

## Pump Performance Datasheet

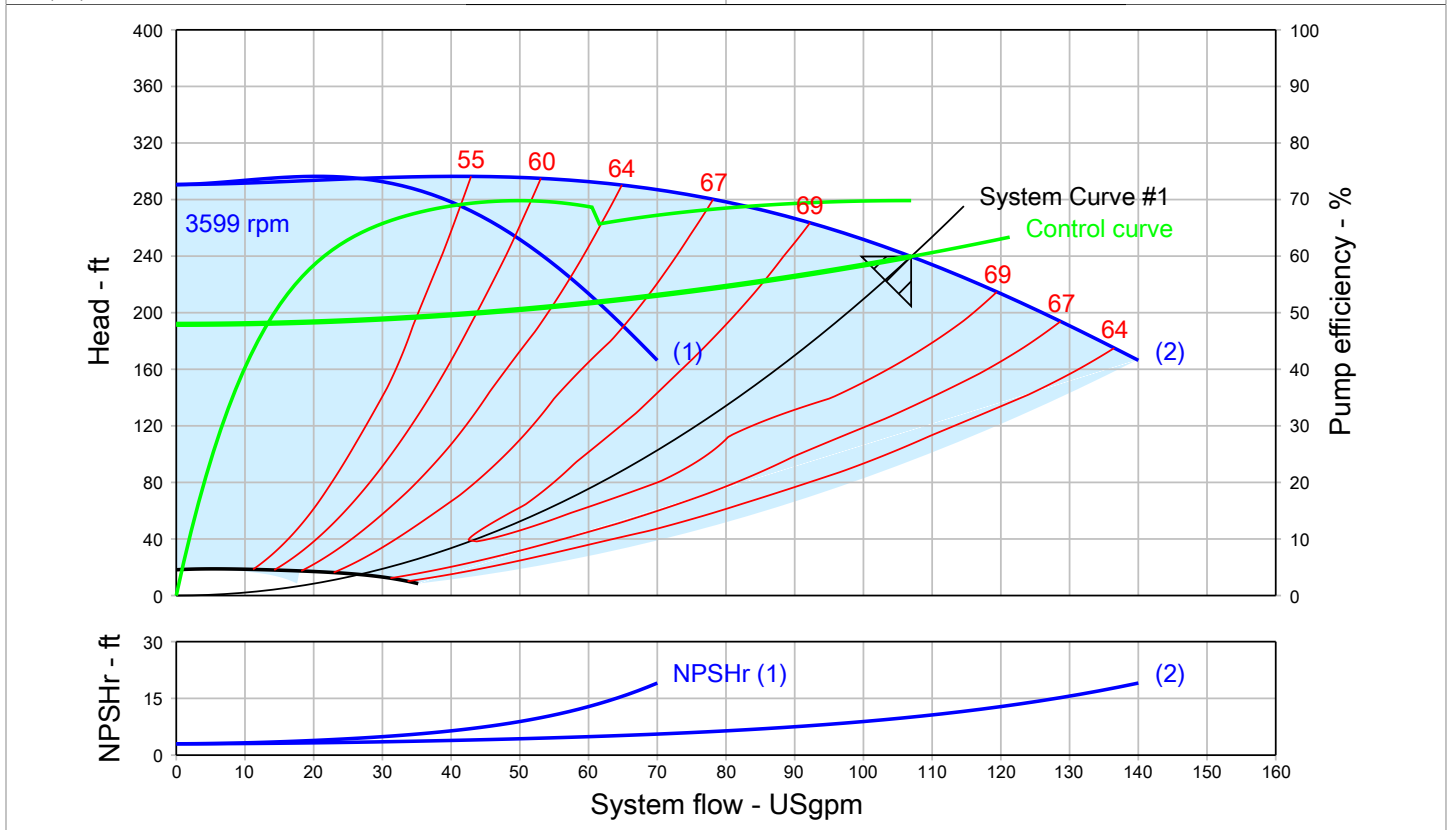
|  |                         |                              |
|--|-------------------------|------------------------------|
| Customer :                               | Quote Number / ID :     | 1471203                      |
| Customer ref. / PO :                     | Model :                 | Hydro MPC-E 2CRE 10-6 3x208V |
| Tag Number : 001                         |                         | 60Hz                         |
| Service :                                | Part Number :           | 99863842                     |
| Quantity : 1                             | Stages :                | 5                            |
| Quantity of pumps : 2 active + 0 standby | Based on curve number : | RC10410                      |
|  | Date last saved :       | 05/13/2022 2:24 PM           |

| Operating Conditions                            |                     | Liquid                        |                    |
|---|---------------------|-------------------------------|--------------------|
| System flowrate                                 | : 106.9 USgpm       | Liquid type                   | : Cold Water       |
| Flowrate per pump                               | : 53.47 USgpm       | Additional liquid description | :                  |
| Differential head / pressure, rated (requested) | : 239.7 ft          | Temperature, max              | : 68.00 deg F      |
| Differential head / pressure, rated (actual)    | : 239.7 ft          | Fluid density, rated / max    | : 1.000 / 1.000 SG |
| Suction pressure, min / max                     | : 0.00 / 0.00 psi.g | Viscosity, rated              | : 1.00 cP          |
| NPSH available, rated                           | : Ample             | Vapor pressure, rated         | : 0.34 psi.a       |
| Site Supply Frequency                           | : 60 Hz             |                               |                    |
| Power Supply                                    | : 3ph 208V          |                               |                    |

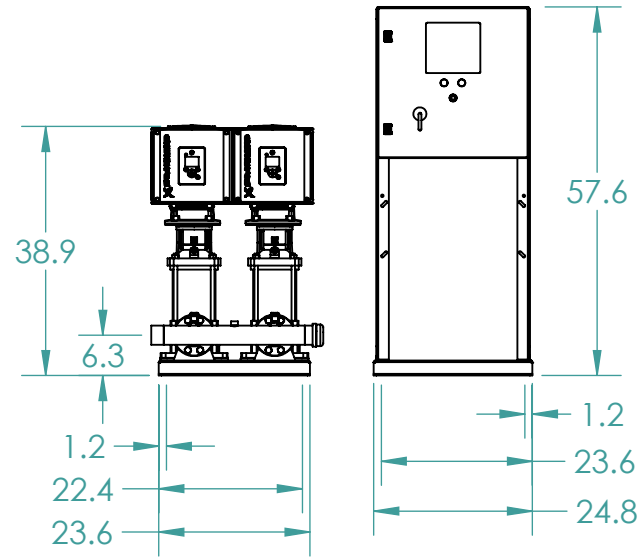
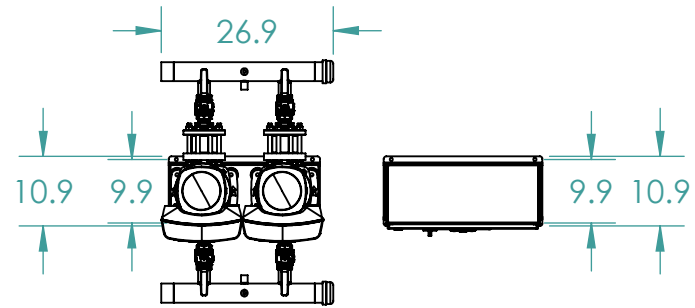
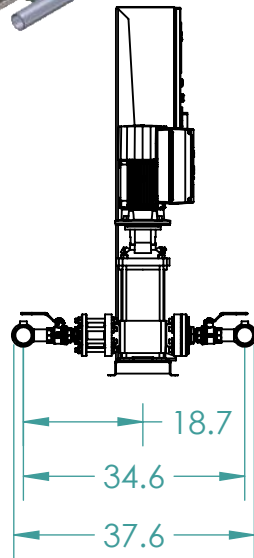
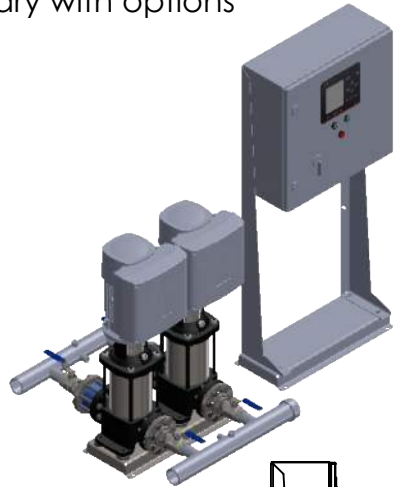
| Performance     |            | Material          |  |
|-----------------|------------|-------------------|--|
| Speed, rated    | : 3599 rpm | Material selected | : Standard - Cast Iron / 304 Stainless Steel |
| Speed, maximum  | : 3599 rpm |                   |  |
| Speed, minimum  | : 902 rpm  |                   |  |
| Pump efficiency | : 69.81 %  |                   |  |

| Performance                            |                             | Pressure Data                      |               |
|--|-----------------------------|------------------------------------|---------------|
| NPSH required / margin required        | : 10.05 / 0.00 ft           | Pump shut off pressure             | : 128.3 psi.g |
| nq (imp. eye flow) / S (imp. eye flow) | : 28 / 90 Metric units      | Maximum allowable suction pressure | : 217.6 psi.g |
| Head maximum, rated speed              | : 296.4 ft                  |                                    |               |
| Head rise to shutoff                   | : 21.22 %                   |                                    |               |
| Flow, best eff. point                  | : 53.47 USgpm               |                                    |               |
| Flow ratio, rated / BEP                | : 100.00 %                  |                                    |               |
| Speed ratio (rated / max)              | : 100.00 %                  |                                    |               |
| Head ratio (rated speed / max speed)   | : 100.00 %                  |                                    |               |
| Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]       | : 1.00 / 1.00 / 1.00 / 1.00 |                                    |               |
| Selection status                       | : Acceptable                |                                    |               |

| Energy Indexes |        |
|----------------|--------|
| PEI (VL)       | : 0.41 |
| ER (VL)        | : 59   |



1. Manifolds 2.5" NPT Class 150 AISI 316SS Schedule 10s ASTM A312 or  $\phi 76.1\text{mm} \times 2\text{mm}$
  2. Base/Frame AISI 304SS
  3. Standard system layout : panel right facing suction
  4. Full port ball valve ASTM
  5. UL Type 3R/12 rated electrical panel
- Note: panel size will vary with options



**Ball Valves**

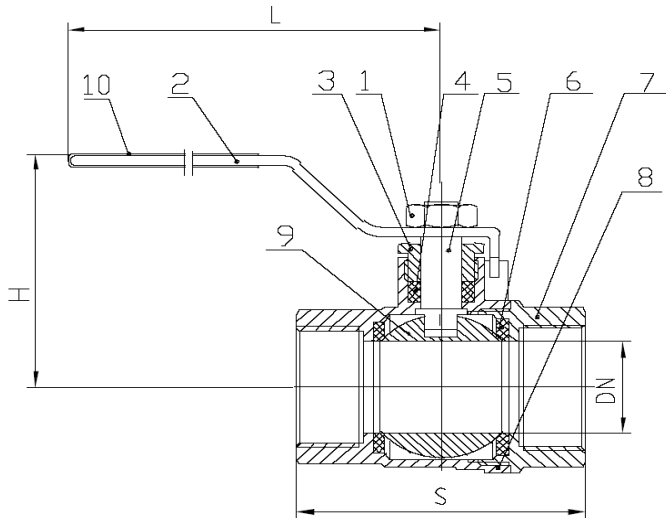


**General**

- Threaded Ends
- Blow Out Proof Stem
- 600 WOG
- 2-Piece Body
- Teflon Seats
- Teflon Packing

**Dimensions & Weights**

| Size   | DN (in) | S (in) | H (in) | L (in) | WT. (lb) |
|--------|---------|--------|--------|--------|----------|
| 1/4"   | 0.39    | 1.76   | 1.75   | 3.54   | 0.35     |
| 3/4"   | 0.75    | 2.50   | 2.18   | 3.94   | 0.79     |
| 1-1/4" | 1.26    | 3.42   | 2.87   | 4.80   | 1.75     |
| 1-1/2" | 1.57    | 3.76   | 3.48   | 5.91   | 2.47     |
| 2"     | 1.97    | 4.25   | 3.82   | 5.91   | 3.46     |

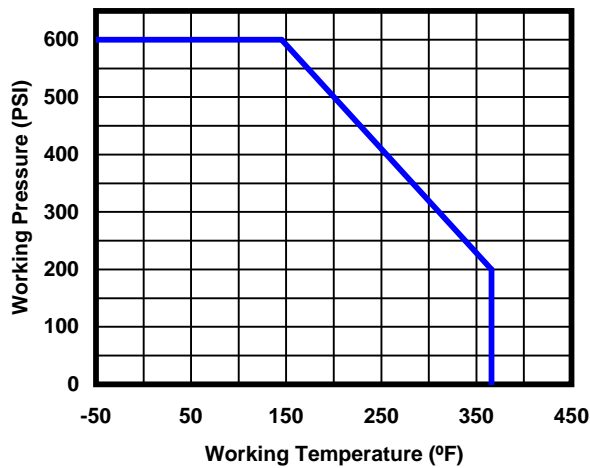


**MATERIAL SPECIFICATIONS**

| NO. | PART      | MATERIAL (ASTM)          |
|-----|-----------|--------------------------|
| 1   | NUT       | ZINC PLATED STEEL        |
| 2   | HANDLE    | ZINC PLATED STEEL        |
| 3   | BONNET    | BRASS (C37000)           |
| 4   | PACKING   | TEFLON                   |
| 5   | STEM      | BRASS (C37000)           |
| 6   | BALL SEAT | TEFLON                   |
| 7   | END PIECE | LOW LEAD BRASS (LTN60-6) |
| 8   | BODY      | LOW LEAD BRASS (LTN60-6) |
| 9   | BALL      | LOW LEAD BRASS (LTN60-6) |
| 10  | SLEEVE    | PVC                      |

**APPROVALS**

- NSF 61, IAPMO - N4359
- AB1953, IAPMO - 5653

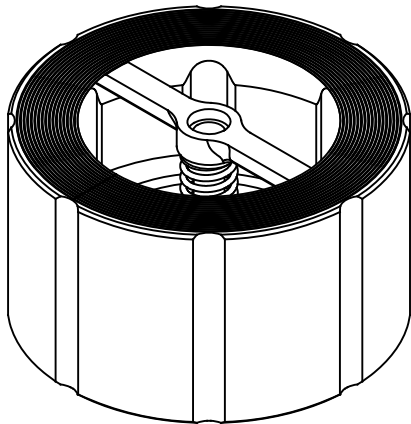
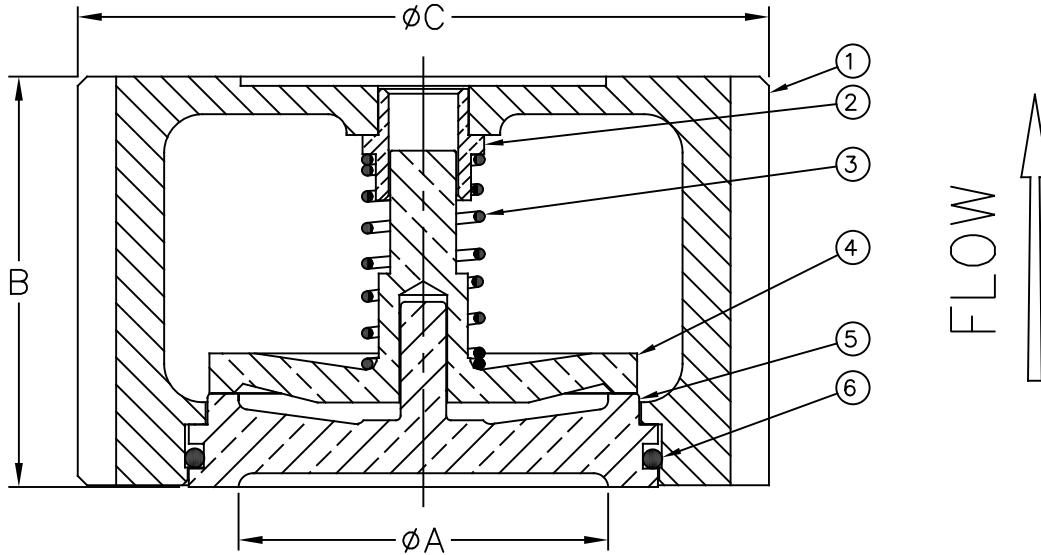


# Wafer Check Valve    Silent Check    Model 888

Sizes 2", 3" , 4" & 5" / 50 mm, 80mm, 100mm & 125 mm



## Materials (Ductile Iron Body)



| Item # | Qty | Description         | Material        | ASTM          |
|--------|-----|---------------------|-----------------|---------------|
| 1      | 1   | Body (Epoxy Coated) | Ductile Iron    | A536 65-45-12 |
| 2      | 1   | Bushing             | Bronze          | C95400        |
| 3      | 1   | Spring              | Stainless Steel | 302           |
| 4      | 1   | Poppet              | Silicon Brass   | C87800        |
| 5      | 1   | Seat Ring*          | Silicon Brass   | C87800        |
| 6      | 1   | O'Ring              | EPDM            | 5778-70       |

\*OPTIONAL RESILIENT SEAT AVAILABLE, ADD "R" TO THE PART NUMBER  
 Max Temp 250°F (121°C)  
 Max Inlet Pressure @ 150° F (65°C) 150# 300 psi (21bar)  
 Max Inlet Pressure @ 150° F (65°C) 300# 500 psi (34bar)  
 5" VALVE IS NOT NSF APPROVED  
 PATENT # 6,024,121

## Dimensions

| Size |     | Part # | A       |     | B     |     | C     |     | Weight |      | # of Bolts |      | Bolt Size by Flange |             |
|------|-----|--------|---------|-----|-------|-----|-------|-----|--------|------|------------|------|---------------------|-------------|
| inch | mm  |        | inch    | mm  | inch  | mm  | inch  | mm  | lbs    | kg   | 150#       | 300# | 150#                | 300#        |
| 2    | 50  | 2434   | 2-13/32 | 61  | 2-5/8 | 67  | 4-1/4 | 108 | 5      | 2.5  | 4          | 8    | 5/8 x 5-1/4         | 5/8 x 5-1/2 |
| 3    | 80  | 2435   | 3-1/4   | 83  | 3-1/8 | 79  | 5-3/4 | 146 | 11     | 5    | 4          | 8    | 5/8 x 6-1/4         | 3/4 x 7     |
| 4    | 100 | 2436   | 4-3/8   | 111 | 4     | 102 | 7     | 178 | 18     | 8    | 8          | 8    | 5/8 x 7             | 3/4 x 8     |
| 5    | 125 | 2433   | 5-1/4   | 133 | 4-3/4 | 121 | 8-3/8 | 213 | 25     | 11.5 | 8          | 8    | 3/4 x 7-3/4         | 3/4 x 9     |

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April 4, 1995  
 Dwg No: S888-1 Rev W (7/19)

FLOMATIC CORPORATION  
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 FAX (518) 761-9798

# Silent Check Valve

# Seating Detail

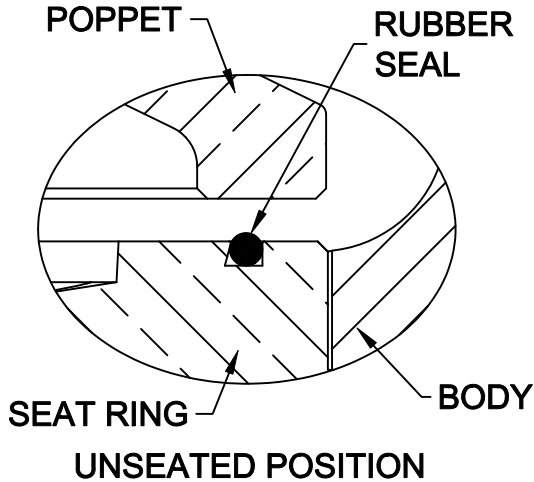


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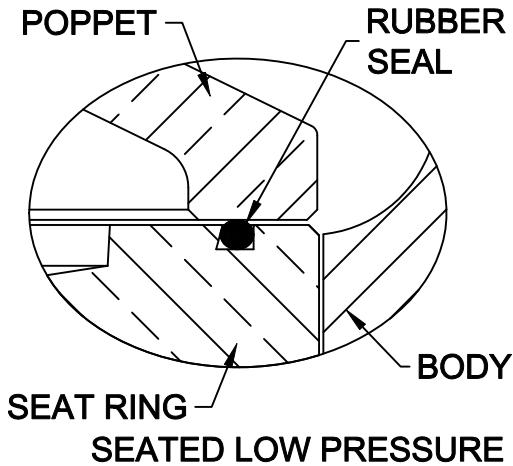
Models 888R,STR,S6R & 402BTR,STR, S6R



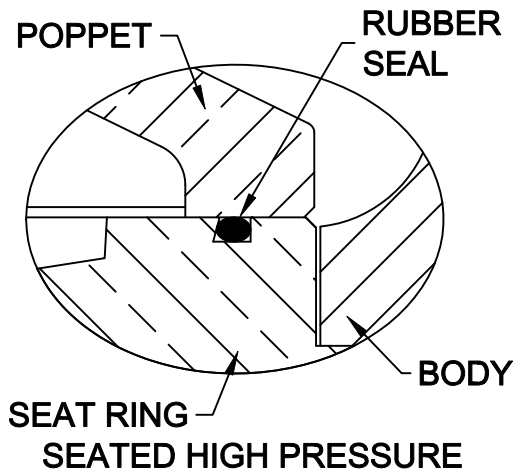
## Materials



PROVIDES DRIP-TIGHT SEATING AT LOW PRESSURES WITHOUT DAMAGE TO SEAL AT HIGHER PRESSURES.



THE UNIQUE SEATING ACTION STARTS WITH INITIAL CONTACT BETWEEN THE POPPET AND SEAL. AS PRESSURE INCREASES, THE SEAL IS COMPRESSED AND ALLOWS THE POPPET TO MAKE CONTACT WITH THE SEAT RING. THIS PREVENTS ANY FURTHER COMPRESSION OF THE SEAL.



THE SEATING ACTION PROVIDES BOTH, DRIP-TIGHT SEATING AT LOW PRESSURE AND METAL-TO-METAL SEATING WITH SEAL SUPPORT FOR HIGHER PRESSURES.

EPDM SEAL  
Patent # 6,024,121

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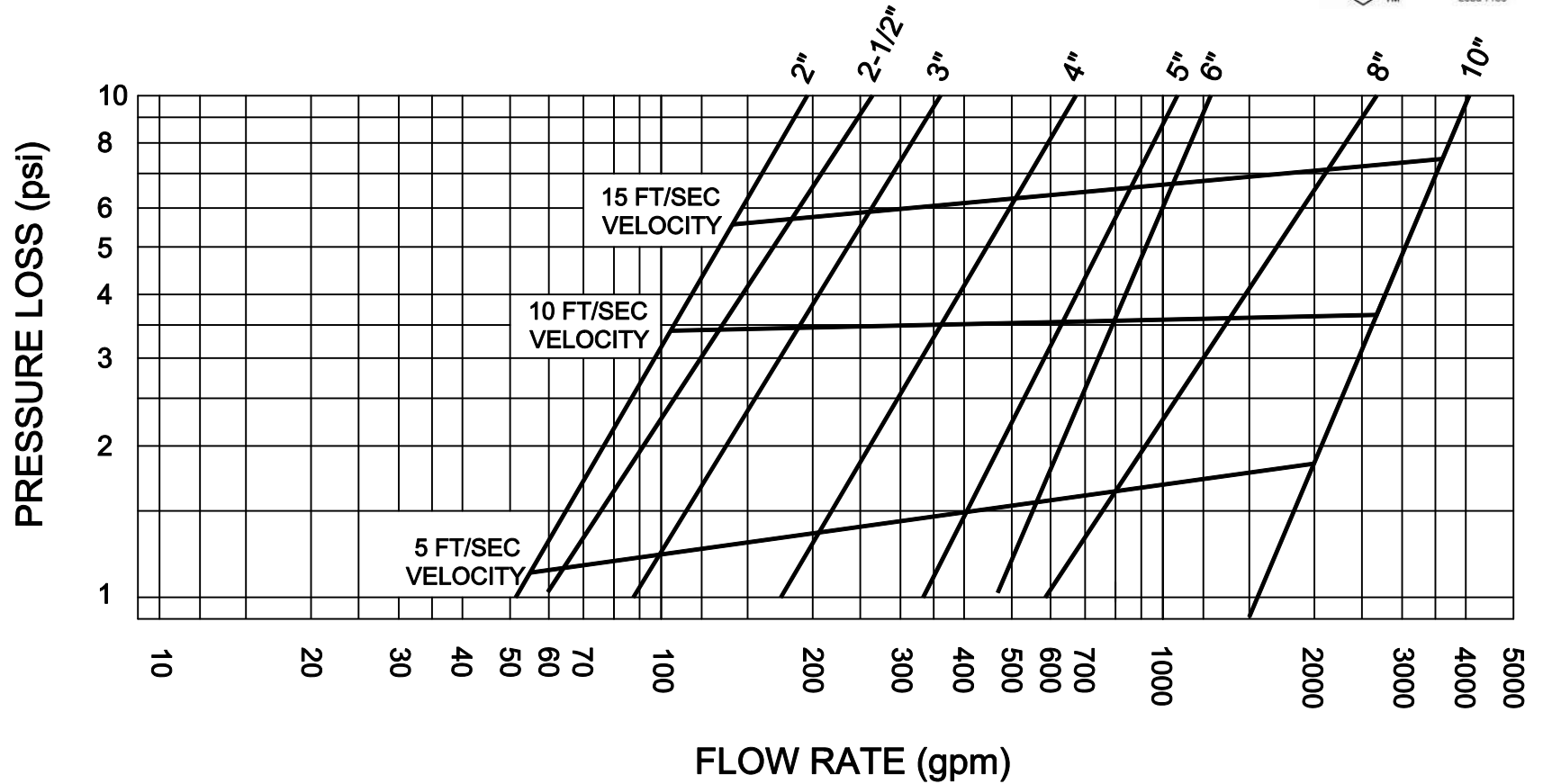
# Wafer Check Valve

# Headloss Chart

# Model 888/888R



Sizes 2" thru 10"/ 50 mm thru 250 mm



PATENT # 6,024,121

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Dwg No: S888HL Rev: E (6/13)

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# D80 Series

Dry or Liquid Filled • Stainless Steel Case

UTILITY GAUGES



D82LFB shown



Standard

Optional

- ▶ 1 1/2", 2", 2 1/2", 4" Dial Sizes
- ▶ ±1.6% Accuracy (1% Optional)
- ▶ Stainless Steel Case
- ▶ Glycerine Fill Standard

The Trerice **D80 Series** Industrial Gauge is designed for rugged performance requirements at an economical cost. This liquid filled gauge is furnished with a stainless steel case and crimped ring. Wetted parts are either bronze tube with Lead-Free (PBF) brass socket or stainless steel.

- **Optional features and case style variations available: Please consult the Options & Accessories Section for details.**
- **For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.**

## Specifications

| Models                         | Wetted Parts   |
|--------------------------------|--|
| <b>D82B</b> (dry)              | Bronze tube, brass socket                                      |
| <b>D82LFB</b> (liquid filled)  | Lead-Free (PBF) Meets NSF/ANSI Standards 372 and 61            |
| <b>D83SS</b> (dry)             | 316 Stainless steel tube & socket                              |
| <b>D83LFSS</b> (liquid filled) |  |
| <b>Dial Sizes</b>              | 1 1/2", 2", 2 1/2", 4"   |
| <b>Fill</b>                    | Glycerine, other fills available See Optional Features Section |
| <b>Movement</b>                | <b>D82:</b> Brass<br><b>D83:</b> 316 Stainless steel           |
| <b>Connection</b>              | Lower male or center back male, (Lower back male 4" Dial only) |
| <b>Case</b>                    | 304 stainless steel, stem-mounted flangeless                   |
| <b>Ring</b>                    | Crimped 304 stainless steel                                    |
| <b>Window</b>                  | Acrylic  |
| <b>Pointer</b>                 | Plain, black finished  |
| <b>Dial Face</b>               | Aluminum, white background with black graduations and markings |
| <b>Accuracy</b>                | ±1.6% Full Scale (1% available as an option)                   |
| <b>Maximum Temperature</b>     | <b>150°F (65°C)</b>  |

### Approximate Shipping Weight

- 1 1/2" Dial Size: 0.4 lbs [0.18 kg]
- 2" Dial Size: 0.4 lbs [0.18 kg]
- 2 1/2" Dial Size: 0.5 lbs [0.23 kg]
- 4" Dial Size: 1.0 lbs [0.45 kg]

## HOW TO ORDER

Sample Order Number: **D82LFB 25 02 L A 110**

| Model          | Dial Size | Connection Size | Connection Location | Units of Measure | Range Code          |
|----------------|-----------|-----------------|---------------------|------------------|---------------------|
| <b>D82LFB</b>  | 15 1 1/2" | 01 1/8 NPT*     | <b>L</b> Lower      | <b>A</b> psi     | See Standard Ranges |
| <b>D83LFSS</b> | 20 2"     | 02 1/4 NPT**    | <b>B</b> Back       | <b>D</b> psi/kPa |                     |
| <b>D82B</b>    | 25 2 1/2" | 04 1/2 NPT***   |                     |                  |                     |
| <b>D83SS</b>   | 40 4"     |                 |                     |                  |                     |

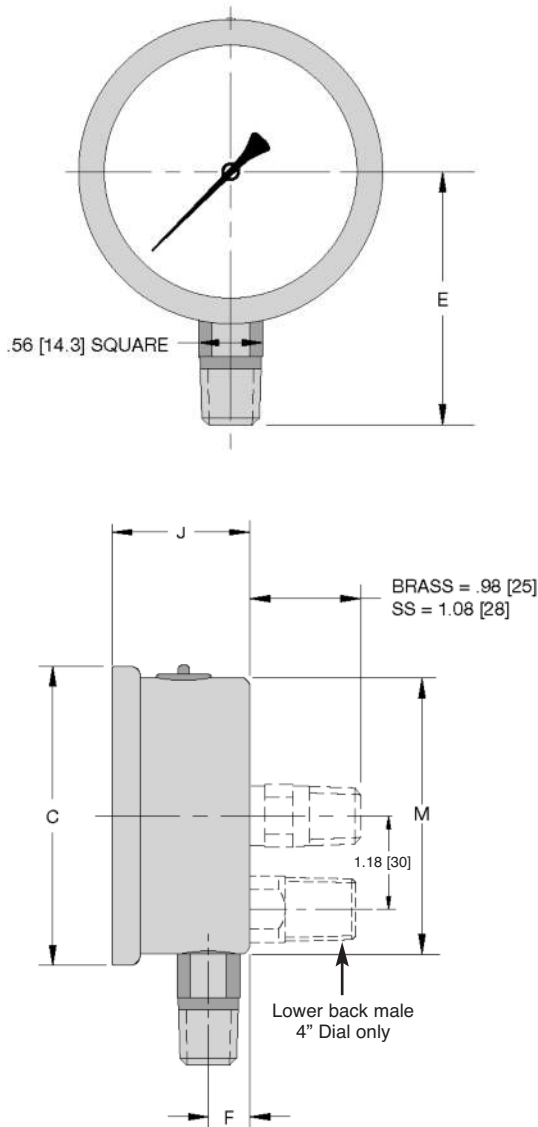
- \* 1/8 NPT connection size not available with 4" dial size.
- \*\* 1/4 NPT connection size not available with 1 1/2" dial size.
- \*\*\* 1/2 NPT connection size only available with 4" dial size.

# D80 Series

Dry or Liquid Filled • Stainless Steel Case

All dimensions are nominal. Dimensions in [ ] are in millimeters.

UTILITY GAUGES



## Standard Ranges

| psi Ranges (A) |                      | D82              |                 | D83              |                 |
|----------------|----------------------|------------------|-----------------|------------------|-----------------|
| Range Code     | Specific Range (psi) | Figure Intervals | Minor Divisions | Figure Intervals | Minor Divisions |
| 010            | 30" Hg to 0          | 5                | 0.5             | 5                | 0.5             |
| 020            | 30" Hg to 15 psi     | 10/5             | 1/0.5           | 10/5             | 1/0.5           |
| 030            | 30" Hg to 30 psi     | 10/5             | 1/1             | 10/5             | 1/1             |
| 040            | 30" Hg to 60 psi     | 10/10            | 2/1             | 10/10            | 2/1             |
| 050            | 30" Hg to 100 psi    | 30/20            | 2/2             | 30/20            | 2/2             |
| 060            | 30" Hg to 150 psi    | 30/30            | 5/2             | 30/30            | 5/2             |
| 070            | 30" Hg to 300 psi    | 30/50            | 5/5             | 30/50            | 5/5             |
| 080            | 0 to 15 psi          | 3                | 0.2             | 3                | 0.2             |
| 090            | 0 to 30 psi          | 5                | 0.5             | 5                | 0.5             |
| 100            | 0 to 60 psi          | 10               | 1               | 10               | 1               |
| 110            | 0 to 100 psi         | 10               | 1               | 10               | 1               |
| 120            | 0 to 160 psi         | 20               | 2               | 20               | 2               |
| 130            | 0 to 200 psi         | 20               | 2               | 20               | 2               |
| 140            | 0 to 300 psi         | 50               | 5               | 50               | 5               |
| 150            | 0 to 400 psi         | 50               | 5               | 50               | 5               |
| 160            | 0 to 600 psi         | 100              | 10              | 100              | 10              |
| 180            | 0 to 1000 psi        | 100              | 20              | 100              | 20              |
| 190            | 0 to 1500 psi        | 300              | 20              | 300              | 20              |
| 200            | 0 to 2000 psi        | 200              | 20              | 200              | 20              |
| 210            | 0 to 3000 psi        | 500              | 50              | 500              | 50              |
| 220            | 0 to 5000 psi        | 1000             | 100             | 1000             | 100             |

Ranges over 5000 PSI are not available on D82LFB.

|     |                |     |     |      |     |
|-----|----------------|-----|-----|------|-----|
| 230 | 0 to 10000 psi | N/A | N/A | 2000 | 200 |
| 240 | 0 to 15000 psi | N/A | N/A | 3000 | 200 |

For dual scale ranges specify the appropriate **Units of Measure: D** (psi/kPa) followed by the corresponding **A** (psi) **Range Code**

| Dial Size  | C          | E          | F         | J         | M          |
|------------|------------|------------|-----------|-----------|------------|
| 1 1/2" D82 | 1.85 [47]  | 1.50 [38]  | 0.32 [8]  | 1.06 [27] | 1.61 [41]  |
| 1 1/2" D83 | 1.85 [47]  | 1.50 [38]  | 0.32 [8]  | 1.06 [27] | 1.61 [41]  |
| 2" D82     | 2.28 [58]  | 1.89 [48]  | 0.39 [10] | 1.14 [29] | 2.05 [52]  |
| 2" D83     | 2.28 [58]  | 2.05 [52]  | 0.35 [9]  | 1.18 [30] | 2.05 [52]  |
| 2 1/2" D82 | 2.68 [68]  | 2.24 [57]  | 0.39 [10] | 1.18 [30] | 2.44 [62]  |
| 2 1/2" D83 | 2.68 [68]  | 2.32 [59]  | 0.51 [13] | 1.38 [35] | 2.44 [62]  |
| 4" D82     | 4.29 [109] | 3.07 [78]  | 0.47 [12] | 1.42 [36] | 3.90 [99]  |
| 4" D83     | 4.29 [109] | 3.94 [100] | 0.75 [19] | 1.93 [49] | 3.94 [100] |



# Data sheet

# MBS 3000 pressure transmitter for industrial applications

## Introduction

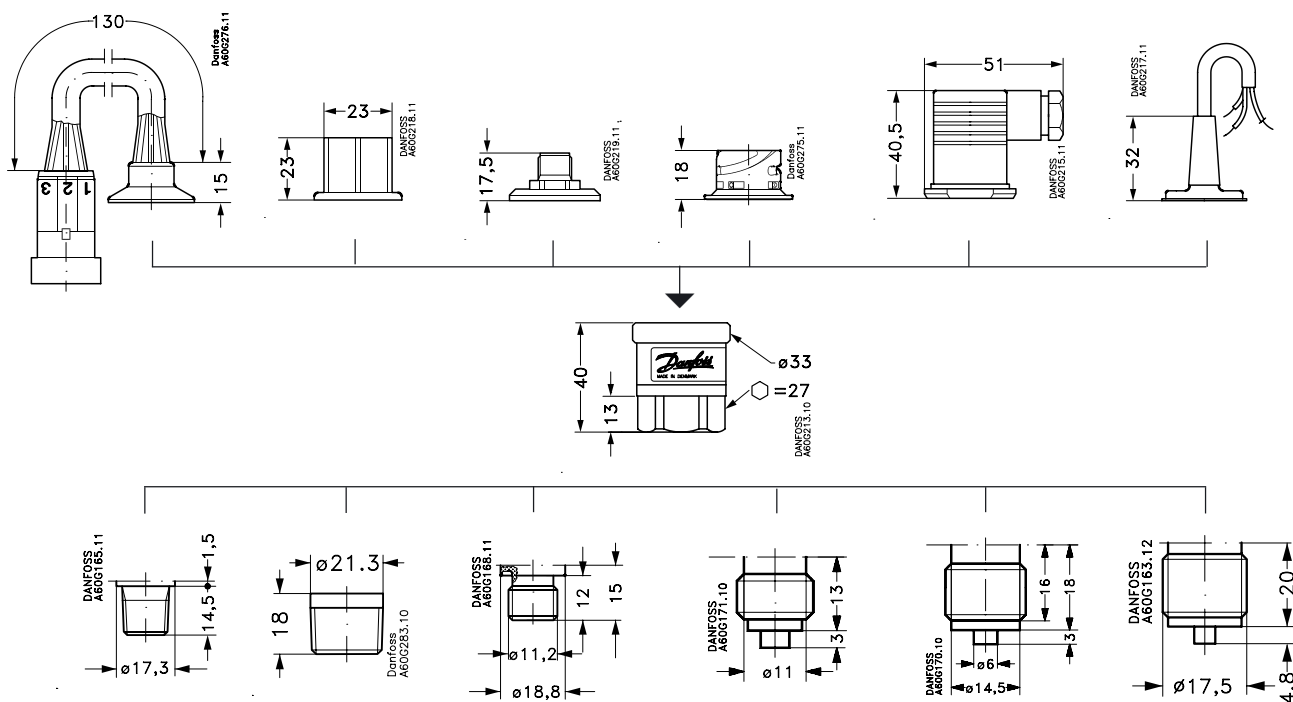


- Designed for use in severe industrial environments
- Enclosure and wetted parts of acid-resistant stainless steel (AISI 316L)
- All standard output signals: 4-20 mA, 0-5 V, 1-5 V, 1-6 V, 0-10 V
- A wide range of pressure and electrical connections
- Temperature compensated and laser calibrated
- Typical applications:
  - Pumps
  - Compressors
  - Pneumatics
  - Water treatment

## Dimensions

### Ordering

|                     |                                    |                                  |                             |                                       |                 |                    |
|---------------------|------------------------------------|----------------------------------|-----------------------------|---------------------------------------|-----------------|--------------------|
| Type code<br>Page 4 | 8                                  | 2                                | 5                           | 7                                     | 1               | 3                  |
|                     | AMP Superseal<br>1.5 series (male) | AMP Econoseal<br>J series (male) | IEC 947-5-2<br>M12x1, 4-pin | ISO 15170-A1-3.2-Sn<br>(Bayonet plug) | DIN 43650, Pg 9 | 2 m screened cable |



### Ordering

|                     |              |              |   |                     |                     |                     |
|---------------------|--------------|--------------|---|---------------------|---------------------|---------------------|
|                     | 1/4 - 18 NPT | 1/2 - 14 NPT | DIN 3852-E-G1/4<br>Gasket:<br>DIN 3869-14 | G 1/4 A<br>(EN 837) | G 3/8 A<br>(EN 837) | G 1/2 A<br>(EN 837) |
| Type code<br>page 4 | AC04         | AC08         | GB04                                      | AB04                | AB06                | AB08                |

Technical data

Main specifications

|                        |             |               |               |              |              |               |               |       |
|------------------------|-------------|---------------|---------------|--------------|--------------|---------------|---------------|-------|
| Pressure connections   | see page 1  |               |               |              |              |               |               |       |
| Measuring ranges [bar] | 0-1<br>0-25 | 0-1.6<br>0-40 | 0-2.5<br>0-60 | 0-4<br>0-100 | 0-6<br>0-160 | 0-10<br>0-250 | 0-16<br>0-400 | 0-600 |
| Output signals         | 4-20 mA     | 0-5 V         | 1-5 V         | 1-6 V        | 0-10 V       |               |               |       |
| Electrical connections | see page 3  |               |               |              |              |               |               |       |

Performance (IEC 770)

|  |  |
|--|--|
| Accuracy                               | ±0.5% FS (typ.)<br>±1% FS (max.)               |
| Non-linearity (best fit straight line) | ≤ ±0.5% FS                                     |
| Hysteresis and repeatability           | ≤ ±0.1% FS                                     |
| Thermal zero point shift               | ≤ ±0.1% FS/10K (typ.)<br>≤ ±0.2% FS/10K (max.) |
| Thermal sensitivity (span) shift       | ≤ ±0.1% FS/10K (typ.)<br>≤ ±0.2% FS/10K (max.) |
| Response time                          | < 4 ms   |
| Overload pressure                      | 6 × FS (max. 1500 bar)                         |
| Burst pressure                         | 6 × FS (max. 2000 bar)                         |
| Durability, P: 10-90% FS               | >10×10 <sup>6</sup> cycles                     |

Electrical specifications

|  | Nom. output signal (short-circuit protected) |                        |                        |
|--|--|------------------------|------------------------|
|  | 4 – 20 mA                                    | 0-5, 1-5, 1-6 V d.c.   | 0-10 V d.c.            |
| Supply voltage [U <sub>B</sub> ], polarity protected     | 9 → 32 V d.c.                                | 9 → 30 V d.c.          | 15 → 30 V d.c.         |
| Supply - current consumption                             | -  | ≤ 5 mA                 | ≤ 8 mA                 |
| Supply voltage dependency                                | ≤ ±0.05% FS/10 V                             |                        |                        |
| Current limitation (linear output up to 1.5x nom. range) | 34 mA (typ.)                                 | -                      |                        |
| Output impedance   | -  | ≤ 25Ω                  |                        |
| Load [R <sub>L</sub> ] (load connected to 0V)            | R <sub>L</sub> ≤ (U <sub>B</sub> -9V)/0.02   | R <sub>L</sub> ≥ 10 kΩ | R <sub>L</sub> ≥ 15 kΩ |

Environmental conditions

|  |                         |                                     |  |              |
|--|-------------------------|-------------------------------------|--|--------------|
| Medium temperature range                                       | -40 → +85°C             |                                     |  |              |
| Ambient temperature range (depending on electrical connection) | see page 3              |                                     |  |              |
| Compensated temperature range                                  | 0 → +80°C               |                                     |  |              |
| Transport temperature range                                    | -50 → +85°C             |                                     |  |              |
| EMC - Emission   | EN 61000-6-3            |                                     |  |              |
| EMC - Immunity   | Electrostatic discharge | Air mode                            | 8 kV                                   | EN 61000-6-2 |
|  |                         | Contact mode                        | 4 kV                                   | EN 61000-6-2 |
|  | RF field                | conducted                           | 10 V/m, 26 MHz - 1 GHz                 | EN 61000-6-2 |
|  |                         | radiated                            | 10 V <sub>rms</sub> , 150 kHz - 30 MHz | EN 61000-6-2 |
|  | Transient               | burst                               | 4 kV (CM), Clamp                       | EN 61000-6-2 |
| surge  |                         | 1 kV (CM,DM), Rg = 42Ω              | EN 61000-6-2                           |              |
| Insulation resistance  | > 100 MΩ at 100 V d.c.  |                                     |  |              |
| Mains frequency test   | 500 V, 50 Hz            |                                     | SEN 361503                             |              |
| Vibration stability  | Sinusoidal              | 15.9 mm-pp, 5Hz-25Hz                | IEC 60068-2-6                          |              |
|  |                         | 20 g, 25 Hz - 2 kHz                 |  |              |
| Shock resistance   | Random                  | 7.5 g <sub>rms</sub> , 5 Hz - 1 kHz | IEC 60068-2-34, IEC 60068-2-36         |              |
|  | Shock                   | 500 g / 1 ms                        | IEC 60068-2-27                         |              |
| Enclosure (depending on electrical connection)                 | Free fall               |                                     | IEC 60068-2-32                         |              |
|  | see page 3              |                                     |  |              |

Mechanical characteristics

|   |                        |                               |
|---|------------------------|-------------------------------|
| Materials   | Wetted parts           | DIN 17440-1.4404 (AISI 316 L) |
|   | Enclosure              | DIN 17440-1.4404 (AISI 316 L) |
|   | Electrical connections | see page 3                    |
| Weight (depending on pressure connection and electrical connection) | 0.2-0.3 kg             |                               |

Electrical connections

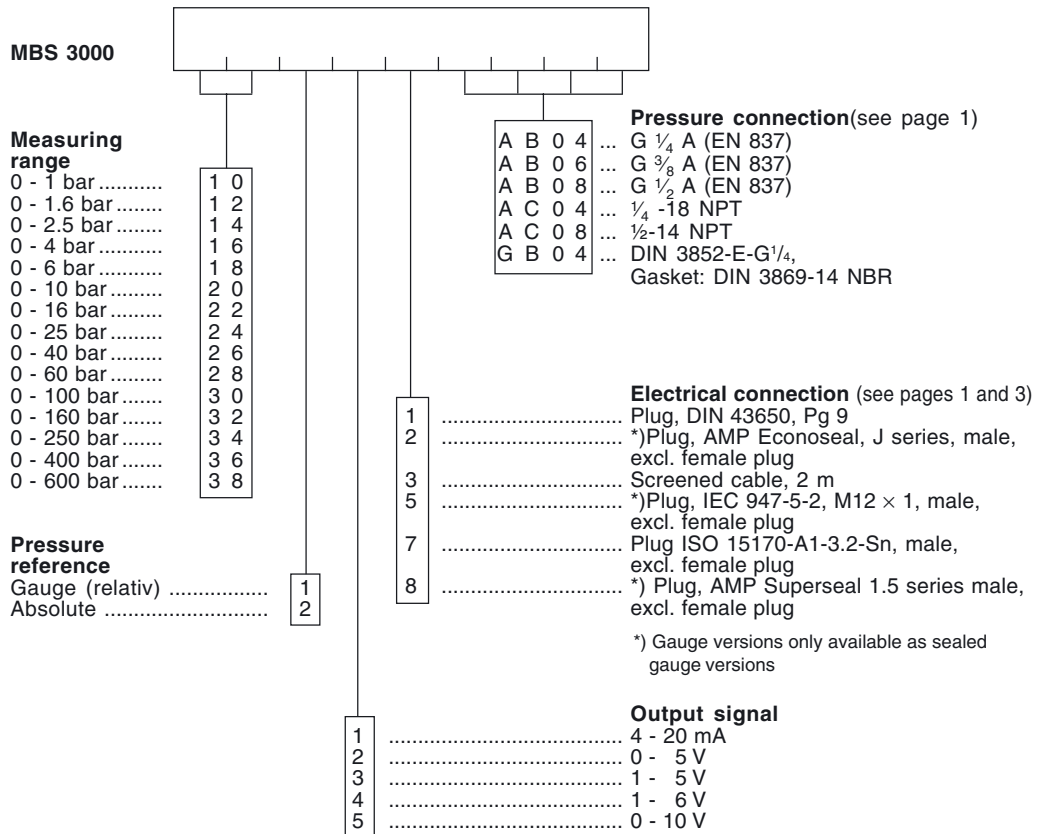
| Type code, page 4  |   |  |   |   |  |
|--|---|--|---|---|--|
| 1  | 2   | 5  | 7   | 8   | 3  |
| DIN 43650, Pg 9<br>  | AMP Econoseal J series (male)<br>                   | IEC 947-5-2 M12x1<br>  | ISO 15170-A1-3.2-Sn (Bayonet plug)<br>                                    | AMP Superseal 1.5 series (male)<br>                 | 2 m screened cable<br>   |
| <i>Ambient temperature</i>   |   |  |   |   |  |
| -40 → + 85 °C  | -40 → + 85 °C                                       | -25 → +85 °C   | -40 → +85 °C  | -40 → +85 °C  | -30 → +85 °C   |
| <i>Enclosure</i>   |   |  |   |   |  |
| IP 65  | IP 67   | IP 67  | IP 67 / IP 69K  | IP 67   | IP67   |
| <i>Materials</i>   |   |  |   |   |  |
| Glass filled polyamid, PA 6.6  | Glass filled polyamid, PA 6.6 <sup>1)</sup>         | Nickel plated brass, CuZn/Ni   | Glass filled polyester, PBT   | Glass filled polyamid, PA 6.6 <sup>2)</sup>         | Polyolifin cable with PE shrinkage tubing  |
| <i>Electrical connection, 4-20 mA output (2 wire)</i>                                  |   |  |   |   |  |
| Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Not used<br>Earth: Connected to MBS housing | Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Not used | Pin 1: +supply<br>Pin 2: Not used<br>Pin 3: Not used<br>Pin 4: ÷supply | Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Ventilation<br>Pin 4: Not used | Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Not used | Brown wire: +supply<br>Black wire: ÷supply<br>Red wire: Not used<br>Orange: Not used<br>Screen: Not connected to MBS housing |
| <i>Electrical connection, 0-5V, 1-5V, 1-6V, 0-10V output</i>                           |   |  |   |   |  |
| Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Output<br>Earth: Connected to MBS housing   | Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Output   | Pin 1: +supply<br>Pin 2: not used<br>Pin 3: Output<br>Pin 4: ÷supply   | Pin 1: +supply<br>Pin 2: Output<br>Pin 3: Ventilation<br>Pin 4: ÷supply   | Pin 1: +supply<br>Pin 2: ÷supply<br>Pin 3: Output   | Brown wire: Output<br>Black wire: ÷supply<br>Red wire: + supply<br>Orange: Not used<br>Screen: Not connected to MBS housing  |

1) Female plug: Glass filled polyester, PBT  
 2) Wire: PETFE (teflon)  
 Protection sleeve: PBT mesh (polyester)

**Ordering of standard MBS 3000 with DIN 43650 plug Pg 9**

| Pressure connection | Pressure range Pe    | Type                 | Code no. |
|---------------------|----------------------|----------------------|----------|
| G 1/4 A<br>(EN 837) | 0 - 1 bar            | MBS 3000 1011-1 AB04 | 060G1113 |
|                     | 0 - 1.6 bar          | MBS 3000 1211-1 AB04 | 060G1429 |
|                     | 0 - 2.5 bar          | MBS 3000 1411-1 AB04 | 060G1122 |
|                     | 0 - 4 bar            | MBS 3000 1611-1 AB04 | 060G1123 |
|                     | 0 - 6 bar            | MBS 3000 1811-1 AB04 | 060G1124 |
|                     | 0 - 10 bar           | MBS 3000 2011-1 AB04 | 060G1125 |
|                     | 0 - 16 bar           | MBS 3000 2211-1 AB04 | 060G1133 |
|                     | 0 - 25 bar           | MBS 3000 2411-1 AB04 | 060G1430 |
|                     | 0 - 40 bar           | MBS 3000 2611-1 AB04 | 060G1105 |
|                     | 0 - 60 bar           | MBS 3000 2811-1 AB04 | 060G1106 |
|                     | 0 - 100 bar          | MBS 3000 3011-1 AB04 | 060G1107 |
|                     | 0 - 160 bar          | MBS 3000 3211-1 AB04 | 060G1112 |
|                     | 0 - 250 bar          | MBS 3000 3411-1 AB04 | 060G1111 |
|                     | 0 - 400 bar          | MBS 3000 3611-1 AB04 | 060G1109 |
| 0 - 600 bar         | MBS 3000 3811-1 AB04 | 060G1110             |          |

**Ordering of special versions**



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# Grundfos CU 352 Pump Controller

Advanced pump system controller for parallel connected pumps for HVAC and Pressure Boosting Applications



## Compatibility

The CU 352 pump controller can control up to six (6) parallel connected pumps in the following manner:

- Direct BUS control: **CRE, CME, VLSE** or **LCSE** pumps
- Direct BUS control: Pumps with Grundfos **CUE** drives
- Digital/Analog control: Pumps with external drives (requires **IO 351B** Input/Output module)

## HVAC Control Modes

- o Constant Differential Pressure control via remote sensor
  - Multi-zone Differential Pressure control up to 6 zones
    - Priority, Minimum or Energy Saving Mode
- o Quadratic, proportional or constant differential pressure control via local sensor
  - Adjustable control curve (Max flow and control head)
  - Efficiency based sequencing automatically updated
- o Constant Flow
- o Constant Temperature
- o Constant Differential Temperature

## Pressure Boosting Control Modes

- o Constant Pressure (pump discharge)
- o Quadratic or Proportional discharge pressure
  - Adjustable control curve (Max flow and min. static head)
- o Constant Pressure (remote sensor)

## Pump Cascade Control

- o Efficiency based pump sequencing
  - \* Updated automatically when setpoint and/or control head are changed
- o Automatic Pump alternation (run hour based)
- o Standby Pumps (single or multiple)
- o Adjustable minimum time between starts / stops
- o Adjustable maximum starts per hour
- o Pump test run (exercise idle pumps)
- o Clock program
- o Proportional Gain and Integral Time adjustment

## Application optimized functions:

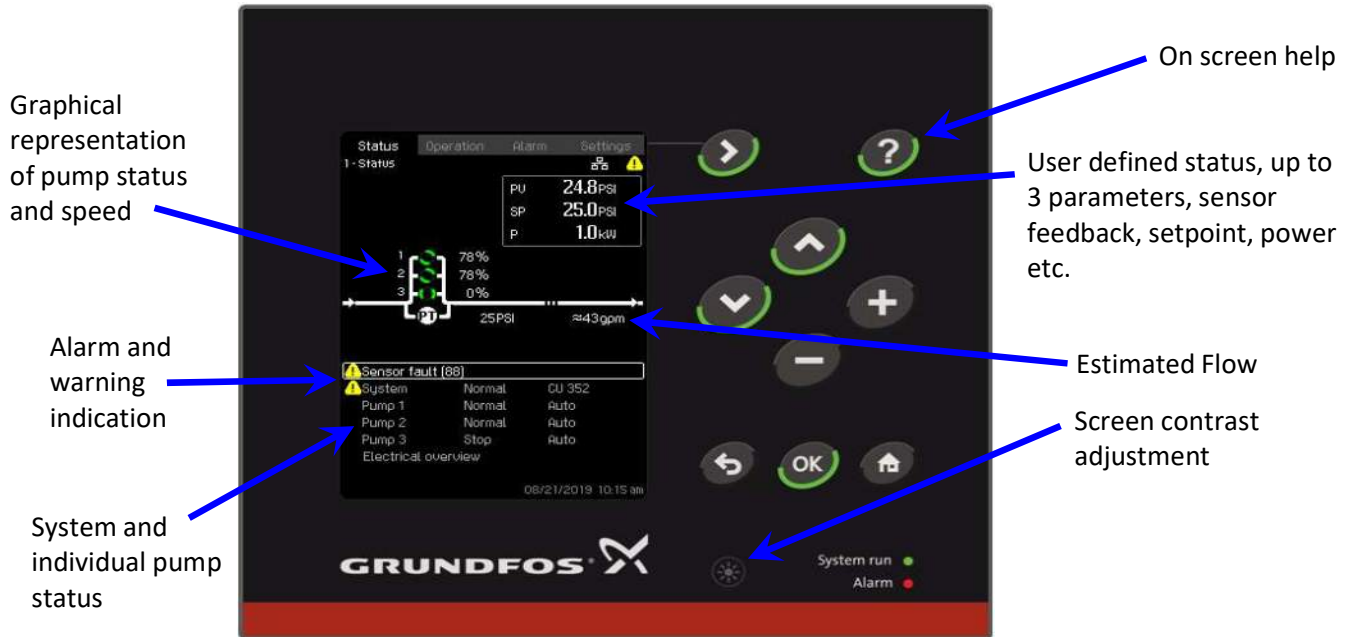
- o Secondary (Fallback) Sensor
- o Pump curve data (5th or 2nd order polynomial)
  - \* Pre-programmed from factory
- o Flow estimation via pump curve data and pressure measurement across pump(s)
- o Reduced operation (generator backup power)
  - Max. kW limit or max. number of pumps
- o Specific energy calculation (kWh per unit volume)
  - \*requires flow sensor input
- o Low Flow Stop (Pressure Boosting)
  - Adjustable low flow setting: Energy saver mode, medium flow or high comfort level

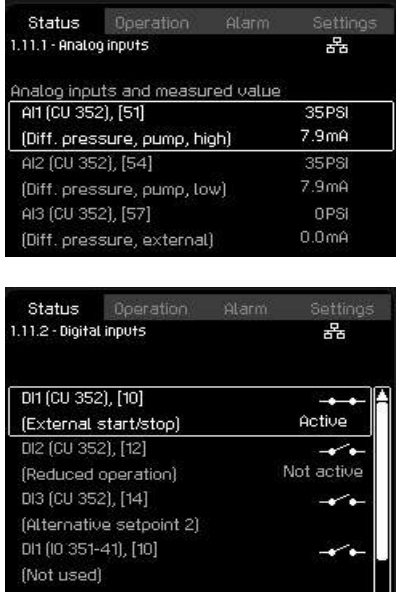

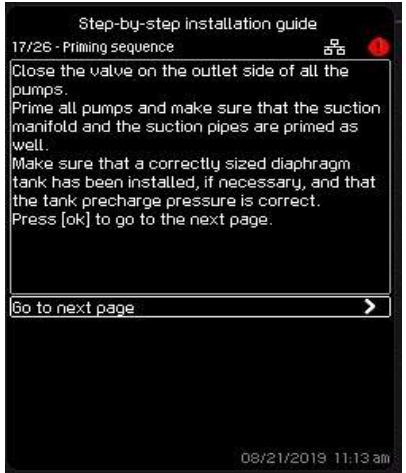
## Protection and Monitoring

- o Check valve failure detection (MLE motors)
- o Pump outside duty range protection
  - \*keeps all operating pumps on their curve
- o Low suction pressure warning and alarm
- o Primary sensor failure reaction setting
- o Soft pressure build-up (Pipe fill mode)
- o Low system pressure warning and alarm
- o High system pressure shutdown
- o Alarm log, last 24, time stamped
- o Data log graph (20 - 3600 samples/hour)
  - (Flow, speed, setpoint, sensor feedback, kW)
- o BMS/EMS communication (see page 4)

# Grundfos CU 352 Pump Controller

## CU 352 Control user interface



| Status of inputs and outputs   | Alarms and warnings | Startup Wizard     |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
|--|---------------------|--------------------|--------------------|-------|------------------------------|-------|--------------------|-------|-----------------------------|-------|--------------------|------|----------------------------|-------|-------|--------|--------------------|--------|-----------------------|--------|--------------------|------------|---------------------|------------|--------------------|------------|--------------------------|------------|-----------------------|------------|------------|------------|---|-------|-------------|----------------|-----------------------------|---------------------|-------|-----------------------------|--------------------|--------------------|-----------------------------|--------------------|--------------------|---------------------------------------|--------------------|--------------------|--|
| <p><b>Electrical overview</b><br/>Shows status of inputs along with wiring landing points [in brackets]</p>  <p><b>1.11.1 - Analog inputs</b></p> <table border="1"> <thead> <tr> <th>Input</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>AI1 (CU 352), [51]</td> <td>35PSI</td> </tr> <tr> <td>(Diff. pressure, pump, high)</td> <td>7.9mA</td> </tr> <tr> <td>AI2 (CU 352), [54]</td> <td>35PSI</td> </tr> <tr> <td>(Diff. pressure, pump, low)</td> <td>7.9mA</td> </tr> <tr> <td>AI3 (CU 352), [57]</td> <td>0PSI</td> </tr> <tr> <td>(Diff. pressure, external)</td> <td>0.0mA</td> </tr> </tbody> </table> <p><b>1.11.2 - Digital inputs</b></p> <table border="1"> <thead> <tr> <th>Input</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>DI1 (CU 352), [10]</td> <td>Active</td> </tr> <tr> <td>(External start/stop)</td> <td>Active</td> </tr> <tr> <td>DI2 (CU 352), [12]</td> <td>Not active</td> </tr> <tr> <td>(Reduced operation)</td> <td>Not active</td> </tr> <tr> <td>DI3 (CU 352), [14]</td> <td>Not active</td> </tr> <tr> <td>(Alternative setpoint 2)</td> <td>Not active</td> </tr> <tr> <td>DI1 (IO 351-41), [10]</td> <td>Not active</td> </tr> <tr> <td>(Not used)</td> <td>Not active</td> </tr> </tbody> </table> | Input               | Value              | AI1 (CU 352), [51] | 35PSI | (Diff. pressure, pump, high) | 7.9mA | AI2 (CU 352), [54] | 35PSI | (Diff. pressure, pump, low) | 7.9mA | AI3 (CU 352), [57] | 0PSI | (Diff. pressure, external) | 0.0mA | Input | Status | DI1 (CU 352), [10] | Active | (External start/stop) | Active | DI2 (CU 352), [12] | Not active | (Reduced operation) | Not active | DI3 (CU 352), [14] | Not active | (Alternative setpoint 2) | Not active | DI1 (IO 351-41), [10] | Not active | (Not used) | Not active | <p><b>Alarm log - Stores last 24 alarms and warnings.</b></p> <ul style="list-style-type: none"> <li>&gt; Time event occurred</li> <li>&gt; Time event cleared</li> <li>&gt; Alarm code for more detailed description.</li> </ul>  <p><b>3.2 - Alarm log</b></p> <table border="1"> <thead> <tr> <th>Alarm</th> <th>Occurred at</th> <th>Disappeared at</th> </tr> </thead> <tbody> <tr> <td>AI3-CU352 Sensor fault (88)</td> <td>08/21/2019 10:12 am</td> <td>-- --</td> </tr> <tr> <td>System Water shortage (214)</td> <td>08/21/2019 8:54 am</td> <td>08/21/2019 8:55 am</td> </tr> <tr> <td>System Water shortage (214)</td> <td>08/21/2019 8:54 am</td> <td>08/21/2019 8:55 am</td> </tr> <tr> <td>System Pumps outside duty range (208)</td> <td>08/21/2019 8:54 am</td> <td>08/21/2019 8:54 am</td> </tr> </tbody> </table> | Alarm | Occurred at | Disappeared at | AI3-CU352 Sensor fault (88) | 08/21/2019 10:12 am | -- -- | System Water shortage (214) | 08/21/2019 8:54 am | 08/21/2019 8:55 am | System Water shortage (214) | 08/21/2019 8:54 am | 08/21/2019 8:55 am | System Pumps outside duty range (208) | 08/21/2019 8:54 am | 08/21/2019 8:54 am | <p><b>Startup Wizard</b><br/>Step by Step installation guide</p> <ul style="list-style-type: none"> <li>&gt; Set time and date format</li> <li>&gt; Remove air/Prime pumps</li> <li>&gt; Check pump rotation</li> <li>&gt; Set primary sensor</li> </ul>  <p><b>17/26 - Priming sequence</b></p> <p>Close the valve on the outlet side of all the pumps.<br/>Prime all pumps and make sure that the suction manifold and the suction pipes are primed as well.<br/>Make sure that a correctly sized diaphragm tank has been installed, if necessary, and that the tank precharge pressure is correct.<br/>Press [ok] to go to the next page.</p> <p>Go to next page</p> |
| Input  | Value               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| AI1 (CU 352), [51]   | 35PSI               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Diff. pressure, pump, high)   | 7.9mA               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| AI2 (CU 352), [54]   | 35PSI               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Diff. pressure, pump, low)  | 7.9mA               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| AI3 (CU 352), [57]   | 0PSI                |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Diff. pressure, external)   | 0.0mA               |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| Input  | Status              |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| DI1 (CU 352), [10]   | Active              |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (External start/stop)  | Active              |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| DI2 (CU 352), [12]   | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Reduced operation)  | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| DI3 (CU 352), [14]   | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Alternative setpoint 2)   | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| DI1 (IO 351-41), [10]  | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| (Not used)   | Not active          |                    |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| Alarm  | Occurred at         | Disappeared at     |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| AI3-CU352 Sensor fault (88)  | 08/21/2019 10:12 am | -- --              |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| System Water shortage (214)  | 08/21/2019 8:54 am  | 08/21/2019 8:55 am |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| System Water shortage (214)  | 08/21/2019 8:54 am  | 08/21/2019 8:55 am |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |
| System Pumps outside duty range (208)  | 08/21/2019 8:54 am  | 08/21/2019 8:54 am |                    |       |                              |       |                    |       |                             |       |                    |      |                            |       |       |        |                    |        |                       |        |                    |            |                     |            |                    |            |                          |            |                       |            |            |            |   |       |             |                |                             |                     |       |                             |                    |                    |                             |                    |                    |                                       |                    |                    |  |

# Grundfos CU 352 Pump Controller

## Sequence of operation

### Hydronic Circulation

The system controller shall operate equal capacity variable speed pumps to maintain a variable (quadratic or linear) or constant differential pressure. The system controller shall receive an analog signal [4-20mA] from a remote or pump system mounted differential pressure sensor. The controller shall be able to receive a system suction pressure and system discharge pressure to determine the system differential pressure (two independent analog signals). The controller shall have the means to protect pumps against dry running via a user defined low suction pressure setting.

### Pressure Boosting

The system controller shall operate equal capacity variable speed pumps to maintain a constant or variable (quadratic or linear) pressure. The system controller shall receive an analog signal [4-20mA] from a remote or pump system mounted pressure sensor. The controller shall be capable of simulating the effect of a remote mounted pressure sensor by quadratically reducing the system discharge pressure setpoint as a function of reduced flow (friction loss compensation).

### Cascade Control

#### Standard Cascade Control (Pumping Efficiency Based):

The pump system controller shall adjust pump speed as necessary to maintain system set-point pressure as flow demand changes. The pump system controller shall start additional pumps upon determination of an increase in efficiency utilizing factory programmed (5th order polynomial) curve data. When the system pressure is equal to the system set-point, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional gain and Integral time (PI) settings for system optimization.

#### Optional Cascade Control (Pump Start Speed Based):

As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach the programable start speed, an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional gain and Integral time (PI) settings for system optimization.

#### Pumps outside duty range (End of curve protection):

When the pumps are outside their allowable operating range, the controller shall switch on an additional pump, distributing a reduced flow through all pumps in operation moving each pump back into its allowable operating region.

### Pump Alternation

All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous with only one pump in operation, the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

### Low Flow Stop (Pressure Boosting)

The system controller shall be capable of detecting low flow allowing for pumps to be switched off in an energy saving mode. Upon detection of low flow, the controller shall increase the system setpoint by 5% (adjustable) to store water in a diaphragm or bladder tank and switch off. The pump shall remain off until the system pressure falls 5% below the system setpoint (adjustable). If system flow is still low when the pump switches back on, the pump shall refill the diaphragm tank to 5% above setpoint and switch off again. If system flow increases above the low flow setting, the pump shall return to normal constant pressure mode maintaining the system setpoint.

# Grundfos CU 352 Pump Controller

## Technical data

### Altitude above sea level

Maximum 6,560 feet (2000 m.)

### Ambient Temperature

During operation: -4°F to +140°F (-20°C to +60°C)

During transportation: -4°F to +140°F (-20°C to +60°C)

- \* At temperatures below 32°F (0°C) the display may react slowly.
- \* The display should not be exposed to direct sunlight

### Relative air humidity

5 to 95%

### Enclosure class

UL type 3R when mounted in the front of a panel with UL type rating 1, 2, 3, 3R, 5, 12, 12K or 13. Overall control panel rating of Type 4/4X available on request.

### Supply voltage

1 x 100-240 VAC +/- 10% 50/60Hz, PE  
(Class 1 equipment)

### Power consumption

Maximum 22 W

### Backup battery

The optional backup battery can keep the CU352 powered during intermittent power outages.

The CU 352 will monitor the following:

- short circuit
- wrong polarity
- defective battery
- battery missing
- low battery voltage

### Digital inputs (3)

|                        |          |
|------------------------|----------|
| Open-circuit voltage   | 24 VDC   |
| Closed-circuit current | 5 mA, DC |
| Frequency range        | 0-4 Hz   |

### Analog inputs (3)

|                           |                         |
|---------------------------|-------------------------|
|                           | 0-20 mA                 |
| Input current and voltage | 4-20 mA                 |
|                           | 0-10 V                  |
| Tolerance                 | ± 3.3 % of full scale   |
| Repetitive accuracy       | ± 1 % of full scale     |
| Input resistance, current | < 250 Ω                 |
| Input resistance, voltage | > 50 kΩ ± 10%           |
|                           | 24 V, 30 mA             |
| Supply to sensor          | short-circuit protected |

### Relay outputs (2)

|                        |              |
|------------------------|--------------|
| Normally open contacts | C, NO        |
| Maximum contact load   | 240 VAC, 2 A |
| Minimum contact load   | 5 VDC, 10 mA |

### Communication protocols

For connection to building management systems, Communication Interface Modules (CIM) can be supplied with the CU 352 controller.

| Protocol     | CIM Type |
|--------------|----------|
| LONworks     | 110      |
| PROFIBUS DP  | 150      |
| PROFINET IO  | 500      |
| Modbus RTU   | 200      |
| Modbus TCP   | 500      |
| BACnet MS/TP | 300      |
| BACnet IP    | 500      |
| Ethernet IP  | 500      |



## MLE

### Product compatibility

- **Multi-stage:** CRE, CRIE, CRNE, MTRE, MTSE, SPKE, CME
- **Single-stage:** TPE2, TPE3, VLSE, LCSE
- **Systems:** Hydro MPC-E, Hydro Multi-E, Hydro Multi-B, Hydro Solo-E, CMBE home booster.



TM06 5684 2219

MLE is a dedicated motor-drive system for pumps and other applications. Pumps equipped with MLE motors overcome application challenges and save energy in a variety of pump installations in order to reach the lowest Life Cycle Cost (LCC) possible.

### Integrated drives

Integrated drives are beneficial because they are installed on non-controlled pumps at no additional installation cost. Once the power supply is connected and the pump is fitted into the pipe system, they are ready to operate at the desired setpoint.

Operating pumps with MLE also reduces CAPEX (capital expense) of additional cabinets, components and facility space by having the entire pump system in line with the pipe system.

MLE is the result of Grundfos' efficient motor technology and it is an efficient IE5 motor, with an efficiency much higher than NEMA Premium, which minimizes OPEX (operating expense).

### Robustness throughout the system

The Grundfos full line supply of components, from the power supply to pipe fittings, provides the most robust solutions:

- Built-in protection against power supply disturbances, environment and motor load.
- MLE is designed to mitigate bearing currents.
- No cooling fans in drive (wear part).

### MLE product range

|               |               |
|---------------|---------------|
| 1 x 200-240 V | 0.33 - 2.0 HP |
| 3 x 200-240 V | 1.5 - 7.5 HP  |
| 3 x 440-480 V | 0.33 - 15 HP* |

\* Up to 30 HP available with different specifications.

### Features and benefits

| Feature   | Benefit  |
|---|--|
| <b>Application control</b>                                    |  |
| Control modes   | Easy commissioning to match system design criteria.  |
| Multipump function including alternating, back-up, or cascade | Neglects the need for external controllers and continuous operation by redundant pump and sensor if either component fails.                              |
| Differential pressure or temperature with 2 sensors           | Lower CAPEX by common inexpensive sensor types.  |
| Pump curve adjustments and run at power limit                 | Stabilizes unstable pump curves and extends operating range.   |
| Setpoint influence  | Adapts QH to internal or measured values.  |
| <b>Energy saving for lower OPEX</b>                           |  |
| AUTOADAPT or FLOWLIMIT  | Continuously adapts to the most efficient curve and reduces pressure loss in the system.   |
| Low-flow stop function  | Improved energy optimization and comfort.  |
| ECM motor that exceeds the NEMA Premium efficiency levels     | ECM motors have significantly lower motor loss than NEMA Premium motors. This alone reduces energy consumption by 10 % with a typical pump load profile. |
| <b>Condition monitoring</b>                                   |  |
| Limit Exceed function   | Any value can be supervised to protect the system.   |
| Loss of prime and dry run                                     | Protects the shaft seal.   |
| Cavitation protection   | Protects the impellers.  |
| Flow estimate and heat energy monitor                         | Monitoring of the heating system's performance.  |
| Overload and temperature                                      | Protects the frequency converter and motor.  |
| Stop at minimum speed   | Protects the pump and saves energy.  |
| Motor bearings monitors                                       | Ensures uptime by preventive maintenance.  |
| <b>Robustness</b>   |  |
| Operating temperature between -4 and +140 °F                  | Allows installation almost anywhere and high margins in control rooms, resulting in longer product service life.   |
| Impulse transient resistance (VDE0160 compliant)              | Resistance against lightning, ESD, switching impulses and utility fault clearing.  |
| Interruptions and voltage sags (SEMIF47 compliant)            | Keeps process running and derates the pump to the available power.   |
| Line harmonics resistance (EN 61000-4-13, class 3)            | Built-in compensation of disturbance to avoid overheating of motor windings and maintaining a steady pump operation.                                     |
| Built-in RFI filters  | Neglects the need for external components.   |
| NEMA3 / NEMA4 enclosures                                      | Installed in-line to pipe systems at no added cost.  |

## Grundfos iSOLUTIONS

Grundfos iSOLUTIONS delivers the optimal combination of pumps, drives and auxiliary components for the specific application, incorporating special features and functions, and building on application knowledge and experience.

Grundfos iSOLUTIONS allows easy integration of pumps, drives, measurements, controls, protections, and communication, saving you valuable engineering, installation and commissioning time.

To learn more, visit: [www.grundfos.com/isolutions](http://www.grundfos.com/isolutions)

## Sensors

MLE is sensor-independent and controls the pump to any measured feedback.

Grundfos offers several sensors to be used in pump solutions:

- pressure sensors
- temperature sensors
- differential pressure sensors
- differential temperature sensors
- flow meters.

## Grundfos GO Remote

Grundfos GO Remote for iOS and Android ensures easy and quick commissioning, monitoring and servicing of pumps with MLE motors.



TW07 4786 2419

## Technical specifications

| Motor data                    |  |                      |                       |
|-------------------------------|--|----------------------|-----------------------|
|                               | Operating range (rpm)  | Constant power (rpm) | Constant torque (rpm) |
| Speed range                   | 180-2000   | 1740-2000            | 900-1740              |
|                               | 360-4000   | 3480-4000            | 1750-3480             |
|                               | 360-4000   | 3400-4000            | 2000-3400             |
|                               | 500-5900   | 4000-5900            | -                     |
| Voltage tolerances            | ± 10 %   |                      |                       |
| Frequency                     | 50-60 Hz ± 5 %   |                      |                       |
| Network                       | TN/TT (optional: IT) according to IEC 60364  |                      |                       |
| Environmental limits          |  |                      |                       |
| Degree of protection          | NEMA3 / NEMA4  |                      |                       |
| Operating temp.               | -4 to +140 °F derating above 122 °F  |                      |                       |
| Storage temp.                 | -4 to +140 °F  |                      |                       |
| Altitude                      | 0-3280 ft without derating / 0-11480 ft with derating  |                      |                       |
| Humidity                      | 0-95 %, non-condensing   |                      |                       |
| Inputs/outputs                | <b>FM100</b>   | <b>FM200</b>         | <b>FM300</b>          |
| Digital inputs                | 1  | 1                    | 2                     |
| Digital inputs/ outputs       | 1  | 1                    | 2                     |
| Relay outputs                 | -  | 2                    | 2                     |
| Analog inputs                 | 1 (only V)   |                      |                       |
| Pt100/Pt1000 inputs           | -  | -                    | 2                     |
| +5 V supply                   | Y  | Y                    | Y                     |
| +24 V supply                  | -  | Y                    | Y                     |
| Grundfos Digital Sensor input | -  | Y                    | Y                     |
| LiqTec sensor input           | -  | -                    | Y                     |
| Digital inputs (dedicated)    | 0-5 V  |                      |                       |
| Digital inputs/ outputs       | 0-24 V, resistive or inductive   |                      |                       |
| Analog input                  | 0-20 mA / 4-20 mA, 0.5 - 3.5 V / 0-5 V / 0-10 V  |                      |                       |
| Relay output                  | 250 V AC/30 V DC, max. continuous current 2 A rms  |                      |                       |
| Connectivity                  |  |                      |                       |
| Wireless (radio)              | Yes, GENlair   |                      |                       |
| RS-485                        | Yes, GENlair   |                      |                       |
| Communication options         | • LONWorks (CIM 100)   |                      |                       |
|                               | • PROFIBUS DP (CIM 150)  |                      |                       |
|                               | • Modbus RTU (CIM 200)   |                      |                       |
|                               | • GSM/GPRS (CIM 250)   |                      |                       |
|                               | • 3G/4G cellular (CIM 260)   |                      |                       |
|                               | • GiC/GRM 3G/4G (CIM 280)  |                      |                       |
|                               | • BACnet MS/TP (CIM 300) PROFINET IO (CIM 500)   |                      |                       |
|                               | • Modbus TCP (CIM 500)   |                      |                       |
|                               | • BACnet IP (CIM 500)  |                      |                       |
|                               | • Ethernet IP (CIM 500)  |                      |                       |
| Compliance                    |  |                      |                       |
| Conformity to standards       | CE, EAC, RCM, CCC, and cURus (UL)  |                      |                       |
| Harmonics                     | IEC/EN 61000-3-12  |                      |                       |
| EMC                           | Up to 10.0 HP (7.5 HP low speed): Category C1 according to EN 61800-3, corresponding to CISPR 11, class B (residential area)         |                      |                       |
|                               | Above 10.0 HP (7.5 HP low speed): Category C3 according to EN 61800-3, corresponding to CISPR 11, class A, group 2 (industrial area) |                      |                       |

99689406 0719

ECM: 1264915

## Vibration Isolation

### Common vibration concerns with frame mounted end suction pumps

- Misalignment between motor shaft and pump shaft is the #1 source of pump vibration
  - o End suction pumps typically have large over-hung impellers with high rotating inertia, that when misaligned creates large unbalanced forces and results in vibration
  - o Offset discharge throat of the volute creates the radial load
  - o Decreased component life
- End suction pump bearing loading is primarily from radial forces



Unbalanced forces and increased vibration

### Grundfos CR Multistage pump benefits:

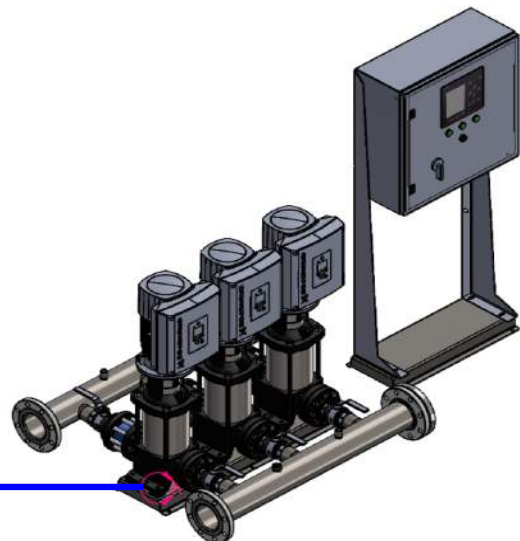
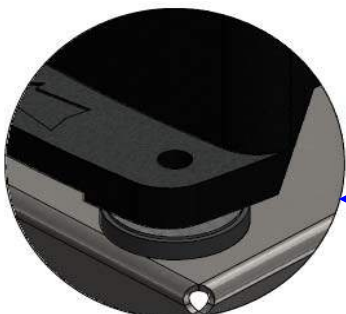
- Register fit between motor and pump
- No alignment required for lifetime of operation
- Minimized vibration
- Longer component life
- Quiet operation (product lubricated pump bearings)
- CR Multistage pumps offer the lowest rotating inertia compared to most other pumps in same duty conditions
- Low rotating inertia equals less opportunity for vibration
- Multistage pump bearing loading is on average 10% radial and 90% axial forces



No alignment is required

### Pump systems with Grundfos CR(E) Multistage pumps

- Vibration Isolation:
  - o 1/2" thick dampeners at pump base mounting points (4 per pump)
  - o Inertia bases and grouting are not required when mounted to concrete housekeeping pad
  - o Flexible connectors on manifold connections are recommended





Panel Part Number:  
99554600

Description  
Control MPC E  
2 X 5HP  
3 X 208/240V

Selected Options: System Fault Light, Audible Alarm, Surge Protection, Pump Run Light, Normal/Emergency Switch, Service Disconnect Switch

|         |           |  |   |                   |  |                             |             |
|---------|-----------|--|---|-------------------|--|-----------------------------|-------------|
| 0       | 4/16/2019 | Control MPC E<br>2 X 5HP<br>3 X 208/240V | This drawing and its content is the property of GRUNDFOS. It may not be copied for third parties or competitors. Changes are only to be made by GRUNDFOS. | PROJECT: 99554600 |  | Panel Part Number: 99554600 | SHEET: 1/10 |
| 1       | 9/9/2019  |  |   |                   |  |                             |             |
|         |           |  |   | EDW-WD-GPC-1006   |  |                             |             |
| ECM/Rev | Date      |  |   |                   |  |                             |             |

### Feeder Circuit Protection:

Feeder circuit protection to be provided by others.  
Type and size to be based on local, state and national electrical codes

**SCCR Rating:** 100 kA RMS Symmetric, 240V

**UL Type Rating:** 3R

### Largest Motor FLA and Panel Maximum FLA:

|                  |         |
|------------------|---------|
| Motor Horsepower | 5HP     |
| Motor FLA        | 13.2FLA |
| Panel Max. FLA   | 27.4FLA |

| Wire Type                                 | Color                 | Abbr. |
|---|-----------------------|-------|
| +12/24VDC Power/PLC Input(s)              | Blue                  | BU    |
| -12/24VDC Power/PLC Input(s)              | Blue w/White Stripe   | BUWH  |
| 115VAC Primary Line Power                 | Black                 | BK    |
| 115VAC Neutral                            | White                 | WH    |
| Ground/PE                                 | Green/Yellow Stripe   | GNYE  |
| Analog Inputs                             | Orange                | OG    |
| Analog Outputs                            | Orange                | OG    |
| Digital Inputs (CU Components)            | Violet                | VT    |
| Ground for Digital Inputs (CU Components) | Violet w/White Stripe | VTWH  |
| Digital Outputs                           | Yellow                | YE    |
| Power L1                                  | Black                 | BK    |
| Power L2                                  | Orange                | OG    |
| Power L3                                  | Red                   | RD    |
| Power Neutral                             | White                 | WH    |
| All Other Wiring                          | Brown                 | BN    |

### Safety / Application Notes:

**\*\* Please Reference the "BOOSTERPAQ - HYDRO MPC"**

**Installation and Operation Instructions "BEFORE" Applying power to Panel.**

\*\* Power supply wires in front of main disconnect switch have dangerous voltage even though the main disconnect switch is off.



\*\* Control panel must be connected professionally to the earth / ground.

\*\* GRUNDFOS MLE motors have an integrated variable frequency drive (VFD) which provides motor overload protection. If a system utilizes MLE motors, the motor overload protection is provided by the VFD and does not require any additional motor overload protection.

#### Cross Reference Definition

(##-##)  
Sheet-Row

#### Wire Types

Internal Panel Wire   
External Wire 

|         |           |
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Control MPC E  
2 X 5HP  
3 X 208/240V

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PROJECT: 99554600

EDW-WD-GPC-1006



Panel Part Number: 99554600

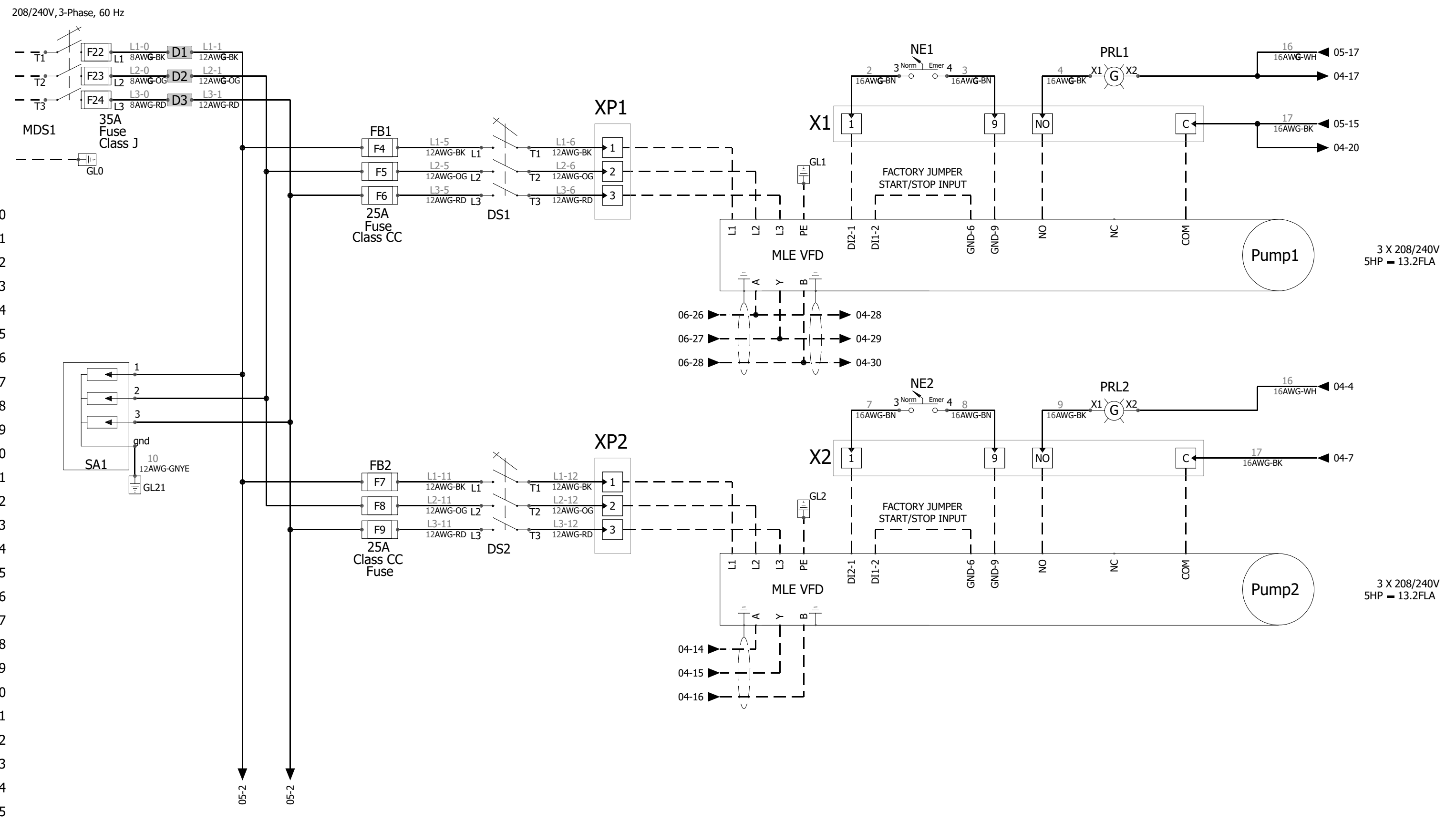
SHEET: 2/10

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| 3  | <u>01</u> | 0        | 4/16/2019 | jharvey    | Cover Page 01   |
| 4  | <u>02</u> | 0        | 4/16/2019 | jharvey    | Cover Page 02   |
| 5  | <u>03</u> | 0        | 4/16/2019 | jharvey    | Drawings list   |
| 6  | <u>04</u> | 0        | 4/16/2019 | jharvey    | Power 01  |
| 7  | <u>05</u> | 0        | 4/16/2019 | jharvey    | Control 01  |
| 8  | <u>06</u> | 0        | 4/16/2019 | jharvey    | Control 02  |
| 9  | <u>07</u> | 0        | 4/16/2019 | jharvey    | Panel Layout  |
| 10 | <u>08</u> | 0        | 4/16/2019 | jharvey    | Panel Views   |
| 11 | <u>09</u> | 0        | 5/17/2019 | kharen     | Bill Of Materials grouped by manufacturer Rev1.0 (Components) |
| 12 | <u>10</u> | 0        | 5/17/2019 | kharen     | Bill Of Materials grouped by manufacturer Rev1.0 (Components) |
| 13 | <u>11</u> | 0        | 4/16/2019 | jharvey    | Main electrical closet  |

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**Control MPC E**  
**2 X 5HP**  
**3 X 208/240V**

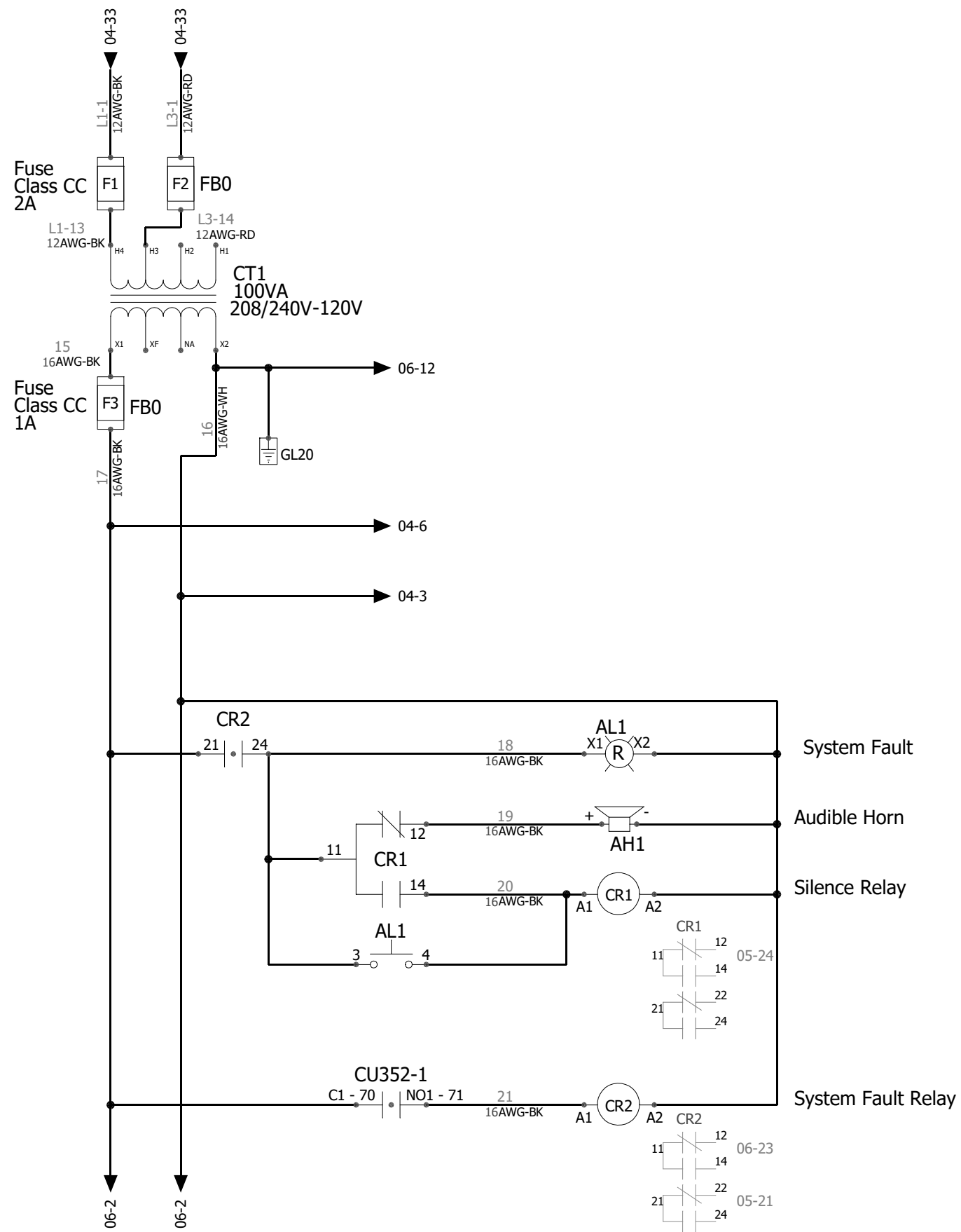
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EDW-WD-GPC-1006

**GRUNDFOS** 

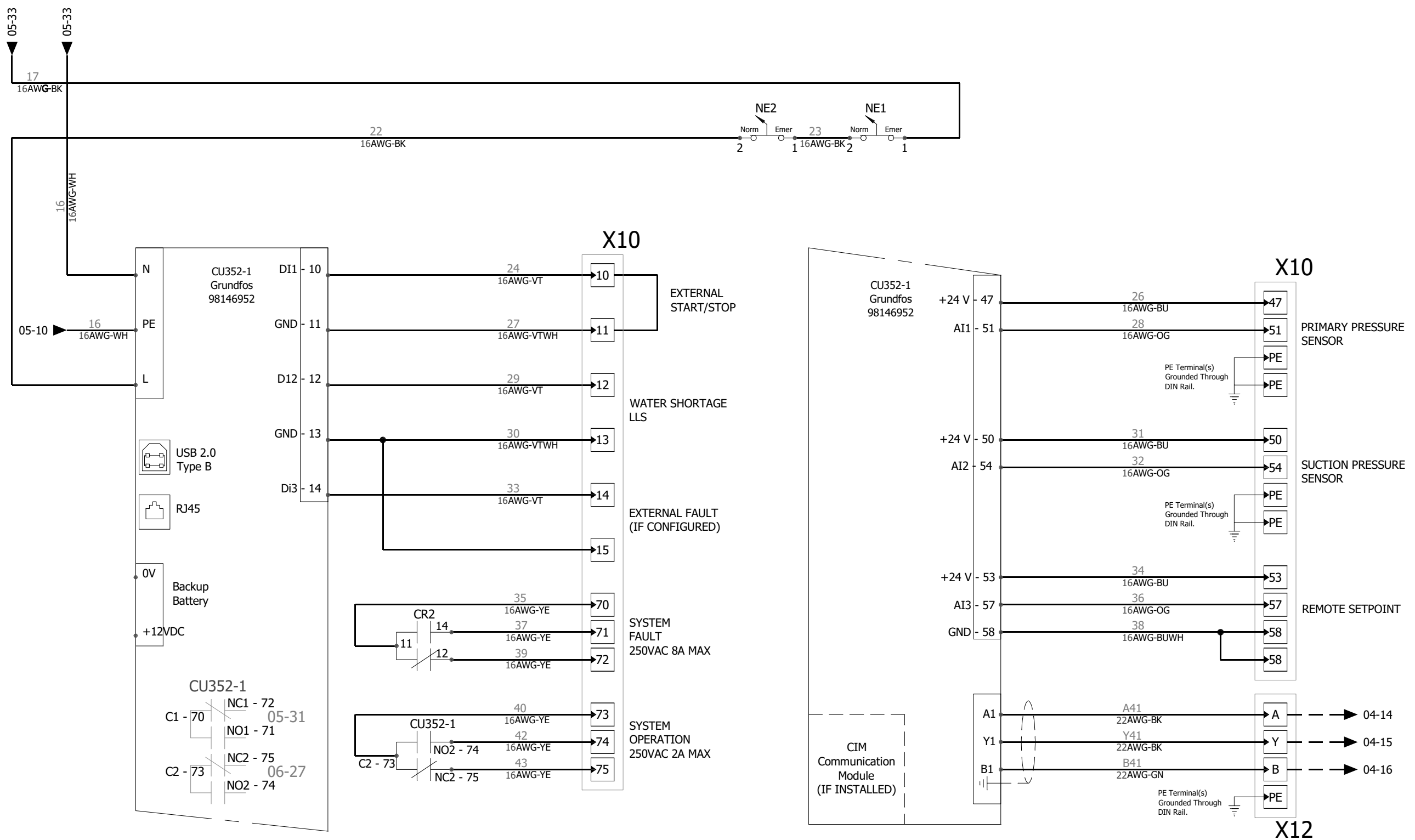
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**CIM COMMUNICATION MODULE TERMINATIONS**

| CIM     | Terminal 1                         | Terminal 2           | Terminal 3            | Terminal 4                    |
|---------|------------------------------------|----------------------|-----------------------|-------------------------------|
| CIM 110 | LON                                | LON terminal A       | LON terminal B        | LON terminal for cable screen |
| CIM 150 | PROFIBUS DP                        | PROFIBUS terminal B  | PROFIBUS terminal A   | PROFIBUS terminal DGND        |
| CIM 200 | Modbus RTU                         | Modbus terminal D1   | Modbus terminal D0    | Modbus terminal common/GND    |
| CIM 300 | BACnet MS/TP                       | BACnet Plus terminal | BACnet Minus terminal | BACnet Ground terminal        |
| CIM 500 | BACnet IP, Modbus TCP, PROFINET IO | RJ45                 | RJ45                  |                               |

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**Control MPC E**  
**2 X 5HP**  
**3 X 208/240V**

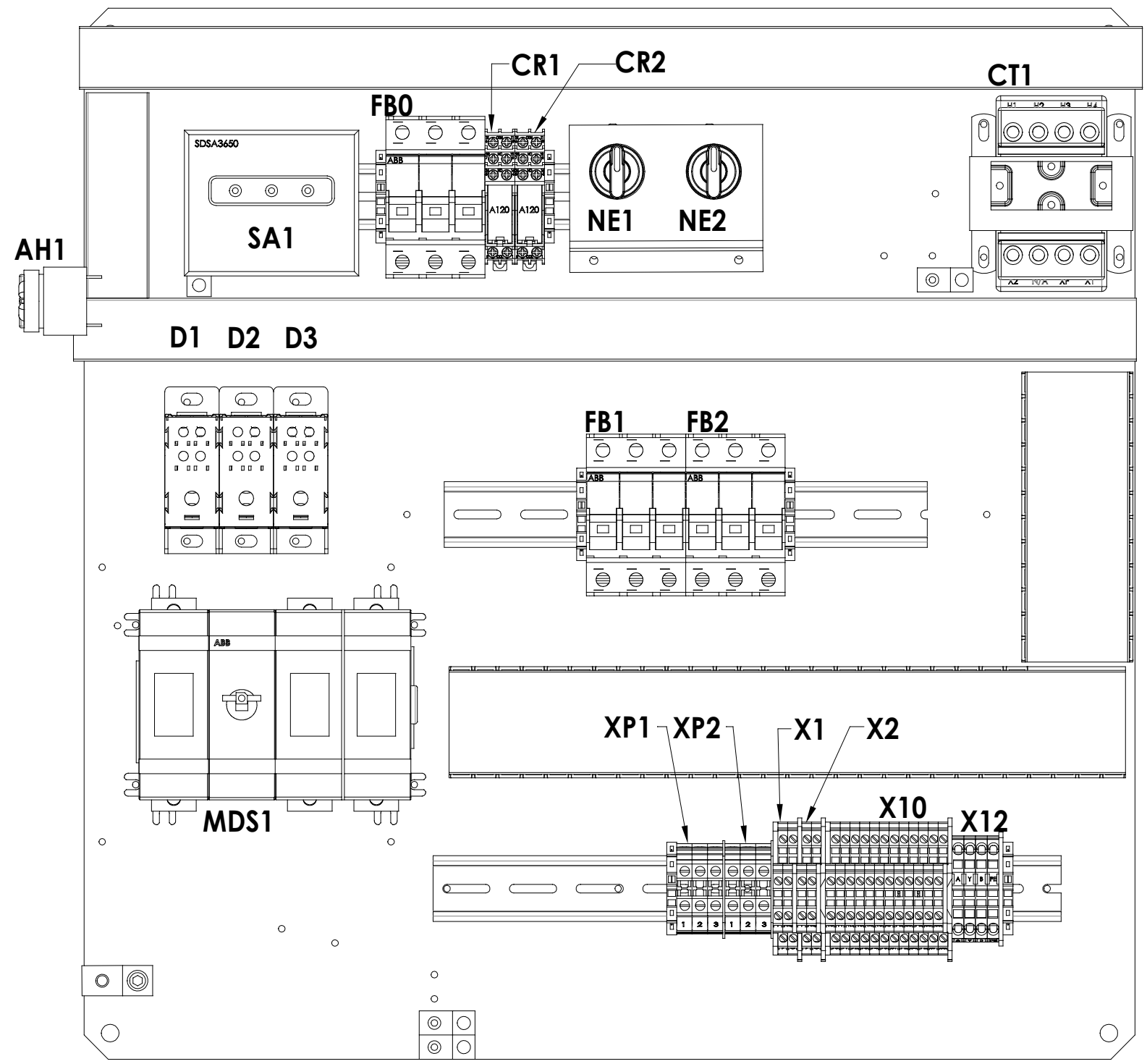
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**GRUNDFOS** 

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Control MPC E  
2 X 5HP  
3 X 208/240V

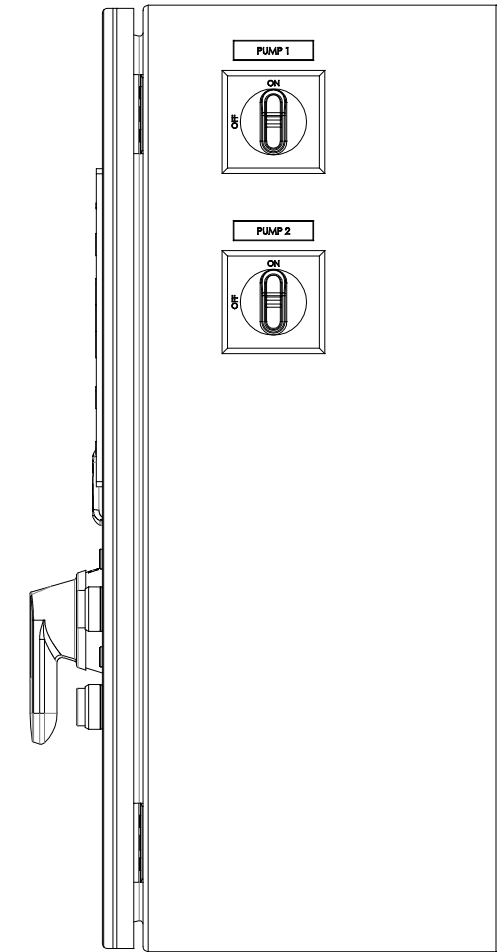
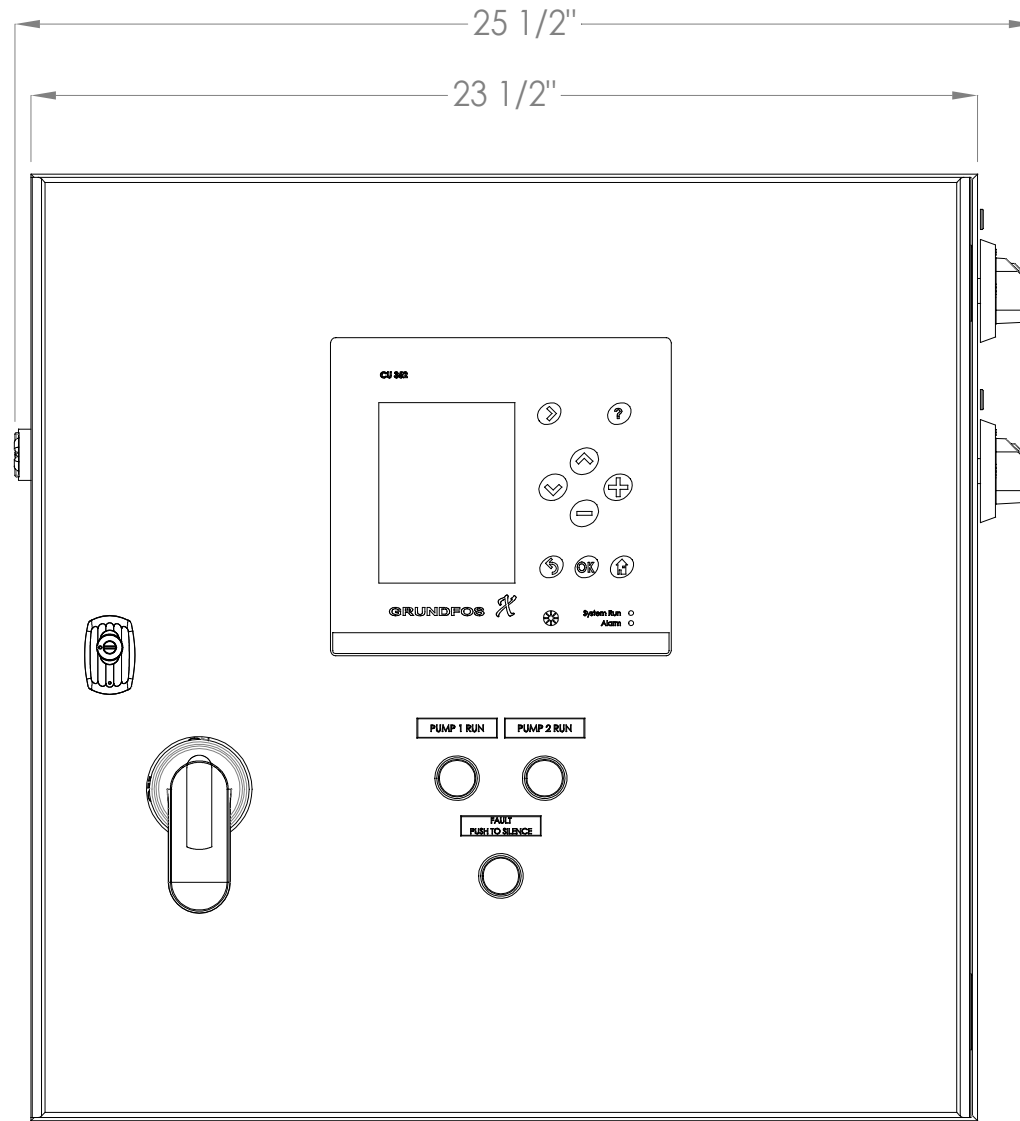
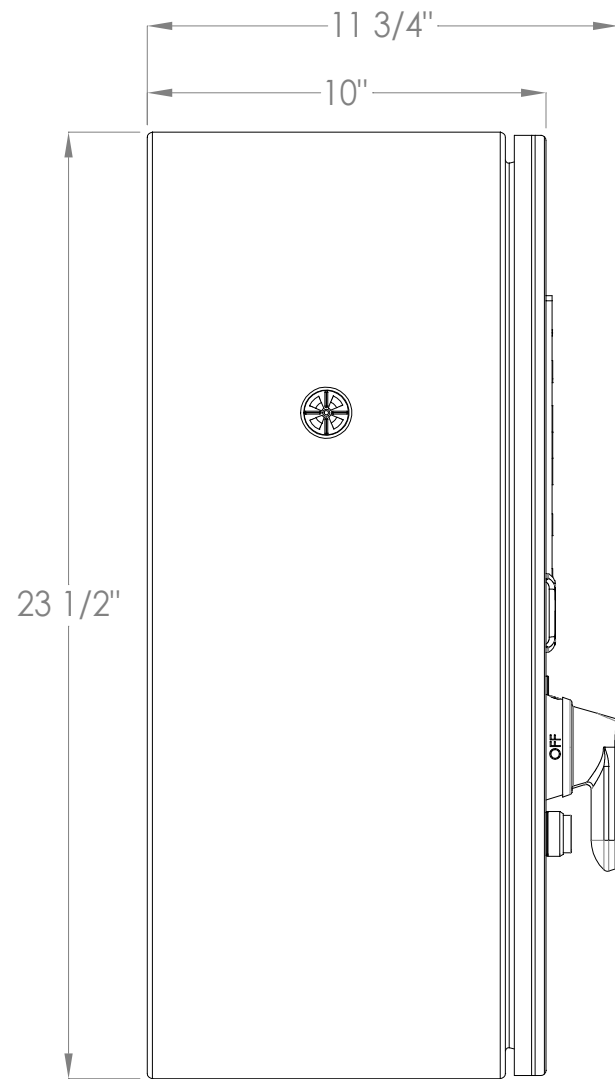
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CLEARANCE FROM FRONT OF ENCLOSURE MUST BE 36".  
CLEARANCE FROM DISCONNECT HANDLE MUST BE 6".

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Control MPC E  
2 X 5HP  
3 X 208/240V

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EDW-WD-GPC-1006



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| Article Number    | Mark                        | Manufacturer | Reference         | Description  | Quantity | Component Type                     |
|-------------------|-----------------------------|--------------|-------------------|--|----------|------------------------------------|
| 13-16-26-1241     | FB0 , FB1 , FB2             | ABB          | E9330CCS          | Fuse Block; 3P, 30 A, Class CC, Indicator, Padlockable                 | 3        | Fuse Block 3-pole                  |
| 13-16-66-1615     | <u>MDS1</u>                 | ABB          | OHY80L6           | Disconnect Handle; Red/Yellow, 30/60/100/250A, Type 4, 4X, 3R, 12      | 1        | Main Disconnect                    |
| 13-16-66-1348     | DS1 , DS2                   | ABB          | OHYS2RJ           | Disconnect Handle; Red/Yellow, for Side Mount, Type 3R, 12             | 2        | Service Disconnect                 |
| 13-16-66-1506     | <u>MDS1</u>                 | ABB          | OHZX10            | Alignment Ring; Use on all Pistol Grip Handles                         | 1        | Main Disconnect                    |
| 13-16-66-1432     | <u>MDS1</u>                 | ABB          | OS60GJ12          | Disconnect Switch; 60A, Fuseable, 600V, 3-Pole, Class J, Center Shaft  | 1        | Main Disconnect                    |
| 13-16-66-1383     | DS1 , DS2                   | ABB          | OT63FT3           | Disconnect Switch; 60A, 600V, 3-Pole, Front Mount                      | 2        | Service Disconnect                 |
| 13-16-66-1610     | <u>MDS1</u>                 | ABB          | EXP6X500          | Disconnect Shaft; 19.7", 6x500   | 1        | Main Disconnect                    |
| 13-16-81-1463     | <u>CT1</u>                  | Acme         | TB100A005C        | Transformer; 100VA, P/208/230/460V, S/115V                             | 1        | Controls Transformer               |
| 13-16-26-1272     | F22 , F23 , F24             | F.Shaw       | A4J35             | Fuse; 35A, 600V, Class J   | 3        | Fuse                               |
| 13-16-26-1060     | <u>F3</u>                   | F.Shaw       | ATQR1             | Fuse; 1A, 600V, 13/32" x 1 1/2", Class CC                              | 1        | Fuse                               |
| 13-16-26-1061     | F1 , F2                     | F.Shaw       | ATQR2             | Fuse; 2A, 600V, 13/32" x 1 1/2", Class CC                              | 2        | Fuse                               |
| 13-16-26-1170     | F4 , F5 , F6 , F7 , F8 , F9 | F.Shaw       | ATQR25            | Fuse; 25A, 600V, 13/32" x 1 1/2", Class CC                             | 6        | Fuse                               |
| 13-16-71-1530     | D1 , D2 , D3                | F.Shaw       | FSPDB3A           | Distribution block; 310A, 600V, 2in/8out                               | 3        | Distribution Block                 |
| 13-16-56-1029     | <u>AH1</u>                  | Floyd Bell   | SP-1081           | Alarm; 120V, 95db, Reduced Sensitivity, Extra Fast Warble, Panel Mount | 1        | Audible Horn                       |
| 13-16-39-1093     | <u>CU352-1</u>              | Grundfos     | 98146952          | (CM) Logic Module; Grundfos MPC Controller (CU352)                     | 1        | CU352                              |
| 13-16-46-1073     | CR1 , CR2                   | Idec         | RJ2S-CL-A120      | Relay; 120V, DPDT, 8A, Indicator                                       | 2        | Silence Relay , System Fault Relay |
| 13-16-46-1283     | CR1 , CR2                   | Idec         | SJ2S-07LW         | Socket; 8 Pin, DIN/Pnl Mt, for RJ Relays                               | 2        | Silence Relay , System Fault Relay |
| 13-66-11-1130     | SAB1                        | OSI          | 13-66-11-1130     | Bracket; Surge Arrestor  | 1        | SA Bracket                         |
| 65-BP-2424-A01    | L1                          | OSI          | 65-BP-2424-A01    | Backplate; 24x24, Aluminum, Pre-Drilled, Layout 01                     | 1        | Main electrical closet             |
| 65-ELEC-BRKT-2HOA | SWB1                        | OSI          | 65-ELEC-BRKT-2HOA | Bracket; HOA or N/E Switch, x2   | 1        | NE Bracket                         |
| 65-LIGHT-1R-032   | <u>AL1</u>                  | OSI          | 65-light-1R-032   | Push Button Light; Fault, Push to Silence                              | 1        | System Fault                       |
| 65-SWITCH-2-12    | NE1 , NE2                   | OSI          | 65-SWITCH-2-12    | Switch; Two Position, 1-NO, 1-NC                                       | 2        | Normal/Emergency Switch            |
| 65-TB-CU352-DB    | <u>X10 1</u>                | OSI          | 65-TB-CU352-DB    | Terminal Blocks; Double Stack, X10 CU352 Terminals                     | 1        | CU352 Terminal Blocks              |

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| 1       | 9/9/2019  |
| ECM/Rev | Date      |

**Control MPC E**  
**2 X 5HP**  
**3 X 208/240V**

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PROJECT: 99554600  
 EDW-WD-GPC-1006



Panel Part Number: 99554600 SHEET: 9/10

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| Article Number       | Mark                             | Manufacturer       | Reference            | Description                                    | Quantity | Component Type                      |
|----------------------|----------------------------------|--------------------|----------------------|--|----------|-------------------------------------|
| 65-TB-GENI           | X12 1                            | OSI                | 65-TB-GENI           | Terminal Blocks; X12 Geni Bus Terminals        | 1        | Geni Bus Terminal Blocks            |
| 65-TB-PT-50A         | XP1 1 , XP2 1                    | OSI                | 65-TB-PT-50A         | Terminal Blocks; Single Pump Pass Through, 50A | 2        | Pump Power Terminal Blocks          |
| 65-TB-SINGLE-PUMP-DB | X1 1 , X2 1                      | OSI                | 65-TB-SINGLE-PUMP-DB | Terminal Blocks; MLE Pump Control              | 2        | Pump Control Terminal Blocks        |
| 13-16-86-1680        | GL0 , GL1 , GL2 ,<br>GL20 , GL21 | Raco               | TA2-Bulk             | Ground Lug; 2AWG, Burndy                       | 5        | Ground Lug                          |
| 13-16-61-1010        | SA1                              | Schneider          | SDSA 3650            | Surge Arrestor; 3 Phase, 600V, WYE             | 1        | Surge Arrestor                      |
| 65-ENCL-2424-RSH     | L1                               | Schneider Electric | 65-ENCL-2424-RSH     | Enclosure; 24X24 Right Side Hinge              | 1        | Main electrical closet              |
| 13-16-36-1421        | PRL1 , PRL2                      | Siemens            | 3SU11036AA401AA0     | Pilot Light; Green, 110 VAC Complete           | 2        | Pump 1 Run Light , Pump 2 Run Light |

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Panel Part Number: 99554600 SHEET: 10/10