TopVault

Installation, Operation, and Maintenance Manual

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USEMCO

FOR YOUR PUMPING STATIONS SERVICE PARTS REQUIREMENTS:

CALL USEMCO INC. FOR PROMPT ACTION!

PHONE: 608-372-5911

■ **USEMCO MAINTAINS A COMPLETE INVENTORY OF CRITICAL SERVICE PARTS FOR IMMEDIATE SHIPMENT:**

- **PUMP PARTS:** FOR MOST MAJOR BRANDS: (FAIRBANKS MORSE - ALLIS CHALMERS - CORNELL - PACO - CRANE DEMING - PEERLESS)

- **ELECTRICAL:** NAME BRAND COMPONENTS OR COMPLETE NEW CONTROL SYSTEMS.

- **ACCESSORIES:** PARTS AND COMPLETE NEW REPLACEMENT UNITS ARE ALSO AVAILABLE FOR ACCESSORIES SUCH AS: SUMP PUMPS - DEHUMIDIFIERS - BLOWERS - VALVES - FITTINGS, ETC.

■ **USEMCO FACTORY TRAINED STAFF AVAILABLE FOR COMPLETE SHOP OR FIELD SERVICE REPAIRS:**

USEMCO INC.   P.O. BOX 550   TOMAH, WISCONSIN 54660-0550

No. 800319

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USEMCO

IMPORTANT NOTE
FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. STUDY THIS OPERATING AND MAINTENANCE MANUAL.

The descriptions and instruction included in this manual cover the standard design of the equipment and any common deviations when possible. This book does not cover all design details and variations nor does it provide for every possible contingency which may be encountered. When information cannot be found in this book, contact the nearest representative.

It is the responsibility of the equipment owner to assure compliance with Federal, State and local safety, health, environmental and property protection codes.

NOTE

In this manual the following symbols are used to point out specific personal injury potential:

WARNING – ELECTRICAL HAZARD

CAUTION – Refer to the information given before performing the work.

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GENERAL SAFETY PRECAUTIONS

1. Do not attempt repairs, adjustments, or maintenance until you are familiar with this manual.
2. Follow all owner procedures to lock out and tag out all energy sources before working on this equipment.
3. Secure and use all required personal protective equipment.
4. Follow owners confined space entry procedures if necessary.
5. Follow all owners' safety procedures.
6. Electrical arcing is possible with any level of line voltage. Follow owner procedures and manual precautions closely.
7. Follow manual instructions at all times.
8. Note ⚠ Cautions and Warnings ⚡ .
9. If using compressed air for cleaning, wear a full face shield.
10. Hot work may be performed only in full compliance with owner program.
11. Do not remove or paint over identification plates and warning labels.

<u>NOTE</u>

In this manual the following symbols are used to point out specific personal injury potential:

⚡ WARNING – ELECTRICAL HAZARD

⚠ CAUTION – Refer to the information given before performing the work.

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ELECTRICAL SAFETY

> ## ⚠ DANGER
> ### HAZARDOUS VOLTAGE.
> Disconnect all power before working on equipment.
>
> Electrical shock will cause serve injury or death

Hazardous electrical voltage may be present on all of this equipment.

> ### CAUTION
> Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

All electrical must be in compliance with NFPA, NEMA or UL codes.

> ### WARNING
> 1. Disconnect power before working on equipment.
> 2. Always keep hands and clothing away from moving parts.
> 3. Electrical repairs should be performed by trained and qualified personnel only.
> 4. Failure to follow instructions and safe electrical procedures could result in serious injuries or death.
> 5. If safety guards are required, be sure the guards are in use.

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STATION SAFETY
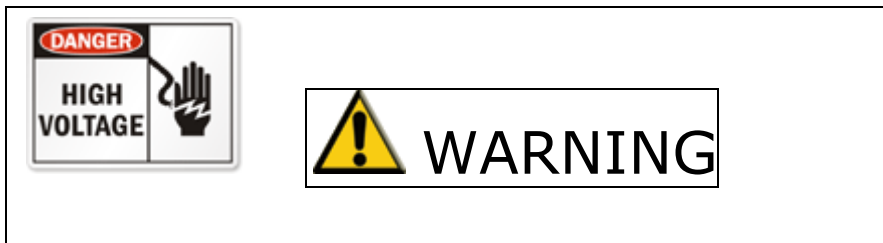
1. Make sure there is a properly grounded receptacle available. All equipment w/ power cords are furnished with provisions for proper grounding to protect you against the possibility of electric shock. (SEE WARNING BELOW)
2. Make certain that the receptacle is within the reach of the equipments power supply cord. DO NOT USE AN EXTENSION CORD. Extension cords that are too long or too light do not deliver sufficient voltage to the equipments motor. But, more important, they could present a safety hazard if the insulation was to become damaged or the connection end would disconnect.
3. Testing for ground. As a safety measure, each electrical outlet shall be checked for ground using an Underwriters Laboratory Listed circuit analyzer which will indicate if the power, neutral and ground wires are correctly connected to your outlet. If they are not, call a qualified licensed electrician.
4. For Added Safety. Equipment with a 3-prong grounded plug must be connected to a 3-prong grounded receptacle. For added safety the receptacle may be protected with a ground fault circuit interrupter.
5. Single phase equipments is supplied with a 3-prong grounded plug to help protect you against the possibility of electrical shock. DO NOT UNDER ANY CIRCUMSTANCES REMOVE THE GROUND PIN. The 3-prong plug must be inserted into a mating 3-prong grounded receptacle. If the installation does not have such a receptacle, it must be changed to the proper type, wired and grounded in accordance with the National Electrical Code and all applicable local codes and ordinances.
6. **"Risk of electrical shock"** When working on equipment make certain all power is disconnected.
7. Installation and servicing of electrical circuits and hardware should be performed by a qualified licensed electrician.
8. All accessories servicing should performed by a qualified person.

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⚠️ STATION ENTRY

1. When applicable, lockout/tagout all energy sources if entry is for other than routine inspection.
2. Visually observe floor conditions to avoid slip, trip, or fall potential.
3. Perform station atmosphere monitoring if necessary. DO NOT ENTER IF READINGS ARE NOT WITHIN ACCEPTABLE RANGE.
4. Power drop and extension cords must be 3 wire grounded and equipped with or connected to a functioning GFCI.

SAFETY AND CLEANING INSTRUCTIONS
CLEANING GUIDELINES

1. Inspect blower and duct work to insure that nothing is obstructing air flow. Clean all screens in ventilation system to insure sufficient air flow. This should be done on a regular basis, conditions should determine frequency.
2. The heater should be cleaned on a regular basis. Us a soft cloth for dusting and for cleaning use only a damp rag and non-abrasive dish detergent. Do not use abrasive or chemical cleaners for they may harm the finish. Should the heater be used in a very dusty location, use a vacuum cleaner dust brush to remove dust and over foreign material from grills.
3. The dehumidifier should be cleaned in the same manner as the blower. The cooling coils and condenser should also be cleaned annually to insure maximum operating efficiency.
4. The station floor should be routinely cleaned on a bi-monthly schedule.
5. Clean the station and touch-up paint after maintenance operations.

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INSTALLATION INSTRUCTIONS
FOR
USEMCO TOP VAULT
ABOVE GRADE SUBMERSIBLE
VALVE CHAMBER

The USEMCO Wetwell Mounted Submersible Pump Control Station will be delivered to the job site as a complete factory assembled unit, with all equipment, factory tested and ready to operate.

Lifting lugs have been provided for convenience in unloading. Spreader bars should be used in unloading to prevent damage to the fiberglass cover.

INSTALLATION INSTRUCTIONS

If shipped as separate wetwell cover and valve vault, set the valve vault assembly on the wetwell cover. Align pre-drilled holes for mounting valve vault. Use bolts, washers, and nylon lock nuts provided to fix the two assemblies.

Set station on the wet well. Rotate station so the discharge pipe aligns with force main. Butyl joint sealant should be used on top of wet well prior to setting station. Anchor the wetwell guide ring to the wetwell.

Connect station common discharge pipe to force main with compression coupling.

Connect station inlet lines and the pump discharge lines with compression couplings.

WET WELL LEVEL CONTROLS:

Install transducer cord through the coupling provided in the base. Pull cord through knock-out in bottom of control panel and wire to terminal board in accordance with wiring schematic.

If required, backup mercury float switches with cords have been provided with the station. These are shipped loose to prevent damage in transit.

Install mercury float cords through the couplings provided in the base. Pull cord through knock-out in bottom of control panel and wire to terminal board in accordance with wiring schematic. Adjust these floats in accordance with the Engineers plans.

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Install pump power and sensor lines through the couplings provided in the base. Pull cord through knock-out in bottom of control panel and wire to terminal board in accordance with wiring schematic.

Cord grips have been provided within the station to allow for proper adjustment of floats.

ELECTRICAL SERVICE:

The station requires a power supply as shown on the electrical wiring diagram.

Provide and mount a remote weatherproof disconnect switch for the station power service.

Install conduit from disconnect switch to electrical connection which has been provided on the station. Wire the disconnect switch to connections within the station control panel in accordance with wiring diagram.

All conduit, wire sizes, and insulation must be in accordance with the National Electrical Code and/or local codes.

ACCESSORIES

The station includes a blower. Ensure the power cable is connected to the blower receptacle found on the front of the control panel.

Install the alarm strobe and horn in the desired location and wire this device in accordance with applicable national and local codes, ordinances, and regulations, and in a manner acceptable to the local authority having jurisdiction. Electrical contacts can be found in the control panel and are shown on the electrical wiring diagram.

DELAYED START-UP

In the event that the station is not to be operational for a period of time the following action should be taken to avoid flooding or electrical damage to the interior of the station due to condensation or freezing. Supply temporary power to the station so that you can:

A – If applicable, place heater in operation (check heater for correct voltage)

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PLACING STATION INTO OPERATION:

Check that all debris that will not pass through the station piping have been removed from the wet well or up stream manhole.

Your station is now ready to start-up, notify your USEMCO representative to schedule the start-up service.

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PRE START UP CHECK LIST

Prior to start up by authorized USEMCO representatives, the following steps must be performed:

1. Exterior piping to the station must be complete.

2. All flange bolting, tubing and piping must be checked and tightened, due to loosening during transportation.

3. Certify any installed fuel lines are leak free prior to putting lines into service

4. All sensing connections, wet well floats, bubbler sensing lines, etc., must be complete.

5. Permanent power is complete to the control panel.

6. Telemetry lines, phone lines, etc., are in and operational.

7. Sufficient water is available to fill the force main, plus allow for any pump performance testing as required by the consulting engineer.

8. Maintenance personnel are notified to be available for training.

9. All financial agreements for payment are resolved, USEMCO will not authorize or perform start-up on equipment which is not paid for.

10. Four weeks notice is required to meet scheduling commitments for start up. Call USEMCO, Inc. Service Dept. (608) 372-5911.

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PREVENTATIVE MAINTENANCE SCHEDULE

I. Weekly
      A. Check operation of exhaust fan and heater.

II. Semi-annually
      A. Lubricate exhaust fan bearing with SAE20 non-detergent oil.

SAFETY PRECAUTIONS

1. Keep the station floor clean, dry and free of debris.

CLEANING REQUIREMENTS

1. The station floor should be routinely cleaned on a bi-monthly schedule.

2. Clean the station and touch up paint after any maintenance operations.

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PIPING AND VALVE DATA SHEET

STATION INLET:

      Size: 2"
      Material: Schedule 40 – 6061-T6 Aluminum
      Connection: Plain End with Restraint Tabs

    Check Valve:
      Type: Ball
      Manufacturer: Flowmatic
      Description: 2", Threaded, Sinking Ball, Model 208

    Discharge Shut Off Valve:
      Type: Plug
      Manufacturer: Dezurik
      Description: 2", Flanged, Lever Operator, Model PEC

STATION DISCHARGE

      Size: 2"
      Material: Schedule 40 – 6061-T6 Aluminum
      Connection: Plain End with Restraint Tabs

Other Features: ¾" manual air release ball valve and piping to wetwell.

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PIPING AND VALVE DATA SHEET

STATION INLET:

       Size: 3"
       Material: Schedule 40 – 6061-T6 Aluminum
       Connection: Plain End with Restraint Tabs

Check Valve:
       Type: Ball
       Manufacturer: Szuster
       Description: 3", Flanged, Sinking Ball, Model ESL II

Discharge Shut Off Valve:
       Type: Plug
       Manufacturer: Milliken
       Description: 3", Flanged, Lever Operator, Series 601N1

STATION DISCHARGE

       Size: 3"
       Material: Schedule 40 – 6061-T6 Aluminum
       Connection: Plain End with Restraint Tabs

Other Features: ¾" manual air release ball valve and piping to wetwell.

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PIPING AND VALVE DATA SHEET

STATION INLET:

        Size: 4"
        Material: Schedule 40 – 6061-T6 Aluminum
        Connection: Plain End with Restraint Tabs

    Check Valve:
        Type: Ball
        Manufacturer: Szuster
        Description: 4", Flanged, Sinking Ball, Model ESL II

    Discharge Shut Off Valve:
        Type: Plug
        Manufacturer: Milliken
        Description: 4", Flanged, Lever Operator, Series 601N1

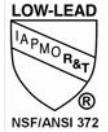STATION DISCHARGE

        Size: 4"
        Material: Schedule 40 – 6061-T6 Aluminum
        Connection: Plain End with Restraint Tabs

Other Features: ¾" manual air release ball valve and piping to wetwell.

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Description:

Flomatic ball check valves, Model 508/50, 208, 208B, 208T, 208S and 408 are designed especially for use with sewage pumps and applications involving viscous liquids or slurries. The principle of the ball check valve is very simple. The ball has sufficient weight to seat tightly even in high viscous liquid, but to open freely so that the headloss is minimal. Flomatic ball check valves can be installed horizontally or vertically provided that they are installed as the illustration shows. **The preferred installation of a ball check is in the vertical position.** This will insure that gravity will seat the ball properly each time. However, if the ball check valve is to be used in a horizontal installation, it is important that the static head is at least 20 feet of water (nine pounds per square inch). **Recommended flow velocity range is 3-5 feet/second** (if a higher flow velocity is required, please consult the factory). Ball check valves with a floating ball should be installed in a **vertical orientation only** and have a minimum of 10 feet of static head to seal correctly. **Do NOT subject ball check valves to freezing conditions.**

The pressure rating for Flomatic ball check valves is 150 pounds per square inch. If a high pressure ball check is required, please consult the factory. Flomatic ball check valves incorporate a standard sinking ball, which operates on gravity. Special floating balls are available for valves to be installed in different positions than described above. The maximum recommended operating temperature for Flomatic ball check valves is 180°F. For any installation which requires higher temperatures, please consult factory.

NOTE: PLASTIC PVC MODEL 208T ARE NOT FOR UNDERGROUND BURIAL, OR BE SUBJECT TO HANGING WEIGHT STRESS OR PUMP START-UP TORQUE / THRUST. IF STRESSES ARE PRESENT USE METAL BODY BALL CHECK

Operation:

Flomatic ball check valves permit flow in one direction only and are tight seated when the outlet pressure exceeds the inlet pressure.

Installation:

1. Check inside the valve to be sure that any materials used in shipping are removed. Check for any foreign material that should not be inside the valve and remove.
2. Check the operation of the ball by pushing it away from the seating surface to be sure it moves freely.
3. Inspect the ends to be sure there are no raised burrs or edges that would allow the valve to not seal when connected.
4. Install the valve with the flow arrow in the direction of flow.
5. If installed in a vertical position the direction of flow must be in an up-arrow direction.
6. If installed in a horizontal position the valve must be installed with ***the cover oriented to the top.***

Maintenance:
Flomatic ball check valves do not require any regular maintenance.

Flomatic Corp, 15 Pruyn's Island, Glens Falls, New York 12801
Phone: 518-761-9797   Fax: 518-761-9798   www.flomatic.com

October 15, 2020 Rev. H
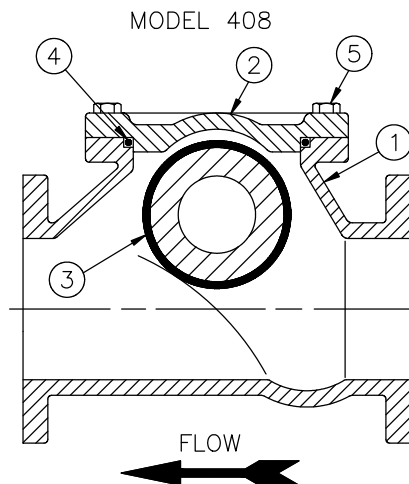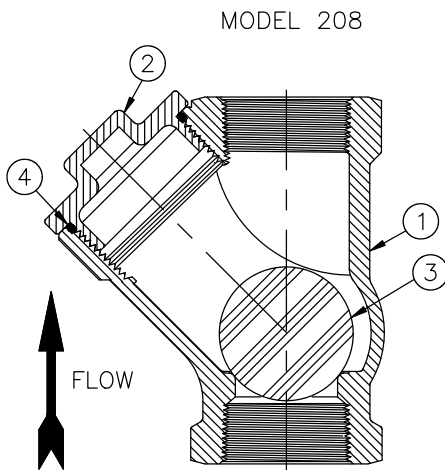YSPEC55

FLOMATIC VALVES

Service / Repair:

Disassembly of the valve may be required due to debris obstructing the valves ability to operate correctly or for inspecting the valve for wear.

NOTE: BEFORE ATTEMPTING TO DISASSEMBLE THE VALVE BE SURE PUMP IS LOCKED OFF AND SYSTEM PRESSURE IS RELIEVED AND ISOLATED FROM VALVE

1. Loosen and remove cover bolts (if applicable) and / or remove the valve cover.
2. Remove the O-ring.
3. Clean and inspect the ball for damage and / or debris.
4. Examine the seating area for damage.
5. Reassemble valve with new or existing parts as needed.
6. Put valve back in operating service.
7. Inspect valve for any cover and end connection leaks.

⚠ **_Cover must face upwards_**

MODEL 208   MODEL 408

FLOW   FLOW

Item #	Qty	Description
1	1	Body
2	1	Cover
3	1	Ball
4	1	O-ring
5	A/R	Bolt / Nut

See spec sheets for part details

Troubleshooting	
Problem: Valve has noisy operation or slams when pump shuts down.	Solution: Check the flow velocity and / or system piping for trapped air.
Problem: Cannot achieve desired flow	Solution: Check valve internally for any foreign material.
Problem: Valve leaking back	Solution: Check ball and seat for damage and / or check the static head conditions.

Information needed to order repair parts:

Valve Model Number
Valve Size

1 Year Limited Warranty: Flomatic valves are guaranteed against defects of materials or workmanship when used for the services recommended. If in any recommended service, a defect develops due to material or workmanship, and the device is returned, freight prepaid, to Flomatic Corporation within 12 months from the date of purchase, it will be repaired or replaced free of charge. Flomatic Corporations' liability shall be limited to our agreement to repair or replace the valve only.

Flomatic Corp, 15 Pruyn's Island, Glens Falls, New York 12801
Phone: 518-761-9797   Fax: 518-761-9798   www.flomatic.com

October 15, 2020 Rev. H
YSPEC55

FLOMATIC VALVES

IN-LINE BALL CHECK VALVES

Technical data

- ❯ Range of available diameters: 1 1/4" – 8".

- ❯ Pressure rated to 230 PSI (all valves are tested to 145 PSI leak test / 230 PSI hydrostatic shell test).

- ❯ Medium temperature: max 104°F (temporarily to 140°F).

- ❯ Flanges complying with ANSI/ASME B16.1 Class 125.

- ❯ API 598 tests and requirements.

- ❯ Painted with a coat of epoxy paint, RAL 5015.

- ❯ Patent no.: US 8,146,618 B2.

Type ESL

Type ESL

Advantages

❯ For Lift Stations

1. Quick replacement time – customers can quickly replace valve balls themselves without damaging equipment.

2. Easy access to valves interior and the ball which enables placing the cover in the so-called servicing position.

3. Reducing energy consumption for sewage pumping due to the smaller resistance of the valve design (relative to standard ball check valves).

❯ For Engineers

1. Fully open position and constant factor K starting from the flow rate of 2.3 fps.

2. Reduction of vibrations making a system work more quietly.
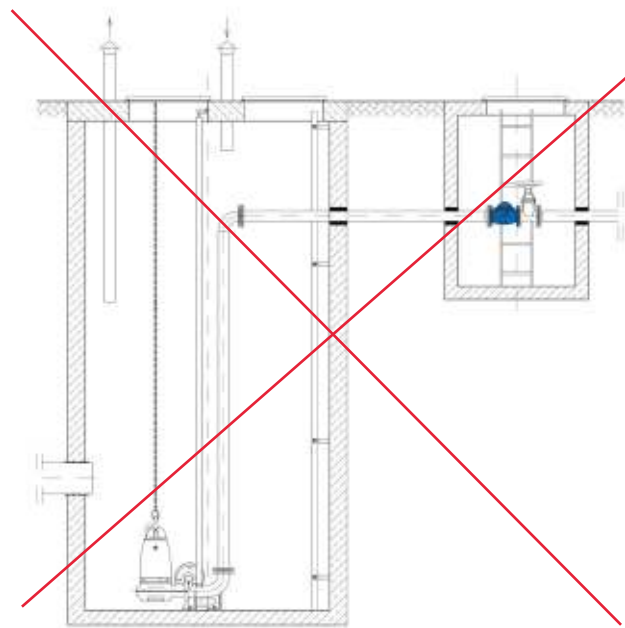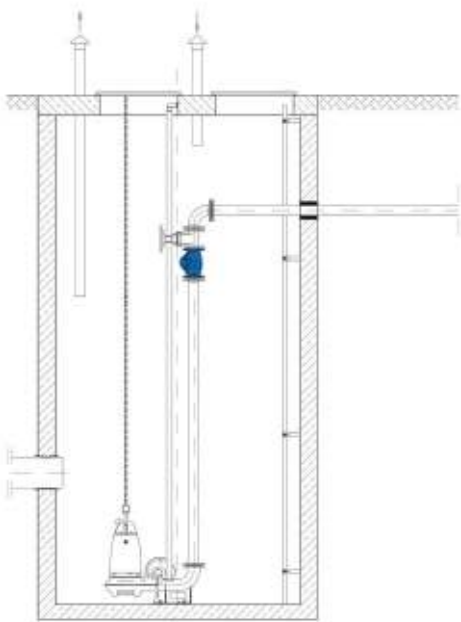
IN-LINE BALL CHECK VALVES

Additional options

For 3" & 4" Piping Configurations

| Type of check valve	Characteristics	Application examples
Version with floating ball (F)	The valve in F version is equipped with a ball, so-called „floating" ball, with a specific weight of approx 49.9 lb/ft³.	Backwater protection (valve is fully opened with the velocity of 0.66 fps).
Version with quasi ball (Q)	The valve in Q version is equipped with a quasi floating ball with a specific weight of approx 63.7 lb/ft³.	Lift stations, pumps with inverter.

Table of options

Type	DN	Size	Ductile Iron	Floating Ball (F)	Quasi Ball (Q)
Type ESL 01 - threaded					
ESL 01	32	1 1/4"	regular	n/a	n/a
ESL 01	40	1 1/2"	regular	n/a	n/a
ESL 01	50	2"	regular	option	n/a
Type ESL 11 - flanged					
ESL 11	50	2"	regular	regular	n/a
ESL 11	65	2 1/2"	regular	regular	n/a
ESL 11	80	3"	regular	regular	option
ESL 11	100	4"	regular	regular	option
ESL 11	125	5"	regular	regular	option
ESL 11	150	6"	regular	regular	option
ESL 11	200	8"	regular	regular	option

In-line ball check valves installation method

ESL 01
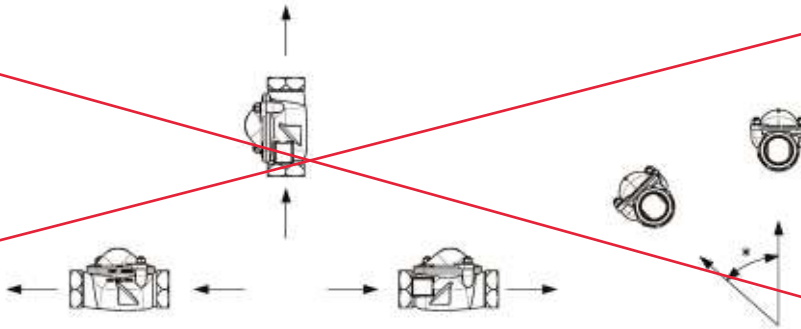
ESL 11
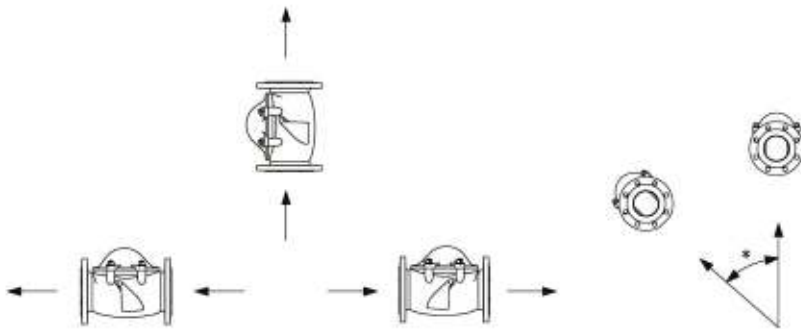
*Vertical deviation in the range:

0 – 10° – when used with solids as gravel and sand

0 – 45° – when used with drinking water

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IN-LINE BALL CHECK VALVES

ESL ball check valves dimensions in accordance with the standard ANSI/ASME B16.1-2005 Class 125

ESL 01

ESL 11

*For 3" & 4" Piping Configurations

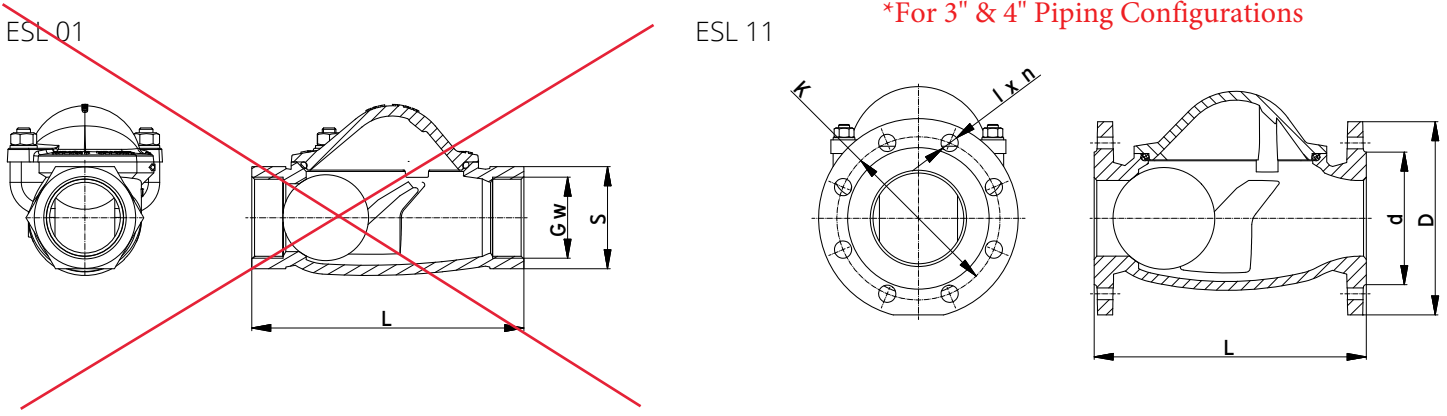| Type	DN	NPS	L	D	d	K	l x n	S	Gw	Weight
			[inch]							[lb]
ESL 01	40	1 1/2"	5 7/8	-	-	-	-	2 3/8	1 1/2	5.3
ESL 01	50	2"	7 7/8	-	-	-	-	2 15/16	2	9.0
ESL 11	50	2"	7 7/8	6 1/2	4	4 15/16	3/4" x 4	-	-	17.6
ESL 11	65	2 1/2"	9 7/16	7 1/4	4 13/16	5 11/16	3/4" x 4	-	-	25.4
ESL 11	80	3"	10 1/4	7 7/8	5 7/16	6 5/16	3/4" x 8	-	-	39.7
ESL 11	100	4"	11 13/16	8 5/8	6 1/4	7 1/8	3/4" x 8	-	-	59.5
ESL 11	125	5"	13 13/16	9 7/8	7 3/8	8 1/4	3/4" x 8	-	-	83.8
ESL 11	150	6"	15 3/4	11 1/4	8 3/8	9 7/16	7/8" x 8	-	-	105.8
ESL 11	200	8"	19 11/16	13 3/8	10 9/16	11 5/8	7/8" x 8	-	-	172.0

ESL ball check valves constructions

ESL 01

ESL 11
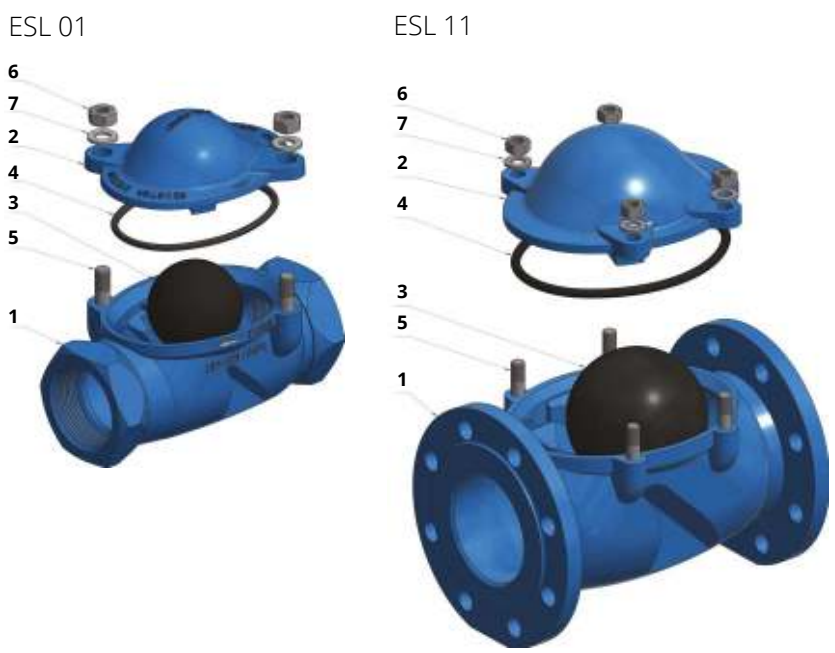
No.	Part	Material*
1	Body	Cast iron, ASTM A126 Class B (for sizes 1 1/4" - 2"); Ductile iron, ASTM A536 Grade 65-45-12 (for sizes 3"-12")
2	Cover	Cast iron, ASTM A126 Class B (for sizes 1 1/4" - 2"); Ductile iron, ASTM A536 Grade 65-45-12 (for sizes 3"-12")
3	Ball	Rubber NBR / EPDM
4	Gasket	Rubber NBR / EPDM
5	Screw cap	Stainless steel, ASTM A240 Grade 304
6	Nut	Stainless steel, ASTM A240 Grade 304
7	Washer	Stainless steel, ASTM A240 Grade 304

*Types of materials may be subject to change.

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DeZURIK

DeZURIK 1/2-3" PEC ECCENTRIC VALVES
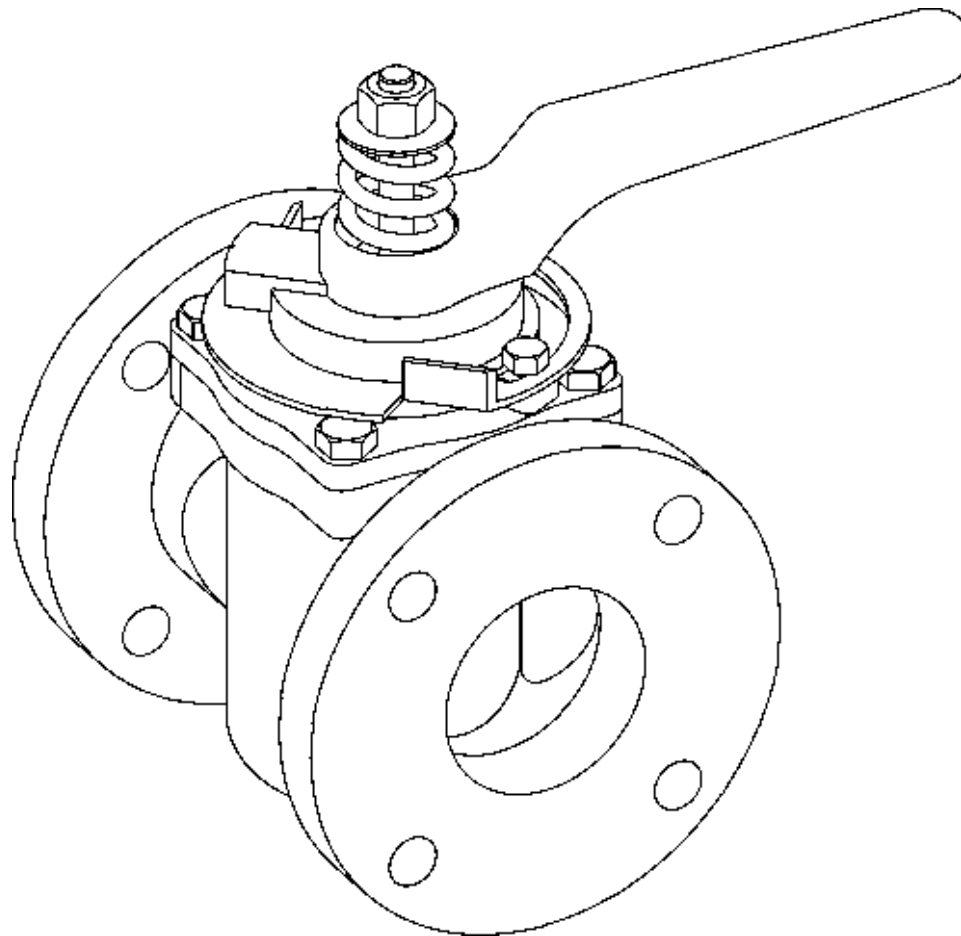
Instruction **D10095**

April 2015

DeZURIK | APCO | HILTON | WILLAMETTE

DeZURIK

1/2-3" PEC Eccentric Valves

Instructions

These instructions provide information about PEC Eccentric Valves. They are for use by personnel who are responsible for installation, operation and maintenance of PEC Eccentric Valves.

Safety Messages

All safety messages in the instructions are flagged with an exclamation symbol and the word Caution, Warning or Danger. These messages indicate procedures that must be followed exactly to avoid equipment damage, personal injury or death. Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

⚠ **WARNING!**

Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials. Handle valves, which have been removed from service with suitable protection for any potential pipeline material in the valve.

Inspection

Your PEC Eccentric Valve has been packaged to provide protection during shipment, however, it can be damaged in transport. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

Parts

Recommended spare parts are listed on the assembly drawing. These parts should be stocked to minimize downtime.

Order parts from your local DeZURIK sales representative, or directly from DeZURIK. When ordering parts, please include the 7-digit part number and 4-digit revision number (example: **9999999R000**) located on the data plate attached to the valve assembly. Also include the part name, the assembly drawing number, the balloon number and the quantity stated on the assembly drawing.

DeZURIK Service

DeZURIK service personnel are available to install, maintain and repair all DeZURIK products. DeZURIK also offers customized training programs and consultation services.

For more information, contact your local DeZURIK sales representative or visit our website at www.dezurik.com.

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DeZURIK
1/2–3" PEC Eccentric Valves

Description

The 1/2 - 3" PEC Eccentric Valve is a quarter turn valve. Clockwise rotation of the valve stem 90 degrees closes the valve.

If an actuator other than DeZURIK is to be mounted on the valve, the actuator must be capable of maintaining the valve plug position with flow in the pipeline.

⚠ **WARNING!**

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

Handling

Lifting the valve improperly may damage it. Do not fasten lifting devices to the actuator, plug or through the seat opening in the body. Lift the valve with slings, chains or cables fastened around the valve body, or fastened to bolts or rods through bolt holes in the flanges.

Required Tools

This valve is assembled using only SAE fasteners. To service this valve, you should have a full set of combination wrenches, Allen wrenches, a large flat tipped screwdriver, a flat pry bar, a pin punch and a dead blow hammer.

> **Note:** You may want to machine a shaft to aid you in removing the lower bearing from the body. See *"Disassembly"* section.

Installation

The type of materials carried in the pipeline and the location of the valve determine the correct installation procedure.

Liquids and Gases

1. Before installation, remove foreign material such as weld spatter, oil, grease, and dirt from the valve and pipeline.
2. Install the valve as shown in Figure 1.
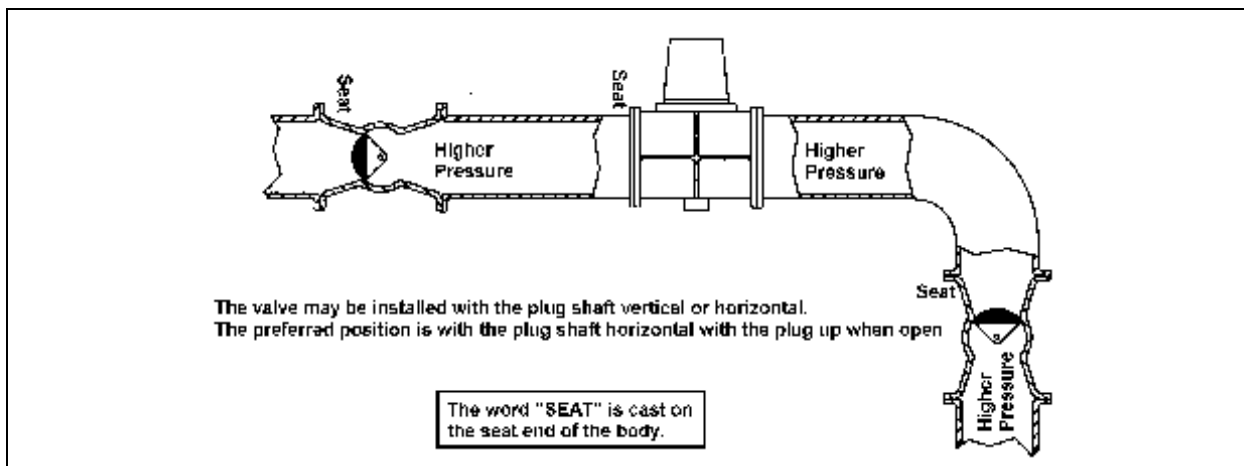
Figure 1 — Liquids and Gases

3. Ensure the valve and flanges are concentric to ensure proper flange sealing.
4. Tighten the flange bolts or studs in a crisscross pattern.

Installation *(continued)*

Suspended Solids

If the pipeline carries suspended solids such as paper stock of 2 percent or higher consistency, mining slurry, or raw sewage:

1. Before installation, remove foreign material such as weld spatter, oil, grease, and dirt from the valve and pipeline.

2. Install the valve as shown in Figure 2.

   a. In HORIZONTAL pipelines, install the valve so that the plug is horizontal and rotates upward as the valve opens.

   b. For VERTICAL pipelines, install the valve with the end marked "SEAT" at top of valve.
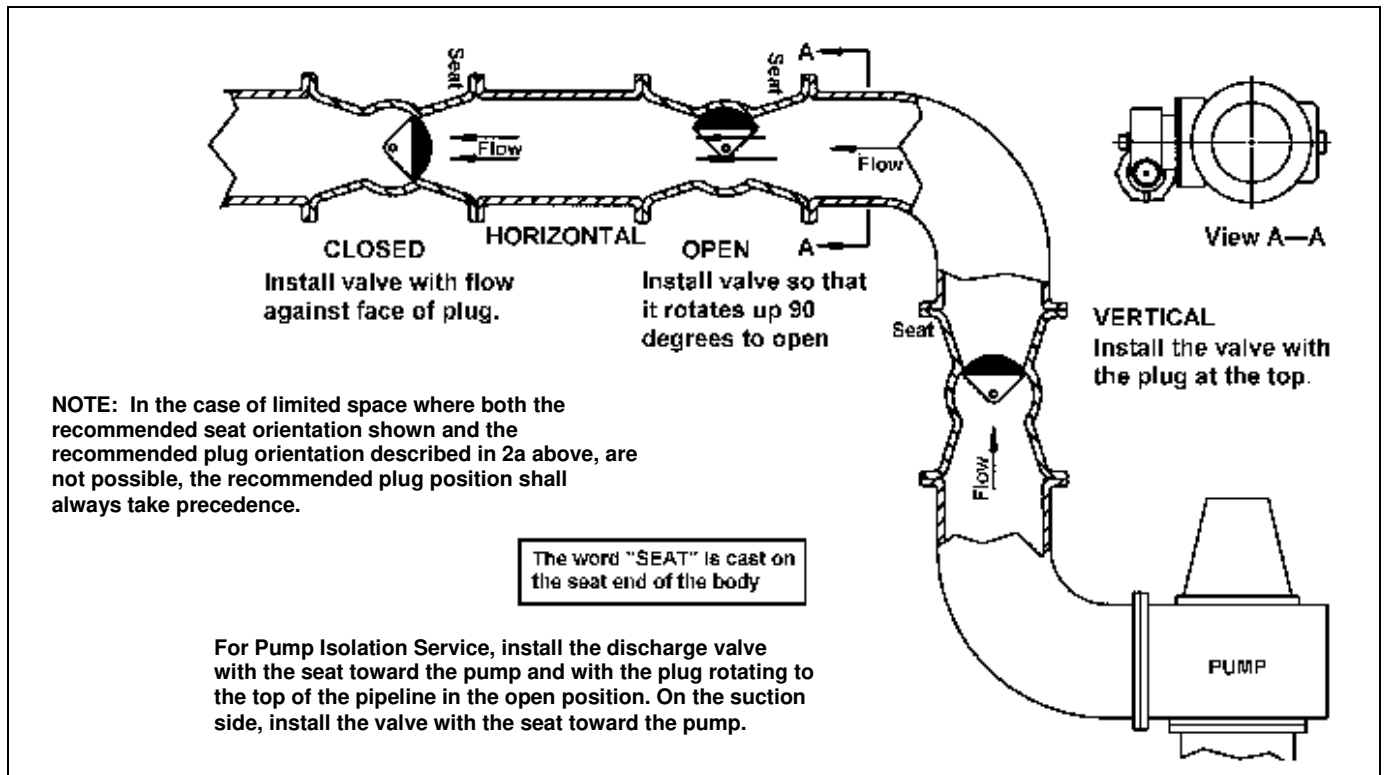
Figure 2 — Liquids with Suspended Solids

3. Tighten the flange bolts or studs in a crisscross pattern.

4. Ensure the valve and flanges are concentric to ensure proper flange sealing.

Lubrication

These valves have been lubricated at the factory and require no routine maintenance lubrication. If the valve is disassembled lubricate the plug journals and felt washer as follows:

OXYGEN SERVICE VALVES -- Lubricate the specified valve components with Hooker Fluorolube GR-362 (no substitutes are allowed) unless valve has an aluminum actuator. Valves with aluminum actuators must be lubricated with DuPont Krytox 240-AC (no substitutes are allowed). To determine if your valve has an aluminum actuator, see the Actuator Instructions.

APPLICATIONS OTHER THAN OXYGEN SERVICE -- Use a flow media compatible grease. The valves have been lubricated at the factory as follows;

- Valves with CAST IRON, DUCTILE IRON, NI-RESIST and BRONZE plugs: Have been lubricated with a medium aluminum complex based lubricant using one of these lubricants.

  - Lubriplate Clearplex-2 (**recommended**)
  - Amoco FG (alternate)
  - Mobilgrease FM 101 (alternate)
  - Petro-Canada Purity FG 2 (alternate)
  - Phillips Philube PF (alternate)

- Valves with all other plug materials: Have been lubricated with a nickel based compound using one of these lubricants.

  - Bostik Never-Seez (**recommended**)
  - Keystyone No-Weld #1 (alternate)

Fusion/Powder Coated Valves

⚠ **CAUTION!**

Valves with fusion/powder coated exterior paint require flat washers to be installed under the flange nuts when installing the valve to the pipeline flange to prevent the paint from cracking or chipping.

Stem Seal Adjustment

Lever Actuator

Tighten the lock nut on the plug stud to compress the spring slightly. The spring tension lifts the plug so the shoulder of the plug compresses the stem seal.

Powered Actuator (Powerrac, G-Unit or Compact)

Tighten the nut or screw to 5 ft-lbs.

Closed Position

The valve must be closed with enough force to achieve shutoff while avoiding excessive torque which will cause premature plug face wear.

If the valve has a lever actuator, follow the procedure below. If the valve has other than a lever actuator, see the Instruction for that actuator.

For lever actuators, loosen the stop ring set screw, close the valve with the torque listed in Table A. While maintaining that torque, position the stop ring against the torque wrench, then tighten the set screw in the stop ring.

Table A: Lever Actuator Seating Torques

Valve Size	Seating Torque (ft lbs)
2"	24

Disassembly

> ⚠️ **WARNING!**
>
> **This valve is a pressure vessel. The bonnet will blow off the actuator if the bonnet bolts are removed with pressure in the valve. Pressure must be completely released before disassembly.**

1. Relieve pipeline pressure.
2. Close the valve.
3. Remove the valve from the pipeline (if desired). It is not necessary to remove the valve from the pipeline.
4. Scribe a line on the actuator housing, valve body, bonnet and plug stem to guide alignment during reassembly.
5. Remove the actuator from the valve as described in the ACTUATOR REMOVAL section of the Actuator Instructions.
6. Remove the lock nut, washer and spring from the stud.
7. Remove the bolts securing the bonnet in place, then pry the bonnet loose from the valve body.
8. Remove the plug from the valve body.
9. Pull the felt washer and seal from the bonnet.
10. Drive the bearing out of the bonnet using a hammer and pin punch.
11. Remove the bearing from the valve body. The bearing can be chiseled out, or it can be hydraulically forced out.

    To hydraulically force the bearing out:

    1. Fill the interior diameter of the bearing with water.
    2. Pound a shaft with the same outside diameter as the lower journal of the valve plug into the bearing
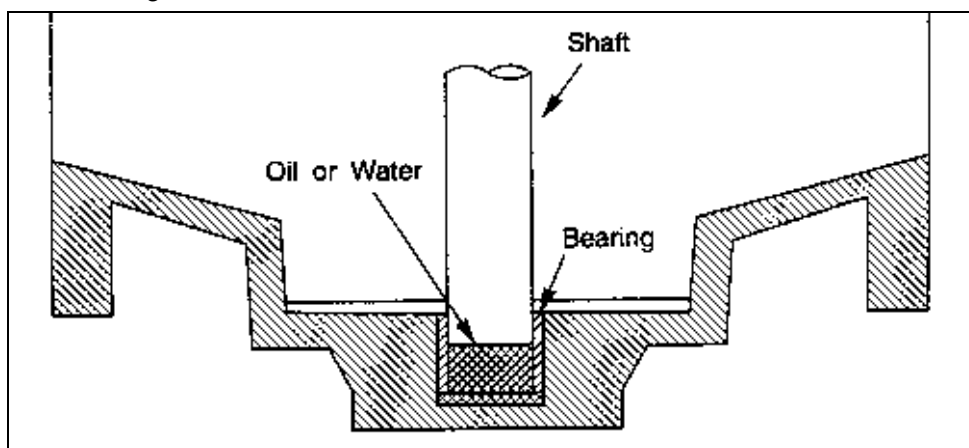
Figure 3 — Hydraulically Removing the Lower Bearing

12. Scrape all gasket material from the bonnet and body.

Reassembly

1. Push a new lower bearing into the valve body, then lubricate the bearing as described in the *"Lubrication"* section.

2. Set a new gasket in the valve body.

3. Press a new bearing into the valve bonnet.

4. Push a new seal into the bonnet. See Figure 4 for correct installation.
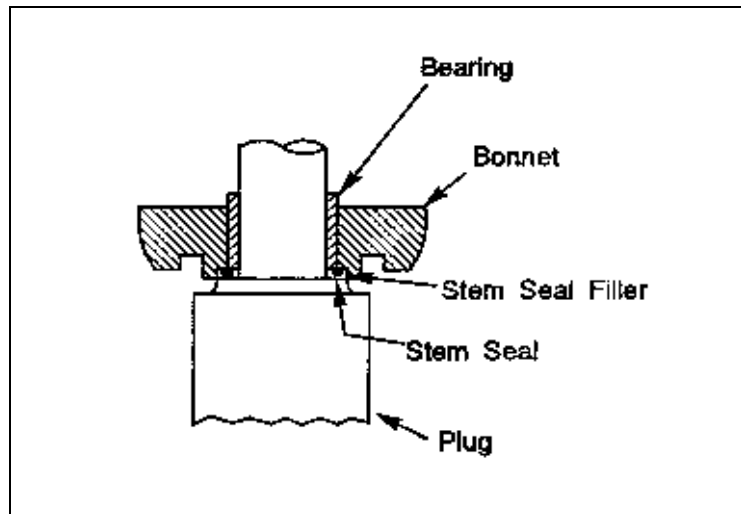
Figure 4 — Bearing and Stem Seal Arrangement

5. Lubricate the upper plug journal, then slide the bonnet down the plug until it contacts the valve body.

6. Line up the scribe marks on the plug stem, bonnet and valve body.

7. Fasten the bonnet to the body.

8. Lubricate the felt washer, then slide it down the plug stem until it fits in the counterbore in the bonnet.

9. Install the actuator as described in the Actuator Instructions.

    Note: If actuator mounting bolts are 1/4 inch bolts, do not exceed 100 inch pounds when tightening them.

10. Slide the spring and washer down the plug stud, and screw the lock nut onto the stud.

11. Tighten the lock nut on the plug stud to compress the spring slightly. The spring tension lifts the plug so the shoulder of the plug compresses the stem seal.

12. Adjust the closed position stop as described in the CLOSED POSITION ADJUSTMENT in these instructions.

Removing Valve from Pipeline

To remove the entire valve assembly from the pipeline, follow these steps.

> ⚠️ **WARNING!**
>
> **This valve is a pressure vessel. The bonnet will blow off the actuator if the bonnet bolts are removed with pressure in the valve. Pressure must be completely released before disassembly.**

1. Relieve pipeline pressure and drain portion of system where valve is located.
2. Close the valve.

> ⚠️ **WARNING!**
>
> **Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.**

3. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.
4. Support the valve assembly, then remove the flange bolts.
5. Remove the valve from the pipeline.

Field Test

Stroke the valve between the fully open and fully closed positions to verify that the valve and actuator are functioning properly.

Emergency Operation

Operate the valve as under normal conditions, taking care to bring the plug to the position required by the particular emergency condition.

Predicted Wear of Parts

Length of service for parts subject to wear is dependent on service conditions.

Troubleshooting

Symptom	Possible Cause	Corrective Action
Packing Leaks.	Packing is loose.	Adjust stem seal. (See *"Stem Seal Adjustment"* section)
	Packing is worn.	Replace stem seal & stem seal filler. (See *"Disassembly & Reassembly"* sections)
Valve does not close.	Object is wedged between plug and seat.	Open the valve completely to flush object. If this doesn't work, remove valve from the pipeline. (See *"Removing Valve from Pipeline"* section)
	Actuator closed position is out of adjustment.	Adjust the closed position stop as described in the Actuator instructions.
Valve leaks when closed.	Plug is worn or damaged.	Replace plug. (See *"Disassembly & Reassembly"* sections)
	Rubber on plug is torn.	

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Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:
Web site: www.dezurik.com   E-Mail: info@dezurik.com

DeZURIK

APCO | HILTON

250 Riverside Ave. N., Sartell, MN 56377 ● Phone: 320-259-2000 ● Fax: 320-259-2227

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Design features, materials of construction and dimensional data, as described in this manual, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.

November 2012

Millcentric
Operation and Maintenance
Manual
Series 600

Milliken Valve Company
190 Brodhead Road, Suite 100
Bethlehem, PA 18017
Phone: (610) 861-8803
Fax: (610) 861-8094
Website: www.millikenvalve.com

<u>Operations & Maintenance</u>

FUNCTIONAL DESCRIPTION

PLUG VALVE

Plug valves are designed with eccentric rubber disc seating surfaces. The plug rotates 1/4 turn to provide shutoff in pipes. The eccentric seating action provides for tighter shutoff as the actuator is adjusted to provide for more rotation. The valve can be adjusted to a maximum of 10 degrees over travel. The valves can be used to regulate flow rate by positioning the plug between 15 and 90 degrees open.

Manually operated plug valves are powered with levers/2" nuts (valves with torque collars), or gear actuators, which convert multiple handwheel, chainwheel, or nut input turns into 1/4 turn valve operation. The travel of the valve plug is limited by physical stops in the torque collar for wrench operated valves, and in the actuator housing for gear operated valves.

CAUTION: Forcing the handwheel, chainwheel, or nut against the stops will not provide tighter shutoff of the valve and may damage the actuator. Only actuator adjustments will affect valve shutoff.

Motor operated valves are powered with gear actuators, which convert multiple motor input turns into 1/4 turn valve operation. The travel of the valve plug is limited by limit switches in the motor housing and physical stop in the actuator housing. Valve shutoff is affected by limit switch and physical stop settings.

CAUTION: Improperly set limit switches and/or physical stops may damage the motor and/or actuator.

Operations & Maintenance

INSTALLATION

When installing the valves, the seat end should be noted. The seat end of the valve is cast in raised letters on the appropriate flange of the valve. Generally, straightway valves should be installed with the highest pressure applied from the opposite end from the seat. This will tend to push the plug into the seat. On pump discharge installations the seat end should be towards the pump.

In the case where shut-off is required in both directions, the valve should be installed so that the highest differential pressure at shut-off is opposite the seat end.

When the service is of a clogging type, with suspended solids likely to build up in the valve body, it is recommended that the valve be installed with the media entering the seat end first. In extreme cases, the valve should be installed with the plug horizontal and rotating upward into the top portion of the valve body cavity to open.
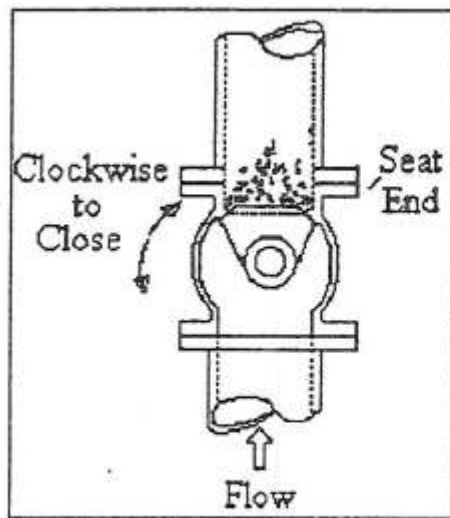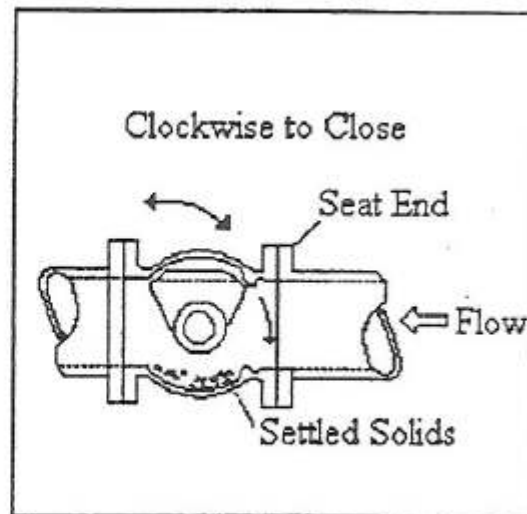
Vertical Pipeline   Horizontal Pipeline

Class 125 flanged end valves have ANSI B16.1 flat faced 125/150 flanges. Class 250 flanged end valves have ANSI B16.1 raised face 250 flanges. Standard ANSI B16.21 flanges and gaskets should be used to install the valves in the pipeline. Certain size valves utilize tapped holes on the top and bottom of the flange where a backing nut is not possible. Please check specific drawings for detailed information on sizes and quantities of hexagon head screws required on these valves.

Prior to installing valve, especially ones that are buried, they should be cycled open and closed several times to ensure they are in good working order and have not been damaged during shipment or storage.

Operations & Maintenance

OPERATING INSTRUCTIONS

Running Torque Adjustment

The nature of the eccentric plug valves "camming" action eliminates the majority of the torque prior to seating. To prevent the plug from creeping open or slamming closed, the torque collar maintains a constant drag on the shoulder of the valve bonnet. This component is factory adjusted. However, once the valve has been installed, it is recommended that the torque adjustment nut be further tightened to assure proper friction exists to prevent unwanted closure.

To prevent the plug from unnecessary movement, rotate the hex head bolt clockwise until there is a substantial drag on the plug but not so much as to prevent the movement of the plug with the supplied wrench.

Wrench Operated Valve with Torque Collar
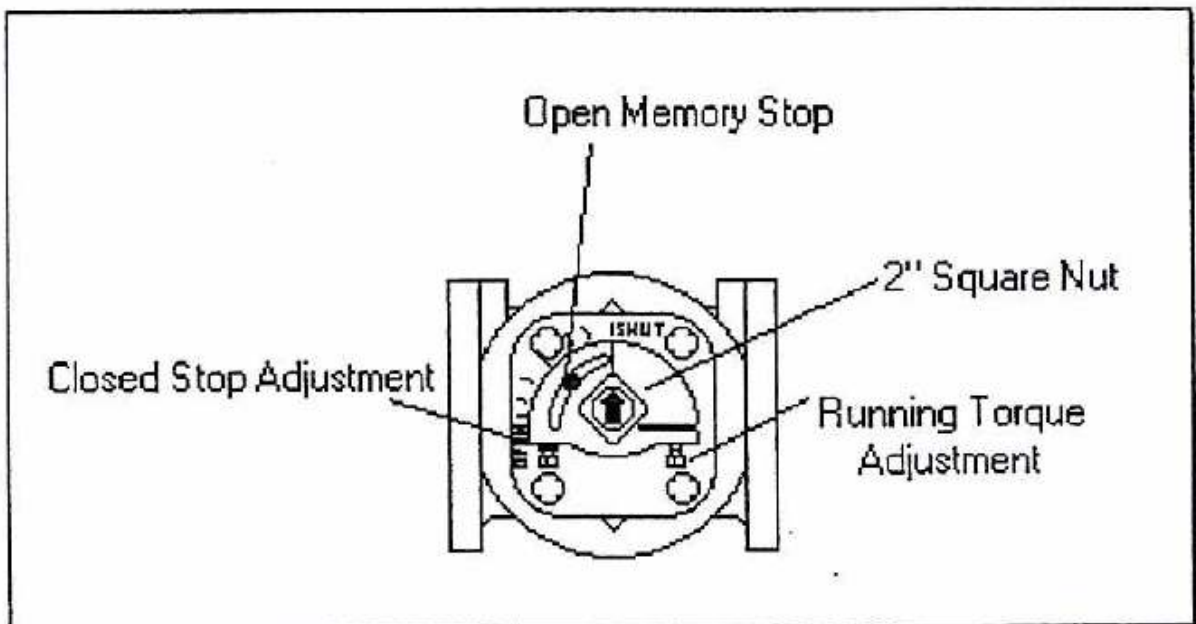
Operations & Maintenance

OPERATING INSTRUCTIONS

Wrench Operated Millcentric

Wrench operated Millcentric valves close by turning the valve 90 degrees clockwise.

Torque Collar
All wrench operated Millcentric valves are equipped with a multifunction device referred to here as a torque collar. This device serves as:

1. Wrench Adaptor-2" square
2. Position Indicator
3. Open Memory Stop
4. Closed Memory Stop
5. Running Torque Adjustment

Position Indicator
The top of the plug has an indicator plate to show the approximate plug position. Cast onto the torque collar is an indicator mark which corresponds to a graduated scale cast on the bonnet of the valve. This scale is divided into 15 degree lines and indicated the exact valve opening from full open to full closed.

Open Memory Stop
The torque collar also incorporates and open memory stop feature. The plug can be set by tightening the open memory stop adjustment bolt after the correct flow is achieved. The valve can then be closed for maintenance and reopened to the proper position without resetting the flow.

Closed Memory Stop
The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.

To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counter-clockwise and then rotate the plug (clockwise) further into the seat and check the flow. Should this movement fail to shut off the flow, repeat the above step. Afterward, reset the lock nut to prevent the position from being altered.

Operations & Maintenance

MAINTENANCE INSTRUCTIONS

WRENCH OPERATED VALVE

The Millcentric is designed and manufactured to be a lifelong valve under normal circumstances. It does not require any routine maintenance.

However if maintenance is required, due to unusual wear or service conditions, the following procedure should be followed:

Disassembly Procedure

Body

The Millcentric is a top entry valve; therefore the body can remain in line during this operation. Remove the allen head cap screw securing the torque collar to the plug stem. Remove the torque collar and set aside. With the valve de-pressurized, remove the hexagonal head cap screws that hold the bonnet to the valve body. Remove the bonnet, leaving the plug in the body. At this point the plug, PTFE thrust washers, journal bearings and bonnet "O" ring are accessible and can be removed and replaced.

Care should be taken not to damage the plug elastomer or bonnet "O" rings upon reassembly.

Reverse the above process for reassembling the Millcentric.

Stem Seals

Remove the allen head cap screw securing the torque collar to the plug stem. Remove the torque collar and set aside.

With the valve de-pressurized, using internal snap ring pliers, remove the snap pin and thrust waster. The "U" cup seals can now be pried out of the seal cavity. To replace reverse the above process. After reassembly, cycle valve from open to close approximately five times in order to ensure "U" cups have been properly seated.

Operations & Maintenance

PREVENTIVE MAINTENANCE

The Millcentric eccentric plug valves do not require any routine maintenance. They should, however, be cycled from fully open to fully closed once every 6 months, which will increase the life of the valve and operator.

Operations & Maintenance

TROUBLE SHOOTING

Wrench Operated Valves

SYMPTON	POSSIBLE CAUSE	ACTION
Valve will not open	-Broken or Misadjusted Torque collar -Obstruction in line -Excessive Line Pressure -Elastomer Damage	-Adjust or Replace torque collar -Remove obstruction -Reduce Pressure -Replace Plug
Valve will not close	-Broken or Misadjusted Torque collar -Obstruction in line -Excessive Line Pressure -Elastomer Damage	-Adjust or Replace torque collar -Remove obstruction -Reduce Pressure -Replace Plug
Valve will not shutoff flow	-Improper stop adjustment -Obstruction in line -Excessive Line Pressure -Elastomer Damage	-Adjust closed stop -Remove obstruction -Reduce Pressure -Replace Plug
Valve leaks at plug stem	-"U" cup seals not properly seated -Damaged "U" cup seal	-Cycle valve from open to close -Replace "U" Cups

<u>Operations & Maintenance</u>

<u>SAFETY</u>

Valves must be de-pressurized before any disassembly procedures are performed.

On gear operated valves, when the gears have the cover removed, extra caution should be taken to make sure hands or fingers are away from the moving parts. Close fitting clothing should be worn so as to avoid getting caught in the moving gears.

<u>Operations & Maintenance</u>

LUBRICATION SCHEDULE

The Millcentric plug valve is a low maintenance non-lubricated eccentric plug valve. As such there is no required lubrication for the valve itself.

The manual worm gear operators where applicable are also sealed grease lubricated units and should not require any type of periodic lubrication. Should the unit need to have the lubricant replaced, it is recommended that **Shell "Gadus S2 V100"** be used, formally named "Alvania RL".

Operations & Maintenance

STORAGE PROCEDURE

Milliken valves are shipped with the plugs in the open position. Care should be taken to maintain this position while the valves are in storage prior to installation in the pipeline.

Flanged valve end protectors (if supplied) should be kept on the valves until they are ready for installation. Special care should be given to mechanical joint valves to prevent damage to the internal pipe seating area.

Valves should be stored where internal contamination due to sand and mud can be kept to a minimum. Care should be taken to avoid direct sunlight on the plug elastomer during storage.

Electric, hydraulic and pneumatic valve actuators should be care for in accordance with the storage instructions of the actuator manufacturer.

<u>Operations & Maintenance</u>

SPARE PARTS LIST

The Milliken eccentric plug valve is a long life valve and does not require stocking spare parts.

<u>Operations & Maintenance</u>

INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

Review Date: 01/18/2012
Original Date: 06/22/2006

Installation and Maintenance Guidelines for NIBCO® One-Piece Bronze, Carbon Steel and Stainless Steel Ball Valves

I. INSTALLATION

1. Function valve before installing. This verifies functionality.
2. Check connecting pipe threads for accuracy. Make sure the pipe threads are clean of any foreign material such as scale or metal shavings.
3. To ensure proper installation, standard piping practices should be followed.
4. The NIBCO one-piece ball valve is a bi-directional valve.

II. MAINTENANCE

1. Routine maintenance consists of tightening the packing to compensate for wear. If there is seepage present at stem seal, tighten the pack nut 1/4 turn until snug.
2. General maintenance consists of periodic observation of the valve to ensure that the valve is functioning correctly.

**NIBCO DOES NOT RECOMMEND DISASSEMBLY OF THIS VALVE
TO ATTEMPT INTERNAL REPAIRS.**

For any technical enquiries please call NIBCO Technical Services.

NIBCO Technical Services • Phone: 1.888.446.4226 • Fax: 1.888.336.4226

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ELECTRIC CONTROL SYMBOLS

				DS	CB
ELECTRICAL CONNECTION		NO CONNECTION	GROUND	DISCONNECT	CIRCUIT BREAKER

NORMALLY OPEN	NORMALLY CLOSED			OL
RELAY CONTACTS		TRANSFORMER	CURRENT TRANSFORMER	OVERLOAD

H O A

THREE POSITION SELECTOR SWITCH	START NORMALLY OPEN	STOP NORMALLY CLOSED	E STOP MUSHROOM HEAD	NORMALLY CLOSED	NORMALLY OPEN	TOGGLE SWITCH
	PUSHBUTTONS			LIMIT SWITCHES		

NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	HEATING TYPE	COOLING TYPE	METER
PRESSURE SWITCHES		FLOAT SWITCHES		THERMOSTATS		

SV

NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	SOLENOID VALVE
ENERGIZED		DE-ENERGIZED		FLOW SWITCHES		
TIMER CONTACTS						

MS	TD	CR	RTM	G	R	
MOTOR STARTER COIL	TIME DELAY	CONTROL RELAY	RUN TIME METER	INDICATOR LIGHT	PUSH TO TEST LIGHT	FLASHER

LETTER INDICATES COLOR

R – RED   W– WHITE
G – GREEN   B – BLUE
A – AMBER   Y – YELLOW

GFI

120 VOLT	GROUND FAULT	F SINGLE PHASE MOTOR
RECEPTACLES		

M THREE PHASE MOTOR

DIM GLOW

RESISTOR

WIRE COLOR CODING

BK – BLACK   BL – BLUE
W – WHITE   GN – GREEN
R – RED   OR – ORANGE
YL – YELLOW   BR – BROWN
GY – GRAY   PK – PINK

ALARM HORN	ALARM BUZZER	ALARM BELL	FLUORESCENT LIGHT	TERMINAL BLOCK	FUSE	HEATER

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USEMCO

SENTRY Lite ™

Lift-Station Pump Controller

SENTRY Lite™ Pump-Controller
USEMCO Inc
Tomah, WI

MAIN MENU

Time: 12:50:08
Date: 09/24/19

| STATUS | METERS | LIGHTS / RESET |
| SETUP / TEST | EVENTS | VIEW SETUP |
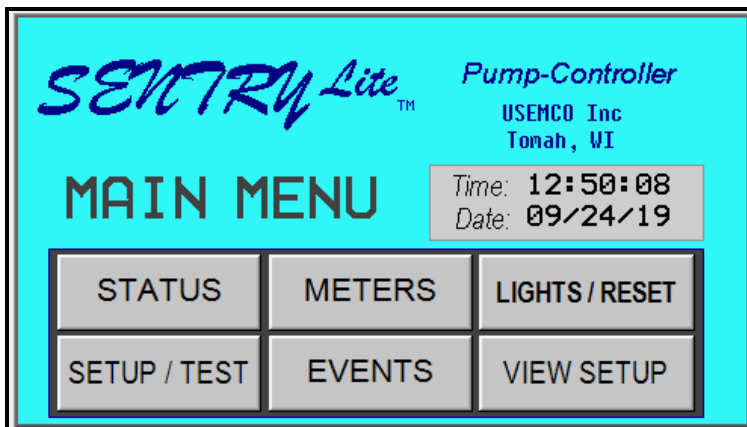
- *Bright Color Touch-screen*
- *Easy screen navigation*
- *Accurate system-monitoring*
- *Adjustable setting to fit your application and system-requirements.*

Additional

Wet Well
Max = 99.9 ft

WETWELL   NEXT   DONE

LEVEL
±99.99'

PUMP 1   PUMP 2

Set Points
HI-LVL   99.9
LAG ON   99.9
LEAD ON   99.9
LAG OFF   99.9
LEAD OFF 99.9

CALL   CALL

* FLOAT

HIGH
LOW

VIEW SETUP   MORE   DONE

.SETPTS.   .ON.   .OFF.
High Level   99.9 FT

LIGHTS & RESET   DONE

PUMP 1   PUMP 2
CALL   CALL
INHIBIT ON   INHIBIT ON

HI-LEVEL
LO-LEVEL
XDCR FLT
FLOAT BU

MODIFY PARAMETERS   DONE

CONFIG	SETPTS	TIMER
RTM RESET	NO FLOATS	SYS CL
		PASSWO

SET POINTS   BACK   SET
HIGH / LOW / START / S
(FEET)

HIGH-LEVEL   LEAD START
SETPOINTS   SETPOINTS
99.9   99.9

LOW-LEVEL   LEAD STOP
SETPOINTS   SETPOINTS
99.9   99.9

ALARM HISTORY   HELP   BACK

CLEAR EVENTS

The *SENTRY Lite* ™ pump controller by USEMCO Inc. is designed with simplicity in-mind. This controller uses state-of-the-art components and incorporates control feature envied by others in the industry. All this is packaged into one unit. Up front is a bright LCD color touch-screen that can produce over 32,000 different colors. Each screen is individually designed to provide the user with the maximum amount of feedback and information. Navigation through the different screens is simple and easy to understand.

Alarm monitoring is critical and done with ease by the *SENTRY Lite* ™ pump controller. Note that every alarm event is time-and-date stamped and placed in one area for easy access and viewing.

Setup is simple and requires little to no training. Field adjustable parameters like transducer rating & offset, set points and timer-delays allow the user to custom fit this controller to the pumping system.

Built-in test routines help to minimize or prevent pump control related problems from occurring. The *SENTRY Lite* ™ pump controller has a built-in 'Pump Test' feature. It allows the user to simulate (increase/decrease) the wet well level. All the necessary controls and feedback are designed on a single screen. This allows the user to perform this operation with ease and confidence.

This controller also comes with a Screen Saver feature where the display will automatically go 'dark' after a timed period expires. This is factory set at 5 minutes. To view the screens again, touch any portion of the display area.

Options available:

Float Backup: This selectable feature allows the user to connect two (2) floats to the controller. These floats will be used to backup the level transducer should it fail. A high-level float condition will activate this feature, disable the transducer and start all available pumps. The pumps will continue to pump until the low-level float is tipped. From this point on, both floats will be used to start and stop all available pump(s). A manual reset is required to resume use of the level transducer. Both floats are required for float backup.

Analog Output: A 4-20mA analog output of the wet well level is available and can be used for additional monitoring.

Screen Illustration:

The following pages are examples of screen images from of the *SENTRY Lite* ™ pump controller. Each screen is provided with a short explanation.

MAIN MENU

The Main Menu screen is used to navigate to other screens for control and monitoring functions. These include system status screen, password protected screens for entering and set points, timer values, and other configuration, screens for alarm events, a screen for resetting alarms and selecting pump-alternation. Note that the LIGHTS / RESET button will flash if an alarm is currently active. Also displayed is the current time & date.
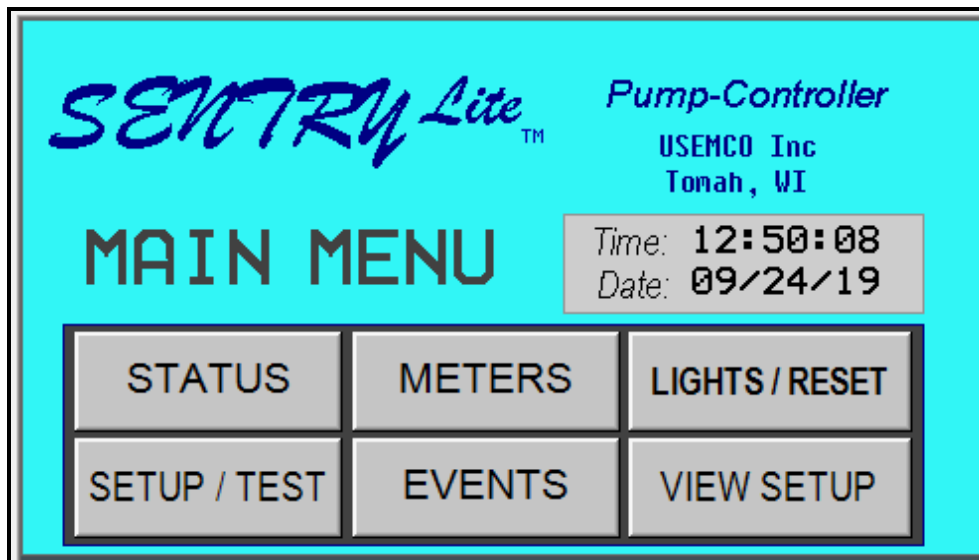
STATUS Screen(s)

These screens are designed to give the operator a general overview of the status of the system. It shows the level of the wet well (numeric & bar-graph), pump run & inhibits, set-points and a common alarm light. Touch the 'NEXT' button to display the float status screen. The current float status can be viewed from this screen if the 'backup float' option has been selected. If not selected, a 'NOT ENABLED' message will appear next to the float status display.
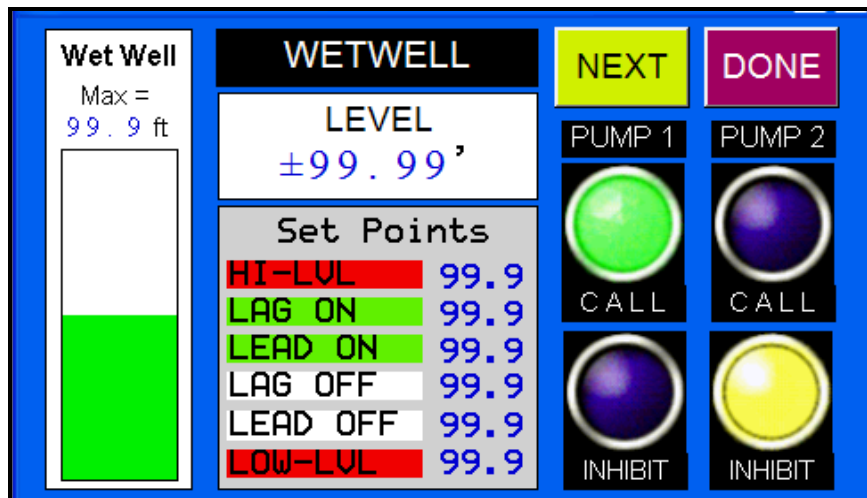
(NEXT)
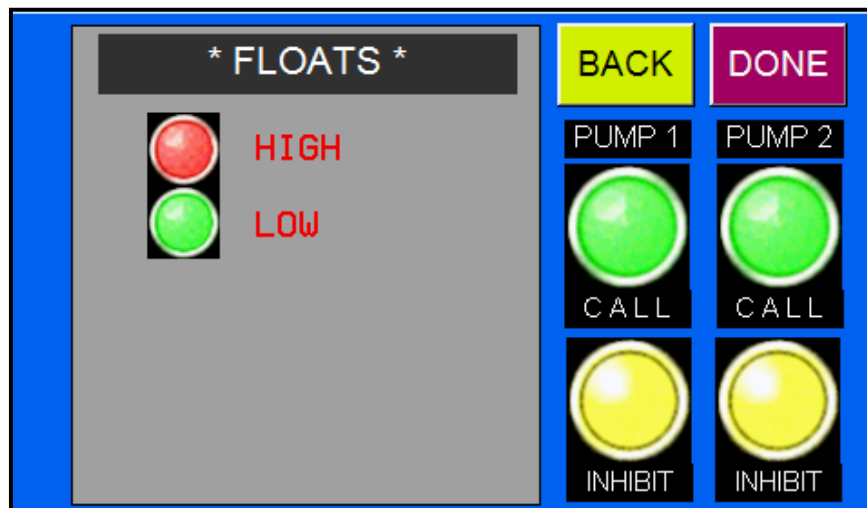
METERS Screen

This screen displays both pump's run-time (duration of the controller 'pump-call') and the number of pump-calls. The meters can be reset by accessing the secured, password protected screen. (* see meter-reset)

```
┌─────────────────────────────────────────────┐
│  RUN-TIME-METERS          ┌──────┐           │
│     & CALLS               │ BACK │           │
│                           └──────┘           │
│   ┌───────────────────────────────────────┐  │
│   │                                        │  │
│   │  PUMP 1  999999.999  HRS              │  │
│   │       2  999999.999  HRS              │  │
│   │                                        │  │
│   │                                        │  │
│   │  PUMP 1  99999  CALLS                 │  │
│   │       2  99999  CALLS                 │  │
│   │                                        │  │
│   └───────────────────────────────────────┘  │
└─────────────────────────────────────────────┘
```

LIGHTS / RESET Screen

This screen is displayed by touching the 'LIGHTS / RESET' button on the Main Menu screen. Note that the LIGHTS / RESET button will flash if an actual alarm is active. Displayed on this screen are indicators representing possible system alarms and control/test status.

```
┌─────────────────────────────────────────────┐
│   LIGHTS & RESET            ┌──────┐          │
│                            │ DONE │          │
│                            └──────┘          │
│  ┌─────────┐  ┌─────────┐   ┌──────────┐    │
│  │ PUMP 1  │  │ PUMP 2  │   │ HI-LEVEL │    │
│  └─────────┘  └─────────┘   └──────────┘    │
│  ┌─────────┐  ┌─────────┐   ┌──────────┐    │
│  │  CALL   │  │  CALL   │   │ LO-LEVEL │    │
│  └─────────┘  └─────────┘   └──────────┘    │
│  ┌─────────┐  ┌─────────┐   ┌──────────┐    │
│  │INHIBIT ON│ │INHIBIT ON│  │ XDCR FLT │    │
│  └─────────┘  └─────────┘   └──────────┘    │
│                             ┌──────────┐    │
│         ┌─────────────┐     │ FLOAT BU │    │
│         │ ALARM RESET │     └──────────┘    │
│         └─────────────┘     ┌──────────┐    │
│                             │ PMP-TST  │    │
│                             └──────────┘    │
└─────────────────────────────────────────────┘
```

VIEW SETUP Screen

These screens are accessed by touching the **'VIEW SETUP.'** button on the Main Menu screen. These screens display the parameters (set-points, transducer rating & off-set, backup float feature status and timed-delays) of the system.

SETUP / TEST Screen

This screen is accessed by touching the **'SETUP / TEST'** button on the Main Menu screen. Two (2) selections allow the operator to setup the controller to 'fit' the pump-station requirement. They are Pump Alternator, Test and Controller Setup (password protected).
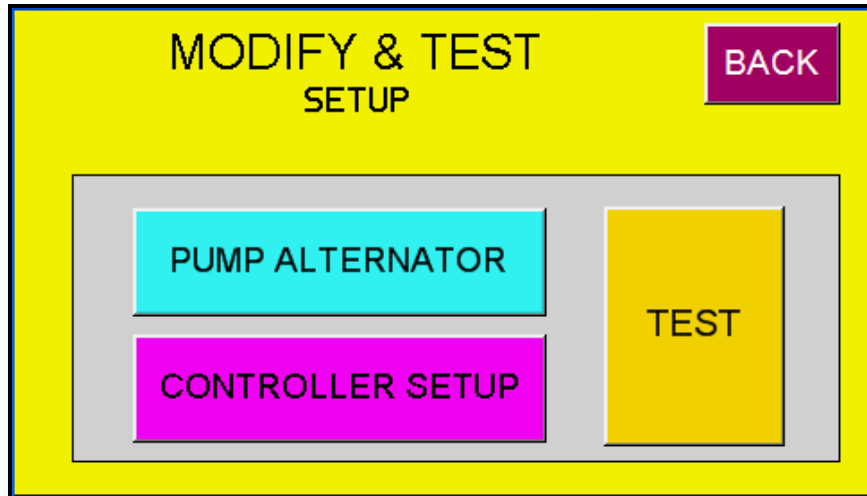
PUMP ALTERNATOR Screen

Touch the SELECT button to sequence thru '**AUTO'**, **'P1 LEAD'** or **'P2 LEAD'**. Selecting AUTO will alternate the lead pump after each cycle. Selecting 'P1 LEAD' will always keep Pump 1 as the lead pump. And selecting 'P2 LEAD' will keep Pump 2 as the lead pump.
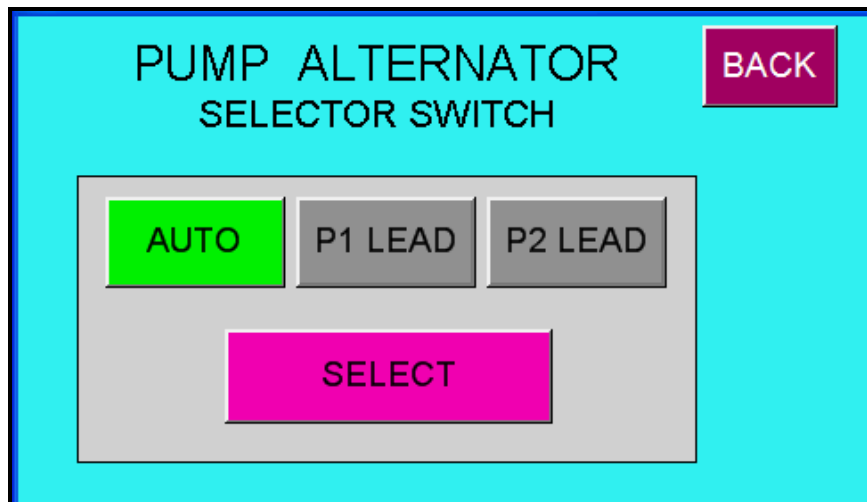
TEST Screen

The controller's TEST pump feature simulates the transducer level to test pump operation and alarms.   A vast amount of information and controls are placed on this one screen. System monitoring of the test and real-time (actual) values are critical and can be viewed all on this screen.
They are: Pump Status lights
                Pump and Alarm Set point values
                Actual and 'simulated' test level reading
                Common Alarm light

Screen Controls:
T-ON – **OFF** button will toggle to activate or turn-off this feature. An idle Active period (no change in level) of 60 seconds will automatically turn-off the test.

INC – use this button to 'raise' the simulated wet well level

DEC – use this button to 'lower' the simulated wet well level

HELP – use this button to go to the 'help' screen for assistance
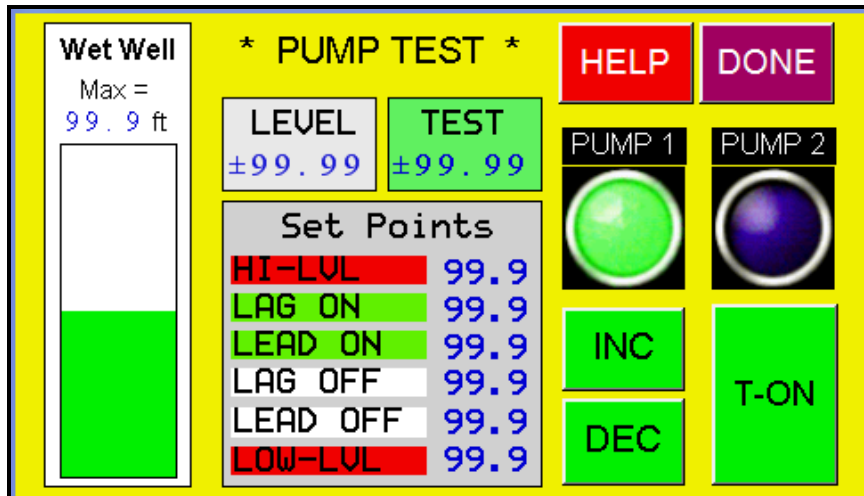
CONTROLLER SETUP (** password protected)

Touch the CONTROLLER SETUP button on the MODIFY & TEST SETUP
screen. A 'Enter password' screen will appear with a numeric-entry
keypad. Enter the correct password followed by touching the ENT button.
A correct entry will display a PASSWORD ACCEPTED screen. Touch
'continue' to proceed. If an invalid password is entered, an 'Incorrect
Password' message will appear.

```
PASSWORD
ACCEPTED

CONTINUE
```
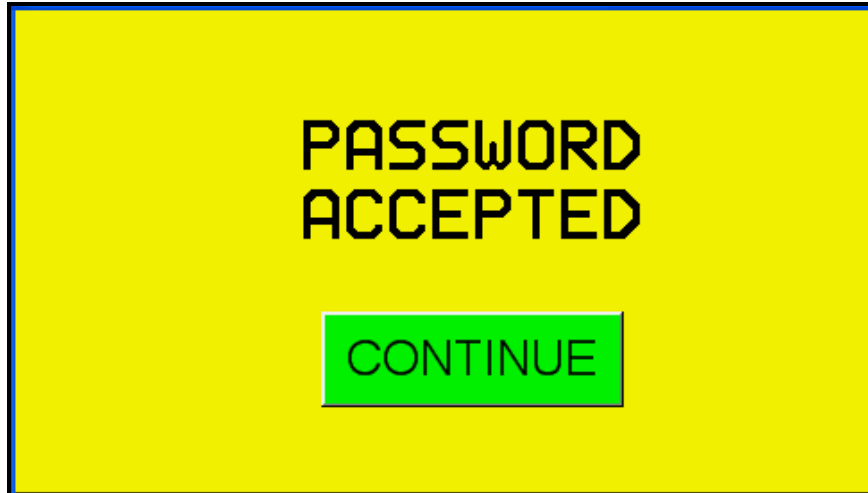
MODIFY PARAMETERS (**)

Seven buttons are available from this screen to enter specific system
values such as transducer-rating, set-points, timer-delays, time & date
calendar, meter resets and enabling / disabling the optional-floats.

```
MODIFY  PARAMETERS      DONE

CONFIG      SETPTS      TIMERS

RTM RESET   NO FLOATS   SYS CLK

                        PASSWORD
```
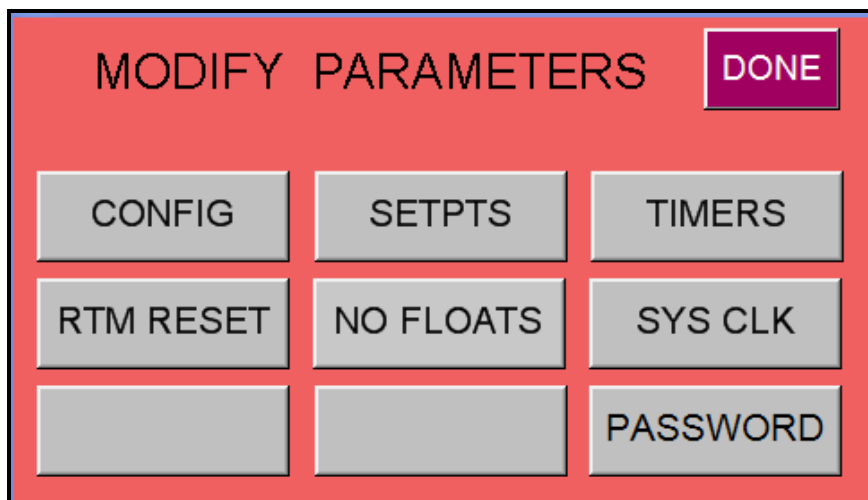
CONFIG Screen

Enter the transducer rating by touching the displayed current-value. A numeric keypad will appear on the screen. Enter the desired value followed by touching the ENT button. The entered value will now be displayed. Touch the Transducer Off-set value to enter the 'off-set'. Use the keypad to enter the offset. Touch the 'DONE' button to return to the previous screen.

MODIFY SETPOINTS

From the 'Modify Parameter' screen, touch the 'SETPNTS' button to display the set point adjustment screen. Six adjustable set points are available and can be changed by touching the digit in each box. A numeric keypad will appear on the screen after touching the digit. Enter the desired value followed by the ENT button. After completing the changes, touch the BACK button to return to the Modify Parameter screen

        HIGH-LEVEL (wet well)
        LOW-LEVEL (wet well)
        LEAD-START (pump) level
        LEAD-STOP (pump) level
        LAG-START (pump) level
        LAG-STOP (pump) level

SET POINTS
HIGH / LOW / START / STOP
(FEET)

BACK

HIGH-LEVEL SETPOINTS	LEAD START SETPOINTS	LAG START SETPOINTS
99.9	99.9	99.9
LOW-LEVEL SETPOINTS	LEAD STOP SETPOINTS	LAG STOP SETPOINTS
99.9	99.9	99.9

TIMERS Screen

From the 'Modify Parameter' screen, touch the 'TIMERS' button to display the Timers screen. Four adjustable delays are available and can be changed by touching the digit in each box. A numeric keypad will appear on the screen. Enter the desired value, followed by the ENT button. Touch the BACK button to return to the Modify Parameter screen

HIGH LEVEL ALM DELAY (delay before activating alarm after the
    set point is reached)
LOW LEVEL ALM DELAY   (delay before activating alarm after the
    set point is reached)
LEAD PMP START-DLY   (delay start after the lead set point is
    reached)
LAG PMP START-DLY   (delay start after the lag set point is
    reached)

TIMERS (SEC.)   BACK

99 HIGH LEVEL   99 LEAD PMP
   ALM DELAY   START-DLY

99 LOW LEVEL   99 LAG PMP
   ALM DELAY   START-DLY

RTM RESET Screen

From the 'Modify Parameter' screen, touch the 'RTM RESET' button to display the RESET PUMP RTM & CALLS screen. Touch the RESET button for each pump to reset the meter(s). Touch the BACK button to return to the 'Modify Parameter' screen.

Change PASSWORD Screen

From the 'Modify Parameter' screen, touch the 'PASSWORD' button to display the CHANGE PASSWORD screen. Touch the displayed Current Password number. A pop-up numeric keypad will appear. Input the 'new' four-digit password followed by the enter key. Note: Record the 'new' password in a safe location.

'BACKUP' FLOAT Option

From the 'Modify Parameter' screen, touch the combination 'NO FLOAT' / 'FLOAT ACT' button to toggle the float-backup setting.

This selectable feature allows the user to connect two (2) floats to the controller. These floats will be used to backup the level transducer should it fail. A high-level float condition will activate this feature, disable the transducer and start all available pumps. The pumps will continue to pump until the low-level float is tipped. From this point on, both floats will be used to start and stop all available pump(s). A manual reset is required to resume use of the level transducer.

** Both floats are required for float backup.

Touch the BACK button to return to the 'Modify Parameter' screen.

MODIFY PARAMETERS   DONE

CONFIG   RTM RESET

SETPTS   FLOAT ACT.

TIMERS   SYS CLK
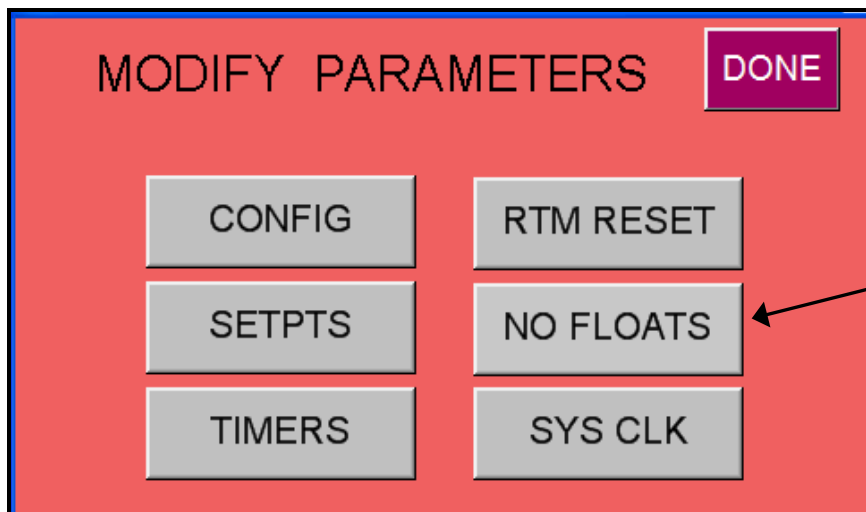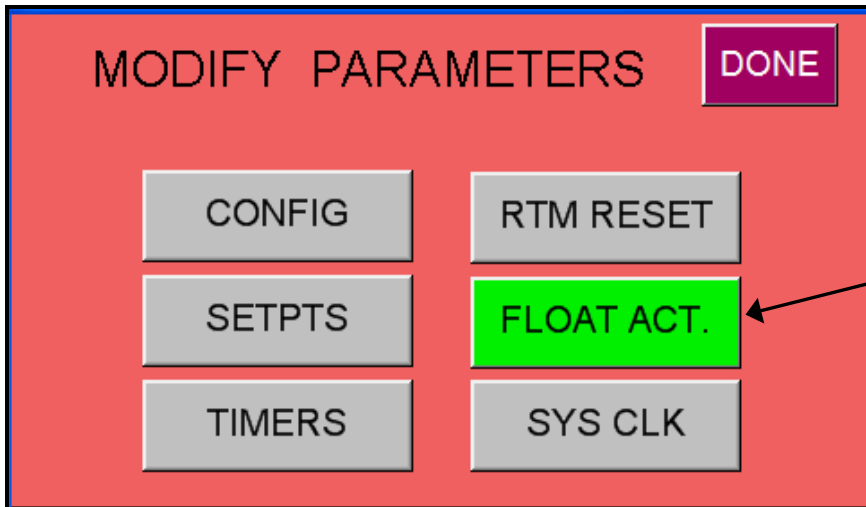
SYS CLK Screen

From the 'Modify Parameter' screen, touch the SYS CLK button to display the TIME & DATE ADJUSTMENT screen. From this screen, the user can adjust the controller time and date. A 'HELP' button is available to assist with the setting. Touch the BACK button to return to the 'Modify Parameter' screen.

EVENT Screen

From the MAIN MENU screen, touch the EVENT button. All alarms will be logged and display on this screen. Each event will have a time and date stamp of when it occurred. Alarms occurring earlier on a 'full' screen can be viewed by using the 'up' and 'down' buttons. All entries in the log can be cleared by touching the CLEAR HISTORY button.   Any alarm events that are cleared is lost and not recoverable.

A 'HELP' button is available that provides information on how to contact this pump controller manufacturer if additional information is needed.

SENTRY Lite ™ **WORKSHEET**

CONFIGURE CONTROLLER

	PARAMETER	RANGE	UNITS	SETTING
1.	Transducer Rating	0.0 to 99.9	PSI	_____
2.	Transducer Offset	0.0 to 99.9	FEET	_____
3.	Configure Floats	NO FLOATS FLOAT ACT		_____
4.	Pump Alternation	AUTO P1 - Lead P2 – Lead		_____

	TIMERS	RANGE	UNITS	SETTING
1	Lead Pump On-Delay	0 to 99	seconds	_____
2.	Lag Pump On-Delay	0 to 99	seconds	_____
3	High Alarm On-Delay	0 to 99	seconds	_____
4.	Low Alarm On-Delay	0 to 99	seconds	_____

SETPOINTS

	PARAMETER	ON Setpt.	UNITS
1.	HIGH LEVEL	_____	FEET
2.	LOW LEVEL	_____	FEET
3.	LEAD START	_____	FEET
4.	LEAD STOP	_____	FEET
5.	LAG START	_____	FEET
6.	LAG STOP	_____	FEET

Hardware Specifications:

Power: 24VDC +/- 10%, 8W max   Ports: 2 Serial: RS232/RS485 (DB9)
Bezel: IP 66 / (NEMA 4)   USB: Prog/SCADA/device
Screen: 4.3" 480 x 272 pixel   Ethernet (opt.):   Modbus TCP/IP, Prog.
LCD Type: TFT Color Touch screen   Operating Temperature: 0C to 50C
Colors: 32,000   Approvals: CE, UL (Class 1 Div 2),
Backlight: LED   RoHS compliant
Mounting: Front Panel Mounting, IP66, N4/4X rated

Digital Inputs: 12 DC inputs, Bi-directional (2 high-speed)
                     24 VDC (Max 30 VDC)
                     H/S Max input frequency 200 KHz

Digital Outputs: 8 Relay outputs
                     2 PNP

Analog Inputs: 2 (0-5V / 0-10V / 4-20mA / 0-20mA)
                        16-bit resolution

Analog Outputs: 1 (4-20mA / 0-20mA / 0-5V / 0-10V)
                        12- bit resolution

INSTRUCTION MANUAL (STARTUP) (ENGLISH)

—CONTENTS—

This Instruction Manual provides handling information and precautions for use of this product.
Please forward this Instruction Manual to the end user.

Safety instructions

Do not attempt to install, operate, maintain or inspect the product until you have read through this Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, qualified personnel means personnel who meets all the conditions below.

• A person who took a proper engineering training. Such training may be available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
• A person who can access operating manuals for the protective devices (e.g. light curtain) connected to the safety control system. A person who has read and familiarized himself/herself with the manuals.

In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION"

⚠WARNING   Incorrect handling may cause hazardous conditions, resulting in death or severe injury.

⚠CAUTION   Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

Note that even the **⚠CAUTION** level may lead to a serious consequence depending on conditions. Be sure to follow the instructions of both levels as they are critical to personnel safety.

◆ **Electric shock prevention**

⚠WARNING

● Do not remove the front cover or the wiring cover while the power of this product is ON, and do not run this product with the front cover or the wiring cover removed as the exposed high voltage terminals or the charging part of the circuitry can be touched. Doing so may cause an electric shock.
● Even if power is OFF, do not remove the front cover except for wiring or periodic inspection as you may accidentally touch the charged circuits of this product and get an electric shock.
● Before wiring or inspection, LED indication of the operation panel must be switched OFF. Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
● This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards). A neutral-point earthed (grounded) power supply must be used for 400 V class inverter to be compliant with EN standard.
● Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
● The inverter must be installed before wiring. Otherwise you may get an electric shock or be injured.
● Setting dial and key operations must be performed with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
● Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.
● Do not change the cooling fan while power is ON. It is dangerous to change the cooling fan while power is ON.
● Do not touch the printed circuit board or handle the cables with wet hands. Otherwise you may get an electric shock.

⚠WARNING

● When measuring the main circuit capacitor capacity, the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.
● A PM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals holds high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual motor starter must be connected at the inverter's output side, and wiring and inspection must be performed while the motor starter is open. Otherwise you may get an electric shock.

◆ **Fire prevention**

⚠CAUTION

● The inverter must be installed on a nonflammable wall without any through holes so that nobody touches the heat sink, etc. on the rear side of the inverter. Installing it to or near flammable material may cause a fire.
● If the inverter has become faulty, the inverter power must be switched OFF. A continuous flow of large current may cause a fire.
● Do not connect a resistor directly to the DC terminals P/+ and N/-. Doing so could cause a fire.
● Be sure to perform daily and periodic inspections as specified in the Instruction Manual (Detailed). There is a possibility of explosion, damage, or fire if this product is used without inspection.

◆ **Injury prevention**

⚠CAUTION

● The voltage applied to each terminal must be the ones specified in the Instruction Manual (Detailed). Otherwise an explosion or damage may occur.
● The cables must be connected to the correct terminals. Otherwise an explosion or damage may occur.
● The polarity (+ and -) must be correct. Otherwise an explosion or damage may occur.
● While power is ON or for some time after power-OFF, do not touch the inverter as it will be extremely hot. Touching these devices may cause a burn.

◆ **Additional instructions**
The following instructions must be also followed. If the product is handled incorrectly, it may cause unexpected fault, an injury, or an electric shock.

⚠CAUTION

Transportation and installation
● Any person who is opening a package using a sharp object, such as a knife and cutter, must wear gloves to prevent injuries caused by the edge of the sharp object.
● The product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
● Do not stand or place heavy objects on the product.
● Do not stack the boxes containing inverters higher than the number recommended.
● When carrying the inverter, do not hold it by the front cover; it may fall or break.
● During installation, caution must be taken not to drop the inverter as doing so may cause injuries.
● The product must be installed on the surface that withstands the weight of the inverter.
● Do not install the product on a hot surface.
● Ensure the mounting orientation of this product is correct.
● Ensure this product is mounted securely in its enclosure.
● Do not install or operate the inverter if it is damaged or has parts missing.
● Prevent conductive items such as screws and metal fragments, or flammable substances such as oil from entering the inverter.
● As the inverter is a precision instrument, do not drop or subject it to impact.
● The surrounding air temperature for LD rating must be between -10 and +50°C (non-freezing). The surrounding air temperature for SLD rating must be between -10 and +40°C (non-freezing). Otherwise the inverter may be damaged.
● The ambient humidity must be 95%RH or less (non-condensing). Otherwise the inverter may be damaged. (Refer to **page 3** for details.)

1

⚠ CAUTION

Transportation and installation
- The temporary storage temperature (applicable to a short limited time such as a transportation time) must be between -20 and +65°C. Otherwise the inverter may be damaged.
- The inverter must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the inverter may be damaged.
- This product must be used at an altitude of 2500 m or less, with 5.9 m/s^2 or less vibration*1 at 10 to 55 Hz (directions of X, Y, Z axes). (For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.) Otherwise the product may be damaged.
- If halogens (including fluorine, chlorine, bromine, and iodine) contained in fumigants for wood packages enter this product, the product may be damaged. Prevent the entry of fumigant residuals or use an alternative method such as heat disinfection. Note that sterilization or disinfection of wood packages should be performed before packing the product.

Wiring
- Do not install a power factor correction capacitor, surge absorber, or radio noise filter on the output side of this product. These devices may overheat or burn out.
- The output of the inverter (terminals U, V, and W) must be correctly connected to a motor. Otherwise the motor rotates inversely.
- PM motor terminals (U, V, W) hold high-voltage while the PM motor is running even after the power is turned OFF. Before wiring, the PM motor must be confirmed to be stopped. Otherwise you may get an electric shock.
- Never connect a PM motor to the commercial power supply. Applying the commercial power supply to input terminals (U, V, W) of a PM motor will burn the PM motor. The PM motor must be connected with the output terminals (U, V, W) of the inverter.

*1   2.9 m/s^2 or less for the FR-F840-04320(185K) or higher.

⚠ CAUTION

Test operation
- Before starting operation, each parameter must be confirmed and adjusted. A failure to do so may cause some machines to make unexpected motions.

⚠ WARNING

Usage
- Stay away from the equipment after using the retry function in this product as the equipment will restart suddenly after the output shutoff of this product.
- Depending on the product's function settings, the product does not stop its output even when the STOP/RESET key on the operation panel is pressed. To prepare for it, provide a separate circuit and switch (to turn the product power OFF, or apply a mechanical brake, etc.) for an emergency stop.
- Be sure to turn OFF the start (STF/STR) signal before clearing the fault as this product will restart the motor suddenly after a fault is cleared.
- Do not use a PM motor for an application where the PM motor is driven by its load and runs at a speed higher than the maximum motor speed.
- Use only a three-phase induction motor or PM motor as a load on this product. Connection of any other electrical equipment to the product output may damage the equipment.
- Performing pre-excitation (LX signal and X13 signal) under torque control may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. It must be confirmed that the motor running will not cause any safety problem before performing pre-excitation.
- Do not modify the product.
- Do not remove any part which is not instructed to be removed in the Instruction Manual (Detailed). Doing so may lead to a failure or damage.

⚠ CAUTION

Usage
- The electronic thermal O/L relay function may not be enough for protection of the motor from overheating. It is recommended to install an external thermal relay or a PTC thermistor for overheat protection.
- Do not use a magnetic contactor on the product input side for frequent starting/stopping of the product. Otherwise the life of the product decreases.
- Use a noise filter or other means to minimize the electromagnetic interference with other electronic equipment used nearby the product.
- Appropriate measures must be taken to suppress harmonics. Otherwise power supply harmonics generated from the inverter may heat/damage the power factor correction capacitor or a generator.
- To drive a 400 V class motor by this product, use an insulation-enhanced motor, or take measures to suppress surge voltage. Otherwise surge voltage attributable to the line constants may occur at the motor terminals, deteriorating the insulation of the motor.
- As all parameters return to their initial values after the Parameter clear or All parameter clear is performed, the parameters must be set again as required before the operation is started.
- The inverter can be easily set for high-speed operation. Therefore, consider all things related to the operation such as the performance of a motor and equipment in a system before the setting change.
- The stop state of the product by the product's brake function (DC injection brake function) cannot be held. Install a device to apply brakes to a motor or equipment in a system for safety.
- Before running the product which have been stored and not been operated for a long period, perform an inspection and test operation.
- To avoid damage to the product due to static electricity, static electricity in your body must be discharged before you touch the product.
- Only one PM motor can be connected to an inverter.
- A PM motor must be used under PM motor control. Do not use a synchronous motor, induction motor, or synchronous induction motor.

⚠ CAUTION

Usage
- In the system with a PM motor, the inverter power must be turned ON before closing the contacts of the contactor at the output side.
- When the emergency drive operation is performed, the operation is continued or the retry is repeated even when a fault occurs, which may damage or burn the inverter and motor. Before restarting the normal operation after using the emergency drive function, make sure that the inverter and motor have no fault.
- In order to protect the inverter and the system against unauthorized access by external systems via network, take security measures including firewall settings.
- In order to protect security (confidentiality, integrity, and availability) of the inverter and the system against unauthorized access, DoS*2 attack, computer virus, or any other form of cyberattack by external systems via network, take security measures that include firewall or virtual private network (VPN) settings and installation of antivirus software on computers. We shall not be liable for any problems resulting from failures of the inverter or the system that might occur due to DoS attack, unauthorized access, computer virus, or any other form of cyberattack.
- Depending on the network environment, the inverter may not operate as intended due to delays or disconnection in communication. Carefully consider the conditions and safety for the inverter on site.

Emergency stop
- A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous conditions in case of failure of this product or an external device controlling this product.
- If the breaker installed on this product input side trips, check for the wiring fault (such as short circuit) and damage to internal parts of the inverter, etc. Identify and remove the cause of the trip before resetting the tripped breaker and applying the power to this product again.
- When any protective function is activated, take an appropriate corrective action before resetting this product to resume the operation.

Maintenance, inspection and parts replacement
- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter. Doing so will cause a failure.

Disposal
- The inverter must be treated as industrial waste.

*2   DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

General instruction
- For clarity, illustrations in this Instruction Manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed prior to starting operation. For details on the PM motor, refer to the Instruction Manual of the PM motor.

Application of caution labels
Caution labels are used to ensure safety during use of Mitsubishi Electric inverters.
Apply the following labels to the inverter if the "retry function" and/or "automatic restart after instantaneous power failure" have been enabled.
- For the retry function

> ⚠ **CAUTION**
> (Retry Function Has Been Selected)
>
> ⚠ **Stay away from the motor and machine. They will start suddenly (after given time has elapsed) when alarm occurs.**

- For automatic restart after instantaneous power failure

> ⚠ **CAUTION**
> (Automatic Restart after Instantaneous Power Failure Has Been Selected)
>
> ⚠ **Stay away from the motor and machine. They will start suddenly (after reset time has elapsed) when instantaneous power failure occurs.**
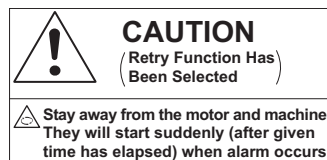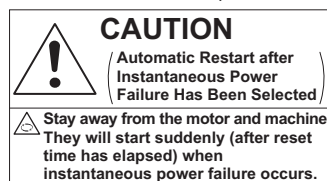
Application of motor control labels
Apply the following labels to the inverter to avoid connecting motors not intended for a particular motor control setting.

> **Induction motor setting**
> ⚠ The inverter is set for the induction motor control.
> IM LED is ON during induction motor control.
> Do not drive a PM motor.
>
> [display: 0.00 Hz]
> PU   MON   IM
> EXT   PRM   PM
> NET   P.RUN

> **PM motor control setting**
> ⚠ The inverter is set for the PM motor control.
> PM LED is ON during PM motor control.
> Do not drive an induction motor.
>
> [display: 0.00 Hz]
> PU   MON   IM
> EXT   PRM   PM
> NET   P.RUN
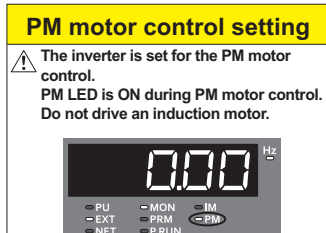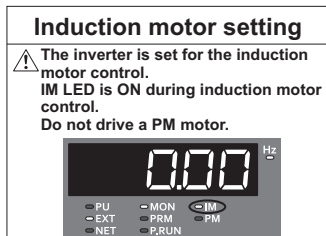
1 INVERTER INSTALLATION AND PRECAUTIONS

◆ Inverter model

FR - F8 2 0 - 00046 - E1 -

Symbol	Voltage class
2	200 V class
4	400 V class

Symbol	Description
00023 to 06830	Inverter SLD rated current (A)
0.75 to 315K	Inverter LD rated capacity (kW)

Symbol	Type[*1]	Communication type
E1	FM	Ethernet[*2]
E2	CA	

Symbol	Circuit board coating (conforming to IEC60721-3-3 3C2/3S2)	Plated conductor
Without	Without	Without
60	With	Without
06[*3]	With	With

[*1] Specification differs by the type. Major differences are shown in the table below.

Type	Monitor output	Initial setting				
		Built-in EMC filter	Control logic	Rated frequency	Pr.19 Base frequency voltage	Pr.570 Multiple rating setting
FM (terminal FM equipped model)	Terminal FM: pulse train output Terminal AM: analog voltage output (0 to ±10 VDC)	OFF	Sink logic	60 Hz	9999 (same as the power supply voltage)	1 (LD rating)
CA (terminal CA equipped model)	Terminal CA: analog current output (0 to 20 mADC) Terminal AM: analog voltage output (0 to ±10 VDC)	ON	Source logic	50 Hz	8888 (95% of the power supply voltage)	0 (SLD rating)

[*2] Inverter equipped with a built-in Ethernet board (FR-A8ETH).
[*3] Applicable for the FR-F820-00340(7.5K) or higher, and the FR-F840-00170(7.5K) or higher.

Capacity plate

Inverter model → FR-F820-00046-E1
Serial number → SERIAL: XXXXXXXXX

Rating plate

Inverter model → MODEL : FR-F820-00046-E1
Input rating → INPUT : XXXXX
Output rating → OUTPUT : XXXXX
SERIAL → SERIAL : XXXXXXXXX
Country of origin → MADE IN XXXXX

INVERTER PASSED
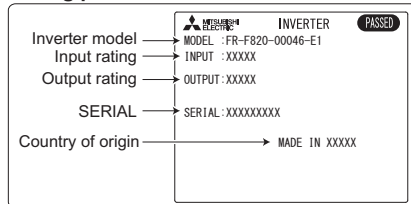
NOTE

• In this Instruction Manual, the inverter model name consists of the applicable motor capacity and the rated current. (Example) FR-F820-00046(0.75K)

◆ Inverter placement

Installation on the enclosure
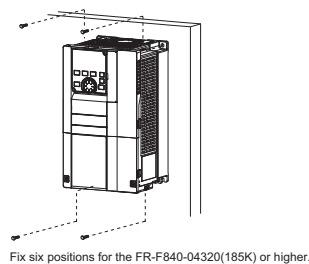
Fix six positions for the FR-F840-04320(185K) or higher.

• Install the inverter on a strong surface securely with screws.
• Leave enough clearances and take cooling measures.
• Avoid places where the inverter is subjected to direct sunlight, high temperature and high humidity.
• Install the inverter on a nonflammable wall surface.
• When encasing multiple inverters, install them in parallel as a cooling measure.
• When designing or building an enclosure for the inverter, carefully consider influencing factors such as heat generation of the contained devices and the operating environment.

Clearances (front)
FR-F820-03160(75K) or lower, FR-F840-01800(75K) or lower
10cm or more
5cm or more[*1,*2]   5cm or more[*1,*2]
10cm or more

FR-F820-03800(90K) or higher, FR-F840-02160(90K) or higher
20cm or more
10cm or more   10cm or more
20cm or more

Clearances (side)
5cm or more[*1,*3]   Inverter

Vertical
Allow clearance.
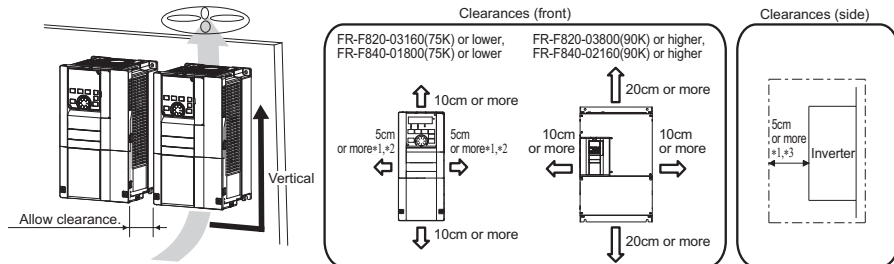
[*1] For the FR-F820-00250(5.5K) or lower and FR-F840-00126(5.5K) or lower, allow 1 cm or more clearance.
[*2] When using the FR-F820-01250(30K) or lower and FR-F840-00620(30K) or lower at the surrounding air temperature of 40°C or less (30°C or less for the SLD rated inverter), side-by-side installation (0 cm clearance) is available.
[*3] For replacing the cooling fan of the FR-F840-04320(185K) or higher, 30 cm of space is necessary in front of the inverter. Refer to the FR-F800 Instruction Manual (Detailed) for fan replacement.

◆ Installation environment

Before installation, confirm that the following environment conditions are met.

Item		Description	Enclosure
Surrounding air temperature[*4*5]	LD rating	-10 to +50°C (non-freezing)	
	SLD rating	-10 to +40°C (non-freezing)	
Ambient humidity		With circuit board coating (conforming to IEC60721-3-3 3C2/3S2): 95% RH or less (non-condensing), Without circuit board coating: 90% RH or less (non-condensing)	
Storage temperature		-20 to +65°C[*1]	
Atmosphere		Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)	
Altitude		2500 m or lower[*2]	
Vibration		5.9 m/s^2[*3] or less at 10 to 55 Hz (directions of X, Y, Z axes)	

[*1] Temperature applicable for a short time, e.g. in transit.
[*2] For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per altitude increase of 500 m.
[*3] 2.9 m/s^2 or less for the FR-F840-04320(185K) or higher.
[*4] Surrounding Air Temperature is a temperature measured at a measurement position in an enclosure. Ambient Temperature is a temperature outside an enclosure.
[*5] For the amount of heat generated by the inverter unit, refer to the Instruction Manual (Detailed).

◆ Accessory

- Fan cover fixing screws: These screws are necessary for compliance with the EU Directives. (Refer to **page 18**.)

Capacity	Screw size (mm)	Quantity
FR-F820-00105(2.2K) to FR-F820-00250(5.5K) FR-F840-00083(3.7K), FR-F840-00126(5.5K)	M3 × 35	1
FR-F820-00340(7.5K), FR-F820-00490(11K) FR-F840-00170(7.5K), FR-F840-00250(11K)	M3 × 35	2
FR-F820-00630(15K) to FR-F820-01250(30K) FR-F840-00310(15K) to FR-F840-00620(30K)	M4 × 40	2

- Eyebolt for hanging the inverter

Capacity	Eyebolt size	Quantity
FR-F840-04320(185K) to FR-F840-06830(315K)	M12	2

- Earthing (grounding) cable (1): For connection with a communication option
- CD-ROM (1): Including the Instruction Manual (Detailed) and other documents

◆ Installing a communication option

- To use a communication option, the enclosed earthing (grounding) cable needs to be installed. Install the cable according to the following procedure.

No.	Installation procedure
1	Insert spacers into the mounting holes that will not be tightened with the option mounting screws.
2	Fit the connector of the communication option to the guide of the connector of the inverter, and insert the option as far as it goes. (Insert it to the inverter option connector 1.)
3	Remove the mounting screw (lower) of the Ethernet board earth plate. Fit the one terminal of the earthing (grounding) cable on the Ethernet board earth plate and fix it securely to the inverter with the mounting screw (tightening torque 0.33 N•m to 0.40 N•m).
4	Fix the left part of the communication option securely with the option mounting screw, and place another terminal of the earthing (grounding) cable on the right part of the option and fix the cable terminal and the option with the option mounting screw (tightening torque 0.33 N•m to 0.40 N•m). If the screws are not tightened properly, the connector may not be inserted deep enough. Check the connector.

Example of FR-A8NC
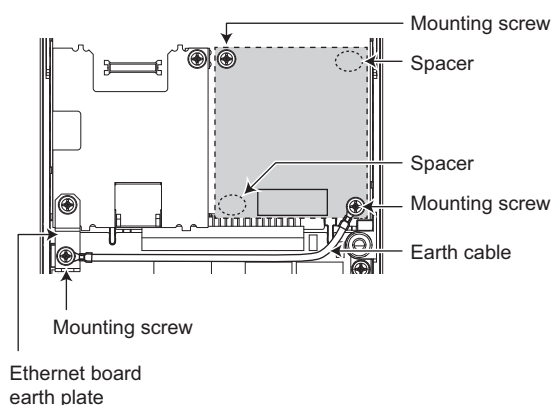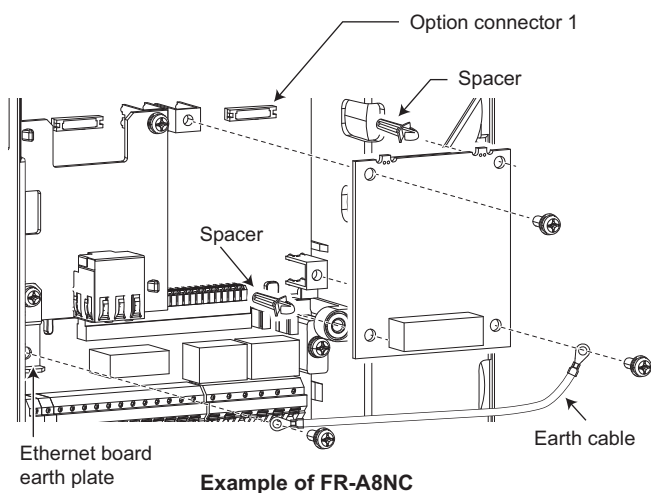
NOTE

- The number and shape of the spacers used differ depending on the communication option type. Refer to the Instruction Manual of each communication option for details.
- The earth plate enclosed with a communication option is not used.

2 WIRING

2.1 Terminal connection diagrams

◆ FM type

*1 For the FR-F820-03160(75K) or higher, the FR-F840-01800(75K) or higher, always connect a DC reactor (FR-HEL), which is available as an option. (To select a DC reactor, refer to the Instruction Manual (Detailed), and select one according to the applicable motor capacity.)
When connecting a DC reactor, if a jumper is installed across terminals P1 and P/+, remove the jumper before installing the DC reactor. (The jumper is not installed for the FR-F820-03160(75K) or higher and the FR-F840-01800(75K) or higher.)
*2 When using separate power supply for the control circuit, remove the jumper between R1/L11 and S1/L21.
*3 The function of these terminals can be changed with the input terminal assignment **(Pr.178 to Pr.189)**. (Refer to **page 13**.)
*4 Terminal JOG is also used as the pulse train input terminal. Use **Pr.291** to choose JOG or pulse.
*5 Terminal input specifications can be changed by analog input specification switchover **(Pr.73, Pr.267)**. To input a voltage, set the voltage/current input switch OFF. To input a current, set the voltage/current input switch ON. Terminals 10 and 2 are also used as a PTC input terminal. **(Pr.561)** (Refer to the FR-F800 Instruction Manual (Detailed).)
*6 It is recommended to use 2 W 1 kΩ when the frequency setting signal is changed frequently.
*7 Do not use terminals PR and PX. The jumper may or may not be attached depending on the inverter. (Refer to **page 7**.)
*8 Do not connect the DC power supply (under DC feeding mode) to terminal P3.
*9 The function of these terminals can be changed with the output terminal assignment **(Pr.195, Pr.196)**. (Refer to **page 13**.)
*10 The function of these terminals can be changed with the output terminal assignment **(Pr.190 to Pr.194)**. (Refer to **page 13**.)
*11 Terminal F/C (FM) can be used to output pulse trains as open collector output by setting **Pr.291**.
*12 Not required when calibrating the scale with the operation panel.
*13 No function is assigned in the initial status. Assign the function using **Pr.186 CS terminal function selection**. (Refer to **page 13**.)
*14 The option connector 2 cannot be used because the Ethernet board is installed in the initial status. The Ethernet board must be removed to install a plug-in option to the option connector 2. (However, Ethernet communication is disabled in that case.)

NOTE

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.

◆ CA type

FR-F820-00770(18.5K) to 01250(30K), FR-F840-00470(22K) to 01800(75K)

DC reactor (FR-HEL)*1

Brake unit (Option)

Earth (Ground)

Jumper

P1 P/+ P3 PR*7 N/-

*8

Inrush current limit circuit

Source logic
◎ Main circuit terminal
○ Control circuit terminal

DC reactor (FR-HEL)*1

Brake unit (Option)

Earth (Ground) Jumper Jumper*7

P1 P/+ PX*7 PR*7 N/-

Inrush current limit circuit

MCCB MC

Three-phase AC power supply

R/L1 S/L2 T/L3

R1/L11 S1/L21

Jumper *2

Earth (Ground)

EMC filter ON/OFF connecter

ON OFF

Main circuit

U V W

J K

Motor

M

Earth (Ground)

Control circuit

Control input signals (No voltage input allowed)*3

Forward rotation start — STF
Reverse rotation start — STR
Start self-holding selection — STP(STOP)
Multi-speed selection — High speed — RH
Middle speed — RM
Low speed — RL
Jog operation — JOG *4
Second function selection — RT
Output stop — MRS
Reset — RES
Terminal 4 input selection (Current input selection) — AU
*11 — CS
Common for external power supply transistor — SD
Contact input common 24VDC power supply — PC

SOURCE SINK 24V

Relay output*9

C1
B1 Relay output 1 (Fault output)
A1
C2
B2 Relay output 2
A2

Open collector output*10

RUN Running
SU Up to frequency
IPF Instantaneous power failure
OL Overload
FU Frequency detection
SE Open collector output common Sink/source common

24V external power supply input — +24
Common terminal — SD

*5 Voltage/current input switch

PU connector

USB A connector

USB mini B connector

Ethernet connector *12

F/C (CA)

(+)
(-) Analog current output (0 to 20mADC)

AM

(+)
(-) Analog signal output (DC0 to ±10V)

Frequency setting signals (Analog)

10E(+10V)
10(+5V)

ON OFF 2 4

Frequency setting potentiometer 1/2W1kΩ*6

2 DC0 to 5V Initial value
DC0 to 10V
DC0 to 20mA selectable *5

5 (Analog common)

Auxiliary input (+) (-)

1 DC0 to ±10V Initial value
(DC0 to ±5V selectable) *5

Terminal 4 input (Current input) (+) (-)

4 DC4 to 20mA Initial value
DC0 to 5V
DC0 to 10V selectable *5

Connector for plug-in option connection

Connector 1 Connector 2*12
Connector 3

Safety stop signal

Shorting wire 24V

PC
Safety stop input (Channel 1) — S1
Safety stop input (Channel 2) — S2
Safety stop input common — SIC
SD

Output shutoff circuit

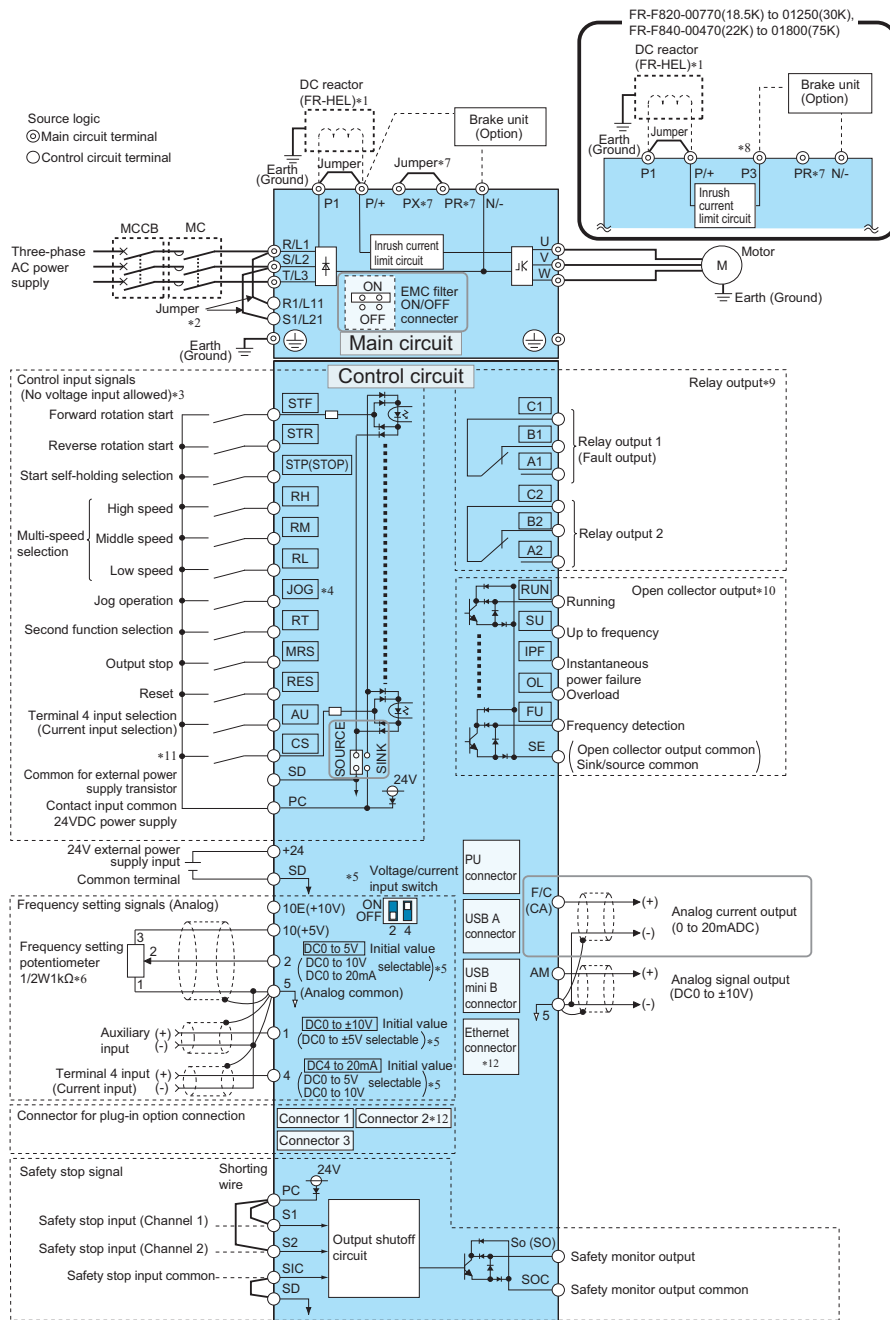So (SO) Safety monitor output
SOC Safety monitor output common

*1 For the FR-F820-03160(75K) or higher, the FR-F840-01800(75K) or higher, always connect a DC reactor (FR-HEL), which is available as an option. (To select a DC reactor, refer to the Instruction Manual (Detailed), and select one according to the applicable motor capacity.)
When connecting a DC reactor, if a jumper is installed across terminals P1 and P/+, remove the jumper before installing the DC reactor. (The jumper is not installed for the FR-F820-03160(75K) or higher and the FR-F840-01800(75K) or higher.)
*2 When using separate power supply for the control circuit, remove the jumper between R1/L11 and S1/L21.
*3 The function of these terminals can be changed with the input terminal assignment (Pr.178 to Pr.189). (Refer to page 13.)
*4 Terminal JOG is also used as the pulse train input terminal. Use Pr.291 to choose JOG or pulse.
*5 Terminal input specifications can be changed by analog input specification switchover (Pr.73, Pr.267). To input a voltage, set the voltage/current input switch OFF. To input a current, set the voltage/current input switch ON. Terminals 10 and 2 are also used as a PTC input terminal. (Pr.561) (Refer to the FR-F800 Instruction Manual (Detailed).)
*6 It is recommended to use 2 W 1 kΩ when the frequency setting signal is changed frequently.
*7 Do not use terminals PR and PX. The jumper may or may not be attached depending on the inverter. (Refer to page 7.)
*8 Do not connect the DC power supply (under DC feeding mode) to terminal P3.
*9 The function of these terminals can be changed with the output terminal assignment (Pr.195, Pr.196). (Refer to page 13.)
*10 The function of these terminals can be changed with the output terminal assignment (Pr.190 to Pr.194). (Refer to page 13.)
*11 No function is assigned in the initial status. Assign the function using Pr.186 CS terminal function selection. (Refer to page 13.)
*12 The option connector 2 cannot be used because the Ethernet board is installed in the initial status. The Ethernet board must be removed to install a plug-in option to the option connector 2. (However, Ethernet communication is disabled in that case.)

NOTE

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.

2.2 Main circuit terminals

◆ Cable gauge of main circuit terminals and earth (ground) terminals

Use an appropriate cable gauge to suppress the voltage drop to 2% or less.
If the wiring distance is long between the inverter and motor, the voltage drop in the main circuit will cause the motor torque to decrease especially at a low speed.
The following table indicates a selection example for the wiring length of 20 m.

◆ LD rating (Pr.570 Multiple rating setting = "1")

• 200 V class (220 V input power supply)

Applicable inverter model	Terminal screw Size *4	Tightening torque N·m	Crimp terminal R/L1, S/L2, T/L3	Crimp terminal U, V, W	HIV cables, etc. (mm²) *1 R/L1, S/L2, T/L3	HIV U, V, W	HIV P/+, P1	HIV Earthing (grounding) cable	AWG/MCM *2 R/L1, S/L2, T/L3	AWG/MCM U, V, W	PVC cables, etc. (mm²) *3 R/L1, S/L2, T/L3	PVC U, V, W	PVC Earthing (grounding) cable
FR-F820-00046(0.75K) to 00105(2.2K)	M4	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
FR-F820-00167(3.7K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
FR-F820-00250(5.5K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
FR-F820-00340(7.5K)	M5	2.5	5.5-5	5.5-5	14	5.5	14	5.5	6	10	16	6	16
FR-F820-00490(11K)	M5	2.5	14-5	14-5	14	14	14	8	6	6	16	16	16
FR-F820-00630(15K)	M5	2.5	22-5	22-5	22	22	22	14	4	4	25	25	16
FR-F820-00770(18.5K)	M6	4.4	38-6	22-6	38	22	38	14	2	4	35	25	25
FR-F820-00930(22K)	M8 (M6)	7.8	38-8	38-8	38	38	38	22	2	2	35	35	25
FR-F820-01250(30K)	M8 (M6)	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F820-01540(37K)	M8 (M6)	7.8	80-8	60-8	80	60	80	22	3/0	1/0	70	70	35
FR-F820-01870(45K)	M10 (M8)	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F820-02330(55K)	M10 (M8)	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F820-03160(75K)	M12 (M8)	46	150-12	150-12	125	125	125	38	250	250	120	120	—
FR-F820-03800(90K)	M12 (M8)	46	150-12	150-12	150	150	150	38	2×4/0	2×4/0	150	150	—
FR-F820-04750(110K)	M12 (M8)	46	150-12	150-12	150	150	2×100	60	2×4/0	2×4/0	2×95	2×95	—

• 400 V class (440 V input power supply)

Applicable inverter model	Terminal screw Size *4	Tightening torque N·m	Crimp terminal R/L1, S/L2, T/L3	Crimp terminal U, V, W	HIV cables, etc. (mm²) *1 R/L1, S/L2, T/L3	HIV U, V, W	HIV P/+, P1	HIV Earthing (grounding) cable	AWG/MCM *2 R/L1, S/L2, T/L3	AWG/MCM U, V, W	PVC cables, etc. (mm²) *3 R/L1, S/L2, T/L3	PVC U, V, W	PVC Earthing (grounding) cable
FR-F840-00023(0.75K) to 00083(3.7K)	M4	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
FR-F840-00126(5.5K)	M4	1.5	2-4	2-4	2	2	3.5	3.5	12	14	2.5	2.5	4
FR-F840-00170(7.5K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
FR-F840-00250(11K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	10
FR-F840-00310(15K)	M5	2.5	8-5	5.5-5	8	5.5	8	5.5	8	10	10	6	10
FR-F840-00380(18.5K)	M5	2.5	14-5	8-5	14	8	14	8	6	8	16	10	16
FR-F840-00470(22K)	M6	4.4	14-6	14-6	14	14	22	14	6	6	16	16	16
FR-F840-00620(30K)	M6	4.4	22-6	22-6	22	22	22	14	4	4	25	25	16
FR-F840-00770(37K)	M6	4.4	22-6	22-6	22	22	22	14	4	4	25	25	16
FR-F840-00930(45K)	M8	7.8	38-8	38-8	38	38	38	22	1	2	50	50	25
FR-F840-01160(55K)	M8	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F840-01800(75K)	M8	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F840-02160(90K)	M10	26.5	60-10	60-10	60	60	80	22	1/0	1/0	50	50	25
FR-F840-02600(110K)	M10	26.5	80-10	80-10	80	80	80	22	3/0	3/0	70	70	35
FR-F840-03250(132K)	M10 (M12)	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F840-03610(160K)	M10 (M12)	26.5	150-10	150-10	125	125	150	38	250	250	120	120	70
FR-F840-04320(185K)	M12 (M10)	46	150-12	150-12	150	150	150	38	300	300	150	150	95
FR-F840-04810(220K)	M12 (M10)	46	100-12	100-12	2×100	2×100	2×100	60	2×4/0	2×4/0	2×95	2×95	95
FR-F840-05470(250K)	M12 (M10)	46	100-12	100-12	2×100	2×100	2×125	60	2×4/0	2×4/0	2×95	2×95	95
FR-F840-06100(280K)	M12 (M10)	46	150-12	150-12	2×125	2×125	2×125	60	2×250	2×250	2×120	2×120	120
FR-F840-06830(315K)	M12 (M10)	46	150-12	150-12	2×150	2×150	2×150	60	2×300	2×300	2×150	2×150	150

*1 For FR-F820-02330(55K) or lower and FR-F840-01160(55K) or lower, this cable gauge is with the continuous maximum permissible temperature of 75°C (HIV cable (600 V class 2 vinyl-insulated cable), etc.). Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20 m or less.
For FR-F820-03160(75K) or higher and FR-F840-01800(75K) or higher, this cable gauge is with the continuous maximum permissible temperature of 90°C or higher (LMFC (heat resistant flexible cross-linked polyethylene insulated cable), etc.). Assumes that the surrounding air temperature is 50°C or less and the wiring is in-enclosure.

*2 For all the 200 V class capacities and FR-F840-00930(45K) or lower, this cable gauge is with the continuous maximum permissible temperature of 75°C (THHW cable). This is assumes a surrounding air temperature of 40°C or less and wiring distance of 20 m or less.
For FR-F840-01160(55K) or higher, this cable gauge is with continuous maximum permissible temperature of 90°C (THHN cable). This assumes a surrounding air temperature of 40°C or lower and in-enclosure wiring. (For the use in the United States or Canada, refer to .)

*3 For FR-F820-00770(18.5K) or lower and FR-F840-00930(45K) or lower, the cable gauge is with the continuous maximum permissible temperature of 70°C (PVC cable). This assumes a surrounding air temperature of 40°C or less and wiring distance of 20 m or less.
For FR-F820-00930(22K) or higher and FR-F840-01160(55K) or higher, this cable gauge is with continuous maximum permissible temperature of 90°C (XLPE cable). This assumes a surrounding air temperature of 40°C or less and in-enclosure wiring. (Selection example for use mainly in Europe.)

*4 The terminal screw size indicates the size of the terminal screw for R/L1, S/L2, T/L3, U, V, W, P/+, N/-, P1, P3, and the screw for earthing (grounding).
The screw size for earthing (grounding) of FR-F820-00930(22K) or higher is indicated in parentheses.
The screw size for P/+ terminal for connecting an option to FR-F840-03250(132K) or FR-F840-03610(160K) is indicated in parentheses.
The screw size for earthing (grounding) of FR-F840-04320(185K) or higher is indicated in parenthesis.

◆ SLD rating (Pr.570 Multiple rating setting = "0")

- 200 V class (220 V input power supply)

Applicable inverter model	Terminal screw Size *4	Tightening torque N•m	Crimp terminal R/L1, S/L2, T/L3	Crimp terminal U, V, W	HIV cables, etc. (mm²) *1 R/L1, S/L2, T/L3	HIV U, V, W	HIV P/+, P1	HIV Earthing (grounding) cable	AWG/MCM *2 R/L1, S/L2, T/L3	AWG/MCM U, V, W	PVC cables, etc. (mm²) *3 R/L1, S/L2, T/L3	PVC U, V, W	PVC Earthing (grounding) cable
FR-F820-00046(0.75K) to 00105(2.2K)	M4	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
FR-F820-00167(3.7K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
FR-F820-00250(5.5K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
FR-F820-00340(7.5K)	M5	2.5	14-5	8-5	14	8	14	5.5	6	8	16	10	16
FR-F820-00490(11K)	M5	2.5	14-5	14-5	14	14	14	8	6	6	16	16	16
FR-F820-00630(15K)	M5	2.5	22-5	22-5	22	22	22	14	4	4	25	25	16
FR-F820-00770(18.5K)	M6	4.4	38-6	22-6	38	22	38	14	2	4	50	25	25
FR-F820-00930(22K)	M8 (M6)	7.8	38-8	38-8	38	38	38	22	2	2	50	50	25
FR-F820-01250(30K)	M8 (M6)	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F820-01540(37K)	M8 (M6)	7.8	80-8	80-8	80	80	80	22	3/0	3/0	70	70	35
FR-F820-01870(45K)	M10 (M8)	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F820-02330(55K)	M10 (M8)	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F820-03160(75K)	M12 (M8)	46	150-12	150-12	125	125	125	38	250	250	120	120	—
FR-F820-03800(90K)	M12 (M8)	46	100-12	100-12	150	150	150	38	2×4/0	2×4/0	2×95	2×95	—
FR-F820-04750(110K)	M12 (M8)	46	100-12	100-12	2×100	2×100	2×100	60	2×4/0	2×4/0	2×95	2×95	—

- 400 V class (440 V input power supply)

Applicable inverter model	Terminal screw Size *4	Tightening torque N•m	Crimp terminal R/L1, S/L2, T/L3	Crimp terminal U, V, W	HIV cables, etc. (mm²) *1 R/L1, S/L2, T/L3	HIV U, V, W	HIV P/+, P1	HIV Earthing (grounding) cable	AWG/MCM *2 R/L1, S/L2, T/L3	AWG/MCM U, V, W	PVC cables, etc. (mm²) *3 R/L1, S/L2, T/L3	PVC U, V, W	PVC Earthing (grounding) cable
FR-F840-00023(0.75K) to 00083(3.7K)	M4	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
FR-F840-00126(5.5K)	M4	1.5	2-4	2-4	2	2	3.5	3.5	12	14	2.5	2.5	4
FR-F840-00170(7.5K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
FR-F840-00250(11K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	10
FR-F840-00310(15K)	M5	2.5	8-5	5.5-5	8	5.5	8	5.5	8	10	10	6	10
FR-F840-00380(18.5K)	M5	2.5	14-5	8-5	14	8	14	8	6	8	16	10	16
FR-F840-00470(22K)	M6	4.4	14-6	14-6	14	14	22	14	6	6	16	16	16
FR-F840-00620(30K)	M6	4.4	22-6	22-6	22	22	22	14	4	4	25	25	16
FR-F840-00770(37K)	M6	4.4	22-6	22-6	22	22	22	14	4	4	25	25	16
FR-F840-00930(45K)	M8	7.8	38-8	38-8	38	38	38	22	1	2	50	50	25
FR-F840-01160(55K)	M8	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F840-01800(75K)	M8	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25
FR-F840-02160(90K)	M10	26.5	80-10	80-10	80	80	80	22	3/0	3/0	70	70	35
FR-F840-02600(110K)	M10	26.5	100-10	100-10	100	100	100	38	4/0	4/0	95	95	50
FR-F840-03250(132K)	M10 (M12)	26.5	150-10	150-10	125	125	150	38	250	250	120	120	70
FR-F840-03610(160K)	M10 (M12)	26.5	150-10	150-10	150	150	150	38	300	300	150	150	95
FR-F840-04320(185K)	M12 (M10)	46	100-12	100-12	2×100	2×100	2×100	60	2×4/0	2×4/0	2×95	2×95	95
FR-F840-04810(220K)	M12 (M10)	46	100-12	100-12	2×100	2×100	2×125	60	2×4/0	2×4/0	2×95	2×95	95
FR-F840-05470(250K)	M12 (M10)	46	150-12	150-12	2×125	2×125	2×125	60	2×250	2×250	2×120	2×120	120
FR-F840-06100(280K)	M12 (M10)	46	150-12	150-12	2×150	2×150	2×150	60	2×300	2×300	2×150	2×150	150
FR-F840-06830(315K)	M12 (M10)	46	150-12	150-12	2×200	2×200	2×200	100	2×350	2×350	2×185	2×185	2×95

*1 For all the 200 V class capacities and FR-F840-01160(55K) or lower, this cable gauge is with the continuous maximum permissible temperature of 75°C (HIV cable (600 V class 2 vinyl-insulated cable), etc.). Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20 m or less.
For FR-F840-01800(75K) or higher, this cable gauge is with the continuous maximum permissible temperature of 90°C or higher (LMFC (heat resistant flexible cross-linked polyethylene insulated cable), etc.). Assumes that the surrounding air temperature is 50°C or less and the wiring is in-enclosure.

*2 For all the 200 V class capacities and FR-F840-00930(45K) or lower, this cable gauge is with the continuous maximum permissible temperature of 75°C (THHW cable). This is assumes a surrounding air temperature of 40°C or less and wiring distance of 20 m or less.
For FR-F840-01160(55K) or higher, this cable gauge is with continuous maximum permissible temperature of 90°C (THHN cable). This assumes a surrounding air temperature of 40°C or lower and in-enclosure wiring. (For the use in the United States or Canada, refer to .)

*3 For FR-F820-00930(22K) or lower and FR-F840-00930(45K) or lower, the cable gauge is with the continuous maximum permissible temperature of 70°C (PVC cable). This assumes a surrounding air temperature of 40°C or less and wiring distance of 20 m or less.
For FR-F820-01250(30K) or higher and FR-F840-01160(55K) or higher, this cable gauge is with continuous maximum permissible temperature of 90°C (XLPE cable). This assumes a surrounding air temperature of 40°C and in-enclosure wiring. (Selection example for use mainly in Europe.)

*4 The terminal screw size indicates the size of the terminal screw for R/L1, S/L2, T/L3, U, V, W, P/+, N/-, P1, P3, and the screw for earthing (grounding).
The screw size for earthing (grounding) of FR-F820-00930(22K) or higher is indicated in parentheses.
The screw size for P/+ terminal for connecting an option to FR-F840-03250(132K) or FR-F840-03610(160K) is indicated in parentheses.
The screw size for earthing (grounding) of FR-F840-04320(185K) or higher is indicated in parenthesis.

The line voltage drop can be calculated by the following formula:

Line voltage drop [V] = $\sqrt{3}$ × wire resistance [mΩ/m] × wiring distance [m] × current [A] / 1000

Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

NOTE

- Tighten the terminal screw to the specified torque. A screw that has been tightened too loosely can cause a short circuit or malfunction. A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breakage.
- Use crimping terminals with insulation sleeves to wire the power supply and motor.

2.3 Control circuit terminal

◆ Wiring precautions

- It is recommended to use a cable of 0.3 to 0.75 mm² for connection to the control circuit terminals.
- The wiring length should be 30 m (200 m for terminal FM) at the maximum.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.
- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A1, B1, C1, A2, B2, C2) via a relay coil, lamp, etc.
- Do not connect any terminal SD on the inverter and the 0 V terminal of the external power supply (when the sink logic is selected).

Micro signal contacts   Twin contacts
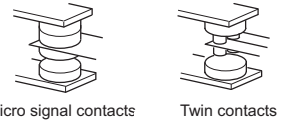
◆ Wiring method

- Crimp terminals commercially available (as of April 2019)

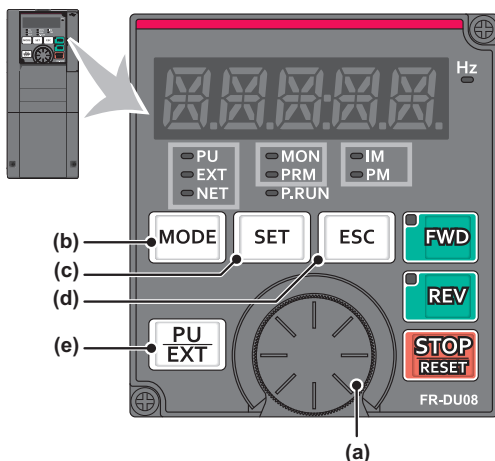| Wire gauge (mm²)	Ferrule part No.			Manufacturer	Crimping tool model No.
	With insulation sleeve	Without insulation sleeve	For UL wire∗1		
0.3	AI 0,34-10TQ	—	—	Phoenix Contact Co., Ltd.	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB		
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB		
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB		
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB∗2		
0.75 (for two wires)	AI-TWIN 2×0,75-10GY	—	—		

∗1   A ferrule terminal with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.
∗2   Applicable for terminals A1, B1, C1, A2, B2, and C2.

Wire gauge (mm²)	Blade terminal part No.	Insulation cap part No.	Manufacturer	Crimping tool model No.
0.3 to 0.75	BT 0.75-11	VC 0.75	NICHIFU Co., Ltd.	NH 69

3 BASIC OPERATION

3.1 Operation panel (FR-DU08)

No.	Name	Description
(a)	Setting dial	The setting dial of the Mitsubishi Electric inverters. Turn the setting dial to change the setting of frequency or parameter, etc. Press the setting dial to perform the following operations: • To display a set frequency in the monitoring mode (The monitor item shown on the display can be changed by using **Pr.992**.) • To display the present setting during calibration • To display a fault history number in the fault history mode
(b)	MODE key	Switches the operation panel to a different mode. The easy setting of the inverter operation mode is enabled by pressing this key simultaneously with [PU/EXT] key. Every key on the operation panel becomes inoperable by pressing this key for 2 seconds. The key inoperable function is invalid when **Pr.161**="0 (initial setting)". (Refer to the FR-A800 Instruction Manual (Detailed).)
(c)	SET key	Confirms each selection. When this key is pressed during inverter operation, the monitor item changes. (The monitor item can be changed according to the settings of **Pr.52, Pr.774 to Pr.776**.)
(d)	ESC key	Goes back to the previous display. Holding this key for a longer time changes the display back to the monitor mode.
(e)	PU/EXT key	Switches between the PU operation mode, the PUJOG operation mode, and the External operation mode. The easy setting of the inverter operation mode is enabled by pressing this key simultaneously with [MODE] key. Also cancels the PU stop warning.

3.1.1 Basic operation of the operation panel (factory setting)

Operation mode switchover/Frequency setting

PU
EXT

External operation mode∗1(At power-ON)

PU
EXT

PU operation mode∗1

PU
EXT

PU Jog operation mode∗1

JOG

Alternating
(Example)

Value change

SET

F

60.00

Frequency setting written and complete!!

Monitor

First screen (Output frequency∗2 monitoring)

SET

0.00A

Second screen
(Output current∗2 monitoring)

SET

0.00V

Third screen
(Output voltage∗2 monitoring)

SET

MODE

Parameter setting

P. 0

P. 79

SET

0

The present setting displayed.

MODE

2

SET

Alternating
(Example)

2 P. 79

Value change

Parameter write complete!!

∗5

MODE

Pr.CLR

ALL.CL

Err.CL

Pr.CPY

Parameter clear

All parameter clear

Fault history clear

Parameter copy

Pr.Md

AUTO

I PM

Pr.CHG

Group parameter setting

Automatic parameter setting

IPM initialization

Initial value change list

Function

FUNC.

SET

TRC - -

Trace function ∗3

PID - -

PID gain tuning ∗3

MODE

Fault record

E - - - - -

(Example)
Blinking
E. THM

Fault record 1 ∗4

(Example)
Blinking
E PUE

Fault record 2 ∗4

(Example)
Blinking
E 0

Fault record 8 ∗4

The last eight fault records can be displayed.
On the display of the last fault record (fault record 1), a decimal point LED is ON.
When the fault history is empty, E 0 is displayed.

ESC
Hold down

∗1 For the details of operation modes, refer to the FR-F800 Instruction Manual (Detailed).
∗2 The monitor items can be changed. (Refer to the FR-F800 Instruction Manual (Detailed).)
∗3 For the details, refer to the FR-F800 Instruction Manual (Detailed).
∗4 For the details of faults history, refer to the FR-F800 Instruction Manual (Detailed).
∗5 The USB memory mode will appear if a USB memory device is connected. Refer to the FR-F800 Instruction Manual (Detailed) for the details of the USB memory mode.

4 FAILSAFE SYSTEM WHICH USES THE INVERTER

When a fault is detected by the protective function, the protective function is activated and outputs a Fault (ALM) signal. However, a fault signal may not be output at an inverter's fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi assures the best quality products, provide an interlock which uses inverter status output signals to prevent accidents such as damage to the machine when the inverter fails for some reason. Also, at the same time consider the system configuration where a failsafe from outside the inverter, without using the inverter, is enabled even if the inverter fails.

◆ Interlock method which uses the inverter status output signals

By combining the inverter output signals to provide an interlock as shown below, an inverter failure can be detected.

Interlock method	Check method	Used signals	Refer to
Inverter protective function operation	Operation check of an alarm contact. Circuit error detection by negative logic.	Fault (ALM) signal	Chapter 5 of the FR-F800 Instruction Manual (Detailed).
Inverter operating status	Operation ready signal check.	Inverter operation ready (RY) signal	Chapter 5 of the FR-F800 Instruction Manual (Detailed).
Inverter running status	Logic check of the start signal and running signal.	Start signal (STF signal, STR signal) Inverter running (RUN) signal	Chapter 5 of the FR-F800 Instruction Manual (Detailed).
Inverter running status	Logic check of the start signal and output current.	Start signal (STF signal, STR signal) Output current detection (Y12) signal	Chapter 5 of the FR-F800 Instruction Manual (Detailed).

◆ Backup method outside the inverter

Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, if an inverter CPU fails in a system interlocked with the inverter's fault, start, and RUN signals, no fault signal will be output and the RUN signal will be kept ON because the inverter CPU is down.

Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as performing a check as below according to the level of importance of the system.

- Start signal and actual operation check

Check the motor running and motor current while the start signal is input to the inverter by comparing the start signal to the inverter and detected speed of the speed detector or detected current of the current detector. Note that the current is flowing through the motor while the motor coasts to stop, even after the inverter's start signal is turned OFF. For the logic check, configure a sequence considering the inverter's deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

- Command speed and actual operation check

Check for a gap between the actual speed and commanded speed by comparing the inverter's speed command and the speed detected by the speed detector.

To the alarm detection sensor
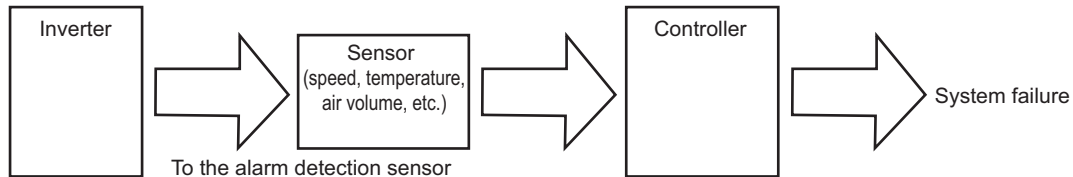
5 PRECAUTIONS FOR USE OF THE INVERTER

The FR-F800 series inverter is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product. Before starting operation, always recheck the following points.

- **Use crimping terminals with insulation sleeves to wire the power supply and the motor.**
- **Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.**
- **After wiring, wire offcuts must not be left in the inverter.**
  Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
  When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- **Use an appropriate cable gauge to suppress the voltage drop to 2% or less.**
  If the wiring distance is long between the inverter and motor, a voltage drop in the main circuit will cause the motor torque to decrease especially during the output of a low frequency.
  Refer to **page 7** for the recommended cable gauge.
- **Keep the total wiring length within the specified length.**
  In long distance wiring, charging currents due to stray capacitance in the wiring may degrade the fast-response current limit operation or cause the equipment on the inverter's output side to malfunction. Pay attention to the total wiring length. (Refer to Chapter 2 of the FR-F800 Instruction Manual (Detailed).)
- **Electromagnetic wave interference**
  The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, activate the EMC filter (turn ON the EMC filter ON/OFF connector) to minimize interference. (Refer to Chapter 3 of the FR-F800 Instruction Manual (Detailed).)

- **Electrical corrosion of the bearing**

  When a motor is driven by the inverter, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing in rare cases depending on the wiring, load, operating conditions of the motor or specific inverter settings (high carrier frequency and EMC filter ON).

  Contact your sales representative to take appropriate countermeasures for the motor.

  The following shows examples of countermeasures for the inverter.
  - Decrease the carrier frequency.
  - Turn OFF the EMC filter.
  - Provide a common mode choke on the output side of the inverter.∗1 (This is effective regardless of the EMC filter ON/OFF connector setting.)
      - ∗1 Recommended common mode choke: FT-3KM F series FINEMET® common mode choke cores manufactured by Hitachi Metals, Ltd.
        FINEMET is a registered trademark of Hitachi Metals, Ltd.

- **Do not install a power factor correction capacitor, surge suppressor or capacitor type filter on the inverter's output side.**

  Doing so will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is connected, immediately remove it.

- **For some short time after the power-OFF, a high voltage remains in the smoothing capacitor, and it is dangerous.**

  A smoothing capacitor holds high voltage some time after power-OFF. When accessing the inverter for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/- of the inverter is low enough using a tester, etc.

- **If "EV" is displayed on the operation panel, turn OFF the 24 V external power supply before performing wiring.**

- **A short circuit or earth (ground) fault on the inverter's output side may damage the inverter module.**
  - Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter module.
  - Fully check the to-earth (ground) insulation and phase-to-phase insulation of the inverter's output side before power-ON.
    Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance, etc.

- **Do not use the magnetic contactor (MC) on the inverter's input side to start/stop the inverter.**

  Since repeated inrush currents at power ON will shorten the life of the converter circuit (1,000,000 times for others), frequent starts and stops of the input side MC must be avoided. Turn ON/OFF the inverter's start signals (STF, STR) to run/stop the inverter. (Refer to **page 5**.)

- **Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.**

  Application of a voltage higher than the permissible voltage to the inverter I/O signal circuits or opposite polarity may damage the I/O devices. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short circuit terminals 10E and 5.

- **To use the commercial power supply during general-purpose motor operation, be sure to provide electrical and mechanical interlocks between the electronic bypass contactors MC1 and MC2.**

  When using a switching circuit as shown right, chattering due to mis-configured sequence or arc generated at switching may allow undesirable current to flow in and damage the inverter. Mis-wiring may also damage the inverter.

  (The commercial power supply operation is not available with PM motors.)
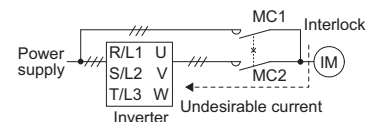
- **If the machine must not be restarted when power is restored after a power failure, provide an MC in the inverter's input side and also make up a sequence which will not switch ON the start signal.**

  If the start signal (start switch) remains ON after a power failure, the inverter will automatically restart as soon as the power is restored.

- **MC on the inverter's input side**

  On the inverter's input side, connect an MC for the following purposes. (For the selection, refer to Chapter 2 of the FR-F800 Instruction Manual (Detailed).)
  - To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.).
  - To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure.
  - To separate the inverter from the power supply to ensure safe maintenance and inspection work.

  If using an MC for emergency stop during operation, select an MC regarding the inverter input side current as JEM 1038-AC-3 class rated current.

- **Handling of the magnetic contactor on the inverter's output side**

  Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When providing MCs to use the commercial power supply during induction motor operation, switch the MCs after both the inverter and motor stop.

  A PM motor is a synchronous motor with high-performance magnets embedded inside. High-voltage is generated at the motor terminals while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, confirm that the motor is stopped. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.

- **Countermeasures against inverter-generated EMI**

  If electromagnetic noise generated from the inverter causes the frequency setting signal to fluctuate and the motor rotation speed to be unstable when changing the motor speed with analog signals, the following countermeasures are effective.
  - Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.
  - Run signal cables as far away as possible from power cables (inverter I/O cables).
  - Use shielded cables.
  - Install a ferrite core on the signal cable (Example: ZCAT3035-1330 TDK).

- **Instructions for overload operation**

  When performing frequent starts/stops by the inverter, rise/fall in the temperature of the transistor element of the inverter will repeat due to a repeated flow of large current, shortening the life from thermal fatigue. Since thermal fatigue is related to the amount of current, the life can be increased by reducing current at locked condition, starting current, etc. Reducing current may extend the service life but may also cause torque shortage, which leads to a start failure. Adding a margin to the current can eliminate such a condition. For an induction motor, use an inverter of a higher capacity (up to 2 ranks). For a PM motor, use an inverter and PM motor of higher capacities.

- **Make sure that the specifications and rating match the system requirements.**

6 Parameter list

For simple variable-speed operation of the inverter, the initial values of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be performed from the operation panel (FR-DU08).

Pr.	Name	Setting range	Initial value
0*13	Torque boost	0 to 30%	6/4/3/2/1.5/1%*1
1*13	Maximum frequency	0 to 120Hz	120Hz*2 / 60Hz*3
2*13	Minimum frequency	0 to 120Hz	0Hz
3*13	Base frequency	0 to 590Hz	60/50Hz*9
4*13	Multi-speed setting (high speed)	0 to 590Hz	60/50Hz*9
5*13	Multi-speed setting (middle speed)	0 to 590Hz	30Hz
6*13	Multi-speed setting (low speed)	0 to 590Hz	10Hz
7*13	Acceleration time	0 to 3600s	5s*4 / 15s*5
8*13	Deceleration time	0 to 3600s	10s*4 / 30s*5
9*13	Electronic thermal O/L relay	0 to 500A*2 / 0 to 3600A*3	Inverter rated current
10	DC injection brake operation frequency	0 to 120Hz, 9999	3Hz
11	DC injection brake operation time	0 to 10s, 8888	0.5s
12	DC injection brake operation voltage	0 to 30%	4/2/1%*6
13	Starting frequency	0 to 60Hz	0.5Hz
14	Load pattern selection	0, 1, 12 to 15	1
15	Jog frequency	0 to 590Hz	5Hz
16	Jog acceleration/deceleration time	0 to 3600s	0.5s
17	MRS input selection	0, 2, 4	0
18	High speed maximum frequency	0 to 590Hz	120Hz*2 / 60Hz*3
19	Base frequency voltage	0 to 1000V, 8888, 9999	9999/8888*9
20	Acceleration/deceleration reference frequency	1 to 590Hz	60/50Hz*9
21	Acceleration/deceleration time increments	0, 1	0
22	Stall prevention operation level (Torque limit level)	0 to 400%	120/110%*9
23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	9999
24 to 27	Multi-speed setting (4 speed to 7 speed)	0 to 590Hz, 9999	9999
28	Multi-speed input compensation selection	0, 1	0
29	Acceleration/deceleration pattern selection	0 to 3, 6	0
30	Regenerative function selection	0 to 2, 10, 11, 20, 21, 100 to 102, 110, 111, 120, 121	0
31	Frequency jump 1A	0 to 590Hz, 9999	9999
32	Frequency jump 1B		9999
33	Frequency jump 2A		9999
34	Frequency jump 2B		9999
35	Frequency jump 3A		9999
36	Frequency jump 3B		9999
37	Speed display	0, 1 to 9998	0
41	Up-to-frequency sensitivity	0 to 100%	10%
42	Output frequency detection	0 to 590Hz	6Hz
43	Output frequency detection for reverse rotation	0 to 590Hz, 9999	9999
44	Second acceleration/deceleration time	0 to 3600s	5s
45	Second deceleration time	0 to 3600s, 9999	9999
46	Second torque boost	0 to 30%, 9999	9999
47	Second V/F (base frequency)	0 to 590Hz, 9999	9999
48	Second stall prevention operation level	0 to 400%	120/110%*9
49	Second stall prevention operation frequency	0 to 590Hz, 9999	0Hz
50	Second output frequency detection	0 to 590Hz	30Hz

Pr.	Name	Setting range	Initial value
51	Second electronic thermal O/L relay	0 to 500A, 9999*2 / 0 to 3600A, 9999*3	9999
52	Operation panel main monitor selection	0, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	0
54	FM/CA terminal function selection*9	1 to 5, 7 to 14, 17, 18, 21, 24, 34, 50, 52, 53, 61, 62, 67, 69, 70, 83, 85 to 90, 92, 93, 95, 98	1
55	Frequency monitoring reference	0 to 590Hz	60/50Hz*9
56	Current monitoring reference	0 to 500A*2 / 0 to 3600A*3	Inverter LD/SLD rated current*9
57	Restart coasting time	0, 0.1 to 30s, 9999	9999
58	Restart cushion time	0 to 60s	1s
59	Remote function selection	0 to 3, 11 to 13	0
60	Energy saving control selection	0, 4, 9	0
65	Retry selection	0 to 5	0
66	Stall prevention operation reduction starting frequency	0 to 590Hz	60/50Hz*9
67	Number of retries at fault occurrence	0 to 10, 101 to 110	0
68	Retry waiting time	0.1 to 600s	1s
69	Retry count display erase	0	0
70	Parameter for manufacturer setting. Do not set.		
71	Applied motor	0 to 6, 13 to 16, 20, 23, 24, 40, 43, 44, 50, 53, 54, 70, 73, 74, 210, 213, 214, 240, 243, 244, 8090, 8093, 8094, 9090, 9093, 9094	0
72	PWM frequency selection	0 to 15*2 / 0 to 6, 25*3	2
73	Analog input selection	0 to 7, 10 to 17	1
74	Input filter time constant	0 to 8	1
75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17, 1000 to 1003, 1014 to 1017*2 / 0 to 3, 14 to 17, 100 to 103, 114 to 117, 1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117*3	14
76	Fault code output selection	0 to 2	0
77	Parameter write selection	0 to 2	0
78	Reverse rotation prevention selection	0 to 2	0
79*13	Operation mode selection	0 to 4, 6, 7	0
80	Motor capacity	0.4 to 55kW, 9999*2 / 0 to 3600kW, 9999*3	9999
81	Number of motor poles	2, 4, 6, 8, 10, 12, 9999	9999
82	Motor excitation current	0 to 500A, 9999*2 / 0 to 3600A, 9999*3	9999
83	Rated motor voltage	0 to 1000V	200/400V*7
84	Rated motor frequency	10 to 400Hz, 9999	9999
85	Excitation current break point	0 to 400Hz, 9999	9999
86	Excitation current low-speed scaling factor	0 to 300%, 9999	9999
89	Speed control gain (Advanced magnetic flux vector)	0 to 200%, 9999	9999
90	Motor constant (R1)	0 to 50Ω, 9999*2 / 0 to 400mΩ, 9999*3	9999

Pr.	Name	Setting range	Initial value
91	Motor constant (R2)	0 to 50Ω, 9999*2 / 0 to 400mΩ, 9999*3	9999
92	Motor constant (L1)/d-axis inductance (Ld)	0 to 6000mH, 9999*2 / 0 to 400mH, 9999*3	9999
93	Motor constant (L2)/q-axis inductance (Lq)	0 to 6000mH, 9999*2 / 0 to 400mH, 9999*3	9999
94	Motor constant (X)	0 to 100%, 9999	9999
95	Online auto tuning selection	0, 1	0
96	Auto tuning setting/status	0, 1, 11, 101	0
100	V/F1 (first frequency)	0 to 590Hz, 9999	9999
101	V/F1 (first frequency voltage)	0 to 1000V	0V
102	V/F2 (second frequency)	0 to 590Hz, 9999	9999
103	V/F2 (second frequency voltage)	0 to 1000V	0V
104	V/F3 (third frequency)	0 to 590Hz, 9999	9999
105	V/F3 (third frequency voltage)	0 to 1000V	0V
106	V/F4 (fourth frequency)	0 to 590Hz, 9999	9999
107	V/F4 (fourth frequency voltage)	0 to 1000V	0V
108	V/F5 (fifth frequency)	0 to 590Hz, 9999	9999
109	V/F5 (fifth frequency voltage)	0 to 1000V	0V
111	Check valve deceleration time	0 to 3600s, 9999	9999
117	PU communication station number	0 to 31	0
118	PU communication speed	48, 96, 192, 384, 576, 768, 1152	192
119	PU communication stop bit length / data length	0, 1, 10, 11	1
120	PU communication parity check	0 to 2	2
121	PU communication retry count	0 to 10, 9999	1
122	PU communication check time interval	0, 0.1 to 999.8s, 9999	9999
123	PU communication waiting time setting	0 to 150ms, 9999	9999
124	PU communication CR/LF selection	0 to 2	1
125*13	Terminal 2 frequency setting gain frequency	0 to 590Hz	60/50Hz*9
126*13	Terminal 4 frequency setting gain frequency	0 to 590Hz	60/50Hz*9
127	PID control automatic switchover frequency	0 to 590Hz, 9999	9999
128	PID action selection	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	0
129	PID proportional band	0.1 to 1000%, 9999	100%
130	PID integral time	0.1 to 3600s, 9999	1s
131	PID upper limit	0 to 100%, 9999	9999
132	PID lower limit	0 to 100%, 9999	9999
133	PID action set point	0 to 100%, 9999	9999
134	PID differential time	0.01 to 10s, 9999	9999
135	Electronic bypass sequence selection	0, 1	0
136	MC switchover interlock time	0 to 100s	1s
137	Start waiting time	0 to 100s	0.5s
138	Bypass selection at a fault	0, 1	0
139	Automatic switchover frequency from inverter to bypass operation	0 to 60Hz, 9999	9999
140	Backlash acceleration stopping frequency	0 to 590Hz	1Hz
141	Backlash acceleration stopping time	0 to 360s	0.5s
142	Backlash deceleration stopping frequency	0 to 590Hz	1Hz
143	Backlash deceleration stopping time	0 to 360s	0.5s

Pr.	Name	Setting range	Initial value
144	Speed setting switchover	0, 2, 4, 6, 8, 10, 12, 102, 104, 106, 108, 110, 112	4
145	PU display language selection	0 to 7	—
147	Acceleration/deceleration time switching frequency	0 to 590Hz, 9999	9999
148	Stall prevention level at 0 V input	0 to 400%	120/110%*9
149	Stall prevention level at 10 V input	0 to 400%	150/120%*9
150	Output current detection level	0 to 400%	120/110%*9
151	Output current detection signal delay time	0 to 10s	0s
152	Zero current detection level	0 to 400%	5%
153	Zero current detection time	0 to 10s	0.5s
154	Voltage reduction selection during stall prevention operation	0, 1, 10, 11	1
155	RT signal function validity condition selection	0, 10	0
156	Stall prevention operation selection	0 to 31, 100, 101	0
157	OL signal output timer	0 to 25s, 9999	0s
158	AM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52 to 54, 61, 62, 67, 69, 70, 86 to 96, 98	1
159	Automatic switchover frequency range from bypass to inverter operation	0 to 10Hz, 9999	9999
160*13	User group read selection	0, 1, 9999	9999/0*9
161	Frequency setting/key lock operation selection	0, 1, 10, 11	0
162	Automatic restart after instantaneous power failure selection	0 to 3, 10 to 13, 1000 to 1003, 1010 to 1013	0
163	First cushion time for restart	0 to 20s	0s
164	First cushion voltage for restart	0 to 100%	0%
165	Stall prevention operation level for restart	0 to 400%	120/110%*9
166	Output current detection signal retention time	0 to 10s, 9999	0.1s
167	Output current detection operation selection	0, 1, 10, 11	0
168	Parameter for manufacturer setting. Do not set.		
169			
170	Watt-hour meter clear	0, 10, 9999	9999
171	Operation hour meter clear	0, 9999	9999
172	User group registered display/batch clear	9999, (0 to 16)	0
173	User group registration	0 to 1999, 9999	9999
174	User group clear	0 to 1999, 9999	9999
178	STF terminal function selection		60
179	STR terminal function selection		61
180	RL terminal function selection	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 37, 46 to 48, 50, 51, 57, 58, 60 to 62, 64 to 67, 70 to 73, 77 to 81, 84, 94 to 98, 128, 129, 9999 *11	0
181	RM terminal function selection		1
182	RH terminal function selection		2
183	RT terminal function selection		3
184	AU terminal function selection		4
185	JOG terminal function selection		5
186	CS terminal function selection		9999
187	MRS terminal function selection		24
188	STOP terminal function selection		25
189	RES terminal function selection		62

Pr.	Name	Setting range	Initial value
190	RUN terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90 to 96, 98 to 105, 107, 108, 110 to 116, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 242, 247, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 342, 347, 9999*12	0
191	SU terminal function selection		1
192	IPF terminal function selection		2
193	OL terminal function selection		3
194	FU terminal function selection		4
195	ABC1 terminal function selection		99
196	ABC2 terminal function selection		9999
232 to 239	Multi-speed setting (8 speed to 15 speed)	0 to 590Hz, 9999	9999
240	Soft-PWM operation selection	0, 1	1
241	Analog input display unit switchover	0, 1	0
242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	100%
243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	75%
244	Cooling fan operation selection	0, 1, 101 to 105, 1000, 1001, 1101 to 1105	1
245	Rated slip	0 to 50%, 9999	9999
246	Slip compensation time constant	0.01 to 10s	0.5s
247	Constant-power range slip compensation selection	0, 9999	9999
248	Self power management selection	0 to 2	0
249	Earth (ground) fault detection at start	0, 1	0
250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	9999
251	Output phase loss protection selection	0, 1	1
252	Override bias	0 to 200%	50%
253	Override gain	0 to 200%	150%
254	Main circuit power OFF waiting time	1 to 3600s, 9999	600s
255	Life alarm status display	(0 to 255)	0
256	Inrush current limit circuit life display	(0 to 100%)	100%
257	Control circuit capacitor life display	(0 to 100%)	100%
258	Main circuit capacitor life display	(0 to 100%)	100%
259	Main circuit capacitor life measuring	0, 1, 11	0
260	PWM frequency automatic switchover	0, 1	1
261	Power failure stop selection	0 to 2, 11, 12, 21, 22	0
262	Subtracted frequency at deceleration start	0 to 20Hz	3Hz
263	Subtraction starting frequency	0 to 590Hz, 9999	60/50Hz*9
264	Power-failure deceleration time 1	0 to 3600s	5s
265	Power-failure deceleration time 2	0 to 3600s, 9999	9999
266	Power failure deceleration time switchover frequency	0 to 590Hz	60/50Hz*9
267	Terminal 4 input selection	0 to 2	0
268	Monitor decimal digits selection	0, 1, 9999	9999
269	Parameter for manufacturer setting. Do not set.		
289	Inverter output terminal filter	5 to 50ms, 9999	9999
290	Monitor negative output selection	0 to 7	0
291	Pulse train I/O selection	0, 1, 10, 11, 20, 21, 100 (FM type) / 0, 1 (CA type)	0
294	UV avoidance voltage gain	0 to 200%	100%
295	Frequency change increment amount setting	0, 0.01, 0.10, 1.00, 10.00	0
296	Password lock level	0 to 6, 99, 100 to 106, 199, 9999	9999

Pr.	Name	Setting range	Initial value
297	Password lock/unlock	(0 to 5), 1000 to 9998, 9999	9999
298	Frequency search gain	0 to 32767, 9999	9999
299	Rotation direction detection selection at restarting	0, 1, 9999	9999
313 *14	DO0 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 96, 98 to 105, 107, 108, 110 to 116, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 166, 168, 170 to 180, 185 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 242, 247, 248, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 342, 347, 348, 9999	9999
314 *14	DO1 output selection		9999
315 *14	DO2 output selection		9999
316 *14	DO3 output selection		9999
317 *14	DO4 output selection		9999
318 *14	DO5 output selection		9999
319 *14	DO6 output selection		9999
320 *14	RA1 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 91, 94 to 96, 98, 99, 200 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 242, 247, 248, 9999	9999
321 *14	RA2 output selection		9999
322 *14	RA3 output selection		9999
338	Communication operation command source	0, 1	0
339	Communication speed command source	0 to 2	0
340	Communication startup mode selection	0 to 2, 10, 12	0
342	Communication EEPROM write selection	0, 1	0
349	Communication reset selection/Ready bit status selection/Reset selection when inverter errors cleared	0, 1, 100, 101, 1000, 1001, 1100, 1101, 10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101	0
374	Overspeed detection level	0 to 590Hz, 9999	9999
384	Input pulse division scaling factor	0 to 250	0
385	Frequency for zero input pulse	0 to 590Hz	0
386	Frequency for maximum input pulse	0 to 590Hz	60/50Hz*9
390	% setting reference frequency	1 to 590Hz	60/50Hz*9
414	PLC function operation selection	0 to 2, 11, 12	0
415	Inverter operation lock mode setting	0, 1	0
416	Pre-scale function selection	0 to 5	0
417	Pre-scale setting value	0 to 32767	1
450	Second applied motor	0, 1, 3 to 6, 13 to 16, 20, 23, 24, 40, 43, 44, 50, 53, 54, 70, 73, 74, 210, 213, 214, 240, 243, 244, 8090, 8093, 8094, 9090, 9093, 9094, 9999	9999
453	Second motor capacity	0.4 to 55kW, 9999*2 / 0 to 3600kW, 9999*3	9999
454	Number of second motor poles	2, 4, 6, 8, 10, 12, 9999	9999
455	Second motor excitation current	0 to 500A, 9999*2 / 0 to 3600A, 9999*3	9999
456	Rated second motor voltage	0 to 1000V	200/400V*7
457	Rated second motor frequency	10 to 400Hz, 9999	9999
458	Second motor constant (R1)	0 to 50Ω, 9999*2 / 0 to 400mΩ, 9999*3	9999

Pr.	Name	Setting range	Initial value
459	Second motor constant (R2)	0 to 50Ω, 9999*2 / 0 to 400mΩ, 9999*3	9999
460	Second motor constant (L1) / d-axis inductance (Ld)	0 to 6000mH, 9999*2 / 0 to 400mH, 9999*3	9999
461	Second motor constant (L2) / q-axis inductance (Lq)	0 to 6000mH, 9999*2 / 0 to 400mH, 9999*3	9999
462	Second motor constant (X)	0 to 100%, 9999	9999
463	Second motor auto tuning setting/status	0, 1, 11, 101	0
495	Remote output selection	0, 1, 10, 11	0
496	Remote output data 1	0 to 4095	0
497	Remote output data 2	0 to 4095	0
498	PLC function flash memory clear	0, 9696 (0 to 9999)	0
502	Stop mode selection at communication error	0 to 4	0
503	Maintenance timer 1	0 (1 to 9998)	0
504	Maintenance timer 1 warning output set time	0 to 9998, 9999	9999
505	Speed setting reference	1 to 590Hz	60/50Hz*9
506	Display estimated main circuit capacitor residual life	(0 to 100%)	100%
507	Display/reset ABC1 relay contact life	(0 to 100%)	100%
508	Display/reset ABC2 relay contact life	(0 to 100%)	100%
514	Emergency drive dedicated retry waiting time	0.1 to 600s, 9999	9999
515	Emergency drive dedicated retry count	1 to 200, 9999	1
522	Output stop frequency	0 to 590Hz, 9999	9999
523	Emergency drive mode selection	100, 111, 112, 121, 122, 123, 124, 200, 211, 212, 221, 222, 223, 224, 300, 311, 312, 321, 322, 323, 324, 400, 411, 412, 421, 422, 423, 424, 9999	9999
524	Emergency drive running speed	0 to 590Hz/ 0 to 100%, 9999	9999
541	Frequency command sign selection	0, 1	0
544	CC-Link extended setting	0, 1, 12, 14, 18, 24, 28, 100, 112, 114, 118, 128	0
547	USB communication station number	0 to 31	0
548	USB communication check time interval	0 to 999.8s, 9999	9999
550	NET mode operation command source selection	0, 1, 5, 9999	9999
551	PU mode operation command source selection	1 to 3, 5, 9999	9999
552	Frequency jump range	0 to 30Hz, 9999	9999
553	PID deviation limit	0 to 100%, 9999	9999
554	PID signal operation selection	0 to 7, 10 to 17	0
555	Current average time	0.1 to 1.0s	1s
556	Data output mask time	0 to 20s	0s
557	Current average value monitor signal output reference current	0 to 500A*2 / 0 to 3600A*3	Inverter LD/SLD rated current*9
560	Second frequency search gain	0 to 32767, 9999	9999
561	PTC thermistor protection level	0.5 to 30kΩ, 9999	9999
563	Energization time carrying-over times	(0 to 65535)	0
564	Operating time carrying-over times	(0 to 65535)	0
565	Second motor excitation current break point	0 to 400Hz, 9999	9999
566	Second motor excitation current low-speed scaling factor	0 to 300%, 9999	9999
569	Second motor speed control gain	0 to 200%, 9999	9999
570	Multiple rating setting	0, 1	1/0*9
571	Holding time at a start	0 to 10s, 9999	9999
573	4 mA input check selection	1 to 4, 11 to 14, 21 to 24, 9999	9999
574	Second motor online auto tuning	0, 1	0

Pr.	Name	Setting range	Initial value
575	Output interruption detection time	0 to 3600s, 9999	1s
576	Output interruption detection level	0 to 590Hz	0Hz
577	Output interruption cancel level	900 to 1100%	1000%
578	Auxiliary motor operation selection	0 to 3	0
579	Motor connection function selection	0 to 3	0
580	MC switchover interlock time (multi-pump)	0 to 100s	1s
581	Start waiting time (multi-pump)	0 to 100s	1s
582	Auxiliary motor connection-time deceleration time	0 to 3600s, 9999	1s
583	Auxiliary motor disconnection-time acceleration time	0 to 3600s, 9999	1s
584	Auxiliary motor 1 starting frequency	0 to 590Hz	60/50Hz*9
585	Auxiliary motor 2 starting frequency	0 to 590Hz	60/50Hz*9
586	Auxiliary motor 3 starting frequency	0 to 590Hz	60/50Hz*9
587	Auxiliary motor 1 stopping frequency	0 to 590Hz	0Hz
588	Auxiliary motor 2 stopping frequency	0 to 590Hz	0Hz
589	Auxiliary motor 3 stopping frequency	0 to 590Hz	0Hz
590	Auxiliary motor start detection time	0 to 3600s	5s
591	Auxiliary motor stop detection time	0 to 3600s	5s
592	Traverse function selection	0 to 2	0
593	Maximum amplitude amount	0 to 25%	10%
594	Amplitude compensation amount during deceleration	0 to 50%	10%
595	Amplitude compensation amount during acceleration	0 to 50%	10%
596	Amplitude acceleration time	0.1 to 3600s	5s
597	Amplitude deceleration time	0.1 to 3600s	5s
598	Undervoltage level	175 to 215VDC/ 350 to 430VDC*7, 9999	9999
599	X10 terminal input selection	0,1	0
600	First free thermal reduction frequency 1	0 to 590Hz, 9999	9999
601	First free thermal reduction ratio 1	1 to 100%	100%
602	First free thermal reduction frequency 2	0 to 590Hz, 9999	9999
603	First free thermal reduction ratio 2	1 to 100%	100%
604	First free thermal reduction frequency 3	0 to 590Hz, 9999	9999
606	Power failure stop external signal input selection	0, 1	1
607	Motor permissible load level	110 to 250%	150%
608	Second motor permissible load level	110 to 250%, 9999	9999
609	PID set point/deviation input selection	1 to 5	2
610	PID measured value input selection	1 to 5, 101 to 105	3
611	Acceleration time at a restart	0 to 3600s, 9999	9999
617	Reverse rotation excitation current low-speed scaling factor	0 to 300%, 9999	9999
653	Speed smoothing control	0 to 200%	0
654	Speed smoothing cutoff frequency	0 to 120Hz	20Hz
655	Analog remote output selection	0, 1, 10, 11	0
656	Analog remote output 1	800 to 1200%	1000%
657	Analog remote output 2	800 to 1200%	1000%
658	Analog remote output 3	800 to 1200%	1000%
659	Analog remote output 4	800 to 1200%	1000%
660	Increased magnetic excitation deceleration operation selection	0, 1	0
661	Magnetic excitation increase rate	0 to 40%, 9999	9999
662	Increased magnetic excitation current level	0 to 300%	100%
663	Control circuit temperature signal output level	0 to 100°C	0°C

Pr.	Name	Setting range	Initial value
665	Regeneration avoidance frequency gain	0 to 200%	100%
668	Power failure stop frequency gain	0 to 200%	100%
673	SF-PR slip amount adjustment operation selection	2, 4, 6, 9999	9999
674	SF-PR slip amount adjustment gain	0 to 500%	100%
675	User parameter auto storage function selection	1, 9999	9999
684	Tuning data unit switchover	0, 1	0
686	Maintenance timer 2	0 (1 to 9998)	0
687	Maintenance timer 2 warning output set time	0 to 9998, 9999	9999
688	Maintenance timer 3	0 (1 to 9998)	0
689	Maintenance timer 3 warning output set time	0 to 9998, 9999	9999
692	Second free thermal reduction frequency 1	0 to 590Hz, 9999	9999
693	Second free thermal reduction ratio 1	1 to 100%	100%
694	Second free thermal reduction frequency 2	0 to 590Hz, 9999	9999
695	Second free thermal reduction ratio 2	1 to 100%	100%
696	Second free thermal reduction frequency 3	0 to 590Hz, 9999	9999
699	Input terminal filter	5 to 50ms, 9999	9999
702	Maximum motor frequency	0 to 400Hz, 9999	9999
706	Induced voltage constant (phi f)	0 to 5000mV/ (rad/s), 9999	9999
707	Motor inertia (integer)	10 to 999, 9999	9999
711	Motor Ld decay ratio	0 to 100%, 9999	9999
712	Motor Lq decay ratio	0 to 100%, 9999	9999
717	Starting resistance tuning compensation	0 to 200%, 9999	9999
721	Starting magnetic pole position detection pulse width	0 to 6000µs, 10000 to 16000µs, 9999	9999
724	Motor inertia (exponent)	0 to 7, 9999	9999
725	Motor protection current level	100 to 500%, 9999	9999
726	Auto Baudrate/Max Master	0 to 255	255
727	Max Info Frames	1 to 255	1
728	Device instance number (Upper 3 digits)	0 to 419	0
729	Device instance number (Lower 4 digits)	0 to 9999	0
738	Second motor induced voltage constant (phi f)	0 to 5000mV/ (rad/s), 9999	9999
739	Second motor Ld decay ratio	0 to 100%, 9999	9999
740	Second motor Lq decay ratio	0 to 100%, 9999	9999
741	Second starting resistance tuning compensation	0 to 200%, 9999	9999
742	Second motor magnetic pole detection pulse width	0 to 6000µs, 10000 to 16000µs, 9999	9999
743	Second motor maximum frequency	0 to 400Hz, 9999	9999
744	Second motor inertia (integer)	10 to 999, 9999	9999
745	Second motor inertia (exponent)	0 to 7, 9999	9999
746	Second motor protection current level	100 to 500%, 9999	9999
753	Second PID action selection	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	0
754	Second PID control automatic switchover frequency	0 to 590Hz, 9999	9999
755	Second PID action set point	0 to 100%, 9999	9999
756	Second PID proportional band	0.1 to 1000%, 9999	100%
757	Second PID integral time	0.1 to 3600s, 9999	1s
758	Second PID differential time	0.01 to 10.00s, 9999	9999
759	PID unit selection	0 to 43, 9999	9999
760	Pre-charge fault selection	0, 1	0
761	Pre-charge ending level	0 to 100%, 9999	9999
762	Pre-charge ending time	0 to 3600s, 9999	9999

Pr.	Name	Setting range	Initial value
763	Pre-charge upper detection level	0 to 100%, 9999	9999
764	Pre-charge time limit	0 to 3600s, 9999	9999
765	Second pre-charge fault selection	0, 1	0
766	Second pre-charge ending level	0 to 100%, 9999	9999
767	Second pre-charge ending time	0 to 3600s, 9999	9999
768	Second pre-charge upper detection level	0 to 100%, 9999	9999
769	Second pre-charge time limit	0 to 3600s, 9999	9999
774	Operation panel monitor selection 1	1 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98,100, 9999	9999
775	Operation panel monitor selection 2		9999
776	Operation panel monitor selection 3		9999
777	4 mA input check operation frequency	0 to 590Hz, 9999	9999
778	4 mA input check filter	0 to 10s	0s
779	Operation frequency during communication error	0 to 590Hz, 9999	9999
791	Acceleration time in low-speed range	0 to 3600s, 9999	9999
792	Deceleration time in low-speed range	0 to 3600s, 9999	9999
799	Pulse increment setting for output power	0.1, 1, 10, 100, 1000kWh	1kWh
800	Control method selection	9, 20, 109, 110	20
820	Speed control P gain 1	0 to 1000%	25%
821	Speed control integral time 1	0 to 20s	0.333s
822	Speed setting filter 1	0 to 5s, 9999	9999
824	Torque control P gain 1 (current loop proportional gain)	0 to 500%	50%
825	Torque control integral time 1 (current loop integral time)	0 to 500ms	40ms
827	Torque detection filter 1	0 to 0.1s	0s
828	Parameter for manufacturer setting. Do not set.		
830	Speed control P gain 2	0 to 1000%, 9999	9999
831	Speed control integral time 2	0 to 20s, 9999	9999
832	Speed setting filter 2	0 to 5s, 9999	9999
834	Torque control P gain 2	0 to 500%, 9999	9999
835	Torque control integral time 2	0 to 500ms, 9999	9999
837	Torque detection filter 2	0 to 0.1s, 9999	9999
849	Analog input offset adjustment	0 to 200%	100%
858	Terminal 4 function assignment	0, 4, 9999	0
859	Torque current/Rated PM motor current	0 to 500A, 9999*2 / 0 to 3600A, 9999*3	9999
860	Second motor torque current/Rated PM motor current	0 to 500A, 9999*2 / 0 to 3600A, 9999*3	9999
864	Torque detection	0 to 400%	150%
866	Torque monitoring reference	0 to 400%	150%
867	AM output filter	0 to 5s	0.01s
868	Terminal 1 function assignment	0, 4, 9999	0
869*10	Current output filter	0 to 5s	0.02s
870	Speed detection hysteresis	0 to 5Hz	0Hz
872	Input phase loss protection selection	0, 1	0
874	OLT level setting	0 to 400%	120/110% *9
882	Regeneration avoidance operation selection	0 to 2	0
883	Regeneration avoidance operation level	300 to 800V	DC380/DC760V*7
884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	0
885	Regeneration avoidance compensation frequency limit value	0 to 590Hz, 9999	6Hz
886	Regeneration avoidance voltage gain	0 to 200%	100%
888	Free parameter 1	0 to 9999	9999
889	Free parameter 2	0 to 9999	9999
891	Cumulative power monitor digit shifted times	0 to 4, 9999	9999

Pr.	Name	Setting range	Initial value
892	Load factor	30 to 150%	100%
893	Energy saving monitor reference (motor capacity)	0.1 to 55kW*2 / 0 to 3600kW*3	Inverter LD/SLD rated capacity*9
894	Control selection during commercial power-supply operation	0 to 3	0
895	Power saving rate reference value	0, 1, 9999	9999
896	Power unit cost	0 to 500, 9999	9999
897	Power saving monitor average time	0, 1 to 1000h, 9999	9999
898	Power saving cumulative monitor clear	0, 1, 10, 9999	9999
899	Operation time rate (estimated value)	0 to 100%, 9999	9999
C0 (900)*8	FM/CA terminal calibration*9	—	—
C1 (901)*8	AM terminal calibration	—	—
C2 (902)*8	Terminal 2 frequency setting bias frequency	0 to 590Hz	0Hz
C3 (902)*8	Terminal 2 frequency setting bias	0 to 300%	0%
125 (903)*8	Terminal 2 frequency setting gain frequency	0 to 590Hz	60/50Hz*9
C4 (903)*8	Terminal 2 frequency setting gain	0 to 300%	100%
C5 (904)*8	Terminal 4 frequency setting bias frequency	0 to 590Hz	0Hz
C6 (904)*8	Terminal 4 frequency setting bias	0 to 300%	20%
126 (905)*8	Terminal 4 frequency setting gain frequency	0 to 590Hz	60/50Hz*9
C7 (905)*8	Terminal 4 frequency setting gain	0 to 300%	100%
C12 (917)*8	Terminal 1 bias frequency (speed)	0 to 590Hz	0Hz
C13 (917)*8	Terminal 1 bias (speed)	0 to 300%	0%
C14 (918)*8	Terminal 1 gain frequency (speed)	0 to 590Hz	60/50Hz*9
C15 (918)*8	Terminal 1 gain (speed)	0 to 300%	100%
C16 (919)*8	Terminal 1 bias command (torque/magnetic flux)	0 to 400%	0%
C17 (919)*8	Terminal 1 bias (torque/magnetic flux)	0 to 300%	0%
C18 (920)*8	Terminal 1 gain command (torque/magnetic flux)	0 to 400%	150%
C19 (920)*8	Terminal 1 gain (torque/magnetic flux)	0 to 300%	100%
C8 (930)*8,*10	Current output bias signal	0 to 100%	0%
C9 (930)*8,*10	Current output bias current	0 to 100%	0%
C10 (931)*8,*10	Current output gain signal	0 to 100%	100%
C11 (931)*8,*10	Current output gain current	0 to 100%	100%
C38 (932)*8	Terminal 4 bias command (torque/magnetic flux)	0 to 400%	0%
C39 (932)*8	Terminal 4 bias (torque/magnetic flux)	0 to 300%	20%
C40 (933)*8	Terminal 4 gain command (torque/magnetic flux)	0 to 400%	150%
C41 (933)*8	Terminal 4 gain (torque/magnetic flux)	0 to 300%	100%
C42 (934)*8	PID display bias coefficient	0 to 500.00, 9999	9999
C43 (934)*8	PID display bias analog value	0 to 300%	20%
C44 (935)*8	PID display gain coefficient	0 to 500.00, 9999	9999
C45 (935)*8	PID display gain analog value	0 to 300%	100%
977	Input voltage mode selection	0, 1	0
989	Parameter copy alarm release	10*2 / 100*3	10*2 / 100*3
990	PU buzzer control	0, 1	1
991	PU contrast adjustment	0 to 63	58
992	Operation panel setting dial push monitor selection	0 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98,100	0

Pr.	Name	Setting range	Initial value
997	Fault initiation	0 to 255, 9999	9999
998*13	PM parameter initialization	0, 12, 14, 112, 114, 8009, 8109, 9009, 9109	0
999*13	Automatic parameter setting	1, 2,10 to 13, 20, 21, 9999	9999
1000	Direct setting selection	0 to 2	0
1002	Lq tuning target current adjustment coefficient	50 to 150%, 9999	9999
1006	Clock (year)	2000 to 2099	2000
1007	Clock (month, day)	101 to 131, 201 to 229, 301 to 331, 401 to 430, 501 to 531, 601 to 630, 701 to 731, 801 to 831, 901 to 930, 1001 to 1031, 1101 to 1130, 1201 to 1231	101
1008	Clock (hour, minute)	0 to 59, 100 to 159, 200 to 259, 300 to 359, 400 to 459, 500 to 559, 600 to 659, 700 to 759, 800 to 859, 900 to 959, 1000 to 1059, 1100 to 1159, 1200 to 1259, 1300 to 1359, 1400 to 1459, 1500 to 1559, 1600 to 1659, 1700 to 1759, 1800 to 1859, 1900 to 1959, 2000 to 2059, 2100 to 2159, 2200 to 2259, 2300 to 2359	0
1013	Running speed after emergency drive retry reset	0 to 590Hz	60/50Hz*9
1015	Integral stop selection at limited frequency	0 to 2, 10 to 12	0
1016	PTC thermistor protection detection time	0 to 60s	0s
1018	Monitor with sign selection	0, 1, 9999	9999
1020	Trace operation selection	0 to 4	0
1021	Trace mode selection	0 to 2	0
1022	Sampling cycle	0 to 9	2
1023	Number of analog channels	1 to 8	4
1024	Sampling auto start	0, 1	0
1025	Trigger mode selection	0 to 4	0
1026	Number of sampling before trigger	0 to 100%	90%
1027	Analog source selection (1ch)	1 to 3, 5 to 14, 17, 18, 20, 23, 24, 34, 40 to 42, 52 to 54, 61, 62, 64, 67, 68, 81 to 96, 98, 201 to 213, 230 to 232, 237, 238	201
1028	Analog source selection (2ch)		202
1029	Analog source selection (3ch)		203
1030	Analog source selection (4ch)		204
1031	Analog source selection (5ch)		205
1032	Analog source selection (6ch)		206
1033	Analog source selection (7ch)		207
1034	Analog source selection (8ch)		208
1035	Analog trigger channel	1 to 8	1
1036	Analog trigger operation selection	0, 1	0
1037	Analog trigger level	600 to 1400	1000
1038	Digital source selection (1ch)	1 to 255	1
1039	Digital source selection (2ch)		2
1040	Digital source selection (3ch)		3
1041	Digital source selection (4ch)		4
1042	Digital source selection (5ch)		5
1043	Digital source selection (6ch)		6
1044	Digital source selection (7ch)		7
1045	Digital source selection (8ch)		8
1046*13	Digital trigger channel	1 to 8	1

Pr.	Name	Setting range	Initial value
1047	Digital trigger operation selection	0, 1	0
1048	Display-off waiting time	0 to 60min	0min
1049	USB host reset	0, 1	0
1106	Torque monitor filter	0 to 5s, 9999	9999
1107	Running speed monitor filter	0 to 5s, 9999	9999
1108	Excitation current monitor filter	0 to 5s, 9999	9999
1124	Station number in inverter-to-inverter link	0 to 5, 9999	9999
1125	Number of inverters in inverter-to-inverter link system	2 to 6	2
1132	Pre-charge change increment amount	0 to 100%, 9999	9999
1133	Second pre-charge change increment amount	0 to 100%, 9999	9999
1136	Second PID display bias coefficient	0 to 500, 9999	9999
1137	Second PID display bias analog value	0 to 300%	20%
1138	Second PID display gain coefficient	0 to 500, 9999	9999
1139	Second PID display gain analog value	0 to 300%	100%
1140	Second PID set point/ deviation input selection	1 to 5	2
1141	Second PID measured value input selection	1 to 5, 101 to 105	3
1142	Second PID unit selection	0 to 43, 9999	9999
1143	Second PID upper limit	0 to 100%, 9999	9999
1144	Second PID lower limit	0 to 100%, 9999	9999
1145	Second PID deviation limit	0.0 to 100.0%, 9999	9999
1146	Second PID signal operation selection	0 to 7, 10 to 17	0
1147	Second output interruption detection time	0 to 3600s, 9999	1s
1148	Second output interruption detection level	0 to 590Hz	0Hz
1149	Second output interruption cancel level	900 to 1100%	1000%
1150 to 1199	User parameters 1 to 50	0 to 65535	0
1211	PID gain tuning timeout time	1 to 9999s	100s
1212	Step manipulated amount	900 to 1100%	1000%
1213	Step response sampling cycle	0.01 to 600s	1s
1214	Timeout time after the maximum slope	1 to 9999s	10s
1215	Limit cycle output upper limit	900 to 1100%	1100%
1216	Limit cycle output lower limit	900 to 1100%	1000%
1217	Limit cycle hysteresis	0.1 to 10%	1%
1218	PID gain tuning setting	0, 100 to 102, 111, 112, 121, 122, 200 to 202, 211, 212, 221, 222	0
1219	PID gain tuning start/ status	(0), 1, 8, (9, 90 to 96)	0
1300 to 1343, 1350 to 1359	Communication option parameters		
1361	Detection time for PID output hold	0 to 900s	5s
1362	PID output hold range	0 to 50%, 9999	9999
1363	PID priming time	0 to 360s, 9999	9999
1364	Stirring time during sleep	0 to 3600s	15s
1365	Stirring interval time	0 to 1000h	0h
1366	Sleep boost level	0 to 100%, 9999	9999
1367	Sleep boost waiting time	0 to 360s	0s
1368	Output interruption cancel time	0 to 360s	0s
1369	Check valve closing completion frequency	0 to 120Hz, 9999	9999
1370	Detection time for PID limiting operation	0 to 900s	0s
1371	PID upper/lower limit pre-warning level range	0 to 50%, 9999	9999
1372	PID measured value control set point change amount	0 to 50%	5%
1373	PID measured value control set point change rate	0 to 100%	0%
1374	Auxiliary pressure pump operation starting level	900 to 1100%	1000%

Pr.	Name	Setting range	Initial value
1375	Auxiliary pressure pump operation stopping level	900 to 1100%	1000%
1376	Auxiliary motor stopping level	0 to 100%, 9999	9999
1377	PID input pressure selection	1 to 3, 9999	9999
1378	PID input pressure warning level	0 to 100%	20%
1379	PID input pressure fault level	0 to 100%, 9999	9999
1380	PID input pressure warning set point change amount	0 to 100%	5%
1381	PID input pressure fault operation selection	0, 1	0
1410	Starting times lower 4 digits	0 to 9999	0
1411	Starting times upper 4 digits	0 to 9999	0
1412	Motor induced voltage constant (phi f) exponent	0 to 2, 9999	9999
1413	Second motor induced voltage constant (phi f) exponent	0 to 2, 9999	9999
1424	Ethernet communication network number	1 to 239	1
1425	Ethernet communication station number	1 to 120	1
1426	Link speed and duplex mode selection	0 to 4	0
1427	Ethernet function selection 1	502, 5000 to 5002, 5006 to 5008, 5010 to 5013, 9999, 45237, 47808, 61450	5001
1428	Ethernet function selection 2		45237
1429	Ethernet function selection 3		9999
1431	Ethernet signal loss detection function selection	0 to 3	0
1432	Ethernet communication check time interval	0 to 999.8s, 9999	9999
1434	IP address 1 (Ethernet)	0 to 255	192
1435	IP address 2 (Ethernet)	0 to 255	168
1436	IP address 3 (Ethernet)	0 to 255	50
1437	IP address 4 (Ethernet)	0 to 255	1
1438	Subnet mask 1	0 to 255	255
1439	Subnet mask 2	0 to 255	255
1440	Subnet mask 3	0 to 255	255
1441	Subnet mask 4	0 to 255	0
1442	IP filter address 1 (Ethernet)	0 to 255	0
1443	IP filter address 2 (Ethernet)	0 to 255	0
1444	IP filter address 3 (Ethernet)	0 to 255	0
1445	IP filter address 4 (Ethernet)	0 to 255	0
1446	IP filter address 2 range specification (Ethernet)	0 to 255, 9999	9999
1447	IP filter address 3 range specification (Ethernet)	0 to 255, 9999	9999
1448	IP filter address 4 range specification (Ethernet)	0 to 255, 9999	9999
1449	Ethernet command source selection IP address 1	0 to 255	0
1450	Ethernet command source selection IP address 2	0 to 255	0
1451	Ethernet command source selection IP address 3	0 to 255	0
1452	Ethernet command source selection IP address 4	0 to 255	0
1453	Ethernet command source selection IP address 3 range specification	0 to 255, 9999	9999
1454	Ethernet command source selection IP address 4 range specification	0 to 255, 9999	9999
1455	Keepalive time	1 to 7200s	3600s
1460	PID multistage set point 1		9999
1461	PID multistage set point 2		9999
1462	PID multistage set point 3	0 to 100%, 9999	9999
1463	PID multistage set point 4		9999
1464	PID multistage set point 5		9999
1465	PID multistage set point 6		9999
1466	PID multistage set point 7		9999
1469	Number of cleaning times monitor	0 to 255	0
1470	Number of cleaning times setting	0 to 255	0
1471	Cleaning trigger selection	0 to 15	0
1472	Cleaning reverse rotation frequency	0 to 590Hz	30Hz
1473	Cleaning reverse rotation operation time	0 to 3600s	5s

Pr.	Name	Setting range	Initial value
1474	Cleaning forward rotation frequency	0 to 590Hz, 9999	9999
1475	Cleaning forward rotation operation time	0 to 3600s, 9999	9999
1476	Cleaning stop time	0 to 3600s	5s
1477	Cleaning acceleration time	0 to 3600s, 9999	9999
1478	Cleaning deceleration time	0 to 3600s, 9999	9999
1479	Cleaning time trigger	0 to 6000hr	0
1480	Load characteristics measurement mode	0, 1, (2, 3, 4, 5, 81, 82, 83, 84, 85)	0
1481	Load characteristics load reference 1	0 to 400%, 8888, 9999	9999
1482	Load characteristics load reference 2	0 to 400%, 8888, 9999	9999
1483	Load characteristics load reference 3	0 to 400%, 8888, 9999	9999
1484	Load characteristics load reference 4	0 to 400%, 8888, 9999	9999
1485	Load characteristics load reference 5	0 to 400%, 8888, 9999	9999
1486	Load characteristics maximum frequency	0 to 590Hz	60/50Hz*9
1487	Load characteristics minimum frequency	0 to 590Hz	6Hz
1488	Upper limit warning detection width	0 to 400%, 9999	20%
1489	Lower limit warning detection width	0 to 400%, 9999	20%
1490	Upper limit fault detection width	0 to 400%, 9999	9999
1491	Lower limit fault detection width	0 to 400%, 9999	9999
1492	Load status detection signal output delay time / load reference measurement waiting time	0 to 60s	1s
1499	Parameter for manufacturer setting. Do not set.		
Pr.CLR	Parameter clear	(0), 1	0
ALL.CL	All parameter clear	(0), 1	0
Err.CL	Fault history clear	(0), 1	0
Pr.CPY	Parameter copy	(0), 1 to 3	0
Pr.CHG	Initial value change list	—	—
IPM	IPM initialization	0, 12	0
AUTO	Automatic parameter setting	—	—
Pr.Md	Group parameter setting	(0), 1, 2	0

*1 Differs according to capacities.
- 6%: FR-F820-00046(0.75K) and FR-F840-00023(0.75K)
- 4%: FR-F820-00077(1.5K) to 00167(3.7K) and FR-F840-00038(1.5K) to 00083(3.7K)
- 3%: FR-F820-00250(5.5K), 00340(7.5K), FR-F840-00126(5.5K) and 00170(7.5K)
- 2%: FR-F820-00490(11K) to 01540(37K) and FR-F840-00250(11K) to 00770(37K)
- 1.5%: FR-F820-01870(45K), 02330(55K), FR-F840-00930(45K) and 01160(55K)
- 1%: FR-F820-03160(75K) or higher and FR-F840-01800(75K) or higher

*2 For FR-F820-02330(55K) or lower and FR-F840-01160(55K) or lower
*3 For FR-F820-03160(75K) or higher and FR-F840-01800(75K) or higher
*4 For FR-F820-00340(7.5K) or lower and FR-F840-00170(7.5K) or lower
*5 For FR-F820-00490(11K) or higher and FR-F840-00250(11K) or higher
*6 Differs according to capacities.
- 4%: FR-F820-00340(7.5K) or lower and FR-F840-00170(7.5K) or lower
- 2%: FR-F820-00490(11K) to 02330(55K) and FR-F840-00250(11K) to 01160(55K)
- 1%: FR-F820-03160(75K) or higher and FR-F840-01800(75K) or higher

*7 Differs according to the voltage class. (200 V class/400 V class)
*8 The parameter number in parentheses is the one for use with the LCD operation panel and parameter unit.
*9 Differs according to types. (FM type/CA type)
*10 The setting is available only with the CA type.
*11 The setting value "60" is only available for **Pr.178**, and "61" is only for **Pr.179**.
*12 The setting values "92, 93, 192, 193" are only available for **Pr.190 to Pr.194**.
*13 Simple mode parameters. (When **Pr.160** = "9999", only the simple mode parameters are displayed.)
*14 The setting is available when the PLC function is enabled.

Appendix

Appendix 1 Instructions for compliance with the EU Directives

The EU Directives are issued to standardize different national regulations of the EU Member States and to facilitate free movement of the equipment, whose safety is ensured, in the EU territory.

Since 1996, compliance with the EMC Directive that is one of the EU Directives has been legally required. Since 1997, compliance with the Low Voltage Directive, another EU Directive, has been also legally required. When a manufacturer confirms its equipment to be compliant with the EMC Directive and the Low Voltage Directive, the manufacturer must declare the conformity and affix the CE marking.

- The authorized representative in the EU
  The authorized representative in the EU is shown below.
  Name: Mitsubishi Electric Europe B.V.
  Address: Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany

◆ EMC Directive

We declare that this inverter conforms with the EMC Directive and affix the CE marking on the inverter.
- EMC Directive: 2014/30/EU
- Standard(s): EN 61800-3:2004+A1:2012 (Second environment / PDS Category "C3")
- This inverter is not intended to be used on a low-voltage public network which supplies domestic premises. When using the inverter in a residential area, take appropriate measures and ensure the conformity of the inverter used in the residential area.
- Radio frequency interference is expected if used on such a network.
- The installer shall provide a guide for installation and use, including recommended mitigation devices.

Note:

First environment

Environment including buildings/facilities which are directly connected to a low voltage main supply which also supplies residential buildings. Directly connected means that there is no intermediate transformer between these buildings.

Second environment

Environment including all buildings/facilities which are not directly connected to a low voltage main supply which also supplies residential buildings.

◆ Note

Set the EMC filter valid and install the inverter and perform wiring according to the following instructions.
- This inverter is equipped with an EMC filter with a class C3. Enable the EMC filter. (For details, refer to the FR-F800 Instruction Manual (Detailed).)
- Connect the inverter to an earthed power supply.
- Install a motor and a control cable written in the EMC Installation Guidelines (BCN-A21041-204) and Technical News (MF-S-114, 115) according to the instruction.
- To ensure sufficient function of the built-in EMC filter motor cable lengths should not be exceeded more than 20 m.
- Confirm that the inverter conforms with the EMC Directive as the industrial drives application for final installation.
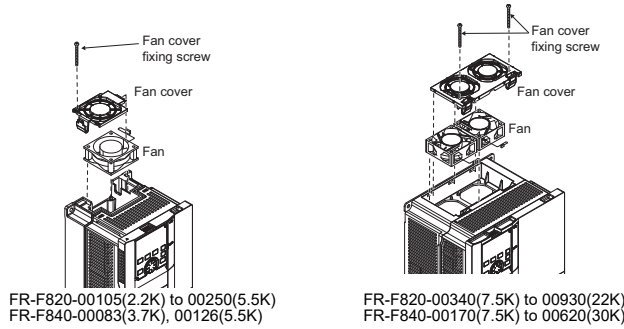
◆ Low Voltage Directive

We have self-confirmed our inverters as products compliant to the Low Voltage Directive (Conforming standard EN 61800-5-1) and affix the CE marking on the inverters.

◆ Outline of instructions

- Do not use an earth leakage current breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth securely.
- Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
- Use the cable sizes on **page 7** under the following conditions.
  • Surrounding air temperature: 40°C (104°F) maximum
  If conditions are different from above, select appropriate wire according to EN 60204-1 or IEC 60364-5-52.
- Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.
  For use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated on **page 7**.
- Use the molded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- This product can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

- Use the inverter under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earthed-neutral system power supply, 400 V class only) and pollution degree 2 or lower specified in IEC 60664. An insulating transformer needs to be installed in the input side of the FR-F820 series inverters.
  • To use the inverter of FR-F820-01250(30K) or higher and FR-F840-00770(37K) or higher (IP00) under the conditions of pollution degree 2, install it in the enclosure of IP 2X or higher.
  • To use the inverter under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
  • To use the inverter of FR-F820-00930(22K) or lower and FR-F840-00620(30K) or lower (IP20) outside of an enclosure in the environment of pollution degree 2, fix a fan cover with fan cover fixing screws enclosed.

FR-F820-00105(2.2K) to 00250(5.5K)
FR-F840-00083(3.7K), 00126(5.5K)

FR-F820-00340(7.5K) to 00930(22K)
FR-F840-00170(7.5K) to 00620(30K)

- On the input and output of the inverter, use cables of the type and size set forth in EN 60204-1 or IEC 60364-5-52.
- The operating capacity of the relay outputs (terminal symbols A1, B1, C1, A2, B2, C2) should be 30VDC, 0.3A. (Relay output has basic isolation from the inverter internal circuit.)
- Control circuit terminals on **page 5** are safely isolated from the main circuit.
- Environment (For the detail, refer to **page 3**.)

	During Operation	In Storage	During Transportation
Surrounding air temperature	LD rating: -10 to +50°C SLD rating: -10 to +40°C	-20 to +65°C	-20 to +65°C
Ambient humidity	95% RH or less	95% RH or less	95% RH or less
Maximum altitude	2500 m∗1	2500 m	10000 m

∗1 For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

◆ **Branch circuit protection**

Class T, Class J, Class CC, or Class L fuse, or UL 489 Molded Case Circuit Breaker (MCCB) must be provided.
For the FR-F820 series, Class T, Class J, or Class CC fuse, or UL 489 Molded Case Circuit Breaker (MCCB) must be provided. (Use a product which conforms to the EN or IEC Standard.)

FR-F820-[]		00046 (0.75K)	00077 (1.5K)	00105 (2.2K)	00167 (3.7K)	00250 (5.5K)	00340 (7.5K)	00490 (11K)	00630 (15K)	00770 (18.5K)
Rated fuse voltage (V)		240 V or more								
Fuse allowable rating (A)	Without power factor improving reactor	15	20	30	40	60	80	150	175	200
	With power factor improving reactor	15	20	20	30	50	70	125	150	200
Molded case circuit breaker (MCCB) Maximum allowable rating (A) ∗1		15	15	25	40	60	80	110	150	190

FR-F820-[]		00930 (22K)	01250 (30K)	01540 (37K)	01870 (45K)	02330 (55K)	03160 (75K)	03800 (90K)	04750 (110K)
Rated fuse voltage (V)		240 V or more							
Fuse allowable rating (A)	Without power factor improving reactor	225	300	350	400	500	—	—	—
	With power factor improving reactor	200	250	300	350	400	500	600	700
Molded case circuit breaker (MCCB) Maximum allowable rating (A) ∗1		225	300	350	450	500	700	900	1000

FR-F840-[]		00023 (0.75K)	00038 (1.5K)	00052 (2.2K)	00083 (3.7K)	00126 (5.5K)	00170 (7.5K)	00250 (11K)	00310 (15K)	00380 (18.5K)	00470 (22K)	00620 (30K)	00770 (37K)
Rated fuse voltage (V)		500 V or more											
Fuse allowable rating (A)	Without power factor improving reactor	6	10	15	20	30	40	70	80	90	110	150	175
	With power factor improving reactor	6	10	10	15	25	35	60	70	90	100	125	150
Molded case circuit breaker (MCCB) Maximum allowable rating (A) ∗1		15	15	15	20	30	40	60	70	90	100	150	175

FR-F840-[]		00930 (45K)	01160 (55K)	01800 (75K)	02160 (90K)	02600 (110K)	03250 (132K)	03610 (160K)	04320 (185K)	04810 (220K)	05470 (250K)	06100 (280K)	06830 (315K)
Rated fuse voltage (V)		500 V or more											
Fuse allowable rating (A)	Without power factor improving reactor	200	250	—	—	—	—	—	—	—	—	—	—
	With power factor improving reactor	175	200	250	300	350	400	500	600	700	800	900	1000
Molded case circuit breaker (MCCB) Maximum allowable rating (A) ∗1		225	250	450	450	500	—	—	—	—	—	—	—

∗1 Maximum allowable rating by US National Electrical Code. Exact size must be chosen for each installation.

◆ **Short circuit ratings**

- 200 V class
Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 240 V Maximum.
- 400 V class
Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 V Maximum.

◆ Motor overload protection

When using the electronic thermal relay function as motor overload protection, set the rated motor current in **Pr.9 Electronic thermal O/L relay**.

Operation characteristics of electronic thermal relay function (LD rating)
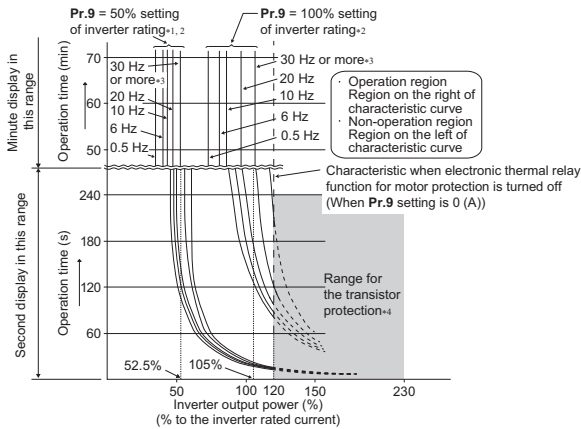
This function detects the overload of the motor, stops the operation of the inverter's output transistor, and stops the output. (The operation characteristic is shown on the left.)

- When using the Mitsubishi constant-torque motor

(1) Set one of "1", "13" to "16", "50", "53", "54" in **Pr.71**. (This provides a 100% continuous torque characteristic in the low-speed range.)

(2) Set the rated current of the motor in **Pr.9**.

∗1   When a value 50% of the inverter rated output current (current value) is set in **Pr.9**

∗2   The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.

∗3   When you set the electronic thermal relay function dedicated to the Mitsubishi Electric constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.

∗4   Transistor protection is activated depending on the temperature of the heatsink. The protection may be activated even with less than 120% depending on the operating conditions.

● NOTE

- The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
- When multiple motors are driven with a single inverter or when a multi-pole motor or a special motor is driven, install an external thermal relay (OCR) between the inverter and motors. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (details in the FR-F800 Instruction Manual (Detailed)) when selecting the setting for an external thermal relay.
- The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.
- Electronic thermal memory retention function is not provided by the drive.

Appendix 2 Instructions for UL and cUL

(Standard to comply with: UL 508C, CSA C22.2 No.274-13)

◆ General precaution

CAUTION - Risk of Electric Shock -
The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.
ATTENTION - Risque de choc électrique -
La durée de décharge du condensateur de bus est de 10 minutes. Avant de commencer le câblage ou l'inspection, mettez l'appareil hors tension et attendez plus de 10 minutes.

◆ Installation

The below types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions.
Design the enclosure so that the surrounding air temperature, humidity and ambience of the inverter will satisfy the specifications. (Refer to .)

◆ Branch circuit protection

For installation in the United States, Class T, Class J, Class CC, or Class L fuse, UL 489 Molded Case Circuit Breaker (MCCB), or Type E combination motor controller must be provided, in accordance with the National Electrical Code and any applicable local codes.
For installation in Canada, Class T, Class J, Class CC, or Class L fuse, UL 489 Molded Case Circuit Breaker (MCCB), or Type E combination motor controller must be provided, in accordance with the Canadian Electrical Code and any applicable local codes.
For the FR-F820 series, Class T, Class J, or Class CC fuse, UL 489 Molded Case Circuit Breaker (MCCB), or Type E combination motor controller must be provided.

FR-F820-[]		00046 (0.75K)	00077 (1.5K)	00105 (2.2K)	00167 (3.7K)	00250 (5.5K)	00340 (7.5K)	00490 (11K)	00630 (15K)	00770 (18.5K)
Rated fuse voltage (V)		240 V or more								
Fuse allowable rating (A)	Without power factor improving reactor	15	20	30	40	60	80	150	175	200
	With power factor improving reactor	15	20	20	30	50	70	125	150	200
Molded case circuit breaker (MCCB) Maximum allowable rating (A) *1*2		15	15	25	40	60	80	110	150	190
Type E combination motor controller *3	Maximum current rating (A)	8	13	18	25	32	—	—	—	—
	Maximum SCCR (kA) *4	50	50	50	25	25	—	—	—	—

FR-F820-[]		00930 (22K)	01250 (30K)	01540 (37K)	01870 (45K)	02330 (55K)	03160 (75K)	03800 (90K)	04750 (110K)
Rated fuse voltage (V)		240 V or more							
Fuse allowable rating (A)	Without power factor improving reactor	225	300	350	400	500	—	—	—
	With power factor improving reactor	200	250	300	350	400	500	600	700
Molded case circuit breaker (MCCB) Maximum allowable rating (A) *1*2		225	300	350	450	500	700	900	1000
Type E combination motor controller	Maximum current rating (A)	—	—	—	—	—	—	—	—
	Maximum SCCR (kA)	—	—	—	—	—	—	—	—

FR-F840-[]		00023 (0.75K)	00038 (1.5K)	00052 (2.2K)	00083 (3.7K)	00126 (5.5K)	00170 (7.5K)	00250 (11K)	00310 (15K)	00380 (18.5K)	00470 (22K)	00620 (30K)	00770 (37K)
Rated fuse voltage (V)		500 V or more											
Fuse allowable rating (A)	Without power factor improving reactor	6	10	15	20	30	40	70	80	90	110	150	175
	With power factor improving reactor	6	10	10	15	25	35	60	70	90	100	125	150
Molded case circuit breaker (MCCB) Maximum allowable rating (A) *1*2		15	15	15	20	30	40	60	70	90	100	150	175
Type E combination motor controller *3	Maximum current rating (A)	4	6.3	8	13	18	25	32	—	—	—	—	—
	Maximum SCCR (kA) *4	50	50	50	50	50	25	25	—	—	—	—	—

FR-F840-[]		00930 (45K)	01160 (55K)	01800 (75K)	02160 (90K)	02600 (110K)	03250 (132K)	03610 (160K)	04320 (185K)	04810 (220K)	05470 (250K)	06100 (280K)	06830 (315K)
Rated fuse voltage (V)		500 V or more											
Fuse allowable rating (A)	Without power factor improving reactor	200	250	—	—	—	—	—	—	—	—	—	—
	With power factor improving reactor	175	200	250	300	350	400	500	600	700	800	900	1000
Molded case circuit breaker (MCCB) Maximum allowable rating (A) *1*2		225	250	450	450	500	—	—	—	—	—	—	—
Type E combination motor controller	Maximum current rating (A)	—	—	—	—	—	—	—	—	—	—	—	—
	Maximum SCCR (kA)	—	—	—	—	—	—	—	—	—	—	—	—

*1　Maximum allowable rating by the US National Electrical Code. Exact size must be chosen for each installation.
*2　Select an appropriate molded case circuit breaker with a rating that is suitable for the size of the cable.
*3　For UL/cUL certification, use the following product.

Model	Manufacturer	Rated voltage, VAC
MMP-T32	Mitsubishi Electric Corp.	480Y/277

*4　Suitable for use in a circuit capable of delivering not more than 50 or 25 kA rms symmetrical amperes, 480Y/277 volts maximum when protected by the Type E combination motor controllers indicated in the above table.
*5　Type E combination motor controller is combination of Manual motor starter, Short-circuit Display Unit "UT-TU" and Power Side Terminal Cover Kit "UT-CV3".

◆ Wiring to the power supply and the motor

Refer to the National Electrical Code (Article 310) regarding the allowable current of the cable. Select the cable size for 125% of the rated current according to the National Electrical Code (Article 430).
For wiring the input (R/L1, S/L2, T/L3) and output (U, V, W) terminals of the inverter, use the UL listed copper, stranded wires (rated at 75°C) and round crimping terminals. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

◆ Short circuit ratings

- 200 V class
  Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 240 V Maximum.
- 400 V class
  Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 V Maximum.

◆ Motor overload protection

When using the electronic thermal relay function as motor overload protection, set the rated motor current in **Pr.9 Electronic thermal O/L relay**.

Operation characteristics of electronic thermal relay function (LD rating)
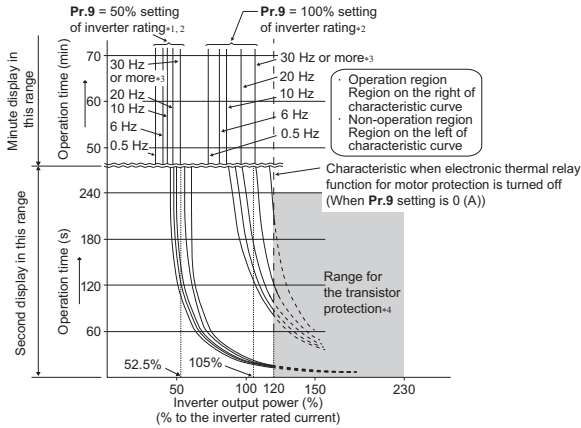
This function detects the overload (overheat) of the motor, stops the operation of the inverter's output transistor, and stops the output. (The operation characteristic is shown on the left.)

- When using the Mitsubishi constant-torque motor
(1) Set one of "1", "13" to "16", "50", "53", "54" in **Pr.71**. (This provides a 100% continuous torque characteristic in the low-speed range.)
(2) Set the rated current of the motor in **Pr.9**.

∗1 When a value 50% of the inverter rated output current (current value) is set in **Pr.9**
∗2 The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.
∗3 When you set the electronic thermal relay function dedicated to the Mitsubishi Electric constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.
∗4 Transistor protection is activated depending on the temperature of the heatsink. The protection may be activated even with less than 120% depending on the operating conditions.

NOTE

- The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
- When multiple motors are driven with a single inverter or when a multi-pole motor or a special motor is driven, install an external thermal relay (OCR) between the inverter and motors. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (details in the FR-F800 Instruction Manual (Detailed)) when selecting the setting for an external thermal relay.
- The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.

Appendix 3   Instructions for EAC

The product certified in compliance with the Eurasian Conformity has the EAC marking.

Note: EAC marking
In 2010, three countries (Russia, Belarus, and Kazakhstan) established a Customs Union for the purposes of revitalizing the economy by forming a large economic bloc by abolishing or reducing tariffs and unifying regulatory procedures for the handling of articles.
Products to be distributed over these three countries of the Customs Union must comply with the Customs Union Technical Regulations (CU-TR), and the EAC marking must be affixed to the products.

For information on the country of origin, manufacture year and month, and authorized sales representative (importer) in the CU area of this product, refer to the following:

- Country of origin indication
  Check the rating plate of the product. (Refer to **page 3**.)
  Example: MADE IN JAPAN

- Manufactured year and month
  Check the SERIAL number indicated on the rating plate of the product. (Refer to **page 3**.)

Rating plate example

□	○	○	○○○○○○
Symbol	Year	Month	Control number

SERIAL

The SERIAL consists of one symbol, two characters indicating the production year and month, and six characters indicating the control number. The last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z (December).

- Authorized sales representative (importer) in the CU area
  The authorized sales representative (importer) in the CU area is shown below.
  Name: Mitsubishi Electric (Russia) LLC
  Address: 52, bld 1 Kosmodamianskaya Nab 115054, Moscow, Russia
  Phone: +7 (495) 721-2070
  Fax: +7 (495) 721-2071

Appendix 4 Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is applied to the product as follows based on the "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products" of the People's Republic of China.

电器电子产品有害物质限制使用标识要求

环境保护使用期
限标识

本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

• 产品中所含有害物质的名称及含量

部件名称 *2	有害物质 *1					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
电路板组件 （包括印刷电路板及其构成的零部件，如电阻、电容、集成电路、连接器等）、电子部件	×	○	×	○	○	○
金属壳体、金属部件	×	○	○	○	○	○
树脂壳体、树脂部件	○	○	○	○	○	○
螺丝、电线	○	○	○	○	○	○

上表依据 SJ/T11364 的规定编制。
○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。
×：表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 规定的限量要求。
    *1   即使表中记载为 ×，根据产品型号，也可能会有有害物质的含量为限制值以下的情况。
    *2   根据产品型号，一部分部件可能不包含在产品中。

Appendix 5 Referenced Standard (Requirement of Chinese standardized law)

This Product is designed and manufactured accordance with following Chinese standards.

Machinery safety : GB/T 16855.1
                  GB/T 12668.502
                  GB 28526
                  GB/T 12668.3
Electrical safety : GB/T 12668.501
EMC : GB/T 12668.3

WARRANTY

When using this product, make sure to understand the warranty described below.

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and the actual cost will be charged.
    However, it will not be charged if we are responsible for the cause of the failure.
(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.
(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;
    • a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
    • a failure caused by any alteration, etc. to the Product made on your side without our approval
    • a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
    • a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
    • any replacement of consumable parts (condenser, cooling fan, etc.)
    • a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
    • a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
    • any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.
(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas

Our regional FA Center in overseas countries will accept the repair work of the Product; however, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:
(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

(1) For the use of our product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.
(2) Our product is designed and manufactured as a general purpose product for use at general industries.
    Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used.
    In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used.
    We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

◆ About the enclosed CD-ROM

- The enclosed CD-ROM contains PDF copies of the manuals related to this product.

◆ Before using the enclosed CD-ROM

- The copyright and other rights of the enclosed CD-ROM all belong to Mitsubishi Electric Corporation.
- No part of the enclosed CD-ROM may be copied or reproduced without the permission of Mitsubishi Electric Corporation.
- Specifications of the enclosed CD-ROM are subject to change for modification without notice.
- We are not responsible for any damages and lost earnings, etc. from use of the enclosed CD-ROM.
- Trademarks

  Microsoft, Windows, Windows Vista, and Internet Explorer are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

  Adobe and Adobe Reader are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

  Intel and Pentium are trademarks of Intel Corporation in the United States and/or other countries.

  Other company and product names of companies herein are all trademarks or registered trademarks of those respective companies.
- Warranty

  We do not provide a warranty against defects in the enclosed CD-ROM and related documents.

> **NOTE**
> - This is a personal computer dedicated CD-ROM. Do not attempt to play it on ordinary audio devices. The loud volume may damage hearing and speakers.

◆ System requirements for the enclosed CD-ROM

- The following system is required to read instruction manuals contained in the enclosed CD-ROM.

Item	Specifications
OS	Microsoft$^®$ Windows$^®$ 10, Windows$^®$ 8.1, Windows$^®$ 8, Windows$^®$ 7, Windows Vista$^®$
CPU	Intel$^®$ Pentium$^®$ or better processor
Memory	128 MB of RAM
Hard disk	90 MB of available hard-disk space
CD-ROM drive	Double speed or more (more than quadruple speed is recommended)
Monitor	800×600 dot or more
Application	Adobe$^®$ Reader$^®$ 7.0 or more Internet Explorer$^®$ 6.0 or more

◆ Operating method of the enclosed CD-ROM

- How to read instruction manuals

  Step 1. Start a personal computer and place the enclosed CD-ROM in the CD-ROM drive.

  Step 2. The main window automatically opens by the web browser.

  Step 3. Choose your language from a language select menu.

  Step 4. Click a manual you want to read in the "INSTRUCTION MANUAL" list.

  Step 5. PDF manual you clicked opens.

- Manual opening of the enclosed CD-ROM

  Step 1. Start a personal computer and place the enclosed CD-ROM in the CD-ROM drive.

  Step 2. Open "index.html" file in the enclosed CD-ROM.

  Step 3. The main window opens by the web browser. Follow the instructions from Step 3 of "How to read instruction manuals".

- PDF data of the instruction manual are stored in "MANUAL" folder on the enclosed CD-ROM.

MEMO

REVISIONS

Revision date	*Manual Number	Revision
Nov. 2016	IB-0600643-A	First edition
Mar. 2019	IB-0600643-B	Added • PID manipulated amount: 0% to 100% (Pr.1015 = "2 or 12") • User parameter auto storage function (Pr.675) • User parameter read source selection (Pr.414 = "11 or 12") • Ethernet function selection (Pr.1427 to Pr.1429 = "47808") • Reset selection (Pr.75 = "1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117") • Referenced Standard (Requirement of Chinese standardized law) • Communication reset selection/Ready bit status selection (Pr.349 = "100 or 101") • Monitor with sign selection (Pr.1018 = "1") • Application of caution labels
Jun. 2020	IB-0600643-C	Added • Main circuit capacitor life measurement at power OFF (every time) (**Pr.259** = "11") • **Pr.506 Display estimated main circuit capacitor residual life** • Current input check terminal selection (**Pr.573** = "11 to 14, 21 to 24") • Low-speed forward rotation command (RLF) signal, Low-speed reverse rotation command (RLR) signal • Cooling fan operation selection during the test operation (**Pr.244** = "1000, 1001, 1101 to 1105") • **Pr.507 Display/reset ABC1 relay contact life**, **Pr.508 Display/reset ABC2 relay contact life** Edited • Tightening torque specifications

FR-F800 Series
Instruction Manual Supplement

1 Cooling fan operation selection during the test operation

The cooling fan can be stopped during PM motor test operation.

Pr.	Name	Initial value	Setting range	Description	
244	**Cooling fan operation selection**	1	0	Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON) The cooling fan operates at power ON.	
			1	Cooling fan ON/OFF control is enabled. The fan is always ON while the inverter is running. During a stop, the inverter status is monitored and the fan switches ON/OFF according to the temperature.	
			101 to 105	Cooling fan ON/OFF control is enabled. Set the cooling fan stop waiting time within 1 to 5 seconds.	
			1000	Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON) The cooling fan operates at power ON.	The cooling fan can be set to always OFF during PM motor test operation.
			1001	Cooling fan ON/OFF control is enabled. The fan is always ON while the inverter is running. During a stop, the inverter status is monitored and the fan switches ON/OFF according to the temperature.	
			1101 to 1105	Cooling fan ON/OFF control is enabled. Set the cooling fan stop waiting time within 1 to 5 seconds.	
H100	**Cooling fan operation selection**	1	0	Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON) The cooling fan operates at power ON.	
			1	Cooling fan ON/OFF control is enabled. The fan is always ON while the inverter is running. During a stop, the inverter status is monitored and the fan switches ON/OFF according to the temperature.	
			101 to 105	Cooling fan ON/OFF control is enabled. Set the cooling fan stop waiting time within 1 to 5 seconds.	
H106	**Cooling fan operation selection during the test operation**	0	0	The cooling fan operates according to the **H100** setting during PM motor test operation.	
			1	The cooling fan can be set to always OFF during PM motor test operation.	

◆ Cooling fan operation selection during the test operation (P.H106)

- When **P.H106** = "1" or **Pr.244** = "1000, 1001, or 1101 to 1105", the cooling fan can be set to always OFF during PM motor test operation.

2 Inverter parts life display

The degree of deterioration of the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, and relay contacts of terminals A, B, and C can be diagnosed on the monitor. When the life span of each part is near its end, the self-diagnostic warning is output to prevent a fault. (Use the life check of this function as a guideline only, since the life span of each part except for the main circuit capacitor is calculated theoretically.)

Pr.	Name	Initial value	Setting range	Description
255 E700	Life alarm status display	0	(0 to **255**)[*1]	Displays whether or not the life alarm output level is reached for the following parts: the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, and relay contacts of terminals A, B, and C. Read-only.
507 E706	Display/reset ABC1 relay contact life	100%	(0 to 100%)	Displays the degree of deterioration of the relay contacts of terminals A1, B1, and C1.
508 E707	Display/reset ABC2 relay contact life	100%	(0 to 100%)	Displays the degree of deterioration of the relay contacts of terminals A2, B2, and C2.

*1 The setting range (read-only) differs depending on the inverter model (standard model, separate converter type, or IP55 compatible model).

◆ Life alarm display and signal output (Y90 signal, Pr.255)

Point

- In the life diagnosis of the main circuit capacitor, the alarm signal (Y90) is not output unless measurement by turning OFF the power supply is performed.

- **Pr.255 Life alarm status display** and the Life alarm (Y90) signal can be used to check whether or not the life alarm output level is reached for the following parts: the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, relay contacts of terminals A, B, and C, and internal air circulation fan. (Internal air circulation fans are equipped with IP55 compatible models.)

bit0 Control circuit capacitor life
bit1 Main circuit capacitor life (Standard models and IP55 compatible models only)
bit2 Cooling fan life
bit3 Inrush current limit circuit life (Standard models and IP55 compatible models only)
bit4 Life of internal air circulation fans (IP55 compatible models only)
bit5 Estimated residual-life of main circuit capacitor (Standard models and IP55 compatible models only)
bit6 ABC1 relay contact life
bit7 ABC2 relay contact life

- Pr.255 read
- Pr.255 setting read
- Bit image is displayed in decimal

- When the parts have reached the life alarm output level, the corresponding bits of **Pr.255** turns ON. The ON/OFF state of the bits can be checked with **Pr.255**. The following table shows examples.

Pr.255 Decimal	Pr.255 Binary	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Remarks
239	11101111	○	○	○	×	○	○	○	○	All parts have reached alarm output level for standard structure models.
5	101	×	×	×	×	×	○	×	○	Control circuit capacitor and cooling fan have reached alarm output level.
0	0	×	×	×	×	×	×	×	×	No parts have reached alarm output level.

○: Parts reaching alarm output level ×: Parts not reaching alarm output level

- The Life alarm (Y90) signal turns ON when the life alarm output level is reached for either of the following: the control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life, internal air circulation fan life, estimated residual-life of the main circuit capacitor, ABC1 relay contact life, or ABC2 relay contact life.
- For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

- When using an option (FR-A8AY, FR-A8AR, FR-A8NC, FR-A8NCE, or FR-A8NCG), warning signals can be output individually: Control circuit capacitor life (Y86) signal, Main circuit capacitor life (Y87) signal, Cooling fan life (Y88) signal, Inrush current limit circuit life (Y89) signal, Estimated residual-life of main circuit capacitor (Y248) signal, ABC1 relay contact life (Y249) signal, and ABC2 relay contact life (Y250) signal.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Life display of the relay contacts of terminals A, B, and C (Pr.507, Pr.508)

- The degree of deterioration of the relay contacts of terminals A1, B1, and C1 is displayed in **Pr.507**, and that for terminals A2, B2, and C2 is displayed in **Pr.508**.
- The number of times the contacts of relay turn ON is counted down from 100% (0 time) by 1% (500 times). When the counter reaches 10% (45,000 times), bit 6 or bit 7 of **Pr.255** turns ON and a warning is output by the Y90 signal.
- Any value can be set in **Pr.507** and **Pr.508**. After replacement of the control circuit terminal block or installation of a control terminal option, set **Pr.507** and **Pr.508** again.

3 For customers using communication options manufactured by HMS

◆ DriveControl writing restriction selection

- The command source to change the DriveControl settings (including Netctrl bit and Netref bit) can be selected.

Pr.	Name	Initial value	Setting range	Description
349	**Communication reset selection/Ready bit status selection**	0	0, 1, 100, 101, 1000, 1001, 1100, 1101, **10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101**	Use this parameter to select the error reset operation, Ready bit status, inverter reset operation when a fault is cleared, and DriveControl writing restriction.
N010	**Communication reset selection**	0	0	Error reset is enabled in any operation mode.
			1	Error reset is enabled in the Network operation mode.
N240	**Ready bit status selection**	0	0	The status of Ready bit in communication data can be changed when an HMS network option is installed.
			1	
N241	**Reset selection after inverter faults are cleared**	0	0	The inverter is reset when a fault is cleared.
			1	The inverter is not reset when a fault is cleared.
N242	**DriveControl writing restriction selection**	0	0	DriveControl writing is not restricted.
			1	DriveControl writing is restricted.

■ DriveControl writing restriction selection (P.N242)

- The command source to change the DriveControl settings can be restricted to only the command source selected by **Pr.550 NET mode operation command source selection**.

Setting value					Description					
					Communication reset selection[1]		Ready bit status selection[2]		Reset selection after inverter faults are cleared	DriveControl writing restriction selection
Pr.349	N010	N240	N241	N242	NET operation mode	Other than NET operation mode	Main circuit: power-ON	Main circuit: power-OFF[3]		
0	0	0	0	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset enabled	Not restricted
1	1	0	0	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset enabled	Not restricted
100	0	1	0	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset enabled	Not restricted
101	1	1	0	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset enabled	Not restricted
1000	0	0	1	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset disabled[4]	Not restricted
1001	1	0	1	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset disabled[4]	Not restricted
1100	0	1	1	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset disabled[4]	Not restricted
1101	1	1	1	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset disabled[4]	Not restricted
10000	0	0	0	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset enabled	Restricted[4]
10001	1	0	0	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset enabled	Restricted[4]
10100	0	1	0	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset enabled	Restricted[4]
10101	1	1	0	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset enabled	Restricted[4]
11000	0	0	1	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset disabled[4]	Restricted[4]
11001	1	0	1	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset disabled[4]	Restricted[4]
11100	0	1	1	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset disabled[4]	Restricted[4]
11101	1	1	1	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset disabled[4]	Restricted[4]

*1   The operation mode affects the availability of communication reset.
*2   The ON/OFF state of the power supply affects the ON/OFF state of Ready bit.
*3   When 24 V external power is available for control circuit or power is input only to control circuit.
*4   Available when the HMS network option is installed.

4 BACnet network port

◆ Supported property of BACnet standard object type

• The BACnet network port is added.

R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)

Property	Object support condition							
	Analog Input	Analog Output	Analog Value	Binary Input	Binary Output	Binary Value	Device	Network Port
APDU Timeout							R	
Application Software Version (Application Software Version)							R	
Database Revision							R	
Device Address Binding (Device Address Binding)							R	
Event State	R	R	R	R	R	R		
Firmware Revision							R	
Max APDU Length Accepted							R	
Max Info Frames							W	W
Max Master							W	W
Model Name							R	
Number of APDU Retries							R	
Object Identifier	R	R	R	R	R	R	R	R
Object List							R	
Object Name	R	R	R	R	R	R	R	R
Object Type	R	R	R	R	R	R	R	R
Out Of Service	R	R	R	R	R	R		R
Polarity				R	R			
Present Value	R	C	C[*1]	R	C	C[*1]		
Priority Array		R	R[*2]		R	R[*2]		
Protocol Object Types Supported (Protocol Object Types Supported)							R	
Protocol Revision							R	
Protocol Services Supported (Protocol Services Supported)							R	
Protocol Version							R	
Relinquish Default		R	R[*2]		R	R[*2]		
Segmentation Supported							R	
Status Flags	R	R	R	R	R	R		R
System Status							R	
Unit	R	R	R					
Vendor Identifier							R	
Vendor Name							R	
Property List	R	R	R	R	R	R	R	R
Current Command Priority		R			R			
Reliability								R
Network Type								R
Protocol Level								R
Network Number								R[*3]
Network Number Quality								R
Changes Pending								R
APDU Length								R
Link Speed								R
MAC Address								R
IP Address								R
IP Subnet_Mask								R
IP Default Gateway								R
IP DNS Server								R

*1   This property is commandable for some instances of this object. Otherwise it is read/write.

*2   This property is supported only for instances of this object where the Present Value property is commandable.

*3   Writing is possible when the network type is not PTP.

◆ Details of the supported properties

- The details of the properties supported by the network port are as follows.

Property	Details	
	BACnet MS/TP	BACnet/IP
Max Info Frames	Shows the maximum number of frames that the inverter can transmit while it owns the token. When a value is written, it is reflected to the **Pr.727** setting.	A rejection code (0) is displayed when the property is read/written.
Max Master	Shows the maximum address for master node When a value is written, it is reflected to the **Pr.726** setting.	A rejection code (0) is displayed when the property is read/written.
Object Identifier	Shows the unique numeric code to identify the object.	
Object Name	Shows the object name.	
Object Type	Network Port: NETWORK_PORT (56)	
Out Of Service	FALSE (0)	
Status Flags	Always 0.	
Property List	Shows the property identifier list.	
Reliability	Shows the reliability of the network port. Fixed to no-fault-detected (0) for the FR-F800(-E).	
Network Type	Shows the communication method of the network. Fixed to MSTP (2) for the FR-F800.	Shows the communication method of the network. Fixed to IPV4 (5) for the FR-F800-E.
Protocol Level	Shows the protocol level. Fixed to BACNET_APPLICATION (2) for the FR-F800(-E).	
Network Number	Shows the network number. Fixed to 0 for the FR-F800(-E). If a value other than "0" is written, an error code VALUE_OUT_OF_RANGE (37) will be returned.	
Network Number Quality	Shows the quality of the network port number. Fixed to UNKNOWN (0) for the FR-F800(-E).	
Changes Pending	If the property value whose change is to be reflected at a reset is changed, TRUE is returned. FALSE is returned after the status is initialized by a reset.	
APDU Length	Shows the maximum number of octets. Fixed to 50 octets for the FR-F800.	Shows the maximum number of octets. Fixed to 1024 octets for the FR-F800-E.
Link Speed	Shows the communication speed in the unit of bit/s. The **Pr.332** setting value × 100 equals the communication speed.	Shows the communication speed in the unit of bit/s. The **Pr.1426** setting value is used for the communication speed.
MAC Address	Shows the MAC address of the network port. The **Pr.331** setting value is used for the MAC address. For example, the MAC address is 7F when **Pr.331** = "127".	A rejection code (0) is displayed when the property is read/written.
IP Address	A rejection code (0) is displayed when the property is read.	Shows the octet string of the IP address assigned to the inverter. For example, C0A83200 is displayed when the IP address is 192.168.50.0.
IP Subnet Mask	A rejection code (0) is displayed when the property is read.	Shows the octet string of the subnet mask assigned to the inverter. For example, FFFFFF00 is displayed when the subnet mask is 255.255.255.0.
IP Default Gateway	A rejection code (0) is displayed when the property is read.	Fixed to "00000000" for the FR-F800-E.
IP DNS Server	A rejection code (0) is displayed when the property is read.	Fixed to "00000000" for the FR-F800-E.

| HEADQUARTERS | | EUROPEAN REPRESENTATIVES | | EUROPEAN REPRESENTATIVES | | EURASIAN REPRESENTATIVES | |

HEADQUARTERS

Mitsubishi Electric Europe B.V. **EUROPE**
Mitsubishi-Electric-Platz 1
D-40882 Ratingen
Phone: +49 (0)2102 / 486-0
Fax: +49 (0)2102 / 486-1120

Mitsubishi Electric Europe B.V. **CZECH REP.**
Pekařská 621/7
CZ-155 00 Praha 5
Phone: +420 255 719 200
Fax: +420 251 551 471

Mitsubishi Electric Europe B.V. **FRANCE**
25, Boulevard des Bouvets
F-92741 Nanterre Cedex
Phone: +33 (0)1 / 55 68 55 68
Fax: +33 (0)1 / 55 68 57 57

Mitsubishi Electric Europe B.V. **IRELAND**
Westgate Business Park, Ballymount
IRL-Dublin 24
Phone: +353 (0)1 4198800
Fax: +353 (0)1 4198890

Mitsubishi Electric Europe B.V. **ITALY**
Viale Colleoni 7 Palazzo Sirio
I-20864 Agrate Brianza (MB)
Phone: +39 039 / 60 53 1
Fax: +39 039 / 60 53 312

Mitsubishi Electric Europe B.V. **NETHERLANDS**
Nijverheidsweg 23C
NL-3641RP Mijdrecht
Phone: +31 (0) 297 250 350

Mitsubishi Electric Europe B.V. **POLAND**
ul. Krakowska 50
PL-32-083 Balice
Phone: +48 (0) 12 347 65 00
Fax: +48 (0) 12 630 47 01

Mitsubishi Electric (Russia) LLC **RUSSIA**
2 bld. 1, Letnikovskaya st.
RU-115114 Moscow
Phone: +7 495 / 721 2070
Fax: +7 495 / 721 2071

Mitsubishi Electric Europe B.V. **SPAIN**
Carretera de Rubí 76-80 Apdo. 420
E-08190 Sant Cugat del Vallés (Barcelona)
Phone: +34 (0) 93 / 5653131
Fax: +34 (0) 93 / 5891579

Mitsubishi Electric Europe B.V. (Scandinavia) **SWEDEN**
Hedvig Möllers gata 6,
SE- 223 55 Lund
Phone: +46 (0) 8 625 10 00

Mitsubishi Electric Turkey Elektrik Ürünleri A.Ş. **TURKEY**
Fabrika Otomasyonu Merkezi
Şerifali Mahallesi Nutuk Sokak No.5
TR-34775 Ümraniye-İSTANBUL
Phone: +90 (216) 969 25 00
Fax: +90 (216) / 526 39 95

Mitsubishi Electric Europe B.V. **UK**
Travellers Lane
UK-Hatfield, Herts. AL10 8XB
Phone: +44 (0)1707 / 28 87 80
Fax: +44 (0)1707 / 27 86 95

Mitsubishi Electric Europe B.V. **UAE**
Dubai Silicon Oasis
United Arab Emirates - Dubai
Phone: +971 4 3724716
Fax: +971 4 3724721

Mitsubishi Electric Corporation **JAPAN**
Tokyo Building 2-7-3
Marunouchi, Chiyoda-ku
Tokyo 100-8310
Phone: +81 (3) 3218-2111
Fax: +81 (3) 3218-2185

Mitsubishi Electric Automation, Inc. **USA**
500 Corporate Woods Parkway
Vernon Hills, IL 60061
Phone: +1 (847) 478-2100
Fax: +1 (847) 478-0328

EUROPEAN REPRESENTATIVES

GEVA **AUSTRIA**
Wiener Straße 89
A-2500 Baden
Phone: +43 (0)2252 / 85 55 20
Fax: +43 (0)2252 / 488 60

OOO TECHNIKON **BELARUS**
Prospect Nezavisimosti 177-9
BY-220125 Minsk
Phone: +375 (0)17 / 393 1177
Fax: +375 (0)17 / 393 0081

INEA RBT d.o.o. **BOSNIA AND HERZEGOVINA**
Stegne 11
SI-1000 Ljubljana
Phone: +386 (0)1/ 513 8116
Fax: +386 (0)1/ 513 8170

AKHNATON **BULGARIA**
4, Andrei Ljapchev Blvd., PO Box 21
BG-1756 Sofia
Phone: +359 (0)2 / 817 6000
Fax: +359 (0)2 / 97 44 06 1

INEA CR **CROATIA**
Losinjska 4 a
HR-10000 Zagreb
Phone: +385 (0)1 / 36 940 - 01/ -02/ -03
Fax: +385 (0)1 / 36 940 - 03

AutoCont C. S. S.R.O. **CZECH REPUBLIC**
Kafkova 1853/3
CZ-702 00 Ostrava 2
Phone: +420 595 691 150
Fax: +420 595 691 199

HANS FØLSGAARD A/S **DENMARK**
Theilgaards Torv 1
DK-4600 Køge
Phone: +45 4320 8600
Fax: +45 4396 8855

Electrobit OÜ **ESTONIA**
Pärnu mnt. 160i
EST-11317, Tallinn
Phone: +372 6518 140

UTU Automation Oy **FINLAND**
Peltotie 37i
FIN-28400 Ulvila
Phone: +358 (0)207 / 463 500
Fax: +358 207 / 463 501

UTECO A.B.E.E. **GREECE**
5, Mavrogenous Str.
GR-18542 Piraeus
Phone: +30 (0)211 / 1206-900
Fax: +30 (0)211 / 1206-999

MELTRADE Kft. **HUNGARY**
Fertő utca 14.
HU-1107 Budapest
Phone: +36 (0)1 / 431-9726
Fax: +36 (0)1 / 431-9727

OAK Integrator Products SIA **LATVIA**
Ritausmas iela 23
LV-1058 Riga
Phone: +371 67842280

Automatikos Centras, UAB **LITHUANIA**
Neries krantiné 14A-101
LT-48397 Kaunas
Phone: +370 37 262707
Fax: +370 37 455605

ALFATRADE Ltd. **MALTA**
99, Paola Hill
Malta-Paola PLA 1702
Phone: +356 (0)21 / 697 816
Fax: +356 (0)21 / 697 817

EUROPEAN REPRESENTATIVES

INTEHSIS SRL **MOLDOVA**
bld. Traian 23/1
MD-2060 Kishinev
Phone: +373 (0)22 / 66 4242
Fax: +373 (0)22 / 66 4280

Fonseca S.A. **PORTUGAL**
R. João Francisco do Casal 87/89
PT-3801-997 Aveiro, Esgueira
Phone: +351 (0)234 / 303 900
Fax: +351 (0)234 / 303 910

SIRIUS TRADING & SERVICES SRL **ROMANIA**
Aleea Lacul Morii Nr. 3
RO-060841 Bucuresti, Sector 6
Phone: +40 (0)21 / 430 40 06
Fax: +40 (0)21 / 430 40 02

INEA SR d.o.o. **SERBIA**
Ul. Karadjordjeva 12/217
SER-11300 Smederevo
Phone: +386 (026) 461 54 01

SIMAP SK (Západné Slovensko) **SLOVAKIA**
Dolné Pažite 603/97
SK-911 06 Trenčín
Phone: +421 (0)32 743 04 72
Fax: +421 (0)32 743 75 20

INEA RBT d.o.o. **SLOVENIA**
Stegne 11
SI-1000 Ljubljana
Phone: +386 (0)1 / 513 8116
Fax: +386 (0)1 / 513 8170

OMNI RAY AG **SWITZERLAND**
Im Schörli 5
CH-8600 Dübendorf
Phone: +41 (0)44 / 802 28 80
Fax: +41 (0)44 / 802 28 28

CSC- AUTOMATION Ltd. **UKRAINE**
4 B, Yevhena Sverstyuka Str.
UA-02002 Kiev
Phone: +380 (0)44 / 494 33 44
Fax: +380 (0)44 / 494-33-66

EURASIAN REPRESENTATIVES

TOO Kazpromavtomatika **KAZAKHSTAN**
UL. ZHAMBYLA 28,
KAZ-100017 Karaganda
Phone: +7 7212 / 50 10 00
Fax: +7 7212 / 50 11 50

MIDDLE EAST REPRESENTATIVE

EIM Energy **EGYPT**
3 Roxy Square
ET-11341 Heliopolis, Cairo
Phone: +202 24552559
Fax: +202 245266116

SHERF Motion Techn. Ltd. **ISRAEL**
Rehov Hamerkava 19
IL-58851 Holon
Phone: +972 (0)3 / 559 54 62
Fax: +972 (0)3 / 556 01 82

CEG LIBAN **LEBANON**
Cebaco Center/Block A Autostrade DORA
Lebanon-Beirut
Phone: +961 (0)1 / 240 445
Fax: +961 (0)1 / 240 193

AFRICAN REPRESENTATIVE

ADROIT TECHNOLOGIES **SOUTH AFRICA**
20 Waterford Office Park 189 Witkoppen Road
ZA-Fourways
Phone: + 27 (0)11 / 658 8100
Fax: + 27 (0)11 / 658 8101

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

BE SURE POWER IS DISCONNECTED PRIOR TO INSTALLATION!
FOLLOW NATIONAL, STATE AND LOCAL CODES.
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION.

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

The Model 460-14 MotorSaver® is an auto-ranging voltage monitor designed to protect 3-phase motors regardless of size. The MotorSaver® is used on 190-480VAC, 50/60 Hz motors to protect from damage caused by single-phasing, low voltage, high voltage, phase reversal, and voltage unbalance. The isolated output contacts allow separate power sources to be used for control circuits.

CONNECTIONS

1. Mount the MotorSaver® in a convenient location in or near the motor control panel. If the location is wet or dusty, the MotorSaver® should be mounted in a NEMA 4 or 12 enclosure. The MotorSaver® can be mounted to a back panel using two #6 or #8 x 5/8 screws or can be snapped onto a DIN rail.

2. Connect L1, L2 and L3 on the MotorSaver's terminal strip to the LINE SIDE of the motor starter (see Figure 1).

3. Connect the output relay to the circuitry to be controlled. For motor control, connect the normally open contact in series with the magnetic coil of the motor starter as shown in Figure 1. For alarm operation, connect the normally closed contact in series with the control circuit as in Figure 2.

II-460-14-B
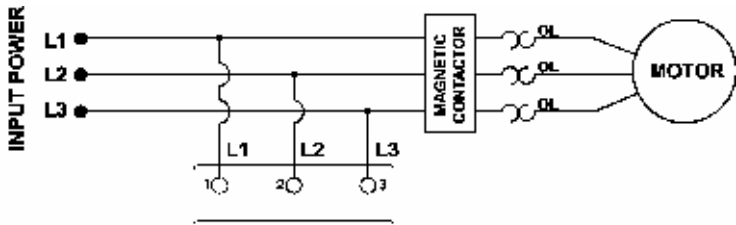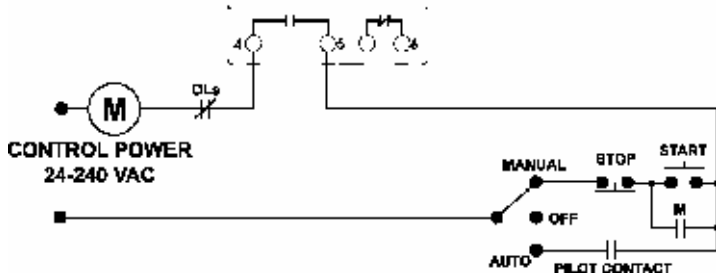
Figure 1. Control Wiring Diagram
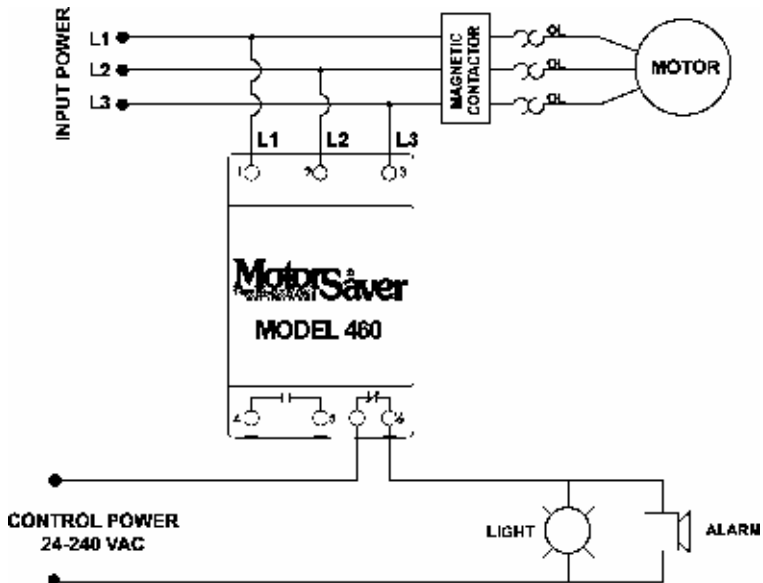
Figure 2. Alarm Wiring Diagram

7/05

SETTINGS

1. **Line voltage adjustment:** Rotate the VOLTAGE ADJ. (VAC) to the nominal 3-phase line voltage feeding the motor to be protected.

2. **Restart delay adjustment:** Rotate the RESTART (SEC) adjustment to the desired position. The restart delay is the time between the MotorSaver® seeing acceptable voltage and the MotorSaver® closing its output contacts. For compressor applications, the restart delay should be set for the approximate time it takes for the head pressure to bleed off of the compressor. For other applications, the restart delay is typically set between 2 and 10 seconds.

3. **Trip delay adjustment:** Rotate the TRIP DELAY (SEC) adjustment to the desired setting. This adjustment does not affect the trip delay on phasing faults. Typically, the trip delay adjustment is set between 1 and 5 seconds. In areas where voltage fluctuations are frequent, the trip delay adjustment may be set greater than 10 seconds.

4. **Voltage unbalance adjustment:** Rotate the UNBALANCE TRIP (NEMA%) adjustment to the desired unbalance trip level. The NEMA MG1 standard does not recommend operating a motor above 1% voltage unbalance without derating the motor. The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. SymCom recommends consulting the motor manufacturer for specific tolerances.
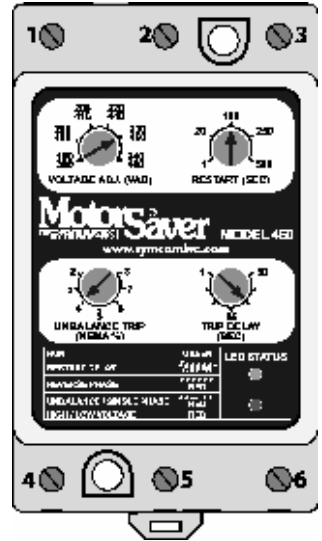
Percent Unbalance = Maximum deviation from the average x 100%
                                      Average

Example: The measured line-to-line voltages are 203, 210, and 212.

Average = 203 + 210 + 212   = 208.3
                      3

The maximum deviation from the average is the largest difference between the average voltage (208.3) and any one voltage reading.

208.3 - 203 = 5.3   210 - 208.3 = 1.7   212 - 208.3 = 3.7

The maximum deviation from the average is 5.3.

5.3 x 100 = 2.5% unbalance
208.3

POWER-UP

Turn on the 3-phase power to the motor. The MotorSaver's green RUN light will blink during the restart delay. After the restart delay, the MotorSaver® will energize its output contacts and the green light will illuminate. If the contacts do not energize and the RUN light does not illuminate, see the TROUBLESHOOTING section.

DIAGNOSTIC INDICATOR LIGHTS	
RUN	**GREEN**
RESTART DELAY	⎍⎍⎍⎍⎍⎍ **GREEN**
REVERSE PHASE	⎍⎍⎍⎍⎍⎍ **RED**
UNBALANCE / SINGLE PHASE	⎍⎍___⎍⎍ **RED**
HIGH / LOW VOLTAGE	**RED**

TROUBLESHOOTING

SYMPTOM	LIGHT PATTERN	SOLUTION
No lights are on - the unit seems completely dead	**N/A**	Measure the three line-to-line voltages. If any of the voltages are below 150VAC, the MotorSaver® does not have enough power to operate its internal electronics. If the voltages are correct, call SymCom at (800) 843-8848 or (605) 348-5580.
Red light is blinking (on initial power-up)	⊓⊔⊓⊔⊓⊔⊓⊔ **RED**	Turn off the 3-phase power. Swap any two leads powering the MotorSaver® (L1, L2, or L3) There is a 50-50 chance of connecting L1, L2 and L3 correctly the first time. Reapply 3-phase power.
Red light is blinking (after the motor has previously been running)	⊓⊔⊓⊔⊓⊔⊓⊔ **RED**	The incoming lines have been reverse-phased. The MotorSaver® is preventing the motor from running backwards. Correct the phase sequence.
Red light is blinking in this pattern	⊓⊔___⊓⊔ **RED**	The voltage is unbalanced or single-phased. Measure the incoming line voltages and calculate the % unbalance. If the voltage unbalance does not exceed the % unbalance reset value, call SymCom at (800) 843-8848 or (605) 348-5580.
Red light is on steady	**RED**	The voltage is out of tolerance. Measure the three line-to-line voltages. Calculate the average of the three voltages. If the average is 7% above or below the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within ±7% of the selected line voltage, call SymCom at (800) 843-8848 or (605) 348-5580.
Green light blinks and motor is not running	⊓⊔⊓⊔⊓⊔⊓⊔ **GREEN**	The MotorSaver® is timing through the restart delay.
Green light is on steady, but motor does not start	**GREEN**	The MotorSaver® is in run mode. Ensure other control devices are allowing the motor to start. Check control circuit for loose wires or malfunctioning switches.

MOTORSAVER® 460-14 SPECIFICATIONS

3-Phase Line Voltage	190-480VAC
Frequency	50*/60Hz
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2-8% adjustable
Reset	Trip setting minus 1% (5-8%)
	Trip setting minus 0.5% (2-4%)
Trip Delay Time	
Low, High and Voltage Unbalance	1-30 seconds adjustable
Single-Phasing Faults (>25% UB)	1 second fixed
Restart Delay Time	
After a fault or power loss	1-500 seconds adjustable
Output Contact Rating – DPST	
Pilot Duty	480VA @ 240VAC
General Purpose	8A @ 240VAC
Power Consumption	6 Watts (max.)
Weight	14 oz.
Enclosure	Polycarbonate
Terminal	
Torque	6 in.-lbs.
Wire AWG	12-20 AWG
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947-6-2
Standards Passed	
Electrostatic Discharge (ESD)	IEC 100-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	159 MHz, 10V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5kV input power and controls
Surge	
IEC	IEC 1000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° to 70°C (-4° to 158°F)
Class of Protection	IP20, NEMA 1 (Finger Safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

*NOTE: 50Hz will increase all delay timers by 20%

DIMENSIONS
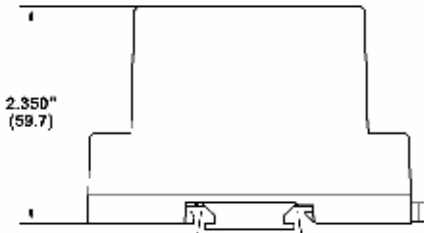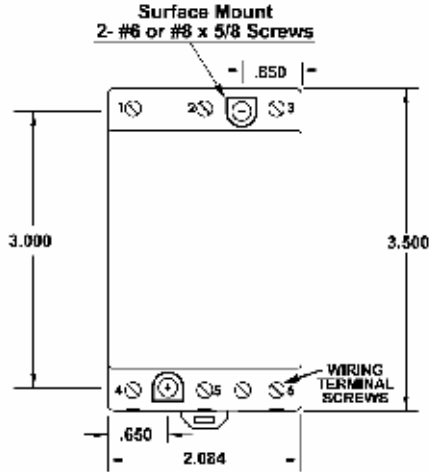
SymCom, Inc. warrants its microcontroller-based products against defects in material or workmanship for a period of five (5) years from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material or workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, and conditions, please refer to the SymCom Terms and Conditions of Sale document.

7/05

Visit our website at www.symcom.com for our complete catalog and product listings!

www.SymCom.com
... your electronic control & protection specialists

SDSA3650, SDSA4040, and SDSA2040 Surge Protective Devices

Dispositivo de protección contra sobretensiones transitorias (SPD) SDSA3650, SDSA4040, y SDSA2040

Dispositif de protection contre les surtensions transitoires (SPD) SDSA3650, SDSA4040, et SDSA2040

SDSA3650   **SDSA3650D**

Retain for future use.

Introduction

The SDSA Surge Protective Device (SPD) is designed to provide surge suppression for three-phase services.

Precautions

⚠ DANGER / PELIGRO / DANGER		
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH	**PELIGRO DE DESCARGA ELÉCTRICA, EXPLOSIÓN O DESTELLO POR ARQUEO**	**RISQUE D'ÉLECTROCUTION, D'EXPLOSION OU D'ÉCLAIR D'ARC**
• Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.	• Utilice equipo de protección personal (EPP) apropiado y siga las prácticas de seguridad en trabajos eléctricos establecidas por su Compañía, consulte la norma 70E de NFPA y NOM-029-STPS.	• Portez un équipement de protection personnelle (ÉPP) approprié et observez les méthodes de travail électrique sécuritaire. Voir NFPA 70E.
• This equipment must only be installed and serviced by qualified electrical personnel.	• Solamente el personal eléctrico especializado deberá instalar y prestar servicio de mantenimiento a este equipo.	• Seul un personnel qualifié doit effectuer l'installation et l'entretien de cet appareil.
• Turn off all power supplying this equipment before working on or inside equipment.	• Desenergice el equipo antes de realizar cualquier trabajo dentro o fuera de él.	• Coupez toutes les alimentations de l'appareil avant d'y travailler.
• Always use a properly rated voltage sensing device to confirm power is off.	• Siempre utilice un dispositivo detector de tensión nominal adecuado para confirmar la desenergización del equipo.	• Utilisez toujours un dispositif de détection de tension à valeur nominale appropriée pour vous assurer que l'alimentation est coupée.
• Replace all devices, doors and covers before turning on power to this equipment.	• Vuelva a colocar todos los dispositivos, las puertas y las cubiertas antes de volver a energizar el equipo.	• Replacez tous les dispositifs, les portes et les couvercles avant de mettre l'appareil sous tension.
• This equipment must be effectively grounded per all applicable codes. Use an equipment-grounding conductor to connect this equipment to the power system ground.	• Este equipo deberá estar correctamente conectado a tierra de acuerdo con los códigos aplicables. Utilice un conductor de conexión a tierra del equipo para conectar este último a la tierra del sistema de alimentación.	• Cet appareil doit être effectivement mis à la terre selon tous les codes en vigueur. Utilisez un conducteur de m.à.l.t. d'appareil pour raccorder celui-ci à la terre du système d'alimentation.
Failure to follow these instructions will result in death or serious injury.	**El incumplimiento de estas instrucciones podrá causar la muerte o lesiones serias.**	**Si ces directives ne sont pas respectées, cela entraînera la mort ou des blessures graves.**

SQUARE D ™

by Schneider Electric

SDSA3650, SDSA4040, and SDSA2040 Surge Protective Devices
Dispositivo de protección contra sobretensiones transitorias (SPD) SDSA3650, SDSA4040, y SDSA2040
Dispositif de protection contre les surtensions transitoires (SPD) SDSA3650, SDSA4040, et SDSA2040

8291-0068
Rev. 01, 04/2015

⚠ CAUTION / PRECAUCIÓN / ATTENTION

LOSS OF SURGE SUPPRESSION	**PÉRDIDA DE SUPRESIÓN DE SOBRETENSIONES TRANSITORIAS**	**PERTE DE LA SUPPRESSION DES SURTENSIONS TRANSITOIRES**
• Ungrounded power systems are inherently unstable and can produce excessively high line-to-ground voltages during certain fault conditions. During these fault conditions any electrical equipment, including an SPD, may be subjected to voltages which exceed their designed ratings. This information is being provided to the user so that an informed decision can be made before installing any electrical equipment on an ungrounded power system.	• Los sistemas de alimentación sin conexión a tierra son inherentemente inestables y pueden producir tensiones excesivamente altas de línea a tierra durante ciertas condiciones de falla. Durante estas condiciones de falla cualquier equipo eléctrico, incluyendo un SPD, puede ser sometido a tensiones que excedan sus valores nominales para los cuales fueron diseñados. Esta información se proporciona al usuario para que pueda tomar una decisión informada antes de instalar cualquier equipo eléctrico en un sistema de alimentación sin conexión a tierra.	• Les systèmes d'alimentation sans mise à la terre (systèmes flottants) sont, par inhérence, instables et peuvent produire des tensions phase-terre excessivement hautes pendant certaines conditions de défaut. Pendant ces conditions de défaut, tout appareillage électrique, y compris un dispositif de protection contre les surtensions (SPD), peut être soumis à des tensions qui dépassent ses capacités nominales. Ces informations sont fournies à l'utilisateur de sorte qu'une décision fondée puisse être prise avant d'installer un appareillage électrique sur un système d'alimentation non mis à la terre (systèmes flottants).
• Turn off all power supplying the equipment and isolate the Surge Protective Device before Megger® or hi-potential testing.	• Desenergice el equipo y aísle el dispositivo de protección contra sobretensiones transitorias antes de realizar cualquier prueba de rigidez dieléctrica o con Megger®.	• Coupez toute alimentation de cet appareil et isolez le dispositif de protection contre les surtensions transitoires avant de procéder à l'essai de rupture diélectrique ou avec Megger®.
Failure to follow these instructions can result in injury or equipment damage.	**El incumplimiento de estas instrucciones puede causar lesiones o daño al equipo.**	**Si ces directives ne sont pas respectées, cela peut entraîner des blessures ou des dommages matériels.**

Installation

1. Turn off all power supplying this equipment before working on or inside equipment. For mounting, see Figure 1.

   NOTE: This device is classified as a Type 1 SPD, therefore it can be installed with or without a dedicated circuit breaker.

2. Confirm SPD is rated for the system by comparing voltage measurements to the Line Voltage (L-L, L-N) on the product label (see Figure 2).

3. Connect the black wires of the SPD to each of the incoming lines. Connect the neutral wire (white) of the SPD to the neutral bar. When no neutral is present, connect the white wire to the grounding bar (see Figure 2).

Instalación

1. Desenergice el equipo antes de realizar cualquier trabajo dentro o fuera de él. Para obtener detalles de montaje, vea la figura 1.

   NOTA: Este dispositivo está clasificado como un SPD tipo 1, por lo tanto se puede instalar con o sin un interruptor automático dedicado.

2. Asegúrese de que el SPD sea adecuado para su sistema comparando las mediciones de tensión en la tensión de línea (L-L, L-N), especificadas en la etiqueta del producto (vea la figura 2).

3. Conecte los conductores negros del SPD a cada una de las líneas entrantes. Conecte el conductor neutro (blanco) del SPD a la barra de neutro. Cuando no hay un neutro, conecte el conductor blanco a la barra de puesta a tierra (vea la figura 2).

Installation

1. Couper toutes les alimentations de l'appareil avant d'y travailler. Pour le montage voir la figure 1.

   REMARQUE : Ce dispositif est classé comme un SPD type 1 et peut donc être installé avec ou sans un disjoncteur dédié.

2. S'assurer que le SPD est de la valeur nominale convenant à votre système en comparant les mesures de tension à la tension de ligne (L-L, L-N) sur l'étiquette du produit (voir la figure 2).

3. Raccorder les fils noirs du SPD à chaque ligne d'arrivée. Raccorder le fil du neutre (blanc) du SPD à la barre du neutre. Lorsque le neutre n'est pas présent, raccorder le fil blanc à la barre de m.à.l.t. (voir la figure 2).

For troubleshooting, call the Surgelogic Technical Assistance Group at 1-800-577-7353.

SDSA3650, SDSA4040, and SDSA2040 Surge Protective Devices
8291-0068   Dispositivo de protección contra sobretensiones transitorias (SPD) SDSA3650, SDSA4040, y SDSA2040
Rev. 01, 04/2015   Dispositif de protection contre les surtensions transitoires (SPD) SDSA3650, SDSA4040, et SDSA2040

NOTE: Delta models do not include or require a neutral (white) wire.

4. Twist wires 1/2 turn every 12 in. (30 cm) of length.

5. Keep conductor length as short as possible with no sharp bends.

   NOTE: Do not loop or coil wires.

6. Install cover and/or close door on equipment.

NOTA: Los modelos en delta no incluyen ni requieren un conductor neutro (blanco).

4. Tuerza los conductores ½ vuelta o más por cada 305 mm (12 pulgadas) de longitud.

5. Mantenga la longitud de los conductores lo más corta posible evitando doblarlos en ángulo recto.

   NOTA: No haga bucles o enrolle los cables.

6. Instale la cubierta y/o cierre la puerta del equipo.

REMARQUE : Les modèles en triangle ne comprennent ni n'exigent un fil neutre (blanc).

4. Torsader les conducteurs de 1/2 tour ou plus par 305 mm (12 po) de longueur.

5. Maintenir la longueur des conducteurs aussi courte que possible et sans courbures accentuées.

   REMARQUE : Ne pas faire de boucles et ne pas enrouler les fils.

6. Installer le couvercle ou fermer la porte de l'appareil.

Figure / Figura / Figure 1 : Mounting and Wiring / Montaje y alambrado / Montage et câblage
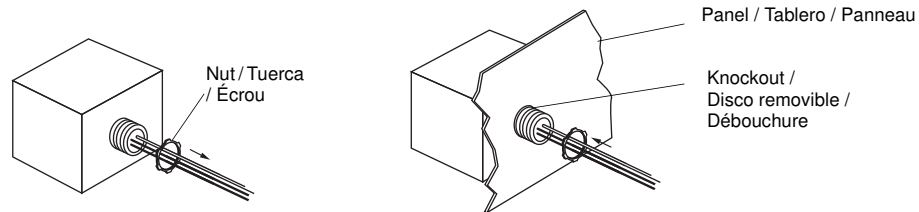
Figure / Figura / Figure 2 : Wiring / Alambrado / Câblage

3-Phase, 4-Wire WYE
3 fases, 4 hilos en estrella
triphasée, 4 fils en étoile

SDSA2040 – 208Y/120 Vac, V~(ca)
SDSA4040 – 480Y/277 Vac, V~(ca)
SDSA3650 – 600Y/347 Vac, V~(ca)

3-Phase, 4-Wire High-Leg Delta
Instalación en delta con extremo alto de 3 fases, 4 hilos
Triphasée, 4 fils, sommet du triangle (high-leg)

SDSA2040D – 240/120 Vac, V~(ca)

1-Phase, 2-Wire
1 fase, 2 hilos
Monophasée, 2 fils

SDSA2040 – 208Y/120 Vac, V~(ca)
SDSA4040 – 480Y/277 Vac, V~(ca)
SDSA3650 – 600Y/347 Vac, V~(ca)

3-Phase, 3-Wire Delta
Instalación en delta de 3 fases, 3 hilos
Triphasée, 3 fils en triangle

SDSA2040D – 240 Vac, V~(ca)
SDSA4040D – 480 Vac, V~(ca)
SDSA3650D – 600Y Vac, V~(ca)

SDSA3650, SDSA4040, and SDSA2040 Surge Protective Devices
Dispositivo de protección contra sobretensiones transitorias (SPD) SDSA3650, SDSA4040, y SDSA2040
Dispositif de protection contre les surtensions transitoires (SPD) SDSA3650, SDSA4040, et SDSA2040

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Figure / Figura / Figure 3 : Diagnostic Operation / Diagnóstico del funcionamiento del equipo / Diagnostic de fonctionnement
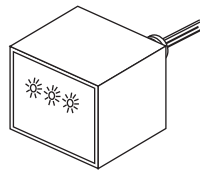
Indicator Light ON = OK /
Luz indicadora = funcionamiento normal /
Voyant = OK
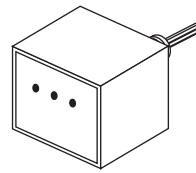
Indicator Light OFF = Loss of surge suppression /
Luz indicadora = pérdida de supresión de sobretensiones transitorias /
Voyant = Perte de suppression des surtensions transitoires /

- **Indicator Light ON** = Normal Operation
- **Indicator Light OFF** = Check circuit breakers and connections. Verify line voltage at point of connection; if all correct, replace unit.

- **Luz indicadora** = Funcionamiento normal
- **Luz indicadora** = Revise los interruptores automáticos y las conexiones. Verifique la tensión de línea en el punto de conexión; si todo se encuentra en órden, sustituya el SPD.

- **Voyant** = Fonctionnement normal
- **Voyant** = Vérifier les disjoncteurs et les raccordements. Vérifier la tension de ligne au point de raccordement; si tout est correct, remplacer le SPD.

Dimensions

Dimensiones

Dimensions

Figure / Figura / Figure 4 : Dimensions / Dimensiones / Dimensions


```
3.00
(76)

3.60
(92)

3.39
(86)

2.64
(67)

in. / pulg / po
(mm)
```
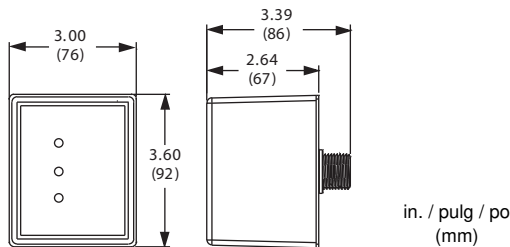
Note: Knockout trade size is 0.5 in. (13 mm). Actual hole size is 0.875 in. (22 mm).

Nota: El tamaño estándar del disco desprendible es de 13 mm (0,5 pulg). El tamaño real del agujero es de 22 mm (0,875 pulg).

Remarque : La taille commerciale des débouchures est de 13 mm (0,5 po). Taille réelle du trou : 22 mm (0,875 po).

For troubleshooting, call the Surgelogic Technical Assistance Group at 1-800-577-7353.

PEPPERL+FUCHS

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS I, DIVISION 1   GROUPS E,F,G
CLASS II DIVISION 1

NON-HAZARDOUS AREA ⑤
OR
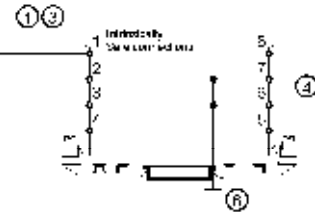CLASS I DIVISION 2 GROUPS A,B,C,D ⑩

Any Simple Apparatus ③ or I.S. devices with Entity Concept parameters ①
(V max, I max, Ci, Li) appropriate for connection to associated apparatus with
Entity Concept parameters listed in Table 1.

CONNECTION DIAGRAM 1

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I DIVISION 2   GROUPS A,B,C,D
CLASS I, DIVISION 2   GROUPS F,G
CLASS II DIVISION 2

Non-incendive field circuit with Entity Concept parameters ① (V max, I max,
Ci, Li) appropriate for connection to non-incendive source with Entity
Concept parameters listed in Table 1.

CONNECTION DIAGRAM 1A

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS I, DIVISION 1   GROUPS E,F,G
CLASS II DIVISION 1

Any Simple Apparatus ③ or I.S. devices with Entity Concept parameters ①
(V max, I max, Ci, Li) appropriate for connection to associated apparatus with
Entity Concept parameters listed in Table 1.

Any Simple Apparatus ③ or I.S. devices with Entity Concept parameters ①
(V max, I max, Ci, Li) appropriate for connection to associated apparatus with
Entity Concept parameters listed in Table 1.

Note: Ground returns must be run separately
CONNECTION DIAGRAM 2

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I DIVISION 2   GROUPS A,B,C,D
CLASS I, DIVISION 2   GROUPS F,G
CLASS II DIVISION 2

Non-incendive field circuit with Entity Concept parameters ① (V max, I max,
Ci, Li) appropriate for connection to non-incendive source with Entity
Concept parameters listed in Table 1.

Non-incendive field circuit with Entity Concept parameters ① (V max, I max,
Ci, Li) appropriate for connection to non-incendive source with Entity
Concept parameters listed in Table 1.

Note: Ground returns must be run separately
CONNECTION DIAGRAM 2A

CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11
PEPPERL+FUCHS	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers		respons.	GB-TC	**116-0139D**
			approved	GB-PAW	
Twinsburg			norm	GB-PT	sheet 1 of 11

PEPPERL+FUCHS

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS I, DIVISION 1   GROUPS E,F,G
CLASS II DIVISION 1

NON-HAZARDOUS AREA ⑤
OR
CLASS I, DIVISION 2 GROUPS A,B,C,D ①

Any Simple Apparatus ② or I.S. devices with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to associated apparatus with Entry Concept parameters listed in Table 1.

CONNECTION DIAGRAM 3

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I DIVISION 2   GROUPS A,B,C,D
CLASS I, DIVISION 2   GROUPS E,F,G
CLASS II DIVISION 2

Non-incendive field circuit with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to non-incendive source with Entry Concept parameters listed in Table 1.
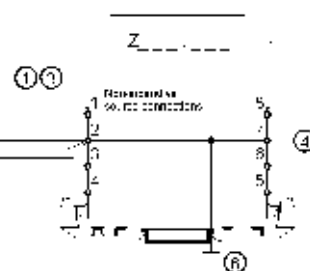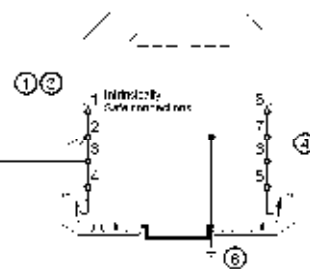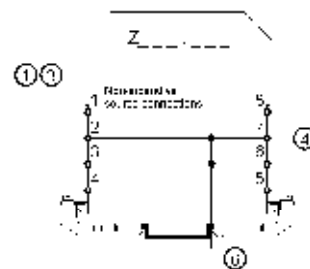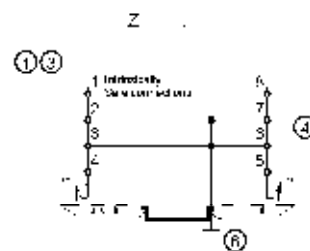
CONNECTION DIAGRAM 3A

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS I, DIVISION 1   GROUPS E,F,G
CLASS II DIVISION 1

Any Simple Apparatus ② or I.S. devices with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to associated apparatus with Entry Concept parameters listed in Table 1.

Any Simple Apparatus ② or I.S. devices with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to associated apparatus with Entry Concept parameters listed in Table 1.

Any Simple Apparatus ② or I.S. devices with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to associated apparatus with Entry Concept parameters listed in Table 1.

Note: Ground returns must be run separately
CONNECTION DIAGRAM 4

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I DIVISION 2   GROUPS A,B,C,D
CLASS I, DIVISION 2   GROUPS E,F,G
CLASS II DIVISION 2

Non-incendive field circuit with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to non-incendive source with Entry Concept parameters listed in Table 1.

Non-incendive field circuit with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to non-incendive source with Entry Concept parameters listed in Table 1.

Non-incendive field circuit with Entry Concept parameters ① (Vmax, Imax, Ci, Li) appropriate for connection to non-incendive source with Entry Concept parameters listed in Table 1.

Note: Ground returns must be run separately
CONNECTION DIAGRAM 4A

CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11	
PEPPERL+FUCHS Twinsburg	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers		respons.	GB-TC	**116-0139D**
			approved	GB-PAW	
			norm	GB-PT	sheet 2 of 11

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS II, DIVISION 1   GROUPS E,F,G
CLASS III DIVISION 1

NON-HAZARDOUS AREA ⑤
OR
CLASS I, DIVISION 2 GROUPS A,B,C,D ①

Any Simple Apparatus ② or ⑧ devices with Entity Concept parameters ⑦
(Vmax, Imax, Ci, Li) appropriate for connection to associated apparatus with
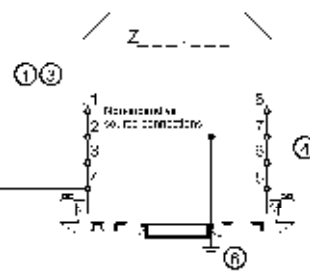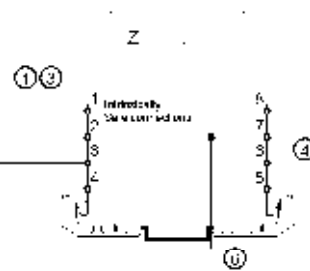Entity Concept parameters listed below.

CONNECTION DIAGRAM 5

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I DIVISION 2   GROUPS A,B,C,D
CLASS II, DIVISION 2   GROUPS F,G
CLASS III DIVISION 2

Non incendive field circuit with Entry Concept parameters ① (Vmax, Imax,
Ci, Li) appropriate for connection to non incendive source with Entry
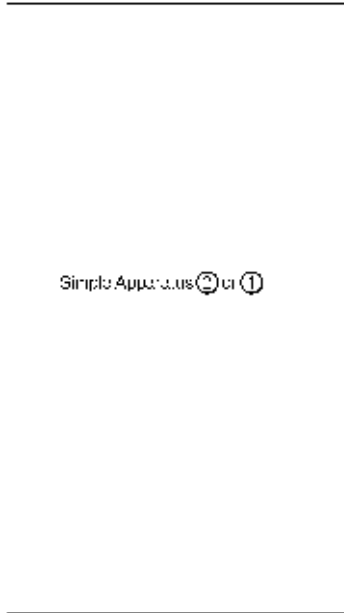Concept parameters listed in Table 1.

CONNECTION DIAGRAM 5A

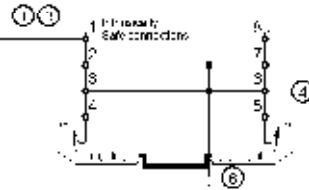| Dieses Dokument enthält sicherheitsrelevante Angaben. Es darf nicht ohne Absprache mit dem Normenfachmann geändert werden!				
This document contains safety-relevant information. It must not be altered without the authorization of the norm expert!				
CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11
PEPPERL+FUCHS Twinsburg	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers	respons.	GB-TC	116-0139D
		approved	GB-PAW	
		norm	GB-PT	sheet 3 of 11

HAZARDOUS AREA
CLASS I DIVISION 1   GROUPS A,B,C,D
CLASS I, DIVISION 1   GROUPS E,F,G
CLASS II DIVISION 1

NON-HAZARDOUS AREA ⑤
OR
CLASS I, DIVISION 2 GROUPS A,B,C,D ④

Simple Apparatus ② or ①

CONNECTION DIAGRAM 6

Dieses Dokument enthält sicherheitsrelevante Angaben. Es darf nicht ohne Absprache mit dem Normenfachmann geändert werden!				
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CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11

PEPPERL+FUCHS	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers		respons.	GB-TC	116-0139D
			approved	GB-PAW	
Twinsburg			norm	GB-PT	sheet 4 of 11

PEPPERL+FUCHS

NON-HAZARDOUS AREA ⑤
OR
CLASS I, DIVISION 2 GROUPS A,B,C, D ⑩

Non-incendive field circuit with Entity
Concept parameters ⑦ (Vmax, Imax, Ci, Li)
appropriate for connection to non-incendive
source with Entity Concept parameters
listed in Table 1.

CONNECTION DIAGRAM 6A

	Dieses Dokument enthält sicherheitsrelevante Angaben. Es darf nicht ohne Absprache mit dem Normenfachmann geändert werden!				
	This document contains safety-relevant information. It must not be altered without the authorization of the norm expert!				
CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11	
PEPPERL+FUCHS	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers		respons.	GB-TC	**116-0139D**
			approved	GB-PAW	
Twinsburg			norm	GB-PT	sheet 5 of 11

TABLE 1 – ENTITY PARAMETERS

MODEL NUMBER	TERMINALS	Uo (Voc) (V)	Io (Isc) (mA)	Vt (V)	It (mA)	Groups Ca (µF)			Groups La(mH)		
						A,B	C,E	D,F,G	A,B	C,E	D,F,G
Z705	1,2	4.94	504	-	-	100	300	800	0.14	0.42	1.12
Z710	1,2	9.56	195	-	-	3	9	24	0.86	2.58	6.88
Z710.CL	1,2	9.56	195	-	-	3	9	24	0.86	2.58	6.88
Z713	1,2	15.75	723	-	-	0.48	1.44	3.84	0.076	0.228	0.608
Z715	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
Z715.CL	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
Z715.1K	1,2	14.7	15	-	-	0.58	1.74	4.64	144	432	1152
Z722	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
Z722.CL	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
Z726	1,2	27.5	155	-	-	-	0.27	0.72	-	4	8
Z728	1,2	28	93	-	-	0.083	0.249	0664	3.05	9.15	24.4
Z728.CL	1,2	28	93	-	-	0.083	0.249	0664	3.05	9.15	24.4
Z728.H	1,2	28	119	-	-	0.083	0.249	0664	1.82	5.46	14.56
Z731	1,2	28	93	-	-	0.083	0.249	0664	3.05	9.15	24.4
	2,3	7.2	1470	-	-	13.5	40.5	108	0.02	0.06	0.16
	2,4	7.2	1470	-	-	13.5	40.5	108	0.02	0.06	0.16
	1,2,3,4	-	-	28	1570	0.083	0.249	0664	0.02	0.06	0.16
Z755	1,2	4.94	504	-	-	100	300	800	0.14	0.42	1.12
	3,4	4.94	504	-	-	100	300	800	0.14	0.42	1.12
	1,2,3,4	-	-	4.94	1008	100	300	800	0.03	0.09	0.24
Z757	1,2	7.14	729	-	-	13.5	40.5	108	0.07	0.21	0.56
	3,4	7.14	729	-	-	13.5	40.5	108	0.07	0.21	0.56
	1,2,3,4	-	-	7.14	1457	13.5	40.5	108	0.02	0.06	0.16
Z763	1,2	11.6	370	-	-	1.41	4.23	11.28	0.24	0.72	1.92
	3,4	1.6	51	-	-	100	300	800	14	42	112
	1,2,3,4	-	-	13.2	422	0.94	2.82	7.52	0.2	0.6	1.6
Z764	1,2	11.6	12	-	-	1.41	4.23	11.28	240	720	1,920
	3,4	11.6	12	-	-	1.41	4.23	11.28	240	720	1,920
	1,2,3,4	-	-	11.6	24	1.41	4.23	11.28	61	183	488
Z765	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	3,4	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	1,2,3,4	-	-	14.7	300	0.58	1.74	4.64	0.32	0.96	2.56
Z772	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
	3,4	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
	1,2,3,4	-	-	22	300	-	0.51	1.36	-	4.35	11.6
Z778	1,2	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	3,4	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	1,2,3,4	-	-	28	93	0.083	0.249	0.664	3.05	9.15	24.4
Z779	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	1,2,3,4	-	-	28	186	-	0.249	0.664	-	4	8
Z779.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	1,2,3,4	-	-	28	238	-	0.249	0.664	-	2	4
Z786	1,2	28	0	-	-	0.083	0.249	0.664	5	15	40
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	0	0.083	0.249	0.664	5	15	40

PEPPERL+FUCHS
Twinsburg

Control Drawing
Installation Drawing for UL listed
Z7.., Z8.., Z9..
Zener Barriers

respons.	GB-TC	116-0139D
approved	GB-PAW	
norm	GB-PT	sheet 6 of 11

PEPPERL+FUCHS

TABLE 1 – ENTITY PARAMETERS (Continued)

MODEL NUMBER	TERMINALS	Uo (Voc) (V)	Io (Isc) (mA)	Vt (V)	It (mA)	Groups Ca (µF)			Groups La(mH)		
						A,B	C,E	D,F,G	A,B	C,E	D,F,G
Z787	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	93	0.083	0.249	0.664	3.05	9.15	24.4
Z787.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	119	0.083	0.249	0.664	1.82	5.46	14.56
Z788	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	288	0.083	0.249	0.664	0.32	0.96	2.56
Z788.R	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	288	0.083	0.249	0.664	0.32	0.96	2.56
Z788.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	314	0.083	0.249	0.664	0.26	0.78	2.08
Z788.R.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	314	0.083	0.249	0.664	0.26	0.78	2.08
Z796	1,2	26.6	85	-	-	0.094	0.282	0.752	5.14	15.42	41.12
	3,4	20.5	50	-	-	0.203	0.609	1.624	14.6	43.8	116.8
	1,2,3,4	-	-	26.6	135	0.094	0.282	0.752	2.05	6.15	16.4
Z796.L	1,2	26.0	83	-	-	0.094	0.282	0.752	5.14	15.42	41.12
	3,4	20.0	49	-	-	0.203	0.609	1.624	14.6	43.8	116.8
	1,2,3,4	-	-	26.0	132	0.094	0.282	0.752	2.05	6.15	16.4
Z805	1,2	4.94	504	-	-	100	300	800	0.14	0.42	1.12
Z810	1,2	9.56	195	-	-	3	9	24	0.86	2.58	6.88
Z810.CL	1,2	9.56	195	-	-	3	9	24	0.86	2.58	6.88
Z813	1,2	15.75	723	-	-	0.48	1.44	3.84	0.076	0.228	0.608
Z815	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
Z815.CL	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
Z815.1K	1,2	14.7	15	-	-	0.58	1.74	4.64	144	432	1152
Z822	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
Z822.CL	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
Z828	1,2	28	93	-	-	0.083	0.249	0664	3.05	9.15	24.4
Z828.CL	1,2	28	93	-	-	0.083	0.249	0664	3.05	9.15	24.4
Z828.H	1,2	28	119	-	-	0.083	0.249	0664	1.82	5.46	14.56
Z855	1,2	4.94	504	-	-	100	300	800	0.14	0.42	1.12
	3,4	4.94	504	-	-	100	300	800	0.14	0.42	1.12
	1,2,3,4	-	-	4.94	1008	100	300	800	0.03	0.09	0.24
Z857	1,2	7.14	729	-	-	13.5	40.5	108	0.07	0.21	0.56
	3,4	7.14	729	-	-	13.5	40.5	108	0.07	0.21	0.56
	1,2,3,4	-	-	7.14	1457	13.5	40.5	108	0.02	0.06	0.16
Z864	1,2	11.6	12	-	-	1.41	4.23	11.28	240	720	1,920
	3,4	11.6	12	-	-	1.41	4.23	11.28	240	720	1,920
	1,2,3,4	-	-	11.6	24	1.41	4.23	11.28	61	183	488
Z865	1,2	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	3,4	14.7	150	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	1,2,3,4	-	-	14.7	300	0.58	1.74	4.64	0.32	0.96	2.56

TABLE 1 – ENTITY PARAMETERS (Continued)

MODEL NUMBER	TERMINALS	Uo (Voc) (V)	Io (Isc) (mA)	Vt (V)	It (mA)	Groups Ca (µF)			Groups La(mH)		
						A,B	C,E	D,F,G	A,B	C,E	D,F,G
Z872	1,2	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
	3,4	22	150	-	-	0.17	0.51	1.36	1.45	4.35	11.6
	1,2,3,4	-	-	22	300	-	0.51	1.36	-	4.35	11.6
Z878	1,2	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	3,4	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	1,2,3,4	-	-	28	93	0.083	0.249	0.664	3.05	9.15	24.4
Z879	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	1,2,3,4	-	-	28	186	-	0.249	0.664	-	4	8
Z879.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	1,2,3,4	-	-	28	238	-	0.249	0.664	-	2	4
Z886	1,2	28	0	-	-	0.083	0.249	0.664	5	15	40
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	0	0.083	0.249	0.664	5	15	40
Z887	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	93	0.083	0.249	0.664	3.05	9.15	24.4
Z887.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	28	0	-	-	0.083	0.249	0.664	5	15	40
	1,2,3,4	-	-	28	119	0.083	0.249	0.664	1.82	5.46	14.56
Z888	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	288	0.083	0.249	0.664	0.32	0.96	2.56
Z888.R	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	288	0.083	0.249	0.664	0.32	0.96	2.56
Z888.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	314	0.083	0.249	0.664	0.26	0.78	2.08
Z888.R.H	1,2	28	119	-	-	0.083	0.249	0.664	1.82	5.46	14.56
	3,4	9.56	195	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	28	314	0.083	0.249	0.664	0.26	0.78	2.08
Z896	1,2	26.6	85	-	-	0.094	0.282	0.752	5.14	15.42	41.12
	3,4	20.5	50	-	-	0.203	0.609	1.624	14.6	43.8	116.8
	1,2,3,4	-	-	26.6	135	0.094	0.282	0.752	2.05	6.15	16.4
Z896.L	1,2	26.0	83	-	-	0.094	0.282	0.752	5.14	15.42	41.12
	3,4	20.0	49	-	-	0.203	0.609	1.624	14.6	43.8	116.8
	1,2,3,4	-	-	26.0	132	0.094	0.282	0.752	2.05	6.15	16.4
Z905	1,2	4.89	499	-	-	100	300	800	0.14	0.42	1.12
Z910	1,2	9.94	203	-	-	3	9	24	0.86	2.58	6.88
Z915	1,2	15	153	-	-	0.58	1.74	4.64	1.3	3.9	10.4
Z915.1k	1,2	15	15	-	-	0.58	1.74	4.64	144	432	1152
Z922	1,2	+11	218	-	-	1.97	5.91	15.76	0.74	2.22	5.92
	3,4	-11	218	-	-	1.97	5.91	15.76	0.74	2.22	5.92
	1,2,3,4	-	-	22	218	0.17	0.51	1.36	0.26	0.78	2.08
Z928	1,2	28	93	-	-	0.083	0.249	0.664	3.05	9.15	24.4

PEPPERL+FUCHS

TABLE 1 – ENTITY PARAMETERS (Continued)

MODEL NUMBER	TERMINALS	Uo (Voc) (V)	Io (Isc) (mA)	Vt (V)	It (mA)	Groups Ca (µF)			Groups La(mH)		
						A,B	C,E	D,F,G	A,B	C,E	D,F,G
Z954	1,2	4.5	383	-	-	100	300	800	0.24	0.72	1.92
	2,3	4.5	383	-	-	100	300	800	0.24	0.72	1.92
	2,4	4.5	383	-	-	100	300	800	0.24	0.72	1.92
	1,2,3;2,3,4	9	765	-	-	4.9	14.7	39.2	0.068	0.204	0.544
	1,2,3,4	-	-	9	1150	4.9	14.7	39.2	0.030	0.090	0.24
Z955	1,2	4.89	499	-	-	100	300	800	0.14	0.42	1.12
	3,4	4.89	499	-	-	100	300	800	0.14	0.42	1.12
	1,2,3,4	-	-	9.78	998	3.3	9.9	26.4	0.030	0.090	0.24
Z960	1,2	9.94	203	-	-	3	9	24	0.86	2.58	6.88
	3,4	9.94	203	-	-	3	9	24	0.86	2.58	6.88
	1,2,3,4	-	-	9.94	406	3	9	24	0.19	0.57	1.52
Z961 (Single module Installation)	1,2	8.7	89	-	-	4.9	14.7	39.2	4.69	14.07	37.52
	3,4	8.7	89	-	-	4.9	14.7	39.2	4.69	14.07	37.52
	1,2,3,4	-	-	17.4	178	0.346	1.038	2.768	1.14	3.42	9.12
Z961 (Installed as detailed in Diagram 6)	1,4	-	-	17.4	213	0.346	1.038	2.768	1.14	3.42	9.12
Z961.H	1,2	8.7	25	-	-	4.9	14.7	39.2	57	171	456
	3,4	8.7	25	-	-	4.9	14.7	39.2	57	171	456
	1,2,3,4	-	-	17.4	49	0.346	1.038	2.768	15.2	45.6	121.6
Z964	1,2	12	12	-	-	1.41	4.23	11.28	240	720	1920
	3,4	12	12	-	-	1.41	4.23	11.28	240	720	1920
	1,2,3,4	-	-	24	24	0.125	0.375	1	61	183	488
Z965	1,2	15	153	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	3,4	15	153	-	-	0.58	1.74	4.64	1.3	3.9	10.4
	1,2,3,4	-	-	15	306	0.58	1.74	4.64	0.29	0.87	2.32
Z966	1,2	12	82	-	-	1.41	4.23	11.28	5.52	16.56	44.16
	3,4	12	82	-	-	1.41	4.23	11.28	5.52	16.56	44.16
	1,2,3,4	-	-	24	164	0.125	0.375	1	1.38	4.14	11.04
Z966.H	1,2	12	164	-	-	1.41	4.23	11.28	1.38	4.14	11.04
	3,4	12	164	-	-	1.41	4.23	11.28	1.38	4.14	11.04
	1,2,3,4	-	-	24	328	0.125	0.375	1	0.33	0.99	2.64
Z967	1,2	16.8	143	-	-	0.38	1.14	3.04	1.63	4.89	13.04
	3,4	16.8	143	-	-	0.38	1.14	3.04	1.63	4.89	13.04
	1,2,3,4	-	-	16.8	286	0.38	1.14	3.04	0.24	0.72	1.92
Z969	1,2	14.24	400	-	-	0.68	2.04	5.44	0.16	0.48	1.28
	3,4	17.6	349	-	-	0.33	0.99	2.64	0.14	0.42	1.12
	1,2,3,4	-	-	17.6	749	0.33	0.99	2.64	0.071	0.213	0.568
Z972	1,2	22	73	-	-	0.17	0.51	1.36	6.95	20.85	55.6
	3,4	22	73	-	-	0.17	0.51	1.36	6.95	20.85	55.6
	1,2,3,4	-	-	22	146	0.17	0.51	1.36	1.45	4.35	10.8
Z978	1,2	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	3,4	28	46	-	-	0.083	0.249	0.664	17.2	51.6	137.6
	1,2,3,4	-	-	28	93	0.083	0.249	0.664	3.05	9.15	24.4

PEPPERL+FUCHS

Notes:

1.   The Entity Concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved values of Uo (Voc), Io (Isc) and Po for the associated apparatus are less than or equal to Vmax (Ui) and Imax (Ii) for the intrinsically safe apparatus and the approved values of Ca (Co) and La (Lo) for the associated apparatus are greater than Ci + Ccable and Li + Lcable, respectively, for the intrinsically safe apparatus.

The parameters in Table 1 apply when one of the two conditions below is given:
- The total Li of the external circuit (excluding the cable) is < 1% of the Lo value or
- The total Ci of the external circuit (excluding the cable) is < 1% of the Co value.
The parameters in Table 1 are reduced to 50% when both of the two conditions below are given:
- The total Li of the external circuit (excluding the cable) > 1% of the Lo and
- The total Ci of the external circuit (excluding the cable) > 1% of the Co.
Note: the reduced capacitance of the external circuit (including cable) shall not be greater than 1uF for C, D (IIB) and 600nF for A, B (IIC).

Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in Note 1. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft.

2.   Simple Apparatus: An electrical component or combination of components of simple construction with well defined electrical parameters that does not generate more than 1.5 volts, 100 milliamps, and 25 milliwatts, or a passive component that does not dissipate more than 1.3 watts and is compatible with the intrinsic safety of the circuit in which it is used (USA). A switch non-inductive resistive device or thermocouple (Canada).

3.   Wiring methods must be in accordance with the electrical code of the country in use.
Barriers with multiple intrinsically safe field wiring pairs shall be installed as separate intrinsically safe circuits.
Power, inputs and outputs must be in accordance with Class I, Division 2 wiring methods of National Electrical Code ANSI/NFPA 70, Canadian Electrical Code C22.1 or in accordance with the authority having jurisdiction.
Intrinsically safe circuits must be wired and separated in accordance with Article 504.20 or other local codes, as applicable.

4.   Barriers shall not be connected to any device which uses or generates internally any voltage in excess of 250V Rms or DC unless the device has been determined to adequately isolate the voltage from the barrier.

Dieses Dokument enthält sicherheitsrelevante Angaben. Es darf nicht ohne Absprache mit dem Normenfachmann geändert werden!					
This document contains safety-relevant information. It must not be altered without the authorization of the norm expert!					
CONFIDENTIAL according ISO 16016	Only valid as long as released in EDM or with a valid production documentation!		scale:	date:2014-Nov-11	
PEPPERL+FUCHS	Control Drawing Installation Drawing for UL listed Z7.., Z8.., Z9.. Zener Barriers		respons.	GB-TC	116-0139D
			approved	GB-PAW	
Twinsburg			norm	GB-PT	sheet 10 of 11

5. The barriers are rated 'Nonincendive'. If the barriers are intended to be mounted in a Division 2 location, they must be mounted in an enclosure with a minimum ingress protection of IP2X. If the barriers are intended to be mounted in a Zone 2 location that is subject to contamination by water or dust, they must be mounted in an enclosure with a minimum ingress protection of IP54. If the barriers are intended to be mounted in a Zone 2 indoor location that is not subject to contamination by water or dust, they must be mounted in an enclosure with a minimum ingress protection of IP4X. The enclosure must be able to accept Division 2 / Zone 2 wiring methods. A temperature rating of T4 applies to all nonincendive rated barriers.

In Class I, Division 2 installations, the subject equipment shall be mounted within a tool-secured enclosure which is capable of accepting one or more of the Class I, Division 2 wiring methods specified in the National Electrical Code (ANSI/NFPA 70) or Canadian Electrical Code (C22.1), as applicable.

In Class I, Zone 2 installations, the subject equipment shall be mounted within a tool-secured enclosure which is capable of accepting one or more of the Class I, Zone 2 wiring methods specified in the National Electrical Code (ANSI/NFPA 70) or Canadian Electrical Code (C22.1), as applicable. The equipment shall be installed in an enclosure with a minimum ingress protection rating of IP54 unless the apparatus is intended to be afforded an equivalent degree of protection by location.

6. Barriers must be connected to a suitable ground electrode per the National Electrical Code, ANSI/NFPA 70, Article 504. The resistance of the ground path must be less than 1 ohm. Any of the terminals 2,3,6,7 or the two wire clamp terminals at the base of the barrier may be used for this purpose. Alternatively, the ground connection may be established by mounting the barrier on standard 35mm DIN rail, when meeting the following conditions:

   a. DIN rail must be standard 35mm DIN rail (35mm ± 0.3mm).

   b. Any corrosion on the DIN rail must be removed and the DIN rail must be checked for the standard tolerance of 35mm ± 0.3mm.

   c. A continuity check must be conducted between the DIN rail and any ground terminal on the barrier, terminals 2,3,6,7 or the wire clamp terminals at the base of the barrier.

   d. Connect 35mm DIN rail to the ground electrode using hardware suitable to provide a ground path resistance of less than 1 ohm.

7. Up to 5 channels can be connected to a simple apparatus as shown in connection diagram 6 (6A).

Features

- 2-channel
- DC version, positive polarity
- Working voltage 26.5 V at 10 µA
- Series resistance max. 327 Ω
- Fuse rating 50 mA
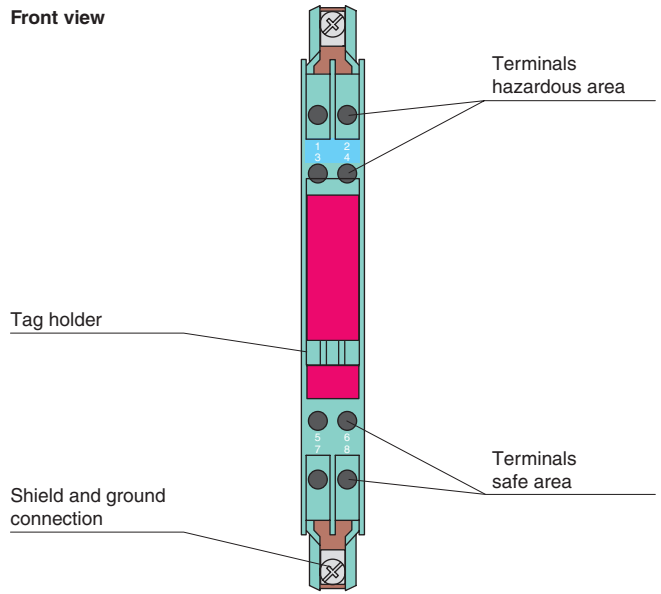- DIN rail mounting
- With diode return

Function

The Zener Barrier prevents the transfer of unacceptably high energy from the safe area into the hazardous area.

The zener diodes in the Zener Barrier are connected in the reverse direction. The breakdown voltage of the diodes is not exceeded in normal operation. If this voltage is exceeded, due to a fault in the safe area, the diodes start to conduct, causing the fuse to blow. The Zener Barrier has a positive polarity, i. e. the anodes of the zener diodes are grounded.
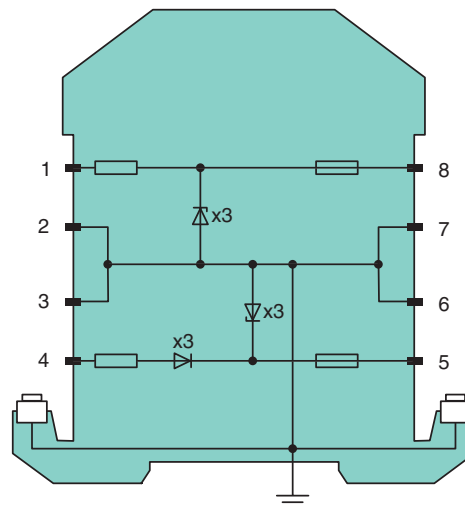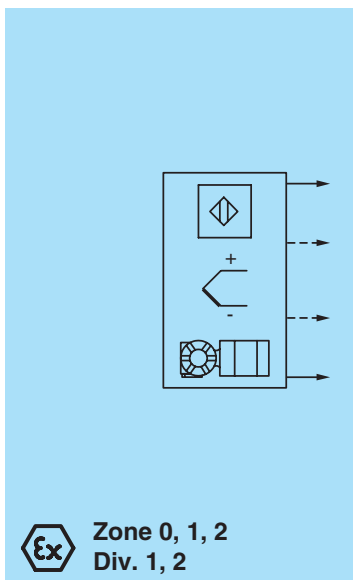
The Zener Barrier is for evaluation of signals from the hazardous area. The diodes of diode return prevent a current into the hazardous area, therefore the current assumption for intrinsic safety calculations is zero.

Depending on the application, increased or decreased intrinsic safety parameters apply for serial or parallel connection. For the detailed parameters refer to the Zener Barrier certificate. Application examples can be found in the system description of the Zener Barriers.

Assembly

Front view

Terminals hazardous area

Tag holder

Shield and ground connection

Terminals safe area

CE   Ex

Connection

Ex Zone 0, 1, 2
Div. 1, 2

Zone 2
Div. 2

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Pepperl+Fuchs Group
www.pepperl-fuchs.com

USA: +1 330 486 0002
pa-info@us.pepperl-fuchs.com

Germany: +49 621 776 2222
pa-info@de.pepperl-fuchs.com

Singapore: +65 6779 9091
pa-info@sg.pepperl-fuchs.com

PEPPERL+FUCHS
PROTECTING YOUR PROCESS

1

General specifications	
Type	DC version, positive polarity
Electrical specifications	
Nominal resistance	300 Ω
Series resistance	terminals 1 and 8 : max. 327 Ω
Voltage drop	terminals 4 and 5 : 1.2 V + (36 Ω x signal current)
Fuse rating	50 mA
Hazardous area connection	
Connection	terminals 1, 2; 3, 4
Safe area connection	
Connection	terminals 5, 6; 7, 8
Working voltage	max. 27 V , 26.5 V at 10 µA
Conformity	
Degree of protection	IEC 60529
Ambient conditions	
Ambient temperature	-20 ... 60 °C (-4 ... 140 °F)
Storage temperature	-25 ... 70 °C (-13 ... 158 °F)
Relative humidity	max. 75 % , without moisture condensation
Mechanical specifications	
Degree of protection	IP20
Connection	screw terminals , max. core cross-section 2 x 2.5 mm^2
Mass	approx. 150 g
Dimensions	12.5 x 115 x 110 mm (0.5 x 4.5 x 4.3 in)
Construction type	modular terminal housing , see system description
Mounting	on 35 mm DIN mounting rail acc. to EN 60715:2001
Data for application in connection with Ex-areas	
EC-Type Examination Certificate	BAS 01 ATEX 7005 , for additional certificates see www.pepperl-fuchs.com
Group, category, type of protection	⟨Ex⟩ II (1)GD, I (M1) [Ex ia Ga] IIC, [Ex ia Da] IIIC, [Ex ia Ma] I (-20 °C ≤ T$_{amb}$ ≤ 60 °C) [circuit(s) in zone 0/1/2]
Voltage U$_o$	28 V
Current I$_o$	93 mA
Power P$_o$	650 mW
Supply	
Maximum safe voltage U$_m$	250 V
Series resistance	min. 301 Ω
Statement of conformity	TÜV 99 ATEX 1484 X , observe statement of conformity
Group, category, type of protection, temperature class	⟨Ex⟩ II 3G Ex nA IIC T4 Gc [device in zone 2]
Directive conformity	
Directive 94/9/EC	EN 60079-0:2012, EN 60079-11:2012 , EN 60079-15:2010
International approvals	
FM approval	
Control drawing	116-0118
UL approval	
Control drawing	116-0139
CSA approval	
Control drawing	116-0119
IECEx approval	IECEx BAS 09.0142
Approved for	[Ex ia Ga] IIC, [Ex ia Da] IIIC, [Ex ia Ma] I
General information	
Supplementary information	EC-Type Examination Certificate, Statement of Conformity, Declaration of Conformity, Attestation of Conformity and instructions have to be observed where applicable. For information see www.pepperl-fuchs.com.

Refer to "General Notes Relating to Pepperl+Fuchs Product Information".

Pepperl+Fuchs Group
www.pepperl-fuchs.com

USA: +1 330 486 0002
pa-info@us.pepperl-fuchs.com

Germany: +49 621 776 2222
pa-info@de.pepperl-fuchs.com

Singapore: +65 6779 9091
pa-info@sg.pepperl-fuchs.com

PEPPERL+FUCHS
PROTECTING YOUR PROCESS

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March 2019

901-0000-329

DANGER!

Potentially hazardous voltages are present. Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all National, State & Local Codes.
Présence de tensions potentiellement dangereuses. Une décharge électrique peut causer la mort ou des blessures graves.
L'installation devrait être effectuée par du personnel qualifié suivant tous les codes nationaux, provinciaux et locaux.

BE SURE TO REMOVE ALL POWER SUPPLYING THIS EQUIPMENT BEFORE CONNECTING OR DISCONNECTING WIRING.
READ INSTRUCTIONS BEFORE INSTALLING OR OPERATING THIS DEVICE. KEEP FOR FUTURE REFERENCE.
S'ASSURER DE SUPPRIMER TOUTE ALIMENTATION ÉLECTRIQUE DE CET ÉQUIPEMENT AVANT DE BRANCHER OU DE DÉBRANCHER LES CÂBLAGES.
LIRE LES INSTRUCTIONS AVANT D'INSTALLER OU D'UTILISER CET APPAREIL ET LES CONSERVER POUR RÉFÉRENCE ULTÉRIEURE.

Installation & Wiring

1. The ISE Series Intrinsically Safe relays are UL913 Listed as associated apparatus for interfacing between hazardous and safe areas. The ISE relay must be installed in a suitable enclosure in a safe area.
2. For DIN-rail mounting, snap the relay on 35mm DIN track. For panel mounting, using a thumb, gently extend the two black DIN-rail clips from under the relay until they snap into place and the mounting hole on each one is visible. Mount the relay to the panel using a #8 screw through the hole on each clip.
3. Connect all wires to the device per Macromatic Control Drawing ISD2A01 (on back). Use #14-24 solid or stranded copper wire with a terminal tightening torque of 7 in-lbs.

Standard Operation

Each ISE Series relay consists of an intrinsically safe input and a corresponding electromechanical relay output. There is one bi-color LED for status indication. With input voltage applied, the LED will be ON (GREEN) to indicate power is applied. When the input device from the hazardous area is closed, the output relay is energized and the LED is ON (ORANGE). When the input device opens, the output relay will de-energize and the LED will be ON (GREEN).

Inverted Operation (V-suffix)

Each ISE Series relay consists of an intrinsically safe input and a corresponding electromechanical relay output. There is one bi-color LED for status indication. With input voltage applied, the LED will be ON (GREEN) to indicate power is applied. When the input device from the hazardous area is **open**, the output relay is energized and the LED is ON (ORANGE). When the input device **closes**, the output relay will be de-energized and the LED will be ON (GREEN).

Troubleshooting: If the unit fails to operate properly, check that all connections are correct per Macromatic Control Drawing ISD2A01. If problems continue, contact Macromatic at 800-238-7474 or e-mail tech-support@macromatic.com for assistance.

Warranty: All catalog-listed ISE Series Intrinsically Safe Relays manufactured by Macromatic are warranted to be free from defects in workmanship or material under normal service and use for a period of five (5) years from date of manufacture.

CONTROL DRAWING ISD2A01

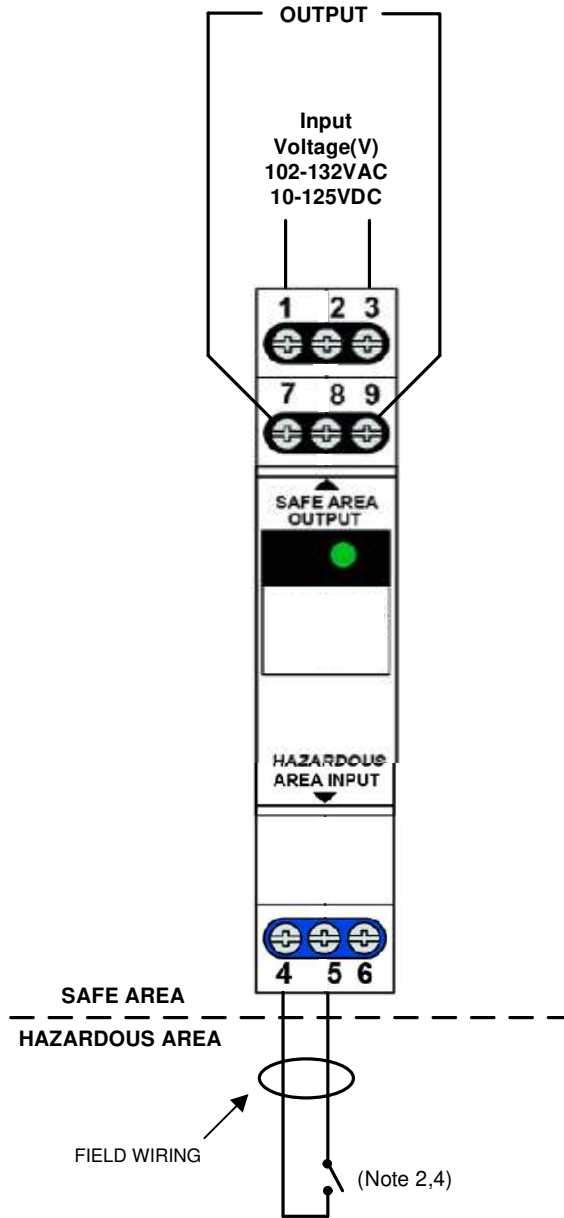## ASSOCIATED APPARATUS / APPAREILLAGE CONNEXE

Revision A

Notes:

1. The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

2. This associated apparatus may be connected to simple apparatus as defined in Article 504.2 installed and temperature classified in accordance with Article 504.10(D) of the National Electrical Code (ANSI/NFPA 70), or other local codes as applicable.

3. Capacitance and inductance of the field wiring from the simple aparatus to the associated apparatus shall be calculated. Cable capacitance, Ccable, must be less than the marked capacitance, Ca (or Co), shown on the associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft.

4. If connected to intrinsically safe equipment, the equipment must be third party listed as intrinsically safe for the application, and have intrinsically safe entity parameters conforming with the below.

I.S. Equipment		Associated Apparatus
V max (or Ui)	≥	Voc (or Uo)
I max (or Ii)	≥	Isc (or Io)
P max, Pi	≥	Po
Ci + Ccable	≥	Ca (or Co)
Li + Lcable	≥	La (or Lo)

5. If connected to intrinsically safe equipment, capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and included in the system calculations as shown in Note 6.

6. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, La (or Lo), respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft.

7. Associated apparatus must be installed in an enclosure suitable for the application in accordance with the National Electrical Code (ANSI/NFPA 70) for installation in the United States, the Canadian Electrical Code for installations in Canada, or other local codes, as applicable.

8. Intrinsically safe circuits must be wired and separated in accordance with Article 504.20 of the National Electrical Code (ANSI/NFPA 70) or other local codes, as applicable.

9. This associated apparatus has not been evaluated for use in combination with another associated apparatus.

10. If connected to intrinsically safe equipment, installations in which both the Ci and Li of the intrinsically safe equipment exceed 1% of the Ca (or Co) and La (or Lo) parameters of the associated apparatus (excluding the cable), then 50% of Ca (or Co) and La (or Lo) parameters are applicable and shall not be exceeded. The reduced capacitance shall not be greater than 1 µF for Groups C and/or D, and 600 nF for Groups A and B. The values of Ca (or Co) and La (or Lo) determined by this method shall not be exceeded by the sum of all of Ci plus cable capacitances and the sum of all of the Li plus cable inductances.

11. All channels comprise a single intrinsically safe circuit.

Approvals:

(UL) LISTED
Class I; Division I; Groups A,B,C,D
Class II; Division I; Groups E,F,G
Class III
Zone 0; [Ex ia] IIC Ga
Zone 20; [Ex ia] IIIC Da

c(UL) LISTED

ISE, MBE SERIES

OUTPUT

Input
Voltage(V)
102-132VAC
10-125VDC

1 2 3

7 8 9

SAFE AREA
OUTPUT

HAZARDOUS
AREA INPUT

4 5 6

SAFE AREA
─ ─ ─ ─ ─ ─ ─ ─ ─ ─
HAZARDOUS AREA

FIELD WIRING

(Note 2,4)

Ratings:

- Input Voltage(V): 102-132VAC 10-125VDC
- Temperature(Ta): -28°C≤Ta≤60°C (Max. 3 A)
  -28°C≤Ta≤40°C (Max. 5 A)
- Maximum Voltage(Um): 132VAC
- Contacts Ratings (terminals 7,9):
  - 5A 125VAC/30VDC (Max. Ta 40°C)
  - 3A 125VAC/30VDC (Max. Ta 60°C)
  - D300 Pilot Duty (Max. Ta 60°C)

Entity Parameters(terminals 4-5):

Voc(Uo)	10.29 V
Isc(Io)	18.05 mA
Po	46.44 mW
Ca(Co)	2.63 uF
La(Lo)	109.10 mH

SAFETY INSTRUCTIONS
AF(C)09...38(Z)(B), NF(C)(Z)(B)22...80E, CA4, CAL4, CAT4, CC4, LDC4
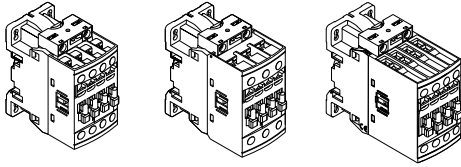## Contactors AF, contactor relays NF and accessories

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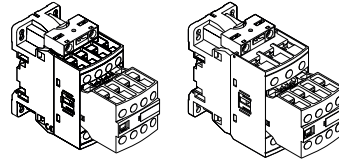|	
ar	تحذير: جهد كهربائي خطر! راجع تعليمات التشغيل. افصل الكهرباء وقم بتأمينها قبل العمل في هذا الجهاز تنبيه! يجب عدم التركيب إلا من خلال شخص على دراية بمجال التقنية الكهربائية .
bg	Предупреждение: Опасно напрежение! Вижте инструкциите за работа. Изключете и блокирайте захранването преди. да работите с устройството. Внимание! Да се монтира само от експерт електротехник.
cs	Varování: Nebezpečné napětí! Viz návod k obsluze. Před zahájením prací na tomto zařízení odpojte a uzamkněte napájení. Pozor! Toto zařízení smí instalovat pouze osoba s elektrotechnickou odborností.
da	Advarsel: Farlig elektrisk spænding! Se installationsinstruktioner. Frakobl enheden, og afbryd strømforsyningen, før du arbejder med denne enhed. Giv agt! Installation må kun foretages af personer med elektroteknisk ekspertise.
de	Warnung: Gefährliche Spannung! Siehe Installationsanleitung. Vor dem Arbeiten Gerät ausschalten und von der Spannungsversorgung trennen. Achtung! Installation nur durch elektrotechnische Fachkraft.
el	Προειδοποίηση: Επικίνδυνη τάση! Ανατρέξτε στις οδηγίες λειτουργίας. Αποσυνδέστε και απομονώστε την παροχή ισχύος προτού ξε κινήσετε τις εργασίες σε αυτή τη συσκευή. Προσοχή! Η εγκατάσταση πρέπει να γίνεται μόνο από αδειούχο ηλεκτρολόγο εγκαταστάτη.
en	Warning: Hazardous voltage! Refer to installation instructions. Disconnect and lock out power before working on this device. Attention! Installation by person with electrotechnical expertise only.
es	Advertencia: ¡Tensión peligrosa! Consulte las instrucciones de instalación. Antes de trabajar con este dispositivo, desconecte y bloquee la corriente. ¡Atención! La instalación debe ser realizada únicamente por un técnico electricista.
et	Hoiatus: Elektrilöögi oht! Lisateavet vaadake kasutusjuhendist. Enne selle seadmega töötamist ühendage lahti ja lukustage toide. Tähelepanu! Seadet tohib paigaldada ainult elektrotehnilise kogemusega isik.
fi	Varoitus: Vaarallinen jännite! Katso asennusohje. atkaise virta ja estä virran kytkeminen lukituksella ennen töiden aloittamista. Huomio! Asennuksen saa suorittaa vain henkilö, jolla on kokemusta sähkötekniikasta.
fr	Avertissement: Tension dangereuse! Consultez les consignes d'installation. Débranchez et verrouillez l'alimentation électrique avant d'entreprendre des travaux sur cet appareil. Attention! L'installation doit être effectuée uniquement par une personne ayant une expertise en électrotechnique.
hr	Upozorenje: Opasan napon! Pogledajte upute za ugradnju. Odspojite i isključite struju prije rada na ovom uređaju. Pažnja! Ugradnja je dopuštena samo osobama stručnim u području elektrotehnike.
hu	Figyelmeztetés: Veszélyes feszültség! Lásd a használati utasítást. Válassza le és zárja ki az áramellátást, mielőtt a berendezésen dolgozni kezd. Figyelem! Az üzembe helyezést csak elektrotechnikai szakértelemmel rendelkező személy végezheti el.
it	Attenzione: Tensione pericolosa! Fare riferimento alle istruzioni per l'uso. Prima di intervenire su questo dispositivo, scollegare e isolare tutte le fonti di alimentazione. Attenzione! L'installazione deve essere eseguita esclusivamente da un installatore qualificato.
lt	Įspėjimas: Pavojinga įtampa! Žr. naudojimo instrukcijas. Atjunkite ir laikinai užblokuokite maitinimą prieš dirbdami su šiuo įrenginiu. Dėmesio! Įrengti gali tik asmuo, turintis elektrotechniko patirties.
lv	Brīdinājums: Bīstams spriegums! Skatiet darba norādījumus. Pirms sākat darbu ar šo ierīci, atvienojiet un bloķējiet strāvas padevi. Uzmanību! Uzstādīšanu drīkst veikt tikai persona ar zināšanām par elektrotehniku.
nl	Waarschuwing: Gevaarlijke spanning! Raadpleeg de installatie-instructies. Koppel dit apparaat los van de stroomvoorziening voordat u werkzaamheden uitvoert. Let op! Installatie mag alleen worden uitgevoerd door een monteur met elektrotechnische expertise.
no	Advarsel: Farlig spenning! Se i bruksanvisningen. Koble fra og steng av strømmen før du arbeider på denne enheten. Forsiktig! Montering skal kun utføres av kvalifiserte personer med elektrokompetanse.
pl	Ostrzeżenie: Niebezpieczne napięcie! Patrz: instrukcja instalacji. Przed rozpoczęciem wykonywania pracy z tym urządzeniem odłącz i zablokuj zasilanie. Uwaga! Montaż może wykonywać wyłącznie osoba posiadająca doświadczenie elektrotechniczne.
pt	Aviso: Tensão perigosa! Consulte as instruções de instalação. Desconecte e desligue a energia elétrica antes de trabalhar nesse dispositivo. Atenção! A instalação deve ser feita apenas por uma pessoa com especialidade eletrotécnica.
ro	Avertisment: Tensiune electrică periculoasă! Consultați instrucțiunile de utilizare. Deconectați și închideți sursa de energie înainte de a lucra cu acest dispozitiv. Atenție! Instalarea trebuie realizată doar de către o persoană cu expertiză electrotehnică.
ru	Предупреждение: Опасное электрическое напряжение! Обратитесь к инструкциям по монтажу. Отключите электропитание и обеспечьте безопасность перед началом работ. Внимание! Монтаж должен выполняться только специалистом по электротехническим работам.
sk	Výstraha: Nebezpečné napätie! Pozrite si návod na použitie. Pred začatím prác na tomto zariadení odpojte a zablokujte napájanie. Pozor! Inštaláciu smie vykonávať len osoba s odbornými znalosťami v oblasti elektrotechniky.
sl	Opozorilo: Nevarna napetost! Glejte navodila za uporabo. Pred delom na tej napravi izklopite in zaklenite električno napajanje. Pozor! Namestitev sme izvesti samo elektrotehnični strokovnjak.
sv	Varning: Livsfarlig spänning! Se i bruksanvisningen. Frånkoppla och blockera anläggning eller en anläggningsdel innan arbete utförs. Obs! Får endast installeras av behörig elektriker.
tr	Uyarı: Tehlikeli gerilim! Montaj talimatlarına bakın. Bu cihaz üzerinde çalışmadan önce elektriği kesin ve kilitleyin. Dikkat! Yalnızca elektroteknik uzmanlığa sahip kişiler tarafından kurulabilir.
zh	警告：高压危险! 请参见操作手册。操作本设备前请断开并锁定电源。注意! 安装仅限专业电工人员。

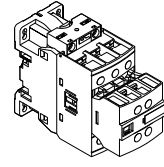# AF(C)09...38(Z)(B), NF(C)(Z)(B)22...80E, CA4, CAL4, CAT4, CC4, LDC4
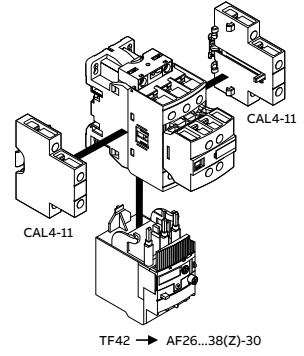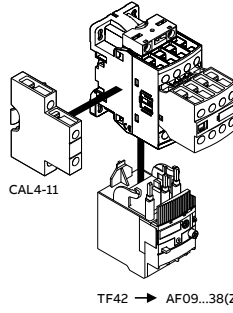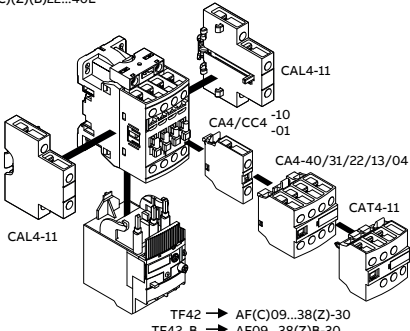
Contactors AF, contactor relays NF and accessories

AF(C)09...16(Z)(B)-30-01
AF(C)09...16(Z)(B)-30-10
AF(C)09...16(Z)(B)-40-00
AF(C)09...16(Z)(B)-22-00
NF(C)(Z)(B)22...40E

AF(C)26...38(Z)(B)-30-00

AF(C)26...38(Z)(B)-40-00
AF(C)26...38(Z)(B)-22-00

AF09...16(Z)-30-22
NF(C)(Z)(B)44...80E

AF26...38(Z)(B)-30-22

AF26...38(Z)-30-11

CAL4-11

CA4/CC4 -10
-01

CA4-40/31/22/13/04

CAT4-11

CAL4-11

TF42 → AF(C)09...38(Z)-30
TF42..B → AF09...38(Z)B-30

CAL4-11

TF42 → AF09...38(Z)-30

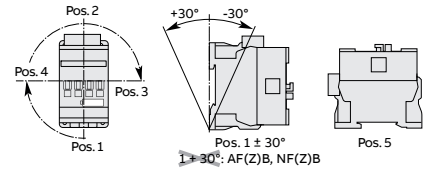CAL4-11

CAL4-11

TF42 → AF26...38(Z)-30

⚠ CC4 : * max 1x CC4-10 + max 1x CC4-01 / CC4-01 : ** max NC-1

	NF(C)(Z)(B)40E AF(C)09...16(Z)(B)-30-10 AF(C)09...16(Z)(B)-40-00 AF(C)26...38(Z)(B)-30-00	NF(C)(Z)(B)22...31E AF(C)09...16(Z)(B)-30-01 AF(C)26...38(Z)(B)-40-00 AF(C)09...38(Z)(B)-22-00	NF(C)(Z)(B)44...80E AF09...38(Z)-30-22	AF26...38(Z)(B)-30-11
Pos. 1, 2, 3, 4	max 6 aux contacts* / 4NC**	max 6 aux contacts* / 3NC**	max 1x CAL4-11	max 2x CAL4-11
Pos. 1 ± 30°, 5	max 6 aux contacts* / 3NC**	max 6 aux contacts* / 2NC**	max 1x CAL4-11	max 2x CAL4-11

Pos. 2
Pos. 4
Pos. 3
Pos. 1
+30° -30°
Pos. 1 ± 30°
Pos. 5
1 ± 30°: AF(Z)B, NF(Z)B

				Rigid Solid	Rigid Stranded				
AF(C)09...16(Z)(B)	M 3.5 1.5 Nm (13 Lb.in)	Ø 5.5 mm (0.22 in)		1 or 2 x 1...4 mm² 1 or 2 x AWG 16-10	1 or 2 x 1...6 mm² 1 or 2 x AWG 16-10	1 or 2 x 0.75...6 mm²	1 x 0.75...4 mm² 2 x 0.75...2.5 mm²	10 mm (0.39 in)	< 9.6 mm (0.38 in)
AF(C)26...38(Z)(B)-30	M 4 2.5 Nm (22 Lb.in)	Ø 6.5 mm (0.26 in)		1 or 2 x 2.5...4 mm² 1 or 2 x AWG 14-10	1 or 2 x 2.5...10 mm² 1 or 2 x AWG 14-8	1 or 2 x 1.5...10 mm²	1 x 1.5...10 mm² 2 x 1.5...4 mm²	14 mm (0.55 in)	< 12.5 mm (0.49 in)
AF(C)26...38(Z)(B)-40/22	M 4.5 2.5 Nm (22 Lb.in)	Ø 5.5 mm (0.22 in)	Pozidriv N°2	1 or 2 x 1.5...4 mm² 1 or 2 x AWG 16-10	1 or 2 x 1.5...16 mm² 1 or 2 x AWG 16-6	1 or 2 x 1.5...16 mm²	1 or 2 x 1.5...16 mm²	12 mm (0.47 in)	-
NF(C)(Z)(B).. AF(C)09...16(Z)(B)-30-10 AF(C)09...16(Z)(B)-30-01 AF09...38(Z)-30-22 AF26...38(Z)-30-11 NF(C)(Z)(B).. AF(C)09...38(Z)(B) LDC4 CA4-.. CC4-.. CAT4-.. CAL4-11	M 3.5 1.2 Nm (11 Lb.in)	Ø 5.5 mm (0.22 in)		1 or 2 x 1...2.5 mm² 1 or 2 x AWG 18-14		1 or 2 x 0.75...2.5 mm²	1 x 0.75...2.5 mm² 2 x 0.75...1.5 mm²	10 mm (0.39 in)	< 8 mm (0.31 in)

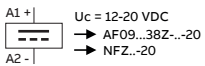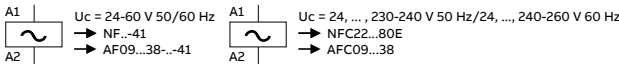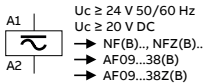| Push-in / Spring	Wiring / Unwiring		Rigid Solid				
LDC4K	Wiring / Unwiring Wiring Push-in / Unwiring with screwdriver	Ø 3 mm (0.12 in) x 0.5 mm (0.02 in)	1 or 2 x 1...2.5 mm² 1 or 2 x AWG 18-14	1 or 2 x 1...2.5 mm²	1 or 2 x 1...1.5 mm²	-	10 mm (0.39 in)
CA(L)4-..K	Wiring / Unwiring with screwdriver			1 or 2 x 0.5...2.5 mm²	1 or 2 x 0.5...1.5 mm²	1 or 2 x 0.5...2.5 mm²	

AF(C)09...38(Z)(B), NF(C)(Z)(B)22...80E, CA4, CAL4, CAT4, CC4, LDC4
Contactors AF, contactor relays NF and accessories

According to UL60947-4-1 and CSA C22.2 NO. 60947-4-1, for use on a circuit capable of delivering not more than the max. symmetrical amperes at the max. voltage shown in the table below.
WARNING : if opening of BCP, controller shall be examined and replaced if damaged.

Max short-circuit at 480 V, 600 V (kA)	AF(C)09...12		AF(C)16		AF(C)26-30		AF(C)30...38-30	
	max Fuse 30 A/RK5	30 A/J	max Fuse 60 A/RK5	60 A/J	max Fuse 60 A/RK5	60 A/J	max Fuse 100 A/RK5	100 A/J
	5	100	5	100	5	100	5	100

Max short-circuit at	AF(C)09...16	AF(C)26...38-30
	Circuit Breaker XT2V125 (60 A)	Circuit Breaker XT2V125 (125 A)
480 V (kA)	10	100
600 V (kA)	10	42

Acc. to UL60947-4-1 and CSA C22.2
NO. 60947-4-1 min. enclosure for:
AF(C)09...16(Z)(B), NF(C)(Z)(B)..: 180 x 130 x 150 mm
AF(C)26...38(Z)(B)-30: 255 x 180 x 175 mm
AF(C)26...38(Z)(B)-40/22: 180 x 130 x 175 mm

A1 — Uc ≥ 24 V 50/60 Hz / Uc ≥ 20 V DC
→ NF(B).., NFZ(B)..
→ AF09...38(B)
A2 → AF09...38Z(B)

A1 — Uc = 24-60 V 50/60 Hz
→ NF..-41
A2 → AF09...38-..-41

A1 — Uc = 24, ... , 230-240 V 50 Hz/24, ..., 240-260 V 60 Hz
→ NFC22...80E
A2 → AFC09...38

A1 + — Uc = 12-20 VDC
→ AF09...38Z-..-20
A2 - → NFZ..-20

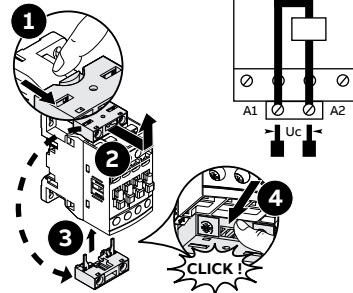A1 — Uc = 48-130 V 50/60 Hz-DC
→ NF..-12
A2 → AF09...38-..-12

NOTICE: This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.

... V 50/60 Hz	Devices comply to GB21518	Energy efficiency level	Holding power VA
24...250 V	AF09...38(Z)(B)-30..	2	3.5
250...500 V	AF09...16(B)-30..	2	5
	AF26...38(B)-30..	2	5.5
24...260 V	AFC09...16-30..	3	9.5
	AFC26...38-30..	2	9.5

NF(C)(Z)(B).. / AF(C)09...38(Z)(B)
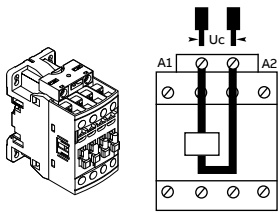
NF(C)(Z)(B).. / AF(C)09...38(Z)(B)

NF(C)(Z)(B).. + LDC4(K) / AF(C)09...38(Z)(B) + LDC4(K)
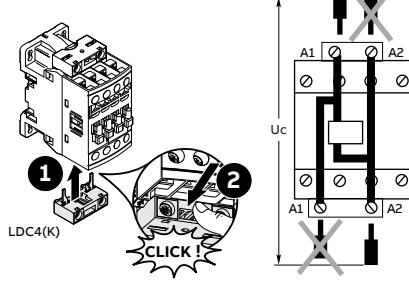
NF(C)(Z)(B).. + CAT4-.. / AF(C)09...38(Z)(B) + CAT4-..

Uc = 12-20 V DC
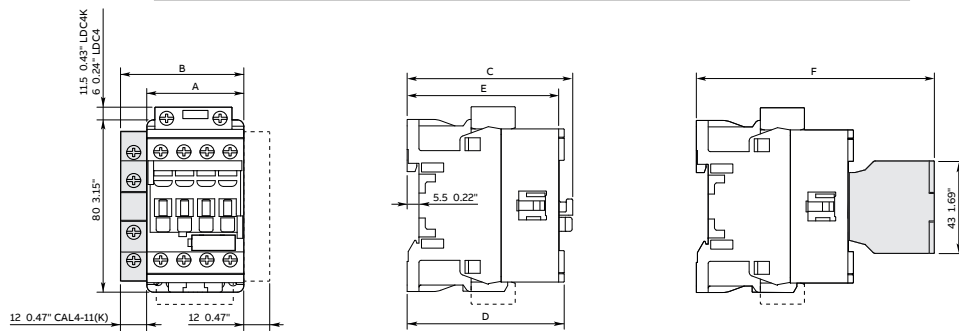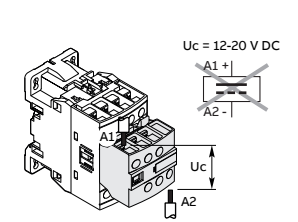
	A mm inch	B mm inch	C mm inch	D mm inch	E mm inch	F mm inch	
						CA4(K) CC4	CAT4
AF(C)09...16(Z)(B) NF(C)(Z)(B)22...40E	45 1.77"	57 2.24"	77 3.03"	73 2.87"	71 2.80"	110.5 4.35"	102.5 5.03"
AF(C)26...38(Z)(B)-30			86 3.39"	82 3.23"	80 3.15"	119.5 4.70"	111.5 4.39"
AF(C)26...38(Z)(B)-40			101 3.98"	97 3.82"	95 3.74"	134.5 5.30"	126.5 4.98"
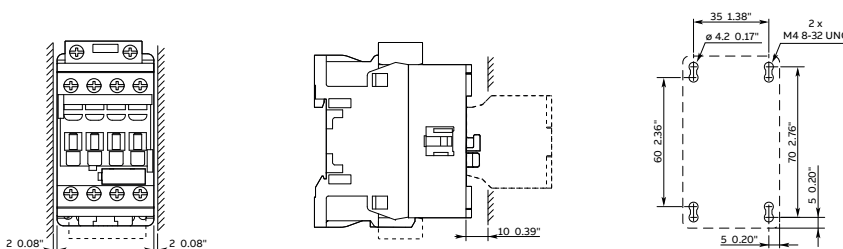
AF(C)09…38(Z)(B), NF(C)(Z)(B)22…80E, CA4, CAL4, CAT4, CC4, LDC4
Contactors AF, contactor relays NF and accessories

Assembly
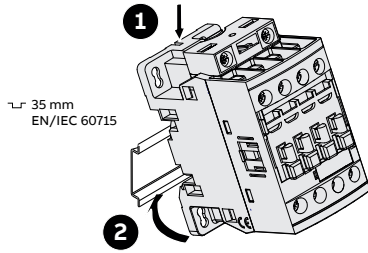
Disassembly
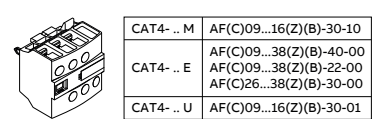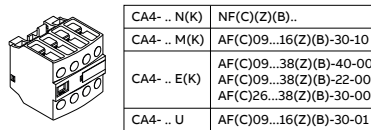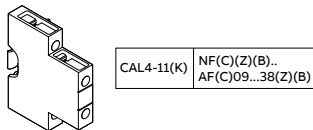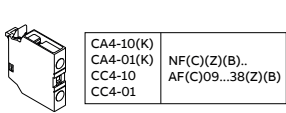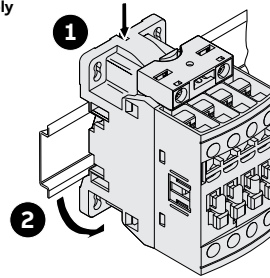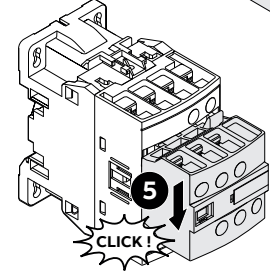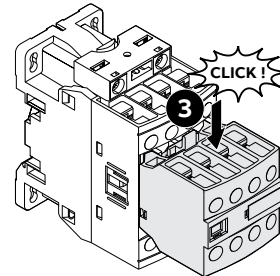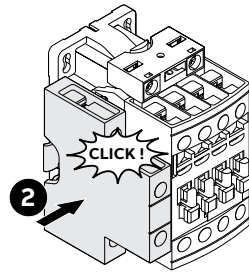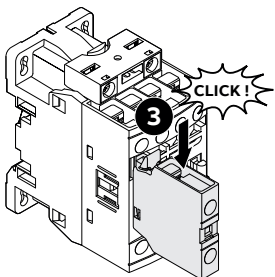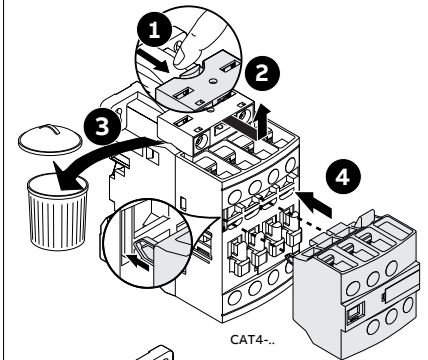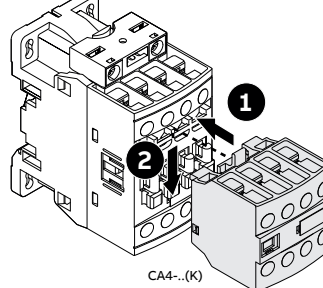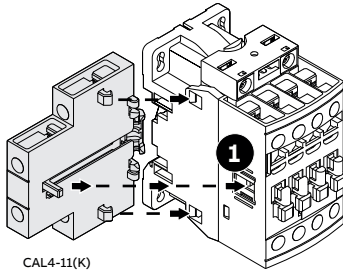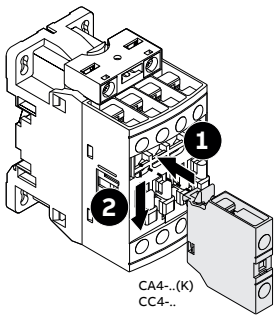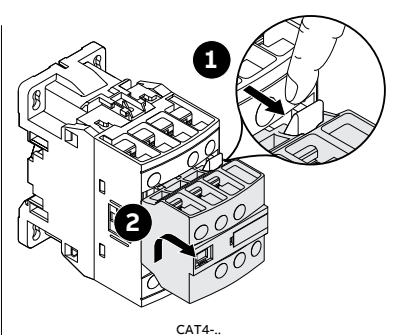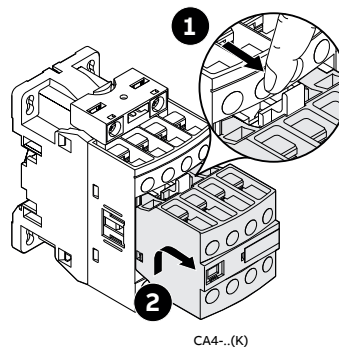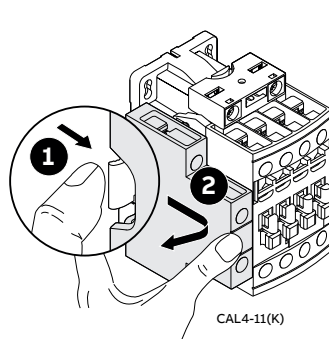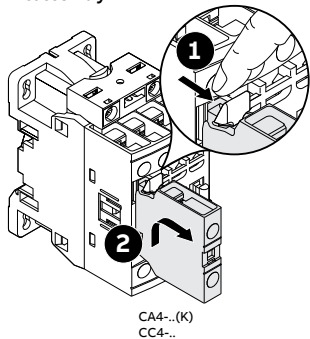
⌐ 35 mm
EN/IEC 60715

CA4-10(K)	
CA4-01(K)	NF(C)(Z)(B)..
CC4-10	AF(C)09…38(Z)(B)
CC4-01	

| CAL4-11(K) | NF(C)(Z)(B).. |
| | AF(C)09…38(Z)(B) |

CA4- .. N(K)	NF(C)(Z)(B)..
CA4- .. M(K)	AF(C)09…16(Z)(B)-30-10
CA4- .. E(K)	AF(C)09…38(Z)(B)-40-00
	AF(C)09…38(Z)(B)-22-00
	AF(C)26…38(Z)(B)-30-00
CA4- .. U	AF(C)09…16(Z)(B)-30-01

CAT4- .. M	AF(C)09…16(Z)(B)-30-10
CAT4- .. E	AF(C)09…38(Z)(B)-40-00
	AF(C)09…38(Z)(B)-22-00
	AF(C)26…38(Z)(B)-30-00
CAT4- .. U	AF(C)09…16(Z)(B)-30-01

Assembly

CA4-..(K)
CC4-..

CAL4-11(K)

CA4-..(K)

CAT4-..

CLICK !

Disassembly

CA4-..(K)
CC4-..

CAL4-11(K)

CA4-..(K)

CAT4-..

Revision
H

Revision date
2021-12-03

Document number
1SBC101027M6801

System pro *M* compact®
Miniature Circuit Breaker SU200 M
for branch circuit protection acc. to UL 489

2CDC021004S0014

2CDC021046S0014

The miniature circuit breaker SU200 M is ABB's solution for UL 489 branch circuit protection up to 480 Y/277 V AC and 96 V DC. This circuit breaker is an all-round device for AC and DC applications for universal use in North American and global markets due to its approvals acc. to the international standards UL, CSA and IEC. Moreover, SU200 M is fully compatible with System pro *M* compact® UL 489 accessories.

Features

– High performance MCB with 10 kA interrupting capacity acc. to UL 489 / CSA 22.2 No. 5 and 15 kA breaking capacity acc. to IEC/EN 60947-2
– Certified up to I_n = 40 A at 480 Y/277 V AC acc. to UL 489 / CSA 22.2 No. 5
– Certified for AC and DC use acc. to UL and CSA
– 40 °C reference temperature acc. to UL and CSA
– Current limiting acc. to UL 489
– Clear contact position indication in red/green ("real CPI")

Standards and approvals

Standards	
UL 489	
CSA 22.2 No. 5	
IEC/EN 60947-2	
Approvals	
UL 489	US
CSA 22.2 No. 5	CA
VDE	DE
CCC	CN

Power and productivity
for a better world™

ABB

Miniature Circuit Breaker SU200 M
Technical data

General Data	
Standards	UL 489, CSA 22.2 No. 5, IEC/EN 60947-2
Poles	1P, 2P, 3P, 4P
Tripping characteristics	C, K, Z
Rated current I_n	0.2 - 63 A
Rated frequency f	50 / 60 Hz, DC (0 Hz)
Rated insulation voltage U_i acc. to IEC/EN 60664-1	250 V AC (phase to ground), 440 V AC (phase to phase)
Overvoltage category	III
Pollution degree	3

IEC/EN 60947-2		
Rated operational voltage U_e		1P: 230 V AC; 2P, 3P, 4P: 400 V AC
Max. power frequency recovery voltage U_{max}	AC	1P: 253 V AC; 2P, 3P, 4P: 440 V AC
Min. operating voltage		12 V AC, 12 V DC
Rated ultimate short-circuit breaking capacity I_{cu}		15 kA
Rated service short-circuit breaking capacity I_{cs}		$\leq$ 40 A: 11.25 kA
		> 40 A: 7.5 kA
Rated impulse withstand voltage U_{imp} (1.2/50µs)		4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)
Dielectric test voltage		2 kV (50 / 60Hz, 1 min.)
Reference temperature for tripping characteristics		30 °C
Electrical endurance		I_n < 30 A: 20,000 ops (AC), $I_n \geq$ 30 A: 10,000 ops. (AC);
		1 cycle (2 s - ON, 13 s - OFF, $I_n \leq$ 32 A), 1 cycle (2 s - ON, 28 s - OFF, I_n > 32 A)

UL / CSA		
Rated voltage	AC	1P: 277 V AC up to 40 A for C, Z char.,
	AC	277 V AC up to 35 A for K char., 240 V AC
	AC	2P, 3P, 4P: 480 Y / 277 V AC up to 40 A for C, Z char.,
	AC	480 Y / 277 V AC up to 35 A for K char., 240 V AC
	DC	1P: 48 V DC; 2P: 96 V DC (2p in series)
Rated interrupting capacity acc. to UL 1077		–
Short-circuit current rating acc. to UL 489		10 kA
Application		–
Reference temperature for tripping characteristics		40 °C
Electrical endurance		6,000 ops (AC), 6,000 ops. (DC); 1 cycle (1 s - ON, 9 s - OFF)

Mechanical data	
Housing	Insulation group II, RAL 7035
Toggle	Insulation group II, black, sealable
Contact position indication	Real CPI (green OFF / red ON)
Protection degree acc. to DIN EN 60529	IP20*, IP40 in enclosure with cover
Mechanical endurance	20,000 ops.
Shock resistance acc. to IEC/EN 60068-2-27	25 g - 2 shocks - 13 ms
Vibration resistance acc. to IEC/EN 60068-2-6	5g - 20 cycles at 5…150…5 Hz with load 0.8 I_n
Environmental conditions (damp heat cyclic) acc. to IEC/EN 60068-2-30	28 cycles with 55°C/90-96% and 25°C/95-100%
Ambient temperature	-25 … +55°C
Storage temperature	-40 ... +70 °C

Installation	
Terminal	Failsafe bi-directional cylinder-lift terminal
Cross-section of conductors (top/bottom)	solid, stranded: 35 mm² / 35 mm²
	flexible: 25 mm² / 25 mm²
	18 – 4 AWG
Cross-section of busbars (top/bottom)	10 mm² / 10 mm²
	18 – 8 AWG
Torque	2.8 Nm
	AWG 18-16: 13.3 in-lbs.
	AWG 14-10: 17.7 in-lbs.
	AWG 8-4: 39.8 in-lbs.
Screwdriver	No. 2 Pozidrive
Mounting	On DIN rail 35 mm acc. to EN 60715 by fast clip
Mounting position	any
Supply	optional

Dimensions and weight	
Mounting dimensions acc. to DIN 43880	Mounting dimension 3
Pole dimensions (H x D x W)	111 x 69 x 17.5 mm
Pole weight	approx. 125 g

Combination with auxiliary elements	
Auxiliary contact	Yes
Signal contact	Yes
Shunt trip	Yes

* Also fulfilling the requirements acc. to the protection degree IPXXB

Miniature Circuit Breaker SU200 M
Ordering data characteristic K

Number of poles	Rated current I_n A	Type	Order code	Weight per PCE kg	Packing unit PCE
1	0.2	SU201M-K0,2	2CDS271337R0087	0.125	10
	0.3	SU201M-K0,3	2CDS271337R0117	0.125	10
	0.5	SU201M-K0,5	2CDS271337R0157	0.125	10
	0.75	SU201M-K0,75	2CDS271337R0187	0.125	10
	1	SU201M-K1	2CDS271337R0217	0.125	10
	1.6	SU201M-K1,6	2CDS271337R0257	0.125	10
	2	SU201M-K2	2CDS271337R0277	0.125	10
	3	SU201M-K3	2CDS271337R0317	0.125	10
	4	SU201M-K4	2CDS271337R0337	0.125	10
	5	SU201M-K5	2CDS271337R0357	0.125	10
	6	SU201M-K6	2CDS271337R0377	0.125	10
	8	SU201M-K8	2CDS271337R0407	0.125	10
	10	SU201M-K10	2CDS271337R0427	0.125	10
	13	SU201M-K13	2CDS271337R0447	0.125	10
	15	SU201M-K15	2CDS271337R0457	0.125	10
	16	SU201M-K16	2CDS271337R0467	0.125	10
	20	SU201M-K20	2CDS271337R0487	0.125	10
	25	SU201M-K25	2CDS271337R0517	0.125	10
	30	SU201M-K30	2CDS271337R0527	0.125	10
	32	SU201M-K32	2CDS271337R0537	0.125	10
	35	SU201M-K35	2CDS271337R0547	0.125	10
	40	SU201M-K40	2CDS271337R0557	0.125	10
	50	SU201M-K50	2CDS271337R0577	0.125	10
	60	SU201M-K60	2CDS271337R0587	0.125	10
	63	SU201M-K63	2CDS271337R0607	0.125	10
2	0.2	SU202M-K0,2	2CDS272337R0087	0.250	5
	0.3	SU202M-K0,3	2CDS272337R0117	0.250	5
	0.5	SU202M-K0,5	2CDS272337R0157	0.250	5
	0.75	SU202M-K0,75	2CDS272337R0187	0.250	5
	1	SU202M-K1	2CDS272337R0217	0.250	5
	1.6	SU202M-K1,6	2CDS272337R0257	0.250	5
	2	SU202M-K2	2CDS272337R0277	0.250	5
	3	SU202M-K3	2CDS272337R0317	0.250	5
	4	SU202M-K4	2CDS272337R0337	0.250	5
	5	SU202M-K5	2CDS272337R0357	0.250	5
	6	SU202M-K6	2CDS272337R0377	0.250	5
	8	SU202M-K8	2CDS272337R0407	0.250	5
	10	SU202M-K10	2CDS272337R0427	0.250	5
	13	SU202M-K13	2CDS272337R0447	0.250	5
	15	SU202M-K15	2CDS272337R0457	0.250	5
	16	SU202M-K16	2CDS272337R0467	0.250	5
	20	SU202M-K20	2CDS272337R0487	0.250	5
	25	SU202M-K25	2CDS272337R0517	0.250	5
	30	SU202M-K30	2CDS272337R0527	0.250	5
	32	SU202M-K32	2CDS272337R0537	0.250	5
	35	SU202M-K35	2CDS272337R0547	0.250	5
	40	SU202M-K40	2CDS272337R0557	0.250	5
	50	SU202M-K50	2CDS272337R0577	0.250	5
	60	SU202M-K60	2CDS272337R0587	0.250	5
	63	SU202M-K63	2CDS272337R0607	0.250	5

2CDC021004S0014

2CDC021045S0014

Miniature Circuit Breaker SU200 M
Ordering data characteristic K

2CDC021046S0014

2CDC021047S0014

Number of poles	Rated current I_n A	Type	Order code	Weight per PCE kg	Packing unit PCE
3	0.2	SU203M-K0,2	2CDS273337R0087	0.375	3
	0.3	SU203M-K0,3	2CDS273337R0117	0.375	3
	0.5	SU203M-K0,5	2CDS273337R0157	0.375	3
	0.75	SU203M-K0,75	2CDS273337R0187	0.375	3
	1	SU203M-K1	2CDS273337R0217	0.375	3
	1.6	SU203M-K1,6	2CDS273337R0257	0.375	3
	2	SU203M-K2	2CDS273337R0277	0.375	3
	3	SU203M-K3	2CDS273337R0317	0.375	3
	4	SU203M-K4	2CDS273337R0337	0.375	3
	5	SU203M-K5	2CDS273337R0357	0.375	3
	6	SU203M-K6	2CDS273337R0377	0.375	3
	8	SU203M-K8	2CDS273337R0407	0.375	3
	10	SU203M-K10	2CDS273337R0427	0.375	3
	13	SU203M-K13	2CDS273337R0447	0.375	3
	15	SU203M-K15	2CDS273337R0457	0.375	3
	16	SU203M-K16	2CDS273337R0467	0.375	3
	20	SU203M-K20	2CDS273337R0487	0.375	3
	25	SU203M-K25	2CDS273337R0517	0.375	3
	30	SU203M-K30	2CDS273337R0527	0.375	3
	32	SU203M-K32	2CDS273337R0537	0.375	3
	35	SU203M-K35	2CDS273337R0547	0.375	3
	40	SU203M-K40	2CDS273337R0557	0.375	3
	50	SU203M-K50	2CDS273337R0577	0.375	3
	60	SU203M-K60	2CDS273337R0587	0.375	3
	63	SU203M-K63	2CDS273337R0607	0.375	3
4	0.2	SU204M-K0,2	2CDS274337R0087	0.500	2
	0.3	SU204M-K0,3	2CDS274337R0117	0.500	2
	0.5	SU204M-K0,5	2CDS274337R0157	0.500	2
	0.75	SU204M-K0,75	2CDS274337R0187	0.500	2
	1	SU204M-K1	2CDS274337R0217	0.500	2
	1.6	SU204M-K1,6	2CDS274337R0257	0.500	2
	2	SU204M-K2	2CDS274337R0277	0.500	2
	3	SU204M-K3	2CDS274337R0317	0.500	2
	4	SU204M-K4	2CDS274337R0337	0.500	2
	5	SU204M-K5	2CDS274337R0357	0.500	2
	6	SU204M-K6	2CDS274337R0377	0.500	2
	8	SU204M-K8	2CDS274337R0407	0.500	2
	10	SU204M-K10	2CDS274337R0427	0.500	2
	13	SU204M-K13	2CDS274337R0447	0.500	2
	15	SU204M-K15	2CDS274337R0457	0.500	2
	16	SU204M-K16	2CDS274337R0467	0.500	2
	20	SU204M-K20	2CDS274337R0487	0.500	2
	25	SU204M-K25	2CDS274337R0517	0.500	2
	30	SU204M-K30	2CDS274337R0527	0.500	2
	32	SU204M-K32	2CDS274337R0537	0.500	2
	35	SU204M-K35	2CDS274337R0547	0.500	2
	40	SU204M-K40	2CDS274337R0557	0.500	2
	50	SU204M-K50	2CDS274337R0577	0.500	2
	60	SU204M-K60	2CDS274337R0587	0.500	2
	63	SU204M-K63	2CDS274337R0607	0.500	2

Thermal overload relay TF42

Thermal overload relays are economic electromechanical protection devices for the main circuit. They are used mainly to protect motors against overload and phase failures. Starter combinations are setup together with contactors.

1SBC101247F0010

Description

– Overload protection – trip class 10
– Phase loss sensitivity
– Temperature compensation from -25 … +60 °C
– Adjustable current setting for overload protection
– Automatic or manual reset selectable
– Suitable for three- and single-phase application
– Trip-free mechanism
– Status indication
– STOP and TEST function
– Direct mounting onto block contactors
– Sealable operating elements

Approvals

cULus	cULus UL 508
CB	CB scheme
CCC	CCC
GOST-R	GOST-R
ABS	ABS
RINA	RINA
DNV	DNV
Lloyd's Register	Lloyd's Register

Marks

CE   CE

Order data

TF42 screw terminal
For AF contactors

Setting range	Type	Order code	Packing unit	Weight per PCE
A			PCE	kg
0.10 … 0.13	TF42-0.13	1SAZ721201R1005	1	0.130
0.13 … 0.17	TF42-0.17	1SAZ721201R1008	1	0.130
0.17 … 0.23	TF42-0.23	1SAZ721201R1009	1	0.130
0.23 … 0.31	TF42-0.31	1SAZ721201R1013	1	0.130
0.31 … 0.41	TF42-0.41	1SAZ721201R1014	1	0.130
0.41 … 0.55	TF42-0.55	1SAZ721201R1017	1	0.130
0.55 … 0.74	TF42-0.74	1SAZ721201R1021	1	0.130
0.74 … 1.00	TF42-1.0	1SAZ721201R1023	1	0.130
1.00 … 1.30	TF42-1.3	1SAZ721201R1025	1	0.130
1.30 … 1.70	TF42-1.7	1SAZ721201R1028	1	0.130
1.70 … 2.30	TF42-2.3	1SAZ721201R1031	1	0.130
2.30 … 3.10	TF42-3.1	1SAZ721201R1033	1	0.130
3.10 … 4.20	TF42-4.2	1SAZ721201R1035	1	0.130
4.20 … 5.70	TF42-5.7	1SAZ721201R1038	1	0.130
5.70 … 7.60	TF42-7.6	1SAZ721201R1040	1	0.130
7.60 … 10.0	TF42-10	1SAZ721201R1043	1	0.130
10.0 … 13.0	TF42-13	1SAZ721201R1045	1	0.130
13.0 … 16.0	TF42-16	1SAZ721201R1047	1	0.130
16.0 … 20.0	TF42-20	1SAZ721201R1049	1	0.145
20.0 … 24.0	TF42-24	1SAZ721201R1051	1	0.145
24.0 … 29.0	TF42-29	1SAZ721201R1052	1	0.145
29.0 … 35.0	TF42-35	1SAZ721201R1053	1	0.145
35.0 … 38.0/40.0	TF42-38	1SAZ721201R1055	1	0.145

Suitable for mounting on:
AF09 … AF16
AF26 … AF38

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ABB

Functional description
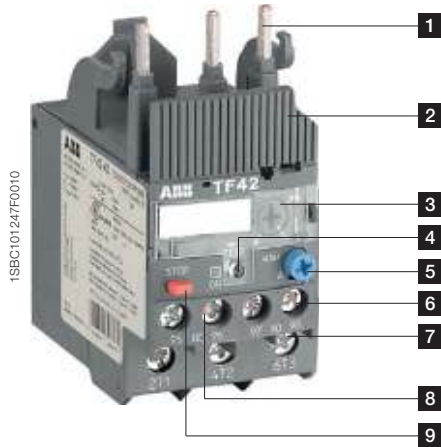
1 Terminals (1L1, 3L2, 5L3)

2 Sealable operating elements

3 Current setting range
Adjustable current setting for overload protection

4 Status indication

5 RESET button
Automatic or manual reset selectable

6 Signaling contacts 97-98

7 Terminals 2T1, 4T2, 6T3

8 Tripping contacts 95-96

9 STOP button

Application / internal function

The thermal overload relays are three pole relays with bimetal tripping elements (1 per pole). The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements become bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98). The contact 95-96 is used to control the load contactor.

The overload relays have a setting scale in Amperes, which allows the direct adjusting of the relay without any additional calculation. In compliance with international and national standards, the setting current is the rated current of the motor and not the tripping current (no tripping at 1.05 x I, tripping at 1.2 x I; I = setting current). The relays are constructed in way that they protect themselves in the event of an overload. The overload relay has to be protected against short-circuit. The appropriate short-circuit protection devices are shown in the table.

Operation mode
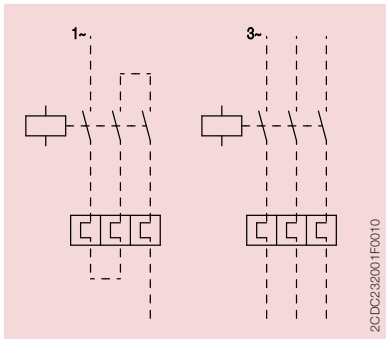
	Contact 95-96	Contact 97-98	Status indication	Comment
Trip state	open	closed		
RESET state	closed	open	ON	
TEST manual reset mode	open	closed		
TEST auto reset mode	open	closed		while TEST is operated
STOP while device is in trip state	open	closed		STOP button has no function
STOP while device is in RESET state	open	open		while STOP button is pressed

Wiring diagram
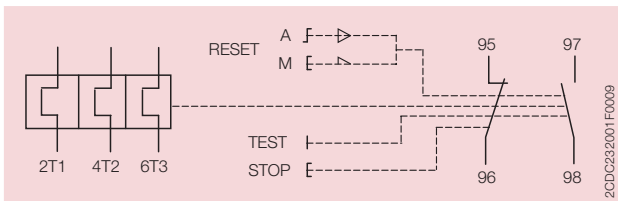
Features:

- 13 Functions
- 10 Time Ranges
- Front knobs for Time Range, Time Scale & Mode Setting
- Slim, Space Saving Design
- DIN Rail Mount

Size: DIN 17.5mm

Certifications: CE

c(UL)us LISTED

IND. CONT. EQ.
496Y

Technical Specifications

Input Specifications

Accuracy	Setting: ±5% of F.S. Repeat: ± 0.5% (F.S. = Full Scale)
Reset	Reset time < 100 msec

Output Specifications

Output Contact	SPDT (1 C/O)
Contact Rating	NO/5A, NC/3A@250V AC

Functional Specifications

Modes	On delay (A) Interval (B) Cyclic equal OFF first (C) Cyclic equal ON first (Ci) Pulse output, 500ms fixed (D) Delay on break (E) Delay on make / Delay on break (F) Interval after break (H) Single shot (I) Retriggerable Single shot (J) Latching relay (K) Delay with Totalise (Ai) Interval with totalise (Bi)
Time Ranges	0.1 - 1 sec, 0.3 - 3 sec, 1 - 10 sec, 3 - 30 sec 0.1 - 1 min, 0.3 - 3 min, 1 - 10 min, 3 - 30 min 0.1 - 1 hr, 0.3 - 3 hr

Supply Voltage

Supply Voltage	20-240V AC 12-240V DC AC : (50 / 60 Hz)
Power Consumption	3.2VA max

Environmental Specifications

Temperature	Operating: 0 to 50℃ (32 to 122℉) Storage: -20 to 75℃ (-4 to 167℉)
Humidity (non-condensing)	95% RH
Weight	2.257 oz.
Protection Level	NEMA 12

Dimensions
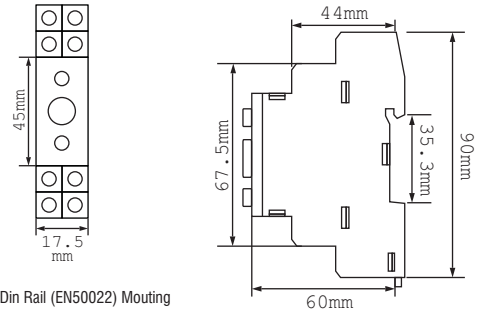
Symmetrical 35mm Din Rail (EN50022) Mouting

Terminal Connections

cꟳᴸus	Cable Size (AWG): 16 ; Tightening Torque (Lb-inch): 4.5
IEC	Cable Size (mm²): 1.5 ; Tightening Torque (N-m): 0.5
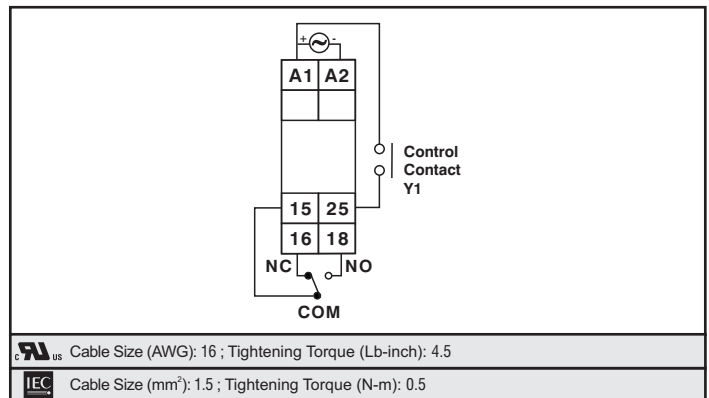
Ordering Information

Part No.	Supply Voltage	Certification	
		CE	UL
175MU	20-240V AC 12-240V DC	▪	▪

Timing Diagram

Function: ON Delay (A)

Supply Voltage

NO Contact
NC Contact

T = set time

Function: Interval (B)

Supply Voltage
Start

NO Contact
NC Contact

T = set time

Function: Cyclic Equal OFF First (C)

Supply Voltage

Control Contact (Y1)

NO Contact
NC Contact

T = set time

Function: Cyclic Equal ON First (Ci)

Supply Voltage

NO Contact
NC Contact

T = set time

Function: Pulse Output (D)

Supply Voltage

NO Contact
NC Contact

T = Set time ; P = 500msec

Function: Delay On Break (E)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

T = set time; t1 < T

Function: Delay On Make / Break (F)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

T = Set time

Function: Interval After Break (H)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

T = Set time

Function: Single Shot (I)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

T = Set time

Function: Retriggerable Single Shot (J)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

ta<T ; T = Set time

Function: Latching Relay (K)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

Function: Delay With Totalize (Ai)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

t1 + t2= T ; T = Set time

Function: Interval With Totalize (Bi)

Supply Voltage (U)

Control Contact Y1

NO Contact
NC Contact

t1 + t2= T ; T = Set time

Series TSS2 Dual Stage Temperature Switch

Specifications - Installation and Operating Instructions

1-27/64 [36.12]

3 [76.2]

BLUE BUTTONS

1-9/64 [28.97]

2-7/16 [61.91]
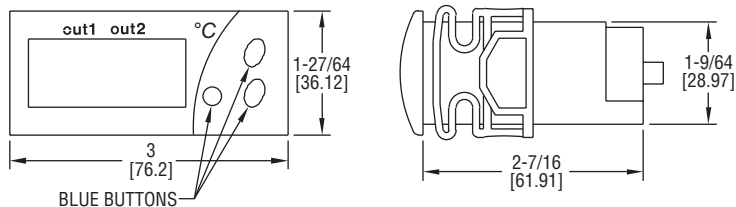
WIRING DIAGRAM
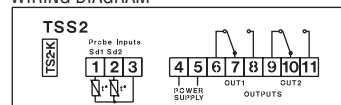
The TSS2 is an electronic temperature controller designed for ON/OFF control or Neutral Area Control. They can be provided with 1 or 2 probes (PTC or NTC) according to parameter P5 and it provides two output relays plus an alarm buzzer. The unit controls cooling, heating or both, since its relays can be setup for direct or reverse operation. The user is able to program 34 different parameters including set points, hysteresis, configuration of alarms and probe adjustment using the silicone front keypad. The unit features error warning and password protection.

Each suffix can take the following values:

MODEL CODE

TSS2 –

OUTPUTS
2 = 2 OUTPUTS

DISPLAY COLOR
0=RED

SUPPLY VOLTAGE
1 = 115 VAC
2 = 230 VAC
3 = 12 VAC/DC
4 = 23 VAC/DC

UNITS
0 = °F
1 = °C
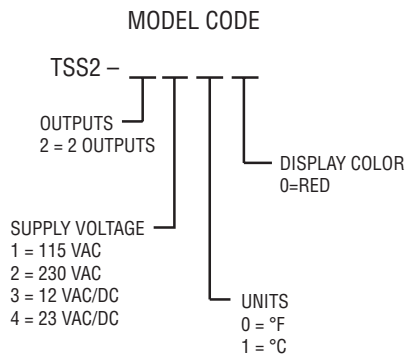
Note: Unit must be mounted away from vibration, impacts, water and corrosive gases.

• Cut hole in panel 71 x 29 mm (2.80 x 1.14 inches).
• Apply silicone (or rubber gasket) around the perimeter of the hole to prevent leakage.
• Insert unit into hole of panel.
• Slide removable fitting clips onto unit from the back until secure to panel.
• Wiring diagram is displayed on the top of the unit.
• **Note:** DO NOT INSTALL PROBE CABLE NEAR POWER CABLES.

SPECIFICATIONS
Probe Range:
  PTC: -58 to 302°F (-50 to 150°C);
  NTC: -58 to 230°F (-50 to 110°C).
Input:
  PTC: 1000Ω @ 25°C;
  NTC: 10 kΩ @ 25°C.
Outputs: OUT1 - SPDT relay rated 16A @ 240 VAC resistive; OUT2 - SPDT relay rated 8A @ 240 VAC resistive.
Horsepower Rating (HP): 1 HP (OUT1).
Power Requirements: 115 VAC, 230 VAC, 12 VAC/VDC or 24 VAC/VDC (depending on model).
Accuracy: 1% FS.
Display: 3-digit and sign, red LED.
Resolution: 0.1° (<100°); 1° (≥100°).
Memory Backup: Nonvolatile memory.
Temperature Limit: Ambient: 32 to 158°F (0 to 70°C).
Storage Temperature: -4 to 176°F (-20 to 80°C).
Dimensions: 3 x 1-27/64 x 2-7/16 in.
Front Panel Rating: IP64.
Weight: 2.3 oz (65 g).
Agency Approvals: CE, cURus.

Maintenance, cleaning and repair
After final installation of the unit, no routine maintenance is required. Clean the surface of the display controller with a soft and damp cloth. Never use abrasive detergents, petrol, alcohol or solvents. All repairs must be made by authorized personnel.

LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

List of parameters

	Description	Units	Range
SP1	Set Point 1	Degrees	r4 to r6
SP2	Set Point 2	Degrees	r5 to r7
r0	Dependency SP1-SP2	Range	ind/dep
r1	Differential for SP1	Degrees	0.1 to 20.0
r2	Differential for SP2	Degrees	0.1 to 20.0
r3	Band differential	Degrees	0.1 to 20.0
r4	Lowest value for SP1	Degrees	-99.9 to r6
r5	Lowest value for SP2	Degrees	-99.9 to r7
r6	Highest value for SP1	Degrees	r4 to 302
r7	Highest value for SP2	Degrees	r5 to 302
r8	Regulation or operating mode	Range	On1/On2/nEU
A0	Alarm differential	Degrees	0.1 to 20.0
A1	Maximum alarm probe 1 (1)	Degrees	0.1 to 99.9
A2	Maximum alarm probe 2 (2)	Degrees	0.1 to 99.9
A3	Minimum alarm probe 1 (1)	Degrees	0.1 to 99.9
A4	Minimum alarm probe 2 (2)	Degrees	0.1 to 99.9
A5	Alarm verification time	h-m (*)	0.0 to 18.0
A6	Alarm probe 1 selection	Range	AHL/Ano/AH/AL
A7	Alarm probe 2 selection	Range	AHL/Ano/AH/AL
c0	Minimum relay stop time	Minutes	0 to 240
c1	Operation relay 1	Range	dir/inv
c2	Operation relay 2	Range	dir/inv
c3	Default operation relay 1	Range	Opn/Clo
c4	Default operation relay 2	Range	Opn/Clo
P0	Temperature scale selection	Range	ºC/ºF
P1	Calibration of probe 1	Degrees	-20.0 to 20.0
P2	Calibration of probe 2	Degrees	-20.0 to 20.0
P3	Decimal point	Range	no/yes
P4	Probe to be displayed	Range	sd1/sd2
P5	Number of probes	Range	1/2
H0	Reprogramming	Range	0
H1	Keyboard protection	Range	no/yes
H2	Operation LED OUT1	Range	dir/inv
H3	Operation LED OUT2	Range	dir/inv
H4	Address for serial communication	Numeric	0 to 999
H5	Access code to parameters	Numeric	0 to 999
H6	Probe type	Range	Ptc/Ntc

(*)h-m are data in format XX.Y where XX are hours and Y tens of minutes.
(1)referred to set 1.
(2)referred to set 2.

Parameter descriptions

SP1 = Operation order of relay 1. Specifies the ON/OFF point of relay 1. Variable between r4 and r6.
SP2 = Operation order of relay 2. Specifies the ON/OFF point of relay 2. Variable between r5 and r7.
r0 = Dependency between SP1 and SP2. Only for mode ONOFF1
ind = order for relay 2, SP2.
dep = order for relay 2, SP1+SP2.
r1 = Differential or hysteresis for relay 1. Temperature differential between ON/OFF of relay 1 in ON/OFF control.
r2 = Differential or hysteresis for relay 2. Temperature differential between ON/OFF of relay 2 in ON/OFF control.
r3 = Band differential. Temperature differential between ON/OFF of relays 1 and 2 in neutral area control. For relay 1 it is added to SP1 and for relay 2 it is subtracted from SP1.
r4 = Lowest value for SP1.
r5 = Lowest value for SP2.
r6 = Highest value for SP1.
r7 = Highest value for SP2.
r8 = Regulation or operating mode. Selection of the operating mode.
A0 = Alarm differential. It is the temperature differential between the alarm On and Off cycle.
A1 = Maximum alarm probe1.
A2 = Maximum alarm probe2.
　　Maximum alarm ON when probe 2 higher than SP2+A2
　　Maximum alarm OFF when probe 2 lower than SP2+A2-A0.
A3 = Minimum alarm probe1.
　　Minimum alarm ON when probe 1 lower than SP1-A3
　　Minimum alarm OFF when probe 1 higher than SP1-A3+A0.

A4 = Minimum alarm probe2.
　　Minimum alarm ON when probe 2 lower than SP2-A4
　　Minimum alarm OFF when probe 2 higher than SP2-A4+A0.
A5 = Alarm verification time. Time from the alarm event until it trips.
A6 = Alarm probe 1 selection.
　　AHL=Maximum and minimum alarm probe 1 enabled.
　　Ano=No alarms probe 1.
　　AH=Maximum alarm probe 1 enabled.
　　AL=Minimum alarm probe 1 enabled.
A7 = Alarm probe 2 selection.
　　AHL=Maximum and minimum alarm probe 2 enabled.
　　Ano=No alarms probe 2.
　　AH=Maximum alarm probe 2 enabled.
　　AL=Minimum alarm probe 2 enabled.
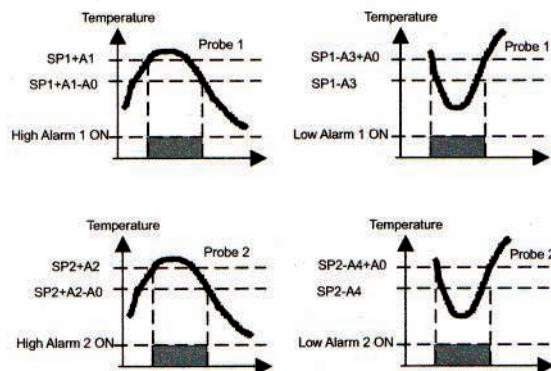
c0 = Minimum relay stop time. Minimum time from the disconnection of a relay until it can be switched on again.
c1 = Operation relay 1. Selection between direct or reverse operation for relay 1.
c2 = Operation relay 2. Selection between direct or reverse operation for relay 2.
c3 = Default operation relay 1. In case of failure of probe 1:
　　oPn= relay 1 will remain open.
　　Clo= relay 1 will remain closed.
c4 = Default operation relay 2. In case of failure of probe 1 (for all modes excepting ON OFF2) or in case of failure of probe 2 (for mode ON OFF2):
　　oPn= relay 2 will remain open.
　　Clo= relay 2 will remain closed.
P0 = Temperature scale selection.
P1 = Calibration of probe 1. Offset degrees to be added to probe 1.
P2 = Calibration of probe 2. Offset degrees to be added to probe 2.
P3 = Decimal point. If the displayed value of the probes is desired with decimals or not.
P4 = Probe to be displayed. Probe always on the display. The other probe can be seen pressing the keys SET+UP.
　　sd1= probe 1.
　　sd2= probe 2.
P5 = Number of probes. If P5=1, there is not ON OFF2 mode. If selected, it will operate as ONOFF1.
H0 = Reprogramming. Parameter to reprogram the thermostat.
H1 = Keyboard protection.
　　To change the sets, enter into parameter and exit again. The protection setting is momentarily released. It switches on again 1 minute after the last time a key was pressed.
　　Yes= Keyboard Protected.
　　No=Keyboard non protected.
H2 = Operation of LED OUT1.
dir = On when relay 1 is ON.
inv = On when relay 1 is OFF.
H3 = Operation of LED OUT2.
dir = On when relay 2 is ON.
inv = On when relay 2 is OFF.
H4 = Serial communication address. Address for computer connection.
H5 = Parameter entry code. Factory set as 0.
H6 = Input probe type selectable between PTC or NTC.

Message display

Under normal operation, the temperature of the probe selected by P4 will be displayed, the following messages may also appear:
•**Err** Memory reading error.
•**ErP** Error of the probe not shown on the display.
•**AH1** Maximum temperature alarm, probe 1.
•**AL1** Minimum temperature alarm, probe 1.
•**AH2** Maximum temperature alarm, probe 2.
•**AL2** Minimum temperature alarm, probe 2.
•**ooo** Open probe.
• **---** Shorted probe.
Pressing SET with UP it displays the probe not selected by P4.
When the probe not selected by P4 is displayed, it alternates its value with message Sd1 or Sd2 depending if it is probe 1 or probe 2.
The display blinks when waiting for a value confirmation.

LED indications

Out1: Indicates relay 1 On or Off as per parameter H2. If H2=dir, with relay 1 On, LED lit, if H2=inv, with relay 1 On, LED off. It blinks when SP1 is displayed.
Out2: Indicates relay 2 On or Off as per parameter H3. If H3=dir, with relay 2 On, LED lit, if H3=inv, with relay 2 On, LED off. It blinks when SP2 is displayed.

Setting SP1 and SP2

• Press and release SET. The current value of order 1 is displayed. SP1 and led OUT1 blink.
• Press UP or DOWN to increase or decrease the value.
• Press SET to confirm the new value. The actual value of order 2 will be displayed, SP2 and LED OUT2 blink.
• Press UP or DOWN to increase or decrease the value.
• Press SET to confirm the new value and exit.

Parameter setup

• Press SET for 8 seconds. Value 0 will blink.
• With UP and DOWN input the code (factory set as 0).
• Press SET to confirm the code. If correct, the label of the first parameter will be displayed.
• With UP or DOWN go to the desired parameter in the parameter list.
• Press SET to see the value.
• With UP or DOWN change the value to the new value as desired.
• Press SET to confirm and exit again to the parameter list. (Also to exit to the list without parameter modification.)
• Press SET + DOWN to exit setup or wait for 1 minute.

Resetting the keyboard code

You can setup to 0 the keyboard code switching the unit off and on while pressing the SET key.

Buzzer disconnection

Pressing SET with DOWN turns off the buzzer alarm. The message of alarm continue appearing in the display.

Reprogramming factory values (H0)

•Access to parameter H0 as explained in parameter setup.
•Value 0 will be displayed.
•Press SET for 8 seconds. Pro will be displayed if they have been setup correctly.
•Press SET + DOWN to exit setup or wait for 1 minute.

	Description	Factory value
SP1	Set Point 1	10.0
SP2	Set Point 2	10.0
r0	Dependency SP1 - SP2	ind
r1	Differential for SP1	1.0
r2	Differential for SP2	1.0
r3	Band differential 1.0	1.0
r4	Lower value for SP1	-99.9
r5	Lower value for SP2	-99.9
r6	Higher value for SP1	99.9
r7	Higher value for SP2	99.9
r8	Regulation or operating mode	On1
A0	Alarm differential	0.1
A1	Maximum alarm probe 1	99.9
A2	Maximum alarm probe 2	99.9
A3	Minimum alarm probe 1	99.9
A4	Minimum alarm probe 2	99.9
A5	Alarm verification time	18.0
A6	Alarm probe 1 selection	AHL
A7	Alarm probe 2 selection	AHL
c0	Minimum relay stop time	0
c1	Operation relay 1	dir
c2	Operation relay 2	dir
c3	Default operation relay 1	Opn
c4	Default operation relay 2	Opn
P0	Temperature scale selection	ºC
P1	Calibration of probe 1	0.0
P2	Calibration of probe 2	0.0
P3	Decimal point	yes
P4	Probe to be displayed	sd1
P5	Number of probes	2
H0	Reprogramming	0
H1	Keyboard protection	no
H2	Operation LED OUT1	dir
H3	Operation LED OUT2	dir
H4	Address for serial communication	0
H5	Access code to parameters	0
H6	Probe type	Ptc

Operating modes
Mode ON OFF1 (On1) with r0=ind.
Relay 1 with c1=dir.

    Temperature of probe 1 >= SP1+r1 -->relay 1 ON
    Temperature of probe 1 <= SP1 -->relay 1 OFF

Figure 1
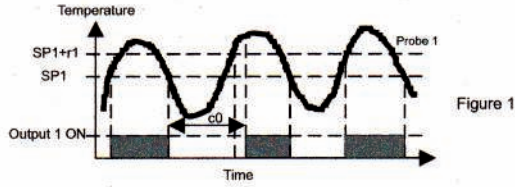
Relay 1 with c1=inv.

    Temperature of probe 1 <= SP1-r1 -->relay 1 ON
    Temperature of probe 1 >= SP1 -->relay 1 OFF
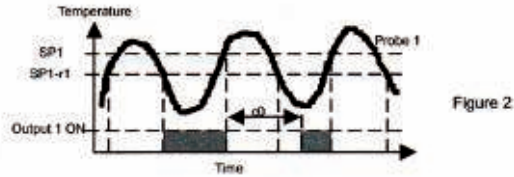
Figure 2

Relay 2 with c2=dir.

    Temperature of probe 1 >= SP2+r2 -->relay 2 ON
    Temperature of probe 1 <= SP2 -->relay 2 OFF
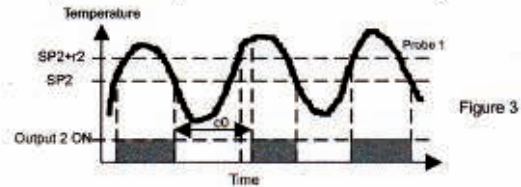
Figure 3

Relay 2 with c2=inv.

    Temperature of probe 1 <= SP2-r2 -->relay 2 ON
    Temperature of probe 1 >= SP2 -->relay 2 OFF

Figure 4

Mode ON OFF1 (On1) with r0=dep.
Output 1 works as in independent ON/OFF control (Figure 1 and 2), but output 2 works as follows:
Relay 2 with c2=dir.
Temperature of probe 1 >= SP1+SP2+r2 -->relay 2 ON
Temperature of probe 1 <= SP1+SP2 -->relay 2 OFF

Relay 2 with c2=inv.
Temperature of probe 1 <= SP1+SP2-r2 -->relay 2 ON
Temperature of probe 1 >= SP1+SP2 -->relay 2 OFF
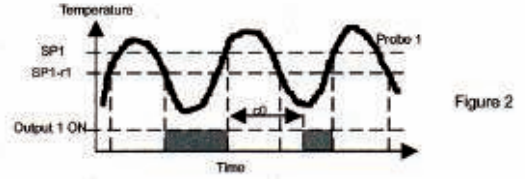
Figure 2

Mode ON OFF2 (On2)
Output 1 works as in independent ON/OFF control (Figure 1 and 2), but output 2 works as follows:
Relay 2 with c2=dir.
Temperature of probe 2 >= SP2+r2 -->relay 2 ON
Temperature of probe 2 <= SP2 -->relay 2 OFF

Figure 6

Relay 2 with c2=inv.
Temperature of probe 2 <= SP2-r2 -->relay 2 ON
Temperature of probe 2 >= SP2 -->relay 2 OFF

Figure 7
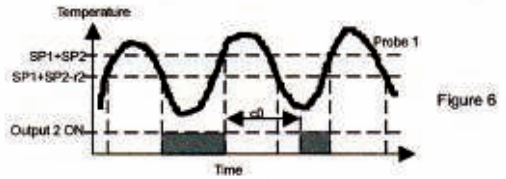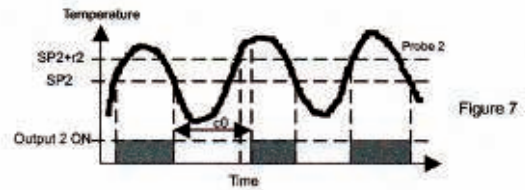
Neutral Area Mode (nEU)
Relay 1
Temperature of probe 1 >= SP1+r3 -->relay 2 ON
Temperature of probe 1 <= SP1 -->relay 2 OFF

Relay 2
Temperature of probe 1 <= SP1-r3 -->relay 2 ON
Temperature of probe 1 >= SP1 -->relay 2 OFF

Figure 7
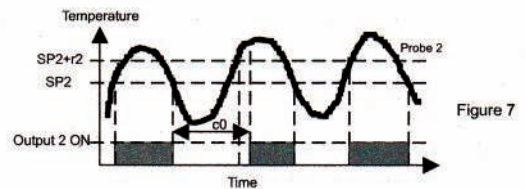
Operation in case of error.
If probe 1 fails, the operation is through c3. (See Parameter description.)
If probe 2 fails, the operation is through c4. (See Parameter description.)
In case of memory failure, both relays will remain open.

STATION ACCESSORY DATA SHEET

Exhaust Fan:

      Number of Units: 1
      Manufacturer: Dayton
      Model: 484X36
      Capacity: 254 cfm

Heater:

      Number Of Units: 1
      Manufacturer: King
      Model: W1210
      Capacity: 500 watts
      Power: Volts - 120   Phase – 1

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® Dayton

Utility Shutter-Mounted Exhaust Fans

Models: 484X36, 484X37, 484X38, 484X39, 484X40, 484X41, 484X42, 484X43, 484X44, 484X46, 484X47, 484X48, 484X49, 484X50

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PLEASE READ AND SAVE THESE INSTRUCTIONS. READ CAREFULLY BEFORE ATTEMPTING TO ASSEMBLE, INSTALL, OPERATE OR MAINTAIN THE PRODUCT DESCRIBED.

PROTECT YOURSELF AND OTHERS BY OBSERVING ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE! RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

PLEASE REFER TO BACK COVER FOR INFORMATION REGARDING DAYTON'S WARRANTY AND OTHER IMPORTANT INFORMATION.

Model #: _____

Serial #: _____

Purch. Date: _____

GETTING STARTED

Tools/Materials Needed:

- Saw to cut rough opening
- Appropriate fasteners to attach to wall
- Screwdriver or wrench to attach fasteners
- Sealant or caulk

Contents:

- Shutter Style Exhaust Fan (1)
- Operating Instructions and Parts Manual (1)

Inspection:

After unpacking your exhaust fan, carefully inspect for any damage that may have occurred during transit. Inspect for loose, missing or damaged parts. If there is physical damage to any parts of the fan, a freight claim must be filed with the carrier. Check to ensure that all bolts, screws and set screws are securely tightened that may have come loose during transit. Retighten as required. Rotate fan propeller by hand to be sure it turns freely.

GENERAL SAFETY INSTRUCTIONS

⚠ DANGER *Before installing or servicing, always lock out and tag power source. Do not rely on a switch as the only means of disconnecting power. Failure to disconnect power source can result in fire, electrical shock or serious injury. Motor will restart without warning after thermal protector trips. Do not touch an operating motor as it may be hot enough to cause injury. Do not place any body parts or objects in fan propeller while fan is connected to a power source.*

⚠ WARNING Read and follow all instructions, cautions, dangers and warnings. Failure to do so could result in personal injury, death or property damage.

Make sure the electrical power source conforms to the requirements of the fan(s) as well as local codes.

Electrical connections, installation and maintenance must be performed by qualified electrical personnel in accordance with all applicable codes and ordinances. Refer to Fig. 1 of this manual.

Unit must be adequately grounded.

To reduce the risk of fire or electrical shock, do not expose this fan to water.

Do not touch electrically live components.

Free rotation of the fan propeller is critical. It must not touch any part of the guard or shutter.

Ensure that all power cords do not come in contact with any sharp edges, hot surfaces or chemicals. Immediately replace any damaged cords.

These utility exhaust fans are for general purpose exhaust applications only. Do not use these exhaust fans in explosive or corrosive atmospheres.

⚠ CAUTION *In the United States to reduce the risk of injury to persons, OSHA requires OSHA compliant guards when fan is installed within 7ft of the floor or working level. In Canada, to reduce the risk of injury to persons, CSA complying guards are required when fan is installed below 2.5 m (8.2ft) above floor or grade level.*

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GETTING STARTED

SAFETY / SPECIFICATIONS

ASSEMBLY / INSTALLATION

OPERATION

TROUBLESHOOTING

MAINTENANCE / REPAIR

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Recommended Accessories:

Speed Control(48C172) for 484X36, 484X37, 484X38, 484X39, 484X40, 484X43, 484X46.
2 Speed Fan Switch(1DGZ9) for 484X48.

SPECIFICATIONS

Power Requirements:	115v/60hz
Mounting Orientation:	Vertical, wall
Shutter Blades & Frame Material:	Aluminum
Propeller Material:	Aluminum, Galvanized Steel
Certifications:	UL/cUL 705
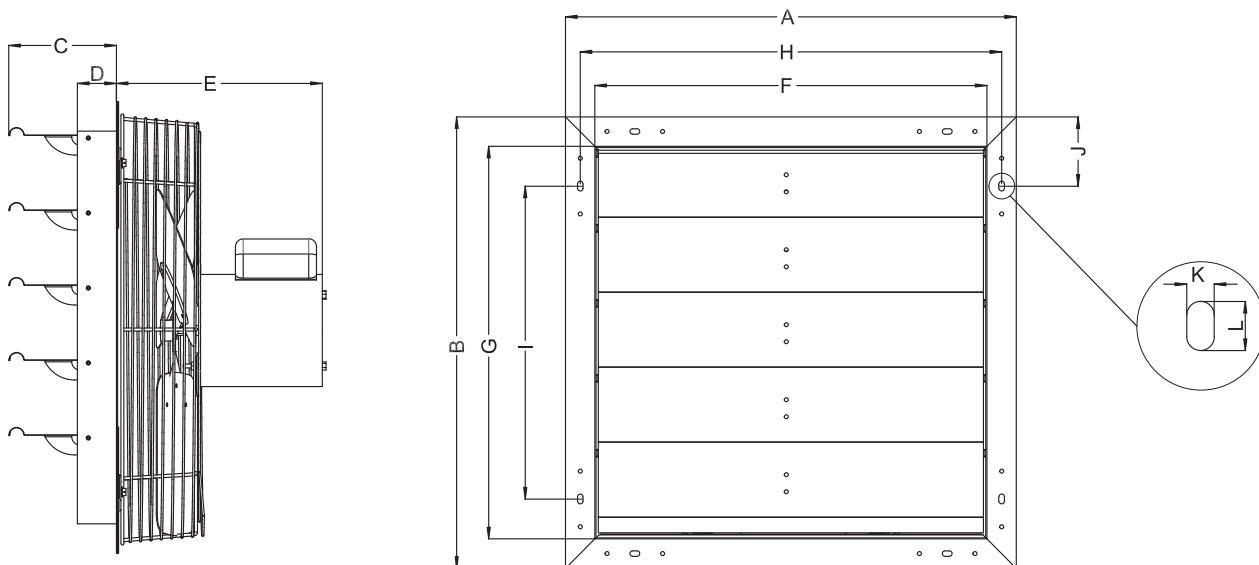
Dimension (In.)														
Model	Prop Dia.	A	B	C	D	E	F	G	H	I	J	K	L	Suggested Wall Opening (Sq)
484X36	7"	11"	11"	5 3/4"	2"	6"	8 1/8"	8 1/8"	9 5/8"	4 1/16"	3 1/2"	5/16"	1/2"	8 1/2"
484X37	10"	13"	13"	5 3/4"	2"	6"	10 1/8"	10 1/8"	11 5/8"	6"	3 1/2"	5/16"	1/2"	10 1/2"
484X38	12"	15"	15"	5 3/4"	2"	6"	12 1/8"	12 1/8"	13 5/8"	8"	3 1/2"	5/16"	1/2"	13"
484X39	16"	19"	19"	5 3/4"	2"	6"	16 1/8"	16 1/8"	17 3/4"	11 7/8"	3 1/2"	5/16"	1/2"	17"
484X40	18"	21"	21"	5 3/4"	2"	6"	18 1/8"	18 1/8"	19 3/4"	14"	3 1/2"	5/16"	1/2"	19"
484X41	18"	21"	21"	5 3/4"	2"	6"	18 1/8"	18 1/8"	19 3/4"	14"	3 1/2"	5/16"	1/2"	19"
484X42	20"	23"	23"	5 3/4"	2"	11"	20 1/8"	20 1/8"	21 3/4"	16"	3 1/2"	5/16"	1/2"	21"
484X43	20"	23"	23"	5 3/4"	2"	11"	20 1/8"	20 1/8"	21 3/4"	16"	3 1/2"	5/16"	1/2"	21"
484X44	20"	23"	23"	5 3/4"	2"	11"	20 1/8"	20 1/8"	21 3/4"	16"	3 1/2"	5/16"	1/2"	21"
484X46	24"	27"	27"	5 3/4"	2"	12"	24 1/8"	24 1/8"	25 5/8"	20"	3 1/2"	5/16"	1/2"	25"
484X47	24"	27"	27"	5 3/4"	2"	12"	24 1/8"	24 1/8"	25 5/8"	20"	3 1/2"	5/16"	1/2"	25"
484X48	24"	27"	27"	5 3/4"	2"	12"	24 1/8"	24 1/8"	25 5/8"	20"	3 1/2"	5/16"	1/2"	25"
484X49	30"	33"	33"	5 3/4"	2"	13"	30 1/8"	30 1/8"	31 5/8"	26"	3 1/2"	5/16"	1/2"	31"
484X50	36"	39"	39"	5 3/4"	2"	13"	36 1/4"	36 1/4"	37 5/8"	32"	3 1/2"	5/16"	1/2"	37"

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PERFORMANCE

Model	Prop Dia.	Spd	Nom. HP	Amps	Nom. RPM	Bearing Type	Sones @ 0.00 SP	CFM @ 0.00 SP	CFM @ 0.125 SP	CFM @ 0.25 SP	Recommended Speed Control
484X36	7"	Var.	1/25	0.5	1550	Ball	5.37	254	197	NA	48C172
484X37	10"	Var.	1/25	0.6	1550	Ball	6.19	625	420	NA	48C172
484X38	12"	Var.	1/15	0.6	1550	Ball	6.00	884	401	NA	48C172
484X39	16"	Var.	1/10	0.9	1550	Ball	6.39	1381	770	NA	48C172
484X40	18"	Var.	1/8	1.0	1075	Ball	7.40	1785	605	NA	48C172
484X41	18"	1	1/4	3.0	1550	Ball	7.28	3128	2567	2201	N/A
484X42	20"	1	1/4	2.6	1550	Ball	7.01	3223	2508	2072	N/A
484X43	20"	Var.	1/4	3.0	1075	Ball	11.30	3151	2335	1099	48C172
484X44	20"	1	1/3	4.5	1600	Ball	8.10	4034	3334	2924	N/A
484X46	24"	Var.	1/4	3.0	1075	Ball	7.00	4163	3009	1097	48C172
484X47	24"	1	1/3	3.2	1075	Ball	7.42	4479	3428	1894	N/A
484X48	24"	2	1/3	3.2	1075/945	Ball	7.42/6.92	4424/3746	3385/2069	1886/0	1DGZ9
484X49	30"	1	1/3	3.8	825	Ball	7.01	5893	4288	2374	N/A
484X50	36"	1	1/2	5.7	825	Ball	8.24	8860	6828	3140	N/A

Note: Performance may vary slightly due to customer installation and operating conditions.

INSTALLATION INSTRUCTIONS

1. Cut hole in wall, frame according to the suggested wall opening shown in dimensional chart for the appropriate size shutter fan or as required. Each installation may vary. Check and verify your specific requirements prior to cutting rough-in hole.
2. Ensure the unit is securely mounted in a rigid framework and sits flat against the wall to avoid unwanted noise or premature failure of components. Louvers should open towards the outside of the room you are exhausting air from.
3. Consult a qualified electrician to properly wire the exhaust fan (as well as additional controls or switches) according to the manufacturer's provided wiring diagram on the motor and control/switch.
4. Install compatible controls/switches according to wire diagrams provided by the manufacturer. Ensure your model shutter exhaust fan is compatible with the control you have chosen.
5. Connect power to the motor using approved wiring method shown below. Refer to Fig.1.

Fig.1: Wiring Schematics

3

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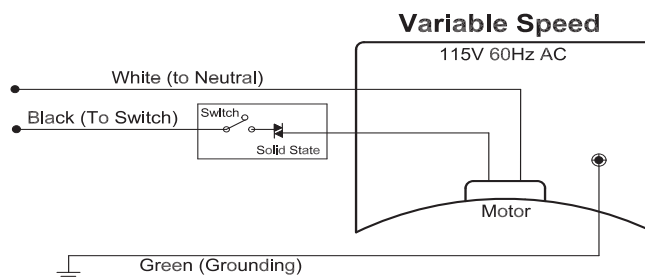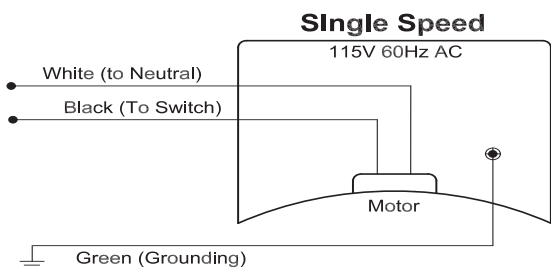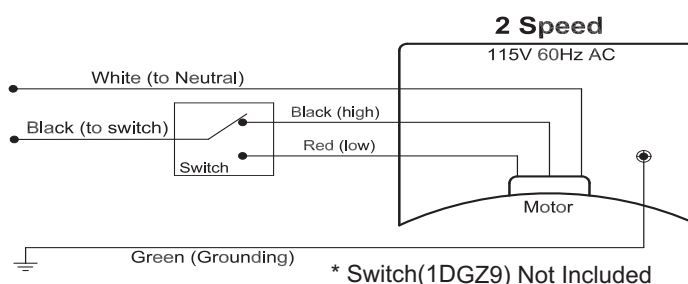
OPERATION

⚠ CAUTION *Before starting or operating your new fan, ensure that the propeller is properly secured and torqued to the motor shaft. Check all fasteners for tightness. Ensure propeller rotates freely and shutters open easily.*

Fan inlet area and discharge area must be free of obstructions.

Once power is applied to fan, verify shutter louvers open for proper air discharge. Louver should open towards outside of room that air is being exhausted from.

Verify the amp draw does not exceed motor label amps or is not significantly less than motor label amps.   .

TROUBLESHOOTING GUIDE

Symptom	Possible Cause(s)	Corrective Action
Excessive noise	1. Dry motor bearings	1. Replace motor
	2. Loose propeller	2. Tighten set screws on propeller hub.
	3. Bent/damaged propeller	3. Replace propeller
	4. Loose guard assembly or motor fasteners.	4. Tighten as required to 15-20 inch/lbs.
Fan inoperative	1. Blown fuse or open circuit breaker.	1. Replace fuse or reset circuit breaker.
	2. Defective motor	2. Replace motor
	3. Switch in Off position	3. Turn switch on
Insufficient airflow	1. Blocked intake or exhaust opening.	1. Clear intake and exhaust openings of any obstructions. Clean the motor, guard, propeller and shutter assembly. Increase fresh air intake opening size.
	2. Low voltage	2. Determine cause and correct

MAINTENANCE

⚠ DANGER *Disconnect and lockout power source before servicing. Only qualified personnel should service this equipment.*

Periodic maintenance schedules should be set to ensure reliability and performance of the fan. This maintenance should include inspection of all fasteners, propeller torque, and proper cleaning of the complete fan assembly.

Check for excessive vibration while fan is running.

Periodically inspect and tighten all set screws and hardware.

Motors do not require lubrication. They feature permanently sealed ball bearings.

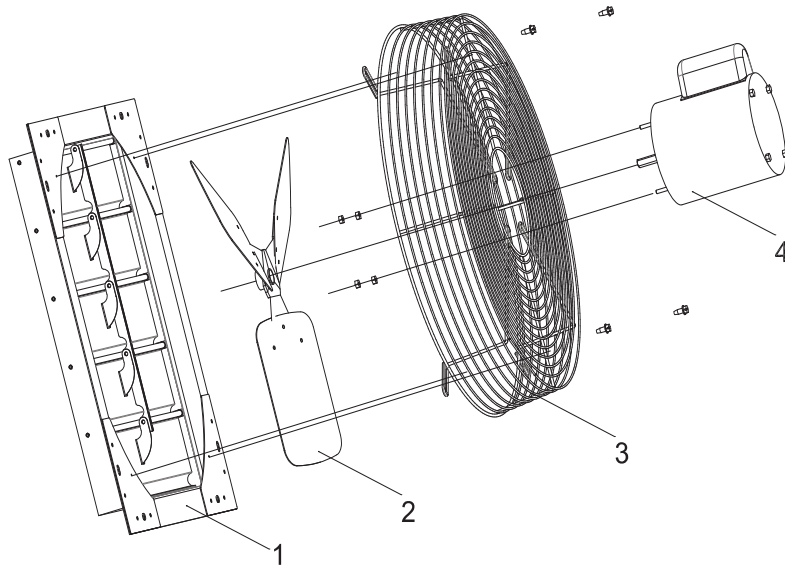The fan propeller should be periodically cleaned to ensure proper balance and performance.

Periodically clean fan guard to ensure optimum performance.

REPAIR PARTS ILLUSTRATION FOR DAYTON EXHAUST FANS

GETTING STARTED

SAFETY / SPECIFICATIONS

ASSEMBLY / INSTALLATION

OPERATION

TROUBLESHOOTING

MAINTENANCE / REPAIR

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Note: Illustrations may not be representative of finished product with regards to design of fan propeller. All parts lists are accurate.

CAPACITOR INFORMATION

Ref.	Descrip.	484X36	484X37	Qty.
1	Shutter	494R68	494R69	1
2	Propeller	494R34	494R35	1
3	Guard	494R59	494R60	1
4	Motor	494R47	494R47	1
Ref.	**Descrip.**	**484X38**	**484X39**	**Qty.**
1	Shutter	494R70	494R71	1
2	Propeller	494R36	494R37	1
3	Guard	494R61	494R62	1
4	Motor	494R48	494R49	1
Ref.	**Descrip.**	**484X40**	**484X41**	**Qty.**
1	Shutter	494R72	494R72	1
2	Propeller	494R38	494R39	1
3	Guard	494R63	494R63	1
4	Motor	494R50	494R51	1
Ref.	**Descrip.**	**484X42**	**484X43**	**Qty.**
1	Shutter	494R73	494R73	1
2	Propeller	494R41	494R40	1
3	Guard	494R64	494R64	1
4	Motor	494R52	494R53	1
Ref.	**Descrip.**	**484X44**	**484X46**	**Qty.**
1	Shutter	494R73	494R74	1
2	Propeller	494R42	494R44	1
3	Guard	494R64	494R65	1
4	Motor	494R54	494R53	1
Ref.	**Descrip.**	**484X47**	**484X48**	**Qty.**
1	Shutter	494R74	494R74	1
2	Propeller	494R43	494R43	1
3	Guard	494R65	494R65	1
4	Motor	494R55	494R56	1
Ref.	**Descrip.**	**484X49**	**484X50**	**Qty.**
1	Shutter	494R75	494R76	1
2	Propeller	494R45	494R46	1
3	Guard	494R66	494R67	1
4	Motor	494R57	494R58	1

SKU:	Motor Model	µF	VAC	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E
484X36	494R47	6	250	1"	1 7/16"	5/8"	N/A	N/A
484X37	494R47	6	250	1"	1 7/16"	5/8"	N/A	N/A
484X38	494R48	5	250	N/A	N/A	N/A	1 3/16"	1 13/16"
484X39	494R49	10	250	N/A	N/A	N/A	1 3/16"	1 13/16"
484X40	494R50	10	250	N/A	N/A	N/A	1 3/16"	1 13/16"
484X41	494R51	20	450	N/A	N/A	N/A	1 9/16"	2 3/4"
484X42	494R52	20	450	N/A	N/A	N/A	1 9/16"	2 3/4"
484X43	494R53	25	370	N/A	N/A	N/A	1 3/4"	3"
484X44	494R54	20	370	N/A	N/A	N/A	1 3/4"	3"
484X46	494R53	25	370	N/A	N/A	N/A	1 3/4"	3"
484X47	494R55	30	370	N/A	N/A	N/A	1 3/4"	3"
484X48	494R56	30	370	N/A	N/A	N/A	1 3/4"	3"
484X49	494R57	25	370	N/A	N/A	N/A	1 3/4"	3"
484X50	494R58	30	370	N/A	N/A	N/A	1 3/4"	3"

For Repair Parts, call 1-800-Grainger
24 hours a day
365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

DAYTON ONE-YEAR LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *All Dayton® product models covered in this manual are warranted by Dayton Electric Mfg. Co. ("Dayton") to the original user against defects in workmanship or materials under normal use for one year after date of purchase. If the Dayton product is part of a set, only the portion that is defective is subject to this warranty. Any product or part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton or Dayton's designee designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced with a new or reconditioned product or part of equal utility or a full refund given, at Dayton's or Dayton's designee's option, at no charge. For limited warranty claim procedures, see "Warranty Service" below. This warranty is void if there is evidence of misuse, mis-repair, mis-installation, abuse or alteration. This warranty does not cover normal wear and tear of Dayton products or portions of them, or products or portions of them which are consumable in normal use. This limited warranty gives purchasers specific legal rights, and you may also have other rights which vary from jurisdiction to jurisdiction.*

WARRANTY DISCLAIMERS AND LIMITATIONS OF LIABILITY RELATING TO ALL CUSTOMERS FOR ALL PRODUCTS

LIMITATION OF LIABILITY *. TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

WARRANTY DISCLAIMER *. A DILIGENT EFFORT HAS BEEN MADE TO PROVIDE PRODUCT INFORMATION AND ILLUSTRATE THE PRODUCTS IN THIS LITERATURE ACCURATELY; HOWEVER, SUCH INFORMATION AND ILLUSTRATIONS ARE FOR THE SOLE PURPOSE OF IDENTIFICATION, AND DO NOT EXPRESS OR IMPLY A WARRANTY THAT THE PRODUCTS ARE MERCHANTABLE, OR FIT FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS WILL NECESSARILY CONFORM TO THE ILLUSTRATIONS OR DESCRIPTIONS. EXCEPT AS PROVIDED BELOW, NO WARRANTY OR AFFIRMATION OF FACT, EXPRESSED OR IMPLIED, OTHER THAN AS STATED IN THE "LIMITED WARRANTY" ABOVE IS MADE OR AUTHORIZED BY DAYTON.*

PRODUCT SUITABILITY. *MANY JURISDICTIONS HAVE CODES AND REGULATIONS GOVERNING SALES, CONSTRUCTION, INSTALLATION, AND/OR USE OF PRODUCTS FOR CERTAIN PURPOSES, WHICH MAY VARY FROM THOSE IN NEIGHBORING AREAS. WHILE ATTEMPTS ARE MADE TO ASSURE THAT DAYTON PRODUCTS COMPLY WITH SUCH CODES, DAYTON CANNOT GUARANTEE COMPLIANCE, AND CANNOT BE RESPONSIBLE FOR HOW THE PRODUCT IS INSTALLED OR USED. BEFORE PURCHASE AND USE OF A PRODUCT, REVIEW THE SAFETY/SPECIFICATIONS, AND ALL APPLICABLE NATIONAL AND LOCAL CODES AND REGULATIONS, AND BE SURE THAT THE PRODUCT, INSTALLATION, AND USE WILL COMPLY WITH THEM.*

CONSUMERS ONLY. *CERTAIN ASPECTS OF DISCLAIMERS ARE NOT APPLICABLE TO CONSUMER PRODUCTS SOLD TO CONSUMERS; (A) SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU; (B) ALSO, SOME JURISDICTIONS DO NOT ALLOW A LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU; AND (C) BY LAW, DURING THE PERIOD OF THIS LIMITED WARRANTY, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE APPLICABLE TO CONSUMER PRODUCTS PURCHASED BY CONSUMERS, MAY NOT BE EXCLUDED OR OTHERWISE DISCLAIMED.*

THIS LIMITED WARRANTY ONLY APPLIES TO UNITED STATES PURCHASERS FOR DELIVERY IN THE UNITED STATES.

WARRANTY SERVICE

To obtain warranty service if you purchased the covered product directly from W.W. Grainger, Inc. ("Grainger"), (i) write or call or visit the local Grainger branch from which the product was purchased or another Grainger branch near you (see www.grainger.com for a listing of Grainger branches); or (ii) contact Grainger by going to www.grainger.com and clicking on the "Contact Us" link at the top of the page, then clicking on the "Email us" link; or (iii) call Customer Care (toll free) at 1-888-361-8649. To obtain warranty service if you purchased the covered product from another distributor or retailer, (i) go to www.grainger.com for Warranty Service; (ii) write or call or visit a Grainger branch near you; or (iii) call Customer Care (toll free) at 1-888-361-8649. In any case, you will need to provide, to the extent available, the purchase date, the original invoice number, the stock number, a description of the defect, and anything else specified in this Dayton One-Year Limited Warranty. You may be required to send the product in for inspection at your cost. You can follow up on the progress of inspections and corrections in the same ways. Title and risk of loss pass to buyer on delivery to common carrier, so if product was damaged in transit to you, file claim with carrier, not retailer, Grainger or Dayton. For warranty information for purchasers and/or delivery outside the United States, please use the following applicable contact information:

Dayton Electric Mfg. Co.,

100 Grainger Parkway, Lake Forest, IL 60045 U.S.A

or call 1-888-361-8649

DM_US 44930530-6.019350.0029

king

W Fan Force Electric Space Heater

⚠ DANGER ⚠

ELECTRIC SHOCK OR FIRE HAZARD

Read all wire sizing, voltage requirements and safety data to avoid property damage and personal injury.

Figure 1
Covers all W Series models

⚠ WARNING ⚠

Read Carefully - These instructions are written in an effort to prevent potential difficulties that might arise during installation. Studying the instructions first may save you considerable time and money later. Observing the following procedures will keep installation time to a minimum. **Save these instructions for future use**.

IMPORTANT INSTRUCTIONS

When using electrical heating appliances, basic precautions should always be followed to reduce the risk of fire, electric shock and injury to persons, including the following:
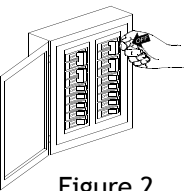
1. **Read all instructions before wiring or using this heater.**

⚠ 2. WARNING: This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces. Keep combustible materials, such as furniture, pillows, bedding, papers, clothes, boxes, etc., and curtains at least 3ft (.9 m) from the front of the heater and keep them away from the sides and rear.

⚠ 3. CAUTION: Extreme caution is necessary when any heater is used by or near children or invalids and whenever the heater is left operating and unattended.

4. Do not operate any heater after it malfunctions. Disconnect power at service panel and have heater inspected by qualified electrician for repair before reusing.

5. Do not use outdoors.

⚠ 6. WARNING: To disconnect heater, turn controls to OFF, and turn OFF power to heater circuit at

Figure 2

main disconnect panel.

⚠ 7. WARNING: Do not insert or allow foreign objects to enter any ventilation or exhaust opening as this may cause an electric shock, fire, or damage to the heater.

8. To prevent a possible of fire, do not block air intakes or exhaust in any manner.

9. A heater has hot and arching or sparking parts inside. Do not use it in areas where gasoline, paint, or flammable vapors or liquids are used or stored.

⚠ 10. WARNING: Use this heater only as described in this manual. Any other use is not recommended by the manufacturer and may cause fire, electric shock, explosion or injury to people and or property.

11. Heater is not intended for use in bathrooms, laundry areas or similar indoor locations. Never locate heater where it may fall into a bathtub or other water container.

SAVE THESE INSTRUCTIONS

CAUTION!
Turn OFF all electrical power to install heater

Figure 2

⚠ DANGER ⚠

ELECTRIC SHOCK OR FIRE HAZARD

Read all wire sizing, voltage requirements and safety data to avoid property damage and personal injury.

Figure 3

Rating Label Location

WARRANTIES ARE VOID IF THIS
HEATER IS USED DURING
CONSTRUCTION FOR HEAT
MODEL: W2420
VOLTS240/:208
WATTS:2000/1000
WATTS 208V:1500/750

MADE IN U.S.A.

Figure 4

Selecting A Location For Your Heater:

DO NOT install less than 6" (15cm) from vertical side walls or open edge of door. This heater must have an unrestricted airflow. DO NOT select a location where it is likely to be blocked by furniture, curtains, etc. Be sure the location selected allows sufficient space for the heater as shown by Table 1. DO NOT locate this heater in an area where combustible vapors, gases liquids, or excessive lint, dust or moisture is present.

Minimum Clearances for heater: Table 1

Front	TOP	BOTTOM	SIDES
36 in	12 in	4 in	6 in
0.9 m	30.5 cm	10.2 cm	15.2 cm

Zero clearance to insulation.
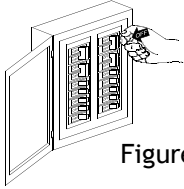
The wire and breaker sizing chart will give a general rule of installation size. Consult an electrician if you are not knowledgeable about wiring codes.

Wire and Breaker Sizing: Table 2

Total Amps	Minimum AWG. Wire Size (Copper	Circuit Breaker or Fuse Size
0 thru 12	#14	15 amp
12.1 thru 16	#12	20 amp
16.1 thru 24	#10	30 amp

WIRING: Branch Circuit Connection

1. Connect heater only to the voltage, amperage and frequency specified on the nameplate.
2. Wiring procedures and connections shall be in accordance with all National and local codes having jurisdiction.
3. Set the bag containing the grille and packet with two (2) grille screws aside.
4. Loosen mounting screw and remove fan heater assembly.
5. A knockout of 1/2 inch conduit size (7/8 inch / 2.2cm) is provided in the back and side of the heater for power to enter. Provide proper strain relief connectors for your wire entering the wallbox.
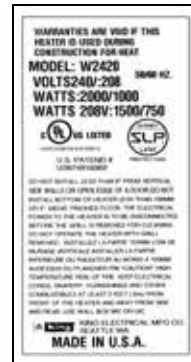
6. Install wallbox a minimum of 6" from vertical sidewalls and 4" above floor. **The front edge of wall can MUST extend 1/2" beyond finished wall surface.**
7. Secure wallbox to the 2 x 4 studs using the two (2) holes on the side of the wallbox. Secure to wall stud on opposite side if required.
8. Connect supply wires, attach ground feed wire to the green ground wire with wire nuts.
9. Reinstall heater assembly into wallbox with screw at top of interior.
10. Install grille securely with screws provided in packet. Do not over tighten.
11. Test unit by turning thermostat up past room temperature. You will see a puff of smoke as the elements are energized and the fan turns on. This is a normal burn off of manufacturing lubricants and will dissipate in 5 minutes.
12. Heater will continue to run until the room temperature you set is reached and then turn itself off until the temperature drops again.

CAUTION - High temperature. Risk of fire, keep electrical cords, drapery, furnishings, and other combustibles at least 3 feet (0.9 m) from the front of the heater as well as away from the side and rear. To reduce the risk of fire, do not store or use gasoline or other flammable vapors and liquids in the vicinity of the heater.
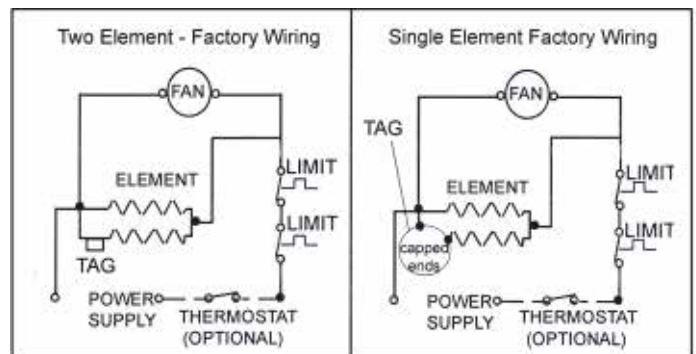
Wiring Diagram   Figure 5   2

W Series Heater

King

This heater is equipped with a thermal overload Smart Limit Protection which disconnects elements and motor in the event normal operating temperatures are exceeded. If thermal overload trips due to abnormal operating temperatures, thermal overload shall remain open until manually reset by turning the heater OFF for fifteen minutes. Inspect for any objects on or adjacent to the heater that may cause high temperatures. After inspecting the heater, keep the power to the heater off for 10 minutes to reset the SLP thermal protector. If the SLP thermal protector shuts the heater off again, immediately turn the heater OFF at the circuit breaker and inspect the heater for possible fan motor failure or dirt and lint on the heating element. Repeat the starting procedure. **DO NOT TAMPER OR REMOVE THIS THIS DEVICE.**

General information and Guidelines:
This heater must be properly installed before it is used. DO NOT tamper with or change the operating of this heater. Service Personnel refer to Maintenance & Warranty section for service of any type.

Operation:
1. This heater must be properly installed in accordance with the National Electrical Codes (NEC) & local electrical codes before it is used.
2. After the electric heater has been completely installed, all thermostats should be turned to LOW or NO HEAT. Turn ON breakers, wait 3 to 5 minutes and check to see that the heaters are not operating. If operating, disconnect power and check for improper wiring. If none are operating then turn thermostats to highest position and wait 3 to 5 minutes. Check to see that all heaters are operating. Should any not be operating, disconnect power and check wiring.
3. Allow entire system to operate steadily for 1/2 hour. This should remove oily residue from manufacturing. (Some smoking may occur).
4. Select the setting for comfort on all thermostats.
5. A safety limit control is provided to turn off the heater automatically if it is blocked or otherwise overheats due to an abnormal condition. **DO NOT** bypass or remove this safety device from the electrical circuit-see Warning Figure 3 on page 2. During normal use, this safety control should not operate. If you find that this control is operating, make sure the heater is not being blocked. If it continues to cycle the heater off, disconnect power to heater and have it checked and repaired by a qualified electrician.

Table 3

Troubleshooting Chart for Electric Heaters

SYMPTOM	PROBLEM	SOLUTION
Breaker Trips	1. Short Circuit 2. Overloaded Circuit 3. Improper Voltage	1. Find source of short. Trace heater circuit and verify the heater is wire properly. 2. Reduce wattage in circuit. Refer to circuit sizing table for maximum wattage. 3. Verify the heater voltage matches the supply voltage.
Heater not working	1. No Power 2. Loose Connections 3. Defective Limit	1. Turn Breaker ON, turn thermostat ON, check that the breaker is position properly on panel bus-bar. A 2-Pole breaker must be connected to both bus-bars (A&B phase) to produce 240V power. 2. Tighten wire connections. 3. By-pass the limit to test. If heater works, replace the limit.
Heater Smokes	1. Oil on Element 2. Needs Cleaning	1. It is normal for the element to burn off some light finishing oil used in the manufacturing process when first energized. Open windows and allow room to vent until it stops, usually within a few minutes. 2. Remove any dust or dirt accumulations.
Room Temperature does not match thermostat setting	1. Thermostat affected by another heat source. 2. Improper calibration	1. Sunlight or other heat sources can affect the thermostat. Move the thermostat to another location or remove the heat source. 2. Remove cover and adjust calibration screw.
Room Temperature swings from too hot to too cold	1. Defective or low quality thermostat	1. Replace with a better quality thermostat. Anticipated thermostats are fairly accurate; an electronic thermostat is best.

SAVE THESE INSTRUCTIONS

Maintenance & Warranty

Maintenance & Cleaning: Basic maintenance is listed below and should be performed annually. When necessary, any required servicing should be performed by qualified service personnel. Your heater will give you years of service and comfort with only minimum care. To assure efficient operation follow the simple instructions below.
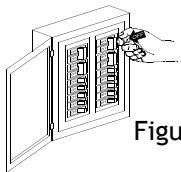
WARNING: Turn the electrical power OFF at the electrical panel board (circuit breaker or fuse box) and lock or tag this panel board door to prevent someone from turning on power while you are working on this heater. Failure to do so could result in serious electrical shock, burns, or possible death.

Figure 2   **Before cleaning this heater, the heating element of the heater must be cool.**

1. Before removing grille, turn the electrical power OFF. Circuit breakers are often not marked correctly and turning the wrong breaker off could mean electricity is flowing to the heater, even if the heater does not appear to be working. If you are uncomfortable working with electrical appliances, unable to follow these guidelines, or do not have the necessary equipment, consult a qualified electrician. Once you verify the power is off completely, proceed to the next step.
2. Remove screws and take off grille. Wash grille with hot soapy water and dry immediately
3. Using a hair dryer or vacuum on blow cycle, hold the fan in place to prevent it from turning and blow debris back through the element. Do not touch element. Vacuum lose debris without touching the elements.
4. Replace grille and secure with screws.
5. Turn thermostat to desired setting.
6. Turn power back ON at the electrical panel board.

Remote Wall Thermostat

Figure 6
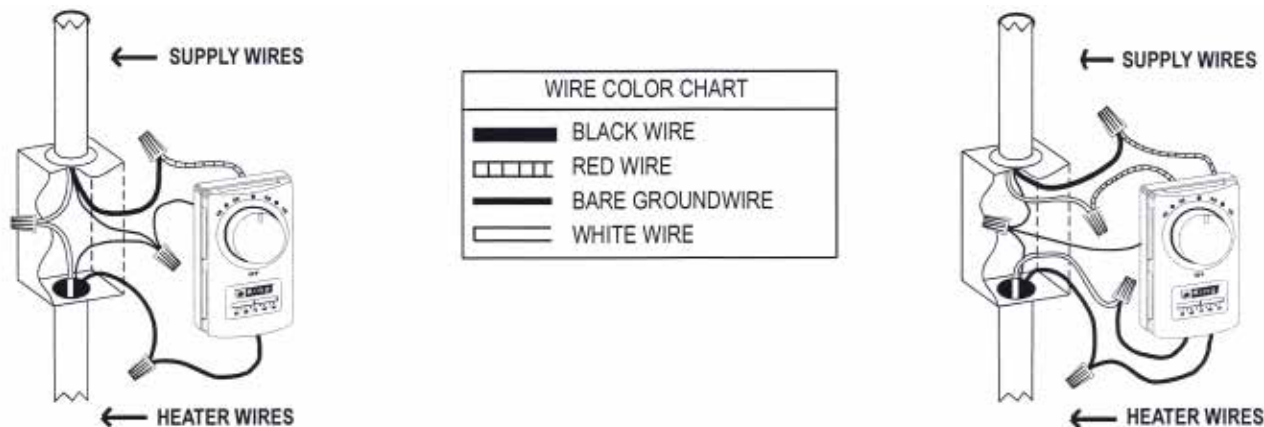
Connection Diagram for Wall Mounted Single Pole Thermostat
1. Red thermostat wire to black power supply wire.
2. Black thermostat wire to black heater wire.
3. White power supply wire to white heater wire.
4. Connect all bare ground wires together.

Connection Diagram for Wall Mounted Double Pole Thermostat
1. Connect the two red thermostat wires to the black and white power supply wires.
2. Connect the two black thermostat wires to the black and white heater wires.
3. Connect all the bare ground wires together.

Warranty Information

King Electrical Manufacturing Company will repair or replace, without charge to the original owner, any W Series heater found to be defective or malfunctioning within 1 year of installation. This warranty requires the owner or his agent install the equipment in accordance with the National Electrical Code, any other applicable heating or electrical codes, and the manufacturer's installation instructions. It further requires that reasonable and necessary maintenance be performed on the unit. Failure to properly maintain the unit will result in the warranty being voided. The company is not liable for abuse or misuse of product as may be finally determined by the company. The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs and shipping costs incurred to return products to King Manufacturing. King Manufacturing will repair or replace, at our option, at no charge to the customer with return freight paid by King. King Manufacturing shall not be liable for consequential damages arising with respect to the product, whether based upon negligence, tort, strict liability or contract. No other written or oral warranty applies, nor any warranties by representatives dealers, employees of King, or any other person. All returns require a King Return Goods Authorization (RGA); Unauthorized returns will be refused. Do not return malfunctioning/defective products to store.

CORROSION PROTECTION DATA SHEET

Shot blast all steel surfaces to SSPC-SP10 for near white blasting.

METAL COATING:

Steel Surfaces: Apply two coats epoxy finish, 3 mils each total 6 mils dry.

Manufacturer: Tnemec

Product: Series N69

Color: Cadet Blue – 14BL

Color for fiberglass cover is Tan.

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PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water.

COLORS Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH Satin

SPECIAL QUALIFICATIONS A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69F, V69F, 90E-92, 90-97, H90-97, 90G-1K97, 90-98, 91-H$_2$O, 94-H$_2$O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69F, V69F, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or 130, 215, 218, 1254

TOPCOATS 22, 46H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69 is 21 days for atmospheric service. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

ALL SURFACES Must be clean, dry and free of oil, grease, chalk and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS **Unthinned:** 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)

HAPS **Unthinned:** 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids

THEORETICAL COVERAGE 1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

Published technical data and instructions are subject to change without notice. The online catalog at www.tnemec.com should be referenced for the most current technical data and instructions or you may contact your Tnemec representative for current technical data and instructions.

PDSN69   Page 1 of 2

HI-BUILD EPOXOLINE® II | SERIES N69

NUMBER OF COMPONENTS	Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.
PACKAGING	5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.
NET WEIGHT PER GALLON	13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) †
STORAGE TEMPERATURE	Minimum 20°F (-7°C) Maximum 110°F (43°C)
TEMPERATURE RESISTANCE	(Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)
SHELF LIFE	Part A: 24 months; Part B: 12 months at recommended storage temperature.
FLASH POINT - SETA	Part A: 82°F (28°C) Part B: 93°F (34°C)
HEALTH & SAFETY	Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product. **Keep out of the reach of children.**

APPLICATION

COVERAGE RATES

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING
l. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING
Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon.

POT LIFE
Without 44-700: 6 hours at 50°F (10°C)   4 hours at 75°F (24°C)   1 hour at 100°F (38°C)
With 44-700: 2 hours at 50°F (10°C)   1 hour at 75°F (24°C)   30 minutes at 100°F (38°C)

SPRAY LIFE
Without 44-700: 1 hour at 75°F (24°C)   With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE
Minimum 50°F (10°C)   Maximum 135°F (57°C)   The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP
Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

Safety Data Sheet

Issue Date 26-Oct-2016   **Revision Date** 26-Oct-2016   **Revision Number** 13

1. IDENTIFICATION

Product identifier
Product Code   N-69-00WHA
Product Name   HB EPOXOLINEII TNEMEC WHITE

Other means of identification
Common Name   SERIES N69/V69, PART A
UN/ID no.   1263

Recommended use of the chemical and restrictions on use
Recommended Use   industrial paint.
Uses advised against   Consumer use, For professional use only. Not for residential use.

Details of the supplier of the safety data sheet

Manufacturer Address	**Distributor**
Tnemec Company, Inc. 6800 Corporate Drive, Kansas City, MO 64120-1372 816-474-3400	Tnemec Company, Inc. 86 Boul, des Entreprises, Ste. 203, Boisbriand, Quebec Canada J7G 2T3

Emergency telephone number
Company Phone Number   Tnemec Regulatory Dept: 816-474-3400
24 Hour Emergency Phone Number   800-535-5053 (Infotrac)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute toxicity - Oral	Category 4
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1
Skin sensitization	Category 1
Carcinogenicity	Category 2
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Specific target organ toxicity (repeated exposure)	Category 1
Flammable Liquids	Category 3

Label elements

EMERGENCY OVERVIEW

Danger

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Hazard statements
Harmful if swallowed
Causes skin irritation
Causes serious eye damage
May cause an allergic skin reaction
Suspected of causing cancer
Suspected of damaging fertility or the unborn child
May cause respiratory irritation. May cause drowsiness or dizziness
Causes damage to organs through prolonged or repeated exposure
Flammable liquid and vapor

Appearance opaque   **Physical state** liquid   **Odor** aromatic

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/mixing/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool

Response
IF exposed or concerned: Get medical advice/attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
If skin irritation or rash occurs: Get medical advice/attention
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
In case of fire: Use CO2, dry chemical, or foam for extinction

Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Keep away from children

Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

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If product is in liquid or paste form, physical or health hazards listed related to dust are not considered significant. However, product may contain substances that could be potential hazards if caused to become airborne due to grinding, sanding or other abrasive processes.
Other information
Harmful to aquatic life with long lasting effects
SEE SAFETY DATA SHEET
Acute Toxicity   8.93713 % of the mixture consists of ingredient(s) of unknown toxicity.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No	Weight-%
BARIUM SULFATE (TOTAL DUST)	7727-43-7	10 - 30%
TITANIUM DIOXIDE (TOTAL DUST)	13463-67-7	10 - 30%
TALC (RESPIRABLE DUST)	14807-96-6	10 - 30%
XYLENE	1330-20-7	1 - 10%
MODIFIED CYCLOALIPHATIC POLYAMINE	68953-36-6	1 - 10%
BENZYL ALCOHOL	100-51-6	1 - 10%
N-BUTANOL (SKIN)	71-36-3	1 - 10%
ETHYL BENZENE	100-41-4	1 - 10%
ISOPHORONE DIAMINE	2855-13-2	1 - 10%
AMORPHOUS SILICA	7631-86-9	1 - 10%
TETRAETHYLENEPENTAMINE	112-57-2	0.1 - 1%
P-P'-ISOPROPYLIDENEDIPHENOL	80-05-7	0.1 - 1%
BENZENE, 1,3-DIMETHYL	108-38-3	0.1 - 1%

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

General advice   If symptoms persist, call a physician.

Eye contact   Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.

Skin contact   Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Consult a physician.

Inhalation   If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion   If swallowed, do not induce vomiting. Get medical attention immediately.

Self-protection of the first aider   Use personal protective equipment. Avoid contact with eyes, skin and clothing.

Most important symptoms and effects, both acute and delayed

Notes to physician   Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Carbon dioxide. Foam. Dry chemical.

Unsuitable extinguishing media Do not use a solid water stream as it may scatter and spread fire.

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Specific hazards arising from the chemical
Thermal decomposition can lead to release of irritating gases and vapours In the event of fire and/or explosion do not breathe fumes

Hazardous combustion products Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds. Aldehydes. Carbon oxides. Hydrocarbons. Oxides of nitrogen.

Protective equipment and precautions for firefighters
Use water spray to cool unopened containers. In the event of fire, wear self-contained breathing apparatus. Keep away from heat/sparks/open flames/hot surfaces. MAY CAUSE HEAT AND PRESSURE BUILD-UP IN CLOSED CONTAINERS. Solvent vapors are heavier than air and may spread along floors. Flash back possible over considerable distance.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions   Avoid contact with eyes, skin and clothing. Use personal protective equipment. Remove all sources of ignition.

Environmental Precautions

Environmental precautions   Prevent further leakage or spillage if safe to do so. Do not flush into surface water or sanitary sewer system.

Methods and material for containment and cleaning up

Methods for containment   Remove all sources of ignition. Spills may be collected with inert, absorbent material for proper disposal. Use non-sparking tools, protective gloves, goggles and clothing, adequate ventilation, avoid the breathing of vapors and use respiratory protective devices. Transfer absorbent material to suitable containers for proper disposal.

Methods for cleaning up   If spilled, contain spilled material and remove with inert absorbent. Dispose of contaminated absorbent, container and unused contents in accordance with local, state and federal regulations.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling   Close container after each use. Avoid contact with eyes, skin and clothing. Do not eat, drink or smoke when using this product. If splashes are likely to occur, wear goggles. Wear protective gloves/clothing. Do not burn, or use a cutting torch on, the empty drum. When used in a mixture, read the labels and safety data sheets of all components. Wash thoroughly after handling.

Conditions for safe storage, including any incompatibilities

Storage   Keep container tightly closed in a dry and well-ventilated place. Keep out of the reach of children.

Incompatible products   Strong oxidizing agents. Acids. Bases. Cleaning solutions such as Chromerge and Aqua Regia.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure guidelines   .

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH

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BARIUM SULFATE (TOTAL DUST) 7727-43-7	TWA: 5 mg/m^3	TWA: 10 mg/m^3 TWA: 5 mg/m^3 TWA: 15 mg/m^3	
TITANIUM DIOXIDE (TOTAL DUST) 13463-67-7	TWA: 10 mg/m^3	TWA: 10 mg/m^3 TWA: 15 mg/m^3	5000 mg/m^3
TALC (RESPIRABLE DUST) 14807-96-6	TWA: 2 mg/m^3	TWA: 2 mg/m^3	1000 mg/m^3
XYLENE 1330-20-7	TWA: 100 ppm STEL: 150 ppm	TWA: 100 ppm TWA: 435 mg/m^3 STEL: 150 ppm STEL: 655 mg/m^3	
N-BUTANOL (SKIN) 71-36-3	TWA: 20 ppm	Skin Ceiling: 50 ppm Ceiling: 150 mg/m^3 TWA: 100 ppm TWA: 300 mg/m^3	1400 ppm
ETHYL BENZENE 100-41-4	TWA: 20 ppm	TWA: 100 ppm TWA: 435 mg/m^3 STEL: 125 ppm STEL: 545 mg/m^3	800 ppm
AMORPHOUS SILICA 7631-86-9	-	TWA: 6 mg/m^3	3000 mg/m^3
BENZENE, 1,3-DIMETHYL 108-38-3	TWA: 100 ppm STEL: 150 ppm	-	900 ppm

Appropriate engineering controls

Engineering measures   Sufficient ventilation, in volume and pattern, should be provided through both local and general exhaust to keep the air contaminant concentration below current applicable OSHA Permissible Exposure Limits (PEL) and ACGIH"s Threshold Limit Values (TLV). Appropriate ventilation should be employed to remove hazardous decomposition products formed during welding or flame cutting operations of surfaces coated with this product.

Individual protection measures, such as personal protective equipment

Eye/face protection   Use chemical resistant splash type goggles. If splashes are likely to occur, wear face-shield.

Skin and body protection   Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Respiratory protection   Use only with adequate ventilation. Do not breathe vapors, spray mist, or dust. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates vapor/mist or dust levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application. Follow respirator manufacturer's directions for respirator use.

General hygiene considerations   Handle in accordance with good industrial hygiene and safety practice.
Avoid breathing dust created by cutting, sanding, or grinding.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	opaque	**Odor**	aromatic
Color	No information available	**Odor threshold**	No information available

Property   **Values**   **Remarks**

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pH		No data available
Melting point / freezing point		No data available
Boiling point / boiling range	116 °C / 241.0 °F	
Flash point	26 °C / 78.0 °F	Pensky Martens - Closed Cup
Evaporation rate		No data available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No data available
Upper flammability limit	12.3	
Lower flammability limit	1.5	
Vapor pressure		No data available
Vapor density		No data available
Specific gravity	1.82981	g/cm3
Water solubility	Insoluble in cold water	
Solubility in other solvents		No data available
Partition coefficient: n-octanol/water		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity	1100 centipoises	approx

Other Information

Density	15.26062 lbs/gal
Volatile organic compounds (VOC) content	2.62788 lbs/gal
Total volatiles weight percent	17.22 %
Total volatiles volume percent	36.7 %

10. STABILITY AND REACTIVITY

Reactivity
No data available

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
None under normal processing.

Conditions to avoid
Heat, flames and sparks. Epoxy constituents.

Incompatible materials
Strong oxidizing agents, Acids, Bases, Cleaning solutions such as Chromerge and Aqua Regia

Hazardous decomposition products
Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds. Oxides of nitrogen. Aldehydes. Hydrocarbons. Carbon oxides.

11. TOXICOLOGICAL INFORMATION

Information on Likely Routes of Exposure

Inhalation	Vapors may irritate throat and respiratory system. May cause central nervous system depression with nausea, headache, dizziness, vomiting, and incoordination.
Eye contact	Causes serious eye damage.
Skin contact	Irritating to skin. May cause sensitization by skin contact.
Ingestion	Harmful if swallowed.

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Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
TITANIUM DIOXIDE (TOTAL DUST) 13463-67-7	> 10000 mg/kg (Rat)		
XYLENE 1330-20-7	= 3500 mg/kg (Rat)	> 4350 mg/kg (Rabbit) > 1700 mg/kg (Rabbit)	= 5000 ppm (Rat) 4 h = 29.08 mg/L (Rat) 4 h
BENZYL ALCOHOL 100-51-6	= 1230 mg/kg (Rat)	= 2 g/kg (Rabbit)	= 8.8 mg/L (Rat) 4 h
N-BUTANOL (SKIN) 71-36-3	= 700 mg/kg (Rat) = 790 mg/kg (Rat)	= 3402 mg/kg (Rabbit) = 3400 mg/kg (Rabbit)	> 8000 ppm (Rat) 4 h
ETHYL BENZENE 100-41-4	= 3500 mg/kg (Rat)	= 15400 mg/kg (Rabbit)	= 17.4 mg/L (Rat) 4 h
ISOPHORONE DIAMINE 2855-13-2	= 1030 mg/kg (Rat)		
AMORPHOUS SILICA 7631-86-9	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 2.2 mg/L (Rat) 1 h
TETRAETHYLENEPENTAMINE 112-57-2	= 3990 mg/kg (Rat)	= 660 µL/kg (Rabbit)	
P-P'-ISOPROPYLIDENEDIPHENOL 80-05-7	= 3300 mg/kg (Rat)	= 3 mL/kg (Rabbit)	> 0.17 mg/L (Rat) 6 h
BENZENE, 1,3-DIMETHYL 108-38-3	= 5 g/kg (Rat)	= 14100 µL/kg (Rabbit)	

Information on toxicological effects

Symptoms	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting. Skin disorders. Irritating to eyes and skin.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Chronic Toxicity	Skin sensitizer. Substances known to be mutagenic to man. Substances known to impair fertility. May cause cancer. Avoid repeated exposure.
Sensitization	May cause sensitization of susceptible persons.
Mutagenicity	May cause genetic defects.
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	ACGIH	IARC	NTP	OSHA
TITANIUM DIOXIDE (TOTAL DUST) 13463-67-7		Group 2B		X
TALC (RESPIRABLE DUST) 14807-96-6		Group 2B Group 3		
XYLENE 1330-20-7		Group 3		
ETHYL BENZENE 100-41-4	A3	Group 2B		X
AMORPHOUS SILICA 7631-86-9		Group 3		
BENZENE, 1,3-DIMETHYL 108-38-3		Group 3		

Reproductive effects	Suspected of damaging fertility or the unborn child.
STOT - single exposure	Eyes, Central Nervous System (CNS), Skin
STOT - repeated exposure	Causes damage to organs through prolonged or repeated exposure
Target organ effects	blood, Central nervous system, Central Vascular System (CVS), Gastrointestinal tract, Eyes, kidney, liver, Lungs, respiratory system, Skin.
Aspiration hazard	No information available.

Acute Toxicity   8.93713 % of the mixture consists of ingredient(s) of unknown toxicity.
The following values are calculated based on chapter 3.1 of the GHS document .

12. ECOLOGICAL INFORMATION

Ecotoxicity

11.87839 % of the mixture consists of components(s) of unknown hazards to the aquatic environment

Component	Toxicity to algae	Toxicity to fish	Toxicity to daphnia
TALC (RESPIRABLE DUST) 14807-96-6		100: 96 h Brachydanio rerio g/L LC50 semi-static	
XYLENE 1330-20-7		LC50= 13.4 mg/L Pimephales promelas 96 h LC50 2.661 - 4.093 mg/L Oncorhynchus mykiss 96 h LC50 13.5 - 17.3 mg/L Oncorhynchus mykiss 96 h LC50 13.1 - 16.5 mg/L Lepomis macrochirus 96 h LC50= 19 mg/L Lepomis macrochirus 96 h LC50 7.711 - 9.591 mg/L Lepomis macrochirus 96 h LC50 23.53 - 29.97 mg/L Pimephales promelas 96 h LC50= 780 mg/L Cyprinus carpio 96 h LC50> 780 mg/L Cyprinus carpio 96 h LC50 30.26 - 40.75 mg/L Poecilia reticulata 96 h	EC50 = 3.82 mg/L 48 h LC50 = 0.6 mg/L 48 h
BENZYL ALCOHOL 100-51-6	35: 3 h Anabaena variabilis mg/L EC50	10: 96 h Lepomis macrochirus mg/L LC50 static 460: 96 h Pimephales promelas mg/L LC50 static	23: 48 h water flea mg/L EC50
N-BUTANOL (SKIN) 71-36-3	500: 72 h Desmodesmus subspicatus mg/L EC50 500: 96 h Desmodesmus subspicatus mg/L EC50	100000 - 500000: 96 h Lepomis macrochirus µg/L LC50 static 1730 - 1910: 96 h Pimephales promelas mg/L LC50 static 1740: 96 h Pimephales promelas mg/L LC50 flow-through 1910000: 96 h Pimephales promelas µg/L LC50 static	1983: 48 h Daphnia magna mg/L EC50 1897 - 2072: 48 h Daphnia magna mg/L EC50 Static
ETHYL BENZENE 100-41-4	1.7 - 7.6: 96 h Pseudokirchneriella subcapitata mg/L EC50 static 2.6 - 11.3: 72 h Pseudokirchneriella subcapitata mg/L EC50 static 4.6: 72 h Pseudokirchneriella subcapitata mg/L EC50 438: 96 h Pseudokirchneriella subcapitata mg/L EC50	11.0 - 18.0: 96 h Oncorhynchus mykiss mg/L LC50 static 7.55 - 11: 96 h Pimephales promelas mg/L LC50 flow-through 9.1 - 15.6: 96 h Pimephales promelas mg/L LC50 static 32: 96 h Lepomis macrochirus mg/L LC50 static 4.2: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 9.6: 96 h Poecilia reticulata mg/L LC50 static	1.8 - 2.4: 48 h Daphnia magna mg/L EC50
ISOPHORONE DIAMINE 2855-13-2	37: 72 h Desmodesmus subspicatus mg/L EC50	110: 96 h Leuciscus idus mg/L LC50 semi-static	42: 24 h Daphnia magna mg/L EC50 14.6 - 21.5: 48 h Daphnia magna mg/L EC50 semi-static
AMORPHOUS SILICA 7631-86-9	440: 72 h Pseudokirchneriella subcapitata mg/L EC50	5000: 96 h Brachydanio rerio mg/L LC50 static	7600: 48 h Ceriodaphnia dubia mg/L EC50
TETRAETHYLENEPENTAMINE 112-57-2	2.1: 72 h Pseudokirchneriella subcapitata mg/L EC50	420: 96 h Poecilia reticulata mg/L LC50 static	24.1: 48 h Daphnia magna mg/L EC50
P-P'-ISOPROPYLIDENEDIPHENOL 80-05-7	2.5: 96 h Pseudokirchneriella subcapitata mg/L EC50	3.6 - 5.4: 96 h Pimephales promelas mg/L LC50 flow-through 4.0 - 5.5: 96 h Pimephales promelas mg/L LC50 static 4: 96 h Oncorhynchus mykiss mg/L LC50 9.9: 96 h Brachydanio rerio mg/L LC50 static	9.2 - 11.4: 48 h Daphnia magna mg/L EC50 Static 3.9: 48 h Daphnia magna mg/L EC50 10.2: 48 h Daphnia magna mg/L EC50
BENZENE, 1,3-DIMETHYL 108-38-3	4.9: 72 h Pseudokirchneriella subcapitata mg/L EC50 static	14.3 - 18: 96 h Pimephales promelas mg/L LC50 flow-through 12.9: 96 h Poecilia reticulata mg/L LC50 semi-static 8.4: 96 h Oncorhynchus mykiss mg/L LC50 semi-static	2.81 - 5.0: 48 h Daphnia magna mg/L EC50 Static

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Mobility in Environmental Media

Component	log Pow

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XYLENE 1330-20-7	2.77
BENZYL ALCOHOL 100-51-6	1.1
N-BUTANOL (SKIN) 71-36-3	0.785
ETHYL BENZENE 100-41-4	3.118
ISOPHORONE DIAMINE 2855-13-2	0.79
TETRAETHYLENEPENTAMINE 112-57-2	.99
P-P'-ISOPROPYLIDENEDIPHENOL 80-05-7	2.2
BENZENE, 1,3-DIMETHYL 108-38-3	3.2

Other Adverse Effects   No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Methods   Keep container tightly closed. If spilled, contain spilled material and remove with inert absorbent. Dispose of contaminated absorbent, container and unused contents in accordance with local, state and federal regulations.

Contaminated packaging   Empty containers should be taken to an approved waste handling site for recycling or disposal.

Component	RCRA	RCRA - Basis for Listing	RCRA - D Series Wastes	RCRA - U Series Wastes
XYLENE 1330-20-7		Included in waste stream: F039		U239
N-BUTANOL (SKIN) 71-36-3		Included in waste stream: F039		U031
ETHYL BENZENE 100-41-4		Included in waste stream: F039		

Component	CAWAST
XYLENE 1330-20-7	Toxic Ignitable
N-BUTANOL (SKIN) 71-36-3	Toxic
ETHYL BENZENE 100-41-4	Toxic Ignitable

14. TRANSPORT INFORMATION

DOT
  UN/ID no.   1263
  Proper Shipping Name   paint
  Hazard Class   3
  Packing Group   III
  Emergency Response Guide   128
  Number

IATA

Additional information   Call TNEMEC Traffic Department - 816-474-3400 for additional information or other modes of Transportation.

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15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Does not comply
ENCS	Does not comply
IECSC	Complies
KECL	Does not comply
PICCS	Does not comply
AICS	Does not comply

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

The following chemical(s) are listed as HAP under the U.S. Clean Air Act, Section 12 (40 CFR 61):

Component	HAPS Data
XYLENE	
ETHYL BENZENE	
BENZENE, 1,3-DIMETHYL	

United States of America

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and and Title 40n of the Code of Federal Regulations, Part 372:

Component	SARA 313 - Threshold Values
BARIUM SULFATE (TOTAL DUST) - 7727-43-7	1.0
XYLENE - 1330-20-7	1.0
N-BUTANOL (SKIN) - 71-36-3	1.0
ETHYL BENZENE - 100-41-4	0.1
P-P'-ISOPROPYLIDENEDIPHENOL - 80-05-7	1.0
BENZENE, 1,3-DIMETHYL - 108-38-3	1.0

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Component	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
XYLENE 1330-20-7	100 lb			X
ETHYL BENZENE 100-41-4	1000 lb	X	X	X
BENZENE, 1,3-DIMETHYL 108-38-3				X

CERCLA

Component	Hazardous Substances RQs	CERCLA EHS RQs	RQ
XYLENE 1330-20-7	100 lb		RQ 100 lb final RQ RQ 45.4 kg final RQ

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N-BUTANOL (SKIN) 71-36-3	5000 lb		RQ 5000 lb final RQ RQ 2270 kg final RQ
ETHYL BENZENE 100-41-4	1000 lb		RQ 1000 lb final RQ RQ 454 kg final RQ
BENZENE, 1,3-DIMETHYL 108-38-3	1000 lb		RQ 1000 lb final RQ RQ 454 kg final RQ

United States of America

California Prop. 65
WARNING! This product contains a chemical known in the State of California to cause cancer

Component	California Prop. 65
TITANIUM DIOXIDE (TOTAL DUST) - 13463-67-7	Carcinogen
ETHYL BENZENE - 100-41-4	Carcinogen
P-P'-ISOPROPYLIDENEDIPHENOL - 80-05-7	Female Reproductive

California SCAQMD Rule 443
Contains Photochemically Reactive Solvent

State Right-to-Know

Component	New Jersey	Massachusetts	Pennsylvania
BARIUM SULFATE (TOTAL DUST) 7727-43-7	X	X	X
TITANIUM DIOXIDE (TOTAL DUST) 13463-67-7	X	X	X
TALC (RESPIRABLE DUST) 14807-96-6	X	X	X
XYLENE 1330-20-7	X	X	X
BENZYL ALCOHOL 100-51-6		X	X
N-BUTANOL (SKIN) 71-36-3	X	X	X
ETHYL BENZENE 100-41-4	X	X	X
ISOPHORONE DIAMINE 2855-13-2	X		
AMORPHOUS SILICA 7631-86-9	X	X	X
TETRAETHYLENEPENTAMINE 112-57-2	X	X	X
P-P'-ISOPROPYLIDENEDIPHENOL 80-05-7	X	X	X
BENZENE, 1,3-DIMETHYL 108-38-3	X	X	X

16. OTHER INFORMATION

NFPA **Health** 2 **Flammability** 3 **Instability** 1 **Physical hazard** *

HMIS (Hazardous Material Information System) **Health** 2* **Flammability** 3 **Reactivity** 1

Prepared By Tnemec Regulatory Dept: 816-474-3400
Revision Date 26-Oct-2016
Revision Summary
9 4 5 7 10 8 2 11 14 1

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Disclaimer
For specific information regarding occupational safety and health standards, please refer to the Code of Federal Regulations, Title 29, Part 1910.
To the best of our knowledge, the information contained herein is accurate. However, neither the Tnemec Company or any of its subsidiaries assume any liability whatsoever for the accuracy of completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown health hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

End of SDS

Issue Date 07-Aug-2015	**Revision Date** 07-Aug-2015	**Revision Number** 10

1. IDENTIFICATION

Product identifier

Product Code   N-69-0069B
Product Name   H-B EPOXOLINE II CONVERTER

Other means of identification

Common Name   SERIES N69/N69F, PART B
UN/ID no.   1263

Recommended use of the chemical and restrictions on use

Recommended Use   industrial paint.
Uses advised against   Consumer use, For professional use only. Not for residential use.

Details of the supplier of the safety data sheet

Manufacturer Address   **Distributor**

Tnemec Company, Inc. 6800 Corporate Drive, Kansas City, MO   Tnemec Company, Inc. 86 Boul, des Entreprises, Ste. 203
64120-1372   Boisbriand, Quebec Canada J7G 2T3

Emergency telephone number

Company Phone Number   Tnemec Regulatory Dept: 816-474-3400
24 Hour Emergency Phone Number 800-535-5053 (Infotrac)
Emergency Telephone   United States: 800-535-5053 (INFOTRAC) - TNEMEC REGULATORY DEPT:
                                                        816-474-3400

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Skin sensitization	Category 1
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1B
Reproductive Toxicity	Category 1B
Specific target organ toxicity (repeated exposure)	Category 2
Flammable Liquids	Category 3

Label elements

EMERGENCY OVERVIEW

Danger

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Hazard statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause genetic defects
May cause cancer
May damage fertility or the unborn child
May cause damage to organs through prolonged or repeated exposure
Flammable liquid and vapor

Appearance opaque	**Physical state** liquid	**Odor** aromatic

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/mixing/equipment
Use only non-sparking tools
Take precautionary measures against static discharge

Response
IF exposed or concerned: Get medical advice/attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
If skin irritation or rash occurs: Get medical advice/attention
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
In case of fire: Use CO2, dry chemical, or foam for extinction

Storage
Store locked up
Store in a well-ventilated place. Keep cool

Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)
Other information
Toxic to aquatic life with long lasting effects
SEE SAFETY DATA SHEET
Acute Toxicity   26.1844305 % of the mixture consists of ingredient(s) of unknown toxicity.

3. COMPOSITION/INFORMATION ON INGREDIENTS

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Component	CAS-No	Weight-%
TALC (RESPIRABLE DUST)	14807-96-6	30 - 60%
EPOXY RESIN (LER)	25085-99-8	10 - 30%
SOLID EPOXY RESIN	-	10 - 30%
BARIUM SULFATE (TOTAL DUST)	7727-43-7	1 - 10%
XYLENE	1330-20-7	1 - 10%
METHYL ISOBUTYL KETONE	108-10-1	1 - 10%
AROMATIC HYDROCARBON MIXTURE	64742-95-6	1 - 10%
1,2,4-TRIMETHYLBENZENE	95-63-6	1 - 10%
ETHYL BENZENE	100-41-4	1 - 10%
BENZENE, 1,4-DIMETHYL	106-42-3	0.1 - 1%
BENZENE, 1,3-DIMETHYL	108-38-3	0.1 - 1%

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

General advice	If symptoms persist, call a physician.
Eye contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If eye irritation persists, consult a specialist.
Skin contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. If skin irritation persists, call a physician.
Inhalation	Remove to fresh air. Oxygen or artificial respiration if needed.
Ingestion	If swallowed, do not induce vomiting. Get medical attention immediately.
Self-protection of the first aider	Use personal protective equipment. Avoid contact with eyes, skin and clothing.

Most important symptoms and effects, both acute and delayed

Notes to physician	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Carbon dioxide. Foam. Dry chemical.

Unsuitable extinguishing media Do not use a solid water stream as it may scatter and spread fire.

Specific hazards arising from the chemical
Thermal decomposition can lead to release of irritating gases and vapours In the event of fire and/or explosion do not breathe fumes

Hazardous combustion products Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds. Carbon oxides. Hydrocarbons. Aldehydes.

Protective equipment and precautions for firefighters
Use water spray to cool unopened containers. In the event of fire, wear self-contained breathing apparatus. Keep away from heat/sparks/open flames/hot surfaces. MAY CAUSE HEAT AND PRESSURE BUILD-UP IN CLOSED CONTAINERS. Solvent vapors are heavier than air and may spread along floors. Flash back possible over considerable distance.

6. ACCIDENTAL RELEASE MEASURES

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Personal precautions, protective equipment and emergency procedures

Personal precautions	Avoid contact with eyes, skin and clothing. Use personal protective equipment. Remove all sources of ignition.

Environmental Precautions

Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not flush into surface water or sanitary sewer system.

Methods and material for containment and cleaning up

Methods for containment	Remove all sources of ignition. Spills may be collected with inert, absorbent material for proper disposal. Use non-sparking tools, protective gloves, goggles and clothing, adequate ventilation, avoid the breathing of vapors and use respiratory protective devices. Transfer absorbent material to suitable containers for proper disposal.
Methods for cleaning up	If spilled, contain spilled material and remove with inert absorbent. Dispose of contaminated absorbent, container and unused contents in accordance with local, state and federal regulations.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling	Close container after each use. Avoid contact with eyes, skin and clothing. Do not eat, drink or smoke when using this product. If splashes are likely to occur, wear goggles. Wear protective gloves/clothing. Do not burn, or use a cutting torch on, the empty drum. When used in a mixture, read the labels and safety data sheets of all components. Wash thoroughly after handling.

Conditions for safe storage, including any incompatibilities

Storage	Keep container tightly closed in a dry and well-ventilated place. Keep out of the reach of children.
Incompatible products	Acids. Bases. Amines. Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure guidelines   .

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
TALC (RESPIRABLE DUST) 14807-96-6	TWA: 2 mg/m³	TWA: 2 mg/m³	1000 mg/m³
BARIUM SULFATE (TOTAL DUST) 7727-43-7	TWA: 5 mg/m³	TWA: 10 mg/m³ TWA: 5 mg/m³ TWA: 15 mg/m³	
XYLENE 1330-20-7	TWA: 100 ppm STEL: 150 ppm	TWA: 100 ppm TWA: 435 mg/m³ STEL: 150 ppm STEL: 655 mg/m³	
METHYL ISOBUTYL KETONE 108-10-1	TWA: 20 ppm STEL: 75 ppm	TWA: 50 ppm TWA: 205 mg/m³ STEL: 75 ppm STEL: 300 mg/m³ TWA: 100 ppm TWA: 410 mg/m³	500 ppm

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ETHYL BENZENE 100-41-4	TWA: 20 ppm	TWA: 100 ppm TWA: 435 mg/m³ STEL: 125 ppm STEL: 545 mg/m³	800 ppm
BENZENE, 1,4-DIMETHYL 106-42-3	TWA: 100 ppm STEL: 150 ppm	-	900 ppm
BENZENE, 1,3-DIMETHYL 108-38-3	TWA: 100 ppm STEL: 150 ppm	-	900 ppm

Appropriate engineering controls

Engineering measures   Sufficient ventilation, in volume and pattern, should be provided through both local and general exhaust to keep the air contaminant concentration below current applicable OSHA Permissible Exposure Limits (PEL) and ACGIH"s Threshold Limit Values (TLV). Appropriate ventilation should be employed to remove hazardous decomposition products formed during welding or flame cutting operations of surfaces coated with this product.

Individual protection measures, such as personal protective equipment

Eye/face protection   Use chemical resistant splash type goggles. If splashes are likely to occur, wear face-shield.

Skin and body protection   Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Respiratory protection   Use only with adequate ventilation. Do not breathe vapors, spray mist, or dust. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates vapor/mist or dust levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application. Follow respirator manufacturer's directions for respirator use.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.
                                    Avoid breathing dust created by cutting, sanding, or grinding.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	opaque	**Odor**	aromatic
Color	No information available	**Odor threshold**	No information available

Property	**Values**	**Remarks**
pH		No data available
Melting point / freezing point		No data available
Boiling point / boiling range	98 °C / 208.0 °F	
Flash point	35 °C / 95.0 °F	Pensky Martens - Closed Cup
Evaporation rate		No data available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No data available
Upper flammability limit	N/A	
Lower flammability limit	N/A	
Vapor pressure		No data available
Vapor density		No data available
Specific gravity	1.46987	g/cm3
Water solubility	Insoluble in cold water	
Solubility in other solvents		No data available
Partition coefficient: n-octanol/water		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity	centipoises	approx

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Other Information

Density	12.25872 lbs/gal
Volatile organic compounds (VOC) content	0.28741 lbs/gal
Total volatiles weight percent	17.56 %
Total volatiles volume percent	29.86 %

10. STABILITY AND REACTIVITY

Reactivity
No data available

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
None under normal processing.

Conditions to avoid
Heat, flames and sparks.

Incompatible materials
Acids, Bases, Amines, Strong oxidizing agents

Hazardous decomposition products
Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke).
Carbon monoxide. Unidentified organic and inorganic compounds. Carbon oxides. Hydrocarbons. Aldehydes. Chlorine. Fluorine.

11. TOXICOLOGICAL INFORMATION

Information on Likely Routes of Exposure

Inhalation	HARMFUL BY INHALATION.
Eye contact	Causes serious eye irritation.
Skin contact	Irritating to skin. May cause sensitization by skin contact.
Ingestion	Harmful if swallowed. Aspiration may cause pulmonary edema and pneumonitis.

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
XYLENE 1330-20-7	= 3500 mg/kg (Rat)	> 1700 mg/kg (Rabbit) > 4350 mg/kg (Rabbit)	= 29.08 mg/L (Rat) 4 h = 5000 ppm (Rat) 4 h
METHYL ISOBUTYL KETONE 108-10-1	= 2080 mg/kg (Rat)	= 3000 mg/kg (Rabbit)	= 8.2 mg/L (Rat) 4 h
AROMATIC HYDROCARBON MIXTURE 64742-95-6	= 8400 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	= 3400 ppm (Rat) 4 h
1,2,4-TRIMETHYLBENZENE 95-63-6	= 3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	= 18 g/m³ (Rat) 4 h
ETHYL BENZENE 100-41-4	= 3500 mg/kg (Rat)	= 15400 mg/kg (Rabbit)	= 17.2 mg/L (Rat) 4 h
BENZENE, 1,4-DIMETHYL 106-42-3	= 4029 mg/kg (Rat)		= 4740 ppm (Rat) 4 h = 4550 ppm (Rat) 4 h
BENZENE, 1,3-DIMETHYL 108-38-3	= 5000 mg/kg (Rat)	= 14100 µL/kg (Rabbit)	

Information on toxicological effects

Symptoms	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting. Skin disorders. Irritating to eyes and skin.

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Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization	May cause sensitization of susceptible persons.
Mutagenicity	May cause genetic defects.
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	ACGIH	IARC	NTP	OSHA
TALC (RESPIRABLE DUST) 14807-96-6		Group 3		
XYLENE 1330-20-7		Group 3		
METHYL ISOBUTYL KETONE 108-10-1	A3	Group 2B		X
ETHYL BENZENE 100-41-4	A3	Group 2B		X
BENZENE, 1,4-DIMETHYL 106-42-3		Group 3		
BENZENE, 1,3-DIMETHYL 108-38-3		Group 3		

Reproductive effects	Suspected of damaging fertility or the unborn child.
STOT - single exposure	No information available
STOT - repeated exposure	Causes damage to organs through prolonged or repeated exposure
Target organ effects	Central nervous system, Central Vascular System (CVS), Eyes, Lungs, respiratory system, Skin.
Aspiration hazard	Risk of serious damage to the lungs (by aspiration).

| **Acute Toxicity** | 26.1844305 % of the mixture consists of ingredient(s) of unknown toxicity. |

The following values are calculated based on chapter 3.1 of the GHS document .

12. ECOLOGICAL INFORMATION

Ecotoxicity

Toxic to aquatic life with long lasting effects

18.01842 % of the mixture consists of components(s) of unknown hazards to the aquatic environment

Component	Toxicity to algae	Toxicity to fish	Toxicity to daphnia
TALC (RESPIRABLE DUST) 14807-96-6		100: 96 h Brachydanio rerio g/L LC50 semi-static	
EPOXY RESIN (LER) 25085-99-8	11 mg/L 72 hr	2 mg/L 96 hr Oncorhynchus mykiss	1.8 mg/L 48h
XYLENE 1330-20-7		LC50= 13.4 mg/L Pimephales promelas 96 h LC50 2.661 - 4.093 mg/L Oncorhynchus mykiss 96 h LC50 13.5 - 17.3 mg/L Oncorhynchus mykiss 96 h LC50 13.1 - 16.5 mg/L Lepomis macrochirus 96 h LC50= 19 mg/L Lepomis macrochirus 96 h LC50 7.711 - 9.591 mg/L Lepomis macrochirus 96 h LC50 23.53 - 29.97 mg/L Pimephales promelas 96 h LC50= 780 mg/L Cyprinus carpio 96 h LC50> 780 mg/L Cyprinus carpio 96 h LC50 30.26 - 40.75 mg/L Poecilia reticulata 96 h	EC50 = 3.82 mg/L 48 h LC50 = 0.6 mg/L 48 h
METHYL ISOBUTYL KETONE 108-10-1	400: 96 h Pseudokirchneriella subcapitata mg/L EC50	496 - 514: 96 h Pimephales promelas mg/L LC50 flow-through	170: 48 h Daphnia magna mg/L EC50
AROMATIC HYDROCARBON MIXTURE 64742-95-6		9.22: 96 h Oncorhynchus mykiss mg/L LC50	6.14: 48 h Daphnia magna mg/L EC50
1,2,4-TRIMETHYLBENZENE 95-63-6		7.19 - 8.28: 96 h Pimephales promelas mg/L LC50 flow-through	6.14: 48 h Daphnia magna mg/L EC50

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ETHYL BENZENE 100-41-4	4.6: 72 h Pseudokirchneriella subcapitata mg/L EC50 438: 96 h Pseudokirchneriella subcapitata mg/L EC50 2.6 - 11.3: 72 h Pseudokirchneriella subcapitata mg/L EC50 static 1.7 - 7.6: 96 h Pseudokirchneriella subcapitata mg/L EC50 static	11.0 - 18.0: 96 h Oncorhynchus mykiss mg/L LC50 static 32: 96 h Lepomis macrochirus mg/L LC50 static 4.2: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 7.55 - 11: 96 h Pimephales promelas mg/L LC50 flow-through 9.6: 96 h Poecilia reticulata mg/L LC50 static 9.1 - 15.6: 96 h Pimephales promelas mg/L LC50 static	1.8 - 2.4: 48 h Daphnia magna mg/L EC50
BENZENE, 1,4-DIMETHYL 106-42-3	3.2: 72 h Pseudokirchneriella subcapitata mg/L EC50 static 105.1: 3 h Chlorella vulgaris mg/L EC50	2.6: 96 h Oncorhynchus mykiss mg/L LC50 8.8: 96 h Poecilia reticulata mg/L LC50 semi-static 7.2 - 9.9: 96 h Pimephales promelas mg/L LC50 static 2.6: 96 h Oncorhynchus mykiss mg/L LC50 static	3.55 - 6.31: 48 h Daphnia magna mg/L EC50 Static
BENZENE, 1,3-DIMETHYL 108-38-3	4.9: 72 h Pseudokirchneriella subcapitata mg/L EC50 static	8.4: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 14.3 - 18: 96 h Pimephales promelas mg/L LC50 flow-through 12.9: 96 h Poecilia reticulata mg/L LC50 semi-static	2.81 - 5.0: 48 h Daphnia magna mg/L EC50 Static

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Mobility in Environmental Media

Component	log Pow
XYLENE 1330-20-7	2.77
METHYL ISOBUTYL KETONE 108-10-1	1.19
1,2,4-TRIMETHYLBENZENE 95-63-6	3.63
ETHYL BENZENE 100-41-4	3.118
BENZENE, 1,4-DIMETHYL 106-42-3	3.15
BENZENE, 1,3-DIMETHYL 108-38-3	3.2

Other Adverse Effects   No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Methods   Keep container tightly closed. If spilled, contain spilled material and remove with inert absorbent. Dispose of contaminated absorbent, container and unused contents in accordance with local, state and federal regulations.

Contaminated packaging   Empty containers should be taken to an approved waste handling site for recycling or disposal.

Component	RCRA	RCRA - Basis for Listing	RCRA - D Series Wastes	RCRA - U Series Wastes
XYLENE 1330-20-7		Included in waste stream: F039		U239
METHYL ISOBUTYL KETONE 108-10-1		Included in waste stream: F039		U161
ETHYL BENZENE 100-41-4		Included in waste stream: F039		

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Component	CAWAST
BARIUM SULFATE (TOTAL DUST) 7727-43-7	Toxic
XYLENE 1330-20-7	Toxic Ignitable
ETHYL BENZENE 100-41-4	Toxic Ignitable

14. TRANSPORT INFORMATION

DOT

UN/ID no.	1263
Hazard Class	3
Packing Group	III
Emergency Response Guide Number	1285

IATA

UN/ID no.	1263
Hazard Class	3
Packing Group	III
ERG Code	366

Additional information   Call TNEMEC Traffic Department - 816-474-3400 for additional information or other modes of Transportation.

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Does not comply
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Does not comply

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

The following chemical(s) are listed as HAP under the U.S. Clean Air Act, Section 12 (40 CFR 61):
Component   **HAPS Data**
XYLENE
METHYL ISOBUTYL KETONE
ETHYL BENZENE
BENZENE, 1,4-DIMETHYL
BENZENE, 1,3-DIMETHYL

United States of America

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SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and and Title 40n of the Code of Federal Regulations, Part 372:

Component	SARA 313 - Threshold Values
BARIUM SULFATE (TOTAL DUST) - 7727-43-7	1.0
XYLENE - 1330-20-7	1.0
METHYL ISOBUTYL KETONE - 108-10-1	1.0
1,2,4-TRIMETHYLBENZENE - 95-63-6	1.0
ETHYL BENZENE - 100-41-4	0.1
BENZENE, 1,4-DIMETHYL - 106-42-3	1.0
BENZENE, 1,3-DIMETHYL - 108-38-3	1.0

SARA 311/312 Hazardous
Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Component	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
XYLENE 1330-20-7	100 lb			X
ETHYL BENZENE 100-41-4	1000 lb	X	X	X
BENZENE, 1,4-DIMETHYL 106-42-3				X
BENZENE, 1,3-DIMETHYL 108-38-3				X

CERCLA

Component	Hazardous Substances RQs	CERCLA EHS RQs	RQ
XYLENE 1330-20-7	100 lb		RQ 100 lb final RQ RQ 45.4 kg final RQ
METHYL ISOBUTYL KETONE 108-10-1	5000 lb		RQ 5000 lb final RQ RQ 2270 kg final RQ
ETHYL BENZENE 100-41-4	1000 lb		RQ 1000 lb final RQ RQ 454 kg final RQ
BENZENE, 1,4-DIMETHYL 106-42-3	100 lb		RQ 100 lb final RQ RQ 45.4 kg final RQ
BENZENE, 1,3-DIMETHYL 108-38-3	1000 lb		RQ 1000 lb final RQ RQ 454 kg final RQ

United States of America

California Prop. 65
WARNING! This product contains a chemical known in the State of California to cause cancer

Component	California Prop. 65
METHYL ISOBUTYL KETONE - 108-10-1	Carcinogen Developmental
ETHYL BENZENE - 100-41-4	Carcinogen

California SCAQMD Rule 443
Contains Photochemically Reactive Solvent

State Right-to-Know

Component	New Jersey	Massachusetts	Pennsylvania
TALC (RESPIRABLE DUST) 14807-96-6	X	X	X
BARIUM SULFATE (TOTAL DUST) 7727-43-7	X	X	X

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XYLENE 1330-20-7	X	X	X
METHYL ISOBUTYL KETONE 108-10-1	X	X	X
1,2,4-TRIMETHYLBENZENE 95-63-6	X	X	X
ETHYL BENZENE 100-41-4	X	X	X
BENZENE, 1,4-DIMETHYL 106-42-3	X	X	X
BENZENE, 1,3-DIMETHYL 108-38-3	X	X	X

16. OTHER INFORMATION

NFPA   **Health** 2   **Flammability** 3   **Instability** 1   **Physical hazard** *
HMIS (Hazardous   **Health** 2*   **Flammability** 3   **Reactivity** 1
Material Information
System)

Prepared By   Tnemec Regulatory Dept: 816-474-3400
Revision Date   07-Aug-2015
Revision Summary
9 4 5 7 10 8 11 14
Disclaimer
For specific information regarding occupational safety and health standards, please refer to the Code of Federal Regulations, Title 29, Part 1910.
To the best of our knowledge, the information contained herein is accurate. However, neither the Tnemec Company or any of its subsidiaries assume any liability whatsoever for the accuracy of completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown health hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

End of SDS

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STATION SHIP LOOSE

Level Transducer:
    Type: Submersible
    Manufacturer: Blue Ribbon Corp.
    Description: Model BC001

Float Level Switches:
    Type: Non-Mercury, Suspension Mount, Weighted
    Manufacturer: Anchor Scientific
    Description: Model GSE30NO

Horn/Strobe:
    Type: 120V, Strobe/Horn w/ NEMA 4X Backbox
    Manufacturer: Edwards
    Description: Model 868STRR-N5

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BC001 Birdcage Installation Manual

Product Overview:
This manual is applicable for the BC001 Birdcage Submersible Level Transmitters.

If the product you have has a different prefix part number than listed above please contact the factory for the installation manual. The part number and/or serial number will help identify the exact product you have. Failure to identify the product you have before installation may cause permanent damage to the instrument and in most cases, void the manufacturer's warranty.

The Patented Birdcage design provides a Heavy Duty 316 SS Protective Stand-off Plate that protects the 3-1/2" Flush Diaphragm from debris floating in the media which could strike the diaphragm, causing damage.

Electrical Features:
The BC001 submersible level transmitters include Internal Voltage Surge Protection via a gas tube arrestor across the input power leads and Lightning Protection via a MOV (Metal Oxide Varistor) to ground which provides secondary protection and in some instances can react quicker when used in conjunction with the gas tube suppressor. Typically the MOV will discharge the initial buildup of the surge limiting the energy to the circuit.

Materials:
The BC001 submersible level transmitters utilize a silicon piezo-resistive sensor for accurate hydrostatic level measurement. The transmitters include corrosion resistant wetted parts of 316L stainless steel construction with either Polyurethane or Tefzel cable. The transmitters are designed to be submerged directly in the media being measured. Ensure that the transmitters are compatible with the media being measured before being submerged as failure to do so may cause catastrophic failure of the device and void the warranty.

Polyurethane and Tefzel cables are ~0.330" OD with multi-conductors. The internal wires are 22AWG with a drain / shield and 1/8" OD integral vent tube for barometric reference.

Standard Wiring

Wire Color	BC001
Red	+Excitation/Signal
Green	NC
White	NC
Black	-Excitation/Signal
Shield	Shield

The cable is fully shielded with the shield connected to the metal housing at the transducer end and terminated in an insulated wire at the termination end.

The integral vent tube includes a hydrophobic filter on the end to prevent moisture migration. For the most accurate performance of the unit, the cable should be terminated in a water tight box. See Care & Handling section for further instructions.

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BLUE RIBBON CORP.

BC001 Birdcage Installation Manual

The submersible level transmitters are calibrated at the factory per the range and output ordered. Standard units are not field adjustable. Units should perform as indicated on the Calibration Certificate and product label.

Installation:

The BC001 submersible level transmitters provide a linear output in relation to the depth / head pressure above the lowest point on the transmitter to the top of the media level.

The submersible level transmitters are designed to sit on the bottom of an application. The area between the flush diaphragm and the stand-off plate is approximately ¾" to allow solids to pass through. The weight of the Birdcage, in most instances, will prevent the transmitter from moving in turbulent flow. However, if the transmitter is mounted and elevated above the bottom of an application, a stilling well or perforated stand pipe may be utilized to reduce the possibility of movement if turbulent flow conditions are present. It is recommended to suspend the transmitters via an external support grip, not the cable itself.

An inexpensive way to support the transmitter is via the ½" NPT Male conduit connection. This comes standard on the Model BC001. A rigid metal or plastic pipe or ½" NPT Female conduit with 316 SS chain can then be attached to the transmitter before lowering into the media.

When lowering the transmitter into your media, avoid throwing or dropping the transmitter from an extreme height. The impact on the media surface could exert extreme pressure on the flush diaphragm, thus exceeding the maximum pressure rating. Such damage will void the warranty.

The cable attached to this instrument is specifically engineered for submersible applications. The standard polyurethane outer jacket provides long-term reliability under most conditions. The cable should be handled carefully as the jacket may be subject to damage if "raked" over sharp edges such as a well casing. Care also needs to be taken to prevent the cable from being crushed, which in turn may close the vent tube and cause the appearance of drift in the transmitters output. If your installation requires bending the cable, take care not to crimp the integral vent tube. Do not bend the cable more than a radius of 1 inch.

It is recommended that the cable be terminated in a water-tight junction box, using a water tight compression style fitting to secure the cable as it enters the junction box. Care needs to be taken to not over tighten the fitting as damage to the cable or integral vent tube could occur. Blue Ribbon also recommends the use of surge protection at the termination end of the cable, typically inside the junction box. This insures further protection of the transmitter and additional equipment on the line. Blue Ribbon also offers DIN rail mounted surge protection. Contact the factory for more information. Nothing is 100% effective, especially if hit with a direct lightning strike. If an area is prone to strikes using a combination of these options greatly reduces the risk of failure.

The end of the cable typically provides 2 signal wires, a ground wire and integral barometric reference vent tube. The shield should be terminated to a good earth ground. The vent tube is specially prepared at the factory to help eliminate moisture migration with a hydrophobic filter.   Every effort should be made to leave this vent tube filter intact. Should the cable be longer than is required, it is recommended that the excess length be accommodated in a service loop. If this is not possible, a replacement filter should be purchased from Blue Ribbon. This PN is: VT-PB and is installed in a similar fashion to shrink fit. **(Reference Fig. 1)**
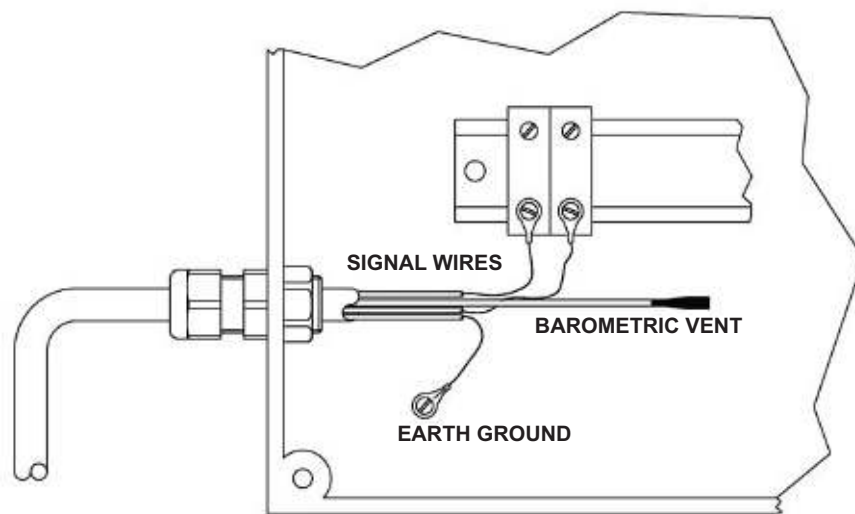
BLUE RIBBON CORP.

BC001 Birdcage Installation Manual

Fig. 1: Termination of the cable in a water tight enclosure or panel box.

Fig. 1

SIGNAL WIRES

BAROMETRIC VENT

EARTH GROUND

Power Supply:

The 4-20mA transmitters require a DC power supply, (typically 10-36 VDC) and mA meter wired in a current loop.

Connect the Red wire of the transducer to the + (positive) terminal of the power supply.
Connect the Black wire of the transducer to the + (positive) input terminal of the meter.
Connect the – (negative) input terminal of the meter to the – (negative) terminal of the power supply. (See the wiring chart in the beginning of the manual)

The VDC or mV/V transmitters require a DC power supply (10-36 VDC on the 0-5 VDC version and a regulated 5-15 VDC on the mV/V version) and VDC meter.

Connect the Red wire from the transducer to + (positive) on the power supply.
Connect the Green wire to the + (positive) signal of the VDC meter.
Connect the Black wire from the transducer to both the – (negative) Power on the power supply and – (negative) signal on the VDC meter.

BLUE RIBBON CORP.

BC001 Birdcage Installation Manual

Care & Handling

Insure that the media being measured is compatible with materials of construction.

The BC001 has a Heavy Duty 316 SS Protective Stand-off Plate. This provides protection to the flush diaphragm during installation, operation and handling. This protective plate should not be removed unless absolutely necessary. Doing so will expose the flush diaphragm which can be damaged if not handled properly.

If this transmitter becomes clogged during use, flush the end of the transmitter in a warm bucket of water to loosen the debris. A mild non-corrosive detergent may be used to soak the transmitter in to further loosen debris.

If this does not resolve the issue then carefully remove the Stand-off Plate. No sharp instruments should be used to scrape or brush the flush diaphragm as it will damage it. Repeat the above procedure of soaking the transmitter.

The Stand-off Plate should then be carefully reinstalled without striking the sensing diaphragm with any sharp or blunt object. Excessive pressure on the sensing diaphragm could also overpressure the transmitter.

Each submersible transmitter is supplied with a barometric vent tube which is integral to the cable. This vent tube is connected to the reference side of the sensor inside the housing. The other end is terminated outside the cable jacketing with a vent tube filter. This element helps prevent moisture migration into the vent tube. Care should be taken when installing the terminated end of the cable in a water tight enclosure, panel box or dry area outside the elements. A simple enclosure as shown previously in the manual will help protect this vent filter.

Care should be taken to insure the integral cable does not become cut or nicked during use or installation. Failure to do so may cause water intrusion into the cable and eventually failure of the transmitter.

In the event this breather element becomes damaged or torn off the vent tube, Blue Ribbon can supply a replacement element. Part No: VT-PB. Consult the factory for this part

If upon receipt of your device it is evident the cable supplied was not ordered to the correct length or if you wish to add more length, a simple solution is to provide a termination box where the vented cable from the transmitter can be spliced to any non-vented or vented cable. The termination box can be vented but not allow water to intrude. Never splice the cable and submerge under water. Blue Ribbon has found that an underwater splice is unreliable and prone to failure.

If the transmitter fails to respond or provide proper readings, a few simple trouble shooting techniques should be employed before sending the unit back to the factory or replacing.

If possible, isolate the transmitter from the reading device such as a panel meter or PLC. If possible use a different power supply and handheld multimeter that is capable of reading the 20mA or 5 VDC output.

BC001 Birdcage Installation Manual

This ensures that the transmitter is the culprit in question in the system. If the transmitter reads the proper output then the power supply, meter or PLC may be at fault.

If isolating the transmitter from the system still provides poor or no reading the transmitter should be removed from the system and visually inspected. If damage to the cable is found it is likely that water intrusion has occurred and the assembly cannot be repaired and a replacement unit must be purchased. If upon visual inspect all looks good a continuity check may be performed between the power or signal wires and the case of the transmitter. A reading between the signal or power wires and the case or shield /ground wire probably indicates a short by water intrusion or it may indicate a lightning strike has damaged the unit.

If the failure still is uncertain returning the transmitter to Blue Ribbon for analysis is recommended. Blue Ribbon requests that the transmitter be sanitized if in a sewage application and then sent back.

Please contact the factory first to obtain an RMA number. A request for RMA can also be found on our web site:

www.blueribboncorp.com.

If you have any further questions regarding installation, care and handling or trouble shooting please feel free to contact one of our application specialist to assist you.

2770 Long Road, Grand Island, NY 14072

Tel. (716) 773-9300 • Fax (716) 773-5019 • brsales@blueribboncorp.com • www.blueribboncorp.com

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Electronic Horn/Strobe Signal Appliance Installation Sheet

Description

The horn/strobes are high quality signals intended for use in cUL general signaling applications. The strobes flash at 1 fps across their full operating voltage range. See Table 1 for model numbers and "Specifications" for details.

Table 1: Models

Number	Description
867STR(*)-**	Horn/Strobe, Surface Mount Indoor, Gray
868STR(*)-**	Horn/Strobe, Surface Mount Outdoor, Gray
869STR(*)-**	Horn/Strobe, Flush or Panel Mount Indoor, Gray

* Insert lens color: C = Clear, R = Red, G = Green, B = Blue, A = Amber.

** The horns are available in two voltages. Insert suffix as required: N5 = 120 VAC, AQ = 24 V AC/DC

Installation

Install and wire this device in accordance with applicable national and local codes, ordinances, and regulations, and in a manner acceptable to the local authority having jurisdiction.

WARNINGS

- To reduce the risk of shock, do not connect AC or battery power to the horn until directed in these instructions.

- To reduce the risk of shock, do not tamper with this device when the signal circuit is energized. Disconnect all power and wait 5 minutes for stored energy to dissipate before handling.

1. Select a mounting method as detailed in Figure 1 and install the electrical box using suitable hardware.

   For outdoor applications, install the weatherproof box using four #10 × 1-1/4 (32 mm) screws and caplugs provided in the enclosed parts bag. Carefully adhere the gasket, part number P-007549-0082 (provided in the enclosed parts bag) to the box as shown in Figure 1.

   Notes

   - Be sure that the hook flange is facing outward as shown in Figure 1 (item 10).

   - The designation "TOP" on boxes denotes orientation of box after installation.

2. Attach the mounting plate using two #8-32 screws provided with the surface box or four #8-32 screws provided with weatherproof box. The flush box uses two #8-32 screws (not provided).

3. Bring the signaling circuit field wiring into the electrical box.

4. Connect signaling circuit field wires to terminals on horn/strobe assembly (Figure 2 through Figure 4).

5. Ground in accordance with national and local electrical codes. A green ground screw is provided with both the indoor and outdoor surface boxes.

6. Mount the horn/strobe on the mounting plate (Figure 1).

   a. The inside of the top of the grille has hinges that pass through cutouts and engage with tabs on the mounting plate. With the bottom of the grille lifted out slightly, place the grille over the mounting plate so that the hinges of the grille are in the mounting cutouts.

   b. Properly seat the grille by pressing the bottom in.

   c. Fasten the bottom of the grille to the mounting plate by installing the captive combination drive screw.

7. Apply power and activate the horn/strobe unit to verify that it is operating properly.

Maintenance

Caution: Should the unit fail to operate properly, do not attempt repair. Contact the supplier for replacement.

Perform a visual inspection and an operational test twice a year.

Specifications

|	N5 model	AQ model	
Operating voltage*	120 VAC 50/60 Hz	24 VAC 50/60 Hz	24 VDC
Operating current, horn**	33 mA	72 mA	22 mA
Operating current, strobe**	115 mA	390 mA	390 mA
Flash rate (per second)	Approximately 1 fps		
Sound level output at 10 ft. (3.05 m) anechoic chamber	90 dBA nominal		
Operating environment	Indoor: 93% at 90°F (32°C) relative humidity; 32 to 120°F (0 to 49°C) variable ambient temperature		
	Outdoor: 98% at 104°F (40°C) relative humidity; −31 to 150°F (−35°F to 66°C) variable ambient temperature		

* The operating voltage to the horn may be continuous or coded such as march time or a temporal pattern meeting ISO8201 (ANSI S3.41) Audible Emergency Evacuation Signal.

** Horn and strobe currents are additive when connected in parallel.

Models 867STR(*)-AQ, 868STR(*)-AQ and 869STR(*)-AQ potentially generate timing signals or pulses above 9 kHz and therefore have been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Figure 1: Detailed view
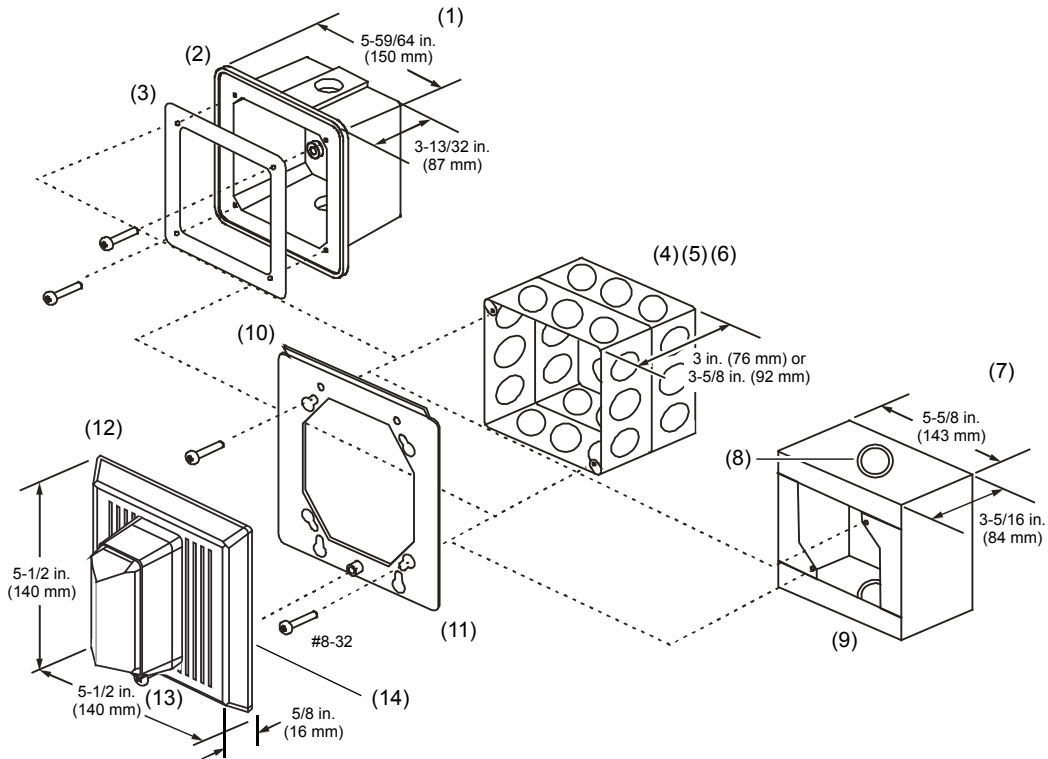
(1) Surface (outdoor)
(2) Weatherproof box
(3) Gasket
(4) Flush/Panel
(5) Standard North American 4 in. sq. × 1-1/2 in. deep electrical box (Universal #52171) with 1-1/2 in. (38 mm) deep extension ring (Universal #53151 or equivalent)
(6) CAUTION CANADA: If using Iberville (Commander) extension ring, use standard North American box with 2-1/8 in. (54 mm) deep extension ring (Universal #53171)

(7) Surface (indoor)
(8) Knockouts for 1/2 in. (13 mm) or 3/4 in. (19 mm) conduit; top, bottom, back
(9) Surface box
(10) Hook flange
(11) Mounting plate (supplied)
(12) Electronic horn/strobe
(13) Captive combination drive screw
(14) Terminal block (see Figure 4)
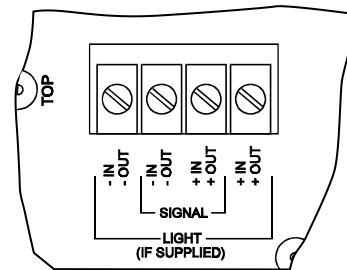
Figure 2: Wiring the horn and strobe on the same circuit
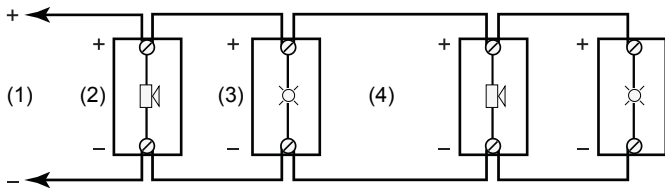
(1) Applicable voltage source
(2) Horn
(3) Strobe
(4) Polarity must be observed for units operating on VDC

Figure 3: Wiring the horn and strobe on different circuits
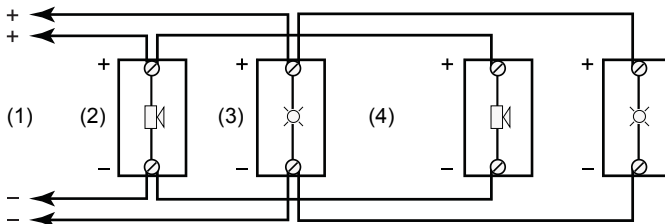
(1) Applicable voltage source
(2) Horn
(3) Strobe
(4) Polarity must be observed for units operating on VDC

Figure 4: Terminals

Regulatory information

Ratings	CAN/CSA C22.2 No. 205
	UL 464

Contact information

For contact information, see www.edwardsfiresafety.com

USEMCO INCORPORATED

USEMCO.

Warranty Certificate

USEMCO, Inc., Tomah, Wisconsin, manufacturer of the factory built pump station, guarantees the station to be free from defects in material and workmanship for a period of up to one year commencing from the date the pump station is placed into operation by USEMCO's authorized personnel, but in no event is the pump station guaranteed for longer than 18 months from date of invoice. This guarantee is contingent upon start up by USEMCO's authorized personnel and shall become void if start up is performed by anyone else.

USEMCO will be a single source of responsibility to the owner for the guarantee of the pump station and components provided by USEMCO. During the guarantee period, if any part is defective or fails to perform as specified when operating at design conditions and if station has been protected prior to start up and has been installed, operated and maintained in accordance with the written instructions provided by USEMCO, USEMCO shall exchange free of charge a replacement for the defective part. The owner shall return the defective part, if so requested.

During the guarantee period, USEMCO will provide without charge such labor as may be required to replace, repair or modify the following major components only: The pumps, pump motors, the structure, flowmeter, valves and cast iron piping. Labor costs or other expenses resulting from the replacement of defective parts or from the installation of parts other than those listed above shall be at the expense of the owner.

USEMCO shall not assume responsibility for the cost of any repairs or alterations to the pump station structure or its components.

The replacement of parts normally consumed in service such as pump shaft seals, light bulbs, grease, oil, packing, etc., items considered as part of routine maintenance are not eligible for free of charge replacements under this warranty.

USEMCO makes no other warranty either expressed or implied and is not responsible for contingent liability or consequential damages of any nature resulting from defects in design, materials, workmanship, or delays in delivery, replacement or otherwise.