
<b>Contact materials</b>		AgNi			AgAu–Bifurcated
<b>Conventional thermal current</b> (Ith)	For ambient temperature ≤ 131 °F (55 °C)	12 A	10 A	6 A	3 A
	Conforming to IEC in utilization category AC-1	N.O. 6 A	10 A 5 A	6 A 3 A	2 A 1 A
<b>Rated operational current</b>		Conforming to UL Resistive @277 Vac, hp @120 Vac	12 A, 1/2 hp	10 A, 1/3 hp	8 A, 1/3 hp
<b>Maximum operating rate</b> In operating cycles/hour	No load	18,000			
	Under load	1,200			
<b>Switching voltage</b>	Maximum	250 Vac/Vdc			
<b>Switching capacity</b>	Minimum	10 mA on 17 V			2 mA on 5 V
	Maximum	3,000 VA	2,500 VA	1,500 VA	750 VA
<b>Utilization coefficient</b>		20%			
<b>Mechanical durability</b> in millions of operating cycles		10			
<b>Electrical durability</b> in millions of operating cycles	Resistive load	0.1			



## Electrical durability of contacts

### Resistive load AC



A=RXM2AB●●● B=RXM3AB●●● C=RXM4AB●●● D=RXM4GB●●●

## Coil characteristics

Average consumption		AC	1.2 VA								
		DC	0.9 W								
Drop-out voltage threshold		AC	≥ 0.15 Uc								
		DC	≥ 0.1 Uc								
Operating time (response time)	Between coil energization and making of the N.O. contact	AC	20 ms								
		DC	20 ms								
	Between coil de-energization and making of the N.C. contact	AC	20 ms								
		DC	20 ms								
Coil voltage Uc			12 V	24 V	48 V	110 V	120 V	125 V	220 V	230 V	240 V
Relay coil voltage codes			JD	BD	ED	FD	—	GD	MD	—	—
DC	Average resistance at 68 °F (20 °C) ± 10%		160 Ω	650 Ω	2,600 Ω	11,000 Ω	—	11,000 Ω	14,000 Ω	—	—
	Operating voltage limits	Min.	9.6 V	19.2 V	38.4 V	88 V	—	100 V	176 V	—	—
		Max.	13.2 V	26.4 V	52.8 V	121 V	—	138 V	242 V	—	—
Relay coil voltage codes			—	B7	E7	—	F7	—	M7	P7	U7
AC	Average resistance at 68 °F (20 °C) ± 15%		—	180 Ω	770 Ω	—	4,430 Ω	—	15,000 Ω	15,000 Ω	15,500 Ω
	Operating voltage limits	Min.	—	19.2 V	38.4 V	—	96 V	—	176 V	184 V	192 V
		Max.	—	26.4 V	52.8 V	—	132 V	—	242 V	253 V	264 V

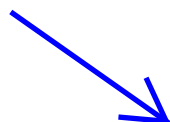
## Socket characteristics

Socket type		RXZE2S108M	RXZE2S111M	RXZE2S114M	RXZE2M114	RXZE2M114M
Relay types used		RXM2●●●●●	RXM3●●●●●	RXM4●●●●●	RXM2●●●●● <sup>1</sup> RXM4●●●●●	RXM2●●●●● <sup>1</sup> RXM4●●●●●
Product certifications		cURus File E172326 CCN SWIV2, SWIV8; CSA (pending); CE; RoHS compliant				
Conventional thermal current (Ith)		12 A	10 A			
Degree of protection	Conforming to IEC/EN 60529	IP 20				
Connection	Solid wire without cable end	1 conductor: AWG 20–12 (0.5–2.5 mm <sup>2</sup> ) 2 conductors: AWG 20–14 (0.5–1.5 mm <sup>2</sup> )				
	Flexible wire with cable end	1 conductor: AWG 24–14 (0.2–2.5 mm <sup>2</sup> ) 2 conductors: AWG 24–16 (0.2–1.5 mm <sup>2</sup> )				
	Flexible wire without cable end	1 conductor: AWG 24–14 (0.2–2.5 mm <sup>2</sup> ) 2 conductors: AWG 24–16 (0.2–1.5 mm <sup>2</sup> )				
Maximum tightening torque		5.3 lbf-in (0.6 N●m) (M3 screw)				
Contact terminal arrangement		Separate			Mixed	
Bus jumper Ith: 5 A		Yes			No	

<sup>1</sup> When mounting relay RXM2●●●●● on socket RXZE2M●●●●, the thermal current must not exceed 10 A.



RXM2AB2F7



## Miniature relays with lockable test button, without LED (sold in lots of 10)

	Number and type of contacts - Thermal current (Ith)										
	DPDT - 12 A				3PDT - 10 A				4PDT - 6 A		
Coil Voltage	Catalog Number	Weight			Catalog Number	Weight			Catalog Number	Weight	
		lb.	kg			lb.	kg			lb.	kg
12 Vdc	RXM2AB1JD	0.082	0.037		RXM3AB1JD	0.084	0.038		RXM4AB1JD	0.080	0.036
24 Vdc	RXM2AB1BD	0.082	0.037		RXM3AB1BD	0.084	0.038		RXM4AB1BD	0.080	0.036
48 Vdc	RXM2AB1ED	0.082	0.037		RXM3AB1ED	0.084	0.038		RXM4AB1ED	0.080	0.036
110 Vdc	RXM2AB1FD	0.082	0.037		RXM3AB1FD	0.084	0.038		RXM4AB1FD	0.080	0.036
220 Vdc	—	—	—		—	—	—		RXM4AB1MD	0.080	0.036
24 Vac	RXM2AB1B7	0.082	0.037		RXM3AB1B7	0.084	0.038		RXM4AB1B7	0.080	0.036
48 Vac	RXM2AB1E7	0.082	0.037		RXM3AB1E7	0.084	0.038		RXM4AB1E7	0.080	0.036
120 Vac	RXM2AB1F7	0.082	0.037		RXM3AB1F7	0.084	0.038		RXM4AB1F7	0.080	0.036
230 Vac	RXM2AB1P7	0.082	0.037		RXM3AB1P7	0.084	0.038		RXM4AB1P7	0.080	0.036
240 Vac	—	—	—		—	—	—		RXM4AB1U7	0.080	0.036

## Miniature relays with lockable test button, with LED (sold in lots of 10)

12 Vdc	RXM2AB2JD	0.082	0.037	RXM3AB2JD	0.084	0.038	RXM4AB2JD	0.080	0.036
24 Vdc	RXM2AB2BD	0.082	0.037	RXM3AB2BD	0.084	0.038	RXM4AB2BD	0.080	0.036
48 Vdc	RXM2AB2ED	0.082	0.037	RXM3AB2ED	0.084	0.038	RXM4AB2ED	0.080	0.036
110 Vdc	RXM2AB2FD	0.082	0.037	RXM3AB2FD	0.084	0.038	RXM4AB2FD	0.080	0.036
125 Vdc	—	—	—	—	—	—	RXM4AB2GD	0.080	0.036
24 Vac	RXM2AB2B7	0.082	0.037	RXM3AB2B7	0.084	0.038	RXM4AB2B7	0.080	0.036
48 Vac	RXM2AB2E7	0.082	0.037	RXM3AB2E7	0.084	0.038	RXM4AB2E7	0.080	0.036
120 Vac	RXM2AB2F7	0.082	0.037	RXM3AB2F7	0.084	0.038	RXM4AB2F7	0.080	0.036
230 Vac	RXM2AB2P7	0.082	0.037	RXM3AB2P7	0.084	0.038	RXM4AB2P7	0.080	0.036



RXM4GB2F7

## Miniature relays with low level contacts, without LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)				
4PDT - 3 A				
Coil Voltage	Catalog Number	Weight		
		lb.	kg	
12 Vdc	RXM4GB1JD	0.080	0.036	
24 Vdc	RXM4GB1BD	0.080	0.036	
48 Vdc	RXM4GB1ED	0.080	0.036	
110 Vdc	RXM4GB1FD	0.080	0.036	
24 Vac	RXM4GB1B7	0.080	0.036	
48 Vac	RXM4GB1E7	0.080	0.036	
120 Vac	RXM4GB1F7	0.080	0.036	
230 Vac	RXM4GB1P7	0.080	0.036	

## Miniature relays with low level contacts, with LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)				
4PDT - 3 A				
Coil Voltage	Catalog Number	Weight		
		lb.	kg	
12 Vdc	RXM4GB2JD	0.080	0.036	
24 Vdc	RXM4GB2BD	0.080	0.036	
48 Vdc	RXM4GB2ED	0.080	0.036	
110 Vdc	RXM4GB2FD	0.080	0.036	
24 Vac	RXM4GB2B7	0.080	0.036	
48 Vac	RXM4GB2E7	0.080	0.036	
120 Vac	RXM4GB2F7	0.080	0.036	
230 Vac	RXM4GB2P7	0.080	0.036	
240 Vac	RXM4GB2U7	0.080	0.036	



RXM2AB3F7

**Miniature relays without lockable test button, with LED**

		Number and Type of Contacts—Thermal Current (Ith)						
		DPDT - 12 A				4PDT - 6 A		
Coil Voltage	Catalog No.	Weight				Catalog No.	Weight	
		lb.	kg	lb.	kg			
Sold in lots of 10								
12 Vdc	RXM2AB3JD	0.082	0.037			RXM4AB3JD	0.080	0.036
24 Vdc	RXM2AB3BD	0.082	0.037			RXM4AB3BD	0.080	0.036
48 Vdc	RXM2AB3ED	0.082	0.037			RXM4AB3ED	0.080	0.036
110 Vdc	RXM2AB3FD	0.082	0.037			RXM4AB3FD	0.080	0.036
125 Vdc	—	—	—			RXM4AB3GD	0.080	0.036
24 Vac	RXM2AB3B7	0.082	0.037			RXM4AB3B7	0.080	0.036
48 Vac	RXM2AB3E7	0.082	0.037			RXM4AB3E7	0.080	0.036
120 Vac	RXM2AB3F7	0.082	0.037			RXM4AB3F7	0.080	0.036
230 Vac	RXM2AB3P7	0.082	0.037			RXM4AB3P7	0.080	0.036
Sold in lots of 100								
24 Vdc	RXM2AB3BDTQ	0.082	0.037			RXM4AB3BDTQ	0.080	0.036
24 Vac	RXM2AB3B7TQ	0.082	0.037			RXM4AB3B7TQ	0.080	0.036
230 Vac	RXM2AB3P7TQ	0.082	0.037			RXM4AB3P7TQ	0.080	0.036

**Miniature relays with low level contacts,  
without lockable test button, with LED**

	4PDT (low level) - 3 A		
Coil Voltage	Catalog No.	Weight	
		lb.	kg
Sold in lots of 10			
12 Vdc	RXM4GB3JD	0.080	0.036
24 Vdc	RXM4GB3BD	0.080	0.036
48 Vdc	RXM4GB3ED	0.080	0.036
110 Vdc	RXM4GB3FD	0.080	0.036
125 Vdc	—	—	—
24 Vac	RXM4GB3B7	0.080	0.036
48 Vac	RXM4GB3E7	0.080	0.036
120 Vac	RXM4GB3F7	0.080	0.036
230 Vac	RXM4GB3P7	0.080	0.036

See page 9 for sockets and accessories.



RXZ E2M114M with  
relay RXM4AB2P7TQ



RXZ E2S114M with  
relay RXM4AB2F7TQ



RXM 041



REXL4



RXZ400

## Miniature relays with lockable test button, without LED (sold in lots of 100)

Coil Voltage	Number and type of contacts - Thermal current (Ith)				
	DPDT - 12 A			4PDT - 6 A	
	Catalog Number	Weight		Catalog Number	Weight
		lb.	kg		lb.
12 Vdc	—	—	—	RXM4AB1JDTQ	0.080
24 Vdc	RXM2AB1BDTQ	0.082	0.037	RXM4AB1BDTQ	0.080
48 Vdc	—	—	—	RXM4AB1EDTQ	0.080
110 Vdc	—	—	—	RXM4AB1FDTQ	0.080
220 Vdc	—	—	—	RXM4AB1MDTQ	0.080
24 Vac	RXM2AB1B7TQ	0.082	0.037	RXM4AB1B7TQ	0.080
48 Vac	—	—	—	RXM4AB1E7TQ	0.080
120 Vac	RXM2AB1F7TQ	0.082	0.037	RXM4AB1F7TQ	0.080
230 Vac	RXM2AB1P7TQ	0.082	0.037	RXM4AB1P7TQ	0.080

## Miniature relays with LED (sold in lots of 100)

24 Vdc	—	—	—	RXM4AB2BDTQ	0.080
24 Vac	RXM2AB2B7TQ	0.082	0.037	RXM4AB2B7TQ	0.080
230 Vac	RXM2AB2P7TQ	0.082	0.037	RXM4AB2P7TQ	0.080

## Sockets (sold in lots of 10)

Contact terminal arrangement	Connection	Relay type	Catalog Number	Weight	
				lb.	kg
Mixed	Screw clamp terminals	RXM2 1 RXM4	RXZE2M114 2	0.11	0.048
	Box lug connector	RXM2 1 RXM4	RXZE2M114M 2	0.12	0.056
Separate	Box lug connector	RXM2	RXZE2S108M 3	0.13	0.058
		RXM3	RXZE2S111M 2	0.15	0.066
		RXM4	RXZE2S114M 2	0.15	0.070

<sup>1</sup> When mounting relay RXM2 on socket RXZE2M, the thermal current must not exceed 10 A.

<sup>2</sup> Thermal current Ith: 10 A

<sup>3</sup> Thermal current Ith: 12 A

## Protection modules (sold in lots of 20)

Description	Voltage	For use with	Catalog Number	Weight	
				oz.	g
Diode	6–250 Vdc	All sockets	RXM040W	0.11	3.0
RC circuit	24–60 Vac	All sockets	RXM041BN7	0.35	10.0
	110–240 Vac	All sockets	RXM041FU7	0.35	10.0
Varistor	6–24 Vac/Vdc	All sockets	RXM021RB	1.06	30.0
	24–60 Vac/Vdc	All sockets	RXM021BN	1.06	30.0
	110–240 Vac/Vdc	All sockets	RXM021FP	1.06	30.0

## Timing relays

Description	For use with	Catalog Number	Weight	
			lb.	kg
2 timed DPDT contacts (function A—On-delay)	Sockets RXZ E	REXL2 4	0.09	0.042
4 timed 4PDT contacts (function A—On-delay)		REXL4 4	0.09	0.042

<sup>4</sup> Please refer to the Zelio® Time - Timers catalog (9050CT0001R2/05).

## Accessories (sold in lots of 10)

Description	For use with	Catalog Number	Weight	
			oz.	g
Metal hold-down clip	All sockets	RXZ400	0.04	1.0
Plastic hold-down clip	All sockets	RXZR335	0.18	5.0
Bus jumper, 2-pole (Ith: 5 A)	All sockets with separate contacts	RXZS2	0.18	5.0
Mounting adapter for DIN rail <sup>5</sup>	All relays	RXZE2DA	0.14	4.0
Mounting adapter for mounting directly to a panel	All relays	RXZE2FA	0.07	2.0
Clip-in markers	All relays (sheet of 108 markers)	RXZL520	2.82	80.0
	All sockets except RXZE2M114	RXZL420	0.04	1.0

<sup>5</sup> Test button becomes inaccessible.

# Zelio® Plug-in Relays

## Dimensions

## RXM Miniature Relays

### Relays

RXM●●●●●●

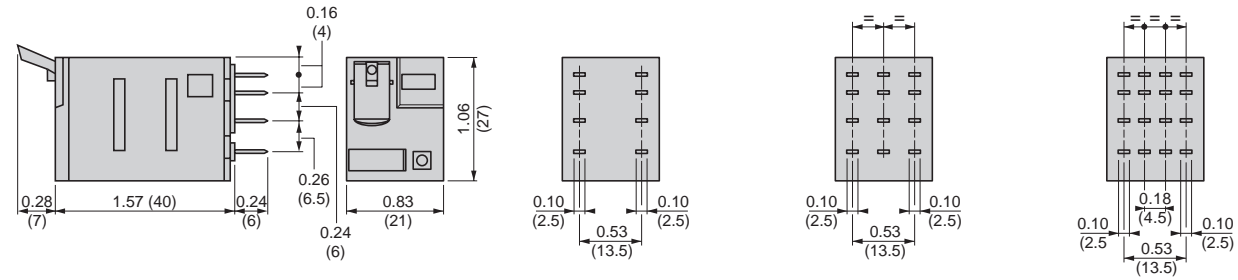
RXM2

RXM3

RXM4

Common view

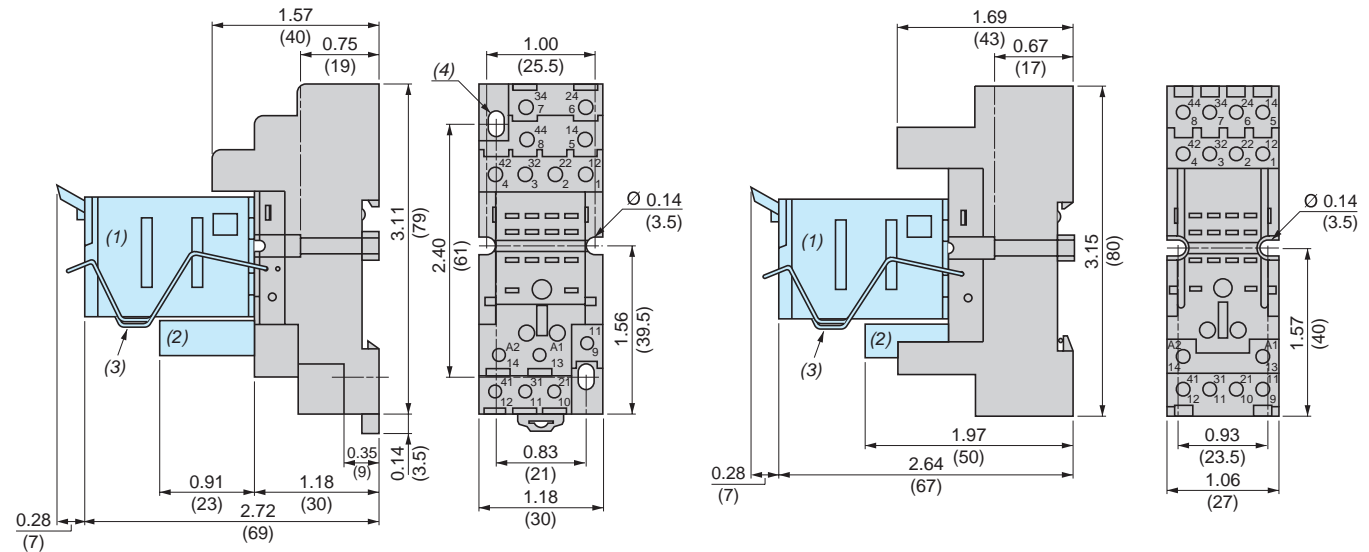
Pin side view



### Sockets

RXZE2M114

RXZE2M114M



RXZE2S●●●●

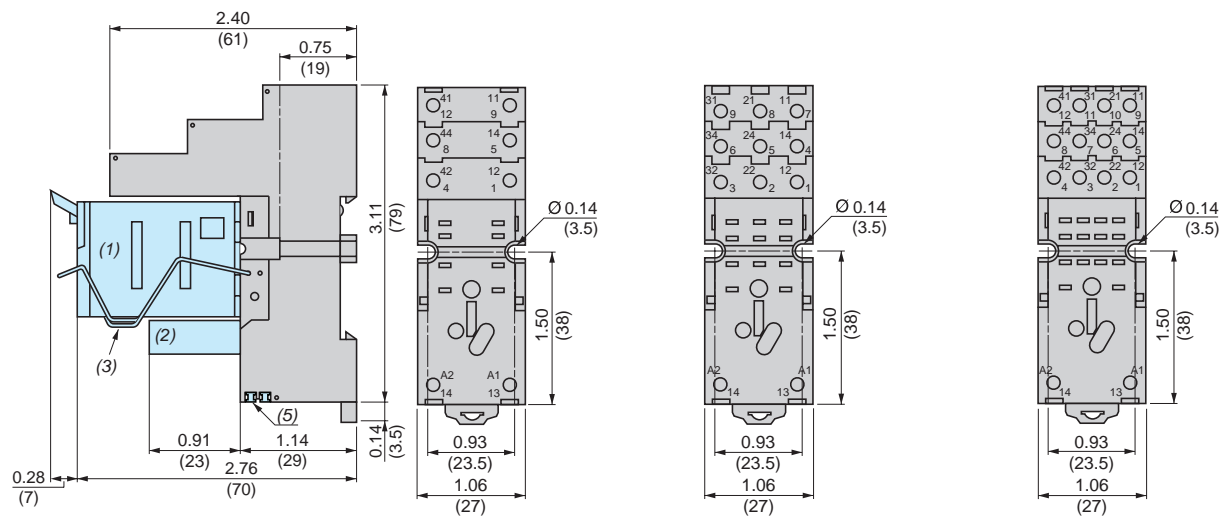
RXZE2S108M

RXZE2S111M

RXZE2S114M

Common side view

Pin side view

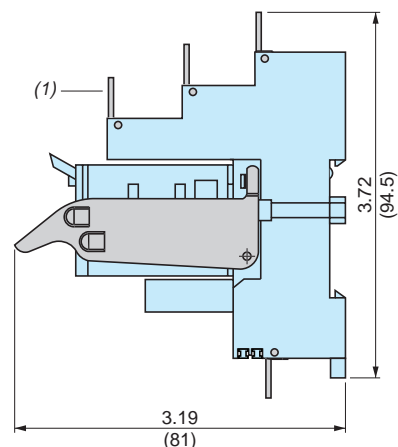
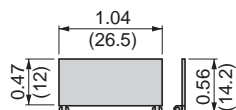
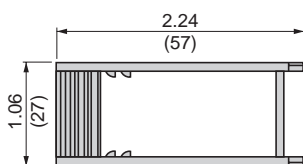


- (1) Relays
- (2) Add-on protection module
- (3) Hold-down clip
- (4) 2 elongated holes Ø 0.14 x 0.26 (3.5 x 6.5)
- (5) 2 bus jumpers

Dimensions = Inches  
(mm)

## Plastic clamp and clip-in markers

RXZR335	RXZL420	Mounting on all sockets
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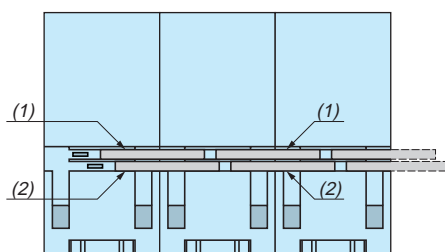
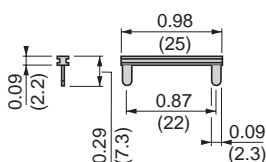


(1) Clip-in markers for all sockets except RXZE2M114.

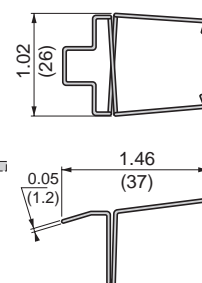
## Bus jumper

RXZS2	Mounting on sockets with separate contacts (view from below)	Metal clamp RXZ400
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### Example of bus jumper mounting on sockets

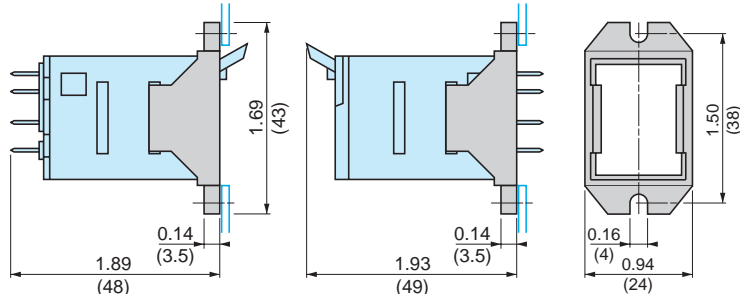
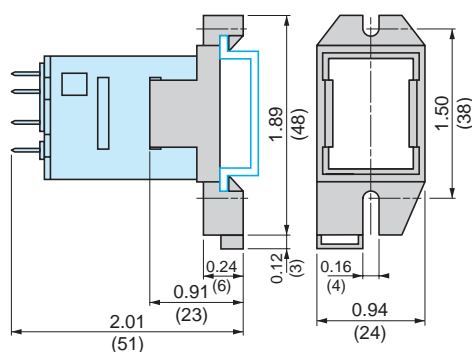


(1) 2 bus jumpers (polarity A2)  
(2) 2 bus jumpers (polarity A1)



## Mounting adapter for rail<sup>1</sup>

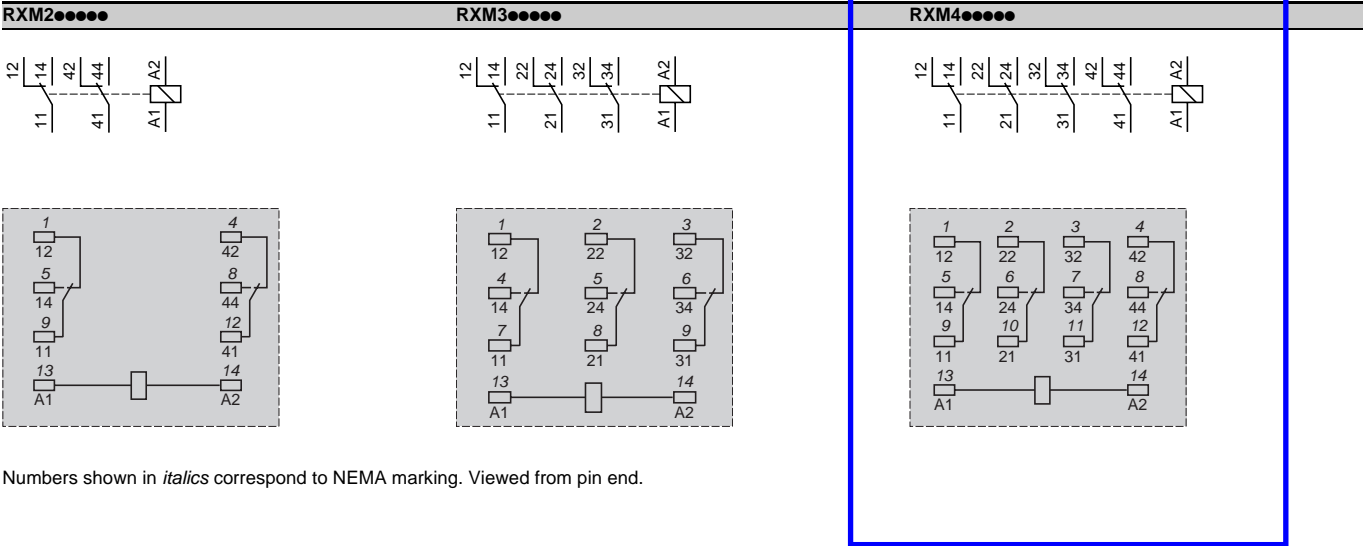
RXZE2DA	Mounting adapter for panel RXZE2FA
---------	---------------------------------------



<sup>1</sup> Test button becomes inaccessible

Dimensions = Inches  
(mm)

Miniature relays







## Technical Data

# PowerFlex® 4 and PowerFlex® 40 AC Drives





# PowerFlex® 4 and PowerFlex® 40 AC Drives Technical Data

Providing users with powerful motor speed control in a compact, space saving design, the Allen-Bradley **PowerFlex 4** and **40** AC drives are the smallest and most cost-effective members of the PowerFlex family of drives. Available in power ratings from 0.2 to 11 kW (0.25 to 15 HP) and in voltage classes of 120, 240, 480 and 600 volts, PowerFlex 4 and 40 are designed to meet global OEM and end-user demands for flexibility, space savings, ease of use and are cost-effective alternatives for speed control of applications such as machine tools, fans, pumps and conveyors and material handling systems.

## Table of Contents

Description	Page
PowerFlex 4 and 40 Common Attributes . . . . .	3
Performance . . . . .	4
PowerFlex 40 Advanced Features . . . . .	5
Communication & Software . . . . .	6
Feature Comparison . . . . .	7
Catalog Number Explanation . . . . .	8
Product Selection . . . . .	9
User Installed Options . . . . .	12
Installation Considerations . . . . .	13
Control Wiring . . . . .	14
Specifications . . . . .	18
Parameter Descriptions . . . . .	21
Approximate Dimensions . . . . .	24
Standard Packaged Drives . . . . .	30



*Shaded areas are applicable to PowerFlex 40 only.*

## PowerFlex 4-Class Common Attributes

### Packaging and Mounting

- Installation can be a virtual snap using the **DIN rail mounting** feature on A and B frame drives. Panel mounting is also available, providing added flexibility.
- **Flange mount** drives are available to reduce overall enclosure size.
- **Zero Stacking™** is allowable for ambient temperatures up to 40°C, saving valuable panel space. 50°C ambient temperatures are permitted with minimal spacing between drives.
- **Integral filtering** is available on all 230V single phase ratings, providing a cost-effective means of meeting EN55011, Class A and B EMC requirements. External filters provide compliance to Class A and B requirements for all PowerFlex 4 and 40 ratings.
- An optional **IP30 (NEMA 1) conduit box** is easily adapted to the standard IP20 (NEMA Type Open) product, providing increased environmental ratings.



### Start Up, Programming and Operation

- An **integral keypad** provides out of the box operation using the local potentiometer and control keys.
- The 10 most common application parameters are contained in the **Basic Program Group**, making programming fast and easy.
- The **programming keys** have the same function as all other PowerFlex drives, so if you can program one PowerFlex drive, you can program them all.
- **4 digit display** with 10 additional LED indicators provides an intuitive display of drive status and information.
- Integral **RS-485 communications** can be used for programming from a PC. It can also be used in a multi-drop network configuration. A serial converter module provides connectivity to any controller with a DF1 port.
- A **NEMA Type 4X** remote and **NEMA Type 1 hand-held LCD keypad** provide additional programming and control flexibility, both featuring the popular CopyCat function.



### Optimized Performance

- **Removable MOV** to ground provides trouble-free operation when used on ungrounded distribution systems.
- A **relay pre-charge** limits inrush current.
- **Integral brake transistor**, available on all ratings (except no brake version), provides dynamic braking capability with simple low cost brake resistors.
- DIP switch settable **24V DC sink or source control** for control wiring flexibility.
- 150% overload for 60 seconds or 200% overload for 3 seconds provides **robust overload protection**.
- **Adjustable PWM frequency up to 16 kHz** ensures quiet operation.

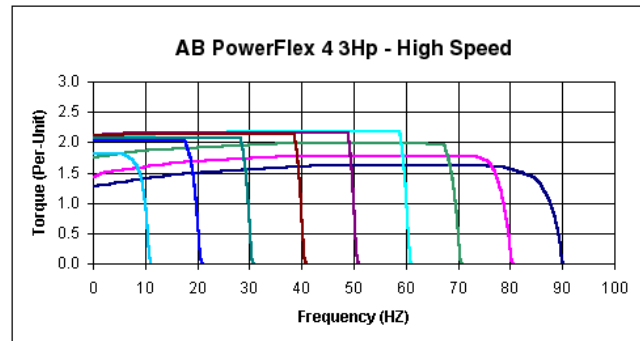


## Performance

### Sensorless Vector Performance

#### PowerFlex 4

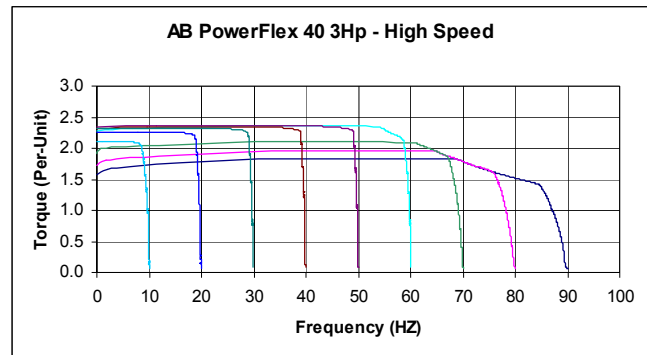
- Drive automatically provides auto boost (IR compensation) and slip compensation.
- Provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation even as loading increases.



### Sensorless Vector Control

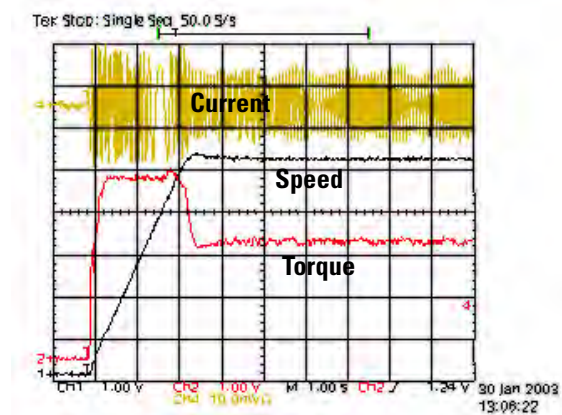
#### PowerFlex 40

- Sensorless Vector Control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive.
- The Autotune feature allows the PowerFlex 40 to adapt to individual motor characteristics.



## Performance

- This graph depicts the ability of a PowerFlex 40 drive to accelerate into at least 150% load. A PowerFlex 4 will perform similarly, but with a slightly higher acceleration time.
- At 100% motor load, the drive will run the motor at synchronous speed.
- Excellent current regulation.
- Linear acceleration.
- Best in class digital input response time and repeatability.



## PowerFlex 40 Advanced Features

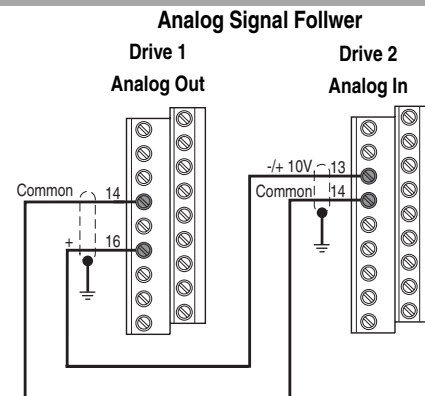
### Performance

- **Sensorless Vector Control** develops high torque over a wide speed range and adapts to individual motor characteristics.
- **Variable PWM** allows the drive to output more current at low frequencies.
- Integral **PID** functionality enhances application flexibility.
- **Timer, Counter, Basic Logic and StepLogic™ functions** can reduce hardware design costs and simplify control schemes.
  - **Timer function:** Relay or opto outputs controlled by drive performing timer function. Timer is initiated by activating a digital input programmed as “Timer Start.”
  - **Counter function:** Relay or opto outputs controlled by drive performing counter function. Counter function is activated by a digital input programmed as “Counter Input.”
  - **Basic Logic:** Relay or opto outputs controlled by status of digital inputs programmed as “Logic Inputs.” Performs basic Boolean logic.
  - **StepLogic:** Logic-based steps using preset speed settings. Each step can be programmed for a specific speed, direction and accel/decel profile. Drive outputs can be used to indicate which step is being performed.



### I/O

- **Two (2) Analog Inputs** (one unipolar and one bipolar) are independently isolated from the rest of the drive I/O. These inputs can be toggled between via a digital input.
- **Three (3) fixed and four (4) fully programmable Digital Inputs** provide application versatility.
- **One (1) Analog Output** is DIP switch selectable for either 0-10V or 0-20mA. This scalable, 10-bit output is suitable for metering or as a speed reference for another drive.
- **Two (2) Opto Outputs** and one (1) form C relay output can be used to indicate various drive, motor or logic conditions.



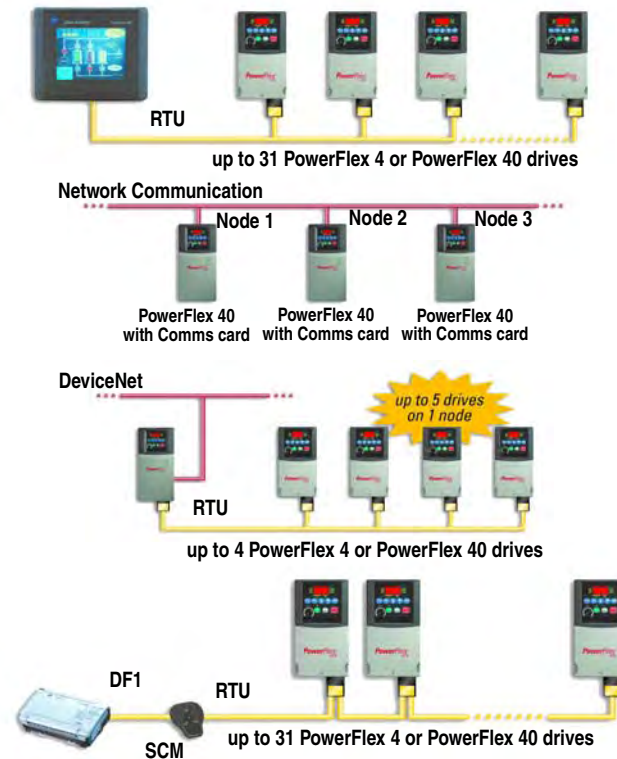
### Communications

- Integral communication cards such as **DeviceNet™**, **EtherNet/IP** and **PROFIBUS** can improve machine performance.
- **Field installed option** allows for future addition of stand-alone drives to a network.
- **Online EDS file creation** with RS NetWorx providing ease of set-up on a network.



### Versatile Programming and Network Solutions

- PowerFlex 4 and PowerFlex 40 are compatible with any device that acts as a RTU Master and supports standard 03 and 06 RTU commands.
- A network can be configured using PowerFlex 40 drives with optional communication cards for high performance and flexible configuration capabilities.
  - DeviceNet
  - EtherNet/IP
  - PROFIBUS
- A multi-drive solution can be reached using a single PowerFlex 40 DeviceNet option, with the ability for up to five (5) drives to reside on one (1) node.
- Integral RS485 communications enable the drives to be used in a multi-drop network configuration. A serial converter module (SCM) provides connectivity to any controller with a DF1 port. The SCM can be eliminated if the controller acts as a RTU Master.

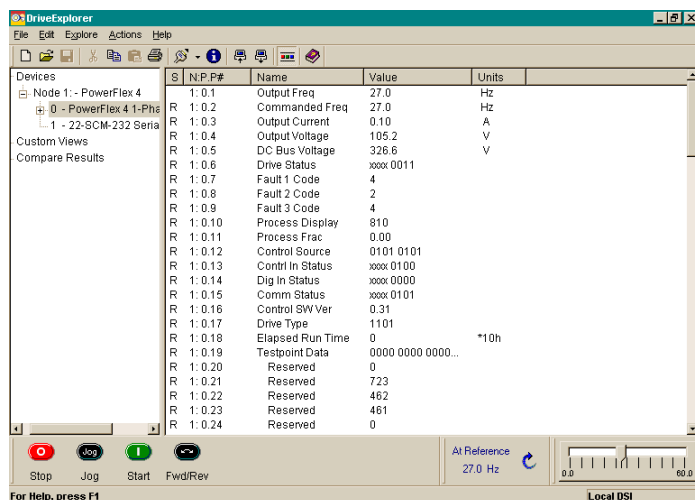


### PC Programming Software

Through the use of a Serial Converter Module and DriveExplorer™ or DriveTools™ SP software, programming can be greatly simplified.

#### DriveExplorer Software

- View and modify drive and adapter parameters in a method similar to the file management capability of Microsoft Windows Explorer.
- Operate the drive via an on-screen Control Bar, which is a tool that allows you to start, stop, and change the speed reference of the drive.
- Save, restore and print parameter information.
- Compare current parameters with factory defaults or previously saved parameter values.
- Edit, upload and download parameters.



#### DriveTools SP Software

- Online and offline programming capability
- In-grid and dialog-based parameter editing
- Immediate visual indication of drive and communication status when viewing online drive
- Integrated HTML Help architecture

## Feature Comparison

Use the chart below to assist in determining which product is most appropriate for an application.



	<b>PowerFlex<sup>®</sup> 4</b>	<b>PowerFlex<sup>®</sup> 40</b>
<b>Feature</b>	<b>22A...</b>	<b>22B...</b>
<b>Catalog Reference</b>		
<b>Maximum (kW)HP Rating/Input Voltage</b>	(1.1) 1.5 HP/115V, 1ø (2.2) 3 HP/230V, 1ø (3.7) 5 HP/230V, 3ø (3.7) 5 HP/460V, 3ø	(1.1) 1.5 HP/115V, 1ø (2.2) 3 HP/230V, 1ø (7.5) 10 HP/230V, 3ø (11.0) 15 HP/460V, 3ø (11.0) 15 HP/600V, 3ø
<b>Overload Capacity</b>	150% for 60 seconds 200% for 3 seconds	150% for 60 seconds 200% for 3 seconds
<b>NEMA 1/IP30 Option</b>	●	●
<b>EMC Filtering</b>	Internal - 1ø, 230V External - All 1ø, 115V and 3ø Ratings	Internal - 1ø, 230V External - All 1ø, 115V and 3ø Ratings
<b>DIN Rail Mounting Standard</b>	●	● (Through 5 HP)
<b>Integral Keypad with Speed Pot</b>	●	●
<b>Keypad - Remote LCD</b>	●	●
<b>Keypad CopyCat Function</b>	●	●
<b>Control Type</b>	V/Hz	Sensorless Vector & V/Hz
<b>Internal DB Transistor</b>	● Not available on no brake models.	●
<b>Preset Speeds</b>	4	8
<b>Carrier Frequency</b>	2-16 kHz	2-16 kHz
<b>Skip Frequency</b>		●
<b>Process Control Loop</b>		● (PID)
<b>StepLogic Functionality</b>		●
<b>Timer/Counter Functions</b>		●
<b>Control Voltage</b>	24V sink/source	24V sink/source
<b>Discrete Inputs</b>	3 fixed for START/STOP/REV 2 fully programmable	3 fixed for START/STOP/REV 4 fully programmable
<b>Analog Input - Unipolar</b>	1 (0-10V or 4-20 mA)	2 (0-10V and 4-20 mA)
<b>Analog Input - Bipolar</b>		1 (+/- 10V) ❶
<b>Analog Response</b>	2 Hz (500 ms)	100 Hz (10 ms)
<b>Relay Output</b>	1 - N.O./N.C. dry contact	1 - N.O./N.C. dry contact
<b>Digital/Optocoupler Output</b>		2
<b>Analog Output</b>		● (0-10V or 4-20 mA)
<b>Integral RS485</b>	●	●
<b>RS232 (Requires use of Serial Converter Module)</b>	●	●
<b>DeviceNet</b>		●
<b>EtherNet/IP</b>		●
<b>PROFIBUS</b>		●

❶ When using bipolar input, the 0-10V unipolar input cannot be used.

## Catalog Number Explanation

Position								
1-3	4	5	6-8	9	10	11	12 <sup>(1)</sup>	13-14
<b>22A</b>	<b>-</b>	<b>A</b>	<b>1P5</b>	<b>N</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>AA</b>
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Version	Optional

<b>Code</b>	<b>Version</b>
22A PowerFlex 4	3 No Brake IGBT
22B PowerFlex 40	4 Standard

<b>Code</b>	<b>Voltage</b>	<b>Ph</b>
V	120V AC	1
A	240V AC	1
B	240V AC	3
D	480V AC	3
E	600V AC	3

<b>Code</b>	<b>Rating</b>
0	Not Filtered
1	Filtered

<b>Code</b>	<b>Interface Module</b>
1	Fixed Keypad

<b>Code</b>	<b>Purpose</b>
AA	Reserved for custom firmware
Thru	
ZZ	

<b>Code</b>	<b>Enclosure</b>
N	Panel Mount - IP 20 (NEMA Type Open)
F	Flange Mount - IP 20 (NEMA Type Open)
H	Replacement Plate Drive - IP 20 (NEMA Type Open)
- Contact factory for ordering information.	

Output Current @ 100-120V Input		
Code	Amps	kW (HP)
1P5	1.5	0.2 (0.25)
2P3	2.3	0.4 (0.5)
4P5	4.5	0.75 (1.0)
5P0	5.0	0.75 (1.0)
6P0	6.0	1.1 (1.5)

Output Current @ 200-240 Input, NO BRAKE (2)		
Code	Amps	kW (HP)
1P4	1.4	0.2 (0.25)
2P1	2.1	0.4 (0.5)
3P6	3.6	0.75 (1.0)
6P8	6.8	1.5 (2.0)
9P6	9.6	2.2 (3.0)

Output Current @ 200-240V Input		
Code	Amps	kW (HP)
1P5	1.5	0.2 (0.25)
2P3	2.3	0.4 (0.5)
4P5	4.5	0.75 (1.0)
5P0	5.0	0.75 (1.0)
8P0	8.0	1.5 (2.0)
012	12.0	2.2 (3.0)
017	17.5	3.7 (5.0)
024	24.0	5.5 (7.5)
033	33.0	7.5 (10.0)

Output Current @ 380-480V Input		
Code	Amps	kW (HP)
1P4	1.4	0.4 (0.5)
2P3	2.3	0.75 (1.0)
4P0	4.0	1.5 (2.0)
6P0	6.0	2.2 (3.0)
8P7	8.7	3.7 (5.0)
010	10.5	4.0 (5.0)
012	12.0	5.5 (7.5)
017	17.0	7.5 (10.0)
024	24.0	11.0 (15.0)

Output Current @ 460-600V Input		
Code	Amps	kW (HP)
1P7	1.7	0.75 (1.0)
3P0	3.0	1.5 (2.0)
4P2	4.2	2.2 (3.0)
6P6	6.6	4.0 (5.0)
9P9	9.9	5.5 (7.5)
012	12.0	7.5 (10.0)
019	19.0	11.0 (15.0)

(1) Position 12 of the Catalog Number now indicates drive version. All PowerFlex 4 and 40 drives are equipped with RS485 communication.  
 (2) PowerFlex 4 option only.



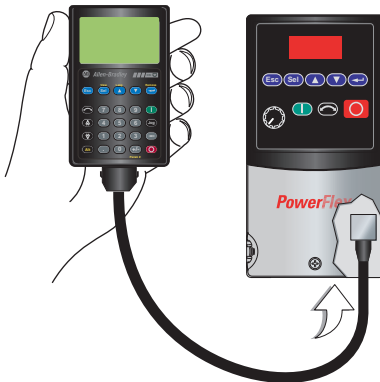


# Allen-Bradley

## PowerFlex® 4-Class HIM (DSI) Quick Reference

### Human Interface Modules (HIM)

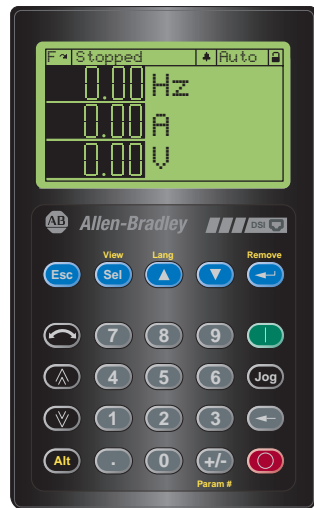
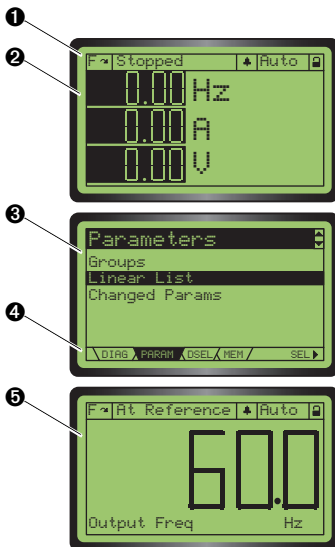
22-HIM-A3 — IP20 (NEMA Type 1)



22-HIM-C2S — IP66 (NEMA Type 4X/12)



### Display Descriptions



















#### Display

1	Status Line: Direction   Operating Status   Drive Status   Auto/Manual Mode   Parameters Locked/Unlocked
2	Process Display screen: <ul style="list-style-type: none"> <li>Output Frequency</li> <li>User Display Line 1 (HIM Parameter 04)</li> <li>User Display Line 2 (HIM Parameter 05)</li> </ul>
3	Programming screen
4	Menu Navigation Tabs
5	Large Format User Display screen:



# Key Descriptions

Keys	Description
	Exit a menu, cancel a change to a parameter value, or acknowledge a fault/alarm.
	Select a digit, select a bit, or select a menu tab.
	Scroll through options, increase a value, or toggle a bit.
	Scroll through options, decrease a value, or toggle a bit.
	Enter a menu, enter edit mode in a parameter screen, or save a change to a parameter value.
 plus...	<div> <div>View </div> <div>Lang </div> <div>Remove </div> <div> Param #</div> </div> Toggle between the Process Display and Large Format Display.
	Start the drive.
	Stop the drive or clear a fault.
	Change direction.
	Jog the drive.
	Type parameter numbers and values.
	Increase or decrease the speed Reference to the drive after these keys are enabled by setting drive parameter P038 - [Speed Reference] as follows: <ul style="list-style-type: none"> <li>When the HIM is the DSI Master, set parameter P038 to "5" (Comm Port).</li> <li>When the HIM is the DSI Slave, set parameter P038 to "1" (Internal Freq).</li> </ul> To view the HIM's active device type status (Master or Slave), see HIM <b>Parameter 10 - [M/S Status]</b> .

# Menu Navigation Tabs

Tabs	Description
DIAG	The Diagnostics tab is used to display faults, the device (drive or peripheral) status, and device version.
PARAM	The Parameters tab is used to edit parameters. Parameters can be displayed in groups, in a linear list, or only those changed from their defaults.
DSEL	The Device Select tab is used to select the device (drive or peripheral) that the HIM is to access.
MEM	The Memory Storage tab is used for HIM CopyCat (uploading/downloading configurations to the HIM EEPROM).
HIM	The HIM Setup tab is used to access HIM parameters, view the HIM version, and to edit the Reference text when a user-defined Reference is used.

# Parameter List

Parameter		
No.	Name and Description	Details
01	<b>[Startup Display]</b> Selects the display screen shown when the HIM is powered up.	Default: 0 = Main Menu Values: 0 = Main Menu 1 = Process Disp 2 = Large Disp 3 = Startup Param Type: Read/Write
02	<b>[Startup Param]</b> Selects a desired drive parameter to be displayed if <b>Parameter 01 - [Startup Display]</b> is set to "3" (Startup Param).	Default: 1 Minimum: 1 Maximum: 65535 Type: Read/Write
03	<b>Reserved</b>	
04	<b>[User Disp Line 1]</b> Selects a desired drive parameter to be displayed on User Display Line 1 of the Process Display screen. For example, setting to "3" selects PowerFlex 4-Class drive Parameter 3 - [Output Current] to be displayed.	Default: 3 Minimum: 1 Maximum: 65535 Type: Read/Write
05	<b>[User Disp Line 2]</b> Selects a desired drive parameter to be displayed on User Display Line 2 of the Process Display screen. For example, setting to "5" selects PowerFlex 4-Class drive Parameter 5 - [DC Bus Voltage] to be displayed.	Default: 5 Minimum: 1 Maximum: 65535 Type: Read/Write
06	<b>[Large Disp Param]</b> Selects a desired drive parameter to be displayed on the Large Format User Display screen. For example, setting to "1" selects PowerFlex 4-Class drive Parameter 1 - [Output Freq] to be displayed. Setting to "0" enables the Scaled Reference to be displayed.	Default: 1 Minimum: 0 Maximum: 65535 Type: Read/Write
07	<b>[LCD Contrast]</b> Sets the HIM LCD contrast level.	Default: 50% Minimum: 0% Maximum: 100% Type: Read/Write
08	<b>[Reset HIM]</b> 1 (Reset): Resets the HIM. 2 (Set Defaults): Resets HIM parameters to factory settings. This parameter returns to a value of "0" (Ready) after the reset function is complete.	Default: 0 = Ready Values: 0 = Ready 1 = Reset 2 = Set Defaults Type: Read/Write
09	<b>[Device Type]</b> Selects the HIM device type. When set to "0" (Auto), the HIM is automatically configured as either a DSI Master or Slave depending on the presence of other peripheral devices.	Default: 0 = Auto Values: 0 = Auto 1 = Slave 2 = Master Type: Read/Write
10	<b>[M/S Status]</b> Displays the HIM active device type.	Default: N/A Values: 1 = Slave 2 = Master Type: Read Only
11	<b>[HIM Ref Preset]</b> 0 (Zero Start): HIM Reference is always "0.0" at power on. 1 (Host Output): HIM will assume the Host's output feedback (bumpless transfer) and preset its Reference when the Reference is configured to be received on the RS-485 port. This can be verified by viewing Diagnostics/Device Status/Remote Freq Ref = 1. 2 (Last HIM Ref): HIM will store the HIM Reference in EEPROM each time it is changed. HIM Reference is restored at power on.	Default: 0 = Zero Start Values: 0 = Zero Start 1 = Host Output 2 = Last HIM Ref Type: Read/Write

Parameter		
No.	Name and Description	Details
12	<b>[Ref Scaling]</b> Enables or disables scaling the Reference to a user-defined value. When <b>Parameter 12 - [Ref Scaling]</b> is set to "1" (Enabled), use HIM Parameters 13...22 to scale the Reference.	Default: 0 = Disabled Values: 0 = Disabled 1 = Enabled Type: Read/Write
13	<b>[Ref Max Value]</b> Sets the user-defined value to be displayed when the drive is running at 60 Hz.	Default: 600 Minimum: 100 Maximum: 65535 Type: Read/Write
14	<b>[Ref Dec Position]</b> Sets the number of digits to be displayed to the right of the decimal point for the Reference.	Default: 1 Minimum: 0 Maximum: 3 Type: Read/Write
15	<b>[Ref Units Char 1]</b> <b>[Ref Units Char 2]</b> <b>[Ref Units Char 3]</b> <b>[Ref Units Char 4]</b> <b>[Ref Units Char 5]</b> <b>[Ref Units Char 6]</b> <b>[Ref Units Char 7]</b> <b>[Ref Units Char 8]</b> Selects up to 8 characters (from the ISO 8859-1 character set) to use for the Reference units on the Process Display. Parameters 15...22 can also be configured using the "Edit Ref Text" selection in the HIM Setup tab.	Default: 72 ("H")
16		Default: 122 ("z")
17		Default: 32 (blank - no character)
18		Default: 32 (blank - no character)
19		Default: 32 (blank - no character)
20		Default: 32 (blank - no character)
21		Default: 32 (blank - no character)
22		Default: 32 (blank - no character) Minimum: 32 Maximum: 255 Type: Read/Write
23	<b>[Fault Dspy Type]</b> Selects the type of display flash to be shown when a drive or peripheral fault is detected.	Default: 0 = Flash Bklite Values: 0 = Flash Bklite 1 = Flash None Type: Read/Write
24	<b>[Alarm Dspy Type]</b> Selects the type of display flash to be shown when a drive alarm is detected.	Default: 1 = Flash None Values: 0 = Flash Bklite 1 = Flash None Type: Read/Write

**NOTE:** New settings to HIM parameters are implemented immediately. Resetting the HIM is not required for new values to take effect.

U.S. Allen-Bradley Drives Technical Support

Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

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

#### Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

## Features

- 600W Peak Pulse Power Dissipation
- Voltage Range 6.8V - 400V
- Constructed with Glass Passivated Die
- Uni- and Bidirectional Versions Available
- Excellent Clamping Capability
- Fast Response Time
- **Lead Free Finish, RoHS Compliant (Note 1)**

## Mechanical Data

- Case: DO-15
- Case Material: Molded Plastic. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Leads: Plated Leads, Solderable per MIL-STD-202, Method 208 <sup>(e3)</sup>
- Marking: Unidirectional - Type Number and Cathode Band
- Marking: Bidirectional - Type Number Only
- Ordering Information: See Page 4
- Weight: 0.4 grams (approximate)

## Maximum Ratings @T<sub>A</sub> = 25°C unless otherwise specified

Characteristic	Symbol	Value	Unit
Peak Power Dissipation, t <sub>p</sub> = 1.0 ms (Non repetitive current pulse, derated above T <sub>A</sub> = 25°C)	P <sub>pk</sub>	600	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave, Superimposed on Rated Load Duty Cycle = 4 pulses per minute maximum	I <sub>FSM</sub>	100	A
Forward Voltage @ I <sub>F</sub> = 35A 300µs Square Wave Pulse, Unidirectional Only	V <sub>F</sub>	V <sub>BR</sub> ≤ 200V V <sub>BR</sub> > 200V	3.5 5.0 V

## Thermal Characteristics

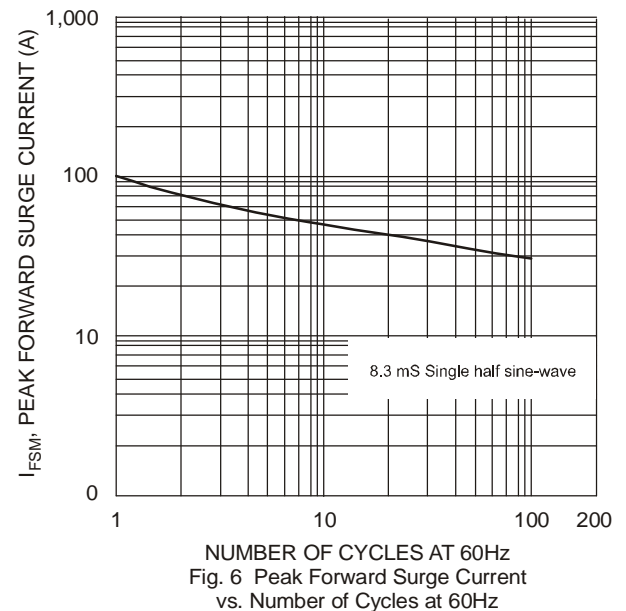
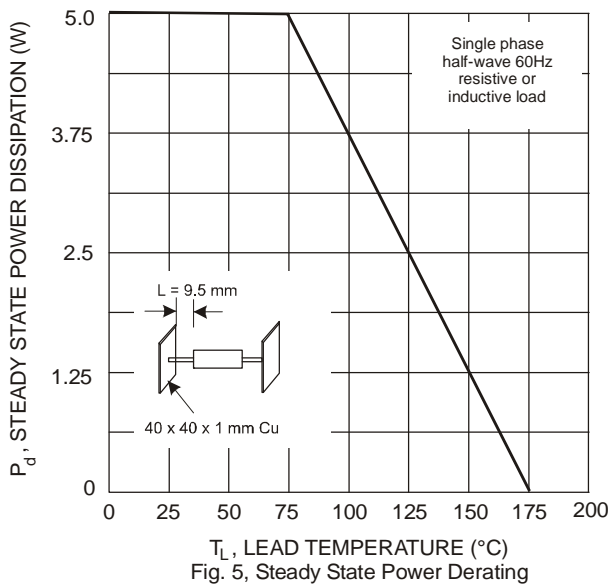
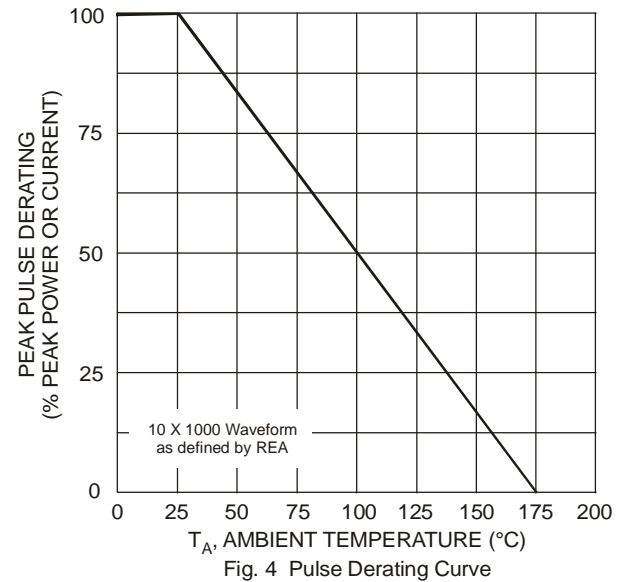
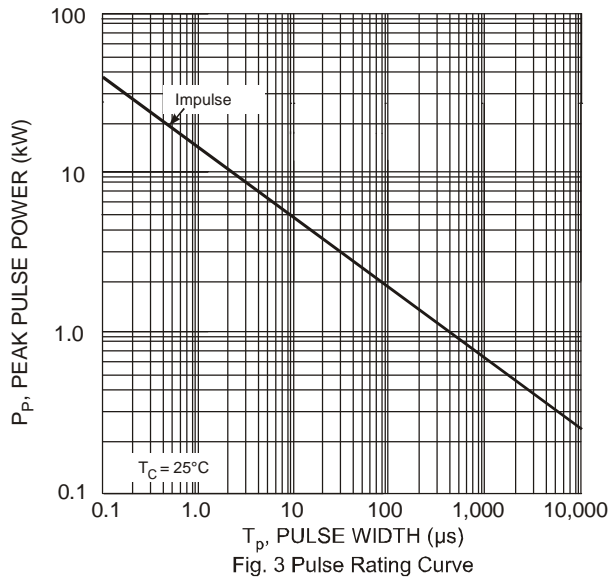
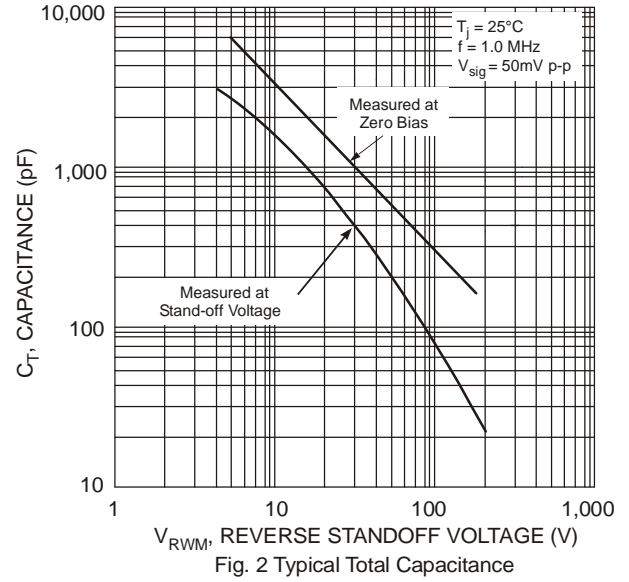
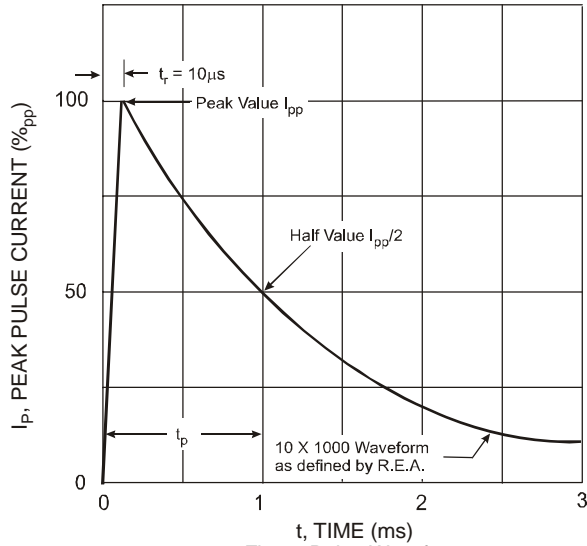
Characteristic	Symbol	Value	Unit
Steady State Power Dissipation at T <sub>L</sub> = 75°C Lead Lengths 9.5 mm (Mounted on Copper Land Area of 40mm)	P <sub>D</sub>	5.0	W
Typical Thermal Resistance, Junction to Case	R <sub>θJC</sub>	20	°C/W
Typical Thermal Resistance, Junction to Lead	R <sub>θJL</sub>	15	°C/W
Typical Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	75	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +175	°C

Notes: 1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied, see EU Directive 2002/95/EC Annex Notes.

## Electrical Characteristics @T<sub>A</sub> = 25°C unless otherwise specified

Type Number (Note 2)	Type Number (Note 2)	Reverse Standoff Voltage	Breakdown Voltage V <sub>BR</sub> @ I <sub>T</sub>		Test Current	Max Reverse Leakage (Note 3) @ V <sub>R</sub>	Max Clamping Voltage @ I <sub>pp</sub>	Max Peak Pulse Current
(UNI)	(BI)	V <sub>RWM</sub> (V)	Min (V)	Max (V)	I <sub>T</sub> (mA)	I <sub>R</sub> (μA)	V <sub>C</sub> (V)	I <sub>PP</sub> (A)
P6KE6V8A	P6KE6V8CA	5.80	6.45	7.14	10	1000	10.5	57.0
P6KE7V5A	P6KE7V5CA	6.40	7.13	7.88	10	500	11.3	53.0
P6KE8V2A	P6KE8V2CA	7.02	7.79	8.61	10	200	12.1	50.0
P6KE9V1A	P6KE9V1CA	7.78	8.65	9.55	1.0	50	13.4	45.0
P6KE10A	P6KE10CA	8.55	9.50	10.50	1.0	10	14.5	41.0
P6KE11A	P6KE11CA	9.40	10.50	11.60	1.0	5.0	15.6	38.0
P6KE12A	P6KE12CA	10.20	11.40	12.60	1.0	5.0	16.7	36.0
P6KE13A	P6KE13CA	11.10	12.40	13.70	1.0	5.0	18.2	33.0
P6KE15A	P6KE15CA	12.80	14.30	15.80	1.0	5.0	21.2	28.0
P6KE16A	P6KE16CA	13.60	15.20	16.80	1.0	5.0	22.5	27.0
P6KE18A	P6KE18CA	15.30	17.10	18.90	1.0	5.0	25.2	24.0
P6KE20A	P6KE20CA	17.10	19.00	21.00	1.0	5.0	27.7	22.0
P6KE22A	P6KE22CA	18.80	20.90	23.10	1.0	5.0	30.6	20.0
P6KE24A	P6KE24CA	20.50	22.80	25.20	1.0	5.0	33.2	18.0
P6KE27A	P6KE27CA	23.10	25.70	28.40	1.0	5.0	37.5	16.0
P6KE30A	P6KE30CA	25.60	28.50	31.50	1.0	5.0	41.4	14.40
P6KE33A	P6KE33CA	28.20	31.40	34.70	1.0	5.0	45.7	13.20
P6KE36A	P6KE36CA	30.80	34.20	37.80	1.0	5.0	49.9	12.00
P6KE39A	P6KE39CA	33.30	37.10	41.00	1.0	5.0	53.9	11.20
P6KE43A	P6KE43CA	36.80	40.90	45.20	1.0	5.0	59.3	10.10
P6KE47A	P6KE47CA	40.20	44.70	49.40	1.0	5.0	64.8	9.30
P6KE51A	P6KE51CA	43.60	48.50	53.60	1.0	5.0	70.1	8.60
P6KE56A	P6KE56CA	47.80	53.20	58.80	1.0	5.0	77.0	7.80
P6KE62A	P6KE62CA	53.00	58.90	65.10	1.0	5.0	85.0	7.10
P6KE68A	P6KE68CA	58.10	64.60	71.40	1.0	5.0	92.0	6.50
P6KE75A	P6KE75CA	64.10	71.30	78.80	1.0	5.0	103.0	5.80
P6KE82A	P6KE82CA	70.10	77.90	86.10	1.0	5.0	113.0	5.30
P6KE91A	P6KE91CA	77.80	86.50	95.50	1.0	5.0	125.0	4.80
P6KE100A	P6KE100CA	85.50	95.00	105.00	1.0	5.0	137.0	4.40
P6KE110A	P6KE110CA	94.00	105.00	116.00	1.0	5.0	152.0	4.00
P6KE120A	P6KE120CA	102.00	114.00	126.00	1.0	5.0	165.0	3.60
P6KE130A	P6KE130CA	111.00	124.00	137.00	1.0	5.0	179.0	3.30
P6KE150A	P6KE150CA	128.00	143.00	158.00	1.0	5.0	207.0	2.90
P6KE160A	P6KE160CA	136.00	152.00	168.00	1.0	5.0	219.0	2.70
P6KE170A	P6KE170CA	145.00	162.00	179.00	1.0	5.0	234.0	2.60
P6KE180A	P6KE180CA	154.00	171.00	189.00	1.0	5.0	246.0	2.40
P6KE200A	P6KE200CA	171.00	190.00	210.00	1.0	5.0	274.0	2.20
P6KE220A	P6KE220CA	185.00	209.00	231.00	1.0	5.0	328.0	1.83
P6KE250A	P6KE250CA	214.00	237.00	263.00	1.0	5.0	344.0	1.75
P6KE300A	P6KE300CA	256.00	285.00	315.00	1.0	5.0	414.0	1.45
P6KE350A	P6KE350CA	300.00	332.00	368.00	1.0	5.0	482.0	1.25
P6KE400A	P6KE400CA	342.00	380.00	420.00	1.0	5.0	548.0	1.10

Notes: 2. Suffix 'C' denotes bidirectional device.  
3. For bidirectional devices having V<sub>R</sub> of 10 volts and under, the I<sub>R</sub> limit is doubled.



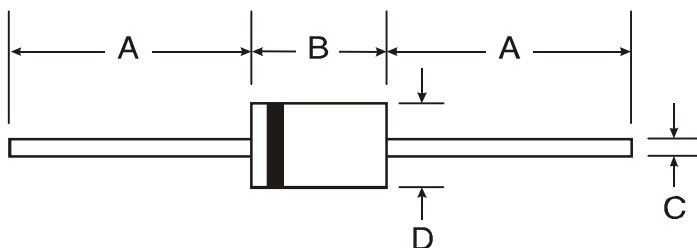
## Ordering Information (Note 4)

Part Number	Case	Packaging
(Type Number)-B*	DO-15	500/Bulk
(Type Number)-T*	DO-15	4K/Tape & Reel, 13-inch

\* Add "-B" or "-T" to the appropriate type number in Table 1 for Bulk or Tape & Reel, respectively. Example: 6.40V VRWM = P6KE7V5A-B for Bulk, P6KE7V5A-T for Tape & Reel.

Notes: 4. For packaging details, go to our website at <http://www.diodes.com/datasheets/ap02008.pdf>.

## Package Outline Dimensions



DO-15		
Dim	Min	Max
A	25.40	—
B	5.50	7.62
C	0.686	0.889
D	2.60	3.60
All Dimensions in mm		

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**Allen-Bradley**

**PowerFlex<sup>®</sup>**  
40

## **Adjustable Frequency AC Drive**

**FRN 2.xx**

### **User Manual**

Revision "C" February '04

Approved 2/24/04

Revision "D" Next

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

**Rockwell  
Automation**

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. “*Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls*” (Publication SGI-1.1 available from your local Rockwell Automation Sales Office or online at <http://www.ab.com/manuals/gi>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual we use notes to make you aware of safety considerations.



**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

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Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

**Important:** Identifies information that is especially important for successful application and understanding of the product.

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**Shock Hazard** labels may be located on or inside the drive to alert people that dangerous voltage may be present.

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ControlNet is a trademark of ControlNet International, Ltd.

DeviceNet is a trademark of the Open DeviceNet Vendor Association.

## Summary of Changes

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The information below summarizes the changes to the PowerFlex 40 *User Manual* since the June 2003 release.

Description of New or Updated Information	See Page(s)
600 Volt ratings added to product line.	Throughout
480 Volt, 11 kW (15 HP) rating added to product line.	Throughout
Position 12 of the Catalog Number now indicates drive type.	<a href="#">P-4</a>
Flange Mount drive enclosure added.	<a href="#">P-4</a> , <a href="#">B-9</a>
Remote HIM Menu Structure added.	<a href="#">2-5</a>
The following parameters have been added:	
d029 [Torque Current]	<a href="#">3-8</a>
P042 [Voltage Class]	<a href="#">3-13</a>
A109 [Anlg out Setpt]	<a href="#">3-32</a>
A115 [Process Time Lo]	<a href="#">3-33</a>
A116 [Process Time Hi]	<a href="#">3-33</a>
A117 [Bus Reg Mode]	<a href="#">3-33</a>
A160 [EM Brk Off Delay]	<a href="#">3-41</a>
A161 [EM Brk On Delay]	<a href="#">3-41</a>
A162 [MOP Reset Sel]	<a href="#">3-41</a>
Options have been added to the following parameters:	
P036 [Start Source]	<a href="#">3-10</a>
P037 [Stop Mode]	<a href="#">3-11</a>
P038 [Speed Reference]	<a href="#">3-12</a>
A051-A054 [Dig Inx Sel]	<a href="#">3-14</a>
A055 [Relay Out Sel]	<a href="#">3-15</a>
A058 & A061 [Opto Outx Sel]	<a href="#">3-17</a>
A065 [Analog Out Sel]	<a href="#">3-20</a>
All drive ratings now support dynamic braking.	<a href="#">B-2</a>
Remote Small HIM, Cat. No. 22-HIM-C2S, dimensions added.	<a href="#">B-17</a>

The information below summarizes the changes to the PowerFlex 40 *User Manual* since the January 2003 release.

Description of New or Updated Information	See Page(s)
Fusing and circuit breaker information updated.	<a href="#">1-6</a>
Requirements for motor cable types expanded.	<a href="#">1-8</a>
I/O wiring examples clarified.	<a href="#">1-16</a>
Parameter A136 [PID Diff Rate] default value is 0.00.	<a href="#">3-38</a>
Minimum resistance values for Dynamic Brake Modules added.	<a href="#">B-2</a>
Inductance rating for 480 Volt, 2.2 kW (3.0 HP) Bulletin 1321-3R Series Line Reactor corrected.	<a href="#">B-3</a>
Dimensions for NEMA Type 1 Bezel kit corrected.	<a href="#">B-18</a>
Appendix E: Step Logic, Basic Logic and Timer/Counter Functions added	<a href="#">E-1</a>
Appendix F: PID Setup added	<a href="#">F-1</a>

# Table of Contents

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<b>Preface</b>	<b>Overview</b>	
		Who Should Use this Manual? . . . . . P-1
		Reference Materials . . . . . P-1
		Manual Conventions . . . . . P-2
		Drive Frame Sizes . . . . . P-2
		General Precautions . . . . . P-3
		Catalog Number Explanation . . . . . P-4
<b>Chapter 1</b>	<b>Installation/Wiring</b>	
		Opening the Cover . . . . . 1-1
		Mounting Considerations . . . . . 1-2
		AC Supply Source Considerations . . . . . 1-3
		General Grounding Requirements . . . . . 1-5
		Fuses and Circuit Breakers . . . . . 1-6
		Power Wiring . . . . . 1-8
		I/O Wiring Recommendations . . . . . 1-12
		Start and Speed Reference Control . . . . . 1-20
		EMC Instructions . . . . . 1-22
<b>Chapter 2</b>	<b>Start Up</b>	
		Prepare For Drive Start-Up . . . . . 2-1
		Integral Keypad . . . . . 2-3
		Viewing and Editing Parameters . . . . . 2-4
		Remote HIM Menu Structure . . . . . 2-5
<b>Chapter 3</b>	<b>Programming and Parameters</b>	
		About Parameters . . . . . 3-1
		Parameter Organization . . . . . 3-2
		Display Group . . . . . 3-3
		Basic Program Group . . . . . 3-9
		Advanced Program Group . . . . . 3-14
		Parameter Cross Reference – by Name . . 3-42
<b>Chapter 4</b>	<b>Troubleshooting</b>	
		Drive Status . . . . . 4-1
		Faults . . . . . 4-1
		Fault Descriptions . . . . . 4-3
		Common Symptoms and Corrective Actions . . 4-5
<b>Appendix A</b>	<b>Supplemental Drive Information</b>	
		Drive, Fuse & Circuit Breaker Ratings . . . A-1
		Specifications . . . . . A-2
<b>Appendix B</b>	<b>Accessories and Dimensions</b>	
		Product Selection . . . . . B-1
		Product Dimensions . . . . . B-7
<b>Appendix C</b>	<b>RS485 (DSI) Protocol</b>	
<b>Appendix D</b>	<b>RJ45 DSI Splitter Cable</b>	
<b>Appendix E</b>	<b>Step Logic, Basic Logic and Timer/Counter Functions</b>	
<b>Appendix F</b>	<b>PID Set Up</b>	
<b>Index</b>		



## Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 40 Adjustable Frequency AC Drive.

For information on...	See page...
<a href="#">Who Should Use this Manual?</a>	<a href="#">P-1</a>
<a href="#">Reference Materials</a>	<a href="#">P-1</a>
<a href="#">Manual Conventions</a>	<a href="#">P-2</a>
<a href="#">Drive Frame Sizes</a>	<a href="#">P-2</a>
<a href="#">General Precautions</a>	<a href="#">P-3</a>
<a href="#">Catalog Number Explanation</a>	<a href="#">P-4</a>

### Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

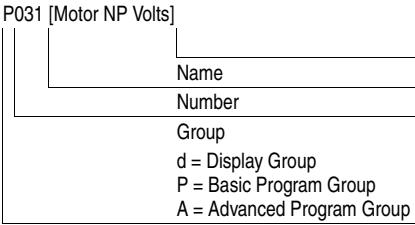
### Reference Materials

The following manuals are recommended for general drive information:

Title	Publication	Available Online at ...
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001...	<a href="http://www.ab.com/manuals/dr">www.ab.com/manuals/dr</a>
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001...	<a href="http://www.ab.com/manuals/dr">www.ab.com/manuals/dr</a>
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	<a href="http://www.ab.com/manuals/gi">www.ab.com/manuals/gi</a>
A Global Reference Guide for Reading Schematic Diagrams	100-2.10	<a href="http://www.ab.com/manuals/gi">www.ab.com/manuals/gi</a>
Guarding Against Electrostatic Damage	8000-4.5.2	<a href="http://www.ab.com/manuals/dr">www.ab.com/manuals/dr</a>

## Manual Conventions

- In this manual we refer to the PowerFlex 40 Adjustable Frequency AC Drive as; drive, PowerFlex 40 or PowerFlex 40 Drive.
- Parameter numbers and names are shown in this format:



- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Shall	Required and necessary
Should	Recommended
Should Not	Not Recommended

## Drive Frame Sizes

Similar PowerFlex 40 drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame sizes is provided in [Appendix B](#).



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## General Precautions

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**ATTENTION:** The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.



**ATTENTION:** Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.



**ATTENTION:** This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.



**ATTENTION:** An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

---

Catalog Number Explanation

1-3	4	5	6-8	9	10	11	12 <sup>(1)</sup>	13-14
22B	-	A	1P5	N	1	1	4	AA
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Type	Optional

**Code**  
22B PowerFlex 40

**Code Voltage Ph.**  
V 120V AC 1  
A 240V AC 1  
B 240V AC 3  
D 480V AC 3  
E 600V AC 3

**Code Rating**  
0 Not Filtered  
1 Filtered

**Code Interface Module**  
1 Fixed Keypad

**Code Enclosure**  
N Panel Mount - IP 20 (NEMA Type Open)  
F Flange Mount - IP 20 (NEMA Type Open)  
H Replacement Plate Drive - IP 20 (NEMA Type Open)  
- Contact factory for ordering information.

**Code Version**  
4 Standard

**Code Purpose**  
AA Reserved for  
thru custom firmware  
ZZ

Output Current @ 100-120V Input

Code	Amps	kW (HP)
2P3	2.3	0.4 (0.5)
5P0	5.0	0.75 (1.0)
6P0	6.0	1.1 (1.5)

Output Current @ 200-240V Input

Code	Amps	kW (HP)
2P3	2.3	0.4 (0.5)
5P0	5.0	0.75 (1.0)
8P0	8.0	1.5 (2.0)
012	12	2.2 (3.0)
017	17.5	3.7 (5.0)
024	24	5.5 (7.5)
033	33	7.5 (10)

Output Current @ 380-480V Input

Code	Amps	kW (HP)
1P4	1.4	0.4 (0.5)
2P3	2.3	0.75 (1.0)
4P0	4.0	1.5 (2.0)
6P0	6.0	2.2 (3.0)
010	10.5	4.0 (5.0)
012	12	5.5 (7.5)
017	17	7.5 (10)
024	24	11 (15)

Output Current @ 500-600V Input

Code	Amps	kW (HP)
1P7	1.7	0.75 (1.0)
3P0	3.0	1.5 (2.0)
4P2	4.2	2.2 (3.0)
6P6	6.6	4.0 (5.0)
9P9	9.9	5.5 (7.5)
012	12.2	7.5 (10)
019	19	11 (15)

(1) Position 12 of the Catalog Number now indicates drive type. All PowerFlex 40 drives are equipped with RS485 communication.

Additional accessories, options and adapters are available. See Appendix B for details.

## Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 40 Drive.

For information on...	See page	For information on...	See page
<a href="#">Opening the Cover</a>	<a href="#">1-1</a>	<a href="#">Fuses and Circuit Breakers</a>	<a href="#">1-6</a>
<a href="#">Mounting Considerations</a>	<a href="#">1-2</a>	<a href="#">Power Wiring</a>	<a href="#">1-8</a>
<a href="#">AC Supply Source Considerations</a>	<a href="#">1-3</a>	<a href="#">I/O Wiring Recommendations</a>	<a href="#">1-12</a>
<a href="#">General Grounding Requirements</a>	<a href="#">1-5</a>	<a href="#">EMC Instructions</a>	<a href="#">1-22</a>

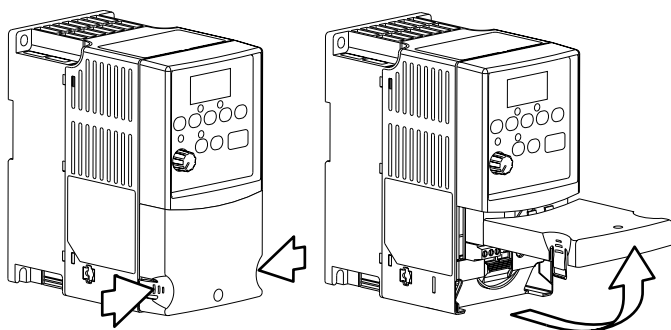
Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.



**ATTENTION:** The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

### Opening the Cover

1. Press and hold in the tabs on each side of the cover.
2. Pull the cover out and up to release.



## Mounting Considerations

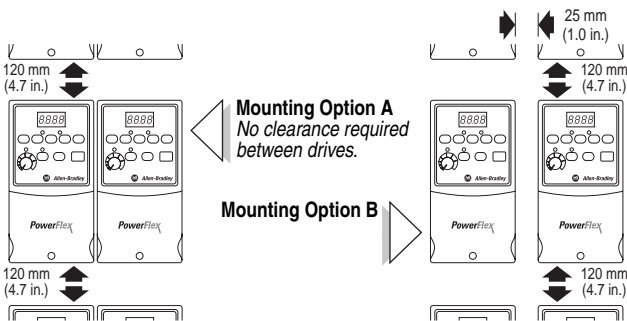
- Mount the drive upright on a flat, vertical and level surface.

Frame	Screw Size	Screw Torque	DIN Rail
B	M4 (#8-32)	1.56-1.96 N-m (14-17 lb.-in.)	35 mm
C	M5 (#10-24)	2.45-2.94 N-m (22-26 lb.-in.)	–

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

## Minimum Mounting Clearances

Refer to [Appendix B](#) for mounting dimensions.



## Ambient Operating Temperatures

Table 1.A Enclosure and Clearance Requirements

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10°C (14°F)	40°C (104°F)	IP 20/Open Type	Use Mounting Option A
		IP 30/NEMA 1/UL Type 1 <sup>(1)</sup>	Use Mounting Option B
	50°C (122°F)	IP 20/Open Type	Use Mounting Option B

<sup>(1)</sup> Rating requires installation of the PowerFlex 40 IP 30/NEMA 1/UL Type 1 option kit.

## Debris Protection

A plastic top panel is included with the drive. Install the panel to prevent debris from falling through the vents of the drive housing during installation. Remove the panel for IP 20/Open Type applications.

## Storage

- Store within an ambient temperature range of -40° to +85°C.
- Store within a relative humidity range of 0% to 95%, non-condensing.
- Do not expose to a corrosive atmosphere.

## AC Supply Source Considerations

### Ungrounded Distribution Systems



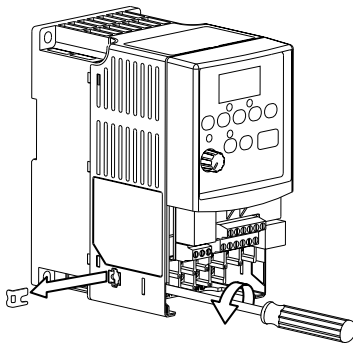
**ATTENTION:** PowerFlex 40 drives contain protective MOVs that are referenced to ground. These devices should be disconnected if the drive is installed on an ungrounded distribution system.

#### Disconnecting MOVs

To prevent drive damage, the MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove the jumper shown in the Figures [1.1](#) and [1.2](#).

1. Turn the screw counterclockwise to loosen.
2. Pull the jumper completely out of the drive chassis.
3. Tighten the screw to keep it in place.

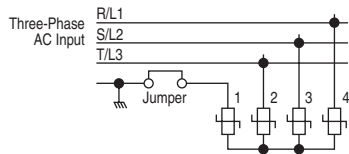
**Figure 1.1 Jumper Location (Typical)**



#### Important:

Tighten screw after jumper removal.

**Figure 1.2 Phase to Ground MOV Removal**



Input Power Conditioning

The drive is suitable for direct connection to input power within the rated voltage of the drive (see [Appendix A](#)). Listed in [Table 1.B](#) are certain input power conditions which may cause component damage or reduction in product life. If any of the conditions exist, as described in [Table 1.B](#), install one of the devices listed under the heading *Corrective Action* on the line side of the drive.

**Important:** Only one device per branch circuit is required. It should be mounted closest to the branch and sized to handle the total current of the branch circuit.

Table 1.B Input Power Conditions

Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	<ul style="list-style-type: none"><li>• Install Line Reactor<sup>(2)</sup></li><li>• or Isolation Transformer</li><li>• or Bus Inductor – 5.5 &amp; 11 kW (7.5 &amp; 15 HP) drives only</li></ul>
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	<ul style="list-style-type: none"><li>• Install Line Reactor</li><li>• or Isolation Transformer</li></ul>
Phase to ground voltage exceeds 125% of normal line to line voltage	
Ungrounded distribution system	
240V open delta configuration (stinger leg) <sup>(1)</sup>	<ul style="list-style-type: none"><li>• Remove MOV jumper to ground.</li><li>• or Install Isolation Transformer with grounded secondary if necessary.</li><li>• Install Line Reactor</li></ul>

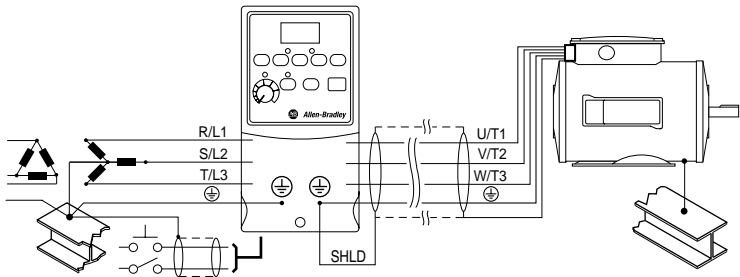
(1) For drives applied on an open delta with a middle phase grounded neutral system, the phase opposite the phase that is tapped in the middle to the neutral or earth is referred to as the “stinger leg,” “high leg,” “red leg,” etc. This leg should be identified throughout the system with red or orange tape on the wire at each connection point. The stinger leg should be connected to the center Phase B on the reactor. Refer to [Table B.D](#) for specific line reactor part numbers.

(2) Refer to [Appendix B](#) for accessory ordering information.

## General Grounding Requirements

The drive Safety Ground -  $\oplus$  (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

Figure 1.3 Typical Grounding



### Ground Fault Monitoring

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

### Safety Ground - $\oplus$ (PE)

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

### Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

### Shield Termination - SHLD

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The conduit box option may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

### RFI Filter Grounding

Using single phase drives with integral filter, or an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

## Fuses and Circuit Breakers

The PowerFlex 40 does not provide branch short circuit protection. This product should be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.



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**ATTENTION:** To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in this section.

---

### Fusing

The PowerFlex 40 has been UL tested and approved for use with input fuses. The ratings in the table that follows are the minimum recommended values for use with each drive rating. The devices listed in this table are provided to serve as a guide.

### Bulletin 140M (Self-Protected Combination Controller)/UL489 Circuit Breakers

When using Bulletin 140M or UL489 rated circuit breakers, the guidelines listed below must be followed in order to meet the NEC requirements for branch circuit protection.

- Bulletin 140M can be used in single and group motor applications.
- Bulletin 140M can be used up stream from the drive **without** the need for fuses.



**Table 1.C Minimum Recommended Branch Circuit Protective Devices**

<b>Voltage Rating</b>	<b>Drive Rating kW (HP)</b>	<b>Fuse Rating<sup>(1)</sup> Amps</b>	<b>140M Motor Protectors<sup>(2)</sup> Catalog No.</b>	<b>Recommended MCS Contactors Catalog No.</b>
120V AC – 1-Phase	0.4 (0.5)	15	140M-C2E-C16	100-C12
	0.75 (1.0)	35	140M-D8E-C20	100-C23
	1.1 (1.5)	40	140M-F8E-C32	100-C37
240V AC – 1-Phase	0.4 (0.5)	10	140M-C2E-B63	100-C09
	0.75 (1.0)	20	140M-C2E-C16	100-C12
	1.5 (2.0)	30	140M-D8E-C20	100-C23
	2.2 (3.0)	40	140M-F8E-C32	100-C37
240V AC – 3-Phase	0.4 (0.5)	6	140M-C2E-B40	100-C07
	0.75 (1.0)	10	140M-C2E-C10	100-C09
	1.5 (2.0)	15	140M-C2E-C16	100-C12
	2.2 (3.0)	25	140M-C2E-C16	100-C23
	3.7 (5.0)	35	140M-F8E-C25	100-C23
	5.5 (7.5)	40	140M-F8E-C32	100-C37
	7.5 (10.0)	60	140M-G8E-C45	100-C60
480V AC – 3-Phase	0.4 (0.5)	3	140M-C2E-B25	100-C07
	0.75 (1.0)	6	140M-C2E-B40	100-C07
	1.5 (2.0)	10	140M-C2E-B63	100-C09
	2.2 (3.0)	15	140M-C2E-C10	100-C09
	4.0 (5.0)	20	140M-C2E-C16	100-C23
	5.5 (7.5)	25	140M-D8E-C20	100-C23
	7.5 (10.0)	30	140M-D8E-C20	100-C23
	11 (15)	50	140M-F8E-C32	100-C43
600V AC – 3-Phase	0.75 (1.0)	6	140M-C2E-B25	100-C09
	1.5 (2.0)	6	140M-C2E-B40	100-C09
	2.2 (3.0)	10	140M-C2E-B63	100-C09
	4.0 (5.0)	15	140M-C2E-C10	100-C09
	5.5 (7.5)	20	140M-C2E-C16	100-C16
	7.5 (10.0)	25	140M-C2E-C16	100-C23
	11 (15)	40	140M-D8E-C25	100-C30

(1) Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001... to determine the frame and breaking capacity required for your application.

## Power Wiring

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**ATTENTION:** National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.



**ATTENTION:** To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” power leads.

---

### Motor Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Do not route more than three sets of motor leads in a single conduit to minimize “cross talk”. If more than three drive/motor connections per conduit are required, shielded cable must be used.

UL installations in 50°C ambient must use 600V, 75°C or 90°C wire. UL installations in 40°C ambient should use 600V, 75°C or 90°C wire. Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

#### Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas.** Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

#### Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in “Wiring and Grounding Guidelines for PWM AC Drives,” publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

#### Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	<ul style="list-style-type: none"> <li>• Four tinned copper conductors with XLPE insulation.</li> <li>• Copper braid/aluminum foil combination shield and tinned copper drain wire.</li> <li>• PVC jacket.</li> </ul>
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	<ul style="list-style-type: none"> <li>• Three tinned copper conductors with XLPE insulation.</li> <li>• 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield.</li> <li>• PVC jacket.</li> </ul>
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	<ul style="list-style-type: none"> <li>• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor.</li> <li>• Black sunlight resistant PVC jacket overall.</li> <li>• Three copper grounds on #10 AWG and smaller.</li> </ul>

**Reflected Wave Protection**

The drive should be installed as close to the motor as possible. Installations with long motor cables may require the addition of external devices to limit voltage reflections at the motor (reflected wave phenomena). See [Table 1.D](#) for recommendations.

The reflected wave data applies to all frequencies 2 to 16 kHz.

For 240V ratings, reflected wave effects do not need to be considered.

**Table 1.D    Maximum Cable Length Recommendations**

Reflected Wave		
380-480V Ratings	Motor Insulation Rating	Motor Cable Only <sup>(1)</sup>
	1000 Vp-p	15 meters (49 feet)
	1200 Vp-p	40 meters (131 feet)
	1600 Vp-p	170 meters (558 feet)

<sup>(1)</sup> Longer cable lengths can be achieved by installing devices on the output of the drive. Consult factory for recommendations.

**Output Disconnect**

The drive is intended to be commanded by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies output power to the motor for the purpose of starting and stopping the motor should not be used. If it is necessary to disconnect power to the motor with the drive outputting power, an auxiliary contact should be used to simultaneously disable drive control run commands.

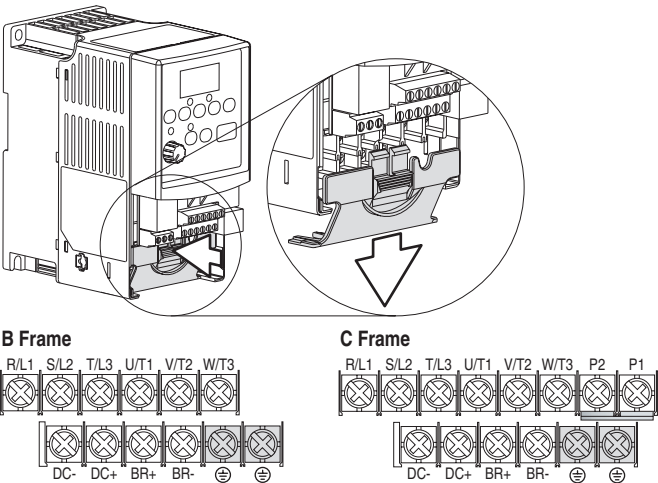
Power Terminal Block

The drive utilizes a finger guard over the power wiring terminals. To remove:

1. Press in and hold the locking tab.
2. Slide finger guard down and out.

Replace the finger guard when wiring is complete.

Figure 1.4 Power Terminal Block (Typical)



Terminal <sup>(1)</sup>	Description
R/L1, S/L2	1-Phase Input
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1
V/T2	To Motor V/T2
W/T3	To Motor W/T3
P2, P1	DC Bus Inductor Connection (C Frame drives only.) The C Frame drive is shipped with a jumper between Terminals P2 and P1. Remove this jumper only when a DC Bus Inductor will be connected. Drive will not power up without a jumper or inductor connected.
DC+, DC-	DC Bus Connection
BR+, BR-	Dynamic Brake Resistor Connection
⊕	Safety Ground - PE

<sup>(1)</sup> **Important:** Terminal screws may become loose during shipment. Ensure that all terminal screws are tightened to the recommended torque before applying power to the drive.

**Table 1.E    Power Terminal Block Specifications**

Frame	Maximum Wire Size <sup>(1)</sup>	Minimum Wire Size <sup>(1)</sup>	Torque
B	5.3 mm <sup>2</sup> (10 AWG)	1.3 mm <sup>2</sup> (16 AWG)	1.7-2.2 N-m (16-19 lb.-in.)
C	8.4 mm <sup>2</sup> (8 AWG)	1.3 mm <sup>2</sup> (16 AWG)	2.9-3.7 N-m (26-33 lb.-in.)

<sup>(1)</sup> Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

## I/O Wiring Recommendations

### Motor Start/Stop Precautions

---



**ATTENTION:** A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.



**ATTENTION:** The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

---

Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

**Important:** I/O terminals labeled “Common” are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference.

---



**ATTENTION:** Driving the 4-20mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

---

### Control Wire Types

Table 1.F Recommended Control and Signal Wire<sup>(1)</sup>

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm <sup>2</sup> (18AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm <sup>2</sup> (18AWG), 3 conductor, shielded for remote pot only.	

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

### I/O Terminal Block

Table 1.G I/O Terminal Block Specifications

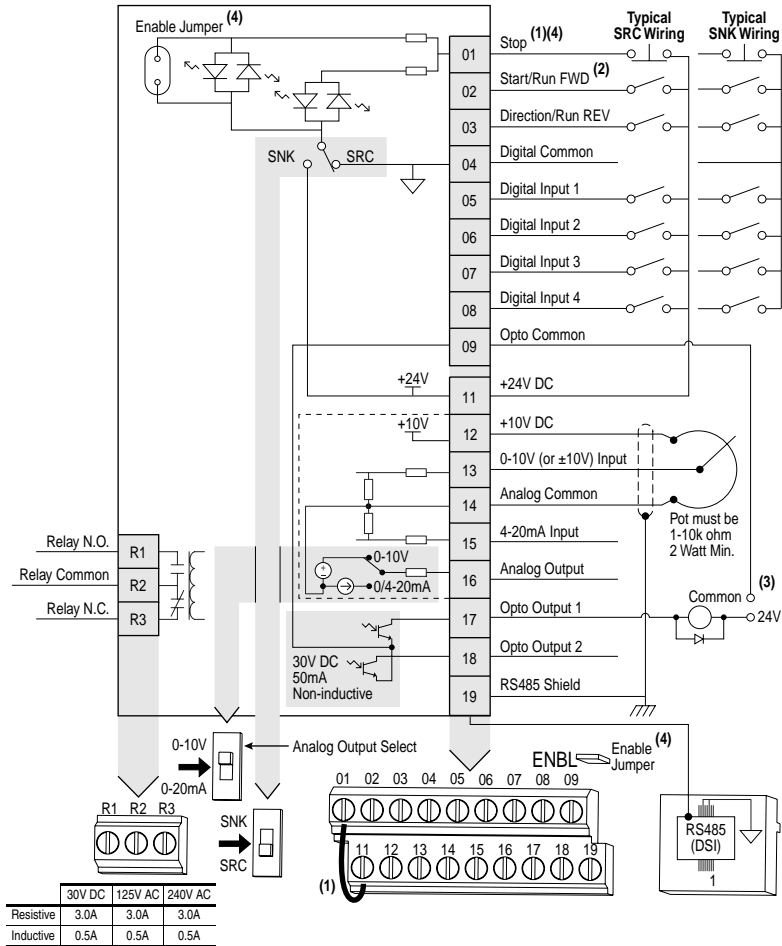
Frame	Maximum Wire Size <sup>(2)</sup>	Minimum Wire Size <sup>(2)</sup>	Torque
B & C	1.3 mm <sup>2</sup> (16 AWG)	0.13 mm <sup>2</sup> (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

(2) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

### Maximum Control Wire Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common must be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 16 should also be connected to ground terminal/protective earth.

Figure 1.5 Control Wiring Block Diagram



(1) **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to “3-Wire” or “Momt FWD/REV” control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037 <sup>(4)</sup>
2-Wire	Per P037	Coast
Momt FWD/REV	Per P037	Per P037 <sup>(4)</sup>
RS485 Port	Per P037	Coast

**Important:** The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.



- (2) Two wire control shown. For three wire control use a momentary input  on I/O Terminal 02 to command a start. Use a maintained input  for I/O Terminal 03 to change direction.
- (3) When using an opto output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.
- (4) When the ENBL enable jumper is removed, I/O Terminal 01 will always act as a hardware enable, causing a coast to stop without software interpretation.



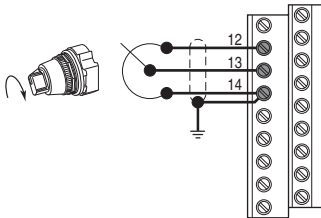
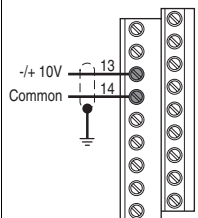
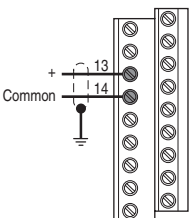
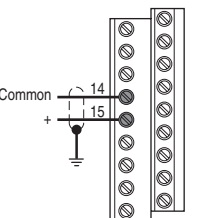
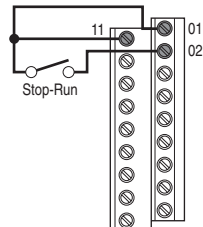
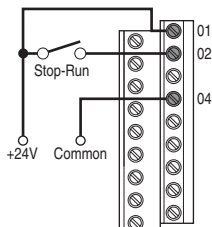
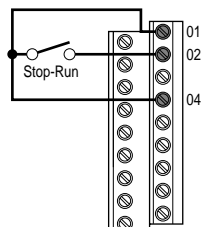
Table 1.H Control I/O Terminal Designations

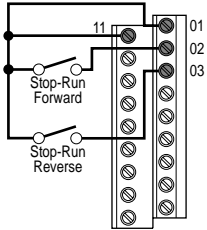
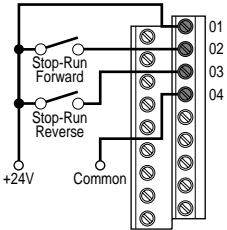
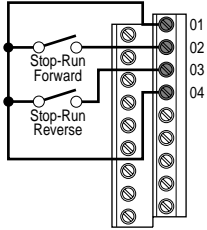
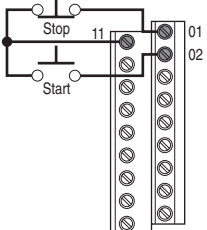
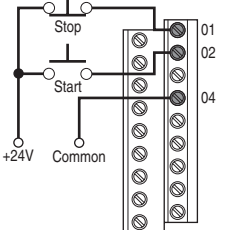
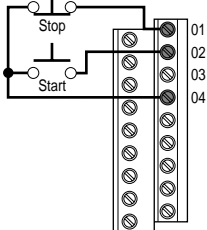
No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	<a href="#">A055</a>
R2	Relay Common	—	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	<a href="#">A055</a>
Analog Output Select DIP Switch		0-10V	Sets analog output to either voltage or current. Setting must match A065 [Analog Out Sel].	
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop <sup>(1)</sup>	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	<a href="#">P036</a> <sup>(1)</sup>
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default.	<a href="#">P036</a> , <a href="#">P037</a>
03	Direction/Run REV	Not Active	To disable reverse operation, see A095 [Reverse Disable].	<a href="#">P036</a> , <a href="#">P037</a> , <a href="#">A095</a>
04	Digital Common	—	For digital inputs. Electronically isolated with digital inputs from analog I/O and opto outputs.	
05	Digital Input 1	Preset Freq	Program with A051 [Digital In1 Sel].	<a href="#">A051</a>
06	Digital Input 2	Preset Freq	Program with A052 [Digital In2 Sel].	<a href="#">A052</a>
07	Digital Input 3	Local	Program with A053 [Digital In3 Sel].	<a href="#">A053</a>
08	Digital Input 4	Jog Forward	Program with A054 [Digital In4 Sel].	<a href="#">A054</a>
09	Opto Common	—	For opto-coupled outputs. Electronically isolated with opto outputs from analog I/O and digital inputs.	
11	+24V DC	—	Referenced to Digital Common. Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	—	Referenced to Analog Common. Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	<a href="#">P038</a>
13	±10V In <sup>(2)</sup>	Not Active	For external 0-10V (unipolar) or ±10V (bipolar) input supply (input impedance = 100k ohm) or potentiometer wiper.	<a href="#">P038</a> , <a href="#">A051-A054</a> , <a href="#">A123</a> , <a href="#">A132</a>
14	Analog Common	—	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs and outputs from digital I/O and opto outputs.	
15	4-20mA In <sup>(2)</sup>	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	<a href="#">P038</a> , <a href="#">A051-A054</a> , <a href="#">A132</a>
16	Analog Output	OutFreq 0-10	The default analog output is 0-10V. To convert to a current value, change the Analog Output Select DIP Switch to 0-20mA. Program with A065 [Analog Out Sel]. Max analog value can be scaled with A066 [Analog Out High]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	<a href="#">A065</a> , <a href="#">A066</a>
17	Opto Output 1	MotorRunning	Program with A058 [Opto Out1 Sel]	<a href="#">A058</a> , <a href="#">A059</a> , <a href="#">A064</a>
18	Opto Output 2	At Frequency	Program with A061 [Opto Out2 Sel]	<a href="#">A061</a> , <a href="#">A062</a> , <a href="#">A064</a>
19	RS485 (DSI) Shield	—	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

(1) See Footnotes (1) and (4) on page 1-14.

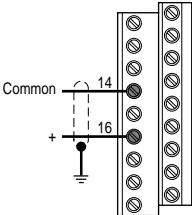
(2) 0-10V In and 4-20mA In are distinct input channels and may be connected simultaneously. Inputs may be used independently for speed control or jointly when operating in PID mode.

**I/O Wiring Examples**

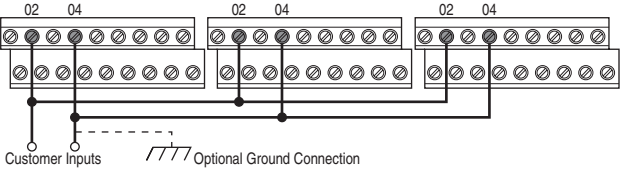

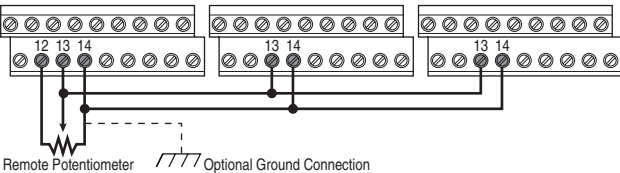
Input/Output	Connection Example		
<b>Potentiometer</b> 1-10k Ohm Pot. Recommended (2 Watt minimum)	<a href="#">P038</a> [Speed Reference] = 2 "0-10V Input"		
			
<b>Analog Input</b> 0 to +10V, 100k ohm impedance 4-20 mA, 250 ohm impedance	<b>Bipolar</b> <a href="#">P038</a> [Speed Reference] = 2 "0-10V Input" and <a href="#">A123</a> [10V Bipolar Enbl] = 1 "Bi-Polar In"	<b>Unipolar (Voltage)</b> <a href="#">P038</a> [Speed Reference] = 2 "0-10V Input"	<b>Unipolar (Current)</b> <a href="#">P038</a> [Speed Reference] = 3 "4-20mA Input"
			
<b>2 Wire SRC Control - Non-Reversing</b> <a href="#">P036</a> [Start Source] = 2, 3 or 4 Input must be active for the drive to run. When input is opened, the drive will stop as specified by <a href="#">P037</a> [Stop Mode]. If desired, a User Supplied 24V DC power source can be used. Refer to the "External Supply (SRC)" example.	<b>Internal Supply (SRC)</b> 		<b>External Supply (SRC)</b>  Each digital input draws 6 mA.
	<b>2 Wire SNK Control - Non-Reversing</b> <b>Internal Supply (SNK)</b> 		

Input/Output	Connection Example	
<b>2 Wire SRC Control - Run FWD/Run REV</b> <a href="#">P036</a> [Start Source] = 2, 3 or 4  Input must be active for the drive to run. When input is opened, the drive will stop as specified by <a href="#">P037</a> [Stop Mode].  If both Run Forward and Run Reverse inputs are closed at the same time, an undetermined state could occur.	<b>Internal Supply (SRC)</b> 	<b>External Supply (SRC)</b>   Each digital input draws 6 mA.
<b>2 Wire SNK Control - Run FWD/Run REV</b>	<b>Internal Supply (SNK)</b> 	
<b>3 Wire SRC Control - Non-Reversing</b> <a href="#">P036</a> [Start Source] = 1  A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by <a href="#">P037</a> [Stop Mode].	<b>Internal Supply (SRC)</b> 	<b>External Supply (SRC)</b>   Each digital input draws 6 mA.
<b>3 Wire SNK Control - Non-Reversing</b>	<b>Internal Supply (SNK)</b> 	



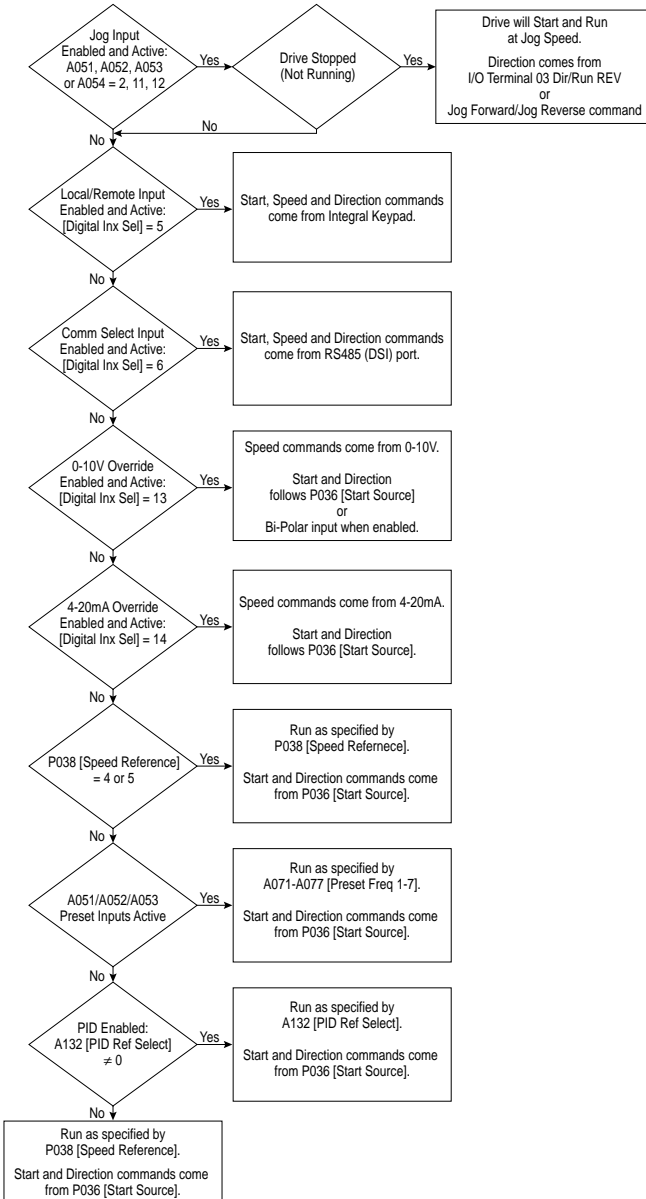
Input/Output	Connection Example
<b>Analog Output</b> <a href="#">A065</a> [Analog Out Sel] determines analog output type and drive conditions. 0-10V, 1k ohm minimum  0-20mA/4-20mA, 525 ohm maximum	<a href="#">A065</a> [Analog Out Sel] = 0 through 14 The Analog Output Select DIP Switch must be set to match the analog output signal mode set in <a href="#">A065</a> [Analog Out Sel]. 

Typical Multiple Drive Connection Examples

Input/Output	Connection Example
<b>Multiple Digital Input Connections</b> Customer Inputs can be wired per External Supply (SRC).	 <p>When connecting a single input such as Run, Stop, Reverse or Preset Speeds to multiple drives, it is important to connect I/O Terminal 04 common together for all drives. If they are to be tied into another common (such as earth ground or separate apparatus ground) only one point of the daisy chain of I/O Terminal 04 should be connected.</p> <div><b>ATTENTION:</b> I/O Common terminals should <b>not</b> be tied together when using SNK (Internal Supply) mode. In SNK mode, if power is removed from one drive, inadvertent operation of other drives that share the same I/O Common connection may occur.</div>
<b>Multiple Analog Connections</b>	 <p>When connecting a single potentiometer to multiple drives it is important to connect I/O Terminal 14 common together for all drives. I/O Terminal 14 common and I/O Terminal 13 (potentiometer wiper) should be daisy-chained to each drive. All drives must be powered up for the analog signal to be read correctly.</p>

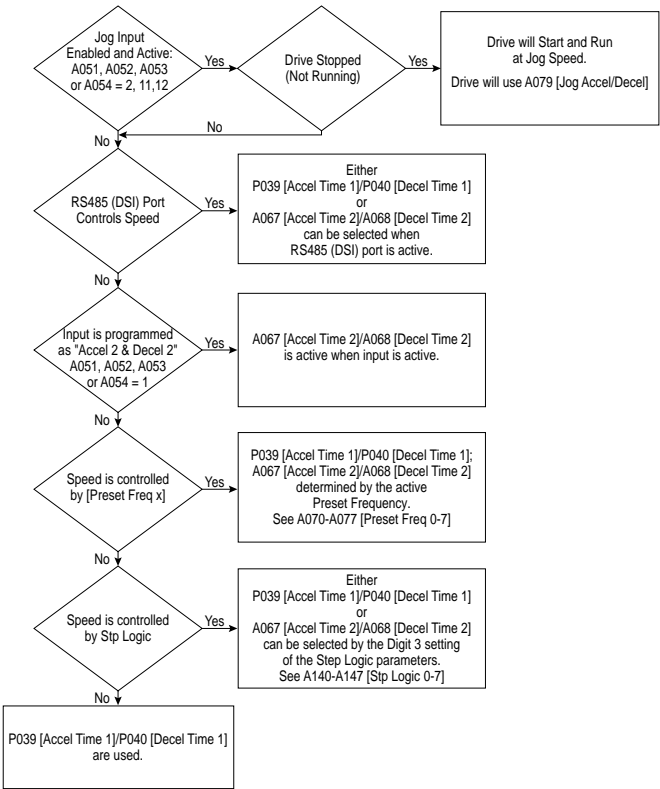
## Start and Speed Reference Control

The drive speed command can be obtained from a number of different sources. The source is normally determined by [P038](#) [Speed Reference]. However, when [A051](#) - [A054](#) [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 is not set to option 0, the speed reference commanded by [P038](#) [Speed Reference] will be overridden. See the chart below for the override priority.



Accel/Decel Selection

The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



## EMC Instructions

### CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at:

<http://www.ab.com/certification/ce/docs>.

### Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

### EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

### General Notes

- If the plastic top panel is removed or the optional conduit box is not installed, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.



Essential Requirements for CE Compliance

Conditions 1-3 listed below **must be** satisfied for PowerFlex drives to meet the requirements of EN61800-3.

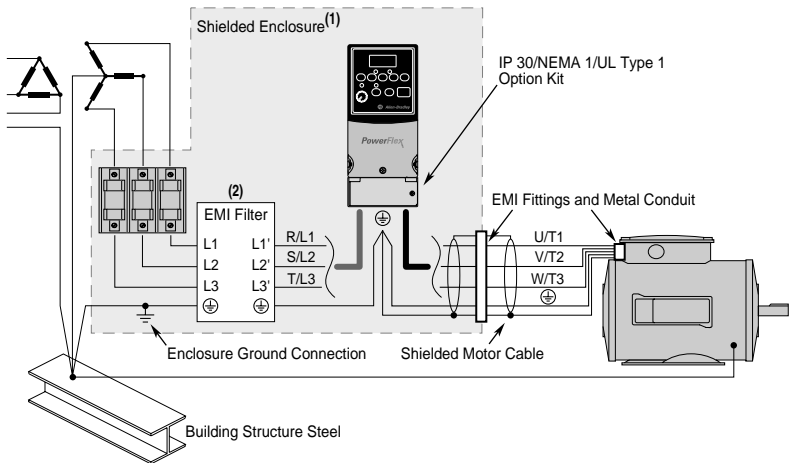
1. Grounding as described in [Figure 1.6](#). Refer to [page 1-6](#) for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. Allowable cable length in [Table 1.1](#) is not exceeded.

Table 1.1 Allowable Cable Length

Filter Type	EN61800-3 First Environment Restricted Distribution or Second Environment <sup>(2)</sup>	EN61800-3 First Environment Unrestricted Distribution <sup>(3)</sup>
Integral	10 meters (33 feet)	1 meter (3 feet)
External - S Type <sup>(1)</sup>	10 meters (33 feet)	1 meter (3 feet)
External - L Type <sup>(1)</sup>	100 meters (328 feet)	5 meters (16 feet)

- (1) Refer to [Appendix B](#) for details on optional external filters.
- (2) Equivalent to EN55011 Class A.
- (3) Equivalent to EN55011 Class B.

Figure 1.6 Connections and Grounding



- (1) First Environment Unrestricted Distribution installations require a shielded enclosure. Keep wire length as short as possible between the enclosure entry point and the EMI filter.
- (2) Integral EMI filters are available on 240V, 1-Phase drives.

**EN61000-3-2**

- 0.75 kW (1 HP) 240V 1-Phase and 3-Phase drives and 0.37 kW (0.5 HP) 240V 1-Phase drives are suitable for installation on a private low voltage power network. Installations on a public low voltage power network may require additional external harmonic mitigation.
- Other drive ratings meet the current harmonic requirements of EN61000-3-2 without additional external mitigation.

# Start Up

This chapter describes how to start up the PowerFlex 40 Drive. To simplify drive setup, the most commonly programmed parameters are organized in a single Basic Program Group.

**Important:** Read the *General Precautions* section before proceeding.



**ATTENTION:** Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed. Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

## Prepare For Drive Start-Up

### Before Applying Power to the Drive

- ☐ 1. Confirm that all inputs are connected to the correct terminals and are secure.
- ☐ 2. Verify that AC line power at the disconnect device is within the rated value of the drive.
- ☐ 3. Verify that any digital control power is 24 volts.
- ☐ 4. Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See [Figure 1.5 on page 1-14](#) for location.

**Important:** The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

- ☐ 5. Verify that the Stop input is present or the drive will not start.

**Important:** If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

### Applying Power to the Drive

- ❑ 6. Apply AC power and control voltages to the drive.
- ❑ 7. Familiarize yourself with the integral keypad features (see [page 2-3](#)) before setting any Program Group parameters.

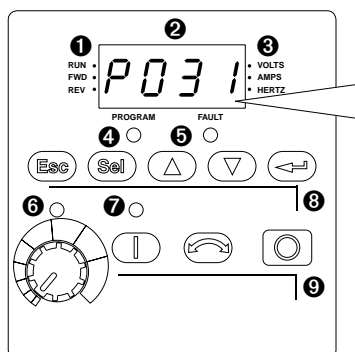
### Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction and control speed directly from the integral keypad.

**Important:** To disable reverse operation, see [A095](#) [Reverse Disable].

If a fault appears on power up, refer to [Fault Descriptions on page 4-3](#) for an explanation of the fault code.

## Integral Keypad



Menu	Description
<i>d</i>	<b>Display Group (View Only)</b> Consists of commonly viewed drive operating conditions.
<i>P</i>	<b>Basic Program Group</b> Consists of most commonly used programmable functions.
<i>A</i>	<b>Advanced Program Group</b> Consists of remaining programmable functions.
<i>F</i>	<b>Fault Designator</b> Consists of list of codes for specific fault conditions. Displayed only when fault is present.

No.	LED	LED State	Description
1	Run/Direction Status	Steady Red	Indicates drive is running and commanded motor direction.
		Flashing Red	Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero.
2	Alphanumeric Display	Steady Red	Indicates parameter number, parameter value, or fault code.
		Flashing Red	Single digit flashing indicates that digit can be edited. All digits flashing indicates a fault condition.
3	Displayed Units	Steady Red	Indicates the units of the parameter value being displayed.
4	Program Status	Steady Red	Indicates parameter value can be changed.
5	Fault Status	Flashing Red	Indicates drive is faulted.
6	Pot Status	Steady Green	Indicates potentiometer on Integral Keypad is active.
7	Start Key Status	Steady Green	Indicates Start key on Integral Keypad is active. The Reverse key is also active unless disabled by <a href="#">A095</a> [Reverse Disable].

No.	Key	Name	Description
8		Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
		Select	Advance one step in programming menu. Select a digit when viewing parameter value.
		Up Arrow	Scroll through groups and parameters.
		Down Arrow	Increase/decrease the value of a flashing digit.
9		Enter	Advance one step in programming menu. Save a change to a parameter value.
		Potentiometer	Used to control speed of drive. Default is active. Controlled by parameter <a href="#">P038</a> [Speed Reference].
		Start	Used to start the drive. Default is active. Controlled by parameter <a href="#">P036</a> [Start Source].
		Reverse	Used to reverse direction of the drive. Default is active. Controlled by parameters <a href="#">P036</a> [Start Source] and <a href="#">A095</a> [Reverse Disable].
		Stop	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter <a href="#">P037</a> [Stop Mode].

## Viewing and Editing Parameters

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Program Group parameter.

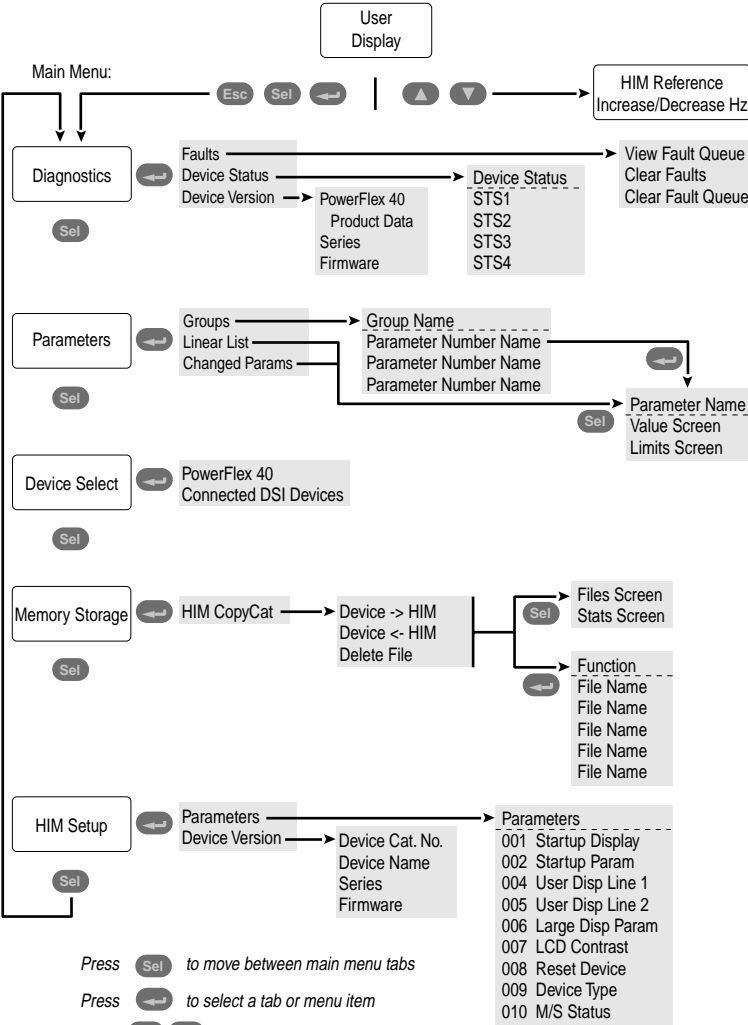
Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.)		
2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash.	Esc	
3. Press Esc again to enter the group menu. The group menu letter will flash.	Esc	
4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A).	Up Arrow or Down Arrow	
5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	Left Arrow or Sel	
6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	Up Arrow or Down Arrow	
7. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	Left Arrow or Sel	
8. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	Left Arrow or Sel	
9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	Up Arrow or Down Arrow	
10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off. Or Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	Esc  Left Arrow	
11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu. If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu.	Esc	

The Basic Program Group ([page 3-9](#)) contains the most commonly changed parameters.

## Remote HIM Menu Structure

The Menu Structure below can be accessed through the following Human Interface Module options:

HIM Option	Catalog Number
Remote Panel Mount Small, LCD Display	22-HIM-C2S
Remote Panel Mount, LCD Display	22-HIM-C2
Remote Handheld, LCD Display	22-HIM-A3



Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

Option	Description
Faults	View fault queue or fault information, clear faults or clear fault queue.
Device Status	View status information about the drive or peripheral.
Device Version	View the firmware version and hardware series of components.

Parameters Menu

Use this menu to access drive parameters. Parameters can be displayed in groups, in a linear list, or only those changed from their defaults.

Device Select Menu

Use this menu to access the drive or peripheral that the drive is to access.

Memory Storage Menu

Drive data can be saved to, or recalled from HIM sets.

*HIM sets* are files stored in permanent nonvolatile HIM memory.

Option	Description
<u>HIM Copycat</u> Device -> HIM Device <- HIM	Save data to a HIM set or load data from a HIM set to active drive memory. A maximum of 5 HIM set can be stored.
Delete File	Delete a HIM set.

HIM Setup Menu

The HIM and drive have features that you can customize.

Option	Description
Parameters	Access parameters in HIM to set display options.
Device Version	View HIM version, hardware series and firmware version



## Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 40 parameters. Parameters are programmed (viewed/edited) using the integral keypad. As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software, a personal computer and a serial converter module. Refer to [Appendix B](#) for catalog numbers.

For information on...	See page...
<a href="#">About Parameters</a>	<a href="#">3-1</a>
<a href="#">Parameter Organization</a>	<a href="#">3-2</a>
<a href="#">Basic Program Group</a>	<a href="#">3-9</a>
<a href="#">Advanced Program Group</a>	<a href="#">3-14</a>
<a href="#">Parameter Cross Reference – by Name</a>	<a href="#">3-43</a>

### About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM**  
ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**  
These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**  
Bit parameters have four individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

Some parameters are marked as follows.



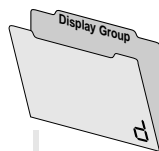
= Stop drive before changing this parameter.



= 32 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

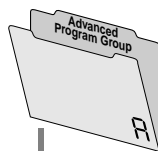
## Parameter Organization

Refer to [page 3-43](#) for an alphabetical listing of parameters.



**See page 3-3**

Output Freq	d001
Commanded Freq	d002
Output Current	d003
Output Voltage	d004
DC Bus Voltage	d005
Drive Status	d006
Fault 1 Code	d007
Fault 2 Code	d008
Fault 3 Code	d009
Process Display	d010
Control Source	d012
Contrl In Status	d013
Dig In Status	d014
Comm Status	d015
Control SW Ver	d016
Drive Type	d017
Elapsed Run Time	d018
Testpoint Data	d019
Analog In 0-10V	d020
Analog In 4-20mA	d021
Output Power	d022
Output Power Fctr	d023
Drive Temp	d024
Counter Status	d025
Timer Status	d026
Stp Logic Status	d028
Torque Current	d029

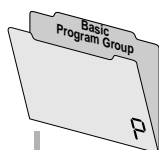


**See page 3-14**

Digital In1 Sel	A051
Digital In2 Sel	A052
Digital In3 Sel	A053
Digital In4 Sel	A054
Relay Out Sel	A055
Relay Out Level	A056
Opto Out1 Sel	A058
Opto Out1 Level	A059
Opto Out2 Sel	A061
Opto Out2 Level	A062
Opto Out Logic	A064
Analog Out Sel	A065
Analog Out High	A066
Accel Time 2	A067
Decel Time 2	A068
Internal Freq	A069
Preset Freq 0	A070
Preset Freq 1	A071
Preset Freq 2	A072
Preset Freq 3	A073
Preset Freq 4	A074
Preset Freq 5	A075
Preset Freq 6	A076
Preset Freq 7	A077
Jog Frequency	A078
Jog Accel/Decel	A079
DC Brake Time	A080
DC Brake Level	A081
DB Resistor Sel	A082
S Curve %	A083
Boost Select	A084
Start Boost	A085
Break Voltage	A086
Break Frequency	A087
Maximum Voltage	A088
Current Limit 1	A089
Motor OL Select	A090
PWM Frequency	A091
Auto Rstrt Tries	A092
Auto Rstrt Delay	A093
Start At PowerUp	A094
Reverse Disable	A095
Flying Start En	A096
Compensation	A097
SW Current Trip	A098
Process Factor	A099
Fault Clear	A100
Program Lock	A101
Testpoint Sel	A102
Comm Data Rate	A103
Comm Node Addr	A104
Comm Loss Action	A105

**See page 3-14**

Comm Loss Time	A106
Comm Format	A107
Language	A108
Anlg Out Setpnt	A109
Anlg In 0-10V Lo	A110
Anlg In 0-10V Hi	A111
Anlg In4-20mA Lo	A112
Anlg In4-20mA Hi	A113
Slip Hertz @ FLA	A114
Process Time Lo	A115
Process Time Hi	A116
Bus Reg Mode	A117
Current Limit 2	A118
Skip Frequency	A119
Skip Freq Band	A120
Stall Fault Time	A121
Analog In Loss	A122
10V Bipolar Enbl	A123
Var PWM Disable	A124
Torque Perf Mode	A125
Motor NP FLA	A126
Autotune	A127
IR Voltage Drop	A128
Flux Current Ref	A129
PID Trim Hi	A130
PID Trim Lo	A131
PID Ref Sel	A132
PID Feedback Sel	A133
PID Prop Gain	A134
PID Integ Time	A135
PID Diff Rate	A136
PID Setpoint	A137
PID Deadband	A138
PID Preload	A139
Stp Logic 0	A140
Stp Logic 1	A141
Stp Logic 2	A142
Stp Logic 3	A143
Stp Logic 4	A144
Stp Logic 5	A145
Stp Logic 6	A146
Stp Logic 7	A147
Stp Logic Time 0	A150
Stp Logic Time 1	A151
Stp Logic Time 2	A152
Stp Logic Time 3	A153
Stp Logic Time 4	A154
Stp Logic Time 5	A155
Stp Logic Time 6	A156
Stp Logic Time 7	A157
EM Brk Off Delay	A160
EM Brk On Delay	A161
MOP Reset Sel	A162



**See page 3-9**

Motor NP Volts	P031
Motor NP Hertz	P032
Motor OL Current	P033
Minimum Freq	P034
Maximum Freq	P035
Start Source	P036
Stop Mode	P037
Speed Reference	P038
Accel Time 1	P039
Decel Time 1	P040
Reset To Defaults	P041
Voltage Class	P042

## Display Group

### d001 [Output Freq]

Related Parameter(s): [d002](#), [d010](#), [P034](#), [P035](#), [P038](#)

Output frequency present at T1, T2 & T3 (U, V & W).

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/ <a href="#">P035</a> [Maximum Freq]
	Display:	0.1 Hz

### d002 [Commanded Freq]

Related Parameter(s): [d001](#), [d013](#), [P034](#), [P035](#), [P038](#)

Value of the active frequency command. Displays the commanded frequency even if the drive is not running.

**Important:** The frequency command can come from a number of sources. Refer to [Start and Speed Reference Control on page 1-20](#) for details.

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/ <a href="#">P035</a> [Maximum Freq]
	Display:	0.1 Hz

### d003 [Output Current]

The output current present at T1, T2 & T3 (U, V & W).

<b>Values</b>	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps

### d004 [Output Voltage]

Related Parameter(s): [P031](#), [A084](#), [A088](#)

Output voltage present at terminals T1, T2 & T3 (U, V & W).

<b>Values</b>	Default:	Read Only
	Min/Max:	0/Drive Rated Volts
	Display:	1 VAC

### d005 [DC Bus Voltage]

Present DC bus voltage level.

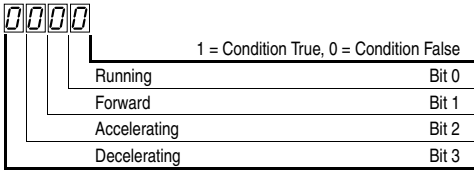
<b>Values</b>	Default:	Read Only
	Min/Max:	Based on Drive Rating
	Display:	1 VDC

## Display Group *(continued)*

### d006 [Drive Status]

Related Parameter(s): [A095](#)

Present operating condition of the drive.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

---

### d007 [Fault 1 Code]

### d008 [Fault 2 Code]

### d009 [Fault 3 Code]

A code that represents a drive fault. The codes will appear in these parameters in the order they occur (d007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once. Refer to [Chapter 4](#) for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	F2/F122
	Display:	F1

---

### d010 [Process Display]

Related Parameter(s): [d001](#), [A099](#)



32 bit parameter.

The output frequency scaled by [A099](#) [Process Factor].

$$\text{Output Freq} \times \text{Process Factor} = \text{Process Display}$$

Values	Default:	Read Only
	Min/Max:	0.00/9999
	Display:	0.01 – 1

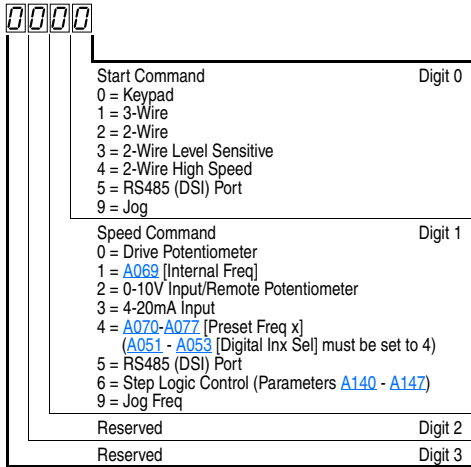
---

## Display Group *(continued)*

### d012 [Control Source]

Related Parameter(s): [P036](#), [P038](#), [A051-A054](#)

Displays the active source of the Start Command and Speed Command which are normally defined by the settings of [P036](#) [Start Source] and [P038](#) [Speed Reference] but may be overridden by digital inputs. Refer to the flowcharts on pages [1-20](#) and [1-21](#) for details.



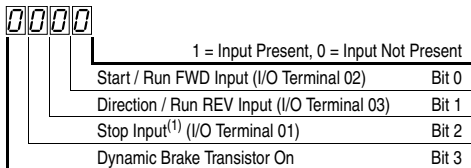
<b>Values</b>	Default:	Read Only
	Min/Max:	0/9
	Display:	1

### d013 [Contrl In Status]

Related Parameter(s): [d002](#), [P034](#), [P035](#)

Status of the control terminal block control inputs.

**Important:** Actual control commands may come from a source other than the control terminal block.



<sup>(1)</sup> The stop input must be present in order to start the drive.  
When this bit is a 1 the drive can be started.  
When this bit is a 0 the drive will stop.

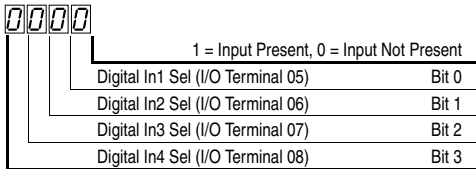
<b>Values</b>	Default:	Read Only
	Min/Max:	0/1
	Display:	1

## Display Group *(continued)*

### d014 [Dig In Status]

Related Parameter(s): [A051-A054](#)

Status of the control terminal block digital inputs.

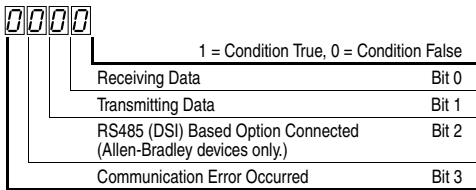


Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

### d015 [Comm Status]

Related Parameter(s): [A103-A107](#)

Status of the communications ports.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

### d016 [Control SW Ver]

Main Control Board software version.

Values	Default:	Read Only
	Min/Max:	1.00/99.99
	Display:	0.01

### d017 [Drive Type]

Used by Rockwell Automation field service personnel.

Values	Default:	Read Only
	Min/Max:	1001/9999
	Display:	1

## Display Group *(continued)*

### d018 [Elapsed Run Time]

Accumulated time drive is outputting power. Time is displayed in 10 hour increments.

<b>Values</b>	Default:	Read Only
	Min/Max:	0/9999 Hrs
	Display:	1 = 10 Hrs

### d019 [Testpoint Data]

Related Parameter(s): [A102](#)

The present value of the function selected in [A102](#) [Testpoint Sel].

<b>Values</b>	Default:	Read Only
	Min/Max:	0/FFFF
	Display:	1 Hex

### d020 [Analog In 0-10V]

Related Parameter(s): [A110](#), [A111](#)

The present value of the voltage at I/O Terminal 13 (100.0% = 10 volts).

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

### d021 [Analog In 4-20mA]

Related Parameter(s): [A112](#), [A113](#)

The present value of the current at I/O Terminal 15 (0.0% = 4mA, 100.0% = 20mA).

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

### d022 [Output Power]

Output power present at T1, T2 & T3 (U, V & W).

<b>Values</b>	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Power × 2)
	Display:	0.01 kW

### d023 [Output Powr Fctr]

The angle in electrical degrees between motor voltage and motor current.

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/180.0 deg
	Display:	0.1 deg

## Display Group *(continued)*

### d024 [Drive Temp]

Present operating temperature of the drive power section.

<b>Values</b>	Default:	Read Only
	Min/Max:	0/120 degC
	Display:	1 degC

### d025 [Counter Status]

The current value of the counter when counter is enabled.

<b>Values</b>	Default:	Read only
	Min/Max:	0/9999
	Display:	1

### d026 [Timer Status]



32 bit parameter.

The current value of the timer when timer is enabled.

<b>Values</b>	Default:	Read Only
	Min/Max:	0.0/9999 Secs
	Display:	0.1 Secs

### d028 [Stp Logic Status]

When [P038](#) [Speed Reference] is set to 6 “Stp Logic”, this parameter will display the current step of the step logic profile as defined by parameters [A140-A147](#) [Stp Logic x].

<b>Values</b>	Default:	Read Only
	Min/Max:	0/7
	Display:	1

### d029 [Torque Current]

The current value of the motor torque current.

<b>Values</b>	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps



## Basic Program Group

### P031 [Motor NP Volts]

Related Parameter(s): [d004](#), [A084](#), [A085](#), [A086](#), [A087](#)



Stop drive before changing this parameter.

Set to the motor nameplate rated volts.

<b>Values</b>	Default:	Based on Drive Rating
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

### P032 [Motor NP Hertz]

Related Parameter(s): [A084](#), [A085](#), [A086](#), [A087](#), [A090](#)



Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

<b>Values</b>	Default:	60 Hz
	Min/Max:	15/400 Hz
	Display:	1 Hz

### P033 [Motor OL Current]

Related Parameter(s): [A055](#), [A058](#), [A061](#), [A089](#), [A090](#),  
[A098](#), [A114](#), [A118](#)

Set to the maximum allowable motor current.

The drive will fault on an F7 [Motor Overload](#) if the value of this parameter is exceeded by 150% for 60 seconds.

<b>Values</b>	Default:	Based on Drive Rating
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

### P034 [Minimum Freq]

Related Parameter(s): [d001](#), [d002](#), [d013](#), [P035](#), [A085](#),  
[A086](#), [A087](#), [A110](#), [A112](#)

Sets the lowest frequency the drive will output continuously.

<b>Values</b>	Default:	0.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

### P035 [Maximum Freq]

Related Parameter(s): [d001](#), [d002](#), [d013](#), [P034](#), [A065](#),  
[A078](#), [A085](#), [A086](#), [A087](#), [A111](#), [A113](#)



Stop drive before changing this parameter.


Sets the highest frequency the drive will output.

<b>Values</b>	Default:	60 Hz
	Min/Max:	0/400 Hz
	Display:	1 Hz

## Basic Program Group *(continued)*

### P036 [Start Source]

Related Parameter(s): [d012](#), [P037](#)

 Stop drive before changing this parameter.

Sets the control scheme used to start the drive.

Refer to [Start and Speed Reference Control on page 1-20](#) for details about how other drive settings can override the setting of this parameter.

**Important:** For all settings except option 3, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

<b>Options</b>	0 "Keypad" (Default)	<ul style="list-style-type: none"><li>• Integral keypad controls drive operation.</li><li>• I/O Terminal 1 "Stop" = coast to stop.</li><li>• When active, the Reverse key is also active unless disabled by <a href="#">A095</a> [Reverse Disable].</li></ul>
	1 "3-Wire"	I/O Terminal 1 "Stop" = stop according to the value set in <a href="#">P037</a> [Stop Mode].
	2 "2-Wire"	I/O Terminal 1 "Stop" = coast to stop.
	3 "2-W Lvl Sens"	Drive will restart after a "Stop" command when: <ul style="list-style-type: none"><li>• Stop is removed</li><li>and</li><li>• Start is held active</li></ul>



**ATTENTION:** Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input for the drive to run again. A Stop function is provided only when the Stop input is active (open).

4	"2-W Hi Speed"	<b>Important:</b> There is greater potential voltage on the output terminals when using this option. <ul style="list-style-type: none"><li>• Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms.</li><li>• I/O Terminal 1 "Stop" = coast to stop.</li></ul>
5	"Comm Port"	<ul style="list-style-type: none"><li>• Remote communications. Refer to Appendix C for details.</li><li>• I/O Terminal 1 "Stop" = coast to stop.</li></ul>
6	"Momt FWD/REV"	<ul style="list-style-type: none"><li>• Drive will start after a momentary input from either the Run FWD Input (I/O Terminal 02) or the Run REV Input (I/O Terminal 03).</li><li>• I/O Terminal 1 "Stop" = stop according to the value set in <a href="#">P037</a> [Stop Mode].</li></ul>

---

## Basic Program Group *(continued)*

### P037 [Stop Mode]

Related Parameter(s): [P036](#), [A080](#), [A081](#), [A082](#), [A105](#), [A160](#)

Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.

**Important:** I/O Terminal 01 is always a coast to stop input except when [P036](#) [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by [P037](#) [Stop Mode].

#### Hardware Enable Circuitry

By default, I/O Terminal 01 is a coast to stop input. The status of the input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a "dedicated" hardware enable configuration can be utilized. This is accomplished by removing the ENBL enable jumper on the control board. In this case, the drive will always coast to a stop regardless of the settings of [P036](#) [Start Source] and [P037](#) [Stop Mode].

<b>Options</b>	<b>0</b>	"Ramp, CF" <sup>(1)</sup> (Default)	Ramp to Stop. "Stop" command clears active fault.
	<b>1</b>	"Coast, CF" <sup>(1)</sup>	Coast to Stop. "Stop" command clears active fault.
	<b>2</b>	"DC Brake, CF" <sup>(1)</sup>	DC Injection Braking Stop. "Stop" command clears active fault.
	<b>3</b>	"DCBrkAuto,CF" <sup>(1)</sup>	DC Injection Braking Stop with Auto Shutoff. <ul style="list-style-type: none"> <li>Standard DC Injection Braking for value set in <a href="#">A080</a> [DC Brake Time].</li> <li>OR</li> <li>Drive shuts off if the drive detects that the motor is stopped.</li> </ul> "Stop" command clears active fault.
	<b>4</b>	"Ramp"	Ramp to Stop.
	<b>5</b>	"Coast"	Coast to Stop.
	<b>6</b>	"DC Brake"	DC Injection Braking Stop.
	<b>7</b>	"DC BrakeAuto"	DC Injection Braking Stop with Auto Shutoff. <ul style="list-style-type: none"> <li>Standard DC Injection Braking for value set in <a href="#">A080</a> [DC Brake Time].</li> <li>OR</li> <li>Drive shuts off if current limit is exceeded.</li> </ul>
	<b>8</b>	"Ramp+EM B,CF"	Ramp to Stop with EM Brake Control. "Stop" Command clears active fault.
	<b>9</b>	"Ramp+EM Brk"	Ramp to Stop with EM Brake Control.

<sup>(1)</sup> Stop input also clears active fault.

## Basic Program Group *(continued)*

**P038 [Speed Reference]**    Related Parameter(s): [d001](#), [d002](#), [d012](#), [d020](#), [d021](#), [P039](#), [P040](#), [A051-A054](#), [A069](#), [A070-A077](#), [A110](#), [A111](#), [A112](#), [A113](#), [A123](#), [A132](#), [A140-A147](#), [A150-A157](#)

Sets the source of the speed reference to the drive.

The drive speed command can be obtained from a number of different sources. The source is normally determined by [P038](#) [Speed Reference]. However, when [A051](#) - [A054](#) [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if [A132](#) [PID Ref Sel] is not set to option 0, the speed reference commanded by [P038](#) [Speed Reference] will be overridden. Refer to the flowchart on [page 1-20](#) for more information on speed reference control priority.

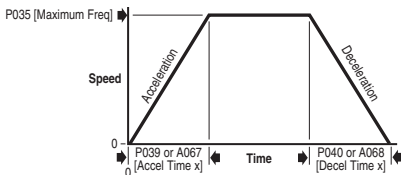
<b>Options</b>	<b>0</b>	"Drive Pot" (Default)	Internal frequency command from the potentiometer on the integral keypad.
	<b>1</b>	"InternalFreq"	Internal frequency command from <a href="#">A069</a> [Internal Freq]. Must be set when using MOP function.
	<b>2</b>	"0-10V Input"	External frequency command from the 0-10V or ±10V analog input or remote potentiometer.
	<b>3</b>	"4-20mA Input"	External frequency command from the 4-20mA analog input.
	<b>4</b>	"Preset Freq"	External frequency command as defined by <a href="#">A070</a> - <a href="#">A077</a> [Preset Freq x] when <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	<b>5</b>	"Comm Port"	External frequency command from the communications port. Refer to Appendix C for details.
	<b>6</b>	"Stp Logic"	External frequency command as defined by <a href="#">A070</a> - <a href="#">A077</a> [Preset Freq x] and <a href="#">A140</a> - <a href="#">A147</a> [Stp Logic x].
	<b>7</b>	"Anlg In Mult"	External frequency command as defined by the product of the analog inputs (shown in <a href="#">d020</a> [Analog In 0-10V] and <a href="#">d021</a> [Analog In 4-20mA]). $[\text{Analog In 0-10V}] \times [\text{Analog In 4-20mA}] = \text{Speed Command}$ Example: $100\% \times 50\% = 50\%$

**P039 [Accel Time 1]**      Related Parameter(s): [P038](#), [P040](#), [A051-A054](#), [A067](#), [A070-A077](#), [A140-A147](#)

Sets the rate of acceleration for all speed increases.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

<b>Values</b>	Default:	10.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



## Basic Program Group *(continued)*

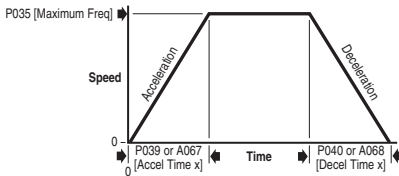
### P040 [Decel Time 1]

Related Parameter(s): [P038](#), [P039](#), [A051-A054](#),  
[A068](#), [A070-A077](#), [A140-A147](#)

Sets the rate of deceleration for all speed decreases.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

<b>Values</b>	Default:	10.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs



### P041 [Reset To Defaults]



Stop drive before changing this parameter.

Resets all parameter values to factory defaults.

<b>Options</b>	0	"Ready/Idle" (Default)	
	1	"Factory Rset"	<ul style="list-style-type: none"> <li>After the reset function is complete, this parameter will set itself back to "0".</li> <li>Causes an F48 <a href="#">Params Defaulted</a> fault.</li> </ul>

### P042 [Voltage Class]



Stop drive before changing this parameter.

Sets the voltage class of 600V drives.

<b>Options</b>	2	"Low Voltage"	480V
	3	"High Voltage" (Default)	600V

## Advanced Program Group

### A051 [Digital In1 Sel]

(I/O Terminal 05)

Related Parameter(s): [d012](#), [d014](#), [P038](#), [P039](#), [P040](#), [A067](#), [A068](#), [A070-A077](#), [A078](#), [A079](#), [A118](#), [A140-A147](#)

### A052 [Digital In2 Sel]

(I/O Terminal 06)

### A053 [Digital In3 Sel]

(I/O Terminal 07)

### A054 [Digital In4 Sel]

(I/O Terminal 08)



Stop drive before changing this parameter.

Selects the function for the digital inputs. Refer to the flowchart on [page 1-20](#) for more information on speed reference control priority.

<b>Options</b>	<b>0</b>	"Not Used"	Terminal has no function but can be read over network communications via <a href="#">d014</a> [Dig In Status].
	<b>1</b>	"Acc & Dec 2"	<ul style="list-style-type: none"> <li>When active, <a href="#">A067</a> [Accel Time 2] and <a href="#">A068</a> [Decel Time 2] are used for all ramp rates except Jog.</li> <li>Can only be tied to one input.</li> </ul> <p>Refer to the flowchart on <a href="#">page 1-21</a> for more information on Accel/Decel selection.</p>
	<b>2</b>	"Jog"	<ul style="list-style-type: none"> <li>When input is present, drive accelerates according to the value set in <a href="#">A079</a> [Jog Accel/Decel] and ramps to the value set in <a href="#">A078</a> [Jog Frequency].</li> <li>When input is removed, drive ramps to a stop according to the value set in <a href="#">A079</a> [Jog Accel/Decel].</li> <li>A valid "Start" command will override this input.</li> </ul>
	<b>3</b>	"Aux Fault"	When enabled, an F2 <a href="#">Auxiliary Input</a> fault will occur when the input is removed.
	<b>4</b>	"Preset Freq" (A051 & A052 Default)	<p>Refer to <a href="#">A070 - A077</a> [Preset Freq x].</p> <p><b>Important:</b> Digital Inputs have priority for frequency control when programmed as Preset Speed and are active. Refer to the flowchart on <a href="#">page 1-20</a> for more information on speed reference control priority.</p>
	<b>5</b>	"Local" (A053 Default)	When active, sets integral keypad as start source and potentiometer on the integral keypad as speed source.
	<b>6</b>	"Comm Port"	<ul style="list-style-type: none"> <li>When active, sets communications device as default start/speed command source.</li> <li>Can only be tied to one input.</li> </ul>
	<b>7</b>	"Clear Fault"	When active, clears an active fault.
	<b>8</b>	"RampStop,CF"	Causes drive to immediately ramp to a stop regardless of how <a href="#">P037</a> [Stop Mode] is set.
	<b>9</b>	"CoastStop,CF"	Causes drive to immediately coast to a stop regardless of how <a href="#">P037</a> [Stop Mode] is set.
	<b>10</b>	"DCInjStop,CF"	Causes drive to immediately begin a DC Injection stop regardless of how <a href="#">P037</a> [Stop Mode] is set.
	<b>11</b>	"Jog Forward" (A054 Default)	Drive accelerates to <a href="#">A078</a> [Jog Frequency] according to <a href="#">A079</a> [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.
	<b>12</b>	"Jog Reverse"	Drive accelerates to <a href="#">A078</a> [Jog Frequency] according to <a href="#">A079</a> [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.

<b>A051 - A054 Options (Cont.)</b>	<b>13</b>	<b>"10V In Ctrl"</b>	Selects 0-10V or $\pm 10V$ control as the frequency reference. Start source is not changed.
	<b>14</b>	<b>"20mA In Ctrl"</b>	Selects 4-20mA control as the frequency reference. Start source is not changed.
	<b>15</b>	<b>"PID Disable"</b>	Disables PID function. Drive uses the next valid non-PID speed reference.
	<b>16</b>	<b>"MOP Up"</b>	Increases the value of <a href="#">A069</a> [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	<b>17</b>	<b>"MOP Down"</b>	Decreases the value of <a href="#">A069</a> [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	<b>18</b>	<b>"Timer Start"</b>	Clears and starts the timer function. May be used to control the relay or opto outputs.
	<b>19</b>	<b>"Counter In"</b>	Starts the counter function. May be used to control the relay or opto outputs.
	<b>20</b>	<b>"Reset Timer"</b>	Clears the active timer.
	<b>21</b>	<b>"Reset Counter"</b>	Clears the active counter.
	<b>22</b>	<b>"Rset Tim&amp;Cnt"</b>	Clears the active timer and counter.
	<b>23</b>	<b>"Logic In1"</b>	Logic function input number 1. May be used to control the relay or opto outputs (see parameters <a href="#">A055</a> , <a href="#">A058</a> , <a href="#">A061</a> Options 11-14). May be used in conjunction with Step Logic parameters <a href="#">A140</a> - <a href="#">A147</a> [Stp Logic x].
	<b>24</b>	<b>"Logic In2"</b>	Logic function input number 2. May be used to control the relay or opto outputs (see parameters <a href="#">A055</a> , <a href="#">A058</a> , <a href="#">A061</a> Options 11-14). May be used in conjunction with Step Logic parameters <a href="#">A140</a> - <a href="#">A147</a> [Stp Logic x].
	<b>25</b>	<b>"Current Lmt2"</b>	When active, <a href="#">A118</a> [Current Limit 2] determines the drive current limit level.
	<b>26</b>	<b>"Anlg Invert"</b>	Inverts the scaling of the analog input levels set in <a href="#">A110</a> [Anlg In 0-10V Lo] and <a href="#">A111</a> [Anlg In 0-10V Hi] or <a href="#">A112</a> [Anlg In4-20mA Lo] and <a href="#">A113</a> [Anlg In4-20mA Hi].

**A055 [Relay Out Sel]**

Related Parameter(s): [P033](#), [A056](#), [A092](#), [A140-A147](#), [A150-A157](#), [A160](#), [A161](#)

Sets the condition that changes the state of the output relay contacts.

<b>Options</b>	<b>0</b>	<b>"Ready/Fault"</b> (Default)	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
	<b>1</b>	<b>"At Frequency"</b>	Drive reaches commanded frequency.
	<b>2</b>	<b>"MotorRunning"</b>	Motor is receiving power from the drive.
	<b>3</b>	<b>"Reverse"</b>	Drive is commanded to run in reverse direction.
	<b>4</b>	<b>"Motor Overld"</b>	Motor overload condition exists.
	<b>5</b>	<b>"Ramp Reg"</b>	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	<b>6</b>	<b>"Above Freq"</b>	<ul style="list-style-type: none"> <li>• Drive exceeds the frequency (Hz) value set in <a href="#">A056</a> [Relay Out Level].</li> <li>• Use A056 to set threshold.</li> </ul>

**A055  
Options  
(Cont.)**

7	"Above Cur"	<ul style="list-style-type: none"> <li>Drive exceeds the current (% Amps) value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Use A056 to set threshold.</li> </ul> <p><b>Important:</b> Value for <a href="#">A056</a> [Relay Out Level] must be entered in percent of drive rated output current.</p>
8	"Above DCVolt"	<ul style="list-style-type: none"> <li>Drive exceeds the DC bus voltage value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Use A056 to set threshold.</li> </ul>
9	"Retries Exst"	Value set in <a href="#">A092</a> [Auto Rstrt Tries] is exceeded.
10	"Above Anlg V"	<ul style="list-style-type: none"> <li>Analog input voltage (I/O Terminal 13) exceeds the value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Do not use if <a href="#">A123</a> [10V Bipolar Enbl] is set to 1 "Bi-Polar In".</li> <li>This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor.</li> <li>Use A056 to set threshold.</li> </ul>
11	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
12	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
13	"Logic 1 & 2"	Both Logic inputs are programmed and active.
14	"Logic 1 or 2"	One or both Logic inputs are programmed and one or both is active.
15	"StpLogic Out"	Drive enters Step Logic step with Digit 3 of Command Word ( <a href="#">A140</a> - <a href="#">A147</a> ) set to enable Step Logic output.
16	"Timer Out"	<ul style="list-style-type: none"> <li>Timer has reached value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Use A056 to set threshold.</li> </ul>
17	"Counter Out"	<ul style="list-style-type: none"> <li>Counter has reached value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Use A056 to set threshold.</li> </ul>
18	"Above PF Ang"	<ul style="list-style-type: none"> <li>Power Factor angle has exceeded the value set in <a href="#">A056</a> [Relay Out Level].</li> <li>Use A056 to set threshold.</li> </ul>
19	"Anlg In Loss"	Analog input loss has occurred. Program <a href="#">A122</a> [Analog In Loss] for desired action when input loss occurs.
20	"ParamControl"	Enables the output to be controlled over network communications by writing to <a href="#">A056</a> [Relay Out Level]. (0 = Off, 1 = On.)
21	"NonRec Fault"	<ul style="list-style-type: none"> <li>Value set in <a href="#">A092</a> [Auto Rstrt Tries] is exceeded.</li> <li><a href="#">A092</a> [Auto Rstrt Tries] is not enabled.</li> <li>A Non-resettable fault has occurred.</li> </ul>
22	"EM Brk Cntrl"	EM brake is energized. Program <a href="#">A160</a> [EM Brk Off Delay] and <a href="#">A161</a> [EM Brk On Delay] for desired action.



## Advanced Program Group *(continued)*

### A056 [Relay Out Level]

Related Parameter(s): [A055](#), [A058](#), [A061](#)



32 bit parameter.

Sets the trip point for the digital output relay if the value of [A055](#) [Relay Out Sel] is 6, 7, 8, 10, 16, 17, 18 or 20.

A055 Setting	A056 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

<b>Values</b>	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

### A058 [Opto Out1 Sel]

Related Parameter(s): [P033](#), [A056](#), [A092](#), [A140-A147](#), [A150-A157](#)

### A061 [Opto Out2 Sel]

Determines the operation of the programmable opto outputs.

<b>Options</b>	<b>0</b>	"Ready/Fault"	Opto outputs are active when power is applied. This indicates that the drive is ready for operation. Opto outputs are inactive when power is removed or a fault occurs.
	<b>1</b>	"At Frequency" (A061 Default)	Drive reaches commanded frequency.
	<b>2</b>	"MotorRunning" (A058 Default)	Motor is receiving power from the drive.
	<b>3</b>	"Reverse"	Drive is commanded to run in reverse direction.
	<b>4</b>	"Motor Overld"	Motor overload condition exists.
	<b>5</b>	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	<b>6</b>	"Above Freq"	<ul style="list-style-type: none"> <li>Drive exceeds the frequency (Hz) value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li> <li>Use A059 or A062 to set threshold.</li> </ul>
	<b>7</b>	"Above Cur"	<ul style="list-style-type: none"> <li>Drive exceeds the current (% Amps) value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li> <li>Use A059 or A062 to set threshold.</li> </ul> <p><b>Important:</b> Value for <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level] must be entered in percent of drive rated output current.</p>
	<b>8</b>	"Above DCVolt"	<ul style="list-style-type: none"> <li>Drive exceeds the DC bus voltage value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li> <li>Use A059 or A062 to set threshold.</li> </ul>
	<b>9</b>	"Retries Exst"	Value set in <a href="#">A092</a> [Auto Rstrt Tries] is exceeded.

**A058,  
A061  
Options  
(Cont.)**


10 "Above Anlg V"	<ul style="list-style-type: none"><li>Analog input voltage (I/O Terminal 13) exceeds the value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li><li>Do not use if <a href="#">A123</a> [10V Bipolar Enbl] is set to 1 "Bi-Polar In".</li><li>This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor.</li><li>Use A059 or A062 to set threshold.</li></ul>
11 "Logic In 1"	An input is programmed as "Logic In 1" and is active.
12 "Logic In 2"	An input is programmed as "Logic In 2" and is active.
13 "Logic 1 & 2"	Both Logic inputs are programmed and active.
14 "Logic 1 or 2"	One or both Logic inputs are programmed and one or both is active.
15 "StpLogic Out"	Drive enters Step Logic step with Digit 3 of Command Word ( <a href="#">A140</a> - <a href="#">A147</a> ) set to enable Step Logic output.
16 "Timer Out"	<ul style="list-style-type: none"><li>Timer has reached value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li><li>Use A059 or A062 to set threshold.</li></ul>
17 "Counter Out"	<ul style="list-style-type: none"><li>Counter has reached value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li><li>Use A059 or A062 to set threshold.</li></ul>
18 "Above PF Ang"	<ul style="list-style-type: none"><li>Power Factor angle has exceeded the value set in <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level].</li><li>Use A059 or A062 to set threshold.</li></ul>
19 "Anlg In Loss"	Analog input loss has occurred. Program <a href="#">A122</a> [Analog In Loss] for desired action when input loss occurs.
20 "ParamControl"	Enables the output to be controlled over network communications by writing to <a href="#">A059</a> or <a href="#">A062</a> [Opto Outx Level]. (0 = Off, 1 = On.)
21 "NonRec Fault"	<ul style="list-style-type: none"><li>Value set in <a href="#">A092</a> [Auto Rstrt Tries] is exceeded.</li><li><a href="#">A092</a> [Auto Rstrt Tries] is not enabled.</li><li>A Non-resettable fault has occurred.</li></ul>
22 "EM Brk Cntrl"	EM brake is energized. Program <a href="#">A160</a> [EM Brk Off Delay] and <a href="#">A161</a> [EM Brk On Delay] for desired action.

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## Advanced Program Group *(continued)*

### A059 [Opto Out1 Level]

### A062 [Opto Out2 Level]

 32 bit parameter.

Determines the on/off point for the opto outputs when [A058](#) or [A061](#) [Opto Outx Sel] is set to option 6, 7, 8, 10, 16, 17, 18 or 20.

A058 & A061 Setting	A059 & A062 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

<b>Values</b>	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

### A064 [Opto Out Logic]

Determines the logic (Normally Open/NO or Normally Closed/NC) of the opto outputs.

A064 Option	Opto Out1 Logic	Opto Out2 Logic
0	NO (Normally Open)	NO (Normally Open)
1	NC (Normally Closed)	NO (Normally Open)
2	NO (Normally Open)	NC (Normally Closed)
3	NC (Normally Closed)	NC (Normally Closed)

<b>Values</b>	Default:	0
	Min/Max:	0/3
	Display:	1

## Advanced Program Group *(continued)*

### A065 [Analog Out Sel]

 Related Parameter(s): [P035](#), [A066](#)

Sets the analog output signal mode (0-10V, 0-20mA, or 4-20mA). The output is used to provide a signal that is proportional to several drive conditions.

Option	Output Range	Minimum Output Value	Maximum Output Value A066 [Analog Out High]	DIP Switch Position	Related Parameter
0 "OutFreq 0-10"	0-10V	0V = 0 Hz	P035 [Maximum Freq]	0-10V	<a href="#">d001</a>
1 "OutCurr 0-10"	0-10V	0V = 0 Amps	200% Drive Rated Output Current	0-10V	<a href="#">d003</a>
2 "OutVolt 0-10"	0-10V	0V = 0 Volts	120% Drive Rated Output Volts	0-10V	<a href="#">d004</a>
3 "OutPowr 0-10"	0-10V	0V = 0 kW	200% Drive Rated Power	0-10V	<a href="#">d022</a>
4 "TstData 0-10"	0-10V	0V = 0000	65535 (Hex FFFF)	0-10V	<a href="#">d019</a>
5 "OutFreq 0-20"	0-20mA	0 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	<a href="#">d001</a>
6 "OutCurr 0-20"	0-20mA	0 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	<a href="#">d003</a>
7 "OutVolt 0-20"	0-20mA	0 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	<a href="#">d004</a>
8 "OutPowr 0-20"	0-20mA	0 mA = 0 kW	200% Drive Rated Power	0-20mA	<a href="#">d022</a>
9 "TstData 0-20"	0-20mA	0 mA = 0000	65535 (Hex FFFF)	0-20mA	<a href="#">d019</a>
10 "OutFreq 4-20"	4-20mA	4 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	<a href="#">d001</a>
11 "OutCurr 4-20"	4-20mA	4 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	<a href="#">d003</a>
12 "OutVolt 4-20"	4-20mA	4 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	<a href="#">d004</a>
13 "OutPowr 4-20"	4-20mA	4 mA = 0 kW	200% Drive Rated Power	0-20mA	<a href="#">d022</a>
14 "TstData 4-20"	4-20mA	4 mA = 0000	65535 (Hex FFFF)	0-20mA	<a href="#">d019</a>
15 "OutTorq 0-10"	0-10V	0V = 0 Amps	200% Drive Rated FLA	0-10V	<a href="#">d029</a>
16 "OutTorq 0-20"	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	<a href="#">d029</a>
17 "OutTorq 4-20"	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	<a href="#">d029</a>
18 "Setpnt 0-10"	0-10V	0V = 0%	100.0% Setpoint Setting	0-10V	<a href="#">A109</a>
19 "Setpnt 0-20"	0-20 mA	0 mA = 0%	100.0% Setpoint Setting	0-20 mA	<a href="#">A109</a>
20 "Setpnt 4-20"	4-20 mA	4 mA = 0%	100.0% Setpoint Setting	0-20 mA	<a href="#">A109</a>

<b>Values</b>	Default:	0
	Min/Max:	0/20
	Display:	1

### A066 [Analog Out High]

 Related Parameter(s): [A065](#)

Scales the Maximum Output Value for the A065 [Analog Out Sel] source setting.

Examples:

A066 Setting	A065 Setting	A065 Max. Output Value
50%	1 "OutCurr 0-10"	5V for 200% Drive Rated Output Current
90%	8 "OutPowr 0-20"	18mA for 200% Drive Rated Power

<b>Values</b>	Default:	100%
	Min/Max:	0/800%
	Display:	1%

### Advanced Program Group *(continued)*

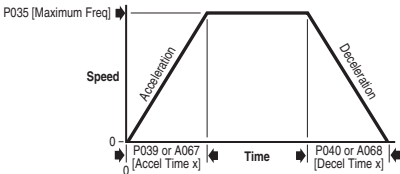
A067 [Accel Time 2]

Related Parameter(s): [P039](#), [A051-A054](#), [A070-A077](#), [A140-A147](#)

When active, sets the rate of acceleration for all speed increases except jog. Refer to the flowchart on page [1-21](#) for details.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



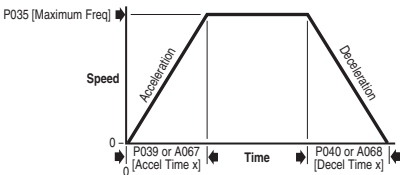
A068 [Decel Time 2]

Related Parameter(s): [P040](#), [A051-A054](#), [A070-A077](#), [A140-A147](#)

When active, sets the rate of deceleration for all speed decreases except jog. Refer to the flowchart on page [1-21](#) for details.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs



A069 [Internal Freq]

Related Parameter(s): [P038](#), [A162](#)

Provides the frequency command to the drive when [P038](#) [Speed Reference] is set to 1 "Internal Freq". When enabled, this parameter will change the frequency command in "real time" using the integral keypad Up Arrow or Down Arrow when in program mode.

**Important:** Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.

If [A051](#) - [A054](#) [Digital Inx Sel] is set to 16 "MOP Up" or 17 "MOP Down" this parameter acts as the MOP frequency reference.

Values	Default:	60.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

## Advanced Program Group (continued)

### A070 [Preset Freq 0]<sup>(1)</sup>

Related Parameter(s): [P038](#), [P039](#), [P040](#), [A051-A053](#),  
[A067](#), [A068](#), [A140-A147](#), [A150-A157](#)

### A071 [Preset Freq 1]

### A072 [Preset Freq 2]

### A073 [Preset Freq 3]

### A074 [Preset Freq 4]

### A075 [Preset Freq 5]

### A076 [Preset Freq 6]

### A077 [Preset Freq 7]

Values	A070 Default: <sup>(1)</sup>	0.0 Hz
	A071 Default:	5.0 Hz
	A072 Default:	10.0 Hz
	A073 Default:	20.0 Hz
	A074 Default:	30.0 Hz
	A075 Default:	40.0 Hz
	A076 Default:	50.0 Hz
	A077 Default:	60.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

Provides a fixed frequency command value when [A051](#) - [A053](#) [Digital Inx Sel] is set to 4 "Preset Frequencies".

An active preset input will override speed command as shown in the flowchart on page [1-20](#).

<sup>(1)</sup> To activate A070 [Preset Freq 0] set [P038](#) [Speed Reference] to option 4 "Preset Freq 0-3".

Input State of Digital In 1 (I/O Terminal 05 when A051 = 4)	Input State of Digital In 2 (I/O Terminal 06 when A052 = 4)	Input State of Digital In 3 (I/O Terminal 07 when A053 = 4)	Frequency Source	Accel / Decel Parameter Used <sup>(2)</sup>
0	0	0	A070 [Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	0	A071 [Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	0	A072 [Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	0	A073 [Preset Freq 3]	[Accel Time 2] / [Decel Time 2]
0	0	1	A074 [Preset Freq 4]	[Accel Time 1] / [Decel Time 1]
1	0	1	A075 [Preset Freq 5]	[Accel Time 1] / [Decel Time 1]
0	1	1	A076 [Preset Freq 6]	[Accel Time 2] / [Decel Time 2]
1	1	1	A077 [Preset Freq 7]	[Accel Time 2] / [Decel Time 2]

<sup>(2)</sup> When a Digital Input is set to "Accel 2 & Decel 2", and the input is active, that input overrides the settings in this table.

### A078 [Jog Frequency]

Related Parameter(s): [P035](#), [A051-A054](#), [A079](#)

Sets the output frequency when a jog command is issued.

Values	Default:	10.0 Hz
	Min/Max:	0.0/[Maximum Freq]
	Display:	0.1 Hz

## Advanced Program Group *(continued)*

### A079 [Jog Accel/Decel]

Related Parameter(s): [A078](#), [A051-A054](#)

Sets the acceleration and deceleration time when a jog command is issued.

Values	Default:	10.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs

### A080 [DC Brake Time]

Related Parameter(s): [P037](#), [A081](#)

Sets the length of time that DC brake current is “injected” into the motor. Refer to parameter [A081](#) [DC Brake Level].

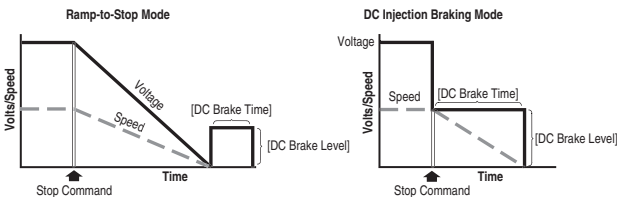
Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs


### A081 [DC Brake Level]


Related Parameter(s): [P037](#), [A080](#)

Defines the maximum DC brake current, in amps, applied to the motor when [P037](#) [Stop Mode] is set to either “Ramp” or “DC Brake”.

Values	Default:	Drive Rated Amps × 0.05
	Min/Max:	0.0/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps



- 


**ATTENTION:** If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.
- 

**ATTENTION:** This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.

Advanced Program Group *(continued)*

**A082 [DB Resistor Sel]**

Related Parameter(s): [P037](#)

 Stop drive before changing this parameter.  
 Enables/disables external dynamic braking.

Setting	Min/Max
0	"Disabled"
1	"Normal RA Res" (5% Duty Cycle) – Refer to <a href="#">Table B.C on page B-2</a> .
2	"NoProtection" (100% Duty Cycle)
3-99	"x%Duty Cycle" Limited (3% – 99% of Duty Cycle)

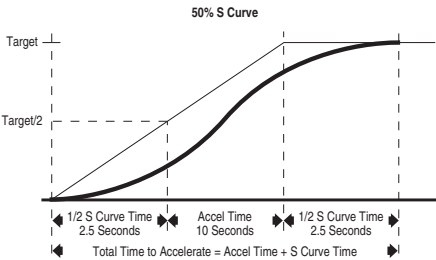
<b>Values</b>	Default:	0
	Min/Max:	0/99
	Display:	1

**A083 [S Curve %]**

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.

<b>Values</b>	Default:	0% (Disabled)
	Min/Max:	0/100%
	Display:	1%

**Example:**  
 Accel Time = 10 Seconds  
 S Curve Setting = 50%  
 S Curve Time =  $10 \times 0.5 = 5$  Seconds  
 Total Time =  $10 + 5 = 15$  Seconds





## Advanced Program Group *(continued)*

### A084 [Boost Select]

Related Parameter(s): [d004](#), [P031](#), [P032](#), [A085](#), [A086](#), [A087](#), [A125](#)

Sets the boost voltage (% of [P031](#) [Motor NP Volts]) and redefines the Volts per Hz curve.

Active when A125 [Torque Perf Mode] = 0 "V/Hz".

Drive may add additional voltage unless Option 5 is selected.

**Options** 0 "Custom V/Hz"

1 "30.0, VT"

2 "35.0, VT"

3 "40.0, VT"

4 "45.0, VT"

5 "0.0 no IR"

6 "0.0"

7 "2.5, CT"

[Default for  
4.0, 5.5, 7.5 & 11 kW  
(5.0, 7.5, 10 & 15 HP  
Drives)]

8 "5.0, CT" (Default)

9 "7.5, CT"

10 "10.0, CT"

11 "12.5, CT"

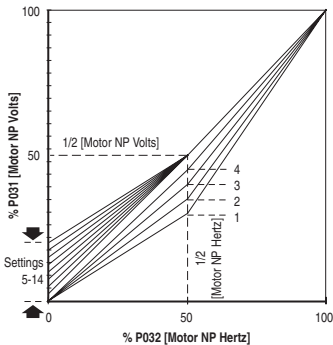
12 "15.0, CT"

13 "17.5, CT"

14 "20.0, CT"

Variable Torque (Typical fan/pump curves.)

Constant Torque



**Advanced Program Group**
*(continued)*

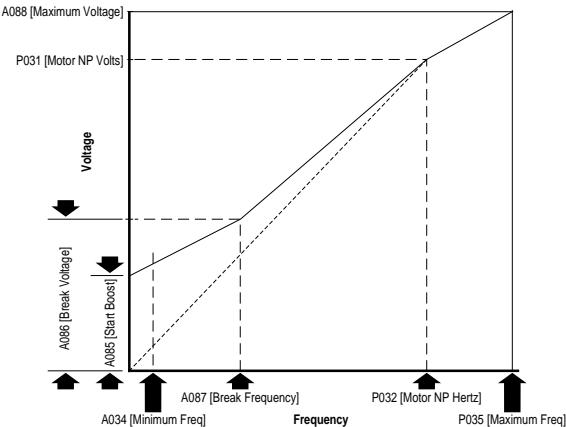
**A085 [Start Boost]**

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A084](#), [A086](#), [A087](#), [A088](#), [A125](#)

Sets the boost voltage (% of [P031](#) [Motor NP Volts]) and redefines the Volts per Hz curve when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”.

Drive may add additional voltage unless Option 5 is selected.

<b>Values</b>	Default:	2.5%
	Min/Max:	0.0/25.0%
	Display:	0.1%



**A086 [Break Voltage]**

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A084](#), [A085](#), [A087](#), [A088](#), [A125](#)

Sets the frequency where break voltage is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

<b>Values</b>	Default:	25.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

**A087 [Break Frequency]**

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A084](#), [A085](#), [A086](#), [A088](#), [A125](#)

Sets the frequency where break frequency is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

<b>Values</b>	Default:	15.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

## Advanced Program Group *(continued)*

### A088 [Maximum Voltage]

Related Parameter(s): [d004](#), [A085](#), [A086](#), [A087](#)

Sets the highest voltage the drive will output.

<b>Values</b>	Default:	Drive Rated Volts
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

### A089 [Current Limit 1]

Related Parameter(s): [P033](#), [A118](#)

Maximum output current allowed before current limiting occurs.

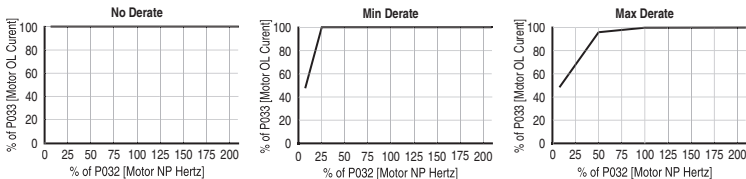
<b>Values</b>	Default:	Drive Rated Amps $\times$ 1.5
	Min/Max:	0.1/Drive Rated Amps $\times$ 1.8
	Display:	0.1 Amps

### A090 [Motor OL Select]

Related Parameter(s): [P032](#), [P033](#)

Drive provides Class 10 motor overload protection. Settings 0-2 select the derating factor for the  $I^2t$  overload function.

<b>Options</b>	0	"No Derate" (Default)
	1	"Min Derate"
	2	"Max Derate"



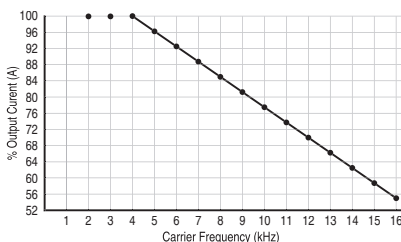
### A091 [PWM Frequency]

Related Parameter(s): [A124](#)

Sets the carrier frequency for the PWM output waveform. The chart below provides derating guidelines based on the PWM frequency setting.

**Important:** Ignoring derating guidelines can cause reduced drive performance.

<b>Values</b>	Default:	4.0 kHz
	Min/Max:	2.0/16.0 kHz
	Display:	0.1 kHz



## Advanced Program Group *(continued)*

### A092 [Auto Rstrt Tries]

Related Parameter(s): [A055](#), [A058](#), [A061](#), [A093](#)

Sets the maximum number of times the drive attempts to reset a fault and restart.

**Clear a Type 1 fault and restart the drive.**

1. Set A092 [Auto Rstrt Tries] to a value other than “0”.
2. Set [A093](#) [Auto Rstrt Delay] to a value other than “0”.

**Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.**

1. Set A092 [Auto Rstrt Tries] to a value other than “0”.
2. Set [A093](#) [Auto Rstrt Delay] to “0”.



**ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

---

<b>Values</b>	Default:	0
	Min/Max:	0/9
	Display:	1

---

### A093 [Auto Rstrt Delay]

Related Parameter(s): [A092](#)

Sets the time between restart attempts when [A092](#) [Auto Rstrt Tries] is set to a value other than zero.

<b>Values</b>	Default:	1.0 Secs
	Min/Max:	0.0/300.0 Secs
	Display:	0.1 Secs

---

### A094 [Start At PowerUp]



Stop drive before changing this parameter.

Enables/disables a feature that allows a Start or Run command to automatically cause the drive to resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.

This parameter will not function if parameter [P036](#) [Start Source] is set to 4 “2-W High Speed”.

---



**ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

---

<b>Options</b>	0	“Disabled” (Default)
	1	“Enabled”

---

## Advanced Program Group *(continued)*

### A095 [Reverse Disable]

Related Parameter(s): [d006](#)



Stop drive before changing this parameter.

Enables/disables the function that allows the direction of motor rotation to be changed. The reverse command may come from a digital command, the keypad or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

<b>Options</b>	<b>0</b>	"Rev Enabled" (Default)
	<b>1</b>	"Rev Disabled"

### A096 [Flying Start En]

Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM.

<b>Options</b>	<b>0</b>	"Disabled" (Default)
	<b>1</b>	"Enabled"

### A097 [Compensation]

Enables/disables correction options that may improve problems with motor instability.

<b>Options</b>	<b>0</b>	"Disabled"	
	<b>1</b>	"Electrical" (Default)	Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusoidal motor currents. This setting attempts to correct this condition.
	<b>2</b>	"Mechanical"	Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.
	<b>3</b>	"Both"	

### A098 [SW Current Trip]

Related Parameter(s): [P033](#)

Enables/disables a software instantaneous (within 100 ms) current trip.

<b>Values</b>	Default:	0.0 (Disabled)
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

### A099 [Process Factor]

Related Parameter(s): [d010](#)


Scales the output frequency value displayed by [d010](#) [Process Display].

$$\text{Output Freq} \times \text{Process Factor} = \text{Process Display}$$

<b>Values</b>	Default:	30.0
	Min/Max:	0.1/999.9
	Display:	0.1

## Advanced Program Group *(continued)*

### A100 [Fault Clear]

 Stop drive before changing this parameter.

Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.

<b>Options</b>	<b>0</b>	“Ready/Idle” (Default)
	<b>1</b>	“Reset Fault”
	<b>2</b>	“Clear Buffer” (Parameters <a href="#">d007-d009</a> [Fault x Code])

---

### A101 [Program Lock]

Protects parameters against change by unauthorized personnel.

<b>Options</b>	<b>0</b>	“Unlocked” (Default)
	<b>1</b>	“Locked”

---

### A102 [Testpoint Sel]

Related Parameter(s): [d019](#)

Used by Rockwell Automation field service personnel.

<b>Values</b>	Default:	400
	Min/Max:	0/FFFF
	Display:	1 Hex

---

### A103 [Comm Data Rate]

Related Parameter(s): [d015](#)

Sets the serial port rate for the RS485 (DSI) port.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

<b>Options</b>	<b>0</b>	“1200”
	<b>1</b>	“2400”
	<b>2</b>	“4800”
	<b>3</b>	“9600” (Default)
	<b>4</b>	“19.2K”
	<b>5</b>	“38.4K”

---

### A104 [Comm Node Addr]

Related Parameter(s): [d015](#)

Sets the drive node address for the RS485 (DSI) port if using a network connection.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

<b>Values</b>	Default:	100
	Min/Max:	1/247
	Display:	1

---

## Advanced Program Group *(continued)*

### A105 [Comm Loss Action]

Related Parameter(s): [d015](#), [P037](#), [A106](#)

Selects the drive's response to a loss of the communication connection or excessive communication errors.

<b>Options</b>	<b>0</b>	"Fault" (Default)	Drive will fault on an F81 Comm Loss and coast to stop.
	<b>1</b>	"Coast Stop"	Stops drive via coast to stop.
	<b>2</b>	"Stop"	Stops drive via <a href="#">P037</a> [Stop Mode] setting.
	<b>3</b>	"Continu Last"	Drive continues operating at communication commanded speed saved in RAM.

### A106 [Comm Loss Time]

Related Parameter(s): [d015](#), [A105](#)

Sets the time that the drive will remain in communication loss before implementing the option selected in [A105](#) [Comm Loss Action].

<b>Values</b>	Default:	5.0 Secs
	Min/Max:	0.1/60.0 Secs
	Display:	0.1 Secs

### A107 [Comm Format]

Related Parameter(s): [d015](#)

Selects the protocol (RTU only), data bits (8 data bits only), parity (**N**one, **E**ven, **O**dd), and stop bits (1 stop bit only) used by the RS485 port on the drive.

Refer to [Appendix C](#) for details on using the drive communication features.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

<b>Options</b>	<b>0</b>	"RTU 8-N-1" (Default)
	<b>1</b>	"RTU 8-E-1"
	<b>2</b>	"RTU 8-O-1"
	<b>3</b>	"RTU 8-N-2"
	<b>4</b>	"RTU 8-E-2"
	<b>5</b>	"RTU 8-O-2"

### A108 [Language]

Selects the language displayed by the remote communications option.

<b>Options</b>	<b>1</b>	"English" (Default)
	<b>2</b>	"Français"
	<b>3</b>	"Español"
	<b>4</b>	"Italiano"
	<b>5</b>	"Deutsch"
	<b>6</b>	"Reserved"
	<b>7</b>	"Português"
	<b>8</b>	"Reserved"
	<b>9</b>	"Reserved"
	<b>10</b>	"Nederlands"

## Advanced Program Group *(continued)*

### A109 [Anlg Out Setpnt]


Related Parameter(s): [A065](#)

When A065 [Analog Out Sel] is set to option 18, 19 or 20, this parameter sets the percentage of analog output desired.

<b>Values</b>	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

### A110 [Anlg In 0-10V Lo]

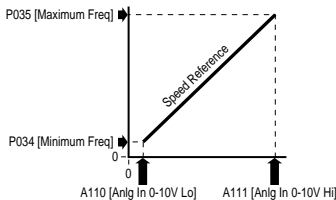
Related Parameter(s): [d020](#), [P034](#), [P038](#), [A122](#)

 Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 0-10V input is used by P038 [Speed Reference].


Analog inversion can be accomplished by setting this value larger than A111 [Anlg In 0-10V Hi].

<b>Values</b>	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



### A111 [Anlg In 0-10V Hi]

Related Parameter(s): [d020](#), [P035](#), [P038](#), [A122](#), [A123](#)

 Stop drive before changing this parameter.


Sets the analog input level that corresponds to P035 [Maximum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A110 [Anlg In 0-10V Lo].

<b>Values</b>	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

### A112 [Anlg In4-20mA Lo]

Related Parameter(s): [d021](#), [P034](#), [P038](#)

 Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 4-20mA input is used by [P038](#) [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A113 [Anlg In4-20mA Hi].

<b>Values</b>	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



## Advanced Program Group *(continued)*

### A113 [Anlg In4-20mA Hi]

Related Parameter(s): [d021](#), [P035](#), [P038](#)



Stop drive before changing this parameter.

Sets the analog input level that corresponds to [P035](#) [Maximum Freq] if a 4-20mA input is used by [P038](#) [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A112 [Anlg In4-20mA Lo].

<b>Values</b>	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

### A114 [Slip Hertz @ FLA]

Related Parameter(s): [P033](#)

Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.

<b>Values</b>	Default:	2.0 Hz
	Min/Max:	0.0/10.0 Hz
	Display:	0.1 Hz

### A115 [Process Time Lo]

Related Parameter(s): [d010](#), [P034](#)

Scales the time value when the drive is running at [P034](#) [Minimum Freq]. When set to a value other than zero, [d010](#) [Process Display] indicates the duration of the process.

<b>Values</b>	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

### A116 [Process Time Hi]

Related Parameter(s): [d010](#), [P035](#)

Scales the time value when the drive is running at [P035](#) [Maximum Freq]. When set to a value other than zero, [d010](#) [Process Display] indicates the duration of the process.

<b>Values</b>	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

### A117 [Bus Reg Mode]

Disables the bus regulator.

<b>Options</b>	0	"Disabled"
	1	"Enabled" (Default)

### A118 [Current Limit 2]

Related Parameter(s): [P033](#), [A051-A054](#), [A089](#)

Maximum output current allowed before current limiting occurs. This parameter is only active if [A051](#) - [A054](#) [Digital Inx Sel] is set to 25 "Current Lmt2" and is active.

<b>Values</b>	Default:	Drive Rated Amps × 1.5
	Min/Max:	0.1/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps

**Advanced Program Group**
*(continued)*

**A119 [Skip Frequency]**

Related Parameter(s): [A120](#)

Sets the frequency at which the drive will not operate.  
 A setting of 0 disables this parameter.

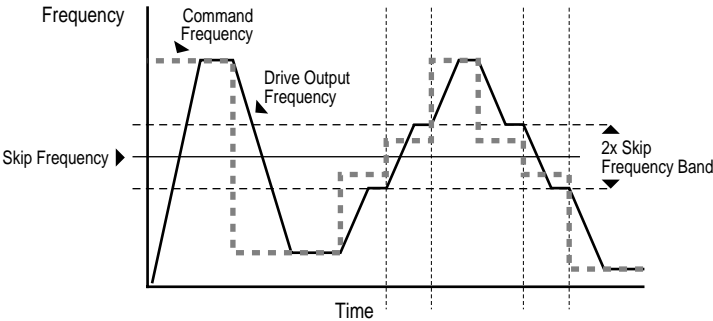
<b>Values</b>	Default:	0 Hz
	Min/Max:	0/400 Hz
	Display:	1 Hz

**A120 [Skip Freq Band]**

Related Parameter(s): [A119](#)

Determines the bandwidth around [A119](#) [Skip Frequency]. A120 [Skip Frequency Band] is split applying 1/2 above and 1/2 below the actual skip frequency.  
 A setting of 0.0 disables this parameter.

<b>Values</b>	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



**A121 [Stall Fault Time]**

Sets the time that the drive will remain in stall mode before a fault is issued.

<b>Options</b>	0	"60 Seconds" (Default)
	1	"120 Seconds"
	2	"240 Seconds"
	3	"360 Seconds"
	4	"480 Seconds"
	5	"Flt Disabled"

## Advanced Program Group *(continued)*

### A122 [Analog In Loss]

Related Parameter(s): [A110](#), [A111](#), [A132](#)

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set [A110](#) [Anlg In 0-10V Lo] to a minimum of 20% (i.e. 2 volts).

<b>Options</b>	<b>0</b>	"Disabled" (Default)
	<b>1</b>	"Fault (F29)" F29 Analog Input Loss
	<b>2</b>	"Stop" Uses P037 [Stop Mode]
	<b>3</b>	"Zero Ref" Drive runs at zero speed reference.
	<b>4</b>	"Min Freq Ref" Drive runs at minimum frequency.
	<b>5</b>	"Max Freq Ref" Drive runs at maximum frequency.
	<b>6</b>	"Int Freq Ref" Drive runs at internal frequency.

### A123 [10V Bipolar Enbl]

Related Parameter(s): [P038](#), [A111](#)

Enables/disables bipolar control. In bipolar mode direction is commanded by the sign of the reference.

<b>Options</b>	<b>0</b>	"Uni-Polar In" (Default) 0 to 10V only
	<b>1</b>	"Bi-Polar In" $\pm 10V$

### A124 [Var PWM Disable]

Related Parameter(s): [A091](#)



Stop drive before changing this parameter.

Enables/disables a feature that varies the carrier frequency for the PWM output waveform defined by A091 [PWM Frequency].

Disabling this feature when low frequency conditions exist may result in IGBT stress and nuisance tripping.

<b>Options</b>	<b>0</b>	"Enabled" (Default)
	<b>1</b>	"Disabled"

### A125 [Torque Perf Mode]

Related Parameter(s): [A084](#), [A085](#), [A086](#), [A087](#), [A127](#)



Stop drive before changing this parameter.

Enables/disables sensorless vector control operation.

<b>Options</b>	<b>0</b>	"V/Hz"
	<b>1</b>	"Sensrls Vect" (Default)

### A126 [Motor NP FLA]

Related Parameter(s): [A127](#)

Set to the motor nameplate rated full load amps.

<b>Values</b>	Default:	Drive Rated Amps
	Min/Max:	0.1/(Drive Rated Amps $\times$ 2)
	Display:	0.1 Amps

## Advanced Program Group *(continued)*

### A127 [Autotune]

Related Parameter(s): [A125](#), [A126](#), [A128](#), [A129](#)



Stop drive before changing this parameter.

Provides an automatic method for setting A128 [IR Voltage Drop] and A129 [Flux Current Ref], which affect sensorless vector performance. Parameter [A126](#) [Motor NP FLA] must be set to the motor nameplate full load amps before running the Autotune procedure.

**Options**    0    “Ready/Idle” (Default)

1    “Static Tune”

2    “Rotate Tune”

“Ready” (0) = Parameter returns to this setting following a “Static Tune” or “Rotate Tune.”

“Static Tune” (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of A128 [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to “Ready” (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be uncoupled from the load.

“Rotate Tune” (2) = A temporary command that initiates a “Static Tune” followed by a rotational test for the best possible automatic setting of A129 [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to “Ready” (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.



**ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

If the Autotune routine fails, an F80 SVC Autotune fault is displayed.

### A128 [IR Voltage Drop]

Related Parameter(s): [A127](#)

Value of volts dropped across the resistance of the motor stator.

<b>Values</b>	Default:	Based on Drive Rating
	Min/Max:	0.0/230.0 VAC
	Display:	0.1 VAC

### A129 [Flux Current Ref]

Related Parameter(s): [A127](#)

Value of amps for full motor flux.

<b>Values</b>	Default:	Based on Drive Rating
	Min/Max:	0.00/[Motor NP Volts]
	Display:	0.01 Amps

## Advanced Program Group *(continued)*

### A130 [PID Trim Hi]

Sets the maximum positive value that is added to a PID reference when PID trim is used.

<b>Values</b>	Default:	60.0
	Min/Max:	0.0/400.0
	Display:	0.1

### A131 [PID Trim Lo]

Sets the minimum positive value that is added to a PID reference when PID trim is used.

<b>Values</b>	Default:	0.0
	Min/Max:	0.0/400.0
	Display:	0.1

### A132 [PID Ref Select]

Related Parameter(s): [P038](#), [A122](#)



Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to [Appendix F](#) for details.

<b>Options</b>	0	"PID Disabled" (Default)
	1	"PID Setpoint"
	2	"0-10V Input"
	3	"4-20mA Input"
	4	"Comm Port"
	5	"Setpnt, Trim"
	6	"0-10V, Trim"
	7	"4-20mA, Trim"
	8	"Comm, Trim"

### A133 [PID Feedback Sel]

Select the source of the PID feedback. Refer to [Appendix F](#) for details.

<b>Options</b>	0	"0-10V Input" (Default)	The PID will not function with a bipolar input. Negative voltages are treated as 0 volts.
	1	"4-20mA Input"	
	2	"Comm Port"	

### A134 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A132 [PID Ref Sel].

<b>Values</b>	Default:	0.01
	Min/Max:	0.00/99.99
	Display:	0.01

## Advanced Program Group *(continued)*

### A135 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A132 [PID Ref Sel].

<b>Values</b>	Default:	0.1 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

---

### A136 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A132 [PID Ref Sel].

<b>Values</b>	Default:	0.01 (1/Secs)
	Min/Max:	0.00/99.99 (1/Secs)
	Display:	0.01 (1/Secs)

---

### A137 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A132 [PID Ref Sel].

<b>Values</b>	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

---

### A138 [PID Deadband]

Sets the lower limit of the PID output.

<b>Values</b>	Default:	0.0%
	Min/Max:	0.0/10.0%
	Display:	0.1%

---

### A139 [PID Preload]

Sets the value used to preload the integral component on start or enable.

<b>Values</b>	Default:	0.0 Hz
	Min/Max:	0.0/400.0 Hz
	Display:	0.1 Hz

---

## Advanced Program Group *(continued)*

**A140 [Stp Logic 0]**

**A141 [Stp Logic 1]**

**A142 [Stp Logic 2]**

**A143 [Stp Logic 3]**

**A144 [Stp Logic 4]**

**A145 [Stp Logic 5]**

**A146 [Stp Logic 6]**

**A147 [Stp Logic 7]**

Related Parameter(s): [P038](#), [P039](#), [P040](#), [A051-A054](#), [A055](#), [A058](#), [A061](#), [A067](#), [A068](#), [A070-A077](#), [A150-A157](#)



Stop drive before changing this parameter.

<b>Values</b>	Default:	00F1
	Min/Max:	0001/bAFF
	Display:	4 Digits

Parameters A140-A147 are only active if [P038](#) [Speed Reference] is set to 6 “Stp Logic”.

These parameters can be used to create a custom profile of frequency commands. Each “step” can be based on time, status of a Logic input or a combination of time and the status of a Logic input.

Digits 0-3 for each [Stp Logic x] parameter must be programmed according to the desired profile.

A Logic input is established by setting a digital input, parameters [A051](#) - [A054](#) [Digital Inx Sel], to 23 “Logic In1” and/or 24 “Logic In2”.

A time interval between steps can be programmed using parameters [A150](#) - [A157](#) [Stp Logic Time x]. See the table below for related parameters.

The speed for any step is programmed using parameters [A070](#) - [A077](#) [Preset Freq x].

Step Logic Parameter (Active when P038 = 6 “Stp Logic”)	Related Preset Frequency Parameter (Can be activated independent of Step Logic Parameters)	Related Step Logic Time Parameter (Active when A140-A147 Digit 0 or 1 are set to 1, b, C, d or E)
A140 [Stp Logic 0]	A070 [Preset Freq 0]	A150 [Stp Logic Time 0]
A141 [Stp Logic 1]	A071 [Preset Freq 1]	A151 [Stp Logic Time 1]
A142 [Stp Logic 2]	A072 [Preset Freq 2]	A152 [Stp Logic Time 2]
A143 [Stp Logic 3]	A073 [Preset Freq 3]	A153 [Stp Logic Time 3]
A144 [Stp Logic 4]	A074 [Preset Freq 4]	A154 [Stp Logic Time 4]
A145 [Stp Logic 5]	A075 [Preset Freq 5]	A155 [Stp Logic Time 5]
A146 [Stp Logic 6]	A076 [Preset Freq 6]	A156 [Stp Logic Time 6]
A147 [Stp Logic 7]	A077 [Preset Freq 7]	A157 [Stp Logic Time 7]

### How Step Logic Works

The step logic sequence begins with a valid start command. A normal sequence always begins with A140 [Stp Logic 0].

#### Digit 0: Logic For Next Step

This digit defines the logic for the next step. When the condition is met the program advances to the next step. Step 0 follows Step 7. Example: Digit 0 is set 3. When “Logic In2” becomes active, the program advances to the next step.

#### Digit 1: Logic to Jump to a Different Step

For all settings other than F, when the condition is met, the program overrides Digit 0 and jumps to the step defined by Digit 2.

#### Digit 2: Different Step to Jump

When the condition for Digit 1 is met, the Digit 2 setting determines the next step or to end the program.

#### Digit 3: Step Settings

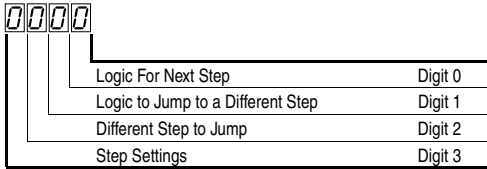
This digit defines what accel/decel profile the speed command will follow and the direction of the command for the current step. In addition, if a relay or opto output (parameters A055, A058 and A061) is set to 15 “StpLogic Out”, this parameter can control the status of that output.

Any Step Logic parameter can be programmed to control a relay or opto output, but you can not control different outputs based on the condition of different Step Logic commands.

**Step Logic Settings**

The logic for each function is determined by the four digits for each step logic parameter. The following is a listing of the available settings for each digit.

Refer to [Appendix E](#) for details.



**Digit 3 Settings**

Required Setting	Accel/Decel Param. Used	Step Logic Output State	Commanded Direction
0	Accel/Decel 1	Off	FWD
1	Accel/Decel 1	Off	REV
2	Accel/Decel 1	Off	No Output
3	Accel/Decel 1	On	FWD
4	Accel/Decel 1	On	REV
5	Accel/Decel 1	On	No Output
6	Accel/Decel 2	Off	FWD
7	Accel/Decel 2	Off	REV
8	Accel/Decel 2	Off	No Output
9	Accel/Decel 2	On	FWD
A	Accel/Decel 2	On	REV
b	Accel/Decel 2	On	No Output

**Digit 2 Settings**

- 0 = Jump to Step 0
- 1 = Jump to Step 1
- 2 = Jump to Step 2
- 3 = Jump to Step 3
- 4 = Jump to Step 4
- 5 = Jump to Step 5
- 6 = Jump to Step 6
- 7 = Jump to Step 7
- 8 = End Program (Normal Stop)
- 9 = End Program (Coast to Stop)
- A = End Program and Fault (F2)

**Digit 1 and Digit 0 Settings**

- 0 = Skip Step (Jump Immediately)
- 1 = Step Based on [Stp Logic Time x]
- 2 = Step if "Logic In1" is Active
- 3 = Step if "Logic In2" is Active
- 4 = Step if "Logic In1" is Not Active
- 5 = Step if "Logic In2" is Not Active
- 6 = Step if either "Logic In1" or "Logic In2" is Active
- 7 = Step if both "Logic In1" and "Logic In2" is Active
- 8 = Step if neither "Logic In1" or "Logic In2" is Active
- 9 = Step if "Logic In1" is Active and "Logic In2" is Not Active
- A = Step if "Logic In2" is Active and "Logic In1" is Not Active
- b = Step after [Stp Logic Time x] and "Logic In1" is Active
- C = Step after [Stp Logic Time x] and "Logic In2" is Active
- d = Step after [Stp Logic Time x] and "Logic In1" is Not Active
- E = Step after [Stp Logic Time x] and "Logic In2" is Not Active
- F = Do Not Step/Ignore Digit 2 Settings



## Advanced Program Group *(continued)*

**A150 [Stp Logic Time 0]**

Related Parameter(s): [P038](#), [A055](#), [A058](#), [A061](#),  
[A070-A077](#), [A140-A147](#)

**A151 [Stp Logic Time 1]**

**A152 [Stp Logic Time 2]**

**A153 [Stp Logic Time 3]**

**A154 [Stp Logic Time 4]**

**A155 [Stp Logic Time 5]**

**A156 [Stp Logic Time 6]**

**A157 [Stp Logic Time 7]**

Sets the time to remain in each step if the corresponding StpLogic command word is set to “Step after Time”.

<b>Values</b>	Default:	30.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

**A160 [EM Brk Off Delay]**

Related Parameter(s): [P037](#)

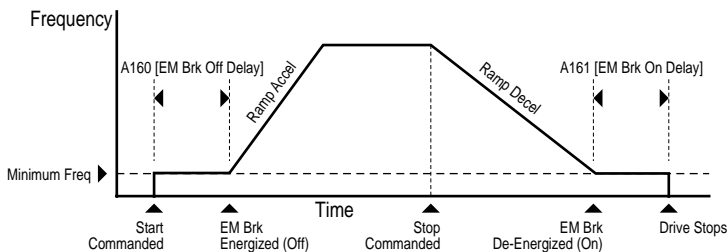
Sets the time the drive remains at minimum frequency before the relay or an opto output is energized and the drive ramps to the commanded frequency.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set [P037](#) [Stop Mode] to 8 “Ramp+EM B,CF” or 9 “Ramp+EM Brk” to enable the electromechanical brake option.

Set [A055](#) [Relay Out Sel], [A058](#) or [A061](#) [Opto Outx Sel] to 22 “EM Brk Cntrl” to control brake operation.

<b>Values</b>	Default:	2.0 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs



**A161 [EM Brk On Delay]**

Related Parameter(s): [P037](#)

Sets the time the drive remains at minimum frequency before the relay or an opto output is de-energizing and the drive stops.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay. Set [P037](#) [Stop Mode] to 8 "Ramp+EM B,CF" or 9 "Ramp+EM Brk" to enable the electromechanical brake option.

Set [A055](#) [Relay Out Sel], [A058](#) or [A061](#) [Opto Outx Sel] to 22 "EM Brk Cntrl" to control brake operation.

<b>Values</b>	Default:	2.0 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs

---

**A162 [MOP Reset Sel]**

Related Parameter(s): [A069](#)

Set the drive to save the current MOP reference command.

<b>Options</b>	<b>0</b> "Zero MOP Ref"	This option clamps <a href="#">A069</a> [Internal Freq] at 0.0 Hz when the drive is not running.
	<b>1</b> "Save MOP Ref" (Default)	Reference is saved in <a href="#">A069</a> [Internal Freq].

---

## Parameter Cross Reference – by Name

Parameter Name	No.	Group	Parameter Name	No.	Group
10V Bipolar Enbl	A123	Advanced Program	Maximum Voltage	A088	Advanced Program
Accel Time 1	P039	Basic Program	Minimum Freq	P034	Basic Program
Accel Time 2	A067	Advanced Program	MOP Reset Sel	A162	Advanced Program
Analog In 0-10V	d020	Display	Motor NP FLA	A126	Advanced Program
Analog In 0-20mA	d021	Display	Motor NP Hertz	P032	Basic Program
Analog In Loss	A122	Advanced Program	Motor NP Volts	P031	Basic Program
Analog Out High	A066	Advanced Program	Motor OL Current	P033	Basic Program
Analog Out Sel	A065	Advanced Program	Motor OL Select	A090	Advanced Program
Anlg In 0-10V Hi	A111	Advanced Program	Opto Out Logic	A064	Advanced Program
Anlg In 4-10V Lo	A110	Advanced Program	Opto Outx Level	A059, A062	Advanced Program
Anlg In4-20mA Hi	A113	Advanced Program	Opto Outx Sel	A058, A061	Advanced Program
Anlg In4-20mA Lo	A112	Advanced Program	Output Current	d003	Display
Anlg Out Setpnt	A109	Advanced Program	Output Freq	d001	Display
Auto Rstrt Delay	A093	Advanced Program	Output Power	d022	Display
Auto Rstrt Tries	A092	Advanced Program	Output Powr Fctr	d023	Display
Autotune	A127	Advanced Program	Output Voltage	d004	Display
Boost Select	A084	Advanced Program	PID Deadband	A138	Advanced Program
Break Frequency	A087	Advanced Program	PID Diff Rate	A136	Advanced Program
Break Voltage	A086	Advanced Program	PID Feedback Sel	A133	Advanced Program
Bus Reg Mode	A117	Advanced Program	PID Integ Time	A135	Advanced Program
Comm Data Rate	A103	Advanced Program	PID Preload	A139	Advanced Program
Comm Format	A107	Advanced Program	PID Prop Gain	A134	Advanced Program
Comm Loss Action	A105	Advanced Program	PID Ref Sel	A132	Advanced Program
Comm Loss Time	A106	Advanced Program	PID Setpoint	A137	Advanced Program
Comm Node Addr	A104	Advanced Program	PID Trim Hi	A130	Advanced Program
Comm Status	d015	Display	PID Trim Lo	A131	Advanced Program
Commanded Freq	d002	Display	Preset Freq x	A070-A077	Advanced Program
Compensation	A097	Advanced Program	Process Display	d010	Display
Contrl In Status	d013	Display	Process Factor	A099	Advanced Program
Control Source	d012	Display	Process Time Hi	A116	Advanced Program
Control SW Ver	d016	Display	Process Time Lo	A115	Advanced Program
Counter Status	d025	Display	Program Lock	A101	Advanced Program
Current Limit x	A089, A118	Advanced Program	PWM Frequency	A091	Advanced Program
DB Resistor Sel	A082	Advanced Program	Relay Out Level	A056	Advanced Program
DC Brake Level	A081	Advanced Program	Relay Out Sel	A055	Advanced Program
DC Brake Time	A080	Advanced Program	Reset To Defaults	P041	Basic Program
DC Bus Voltage	d005	Display	Reverse Disable	A095	Advanced Program
Decel Time 1	P040	Basic Program	S Curve %	A083	Advanced Program
Decel Time 2	A068	Advanced Program	Skip Freq Band	A120	Advanced Program
Dig In Status	d014	Display	Skip Frequency	A119	Advanced Program
Digital Inx Sel	A051-A054	Advanced Program	Slip Hertz @ FLA	A114	Advanced Program
Drive Status	d006	Display	Stp Logic Status	d028	Display
Drive Temp	d024	Display	Stp Logic Step x	A140-A147	Advanced Program
Drive Type	d017	Display	Stp Logic Time x	A150-A157	Advanced Program
Elapsed Run Time	d018	Display	Speed Reference	P038	Basic Program
EM Brk Off Delay	A160	Advanced Program	Stall Fault Time	A121	Advanced Program
EM Brk On Delay	A161	Advanced Program	Start At PowerUp	A094	Advanced Program
Fault Clear	A100	Advanced Program	Start Boost	A085	Advanced Program
Fault x Code	d007-d009	Display	Start Source	P036	Basic Program
Flux Current Ref	A129	Advanced Program	Stop Mode	P037	Basic Program
Flying Start En	A096	Advanced Program	SW Current Trip	A098	Advanced Program
Internal Freq	A069	Advanced Program	Testpoint Data	d019	Display
IR Voltage Drop	A128	Advanced Program	Testpoint Sel	A102	Advanced Program
Jog Accel/Decel	A079	Advanced Program	Timer Status	d026	Display
Jog Frequency	A078	Advanced Program	Torque Current	d029	Display
Language	A108	Advanced Program	Torque Perf Mode	A125	Advanced Program
Maximum Freq	P035	Basic Program	Var PWM Disable	A124	Advanced Program
			Voltage Class	P042	Basic Program

**Notes:**

# Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 40 drive. Included is a listing and description of drive faults (with possible solutions, when applicable).

For information on...	See page...	For information on...	See page...
<a href="#">Drive Status</a>	<a href="#">4-1</a>	<a href="#">Fault Descriptions</a>	<a href="#">4-3</a>
<a href="#">Faults</a>	<a href="#">4-1</a>	<a href="#">Common Symptoms and Corrective Actions</a>	<a href="#">4-5</a>

## Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the integral keypad.

## LED Indications

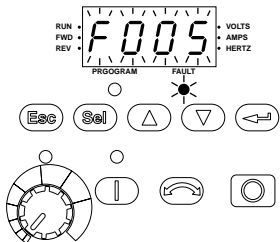
See [page 2-3](#) for information on drive status indicators and controls.

## Faults



A fault is a condition that stops the drive. There are two fault types.

Type	Fault Description	
①	Auto-Reset/Run	When this type of fault occurs, and <a href="#">A092</a> [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, <a href="#">A093</a> [Auto Rstrt Delay], begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resetable	This type of fault may require drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared.

Fault Indication

Condition	Display
<p><b>Drive is indicating a fault.</b></p> <p>The integral keypad provides visual notification of a fault condition by displaying the following.</p> <ul style="list-style-type: none"><li>• Flashing fault number</li><li>• Flashing fault indicator</li></ul> <p>Press the Escape key to regain control of the integral keypad.</p>	

Manually Clearing Faults

Step	Key(s)
<p>1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the integral keypad.</p> <p>Access d007 <a href="#">[Fault 1 Code]</a> to view the most recent fault information.</p> <p>2. Address the condition that caused the fault.</p> <p>The cause must be corrected before the fault can be cleared.</p> <p>See <a href="#">Table 4.A</a>.</p> <p>3. After corrective action has been taken, clear the fault by one of these methods.</p> <ul style="list-style-type: none"><li>• Press Stop if <a href="#">P037</a> [Stop Mode] is set to a value between “0” and “3”.</li><li>• Cycle drive power.</li><li>• Set <a href="#">A100</a> [Fault Clear] to “1” or “2”.</li><li>• Cycle digital input if <a href="#">A051-A054</a> [Digital Inx Sel] is set to option 7 “Clear Fault”.</li></ul>	<p></p> <p></p>

Automatically Clearing Faults

Option / Step
<p><b>Clear a Type 1 fault and restart the drive.</b></p> <ol style="list-style-type: none"><li>1. Set <a href="#">A092</a> [Auto Rstrt Tries] to a value other than “0”.</li><li>2. Set <a href="#">A093</a> [Auto Rstrt Delay] to a value other than “0”.</li></ol> <p><b>Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.</b></p> <ol style="list-style-type: none"><li>1. Set <a href="#">A092</a> [Auto Rstrt Tries] to a value other than “0”.</li><li>2. Set <a href="#">A093</a> [Auto Rstrt Delay] to “0”.</li></ol>

Auto Restart (Reset/Run)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote or “unattended” operation. Only certain faults are allowed to be reset. Certain faults (Type 2) that indicate possible drive component malfunction are not resettable.

Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user selected programming.

## Fault Descriptions

**Table 4.A Fault Types, Descriptions and Actions**

No.	Fault	Type <sup>(1)</sup>	Description	Action
F2	Auxiliary Input	①	Auxiliary input interlock is open.	<ol style="list-style-type: none"> <li>1. Check remote wiring.</li> <li>2. Verify communications programming for intentional fault.</li> </ol>
F3	Power Loss	②	DC bus voltage remained below 85% of nominal.	<ol style="list-style-type: none"> <li>1. Monitor the incoming AC line for low voltage or line power interruption.</li> <li>2. Check input fuses.</li> </ol>
F4	UnderVoltage	①	DC bus voltage fell below the minimum value.	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled	①	Drive is unable to accelerate motor.	Increase <a href="#">P039</a> - <a href="#">A067</a> [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter <a href="#">A089</a> [Current Limit 1].
F7	Motor Overload	①	Internal electronic overload trip.	<ol style="list-style-type: none"> <li>1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter <a href="#">P033</a> [Motor OL Current].</li> <li>2. Verify <a href="#">A084</a> [Boost Select] setting</li> </ol>
F8	Heatsink OvrTmp	①	Heatsink temperature exceeds a predefined value.	<ol style="list-style-type: none"> <li>1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for IP20/Open type installations.</li> <li>2. Check fan.</li> </ol>
F12	HW OverCurrent	②	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper <a href="#">A084</a> [Boost Select] setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	②	A current path to earth ground has been detected at one or more of the drive output terminals.	Check the motor and external wiring to the drive output terminals for a grounded condition.
F29	Analog Input Loss	①	<p>An analog input is configured to fault on signal loss. A signal loss has occurred.</p> <p>Configure with <a href="#">A122</a> [Analog In Loss].</p>	<ol style="list-style-type: none"> <li>1. Check parameters.</li> <li>2. Check for broken/loose connections at inputs.</li> </ol>

<sup>(1)</sup> See [page 4-1](#) for a description of fault types.

No.	Fault	Type <sup>(1)</sup>	Description	Action
F33	Auto Rstrt Tries	②	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of <a href="#">A092</a> [Auto Rstrt Tries].	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	②	A phase to ground fault has been detected between the drive and motor in this phase.	<ol style="list-style-type: none"> <li>1. Check the wiring between the drive and motor.</li> <li>2. Check motor for grounded phase.</li> <li>3. Replace drive if fault cannot be cleared.</li> </ol>
F39	Phase V to Gnd			
F40	Phase W to Gnd			
F41	Phase UV Short	②	Excessive current has been detected between these two output terminals.	<ol style="list-style-type: none"> <li>1. Check the motor and drive output terminal wiring for a shorted condition.</li> <li>2. Replace drive if fault cannot be cleared.</li> </ol>
F42	Phase UW Short			
F43	Phase VW Short			
F48	Params Defaulted		The drive was commanded to write default values to EEPROM.	<ol style="list-style-type: none"> <li>1. Clear the fault or cycle power to the drive.</li> <li>2. Program the drive parameters as needed.</li> </ol>
F63	SW OverCurrent	①	Programmed <a href="#">A098</a> [SW Current Trip] has been exceeded.	Check load requirements and <a href="#">A098</a> [SW Current Trip] setting.
F64	Drive Overload	②	Drive rating of 150% for 1 minute or 200% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
F70	Power Unit	②	Failure has been detected in the drive power section.	<ol style="list-style-type: none"> <li>1. Cycle power.</li> <li>2. Replace drive if fault cannot be cleared.</li> </ol>
F71	Net Loss		The communication network has faulted.	<ol style="list-style-type: none"> <li>1. Cycle power.</li> <li>2. Check communications cabling.</li> <li>3. Check network adapter setting.</li> <li>4. Check external network status.</li> </ol>
F80	SVC Autotune		The autotune function was either cancelled by the user or failed.	Restart procedure.
F81	Comm Loss	②	RS485 (DSI) port stopped communicating.	<ol style="list-style-type: none"> <li>1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required.</li> <li>2. Check connection.</li> <li>3. An adapter was intentionally disconnected.</li> <li>4. Turn off using <a href="#">A105</a> [Comm Loss Action].</li> </ol>
F100	Parameter Checksum	②	The checksum read from the board does not match the checksum calculated.	Set <a href="#">P041</a> [Reset To Defaults] to option 1 "Reset Defaults".
F122	I/O Board Fail	②	Failure has been detected in the drive control and I/O section.	<ol style="list-style-type: none"> <li>1. Cycle power.</li> <li>2. Replace drive if fault cannot be cleared.</li> </ol>

<sup>(1)</sup> See [page 4-1](#) for a description of fault types.



## Common Symptoms and Corrective Actions

### Motor does not Start.

Cause(s)	Indication	Corrective Action
No output voltage to the motor.	None	<p>Check the power circuit.</p> <ul style="list-style-type: none"> <li>• Check the supply voltage.</li> <li>• Check all fuses and disconnects.</li> </ul> <p>Check the motor.</p> <ul style="list-style-type: none"> <li>• Verify that the motor is connected properly.</li> </ul> <p>Check the control input signals.</p> <ul style="list-style-type: none"> <li>• Verify that a Start signal is present. If 2-Wire control is used, verify that either the Run Forward or Run Reverse signal is active, but not both.</li> <li>• Verify that I/O Terminal 01 is active.</li> <li>• Verify that <a href="#">P036</a> [Start Source] matches your configuration.</li> <li>• Verify that <a href="#">A095</a> [Reverse Disable] is not prohibiting movement.</li> </ul>
Drive is Faulted	Flashing red status light	<p>Clear fault.</p> <ul style="list-style-type: none"> <li>• Press Stop</li> <li>• Cycle power</li> <li>• Set <a href="#">A100</a> [Fault Clear] to option 1 "Clear Faults".</li> <li>• Cycle digital input if <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel] is set to option 7 "Clear Fault".</li> </ul>

**Drive does not Start from Start or Run Inputs wired to the terminal block.**

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. <ul style="list-style-type: none"> <li>• Press Stop</li> <li>• Cycle power</li> <li>• Set <a href="#">A100</a> [Fault Clear] to option 1 "Clear Faults".</li> <li>• Cycle digital input if <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel] is set to option 7 "Clear Fault".</li> </ul>
Incorrect programming. <ul style="list-style-type: none"> <li>• <a href="#">P036</a> [Start Source] is set to option 0 "Keypad" or option 5 "RS485 (DSI) Port".</li> <li>• <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel] is set to option 5 "Local" and the input is active.</li> </ul>	None	Check parameter settings.
Incorrect input wiring. See <a href="#">1-16</a> for wiring examples. <ul style="list-style-type: none"> <li>• 2 wire control requires Run Forward, Run Reverse or Jog input.</li> <li>• 3 wire control requires Start and Stop inputs</li> <li>• Stop input is always required.</li> </ul>	None	Wire inputs correctly and/or install jumper.
Incorrect Sink/Source DIP switch setting.	None	Set switch to match wiring scheme.

**Drive does not Start from Integral Keypad.**

Cause(s)	Indication	Corrective Action
Integral keypad is not enabled.	Green LED above Start key is not illuminated.	<ul style="list-style-type: none"> <li>• Set parameter <a href="#">P036</a> [Start Source] to option 0 "Keypad".</li> <li>• Set parameter <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel] to option 5 "Local" and activate the input.</li> </ul>
I/O Terminal 01 "Stop" input is not present.	None	Wire inputs correctly and/or install jumper.

**Drive does not respond to changes in speed command.**

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	The drive "Run" indicator is lit and output is 0 Hz.	<ul style="list-style-type: none"> <li>Check <a href="#">d012</a> [Control Source] for correct source.</li> <li>If the source is an analog input, check wiring and use a meter to check for presence of signal.</li> <li>Check <a href="#">d002</a> [Commanded Freq] to verify correct command.</li> </ul>
Incorrect reference source is being selected via remote device or digital inputs.	None	<ul style="list-style-type: none"> <li>Check <a href="#">d012</a> [Control Source] for correct source.</li> <li>Check <a href="#">d014</a> [Dig In Status] to see if inputs are selecting an alternate source. Verify settings for <a href="#">A051</a> - <a href="#">A054</a> [Digital Inx Sel].</li> <li>Check <a href="#">P038</a> [Speed Reference] for the source of the speed reference. Reprogram as necessary.</li> <li>Review the Speed Reference Control chart on <a href="#">page 1-20</a>.</li> </ul>

**Motor and/or drive will not accelerate to commanded speed.**

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram <a href="#">P039</a> [Accel Time 1] or <a href="#">A067</a> [Accel Time 2].
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	<p>Compare <a href="#">d003</a> [Output Current] with <a href="#">A089</a> [Current Limit 1].</p> <p>Remove excess load or reprogram <a href="#">P039</a> [Accel Time 1] or <a href="#">A067</a> [Accel Time 2].</p> <p>Check for improper <a href="#">A084</a> [Boost Select] setting.</p>
Speed command source or value is not as expected.	None	<p>Verify <a href="#">d002</a> [Commanded Freq].</p> <p>Check <a href="#">d012</a> [Control Source] for the proper Speed Command.</p>
Programming is preventing the drive output from exceeding limiting values.	None	Check <a href="#">P035</a> [Maximum Freq] to insure that speed is not limited by programming.
Torque performance does not match motor characteristics.	None	<p>Set motor nameplate full load amps in parameter <a href="#">A126</a> [Motor NP FLA].</p> <p>Perform <a href="#">A127</a> [Autotune] "Static Tune" or "Rotate Tune" procedure.</p> <p>Set <a href="#">A125</a> [Torque Perf Mode] to option 0 "V/Hz".</p>

**Motor operation is unstable.**

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered.	None	<ol style="list-style-type: none"> <li>1. Correctly enter motor nameplate data into <a href="#">P031</a>, <a href="#">P032</a> and <a href="#">P033</a>.</li> <li>2. Enable <a href="#">A097</a> [Compensation].</li> <li>3. Use <a href="#">A084</a> [Boost Select] to reduce boost level.</li> </ol>

**Drive will not reverse motor direction.**

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel] ( <a href="#">See page 3-14</a> ). Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. ( <a href="#">See page 1-15</a> ).
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Check <a href="#">A095</a> [Reverse Disable].

**Drive does not power up.**

Cause(s)	Indication	Corrective Action
No input power to drive.	None	Check the power circuit. <ul style="list-style-type: none"> <li>• Check the supply voltage.</li> <li>• Check all fuses and disconnects.</li> </ul>
Jumper between I/O Terminals P2 and P1 not installed and/or DC Bus Inductor not connected.	None	Install jumper or connect DC Bus Inductor.

## Supplemental Drive Information

For information on...	See page...
<a href="#">Drive, Fuse &amp; Circuit Breaker Ratings</a>	<a href="#">A-1</a>
<a href="#">Specifications</a>	<a href="#">A-2</a>

### Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

#### Fusing

**If fuses are chosen as the desired protection method**, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2<sup>(1)</sup>, EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used.<sup>(2)</sup>

#### Circuit Breakers

Refer to listings in the following tables for recommended circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters.

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.




(2) Typical designations include; Type CC - KTK-R, FNQ-R  
Type J - JKS, LPJ  
Type T - JJS, JJN

## Specifications

Drive Ratings									
Catalog Number	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
	kW (HP)	Amps	Voltage Range	kVA	Amps	Fuses	140M Motor Protectors <sup>(2)</sup>	Contactors	IP20 Open Waits
<b>100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output</b>									
22B-V2P3N104	0.4 (0.5)	2.3	90-132	1.15	9.0	15	140M-C2E-C16	100-C12	30
22B-V5P0N104	0.75 (1.0)	5.0	90-132	2.45	20.3	35	140M-D8E-C20	100-C23	56
22B-V6P0N104	1.1 (1.5)	6.0	90-132	3.0	24.0	40	140M-F8E-C32	100-C37	70
<b>200 - 240V AC (±10%) – 1-Phase<sup>(1)</sup> Input, 0 - 230V 3-Phase Output</b>									
22B-A2P3N104	0.4 (0.5)	2.3	180-264	1.15	6.0	10	140M-C2E-B63	100-C09	30
22B-A5P0N104	0.75 (1.0)	5.0	180-264	2.45	12.0	20	140M-C2E-C16	100-C12	55
22B-A8P0N104	1.5 (2.0)	8.0	180-264	4.0	18.0	30	140M-D8E-C20	100-C23	80
22B-A012N104	2.2 (3.0)	12.0	180-264	5.5	25.0	40	140M-F8E-C32	100-C37	110
<b>200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output</b>									
22B-B2P3N104	0.4 (0.5)	2.3	180-264	1.15	2.5	6	140M-C2E-B40	100-C07	30
22B-B5P0N104	0.75 (1.0)	5.0	180-264	2.45	5.7	10	140M-C2E-C10	100-C09	55
22B-B8P0N104	1.5 (2.0)	8.0	180-264	4.0	9.5	15	140M-C2E-C16	100-C12	80
22B-B012N104	2.2 (3.0)	12.0	180-264	5.5	15.5	25	140M-C2E-C16	100-C23	115
22B-B017N104	3.7 (5.0)	17.5	180-264	8.6	21.0	35	140M-F8E-C25	100-C23	165
22B-B024N104	5.5 (7.5)	24.0	180-264	11.8	26.1	40	140M-F8E-C32	100-C37	226
22B-B033N104	7.5 (10.0)	33.0	180-264	16.3	34.6	60	140M-G8E-C45	100-C60	290
<b>380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output</b>									
22B-D1P4N104	0.4 (0.5)	1.4	342-528	1.4	1.8	3	140M-C2E-B25	100-C07	30
22B-D2P3N104	0.75 (1.0)	2.3	342-528	2.3	3.2	6	140M-C2E-B40	100-C07	40
22B-D4P0N104	1.5 (2.0)	4.0	342-528	4.0	5.7	10	140M-C2E-B63	100-C09	60
22B-D6P0N104	2.2 (3.0)	6.0	342-528	5.9	7.5	15	140M-C2E-C10	100-C09	90
22B-D010N104	4.0 (5.0)	10.5	342-528	10.3	13.0	20	140M-C2E-C16	100-C23	150
22B-D012N104	5.5 (7.5)	12.0	342-528	11.8	14.2	25	140M-D8E-C20	100-C23	160
22B-D017N104	7.5 (10.0)	17.0	342-528	16.8	18.4	30	140M-D8E-C20	100-C23	200
22B-D024N104	11.0 (15.0)	24.0	342-528	23.4	26.0	50	140M-F8E-C32	100-C43	285
<b>460 - 600V AC (±10%) – 3-Phase Input, 0 - 575V 3-Phase Output</b>									
22B-E1P7N104	0.75 (1.0)	1.7	414-660	2.1	2.3	6	140M-C2E-B25	100-C09	40
22B-E3P0N104	1.5 (2.0)	3.0	414-660	3.65	3.8	6	140M-C2E-B40	100-C09	60
22B-E4P2N104	2.2 (3.0)	4.2	414-660	5.2	5.3	10	140M-C2E-B63	100-C09	90
22B-E6P6N104	4.0 (5.0)	6.6	414-660	8.1	8.3	15	140M-C2E-C10	100-C09	150
22B-E9P9N104	5.5 (7.5)	9.9	414-660	12.1	11.2	20	140M-C2E-C16	100-C16	160
22B-E012N104	7.5 (10.0)	12.2	414-660	14.9	13.7	25	140M-C2E-C16	100-C23	200
22B-E019N104	11.0 (15.0)	19.0	414-660	23.1	24.1	40	140M-D8E-C25	100-C30	285

(1) 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N104 to N114.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001... to determine the frame and breaking capacity required for your application.

<b>Input/Output Ratings</b>		<b>Approvals</b>	
Output Frequency: 0-400 Hz (Programmable) Efficiency: 97.5% (Typical)		<div></div> <div>EMC Directive 89/336 LV: EN 50178, EN 60204 EMC: EN 61800-3, EN 50081-1, EN 50082-2</div>	
<b>Digital Control Inputs (Input Current = 6mA)</b>		<b>Analog Control Inputs</b>	
SRC (Source) Mode: 18-24V = ON 0-6V = OFF	SNK (Sink) Mode: 0-6V = ON 18-24V = OFF	4-20mA Analog: 250 ohm input impedance 0-10V DC Analog: 100k ohm input impedance External Pot: 1-10k ohms, 2 Watt minimum	
<b>Control Output</b>			
Programmable Output (form C relay) Resistive Rating: 3.0A at 30V DC, 3.0A at 125V AC, 3.0A at 240V AC Inductive Rating: 0.5A at 30V DC, 0.5A at 125V AC, 0.5A at 240V AC		Opto Outputs 30V DC, 50mA Non-inductive	Analog Outputs (10 bit) 0-10V, 1k ohm Min. 4-20mA, 525 ohm Max.
<b>Fuses and Circuit Breakers</b>			
Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent. Recommended Circuit Breakers: HMCP circuit breakers or equivalent.			
<b>Protective Features</b>			
Motor Protection: I <sup>2</sup> t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)			
Overcurrent: 200% hardware limit, 300% instantaneous fault			
Over Voltage: 100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line) 200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line) 380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line) 460-600V AC Input – Trip occurs at 1005V DC bus voltage (equivalent to 711V AC incoming line)			
Under Voltage: 100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line) 200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line) 380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line) 460-600V AC Input – If P042 = 3 "High Voltage" trip occurs at 487V DC bus voltage (344V AC incoming line) If P042 = 2 "Low Voltage" trip occurs at 390V DC bus voltage (275V AC incoming line)			
Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs			
Faultless Power Ride Through: 100 milliseconds			
<b>Dynamic Braking</b>			
Internal brake IGBT included with all ratings. Refer to Appendix B for DB resistor ordering information.			

Category	Specification	
Environment	Altitude:	1000 m (3300 ft) max. without derating
	Ambient Operating Temperature	
	Open Type, IP20:	–10 to 50 degrees C (14 to 122 degrees F)
	NEMA Type 1, IP30, UL Type 1:	–10 to 40 degrees C (14 to 104 degrees F)
	Cooling Method	
	Convection:	0.4 kW (0.5 HP) drives
	Fan:	All other drive ratings and 0.4 kW (0.5 HP) 1-Phase drives with Integral “S Type” EMC Filter
	Storage Temperature:	–40 to 85 degrees C (–40 to 185 degrees F)
	Atmosphere:	<b>Important:</b> Drive <b>must not</b> be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
Control	Relative Humidity:	0 to 95% non-condensing
	Shock (operating):	15G peak for 11ms duration ( $\pm 1.0$ ms)
	Vibration (operating):	1G peak, 5 to 2000 Hz
	Carrier Frequency	2-16 kHz. Drive rating based on 4 kHz.
	Frequency Accuracy	
	Digital Input:	Within $\pm 0.05\%$ of set output frequency.
	Analog Input:	Within 0.5% of maximum output frequency, 10-Bit resolution
	Analog Output:	$\pm 2\%$ of full scale, 10-Bit resolution
	Speed Regulation - Open Loop with Slip Compensation:	$\pm 1\%$ of base speed across a 60:1 speed range.
	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
	Accel/Decel:	Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:	150% Overload capability for up to 1 minute 200% Overload capability for up to 3 seconds
	Electronic Motor Overload Protection	Class 10 protection with speed sensitive response.



## Accessories and Dimensions

### Product Selection

Table B.A Catalog Number Description

<b>22B</b>	<b>-</b>	<b>A</b>	<b>1P5</b>	<b>N</b>	<b>1</b>	<b>1</b>	<b>4</b>
Drive	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Type	

Table B.B PowerFlex 40 Drives

Drive Ratings				IP20/NEMA Type Open		IP20 Flange Mount
Input Voltage	kW	HP	Output Current	Catalog Number	Frame Size	Catalog Number
120V 50/60 Hz 1-Phase No Filter	0.4	0.5	2.3A	22B-V2P3N104	B	22B-V2P3F104
	0.75	1.0	5.0A	22B-V5P0N104	B	22B-V5P0F104
	1.1	1.5	6.0A	22B-V6P0N104	B	22B-V6P0F104
240V 50/60 Hz 1-Phase With Integral "S Type" EMC Filter	0.4	0.5	2.3A	22B-A2P3N114	B	—
	0.75	1.0	5.0A	22B-A5P0N114	B	—
	1.5	2.0	8.0A	22B-A8P0N114	B	—
	2.2	3.0	12.0A	22B-A012N114	C	—
240V 50/60 Hz 1-Phase No Filter	0.4	0.5	2.3A	22B-A2P3N104	B	22B-A2P3F104
	0.75	1.0	5.0A	22B-A5P0N104	B	22B-A5P0F104
	1.5	2.0	8.0A	22B-A8P0N104	B	22B-A8P0F104
	2.2	3.0	12.0A	22B-A012N104	C	22B-A012F104
240V 50/60 Hz 3-Phase No Filter	0.4	0.5	2.3A	22B-B2P3N104	B	22B-B2P3F104
	0.75	1.0	5.0A	22B-B5P0N104	B	22B-B5P0F104
	1.5	2.0	8.0A	22B-B8P0N104	B	22B-B8P0F104
	2.2	3.0	12.0A	22B-B012N104	B	22B-B012F104
	3.7	5.0	17.5A	22B-B017N104	B	22B-B017F104
	5.5	7.5	24.0A	22B-B024N104	C	22B-B024F104
	7.5	10.0	33.0A	22B-B033N104	C	22B-B033F104
480V 50/60 Hz 3-Phase No Filter	0.4	0.5	1.4A	22B-D1P4N104	B	22B-D1P4F104
	0.75	1.0	2.3A	22B-D2P3N104	B	22B-D2P3F104
	1.5	2.0	4.0A	22B-D4P0N104	B	22B-D4P0F104
	2.2	3.0	6.0A	22B-D6P0N104	B	22B-D6P0F104
	4.0	5.0	10.5A	22B-D010N104	B	22B-D010F104
	5.5	7.5	12.0A	22B-D012N104	C	22B-D012F104
	7.5	10.0	17.0A	22B-D017N104	C	22B-D017F104
	11.0	15.0	24.0A	22B-D024N104	C	22B-D024F104
600V 50/60 Hz 3-Phase No Filter	0.75	1.0	1.7A	22B-E1P7N104	B	22B-E1P7F104
	1.5	2.0	3.0A	22B-E3P0N104	B	22B-E3P0F104
	2.2	3.0	4.2A	22B-E4P2N104	B	22B-E4P2F104
	4.0	5.0	6.6A	22B-E6P6N104	B	22B-E6P6F104
	5.5	7.5	9.9A	22B-E9P9N104	C	22B-E9P9F104
	7.5	10.0	12.0A	22B-E012N104	C	22B-E012F104
	11.0	15.0	19.0A	22B-E019N104	C	22B-E019F104

**Table B.C Dynamic Brake Modules**

Drive Ratings				Catalog Number <sup>(1)</sup>
Input Voltage	kW	HP	Minimum Resistance $\Omega$	
120V 50/60 Hz 1-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.1	1.5	48	AK-R2-091P500
240V 50/60 Hz 1-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.5	2.0	48	AK-R2-091P500
	2.2	3.0	32	AK-R2-047P500
240V 50/60 Hz 3-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.5	2.0	48	AK-R2-091P500
	2.2	3.0	32	AK-R2-047P500
	3.7	5.0	19	AK-R2-047P500
	5.5	7.5	13	AK-R2-030P1K2
480V 50/60 Hz 3-Phase	7.5	10.0	10	AK-R2-030P1K2
	0.4	0.5	97	AK-R2-360P500
	0.75	1.0	97	AK-R2-360P500
	1.5	2.0	97	AK-R2-360P500
	2.2	3.0	97	AK-R2-120P1K2
	4.0	5.0	77	AK-R2-120P1K2
	5.5	7.5	55	AK-R2-120P1K2
	7.5	10.0	39	AK-R2-120P1K2
600V 50/60 Hz 3-Phase	11.0	15.0	24	AK-R2-120P1K2 <sup>(2)</sup>
	0.75	1.0	120	AK-R2-360P500
	1.5	2.0	120	AK-R2-360P500
	2.2	3.0	82	AK-R2-120P1K2
	4.0	5.0	82	AK-R2-120P1K2
	5.5	7.5	51	AK-R2-120P1K2
	7.5	10.0	51	AK-R2-120P1K2
	11.0	15.0	51	AK-R2-120P1K2 <sup>(2)</sup>

<sup>(1)</sup> The resistors listed in this tables are rated for 5% duty cycle.

<sup>(2)</sup> Requires two resistors wired in parallel.

Table B.D Bulletin 1321-3R Series Line Reactors

Input Voltage	kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance mh	Watts Loss	Catalog Number <sup>(1)</sup>
240V 50/60 Hz 3-Phase	0.4	0.5	4	6	12.0	21 W	1321-3R4-D
	0.75	1.0	8	12	3.0	29 W	1321-3R8-B
	1.5	2.0	8	12	1.5	19.5 W	1321-3R8-A
	2.2	3.0	12	18	1.25	26 W	1321-3R12-A
	3.7	5.0	18	27	0.8	36 W	1321-3R18-A
	5.5	7.5	25	37.5	0.5	48 W	1321-3R25-A
	7.5	10.0	35	52.5	0.4	49 W	1321-3R35-A
480V 50/60 Hz 3-Phase	0.4	0.5	2	3	20.0	11.3 W	1321-3R2-B
	0.75	1.0	4	6	9.0	20 W	1321-3R4-C
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	8	12	5.0	25.3 W	1321-3R8-C
	4.0	5.0	12	18	2.5	31 W	1321-3R12-B
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	18	27	1.5	43 W	1321-3R18-B
600V 50/60 Hz 3-Phase	11.0	15.0	25	37.5	1.2	52 W	1321-3R25-B
	0.75	1.0	2	3	20.0	11.3 W	1321-3R2-B
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	4	6	6.5	20 W	1321-3R4-B
	4.0	5.0	8	12	5.0	25.3 W	1321-3R8-C
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	12	18	2.5	31 W	1321-3R12-B
600V 50/60 Hz 3-Phase	11.0	15.0	18	27	1.5	43 W	1321-3R18-B

<sup>(1)</sup> Catalog numbers listed are for 3% impedance open style units. NEMA Type 1 and 5% impedance reactor types are also available. Refer to publication 1321-TD001....

Table B.E DC Bus Inductors

Input Voltage	kW	HP	Amps	Inductance mh	MTE Catalog Number <sup>(2)</sup>
240V 50/60 Hz 3-Phase	5.5	7.5	32	0.85	32RB001
	7.5	10.0	40	0.5	40RB001
480V 50/60 Hz 3-Phase	5.5	7.5	18	3.75	18RB004
	7.5	10.0	25	4.0	25RB005
	11.0	15.0	32	2.68	32RB003
600V 50/60 Hz 3-Phase	5.5	7.5	12	6.0	12RB004
	7.5	10.0	18	6.0	18RB005
	11.0	15.0	25	4.0	25RB005

<sup>(2)</sup> Use MTE RB Series or equivalent inductors.

**Table B.F EMC Line Filters**

Drive Ratings			S Type Filter Catalog Number <sup>(1)</sup>	L Type Filter Catalog Number <sup>(4)</sup>
Input Voltage	kW	HP		
120V 50/60 Hz 1-Phase	0.4	0.5	–	22-RF018-BL
	0.75	1.0	–	22-RF018-BL
	1.1	1.5	–	22-RF018-BL
240V 50/60 Hz 1-Phase	0.4	0.5	<sup>(2)</sup>	22-RF018-BL
	0.75	1.0	<sup>(2)</sup>	22-RF018-BL
	1.5	2.0	<sup>(2)</sup>	22-RF018-BL
	2.2	3.0	<sup>(2)</sup>	22-RF025-CL
240V 50/60 Hz 3-Phase	0.4	0.5	22-RF021-BS <sup>(3)</sup>	22-RF021-BL
	0.75	1.0	22-RF021-BS <sup>(3)</sup>	22-RF021-BL
	1.5	2.0	22-RF021-BS <sup>(3)</sup>	22-RF021-BL
	2.2	3.0	22-RF021-BS <sup>(3)</sup>	22-RF021-BL
	3.7	5.0	22-RF021-BS <sup>(3)</sup>	22-RF021-BL
	5.5	7.5	22-RF034-CS	22-RF034-CL
	7.5	10.0	22-RF034-CS	22-RF034-CL
480V 50/60 Hz 3-Phase	0.4	0.5	22-RF012-BS	22-RF012-BL
	0.75	1.0	22-RF012-BS	22-RF012-BL
	1.5	2.0	22-RF012-BS	22-RF012-BL
	2.2	3.0	22-RF012-BS	22-RF012-BL
	4.0	5.0	22-RF012-BS	22-RF012-BL
	5.5	7.5	22-RF018-CS	22-RF018-CL
	7.5	10.0	22-RF018-CS	22-RF018-CL
	11.0	15.0	22-RF026-BS	22-RF026-BL
600V 50/60 Hz 3-Phase	0.75	1.0	–	22-RF008-BL
	1.5	2.0	–	22-RF008-BL
	2.2	3.0	–	22-RF008-BL
	4.0	5.0	–	22-RF008-BL
	5.5	7.5	–	22-RF015-BL
	7.5	10.0	–	22-RF015-BL
	11.0	15.0	–	22-RF024-BL

<sup>(1)</sup> This filter is suitable for use with a cable length of at least 10 meters (33 feet) for Class A and 1 meter for Class B environments.

<sup>(2)</sup> These ratings can be ordered with internal “S Type” filters. Refer to the Catalog Number explanation on [page P-4](#) and [Table B.B](#) for details.

<sup>(3)</sup> Filter must be Series B or later.

<sup>(4)</sup> This filter is suitable for use with a cable length of at least 100 meters for Class A and 5 meters for Class B environments.

**Table B.G Human Interface Module (HIM) Option Kits and Accessories**

Item	Description	Catalog Number
LCD Display, Remote Panel Mount	Digital speed control CopyCat capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.9 meter cable	22-HIM-C2S
LCD Display, Remote Panel Mount	Digital speed control CopyCat capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.9 meter cable	22-HIM-C2
LCD Display, Remote Handheld	Digital speed control Full numeric keypad CopyCat capable IP30 (NEMA Type 1) Includes 1.0 meter cable Panel mount with optional Bezel Kit	22-HIM-A3
Bezel Kit	Panel mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1)	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	1.0 Meter (3.3 Feet) 2.9 Meter (9.51 Feet)	22-HIM-H10 22-HIM-H30

**Table B.H IP30/NEMA 1/UL Type 1 Kit**

Item	Description	Drive Frame	Catalog Number
IP30/NEMA 1/UL Type 1 Kit	Field installed kit. Converts drive to IP30/NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel.	B	22-JBAB
		C	22-JBAC
IP30/NEMA 1/UL Type 1 Kit for Communication Option	Field installed kit. Converts drive to IP30/NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel.	B	22-JBCB
		C	22-JBCC

**Table B.I Communication Option Kits and Accessories**

Item	Description	Catalog Number
Communication Adapters	Embedded communication options for use with the PowerFlex family of drives. Requires a Communication Adapter Cover (Ordered Separately). DeviceNet EtherNet	22-COMM-D 22-COMM-E
Communication Adapter Cover	Cover that houses the DeviceNet Communication Adapter. B Frame Drive C Frame Drive	22B-CCB 22B-CCC
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive software. Includes: DSI to RS232 serial converter (1) 1203-SFC serial cable (1) 22-RJ45CBL-C20 cable (1) DriveExplorer Lite CD (1)	22-SCM-232
DSI Cable	2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Serial Cable	2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer.	1203-SFC
Null Cable Converter	For use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Splitter Cable	RJ45 one to two port splitter cable	AK-U0-RJ45-SC1
Terminating Resistors	RJ45 120 Ohm resistors (2 pieces)	AK-U0-RJ45-TR1
Terminal Block	RJ45 Two position terminal block (5 pieces)	AK-U0-RJ45-TB2P
DriveExplorer Software (CD-ROM) Version 3.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online. Compatibility: Windows 95, 98, ME, NT 4.0 (Service Pack 3 or later), 2000, XP and CE <sup>(1)</sup>	9306-4EXP01ENE
DriveExecutive software (CD-ROM) Version 1.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline. Compatibility: Windows 98, ME, NT 4.0 (Service Pack 3 or later), 2000 and XP	9303-4DTE01ENE

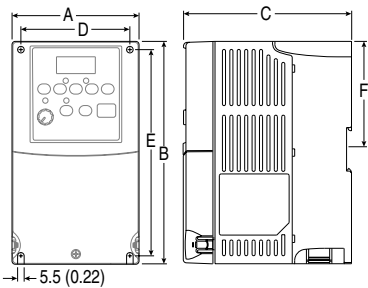
<sup>(1)</sup> See [www.ab.com/drives/driveexplorer.htm](http://www.ab.com/drives/driveexplorer.htm) for supported devices.

Product Dimensions

Table B.J PowerFlex 40 Frames – Ratings are in kW and (HP)

Frame	120V AC – 1-Phase	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase	600V AC – 3-Phase
B	0.4 (0.5) 0.75 (1.0) 1.1 (1.5)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 3.7 (5.0) 5.5 (7.5)	0.4 (0.5) 2.2 (3.0) 4.0 (5.0)
C		2.2 (3.0)	5.5 (7.5) 7.5 (10.0)	5.5 (7.5) 7.5 (10.0)	11.0 (15.0) 15.0 (20.0)

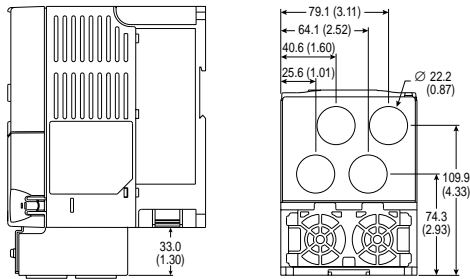
Figure B.1 PowerFlex 40 AC Drive



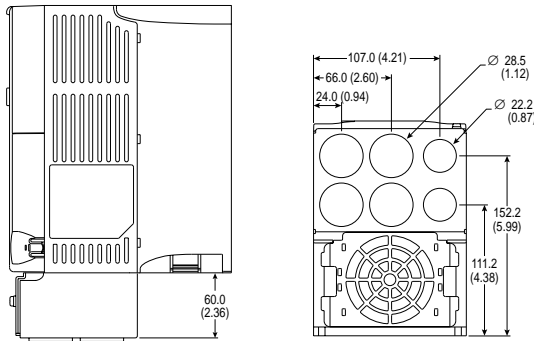
Dimensions are in millimeters and (inches).  
Weights are in kilograms and (pounds).

Frame	A	B	C	D	E	F	Ship Weight
B	100 (3.94)	180 (7.09)	136 (5.35)	87 (3.43)	168 (6.61)	87.4 (3.44)	2.2 (4.9)
C	130 (5.1)	260 (10.2)	180 (7.1)	116 (4.57)	246 (9.7)	—	4.3 (9.5)

Figure B.2 IP 30/NEMA 1/UL Type 1 Option Kit without Communication Option

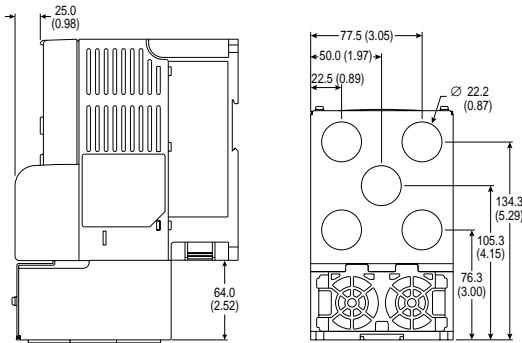


Frame B - 22-JBAB

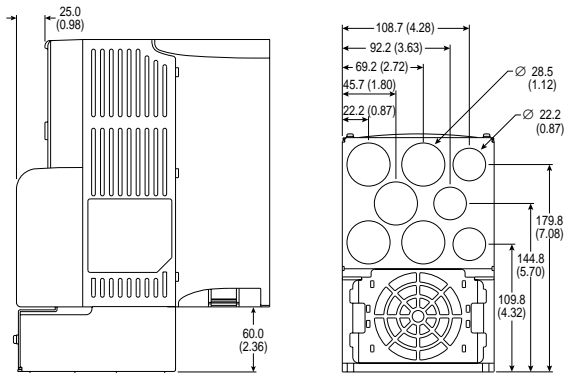


Frame C - 22-JBAC

**Figure B.3 IP 30/NEMA 1/UL Type 1 Option Kit with Communication Option –**  
Dimensions are in millimeters and (inches)



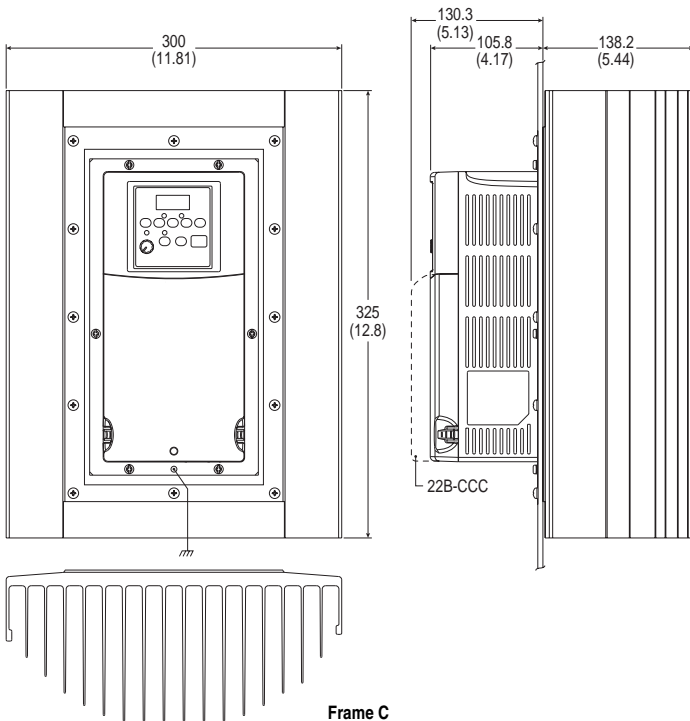
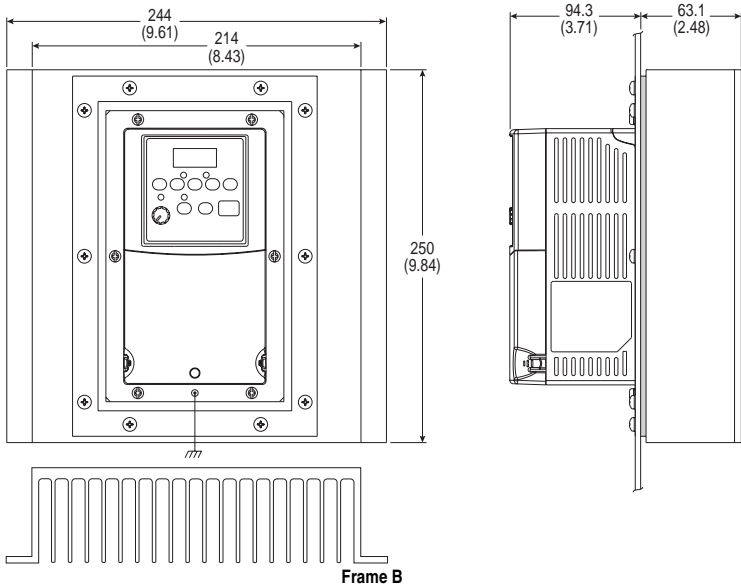
**Frame B - 22-JBCB**



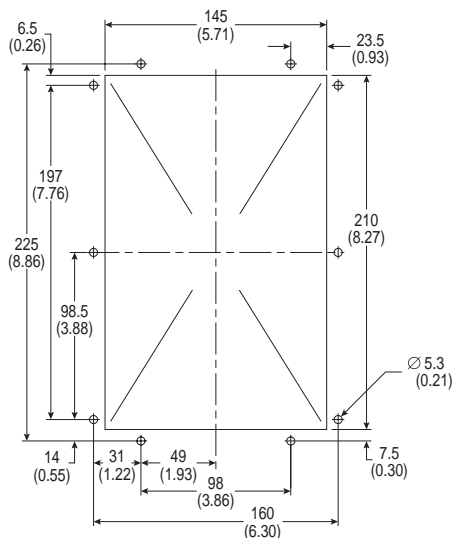
**Frame C - 22-JBCC**



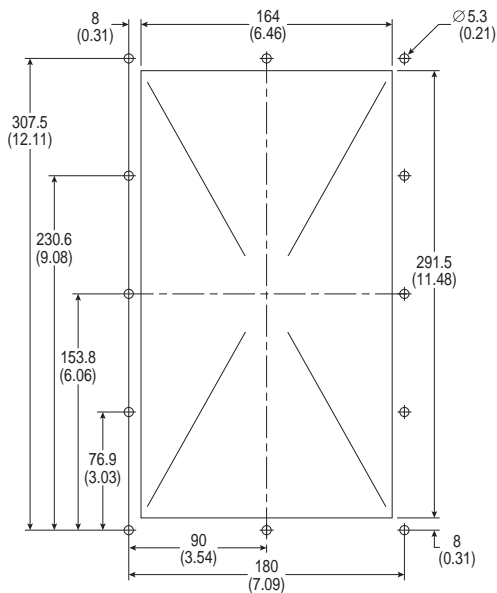
**Figure B.4 PowerFlex 40 Flange Mount Drives – Dimensions are in millimeters and (inches)**



**Figure B.5 PowerFlex 40 Flange Mount Cutout Dimensions** – Dimensions are in millimeters and (inches)

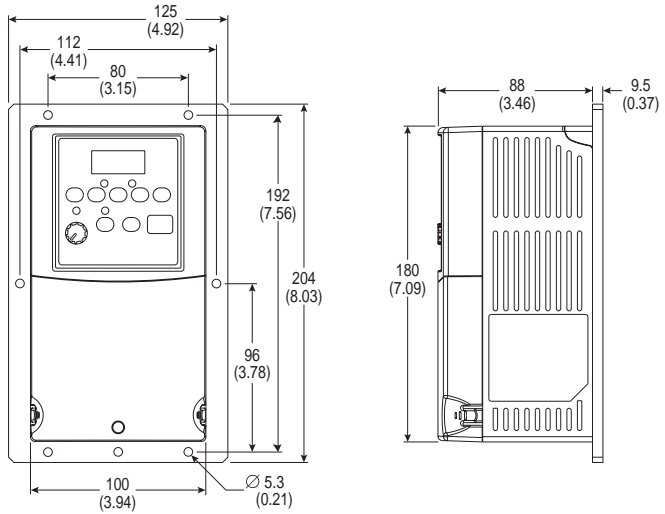


**Frame B**

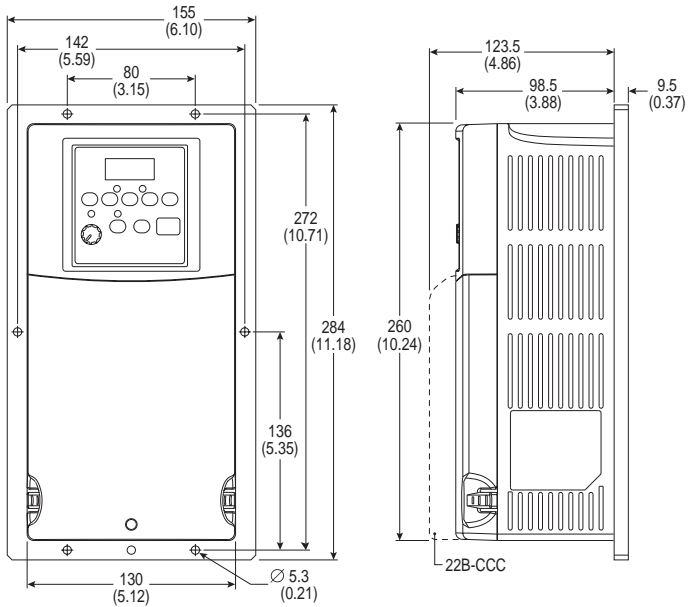


### Frame C

**Figure B.6 PowerFlex 40 Replacement Plate Drive Dimensions** – Dimensions are in millimeters and (inches)

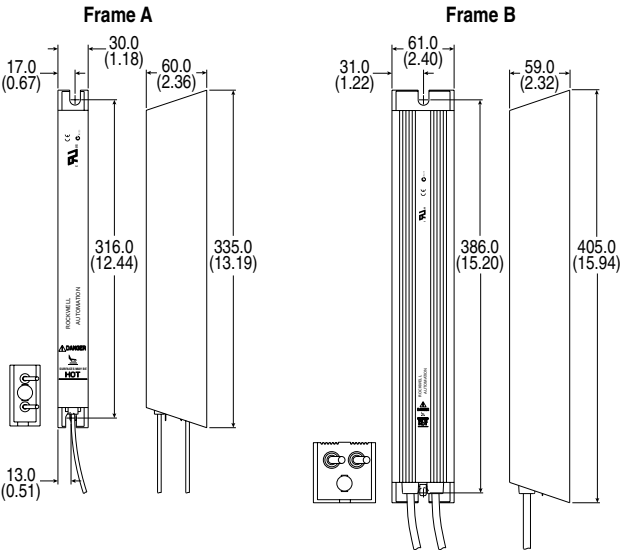


**Frame B**



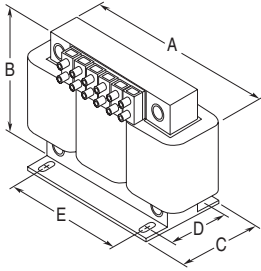
**Frame C**

**Figure B.7 Dynamic Brake Modules** – Dimensions are in millimeters and (inches).  
Weights are in kilograms and (pounds).



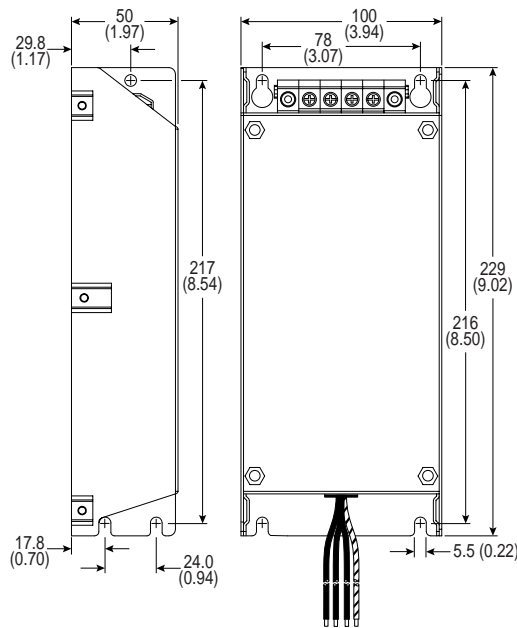
Frame	Catalog Number	Weight
A	AK-R2-091P500, AK-R2-047P500, AK-R2-360P500	1.1 (2.5)
B	AK-R2-030P1K2, AK-R2-120P1K2	2.7 (6)

**Figure B.8 Bulletin 1321-3R Series Line Reactors** – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

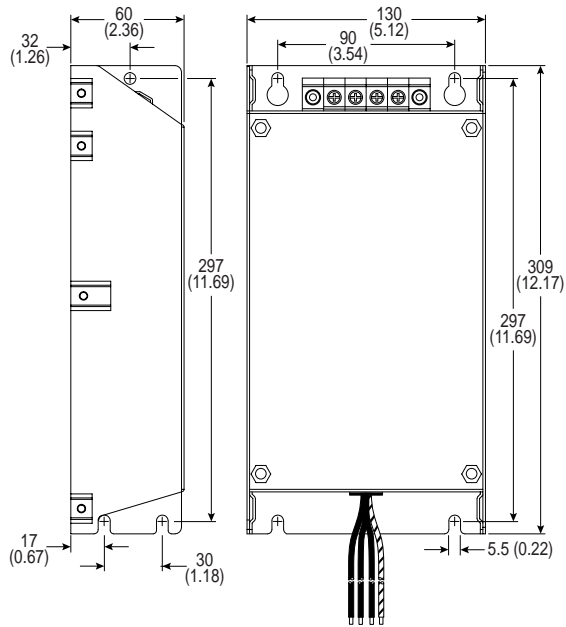


Catalog Number	A	B	C	D	E	Weight
1321-3R2-A	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-A	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C	112 (4.40)	104 (4.10)	86 (3.38)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R4-D	112 (4.40)	104 (4.10)	92 (3.62)	66 (2.60)	37 (1.44)	2.7 (6)
1321-3R8-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.1 (7)
1321-3R8-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C	152 (6.00)	127 (5.00)	85 (3.35)	63 (2.48)	51 (2.00)	4.9 (11)
1321-3R12-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R18-A	152 (6.00)	133 (5.25)	79 (3.10)	54 (2.13)	51 (2.00)	4.1 (9)
1321-3R18-B	152 (6.00)	133 (5.25)	86 (3.40)	63 (2.48)	51 (2.00)	5.4 (12)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)

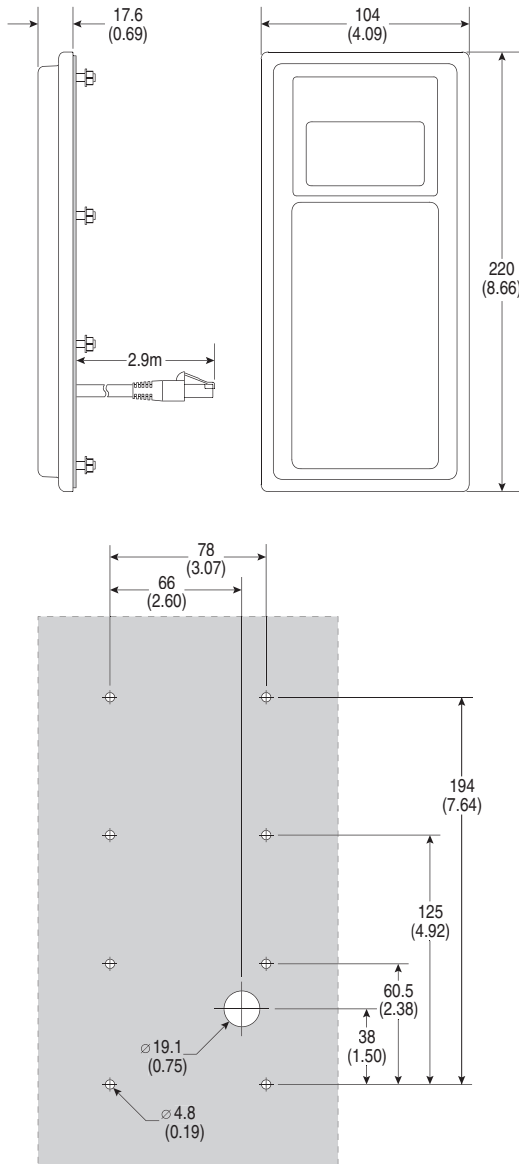
**Figure B.9 Frame B EMC Line Filters** – Dimensions are in millimeters and (inches)  
Catalog Numbers: 22-RF012-BS, -BL; 22-RF018-BS; 22-RF021-BS, -BL



**Figure B.10 Frame C EMC Line Filters** – Dimensions are in millimeters and (inches)  
Catalog Numbers: 22-RF021-BL (Series B); 22-RF025-CL; 22-RF018-CS, -CL;  
22-RF034-CS, -CL

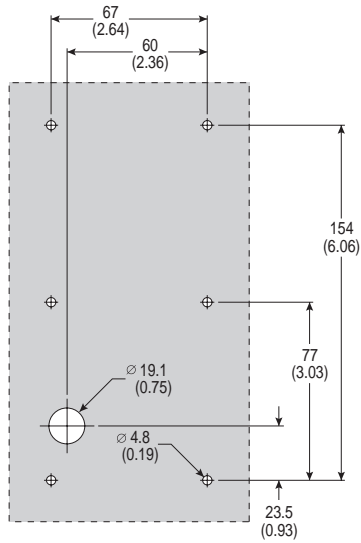
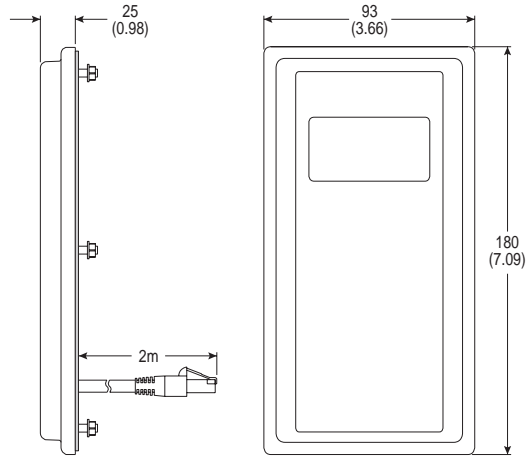


**Figure B.11 Remote (Panel Mount) HIM** – Dimensions are in millimeters and (inches)  
Catalog Number: 22-HIM-C2



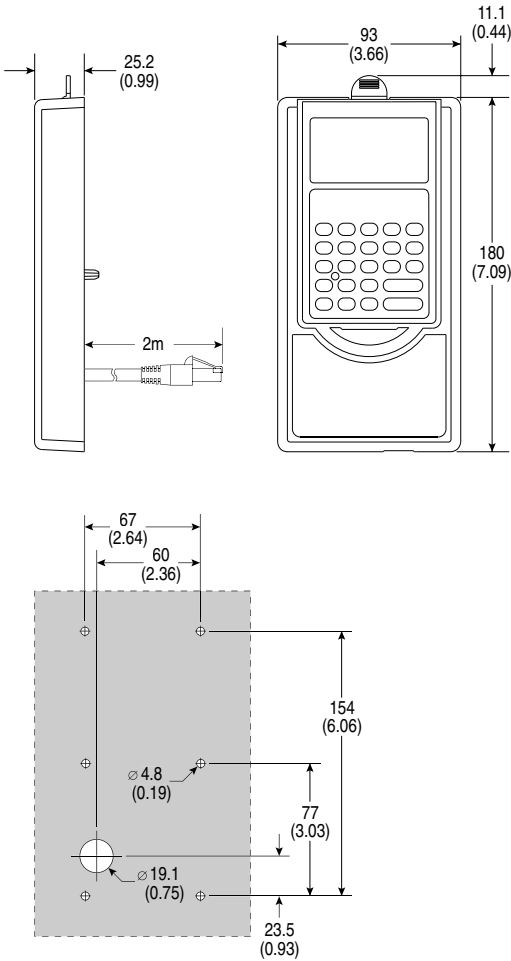


**Figure B.12 Remote (Panel Mount) Small HIM – Dimensions are in millimeters and (inches) Catalog Number: 22-HIM-C2S**



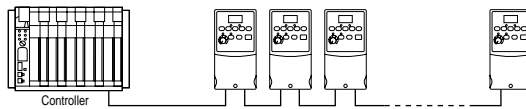
**Important:** The 22-HIM-C2S is smaller than the 22-HIM-C2 and cannot be used as a direct replacement.

**Figure B.13 NEMA Type 1 Bezel** – Dimensions are in millimeters and (inches)  
Catalog Number: 22-HIM-B1



## RS485 (DSI) Protocol

PowerFlex 40 drives support the RS485 (DSI) protocol to allow efficient operation with Rockwell Automation peripherals. In addition, some Modbus functions are supported to allow simple networking. PowerFlex 40 drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

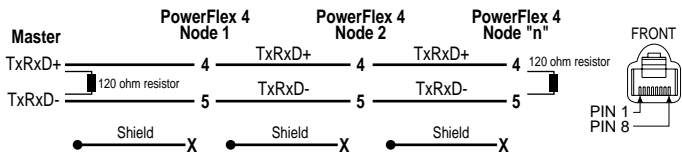


For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

## Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

**Figure C.1 Network Wiring Diagram**



NOTE: The shield is connected at ONLY ONE end of each cable segment.

Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 40 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRx D+” and “TxRx D-” are shown for illustration purposes only. Refer to the master controller’s user manual for network terminations. Note that there is no standard for the “+” and “-” wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

Standard RS485 wiring practices apply. Termination resistors need to be applied at each end of the network cable. RS485 repeaters may need to be used for long cable runs, or if greater than 32 nodes are needed on the network.

Control Terminal 19 on the PowerFlex 40 must also be connected to PE ground (there are two PE terminals on the drive). See [Table 1.H](#) for more information.

## Parameter Configuration

The following PowerFlex 40 parameters are used to configure the drive to operate on a network.

Parameter	Details	Reference
P036 [Start Source]	Set to 5 "RS485 (DSI) Port" if Start is controlled from the network.	<a href="#">Page 3-10</a>
P038 [Speed Reference]	Set to 5 "RS485 (DSI) Port" if the Speed Reference is controlled from the network.	<a href="#">Page 3-12</a>
A103 [Comm Data Rate]	Sets the data rate for the RS485 (DSI) Port. All nodes on the network must be set to the same data rate.	<a href="#">Page 3-30</a>
A104 [Comm Node Addr]	Sets the node address for the drive on the network. Each device on the network requires a unique node address.	<a href="#">Page 3-30</a>
A105 [Comm Loss Action]	Selects the drive's response to communication problems.	<a href="#">Page 3-31</a>
A106 [Comm Loss Time]	Sets the time that the drive will remain in communication loss before the drive implements A105 [Comm Loss Action].	<a href="#">Page 3-31</a>
A107 [Comm Format]	Sets the transmission mode, data bits, parity and stop bits for the RS485 (DSI) Port. All nodes on the network must be set to the same setting.	<a href="#">Page 3-31</a>

## Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 40 drives supports some of the Modbus function codes.

Modbus Function Code	Command
03	Read Holding Registers
06	Preset (Write) Single Register

**Important:** Modbus devices can be 0-based (registers are numbered starting at 0) or 1-based (registers are numbered starting at 1). Depending on the Modbus Master used, the register addresses listed on the following pages may need to be offset by +1. For example, Logic Command may be register address 8192 for some master devices (e.g. ProSoft 3150-MCM SLC Modbus scanner) and 8193 for others (e.g. PanelViews).

### Writing (06) Logic Command Data

The PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8192 (Logic Command). P036 [Start Source] must be set to 5 “RS485 (DSI) Port” in order to accept the commands.

Logic Command		
Address (Decimal)	Bit(s)	Description
8192	0	1 = Stop, 0 = Not Stop
	1	1 = Start, 0 = Not Start
	2	1 = Jog, 0 = No Jog
	3	1 = Clear Faults, 0 = Not Clear Faults
	5,4	00 = No Command
		01 = Forward Command
		10 = Reverse Command
		11 = No Command
	6	Not Used
	7	Not Used
	9,8	00 = No Command
		01 = Accel Rate 1 Enable
		10 = Accel Rate 2 Enable
		11 = Hold Accel Rate Selected
	11,10	00 = No Command
		01 = Decel Rate 1 Enable
		10 = Decel Rate 2 Enable
		11 = Hold Decel Rate Selected
	14,13,12	000 = No Command
		001 = Freq. Source = P036 [Start Source]
		010 = Freq. Source = A069 [Internal Freq]
		011 = Freq. Source = Comms (Addr 8193)
		100 = A070 [Preset Freq 0]
		101 = A071 [Preset Freq 1]
		110 = A072 [Preset Freq 2]
		111 = A073 [Preset Freq 3]
	15	Not Used

### Writing (06) Reference

The Speed Reference to a PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8193 (Reference). P038 [Speed Reference] must be set to 5 “RS485 (DSI) Port” in order to accept the Speed Reference.

Reference	
Address (Decimal)	Description
8193	A decimal value entered as xxx.x where the decimal point is fixed. For example, a decimal “100” equals 10.0 Hz and “543” equals 54.3 Hz.

Reading (03) Logic Status Data

The PowerFlex 40 Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status).

Logic Status		
Address (Decimal)	Bit(s)	Description
8448	0	1 = Ready, 0 = Not Ready
	1	1 = Active (Running), 0 = Not Active
	2	1 = Cmd Forward, 0 = Cmd Reverse
	3	1 = Rotating Forward, 0 = Rotating Reverse
	4	1 = Accelerating, 0 = Not Accelerating
	5	1 = Decelerating, 0 = Not Decelerating
	6	1 = Alarm, 0 = No Alarm
	7	1 = Faulted, 0 = Not Faulted
	8	1 = At Reference, 0 = Not At Reference
	9	1 = Reference Controlled by Comm
	10	1 = Operation Cmd Controlled by Comm
	11	1 = Parameters have been locked
	12	Digital Input 1 Status
	13	Digital Input 2 Status
	14	Digital Input 3 Status <sup>(1)</sup>
	15	Digital Input 4 Status <sup>(1)</sup>

<sup>(1)</sup> This status is available only with firmware revision FRN 2.xx and higher.

Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 40 drive can be read via the network by sending Function Code 03 reads to register address 8451 (Feedback).

Feedback <sup>(2)</sup>	
Address (Decimal)	Description
8451	A xxx.x decimal value where the decimal point is fixed. For example, a decimal "123" equals 12.3 Hz and "300" equals 30.0 Hz.

<sup>(2)</sup> Returns the same data as Reading (03) Parameter d001 [Output Freq].

## Reading (03) Drive Error Codes

The PowerFlex 40 Error Code data can be read via the network by sending Function Code 03 reads to register address 8449 (Drive Error Codes).

		Logic Status
Address (Decimal)	Value (Decimal)	Description
8449	0	No Fault
	2	Auxiliary Input
	3	Power Loss
	4	Undervoltage
	5	Overvoltage
	6	Motor Stalled
	7	Motor Overload
	8	Heatsink Overtemperature
	12	HW Overcurrent (300%)
	13	Ground Fault
	29	Analog Input Loss
	33	Auto Restart Tries
	38	Phase U to Ground Short
	39	Phase V to Ground Short
	40	Phase W to Ground Short
	41	Phase UV Short
	42	Phase UW Short
	43	Phase VW Short
	63	Software Overcurrent
	64	Drive Overload
	70	Power Unit Fail
	80	AutoTune Fail
	81	Communication Loss
	100	Parameter Checksum Error
	122	I/O Board Fail

## Reading (03) and Writing (06) Drive Parameters

To access drive parameters, the Modbus register address equals the parameter number. For example, a decimal “1” is used to address Parameter d001 [Output Freq] and decimal “39” is used to address Parameter P039 [Accel Time 1].

## Additional Information

Refer to <http://www.ab.com/drives/> for additional information.

**Notes:**



# RJ45 DSI Splitter Cable

The PowerFlex 40 drive provides a RJ45 port to allow the connection of a single peripheral device. The RJ45 DSI Splitter Cable can be used to connect a second DSI peripheral device to the drive.

## Connectivity Guidelines

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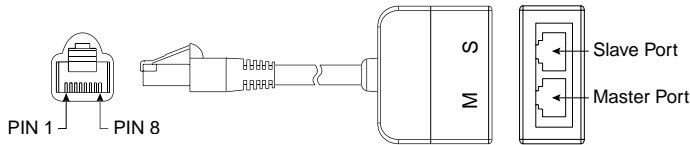
**ATTENTION:** Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

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- Two peripherals maximum can be attached to a drive.
- If a single peripheral is used, it must be connected to the Master port (M) on the splitter and configured for “Auto” (default) or “Master.” Parameter 9 [Device Type] on the DSI / MDI keypads and Parameter 1 [Adapter Cfg] on the Serial Converter are used to select the type (Auto / Master / Slave).
- **Do not use the RJ45 Splitter Cable with a drive that has an internal network communication adapter installed.** Since only one additional peripheral can be added, the second peripheral can be connected directly to the RJ45 port on the drive. The internal Comm is always the Master, therefore the external peripheral must be configured as “Auto” (for temporary connections) or “Slave” (for permanent connections).
- If two peripherals will be powered up at the same time, one must be configured as the “Master” and connected to the Master port (M) and the other must be connected as the “Slave” and connected to the Slave port (S).

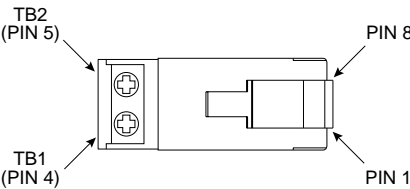
DSI Cable Accessories

**RJ45 Splitter Cable** – Catalog Number: AK-U0-RJ45-SC1



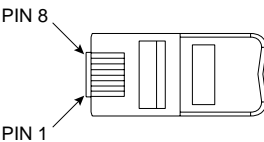
**RJ45 Two-Position Terminal Block Adapter** –

Catalog Number: AK-U0-RJ45-TB2P



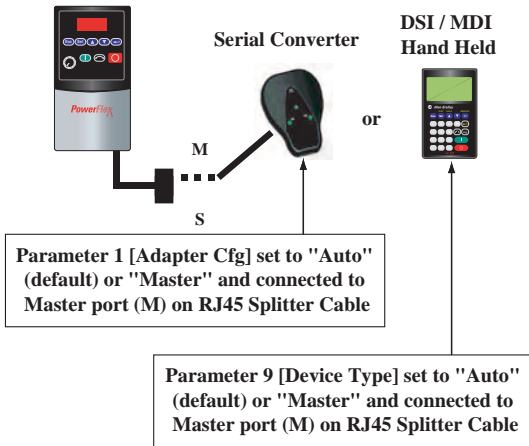
**RJ45 Adapter with Integrated Termination Resistor** –

Catalog Number: AK-U0-RJ45-TR1

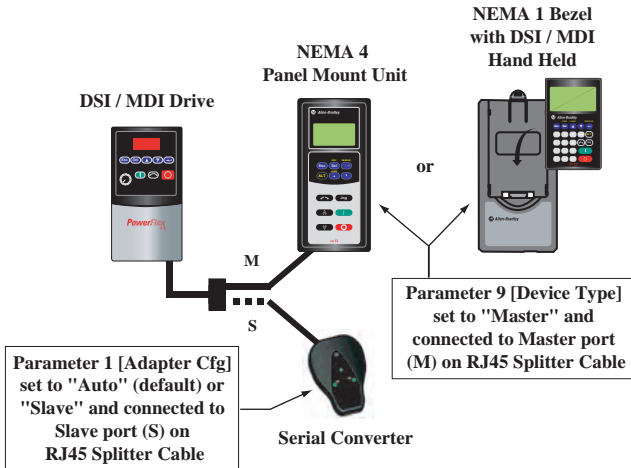


## Connecting One Temporary Peripheral

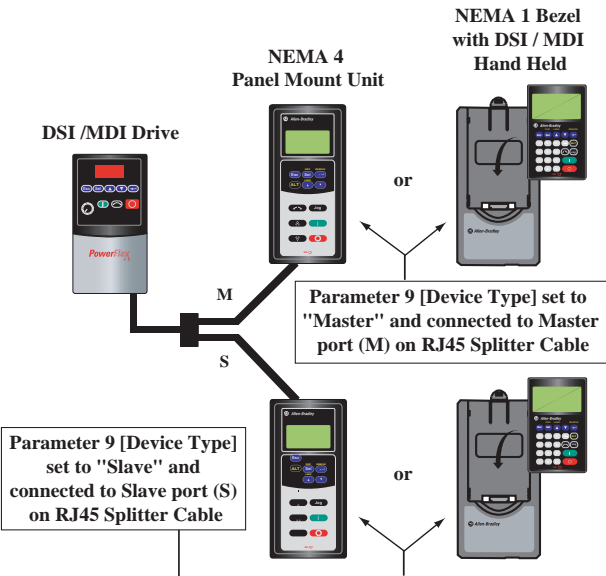
DSI / MDI Drive



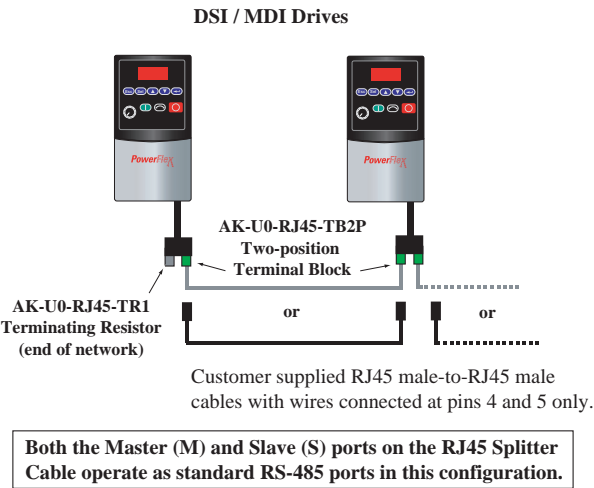
## Connecting One Temporary Peripheral and One Permanent Peripheral



# Connecting Two Permanent Peripherals



# Connecting an RS-485 Network



# Step Logic, Basic Logic and Timer/Counter Functions

Four PowerFlex 40 logic functions provide the capability to program simple logic functions without a separate controller.

- **Step Logic Function**

Steps through up to eight preset speeds based on programmed logic. Programmed logic can include conditions that need to be met from digital inputs programmed as “Logic In1” and “Logic In2” before stepping from one preset speed to the next. A timer is available for each of the eight steps and is used to program a time delay before stepping from one preset speed to the next. The status of a digital output can also be controlled based on the step being executed.

- **Basic Logic Function**

Up to two digital inputs can be programmed as “Logic In1” and/or “Logic In2”. A digital output can be programmed to change state based on the condition of one or both inputs based on basic logic functions such as AND, OR, NOR. The basic logic functions can be used with or without step logic.

- **Timer Function**

A digital input can be programmed for “Timer Start”. A digital output can be programmed as a “Timer Out” with an output level programmed to the desired time. When the timer reaches the time programmed into the output level the output will change state. The timer can be reset via a digital input programmed as “Reset Timer”.

- **Counter Function**

A digital input can be programmed for “Counter In”. A digital output can be programmed as “Counter Out” with an output level programmed to the desired number of counts. When the counter reaches the count programmed into the output level the output will change state. The counter can be reset via a digital input programmed as “Reset Counter”.

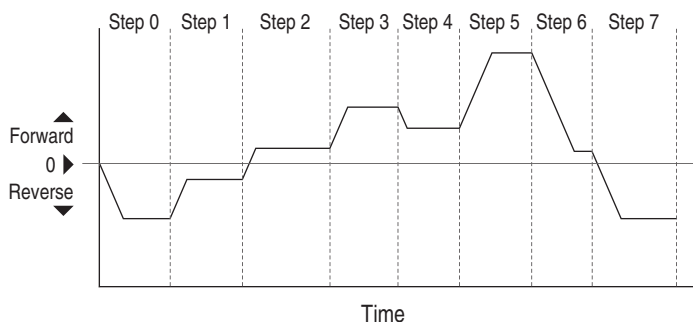
## Step Logic Using Timed Steps

To activate this function, set parameter P038 [Speed Reference] to 6 “Stp Logic”. Three parameters are used to configure the logic, speed reference and time for each step.

- Logic is defined using parameters A140-A147 [Stp Logic x].
- Preset Speeds are set with parameters A070-A077 [Preset Freq x].
- Time of operation for each step is set with parameters A150-A157 [Stp Logic Time x].

The direction of motor rotation can be forward or reverse.

**Figure E.1 Using Timed Steps**



## Step Logic Sequence

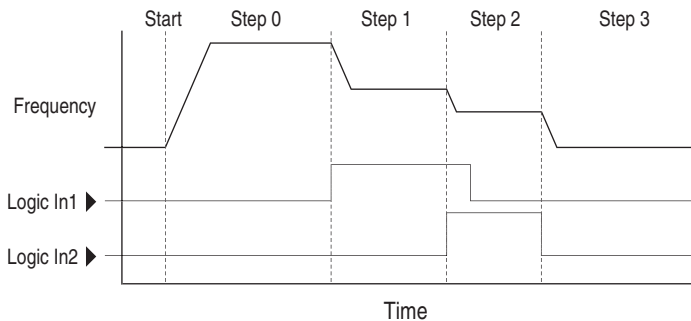
- Sequence begins with a valid start command.
- A normal sequence begins with Step 0 and transition to the next step when the corresponding step logic time has expired.
- Step 7 is followed by Step 0
- Sequence repeats until a stop is issued or a fault condition occurs.

## Step Logic Using Basic Logic Functions

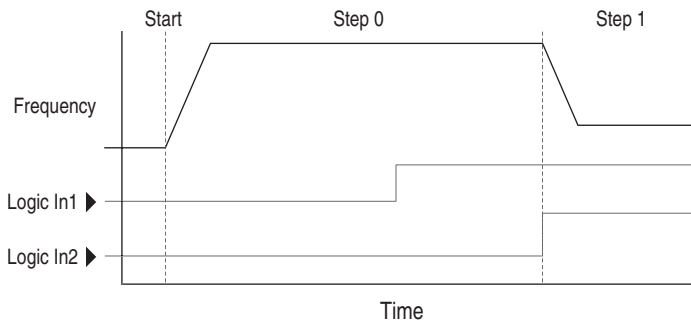
Digital input and digital output parameters can be configured to use logic to transition to the next step. Logic In1 and Logic In2 are defined by programming parameters A051-A054 [Digital Inx Sel] to option 23 “Logic In1” or option 24 “Logic In2”.

### Example

- Run at Step 0.
- Transition to Step 1 when Logic In1 is true.  
Logic senses the edge of Logic In1 when it transitions from off to on. Logic In1 is not required to remain “on”.
- Transition to Step 2 when both Logic In1 and Logic In2 are true.  
The drive senses the level of both Logic In1 and Logic In2 and transitions to Step 2 when both are on.
- Transition to Step 3 when Logic In2 returns to a false or off state.  
Inputs are not required to remain in the “on” condition except under the logic conditions used for the transition from Step 2 to Step 3.



The step time value and the basic logic may be used together to satisfy machine conditions. For instance, the step may need to run for a minimum time period and then use the basic logic to trigger a transition to the next step.



## Timer Function

Digital inputs and outputs control the timer function and are configured with parameters A051-A054 [Digital Inx Sel] set to 18 “Timer Start” and 20 “Reset Timer”.

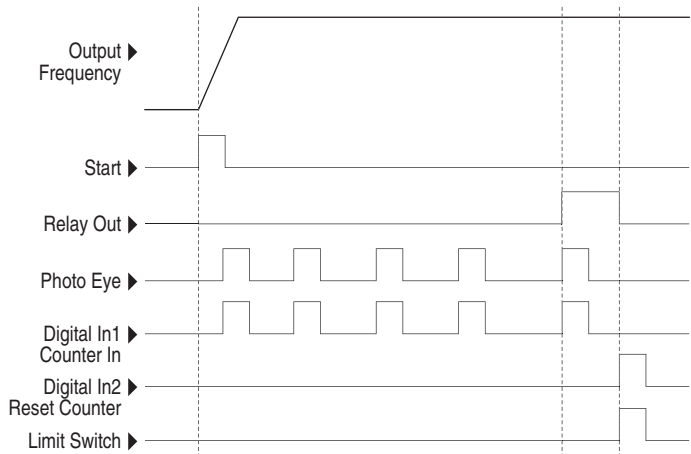
Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired time in seconds.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to option 16 “Timer Out” and causes the output to change state when the preset level is reached.

### Example

- Drive starts up and accelerates to 30 Hz.
- After 30Hz has been maintained for 20 seconds, a 4-20mA analog input becomes the reference signal for speed control.
- The timer function is used to select a preset speed with a 20 second run time that overrides the speed reference while the digital input is active.
- Parameters are set to the following options:
  - P038 [Speed Reference] = 3 “4-20mA Input”
  - A051 [Digital In1 Sel] = 4 “Preset Freq”
  - A052 [Digital In2 Sel] = 18 “Timer Start”
  - A055 [Relay Out Sel] = 16 “Timer Out”
  - A056 [Relay Out Level] = 20.0 Secs
  - A071 [Preset Freq 1] = 30.0 Hz
- The control terminal block is wired such that a start command will also trigger the timer start.
- The relay output is wired to I/O Terminal 05 (Digital Input 1) so that it forces the input on when the timer starts.
- After the timer is complete, the output is turned off releasing the preset speed command. The drive defaults to following the analog input reference as programmed.





Note that a “Reset Timer” input is not required for this example since the “Timer Start” input both clears and starts the timer.

## Counter Function

Digital inputs and outputs control the counter function and are configured with parameters A051-A054 [Digital Inx Sel] set to 19 “Counter In” and 21 “Reset Counter”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired count value.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to 17 “Counter Out” which causes the output to change state when the level is reached.

### Example

- A photo eye is used to count packages on a conveyor line.
- An accumulator holds the packages until 5 are collected.
- A diverter arm redirects the group of 5 packages to a bundling area.
- The diverter arm returns to its original position and triggers a limit switch that resets the counter.
- Parameters are set to the following options:
  - A051 [Digital In1 Sel] set to 19 to select “Counter In”
  - A052 [Digital In2 Sel] set to 21 to select “Reset Counter”
  - A055 [Relay Out Sel] set to 17 to select “Counter Out”
  - A056 [Relay Out Level] set to 5.0 (counts)

## Step Logic Parameters

**Table E.A Code Descriptions for Parameters A140-A147**

Digit 3	Digit 2	Digit 1	Digit 0
0	0	F	1

**Table E.B Digit 3 – Defines the action during the step currently executing.**

Setting	Accel/Decel Parameters Used	Step Logic Output State	Commanded Direction
0	1	Off	FWD
1	1	Off	REV
2	1	Off	No Output
3	1	On	FWD
4	1	On	REV
5	1	On	No Output
6	2	Off	FWD
7	2	Off	REV
8	2	Off	No Output
9	2	On	FWD
A	2	On	REV
b	2	On	No Output

**Table E.C Digit 2 – Defines what step to jump to or how to end program when the logic conditions specified in Digit 1 are met.**

Setting	Logic
0	Jump to Step 0
1	Jump to Step 1
2	Jump to Step 2
3	Jump to Step 3
4	Jump to Step 4
5	Jump to Step 5
6	Jump to Step 6
7	Jump to Step 7
8	End Program (Normal Stop)
9	End Program (Coast to Stop)
A	End Program and Fault (F2)

**Table E.D Digit 1 – Defines what logic must be met to jump to a step other than the very next step.**

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if "Logic In1" is active (logically true)	TRUE
3	Step if "Logic In2" is active (logically true)	TRUE
4	Step if "Logic In1" is not active (logically false)	FALSE
5	Step if "Logic In2" is not active (logically false)	FALSE
6	Step if either "Logic In1" or "Logic In2" is active (logically true)	OR
7	Step if both "Logic In1" and "Logic In2" is active (logically true)	AND
8	Step if neither "Logic In1" or "Logic In2" is active (logically true)	NOR
9	Step if "Logic In1" is active (logically true) and "Logic In2" is not active (logically false)	XOR
A	Step if "Logic In2" is active (logically true) and "Logic In1" is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and "Logic In1" is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and "Logic In2" is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and "Logic In1" is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and "Logic In2" is not active (logically false)	TIMED OR
F	Do not step OR no "jump to", so use Digit 0 logic	IGNORE

**Table E.E Digit 0 – Defines what logic must be met to jump to the very next step.**

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if "Logic In1" is active (logically true)	TRUE
3	Step if "Logic In2" is active (logically true)	TRUE
4	Step if "Logic In1" is not active (logically false)	FALSE
5	Step if "Logic In2" is not active (logically false)	FALSE
6	Step if either "Logic In1" or "Logic In2" is active (logically true)	OR
7	Step if both "Logic In1" and "Logic In2" is active (logically true)	AND
8	Step if neither "Logic In1" or "Logic In2" is active (logically true)	NOR
9	Step if "Logic In1" is active (logically true) and "Logic In2" is not active (logically false)	XOR
A	Step if "Logic In2" is active (logically true) and "Logic In1" is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and "Logic In1" is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and "Logic In2" is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and "Logic In1" is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and "Logic In2" is not active (logically false)	TIMED OR
F	Use logic programmed in Digit 1	IGNORE

# **PID Set Up**

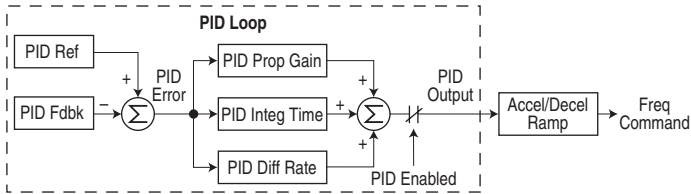
## **PID Loop**

The PowerFlex 40 has a built-in PID (proportional, integral, differential) control loop. The PID loop is used to maintain a process feedback (such as pressure, flow or tension) at a desired set point. The PID loop works by subtracting the PID feedback from a reference and generating an error value. The PID loop reacts to the error, based on the PID Gains, and outputs a frequency to try to reduce the error value to 0. To enable the PID loop, parameter A132 [PID Ref Sel] must be set to an option other than 0 "PID Disabled".

Exclusive Control and Trim Control are two basic configurations where the PID loop may be used.

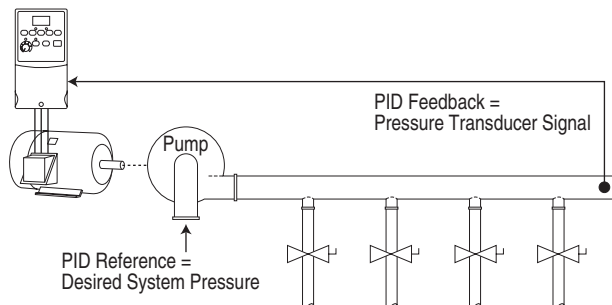
## Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when A132 [PID Ref Sel] is set to option 1, 2, 3 or 4. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



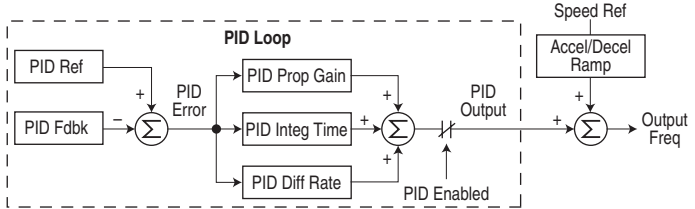
## Example

- In a pumping application, the PID Reference equals the Desired System Pressure set point.
- The Pressure Transducer signal provides PID Feedback to the drive. Fluctuations in actual system pressure, due to changes in flow, result in a PID Error value.
- The drive output frequency increases or decreases to vary motor shaft speed to correct for the PID Error value.
- The Desired System Pressure set point is maintained as valves in the system are opened and closed causing changes in flow.
- When the PID Control Loop is disabled, the Commanded Speed is the Ramped Speed Reference.



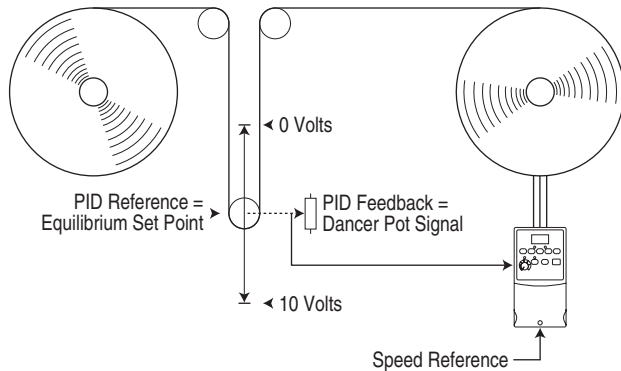
## Trim Control

In Trim Control, the PID Output is added to the Speed Reference. In Trim mode, the output of the PID loop bypasses the accel/decel ramp as shown. Trim Control is used when A132 [PID Ref Sel] is set to option 5, 6, 7 or 8.



## Example

- In a winder application, the PID Reference equals the Equilibrium set point.
- The Dancer Pot signal provides PID Feedback to the drive. Fluctuations in tension result in a PID Error value.
- The Master Speed Reference sets the wind/unwind speed.
- As tension increases or decreases during winding, the Speed Reference is trimmed to compensate. Tension is maintained near the Equilibrium set point.



PID Reference and Feedback

Parameter A132 [PID Ref Sel] is used to enable the PID mode (A132 ≠ 0 “PID Disabled”) and to select the source of the PID Reference. If A132 [PID Ref Sel] is not set to 0 “PID Disabled”, PID can still be disabled by select programmable digital input options (parameters [A051](#)-[A054](#)) such as “Jog”, “Local” or “PID Disable”.

Table F.A A132 [PID Ref Sel] Options

Option	Description
0 "PID Disabled"	Disables the PID loop (default setting)
1 "PID Setpoint"	Selects Exclusive Control. A137 [PID Setpoint] will be used to set the value of the PID Reference
2 "0-10V Input"	Selects Exclusive Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
3 "4-20mA Input"	Selects Exclusive Control. Selects the 4-20mA Input.
4 "Comm Port"	Selects Exclusive Control. The reference word from a communication network (see <a href="#">Appendix C</a> for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
5 "Setpnt, Trim"	Selects Trim Control. A137 [PID Setpoint] will be used to set the value of the PID Reference.
6 "0-10V, Trim"	Selects Trim Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
7 "4-20mA, Trim"	Selects Trim Control. Selects the 4-20mA Input.
8 "Comm, Trim"	Selects Trim Control. The reference word from a communication network (see <a href="#">Appendix C</a> for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.

A133 [PID Feedback Sel] is used to select the source of the PID feedback.

Table F.B A133 [PID Feedback Sel] Options

Option	Description
0 "0-10V Input"	Selects the 0-10V Input (default setting). Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
1 "4-20mA Input"	Selects the 4-20mA Input.
2 "Comm Port"	The reference word from a communication network (see <a href="#">Appendix C</a> of the PowerFlex 40 User Manual for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Feedback. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback.



## Analog PID Reference Signals

Parameters A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] are used to scale or invert an analog PID Reference.

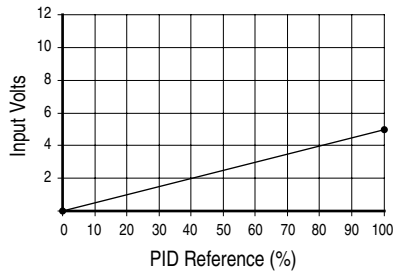
**Important:** Firmware version FRN 2.xx also allows PID Feedback scaling from an analog input.

### Examples

#### Scale Function

For a 0-5 volt signal, the following parameter settings are used so that a 0 volt signal = 0% PID Reference and a 5 volt signal = 100% PID Reference.

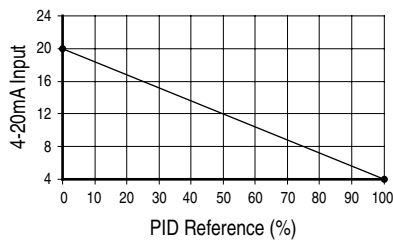
- A110 [Anlg In 0-10V Lo] = 0.0%
- A111 [Anlg In 0-10V Hi] = 50.0%
- A132 [PID Ref Sel] = 0 “0-10V Input”



#### Invert Function

For a 4-20mA signal, the following parameter settings are used so that a 20mA signal = 0% PID Reference and a 4mA signal = 100% PID Reference.

- A112 [Anlg In 4-20mA Lo] = 100.0%
- A113 [Anlg In 4-20mA Hi] = 0.0%
- A132 [PID Ref Sel] = 3 “4-20mA Input”



## PID Deadband

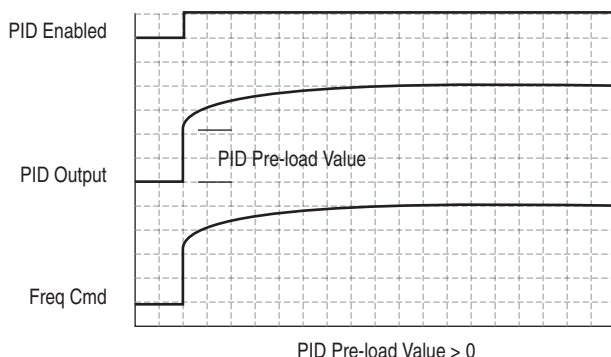
Parameter A138 [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

### Example

- [PID Deadband] is set to 5.0
- The PID Reference is 25.0%
- The PID Regulator will not act on a PID Error that falls between 20.0 and 30.0%

## PID Preload

The value set in A139 [PID Preload], in Hertz, will be pre-loaded into the integral component of the PID at any start or enable. This will cause the drive's frequency command to initially jump to that preload frequency, and the PID loop starts regulating from there.



## PID Limits

A130 [PID Trim Hi] and A131 [PID Trim Lo] are used to limit the PID output and are only used in trim mode. [PID Trim Hi] sets the maximum frequency for the PID output in trim mode. [PID Trim Lo] sets the reverse frequency limit for the PID output in trim mode. Note that when the PID reaches the Hi or Lo limit, the PID regulator stops integrating so that windup does not occur.

## PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- A134 [PID Prop Gain]

The proportional gain (unitless) affects how the regulator reacts to the magnitude of the error. The proportional component of the PID regulator outputs a speed command proportional to the PID error. For example, a proportional gain of 1 would output 100% of max frequency when the PID error is 100% of the analog input range. A larger value for [PID Prop Gain] makes the proportional component more responsive, and a smaller value makes it less responsive. Setting [PID Prop Gain] to 0.00 disables the proportional component of the PID loop.

- A135 [PID Integ Time]

The integral gain (units of seconds) affects how the regulator reacts to error over time and is used to get rid of steady state error. For example, with an integral gain of 2 seconds, the output of the integral gain component would integrate up to 100% of max frequency when the PID error is 100% for 2 seconds. A larger value for [PID Integ Time] makes the integral component less responsive, and a smaller value makes it more responsive. Setting [PID Integ Time] to 0 disables the integral component of the PID loop.

- A136 [PID Diff Rate]

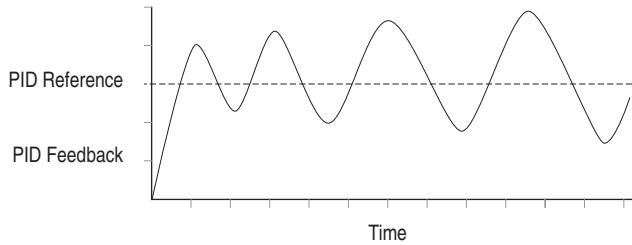
The Differential gain (units of 1/seconds) affects the rate of change of the PID output. The differential gain is multiplied by the difference between the previous error and current error. Thus, with a large error the D has a large effect and with a small error the D has less of an effect. This parameter is scaled so that when it is set to 1.00, the process response is 0.1% of [Maximum Freq] when the process error is changing at 1% / second. A larger value for [PID Diff Rate] makes the differential term have more of an effect and a small value makes it have less of an effect. In many applications, the D gain is not needed. Setting [PID Diff Rate] to 0.00 (factory default) disables the differential component of the PID loop.

### Guidelines for Adjusting the PID Gains

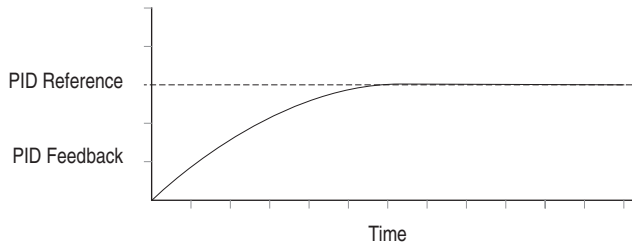
1. Adjust the proportional gain. During this step it may be desirable to disable the integral gain and differential gain by setting them to 0. After a step change in the PID Feedback:
  - If the response is too slow increase A134 [PID Prop Gain].
  - If the response is too quick and/or unstable (see [Figure F.1](#)), decrease A134 [PID Prop Gain].
  - Typically, A134 [PID Prop Gain] is set to some value below the point where the PID begins to go unstable.
2. Adjust the integral gain (leave the proportional gain set as in Step 1). After a step change in the PID Feedback:
  - If the response is too slow (see [Figure F.2](#)), or the PID Feedback does not become equal to the PID Reference, decrease A135 [PID Integ Time].
  - If there is a lot of oscillation in the PID Feedback before settling out (see [Figure F.3](#)), increase A135 [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for A134 [PID Prop Gain] and A135 [PID Integ Time]:
  - Response is still slow after a step change, increase A136 [PID Diff Rate].
  - Response is still unstable, decrease A136 [PID Diff Rate].

The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

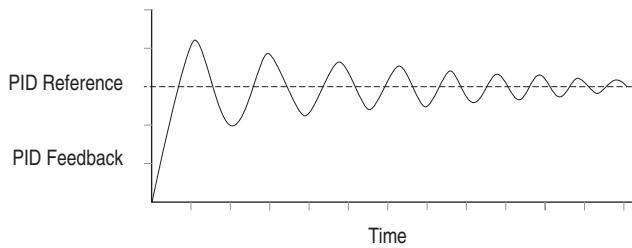
**Figure F.1 Unstable**



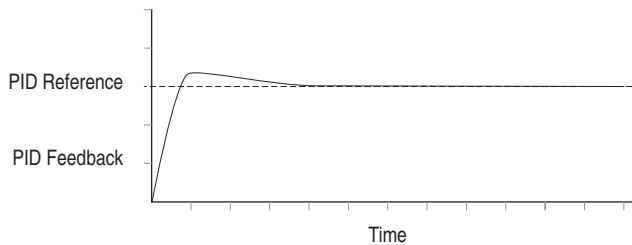
**Figure F.2 Slow Response – Over Damped**



**Figure F.3 Oscillation – Under Damped**



**Figure F.4 Good Response – Critically Damped**



**Notes:**

## A

AC Supply  
    Ground, **1-5**  
    Source, **1-3**  
    Ungrounded, **1-3**  
Advanced Program Group  
    Parameters, **3-14**  
Ambient Temperatures, **1-2**  
Armored Cable, **1-8**  
Auto Rstrt Tries Fault, **4-4**  
Auxiliary Input Fault, **4-3**

## B

Before Applying Power, **2-1, 2-2**  
Bus Capacitors, Discharging, **P-3**

## C

Cable Length, **1-13**  
Cable, Power, **1-8**  
Capacitors, Discharging, **P-3**  
Catalog Number Explanation, **P-4**  
CE Conformity, **1-22**  
Checklist, Start-Up, **2-1, 2-2**  
Circuit Breakers  
    Input, **1-6**  
Comm Loss Fault, **4-4**  
Command Sources for Start and  
    Speed, **1-20**  
Common Symptoms and Corrective  
    Action, **4-5**  
Contactors, Input, **1-12**  
Control, 2 and 3 Wire, **1-16, 1-19**  
Conventions, Manual, **P-2**  
Cover, Opening, **1-1**  
Cross Reference, Parameter  
    by Name, **3-42**

## D

Data, Diagnostic, **2-6**  
Data, Saving, **2-6**  
Diagnostic Data, Viewing, **2-6**  
Dimensions  
    Drive, **B-7**  
    Minimum Clearances, **1-2**

Discharging Bus Capacitors, **P-3**  
Display, **2-3**  
Display Group Parameters, **3-3**  
Distribution Systems, Ungrounded,  
    **1-3**  
Drive Frame Size, **P-2, B-7**  
Drive Grounding, **1-5**  
Drive Overload Fault, **4-4**  
Drive Ratings, **P-4, A-1**  
DriveExecutive, **3-1**  
DriveExplorer, **3-1**

## E

Earthing, see *Grounding*  
EMC/RFI  
    Grounding, Filter, **1-6**  
    Interference, **1-22**  
Enclosure Rating, Changing, **1-2**  
ESD, Static Discharge, **P-3**

## F

Faults  
    Auto Rstrt Tries, **4-4**  
    Auxiliary Input, **4-3**  
    Comm Loss, **4-4**  
    Drive Overload, **4-4**  
    Ground Fault, **4-3**  
    Heatsink OvrTmp, **4-3**  
    HW OverCurrent, **4-3**  
    I/O Board Fail, **4-4**  
    Motor Overload, **4-3**  
    Motor Stalled, **4-3**  
    OverVoltage, **4-3**  
    Parameter Checksum, **4-4**  
    Phase Short, **4-4**  
    Phase to Ground Short, **4-4**  
    Power Loss, **4-3**  
    Power Unit, **4-4**  
    SW OverCurrent, **4-4**  
    UnderVoltage, **4-3**  
Filter, RFI, **1-6**  
Frame Designations, **P-2, A-1, B-7**  
Fuses

Input, **1-6**

Ratings, **A-1**

## G

General Precautions, **P-3**

Ground Fault, **4-3**

Grounding

Filter, **1-6**

General, **1-5**

## H

Heatsink OvrTmp Fault, **4-3**

HW OverCurrent Fault, **4-3**

## I

I/O

Wiring, **1-12**

Wiring Examples, **1-16, 1-19**

I/O Board Fail Fault, **4-4**

Input Contactor, **1-12**

Input Fusing, **1-6**

Input Potentiometer, **1-16**

Input Power Conditioning, **1-4**

Installation, **1-1**

Integral Keypad, **2-3**

Interference, EMC/RFI, **1-22**

## K

Keypad, **2-3**

## L

LEDs, **2-3**

## M

Menu Structure, **2-5**

Minimum Clearances, **1-2**

Motor Cable Length, **1-10**

Motor Overload, **4-3**

Motor Overload Fault, **4-3**

Motor Stalled Fault, **4-3**

motor starter, **1-6**

Mounting Options and Clearances,  
**1-2**

MOVs, **1-3**

## O

Opening the Cover, **1-1**

Operating Temperatures, **1-2**

Operator Interface, **2-3**

OverVoltage Fault, **4-3**

## P

Parameter

Descriptions, **3-1**

Types, **3-1**

Viewing and Editing, **2-4, 2-5**

Parameter Checksum Fault, **4-4**

Parameter Cross Reference

by Name, **3-42**

Parameters

Advanced Program Group, **3-14**

Display Group, **3-3**

Program Group, **3-9**

PE Ground, **1-5**

Phase Short Fault, **4-4**

Phase to Ground Fault, **4-4**

Potentiometer, Wiring, **1-16**

Power Cables/Wiring, **1-8**

Power Conditioning, Input, **1-4**

Power Loss Fault, **4-3**

Power Unit Fault, **4-4**

Powering Up the Drive, **2-1, 2-2**

Precautions, General, **P-3**

Preferences, Setting, **2-6**

Product Selection, **B-1**

Program Group Parameters, **3-9**

Programming, **3-1**

## R

Ratings, **A-1**

Reflective Wave Protection, **1-10**

Removing Cover, **1-1**

Repeated Start/Stop, **1-12**

Repeated Start/Stop Precautions,  
**1-12**

RFI, see *EMC/RFI*

RWR (Reflective Wave Reducer),  
**1-10**



## **S**

- Safety Ground, **1-5**
- Saving Data, Viewing, **2-6**
- Setting Preferences, **2-6**
- Shielded Power Cables, **1-8**
- Short Circuit Protection, **1-6**
- Software, **3-1**
- Start and Speed Reference Selection and Control, **1-20, 1-21**
- Start/Stop, Repeated, **1-12**
- Start-Up Checklist, **2-1, 2-2**
- Static Discharge, ESD, **P-3**
- Status LEDs, **2-3**
- Supply Source, AC, **1-3**
- SW OverCurrent Fault, **4-4**
- System Grounding, **1-5**

## **T**

- Terminal Block
  - I/O, **1-13**
  - Power, **1-12**
- Three Wire Control, **1-16, 1-19**
- Two Wire Control, **1-16, 1-19**

## **U**

- UnderVoltage Fault, **4-3**
- Ungrounded Supply, **1-3**
- Unshielded Power Cables, **1-8**

## **W**

- Wiring, **1-1**
  - Block Diagram, **1-14, 1-15**
  - I/O, **1-12**
  - I/O Examples, **1-16, 1-19**
  - Potentiometer, **1-16**
  - Power, **1-8**







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**Corporate Headquarters**

Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

**Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

**Headquarters for Dodge and Reliance Electric Products**

Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433

Europe/Middle East/Africa: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741

Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 6356-9077, Fax: (65) 6356-9011

**U.S. Allen-Bradley Drives Technical Support**

Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: [support@drives.ra.rockwell.com](mailto:support@drives.ra.rockwell.com), Online: [www.ab.com/support/abdrives](http://www.ab.com/support/abdrives)

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## Slim Line Power Supplies PS5R-S

### Features

- Lightweight and Compact in size
- Wide Power Range: 15W – 240W
- Universal Input:
  - 15W to 90W: 85-264V AC/100-370V DC
  - 120W and 240W: 85-264V AC/100-350V DC
- Power Factor Correction (EN61000-3-2) for 60W to 240W
- Meets SEMI F47 Sag Immunity (120W & 240W)
- NEC Class 2 rated (15W, 30W & 60W)
- Approved for Class 1, Div. 2 Hazardous Locations
- Fused input
- Overcurrent protection, auto-reset
- Overvoltage protection, shut down
- Spring-up Screw Terminal type, IP20
- DIN rail or Panel Surface Mount
- Approvals:
  - CE Marked, TÜV, c-UL, UL 508, UL 1310 (PS5R-SB, -SC, -SD),
  - UL 1604, EN 50178:1997, LVD: EN60950:2000, EMC: Directive,
  - EN61204-3:2000 (EMI: Class B, EMS: Industrial)



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[www.idec.com/powersupply](http://www.idec.com/powersupply)

### Specifications

Specifications

New

Part Numbers	5V DC output	PS5R-SB05	–	–	–	–	–	
	12V DC output	PS5R-SB12	PS5R-SC12	–	–	–	–	
	24V DC output	PS5R-SB24	PS5R-SC24	PS5R-SD24	PS5R-SE24	PS5R-SF24	PS5R-SG24	
Output Capacity		15W (5V Model is 10W)	30W	60W	90W	120W	240W	
Input	Input Voltage (single-phase, 2-wire)		85 to 264 VAC, 100 to 370 VDC				85 to 264V AC, 100 to 350V DC	
	Input Current (maximum)	100VAC	0.45A	0.9A	1.7A	2.3A	1.8A	3.5A
		200VAC	0.3A	0.6A	1.0A	1.4A	1.0A	1.7A
	Internal Fuse Rating		2A	3.15A	3.15A	4A	4A	6.3A
	Inrush Current (cold start)		50A maximum (at 200V AC)					
	Leakage Current (at no load)		132V AC: 0.38 mA maximum 264V AC: 0.75 mA maximum	0.75mA maximum			1mA maximum	
	Typical Efficiency	5V DC	69%	–	–	–	–	–
12V DC		75%	78%	–	–	–	–	
24V DC		79%	80%	83%	82%	84%		
Output Current Ratings	5V DC	2.0A	–	–	–	–	–	
	12V DC	1.2A	2.5A	–	–	–	–	
	24V DC	0.65A	1.3A	2.5A	3.75A	5A	10A	
Voltage Adjustment		±10% (V. ADJ control on front)						
Output Holding Time		20ms minimum (at rated input and output)						
Starting Time		200ms maximum	–	–	–	650ms maximum	500ms maximum	
Rise Time		100ms maximum (at rated input and output)				200ms maximum		
Line Regulation		0.4% maximum						
Load Regulation		1.5% maximum					0.8% max	
Temperature Regulation		0.05% degree C maximum						
Ripple Voltage		2% peak to peak maximum (including noise)				1% peak to peak maximum (including noise)		
Overcurrent Protection		105% or more, auto reset			105 to 130%, auto reset		103 to 110%, auto reset	
Overvoltage Protection		120% min. SHUTDOWN						
Operation Indicator		LED (green)						
Voltage Low Indication		LED (amber)	–	–	–	LED (amber)		

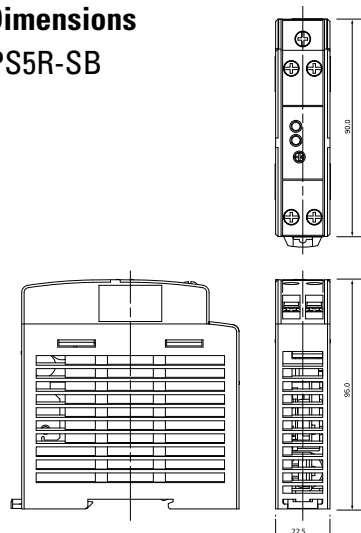
## Specifications Con't

	PS5R-SB	PS5R-SC	PS5R-SD	PS5R-SE	PS5R-SF	PS5R-SG
Parallel Operation	No					
Dielectric Strength	Between Input and Ground: 2000 VAC, 1 minute*					
Insulation Resistance	Between Input & Output Terminals: 100 MΩ Min					
Operating Temperature	-10 to +65°C (14 to 149°F)	-10 to 60°C (14 to 140°F)				
Storage Temperature	-25 to 75°C (-13 to +167°F)					
Operating Humidity	20 to 90% relative humidity (no condensation)					
Vibration Resistance	Frequency 10 to 55Hz, Amplitude 0.375mm					
Shock Resistance	300m/s² (30G) 3 times each in 6 axes					
Approvals	EMC: EN61204-3 (EMI: Class B, EMS: Industrial), c-UL (CSA 22.2 No. 14), UL 1604, UL 508, LVD: EN60950, EN50178					
	UL1310 Class 2, c-UL (CSA 22.2 No. 213 and 223)			—	SEMI F47	
Harmonic Directive	N/A			EN61000-3-2 A14 class A		
Weight (approx.)	160g	250g	285g	440g	630g	1000g
Terminal Screw	M3.5 slotted-Phillips head screw (screw terminal type)					
IP protection	IP20 fingersafe					
Dimensions H x W x D (mm)	90 x 22.5 x 95	95 x 36 x 108		115 x 46 x 121	115 x 50 x 129	125 x 80 x 149.5
Dimensions H x W x D (inches)	3.54 x 0.89 x 3.74	3.74 x 1.42 x 4.25		4.53 x 1.81 x 4.76	4.53 x 1.97 x 5.08	4.92 x 3.15 x 5.89

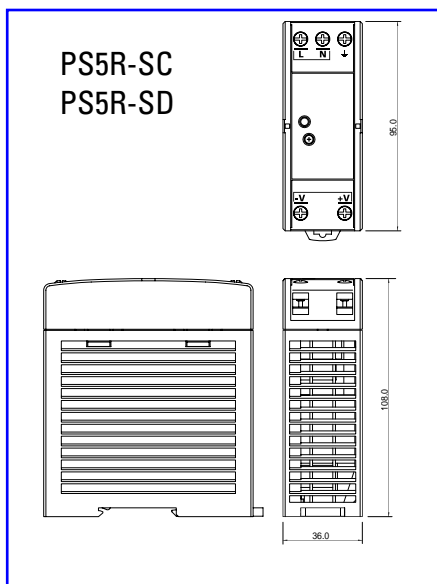
\* Between input and output: 3000VAC, 1 minute; Between output and ground: 500VAC, 1 minute

## Dimensions

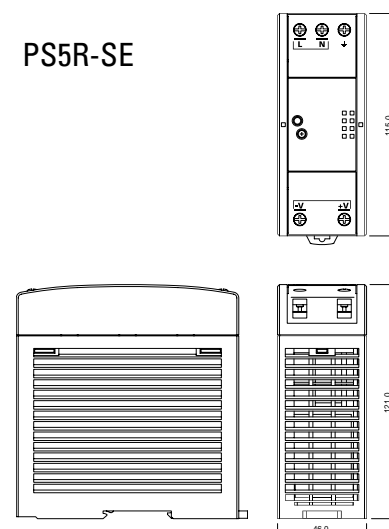
PS5R-SB



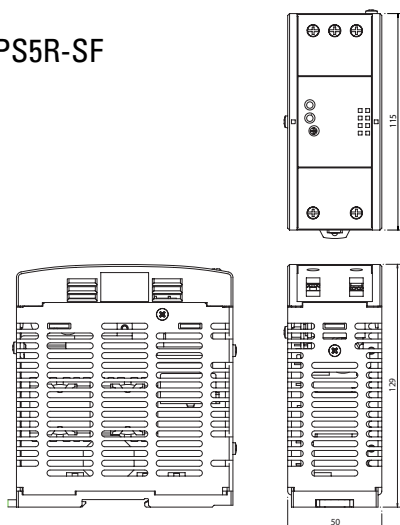
PS5R-SC  
PS5R-SD



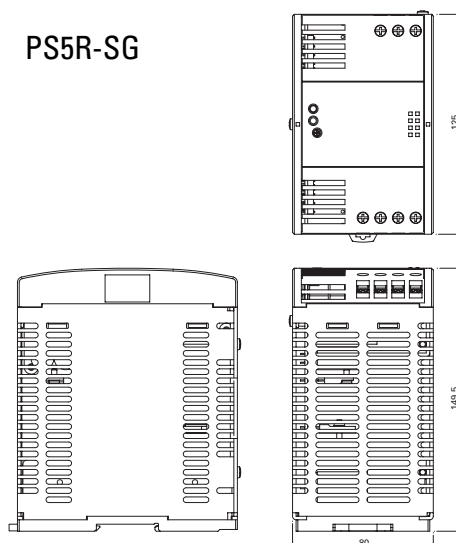
PS5R-SE



PS5R-SF



PS5R-SG



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Catalog No. PS9Y-DS100-0 04/07 10K

**9001SKS43FBH2**Selector Switch , Non-Illuminated, Maintained,  
Gloved-Hand Knob, Black, 3

List Price \$152.00 USD

Availability **Non-Stock Item: This item is not normally stocked in our distribution facility.****Technical Characteristics**

Ampere Rating	10A
Approvals	UL File Number E42259 CCN NKCR - CSA File Number LR24590 Class 3211-03 - CE Marked
Bezel Material	Black Plastic
Contact Configuration	2 NO - 2 NC
Contact Block Code	H2
Contact Type	Standard (Fingersafe)
Enclosure Type	Water tight, Dust tight, Oil tight and Corrosion Resistant (Indoor/Outdoor)
Enclosure Rating	NEMA 1/2/3/3R/4/4X/6/12/13
Head Type	Round
Cam Type	Cam C
Knob Color	Black
Knob Type	Gloved-Hand Knob
Maximum Voltage Rating	600V
Mounting Type	Panel
Number of Operators	1
Number of Positions	3
Operator Action	Maintained
Operator Type	Non-Illuminated
Size	30mm
Type	SK
Terminal Type	Screw Clamp
Utilization Category	AC15 - DC13

**Shipping and Ordering**

Category	21429 - Push Buttons, Corrosion Resistant, Type SK & SKY
Discount Schedule	CP1
GTIN	00785901043829
Package Quantity	1
Weight	0.2 lbs.
Availability Code	Non-Stock Item: This item is not normally stocked in our distribution facility.
Returnability	N
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

**9001SKS11BH2**

Selector Switch , Non-Illuminated, Maintained,  
Standard Knob, Black, 2



List Price \$152.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

**Technical Characteristics**

Ampere Rating	10A
Approvals	UL File Number E42259 CCN NKCR - CSA File Number LR24590 Class 3211-03 - CE Marked
Bezel Material	Black Plastic
Contact Configuration	2 NO - 2 NC
Contact Block Code	H2
Contact Type	Standard (Fingersafe)
Enclosure Type	Water tight, Dust tight, Oil tight and Corrosion Resistant (Indoor/Outdoor)
Enclosure Rating	NEMA 1/2/3/3R/4/4X/6/12/13
Head Type	Round
Cam Type	Cam E
Knob Color	Black
Knob Type	Standard Knob
Maximum Voltage Rating	600V
Mounting Type	Panel
Number of Operators	1
Number of Positions	2
Operator Action	Maintained
Operator Type	Non-Illuminated
Size	30mm
Terminal Type	Screw Clamp
Type	SK
Utilization Category	AC15 - DC13

**Shipping and Ordering**

Category	21429 - Push Buttons, Corrosion Resistant, Type SK & SKY
Discount Schedule	CP1
GTIN	00785901043539
Package Quantity	1
Weight	0.24 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

Generated: 06/30/2010 09:04:09



**9001SKP35A31**Pilot Light , Standard, Plastic (Fresnel), Amber,  
Screw Clamp

List Price \$125.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.****Technical Characteristics**

Approvals	UL File Number E42259 CCN NKCR - CSA File Number LR24590 Class 3211-03 - CE Marked
Bezel Material	Black Plastic
Enclosure Type	Water tight, Dust tight, Oil tight and Corrosion Resistant (Indoor/Outdoor)
Enclosure Rating	NEMA 1/2/3/3R/4/4X/6/12/13
Head Type	Round
Lens Type	Plastic (Fresnel)
Lens Color	Amber
Light Module Supply Voltage	24/28V
Light Module Type	Full Voltage
Size	30mm
Operator Type	Standard
Terminal Type	Screw Clamp
Type	K

**Shipping and Ordering**

Category	21429 - Push Buttons, Corrosion Resistant, Type SK & SKY
Discount Schedule	CP1
GTIN	00785901041283
Package Quantity	1
Weight	0.18 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

**9001SKP35R31**

Pilot Light , Standard, Plastic (Fresnel), Red, Screw  
Clamp, Full Voltage

List Price \$125.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

**Technical Characteristics**

Approvals	UL File Number E42259 CCN NKCR - CSA File Number LR24590 Class 3211-03 - CE Marked
Bezel Material	Black Plastic
Enclosure Type	Water tight, Dust tight, Oil tight and Corrosion Resistant (Indoor/Outdoor)
Enclosure Rating	NEMA 1/2/3/3R/4/4X/6/12/13
Head Type	Round
Lens Type	Plastic (Fresnel)
Lens Color	Red
Light Module Supply Voltage	24/28V
Light Module Type	Full Voltage
Size	30mm
Operator Type	Standard
Terminal Type	Screw Clamp
Type	K

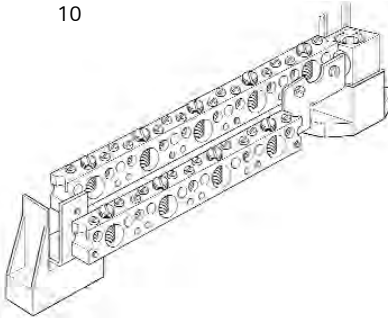

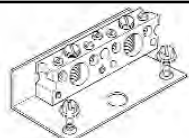
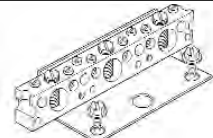
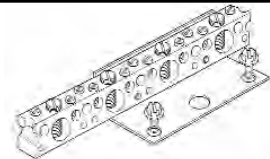
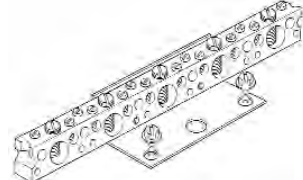
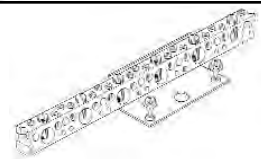

**Shipping and Ordering**

Category	21429 - Push Buttons, Corrosion Resistant, Type SK & SKY
Discount Schedule	CP1
GTIN	00785901041368
Package Quantity	1
Weight	0.18 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

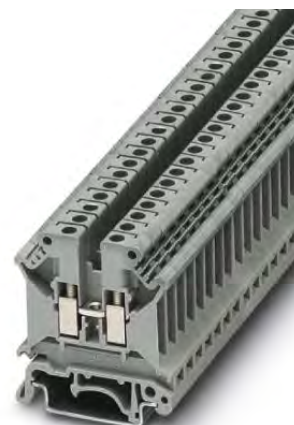
# electriCenter Accessories

## Ground Bar Kits (cont'd)

New Cat No.	UPC Code No.	Replaces Old Cat. No.	UPC Code No.	Description	Pack Qty.
ECLX230M	78364345270-1	LX230M	040892521047	<ul style="list-style-type: none"> <li>■ Insulated Ground Bar,</li> <li>■ 25 positions, #14-6 AWG,</li> <li>■ 9 positions, #14-1/0</li> </ul>	10
					
ECLX068M	78364345293-0	LX068M	040892271577	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 4 positions, #14-6 AWG,</li> <li>■ 1 position, #14-1/0</li> </ul>	20
					
ECLX069M	783643454260-2	LX069M	040892275759	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 5 positions, #14-6 AWG,</li> <li>■ 2 positions, #14-1/0</li> </ul>	20
					
ECLX071M	78364345266-4	LX071M	040892275803	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 8 positions, #14-6 AWG,</li> <li>■ 3 positions, #14-1/0</li> </ul>	20
					
ECLX072M	78364345267-1	LX072M	040892275858	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 11 positions, #14-6 AWG,</li> <li>■ 4 positions, #14-1/0</li> </ul>	20
					
ECLX073M	78364345268-8	LX073M	040892275902	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 14 positions, #14-6 AWG,</li> <li>■ 5 positions, #14-1/0</li> </ul>	10
					
ECLX074M	78364345294-7	LX074M	0140892275957	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 17 positions, #14-6 AWG,</li> <li>■ 6 positions, #14-1/0</li> </ul>	
					
ECLX075M	78364345295-4	LX075M	040892276008	<ul style="list-style-type: none"> <li>■ Ground Bar,</li> <li>■ 20 positions, #14-6 AWG,</li> <li>■ 7 positions, #14-1/0</li> </ul>	
					

# UK 5 N

Order No.: 3004362



<http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3004362>

Feed-through modular terminal block, Type of connection: Screw connection, Cross section: 0.2 mm<sup>2</sup> - 6 mm<sup>2</sup>, AWG 24 - 10, Width: 6.2 mm, Color: gray, Mounting type: NS 35/7,5, NS 35/15, NS 32



## Commercial data

GTIN (EAN)	4017918090760
sales group	A000
Pack	50 pcs.
Customs tariff	85369010
Weight/Piece	0.00922 KG
Catalog page information	Page 343 (CL-2009)

## Product notes

WEEE/RoHS-compliant since:  
01/01/2003



<http://www.download.phoenixcontact.com>  
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

## Technical data

### General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

**Dimensions**

Width	6.2 mm
Length	42.5 mm
Height NS 35/7,5	47 mm
Height NS 35/15	54.5 mm
Height NS 32	52 mm

**Technical data**

Maximum load current	41 A (with 6 mm <sup>2</sup> conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I <sub>N</sub>	32 A
Nominal voltage U <sub>N</sub>	800 V
Open side panel	ja

**Connection data**

Conductor cross section solid min.	0.2 mm <sup>2</sup>
Conductor cross section solid max.	6 mm <sup>2</sup>
Conductor cross section stranded min.	0.2 mm <sup>2</sup>
Conductor cross section stranded max.	4 mm <sup>2</sup>
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.25 mm <sup>2</sup>
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm <sup>2</sup>
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.25 mm <sup>2</sup>
Conductor cross section stranded, with ferrule with plastic sleeve max.	2.5 mm <sup>2</sup>
2 conductors with same cross section, solid min.	0.2 mm <sup>2</sup>
2 conductors with same cross section, solid max.	1.5 mm <sup>2</sup>

2 conductors with same cross section, stranded min.	0.2 mm <sup>2</sup>
2 conductors with same cross section, stranded max.	1.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.25 mm <sup>2</sup>
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm <sup>2</sup>
Cross-section with insertion bridge, solid max.	4 mm <sup>2</sup>
Cross-section with insertion bridge, stranded max.	4 mm <sup>2</sup>
Type of connection	Screw connection
Stripping length	8 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

#### Certificates / Approvals



Certification

ABS, BV, CB, CCA, CSA, CUL, DNV, GL, GOST, KEMA, KR, LR, NK, PRS, RS, UL

Certification Ex:

CUL-EX, FM, GL-EX, IECEx, KEMA-EX, UL-EX

#### CSA

Nominal voltage $U_N$	600 V
Nominal current $I_N$	40 A
AWG/kcmil	28-10

#### CUL

Nominal voltage $U_N$	600 V
Nominal current $I_N$	30 A
AWG/kcmil	30-10

**UL**

Nominal voltage $U_N$	600 V
Nominal current $I_N$	30 A
AWG/kcmil	30-10

**Accessories**

Item	Designation	Description
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**Assembly**

3003224	ATP-UK	Partition plate, Length: 56 mm, Width: 1.5 mm, Height: 59 mm, Color: gray
3022218	CLIPFIX 35	Snap-on end bracket, for 35 mm NS 35/7.5 or NS 35/15 DIN rail, can be fitted with Zack strip ZB 8 and ZB 8/27, terminal strip marker KLM 2 and KLM, width: 9.5 mm, color: gray
3003020	D-UK 4/10	End cover, Length: 42.5 mm, Width: 1.8 mm, Height: 35.9 mm, Color: gray
1201442	E/UK	End clamp, for assembly on NS 32 or NS 35/7,5 DIN rail
1024014	EA 5	Single covers, color: transparent
1024085	EA 5-WS	Single covers, for covering one terminal block, with black symbol (lightning flash) snap fit, color: transparent/yellow
0201595	FB-150 METER	Cross connection rail, for fixed bridging of identical inputs and outputs, made of Cu, nickel-plated, 1 m long
1201028	NS 32 AL UNPERF 2000MM	G rail 32 mm (NS 32)
1201280	NS 32 CU/120QMM UNPERF 2000MM	G-profile DIN rail, deep-drawn, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201358	NS 32 CU/35QMM UNPERF 2000MM	G-profile DIN rail, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201002	NS 32 PERF 2000MM	G-profile DIN rail, material: Steel, perforated, height 15 mm, width 32 mm, length 2 m
1201015	NS 32 UNPERF 2000MM	G-profile DIN rail, material: Steel, unperforated, height 15 mm, width 32 mm, length 2 m
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep-drawn, high profile, unperforated, 1.5 mm thick, material: Aluminum, height 15 mm, width 35 mm, length 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m

1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
0204110	STL 10N/5N	Step bracket, Color: aluminum
0204107	STL 35/ 5	Step bracket, Color: white aluminum
1302215	TS-K	Separating plate, Length: 22.7 mm, Height: 30.5 mm, Color: gray
2303608	ZSR	Distance piece, metal, for branches of FB-150, with screw and thrust washer
0200017	ZSR-EX	Distance piece, metal, for branches of FB-150, with screw and thrust washer

**Bridges**

0201155	EB 2- 6	Insertion bridge, Number of positions: 2, Color: gray
0201142	EB 3- 6	Insertion bridge, Number of positions: 3, Color: gray
0201139	EB 10- 6	Insertion bridge, Number of positions: 10, Color: gray
0201456	FB 2- 6-EX	Fixed bridge, Number of positions: 2, Color: aluminum
0201469	FB 3- 6-EX	Fixed bridge, Number of positions: 3, Color: aluminum
0201029	FB 5- 6	Fixed bridge, Number of positions: 5, Color: aluminum
0201184	FB 10- 6	Fixed bridge, Number of positions: 10, Color: aluminum
0201281	FB 10- 6-EX	Fixed bridge, Number of positions: 10, Color: aluminum
0201524	FB 100- 6	Fixed bridge, Number of positions: 100, Color: aluminum
0203438	FBI 2- 6	Fixed bridge, Number of positions: 2, Color: aluminum
0203250	FBI 10- 6	Fixed bridge, Number of positions: 10, Color: silver
0201650	FBI 100- 6	Fixed bridge, Number of positions: 100, Color: aluminum
0201867	FBI 20- 6	Fixed bridge, Number of positions: 20, Color: aluminum
1302338	IS-K 4	Bridge bar isolator, Color: gray
0301505	ISSBI 10- 6	Bridge bar isolator, Number of positions: 10, Color: silver
0201485	KB- 6-EX	Chain bridge, Number of positions: 1, Color: silver
0202280	LB 10-6 BU	Jumper, Number of positions: 10, Color: blue
0202358	LB 10-6 GY	Jumper, Number of positions: 10, Color: gray
0202293	LB 10-6 RD	Jumper, Number of positions: 10, Color: red
0202303	LB 100-6 BU	Jumper, Number of positions: 100, Color: blue
0202345	LB 100-6 GY	Jumper, Number of positions: 100, Color: gray
0202316	LB 100-6 RD	Jumper, Number of positions: 100, Color: red
2303239	USBR 2-7	Switching jumper, Color: silver



2305538	USBRJ 2-7	Switching jumper, Number of positions: 2, Color: silver
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**Marking**

1007222	SBS 6:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1004115	WS 3- 6	Warning plate, with 2 plastic screws, across 3 terminal blocks, pitch 6 mm
1004209	WS 4- 6	Warning plate, with 2 plastic screws, across 4 terminal blocks, pitch 6 mm
1004403	WS 5- 6	Warning plate, with 2 plastic screws, across 5 terminal blocks, pitch 6 mm
1050499	ZB 6:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

**Plug/Adapter**

0309523	KSS 3- 6	Short circuit connector, Number of positions: 3, Color: black
0301547	KSS 6	Short circuit connector, Number of positions: 2, Color: black
0201744	MPS-MT	Metal part
3001132	PS-UK 2,5 B/E	Test plugs, Color: red
3001239	PS-UK 2,5 B/Z-6	Test plugs, Color: red
3001462	PS-UK 3-5/Z-6	Test plug
0601292	PSB 3/10/4	Female test connector, Color: silver
0201304	PSBJ 3/13/4	Female test connector, Color: silver
0201647	RPS	Reducing plug, Color: gray

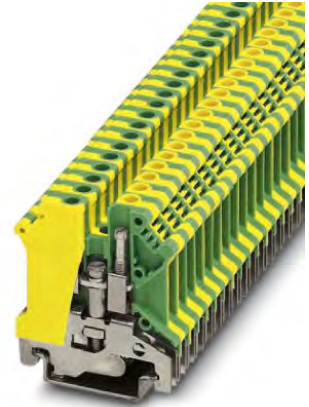
**Diagrams/Drawings**

Circuit diagram



**USLKG 5**

Order No.: 0441504

<http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0441504>

Ground terminal block with screw connection, cross section: 0.2 - 4 mm², AWG: 24 - 10, width: 6.2 mm, color: Green-yellow

**Commercial data**

EAN	4017918002190
Pack	50 Pcs.
Customs tariff	85369010
Weight/Piece	0.02081 KG
Catalog page information	Page 281 (CL-2007)

**Product notes**

WEEE/RoHS-compliant since:  
01/15/2005



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**Technical data****General**

Note	When aligning with a feed-through terminal block with the same shape, an end cover must be interposed with insulation voltages of > 690 V
Number of levels	1

Number of connections	2
Color	green-yellow
Insulating material	PA
Inflammability class acc. to UL 94	V0

**Dimensions**

Width	6.2 mm
Length	42.5 mm
Height NS 35/7,5	47 mm
Height NS 35/15	54.5 mm
Height NS 32	52 mm

**Technical data**

Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-2
Open side panel	nein

**Connection data**

Conductor cross section solid min.	0.2 mm <sup>2</sup>
Conductor cross section solid max.	6 mm <sup>2</sup>
Conductor cross section stranded min.	0.2 mm <sup>2</sup>
Conductor cross section stranded max.	4 mm <sup>2</sup>
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.25 mm <sup>2</sup>
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm <sup>2</sup>
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.25 mm <sup>2</sup>
Conductor cross section stranded, with ferrule with plastic sleeve max.	2.5 mm <sup>2</sup>
2 conductors with same cross section, solid min.	0.2 mm <sup>2</sup>
2 conductors with same cross section, solid max.	1.5 mm <sup>2</sup>

2 conductors with same cross section, stranded min.	0.2 mm <sup>2</sup>
2 conductors with same cross section, stranded max.	1.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm <sup>2</sup>
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.25 mm <sup>2</sup>
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm <sup>2</sup>
Type of connection	Screw connection
Stripping length	8 mm
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

#### Certificates / Approvals



#### CSA

AWG/kcmil	28-10
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#### CUL

AWG/kcmil	26-10
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#### UL

AWG/kcmil	26-10
Certification	ABS, BV, CCA, CSA, CUL, DNV, GOST, KEMA, KR, LR, PRS, RS, UL

#### requested approbations

Certification Ex:	IECEX, KEMA-EX
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**Accessories**

Item	Designation	Description
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**Assembly**

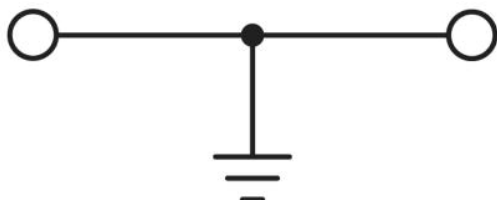
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1201280	NS 32 CU/120QMM UNPERF 2000MM	G-profile DIN rail, deep-drawn, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201358	NS 32 CU/35QMM UNPERF 2000MM	G-profile DIN rail, material: Copper, unperforated, height 15 mm, width 32 mm, length 2 m
1201002	NS 32 PERF 2000MM	G-profile DIN rail, material: Steel, perforated, height 15 mm, width 32 mm, length 2 m
1201015	NS 32 UNPERF 2000MM	G-profile DIN rail, material: Steel, unperforated, height 15 mm, width 32 mm, length 2 m
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m

**Marking**

1007222	SBS 6:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1050499	ZB 6:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

**Drawings**

Circuit diagram



# E/NS 35 N


Order No.: 0800886



<http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0800886>

End clamp, width: 9.5 mm, color: gray

## Commercial data

GTIN (EAN)	 4 017918 129309
sales group	B220
Pack	50 pcs.
Customs tariff	39269097
Catalog page information	Page 318 (NTK-2010)

## Product notes

WEEE/RoHS-compliant since:  
02/01/2005

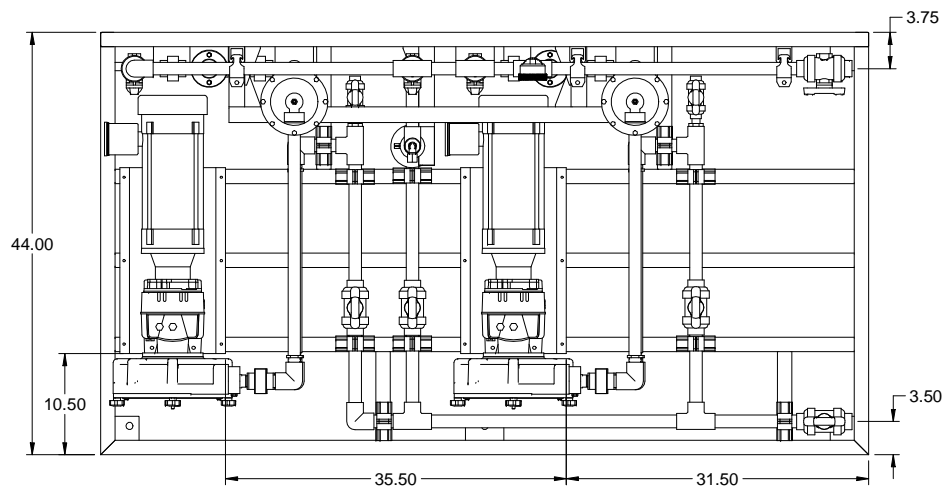


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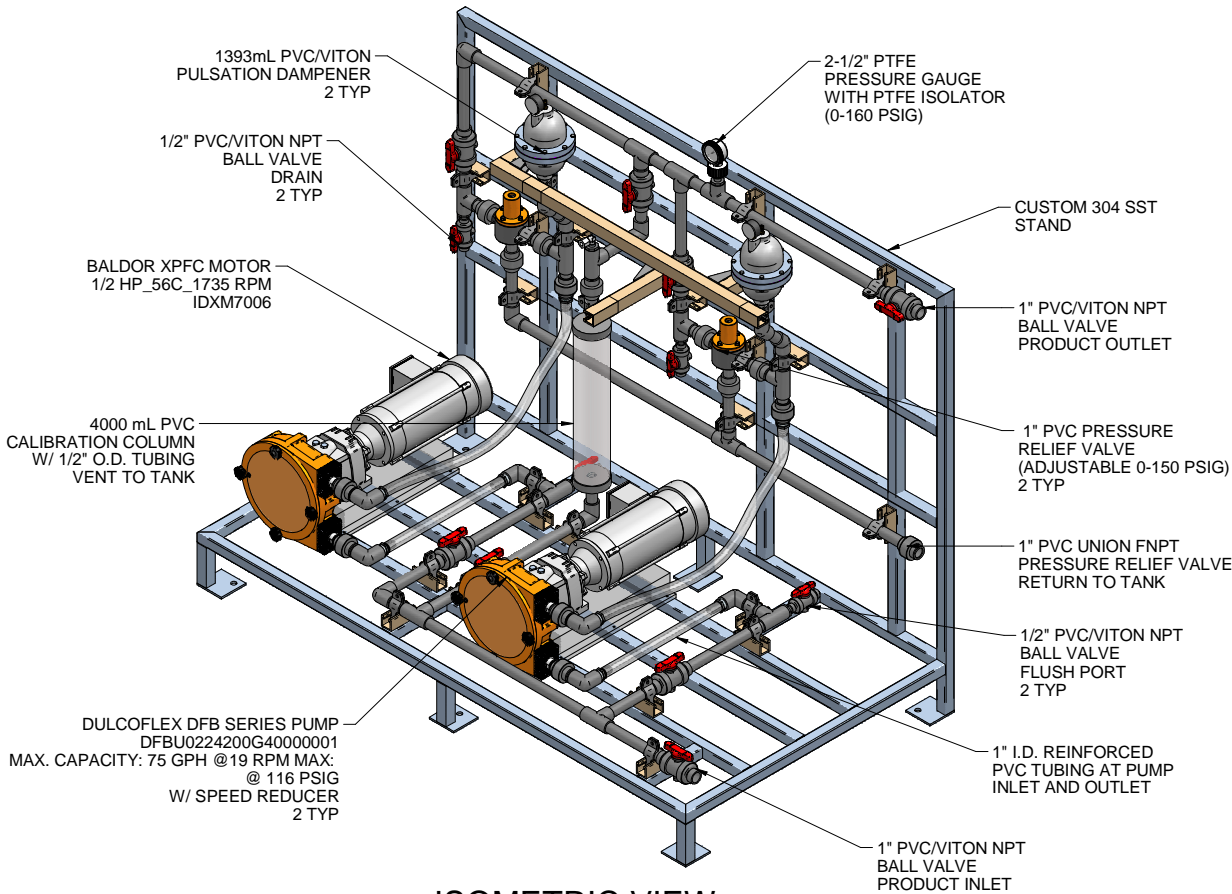
## Technical data

### General data

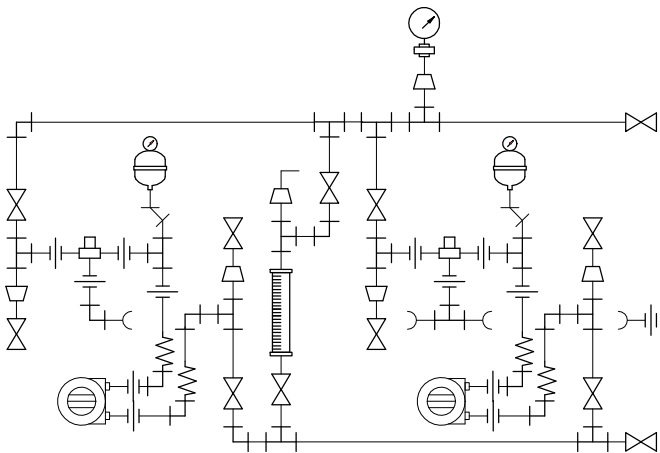
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Length	48.6 mm
Width	9.5 mm
Material	PA
Color	gray



PLAN VIEW

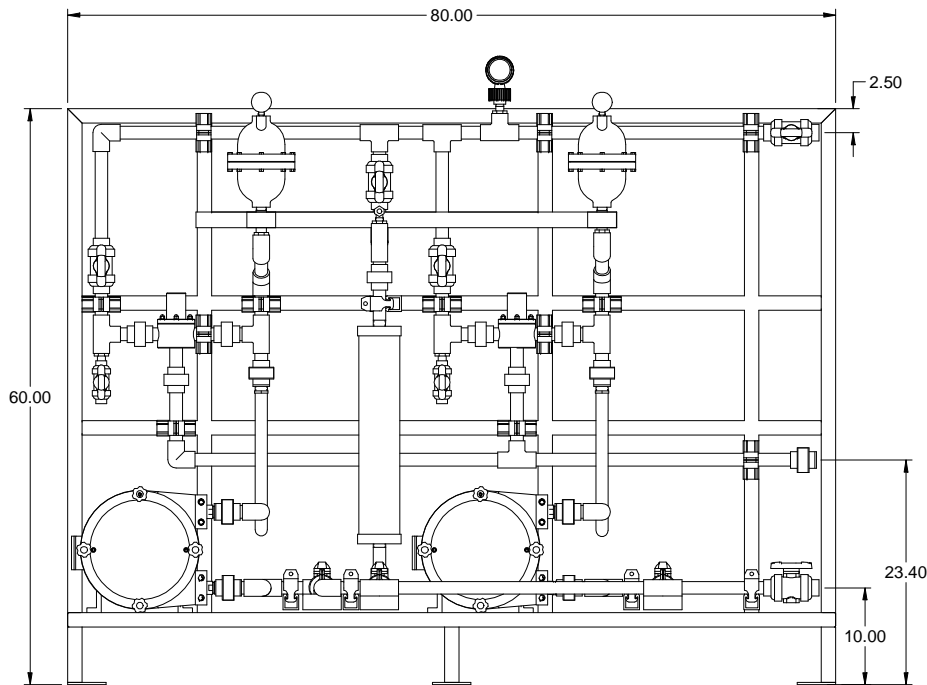


ISOMETRIC VIEW

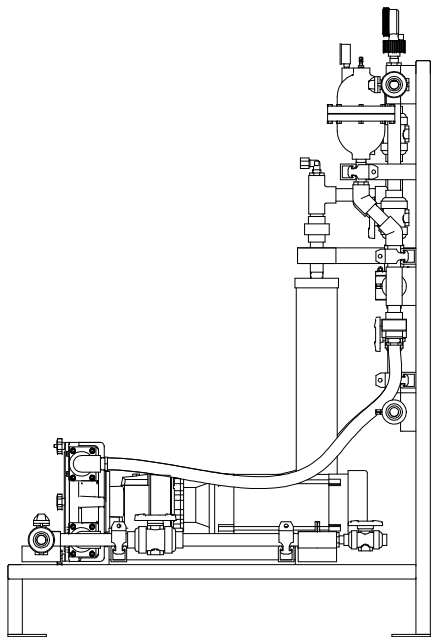


PIPING SCHEMATIC

- NOTES:
1. ALL PIPING AND FITTINGS SHALL BE 1" SCH. 80 PVC SOCKET WELD WITH VITON SEALS UNLESS OTHERWISE REQUIRED BY COMPONENTS.
  2. ALL DIMENSIONS ARE IN INCHES AND ARE SHOWN FOR REFERENCE ONLY.



FRONT VIEW

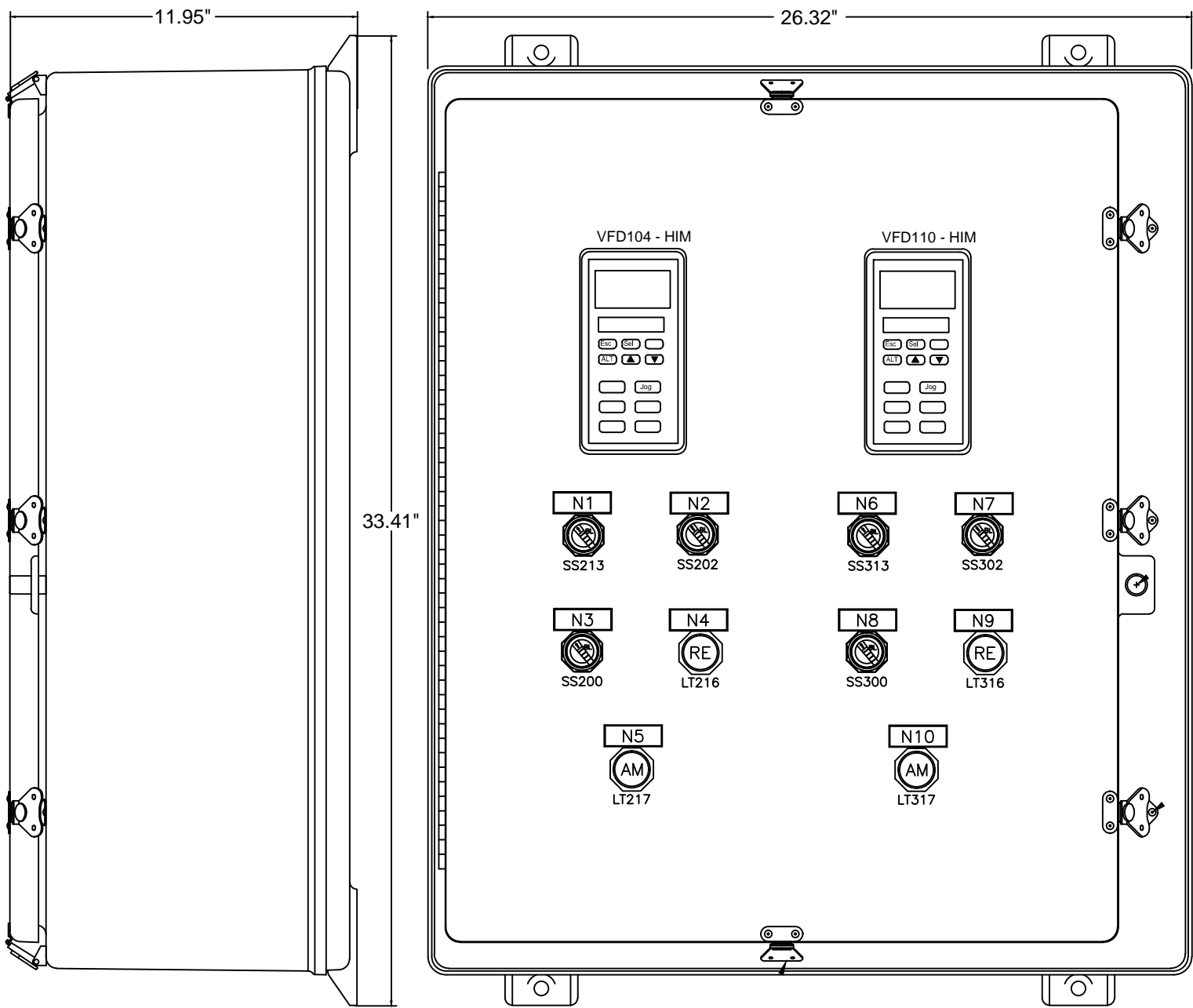


SIDE VIEW

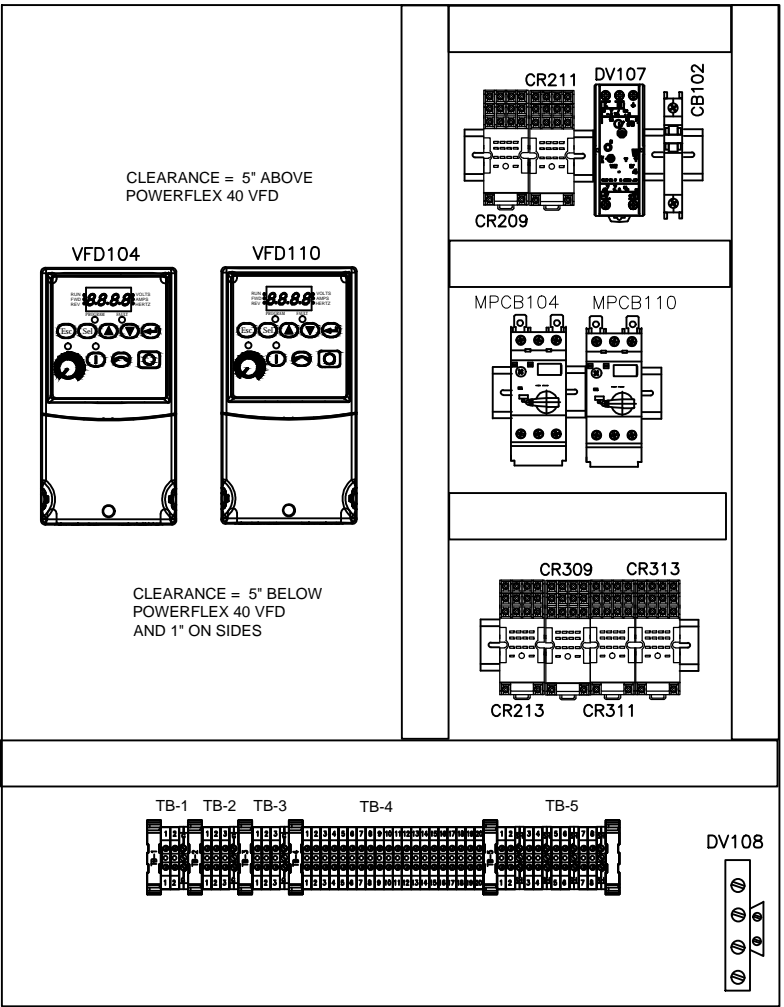
MAXIMUM TESTING PRESSURE =	150 PSI
MAXIMUM OPERATING PRESSURE =	116 PSI
CHEMICAL SERVICE =	PAC

0	02/29/12	FIRST ISSUE	ALS		
REV	DATE	DESCRIPTION	BY	APPD	REVD
REVISIONS					
CUSTOMER					
HENRY P. THOMPSON CO. (SALEM IN. WATER TREATMENT PLANT)					
JOB No		2012600120	PURCHASE ORDER No 20249-001-001		
TITLE					
P2_DFBu_PVC-0100-B_PAC DOSING SKID GENERAL ARRANGEMENT					
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ENGINEERS SEAL		<div><div><div>pfc</div><div>ProMinent</div></div><div><div>ProMinent®</div><div>THE PROMINENT GROUP OF COMPANIES</div></div></div>			
PITTSBURGH, PA USA		WWW.PROMINENT.US			
PROMINENT FLUID CONTROLS LTD. 490 SOUTHGATE DRIVE. GUELPH, ONTARIO, CANADA N1H 6J3 TEL. 519 836 5692 FAX. 519 836 5226		PROMINENT FLUID CONTROLS INC. RIDC PARK WEST 136 INDUSTRY DRIVE, PITTSBURGH P.A., USA. 15275 TEL. 412 787 2484 FAX. 412 787 0704			
DESIGNED		ALS		APPROVED XXX	
DRAWN		ALS		SCALE N.T.S.	
CHECKED		SMC		DATE 02/29/12	
DWG No			REV	PAGE	
2012600120-200			0	1/1	

STAHLIN ENCLOSURE N302410HWT



BACK PANEL BP3024



- N1

PUMP A  
STOP  
START RUN
- N2

PUMP A  
COMMAND SOURCE  
LOCAL REMOTE
- N3

PUMP A  
ROTATION  
FWD REV
- N4

PUMP A  
RUNNING
- N5

PUMP A  
FAULT
- N6

PUMP B  
STOP  
START RUN
- N7

PUMP B  
COMMAND SOURCE  
LOCAL REMOTE
- N8

PUMP B  
ROTATION  
FWD REV
- N9

PUMP B  
RUNNING
- N10

PUMP B  
FAULT

UL LABEL INFORMATION

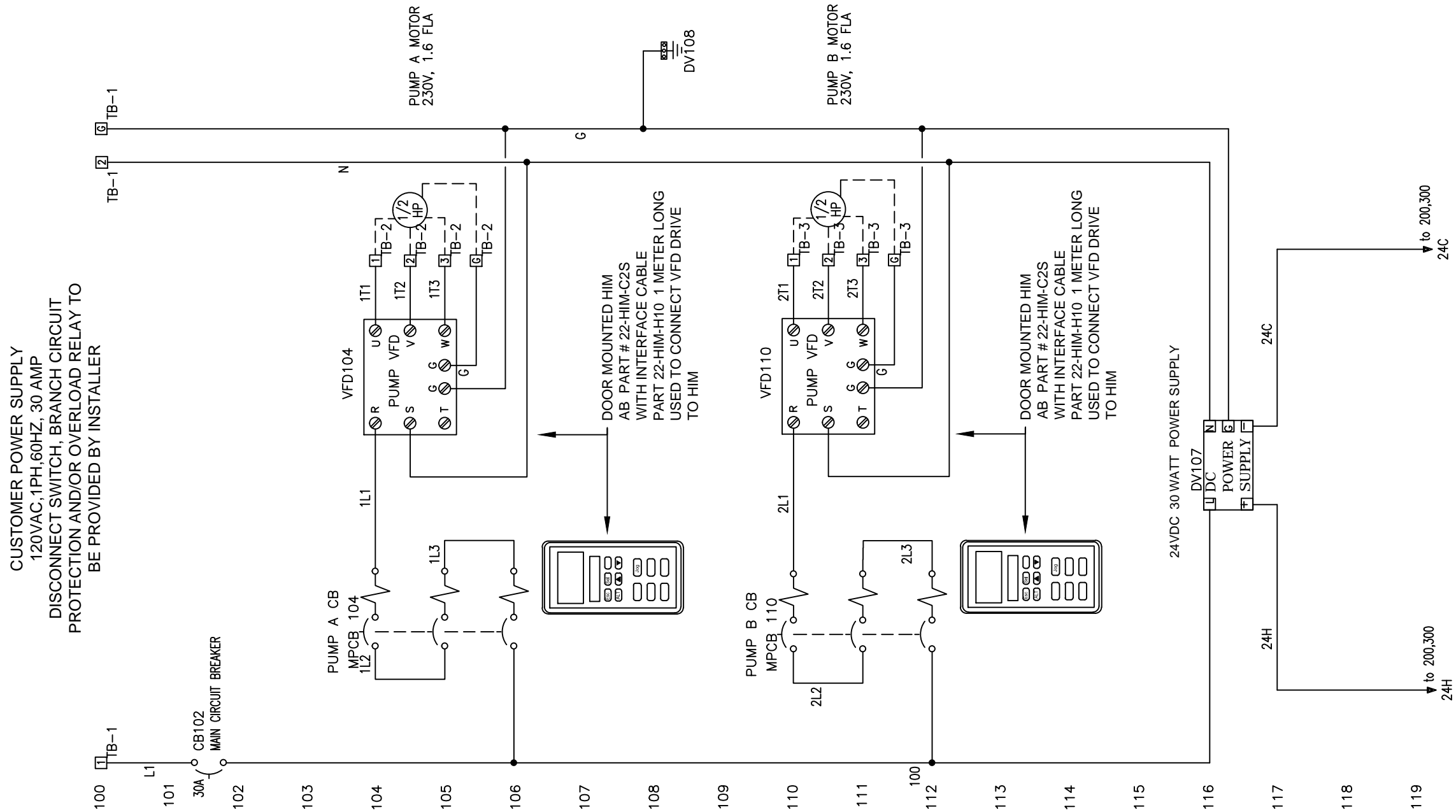
SOURCE: 120VAC PHASE: 1 FREQUENCY: 60Hz  
PANEL FULL LOAD AMPERES: 20  
LARGEST MOTOR: 1.6 AMPERES @ 230V 3 PHASE  
SCCR: 5 KA RMS SYMMETRICAL @ 120 VAC  
ENCLOSURE TYPE: 4X  
DRAWING SERIES: 2012600120-300  
FIELD CONNECTIONS COPPER CONDUCTORS ONLY

DOOR COMPONENTS TO BE MOUNTED ON 4" GRID

COMPONENT LAYOUT SUBJECT TO CHANGE

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A	05-04-12	AS BUILT		CB					
O	03-05-12	ISSUED FOR REVIEW		CB					
REV	DATE	DESCRIPTION		BY					
REVISIONS									
CUSTOMER						HENRY P. THOMPSON			
JOB No		2012600120		PURCHASE ORDER No XX					
TITLE						DUAL PUMP DULCOFLEX CONTROL PANEL ENCLOSURE AND SUB PANEL LAYOUT		DWG No	
						2012600120-300		REV A	
								PAGE 1/1	





LEGEND

———— CP WIRE

----- SKID OR FIELD WIRE

□ CP TERMINAL

Ⓡ REMOTELY LOCATED DEVICE

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REV	DATE	DESCRIPTION		BY	
REVISIONS					
CUSTOMER HENRY P. THOMPSON					
JOB No 2012600120		PURCHASE ORDER No XX			
TITLE DUAL PUMP DULCOFLEX CONTROL PANEL ELECTRICAL SCHEMATIC				DWG No 2012600120-301	
				REV A	PAGE 1/3

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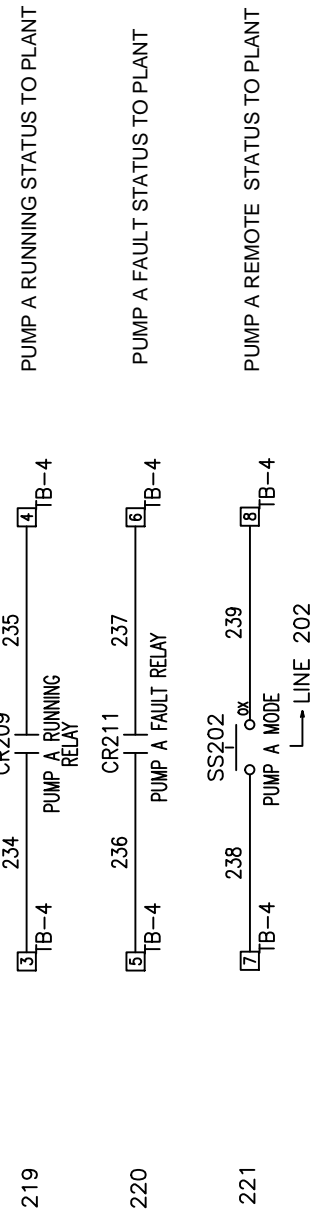
PITTSBURGH, PA USA  
WWW.PROMINENT.US


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FLUID CONTROLS, INC.

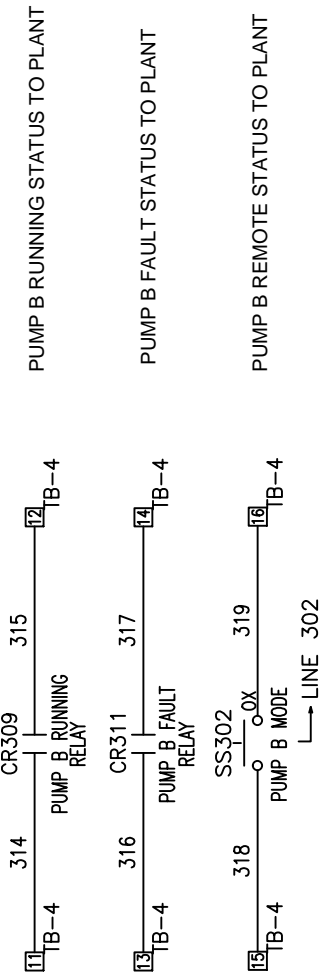
PROMINENT FLUID CONTROLS, INC.  
RIDC PARK WEST  
136 INDUSTRY DRIVE  
PITTSBURGH, PA 15275 USA  
TEL. 412 787 2484 FAX. 412 787 0704


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SCALE NTS  
DATE 03-05-12

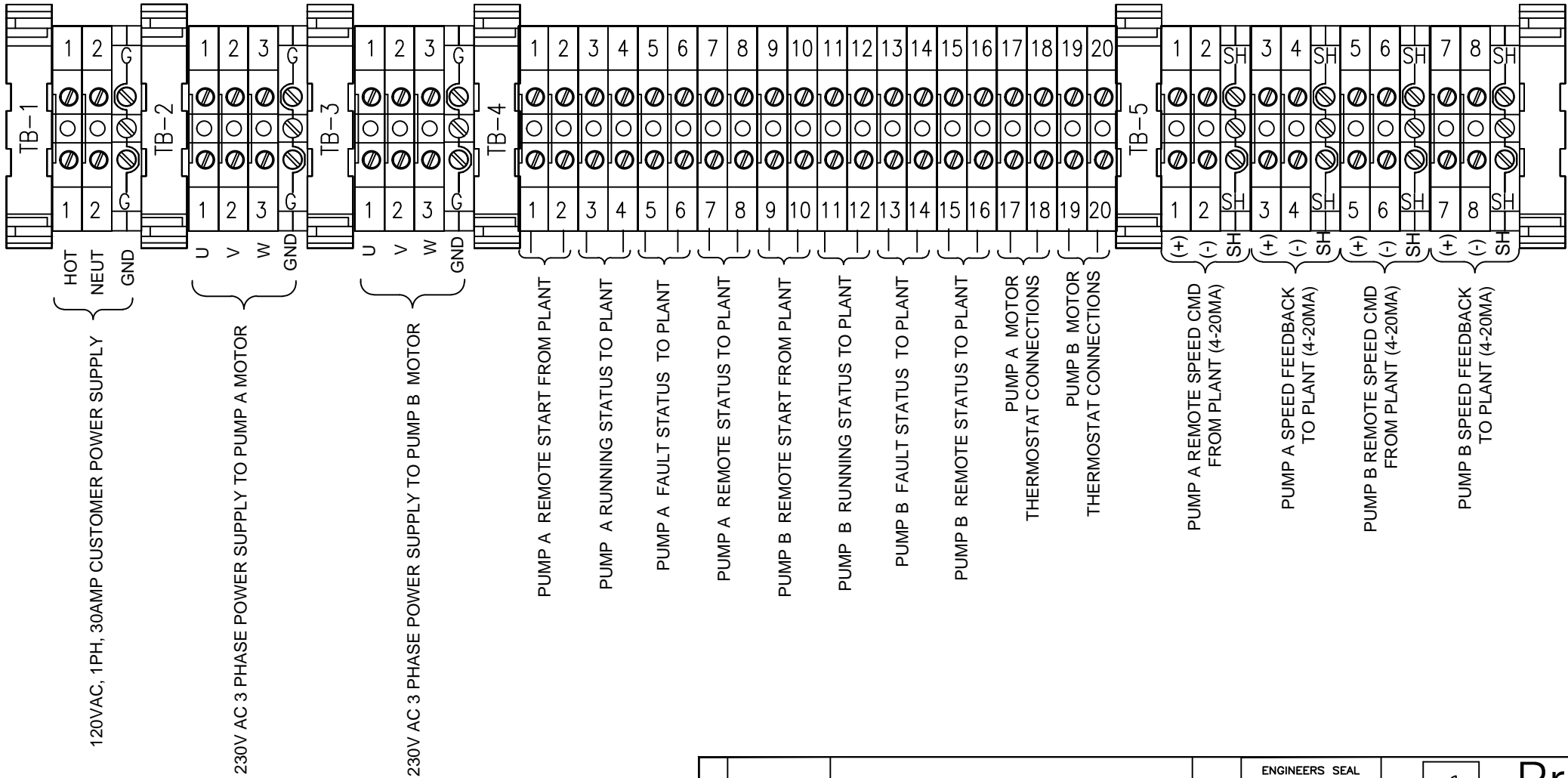



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A	05-04-12	AS BUILT	CB		
0	03-05-12	ISSUED FOR REVIEW	CB		
REV	DATE	DESCRIPTION	BY		
CUSTOMER					
HENRY P. THOMPSON					
JOB No    2012600120		PURCHASE ORDER No XX			
TITLE    DUAL PUMP DULCOFLEX CONTROL PANEL ELECTRICAL SCHEMATIC				DWG No	2012600120-301 <div>           REV    A            PAGE    2/3         </div>



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CUSTOMER					PROMINENT FLUID CONTROLS, INC. RIDC PARK WEST 136 INDUSTRY DRIVE PITTSBURGH, PA 15275 USA TEL. 412 787 2484 FAX. 412 787 0704
HENRY P. THOMPSON					DESIGNED CB DRAWN CB CHECKED SC
JOB No 2012600120		PURCHASE ORDER No XX			APPROVED SCALE NTS DATE 03-05-12
TITLE DUAL PUMP DULCOFLEX CONTROL PANEL ELECTRICAL SCHEMATIC				DWG No 2012600120-301	REV A PAGE 3/3

TERMINAL STRIP



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REVISIONS							
CUSTOMER				<div>PITTSBURGH, PA    USA</div> <div>WWW.PROMINENT.US</div> <div>THIS DRAWING IS THE PROPERTY OF PROMINENT FLUID CONTROLS, INC. AND SHALL NOT BE COPIED OR TRANSFERRED WITHOUT THE WRITTEN CONSENT OF PROMINENT FLUID CONTROLS, INC.</div> <div>PROMINENT FLUID CONTROLS, INC. RIDC PARK WEST 136 INDUSTRY DRIVE PITTSBURGH, PA 15275    USA TEL. 412 787 2484    FAX. 412 787 0704</div> <div>DESIGNED    CB</div> <div>DRAWN    CB</div> <div>CHECKED    SC</div> <div>APPROVED</div> <div>SCALE    NTS</div> <div>DATE    03-05-12</div>			
HENRY P. THOMPSON							
JOB No    2012600120		PURCHASE ORDER No XX					
TITLE							
DUAL PUMP DULCOFLEX CONTROL PANEL TERMINAL STRIP DETAIL							
				DWG No	2012600120-302	REV A	PAGE 1/1

BILL OF MATERIALS

TAGS	QTY	SUB	USER1	CATALOG	MFG	DESCRIPTION
	1		7746793	N302410HWT	STAHLIN	POLYCARBONATE ENCLOSURE WALL–MOUNT ENCLOSURE NEMA 3, 3R, 4, 4X, 12, 13 30" X24" X10" WATER/DUST TIGHT SEAL
	1		7746794	BP3024CS	STAHLIN	SUB PANEL SUB PANEL SUITED FOR N302410HWT ENCLOSURE PAINTED CARBON STEEL
CB102	1		7745117	QOU130	SQD	MINIATURE SINGLE POLE CIRCUIT BREAKER. 30A, THERMAL MAGNETIC OVERLOADS. 120VAC
MPCB 104 MPCB 110	2			330–T25S–2U16	C3 CONTROLS	MOTOR PROTECTION CIRCUIT BREAKER IEC WITH THERMAL & MAGNETIC TRIP ELEMENTS 10 – 16 AMP ADJUSTABLE
CR209 CR211 CR213 CR309 CR311 CR313	6	*1	7746414	8501RXM4AB2BD	SQD	MINIATURE PLUG–IN RELAY TYPE RXM WITH TEST BUTTON TYPE RXM 4PDT 24VDC 4 FORM C 240V MAX AC, 6A, 120 AC, 50/60 HZ COIL
		*1	7746415	8501RXZE2S114M	SQD	RELAY – SOCKET TYPE RXM SOCKET SOCKET PANEL OR DIN RAIL MOUNTING 14–PIN SOCKET USED W/ TYPE 8501–RXM RELAYS
VFD104 VFD110	2	*1		22B–V2P3N104	AB	VFD – 120V AC SP INPUT ; 230VAC 3 PHASE OUTPUT POWERFLEX 40 – LED DISPLAY – DIGITAL KEYPAD 0.5HP IP20 0.37KW, 0.5HP, 2.2A
		*1		22–HIM–C2S	AB	REMOTE DIGITAL KEYPAD FOR USE WITH A POWERFLEX 40 VFD SEPARATE CABLE NEMA 4X
		*1		22–HIM–H10	AB	POWERFLEX COMPONENT CLASS 1.0M DSI HIM CABLE 1 METER LONG FOR USE WITH A POWERFLEX 40 VFD
D209 D309	2		7746082	P6KE24ADICT–ND	DIGIKEY	STEERING DIODE 50 VDC REVERSE VOLTAGE 24VDC 600W
DV108	1		7745193	LX071M	MURRAY	GROUND BAR 3–1/2" AL/CU GROUNDING BAR
LT217 LT317	2		7746393	SKP35A31	SQD	AMBER PILOT LIGHT – STANDARD, NEMA 4/4X/13 30.5mm 24VAC/VDC FULL VOLT PLASTIC FRESNEL LENS CORROSION RESISTANT
LT216 LT316	2		7746394	SKP35R31	SQD	RED PILOT LIGHT – STANDARD, NEMA 4/4X/13 30.5mm 24–28VAC/VDC FULL VOLT PLASTIC FRESNEL LENS CORROSION RESISTANT
DV107	1		7746274	PS5R–SC24	IDEC	24V DC POWER SUPPLY 24V DC 30 WATTS PS5R SLIM LINE SERIES SUPPLY VOLTAGE 85–265V AC
SS200 SS202 SS300 SS302	4		7745921	9001–SKS11BH2	SQD	SELECTOR SW – 2 POS MAINT, NEMA 4/13 30.5mm BLACK KNOB 2 NO 2 NC CAM TYPE E, CONTACT POSITION: 1–KA1, 2–KA1
SS213 SS313	2		7745916	9001–SKS43FBH2	SQD	SELECTOR SW – 3 POS MAINT, NEMA 4,4X,13 30.5mm – 3 POS SELECTOR SWITCH BLACK KNOB 2 NO 2 NC CAM TYPE C, CONTACT POSITION: 1–KA1, 2–KA1
TB–1 TB–2 TB–3 TB–5	7		7746750	0441504	PHOENIX CONTACT	UNIVERSAL GROUND TERMINAL BLOCK – USLKG 5 FEED–THROUGH GROUND GREEN–YELLOW, 0.2–4MM^2, 26–10 AWG CLIPLINE – MODULAR SCREW TERMINAL BLOCK
TB–1 TB–2 TB–3 TB–4 TB–5	32		7746748	3004362	PHOENIX CONTACT	UNIVERSAL TERMINAL BLOCK – UK 5 N FEED–THROUGH 30AMPS CLIPLINE – MODULAR SCREW TERMINAL BLOCK GRAY, 0.2–4MM^2, 30–10 AWG
	6		7746751	0800886	PHOENIX CONTACT	END BRACKET – E/NS 35 N ACCESSORY END BRACKET GRAY, FOR THE NS 35 DIN RAIL 9.5MM WIDTH
	1		7746749	3003224	PHOENIX CONTACT	UNIVERSAL TERMINAL ATP –UK END PLATE FEED–THROUGH END PLATE

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JOB No    2012600120		PURCHASE ORDER No XX			
TITLE    DUAL PUMP DULCOFLEX CONTROL PANEL BILL OF MATERIAL				DWG No    2012600120–303	
				REV    A	
				PAGE    1/1	