## Project Information

Project Name: Shenandoah WWTP Order: 264467
Distributor: Cummins South PO: 02930061734-395784-CJ-SOUTH Quote/Rev: MW16X1022/Rev E
Factory Project Management Representative: Jenny Mcgee Email: jenny.mcgee@cummins.com

## Contents



## Submittal Revision History

| Revision | Description | Affected Documents | Date |
|---|---|---|---|
| 1 | Initial Submittal | N/A | 22MAR23 |
| | | | |
| | | | |
| | | | |

# Section 1 – Project Submittal Information

- Proposed Product Breakdown
- Document Availability
- Submittal Review Comments

## Proposed Product Breakdown

*Power System Sequence of Operation*: A073U484 rev 1
*Specification Variance Form*: 262300 rev 1

*Power System Interconnection Diagram*: A073U481 rev 1
*Specification Variance Form*: Drawings rev 1

**Digital Master Control** *Qty*: 1
*Product Model*: DMCCHAALAA0688 *Major Bill of Material*: A073H691 rev 1 *Outline:* A073U479 rev 1
*Summary*: A system level, fully automatic, logic controller suitable for unattended applications. The Digital Master Controller (DMC) can control up to 4 gensets and 16 feeders in a Dual Transfer Pair bus configuration. Control is performed via a stand-alone PLC CPU utilizing distributed I/O points connected in a ring network topology. Operation is achieved through a 21" touchscreen Human Machine Interface (HMI).

**Switchgear Lineup** *Qty*: 1
*Product Model*: SWGCHAALAA0433 *Major Bill of Material*: A073H692 rev 1 *Outline:* A073U480 rev 1
*Summary*: Low voltage switchgear built by Schneider Electric with customized controls added by Cummins. Lineup consists of 10 sections of Metal-Clad switchgear with all necessary circuit breakers, instrument transformers, protective devices, meters, lamps, controls, etc. fully installed. Control and communication from the DMC are achieved via a combination of standard copper control wiring and ethernet cabling.

**Switchgear Battery** *Qty*: 1
*Product Model*: BAT999999A0220 *Major Bill of Material*: A073H693 rev 1
*Summary*: 24VDC battery system to supply power for switchgear breaker operation. Provided are the necessary battery cells, floor standing battery rack, and charger.

## Document Availability Timeline

The diagram below illustrates the typical stages at which various documents are created and finalized during the Submittal, Approval, Engineering Design, Production Build, and Shipment phases of most projects.

Relevant documents are supplied to customers at both the Submittal and Shipment phases only.
Please contact the appropriate factory project management representative to discuss reviewing any documents not available to customers.

| --Supplied to Customer-- | ----------Not Available to Customer---------- | --Supplied to Customer-- |
|---|---|---|

| **Submittal** | **Approval** | **Engineering Design** | **Production Build** | **Shipment** |
|---|---|---|---|---|
| *Initial* Sequence of Operation | *Production* Sequence of Operation | | | *As-Built* Sequence of Operation |
| *Initial* Interconnection Diagram | *Production* Interconnection Diagram | | | As-Built Interconnection Diagram |
| *Initial* Outline(s) | *Production* Outline(s) | | | *As-Built* Outline(s) |
| *Major* Bill(s) of Material | *Approved* Bill(s) of Material | | *Production* Bill(s) of Material | *As-Built* Bill(s) of Material |
| | | *Initial* Schematic Diagram(s) | *Production* Schematic Diagram(s) | As-Built Schematic Diagram(s) |
| | | *Initial* PLC Program | *Production* PLC Program | *As-Built* PLC Program |
| | | *Initial* HMI Program(s) | *Production* HMI Program(s) | As-Built HMI Program(s) |
| | | *Initial* BMS Mapping | *Production* BMS Mapping | *As-Built* BMS Mapping |
| | | **Engineering Design** | **Production Build** | **Shipment** |

## Submittal Review Comments

Please respond with any submittal review comments and questions by using the space below, by using the comments feature directly within this PDF, or by attaching your own separate document(s). Then return comments along with this submittal package to the appropriate factory project management representative.

# Section 2 – Power System Details

- Specification Variance
- Sequence of Operation
- Major Bill(s) of Material

**SHENANDOAH WWTP**

264467

| CUSTOMER SPECIFICATION DOCUMENT NAME: Section 26 23 00 - Paralleling Switchgear | | | |
|---|---|---|---|
| **SPECIFICATION SECTION:** 26 23 00 | | **SPECIFICATION DATE:** 13FEB23 | |
| **ITEM** | **SECTION PART** | **VARIANCE** | **DESCRIPTION/ENGINEERING COMMENTS** |
| 1 | 1.4.C.3 | DEVIATION | Service and Support names/qualifications/locations are not a part of submittal drawings |
| 2 | 1.4.D | DEVIATION | Switchgear will be tested by SqD per ANSI standards. The certified test reports will be provided after project completion. Switchgear sequence testing will be performed at Cummins Factory according to the sequence of operation and the test reports will be provided after project completion. |
| 3 | 1.5.F | NOTE | Cummins to comply with these standards where applicable. |
| 4 | 1.6 | EXCEPTION | Delivery, Storage, and Handling is by others. Not in Cummins Factory scope. |
| 5 | 2.2.B | EXCEPTION | Generator Controller Panel will be provided by others. Not in Cummins Factory scope. |
| 6 | 2.2.C | NOTE | Cummins shall provide a DMC8000 with single PLC and 21" HMI. |
| 7 | 2.2.D.3 | DEVIATION | Type SIS wire, rated to 90 deg C to be used.<br>Wires labeled with Brady Label adhesive type labels |
| 8 | 2.3.C.2.b | DEVIATION | Feeder sections will accept up to 600kcmil MAX wires due to 4x high arrangement |
| 9 | 3.1 | EXCEPTION | Power Company Approval by others. Not in Cummins Factory scope. |
| 10 | 3.2 | EXCEPTION | Installer Inspection/Examination by others. Not in Cummins Factory scope. |
| 11 | 3.3 | EXCEPTION | Installation by others. Not in Cummins Factory scope. |
| 12 | 3.4 | NOTE | 3x O&M included in quote. 1x to be installed in DMC. 1x to be installed near each Tie breaker in the SWG. |
| 13 | 3.5 | EXCEPTION | Connections by others. Not in Cummins Factory scope. |
| 14 | 3.6 | EXCEPTION | Field Quality Control by others. Not in Cummins Factory scope. |
| 15 | 3.7 | EXCEPTION | Adjusting by others. Not in Cummins Factory scope. |
| 16 | 3.8 | EXCEPTION | Cleaning by others. Not in Cummins Factory scope. |
| 17 | 3.9 | EXCEPTION | Protection by others. Not in Cummins Factory scope. |
| 18 | 3.10 | EXCEPTION | Training by others. Not in Cummins Factory scope. |
| 19 | 3.11 | EXCEPTION | DMC/Switchgear lineup tested separately from Gensets at the factory. Genset simulators to be used during factory testing. |

**SHENANDOAH WWTP**

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| **CUSTOMER SPECIFICATION DOCUMENT NAME:** E0-03. Single Line Diagram - Part A | | | |
|---|---|---|---|
| **ITEM** | **REFERENCE** | **VARIANCE** | **DESCRIPTION/ENGINEERING COMMENTS** |
| 1 | Note 3. | DEVIATION | Detail "E-EDL" not provided. Labels to be per Cummins Outline/ Elevation drawing |

# SEQUENCE OF OPERATIONS

## Shenandoah WWTP
## Revision 1

**Document Number** : A073U484
**Model Number** : DMCCHAALAA0688
**Order Number** : 264467
**Customer** : Cummins South

| Revision No. | Date | Description | Prepared by | Checked by |
|---|---|---|---|---|
| 1 | 03/20/2023 | Submittal Release | J. Kuznia | M. Sekhon |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

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# 1 Power System Components

| Component | Name(s) or Description |
|---|---|
| Generator Set | G1, G2, G3, G4 |
| Generator Set Breaker | 52-G1, 52-G2, 52-G3, 52-G4 |
| Utility Main Breaker | 52-UM1, 52-UM2 |
| Generator Main Breaker | 52-GM1, 52-GM2 |
| Feeder Breaker | 52-F1 through 52-F16 |
| Transfer Pair | Consists of a Utility Main and a Generator Main Breaker Pair |
| Generator Set Bus (Genbus) | The bus on which all generator sets start and parallel onto. |
| Loadbus | The bus on which all loads to be serviced reside.<br>Loadbus 1 – 52-UM1, 52-GM1, 52-F1 through F8<br>Loadbus 2 – 52-UM2, 52-GM2, 52-F9 through F16 |
| PowerCommand Control (PCC) | PCC3300<br>The generator set control system that monitors and performs all of the control and protection functions of the generator set. |
| First Start System | An integrated part of the PCC that inhibits all but the first generator set that is ready to load from closing to the Loadbus. A generator set is considered ready to load when it is at 90% of rated voltage and frequency. All other generator sets in the system are then required to synchronize to the Loadbus before closing their generator set breakers. |
| Digital Master Control (DMC) | The control enclosure that houses the PLC and the operator Human–Machine Interface (HMI). |

# 2 Definitions

| Name | Description |
|---|---|
| Control Selection | The Control Selection defines the source of System Control.<br>**Operator** - User manually controls the system control sequences from any DMC HMI, including the Web.<br>**Hardwired Inputs** - Allows the system to enter Test with Load or Extended Parallel and use the customer inputs to the DMC to trigger the relevant mode. Hardwired Inputs is selectable only when the System Mode is Off.<br>**Scheduler** - Allows the scheduled events set up on the Scheduler screen to run. Scheduler control is selectable only when the System Mode is Off. |
| Loadbus Selection | The Loadbus Selection determines what Loadbus is used for Test with Load and Extended Parallel. Loadbus 1, 2, or both can be selected for Test with Load. Only Loadbus 1 or 2 can be selected for Extended Parallel. |
| System Mode | The system mode indicates the current operating mode of the DMC. Typically, it is set to Off. When it is set to Off, the DMC is in Standby, ready to respond to a utility source failure. Selectable system modes are: Test without Load, Test with Load, and Extended Parallel. |

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| Transition Type | The transition type determines the method of power transfer between the sources.<br>**Auto - Open Transition** - The DMC performs break-before-make transition transfers and retransfers. The loads are not powered for the duration of the Programmed Transition Delay.<br>**Auto - Soft Closed Transition** - The DMC performs make-before-break transition transfers and retransfers. The DMC ramps the load between sources with no interruption.<br>**Manual** - The DMC disables all automatic control operations and allows operator initiated control of the DMC. The operator can request the DMC to open and close breakers, and start and parallel generator sets. This mode does not allow closed transition transfers. |
| Time Delays | Time delays ensure the system is safe and stable before performing a transition.<br>**Programmed Transition Delay** (Range: 1-60 Seconds, Initial Setting: 2 Seconds) – Time period that both sources remain open during an open transition transfer to allow spinning loads to decay to a safe level before the transition. It is initiated when no source is connected and the DMC is in a transfer or retransfer process.<br>**Transfer Delay** (Range: 0-12 Seconds, Initial Setting: 2 Seconds) - Time period that the system waits before transferring to the generator source. It allows time for the utility source to recover from a momentary power outage and for the generator source to stabilize before transferring the load. It is initiated when the minimum generator capacity required is online.<br>**Retransfer Delay** (Range: 1-120 Minutes, Initial Setting: 1 Minute) - Time period that the utility source must be available before the system transfers the load from the generator source to the utility source. It allows time for the utility source to stabilize before transferring the load. It is initiated when the Genbus is connected and the utility source becomes available, in normal or Extended Parallel condition.<br>**Load Add - Genbus Delay** (Range: 0-60 Seconds, Initial Setting: 2 Seconds) – Time delay between load add levels when the source is generator sets.<br>**Load Add - Utility Delay** (Range: 0-60 Seconds, Initial Setting: 2 Seconds) – Time delay between load add levels when the source is utility.<br>**Load Shed - Shed Delay** (Range: 0.1-10 Seconds, Initial Setting: 2 Seconds) - Time delay between load shed levels when the source is generator sets during a bus overload condition.<br>**Utility Fail Delay** (Range: 0-10 Seconds, Initial Setting: 2 Seconds) - The amount of time that the DMC waits after recognizing a utility failure signal before it initiates a transfer to the generator sets. It prevents the transfer during a temporary utility failure.<br>**Max Ramp Time** (Range: 10-180 Seconds, Initial Setting: 20 Seconds) - Used to predict the amount of the time the system should ramp load up or down. When the time expires, the system disconnects the paralleled sources.<br>**Min. Capacity to Connect Time Out** (Range: 30-600 Seconds, Initial Setting: 2 Seconds) - Time used to initiate an alarm if the minimum capacity has not been reached when the generator sets are signaled to start.<br>**Load Demand - Initial Delay** (Range: 1-60 Minutes, Initial Setting: 1 Minute) - Delay that the DMC waits after load demand is enabled and all conditions for load demand have been met before load demand becomes active.<br>**Load Demand - Shutdown Delay** (Range: 1-60 Minutes, Initial Setting: 1 Minute) - Delay that the DMC waits before shutting down a generator set if |

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| | the facility load is sufficiently low. The Shutdown Delay is used to place the appropriate number of generator sets in load demand stop for the load required by the Genbus.<br>**Load Demand - Restart Delay** (Range: 0-1500 Seconds, Initial Setting: 0 Seconds) - Delay required for the Genbus to be at or greater than the restart capacity. The delay helps prevent a generator set from restarting unnecessarily due to load transients. |
| Unload kW | The DMC uses the Unload kW threshold to determine when to open the utility main or generator main breaker during soft closed transition transfers. The default setting is 50kW. |
| Min. Capacity to Connect | The minimum amount of spare capacity required to connect the generator sets to the Loadbus via the generator main breaker. It is used to make sure enough generation is available to serve the Loadbus when the generator sets connect. |
| Required Online Capacity | A user defined estimate of the total kW consumed when all loads are added to the Loadbus. When the capacity of the generator sets connected to the Loadbus is at or exceeds the Required Online Capacity, it is assumed that enough generation exists to power all loads in the system. If all of the generator sets are online, it is assumed that the Required Online Capacity is met. This threshold is used to start timed load adding in the system when more load add levels exist than the number of generator sets in the system. |
| Load Dump | The PCC generates the Load Dump signal based on the parameters defined by the settings in each PCC. The default settings are:<br>Overload - 105% (Range: 80-140%)<br>Overload Time - 60 Seconds (Range: 0-120 Seconds)<br>Under Frequency Offset - 3 Hz (Range: 0-10 Hz)<br>Under Frequency Time - 3 Seconds (Range: 0-20 Seconds) |

# 3 System Modes

## 3.1 Normal Standby Conditions

- Utility sources are available and utility main breakers 52-UM1 and 52-UM2 are closed.
- Generator main breakers 52-GM1 and 52-GM2 are open.
- Generator set breakers are open and the generator sets are not running.
- All generator sets are in Auto at each generator set PCC.
- Feeder breakers are connected and in the closed position.
- System Mode is set to Off.
- Transition Type is set to Auto - Open Transition or Auto - Soft Closed Transition.
- All Auto/Manual switches are in Auto mode.

## 3.2 Single Utility Source Failure

The single utility source failure sequences apply to either utility source. The DMC uses the applicable time delays and settings for each transfer pair. The utility main, feeder, and generator main breakers refer to the respective Loadbus.

### 3.2.1 Loss of Single Utility Source (Auto – Open or Auto – Soft Closed Transition)

1. The DMC receives a single loss of utility source signal from the device monitoring the utility source.
2. The Utility Fail Delay within the DMC starts timing and expires.
3. The DMC sends a start signal to the generator sets.
4. The Min. Capacity to Connect timer starts. (The generator set's start signal is removed if the Min. Capacity to Connect is not reached before the time expires. Operator intervention is required.)
5. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
6. The first generator set closes to the bus as dictated by the First Start System.
7. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
8. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
9. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
10. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
11. After the 52-UM breaker opens, the Programmed Transition Delay starts in the DMC.
12. When the Programmed Transition Delay expires, the DMC verifies that Min. Capacity to Connect is still true.
13. The DMC commands the 52-GM breaker to close. The 52-GM breaker closes.

14. The Loadbus is powered by the generator set source.
15. The normal load add sequence starts as described in *Load Add Sequence during Loss of Utility Source.*
16. Load Demand operates if it is enabled.

### 3.2.2 Return of Single Utility Source (Auto – Open Transition)

1. The DMC detects the removal of the loss of utility source signal from the device monitoring the utility source.
2. The Retransfer Delay starts in the DMC. The Retransfer Delay can be bypassed using the bypass icon displayed on the Oneline screen.
3. When the Retransfer Delay expires, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
4. After the 52-GM breaker opens, the Programmed Transition Delay starts in the DMC.
5. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
6. When the Programmed Transition Delay expires, the DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
7. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source.*
8. The Loadbus is powered by the utility source.
9. The DMC removes the start signals from the generator sets.
10. The PCC on each generator set opens its generator set breaker.
11. The generator sets run in cooldown mode and then stop.
12. The system returns to *Normal Standby Conditions.*

### 3.2.3 Return of Single Utility Source (Auto – Soft Closed Transition)

1. The DMC detects the removal of the loss of utility source signal from the device monitoring the utility source.
2. The Retransfer Delay starts in the DMC.
3. When the Retransfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
4. Once the generator sets synchronize to the utility source and when the sync check conditions are met for the 52-UM breaker, the DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
5. The generator sets ramp down.
6. When the load across the 52-GM breaker is below the Unload kW threshold, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
7. The Loadbus is powered by the utility source.
8. The DMC removes the start signals from the generator sets.
9. The PCC on each generator set opens its generator set breaker.
10. The generator sets run in cooldown mode and then stop.
11. The system returns to *Normal Standby Conditions.*

## 3.3 Dual Utility Source Failures

The DMC uses the applicable time delays and settings for each transfer pair. Loadbus 1 has the highest transfer priority.

### 3.3.1 Loss of Both Utility Sources (Auto – Open or Auto – Soft Closed Transition)

1. The DMC receives the loss of utility source signals from the devices monitoring Utility Source 1 and Utility Source 2.
2. The Utility Fail Delays within the DMC start timing and expire.
3. The DMC sends a start signal to the generator sets when the first Utility Fail Delay expires.
4. The Min. Capacity to Connect timers start. (If the Min. Capacity to Connect is not reached for Loadbus 1 and it is not reached for Loadbus 2 before the timer expires, the start signal is removed. Operator intervention is required.)
5. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
6. The first generator set closes to the bus as dictated by the First Start System.
7. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
8. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
9. If both Loadbus 1 and Loadbus 2 require the generator set source, Loadbus 1 must either lose the requirement for generator set source, transfer to the generator set source, or fail to transfer before it relinquishes priority and allows Loadbus 2 to take priority. If Loadbus 2 is ready to transfer before Loadbus 1, it waits for Loadbus 1 to relinquish priority.
10. When the Transfer Delay expires for the first transfer pair, the DMC commands the 52-UM1 breaker to open. The 52-UM1 breaker opens.
11. All feeder breakers on Loadbus 1 not assigned to Load Shed Level 0 are commanded to open.
12. After the 52-UM1 breaker opens, the Programmed Transition Delay for the first transfer pair starts in the DMC.
13. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect for Loadbus 1 is still true.
14. The DMC commands the 52-GM1 breaker to close. The 52-GM1 breaker closes.
15. Loadbus 1 is powered by the generator set source.
16. All feeder breakers on Loadbus 1 assigned to Load Add Level 1 are commanded to close.
17. When the Transfer Delay expires for the second transfer pair, the DMC commands the 52-UM2 breaker to open. The 52-UM2 breaker opens.
18. All feeder breakers on Loadbus 2 not assigned to Load Shed Level 0 are commanded to open.
19. After the 52-UM2 breaker opens, the Programmed Transition Delay for the second transfer pair starts in the DMC.
20. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect for Loadbus 2 is still true.
21. The DMC commands the 52-GM2 breaker to close. The 52-GM2 breaker closes.

22. The normal load add sequence starts as described in *Load Add Sequence during Loss of Utility Source.*
23. Load Demand operates if it is enabled.

### 3.3.2 Return of Single Utility Source following Loss of Both Utility Sources (Auto – Open Transition)

1. The DMC detects the removal of the loss of utility source signal from the device monitoring the utility source.
2. The Retransfer Delay starts in the DMC for the available utility source. The Retransfer Delay can be bypassed using the bypass icon displayed on the Oneline screen.
3. When the Retransfer Delay expires, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
4. After the 52-GM breaker opens, the Programmed Transition Delay starts in the DMC.
5. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
6. When the Programmed Transition Delay expires, the DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
7. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source.*
8. The Loadbus is powered by the utility source.
9. The generator sets stay connected to the Loadbus that still requires the generator set source.

### 3.3.3 Return of Both Utility Sources (Auto – Open Transition)

1. The DMC detects the removal of the loss of utility source signals from the devices monitoring Utility Source 1 and Utility Source 2.
2. The Retransfer Delays start in the DMC. The Retransfer Delay can be bypassed using the bypass icon displayed on the Oneline screen. The Retransfer Delays may start and expire at different times depending on when the utility source returns and the length of the respective Retransfer Delay.
3. When the Retransfer Delays expire, the DMC commands the 52-GM breakers to open. The 52-GM breakers open.
4. After the 52-GM breakers open, the Programmed Transition Delay for each transfer pair starts in the DMC.
5. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
6. When the Programmed Transition Delay expires, the DMC commands the 52-UM breakers to close. The 52-UM breakers close.
7. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source.*
8. Loadbus 1 and Loadbus 2 are powered by their utility source.
9. The DMC removes the start signals from the generator sets.
10. The PCC on each generator set opens its generator set breaker.
11. The generator sets run in cooldown mode and then stop.
12. The system returns to *Normal Standby Conditions.*

### 3.3.4 Return of Single Utility Source following Loss of Both Utility Sources (Auto – Soft Closed Transition)

1. The DMC detects the removal of the loss of utility source signal from the device monitoring the utility source.
2. The Retransfer Delay starts in the DMC.
3. When the Retransfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
4. Once the generator sets synchronize to the utility source and when the sync check conditions are met for the 52-UM breaker, the DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
5. The generator sets ramp down.
6. When the load across the 52-GM breaker is below the Unload kW threshold, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
7. The Loadbus is powered by the utility source.
8. The generator sets stay connected to the Loadbus that still requires the generator set source.

### 3.3.5 Return of Both Utility Sources (Auto – Soft Closed Transition)

1. The DMC detects the removal of the loss of utility source signals from the devices monitoring Utility Source 1 and Utility Source 2.
2. The Retransfer Delays start in the DMC. The Retransfer Delay can be bypassed using the bypass icon displayed on the Oneline screen. The Retransfer Delays may start and expire at different times depending on when the utility source returns and the length of the respective Retransfer Delay.
3. When the Retransfer Delay expires for the first transfer pair, the master synchronizer is enabled between that utility source and the Genbus to synchronize the generator sets to the utility source.
4. Once the generator sets synchronize to the utility source and the sync check conditions are met for the 52-UM1 breaker, the DMC commands the 52-UM1 breaker to close. The 52-UM1 breaker closes.
5. When the load across the 52-GM1 breaker is below the Unload kW threshold, the DMC commands the 52-GM1 breaker to open. The 52-GM1 breaker opens.
6. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source*.
7. When the Retransfer Delay expires for the second transfer pair, the master synchronizer is enabled between that utility source and the Genbus to synchronize the generator sets to the utility source.
8. Once the generator sets synchronize to the utility source and the sync check conditions are met for the 52-UM2 breaker, the DMC commands the 52-UM2 breaker to close. The 52-UM2 breaker closes.
9. When the load across the 52-GM2 breaker is below the Unload kW threshold, the DMC commands the 52-GM2 breaker to open. The 52-GM2 breaker opens.
10. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source.*
11. Loadbus 1 and Loadbus 2 are powered by their respective utility source.

12. The DMC removes the start signals from the generator sets.
13. The PCC on each generator set opens its generator set breaker.
14. The generator sets run in cooldown mode and then stop.
15. The system returns to *Normal Standby Conditions.*

## 3.4 Test Modes

Test modes may be initiated from different sources.

- From the System Control screen if the Control Selection is set to Operator (all tests).
- From the Scheduler if the Control Selection on the System Control screen is set to Scheduler (Test without Load, Test with Load or Extended Parallel tests).
- From an external hardwired input if the Control Selection on the System Control screen is set to Hardwired Inputs and the test input contact is closed (Test with Load only).

The Loadbus(s) to be tested is selected on the System Control screen.

### 3.4.1 Test without Load On - Single Loadbus (Auto – Open or Auto – Soft Closed Transition)

1. The system is commanded to enter into Test without Load.
2. The DMC sends a start signal to the generator sets.
3. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
4. The first generator set closes to the bus as dictated by the First Start System.
5. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
6. The 52-GM breaker remains open.
7. Load Demand operates if it is enabled.

### 3.4.2 Test without Load Off - Single Loadbus (Auto – Open or Auto – Soft Closed Transition)

1. The system test command is removed from the system.
2. The DMC removes the start signals from the generator sets.
3. The respective PCC on each generator set opens its generator set breaker.
4. The generator sets run in cooldown mode and then stop.
5. The system returns *Normal Standby Conditions.*

### 3.4.3 Test with Load On - Single Loadbus (Auto – Open Transition)

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts. (The generator set's start signal is removed if the Min. Capacity to Connect is not reached before the time expires. Operator intervention is required.)

4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
9. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
10. After the 52-UM breaker opens, the Programmed Transition Delay starts in the DMC.
11. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect is still true.
12. The DMC commands the 52-GM breaker to close. The 52-GM breaker closes and the Min. Capacity to Connect timer stops and resets.
13. The Loadbus is powered by the generator set source.
14. The normal load add sequence starts as described in *Load Add Sequence during Loss of Utility Source.*
15. Load Demand operates if it is enabled.

### 3.4.4 Test with Load Off - Single Loadbus (Auto – Open Transition)

1. The system test command is removed from the system.
2. The system follows the sequence described in *Return of Single Utility Source (Auto – Open Transition).*

### 3.4.5 Test with Load On - Single Loadbus (Auto – Soft Closed Transition)

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts. (The generator set's start signal is removed if the Min. Capacity to Connect is not reached before the time expires. Operator intervention is required.)
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the master synchronizer is enabled between the generator set source and the utility source to synchronize the generator sets to the utility source.
9. The DMC verifies that Min. Capacity to Connect is still true and when the sync check

conditions are met for the 52-GM breaker, the DMC commands the 52-GM breaker to close. The 52-GM breaker closes.

10. The generator sets start to ramp up.
11. When the load across the 52-UM breaker is below the Unload kW threshold, the DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
12. The Loadbus is powered by the generator set source.
13. Load Demand operates if it is enabled.

### 3.4.6 Test with Load Off - Single Loadbus (Auto – Soft Closed Transition)

1. The system test command is removed from the system.
2. The system follows the sequence described in *Return of Single Utility Source (Auto – Open Transition).*

### 3.4.7 Test with Load On - Dual Loadbus (Auto – Open Transition)

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timers start (If the Min. Capacity to Connect is not reached for Loadbus 1 and it is not reached for Loadbus 2 before the timer expires, the start signal is removed. Operator intervention is required.)
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires for the first transfer pair, the DMC commands the 52-UM1 breaker to open. The 52-UM1 breaker opens.
9. All feeder breakers on Loadbus 1 not assigned to Load Shed Level 0 are commanded to open.
10. After the 52-UM1 breaker opens, the Programmed Transition Delay for the first transfer pair starts in the DMC.
11. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect is still true.
12. The DMC commands the 52-GM1 breaker to close. The 52-GM1 breaker closes.
13. Loadbus 1 is powered by the generator set source.
14. All feeder breakers on Loadbus 1 assigned to Load Add Level 1 are commanded to close.
15. The DMC commands the 52-UM2 breaker to open. The 52-UM2 breaker opens.
16. All feeder breakers on Loadbus 2 not assigned to Load Shed Level 0 are commanded to open.
17. After the 52-UM2 breaker opens, the Programmed Transition Delay for that transfer pair starts in the DMC.

18. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect is still true.
19. The DMC commands the 52-GM2 breaker to close. The 52-GM2 breaker closes.
20. Loadbus 2 is powered by the generator set source.
21. The normal load add sequence starts as described in *Load Add Sequence during Loss of Utility Source.*
22. Load Demand operates if it is enabled.

### 3.4.8 Test with Load Off - Dual Loadbus (Auto – Open Transition)

1. The system test command is removed from the system.
2. The system follows the sequence described in *Return of Both Utility Sources (Auto – Open Transition).*

### 3.4.9 Test with Load On - Dual Loadbus (Auto – Soft Closed Transition)

1. The system is commanded to enter into Test with Load.
2. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
3. The first generator set closes to the bus as dictated by the First Start System.
4. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
5. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
6. When the Transfer Delay expires for the first transfer pair, the master synchronizer is enabled between the generator sets and Utility Source 1 to synchronize the generator sets to Utility Source 1.
7. The DMC verifies that Min. Capacity to Connect is still true and when the sync check conditions are met for the 52-GM1 breaker, the DMC commands the 52-GM1 breaker to close. The 52-GM1 breaker closes.
8. The generator sets start to ramp up.
9. When the load across the 52-UM1 breaker is below the Unload kW threshold, the DMC commands the 52-UM1 breaker to open. The 52-UM1 breaker opens.
10. When the Transfer Delay expires for the second transfer pair, the master synchronizer is enabled between the generator sets and Utility Source 2 to synchronize the generator sets to Utility Source 2.
11. The DMC verifies that Min. Capacity to Connect is still true and when the sync check conditions are met for the 52-GM2 breaker, the DMC commands the 52-GM2 breaker to close. The 52-GM2 breaker closes.
12. The generator sets start to ramp up.
13. When the load across the 52-UM2 breaker is below the Unload kW threshold, the DMC commands the 52-UM2 breaker to open. The 52-UM2 breaker opens.
14. Load control will occur as described in *Normal Load Control.*
15. Load Demand operates if it is enabled.

### 3.4.10 Test with Load Off - Dual Loadbus (Auto – Soft Closed Transition)

1. The system test command is removed from the system.
2. The system follows the sequence described in *Return of Both Utility Sources (Auto – Soft Closed Transition).*

## 3.5 Extended Parallel

Extended Parallel allows the generator sets and utility source to run in parallel. Both the generator sets and the utility source can be controlled by kW (real power) or kVAR (reactive power). The kW (real power) and kVAR (reactive power) controls are independent. For example, kW can control the Genbus (baseload) while kVAR controls the utility bus (peak shave). The kW and kVAR Load Control Type and Control Setpoints are set up on the System Control screen.

### 3.5.1 Extended Parallel Start Sequence

1. The utility source is available and connected.
2. The system is commanded to enter into Extended Parallel.
3. The DMC sends a start signal to the generator sets.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC.
8. When the Transfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
9. The DMC verifies that the sync check conditions are met for the 52-GM breaker and the DMC commands the 52-GM breaker to close. The 52-GM breaker closes.
10. The generator sets ramp up to the required kW and kVAR values.
11. The system continues to run in Extended Parallel until commanded to stop or a utility source failure condition is recognized.

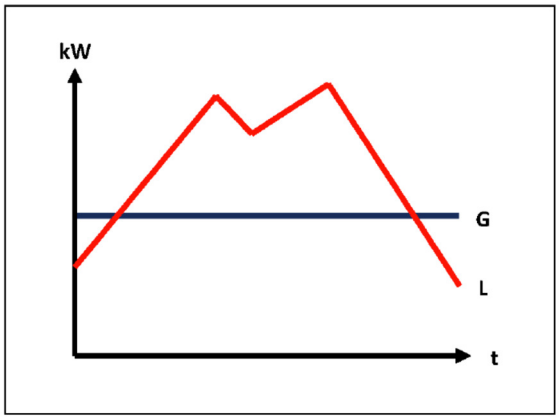
### 3.5.2 Extended Parallel Stop Sequence

1. The Extended Parallel command is removed from the system.
2. The generator sets start to ramp down.
3. When the load across the 52-GM breaker is below the Unload kW threshold, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
4. The Loadbus is powered by the utility source.
5. The DMC removes the start signals from the generator sets.
6. The PCC on each generator set opens its generator set breaker.
7. The generator sets run in cooldown mode and then stop.
8. The system returns to *Normal Standby Conditions.*

## 3.5.3 kW Load Control Type and Setpoint

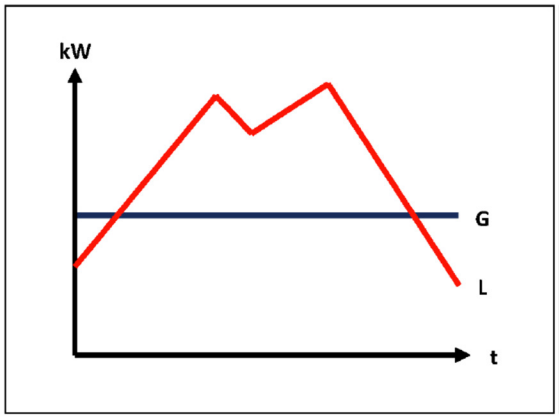
### 3.5.3.1 Generator Bus % Level (%kW Baseload)

- All generator sets operate at the %kW setpoint.
- The generator bus kW is the result of the number and size of the generator sets that are online. This is an open loop control method.
- If a generator set is not available, the remaining generator sets do not provide more power to compensate. The utility source provides the rest of the power required by the loads. If the load falls below the generator set output, power is exported to the utility source.
- The following graph illustrates the Generator Bus % level method, where kW = real power, t = time, L = Load, and G = generator set output.



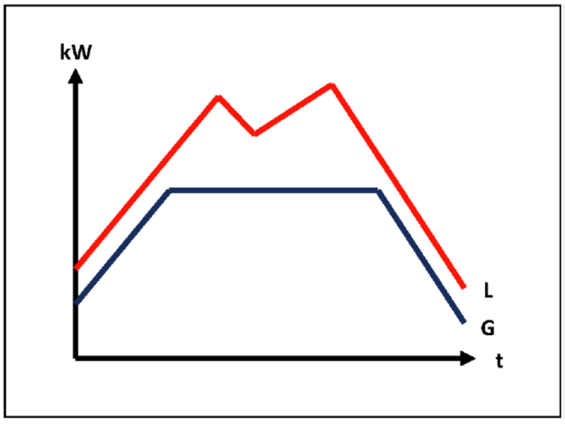

### 3.5.3.2 Generator Bus kW (Baseload)

- The DMC drives the kW control output to achieve the kW setpoint at the generator set main.
- The available generator sets provide a fixed amount of real power. This is a closed loop control method. Generator sets of different sizes contribute the same % kW to the total kW requested. If a generator set is not available, the remaining generator sets provide more power to compensate as long as there is enough capacity. The utility source provides the rest of the power required by the loads. If the load falls below the generator set output, power is exported to the utility source.
- The following graph illustrates the Generator Bus % level method, where kW = real power, t = time, L = Load, and G = generator set output.



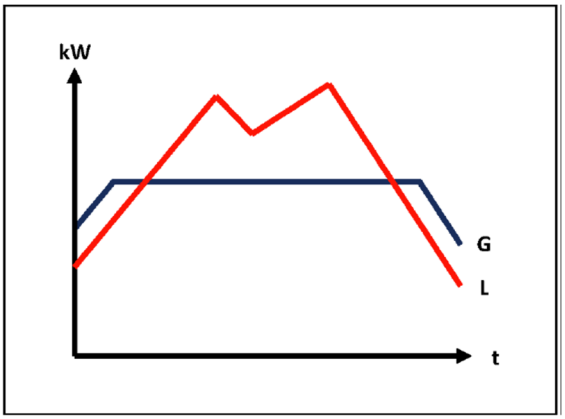

### 3.5.3.3 Generator Bus kW with Utility Constraint (Baseload with Export Limit)

- The DMC drives the kW control output to achieve the kW setpoint from the generator sets and reduces the setpoint to keep the kW at the utility main breaker above the programmed level.
- This prevents tripping a utility main breaker reverse power relay because of the load falling below the generator set kW setpoint. This is a closed loop control method. Generator sets of different sizes contribute the same % kW to the total kW requested.
- The generator sets provide a fixed amount of real power as long as the utility source provides a minimum amount of real power. If the utility source starts providing less power than the minimum amount, the amount of power the generator sets provide is reduced. The Generator Bus kW is the amount of real power provided by the generator sets and the Utility Bus kW Constraint Level is the minimum amount of real power provided by the utility source.
- If the Utility Bus kW Constraint Level is 0 or above, the generator sets are prevented from providing power to the utility source.
- If the Utility Bus kW Constraint Level is less than 0 (negative), the generator sets export power to the utility if the load is less than the amount of real power provided by the generator sets. For example, if the utility source is supposed to provide -500 kW, the generator sets can export up to 500 kW of power to the utility source.
- The following graph illustrates the Generator Bus kW with Utility Constraint method when the minimum amount of real power provided by the utility is set to a positive value, where kW = real power, t = time, L = Load, and G = generator set output.



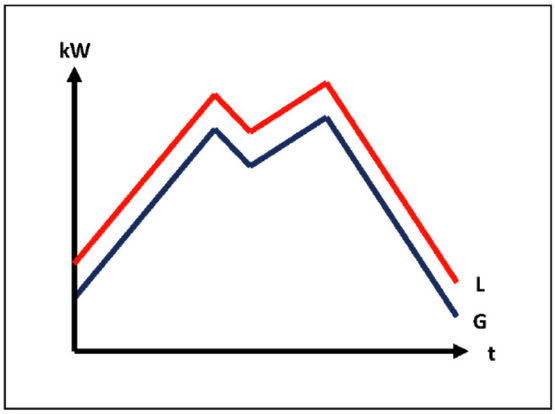

- The following graph illustrates the Generator Bus kW with Utility Constraint method when the

minimum amount of real power provided by the utility source is set to a negative value, where kW = real power, t = time, L = Load, and G = generator set output.




### 3.5.3.4 Utility Bus kW (Peak Shave)

- The DMC drives the kW control output to achieve the kW setpoint at the utility main.
- The utility source provides a fixed amount of real power. The generator sets provide the rest of the power required by the loads. This is a closed loop control method. Generator sets of different sizes contribute the same % kW to the total kW requested.
- The following graph illustrates the Utility Bus kW method, where kW = real power, t = time, L = Load, and G = generator set output.




## 3.5.4 kVAR Load Control Type and Setpoint

kVAR Load Control type must be set to “None” when PCC3100 controllers are present in the system.

### 3.5.4.1 None (Generator Set Controls)

The DMC does nothing. The generator sets control kVAR based on their own settings.

### 3.5.4.2 Generator Bus % Level

The available generator sets run at the percentage of their rated outputs. If a generator set is not

available, the remaining generator sets do not provide more power to compensate. This is an open loop control method.

The Genbus kVAR is the result of the number and size of the generator sets online.

#### 3.5.4.3 Generator Bus Power Factor

The DMC adjusts the kVAR output of the generator set to maintain the power factor on the generator sets. The utility source makes up the difference depending on the load power factor. This is a closed loop control method.

#### 3.5.4.4 Generator Bus kVAR

The DMC drives the kVAR control output to achieve the kVAR setpoint at the generator set main. The utility source makes up the difference depending on the load power factor. This is a closed loop control method.

#### 3.5.4.5 Utility Bus kVAR

The DMC drives the kVAR control output on the generator sets to achieve the kVAR setpoint at the utility main. This is a closed loop control method.

#### 3.5.4.6 Utility Bus Power Factor

The DMC drives the kVAR control output on the generator sets to achieve the power factor setpoint at the utility main. This is a closed loop control method.

# 4 Normal Load Control

## 4.1 Load Control Levels

Normal load control uses two sets of levels for control. Each load is assigned to a load add (0-8) and shed level (0-7). A load add or shed level can have one or more loads assigned to it. A single load may only have 1 level for add and 1 level for shed assigned to it.

A load assigned to Load Add Level 0 is not part of the Load Add sequence and is assigned to Load Shed Level 0. A load assigned to an add level of 0 is forced to have a shed level of 0. This is useful for future loads.

Add levels are used to control the load stepping onto the generator sets while they are connecting to the Genbus. Level 1 is the first load to add. Level 2 is the second load to add, and so forth up to the total number of load add levels assigned in the system.

Shed levels are used to handle load removal from the Genbus if the DMC receives a Load Dump signal from the generator sets. Level 1 is the first load to shed. Level 2 is the second load to shed, and so forth up to the total number of load shed levels in the system. A shed level of 0 is used for critical loads that should never shed. Because a level 0 load never sheds, it cannot have an add level higher than 1 since it is assumed to be on the Genbus when the generator sets connect.

Shed level assignment can be done automatically by the DMC based on the load add level or can be user defined. When the shed sequence is automatically determined, the loads shed in the reverse order that they were added. When user defined, the restrictions stated above for shed level 0 still apply.

## 4.2 Load Control Sizing

When sizing system loads to generator sets, load(s) assigned to Load Add Level 1 should not exceed the kW capacity of the smallest generator set in the system. Loads assigned to Load Add Level 2 should not exceed the kW capacity of the smallest two generator sets in the system. This philosophy should continue for all of the generator sets in the system until the Required Online Capacity is reached. This is important when the generator sets in the system are not the same size. Starting with the smallest generator set takes into account the worst case sizing scenario.

## 4.3 Load Control Timing

The Genbus has two time delays for controlling the load.

- Genbus Delay - The amount of time that must expire before adding the next load add level. The delay ensures that loads do not add too rapidly if the generator sets parallel with each other on the Genbus too quickly.
- Shed Delay – The amount of time that must expire before shedding the next load shed level. The delay allows the system to stabilize before shedding load too rapidly and possibly dropping more load than required to clear an overload condition.

## 4.4 Load Add Sequence during Loss of Utility Source

1. Each load on Loadbus 1 and Loadbus 2 is assigned a load add level.
2. When the first generator set connects to the Loadbus, all loads assigned to Load Add Level 1 are commanded to add.
3. The Genbus Delay timer starts timing.
4. When the second generator set connects to the Loadbus and the Genbus Delay has expired, all loads assigned to Load Add Level 2 are commanded to add.
5. The Genbus Delay resets and starts timing for the newly added load add Level.
6. This sequence continues until the Required Online Capacity for the Loadbus is met or when all existing generator sets connect to the Loadbus. Any remaining levels are added separated by the Genbus Delay.
7. In the event that the Required Online Capacity for the Loadbus is not met and not all existing generator sets connect to the Loadbus, the DMC only adds load add levels equal to the number of generator sets online. Any further load add levels need to be added using the manual commands on the Load Control screen. The operator is responsible for verifying that enough capacity exists to add a specific level. Levels do not need to be added in order.
8. If both Loadbus 1 and Loadbus 2 require generator set service, normal load control on the connected Loadbus is paused until the second Loadbus reaches the Min Capacity to Connect, initiates the transfer, and closes its 52-GM breaker. All loads assigned to Load Add Level 1 are commanded to add.
9. If the second Loadbus fails to connect, the load add pause on the first Loadbus is released and the other load add levels are added per the sequence. Once Load Add Level 1 is added on the second Loadbus, the Genbus Delay timer starts timing. Additional generator sets may already be connected due to the Min. Capacity to connect requirements but additional load add levels always wait for the completion of the Genbus Delay.
10. When the second generator set connects to the Loadbus and the Genbus Delay expires, all loads assigned to Load Add Level 2 on both Loadbus 1 and Loadbus 2 are commanded to add.
11. This sequence continues until the Required Online Capacity for the Loadbus is met or when all existing generator sets connect to the Loadbus. Any remaining levels are added separated by

the Genbus Delay.

12. If an overload condition occurs for any reason, load adding stops and the system starts the load shed sequence.

## 4.5 Load Add Sequence during Return to Utility Source

1. Each load on the Loadbus is assigned a load add level.
2. A level 1 load add command is issued even though all loads assigned to Load Add Level 1 should already be connected to the Loadbus.
3. The Utility Delay starts timing as soon as the 52-UM breaker closes.
4. When the Utility Delay expires, all loads assigned to Load Add Level 2 are commanded to add.
5. The Utility Delay resets and starts timing for the next load add level.
6. This sequence continues until all load add levels are commanded to add.

## 4.6 Load Shed Sequence

1. Each load is assigned a load shed level.
2. One or more connected generator sets sends a Load Dump signal to the DMC.
3. Upon detection of an overload (Load Dump) signal from any generator set, the smallest non-zero load shed level that is connected to the Genbus is instantly turned on. Typically, Load Shed Level 1. It may not be shed level 1 if the load add did not complete before the overload condition occurred or if Load Shed Level 1 was not assigned to a load.
4. The Shed Delay starts timing.
5. When the Shed Delay expires, the DMC continues to monitor the Load Dump signal. If the signal is still present, the next load shed level that is connected to the Genbus is turned on. Typically, Load Shed Level 2.
6. The Shed Delay timer resets and starts timing again for the next load shed level.
7. The sequence continues until all load shed levels that were connected to the Genbus turn on (except for Load Shed Level 0) or the DMC detects that the Load Dump signal has been removed by the generator sets.
8. When the overload condition is no longer active, the operator resets the overload alarm and restores load shed levels on the Load Control screen. Restoration of load shed levels does not need to be done in order. Loads that have been shed cannot be restored until the overload alarm is cleared.
9. As long as the system is on generator set source, there is no automatic restore for levels that have been shed. They must be manually restored by the operator.
10. If an overload condition occurs while the system is on generator set source during Test with Load in Auto – Open Transition and Authorized Return to Utility Required is not selected, the test is immediately terminated and the system is retransferred to the utility source without shedding any loads. If Authorized Return to Utility Required is selected, the system stays in Test with Load and follows the normal shed sequence.
11. If an overload condition occurs while the system is on generator set source during Test with Load in Auto – Soft Closed Transition and Authorized Return to Utility Required s not selected, the test is immediately terminated, a retransfer to the utility source is initiated, and the system follows the normal shed sequence. If Authorized Return to Utility Required is selected, the system stays in Test with Load and follows the normal shed sequence.

12. If a restored level causes an overload condition, restoration of levels is stopped and the load shed sequence starts again.
13. If the system is retransferred to the utility source while there are still shed levels active, the sheds are automatically cleared and the load levels restored to the utility source.

## 4.7 Quick Shed

Quick Shed is used when the failure of a generator set will have a significant affect on the stability of the generator set supply to the load. When Quick Shed is enabled and a generator set shutdown is detected, all load shed levels are shed except for Load Shed Level 0. The load add sequence is restarted and load add levels are added on a timed basis until the number of generator sets connected to the Genbus equals the load add level. If the Required Online Capacity for the Genbus is met again, even with a generator set shutdown, loads are added on a timed basis until all levels are added.

## 4.8 Open Transition Utility Transfer Load Shed

When transferring to a utility source, the DMC allows the capability for feeder breakers to remain closed during the open transition transfer. When the **Open Transition Utility Transfer Load Shed** checkbox is disabled on the Setup screen, it will block load the utility source with the facility load as soon as the utility circuit breaker closes. This reduces the number of cycles on the feeder breakers and the amount of time load is unpowered during the transition to the utility source.

# 5 Load Demand

Load Demand is used to match generating capacity to the load in order to optimize fuel efficiency and prolong generator set life while maintaining the right amount of reserve capacity for the customer's application. Either generator set operating percentage or facility load steps can be used to determine the number of generator sets to run for a specific load. The Load Demand Sequence and Load Demand Set Points are set up on the Load Demand screen. After the parameters are set up, the system follows the selected load demand sequence.

The load demand sequence is automatically adjusted if a generator set warning alarm occurs. The generator set that has a warning fault is moved to the lowest priority generator set in the sequence. If all generator sets are not required to supply the load, the generator set with the fault is the first to shut down to reduce the risk that the warning condition could develop into a more serious fault.

The following conditions can inhibit or cancel load demand. All load demand stop commands are removed.

- An active overload condition
- System is set to Manual mode on the System Control screen (no generator set restarts until the system is returned to Auto – Open Transition or Auto – Soft Closed Transition)
- Genbus metering failure
- Generator set I/O island failure
- System is in Extended Parallel and the Generator Bus %kw Load Control Type is selected
- Load Demand is disabled on the Load Demand screen

# 5.1 Load Demand Sequence

### 5.1.1 Run Hours Monitoring

The load demand sequence changes based on the engine run hours of the generator sets in the system. The generator sets with the lowest run hours have the highest priority in the load demand sequence and accumulate more run hours than the lower priority generator sets. The amount of

difference between the engine hours before the load demand sequence is adjustable from 1-500 hours.

### 5.1.2 Auto Rotate

The load demand sequence changes every time load demand is activated. The lead unit becomes the lowest priority generator set and all other generator sets in the system increase in priority by one level.

### 5.1.3 User Defined

The load demand sequence is set up by the operator. The operator changes the sequence to increase the system reliability.

## 5.2 Load Demand Set Points

The set points used depend on the load demand sequence selected.

The DMC automatically shuts down and restarts generator sets in an order determined by the load demand sequence selected. Generator set faults can cause the DMC to automatically reorder the sequence. The sequence is shown in alphabetical order, such as Lead (A), B, and so on depending on the total number of generator sets in the system.

The shutdown and restart sequence determines the order in which generator sets are shut down and restarted. The sequence is defined in the order, Lead (A) unit, B unit, C unit, D unit, etc. Each letter is assigned a generator set number. Each generator set in the sequence can only appear once. All of the generator sets in the sequence must be part of the system (does not include future generator sets).The shutdown order is executed in reverse alphabetical order. The restart order is executed in alphabetical order. The lead unit is the highest priority and is never shut down.

### 5.2.1 Percent or Absolute kW

The shutdown and restart set points can use %kW or Absolute kW to determine the thresholds for starting and then stopping the generator sets. The default unit is %kW. The larger the site is, the %kW method is less efficient since the reserve capacity is percentage rather than a fixed amount. The Absolute kW value can be used under the following conditions:

- There are more than 4 generator sets in the system.
- The system fuel efficiency has high importance.
- The system redundancy, such as N+1 for the generator sets has high importance.

Absolute kW requires that the load profile of the site be understood well enough to determine spinning reserve requirements.

### 5.2.2 Shutdown %kW (Percent kW)

The percentage of the load that will be carried by the remaining generator sets once a generator set is shut down by load demand. The actual load on the generator sets must be less than this value prior to a generator set shutdown. The shutdown %kW must be at least 5 percent smaller than the restart %kW.

### 5.2.3 Restart %kW (Percent kW)

The percentage of online load with respect to the online generator set capacity that must be exceeded to restart the next generator set in the load demand sequence.

### 5.2.4 Shutdown kW (Absolute kW)

Shutdown kW must be set to a number greater than Restart kW. It should be set based upon how rapidly and how much load can decrease. If set too low, generator sets will cycle on and off too frequently. If set too high, system efficiently will decrease since more generator sets will be running than needed. The shutdown capacity is the amount of reserve capacity that will be left when the lowest priority generator set shuts down. This should be at least 5% of the generator capacity more than the restart kW, or more if the loads that cycle repetitively are larger than this value. The actual pickup and dropout point for each generator set in the system can be viewed once the set points have been entered.

### 5.2.5 Restart kW (Absolute kW)

Restart kW is the minimum amount of spare online capacity that the system will always try to maintain, i.e., the spinning reserve amount. The setting depends on system requirements. To maintain additional generation to cover for a failure of generator sets, setting the Restart kW greater than the size of one generator set ensures that there is some reserve capacity after the generator set goes offline. If fuel economy is more important, the restart kW should be the largest amount of load increase that can happen before the system is able to add another generator set.

### 5.2.6 Initial Delay

The time that the DMC waits after load demand is enabled and all conditions for load demand have been met before load demand becomes active.

### 5.2.7 Shutdown Delay

The time the DMC waits before shutting down a generator set if the facility load is sufficiently low. The Shutdown Delay is used to place the appropriate number of generator sets in load demand stop for the load required by the Genbus. When load demand is enabled, the system calculates the generator sets that can be shut down. Any generator set that has a Shutdown kW that is less than the load kW initiates the Shutdown Delay. If more than one generator set has a Shutdown kW that is less than the load kW, the Shutdown Delay begins timing 5 seconds apart so that the generator sets will be stopped sequentially every 5 seconds.

### 5.2.8 Restart Delay

The Restart Delay is the time required for the Genbus to be at or greater than the restart capacity. The delay helps prevent a generator set from restarting unnecessarily due to load transients.

### 5.2.9 Run Hour Differential (Run Hours)

The minimum difference of run hours between the generator sets for the Run Hours load demand sequence.

### 5.2.10 Spare Capacity Pick Up

The system has a remote input contact that allows the load demand to respond to large load steps. When the input is on, load demand adds the spare capacity pick up kW to the actual load and starts enough generator sets to make sure that the generator sets can supply the additional load. This is useful for facilities that have large loads that are periodically added to the system. The load demand set points are optimized to reduce fuel consumption of the generator sets and provide a means to start large loads.

# 6 Authorized Return to Utility Required

Authorized Return to Utility Required is used to inhibit the automatic retransfer back to the utility source until it is manually initiated by the operator. This selection is on the Setup screen. When selected, the confirmation to retransfer appears on the Oneline screen to allow the operator to authorize the retransfer.

# 7 Generator Set Manual Operation

When Manual mode is selected at the HMI, no automatic operations are performed by the DMC. All generator set start/stop and any breaker open/close must be initiated by the operator.

## 7.1 Manual Operation from the HMI

1. The operator initiates this mode by selecting the Transition Type Manual radio button on the System Control screen.
2. This mode allows the operator to start/stop each generator set and open/close each generator set breaker on the Generator Summary screen.
    - Note: The generator set breakers cannot be closed in Manual mode unless the Loadbus is confirmed dead.
3. This mode allows the operator to open/close utility main and generator main breakers on the Oneline screen.
    - Note: The utility main and generator main breakers cannot be closed in Manual mode under certain conditions.
4. The operator exits this mode by selecting a Transition Type of either Auto – Open Transition or Auto – Soft Closed Transition on the System Control screen.

## 7.2 Manual Operation from the PCC

This mode can be used if the DMC fails and it becomes necessary to start the generator sets and connect them to the Loadbus.

1. Place the mode control switch for the transfer pair in Manual.
2. Place the generator set in manual from the local generator set PCC.
3. Control the utility main and generator main breakers with their individual breaker control switches on the front of the switchgear.
4. The utility main and generator main breakers are electrically interlocked to prevent any manual closed transition operation.
5. Start each generator set manually and close its generator set breaker to a dead bus from the PCC. Refer to the specific generator set manual to perform this function.
6. When the generator sets are connected to the Loadbus, follow the facility safety procedures to manually add additional loads if sufficient capacity exists.
7. Return the generator sets to standby mode by disconnecting facility loads per the facility procedures. Open each generator set breaker and shut down each generator set from the respective PCC.
8. Switch each generator set control switch from Manual to Auto mode at the local generator set PCC.
9. The mode control switch of the transfer pair should be returned to Auto mode after the utility main and generator main breakers are returned to their normal standby conditions.

# 8 Failure Modes

## 8.1 Generator Set Failures

### 8.1.1 Generator Set Fail to Start

If a generator set fails to start after the over crank or fail to crank time delay (set in the PCC) expires, the generator set shuts down and an alarm sounds on the DMC.

### 8.1.2 Generator Set Fail to Synchronize

If a generator set fails to synchronize after a preset time delay (set in the PCC), an alarm sounds on the DMC and the generator set continues attempting to synchronize until signaled to stop by an operator either on the PCC or Generator Summary screen.

### 8.1.3 Generator Set Fail to Come Online

If an available generator set fails to come online after the time delay (set in the PLC) expires, an alarm sounds on the DMC.

### 8.1.4 Generator Set Breaker Fail to Close

If a generator set breaker fails to close, an alarm sounds on the DMC and the generator set may or may not shut down depending on how it is configured in the PCC. The operator resets the alarm at the PCC and DMC.

### 8.1.5 Generator Set Breaker Fail to Open

If a generator set breaker fails to open, an alarm sounds on the DMC and the unit continues to run with the fail to open warning. Once the breaker is open, the operator resets the alarm at the PCC and DMC.

### 8.1.6 Generator Set Breaker Fail to Open on Shutdown

If a generator set breaker fails to open and the generator set shuts down, an alarm sounds on the DMC. The other generator sets are inhibited and start signals are removed to isolate the failed generator set. The failed generator set must be disconnected from the bus to reset the alarm at the DMC.

## 8.2 52-UM Breaker Failures (Auto – Open Transition)

The following sequences apply to Loadbus 1 or Loadbus 2.

### 8.2.1 52-UM Breaker Fail to Open during Loss of Utility Source

1. The DMC receives a loss of utility source signal from the device monitoring the utility source.
2. The Utility Fail Delay within the DMC starts and expires.
3. The DMC sends a start signal to the generator sets.
4. The Min. Capacity to Connect timer starts.
5. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
6. The first generator set closes to the bus as dictated by the First Start System.
7. The remaining generator sets synchronize to the Genbus and close their respective generator

set breakers when synchronization conditions are met within their PCCs.

8. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
9. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker fails to open.
10. The “52-UM Fail to Open” alarm is registered on the DMC.
11. The DMC removes the 52-UM breaker open signal.
13. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.2.2 52-UM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is not available, the system follows the sequence described in *Loss of Single Utility Source (Auto – Open or Auto – Soft Closed Transition).*

### 8.2.3 52-UM Breaker Fail to Open during Test with Load

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker fails to open.
9. The “52-UM Fail to Open” alarm is registered on the DMC.
10. The DMC removes the 52-UM breaker open signal.
11. The system is removed from Test with Load.
12. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.2.4 52-UM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Conditions* and does not reenter the test automatically.

### 8.2.5 52-UM Breaker Fail to Close on Return of Utility Source or Test with Load Off

1. The system is powered by the generator set source.
2. The system is removed from Test with Load or the utility source returns.
3. The Retransfer Delay starts in the DMC.
4. When the Retransfer Delay expires, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
5. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
6. After the 52-GM breaker opens, the Programmed Transition Delay starts in the DMC.
7. When the Programmed Transition Delay expires, the DMC commands the 52-UM breaker to close. The 52-UM breaker fails to close.
8. The “52-UM Fail to Close” alarm is registered on DMC.
9. The DMC removes the 52-UM breaker close signal.
10. The DMC commands the 52-GM breaker to close. The 52-GM breaker closes.
11. The normal load add sequence starts as described in *Load Add Sequence during Loss of Utility Source.*
12. Load Demand operates if it is enabled.
13. If the other transfer pair is ready to be retransferred to the utility source, the system continues the retransfer to the utility source on the other Loadbus.

### 8.2.6 52-UM Breaker Fail to Close Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is available, the system follows the appropriate utility return sequence.
3. If the utility source is not available, the facility remains powered by the generator set source.

## 8.3 52-GM Breaker Failures (Auto - Open Transition)

### 8.3.1 52-GM Breaker Fail to Open on Return of Utility Source or Test with Load Off

1. The system is powered by the generator set source.
2. The system is removed from Test with Load or the utility source returns.
3. The Retransfer Delay starts in the DMC.
4. When the Retransfer delay expires, the DMC commands the 52-GM breaker to open. The 52-GM breaker fails to open.
5. The “52-GM Fail to Open” alarm is registered on the DMC.
6. The DMC removes the 52-GM breaker open signal.
7. The generator sets continue to run and power the Loadbus. If the other transfer pair is ready to be retransferred to the utility source, the system continues the retransfer to the utility source on the other Loadbus.

### 8.3.2 52-GM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-GM breaker and resets the alarm on the DMC.
2. If the utility source is available, the system follows the sequence described *in Return of Single Utility Source (Auto – Open Transition).*
3. If the utility source is not available, the facility remains powered by the generator set source.

### 8.3.3 52-GM Breaker Fail to Close during Loss of Utility Source

1. The DMC receives a loss of utility source signal from the device monitoring the utility source.
2. The Utility Fail Delay within the DMC starts and expires.
3. The DMC sends a start signal to the generator sets.
4. The Min. Capacity to Connect timer starts.
5. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
6. The first generator set closes to the bus as dictated by the First Start System.
7. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
8. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
9. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
10. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
11. After the 52-UM breaker opens, the Programmed Transition Delay starts in the DMC.
12. When the Programmed Transition Delay expires, the DMC verifies that the Min. Capacity to Connect is true.
13. The DMC commands the 52-GM breaker to close. The 52-GM breaker fails to close.
14. The “52-GM Fail to Close” alarm is registered on the DMC.
15. The DMC removes the 52-GM breaker close signal.
16. The DMC removes the start signals from the generator sets.
17. The PCC on each generator set opens its generator set breaker.
18. The generator sets run in cooldown mode and then stop.
19. The facility load remains unpowered.
20. If the utility source returns, the 52-UM breaker closes.
21. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.3.4 52-GM Breaker Fail to Close Reset

1. The operator clears the fault on the 52-GM breaker and resets the alarm on the DMC.
2. If the utility source is not available, the system follows the sequence described in *Loss of Single Utility Source (Auto – Open or Auto – Soft Closed Transition).*

3. If the utility source is available, the system follows the sequence described in *Return of Single Utility Source (Auto – Open Transition).*

### 8.3.5 52-GM Breaker Fail to Close during Test with Load On

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
9. All feeder breakers not assigned to Load Shed Level 0 are commanded to open.
10. After the 52-UM breaker opens, the Programmed Transition Delay starts in the DMC.
11. When the Programmed Transition Delay expires, the DMC verifies that Min. Capacity to Connect is true.
12. The DMC commands the 52-GM breaker to close but the 52-GM breaker fails to close.
13. The “52-GM Fail to Close” alarm is registered on the DMC.
14. The DMC removes the 52-GM breaker close signal.
15. The system is removed from Test with Load.
16. The DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
17. The normal load add sequence starts as described in *Load Add Sequence during Return to Utility Source.*
18. The Loadbus is powered by the utility source.
19. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.3.6 52-GM Breaker Fail to Close Reset

1. The operator clears the fault on the 52-GM breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Conditions* and does not reenter Test with Load automatically.

## 8.4 52-UM Breaker Failure (Auto - Soft Closed Transition)

### 8.4.1 52-UM Breaker Fail to Open during Loss of Utility Source

The system follows the sequence described in Auto – Open Transition *52-UM Breaker Fail to Open during Single Loss of Utility Source.*

### 8.4.2 52-UM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is not available, the system follows the sequence described in *Loss of Single Utility Source (Auto – Open or Auto – Soft Closed Transition).*

### 8.4.3 52-UM Breaker Fail to Open during Test with Load

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
9. The DMC verifies that Min. Capacity to Connect is true and the DMC commands the 52-GM breaker to close. The 52-GM breaker closes and Min. Capacity to Connect timer stops and resets.
10. The generator sets start to ramp up.
11. When the load across the 52-UM breaker is below the Unload kW threshold, the DMC commands the 52-UM breaker to open. The 52-UM breaker fails to open.
12. The “52-UM Fail to Open” alarm is registered on DMC.
13. The system is removed from Test with Load.
14. The generator sets ramp down.
15. When the load across the 52-GM breaker is below the Unload kW threshold, the DMC commands the 52-GM breaker to open. The 52-GM breaker opens.
16. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.4.4 52-UM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Conditions* and does not reenter Test with Load automatically.

### 8.4.5 52-UM Breaker Fail to Close on Return of Utility Source or Test with Load Off

1. The system is powered by the generator set source.
2. The system is removed from Test with Load or the utility source returns.

3. When the Retransfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
4. Once the generator sets synchronize to the bus and the sync check conditions are met for the 52-UM breaker, the DMC commands the 52-UM breaker to close. The 52-UM breaker fails to close.
5. The “52-UM Fail to Close” alarm is registered on DMC.
6. The DMC removes the 52-UM breaker close signal.
7. The system responds with the utility failure sequence described in *Loss of Single Utility Source (Auto – Open or Auto – Soft Closed Transition).*
8. If the other transfer pair is ready to be retransferred to the utility source, the system continues the retransfer to the utility source on the other Loadbus.

### 8.4.6 52-UM Breaker Fail to Close Reset

1. The operator clears the fault on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is available, the system follows the sequence described in *Return of Single Utility Source (Auto – Soft Closed Transition).*

### 8.4.7 Fail to Sync on Return of Utility Source or Test with Load Off

1. The DMC detects the removal of the loss of utility source signal from the device monitoring the utility source or the Test with Load command is removed.
2. The Retransfer Delay starts in the DMC.
3. When the Retransfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
4. If the Fail to Sync time delay expires before the sources are brought into sync, the “Fail to Sync” alarm is registered on the DMC.
5. The synchronizer remains active attempting to synchronize the generator set source to the utility source. The synchronizer is disabled if the other transfer pair is ready to be retransferred to the utility source. Once the other transfer pair has successfully retransferred or failed to sync, the synchronizer is enabled again.
6. The loads continue to be carried by the generator set source until the sources come into sync and the transfer is completed or the operator intervenes.
7. The operator can put the system in Auto – Open Transition mode and reset the alarm on the DMC. The system follows the sequence described in *Return of Single Utility Source (Auto – Open Transition).*

### 8.4.8 Fail to Sync while entering Test with Load or Extended Parallel

1. The system is commanded to enter into Test with Load or Extended Parallel.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator

set breakers when synchronization conditions are met within their PCCs.

7. The Transfer Delay starts in the DMC when:
   - For Test with Load - the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
   - For Extended Parallel - any generator set connects to the Genbus.
8. When the Transfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
9. If the Fail to Sync time delay expires before the sources are brought into sync, the “Fail to Sync” alarm is registered on the DMC.
10. The system is removed from Test with Load or Extended Parallel.
11. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

## 8.5 52-GM Breaker Failures (Auto - Soft Closed Transition)

The following sequences apply to Loadbus 1 or Loadbus 2.

### 8.5.1 52-GM Breaker Fail to Open during Return of Utility Source or Test with Load Off

1. The system is powered by the generator set source.
2. The system is removed from Test with Load or the utility source returns.
3. The Retransfer Delay starts in the DMC.
4. When the Retransfer Delay expires, the master synchronizer is enabled between the utility source and the Genbus to synchronize the generator sets to the utility source.
5. Once the generator sets synchronize to the bus and the sync check conditions are met for the 52-UM breaker, the DMC commands the 52-UM breaker to close. The 52-UM breaker closes.
6. The generator sets start to ramp down.
7. When the load across the 52-GM breaker is below the Unload kW threshold, the DMC commands the 52-GM breaker to open. The 52-GM breaker fails to open.
8. The “52-GM Fail to Open” alarm is registered on the DMC.
9. The DMC removes the 52-GM breaker open signal.
10. The generator sets continue to run and power the Loadbus.
11. The DMC commands the 52-UM breaker to open. The 52-UM breaker opens.
12. The generator sets are block loaded and power the Loadbus.
13. If the other transfer pair is ready to be retransferred to the utility source, the system will continue the retransfer to the utility source on the other Loadbus.

### 8.5.2 52-GM Breaker Fail to Open Reset

1. The operator clears the fault on the 52-GM breaker and resets the alarm on the DMC.
2. If the utility source is available, the system follows the sequence described in *Return of Single Utility Source (Auto – Soft Closed Transition).*

### 8.5.3 52-GM Breaker Fail to Close during Test with Load On

1. The system is commanded to enter into Test with Load.
2. The DMC sends a start signal to the generator sets.
3. The Min. Capacity to Connect timer starts.
4. The generator sets start automatically and independently, and accelerate to rated voltage and frequency.
5. The first generator set closes to the bus as dictated by the First Start System.
6. The remaining generator sets synchronize to the Genbus and close their respective generator set breakers when synchronization conditions are met within their PCCs.
7. The Transfer Delay starts in the DMC when the Min. Capacity to Connect is reached. (Transfer Delay stops and resets if the capacity drops below the setpoint.)
8. When the Transfer Delay expires, the master synchronizer is enabled between the generator set source and the utility source to synchronize the generator sets to the utility source.
9. The DMC verifies that the Min. Capacity to Connect is still true and when the sync check conditions are met for the 52-GM breaker, the DMC commands the 52-GM breaker to close. The 52-GM breaker fails to close.
10. The “52-GM Fail to close” alarm is registered on the DMC.
11. The DMC removes the 52-GM breaker close signal.
12. The system is removed from Test with Load.
13. The facility remains powered by the utility source.
14. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.5.4 52-GM Breaker Fail to Close Reset

1. The operator clears the fault on the 52-GM Breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Condition* and does not reenter Test with Load automatically.

## 8.6 52-UM Breaker Lockout Failures

The following sequences apply to either or both transfer pairs.

### 8.6.1 52-UM Breaker Lockout during Normal Standby Conditions

1. The system is in *Normal Standby Conditions*.
2. The protective relay on the 52-UM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-UM breaker.
4. The “52-UM Lockout Trip” alarm is registered on the DMC.
5. No further action is taken. The DMC will not close a source to the Loadbus until the lockout relay is reset.

### 8.6.2 52-UM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-UM breaker and resets the alarm on the DMC.

2. If the utility source is available, the 52-UM breaker closes if no other source is online.
3. If the utility source is not available, the system follows the appropriate utility failure sequence.

### 8.6.3 52-UM Breaker Lockout during Test without Load

1. The system is in Test without Load.
2. The protective relay on the 52-UM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-UM breaker.
4. The “52-UM Lockout Trip” alarm is registered on the DMC.
5. The generator sets continue to run unaffected in Test without Load.
6. The operator can exit Test without Load at any time but once **Off** is selected on the System Control screen, Test without Load is inhibited.

### 8.6.4 52-UM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is available, the 52-UM breaker closes if no other source is online.
3. If the utility source is not available, the system follows the appropriate utility failure sequence.

### 8.6.5 52-UM Breaker Lockout during Test with Load while Sources are in Parallel

1. The system is in Test with Load and both sources are connected.
2. The protective relay on the 52-UM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-UM breaker.
4. The “52-UM Lockout Trip” alarm is registered on the DMC.
5. The system is removed from Test with Load.
6. The generator sets continue to run and carry the load.
7. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.6.6 52-UM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-UM breaker and resets the alarm on the DMC.
2. If the utility source is available, the system follows the appropriate utility return sequence.
3. If the utility source is not available, the system follows the appropriate utility failure sequence.

## 8.7 52-UM Breaker Protective Relay Failures

If the DMC detects a protective relay failure on the 52-UM breaker, the DMC can no longer determine the state of the utility source and the 52-UM breaker does not have adequate protection. The DMC transfers the facility load to the most reliable protected source. The DMC does not close the 52-UM breaker if the protective relay failure is active.

The following sequences apply to either or both transfer pairs.

### 8.7.1 52-UM Breaker Protective Relay Failure during Normal Standby Conditions

1. The system is in *Normal Standby Conditions.*
2. The DMC receives the protective relay failure signal from the 52-UM breaker.
3. The “52-UM Protective Relay Failure” alarm is registered on the DMC.
4. The system follows the appropriate utility failure sequence.

### 8.7.2 52-UM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active sequence continues.

### 8.7.3 52-UM Breaker Protective Relay Failure during Utility Source Failure

1. The system is powered by the generator set source.
2. The DMC receives the protective relay failure signal from the 52-UM breaker.
3. The “52-UM Protective Relay Failure” alarm is registered on the DMC.
4. The active utility failure sequence continues unaffected by the protective relay failure.

### 8.7.4 52-UM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active sequence continues.

### 8.7.5 52-UM Breaker Protective Relay Failure during Test without Load

1. The system is in Test without Load.
2. The DMC receives the protective relay failure signal from the 52-UM breaker.
3. The “52-UM Protective Relay Failure” alarm is registered on the DMC.
4. The system is removed from Test without Load.
5. The system follows the appropriate utility failure sequence.

### 8.7.6 52-UM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.

3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active sequence continues.

### 8.7.7 52-UM Breaker Protective Relay Failure during Test with Load

1. The system is in Test with Load.
2. The DMC receives the protective relay failure signal from the 52-UM breaker.
3. The “52-UM Protective Relay Failure” alarm is registered on the DMC.
4. The system stays in Test with Load.
5. The operator can exit Test with Load and the system stays on the generator set source because the utility source is considered unavailable.

### 8.7.8 52-UM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active sequence continues.

## 8.8 52-GM Breaker Lockout Failures

The following sequences apply to either or both transfer pairs.

### 8.8.1 52-GM Breaker Lockout during Utility Source Failure

1. The system is powered by the generator set source.
2. The protective relay on the 52-GM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-GM breaker.
4. The “52-GM Lockout Trip” alarm is registered on the DMC.
5. The DMC will not close another source to the Loadbus until the lockout relay is reset.
6. If the other transfer pair requires the generator set source and the generators are not connected to the other loadbus, the system continues the transfer to the generator set source on the other loadbus. If the other transfer pair requires the generator set source and the generators are connected to the other loadbus, the generators continue running supply power to the other loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.8.2 52-GM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-GM breaker and resets the alarm on the DMC.
2. If the utility source is available, the 52-UM breaker closes if no other source is online.

### 8.8.3 52-GM Breaker Lockout during Test with Load

1. The system is powered by the generator set source and is in Test with Load.

2. The protective relay on the 52-GM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-GM breaker.
4. The “52-GM Lockout Trip” alarm is registered on the DMC.
5. The system is removed from Test with Load on the associated loadbus.
6. If the other transfer pair requires the generator set source and the generators are not connected to the other loadbus, the system continues the transfer to the generator set source on the other loadbus. If the other transfer pair requires the generator set source and the generators are connected to the other loadbus, the generators continue running supply power to the other loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.8.4 52-GM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-GM breaker and resets the alarm on the DMC.
2. If the utility source is available, the 52-UM breaker closes if no other source is online.
3. If the utility source is not available, the system follows the system follows the appropriate utility failure sequence.

### 8.8.5 52-GM Breaker Lockout during Test with Load while Sources are in Parallel

1. The system is in Test with Load and both sources are connected.
2. The protective relay on the 52-GM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-GM breaker.
4. The “52-GM Lockout Trip” alarm is registered on the DMC.
5. The system is removed from Test with Load on the associated loadbus.
6. The facility remains powered by the utility source.
7. If the other transfer pair requires the generator set source, the system continues the transfer to the generator set source on the other Loadbus. The DMC removes the start signals from the generator sets if there is no demand for the generator set source.

### 8.8.6 52-GM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-GM breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Conditions.*

## 8.9 52-GM Breaker Protective Relay Failures

The DMC does not close the 52-GM breaker if it has the protective relay failure alarm active.

### 8.9.1 52-GM Breaker Protective Relay Failure during Normal Standby Conditions

1. The system is in *Normal Standby Conditions.*
2. The DMC receives the protective relay failure signal from the 52-GM breaker.

3. The “52-GM Protective Relay Failure” alarm is registered on the DMC.
4. The generator set source is considered unavailable and the system does not respond to a utility source failure condition.
5. The alarm condition must be cleared and the system reset before the generator set source is considered available.

### 8.9.2 52-GM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. The system is in *Normal Standby Conditions.*

### 8.9.3 52-GM Breaker Protective Relay Failure during Utility Source Failure

1. The system is powered by the generator set source.
2. The DMC receives the protective relay failure signal from the 52-GM breaker.
3. The “52-GM Protective Relay Failure” alarm is registered on the DMC.
4. The generator sets continue to run and supply the load. The system depends on the individual generator set protection in the PCC to protect the generator set breakers and the Loadbus.
5. If the protective relay failure occurs before the 52-GM breaker closes in a utility failure sequence, the generator sets stop and the generator set source is considered unavailable. The loads are not serviced.
6. If the protective relay failure occurs after the 52-GM breaker opens in a retransfer sequence, the retransfer sequence completes and loads are serviced by the utility source.

### 8.9.4 52-GM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.

### 8.9.5 52-GM Breaker Protective Relay Failure during Test without Load

1. The system is in Test without Load.
2. The DMC receives the protective relay failure signal from the 52-GM breaker.
3. The “52-GM Protective Relay Failure” alarm is registered on the DMC.
4. The system stays in Test without Load and the generator set source is considered unavailable and does not respond to a utility source failure condition.

### 8.9.6 52-GM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.

3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active utility failure sequence continues.

### 8.9.7 52-GM Breaker Protective Relay Failure during Test with Load

1. The system is in Test with Load.
2. The DMC receives the protective relay failure signal from the 52-GM breaker.
3. The “52-GM Protective Relay Failure” alarm is registered on the DMC.
4. The system stays in Test with Load.
5. The generator sets continue to run and supply the load. The system depends on the individual generator set protection in the PCC to protect the generator set breakers and the Loadbus.
6. The operator can exit Test with Load and the system stays on the generator set source because the utility source is considered unavailable.
7. If the protective relay failure occurs before the 52-GM breaker closes, the test is cancelled and the generator sets stop. The generator set source is considered unavailable. The system follows the sequence described in *Test with Load Off (Auto – Open Transition).*

### 8.9.8 52-GM Breaker Protective Relay Failure Reset

1. The fault condition is cleared on the relay.
2. The operator resets the alarm on the DMC.
3. If the utility source is available, the system follows the appropriate utility return sequence based on the active transition type.
4. If the utility source is not available, the active utility failure sequence continues.

## 8.10 Extended Parallel Failures (Auto - Soft Closed Transition)

### 8.10.1 52-UM Breaker Lockout during Extended Parallel

1. The system is in Extended Parallel.
2. The protective relay on the 52-UM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-UM breaker.
4. The “52-UM Lockout Trip” alarm is registered on the DMC.
5. The system is removed from Extended Parallel.
6. The Loadbus is powered by the generator set source.

### 8.10.2 52-UM Breaker Lockout Reset

1. The utility source is available.
2. The operator resets the lockout relay on the 52-UM breaker and resets the alarm on the DMC.
3. If the utility source is available, the system follows the sequence described *in Return of Single Utility Source (Auto – Soft Closed Transition).*

### 8.10.3 52-GM Breaker Lockout during Extended Parallel

1. The system is in Extended Parallel.
2. The protective relay on the 52-GM breaker detects a lockout condition.
3. The protective relay direct trips and locks out the 52-GM breaker.
4. The “52-GM Lockout Trip” alarm is registered on the DMC.
5. The system is removed from Extended Parallel.
6. The DMC removes the start signals from the generator sets.
7. The PCC on each generator set opens its generator set breaker.
8. The generator sets run in cooldown mode and then stop.
9. The facility remains powered by the utility source.

### 8.10.4 52-GM Breaker Lockout Reset

1. The operator resets the lockout relay on the 52-GM breaker and resets the alarm on the DMC.
2. The system is in *Normal Standby Conditions.*

## 8.11 Utility Source Failure during Test and Extended Parallel

### 8.11.1 Utility Source Failure during Test without Load

1. The system is in Test without Load.
2. The DMC receives a loss of utility source signal from the device monitoring the utility source.
3. The system is removed from Test without Load and the system follows the appropriate utility source failure sequence.
4. When the utility source becomes available, the system follows the appropriate utility source return sequence based on the active transition type.
5. The system is in *Normal Standby Conditions* Normal Standby Conditionsand does not reenter Test without Load automatically.

### 8.11.2 Utility Source Failure during Test with Load

1. The system is in Test with Load.
2. The DMC receives a loss of utility source signal from the device monitoring the utility source.
3. The DMC stays in Test with Load and the loads remain powered by the generator set source.
4. If The DMC receives a loss of utility source signal from the device monitoring the utility source for the Loadbus that is not in Test with Load, the system follows the sequence described in *Load Add Sequence during Loss of Utility Source* for the Loadbus that requires the generator set source.
5. The operator can cancel Test with Load at any time.
   - If the utility source is available, the system follows the appropriate utility source return sequence based on the active transition type.
   - If the utility source is not available, the system exits Test with Load but the generator sets continue to power the loads without interruption.

### 8.11.3 Utility Source Failure during Extended Parallel

1. The system is in Extended Parallel.
2. The DMC receives a loss of utility source signal from the device monitoring the utility source.
3. The device monitoring the utility source immediately opens the 52-UM breaker.
4. The system is removed from Extended Parallel and the loads remain powered by the generator set source.
5. If the utility source is available, the system follows the sequence described in *Return of Single Utility Source (Auto – Soft Closed Transition).*

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PRODUCT | A073U494
BOM | A073H691

**SHENANDOAH WWTP**
264467 | DMCCHAALAA0688

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| **ENCLOSURE** | | | | | | | |
| 1 | A049V849 | 1 | FLOOR STANDING ENCLOSURE (LEFT) | HOFFMAN | N/A | SEISMIC RATED FRAME ASSEMBLY, NO DOOR | |
| 2 | A056V577 | 1 | DOOR | HOFFMAN | N/A | STANDARD CUTOUTS, 21" HMI, NO HANDLE | |
| 3 | A048R778 | 1 | DOOR HANDLE | HOFFMAN | PFHKBL | FLUSH SWING, KEYLOCKING | |
| 4 | A048R789 | 1 | DATA POCKET | HOFFMAN | ADP2 | BLACK, 12" x 12" | |
| 5 | A049V857 | 1 | FLOOR STANDING ENCLOSURE (RIGHT) | HOFFMAN | N/A | SEISMIC RATED FRAME ASSEMBLY, INCLUDES BLANK DOOR | |
| 6 | A048S338 | 1 | FRAME JOINING KIT | HOFFMAN | PJ2F | JOINING HARDWARE, GASKET, SIDE-TO-SIDE CONFIGURATION | |
| 7 | A048S334 | 1 | LIFTING BRACKETS | HOFFMAN | PJLBSS | ANGLED BRACKETS & HARDWARE, SIDE-TO-SIDE CONFIGURATION | |
| 8 | 0414-1663 | 1 | SHIPPING CRATE | CUMMINS | N/A | WOOD CRATE, 69" X 39" X 94" SHIPS TWO DMC SECTIONS | |
| 9 | A052T834 | 2 | DMC8000 LABEL SET | CUMMINS | N/A | CUMMINS LOGO, WEBSITE, HANDLE, POWERCOMMAND, WARNINGS | |
| 10 | 0098-5139 | 2 | UL LABEL | CUMMINS | N/A | UL891, DEADFRONT SECTION | |
| 11 | A054H472 | 2 | DMC8000 SEISMIC LABEL (IBC) | CUMMINS | N/A | SEISMIC COMPLIANCE NOTICE VMA-50122-01C | |
| **CONTROL COMPONENTS** | | | | | | | |
| 12 | A072E706 | 1 | 21" TOUCHSCREEN ASSEMBLY | ADVANTECH | FPM-7211W-P3AE UNO-2473 | Full HD TFT LCD, IP66, WIDE SCREEN, WINDOWS 10, 2.42GHz, 2MB L2 CACHE, 4GB DDR3L, -10 ~ 60°C, 16k TAG | |
| 13 | A056N890 | 1 | X80 BASE RACK | MODICON | BMEXBP0400 | 4 SLOTS + PS, X-BUS + ETHERNET | |
| 14 | A047S936 | 1 | X80 CPU | MODICON | BMXP342000 | STAND ALONE, 2048kB SYSTEM, 128kB DATA, 1792kB PROGRAM | |
| 15 | A041G849 | 1 | X80 NETWORK MODULE | MODICON | BMXNOC0401 | 10BASE-T/100BASE-TX, MODBUS TCP I/O SCANNER, EMBEDDED SWITCH, SNMP ADMIN, RSTP SUPPORT, PORT MIRRORING | |
| 16 | A064Z577 | 2 | X80 POWER SUPPLY | MODICON | BMXCPS3020 | 24-48VDC, 32W | |
| 17 | A047R998 | 1 | X80 BASE RACK | MODICON | BMXXBP0600 | 6 SLOTS + PS, X-BUS | |

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| 18 | A049K352 | 1 | X80 INPUT MODULE | MODICON | BMXDDI1602 | 16 ISOLATED INPUTS, 24VDC SINKING | |
| 19 | A058A215 | 1 | X80 OUTPUT MODULE | MODICON | BMXDRA1605 | 16 RELAY OUTPUTS, 24VDC, 2A | |
| 20 | A041G876 | 2 | STB NETWORK MODULE | MODICON | STBNIP2311 | 10BASE-T/100BASE-T, BOOTP/DHCP, EMBEDDED WEB, SNMP AGENT, MODBUS TCP/IP MESSAGING | |
| 21 | A047S758 | 5 | STB INPUT MODULE | MODICON | STBDDI3725KC | 16 ISOLATED INPUTS, 24VDC | |
| 22 | A047S753 | 3 | STB OUTPUT MODULE | MODICON | STBDDO3705KC | 16 SOLID STATE OUTPUTS, 24VDC, 500mA | |
| 23 | A040L553 | 1 | GATEWAY | PHOENIX CONTACT | 2313452 | RS485, ETHERNET | |
| 24 | A054V134 | 1 | GATEWAY | FIELDSERVER | FPC-N35-1001 | RS485, ETHERNET, LONWORKS | |
| 25 | 0327-1520-01 | 2 | MASTER CONTROL MODULE (MCM3320) | CUMMINS | N/A | METER/SYNCHRONIZER, EXTENDED PARALLELING CONTROL, MODBUS INTERFACE | |
| **ACCESSORIES** | | | | | | | |
| 26 | A068M689 | 1 | NETWORK SWITCH (UNMANAGED) | PHOENIX CONTACT | 1085255 | FL SWITCH 1000N, 16 RJ45, 10/100 Mbps | |
| 27 | A028Z053 | 1 | POWER SUPPLY | PHOENIX CONTACT | 2866763 | QUINT-PS, INPUT: 100-240VAC/DC, OUTPUT: 24VDC, 10A | |
| 28 | A043H869 | 1 | UNINTERRUPTIBLE POWER SUPPLY | PHOENIX CONTACT | 2320225 | QUINT-UPS, 24VDC, 10A | |
| 29 | A043K841 | 1 | UPS BATTERY | PHOENIX CONTACT | 1274118 | UPS-BAT, 24VDC, VRLA, FUSED-50A, 7Ah | |

**SHENANDOAH WWTP**
264467 | SWGCHAALAA0433

Power Generation

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| **POWER BREAKERS** | | | | | | | |
| 1 | N/A | 3 | GENSET BREAKER<br>52-G1, 52-G2, 52-G3 | SQUARE D | COMPONENT OF SWITCHGEAR | MASTERPACT NW BREAKER<br>480V, 3 POLES,DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIA, 480VAC CHARGING MOTOR, 100kAIC, 1600A FRAME, ERMS | |
| 2 | N/A | 1 | GENSET BREAKER<br>PREP SPACE<br>52-G4 | SQUARE D | COMPONENT OF SWITCHGEAR | PREP SPACE FOR MASTERPACT NW BREAKER<br>480V, 3 POLES,DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIA, 480VAC CHARGING MOTOR, 100kAIC, 1600A FRAME, ERMS | |
| 3 | N/A | 2 | GENERATOR MAIN BREAKER<br>52-GM1, 52-GM2 | SQUARE D | COMPONENT OF SWITCHGEAR | MASTERPACT NW BREAKER<br>480V, 4 POLES, DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIA, 480VAC CHARGING MOTOR, 100kAIC, 3000A FRAME, ERMS | |
| 4 | N/A | 2 | FEEDER BREAKER<br>52-F1, 52-F9 | SQUARE D | COMPONENT OF SWITCHGEAR | MASTERPACT NT BREAKER<br>480V, 3 POLES, DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIG, 480VAC CHARGING MOTOR, 100kAIC, 1200A FRAME, ERMS | |
| 5 | N/A | 6 | FEEDER BREAKER<br>52-F2, 52-F5, 52-F6, 52-F10, 52-F13, 52-F14 | SQUARE D | COMPONENT OF SWITCHGEAR | MASTERPACT NT BREAKER<br>480V, 3 POLES, DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIG, 480VAC CHARGING MOTOR, 100kAIC, 800A FRAME | |
| 6 | N/A | 8 | FEEDER BREAKER<br>PREP SPACE<br>52-F3, 52-F4, 52-F7, 52-F8, 52-F11, 52-F12, 52-F15 52-F16 | SQUARE D | COMPONENT OF SWITCHGEAR | PREP SPACE FOR MASTERPACT NT BREAKER<br>480V, 3 POLES, DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIG, 480VAC CHARGING MOTOR, 100kAIC, 800A FRAME | |

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| 7 | N/A | 2 | UTILITY MAIN BREAKER<br>52-UM1, 52-UM2 | SQUARE D | COMPONENT OF SWITCHGEAR | MASTERPACT NW BREAKER<br>480V, 4 POLES, DRAWOUT,<br>24VDC ELECTRONIC OPERATION, LSIG, 480VAC CHARGING MOTOR, 100kAIC, 3000A FRAME,<br>ERMS | |
| **PROTECTIVE RELAYS/METERS** | | | | | | | |
| 8 | A042T595 | 2 | MULTIFUNCTION RELAY<br>SEL-751 | SCHWEITZER | 751202B1B0X70850600 | 24/48VDC CONTROL, 24VDC INPUTS,<br>DUAL 10/100BASE-T RJ45, MULTIMODE ST,<br>4DI/4DO ELECTROMECHANICAL,<br>SYNC CHECK, ARC-FLASH | |
| 9 | 0307-2981-03 | 2 | LOCKOUT RELAY | ELECTROSWITCH | 78PJ04A-011 | SERIES 24, TRIP/RESET, 2 POS MAINTAINED, RED LED, 24VDC, 4 CONTACT DECKS | |
| 10 | 0308-1156-01 | 4 | RELAY TEST SWITCH | ABB | 498A010G01 | FT-1 FLEXITEST SWITCH, BLACK COVER,<br>6 BLACK CURRENT SHORTING POLES,<br>4 RED POTENTIAL POLES | |
| **VOLTAGE/CURRENT TRANSFORMERS** | | | | | | | |
| 11 | N/A | 15 | POTENTIAL TRANSFORMER<br>52-UM1, LOADBUS 1, LOADBUS 2, 52-UM2, GEN BUS | N/A | COMPONENT OF SWITCHGEAR | SINGLE TAP 480:120VAC,<br>1 PER PHASE | |
| 12 | N/A | 6 | CURRENT TRANSFORMER<br>52-GM1, 52-GM2 | N/A | COMPONENT OF SWITCHGEAR | SINGLE RATIO 3000:5A,<br>1 PER PHASE | |
| 13 | N/A | 6 | CURRENT TRANSFORMER<br>52-UM1, 52-UM2 | N/A | COMPONENT OF SWITCHGEAR | SINGLE RATIO 3000:5A,<br>1 PER PHASE | |
| **CONTROL COMPONENTS** | | | | | | | |
| 14 | 0308-1112-01 | 4 | BREAKER CONTROL SWITCH | ELECTROSWITCH | 24PK38D | SERIES 24, TRIP/CLOSE, 3 POS SPRING RETURN TO CENTER, GREEN/RED LED, 24VDC, PISTOL GRIP, 1 CONTACT DECK | |
| 15 | 0308-1111-05 | 2 | MODE CONTROL SWITCH | ELECTROSWITCH | 24PK204LA | SERIES 24, MAN/AUTO, 2 POS MAINTAIN, AMBER/GREEN LED, 24VDC, PISTOL GRIP,<br>4 CONTACT DECKS | |

**SHENANDOAH WWTP**
264467 | SWGCHAALAA0433

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| **ACCESSORIES** | | | | | | | |
| 16 | N/A | 2 | SPD<br>LOADBUS 1, LOADBUS 2 | N/A | COMPONENT OF SWITCHGEAR | SURGE PROTECTION DEVICE, 480VAC, 3 PHASE, 240kA/PHASE | |
| 17 | 0098-5139 | 10 | UL LABEL | CUMMINS | N/A | UL891, DEADFRONT SECTION | |

PRODUCT | A073U496
BOM | A073H693

**SHENANDOAH WWTP**
264467 | BAT999999A0220

| ITEM | PART | QTY | DESCRIPTION | MFR | MFR PART | DETAILS | LOOSE |
|---|---|---|---|---|---|---|---|
| **BATTERY SYSTEM COMPONENTS** | | | | | | | |
| 1 | A073Y043 | 4 | BATTERY | DEKA | HT150ET | SEALED VRLA, 300Ah, 24V BLOCK | X |
| 2 | A073Y044 | 1 | BATTERY RACK | MESA | 1E1R060-41811A | FLOOR STANDING, SINGLE TIER | X |
| 3 | A029F797 | 1 | BATTERY CHARGER | SAFT | AT10-024-050-120-1101020000 | CABINET STYLE, INPUT/OUTPUT BREAKERS, 24VDC, 50A | X |

# Section 3 – Drawings

- Interconnection Diagram
- Outline(s)

SYSTEM NOTES:

1. ALL INTERCONNECTION WIRING IS SIZED FOR A MAXIMUM DISTANCE OF 300ft/100m. MINIMUM WIRE/CABLE SIZE IS AS INDICATED IN WIRING NOTES FOR EACH RUN, TYPICALLY 14AWG/2.5mm² STRANDED. AC AND DC CONTROL WIRES ARE TO BE RUN IN SEPARATE CONDUIT/TRUNKING/CABLING. REFER TO ANY APPLICABLE NATIONAL STANDARDS DURING INSTALLATION. IT IS RECOMMENDED TO PULL 20% EXTRA WIRING ON ALL RUNS FOR SPARES.

2. CURRENT TRANSFORMERS (CT) VA (BURDEN) RATINGS ARE FOR GUIDANCE ONLY. THESE WILL DEPEND ON THE LENGTH OF CABLE RUN BETWEEN THE MASTER CONTROL AND THE CT UNITS. THE CT BURDEN IN THE MASTER CONTROL IS NEGLIGIBLE, EXCLUDING CABLING. WHEN GENSET DIFFERENTIAL CT IS REQUIRED, THE GENSET SHALL BE ORDERED WITH CUSTOM OPTION TO ENSURE ALTERNATOR MOUNTED CT MATCHES SWITCHGEAR CT RATIO AND BURDEN CLASS.

3. VOLTAGE SENSING POINTS SHOWN ARE GENERALIZED. REFER TO SWITCHGEAR SCHEMATICS FOR SPECIFIC DETAILS.

4. AC AND DC CONTROL POWER SHOULD BE SUPPLIED WITHIN +/-10% OF THE NOMINAL VOLTAGE INDICATED.

5. CONNECTIONS SHOWN TO GENSET AUXILIARY EQUIPMENT ARE FOR INFORMATIONAL PURPOSES ONLY. SPECIFIC CONNECTION DETAILS MAY VARY. REFER TO GENSET INSTALLATION MANUAL FOR DETAILS.

6. ETHERNET NETWORK CONNECTIONS ARE RECOMMENDED TO BE CAT V SHIELDED, STRANDED CABLE. CONSULT FACTORY IF THE DISTANCE IF ANY ETHERNET RUN EXCEEDS 300ft/100m. DO NOT RUN IN CONDUIT/TRUNKING/CABLING WITH POWER OR CONTROL WIRING. INSTALL ACCORDING TO ANY APPLICABLE STANDARDS.

7. NETWORK DATA WIRING TO BE MINIMUM 22AWG/0.325mm² CAT V TWISTED PAIR COMMUNICATIONS CABLE. CONNECTIONS ARE NOT POLARITY SENSITIVE. CONSULT THE FACTORY IF SUM OF DISTANCES FROM EACH GENSET TO THE MASTER CONTROL EXCEEDS 4600ft/1400m. DO NOT RUN IN CONDUIT/TRUNKING/CABLING WITH POWER OR CONTROL WIRING. INSTALL ACCORDING TO ANY APPLICABLE STANDARDS.

8. NETWORK DATA CABLE TO BE CONNECTED AS A DAISY CHAIN TOPOLOGY FROM GENERATOR #1 TO GENERATOR #2. THEN FROM GENERATOR #2 TO GENERATOR #3, ETC. GCM SWITCH (S1 FOR PCC3201 & S3 FOR PCC3100) WILL BE SET TO 'TERM' POSITION ON LAST GENSET ONLY. DO NOT RUN IN CONDUIT/TRUNKING/CABLING WITH POWER OR CONTROL WIRING. INSTALL ACCORDING TO ANY APPLICABLE STANDARDS.

9. LOAD CONTROL/SHARING CABLE RUNS ARE TO BE INSTALLED ACCORDING TO ANY APPLICABLE STANDARDS. DO NOT RUN IN CONDUIT/TRUNKING/CABLING WITH POWER OR CONTROL WIRING.

10. BREAKER OPEN COILS ARE OPERATED BY A VOLT-FREE/DRY CONTACT FROM THE MASTER CONTROL. BREAKER CLOSE COILS ARE OPERATED BY A VOLT-FREE/DRY CONTACT FROM THE MASTER CONTROL. CONTROL POWER FOR BREAKER CLOSE AND MOTOR OPERATION IS PROVIDED IN THE SWITCHGEAR. LOW VOLTAGE (<1000V) OPTION CONTACTS ARE RATED 10A @ 250VAC/28VDC. MEDIUM/HIGH VOLTAGE (>1000V) OPTION CONTACTS ARE RATED 15A @ 480VAC/125VDC.

11. CONTACTS FOR OPTIONAL CONTROL OF CUSTOMER LOAD ADD/LOAD SHED EQUIPMENT ARE RATED AT 10A @ 250VAC/28VDC RESISTIVE FOR LOW VOLTAGE (<1000V) OPTION, AND AT 15A @ 480VAC/125VDC RESISTIVE FOR MEDIUM/HIGH VOLTAGE (>1000V) OPTION. CONTACTS CHANGE STATE WHEN LOAD ADD/LOAD SHED LEVELS ARE "ON".

12. BREAKER STATUS INPUTS ARE TO BE VOLT-FREE/DRY CONTACTS. CONTACTS CLOSE TO INDICATE STATE.

13. UNDER VOLTAGE RELEASE WILL OPEN BREAKER WHEN A CONDITION OF LOW OR NO DC VOLTAGE EXISTS.

14. ALL BREAKER RACKED IN CONTACTS ARE SHOWN WITH BREAKER IN THE RACKED OUT POSITION.

15. USE OF CUSTOMER INPUTS IS OPTIONAL. IF USED, CUSTOMER SHOULD SUPPLY A NORMALLY OPEN (N.O.), VOLT-FREE/DRY CONTACT THAT CLOSES TO ACTIVATE. CUSTOMER INPUTS ARE PROJECT SPECIFIC.

16. E-STOP TERMINALS TB9-C1:01,02 SHOULD BE LINKED TOGETHER IF REMOTE E-STOP STATION IS NOT AVAILABLE.

17. PLC MALFUNCTION CONTACT WILL CLOSE IN THE EVENT OF A PLC FAILURE.

18. CONDUIT RUNS BETWEEN EQUIPMENT SHOWN FOR REFERENCE ONLY. FINAL DETAILS TO BE DETERMINED BY INSTALLATION CONTRACTOR.

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 1 OF 11 |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | | | |
| | REV | DESCRIPTION | DATE |

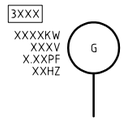
PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

SYSTEM NOTES | 264467 DMCCHAALAA0688

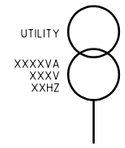
Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

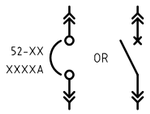
SIZE: A3



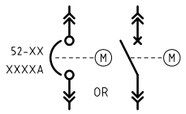

GENERATOR



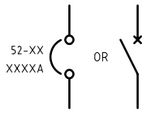

UTILITY SUPPLY



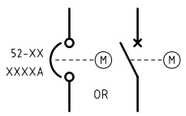

DRAWOUT BREAKER




DRAWOUT BREAKER (MOTORIZED)

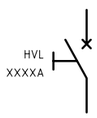



FIXED MOUNT BREAKER



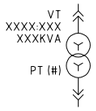

FIXED MOUNT BREAKER (MOTORIZED)


CONTACTOR

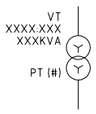



HVL SWITCH/DISCONNECT


POWER FUSE

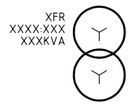



VOLTAGE TRANSFORMER (DRAWOUT)

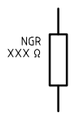



VOLTAGE TRANSFORMER (FIXED)


CURRENT TRANSFORMER

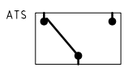



STEP UP/DOWN TRANSFORMER

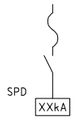



POWER RESISTOR

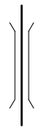

LIGHTNING ARRESTER




TRANSFER SWITCH




SURGE PROTECTION DEVICE



BUSSING DUCT

POWER CABLING

BUSSING LUG

EARTH/GROUND


PROTECTIVE, CONTROL, METERING DEVICE


ANSI DEVICE NUMBER


CONNECTION TERMINAL

LOCATION/EQUIPMENT DESIGNATION


CONDUIT RUN




CONTROL/MONITOR ARROW




CONTROL ONLY ARROW




MONITOR ONLY ARROW

| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 2 OF 11 |
|---|---|---|---|
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

LEGEND

264467
DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

UTILITY

PowerCommand MASTER CONTROL
(DMCCHAALAA0688)

METER/ SYNC 1

METER/ SYNC 2

MAIN SWITCHGEAR MSG (SWGCHAALAA0433)

3300 1000KW 480V G1

3300 1000kW 480V G2

3300 1000KW 480V G3 FUTURE

3300 1000KW 480V G4 FUTURE

3000:5 CT (3)

480:120 PT (3)

SEL 751

52-UM1 3000AF 3000AT LSIG DMC

86

52-G1 1600AF 1600AT LSIA DMC

52-G2 1600AF 1600AT LSIA DMC

52-G3 1600AF 1600AT LSIA DMC

52-G4 1600AF PREP SPACE

3000A, 480/277V, 3P, 4W, 100KA, LOADBUS 1

52-GM1 3000AF 3000AT LSIA DMC

52-GM2 3000AF 3000AT LSIA DMC

3000A, 480/277V, 3P, 4W, 100KA, LOADBUS 2

52-UM2 3000AF 3000AT LSIG DMC

52-F1 1200AF 1200AT LSIG DMC

52-F2 800AF 600AT LSIG DMC

52-F3 800AF PREP SPACE DMC

52-F4 800AF PREP SPACE DMC

52-F5 800AF 600AT LSIG DMC

52-F6 800AF 600AT LSIG DMC

52-F7 800AF PREP SPACE DMC

52-F8 800AF PREP SPACE DMC

52-F9 1200AF 1200AT LSIG DMC

52-F10 800AF 600AT LSIG DMC

52-F11 800AF PREP SPACE DMC

52-F12 800AF PREP SPACE DMC

52-F13 800AF 600AT LSIG DMC

52=F14 800AF 600AT LSIG DMC

52-F15 800AF PREP SPACE DMC

52-F16 800AF PREP SPACE DMC

SPD 240KA

TO MCC-UV1

TO AERATION BLOWER NO 1 VFD

TO MCC-ABLWR1

TO AERATION BLOWER NO 3 VFD

TO MCC-UV2

TO AERATION BLOWER NO 2 VFD

TO MCC-ABLWR2

TO AERATION BLOWER NO 4 VFD

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 3 OF 11 |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

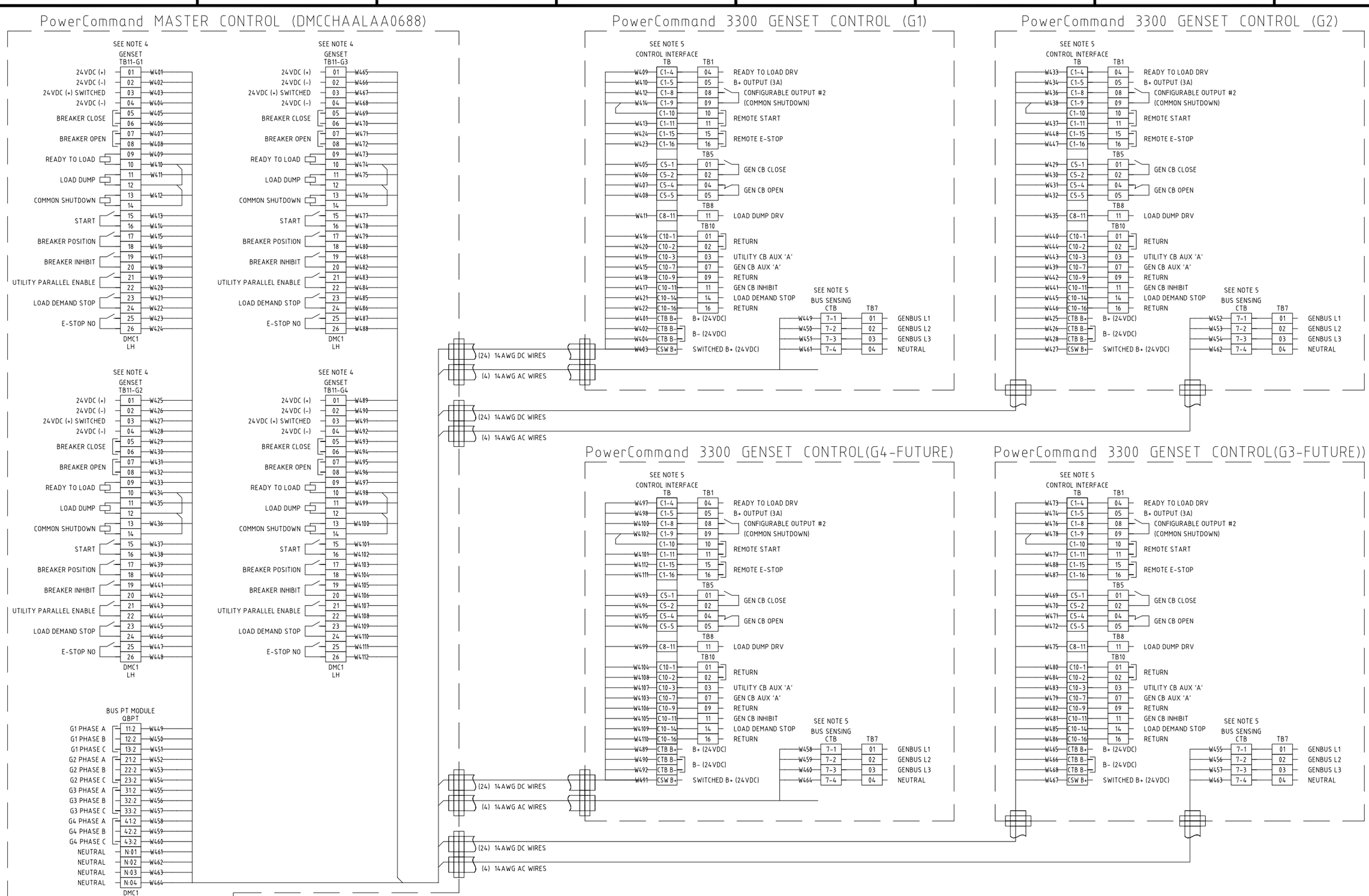
ONELINE DIAGRAM

264467
DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3




| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | A073U481 | SHEET 4 OF 11 | |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

GEN CONNECTIONS | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

PowerCommand MASTER CONTROL
(DMCCHAALAA0688)

SEE NOTE 8
MODBUS
TB23-N1
RS485 (+) 01 W501
RS485 (-) 02 W502
SHIELD 03 W503

SEE NOTES 8 & 9
LOAD SHARE
TB21-L1
KW (+) 01 W504
KW (-) 02 W505
KVAR (+) 03 W506
KVAR (-) 04 W507
SHIELD 05 W508

SEE NOTE 9
LOAD GOVERN
TB22-E1
KW (+) 01 W509
KW (-) 02 W510
KVAR (+) 03 W511
KVAR (-) 04 W512
SHIELD 05 W513

(1) BELDEN 9841 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(1) BELDEN 9418 OR EQUIV

PowerCommand 3300 GENSET CONTROL (G1)

MODBUS DATA
TB15
W501 03 RS485 (+)
W502 04 RS485 (-)
W503 01 SHIELD

(1) BELDEN 9841 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(2) 14AWG DC WIRES

SEE NOTE 5
CONTROL INTERFACE
TB
TB9
W504 C9-8 08 LOAD SHARE KW (+)
W505 C9-7 07 LOAD SHARE KW (-)
W506 C9-10 10 LOAD SHARE KVAR (+)
W507 C9-11 11 LOAD SHARE KVAR (-)
W508 C9-9 09 LOAD SHARE SHIELD
W509 C9-1 01 KW LOAD SETPOINT
W510 C9-2 02 ANALOG RETURN
W511 C9-3 03 KVAR LOAD SETPOINT
W512
TB3
W514 C3-11 11 FIRST START ARBITRATION
W515 C3-12 12

PowerCommand 3300 GENSET CONTROL (G2)

MODBUS DATA
TB15
W501 03 RS485 (+)
W502 04 RS485 (-)
W503 01 SHIELD

(1) BELDEN 9841 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(2) 14AWG DC WIRES

SEE NOTE 5
CONTROL INTERFACE
TB
TB9
W504 C9-8 08 LOAD SHARE KW (+)
W505 C9-7 07 LOAD SHARE KW (-)
W506 C9-10 10 LOAD SHARE KVAR (+)
W507 C9-11 11 LOAD SHARE KVAR (-)
W508 C9-9 09 LOAD SHARE SHIELD
W509 C9-1 01 KW LOAD SETPOINT
W510 C9-2 02 ANALOG RETURN
W511 C9-3 03 KVAR LOAD SETPOINT
W512
TB3
W514 C3-11 11 FIRST START ARBITRATION
W515 C3-12 12

PowerCommand 3300 GENSET CONTROL (G4-FUTURE)

MODBUS DATA
TB15
W501 03 RS485 (+)
W502 04 RS485 (-)
W503 01 SHIELD

(1) BELDEN 9841 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(2) 14AWG DC WIRES

SEE NOTE 5
CONTROL INTERFACE
TB
TB9
W504 C9-8 08 LOAD SHARE KW (+)
W505 C9-7 07 LOAD SHARE KW (-)
W506 C9-10 10 LOAD SHARE KVAR (+)
W507 C9-11 11 LOAD SHARE KVAR (-)
W508 C9-9 09 LOAD SHARE SHIELD
W509 C9-1 01 KW LOAD SETPOINT
W510 C9-2 02 ANALOG RETURN
W511 C9-3 03 KVAR LOAD SETPOINT
W512
TB3
W514 C3-11 11 FIRST START ARBITRATION
W515 C3-12 12

PowerCommand 3300 GENSET CONTROL (G3-FUTURE)

MODBUS DATA
TB15
W501 03 RS485 (+)
W502 04 RS485 (-)
W503 01 SHIELD

(1) BELDEN 9841 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(1) BELDEN 9418 OR EQUIV
(2) 14AWG DC WIRES

SEE NOTE 5
CONTROL INTERFACE
TB
TB9
W504 C9-8 08 LOAD SHARE KW (+)
W505 C9-7 07 LOAD SHARE KW (-)
W506 C9-10 10 LOAD SHARE KVAR (+)
W507 C9-11 11 LOAD SHARE KVAR (-)
W508 C9-9 09 LOAD SHARE SHIELD
W509 C9-1 01 KW LOAD SETPOINT
W510 C9-2 02 ANALOG RETURN
W511 C9-3 03 KVAR LOAD SETPOINT
W512
TB3
W514 C3-11 11 FIRST START ARBITRATION
W515 C3-12 12

| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 5 OF 11 |
|---|---|---|---|
| DWN J. LLEWELLYN<br>CKD J. KUZNIA<br>APVD J. GUNDULRI | -1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

GEN COMMUNICATION | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

## PowerCommand MASTER CONTROL (DMCCHAALAA0688)

SEE NOTES 10, 12, 13 & 14
GENSET BREAKER
TB12-G1

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W601 |
| | 02 | W602 |
| BREAKER OPEN | 03 | W603 |
| | 04 | W604 |
| AUX 'A' | 05 | W605 |
| RTN | 06 | W606 |
| 24VDC UVR (+) | 07 | W607 |
| UVR (-) | 08 | W608 |
| AUX 'A' | 09 | W609 |
| RTN | 10 | W610 |
| RACKED IN | 11 | W611 |
| RTN | 12 | W612 |
| TRIPPED | 13 | W613 |
| RTN | 14 | W614 |
| GROUND FAULT | 15 | W615 |
| RTN | 16 | W616 |
| CONFIG IN 2 | 17 | |
| RTN | 18 | |
| CONFIG OUT 1 | 19 | |
| | 20 | |
| CONFIG OUT 2 | 21 | |
| | 22 | |

SEE NOTES 10, 12, 13 & 14
GENSET BREAKER
TB12-G3

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W633 |
| | 02 | W634 |
| BREAKER OPEN | 03 | W635 |
| | 04 | W636 |
| AUX 'A' | 05 | W637 |
| RTN | 06 | W638 |
| 24VDC UVR (+) | 07 | W639 |
| UVR (-) | 08 | W640 |
| AUX 'A' | 09 | W641 |
| RTN | 10 | W642 |
| RACKED IN | 11 | W643 |
| RTN | 12 | W644 |
| TRIPPED | 13 | W645 |
| RTN | 14 | W646 |
| GROUND FAULT | 15 | W647 |
| RTN | 16 | W648 |
| CONFIG IN 2 | 17 | |
| RTN | 18 | |
| CONFIG OUT 1 | 19 | |
| | 20 | |
| CONFIG OUT 2 | 21 | |
| | 22 | |

SEE NOTES 10, 12, 13 & 14
GENSET BREAKER
TB12-G2

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W617 |
| | 02 | W618 |
| BREAKER OPEN | 03 | W619 |
| | 04 | W620 |
| AUX 'A' | 05 | W621 |
| RTN | 06 | W622 |
| 24VDC UVR (+) | 07 | W623 |
| UVR (-) | 08 | W624 |
| AUX 'A' | 09 | W625 |
| RTN | 10 | W626 |
| RACKED IN | 11 | W627 |
| RTN | 12 | W628 |
| TRIPPED | 13 | W629 |
| RTN | 14 | W630 |
| GROUND FAULT | 15 | W631 |
| RTN | 16 | W632 |
| CONFIG IN 2 | 17 | |
| RTN | 18 | |
| CONFIG OUT 1 | 19 | |
| | 20 | |
| CONFIG OUT 2 | 21 | |
| | 22 | |

SEE NOTES 10, 12, 13 & 14
GENSET BREAKER
TB12-G4

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W649 |
| | 02 | W650 |
| BREAKER OPEN | 03 | W651 |
| | 04 | W652 |
| AUX 'A' | 05 | W653 |
| RTN | 06 | W654 |
| 24VDC UVR (+) | 07 | W655 |
| UVR (-) | 08 | W656 |
| AUX 'A' | 09 | W657 |
| RTN | 10 | W658 |
| RACKED IN | 11 | W659 |
| RTN | 12 | W660 |
| TRIPPED | 13 | W661 |
| RTN | 14 | W662 |
| GROUND FAULT | 15 | W663 |
| RTN | 16 | W664 |
| CONFIG IN 2 | 17 | |
| RTN | 18 | |
| CONFIG OUT 1 | 19 | |
| | 20 | |
| CONFIG OUT 2 | 21 | |
| | 22 | |

(16) 14AWG DC WIRES
(16) 14AWG DC WIRES
(16) 14AWG DC WIRES
(16) 14AWG DC WIRES

## PARALLELING SWITCHGEAR (SWGCHAALAA0433)

SEE NOTE 14
52-G1 BREAKER INTERFACE
TB32-G1

| | | |
|---|---|---|
| W601 | 01 | CLOSE |
| W602 | 02 | RTN |
| W603 | 03 | OPEN |
| W604 | 04 | RTN |
| W605 | 05 | AUX 'A' |
| W606 | 06 | |
| W607 | 07 | UVR |
| W608 | 08 | |
| W609 | 09 | AUX 'A' |
| W610 | 10 | |
| W611 | 11 | RACKED IN |
| W612 | 12 | |
| W613 | 13 | TRIPPED |
| W614 | 14 | |
| W615 | 15 | GROUND FAULT |
| W616 | 16 | |

SEE NOTE 14
52-G3 BREAKER INTERFACE
TB32-G3

| | | |
|---|---|---|
| W633 | 01 | CLOSE |
| W634 | 02 | RTN |
| W635 | 03 | OPEN |
| W636 | 04 | RTN |
| W637 | 05 | AUX 'A' |
| W638 | 06 | |
| W639 | 07 | UVR |
| W640 | 08 | |
| W641 | 09 | AUX 'A' |
| W642 | 10 | |
| W643 | 11 | RACKED IN |
| W644 | 12 | |
| W645 | 13 | TRIPPED |
| W646 | 14 | |
| W647 | 15 | GROUND FAULT |
| W648 | 16 | |

SEE NOTE 14
52-G2 BREAKER INTERFACE
TB32-G2

| | | |
|---|---|---|
| W617 | 01 | CLOSE |
| W618 | 02 | RTN |
| W619 | 03 | OPEN |
| W620 | 04 | RTN |
| W621 | 05 | AUX 'A' |
| W622 | 06 | |
| W623 | 07 | UVR |
| W624 | 08 | |
| W625 | 09 | AUX 'A' |
| W626 | 10 | |
| W627 | 11 | RACKED IN |
| W628 | 12 | |
| W629 | 13 | TRIPPED |
| W630 | 14 | |
| W631 | 15 | GROUND FAULT |
| W632 | 16 | |

SEE NOTE 14
52-G4 BREAKER INTERFACE
TB32-G4

| | | |
|---|---|---|
| W649 | 01 | CLOSE |
| W650 | 02 | RTN |
| W651 | 03 | OPEN |
| W652 | 04 | RTN |
| W653 | 05 | AUX 'A' |
| W654 | 06 | |
| W655 | 07 | UVR |
| W656 | 08 | |
| W657 | 09 | AUX 'A' |
| W658 | 10 | |
| W659 | 11 | RACKED IN |
| W660 | 12 | |
| W661 | 13 | TRIPPED |
| W662 | 14 | |
| W663 | 15 | GROUND FAULT |
| W664 | 16 | |

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 6 OF 11 |
| DWN J. LLEWELLYN<br>CKD J. KUZNIA<br>APVD J. GUNDULRI | -1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

GEN BREAKER CONNECTIONS | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

## PowerCommand MASTER CONTROL (DMCCHAALAA0688)

GENBUS VOLTAGE SENSING
TB13-B1
DMC1 REAR

| | | |
|---|---|---|
| PHASE A | 01 | W707 |
| PHASE B | 02 | W708 |
| PHASE C | 03 | W709 |
| NEUTRAL | 04 | W710 |

GENBUS CURRENT SENSING
SB13-C1

| | | |
|---|---|---|
| PHASE A | 1A | W711 |
| | 2A | W712 |
| PHASE B | 3A | W713 |
| | 4A | W714 |
| PHASE C | 5A | W715 |
| | 6A | W716 |

UTILITY 1 VOLTAGE SENSING
TB13-B2
DMC1 REAR

| | | |
|---|---|---|
| PHASE A | 01 | W717 |
| PHASE B | 02 | W718 |
| PHASE C | 03 | W719 |
| NEUTRAL | 04 | W720 |

UTILITY 1 CURRENT SENSING
SB13-C2

| | | |
|---|---|---|
| PHASE A | 1A | W721 |
| | 2A | W722 |
| PHASE B | 3A | W723 |
| | 4A | W724 |
| PHASE C | 5A | W725 |
| | 6A | W726 |

UTILITY 2 VOLTAGE SENSING
TB13-B3

| | | |
|---|---|---|
| PHASE A | 01 | W727 |
| PHASE B | 02 | W728 |
| PHASE C | 03 | W729 |
| NEUTRAL | 04 | W730 |

UTILITY 2 CURRENT SENSING
SB13-C3

| | | |
|---|---|---|
| PHASE A | 1A | W731 |
| | 2A | W732 |
| PHASE B | 3A | W733 |
| | 4A | W734 |
| PHASE C | 5A | W735 |
| | 6A | W736 |

(10) 12AWG AC WIRES

(10) 12AWG AC WIRES

(10) 12AWG AC WIRES

## PARALLELING SWITCHGEAR (SWGCHAALAA0433)

GENBUS VOLTAGE
TB33-G1

| | | |
|---|---|---|
| W707 | 01 | PHASE A |
| W708 | 02 | PHASE B |
| W709 | 03 | PHASE C |
| W710 | 04 | NEUTRAL |

GENBUS CURRENT
SB33-G1

| | | |
|---|---|---|
| W711 | 1B | PHASE A |
| W712 | 2B | |
| W713 | 3B | PHASE B |
| W714 | 4B | |
| W715 | 5B | PHASE C |
| W716 | 6B | |

UTILITY 1 VOLTAGE
TB33-U1

| | | |
|---|---|---|
| W717 | 01 | PHASE A |
| W718 | 02 | PHASE B |
| W719 | 03 | PHASE C |
| W720 | 04 | NEUTRAL |

UTILITY 1 CURRENT
SB33-U1

| | | |
|---|---|---|
| W721 | 1B | PHASE A |
| W722 | 2B | |
| W723 | 3B | PHASE B |
| W724 | 4B | |
| W725 | 5B | PHASE C |
| W726 | 6B | |

UTILITY 2 VOLTAGE
TB33-U2

| | | |
|---|---|---|
| W727 | 01 | PHASE A |
| W728 | 02 | PHASE B |
| W729 | 03 | PHASE C |
| W730 | 04 | NEUTRAL |

UTILITY 2 CURRENT
SB33-U2

| | | |
|---|---|---|
| W731 | 1B | PHASE A |
| W732 | 2B | |
| W733 | 3B | PHASE B |
| W734 | 4B | |
| W735 | 5B | PHASE C |
| W736 | 6B | |

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | A073U481 | SHEET 7 OF 11 | |
| DWN J. LLEWELLYN<br>CKD J. KUZNIA<br>APVD J. GUNDULRI | -1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

SYSTEM AC CONNECTIONS | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

## PowerCommand MASTER CONTROL (DMCCHAALAA0688)

SEE NOTES 10, 12 & 14
UTILITY MAIN BREAKER
TB14-UM1

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W805 |
| | 02 | W806 |
| BREAKER OPEN | 03 | W807 |
| | 04 | W808 |
| AUX 'A' | 05 | W809 |
| RTN | 06 | W810 |
| AUX 'B' | 07 | W811 |
| RTN | 08 | W812 |
| RACKED IN | 09 | W813 |
| RTN | 10 | W814 |
| TRIPPED | 11 | W815 |
| RTN | 12 | W816 |
| IN AUTO | 13 | W817 |
| RTN | 14 | W818 |
| DIRECT TRIP | 15 | W819 |
| RTN | 16 | W820 |
| UTILITY FAIL | 17 | W821 |
| RTN | 18 | W822 |
| SYNC CHECK | 19 | W823 |
| RTN | 20 | W824 |
| PROT RELAY FAULT | 21 | W825 |
| RTN | 22 | W826 |
| CONFIG IN 3 | 23 | |
| RTN | 24 | |
| SYSTEM PARALLELED | 25 | |
| | 26 | |
| REVERSE POWER DISABLE | 27 | |
| | 28 | |
| CONFIG OUT 1 | 29 | |
| | 30 | |
| CONFIG OUT 2 | 31 | |
| | 32 | |

SEE NOTES 10, 12 & 14
GENERATOR MAIN BREAKER
TB15-GM1

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W849 |
| | 02 | W850 |
| BREAKER OPEN | 03 | W851 |
| | 04 | W852 |
| AUX 'A' | 05 | W853 |
| RTN | 06 | W854 |
| AUX 'B' | 07 | W855 |
| RTN | 08 | W856 |
| RACKED IN | 09 | W857 |
| RTN | 10 | W858 |
| TRIPPED | 11 | W859 |
| RTN | 12 | W860 |
| IN AUTO | 13 | |
| RTN | 14 | |
| DIRECT TRIP | 15 | |
| RTN | 16 | |
| SYNC CHECK | 17 | |
| RTN | 18 | |
| PROT RELAY FAULT | 19 | |
| RTN | 20 | |
| CONFIG OUT | 21 | |
| | 22 | |

SEE NOTES 10, 12 & 14
UTILITY MAIN BREAKER
TB14-UM2

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W827 |
| | 02 | W828 |
| BREAKER OPEN | 03 | W829 |
| | 04 | W830 |
| AUX 'A' | 05 | W831 |
| RTN | 06 | W832 |
| AUX 'B' | 07 | W833 |
| RTN | 08 | W834 |
| RACKED IN | 09 | W835 |
| RTN | 10 | W836 |
| TRIPPED | 11 | W837 |
| RTN | 12 | W838 |
| IN AUTO | 13 | W839 |
| RTN | 14 | W840 |
| DIRECT TRIP | 15 | W841 |
| RTN | 16 | W842 |
| UTILITY FAIL | 17 | W843 |
| RTN | 18 | W844 |
| SYNC CHECK | 19 | W845 |
| RTN | 20 | W846 |
| PROT RELAY FAULT | 21 | W847 |
| RTN | 22 | W848 |
| CONFIG IN 3 | 23 | |
| RTN | 24 | |
| SYSTEM PARALLELED | 25 | |
| | 26 | |
| REVERSE POWER DISABLE | 27 | |
| | 28 | |
| CONFIG OUT 1 | 29 | |
| | 30 | |
| CONFIG OUT 2 | 31 | |
| | 32 | |

SEE NOTES 10, 12 & 14
GENERATOR MAIN BREAKER
TB15-GM2

| | | |
|---|---|---|
| BREAKER CLOSE | 01 | W861 |
| | 02 | W862 |
| BREAKER OPEN | 03 | W863 |
| | 04 | W864 |
| AUX 'A' | 05 | W865 |
| RTN | 06 | W866 |
| AUX 'B' | 07 | W867 |
| RTN | 08 | W868 |
| RACKED IN | 09 | W869 |
| RTN | 10 | W870 |
| TRIPPED | 11 | W871 |
| RTN | 12 | W872 |
| IN AUTO | 13 | |
| RTN | 14 | |
| DIRECT TRIP | 15 | |
| RTN | 16 | |
| SYNC CHECK | 17 | |
| RTN | 18 | |
| PROT RELAY FAULT | 19 | |
| RTN | 20 | |
| CONFIG OUT | 21 | |
| | 22 | |

(16) 14AWG DC WIRES
(22) 14AWG DC WIRES

(16) 14AWG DC WIRES
(22) 14AWG DC WIRES

## PARALLELING SWITCHGEAR (SWGCHAALAA0433)

SEE NOTE 14
52-GM1 BREAKER INTERFACE
TB35-GM1

| | | |
|---|---|---|
| W849 | 01 | CLOSE |
| W850 | 02 | RTN |
| W851 | 03 | OPEN |
| W852 | 04 | RTN |
| W853 | 05 | AUX 'A' |
| W854 | 06 | |
| W855 | 07 | AUX 'B' |
| W856 | 08 | |
| W857 | 09 | RACKED IN |
| W858 | 10 | |
| W859 | 11 | LOCKOUT |
| W860 | 12 | |
| | 13 | SPARE |
| | 14 | |
| | 15 | SPARE |
| | 16 | |

SEE NOTE 14
52-UM1 BREAKER INTERFACE
TB34-UM1

| | | |
|---|---|---|
| W805 | 01 | CLOSE |
| W806 | 02 | RTN |
| W807 | 03 | OPEN |
| W808 | 04 | RTN |
| W809 | 05 | AUX 'A' |
| W810 | 06 | |
| W811 | 07 | AUX 'B' |
| W812 | 08 | |
| W813 | 09 | RACKED IN |
| W814 | 10 | |
| W815 | 11 | LOCKOUT |
| W816 | 12 | |
| W817 | 13 | IN AUTO |
| W818 | 14 | |
| W819 | 15 | DIRECT TRIP |
| W820 | 16 | |
| W821 | 17 | UTILITY FAIL |
| W822 | 18 | |
| W823 | 19 | SYNC CHECK |
| W824 | 20 | |
| W825 | 21 | PROT RELAY FAULT |
| W826 | 22 | |

SEE NOTE 14
52-GM2 BREAKER INTERFACE
TB35-GM2

| | | |
|---|---|---|
| W861 | 01 | CLOSE |
| W862 | 02 | RTN |
| W863 | 03 | OPEN |
| W864 | 04 | RTN |
| W865 | 05 | AUX 'A' |
| W866 | 06 | |
| W867 | 07 | AUX 'B' |
| W868 | 08 | |
| W869 | 09 | RACKED IN |
| W870 | 10 | |
| W871 | 11 | LOCKOUT |
| W872 | 12 | |
| | 13 | SPARE |
| | 14 | |
| | 15 | SPARE |
| | 16 | |

SEE NOTE 14
52-UM2 BREAKER INTERFACE
TB34-UM2

| | | |
|---|---|---|
| W827 | 01 | CLOSE |
| W828 | 02 | RTN |
| W829 | 03 | OPEN |
| W830 | 04 | RTN |
| W831 | 05 | AUX 'A' |
| W832 | 06 | |
| W833 | 07 | AUX 'B' |
| W834 | 08 | |
| W835 | 09 | RACKED IN |
| W836 | 10 | |
| W837 | 11 | LOCKOUT |
| W838 | 12 | |
| W839 | 13 | IN AUTO |
| W840 | 14 | |
| W841 | 15 | DIRECT TRIP |
| W842 | 16 | |
| W843 | 17 | UTILITY FAIL |
| W844 | 18 | |
| W845 | 19 | SYNC CHECK |
| W846 | 20 | |
| W847 | 21 | PROT RELAY FAULT |
| W848 | 22 | |

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 8 OF 11 |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

TRANSFER PAIR CONNECTIONS | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

## PowerCommand MASTER CONTROL (DMCCHAALAA0688)

SEE NOTE 11
LOAD ADD/SHED
TB19-L1

| | | |
|---|---|---|
| LOAD ADD | 01 | W901 |
| | 02 | W902 |
| | 03 | |
| LOAD SHED | 04 | W903 |
| | 05 | W904 |
| | 06 | |
| AUX 'A' | 07 | W905 |
| RTN | 08 | W906 |
| RACKED IN | 09 | W907 |
| RTN | 10 | W908 |
| TRIPPED | 11 | W909 |
| RTN | 12 | W910 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L5

| | | |
|---|---|---|
| LOAD ADD | 01 | W941 |
| | 02 | W942 |
| | 03 | |
| LOAD SHED | 04 | W943 |
| | 05 | W944 |
| | 06 | |
| AUX 'A' | 07 | W945 |
| RTN | 08 | W946 |
| RACKED IN | 09 | W947 |
| RTN | 10 | W948 |
| TRIPPED | 11 | W949 |
| RTN | 12 | W950 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L2

| | | |
|---|---|---|
| LOAD ADD | 01 | W911 |
| | 02 | W912 |
| | 03 | |
| LOAD SHED | 04 | W913 |
| | 05 | W914 |
| | 06 | |
| AUX 'A' | 07 | W915 |
| RTN | 08 | W916 |
| RACKED IN | 09 | W917 |
| RTN | 10 | W918 |
| TRIPPED | 11 | W919 |
| RTN | 12 | W920 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L6

| | | |
|---|---|---|
| LOAD ADD | 01 | W951 |
| | 02 | W952 |
| | 03 | |
| LOAD SHED | 04 | W953 |
| | 05 | W954 |
| | 06 | |
| AUX 'A' | 07 | W955 |
| RTN | 08 | W956 |
| RACKED IN | 09 | W957 |
| RTN | 10 | W958 |
| TRIPPED | 11 | W959 |
| RTN | 12 | W960 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L3

| | | |
|---|---|---|
| LOAD ADD | 01 | W921 |
| | 02 | W922 |
| | 03 | |
| LOAD SHED | 04 | W923 |
| | 05 | W924 |
| | 06 | |
| AUX 'A' | 07 | W925 |
| RTN | 08 | W926 |
| RACKED IN | 09 | W927 |
| RTN | 10 | W928 |
| TRIPPED | 11 | W929 |
| RTN | 12 | W930 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L7

| | | |
|---|---|---|
| LOAD ADD | 01 | W961 |
| | 02 | W962 |
| | 03 | |
| LOAD SHED | 04 | W963 |
| | 05 | W964 |
| | 06 | |
| AUX 'A' | 07 | W965 |
| RTN | 08 | W966 |
| RACKED IN | 09 | W967 |
| RTN | 10 | W968 |
| TRIPPED | 11 | W969 |
| RTN | 12 | W970 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L4

| | | |
|---|---|---|
| LOAD ADD | 01 | W931 |
| | 02 | W932 |
| | 03 | |
| LOAD SHED | 04 | W933 |
| | 05 | W934 |
| | 06 | |
| AUX 'A' | 07 | W935 |
| RTN | 08 | W936 |
| RACKED IN | 09 | W937 |
| RTN | 10 | W938 |
| TRIPPED | 11 | W939 |
| RTN | 12 | W940 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L8

| | | |
|---|---|---|
| LOAD ADD | 01 | W971 |
| | 02 | W972 |
| | 03 | |
| LOAD SHED | 04 | W973 |
| | 05 | W974 |
| | 06 | |
| AUX 'A' | 07 | W975 |
| RTN | 08 | W976 |
| RACKED IN | 09 | W977 |
| RTN | 10 | W978 |
| TRIPPED | 11 | W979 |
| RTN | 12 | W980 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES

## PARALLELING SWITCHGEAR (SWGCHAALAA0433)

SEE NOTE 14
52-F1 BREAKER INTERFACE
TB39-F1

| | | |
|---|---|---|
| W901 | 01 | CLOSE |
| W902 | 02 | RTN |
| W903 | 03 | OPEN |
| W904 | 04 | RTN |
| W905 | 05 | AUX 'A' |
| W906 | 06 | |
| W907 | 07 | RACKED IN |
| W908 | 08 | |
| W909 | 09 | TRIPPED |
| W910 | 10 | |

SEE NOTE 14
52-F2 BREAKER INTERFACE
TB39-F2

| | | |
|---|---|---|
| W911 | 01 | CLOSE |
| W912 | 02 | RTN |
| W913 | 03 | OPEN |
| W914 | 04 | RTN |
| W915 | 05 | AUX 'A' |
| W916 | 06 | |
| W917 | 07 | RACKED IN |
| W918 | 08 | |
| W919 | 09 | TRIPPED |
| W920 | 10 | |

SEE NOTE 14
52-F3 BREAKER INTERFACE
TB39-F3

| | | |
|---|---|---|
| W921 | 01 | CLOSE |
| W922 | 02 | RTN |
| W923 | 03 | OPEN |
| W924 | 04 | RTN |
| W925 | 05 | AUX 'A' |
| W926 | 06 | |
| W927 | 07 | RACKED IN |
| W928 | 08 | |
| W929 | 09 | TRIPPED |
| W930 | 10 | |

SEE NOTE 14
52-F4 BREAKER INTERFACE
TB39-F4

| | | |
|---|---|---|
| W931 | 01 | CLOSE |
| W932 | 02 | RTN |
| W933 | 03 | OPEN |
| W934 | 04 | RTN |
| W935 | 05 | AUX 'A' |
| W936 | 06 | |
| W937 | 07 | RACKED IN |
| W938 | 08 | |
| W939 | 09 | TRIPPED |
| W940 | 10 | |

SEE NOTE 14
52-F5 BREAKER INTERFACE
TB39-F5

| | | |
|---|---|---|
| W941 | 01 | CLOSE |
| W942 | 02 | RTN |
| W943 | 03 | OPEN |
| W944 | 04 | RTN |
| W945 | 05 | AUX 'A' |
| W946 | 06 | |
| W947 | 07 | RACKED IN |
| W948 | 08 | |
| W949 | 09 | TRIPPED |
| W950 | 10 | |

SEE NOTE 14
52-F6 BREAKER INTERFACE
TB39-F6

| | | |
|---|---|---|
| W951 | 01 | CLOSE |
| W952 | 02 | RTN |
| W953 | 03 | OPEN |
| W954 | 04 | RTN |
| W955 | 05 | AUX 'A' |
| W956 | 06 | |
| W957 | 07 | RACKED IN |
| W958 | 08 | |
| W959 | 09 | TRIPPED |
| W960 | 10 | |

SEE NOTE 14
52-F7 BREAKER INTERFACE
TB39-F7

| | | |
|---|---|---|
| W961 | 01 | CLOSE |
| W962 | 02 | RTN |
| W963 | 03 | OPEN |
| W964 | 04 | RTN |
| W965 | 05 | AUX 'A' |
| W966 | 06 | |
| W967 | 07 | RACKED IN |
| W968 | 08 | |
| W969 | 09 | TRIPPED |
| W970 | 10 | |

SEE NOTE 14
52-F8 BREAKER INTERFACE
TB39-F8

| | | |
|---|---|---|
| W971 | 01 | CLOSE |
| W972 | 02 | RTN |
| W973 | 03 | OPEN |
| W974 | 04 | RTN |
| W975 | 05 | AUX 'A' |
| W976 | 06 | |
| W977 | 07 | RACKED IN |
| W978 | 08 | |
| W979 | 09 | TRIPPED |
| W980 | 10 | |

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 9 OF 11 |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

FEEDER BREAKER CONNECTIONS | 264467 DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

## PowerCommand MASTER CONTROL (DMCCHAALAA0688)

SEE NOTE 11
LOAD ADD/SHED
TB19-L9

| | | |
|---|---|---|
| LOAD ADD | 01 | W1001 |
| | 02 | W1002 |
| | 03 | |
| LOAD SHED | 04 | W1003 |
| | 05 | W1004 |
| | 06 | |
| AUX 'A' | 07 | W1005 |
| RTN | 08 | W1006 |
| RACKED IN | 09 | W1007 |
| RTN | 10 | W1008 |
| TRIPPED | 11 | W1009 |
| RTN | 12 | W1010 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L13

| | | |
|---|---|---|
| LOAD ADD | 01 | W1041 |
| | 02 | W1042 |
| | 03 | |
| LOAD SHED | 04 | W1043 |
| | 05 | W1044 |
| | 06 | |
| AUX 'A' | 07 | W1045 |
| RTN | 08 | W1046 |
| RACKED IN | 09 | W1047 |
| RTN | 10 | W1048 |
| TRIPPED | 11 | W1049 |
| RTN | 12 | W1050 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L10

| | | |
|---|---|---|
| LOAD ADD | 01 | W1011 |
| | 02 | W1012 |
| | 03 | |
| LOAD SHED | 04 | W1013 |
| | 05 | W1014 |
| | 06 | |
| AUX 'A' | 07 | W1015 |
| RTN | 08 | W1016 |
| RACKED IN | 09 | W1017 |
| RTN | 10 | W1018 |
| TRIPPED | 11 | W1019 |
| RTN | 12 | W1020 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L14

| | | |
|---|---|---|
| LOAD ADD | 01 | W1051 |
| | 02 | W1052 |
| | 03 | |
| LOAD SHED | 04 | W1053 |
| | 05 | W1054 |
| | 06 | |
| AUX 'A' | 07 | W1055 |
| RTN | 08 | W1056 |
| RACKED IN | 09 | W1057 |
| RTN | 10 | W1058 |
| TRIPPED | 11 | W1059 |
| RTN | 12 | W1060 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L11

| | | |
|---|---|---|
| LOAD ADD | 01 | W1021 |
| | 02 | W1022 |
| | 03 | |
| LOAD SHED | 04 | W1023 |
| | 05 | W1024 |
| | 06 | |
| AUX 'A' | 07 | W1025 |
| RTN | 08 | W1026 |
| RACKED IN | 09 | W1027 |
| RTN | 10 | W1028 |
| TRIPPED | 11 | W1029 |
| RTN | 12 | W1030 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L15

| | | |
|---|---|---|
| LOAD ADD | 01 | W1061 |
| | 02 | W1062 |
| | 03 | |
| LOAD SHED | 04 | W1063 |
| | 05 | W1064 |
| | 06 | |
| AUX 'A' | 07 | W1065 |
| RTN | 08 | W1066 |
| RACKED IN | 09 | W1067 |
| RTN | 10 | W1068 |
| TRIPPED | 11 | W1069 |
| RTN | 12 | W1070 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L12

| | | |
|---|---|---|
| LOAD ADD | 01 | W1031 |
| | 02 | W1032 |
| | 03 | |
| LOAD SHED | 04 | W1033 |
| | 05 | W1034 |
| | 06 | |
| AUX 'A' | 07 | W1035 |
| RTN | 08 | W1036 |
| RACKED IN | 09 | W1037 |
| RTN | 10 | W1038 |
| TRIPPED | 11 | W1039 |
| RTN | 12 | W1040 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

SEE NOTE 11
LOAD ADD/SHED
TB19-L16

| | | |
|---|---|---|
| LOAD ADD | 01 | W1071 |
| | 02 | W1072 |
| | 03 | |
| LOAD SHED | 04 | W1073 |
| | 05 | W1074 |
| | 06 | |
| AUX 'A' | 07 | W1075 |
| RTN | 08 | W1076 |
| RACKED IN | 09 | W1077 |
| RTN | 10 | W1078 |
| TRIPPED | 11 | W1079 |
| RTN | 12 | W1080 |
| CONFIG INPUT | 13 | |
| RTN | 14 | |

(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES
(10) 14AWG DC WIRES

## PARALLELING SWITCHGEAR (SWGCHAALAA0433)

SEE NOTE 14
52-F1 BREAKER INTERFACE
TB39-F9

| | | |
|---|---|---|
| W1001 | 01 | CLOSE |
| W1002 | 02 | RTN |
| W1003 | 03 | OPEN |
| W1004 | 04 | RTN |
| W1005 | 05 | AUX 'A' |
| W1006 | 06 | |
| W1007 | 07 | RACKED IN |
| W1008 | 08 | |
| W1009 | 09 | TRIPPED |
| W1010 | 10 | |

SEE NOTE 14
52-F2 BREAKER INTERFACE
TB39-F10

| | | |
|---|---|---|
| W1011 | 01 | CLOSE |
| W1012 | 02 | RTN |
| W1013 | 03 | OPEN |
| W1014 | 04 | RTN |
| W1015 | 05 | AUX 'A' |
| W1016 | 06 | |
| W1017 | 07 | RACKED IN |
| W1018 | 08 | |
| W1019 | 09 | TRIPPED |
| W1020 | 10 | |

SEE NOTE 14
52-F3 BREAKER INTERFACE
TB39-F11

| | | |
|---|---|---|
| W1021 | 01 | CLOSE |
| W1022 | 02 | RTN |
| W1023 | 03 | OPEN |
| W1024 | 04 | RTN |
| W1025 | 05 | AUX 'A' |
| W1026 | 06 | |
| W1027 | 07 | RACKED IN |
| W1028 | 08 | |
| W1029 | 09 | TRIPPED |
| W1030 | 10 | |

SEE NOTE 14
52-F4 BREAKER INTERFACE
TB39-F12

| | | |
|---|---|---|
| W1031 | 01 | CLOSE |
| W1032 | 02 | RTN |
| W1033 | 03 | OPEN |
| W1034 | 04 | RTN |
| W1035 | 05 | AUX 'A' |
| W1036 | 06 | |
| W1037 | 07 | RACKED IN |
| W1038 | 08 | |
| W1039 | 09 | TRIPPED |
| W1040 | 10 | |

SEE NOTE 14
52-F5 BREAKER INTERFACE
TB39-F13

| | | |
|---|---|---|
| W1041 | 01 | CLOSE |
| W1042 | 02 | RTN |
| W1043 | 03 | OPEN |
| W1044 | 04 | RTN |
| W1045 | 05 | AUX 'A' |
| W1046 | 06 | |
| W1047 | 07 | RACKED IN |
| W1048 | 08 | |
| W1049 | 09 | TRIPPED |
| W1050 | 10 | |

SEE NOTE 14
52-F6 BREAKER INTERFACE
TB39-F14

| | | |
|---|---|---|
| W1051 | 01 | CLOSE |
| W1052 | 02 | RTN |
| W1053 | 03 | OPEN |
| W1054 | 04 | RTN |
| W1055 | 05 | AUX 'A' |
| W1056 | 06 | |
| W1057 | 07 | RACKED IN |
| W1058 | 08 | |
| W1059 | 09 | TRIPPED |
| W1060 | 10 | |

SEE NOTE 14
52-F7 BREAKER INTERFACE
TB39-F15

| | | |
|---|---|---|
| W1061 | 01 | CLOSE |
| W1062 | 02 | RTN |
| W1063 | 03 | OPEN |
| W1064 | 04 | RTN |
| W1065 | 05 | AUX 'A' |
| W1066 | 06 | |
| W1067 | 07 | RACKED IN |
| W1068 | 08 | |
| W1069 | 09 | TRIPPED |
| W1070 | 10 | |

SEE NOTE 14
52-F8 BREAKER INTERFACE
TB39-F16

| | | |
|---|---|---|
| W1071 | 01 | CLOSE |
| W1072 | 02 | RTN |
| W1073 | 03 | OPEN |
| W1074 | 04 | RTN |
| W1075 | 05 | AUX 'A' |
| W1076 | 06 | |
| W1077 | 07 | RACKED IN |
| W1078 | 08 | |
| W1079 | 09 | TRIPPED |
| W1080 | 10 | |

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 10 OF 11 |
| DWN J. LLEWELLYN | -1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

FEEDER BREAKER CONNECTIONS 2

264467
DMCCHAALAA0688

Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

SIZE: A3

PowerCommand MASTER CONTROL (DMCCHAALAA0688)

PARALLELING SWITCHGEAR (SWGCHAALAA0433)

BATTERY SYSTEM (BAT999999A0220)

SEE NOTE 4
DC POWER
TB24
24VDC (+) — 1 — W1106
(–) — 2 — W1107

(ALL COMMS DAISY-CHAINED)
CIRCUIT BREAKER DATA LINK
IFE1
MODBUS TCP/IP — ETH1

(2) 8AWG DC WIRES

SEE NOTE 4
24VDC
BATTERY CHARGER
120VAC LINE — L — W1110
NEUTRAL — N — W1111
GROUND — LUG — W1112
W1106 — OUT+ — DC OUTPUT
W1107 — OUT- — BREAKER
W1104 — TB1-1 — CHARGER ALARM
W1105 — TB1-3

(3) 12AWG AC WIRES — MAINTAINED SOURCE

(2) 14AWG DC WIRES

SEE NOTES 15, 16 & 17
CUSTOMER CONTROL CONNECTIONS
TB9-C1

| | | |
|---|---|---|
| REMOTE E-STOP | 01 | |
| RTN | 02 | |
| LOW FUEL MAIN TANK/CUSTOMER INPUT 1 | 03 | |
| RTN | 04 | |
| SYSTEM TEST/CUSTOMER INPUT 2 | 05 | |
| RTN | 06 | |
| SYSTEM EXTD PARALLEL/CUSTOMER INPUT 3 | 07 | |
| RTN | 08 | |
| SPARE CAPACITY PICKUP/CUSTOMER INPUT 4 | 09 | |
| RTN | 10 | |
| NGR FAULT/CUSTOMER INPUT 5 | 11 | |
| RTN | 12 | |
| CUSTOMER INPUT 6 | 13 | W1104 |
| RTN | 14 | W1105 |
| PLC MALFUNCTION | 15 | |
| | 16 | |
| GENERAL ALARM | 17 | |
| | 18 | |
| CUSTOMER OUTPUT 1 | 19 | |
| | 20 | |
| CUSTOMER OUTPUT 2 | 21 | |
| | 22 | |
| CUSTOMER OUTPUT 3 | 23 | |
| | 24 | |
| CUSTOMER OUTPUT 4 | 25 | |
| | 26 | |

SEE NOTE 4
OPTIONAL DC SOURCE IN
TB24-EXT
24VDC (+) — 01
(–) — 02

SEE NOTE 6
BUILDING MANAGEMENT DATA & REMOTE WEB BROWSING
BMS
MODBUS TCP/IP — RJ45

SEE NOTE 4
MAIN POWER SUPPLY
TB120-A1
120VAC LINE — L — W1101
NEUTRAL — N — W1102
GROUND — E — W1103

(3) 12AWG AC WIRES — MAINTAINED SOURCE

CABINET GROUNDING BAR — FGND — LUG

| | | | |
|---|---|---|---|
| DIAGRAM, INTERCONNECT WIRING | | A073U481 | SHEET 11 OF 11 |
| DWN J. LLEWELLYN | –1 | SUBMITTAL RELEASE | 20MAR23 |
| CKD J. KUZNIA | | | |
| APVD J. GUNDULRI | REV | DESCRIPTION | DATE |

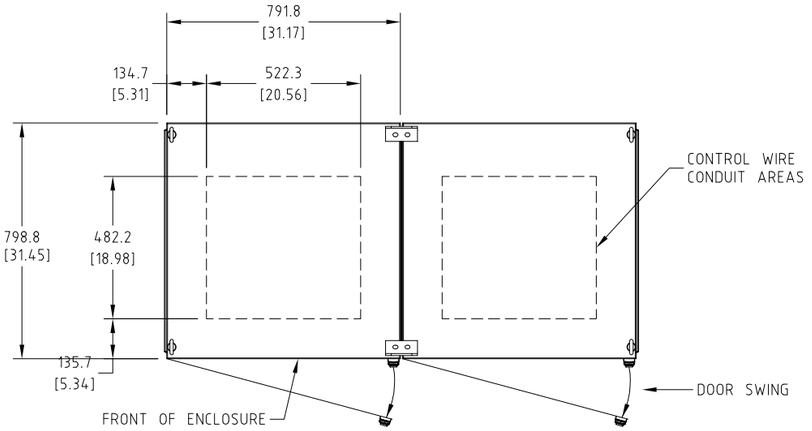
PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

OTHER CONNECTIONS | 264467 DMCCHAALAA0688

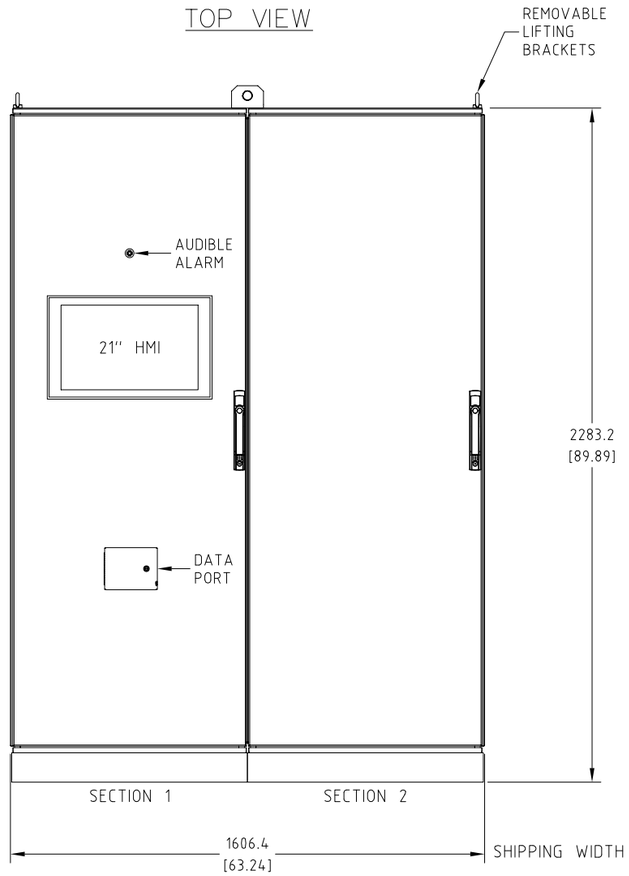
Cummins Inc.

CAD SYSTEM
Autodesk® AutoCAD® Electrical

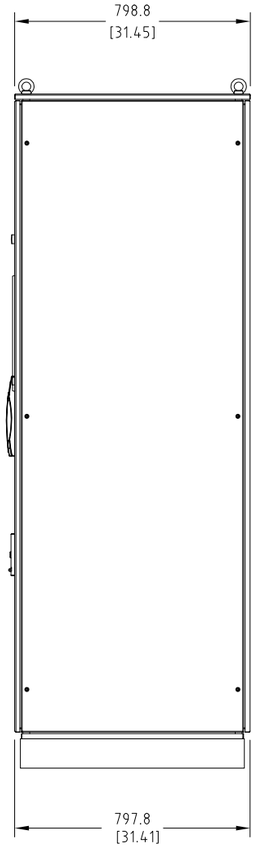
SIZE: A3




TOP VIEW



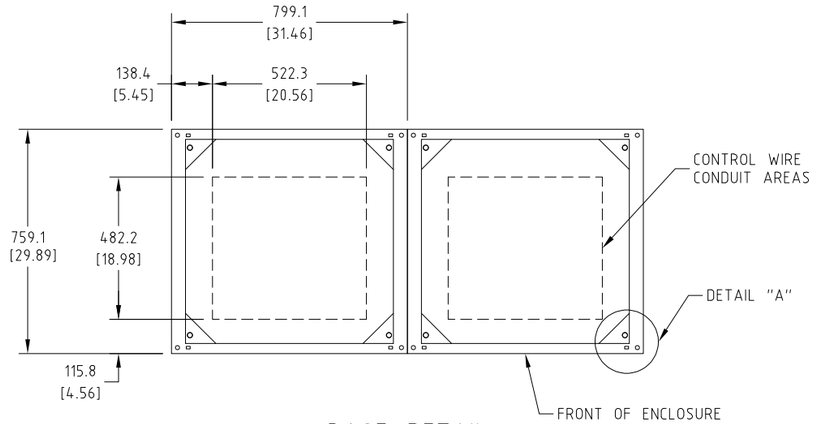

FRONT ELEVATION



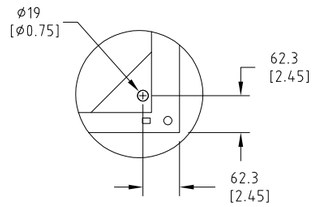

RIGHT SIDE ELEVATION

## GENERAL NOTES

OPERATING VOLTAGE AC: 120 VOLT, 3 PHASE, 4 WIRE, 60 HERTZ
OPERATING VOLTAGE DC: 24 VOLT
INDOOR NEMA 1
FRONT ACCESS ONLY
EXTERIOR COLOR: ANSI #61 GRAY
SECTIONS LABELED PER UL891 STANDARDS
SHIPPING WEIGHT: 1500 LBS 681 KG
SEISMIC RATED



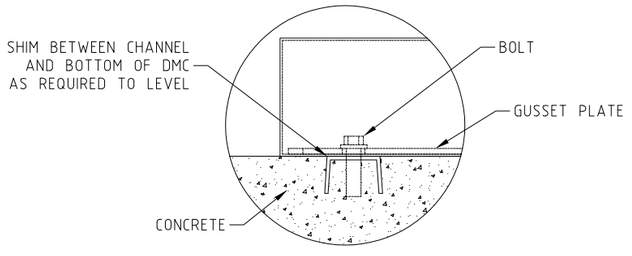

BASE DETAIL




DETAIL 'A'
MOUNTING HOLE DIMENSIONS TRUE ON ALL CORNERS OF ALL CABINETS UNLESS OTHERWISE STATED

## INSTALLATION-FOUNDATION REQUIREMENTS

THE DIGITAL MASTER CONTROL (DMC) MUST BE INSTALLED ON A FLAT LEVEL SURFACE. CUMMINS RECOMMENDS INSTALLING THE DMC ON A PAD LEVELED TO 3 [1/8] IN ANY SQUARE YARD.
USE CONCRETE ANCHOR BOLTS OR INSTALL STEEL CHANNELS IN THE PAD FOR BOLTING OF GEAR (SEE BELOW)




RECOMMENDED MOUNTING DETAIL

| | | | |
|---|---|---|---|
| OUTLINE,SWITCHGEAR | | A073U479 | SHEET 1 OF 1 |
| DWN S. WENTZEL<br>CKD J. KUZNIA<br>APVD J. GUNDLURI | | | |
| | – 1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

DIGITAL MASTER CONTROL | 264467 DMCCHAALAA0688

# Cummins Inc.

DIMENSIONS ARE IN: MILLIMETERS
[ ] ARE IN: INCHES

SIZE: A3 | SCALE: NTS

DIMENSIONING AND TOLERANCING PER:
ASME Y14.5–2009

THIRD ANGLE PROJECTION

CAD SYSTEM
Autodesk® AutoCAD® Electrical

| NAMEPLATE DESIGNATION | | POWER CIRCUIT BREAKER SCHEDULE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE 1 | LINE 2 | MANUFACTURER & TYPE | FRAME | SENSOR PLUG | TRIP SETTING | RATING PLUG | POLES | OPR/MTG | UVR | TRIPPING PARAMETERS | TRIP TYPE | AIC | MECHANICAL LUGS (QTY) PER PHASE & NEUTRAL |
| 52-UM1 | UTILITY MAIN 1 | SQUARE D / NW | 3000A | 3000A | 3000A | A | 4 | EO/DO | - | LSIG | 6.0P | 100K | (8) 3/0 AWG - 750 MCM |
| 52-F1 | MCC-UV1 | SQUARE D / NT | 1200A | 1200A | 1200A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F2 | AERATION BLOWER NO 1 VFD | SQUARE D / NT | 800A | 600A | 600A | A | 4 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F3 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F4 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F5 | MCC-ABLWR1 | SQUARE D / NT | 800A | 600A | 600A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F6 | AERATION BLOWER NO 3 VFD | SQUARE D / NT | 800A | 600A | 600A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F7 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F8 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-GM1 | GEN MAIN 1 | SQUARE D / NW | 3000A | 3000A | 3000A | A | 4 | EO/DO | - | LSIA | 5.0P | 100K | --- |
| 52-G1 | GENERATOR 1 | SQUARE D / NW | 1600A | 1600A | 1600A | A | 3 | EO/DO | 24 VDC | LSIA | 5.0P | 100K | (5) 3/0 AWG - 750 MCM |
| 52-G2 | GENERATOR 2 | SQUARE D / NW | 1600A | 1600A | 1600A | A | 3 | EO/DO | 24 VDC | LSIA | 5.0P | 100K | (5) 3/0 AWG - 750 MCM |
| 52-G3 | GENERATOR 3 | SQUARE D / NW | 1600A | 1600A | 1600A | A | 3 | EO/DO | 24 VDC | LSIA | 5.0P | 100K | (5) 3/0 AWG - 750 MCM |
| 52-G4 | GENERATOR 4 | SQUARE D / NW FUTURE | 1600A | - | - | - | 3 | EO/DO | 24 VDC | LSIA | 5.0P | 100K | (5) 3/0 AWG - 750 MCM |
| 52-GM2 | GEN MAIN 2 | SQUARE D / NW | 3000A | 3000A | 3000A | A | 4 | EO/DO | - | LSIA | 5.0P | 100K | --- |
| 52-F9 | MCC-UV2 | SQUARE D / NT | 1200A | 1200A | 1200A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F10 | AERATION BLOWER NO 2 VFD | SQUARE D / NT | 800A | 600A | 600A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F11 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F12 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F13 | MCC-ABLWR2 | SQUARE D / NT | 800A | 600A | 600A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F14 | AERATION BLOWER NO 4 VFD | SQUARE D / NT | 800A | 600A | 600A | A | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F15 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-F16 | | SQUARE D / NT FUTURE | 800A | - | - | - | 3 | EO/DO | - | LSIG | 6.0P | 100K | (4) #2 AWG - 600 MCM |
| 52-UM2 | UTILITY MAIN 2 | SQUARE D / NW | 3000A | 3000A | 3000A | A | 4 | EO/DO | - | LSIG | 6.0P | 100K | (8) 3/0 AWG - 750 MCM |

NAMEPLATES SHALL BE WHITE SURFACE WITH BLACK TEXT

LEGEND:
EO ELECTRICALLY OPERATED
DO DRAW-OUT
UVR UNDER VOLTAGE RELEASE
LSIG LONG, SHORT, INSTANTANEOUS, GROUND FAULT TRIP
LSIA LONG, SHORT, INSTANTANEOUS, GROUND FAULT ALARM NO TRIP

## DOOR COMPONENTS:

- SEL-751 RELAY
- RELAY TEST SWITCH
- RELAY LOCK OUT SWITCH
- AUTO MANUAL SWITCH
- BREAKER CONTROL SWITCH
- ENERGY REDUCTION MAINTENANCE SETTING
- BREAKER POSITION INDICATION LIGHTS

## GENERAL NOTES:

### POWER SYSTEM DATA:
480Y/277 VOLT, 3 PHASE, 4 WIRE, 60 HERTZ
MAXIMUM AVAILABLE FAULT CURRENT: 100kA
SECTIONS LABELED PER UL891

### BUS SYSTEM DATA:
3000 AMP SILVER PLATED COPPER BUS
BUS INSULATION: NONE
BUS RATING: THERMAL
BUS BRACING: 100kA
GEAR PROVIDED WITH MECHANICAL LUGS.

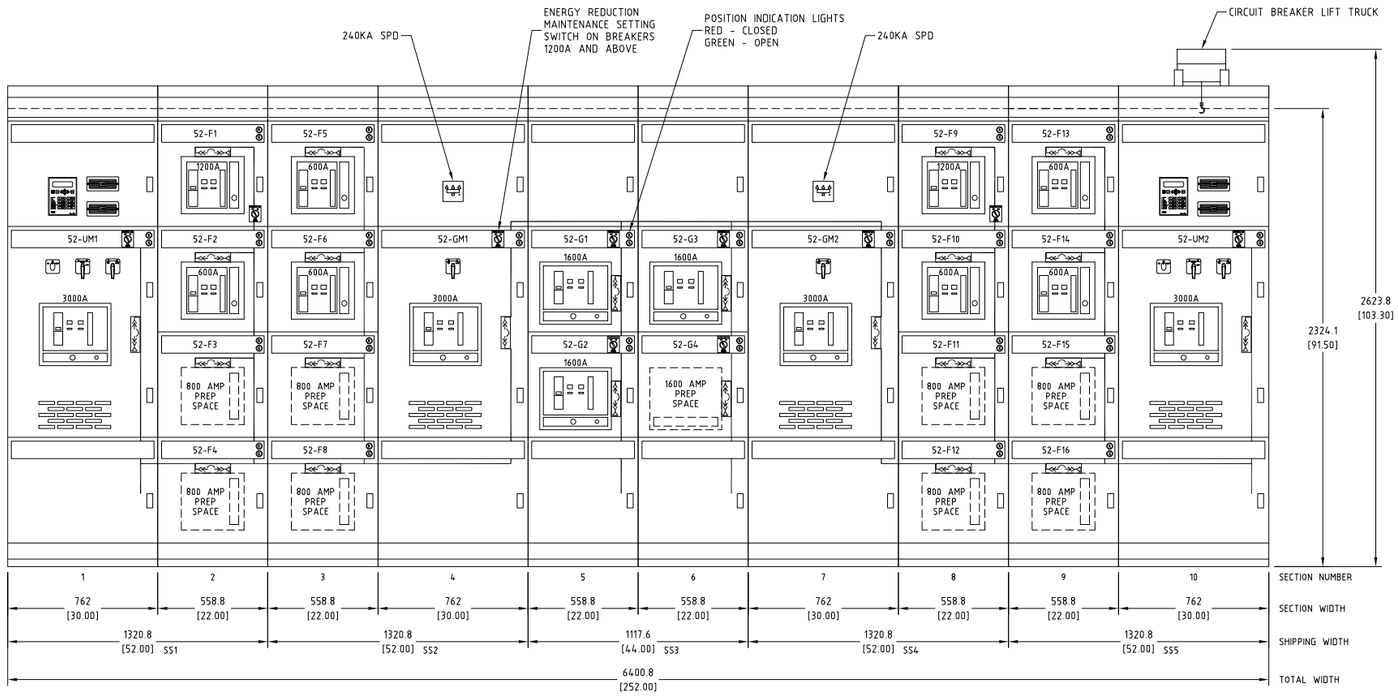
### ENCLOSURE DATA:
INDOOR NEMA 1
SERVICE ENTRANCE RATED
EXTERIOR COLOR: ANSI #61 GRAY
REAR ACCESS BY HINGED PADLOCKABLE DOORS
SEISMIC RATED

### SECTION BARRIERS:
SHUTTERS OVER BUS IN CELL
SECTION SIDE, BUS & CABLE COMPARTMENT
SECTION REAR, BUS & CABLE COMPARTMENT

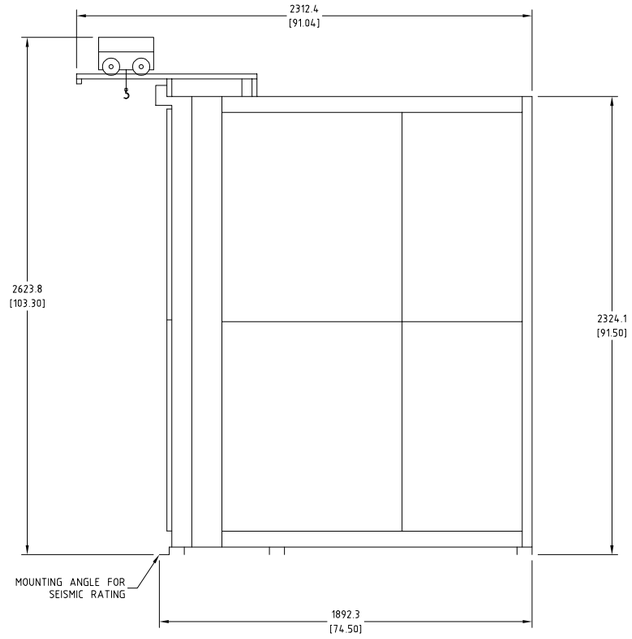
### SHIPPING WEIGHT:
SHIPPING SPLIT SS1: 3962 LBS 1797 KG
SHIPPING SPLIT SS2: 3962 LBS 1797 KG
SHIPPING SPLIT SS3: 3851 LBS 1747 KG
SHIPPING SPLIT SS4: 3962 LBS 1797 KG
SHIPPING SPLIT SS5: 3962 LBS 1797 KG

### INSTRUCTION BULLETIN:
REFER TO 80298-001-06 INSTRUCTION BULLETIN FOR QED6 SWITCHGEAR

### ACCESSORIES:
OVERHEAD BREAKER LIFT TRUCK
MIMIC BUS - BLACK ON GRAY PLASTIC
BREAKER COMMUNICATIONS MODBUS RS485




FRONT ELEVATION




RIGHT SIDE VIEW

| | | | |
|---|---|---|---|
| OUTLINE,SWITCHGEAR | | A073U480 | SHEET 1 OF 3 |
| DWN S. WENTZEL | | | |
| CKD J. KUZNIA | | | |
| APVD J. GUNDLURI | - 1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

MAIN SWITCHGEAR MSG | 264467 SWGCHAALAA0433

# Cummins Inc.

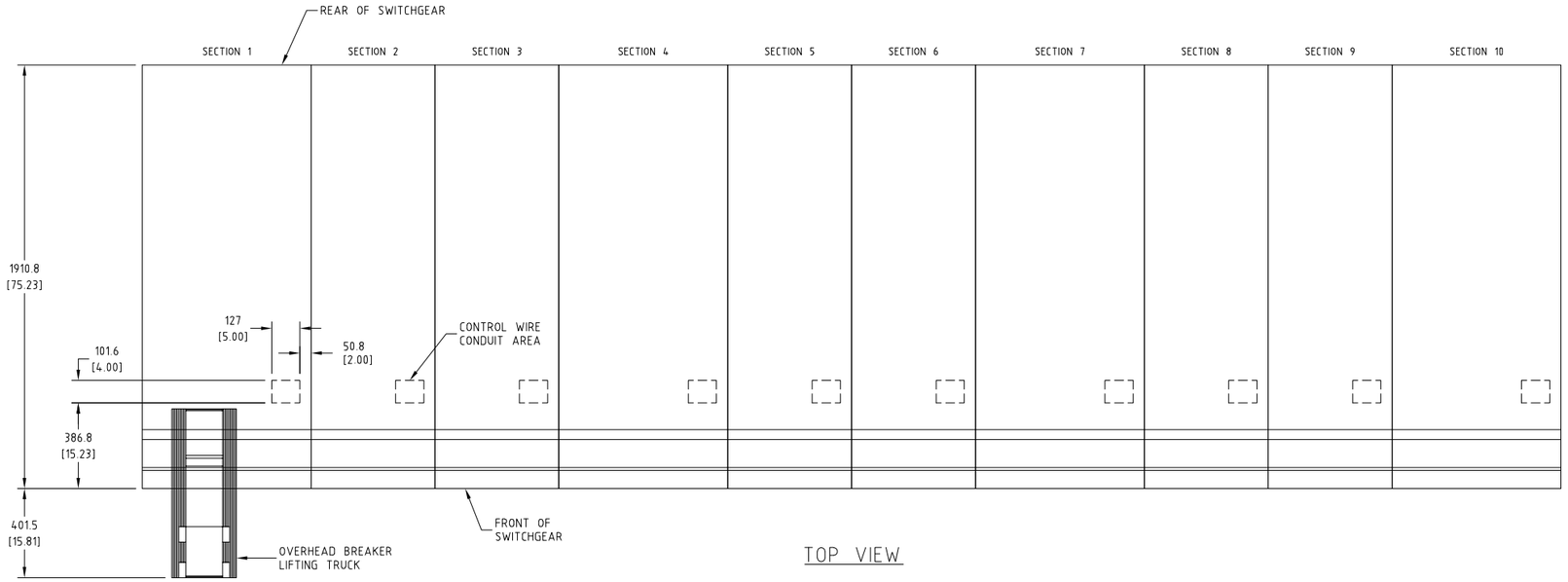
DIMENSIONS ARE IN: MILLIMETERS
[ ] ARE IN: INCHES

SIZE: A3 | SCALE: NTS

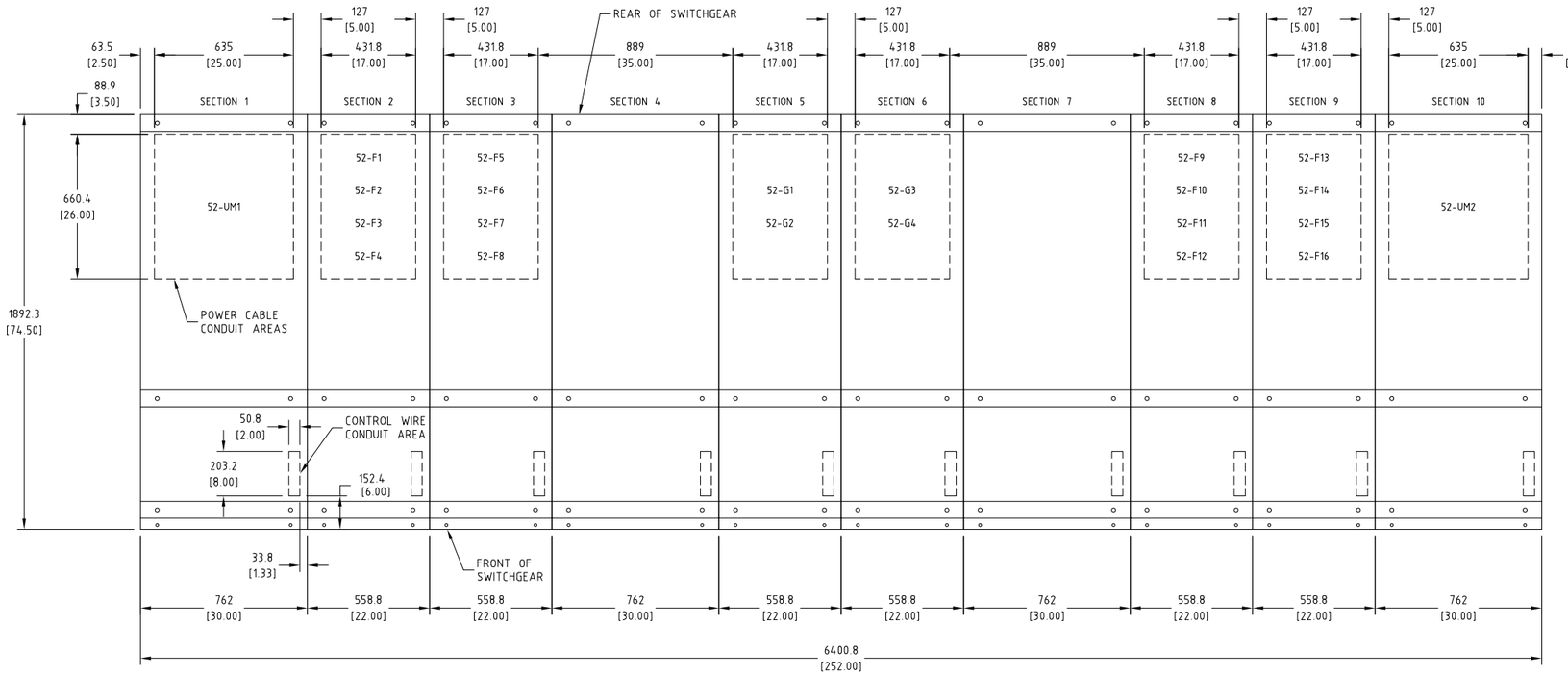
DIMENSIONING AND TOLERANCING PER:
ASME Y14.5-2009

THIRD ANGLE PROJECTION

CAD SYSTEM
Autodesk® AutoCAD® Electrical




TOP VIEW




BASE DETAIL

| | | | |
|---|---|---|---|
| OUTLINE,SWITCHGEAR | | A073U480 | SHEET 2 OF 3 |
| DWN S. WENTZEL<br>CKD J. KUZNIA<br>APVD J. GUNDLURI | – 1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

MAIN SWITCHGEAR MSG | 264467 SWGCHAALAA0433

# Cummins Inc.

DIMENSIONS ARE IN: MILLIMETERS
[ ] ARE IN: INCHES

SIZE: A3 | SCALE: NTS

DIMENSIONING AND TOLERANCING PER:
ASME Y14.5–2009

THIRD ANGLE PROJECTION

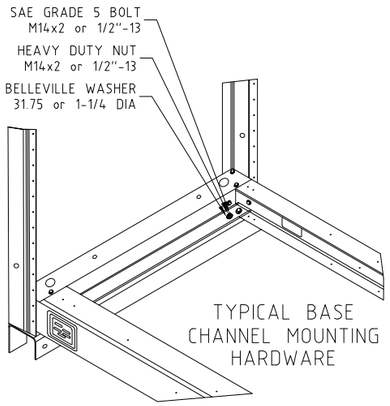
CAD SYSTEM
Autodesk® AutoCAD® Electrical

## REQUIREMENTS FOR SEISMIC RATING – NEMA TYPE 1 ENCLOSURE:

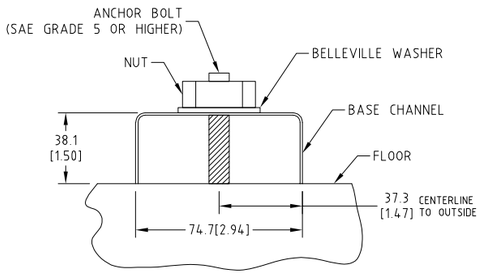
### ANCHORING CONDITIONS:

TO MAINTAIN SEISMIC QUALIFICATIONS, EQUIPMENT MUST BE INSTALLED PER APPLICABLE INSTRUCTION BULLETIN (SEE GENERAL NOTES) AND PER ANY SEISMIC ANCHORING DETAILS PROVIDED BY OTHERS. DO NOT INSTALL EQUIPMENT BEFORE APPROVED SEISMIC ANCHORING DETAILS HAVE BEEN OBTAINED AND SITE PREPARATIONS HAVE BEEN MADE IN ACCORDANCE WITH THE APPROVED SEISMIC ANCHORING DETAILS. ALL POST–INSTALLED ANCHORS SHALL BE APPROVED FOR SEISMIC LOADS.

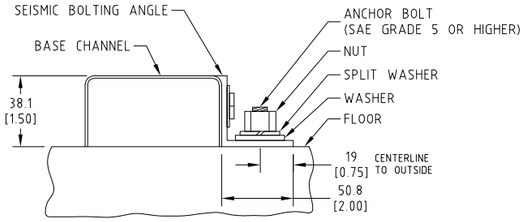
CONSIDERATION MUST BE MADE FOR CONDUIT ENTRY INTO EACH SECTION WHEN DEVELOPING MOUNTING PAD REINFORCEMENT LOCATIONS. REFER TO CONDUIT ENTRY DETAILS (FLOOR PLAN) FOR DIMENSIONAL INFORMATION.




TYPICAL BASE CHANNEL MOUNTING HARDWARE




TYPICAL REAR & CENTER BASE CHANNEL




TYPICAL FRONT BASE CHANNEL WITH SEISMIC BOLTING ANGLE

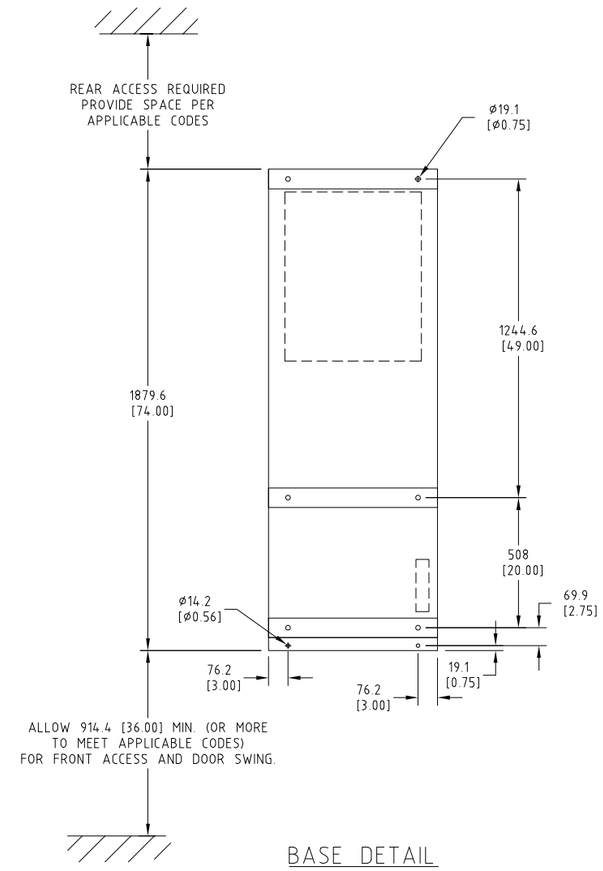
## MOUNTING DETAILS

EACH SECTION MUST BE ANCHORED AT ALL LOCATIONS (REFER TO FLOOR PLAN & MOUNTING DETAILS ABOVE). REAR & CENTER BASE CHANNEL ANCHOR BOLT MOUNTING POINTS ARE 19[0.75] DIAMETER HOLES LOCATED 38[1.5] ABOVE THE BASE OF THE SECTION. SEISMIC BOLTING ANGLE (PROVIDED WHEN SEISMIC RATED OPTION IS SELECTED) ANCHOR BOLT MOUNTING POINTS ARE 14.2[0.56] DIAMETER HOLES LOCATED 6.4[0.25] ABOVE THE BASE OF THE SECTION. USE DIMENSIONS FROM THE FLOOR PLAN TO DETERMINE MOUNTING LOCATIONS.

THE BELLEVILLE WASHER (SHOWN IN DETAIL ABOVE) USED FOR ANCHORING CONNECTIONS IS A TESTED COMPONENT AND IS REQUIRED TO MAINTAIN POSITION RETENTION OF THE EQUIPMENT. THE SLIP CRITICAL CONNECTION PERFORMANCE OF THE BOLTED CONNECTION WAS ESTABLISHED TO THE SHAKE TABLE TESTED SEISMIC CAPACITY OF THE EQUIPMENT AS SHOWN ON THE EQUIPMENT SEISMIC CERTIFICATE SUPPLIED AT THE TIME OF ORDER.

### CENTER OF GRAVITY CALCULATIONS:

VERTICAL CENTER OF GRAVITY: 1397[55] UP FROM FLOOR
HORIZONTAL CENTER OF GRAVITY: USE CENTERLINE OF SECTION FROM LEFT TO RIGHT
DEPTH CENTER OF GRAVITY: 711.2[28] FROM FRONT OF SECTION




BASE DETAIL
POWER SECTION

| | | | |
|---|---|---|---|
| OUTLINE,SWITCHGEAR | | A073U480 | SHEET 3 OF 3 |
| DWN S. WENTZEL | | | |
| CKD J. KUZNIA | | | |
| APVD J. GUNDLURI | – 1 | SUBMITTAL RELEASE | 20MAR23 |
| | REV | DESCRIPTION | DATE |

PROJECT:
SHENANDOAH WWTP
CUMMINS SOUTH

MAIN SWITCHGEAR MSG | 264467 SWGCHAALAA0433

# Cummins Inc.

DIMENSIONS ARE IN: MILLIMETERS
[ ] ARE IN: INCHES

SIZE: A3 | SCALE: NTS

DIMENSIONING AND TOLERANCING PER:
ASME Y14.5–2009

THIRD ANGLE PROJECTION

CAD SYSTEM
Autodesk® AutoCAD® Electrical

# Section 4 – Sample Product Documents

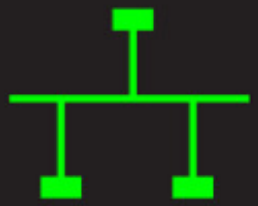
- HMI Screens


Genset 1
Genset 2
Genset 3
Genset 4
Genset 5
Genset 6
Genset 7
Genset 8
52-G1
52-G2
52-G3
52-G4
52-G5
52-G6
52-G7
52-G8
0 kW
Utility 1
Utility 2
52-UM1
52-UM2
52-GM1
52-GM2
0 V
0 kW
Load 1
Load 2
Load 3
Load 4
Load 5
Load 6
Load 7
Load 8
Load 9
Load 10
Load 11
Load 12
Load 13
Load 14
Load 15
Load 16

# Help: Oneline

The Oneline diagram screen provides a graphical representation of the power system components giving an overview of the status and health of the system.

## Bus Condition



**Bus State**

- Green indicates de-energized or dead bus.
- Red indicates energized or live bus.
- Gray indicates unknown state when either of the following conditions occur:
  - Auxiliary contact failure on a source breaker and other source breakers are open.
  - Communication failure with the input and output (I/O) on a source breaker.

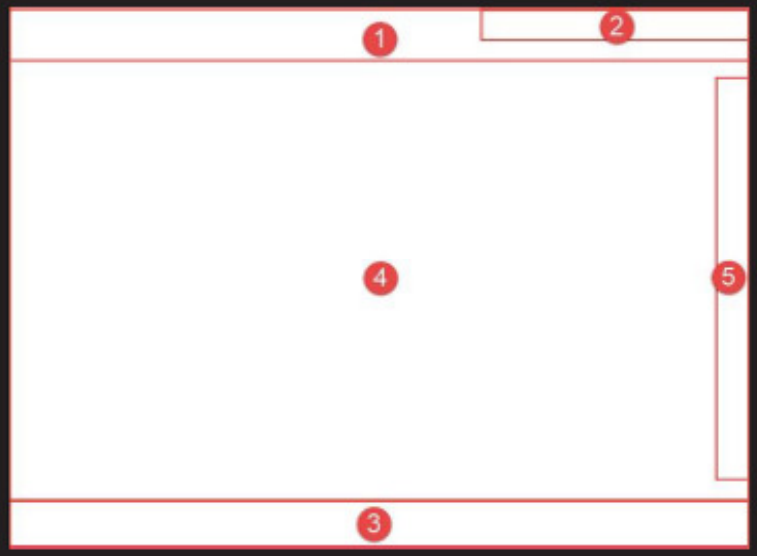
Touch the bus line to display the corresponding AC Metering screen.

## Generator Symbol

# Help: Basic User Guide

The screen contains 5 core areas:

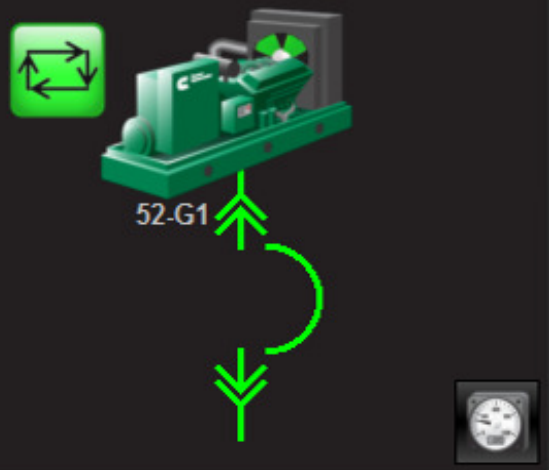
1. Header
2. Utility Navigation Toolbar
3. Primary Navigation Toolbar
4. Content Area
5. Control Panel (when available)




## Header

# Generator Summary

Genset 1




## Units

- (●) US Imperial
- ( ) Metric

## Bus Data

| | L1 | L2 | L3 | Unit |
|---|---|---|---|---|
| Bus Volt L-L | 0 | 0 | 0 | V |
| Bus Volt L-N | 0 | 0 | 0 | V |
| Bus Frequency | 0.0 | | | Hz |

## Annunciator

- Common Alarm
- Generator Supplying Load
- Generator Running
- Not in Auto
- High Battery Voltage
- Low Battery Voltage
- Charger AC Failure
- Failed to Start
- Low Coolant Temperature
- Pre-High Engine Temperature
- High Engine Temperature
- Pre-Low Oil Pressure
- Low Oil Pressure
- Overspeed
- Low Coolant Level
- Low Fuel Level

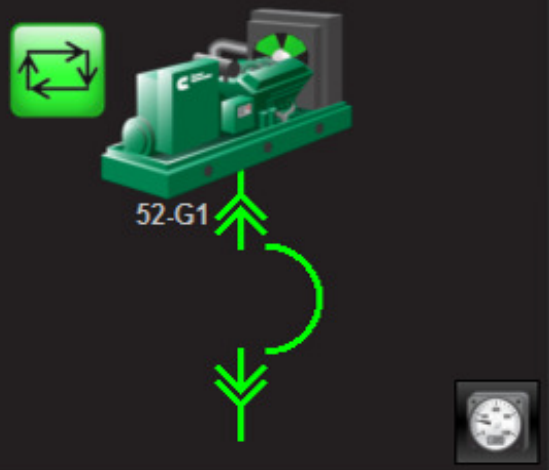
## Engine Data

| | Value | Unit |
|---|---|---|
| Engine RPM | 0 | RPM |
| Oil Pressure | 0.0 | PSI |
| Coolant Temp | 32.0 | F |
| DC Voltage | 0.0 | VDC |
| Engine Runtime | 0 | Hr |
| No. of Runs | 0 | |
| kWH | 0 | kWh |
| Fuel Rate | 0 | Gph |
| Total Fuel | 0 | G |

## Alternator Data

| | L1 | L2 | L3 | Unit |
|---|---|---|---|---|
| Voltage L-L | 0 | 0 | 0 | V |
| Voltage L-N | 0 | 0 | 0 | V |
| Current | 0 | 0 | 0 | A |
| Frequency | 0.0 | | | Hz |
| Power Factor | 0.00 | | | |
| kW | 0 | | | kW |
| % kW | 0 | | | % |
| kVA | 0 | | | kVA |
| kVAR | 0 | | | kVAR |

Genset 1




## Units

US Imperial

Metric

## Bus Data

| | L1 | L2 | L3 | Unit |
|---|---|---|---|---|
| Bus Volt L-L | 0 | 0 | 0 | V |
| Bus Volt L-N | 0 | 0 | 0 | V |
| Bus Frequency | 0.0 | | | Hz |

## Engine Data

| | Value | Unit |
|---|---|---|
| Engine RPM | 0 | RPM |
| Oil Pressure | 0.0 | PSI |
| Coolant Temp | 32.0 | F |
| DC Voltage | 0.0 | VDC |
| Engine Runtime | 0 | Hr |
| No. of Runs | 0 | |
| kWH | 0 | kWh |
| Fuel Rate | 0 | Gph |
| Total Fuel | 0 | G |

## Alternator Data

| | L1 | L2 | L3 | Unit |
|---|---|---|---|---|
| Voltage L-L | 0 | 0 | 0 | V |
| Voltage L-N | 0 | 0 | 0 | V |
| Current | 0 | 0 | 0 | A |
| Frequency | 0.0 | | | Hz |
| Power Factor | 0.00 | | | |
| kW | 0 | | | kW |
| % kW | 0 | | | % |
| kVA | 0 | | | kVA |
| kVAR | 0 | | | kVAR |

Generator Start

Generator Stop

Generator Reset

CB Close

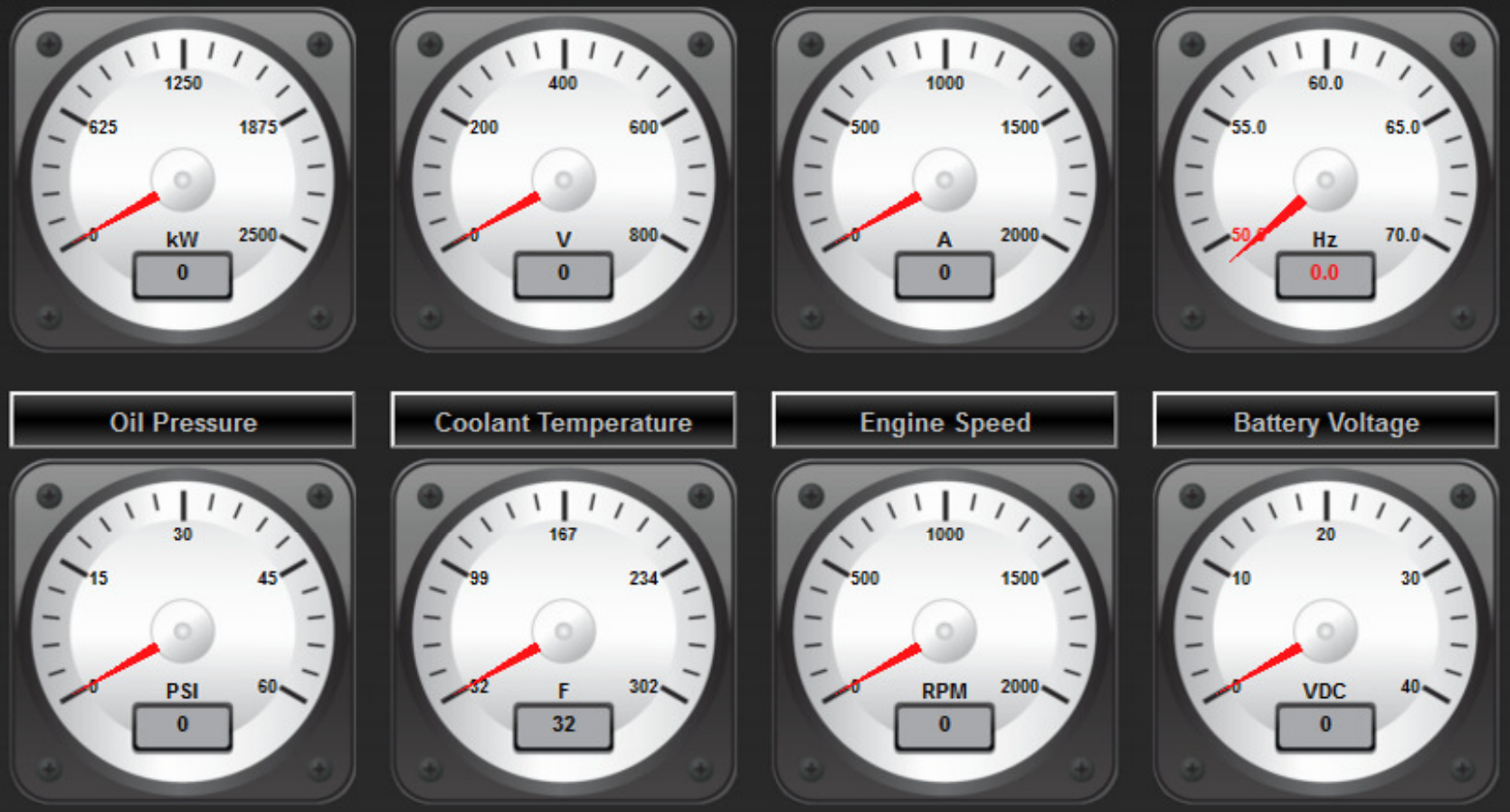
CB Open

# Generator Summary

Genset 1

Units

Annunciator



# Generator Summary

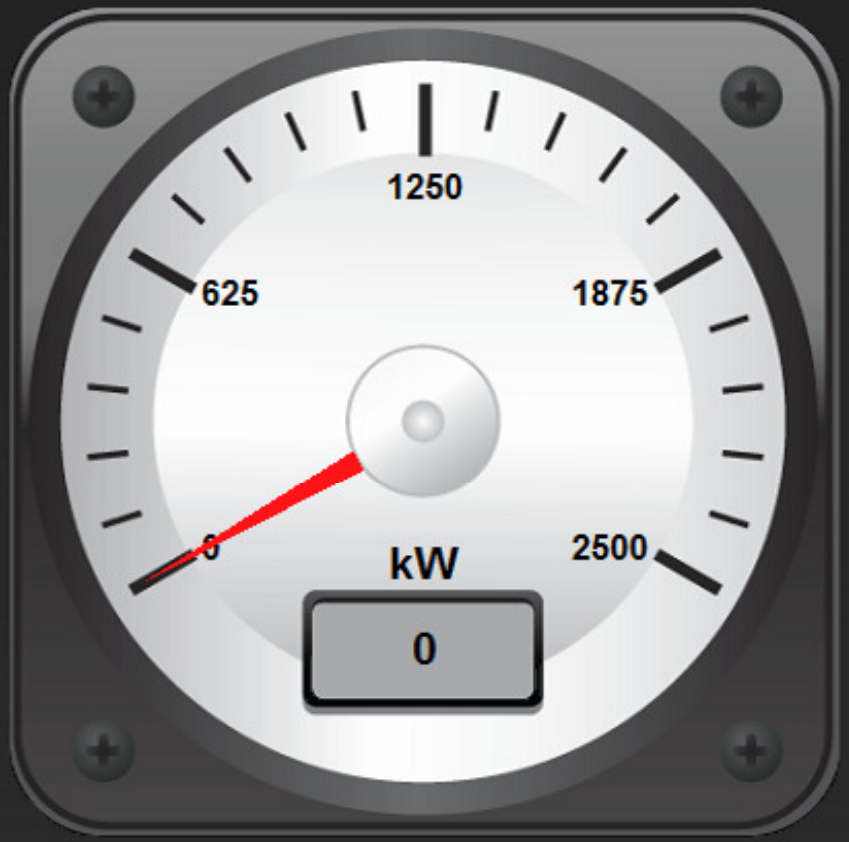
Genset 1

Units

Annunciator

1 2 3 4 5 6 7 8

## Real Power



# AC Metering

Meter 1

## Voltage/Current

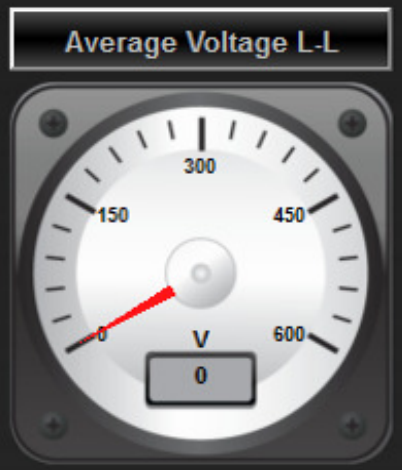
| | Avg | L1 | L2 | L3 | Unit |
|---|---|---|---|---|---|
| Voltage L-L | 0 | 0 | 0 | 0 | V |
| Voltage L-N | 0 | 0 | 0 | 0 | V |
| Current | 0 | 0 | 0 | 0 | A |
| Frequency | 0.0 | | | | Hz |

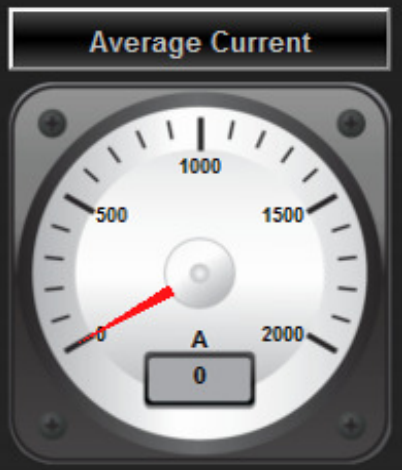
## Power

| | Total | L1 | L2 | L3 | Unit |
|---|---|---|---|---|---|
| Real Power | 0 | 0 | 0 | 0 | kW |
| Reactive Power | 0 | 0 | 0 | 0 | kVAR |
| Apparent Power | 0 | 0 | 0 | 0 | kVA |
| Power Factor | 0.00 | | | | |

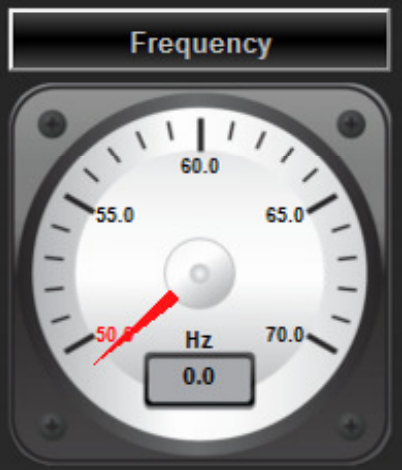
## Energy

| | Value | Unit |
|---|---|---|
| kW Hours (Positive) | 0 | kWh |
| kVAR Hours (Positive) | 0 | kVARh |
| kW Hours (Negative) | 0 | kWh |
| kVAR Hours (Negative) | 0 | kVARh |

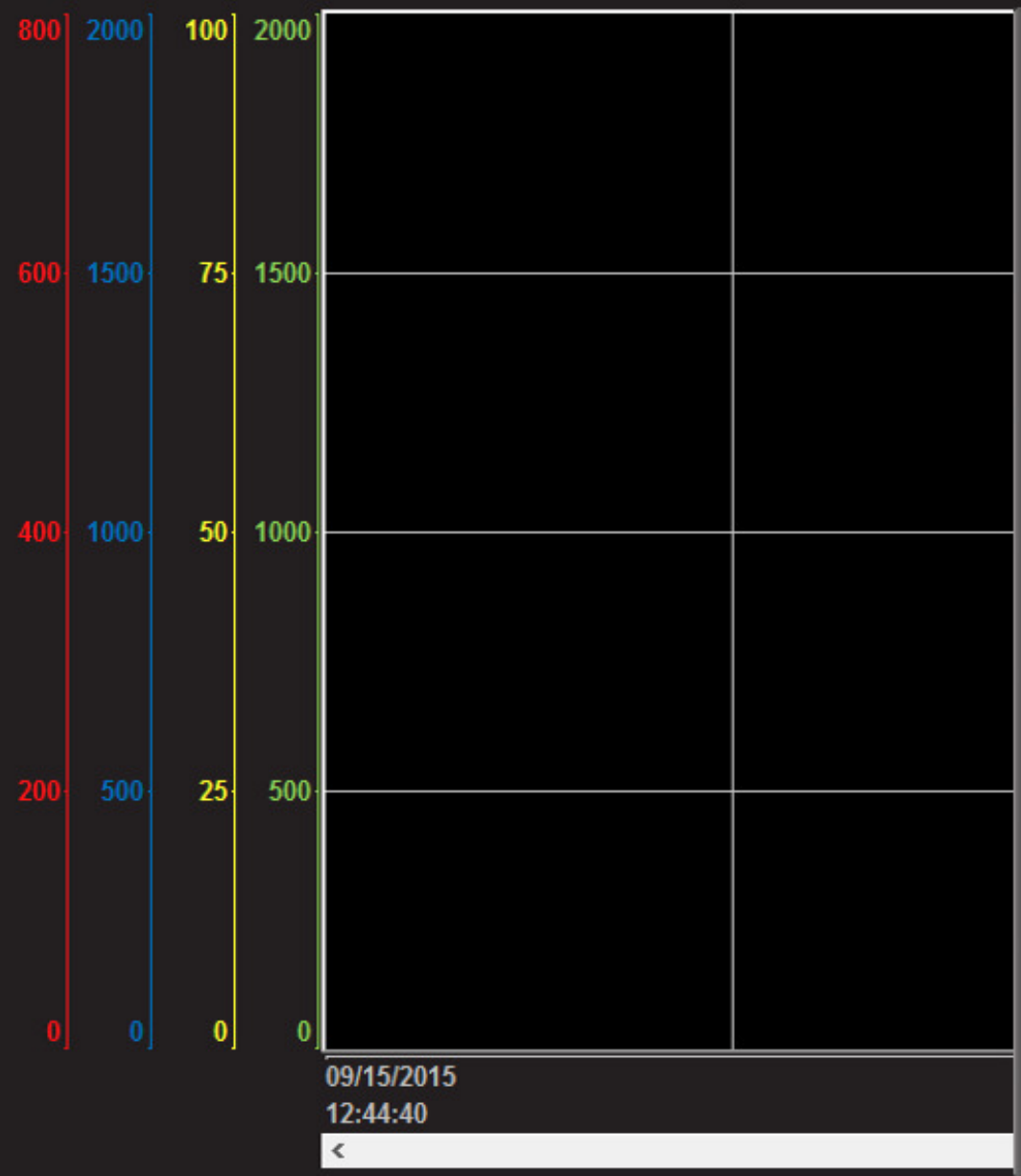






# Trending




Genset 1 Average Voltage L-L

Genset 1 Average Current

Genset 1 Percent kW

Meter 1 kW

Trend Duration 00:10:00

# System Control

1 2 3

## Control Selection

- (●) Operator
- ( ) Hardwired Inputs
- ( ) Scheduler

## Transition Type

- (●) Auto- Open Transition
- ( ) Auto- Soft Closed Transition
- ( ) Manual

## Loadbus Selection

- [x] 1
- [x] 2

## System Mode

- (●) Off
- ( ) Test without Load
- ( ) Test with Load
- ( ) Extended Parallel

## Loadbus 1 Time Delay Settings

| | | |
|---|---|---|
| Programmed Transition Delay | 5 | Sec |
| Transfer Delay | 0 | Sec |
| Retransfer Delay | 15 | Min |

1 2 3

## Bus 1 Extended Paralleling

### kW Load Control Type

- (●) Generator Bus % Level
- ( ) Generator Bus kW
- ( ) Generator Bus kW with Utility Constraint
- ( ) Utility Bus kW

### kW Control Setpoint

| | | |
|---|---|---|
| Generator Bus %kW | 0 | % |
| Generator Bus kW | 0 | kW |
| Utility Bus kW Constraint Level | 0 | kW |
| Utility Bus kW | 0 | kW |

1 2 3

## Bus 1 Extended Paralleling

### kVAR Load Control Type

- (●) None
- ( ) Generator Bus % Level
- ( ) Generator Bus Power Factor
- ( ) Generator Bus kVAR
- ( ) Utility Bus kVAR
- ( ) Utility Bus Power Factor

### kVAR Control Setpoint

| | | |
|---|---|---|
| Generator Bus % kVAR | 0 | % |
| Generator Bus Power Factor | 0.80 | |
| Generator Bus kVAR | 0 | kVAR |
| Utility Bus kVAR | 0 | kVAR |
| Utility Bus Power Factor | 0.80 | |

# Load Control

1 2

| Generator Bus | Load | Capacity | Spare | Unit |
|---|---|---|---|---|
| Power | 0 | 0 | 0 | kW |
| Current | 0 | 0 | 0 | A |

## Load Level Assignment

| | Bus 1 Load Name | Add | Shed |
|---|---|---|---|
| 1 | Load 1 | 1 | 0 |
| 2 | Load 2 | 2 | 7 |
| 3 | Load 3 | 3 | 6 |
| 4 | Load 4 | 4 | 5 |
| 5 | Load 5 | 5 | 4 |
| 6 | Load 6 | 6 | 3 |
| 7 | Load 7 | 7 | 2 |
| 8 | Load 8 | 8 | 1 |

## Bus 1 Add Level

| | Status | Control |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |

## Bus 1 Shed Level

| | Status | Control |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |

## Load Demand

Enable

## Load Demand Setpoints

Percent

Absolute kW

| | | |
|---|---|---|
| Shutdown %kW | 0 | % |
| Restart %kW | 0 | % |
| Initial Delay | 0 | Min |
| Shutdown Delay | 0 | Min |
| Restart Delay | 0 | Sec |
| Run Hour Differential | 0 | Hr |
| Spare Capacity Pick Up | 0 | kW |

## Load Demand Sequence

User Defined

Run Hours

Auto Rotate

| Lead | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

## Load Demand Status

| | Value | Unit |
|---|---|---|
| Next Generator to Start | - | |
| Restart kW | - | kW |
| Next Generator to Stop | - | |
| Shutdown kW | - | kW |
| Generator Bus Load | 0 | kW |

# Event Log

| Event Time | User | Message |
|---|---|---|
| 09/15/2015 12:55:43 | tech | Loadbus 2 is Selected for System Mode |
| 09/15/2015 12:55:42 | tech | Loadbus 1 is Selected for System Mode |
| 09/15/2015 12:48:57 | tech | System in Auto-Open Transition |
| 09/15/2015 12:47:25 | tech | Alarm Silence Pushbutton Active |
| 09/15/2015 12:46:54 | tech | System Manual Mode Active |
| 09/15/2015 12:41:48 | tech | Alarm Silence Pushbutton Active |
| 09/15/2015 12:40:53 | tech | Load 4 Closed |
| 09/15/2015 12:40:42 | tech | Load 9 Closed |
| 09/15/2015 12:40:31 | tech | Load 4 Closed |
| 09/15/2015 12:40:17 | tech | Load 16 Closed |
| 09/15/2015 12:40:14 | tech | Load 15 Closed |
| 09/15/2015 12:40:13 | tech | Load 14 Closed |
| 09/15/2015 12:40:11 | tech | Load 13 Closed |
| 09/15/2015 12:40:09 | tech | Load 12 Closed |
| 09/15/2015 12:40:07 | tech | Load 11 Closed |
| 09/15/2015 12:40:04 | tech | Load 10 Closed |
| 09/15/2015 12:40:03 | tech | Load 9 Closed |
| 09/15/2015 12:39:48 | tech | Load 8 Closed |
| 09/15/2015 12:39:46 | tech | Load 7 Closed |
| 09/15/2015 12:39:43 | tech | Load 6 Closed |
| 09/15/2015 12:39:41 | tech | Load 5 Closed |
| 09/15/2015 12:39:38 | tech | Load 3 Closed |
| 09/15/2015 12:39:35 | tech | Load 2 Closed |
| 09/15/2015 12:39:33 | tech | Load 1 Closed |
| 09/15/2015 12:39:16 | tech | Load 16 Closed |
| 09/15/2015 12:39:14 | tech | Load 15 Closed |

# Current Alarm

| Activation Time | Message |
|---|---|
| 09/15/2015 13:02:45 | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 13:02:44 | Bus 1 Load Control Disabled |
| 09/15/2015 13:02:44 | Bus 2 Load Control Disabled |
| 09/15/2015 13:02:44 | System in Manual |

# Alarm History

| Activation Time | Deactivation Time | Ack Time | User | Message |
|---|---|---|---|---|
| 09/15/2015 13:02:45 | | | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 13:02:44 | | | tech | Bus 2 Load Control Disabled |
| 09/15/2015 13:02:44 | | | tech | Bus 1 Load Control Disabled |
| 09/15/2015 13:02:44 | | | tech | System in Manual |
| 09/15/2015 12:46:54 | 09/15/2015 12:48:57 | 09/15/2015 12:47:25 | tech | System in Manual |
| 09/15/2015 12:46:54 | | 09/15/2015 12:47:25 | tech | System in Manual |
| 09/15/2015 12:46:54 | | | tech | System in Manual |
| 09/15/2015 12:46:54 | 09/15/2015 12:48:57 | 09/15/2015 12:47:25 | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:46:54 | | 09/15/2015 12:47:25 | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:46:54 | | | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:46:54 | 09/15/2015 12:48:57 | 09/15/2015 12:47:25 | tech | Bus 2 Load Control Disabled |
| 09/15/2015 12:46:54 | 09/15/2015 12:48:57 | 09/15/2015 12:47:25 | tech | Bus 1 Load Control Disabled |
| 09/15/2015 12:46:54 | | 09/15/2015 12:47:25 | tech | Bus 2 Load Control Disabled |
| 09/15/2015 12:46:54 | | 09/15/2015 12:47:25 | tech | Bus 1 Load Control Disabled |
| 09/15/2015 12:46:54 | | | tech | Bus 1 Load Control Disabled |
| 09/15/2015 12:46:54 | | | tech | Bus 2 Load Control Disabled |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | 09/15/2015 12:41:48 | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | | tech | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:33:24 | | | guest | Generator Bus 1 Not Available for Automatic Operation |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | 09/15/2015 12:41:48 | tech | Bus 2 Load Control Disabled |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | 09/15/2015 12:41:48 | tech | Bus 1 Load Control Disabled |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | | tech | Bus 1 Load Control Disabled |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | | tech | Bus 2 Load Control Disabled |
| 09/15/2015 12:33:24 | | | guest | Bus 2 Load Control Disabled |
| 09/15/2015 12:33:24 | | | guest | Bus 1 Load Control Disabled |
| 09/15/2015 12:33:24 | 09/15/2015 12:33:45 | 09/15/2015 12:41:48 | tech | System in Manual |

# Scheduler

## Schedule Exception

| | Enable | Repeat Interval | Date | Start Time | Duration (D:H:M) |
|---|---|---|---|---|---|
| 1 | ☑ | Every year | 01 January | 01:00 | 00:01:01 |
| 2 | ☐ | -------- | -- -------- | 00:00 | 00:00:01 |
| 3 | ☐ | -------- | -- -------- | 00:00 | 00:00:01 |

## System Schedule

| | Enable | Repeat Interval | Start Day | Start Time | Duration | Run Mode |
|---|---|---|---|---|---|---|
| 1 | ☑ | Once | Monday | 00:00 | 02:10 | Test without Load |
| 2 | ☑ | Every week | Wednesday | 05:00 | 01:30 | Test with Load |
| 3 | ☐ | -------- | -------- | 00:00 | 00:01 | -------- |
| 4 | ☐ | -------- | -------- | 00:00 | 00:01 | -------- |

# Generator Report

## Report Settings

Enable

Sample Rate 5 Min

Minimum Load 30 % kW

## Report

Genset 1

Report Note

## Report Management

## Report Status

| Generator Name | Status | Load | Runtime |
|---|---|---|---|
| Genset 1 | | 0 % kW | 00:00:00 |
| Genset 2 | | 0 % kW | 00:00:00 |
| Genset 3 | | 0 % kW | 00:00:00 |
| Genset 4 | | 0 % kW | 00:00:00 |
| Genset 5 | | 0 % kW | 00:00:00 |
| Genset 6 | | 0 % kW | 00:00:00 |
| Genset 7 | | 0 % kW | 00:00:00 |
| Genset 8 | | 0 % kW | 00:00:00 |

Power Generation

## Generator Test Report

| | |
|---|---|
| **Generator Name** | Genset 1 |
| **Report Note** | JCAHO Monthly |
| **Report Date** | 01/22/2016 |
| **Report Time** | 14:00:00 |

| Date & Time | Total kW | % kW | Oil Pressure (PSI) | Coolant Temp (F) | Battery Volt | Total kVAR | Freq Hz | Amp L1 | Amp L2 | Amp L3 | Volt L1-L2 | Volt L2-L3 | Volt L3-L1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/22/2016, 14:00:00 | 1000 | 80.0 | 15.0 | 50.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:05:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:10:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:15:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:20:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:25:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:30:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:35:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |
| 01/22/2016, 14:40:00 | 1000 | 80.0 | 15.0 | 60.0 | 24.0 | 80 | 60.0 | 200 | 201 | 202 | 480 | 480 | 480 |

**Genset 1 was tested on 01/22/2016 for 00:40:00 (HH:MM:SS) with at least 30 % kW Load.**

# Section 5 – Part/Product Specification Sheets

- Control Components – DMC
- Accessories – DMC
- Power Breakers
- Protective Relays/Meters
- Control Components – SWG
- Accessories – SWG
- Battery System Components

Specification sheet

# PowerCommand® DMC8000

## Description

The DMC8000 is a system level controller designed to interface directly with Cummins Power Generation PowerCommand® paralleling generator sets. The DMC8000, in conjunction with PowerCommand® genset controls, is a fully automatic, distributed logic controller suitable for unattended applications, which allows for a simpler and more reliable installation.

The control system is capable of controlling many power system architectures, including Isolated Bus, Common Bus, Transfer Pair, Multiple Transfer Pair, Redundant PLCs, Redundant I/O and Remote Screens.

The system is capable of various types of power transfer modes like open transition, 100ms closed transition, and ramping closed transition. The DMC8000 also includes utility paralleling functions for peak-shaving and base load operations. The DMC8000 incorporates a broad range of operational diagnostic functions to greatly enhance system reliability.

The DMC8000 features an easy-to-use, full-function resistive touch screen with multiple levels of operator access to ensure secure control.

## Features

**Load control** – Load control, also known as "Load Add / Shed", is the process of staging load on to the system after power to the loads has been interrupted. This staging of load ensures that power quality is maintained and generators do not become overloaded during the application of load to the generators.

In addition to the orderly addition of load, the load control system also monitors the generators and will remove load from the system if the generators become overloaded.

**Scheduler** – The system scheduler is intended to allow automatic operation of the power system on a pre-defined schedule. The scheduler comes with twelve programmable schedules and six exception periods that block the periodic schedules from operating on a specific occasion.

**Load demand** – The load demand feature is used to match generating capacity to the load to optimize fuel efficiency and prolong generator set life while maintaining correct reserve capacity for the customer's application.

The DMC offers the flexibility in deciding between generator set operating percentages and facility load steps to determine the number of generators to run for a specific load.

**Trending** – Allows the operator to view the system operation over time. The operator can add up to 8 parameters to the trend at any one time. Both the scale for each parameter and the duration of the trend are adjustable. Available parameters can be selected via user friendly drop down menus.

**Building management system interface** – A Modbus® TCIP register map is provided for customer use in configuring third-party controls to monitor the system.

**Reports and emailing** – The DMC8000 can be configured to generate several reports to assist customers in producing documentation required by some regulating bodies. The DMC8000 also gives the customers the ability to conveniently email the reports when completed or on demand.

**Warranty and service** – Products are backed by a comprehensive warranty and a worldwide network of distributors with factory-trained service technicians.

**Breaker control** – Utility main and generator set main breaker interfaces include separate relays for opening and closing breaker, as well as inputs for both “a” and “b” breaker position contacts and tripped status. Breaker diagnostics include contact failure, fail-to-close, fail-to-open, fail-to-disconnect and tripped. If a breaker fails, appropriate control action is taken to maintain system integrity.

**Scheduler** – Allows the system to be operated at preset times in test without load, test with load, or extended parallel mode. A real-time clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval and mode. For example, a test with load can be scheduled to run for one hour every Tuesday at 2 a.m. Up to six different exceptions can be set up to block a program from running during a specific time period.

**Load demand** – Load demand will attempt to match generating capacity to load, typically for the conservation of fuel or optimizing of generator set life. The load demand function will support an unlimited number of generator sets, even across multiple generator buses. Shutdown sequence can either be a fixed sequence or can be based on running hours. With fixed sequence method, the sequence can be changed while the system is in operation. Running hours method will attempt to equalize generator set hours over time by exchanging stopped and running generator sets. To protect system integrity, load demand will restart all generator sets whenever an overload condition is detected. The minimum amount of capacity to maintain online is adjustable. Initial delay for load demand to begin operation is adjustable from 1-60 minutes. Shutdown threshold is adjustable from 20-100% of online capacity minus one generator set. Shutdown delay is adjustable from 1-60 minutes. Restart threshold is adjustable from 20-100% of online capacity. Run hours differential is adjustable from 1-500 hours.

**Load control** – The DMC considers a load to be a transfer switch or feeder breaker. The number and type of loads is customized to a customer’s system. Each load device has a set of control relays associated to it so that the load can be controlled individually by the DMC and so the control priority for the load can be adjustable programmatically. Additionally, each load has a set of status contacts associated with it. Typically this is hardwired except when a network connection is available on the ATS. In addition, each load can be given a custom name via the touch screen.

**True RMS bus metering** – Full-function true RMS bus AC metering (generator bus and utility bus).

## Typical sequence of operation

PowerCommand® digital paralleling systems can be configured for nearly any logical sequence. The following description provides details of typical operation for the system components.

### Synchronizing and paralleling

**Normal Starting Sequence -** System level controller or transfer switches signal each generator set to start in an emergency or test/exercise mode. When signaled, each generator set control automatically and independently starts each generator, accelerates to rated frequency and builds up to rated voltage. The integrated First Start Sensor System in each control monitors this process, and on finding a generator set at 90% of rated voltage and frequency, automatically disables all other units from closing to the bus and closes the ready unit to the generator bus. After the first unit is closed to the bus, the remaining generators sense availability of bus voltage and the synchronizer in each generator set control automatically switches on. Simultaneously, the synchronizer(s) cause each generator set to synchronize with the system bus and then close it at the proper time. As each unit closes to the bus, the unit assumes its proportional share of the total load on the bus.

**Normal Stopping Sequence** - When system start commands are removed from the generator sets, each generator set opens its paralleling breaker and the generator set performs its time delay stop and/or cool-down sequence. As each generator set completes its cool-down sequence, it is automatically switched off.

If a system start signal is received at the generator sets during the cool-down period, one generator set will immediately close to the system bus and all other units will synchronize to it, as described in ‘‘Loss of normal power’’ below.

**Failure of a unit to start or synchronize** - If a generator set fails to start, after the fail-to-start time delay (in the generator set control) has expired, the unit will be shut down and an alarm will sound. If a generator set fails to synchronize, after a preset time delay an alarm will sound but the unit will continue to attempt to synchronize until signaled to stop by manual operation of the control switches on the generator set.

### Power Transfer Control

**Loss of Normal Power -** The power transfer control system continuously monitors the availability of each power source (utility service or generator bus) and automatically connects the system loads to the best available source based on settings programmable by the operator. On loss of normal power, each power transfer control executes a short time delay, then initiates generator system starting by issuing start commands to each generator set. When the first generator set has closed to the bus, the power transfer control system will sense the availability of generator capacity and begin transfer of loads to the generator bus by disconnecting the utility source and connecting the generator bus to system loads. The DMC may inhibit operation of some power transfer devices until adequate capacity is available to serve the connected loads. A manual control system is available to the operator to control sequence of operation of the power transfer controls.

For further information see ‘‘Load and capacity Management’’.

**Return of Normal Power -** When the power transfer control system has sensed that normal source power has returned and is within programmed limits and a time delay re-transfer period is completed, each power transfer control will begin a re-transfer process in either an open or closed transition mode, as selected by the operator. If running in the closed transition mode, the system synchronizes the generator bus to the first utility source, and closes to the utility source. If the system is designed for ‘‘soft’’ transfer between live sources, it ramps down load on the generator bus to a minimum value, and then opens the connection to the generator source. If the system is operating in a ‘‘fast’’ transfer mode, the ramping function is not used and the system will operate from source to source as quickly as possible, typically in 100 milliseconds or less. The transfer process is repeated sequentially across each power transfer point. If running in the open transition mode, the system sequentially transfers back to the utility by opening the connection to the generator bus at each transfer pair, then closing its associated utility connection at an operator-programmed time period. This process is completed at each power transfer point in the system, by each power transfer control. When all loads have been transferred back to the utility, power transfer control system removes the start commands from generator sets.

### System Test or Exercise

**Generator set exercise (test) without load -** The system allows testing of the generator sets at no load. In this operation mode the generator sets will start, build up to rated speed and voltage, synchronize and close to the generator bus, but system loads will not automatically transfer to the generator system. If a power failure occurs during a test period, loads will immediately close into the system on a priority basis. When the system is operating in the closed transition mode, it will always transfer between ‘‘good’’ sources without a power interruption to the load.

**Exercise (test) with load mode -** The system will allow the generator sets to be tested by transfer of the system loads to the generator sets. Sequence of operation in this mode shall be similar to that described for a power failure condition, except that if the system is configured to perform closed transition transfer operations it will transfer the loads without interruption of power to the loads.

### Load and Capacity Management

The load control system in the DMC automatically controls the addition of system loads to the generator bus and the number of generator sets operating on the system. The sequence may utilize automatic transfer switches or feeder breakers to control the load adding and shedding in the system. When all the generator sets are closed to the bus the system will sequence remaining loads on to the system in a timed sequence that is configurable by the operator. Loads may also be manually controlled (added or shed from the system) via the system touchscreen.

**Bus overload -** If a bus overload occurs for any reason, a signal will be generated to initiate load shedding in the system. If the bus does not return to proper frequency within a predetermined period of time (adjustable via the HMI), additional load shed signals will be generated until the generator set bus returns to normal frequency. Loads that are shed due to overload require manual reset via the HMI.

**Load demand mode -** When the system is running in the emergency mode with the "load demand" switch in the HMI in the "on" position, controls continuously monitor the total load on the bus. If the total load on the bus falls below preset limits for a period of 15 minutes (adjustable via the HMI), the controller will automatically shut down generator sets in an operator predetermined order until the minimum number of generators required to operate the load remain on the bus. On sensing that the available bus capacity is being approached, the standby units will automatically be restarted (in the reverse order of which they were shut down) and paralleled with the bus to assume their proportional share of system load. As each load parallels to the bus, load ramps to load share level. The system automatically compensates for generator sets of different sizes.

## Construction

The control system is housed in a rigid, freestanding, NEMA1/IP40, metal enclosed structure designed to require front access only. Framework is constructed of minimum 2.0 mm (12 ga) steel sheet metal. The framework and all other sheet metal components of the system are primed with a rust-inhibiting primer and finished with satin finish ANSI 61 gray enamel. Control components are completely isolated from power-carrying components by metal or insulating barriers. All components and surfaces operating at more than 50 volts are shielded to prevent inadvertent contact. All control wiring is 105 °C (221 °F), 600 volt rated and sized as required for safe, reliable operation. Each wire, device and functional component is identified by silk-screen or similar permanent identification. Terminal blocks are provided for all field connections on DIN-rail mounted devices. The DMC may be integrated into the paralleling switchgear or provided in a separate, freestanding panel. Free-standing panels should be located within 100 meters (350 feet) of the switchgear. (Consult factory if longer distance is required.)

## Operator panel

The easy-to-see operator panel provides the user with a complete range of easy-to-use information.

### Touchscreen operator panel

A full color high-resolution 19 inch (diagonal) touchscreen operator interface panel (HMI) allows the operator to monitor and control the on-site power system. All data is configurable for display in either U.S. standard or metric indications. Screens are configured in a typical Windows® format. Each screen includes navigation buttons to allow quick access to other screens that are logically connected with the screen being displayed. Access to screens that impact on system settings or sequence of operation are controlled by a multi-level password system.

The HMI typically includes the following screens and/or functions:

### One line diagram


The one-line diagram screen displays system status by a combination of animation, changing screen color, text messages, and pop-up indicators. Conditions visible on the screen include:

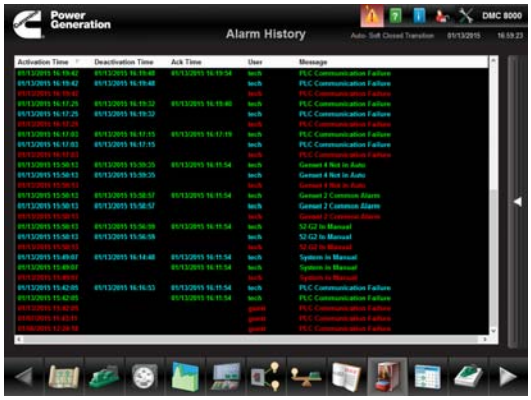
- Generator set(s) and bus configuration with generator set, parallel breaker and bus energized/de-energized indication (red indicating energized, green indicating deenergized).
- Generator set designation, with control data, and performance summary screens accessible through hot keys (links) located on or adjacent to the generator set icon.
- Generator set mode (run/off/auto).
- Generator set status (normal/warning/shutdown/load demand stop).
- Paralleling breaker status (open/closed/tripped/racked out). Optional status and condition displays of other breakers and devices can be supplied where required.
- Bus condition (energized or de-energized) Clicking on the bus icon provides access to a bus AC data screen.

For applications which include automatic transfer switches (ATS), the DMC provides a depiction of the ATS in the one line, indicating source availability and switch position. It also is available with detailed information access to each ATS in the system.

## System Control


The system control screen provides the operator with the ability to enable or disable load demand operation, view timer values and the load demand sequence; initiate test (with or without load); control the shutdown sequence for the generator sets in the load demand mode; set the load demand time delays; set the load demand operation set points; and display and modify the automatic load add and shed sequence. The screen also allows setting of the source availability settings and sequence timing for power transfer. This screen is password-protected to prevent access to the configuration functions by unauthorized users.

### System alarm history




The master control touchscreen records the date, time and nature of all alarm and shutdown conditions reported on the system. This log includes all alarms reported on the generator set and all master control and network connected functions.

Generator set and transfer switches retain a detailed independent log of their perspective operating histories, allowing the user to not only understand system level operation conditions, but also view details of operation of any component in the system.

### Generator set status and control


The generator set status summary provides an analog and graphical display of critical generator set operating parameters for each generator set in the system. The screen includes generator set state display (stopped, time delay start, idle speed state, rated volts/hertz, synchronizing, load share or load govern); analog AC metering for generator set (3-phase, AC volts and current, frequency, kW and power factor); and three-phase AC bus voltage and frequency. The screen provides a complete display of engine and alternator data present in the generator set control. The screen also shows status of the generator set breaker. Hot buttons are provided for this data on all generator sets in the system, including system equipment provided by third parties.

### Trending


The touchscreen provides real-time trend charts for AC output parameters and continuously monitors average voltage, frequency, total kilowatts, and average amperage. Scales of values displayed are field configurable.

### Alarms

Any alarm on any generator set or in the system will cause an alarm bar and warning condition display to appear on the touchscreen. Touching the bar displays a pop-up screen describing the equipment where the fault has occurred, and the name of the fault. The screen allows the operator to attempt to reset warning conditions from the HMI.

### Service information

System information and service information, including the name, address and phone number for the local service point for the equipment, is provided on the main menu screen for the system.

## Operating modes

### Test without Load

The Test without load mode of operation is used to ensure the operation of the generator sets, up to the point where the DMC would normally transfer power to the generators.

### Test with Load

Test with load is a mode of operation that allows the operator to transfer the facility load to the generators.

The Test with load mode of operation can be triggered by an operator via the HMI, by an Input from a SCADA system, or periodically using the system scheduler. When a test is triggered the DMC looks at the selections for Transition Mode and Transfer pair selection to determine the test sequence to perform.

- Transition mode
  - Open transition
  - Hard closed transition (optional)
  - Soft closed transition (optional)
- Multiple transfer pairs (optional)
- Regulating Real Power
  - Genbus Percent
  - Genbus kW
  - Genbus kW with Utility Constraint
  - Utility Bus kW
- Regulating Reactive Power
  - Genset Controlled
  - Genbus Percent
  - Genbus Power Factor
  - Genbus kVAR
  - Utility Bus VAR
  - Utility Bus Power Factor
- Genset Limits
- Load Demand
- Protective Relays
  - Reverse Power Disable

## Control interface - outputs

**Generator set signals–** For each generator set in the system, the control provides start command, load demand control, and control of the generator set excitation and fuel control systems for load control while paralleled with the utility service (mains).

**Genset main and utility main breaker interfaces–** Dedicated separate relays are provided for breaker open and breaker close circuits.

## Network connections

**Modbus RTU Interface–** Provides a standard register map of system data for use in monitoring by a remote device. Controller is a Modbus RTU slave device capable of communication on either RS232 or RS485. Modbus address is configurable. A complete array of system control, adjustments and monitoring data are available and are documented in a published register map.

## Control power

Control power for the system is derived from the generator set 24 VDC starting batteries. A solid-state, no-break "best battery" selector system is provided so that control voltage is available from any generator set battery bank in the system. All incoming battery banks are isolated to prevent the failure of one battery bank from disabling the entire system. The core system control has redundant control power inputs for added reliability, as well as separate high/low DC voltage monitoring.

The PowerCommand® controls mounted on every generator set in the system continually monitors the battery charging system for low and high DC voltage and runs a battery load test every time the engine is started.

Functions and messages on the generator paralleling control include:

- Low DC voltage (battery voltage less than 24 VDC, except during engine cranking)
- High DC voltage (battery voltage greater than 32 VDC)

## Software

DMC8000 is serviced with the following:

- Indusoft Studio 7.1
- Unity 8.1

## Certifications

DMC meets or exceeds the requirements of the following codes and standards:

- CSA C282-M1999 Emergency Electrical Power Supply for Buildings
- CSA 22.2 No. 14 M91 Industrial Controls
- CE Marked
- EN 61439-2 Low Voltage Switchgear and Control Gear
- NFPA 70: U.S. National Electrical Code
- PowerCommand® controls are suitable for use in emergency, critical and standby applications, as defined in articles 700, 701, and 702.
- NFPA 99: Standard for Health Care Facilities
- NFPA 110 for level 1 systems
- UL 891 Listed, Category NIWT7 for U.S. and Canada.
- PowerCommand® control systems and generator sets are designed and manufactured in ISO9001 certified facilities
- IBC – all Risk Categories I to IV structures, shake testing qualified
- OSHPD – all California Building Code Risk Category I to IV structures, shake testing qualified

## Environment

The control is designed for proper operation without recalibration in ambient temperatures from 0 °C to +45 °C (32 °F to 113 °F) and for storage from -20 °C to +70 °C (-4 °F to 158 °F). Control will operate with humidity up to 95%, non-condensing, and at altitudes up to 5000 meters (10,000 feet).

## Warranty

As components of a Cummins Power Generation system, PowerCommand® controls are covered by a standard one-year limited warranty. Warranty options are available; consult your local distributor for details.

### See your distributor for more information


**Cummins Power Generation**

**Americas**
1400 73rd Avenue N.E.
Minneapolis, MN 55432 USA
Phone: 763 574 5000
Fax: 763 574 5298

**Europe, CIS, Middle East and Africa**
Manston Park Columbus Ave.
Manston Ramsgate
Kent CT 12 5BF United Kingdom
Phone 44 1843 255000
Fax 44 1843 255902

**Asia Pacific**
10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838
Phone 65 6417 2388
Fax 65 6417 2399


**Our energy working for you.™**

power.cummins.com




NAS-6119a-EN (10/15)

# FPM-7211W

## 21.5" Industrial Monitor with Projected Capacitive Touchscreen, Direct-VGA and DVI Ports

NEW


## Features

- 21.5" Full HD TFT LED LCD wide screen display
- 16:9 wide screen display, view area increases by 40%
- Supports10 points multi-touch via USB interface in Windows 7/8
- Slim type design for Panel mount / Wall mount easy installation
- Various mounting options: panel, wall, desktop and VESA arm mounting
- Projected Capacitive Touchscreen with reliable glass surface
- Robust design with SECC chassis and Magnesium alloy front panel with IP66 compliance
- OSD control pad on rear cover
- Lockable I/O connectors

## Introduction

With its brand new design, the FPM-7211W provides a new wide screen display size with industrial grade design concept. By truly-flat touch screen, the front bezel meets IP66 testing criteria. FPM-7211W projected capacitive touch can support 5-points touch application. New easy installation design can help you with one person for panel mounting.FPM-7211W monitor with slim enclosure is ideally suited to being either panel or wall mounted.

## Specifications

### General

- **OSD Controls** OSD control in rear cover
- **Certification** BSMI, CCC, CE, FCC Class A, UL
- **Dimensions (W x H x D)** 558.4 x 349.8 x 47.7 mm (21.98" x 13.77" x 1.88")
- **Enclosure** Front panel: Die-cast Magnesium alloy
  Rear cover: SECC
- **Mounting** Panel, wall, desktop, VESA (MIS,100,C)
- **Power Input** Phoeni x Jack: 24 $V_{DC}$ input
  DC Jack: e x ternal 57 W power adapter, with 100 ~ 240 $V_{AC}$ input and 12 $V_{DC}$ @ 4.75 A output

Note: AC power adapter is included.

- **Power Consumption** 25 W + 20%
- **Video Port** VGA & DVI-D port
- **Weight (Net)** 8kg (17.6lbs)

### LCD Display

- **Display Type** Full HD TFT LED LCD
- **Display Size** 21.5"
- **Max. Resolution** 1920 x 1080
- **Max. Color** 16.7 M
- **Viewing Angle (H/V°)** 178/178
- **Luminance (cd/m²)** 300
- **Backlight Life (hrs)** 50,000
- **Contrast Ratio** 5000:1

### Touchscreen

- **Type** Projected Capacitive touch
- **Interface** RS-232 and USB
- **Light Transmission** Above 75%
- **OS Support** Windows XP, Vista,7, 8,XPe and Linux
- **Multi Touch** 5 points, USB interface in Win 7/8.
- **Hardness** >6H

### Environment

- **Operation Temperature** 0 ~ 55°C (32 ~ 131°F)
- **Storage Temperature** -20 ~ 60°C (-4 ~ 140°F)
- **Humidity (Storage)** 10 ~ 90% non-condensing
- **Waterproof** Front panel is IP66 compliant
- **Vibration** 5 ~ 500 Hz, 1 Grms (Operating, Random)

## Ordering Information

- **FPM-7211W-P3AE** 21.5" Full HD Ind Monitor w/PCT TS (RS-232, USB)

## Accessories

- **1702002600** Power Cable US Plug 1.8 M
- **1702002605** Power Cable EU Plug 1.8 M
- **1702031801** Power Cable UK Plug 1.8 M
- **1700000596** Power Cable China/Australia Plug 1.8 M
- **FPM-7181W-SMKE** FPM-7211W Mounting kit for desktop & wall

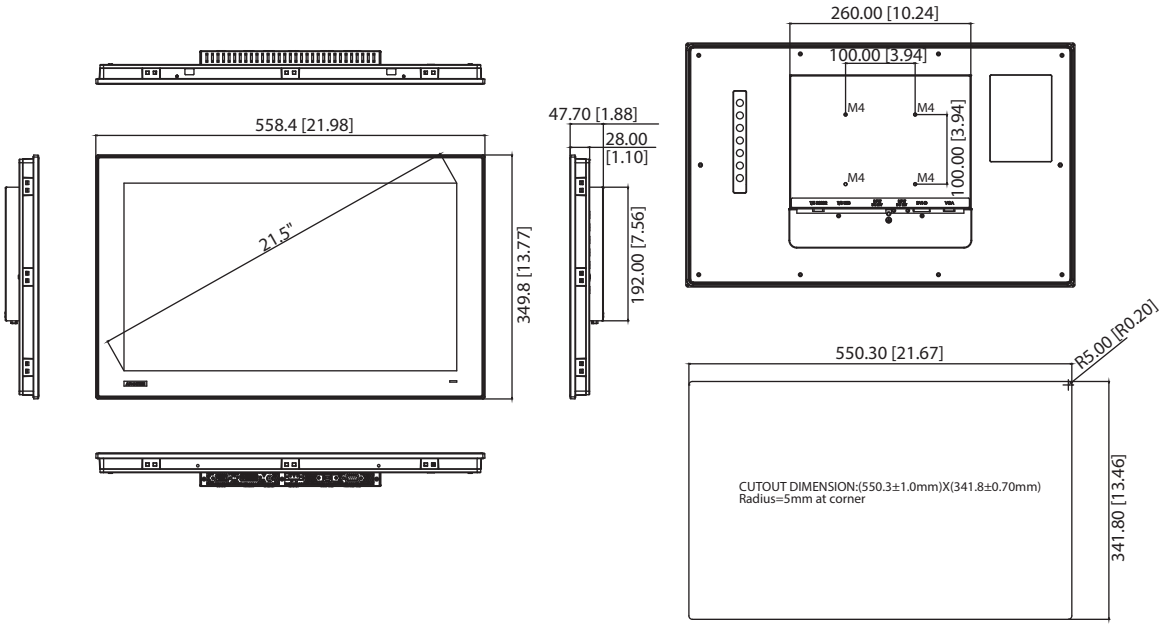




Date updated: 13-Aug-2014

## Dimensions

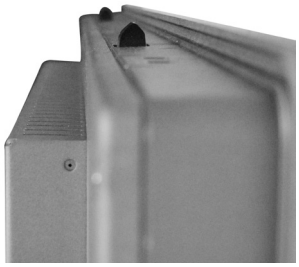
Unit: [mm]




**Panel Cut-out Dimensions: 550.30 x 341.8 mm (21.67" x 13.46")**

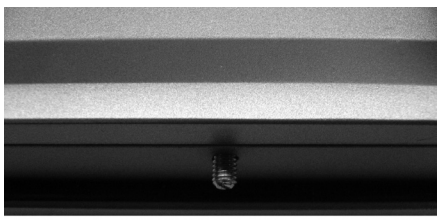
## Easy Installation

**Snap hook in rear cover**



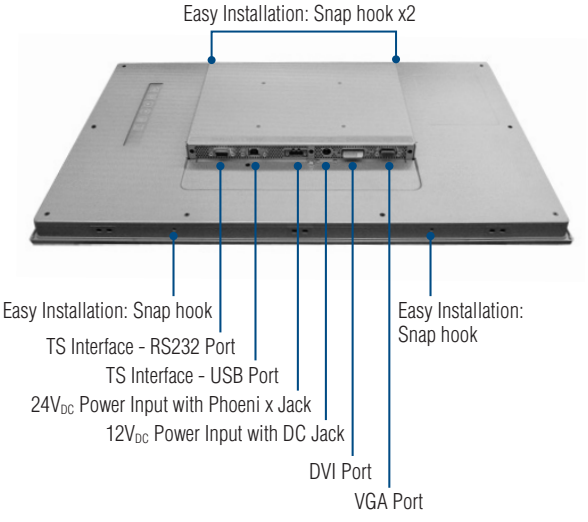
Screw to set up the snap hook out of upper side

**Stopper Screw in rear cover**



Screw for the stopper screw out of down side

## Rear View



# ESRP-CMS-UNO2473

## Multi-Monitor ACP Ready ThinClient, 1x VGA, 1x HDMI


## Features

- Verified with ACP ThinManager, ACP BIOS enabled
- 4th Generation Intel® Celeron® J1900 Processor 2.42 GHz with 4GB DDR3L
- Memory
- 2 x simultaneous, independent multi-monitor video ports: 1 x VGA, 1 x HDMI
- 2 x GbE, 4 x USB 2.0 and 1 x USB 3.0, 2 x RS-232, 2 x RS-232/422/485, 1 x VGA, 1 x HDMI, Audio
- Compact with fanless design
- Rubber stopper design with captive screw
- Chassis grounding protection
- Two independent LANs support Ethernet redundancy allowing the terminal to
- activate and switch to the backup port in a seamless fashion.
- Fault-protected RS-485 transceivers with extended common-mode range

## Introduction

Realize the true value of thin client and centralized management technologies with Advantech's ThinManager compatible industrial thin clients. ACP's ThinManager, the leading thin client solution for the factory floor, and Advantech's industrially hardened thin client hardware provide a unique solutions for centralized management of factory floor applications. The ESRP-CMS-UNO2473 is the perfect ThinManager multi-monitor industrial thin client for applications where flexibility and cost savings of 2 monitors per client is desired. ESRP-CMS-UNO2473 also supports the dual video interfaces such as VGA and HDMI.

## Specifications

### General

- **Certification** CE, FCC, UL, CCC, BSMI
- **Dimensions (W x D x H)** 252 x 149 x 62 mm (9.9" x 5.9" x 2.4")
- **Form Factor** Regular size
- **Enclosure** Aluminum housing
- **Mounting** Stand, wall, VESA (optional), din-rail (optional)
- **Weight (Net)** 1.6kg (3.5lbs)
- **Power Requirements** $24V_{DC}$ ± 20%
- **Power Consumption** 10W (Typical), 14W(Max)

### System Hardware

- **BIOS** ACP BIOS enabled
- **Processor** Intel® Celeron® processor J1900 2.42 GHz Quad Core, 2MB L2
- **System Chip** Intel Celeron J1900 processor SoC integrated
- **Memory** 4GB DDR3L 1333 MHz
- **Graphics Engine** Intel® HD Graphics: Gen7 with 4EU
- **Ethernet** Intel® i210-IT GbE, 802.1Qav, IEEE1588/802.1AS, 802.3az
- **LED Indicators** LEDs for power, battery, LAN (active, status)

### I/O Interfaces

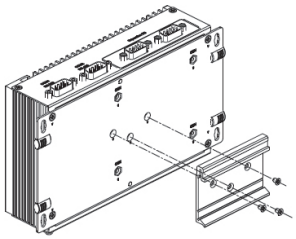
- **Serial Ports** 2 x RS-232, DB9, 50 ~ 115.2kbps, 2 x 232/422/485, DB9, auto flow control, 50 ~ 115.2kbps
- **LAN Ports** 2 x RJ45, 10/100/1000 Mbps IEEE 802.3u 1000Base-T Fast Ethernet
- **USB Ports** 4 x USB 2.0, 1 x USB 3.0
- **Displays** 1 x VGA, supports 2048 x 1536 at 60Hz
  1 x HDMI, supports 1920 x 1080 at 60Hz
- **Audio** Line-In
- **Power Connector** 1 x 3 pins, terminal block
- **Grounding Protection** Chassis grounding

### Environment

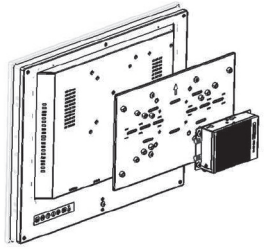
- **Operating Temperature** - 10 ~ 60°C (14 ~ 140°F) @ 5 ~ 85% RH with 0.7m/s airflow
- **Storage Temperature** - 40 ~ 85°C ( -40 ~ 185°F)
- **Relative Humidity** 10 ~ 95% RH @ 40°C, non-condensing
- **Shock Protection** Operating, IEC 60068-2-27, 50G, half sine, 11ms
- **Vibration Protection** Operating, IEC 60068-2-64, 2Grms, random, 5 ~ 500Hz, 1hr/axis
- **Ingress Protection** IP40

## Installation Scenario

**DIN-Rail Mount Illustration**



**VESA Mount Illustration**



THINMANAGER
A Rockwell Automation Technology

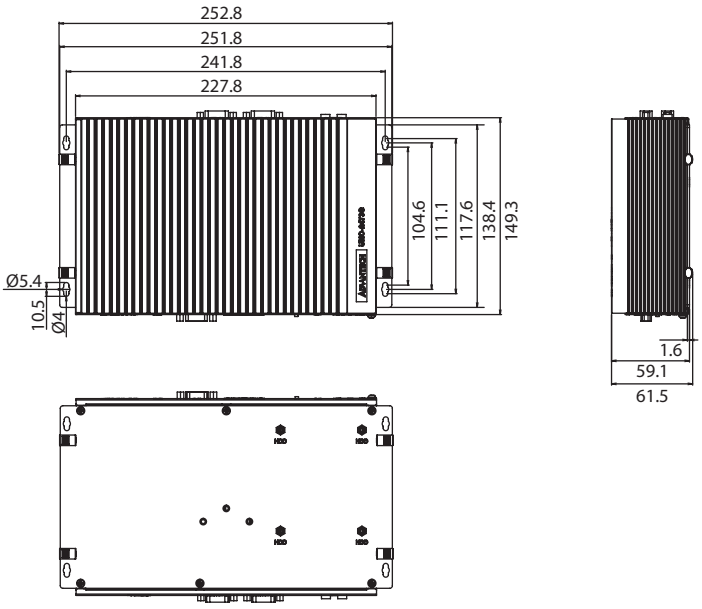




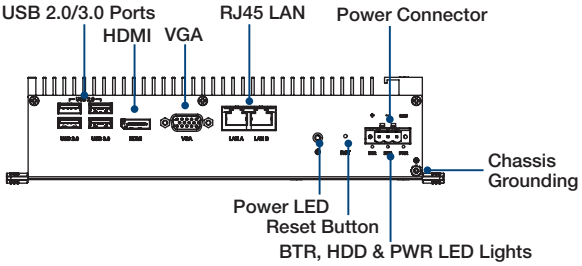
Last updated: 4-May-2021

## Dimensions

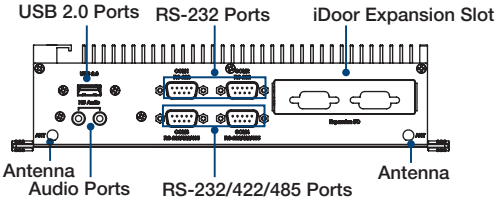
Unit: mm




## Front I/O View




## Rear I/O View




## Ordering Information

- **ESRP-CMS-UNO2473** UNO-2473G-J3AE, ACP Ready ThinClient, VGA x 1, HDMI x 1

## Optional Accessories

- **96PSA-A60W24T2** A/D Power adapter 100-240V 60W 24V
- **1702002600** Power Cable US Plug 1.8 M (Industrial Grade)
- **1702002605** Power Cable EU Plug 1.8 M (Industrial Grade)
- **1702031801** Power Cable UK Plug 1.8 M (Industrial Grade)
- **1700000596** Power Cable China/Australia Plug 1.8 M (Industrial Grade)
- **UNO-2000G-DMKAE** UNO-2000 DIN Rail Kit
- **UNO-2000G-VMKAE** UNO-2000 VESA Mount Kit

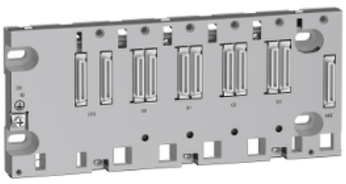
## Monitor Cabling Accessories

***Available in America**

- **XACP-10DP-DPHM-10** DisplayPort to HDMI Cable, 10ft
- **XACP-10DP-DPDVI-10** DisplayPort to DVI Cable, 10ft
- **XACP-10HM-15128-03** HDMI to DVI Cable, 10ft
- **XACP-10DP-DPDP-10** DisplayPort to DisplayPort Cable, 10ft
- **XACP-10HM-128V4-10** HDMI to HDMI Cable, 10ft

# Product data sheet

Specifications



## rack X80 - 4 slots - Ethernet backplane

BMEXBP0400

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon X80 |
| **Accessory / separate part type** | Rack |

## Complementary

| | |
|---|---|
| **Number of slots** | 4 bus X + Ethernet |
| **Product Compatibility** | I/O module<br>BMX processor<br>Specific application module<br>BMXCPS power supply<br>BME processor |
| **Power consumption in W** | 162 mW 3.3 V DC<br>2.8 W 24 V DC |
| **Electrical connection** | 1 connector (XBE) expansion module |
| **Fixing mode** | By 4 screws 0.17…0.25 in (4.32…6.35 mm) panel<br>By 4 M6 screws plate<br>By clips 35 mm symmetrical DIN rail |
| **Current consumption** | 49 mA 3.3 V DC<br>118 mA 24 V DC |
| **MTBF reliability** | 2000000 H |
| **Net Weight** | 1.55 lb(US) (0.705 kg) |

## Environment

| | |
|---|---|
| **IP Degree of Protection** | IP20 |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative Humidity** | 5…95 % without condensation |
| **Directives** | 2014/35/EU - low voltage directive<br>2014/30/EU - electromagnetic compatibility |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595864174037 |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 2.60 in (6.6 cm) |
| **Package 1 Width** | 5.91 in (15.0 cm) |
| **Package 1 Length** | 12.80 in (32.5 cm) |
| **Package 1 Weight** | 25.47 oz (722.0 g) |
| **Unit Type of Package 2** | S04 |
| **Number of Units in Package 2** | 13 |
| **Package 2 Height** | 11.81 in (30.0 cm) |
| **Package 2 Width** | 15.75 in (40.0 cm) |
| **Package 2 Length** | 23.62 in (60.0 cm) |
| **Package 2 Weight** | 22.24 lb(US) (10.086 kg) |

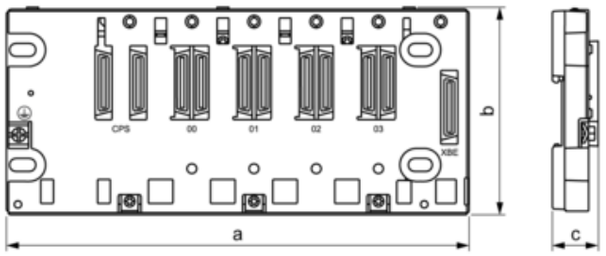
## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

# Product data sheet BMEXBP0400

Dimensions Drawings

## Dimensions




Dimensions in mm

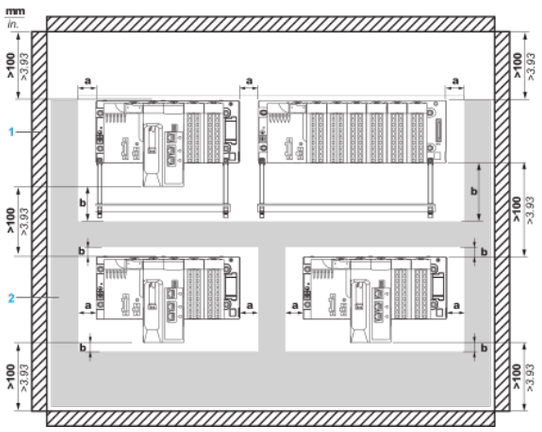
| a | | b | c |
|---|---|---|---|
| Empty Rack | Rack With Extender Module Mounted | | |
| 242.4 | 243.58 | 105.11<br>**NOTE:** Overall height is 134.6 with a CPU mounted. | 19 |

Dimensions in in.

| a | | b | c |
|---|---|---|---|
| Empty Rack | Rack With Extender Module Mounted | | |
| 9.54 | 9.59 | 4.14<br>**NOTE:** Overall height is 5.30 with a CPU mounted. | 0.75 |

## Minimum Clearance

**Minimum Clearance of a typical installation in a cabinet with ducts**



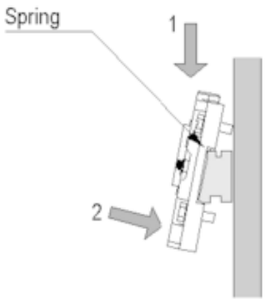

**a** Side clearance: > 40 mm (1.57 in.)

**b** Top and bottom clearance with surrounding objects: > 20 mm (0.79 in.)

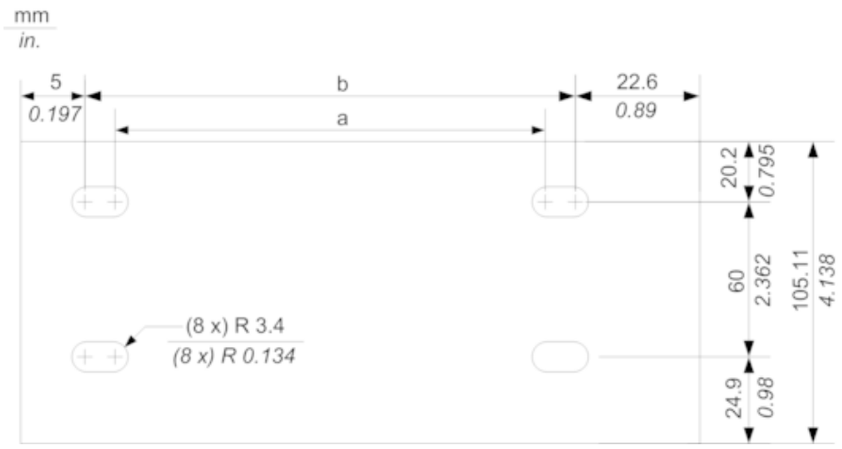
**1** Installation or casing

**2** Wiring duct or tray

## Mounting a Rack on a DIN rail



## Mounting and Fastening the Rack on Panels




**NOTE:** You can use M4, M5, M6, or UNC #6 screws in the fastening holes.

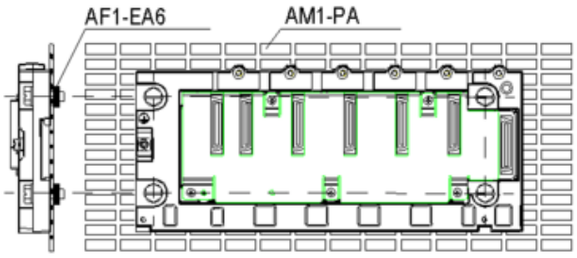
Dimensions in mm

| a | b |
|---|---|
| 202.1 | 214.8 |

Dimensions in in.

| a | b |
|---|---|
| 7.96 | 8.46 |

## Mounting on Telequick Grid AM1-PA and AM3-PA Mounting Grids




Fasten the rack with four M4, M5, M6 or UNC #6 screws

# Product data sheet

Specifications

## Processor module, Modicon M340 automation platform, max 1024 discrete + 256 analog I/O, Modbus

BMXP342000

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon M340 automation platform |
| **Product or Component Type** | Processor module |
| **Number of racks** | 1 |
| **Number of slots** | 11 |
| **Discrete I/O processor capacity** | 1024 I/O single-rack configuration |
| **Analogue I/O processor capacity** | 256 I/O multi-rack configuration<br>66 I/O single-rack configuration |
| **Number of application specific channel** | 36 |
| **Monitoring** | Diagnostic counters Modbus<br>Event counters Modbus |

## Complementary

| | |
|---|---|
| **Control channels** | Programmable loops |
| **Integrated connection type** | Non isolated serial link RJ45 character mode asynchronous in baseband, RS232C 2 twisted shielded pairs 0.3...19.2 kbit/s full duplex<br>Non isolated serial link RJ45 character mode asynchronous in baseband, RS485 1 twisted shielded pair 0.3...19.2 kbit/s half duplex<br>Non isolated serial link RJ45, master/slave Modbus, RTU/ASCII asynchronous in baseband, RS232C 1 twisted shielded pair 0.3...19.2 kbit/s half duplex<br>Non isolated serial link RJ45, master/slave Modbus, RTU/ASCII asynchronous in baseband, RS485 1 twisted shielded pair 0.3...19.2 kbit/s half duplex<br>USB port 12 Mbit/s |
| **Communication module processor capacity** | 2 Ethernet communication module<br>4 AS-Interface module |
| **Number of devices per segment** | 0…32character mode)<br>0…32Modbus) |
| **Number of devices** | 2 point-to-point character mode<br>2 point-to-point Modbus |
| **Bus length** | 0.00…32.81 ft (0…10 m) serial link non isolated character mode segment<br>0.00…32.81 ft (0…10 m) serial link non isolated Modbus segment<br>0.00…3280.84 ft (0…1000 m) serial link isolated character mode segment<br>0.00…3280.84 ft (0…1000 m) serial link isolated Modbus segment<br>0.00…49.21 ft (0…15 m) character mode point-to-point<br>0.00…49.21 ft (0…15 m) Modbus point-to-point |
| **Maximum tap links length** | <49.21 ft (15 m) serial link non isolated character mode segment<br><49.21 ft (15 m) serial link non isolated Modbus segment<br><131.23 ft (40 m) serial link isolated character mode segment<br><131.23 ft (40 m) serial link isolated Modbus segment |
| **Number of addresses** | 0…248 character mode<br>0…248 Modbus |
| **Requests** | 1 K data bytes per request character mode |

| | |
|---|---|
| | 252 data bytes per RTU request Modbus<br>504 data bytes per ASCII request Modbus |
| **Control parameter** | One CRC on each frame (RTU) Modbus<br>One LRC on each frame (ASCII) character mode<br>One LRC on each frame (ASCII) Modbus |
| **Memory description** | Internal RAM 4096 kB<br>Internal RAM 256 kB data<br>Internal RAM 3584 kB program constants and symbols<br>Supplied memory card (BMXRMS008MP) backup of programs, constants, symbols and data |
| **Maximum size of object areas** | 128 kB unlocated internal data<br>16250 %Mi located internal bits<br>32464 %MWi internal words located internal data<br>32760 %KWi constant words located internal data |
| **Default size of object areas** | 128 %KWi constant words located internal data<br>256 %Mi located internal bits<br>512 %MWi internal words located internal data |
| **Application structure** | 1 cyclic/periodic master task<br>1 periodic fast task<br>No auxiliary task<br>32 event tasks |
| **Execution time per instruction** | 0.18 µs Boolean<br>0.26 µs double-length words<br>0.38 µs single-length words<br>1.74 µs floating points |
| **Number of instructions per ms** | 4.2 Kinst/ms 65 % Boolean + 35 % fixed arithmetic<br>5.4 Kinst/ms 100 % Boolean |
| **System overhead** | 0.2 ms fast task<br>1.05 ms master task |
| **Current consumption** | 72 mA 24 V DC |
| **Supply** | Internal power supply via rack |
| **Marking** | CE |
| **Status LED** | 1 LED (Green) processor running (RUN)<br>1 LED (Red) I/O module fault (I/O)<br>1 LED (Red) memory card fault (CARD ERR)<br>1 LED (Red) processor or system fault (ERR)<br>1 LED (Yellow) activity on Modbus (SER COM) |
| **Net Weight** | 0.44 lb(US) (0.2 kg) |

## Environment

| | |
|---|---|
| **Ambient Air Temperature for Operation** | 32…140 °F (0…60 °C) |
| **Relative Humidity** | 10…95 % without condensation |
| **IP Degree of Protection** | IP20 |
| **Protective treatment** | TC |
| **Directives** | 2014/35/EU - low voltage directive<br>2014/30/EU - electromagnetic compatibility |
| **Product certifications** | CE<br>UL<br>CSA<br>RCM<br>EAC<br>Merchant Navy |
| **Standards** | EN 61131-2<br>EN/IEC 61010-2-201<br>UL 61010-2-201<br>CSA C22.2 No 61010-2-201<br>IACS E10<br>EN/IEC 61000-6-5<br>EN/IEC 61850-3 |
| **Environmental characteristic** | Hazardous location class I division 2 |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |

| | |
|---|---|
| **GTIN** | 3595863999266 |
| **Nbr. of units in pkg.** | 1 |
| **Package weight(Lbs)** | 8.47 oz (240.0 g) |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Package 1 Height** | 2.17 in (5.5 cm) |
| **Package 1 width** | 4.33 in (11.0 cm) |
| **Package 1 Length** | 4.53 in (11.5 cm) |
| **Unit Type of Package 2** | S02 |
| **Number of Units in Package 2** | 15 |
| **Package 2 Weight** | 8.63 lb(US) (3.915 kg) |
| **Package 2 Height** | 5.91 in (15.0 cm) |
| **Package 2 width** | 11.81 in (30.0 cm) |
| **Package 2 Length** | 15.75 in (40.0 cm) |

## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

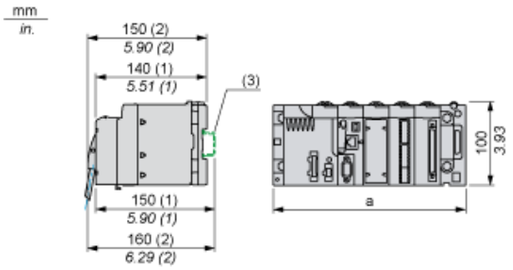
| | |
|---|---|
| **Warranty** | 18 months |

# Product data sheet BMXP342000

Dimensions Drawings

## Modules Mounted on Racks

### Dimensions




**(1)** With removable terminal block (cage, screw or spring).
**(2)** With FCN connector.
**(3)** On AM1 ED rail: 35 mm wide, 15 mm deep. Only possible with BMXXBP0400/0400H/0600/0600H/0800/0800H rack.

| Rack references | a in mm | a in in. |
|---|---|---|
| BMXXBP0400 and BMXXBP0400H | 242.4 | 09.54 |
| BMXXBP0600 and BMXXBP0600H | 307.6 | 12.11 |
| BMXXBP0800 and BMXXBP0800H | 372.8 | 14.68 |
| BMXXBP1200 and BMXXBP1200H | 503.2 | 19.81 |

# Product data sheet

Specifications

## Ethernet TCP/IP network module, Modicon M340 automation platform, 4 x RJ45 10/100

BMXNOC0401

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon M340 automation platform |
| **Product or Component Type** | Ethernet TCP/IP network module |
| **Concept** | Transparent Ready |
| **Integrated connection type** | Ethernet RJ45 10/100 Mbit/s 4 twisted pairs transparent ready class B30 |
| **Protective treatment** | TC |

## Complementary

| | |
|---|---|
| **Communication service** | Bandwidth management<br>Data Editor (via PC terminal)<br>FDR server<br>Rack Viewer<br>SNMP network administrator<br>Modbus TCP I/O Scanner and Messaging<br>Ethernet/IP I/O Scanner and Messaging<br>Embedded 4-port switch<br>RSTP support<br>Port mirroring |
| **Port Ethernet** | 10BASE-T/100BASE-TX |
| **Memory usage** | Application saving<br>Activating the standard web server |
| **Supply** | Internal power supply via rack |
| **Marking** | CE |
| **Local signalling** | for processor running (RUN) 1 LED (green)<br>for processor or system fault (ERR) 1 LED (red)<br>for status of Ethernet network (ETH STS) 1 LED (amber)<br>for MS (Module Status) 1 LED (green/red)<br>for NS (Network Status) 1 LED (green/red) |
| **Control Type** | Processor or system fault (ERR) |
| **Current consumption** | 555 mA 3.3 V DC |
| **Module format** | Standard |
| **Net Weight** | 0.44 lb(US) (0.2 kg) |

## Environment

| | |
|---|---|
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative Humidity** | 10…95 % without condensation |
| **IP Degree of Protection** | IP20 |
| **Directives** | 2014/35/EU - low voltage directive |

| | |
|---|---|
| | 2014/30/EU - electromagnetic compatibility<br>2014/34/EU - ATEX directive |
| **Product certifications** | CE<br>UL<br>CSA<br>RCM<br>EAC<br>Merchant Navy<br>ATEX zone 2/22<br>IECEx zone 2/22 |
| **Standards** | EN/IEC 61131-2<br>EN/IEC 61010-2-201<br>UL 61010-2-201<br>CSA C22.2 No 61010-2-201<br>IACS E10<br>EN/IEC 61000-6-5<br>EN/IEC 61850-3<br>EN/IEC 60079-0 |
| **Environmental characteristic** | Hazardous location class I division 2 |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595864083575 |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 2.17 in (5.5 cm) |
| **Package 1 Width** | 4.33 in (11.0 cm) |
| **Package 1 Length** | 4.72 in (12.0 cm) |
| **Package 1 Weight** | 7.72 oz (219.0 g) |
| **Unit Type of Package 2** | S02 |
| **Number of Units in Package 2** | 15 |
| **Package 2 Height** | 5.91 in (15.0 cm) |
| **Package 2 Width** | 11.81 in (30.0 cm) |
| **Package 2 Length** | 15.75 in (40.0 cm) |
| **Package 2 Weight** | 7.24 lb(US) (3.285 kg) |

## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |

| | |
|---|---|
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

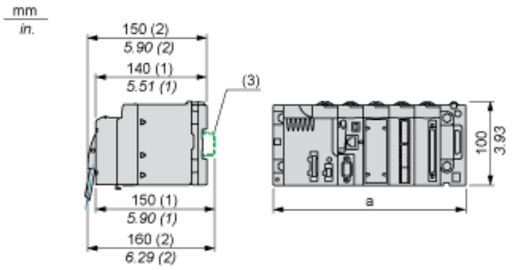
| | |
|---|---|
| **Warranty** | 18 months |

# Product data sheet BMXNOC0401

Dimensions Drawings

## Modules Mounted on Racks

### Dimensions




**(1)** With removable terminal block (cage, screw or spring).
**(2)** With FCN connector.
**(3)** On AM1 ED rail: 35 mm wide, 15 mm deep. Only possible with BMXXBP0400/0400H/0600/0600H/0800/0800H rack.

| Rack references | a in mm | a in in. |
|---|---|---|
| BMXXBP0400 and BMXXBP0400H | 242.4 | 09.54 |
| BMXXBP0600 and BMXXBP0600H | 307.6 | 12.11 |
| BMXXBP0800 and BMXXBP0800H | 372.8 | 14.68 |
| BMXXBP1200 and BMXXBP1200H | 503.2 | 19.81 |

# Product data sheet

Specifications


# power supply module X80 - 24..48 V DC - 31.2 W

BMXCPS3020

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon X80 |
| **Product or Component Type** | Power supply module |
| **Backplane compatibility** | Not compatible with BMEXBP..02 |
| **Primary Voltage** | 24...48 V isolated |
| **Supply circuit type** | DC |
| **Secondary power** | 15 W 3.3 V DC I/O module logic power supply<br>31.2 W 24 V DC I/O module power supply and processor |

## Complementary

| | |
|---|---|
| **Primary voltage limit** | 18...62.4 V |
| **Input current** | 0.83 A 48 V<br>1.65 A 24 V |
| **Inrush current** | 30 A 24 V<br>60 A 48 V |
| **I²t on activation** | 1 A².s 24 V<br>3 A².s 48 V |
| **It on activation** | 0.2 A.s 24 V<br>0.3 A.s 48 V |
| **Protection type** | Internal fuse not accessible primary circuit<br>Overload protection secondary circuit, 24 V sensor power supply<br>Overvoltage protection secondary circuit, 24 V sensor power supply<br>Short-circuit protection secondary circuit, 24 V sensor power supply |
| **Current at secondary voltage** | 1.3 A 24 V DC I/O module power supply and processor<br>4.5 A 3.3 V DC I/O module logic power supply |
| **Maximum power dissipation in W** | 8.5 W |
| **Status LED** | 1 LED (Green) rack voltage OK |
| **Control Type** | RESET push-button cold restart |
| **Electrical connection** | 1 connector 2 alarm relay<br>1 connector 5 line supply, protective earth |
| **Maximum cable distance between devices** | 32.81 ft (10 m) power supply cable copper 0.00 in² (1.5 mm²)<br>49.21 ft (15 m) power supply cable copper 0.00 in² (2.5 mm²) |
| **Insulation resistance** | >= 10 MOhm primary/ground<br>>= 10 MOhm primary/secondary |
| **Net Weight** | 0.75 lb(US) (0.34 kg) |

## Environment

| | |
|---|---|
| **Immunity to microbreaks** | 1 ms |
| **Dielectric strength** | 1500 V primary/ground<br>1500 V primary/secondary |
| **Vibration resistance** | 3 gn |
| **Shock resistance** | 30 gn |
| **IP Degree of Protection** | IP20 |
| **Directives** | 2014/35/EU - low voltage directive<br>2014/30/EU - electromagnetic compatibility |
| **Ambient Air Temperature for Storage** | -40…185 °F (-40…85 °C) |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative humidity** | 5…95 % 131 °F (55 °C) without condensation |
| **Protective treatment** | TC |
| **Operating altitude** | 0...6561.68 ft (0...2000 m)<br>2000...5000 m with derating factor |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595863908985 |
| **Returnability** | Yes |
| **Country of origin** | ID |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 5.19 in (13.183 cm) |
| **Package 1 Width** | 6.08 in (15.437 cm) |
| **Package 1 Length** | 6.16 in (15.654 cm) |
| **Package 1 Weight** | 17.64 oz (500.0 g) |
| **Unit Type of Package 2** | S04 |
| **Number of Units in Package 2** | 12 |
| **Package 2 Height** | 11.81 in (30 cm) |
| **Package 2 Width** | 15.75 in (40 cm) |
| **Package 2 Length** | 23.62 in (60 cm) |
| **Package 2 Weight** | 15.92 lb(US) (7.22 kg) |
| **Package 3 Height** | 17.72 in (45 cm) |

## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope) |

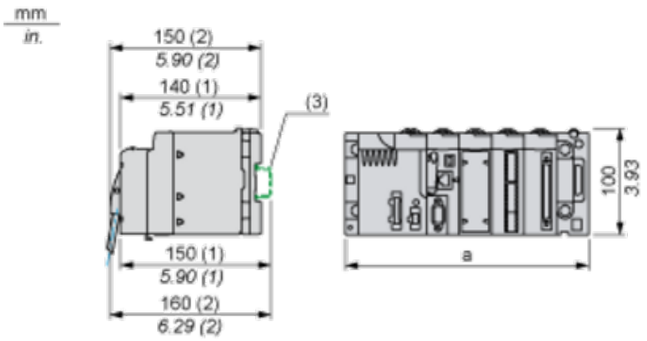
| | |
|---|---|
| | EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

| | |
|---|---|
| **Warranty** | 18 months |

## Modules Mounted on Racks

### Dimensions



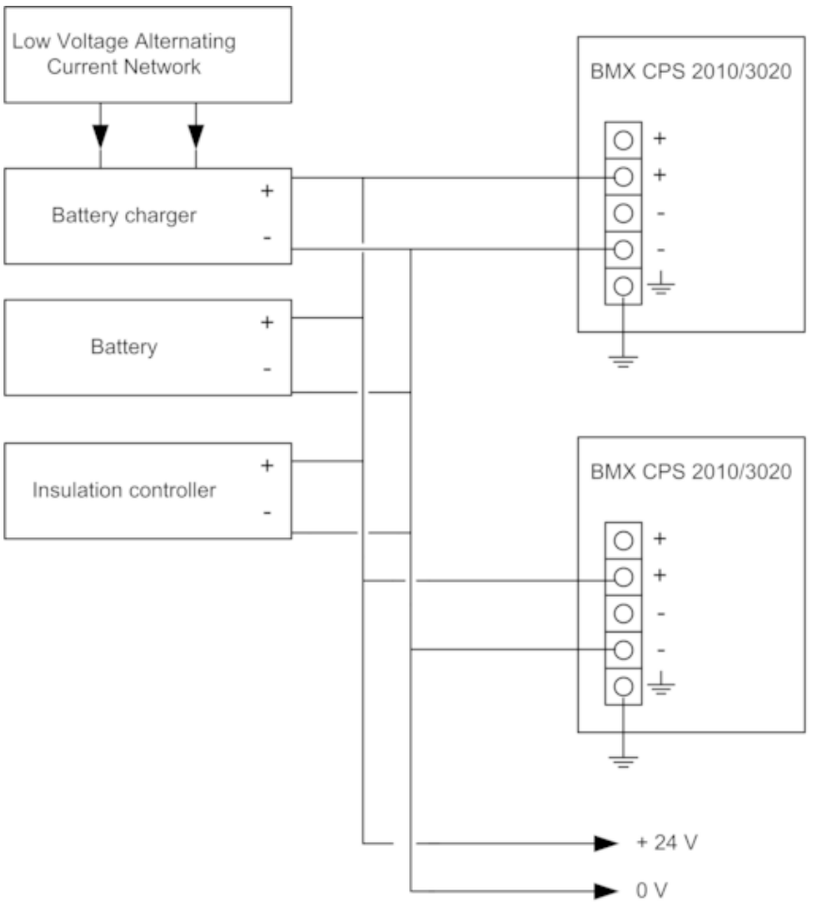

**(1)** With removable terminal block (cage, screw or spring).

**(2)** With FCN connector.

**(3)** On AM1 ED rail: 35 mm wide, 15 mm deep. Only possible with BMXXBP0400/0400H/0600/0600H/0800/0800H rack.

| Rack references | a in mm | a in in. |
|---|---|---|
| BMXXBP0400 and BMXXBP0400H | 242.4 | 09.54 |
| BMXXBP0600 and BMXXBP0600H | 307.6 | 12.11 |
| BMXXBP0800 and BMXXBP0800H | 372.8 | 14.68 |
| BMXXBP1200 and BMXXBP1200H | 503.2 | 19.81 |

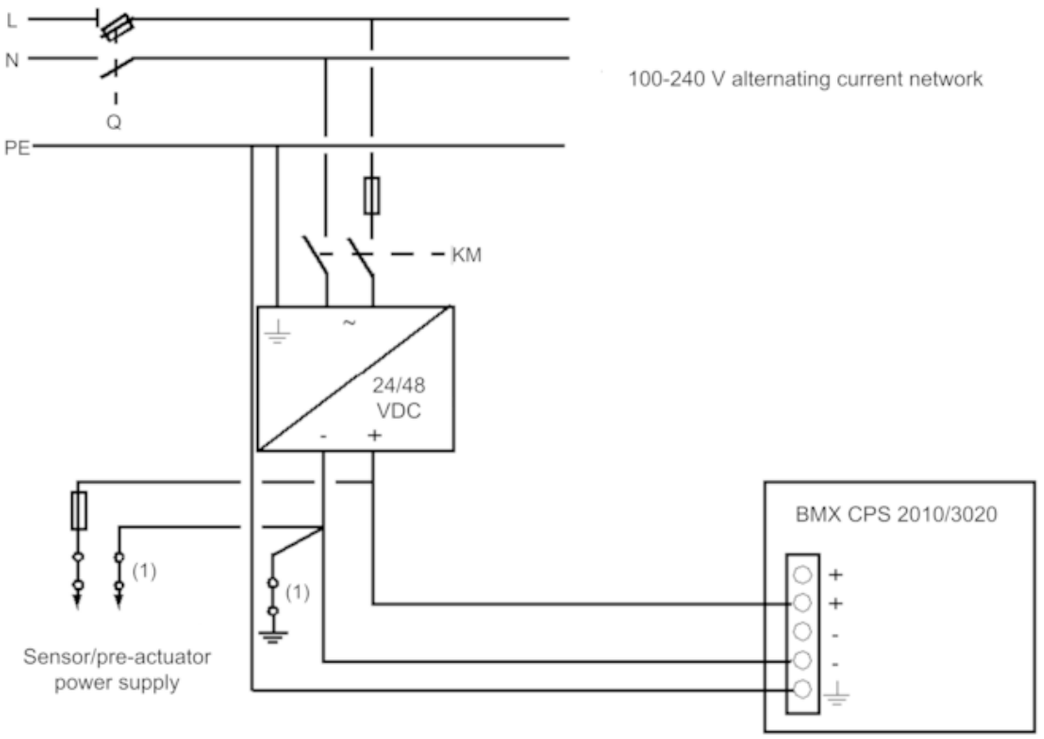
## Connection of Direct Current Power Supply Modules to a 24 Vdc or 48 Vdc Floating Direct Current Network




24 VDC floating network for the power supply of sensors, actuators and input/out modules.

## Connection of Direct Current Power Supply Modules to an Alternating Current Network

### Connection of a Single Rack PLC Station

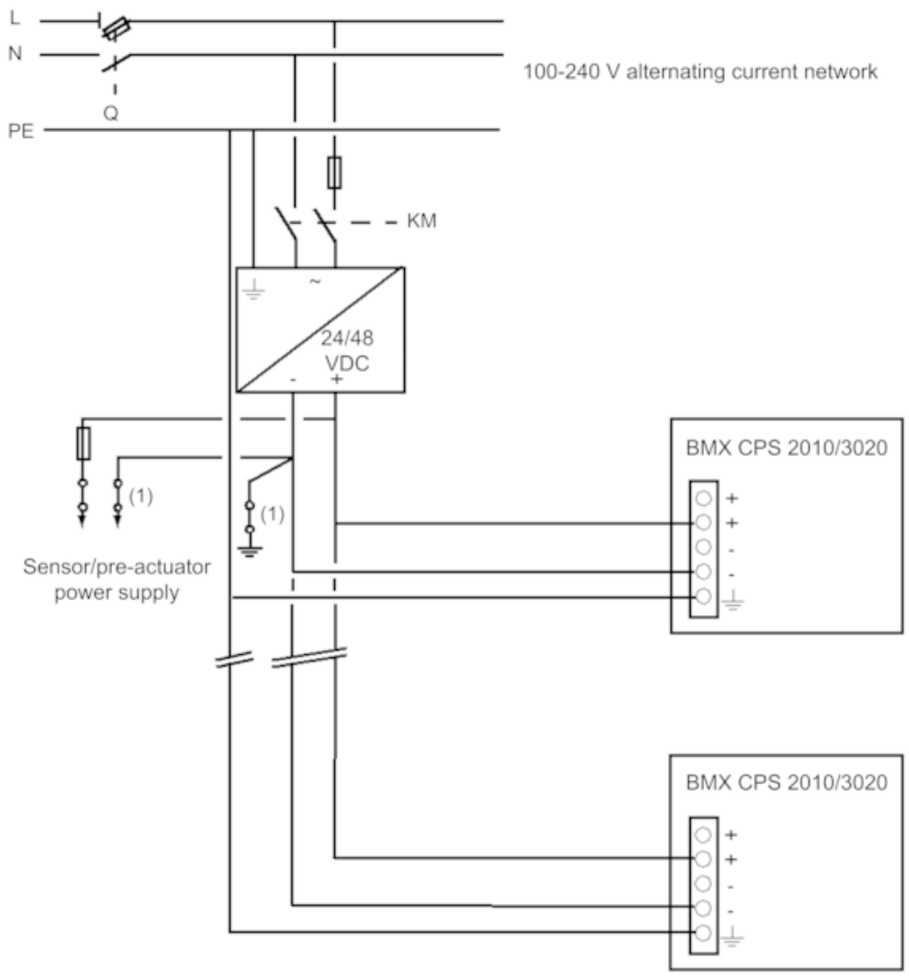



**Q** General isolator

**KM** Line contactor or circuit breaker

**(1)** Insulation connector bar for locating grounding errors

## Connection of a Multi-Rack PLC Station



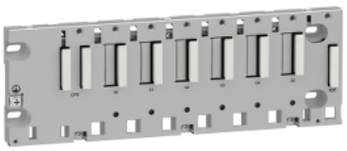

**Q** General isolator

**KM** Line contactor or circuit breaker

**(1)** Insulation connector bar for locating grounding errors

# Product data sheet

Specifications



## Modicon M340 automation platform, rack 6 slots, panel, plate or DIN rail mounting

BMXXBP0600

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon M340 automation platform |
| **Accessory / separate part type** | Rack |

## Complementary

| | |
|---|---|
| **Number of slots** | 6 bus X |
| **Product Compatibility** | BMXP34 processor<br>I/O module<br>Specific application module<br>BMXCPS power supply |
| **Power Consumption in W** | 1.5 W |
| **Electrical connection** | 1 connector (XBE) expansion module |
| **Fixing mode** | By 4 screws 0.17…0.25 in (4.32…6.35 mm) panel<br>By 4 M6 screws plate<br>By clips 35 mm symmetrical DIN rail |
| **Net Weight** | 1.74 lb(US) (0.79 kg) |

## Environment

| | |
|---|---|
| **IP Degree of Protection** | IP20 |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative Humidity** | 10…95 % without condensation |
| **Protective treatment** | TC |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595863908909 |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |

| | |
|---|---|
| **Package 1 Height** | 2.60 in (6.6 cm) |
| **Package 1 Width** | 5.98 in (15.2 cm) |
| **Package 1 Length** | 15.35 in (39.0 cm) |
| **Package 1 Weight** | 29.35 oz (832.0 g) |
| **Unit Type of Package 2** | P06 |
| **Number of Units in Package 2** | 54 |
| **Package 2 Height** | 41.34 in (105.0 cm) |
| **Package 2 Width** | 31.50 in (80.0 cm) |
| **Package 2 Length** | 23.62 in (60.0 cm) |
| **Package 2 Weight** | 132.63 lb(US) (60.16 kg) |
| **Unit Type of Package 3** | S04 |
| **Number of Units in Package 3** | 9 |
| **Package 3 Height** | 11.81 in (30.0 cm) |
| **Package 3 Width** | 15.75 in (40.0 cm) |
| **Package 3 Length** | 23.62 in (60.0 cm) |
| **Package 3 Weight** | 18.43 lb(US) (8.36 kg) |

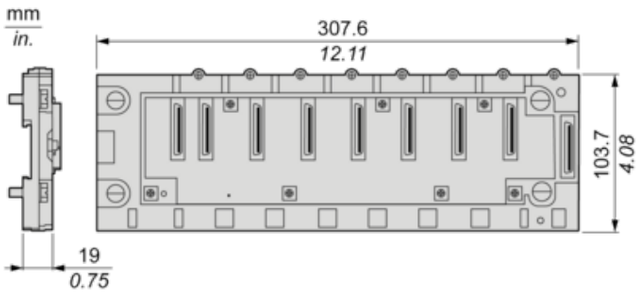
## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

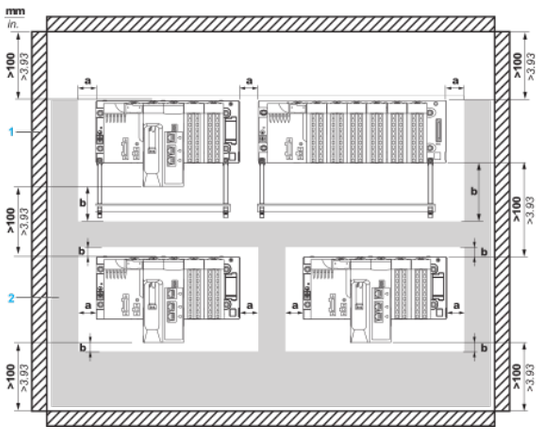
| | |
|---|---|
| **Warranty** | 18 months |

## Dimensions



## Minimum Clearance

**Minimum Clearance of a typical installation in a cabinet with ducts**




**a** Side clearance: > 40 mm (1.57 in.)

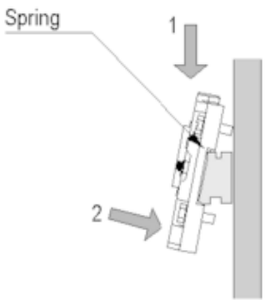
**b** Top and bottom clearance with surrounding objects: > 20 mm (0.79 in.)

**1** Installation or casing

**2** Wiring duct or tray

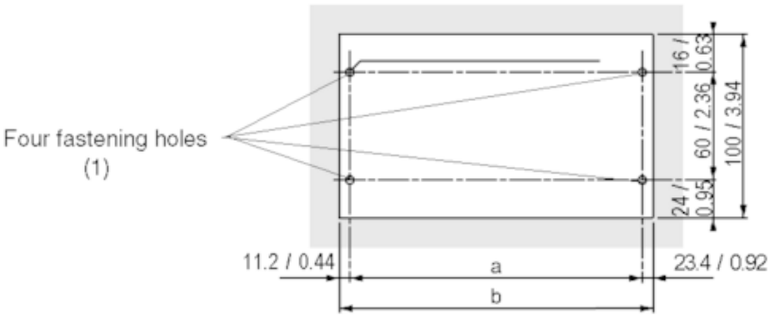
## Mounting and Fastening the Racks

### Mounting on 35 mm (1.38 in.) Wide and 15 mm (0.59 in.) Deep DIN Rails with Four HM6 Screws




### Mounting on Panels

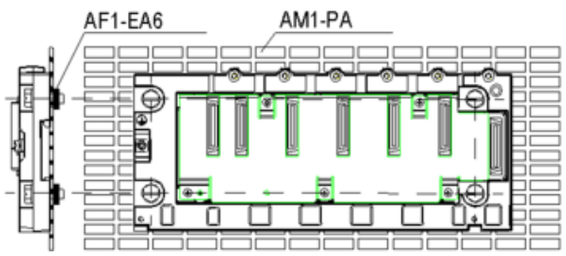
Dimensions in mm / in.




(**1**) The diameter of the fastening holes must allow use of M4, M5, M6 and UNC #6 screws.

| Rack | a | b | Size of the rack and extension module |
|---|---|---|---|
| BMXXBP040 and BMXXBP0400H | 207.8 mm (8.187 in.) | 242.2 mm (9.543 in.) | 243.4 mm (9.59 in.) |
| BMXXBP0600 and BMXXBP0600H | 273 mm (10.756 in.) | 307.6 mm (12.12 in.) | 308.8 mm (12.167 in.) |
| BMXXBP0800 and BMXXBP0800H | 338.2 mm (13.325 in.) | 372.8 mm (14.69 in.) | 374 mm (14.736 in.) |
| BMXXBP1200 and BMXXBP1200H | 468.6 mm (18.463 in.) | 503.2 mm (19.826 in.) | 504.4 mm (19.873 in.) |

### Mounting on Telequick AM1-PA and AM3-PA Mounting Grids




Fasten the rack with four M4, M5, M6 or UNC #6 screws.

# Product data sheet

Specifications

## Discrete input module, M340, 16 Inputs, 24 VDC sink

BMXDDI1602

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon X80 |
| **Product or Component Type** | Discrete input module |
| **Discrete input number** | 16 |
| **Discrete input type** | Isolated |
| **Input type** | Current sink (logic positive) |
| **Discrete input voltage** | 24 V DC positive |
| **Discrete input current** | 3.5 mA |

## Complementary

| | |
|---|---|
| **Input compatibility** | With 2-wire/3-wire proximity sensors IEC 60947-5-2<br>With 2-wire/3-wire proximity sensors IEC 61131-2 type 3 |
| **Sensor power supply** | 19...30 V |
| **Current state 1 guaranteed** | >= 2 mA |
| **Current state 0 guaranteed** | <= 1.5 mA |
| **Input impedance** | 6800 Ohm |
| **Insulation resistance** | > 10 MOhm 500 V DC |
| **Power dissipation in W** | 2.5 W |
| **DC typical response time** | 4 ms |
| **DC maximum response time** | 7 ms |
| **Paralleling of inputs** | Yes |
| **Typical current consumption** | 76 mA 3.3 V DC |
| **MTBF reliability** | 738749 H |
| **Protection type** | 1 external fuse per group of channel 0.5 A fast blow<br>reverse polarity protection |
| **Voltage detection threshold** | < 14 V DC sensor fault<br>> 18 V DC sensor OK |
| **Status LED** | 1 LED (Green) module operating (RUN)<br>1 LED per channel (Green) channel diagnostic<br>1 LED (Red) module error (ERR)<br>1 LED (Red) module I/O |
| **Net Weight** | 0.25 lb(US) (0.115 kg) |

## Environment

| | |
|---|---|
| **IP Degree of Protection** | IP20 |
| **Directives** | 2014/35/EU - low voltage directive<br>2014/30/EU - electromagnetic compatibility |
| **Environmental characteristic** | Fungal spore resistant class 3B2 |
| **Dielectric strength** | 1500 V AC 50/60 Hz 1 minute, primary/secondary |
| **Vibration resistance** | 3 gn |
| **Shock resistance** | 30 gn |
| **Ambient Air Temperature for Storage** | -40…185 °F (-40…85 °C) |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative humidity** | 5…95 % 131 °F (55 °C) without condensation |
| **Operating altitude** | 0...6561.68 ft (0...2000 m)<br>2000...5000 m with derating factor |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595863910001 |
| **Returnability** | Yes |
| **Country of origin** | ID |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 2.16 in (5.488 cm) |
| **Package 1 Width** | 4.40 in (11.188 cm) |
| **Package 1 Length** | 4.62 in (11.741 cm) |
| **Package 1 Weight** | 5.33 oz (151.0 g) |
| **Unit Type of Package 2** | S02 |
| **Number of Units in Package 2** | 15 |
| **Package 2 Height** | 5.91 in (15.0 cm) |
| **Package 2 Width** | 11.81 in (30.0 cm) |
| **Package 2 Length** | 15.75 in (40.0 cm) |
| **Package 2 Weight** | 6.46 lb(US) (2.931 kg) |

## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |

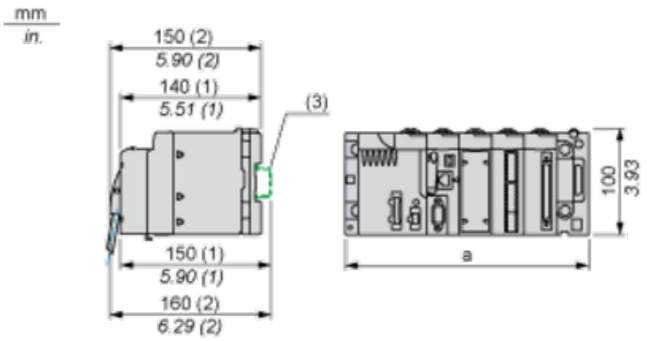
| | |
|---|---|
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

| | |
|---|---|
| **Warranty** | 18 months |

## Modules Mounted on Racks

### Dimensions




**(1)** With removable terminal block (cage, screw or spring).

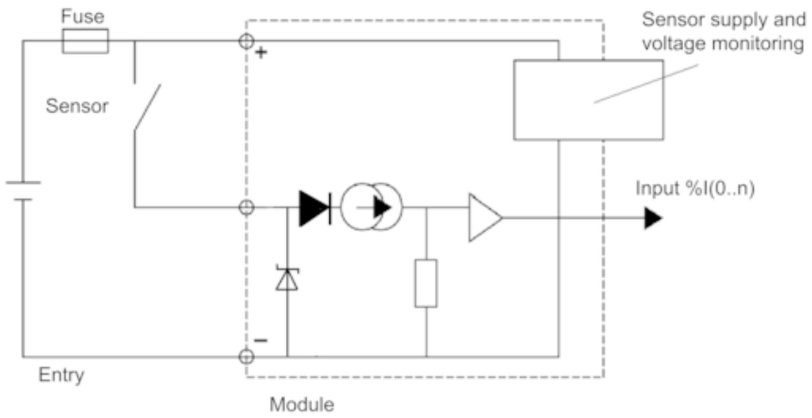
**(2)** With FCN connector.

**(3)** On AM1 ED rail: 35 mm wide, 15 mm deep. Only possible with BMXXBP0400/0400H/0600/0600H/0800/0800H rack.

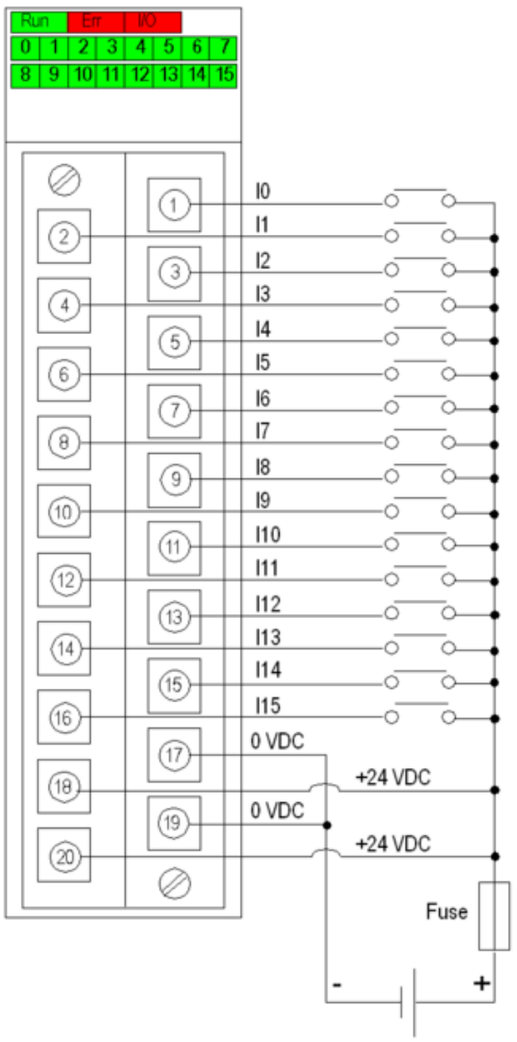
| Rack references | a in mm | a in in. |
|---|---|---|
| BMXXBP0400 and BMXXBP0400H | 242.4 | 09.54 |
| BMXXBP0600 and BMXXBP0600H | 307.6 | 12.11 |
| BMXXBP0800 and BMXXBP0800H | 372.8 | 14.68 |
| BMXXBP1200 and BMXXBP1200H | 503.2 | 19.81 |

## Connecting the Module

### Input Circuit Diagram




### Module Connection




**power supply** 24 VDC
**fuse** fast blow fuse of 0.5 A

# Product data sheet

Specifications

## discrete output module X80 - 16 outputs - relay - 24...48 V DC or 24...240 V AC

BMXDRA1605

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon X80 |
| **Product or Component Type** | Discrete output module |
| **Discrete output number** | 16 EN/IEC 61131-2 |
| **Discrete output type** | Relay |
| **Discrete output voltage** | 24...48 V 19...60 V DC<br>24...240 V 19…264 V AC |

## Complementary

| | |
|---|---|
| **[Ith] conventional free air thermal current** | 2 A |
| **Insulation resistance** | > 10 MOhm 500 V DC |
| **Power dissipation in W** | 3 W |
| **Response time on output** | < 8 ms activation<br>< 10 ms deactivation |
| **Typical current consumption** | 79 mA 3.3 V DC |
| **MTBF reliability** | 1357810 H |
| **Output overload protection** | Use 1 fast blow fuse per channel or group of channel |
| **Output overvoltage protection** | Use discharge diode on each output DC<br>Use RC circuit on each output AC<br>Use ZNO surge limiter on each output AC |
| **Output short-circuit protection** | Use 1 fast blow fuse per channel or group of channel |
| **Minimum switching current** | 1 mA 5 V DC |
| **Electrical durability** | AC-15 100000 cycles 240 VA 200 V 0.7)<br>AC-15 100000 cycles 120 VA 200 V 0.35)<br>AC-12 100000 cycles 200 VA 100 V<br>AC-12 100000 cycles 80 VA 48 V<br>AC-12 100000 cycles 50 VA 24 V<br>AC-15 100000 cycles 120 VA 100 V<br>AC-15 100000 cycles 120 VA 24 V<br>AC-15 100000 cycles 120 VA 48 V<br>DC-12 100000 cycles 24 W 24 V<br>DC-13 100000 cycles 10 W 24 V<br>DC-13 100000 cycles 10 W 48 V<br>AC-15 300000 cycles 72 VA 200 V 0.7)<br>AC-15 300000 cycles 36 VA 200 V 0.35)<br>AC-12 300000 cycles 200 VA 200 V<br>AC-12 300000 cycles 80 VA 100 V<br>AC-12 300000 cycles 50 VA 48 V<br>AC-15 300000 cycles 36 VA 100 V<br>AC-15 300000 cycles 72 VA 100 V<br>AC-15 300000 cycles 36 VA 48 V<br>AC-15 300000 cycles 72 VA 48 V<br>AC-15 300000 cycles 36 VA 24 V |

| | |
|---|---|
| | AC-15 300000 cycles 72 VA 24 V<br>DC-13 300000 cycles 3 W 24 V<br>DC-13 300000 cycles 3 W 48 V<br>DC-13 7000 cycles 24 W 24 V<br>DC-13 7000 cycles 24 W 48 V<br>DC-12 50000 cycles 24 W 48 V |
| **Status LED** | 1 LED (Green) RUN<br>1 LED per channel (Green) channel diagnostic<br>1 LED (Red) ERR<br>1 LED (Red) I/O |
| **Net Weight** | 0.33 lb(US) (0.15 kg) |

## Environment

| | |
|---|---|
| **IP Degree of Protection** | IP20 |
| **Dielectric strength** | 2000 V AC 50/60 Hz 1 min |
| **Vibration resistance** | 3 gn |
| **Shock resistance** | 30 gn |
| **Ambient Air Temperature for Storage** | -40…185 °F (-40…85 °C) |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) |
| **Relative humidity** | 5…95 % 131 °F (55 °C) without condensation |
| **Operating altitude** | 0...6561.68 ft (0...2000 m)<br>2000...5000 m with derating factor |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18160-MODICON M340 |
| **Discount Schedule** | PC34 |
| **GTIN** | 3595863909234 |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 2.09 in (5.3 cm) |
| **Package 1 Width** | 4.33 in (11.0 cm) |
| **Package 1 Length** | 4.53 in (11.5 cm) |
| **Package 1 Weight** | 6.46 oz (183.0 g) |
| **Unit Type of Package 2** | S02 |
| **Number of Units in Package 2** | 15 |
| **Package 2 Height** | 5.91 in (15.0 cm) |
| **Package 2 Width** | 11.81 in (30.0 cm) |
| **Package 2 Length** | 15.75 in (40.0 cm) |
| **Package 2 Weight** | 6.64 lb(US) (3.01 kg) |

## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |

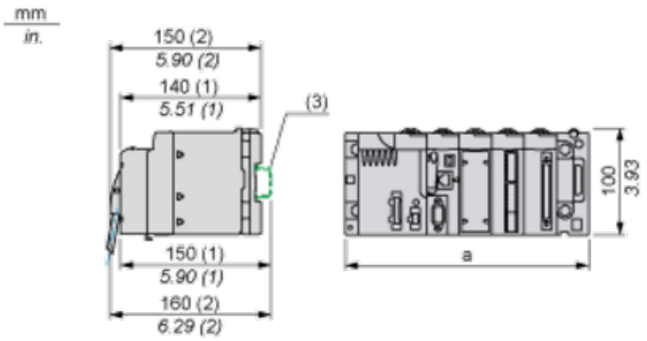
| | |
|---|---|
| **REACh Regulation** | REACh Declaration |
| **REACh free of SVHC** | Yes |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

| | |
|---|---|
| **Warranty** | 18 months |

## Modules Mounted on Racks

### Dimensions




**(1)** With removable terminal block (cage, screw or spring).

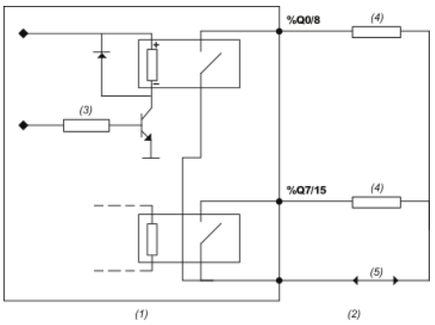
**(2)** With FCN connector.

**(3)** On AM1 ED rail: 35 mm wide, 15 mm deep. Only possible with BMXXBP0400/0400H/0600/0600H/0800/0800H rack.

| Rack references | a in mm | a in in. |
|---|---|---|
| BMXXBP0400 and BMXXBP0400H | 242.4 | 09.54 |
| BMXXBP0600 and BMXXBP0600H | 307.6 | 12.11 |
| BMXXBP0800 and BMXXBP0800H | 372.8 | 14.68 |
| BMXXBP1200 and BMXXBP1200H | 503.2 | 19.81 |

## Connecting the Module

### Output Circuit Diagram




**(1)** Module

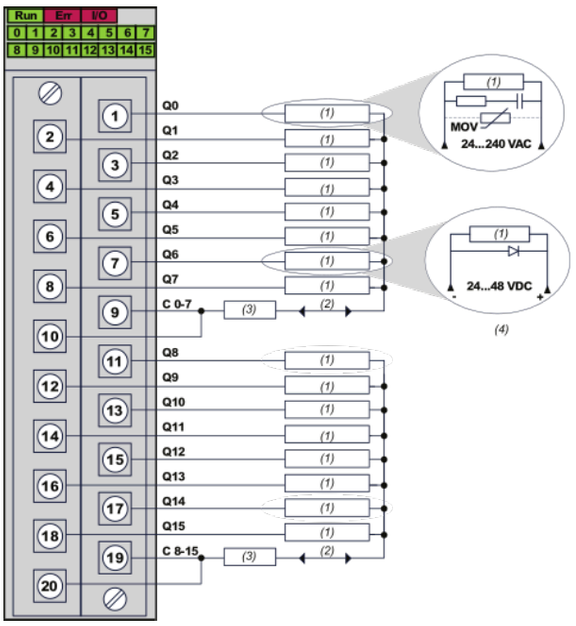
**(2)** Output

**(3)** Command

**(4)** Pre-actuator

**(5)** Power supply

### Module Connection




**(1)** Pre-actuator

**(2)** Power supply : 24...48 VDC or 24...240 VAC

**(3)** Fuse : 1 fast blow fuse of 12 A for each 8-channel group

**(4)** We recommend installing this type of protection on the terminals of each pre-actuator

# Product data sheet

Specifications

## standard Network Interface Module STB - Ethernet modbus TCP/IP - 10...100 Mbits

STBNIP2311

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon STB distributed I/O solution |
| **Product or Component Type** | Standard Network Interface Module |
| **Integrated connection type** | Ethernet Modbus TCP/IP IEEE 802.3 2 female RJ45 double shielded twisted pair via Ethernet network)<br>Ethernet Modbus TCP/IP IEEE 802.3 HE-13 RS232 port)<br>Ethernet Modbus TCP/IP IEEE 802.3 8-way female RS232 port) |
| **Port Ethernet** | 10BASE-T/100BASE-T |
| **Exchange mode** | Half or full duplex |
| **Number of segments** | 1 primary, maximum 6 extensions |
| **Transmission rate** | 10/100 Mbit/s 0.00…328.08 ft (0…100 m) per segment |
| **Structure type** | Industrial LAN<br>Ethernet Modbus TCP/IP network |

## Complementary

| | |
|---|---|
| **Number of addressable I/O module** | 0…32 per island |
| **Communication Service** | SNMP agent<br>BootP/DHCP protocol<br>Modbus TCP/IP messaging<br>Embedded web (configuration,diagnostics and access to variable) |
| **[Us] rated supply voltage** | 24 V DC |
| **Power supply type** | SELV |
| **Maximum supply current** | 700 A |
| **Supply voltage limits** | 19.2…30 V |
| **Input current** | 550 mA supply circuit |
| **Nominal output current** | 0.575 A 140…158 °F (60…70 °C)<br>1.2 A |
| **Output voltage** | 5.25 V DC +/- 0.21 %)logic bus |
| **Marking** | CE |
| **Overvoltage category** | II |
| **Status LED** | 1 LED ACT<br>1 LED island state (RUN)<br>1 LED module error (ERR)<br>1 LED MS<br>1 LED NS<br>1 LED power supply (PWR)<br>1 LED test mode (TEST) |
| **Depth** | 2.76 in (70 mm) |

| | |
|---|---|
| **Height** | 1.59 in (40.5 mm) |
| **Width** | 5.12 in (130 mm) |
| **Net Weight** | 0.32 lb(US) (0.145 kg) |

## Environment

| | |
|---|---|
| **Standards** | IEC 61131-2 : 2003<br>FM Class 1 division 2, groups A, B, C and D T4A with 70 °C |
| **Product Certifications** | UL<br>ODVA<br>C-tick<br>ATEX Cat 3G<br>CSA |
| **Pollution degree** | 2 IEC 60664-1 |
| **Operating altitude** | <= 6561.68 ft (2000 m) |
| **IP degree of protection** | IP20 conforming to EN 61131-2 class 1 |
| **Ambient air temperature for operation** | 32…140 °F (0…60 °C) without derating)<br>-13…158 °F (-25…70 °C) with derating factor) |
| **Ambient Air Temperature for Storage** | -40…185 °F (-40…85 °C) |
| **Relative humidity** | 95 % 140 °F (60 °C) without condensation |
| **Vibration resistance** | 3 gn 58…150 Hz 35 x 7.5 mm symmetrical DIN rail<br>5 gn 58…150 Hz 35 x 15 mm symmetrical DIN rail<br>+/-0.35 mm 10…58 Hz |
| **Shock resistance** | 30 gn 11 ms IEC 88 reference 2-27 |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18215-ADVANTYS STB I/O |
| **Discount Schedule** | PC32 |
| **GTIN** | 3595864062273 |
| **Returnability** | Yes |
| **Country of origin** | FR |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Number of Units in Package 1** | 1 |
| **Package 1 Height** | 1.65 in (4.2 cm) |
| **Package 1 Width** | 2.76 in (7.0 cm) |
| **Package 1 Length** | 5.12 in (13.0 cm) |
| **Package 1 Weight** | 6.35 oz (180.0 g) |
| **Unit Type of Package 2** | S02 |
| **Number of Units in Package 2** | 30 |
| **Package 2 Height** | 5.91 in (15.0 cm) |
| **Package 2 Width** | 11.81 in (30.0 cm) |
| **Package 2 Length** | 15.75 in (40.0 cm) |
| **Package 2 Weight** | 12.35 lb(US) (5.6 kg) |

## Offer Sustainability

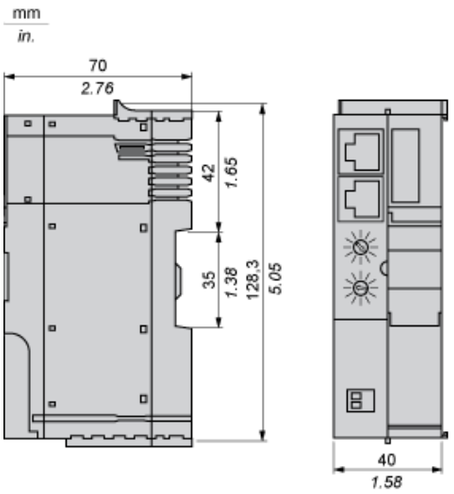
| | |
|---|---|
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |

| | |
|---|---|
| **REACh Regulation** | REACh Declaration |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

| | |
|---|---|
| **Warranty** | 18 months |

## Dimensions



# Product data sheet

Specifications

## basic digital input kit STB - 24 V DC - 16 I

STBDDI3725KC

**Product availability : Stock - Normally stocked in distribution facility**

## Main

| | |
|---|---|
| **Range of Product** | Modicon STB distributed I/O solution |
| **Product or Component Type** | Basic digital input kit |
| **Kit composition** | STBXTS2180, 18-terminal spring clamp connector<br>STBDDI3725 module<br>STBXBA3000 base |
| **Discrete input number** | 16 |
| **Discrete input voltage** | 24 V |
| **Discrete input voltage type** | DC |

## Complementary

| | |
|---|---|
| **Input voltage limits** | 11...30 V at state 1<br>-3...5 V at state 0 |
| **Acceptable Input Voltage** | 30 V |
| **Discrete input current** | 4.5 mA |
| **Current state 0 guaranteed** | <= 1.5 mA |
| **Current state 1 guaranteed** | >= 2.5 mA |
| **Discrete input logic** | Positive |
| **Response time** | 2 ms off-to-on<br>2 ms on-to-off |
| **Protection type** | Power protection integrated fuse on PDM time lag 5 A<br>Input protection resistor-limited<br>Reverse polarity protection |
| **Insulation between channels and logic bus** | 1500 V for 1 minute |
| **Cold swapping** | Yes |
| **Hot swapping** | Yes for basic NIMs |
| **Product Compatibility** | I/O base STBXBA3000<br>Power distribution module STBPDT3100/3105 |
| **[Us] rated supply voltage** | 24 V DC |
| **Supply** | Power distribution module |
| **Current consumption** | 100 mA 5 V DC logic bus |
| **Marking** | CE |
| **Overvoltage category** | II |
| **Status LED** | 1 LED (Green) module status (RDY) |

| | |
|---|---|
| | 1 LED per channel (Green) channel status (IN1 to IN16) |
| **Depth** | 2.56 in (65.1 mm) |
| **Height** | 4.92 in (125 mm) |
| **Width** | 1.11 in (28.1 mm) |
| **Net Weight** | 0.19 lb(US) (0.086 kg) |

## Environment

| | |
|---|---|
| **Standards** | EN/IEC 61131-2 type 3 |
| **Product Certifications** | FM Class 1 Division 2<br>UL<br>CSA |
| **Pollution degree** | 2 IEC 60664-1 |
| **Operating altitude** | <= 6561.68 ft (2000 m) |
| **IP degree of protection** | IP20 conforming to EN 61131-2 class 1 |
| **Ambient air temperature for operation** | -13…158 °F (-25…70 °C) without derating)<br><br>32...140 °F without derating |
| **Ambient air temperature for storage** | -40…185 °F (-40…85 °C) without derating<br><br>-40...185 °F without derating |
| **Relative humidity** | 95 % 140 °F (60 °C) without condensation |
| **Vibration resistance** | 3 gn 58…150 Hz 35 x 7.5 mm symmetrical DIN rail<br>5 gn 58…150 Hz 35 x 15 mm symmetrical DIN rail<br>+/-0.35 mm 10…58 Hz |
| **Shock resistance** | 30 gn 11 ms IEC 88 reference 2-27 |

## Ordering and shipping details

| | |
|---|---|
| **Category** | 18215-ADVANTYS STB I/O |
| **Discount Schedule** | PC32 |
| **GTIN** | 3595863932980 |
| **Returnability** | Yes |
| **Country of origin** | ID |

## Packing Units

| | |
|---|---|
| **Unit Type of Package 1** | PCE |
| **Package 1 Length** | 5.12 in (13 cm) |
| **Number of Units in Package 1** | 1 |
| **Package 2 Width** | 11.81 in (30 cm) |
| **Package 2 Height** | 5.91 in (15 cm) |
| **Package 2 Weight** | 9.36 lb(US) (4.246 kg) |
| **Package 1 Width** | 3.07 in (7.8 cm) |
| **Package 1 Height** | 1.38 in (3.5 cm) |
| **Package 1 Weight** | 6.63 oz (188 g) |
| **Number of Units in Package 2** | 20 |
| **Unit Type of Package 2** | S02 |
| **Package 2 Length** | 15.75 in (40 cm) |

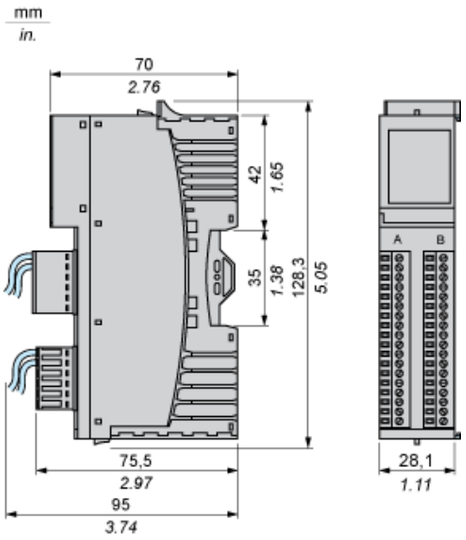
## Offer Sustainability

| | |
|---|---|
| **Sustainable offer status** | Green Premium product |
| **California proposition 65** | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| **REACh Regulation** | REACh Declaration |
| **EU RoHS Directive** | Pro-active compliance (Product out of EU RoHS legal scope)<br>EU RoHS Declaration |
| **Mercury free** | Yes |
| **RoHS exemption information** | Yes |
| **China RoHS Regulation** | China RoHS declaration |
| **Environmental Disclosure** | Product Environmental Profile |
| **Circularity Profile** | End of Life Information |
| **WEEE** | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins. |

## Contractual warranty

| | |
|---|---|
| **Warranty** | 18 months |

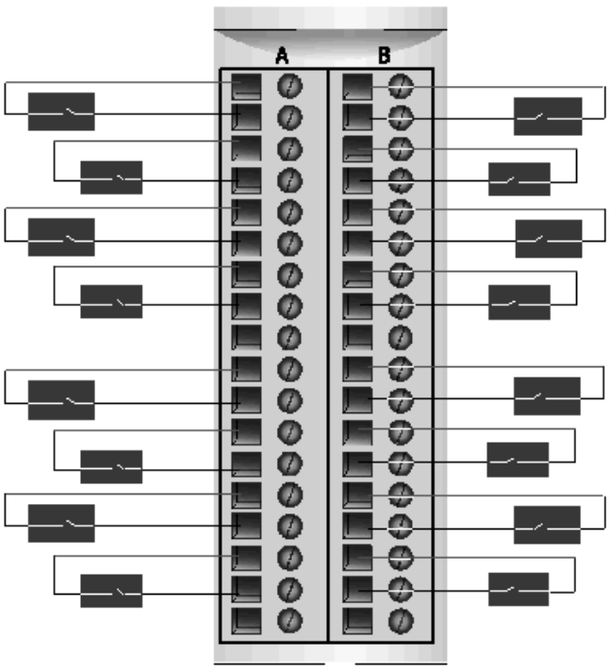
## Dimensions



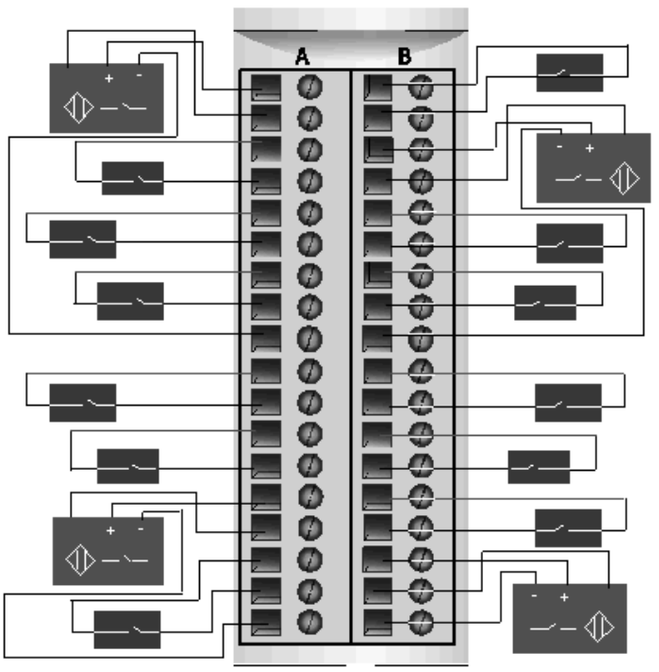
## Wiring Diagrams

### Examples

16 two-wire sensors




1 three-wire sensor per input group




| Pin | Left Connector | Right Connector |
|---|---|---|
| 1 | Sensor power group 1 (+) | Sensor power group 3 (+) |
| 2 | Input from Sensor 1 | Input from Sensor 9 |
| 3 | Sensor power group 1 (+) | Sensor power group 3 (+) |
| 4 | Input from Sensor 2 | Input from Sensor 10 |
| 5 | Sensor power group 1 (+) | Sensor power group 3 (+) |
| 6 | Input from Sensor 3 | Input from Sensor 11 |
| 7 | Sensor power group 1 (+) | Sensor power group 3 (+) |
| 8 | Input from Sensor 4 | Input from Sensor 12 |
| 9 | Sensor power (-) for a 3-wire sensor (PDM-) | Sensor power (-) for a 3-wire sensor (PDM-) |
| 10 | Sensor power group 2 (+) | Sensor power group 4 (+) |
| 11 | Input from Sensor 5 | Input from Sensor 13 |
| 12 | Sensor power group 2 (+) | Sensor power group 4 (+) |

| Pin | Left Connector | Right Connector |
|---|---|---|
| 13 | Input from Sensor 6 | Input from Sensor 14 |
| 14 | Sensor power group 2 (+) | Sensor power group 4 (+) |
| 15 | Input from Sensor 7 | Input from Sensor 15 |
| 16 | Sensor power group 2 (+) | Sensor power group 4 (+) |
| 17 | Input from Sensor 8 | Input from Sensor 16 |
| 18 | Sensor power (-) for a 3-wire sensor (PDM-) | Sensor power (-) for a 3-wire sensor (PDM-) |

# Product data sheet
## Characteristics

# STBDDO3705KC
## basic digital output kit STB - 24 V DC - 16 O

## Main

| | |
|---|---|
| Range of product | Modicon STB distributed I/O solution |
| Product or component type | Basic digital output kit |
| Kit composition | STBDDO3705 module<br>STBXTS2180, 18-terminal spring clamp connector<br>STBXBA3000 base |
| Discrete output number | 16 |
| Discrete output type | Solid state |
| Discrete output voltage | 24 V |
| Discrete output voltage type | DC |

## Complementary

| | |
|---|---|
| Discrete output current | 500 mA |
| Discrete output logic | Positive |
| Permissible voltage | 19.2...30 V DC |
| Output voltage | 19.2...30 V DC |
| Absolute maximum voltage | 35 V 1.3 ms |
| Response time | 2 ms off-to-on<br>2 ms on-to-off |
| Cold swapping | Yes |
| Hot swapping fallback | No for basic NIMs |
| Protection type | Reverse polarity protection<br>Short-circuit protection<br>Thermal overload protection<br>Power protection integrated fuse on PDM time lag 5 A |
| Insulation between channels and logic bus | 1500 V for 1 minute |
| Leakage current | <= 0.4 mA at state 0 30 V |
| Load capacitance | <= 10 µF |
| Load inductance | <= 1000 mH 4 Hz |
| Reset | Manual reset COM fault |
| Product compatibility | I/O base STBXBA3000 |

| | |
|---|---|
| | Power distribution module STBPDT3100/3105 |
| [Us] rated supply voltage | 24 V DC |
| Supply | Power distribution module |
| Current consumption | 135 mA 5 V DC logic bus |
| Marking | CE |
| Overvoltage category | II |
| Status LED | 1 LED green module status (RDY)<br>1 LED per channel green channel status (OUT1 to OUT16) |
| Height | 13.9 mm |
| Depth | 70 mm |
| Width | 128.3 mm |
| Product weight | 0.086 kg |

## Environment

| | |
|---|---|
| Standards | EN/IEC 61131-2 |
| Product certifications | UL<br>CSA<br>FM Class 1 Division 2 |
| Pollution degree | 2 IEC 60664-1 |
| Operating altitude | <= 2000 m |
| IP degree of protection | IP20 EN 61131-2 class 1 |
| Ambient air temperature for operation | 0...60 °C without |
| Ambient air temperature for operation | 32...140 °F without |
| Ambient air temperature for storage | -40...85 °C without |
| Ambient air temperature for storage | -40...185 °F without |
| Relative humidity | 95 % 60 °C without condensation |
| Vibration resistance | +/-0.35 mm 10...58 Hz<br>3 gn 58...150 Hz 35 x 7.5 mm symmetrical DIN rail<br>5 gn 58...150 Hz 35 x 15 mm symmetrical DIN rail |
| Shock resistance | 30 gn 11 ms IEC 88 reference 2-27 |

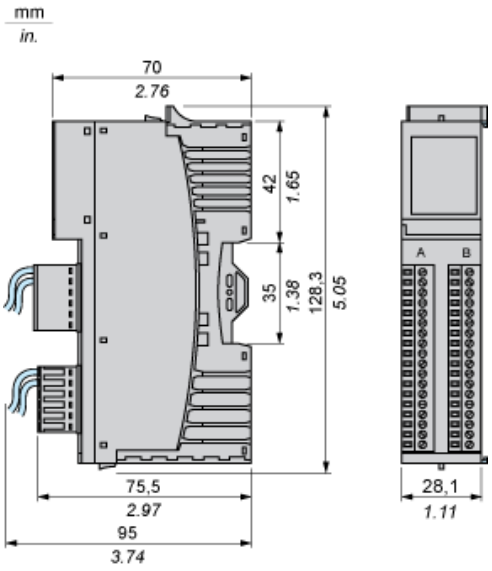
## Offer Sustainability

| | |
|---|---|
| Sustainable offer status | Green Premium product |
| RoHS (date code: YYWW) | Compliant - since 0811 - Schneider Electric declaration of conformity<br>Schneider Electric declaration of conformity |
| REACh | Reference not containing SVHC above the threshold<br>Reference not containing SVHC above the threshold |
| Product environmental profile | Available<br>Product environmental |
| Product end of life instructions | Available<br>End of life manual |

## Contractual warranty

| | |
|---|---|
| Warranty period | 18 months |

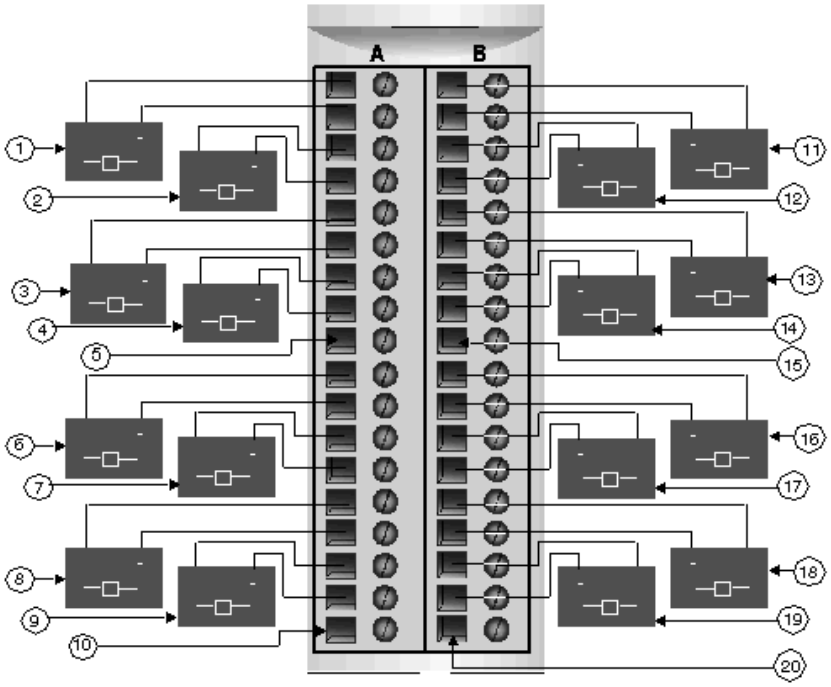
## Dimensiones



## Diagrama de cableado

### Ejemplo

16 actuadores de 2 hilos




| N.º | Grupo 1 | N.º | Grupo 2 |
|---|---|---|---|
| 1 | Canal 1, Conector A, Actuador | 11 | Canal 1, Conector B, Actuador |
| 2 | Canal 2, Conector A, Actuador | 12 | Canal 2, Conector B, Actuador |
| 3 | Canal 3, Conector A, Actuador | 13 | Canal 3, Conector B, Actuador |
| 4 | Canal 4, Conector A, Actuador | 14 | Canal 4, Conector B, Actuador |
| 5 | Pin 9, Conector A (no utilizado) | 15 | Pin 9, Conector B (no utilizado) |
| 6 | Canal 5, Conector A, Actuador | 16 | Canal 5, Conector B, Actuador |
| 7 | Canal 6, Conector A, Actuador | 17 | Canal 6, Conector B, Actuador |
| 8 | Canal 7, Conector A, Actuador | 18 | Canal 7, Conector B, Actuador |
| 9 | Canal 8, Conector A, Actuador | 19 | Canal 8, Conector B, Actuador |
| 10 | Pin 18, Conector A (no utilizado) | 20 | Pin 18, Conector B (no utilizado) |

# Interface converters - FL COMSERVER UNI 232/422/485

2313452

https://www.phoenixcontact.com/us/products/2313452

Please be informed that the data shown in this PDF document is generated from our Online Catalog. Please find the complete data in the user documentation. Our General Terms of Use for Downloads are valid.

**Second generation** FL COMSERVER UNI..., serial device server for converting a serial 232/422/485 interface to Ethernet, supports TCP, UDP, Modbus gateway, and PPP applications, incl. COM port redirector software and user documentation

## Product Description

The FL COMSERVER...232/422/485 products are used to integrate serial V.24 (RS-232)/RS-422/RS-485 interfaces into existing Ethernet networks. This provides an easy way of implementing functions such as cable replacement, network integration or a Modbus gateway.

## Your advantages

- Modbus gateway between Modbus/RTU / ASCII and Modbus/TCP
- All connections can be plugged in using a COMBICON screw terminal block
- Configuration via web-based management
- Software for virtual COM ports supplied as standard

## Commercial Data

| | |
|---|---|
| Item number | 2313452 |
| Packing unit | 1 pc |
| Minimum order quantity | 1 pc |
| Sales Key | C19 |
| Product Key | DNC321 |
| Catalog Page | Page 357 (C-6-2019) |
| GTIN | 4046356451321 |
| Weight per Piece (including packing) | 176.4 g |
| Weight per Piece (excluding packing) | 176.4 g |
| Customs tariff number | 85176200 |
| Country of origin | DE |

## Technical Data

### Notes

Utilization restriction

| | |
|---|---|
| EMC note | EMC: class A product, see manufacturer's declaration in the download area |

Utilization restriction

| | |
|---|---|
| CCCex note | Use in potentially explosive areas is not permitted in China. |

### Product properties

| | |
|---|---|
| Product type | Interface converter |
| MTTF | 2013 Years (SN 29500 standard, temperature 25°C, operating cycle 21%) |
| | 879 Years (SN 29500 standard, temperature 40°C, operating cycle 34.25%) |
| | 359 Years (SN 29500 standard, temperature 40°C, operating cycle 100%) |
| MTBF | 666 Years (Telcordia standard, 25°C temperature, 21% operating cycle (5 days a week, 8 hours a day)) |
| | 179 Years (Telcordia standard, 40°C temperature, 34.25% operating cycle (5 days a week, 12 hours a day)) |

### Electrical properties

| | |
|---|---|
| Electrical isolation | VCC // Ethernet // Serial |
| Maximum power dissipation for nominal condition | 2.4 W |
| Test voltage data interface/data interface | 1.5 $kV_{rms}$ (50 Hz, 1 min.) |
| Test voltage data interface/power supply | 1.5 $kV_{rms}$ (50 Hz, 1 min.) |

Supply

| | |
|---|---|
| Supply voltage range | 19.2 V AC/DC ... 28.8 V AC/DC (via pluggable COMBICON screw terminal block) |
| | 22.8 V DC ... 25.2 V DC (as an alternative or redundant, via backplane bus contact and system current supply) |
| Typical current consumption | 100 mA (24 V DC) |

Function

| | |
|---|---|
| Management | Web-based management, SNMP, emergency exit with Telnet and serial |
| Status and diagnostic indicators | LEDs: UL (logic voltage), TD + RD (data activity serial), FD (full duplex), 100 (100 Mbps mode), Link (Ethernet), Activity (Ethernet), ERR (error) |

### Connection data

Supply

| | |
|---|---|
| Torque | 0.56 Nm ... 0.79 Nm |

## Interfaces

| | |
|---|---|
| Signal | Ethernet |
| | Modbus |
| Web server | yes |

Data: Ethernet interface, 10/100Base-T(X) in accordance with IEEE 802.3

| | |
|---|---|
| Serial transmission speed | 10/100 Mbps, auto negotiation |
| Connection method | RJ45 jack, shielded |
| No. of channels | 1 |
| Transmission length | ≤ 100 m (shielded twisted pair) |
| Protocols supported | TCP/IP, UDP, Modbus (TCP, RTU/ASCII), PPP |
| Auxiliary protocols | ARP, DHCP, BOOTP, SNMP, RIP, RARP, HTTP, TFTP, ICMP |
| Data flow control/protocols | Modbus/TCP |

Data: V.24 (RS-232) interface in acc. with ITU-T V.28, EIA/TIA-232, DIN 66259-1

| | |
|---|---|
| Serial transmission speed | 0.3; 0.6; 1.2; 2.4; 4.8; 7.2; 9.6; 19.2; 38.4; 57.6; 115.2; 187.5; 230.4 kbps |
| Connection method | D-SUB 9 plug |
| Pin assignment | DTE/DCE switchover via web-based management |
| Transmission length | 15 m |
| File format/coding | UART/NRZ: 7/8 Bit Data, 1/2 Bit Stopp, None/Even/Odd Parity |
| Data flow control/protocols | Software handshake, Xon/Xoff, or hardware handshake RTS/CTS // 3964 R compatible, Modbus RTU/ASCII |

Data: RS-422 interface in acc. with ITU-T V.11, EIA/TIA-422, DIN 66348-1

| | |
|---|---|
| Serial transmission speed | 0.3; 0.6; 1.2; 2.4; 4.8; 7.2; 9.6; 19.2; 38.4; 57.6; 115.2; 187.5; 230.4; 500; 1000 kbps |
| Connection method | Plug-in/screw connection via COMBICON |
| Transmission length | ≤ 1200 m |
| Termination resistor | 390 Ω (configurable) |
| | 180 Ω |
| | 390 Ω |
| File format/coding | UART/NRZ: 7/8 Bit Data, 1/2 Bit Stopp, None/Even/Odd Parity |
| Data flow control/protocols | Automatic control |

Data: RS-485 interface, in acc. with EIA/TIA-485, DIN 66259-4/RS-485 2-wire

| | |
|---|---|
| Serial transmission speed | 0.3; 0.6; 1.2; 2.4; 4.8; 7.2; 9.6; 19.2; 38.4; 57.6; 115.2; 187.5; 230.4; 500; 1000 kbps |
| Connection method | Plug-in/screw connection via COMBICON |
| Termination resistor | 390 Ω |
| | 180 Ω |
| | 390 Ω (configurable) |
| File format/coding | UART/NRZ: 7/8 Bit Data, 1/2 Bit Stopp, None/Even/Odd Parity |
| Data flow control/protocols | Automatic control |

## Software

System requirements

| | |
|---|---|
| Supported browsers | Netscape Communicator versions 4.5 and up or Internet Explorer versions 5.5 and up |

## Dimensions

| | |
|---|---|
| Width | 22.5 mm |
| Height | 99 mm |
| Depth | 116 mm |

## Material specifications

| | |
|---|---|
| Color | green |
| Material | PA 6.6-FR (Housing) |

## Environmental and real-life conditions

Ambient conditions

| | |
|---|---|
| Degree of protection | IP20 |
| Ambient temperature (operation) | -25 °C ... 60 °C |
| | -20 °C ... 60 °C (in acc. with UL) |
| Ambient temperature (storage/transport) | -25 °C ... 70 °C |
| Altitude | ≤ 5000 m (For restrictions, see the manufacturer's declaration for altitude operation) |
| Permissible humidity (operation) | 10 % ... 95 % (non-condensing) |
| Permissible humidity (storage/transport) | 5 % ... 95 % (non-condensing) |

## Approval data

CE

| | |
|---|---|
| Certificate | CE-compliant |

CE

| | |
|---|---|
| Identification | EAC |

CE

| | |
|---|---|
| Identification | ☐ II 3G Ex nA IIC T4 Gc X |
| Note | Please follow the special installation instructions in the documentation! |

CE

| | |
|---|---|
| Identification | 508 Listed |
| | Class I, Div. 2, Groups A, B, C, D |

CE

| | |
|---|---|
| Identification | Class I, Zone 2, AEx nA IIC T5 |

CE

| | |
|---|---|
| Identification | Class I, Zone 2, Ex nA IIC T5 Gc X |

CE

| | |
|---|---|
| Certificate | MSIP-REI-PCK-2313452 |

CE

| | |
|---|---|
| Identification | ISA-S71.04-1985 G3 Harsh Group A |

## EMC data

| | |
|---|---|
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |
| Noise emission | EN 61000-6-4 |
| Noise immunity | EN 61000-6-2:2005 |

## Standards and regulations

| | |
|---|---|
| Free from substances that could impair the application of coating | according to P-VW 3.10.7 57 65 0 VW-AUDI-Seat central standard |
| Standards/regulations | EN 50121-4 |

## Mounting

| | |
|---|---|
| Mounting type | DIN rail mounting |



Phoenix Contact USA
586 Fulling Mill Road
Middletown, PA 17057, United States
(+717) 944-1300
info@phoenixcon.com

## Overview

Sierra Monitor pre-programs the ProtoNode solution to provide a virtual plug-and-play, easy, complete protocol package for the OEM including: BACnet MS/TP, BACnet/IP, Metasys N2 by JCI, Modbus TCP/IP, KNX, M-Bus, EtherNet/IP, LonWorks and many others. There are no configuration files to download in the field and all configurations are available to the user/installer simply by selecting the proper DIP switches. ProtoNode OEM users have access to the extensive FieldServer driver library.

ProtoNode is the instant answer to a manufacturer's needs to meet customer demands. As an example, a manufacturer might have five different devices, each requiring a variety of protocols to meet their customer's interoperability needs. They desire a single source solution, with multiprotocol, multi-configuration capability, and they need it now! A single ProtoNode Solution can be provided by FieldServer that has all pretested configuration choices preloaded.

ProtoNode FPC-N34

ProtoNode FPC-N35

## ProtoNode Selection

- Ability to automatically support multiple known controller profiles.
- Designed to be full featured, field programmable, and with multiple protocol support for any protocol translation between Serial, Ethernet, LonWorks, KNX or M-Bus environments.
- Three methods of configuration: 1. Configuration Auto-Selector (via DIP switches)
  2. Auto-Discover known devices
  3. Profile selection via Web Configurator to load multiple configurations
- Support one or multiple field protocols in single ProtoNode.
- Supports up to 10,000 Host and Field Protocol memory points depending upon model selected.
- Has the ability to simultaneously be a Gateway and a BACnet MS/TP to BACnet/IP Router (additional charge).
- BACnet COV support provides fast data communication while reducing the traffic over a BACnet network.
- BACnet BBMD Server support for connecting to remote BACnet networks.
- Supports virtual nodes allowing multiple OEM controllers to connect to a single ProtoNode and seen as separate controllers on the various field networks.
- Easily supports OEM's custom proprietary host serial or Ethernet protocols.
- Multi-Client and Multi-Server support ensures interoperability between any Industrial and or Building Automation protocols.
- BTL Marked and LonMark Certified.

| ProtoNode | Interface Connections | | | | | | | Point Count | | | Certifications | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RS-232 | RS-485 | RS-422 | Ethernet | LonWorks | KNX | M-Bus | Level I | Level II | Level III | BTL | LonMark | KNX |
| FPC-N34 | | 2 | | 1 | | | | 1500 | 5000 | 10000 | Yes | | |
| FPC-N35 | | 1 | | 1 | 1 | | | 1500 | 4096 | n/a | Yes | Yes | |
| FPC-N36 | | 1 | 1 | 1 | | | | 1500 | 5000 | 10000 | Yes | | |
| FPC-N37 | | | 1 | 1 | 1 | | | 1500 | 4096 | n/a | Yes | Yes | |
| FPC-N38 | 1 | 1 | | 1 | | | | 1500 | 5000 | 10000 | Yes | | |
| FPC-N39 | 1 | | | 1 | 1 | | | 1500 | 4096 | n/a | Yes | Yes | |
| FPC-N40 | | 1 | | 1 | | 1 | | 1500 | 5000 | 10000 | Yes | | Pending |
| FPC-N41 | | | | 1 | 1 | 1 | | 1500 | 4096 | n/a | Yes | Yes | Pending |
| FPC-N42 | | 1 | | 1 | | | 1 | 1500 | 5000 | 10000 | Yes | | |
| FPC-N43 | | | | 1 | 1 | | 1 | 1500 | 4096 | n/a | Yes | Yes | |

## Specifications

### Power Requirements

**Power:** 9-30 VDC or 12-24 VAC
(RS-422 = 15-30 VDC or 12-24 VAC)

**Current draw:**
FPC-N34 @ 12V = 240 mA
FPC-N35 @ 12V = 250 mA
FPC-N36 @ 15V = 200 mA
FPC-N37 @ 15V = 210 mA

**M-Bus:**
Slave: 550 mA @ 12V
Master (1 Slave): 580 mA @ 12V
Master (64 Slave): 980 mA @ 12V

### Environmental

**Operating Temp:** -40ºF to 167ºF (-40ºC to 75ºC)
**Relative Humidity:** 5-90% RH, non-condensing

### Enclosure

**Dimensions:** (HxWxD)
4.5 x 3.2 x 1.6 in.
(11.5 x 8.2 x 4.0 cm)

### BACnet Support

- Alarm & Event notification read properties multiples
- BACnet COV's, Trend Logging, BBMD and optional BACnet Router support.
- Support up to 10,000 BACnet Objects
- DIP switches are for setting MAC Address, Node-ID, Baud Rate on the RS-485 Field protocol

### LonMark Certification on the ProtoNode LER

**SPID**: 80:00:95:46:00:84:04:07
**Profiles**: 0000 - Node object (1)
0001 - Open Loop Sensor Object (5)
0003 - Open Loop Actuator Object (5)

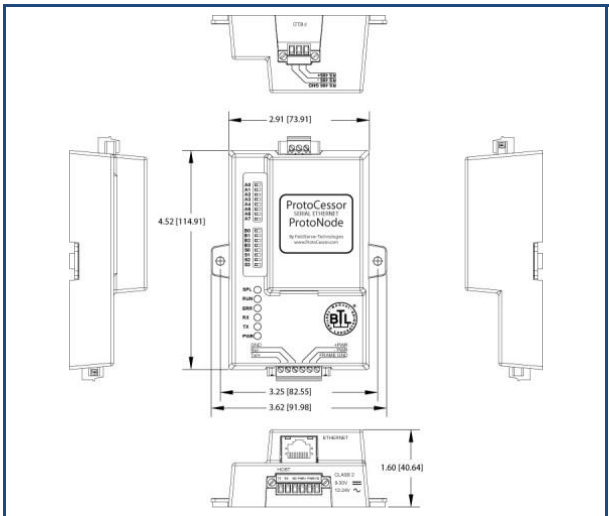
### Warranty

2 years

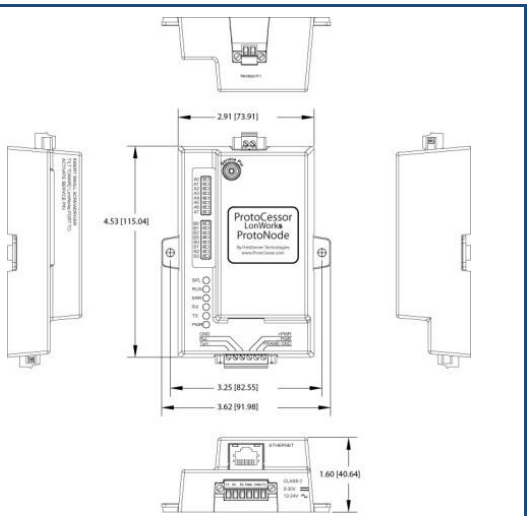
### Approvals

**BACnet** Testing Labs (BTL) B-ASC Ver. 12
**LonMark 3.4 Certified** - ProtoNode LER Series
**TUV Approved** to UL 916 EN 60950-1
EN 50491-3 and CSA C22-2 standards
**RoHS Compliant**
**DNP3 Conformance Tested**
**CE & FCC Approved**

*Specifications subject to change without notice




ProtoNode Non-LonWorks Outline Dimensions

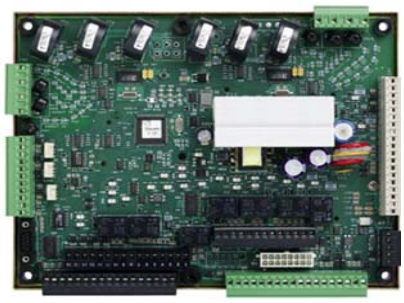



ProtoNode LonWorks Outline Dimensions



Sierra Monitor Corporation
1991 Tarob Court, Milpitas, California 95035 USA
O. +1 408 262-6611 TF: +1 800 72 SIERRA (74377) F. +1 408 262-9042 www.sierramonitor.com

# Generator set control PowerCommand® MCM3320



**> Specification sheet**

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## Description

The PowerCommand® Master Control Module (MCM3320) is a microprocessor-based system control component that is optimized for use with PowerCommand Digital Paralleling genset controls. The MCM3320 integrates master functions into a single control system, providing enhanced reliability and performance compared to conventional control systems.

The MCM3320 is configurable for a number of different operating arrangements. A Power Transfer Control function provides load transfer operation in open transition, closed transition or soft (ramping) transfer modes in a similar fashion to automatic transfer switch controls. The control includes extended parallel/peak shave functions. System topologies supported include transfer pair, common bus (no gen main breaker) and isolated bus with and without logically controlled generator main.

The MCM3320 will directly read AC voltages up to 480 VAC, and can be configured for any frequency, voltage and power connection configuration from 110 to 35,000 VAC.

The MCM3320 is designed for switchgear mounting, but is environmentally protected for operation in severe applications.

Control power for the MCM3320 is typically derived from the generator set starting batteries. The module can be connected to two independent DC sources for redundancy. The control functions over a voltage range from 9 VDC to 32 VDC and requires less than 1 amp for operation.

PowerCommand controls are supported by a worldwide network of independent distributors who provide parts, certified service and warranty support.

## Features

**Bus synchronizing** - Allows one or more gensets with PowerCommand digital paralleling controls operating on a common bus to be actively synchronized to another system bus. Synchronizing function provides for frequency/phase angle and voltage matching.

**Dual source bus AC metering** - Provides simultaneous metering of the genset bus and secondary bus for voltage, frequency, power and energy functions.

**Test mode** - Starts gensets with option to transfer the load to the genset bus (with load or without load test).

**Real time clock with scheduler** - Provides 12 programs and 6 exceptions for automatically initiating a test without load, test with load or a base load or peak shave session.

**Load demand** - Controls the number of generators sets operating to optimize system operating cost.

**Load add/shed control** - Provides signals to control remote loads so that bus overload is avoided on black start or due to system overloads while in operation.

**Sync check** - The sync check function has adjustments for phase angle window, voltage window, frequency window and time delay.

**Diagnostics** - A full suite of built-in diagnostics allows accurate and quick system troubleshooting.

**Modbus RTU Interface** - Allows easy system monitoring by many 3rd party devices.

**Optional operator panels** - Analog meter displays and auxiliary relay panels allow customization to meet specific site requirements with cost effective standard modules.

**Advanced serviceability** - Utilizing InPower™, a PC-based software service tool, as well as a comprehensive package of visual condition displays that are integrated onto the control board.

## Construction

The MCM3320 is a single board, potted control module that interfaces to external components through locking plug-in terminal blocks suitable for wiring up to 2.5 mm (12 ga).

## Status Indicators

The MCM3320 includes a series of integrated operator display functions.

On-board LEDs provides the following status indications:

- Control operating (green flashing)
- Utility connected (green)
- Utility available (green)
- Generator bus connected (amber)
- Generator bus available (amber)
- Common warning (amber)
- Not in auto (red flashing)
- Fail to synchronize (red)
- Synchronizing (green flashing)
- Sync check OK (green)

An on-board alphanumeric coded display provides the following status indications:

- Timing to start
- Timing to stop
- Timing program transition
- Timing to transfer
- Timing to retransfer
- Synchronizing
- OK to close
- Base load mode
- Peak shave mode
- Ramping load on
- Ramping load off
- Manual mode
- Standby mode
- Utility failed
- Test mode

The display also provides fault information to the user.

## Functions

**Bus synchronizing** - Control incorporates a digital master synchronizing function to force a bus of connected generator sets to match the frequency, phase and voltage of another source such as a utility grid. The synchronizer includes provisions for proper operation even with highly distorted bus voltage waveforms and will accommodate up to a minimum of 20 gensets. The synchronizer can match other sources over a range of 90-110% of nominal voltage and up to ±3 Hz and is configurable for units of measurement and has adjustable screen contrast and brightness.

The synchronizer function is configurable for slip frequency synchronizing for applications requiring a known direction of power flow at instant of breaker closure or for applications where phase synchronization performance is otherwise inadequate.

**Sync check** - The sync check function decides when permissive conditions have been met to allow breaker closure. Adjustable criteria are: phase difference from 0.1-20°, frequency difference from 0.001-1.0 Hz, voltage difference from 0.5-10% and a dwell time from 0.5-5.0 seconds. Internally, the sync check is used to perform closed transition operations. An external sync check output is also available. In Master Sync only applications, sync check can also be configured individually to activate in live-dead, dead-live and dead-dead bus conditions.

**Dual source bus AC metering** - The control provides comprehensive three phase AC metering functions for both monitored sources, including: 3-phase voltage (line to-line and line-to-neutral) and current, frequency, phase rotation, individual phase and totalized values of kW, kVar, kVA and power factor; totalized positive and negative kW-hours, kVar-hours and kVA-hours. Three wire or four wire voltage connection with direct sensing of voltages to 480 V, and up to 35 kV with external transformers. Current sensing is accomplished with either 5 amp or 1 CT secondaries and with up to 10,000 amps primary. Maximum power readings are 32,000 kW/kVar/kVA.

**Power transfer control** - Provides integrated automatic power transfer functions including source availability sensing, gensets start/stop and transfer pair monitoring and control. The transfer/retransfer is configurable for open transition, fast closed transition (less than 100 msec interconnect time) or soft closed transition (load ramping) sequences of operation. Utility source failure will automatically start gensets and transfer load, retransferring when utility source returns. Test will start gensets and transfer load if test with load is enabled.

**Sensors and timers include:**

Under voltage sensor: 3-phase L-N or L-L under voltage sensing adjustable for pickup from 85-100% of nominal. Dropout adjustable from 75-98% of pickup. Dropout delay adjustable from 0.1-30 sec

Over voltage sensor: 3-phase L-N or L-L over voltage sensing adjustable for pickup from 95-99% of dropout. Dropout adjustable from 105-135% of nominal. Dropout delay adjustable from 0.5-120 seconds. Standard configuration is disabled, and is configurable to enabled in the field using the optional operator panel or InPower service tools

Over/under frequency sensor: Center frequency adjustable from 45-65Hz. Dropout bandwidth adjustable from 0.3-5% of center frequency beyond pickup bandwidth. Pickup bandwidth adjustable from 0.3-20% of center frequency. Field configurable to enable

Loss of phase sensor: Detects out of range voltage phase angle relationship. Field configurable to enable

Phase rotation sensor: Checks for valid phase rotation of source. Field configurable to enable






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Breaker tripped: If the breaker tripped input is active, the associated source will be considered as unavailable

Genset online capacity sensor: Optionally enabled sensor. Use to require minimum kW capacity online before closing generator bus main breaker

Timers: Control provides adjustable start delay from 0-3600 sec, stop delay from 0-3600 sec, transfer delay from 0-120 sec, retransfer delay from 0-1800 sec, programmed transition delay from 0-60 sec and maximum parallel time from 0-1800 sec

**Breaker control** - Utility main and genset main breaker interfaces include separate relays for opening and closing breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics include contact failure, fail to close, fail to open, fail to disconnect and tripped. Upon breaker failure, appropriate control action is taken to maintain system integrity.

**Extended paralleling** - In extended paralleling mode (when enabled) the controller will start gensets and parallel to a utility source and then govern the real and reactive power output of the gensets based on the desired control point. Function will support up to 20 gensets with a total rating of up to 32000 kW. The control point for the real power (kW) can be configured for either the genset bus metering point ("base load") or the utility metering point ("peak shave"). The control point for the reactive power (kVar or power factor) can also be independently configured for either the genset bus metering point or the utility metering point. This flexibility would allow base kW load from the gensets while maintaining the utility power factor at a reasonable value to avoid penalties due to low power factor. The system always operates within genset ratings. The control point can be changed while the system is in operation. Set points can be adjusted via hardwired analog input or adjusted through an operator panel display or service tool.

**Scheduler** - The scheduler (when enabled) allows the system to be operated at preset times in either test without load, test with load, or extended parallel mode. A real time clock is built in. Up to 12 different programs can be set for day of week, time of day, duration, repeat interval and mode. For example, a test with load for 1 hour every Tuesday at 2 AM can be programmed. Up to 6 different exceptions can also be set up to block a program from running during a specific date and time period.

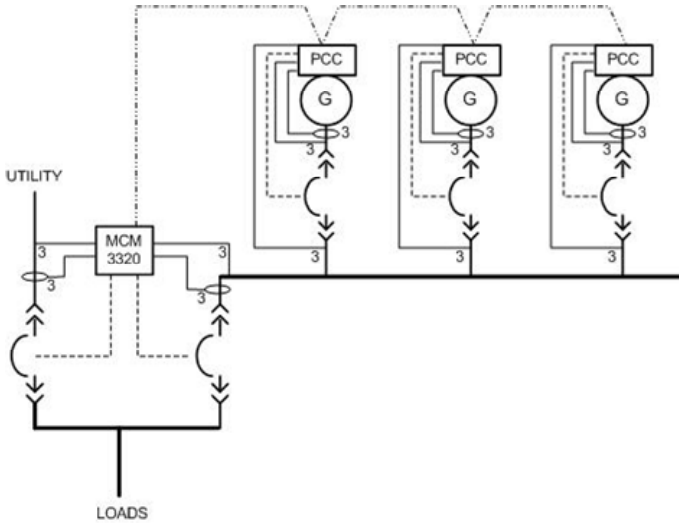
**Load demand** - Load demand (when enabled) will attempt to match generating capacity to load, typically for the conservation of fuel or optimizing of generator set life. The load demand function will support from 2 to 4 gensets. Shutdown sequence can either be a fixed sequence or can be based on running hours. With fixed sequence method, the sequence can be changed while the system is in operation. Running hours method will attempt to equalize genset hours over time by exchanging stopped and running gensets. To protect system integrity, load demand will restart all gensets whenever an overload condition is detected. The minimum amount of capacity to maintain online is adjustable. Initial delay for load demand to begin operation is adjustable from 1-60 minutes. Shutdown threshold is adjustable from 20-100% of online capacity minus one. Shutdown delay is adjustable from 1-60 minutes. Restart threshold is adjustable from 20-100% of online capacity. Run hours differential is adjustable from 1-500 hours.

**Load add/shed** - Load add and shed (when enabled) will control and monitor up to 6 load step levels (such as feeder breaker or automatic transfer switches) in any combination. Up to 6 levels of load add and up to 6 levels of load shed may be defined. The loads add/shed function will support up to 4 gensets. Loads can be added as gensets come online as well as on a timed basis. Loads are shed on a timed basis when an overload condition is detected, protecting system integrity. Shed loads can be restored through operator action. Manual load add and shed is also provided. Load add delay is adjustable from 1-60 sec. Load shed delay is adjustable from 1-10 sec.

**System topologies** - Controller is configured to operate in one of five possible system topologies.

These topologies can be used in combinations in larger systems with coordination by external device. Topologies that may be selected in the control include:

Transfer pair: System consists of a breaker pair - one a generator bus main and the other a utility main.




MCM3320 controls both breakers in open transition, fast closed transition or ramping closed transition modes. It can also be programmed to exercise the generator set bus in parallel with the utility or operate at a programmable output level.

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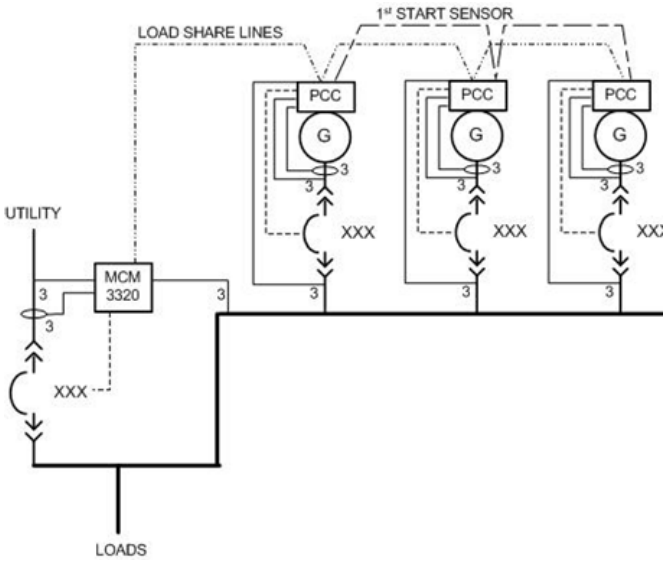
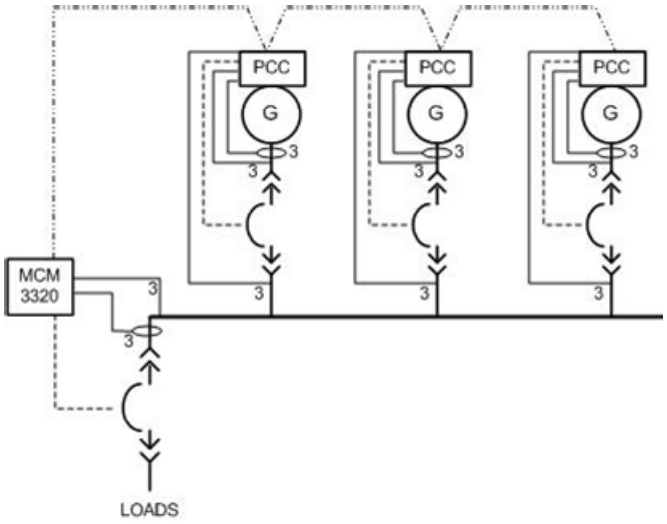
Common bus: system consists of a utility main breaker, but no genset main breaker (only individual genset paralleling breakers)




MCM3320 controls utility main breaker and genset paralleling breakers (via inhibit).

Isolated bus with or without gen main: System consists of an isolated bus and may include a genset main breaker. MCM3320 controls genset main breaker as a programmable function of bus capacity when required




Master synchronize only: controller will only perform metering, synchronizing, sync check and Modbus functions. Intended for use in systems where the only functions desired are metering and synchronizing

## Protective functions and diagnostics

**Data logging** - The control maintains a record of control operations, warning conditions and other events. Records are time stamped.

**Fault simulation mode** - The MCM3320 in conjunction with InPower software, will accept commands to allow a technician to verify the proper operation of the control and its interface by simulating failure modes or by forcing the control to operate outside of its normal operating ranges. InPower also provides a complete list of faults and settings for the protective functions provided by the controller.

**Protective functions** - PowerCommand provides the following system protective functions for each breaker or bus. Note that each protective function will cause the control to take intelligent corrective action to best resolve the problem until an operator can address it. See the Intelligent protective action section for details. Diagnostics can be mapped to any of 8 configurable low-side driver outputs for external use such as driving relays, lamps or as signals to other system devices.

Breaker fail to close warning: When the MCM3320 signals a circuit breaker to close, it will monitor the breaker auxiliary contacts and verify that the breaker has closed. If the control does not sense a breaker closure within an adjustable time period after the close signal, the fail to close warning will be initiated.

Breaker position contact warning: The controller will monitor both 'a' and 'b' position contacts from the breaker. If the contacts disagree as to the breaker position, the breaker position contact warning will be initiated.

Breaker fail to open warning: The control system monitors the operation of breakers that have been signaled to open. If the breaker does not open within an adjustable time delay, a *breaker fail to open* warning is initiated.

Breaker tripped warning: The control accepts inputs to monitor breaker trip/bell alarm contact and will initiate a breaker tripped warning if it should activate.

Fail to disconnect warning: If the controller is unable to open either breaker, a fail to disconnect warning is initiated. Typically this would be mapped to a configurable output, allowing an external device to trip a breaker.

Fail to synchronize warning: Indicates that the generator set bus could not be brought to synchronization with the system bus. Configurable for adjustable, time delay of 10-120 seconds.

Bus overload warning: The control monitors genset bus load relative to the online capacity. It also monitors bus frequency. On a configurable basis, control will initiate a bus overload warning if the bus kW load exceeds an adjustable threshold (80-140%) for an adjustable delay (0-120 s) or the bus frequency falls below an adjustable threshold (0.1-10 Hz) for an adjustable delay (0-20 s). Option to select either or both kW and frequency as triggers.

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Maximum parallel time warning: During closed transition load transfers, control independently monitors paralleled time. If time is exceeded, warning is initiated and genset bus is disconnected.

## Intelligent protective action

When abnormal situations are diagnosed by the control, it will provide as much corrective action as possible to keep the system operating.

**Utility main breaker fail to close warning** - Control will start the gensets and transfer load to the genset bus and remain there until operator resets the fault condition and resolves the problem.

**Genset main breaker fail to close warning** - Control will return to the utility source and will not retry until operator resets the fault condition and resolves the problem.

**Breaker position contact warning** - Control will check for current above a threshold on all 3 phases. If criteria is met, control will remain on the source. If not, control will attempt to transfer to other source.

**Fail to synchronize warning** - If control is trying to perform a closed transition retransfer, but fail to sync occurs, optionally, the control can be configured to perform the retransfer using open transition.

## Control interface

### Inputs

**Synchronize enable** - manual mode sync on/off.
**Utility source failure** - use with external protective relay.
**Transfer inhibit** - prevents transfer to gensets.
**Retransfer Inhibit** - prevents retransfer to utility*.
**Override** - overrides delays and transfer/retransfer inhibit.
**Manual** - prevents automatic breaker operation.
**Test** - initiates a test (with or without load as configured).
**Extended parallel** - initiates a base load or peak shave.
**Reset faults** - resets latched faults.
**Main breaker positions (2/4)** - 'a' or 'a/b' position inputs.
**Main breaker tripped (2)** - from breaker bell alarm.
**Main breaker inhibits (2)** - open/inhibit close of breakers.
**Genset breaker positions (4)** - monitor gensets online.
**KiloWatt set point** - 0-5 V for base load/peak shave.
**kVar/PF set point** - 0-5 V for kVar or power factor.
**3-phase voltages (2)** - 3 or 4 wire voltage sensing.
**3-phase currents (2)** - 5 amp or 1 amp scale.

* Except in case of genset bus failure.

### Outputs

**Configurable customer outputs** - Control includes (8) output signals (low-side relay drivers) for use by external equipment. These may be mapped to any control warning or event. Defaults settings are: common warning, fail to sync, gen bus available, util bus available, fail to disconnect, sync check OK, sync output limit and hardware failure. External relays can be powered from control.

**Generator set signals** - For each generator set in the system, the control provides start command, load demand, load govern enable, paralleling breaker inhibit and fuel rate and excitation control signals.

**Genset main and utility main breaker interfaces** - Dedicated separate relays are provided for breaker open and breaker close circuits.

## Network connections

**Serial interface** - This communication port allows the control to communicate with a personal computer running InPower service and maintenance software.

**Modbus RTU interface** - Provides a standard register map of system data, for use in monitoring by a remote device. Controller is a Modbus RTU slave device capable of communication on either RS232 or RS485. Modbus address is configurable allowing multiple MCM3320 slaves on a single RS485 bus. Baud rates up to 19200 are supported. A complete array of system control, adjustments and monitoring data are available and are documented in a published register map.

**PCCNet** - Proprietary serial interface to operator panel displays, auxiliary IO module and bar graph displays.

## Optional remote inputs/outputs

To utilize the load add and load shed feature, the AUX101 and AUX102 modules are required. These modules provide the relay outputs and switch position inputs for controlling and monitoring up to 6 sets of load feeder breakers or 6 sets of transfer switches. The modules communicate with the MCM3320 over PCCNet.

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## Optional Operator Interface (HMI211)


The control is available with an optional operator panel that may be either locally or remotely mounted. Up to two panels may be used with a single MCM3320 control. The display is composed of a backlit LCD display, with a series of 6 status LED lamps. The display is accompanied by six tactile-feel membrane switches that are used by the operator to navigate through menus for system control, monitoring and adjustments. A main screen one-line diagram with AC data gives a quick overview of current system status. Control and adjustments are password protected. The graphical display is capable of displaying up to 9 lines of data with approximately 27 characters per line. It is adjustable for screen contrast and brightness.

**LED indicating lamps** - The optional display panel includes LED indicating lamps for the following functions:

- Utility parallel
- Lockout
- Warning
- Remote start
- Auto
- Manual

**Home screen** - The home screen provides information in a one-line format relevant to the current system operating state. Information includes source availability, source connected status, voltage, frequency and power data. Faults can also be reset from the home screen.

**System status** - The top line provides the current system status as well as countdown of any timer that is currently in effect such as a retransfer timer.

**System control** - The control menus allow initiating a test, base load, or peak shave operation as well as easy access to adjustments for relevant operating set points.

**Adjustments** - The adjustment screens allow complete configuring, setup and fine tuning of the controller settings.

**Monitoring** - The monitor screens provide organized access to all controller data ranging from AC data, to load demand status information, to breaker position information, to analog and discrete input and output readings.

**Faults** - Diagnostics pop up on the display when they occur and can be acknowledged with a single key press. Fault history information can be viewed through the menu navigation.

## Optional bar graph interface (HMI112)


The control is available with optional bar graph displays. Two displays are used with one MCM3320 control. One bar graph will be dedicated to the utility source, and the other to the genset bus. Bar graphs provide the following readings for each source:

- L1 current percent
- L2 current percent
- L3 current percent
- Total kW percent
- Power factor
- Frequency percent
- L1 L2 voltage percent
- L2 L3 voltage percent
- L3 L1 voltage percent
- Load add/shed modules

## Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and for storage from -40 °C to +80 °C (-40 °C to +176 °C). Control will operate with humidity up to 95% non-condensing and at altitudes up to 5000 m (13,000 ft).

The control system is specifically designed for resistance to RFI/EMI, and to resist the effects of vibration to provide a long reliable life when installed in harsh environment. The control includes transient voltage surge suppression to provide compliance to referenced standards.

The optional display panel is designed for proper operation in ambient temperatures from -20 °C to +70 °C (-4 °F to +158 °F) and for storage from -30 °C to +80 °C (-22 °F to +176 °F).

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## Certifications

PowerCommand SYNC1320 meets or exceeds the requirements of the following codes and standards:

**UL508 recognized**
**CE Mark**
**EN 61000-6-2**
**EN 61000-6-4**
**ISO 7637, pulses #2, 3a, 3b, 5, 7**
**ISO9001** - PowerCommand control systems are designed and manufactured in ISO9001 certified facilities.

## Software

InPower is a PC-based software service tool that is designed to directly communicate to PowerCommand products to facilitate setup, service and monitoring of these products.

## Part numbers

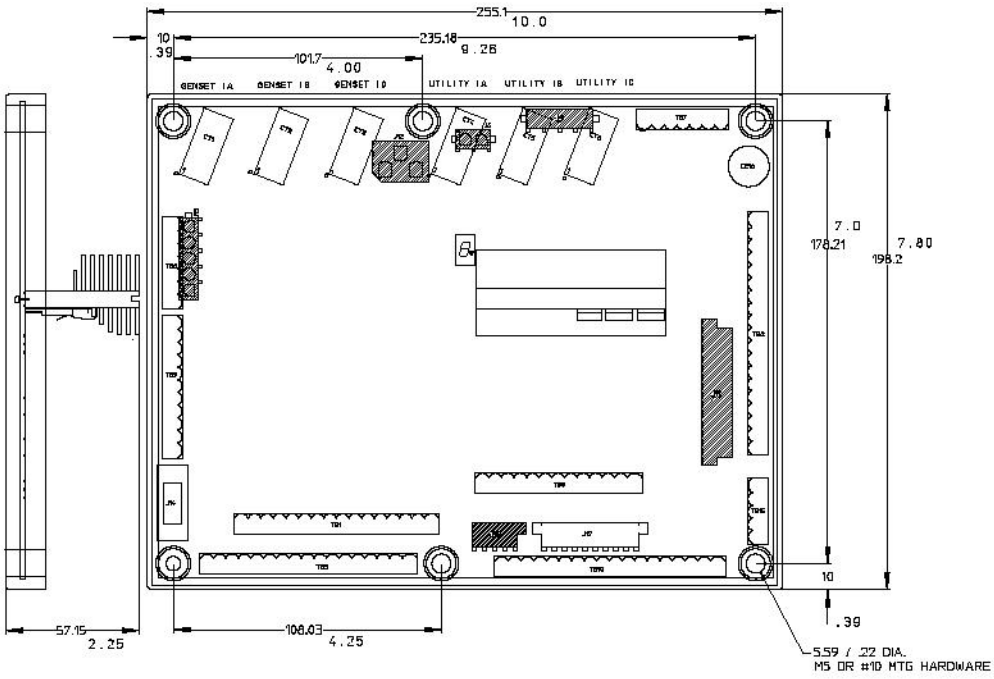
| | |
|---|---|
| MCM3320 (control) | 0327-1520-01 |
| HMI211 (operator panel) | 0300-6090 |
| Operator panel harness | 0338-4747 |
| HMI112 (bar graph) | 0300-6050-01 |
| AUX101/2 (load add shed) | 0541-1342 |
| Interconnect wiring diagram | 0630-3133 |

## Warranty

PowerCommand control systems are a part of complete power systems provided by Cummins Power Generation, and are covered by a one-year limited warranty as a standard feature.

Extended warranty options are available for coverage up to 10 years.

## Dimensions




PCCNet COMPATIBLE


**Cummins Power Generation**

**Americas**
1400 73rd Avenue N.E.
Minneapolis, MN 55432 USA
Phone: 763 574 5000
Fax: 763 574 5298

**Europe, CIS, Middle East and Africa**
Manston Park Columbus Ave.
Manston Ramsgate
Kent CT 12 5BF United Kingdom
Phone 44 1843 255000
Fax 44 1843 255902

**Asia Pacific**
10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838
Phone 65 6417 2388
Fax 65 6417 2399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# Industrial Ethernet Switch - FL SWITCH 1016N

1085255

https://www.phoenixcontact.com/us/products/1085255

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Narrow Ethernet switch, sixteen RJ45 ports with 10/100 Mbps on all ports, automatic data transmission speed detection, autocrossing function, and QoS

## Your advantages

- QoS-prioritized (Quality of Service) messages
- RJ45 ports support a transmission speed of 10/100 Mbps
- Local diagnostic indicators with LEDs
- PROFINET PTCP filter for reliable communication on PROFINET networks
- Enhanced traffic prioritization for automation protocols
- Energy-efficient Ethernet in accord. with IEEE 802.3az
- PROFINET Conformance Class A for real-time data exchange
- Auto negotiation and autocrossing detection simplifies installation and setup

## Commercial Data

| | |
|---|---|
| Item number | 1085255 |
| Packing unit | 1 pc |
| Sales Key | D15 |
| Product Key | DNN116 |
| GTIN | 4055626835037 |
| Weight per Piece (including packing) | 350 g |
| Weight per Piece (excluding packing) | 266 g |
| Customs tariff number | 85176200 |
| Country of origin | TW |

# Technical Data

## Dimensions

| | |
|---|---|
| Width | 40 mm |
| Height | 140.4 mm |
| Depth | 92.4 mm |

## Notes

Utilization restriction

| | |
|---|---|
| EMC note | EMC: class A product, see manufacturer's declaration in the download area |

## Material specifications

| | |
|---|---|
| Housing material | Polycarbonate fiber reinforced |

## Mounting

| | |
|---|---|
| Mounting type | DIN rail mounting |

## Interfaces

Ethernet (RJ45)

| | |
|---|---|
| Number of interfaces | 16 |
| Connection method | RJ45 |
| Note on the connection method | Auto negotiation and autocrossing |
| Transmission speed | 10/100 Mbps |
| Transmission physics | Ethernet in RJ45 twisted pair |
| Transmission length | 100 m (per segment) |
| Signal LEDs | Data receive, link status |
| No. of channels | 16 (RJ45 ports) |

## Product properties

| | |
|---|---|
| Product type | Switch |
| MTTF | 63.7 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%) |
| | 729 Years (SN 29500 standard, temperature 25°C, operating cycle 21%) |
| | 639 Years (Telcordia standard, 25°C temperature, 21% operating cycle (5 days a week, 8 hours a day)) |

Switch functions

| | |
|---|---|
| Basic functions | Unmanaged switch |
| | Autonegotiation |
| | Store and Forward switching mode |
| PROFINET conformance class | Conformance-Class A |
| MAC address table | 8k |

| | |
|---|---|
| Status and diagnostic indicators | LEDs: $U_S$, link and activity per port |
| Additional functions | 100 BASE-TX/100BASE-FX (IEEE 802.3u) |
| | Quality of Service (QoS) prioritization (IEEE 802.1p) |
| | Energy-efficient Ethernet (IEEE 802.3az) |
| | 10Base-T (IEEE 802.3) |

Security functions

| | |
|---|---|
| Basic functions | Unmanaged switch |
| | Autonegotiation |
| | Store and Forward switching mode |

## Electrical properties

| | |
|---|---|
| Transmission medium | Copper |

Supply

| | |
|---|---|
| Supply voltage | 24 V |
| | 24 V AC (50/60 Hz) |
| Supply voltage range | 9 V DC ... 32 V DC |
| | 18 V AC ... 30 V AC (50/60 Hz) |
| Power supply connection | Via COMBICON, max. conductor cross section 2.5 mm² |
| Residual ripple | 3.6 $V_{PP}$ (within the permitted voltage range) |
| Max. current consumption | 266 mA (at 9 V DC) |
| Typical current consumption | 68 mA (at 24 V DC) |

## Connection data

| | |
|---|---|
| Connection method | Push-in spring connection |
| Conductor cross section, rigid | 0.2 mm² ... 2.5 mm² |
| Conductor cross section flexible, with ferrule without plastic sleeve | 0.25 mm² ... 2.5 mm² |
| Stripping length | 10 mm |

## Ambient conditions

| | |
|---|---|
| Degree of protection | IP30 |
| Ambient temperature (operation) | -10 °C ... 60 °C |
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
| Altitude | 2000 m (maximum) |
| Permissible humidity (operation) | 5 % ... 95 % (non-condensing) |
| Permissible humidity (storage/transport) | 5 % ... 95 % (non-condensing) |
| Shock (operation) | 30g (EN 60068-2-27) |
| Vibration (operation) | in acc. with IEC 60068-2-6: 5g, 150 Hz |
| Air pressure (operation) | 79 kPa ... 108 kPa up to 2000 m above mean sea level (Without derating) |
| Air pressure (storage/transport) | 79 kPa ... 108 kPa up to 2000 m above mean sea level (Without derating) |

## Approval data

Conformity/Approvals

| | |
|---|---|
| Conformance | CE-compliant |
| UL, USA / Canada | UL 61010-1, UL 61010-2-201<br>Class I, Div. 2, Groups A, B, C, D, T4<br>Class I, Zone 2, Group IIC, T4 |

## EMC data

| | |
|---|---|
| Conformance with EMC directives | EN 61000-6-2 EN 61000-4-2 (ESD) Criterion B |
| | EN 61000-6-2 EN 61000-4-3 (electromagnetic fields) Criterion A |
| | EN 61000-6-2 EN 61000-4-4 (EFT burst) Criterion A |
| | EN 61000-6-2 EN 61000-4-5 (surge) Criterion B |
| | EN 61000-6-2 EN 61000-4-6 (line noise immunity) Criterion A |
| | EN 61000-6-2 EN 61000-4-8 (electromagnetic fields) Criterion A |
| | EN 61000-6-2 Class A |
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |
| Noise emission | EN 61000-6-4:2007 + A1:2011 |
| Noise immunity | EN 61000-6-2:2005 |

## LED signaling

| | |
|---|---|
| Status display | LEDs: $U_S$, link and activity per port |



Phoenix Contact USA
586 Fulling Mill Road
Middletown, PA 17057, United States
(+717) 944-1300
info@phoenixcon.com

# Power supply unit - QUINT-PS/1AC/24DC/10

2866763

https://www.phoenixcontact.com/us/products/2866763

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Primary-switched power supply unit, QUINT POWER, Screw connection, DIN rail mounting, SFB Technology (Selective Fuse Breaking), input: 1-phase, output: 24 V DC / 10 A

## Product Description

QUINT POWER power supplies with maximum functionality
QUINT POWER circuit breakers magnetically and therefore quickly trip at six times the nominal current, for selective and therefore cost-effective system protection. The high level of system availability is additionally ensured, thanks to preventive function monitoring, as it reports critical operating states before errors occur.
Reliable starting of heavy loads takes place via the static power reserve POWER BOOST. Thanks to the adjustable voltage, all ranges between 5 V DC ... 56 V DC are covered.

## Your advantages

- Reliable starting of difficult loads with the static POWER BOOST power reserve with up to 1.5 times the nominal current permanently
- Fast tripping of standard circuit breakers with dynamic power reserve SFB (selective fuse breaking) technology with up to 6 times the nominal current for 12 ms
- For superior system availability
- Preventive function monitoring

## Commercial Data

| | |
|---|---|
| Item number | 2866763 |
| Packing unit | 1 pc |
| Minimum order quantity | 1 pc |
| Sales Key | C14 |
| Product Key | CMPQ13 |
| Catalog Page | Page 159 (C-6-2015) |
| GTIN | 4046356113793 |
| Weight per Piece (including packing) | 1,497 g |
| Weight per Piece (excluding packing) | 1,100 g |
| Customs tariff number | 85044030 |
| Country of origin | TH |

# Technical Data

## Input data

AC operation

| | |
|---|---|
| Nominal input voltage range | 100 V AC ... 240 V AC |
| | 110 V DC ... 250 V DC |
| Input voltage range | 85 V AC ... 264 V AC |
| | 90 V DC ... 350 V DC (UL 508: ≤ 300 V DC) |
| Input voltage range AC | 85 V AC ... 264 V AC |
| Input voltage range DC | 90 V DC ... 350 V DC (UL 508: ≤ 300 V DC) |
| Electric strength, max. | 300 V AC |
| Voltage type of supply voltage | AC/DC |
| Inrush current | < 15 A |
| Inrush current integral ($I^2t$) | < 1.5 $A^2s$ |
| AC frequency range | 45 Hz ... 65 Hz |
| Frequency range DC | 0 Hz |
| Mains buffering time | > 36 ms (120 V AC) |
| | > 36 ms (230 V AC) |
| Current consumption | 2.2 A (120 V AC) |
| | 1.3 A (230 V AC) |
| | 2.5 A (110 V DC) |
| | 1.2 A (220 V DC) |
| Nominal power consumption | 302 VA |
| Protective circuit | Transient surge protection; Varistor, gas-filled surge arrester |
| Power factor (cos phi) | 0.85 |
| Typical response time | < 0.15 s |
| Input fuse | 10 A (slow-blow, internal) |
| Permissible backup fuse | B10 B16 AC: |
| Permissible DC backup fuse | DC: Connect a suitable fuse upstream |
| Recommended breaker for input protection | 10 A ... 20 A (AC: Characteristics B, C, D, K) |
| Discharge current to PE | < 3.5 mA |

## Output data

| | |
|---|---|
| Efficiency | > 92.5 % (for 230 V AC and nominal values) |
| Output characteristic | U/I |
| Nominal output voltage | 24 V DC ±1 % |
| Setting range of the output voltage ($U_{Set}$) | 18 V DC ... 29.5 V DC (> 24 V DC, constant capacity restricted) |
| Nominal output current ($I_N$) | 10 A (-25 °C ... 60 °C, $U_{OUT}$ = 24 V DC) |
| POWER BOOST ($I_{Boost}$) | 15 A (-25 °C ... 40 °C permanent, $U_{OUT}$ = 24 V DC ) |
| Selective Fuse Breaking ($I_{SFB}$) | 60 A (12 ms) |
| Magnetic circuit breaker tripping | B2 / B4 / B6 / C2 / C4 |
| Derating | 60 °C ... 70 °C (2.5%/K) |
| Feedback voltage resistance | max. 35 V DC |

| | |
|---|---|
| Protection against overvoltage at the output (OVP) | < 35 V DC |
| Control deviation | < 1 % (change in load, static 10 % ... 90 %) |
| | < 2 % (change in load, dynamic 10 % ... 90 %) |
| | < 0.1 % (change in input voltage ±10 %) |
| Residual ripple | < 50 $mV_{PP}$ (with nominal values) |
| Short-circuit-proof | yes |
| Output power | 240 W |
| Maximum no-load power dissipation | 9.1 W |
| Power loss nominal load max. | 22 W |
| Rise time | < 0.05 s ($U_{OUT}$ (10 % ... 90 %)) |
| Connection in parallel | yes, for redundancy and increased capacity |
| Connection in series | yes |

Signal: DC OK active

| | |
|---|---|
| Output description | $U_{OUT}$ > 0.9 x $U_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Maximum inrush current | ≤ 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

Signal: DC OK floating

| | |
|---|---|
| Output description | Relay contact, $U_{OUT}$ > 0.9 x $U_N$: Contact closed |
| Maximum switching voltage | 30 V AC |
| | 24 V DC |
| Maximum inrush current | 0.5 A |
| | 1 A |
| Continuous load current | ≤ 1 A |

Signal: POWER BOOST, active

| | |
|---|---|
| Output description | $I_{OUT}$ < $I_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Output voltage | + 24 V DC |
| Maximum inrush current | 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

Signal: DC OK active

| | |
|---|---|
| Output description | $U_{OUT}$ > 0.9 x $U_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Maximum inrush current | ≤ 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

Signal: DC OK floating

| | |
|---|---|
| Output description | Relay contact, $U_{OUT}$ > 0.9 x $U_N$: Contact closed |
| Maximum switching voltage | 30 V AC |
| | 24 V DC |
| Maximum inrush current | 0.5 A |
| | 1 A |

| | |
|---|---|
| Continuous load current | ≤ 1 A |

Signal: POWER BOOST, active

| | |
|---|---|
| Output description | $I_{OUT}$ < $I_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Output voltage | + 24 V DC |
| Maximum inrush current | 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

Signal: DC OK active

| | |
|---|---|
| Output description | $U_{OUT}$ > 0.9 x $U_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Maximum inrush current | ≤ 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

Signal: DC OK floating

| | |
|---|---|
| Output description | Relay contact, $U_{OUT}$ > 0.9 x $U_N$: Contact closed |
| Maximum switching voltage | 30 V AC |
| | 24 V DC |
| Maximum inrush current | 0.5 A |
| | 1 A |
| Continuous load current | ≤ 1 A |

Signal: POWER BOOST, active

| | |
|---|---|
| Output description | $I_{OUT}$ < $I_N$: High signal |
| Switching voltage range | 18 V DC ... 24 V DC |
| Output voltage | + 24 V DC |
| Maximum inrush current | 20 mA (short-circuit-proof) |
| Continuous load current | ≤ 20 mA |

## Connection data

Input

| | |
|---|---|
| Connection method | Screw connection |
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 16 |
| Conductor cross section AWG max. | 12 |
| Stripping length | 7 mm |
| Screw thread | M3 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

Output

| | |
|---|---|
| Connection method | Screw connection |

| | |
|---|---|
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 16 |
| Conductor cross section AWG max. | 12 |
| Stripping length | 7 mm |
| Screw thread | M3 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

Signal

| | |
|---|---|
| Connection method | Screw connection |
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 16 |
| Conductor cross section AWG max. | 12 |
| Screw thread | M3 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

## LED signaling

| | |
|---|---|
| Types of signaling | LED |
| | Active switching output |
| | Relay contact |

Signal output: DC OK active

| | |
|---|---|
| Status display | $U_{OUT}$ > 0.9 x $U_N$: "DC OK" LED green |
| Note on status display | $U_{OUT}$ < 0.9 x $U_N$: Flashing "DC OK" LED |
| | $I_{OUT}$ < $I_N$: LED ON |

Signal output: DC OK floating

| | |
|---|---|
| Status display | $U_{OUT}$ > 0.9 x $U_N$: "DC OK" LED green |
| Note on status display | $U_{OUT}$ < 0.9 x $U_N$: Flashing "DC OK" LED |

Signal output: POWER BOOST, active

| | |
|---|---|
| Status display | $I_{OUT}$ > $I_N$: LED "BOOST" yellow |

## Electrical properties

| | |
|---|---|
| Number of phases | 1.00 |
| Insulation voltage input/output | 4 kV AC (type test) |
| | 2 kV AC (routine test) |
| Insulation voltage output / PE | 500 V DC (routine test) |
| Insulation voltage input / PE | 3.5 kV AC (type test) |

| | |
|---|---|
| | 2 kV AC (routine test) |

## Product properties

| | |
|---|---|
| Product type | Power supply |
| MTBF (IEC 61709, SN 29500) | > 940000 h (25 °C) |
| | > 530000 h (40 °C) |
| | > 230000 h (60 °C) |

### Insulation characteristics

| | |
|---|---|
| Protection class | I |
| Degree of pollution | 2 |

## Dimensions

| | |
|---|---|
| Width | 60 mm |
| Height | 130 mm |
| Depth | 125 mm |

### Installation dimensions

| | |
|---|---|
| Installation distance right/left | 5 mm / 5 mm |
| Installation distance top/bottom | 50 mm / 50 mm |

### Alternative assembly

| | |
|---|---|
| Width | 122 mm |
| Height | 130 mm |
| Depth | 63 mm |

## Mounting

| | |
|---|---|
| Mounting type | DIN rail mounting |
| Assembly instructions | alignable: $P_N$ ≥50%, 5 mm horizontally, 15 mm next to active components, 50 mm vertically<br>alignable: $P_N$ <50%, 0 mm horizontally, 40 mm vertically top, 20 mm vertically bottom |
| Mounting position | horizontal DIN rail NS 35, EN 60715 |
| With protective coating | No |

## Material specifications

| | |
|---|---|
| Housing material | Metal |
| Hood version | Galvanized sheet steel, free from chrome (VI) |
| Side element version | Aluminum |

## Environmental and real-life conditions

### Ambient conditions

| | |
|---|---|
| Degree of protection | IP20 |
| Ambient temperature (operation) | -25 °C ... 70 °C (> 60 °C Derating: 2,5 %/K) |
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
| Ambient temperature (start-up type tested) | -40 °C |

| | |
|---|---|
| Maximum altitude | 5000 m |
| Climatic class | 3K3 (in acc. with EN 60721) |
| Max. permissible relative humidity (operation) | ≤ 95 % (at 25 °C, non-condensing) |
| Shock | 18 ms, 30g, in each space direction (according to IEC 60068-2-27) |
| Vibration (operation) | < 15 Hz, amplitude ±2.5 mm (according to IEC 60068-2-6) |
| | 15 Hz ... 150 Hz, 2.3g, 90 min. |

## Standards and regulations

| | |
|---|---|
| Rail applications | EN 50121-4 |
| | EN 50121-3-2 |
| HART FSK Physical Layer Test Specification Compliance | Output voltage $U_{Out}$ compliant |
| Standard – Limitation of mains harmonic currents | EN 61000-3-2 |
| Standard - Electrical safety | IEC 61010-2-201 (SELV) |
| Standard - Equipment safety | BG (design tested) |
| Standard - Approval for medical use | IEC 60601-1, 2 x MOOP |
| Standard – Safety extra-low voltage | IEC 61010-1 (SELV) |
| | IEC 61010-2-201 (PELV) |
| Standard - Safe isolation | IEC 61010-2-201 |
| Standard - safety for equipment for measurement, control, and laboratory use | IEC 61010-1 |
| Approval - requirement of the semiconductor industry with regard to mains voltage dips | SEMI F47-0706 Compliance Certificate |
| DeviceNet approval | DeviceNet™ Power Supply Conformance Tested |

Overvoltage category

| | |
|---|---|
| EN 62477-1 | III |

## Approval data

| | |
|---|---|
| CSA | CAN/CSA-C22.2 No. 60950-1-07 |
| | CSA-C22.2 No. 107.1-01 |
| Shipbuilding approval | DNV GL (EMC B), ABS, LR, RINA, NK, BV |
| SIQ | BG (type approved) |
| UL approvals | UL Listed UL 508 |
| | UL/C-UL Recognized UL 60950-1 |
| | UL ANSI/ISA-12.12.01 Class I, Division 2, Groups A, B, C, D (Hazardous Location) |
| DeviceNet approval | DeviceNet™ Power Supply Conformance Tested |

Conformity/Approvals

| | |
|---|---|
| SIL in accordance with IEC 61508 | 0 |

## EMC data

| | |
|---|---|
| Low Voltage Directive | Conformance with Low Voltage Directive 2014/35/EC |
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |
| EMC requirements for noise emission | EN 61000-6-3 |

| | |
|---|---|
| | EN 61000-6-4 |
| EMC requirements for noise immunity | EN 61000-6-1 |
| | EN 61000-6-2 |
| Noise immunity | EN 61000-6-2 |

Electrostatic discharge

| | |
|---|---|
| Standards/regulations | EN 61000-4-2 |

Electrostatic discharge

| | |
|---|---|
| Contact discharge | 8 kV (Test Level 4) |
| Discharge in air | 15 kV (Test Level 4) |
| Comments | Criterion A |

Electromagnetic HF field

| | |
|---|---|
| Standards/regulations | EN 61000-4-3 |

Electromagnetic HF field

| | |
|---|---|
| Frequency range | 80 MHz ... 1 GHz |
| Test field strength | 20 V/m (Test Level 3) |
| Frequency range | 1 GHz ... 2 GHz |
| Test field strength | 10 V/m (Test Level 3) |
| Frequency range | 2 GHz ... 3 GHz |
| Test field strength | 10 V/m (Test Level 3) |
| Comments | Criterion A |

Fast transients (burst)

| | |
|---|---|
| Standards/regulations | EN 61000-4-4 |

Fast transients (burst)

| | |
|---|---|
| Input | 4 kV (Test Level 4 - asymmetrical) |
| Output | 2 kV (Test Level 3 - asymmetrical) |
| Signal | 2 kV (Test Level 4 - asymmetrical) |
| Comments | Criterion A |

Surge voltage load (surge)

| | |
|---|---|
| Standards/regulations | EN 61000-4-5 |
| Input | 2 kV (Test Level 3 - symmetrical) |
| | 4 kV (Test Level 4 - asymmetrical) |
| Output | 1 kV (Test Level 2 - symmetrical) |
| | 2 kV (Test Level 3 - asymmetrical) |
| Signal | 1 kV (Test Level 2 - asymmetrical) |
| Comments | Criterion B |

Conducted interference

| | |
|---|---|
| Standards/regulations | EN 61000-4-6 |

Conducted interference

| | |
|---|---|
| I/O/S | asymmetrical |

| | |
|---|---|
| Frequency range | 0.15 MHz ... 80 MHz |
| Comments | Criterion A |
| Voltage | 10 V (Test Level 3) |

Emitted interference

| | |
|---|---|
| Standards/regulations | EN 61000-6-3 |
| Radio interference voltage in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |
| Emitted radio interference in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |
| Criterion A | Normal operating behavior within the specified limits. |
| Criterion B | Temporary impairment to operational behavior that is corrected by the device itself. |




Phoenix Contact USA
586 Fulling Mill Road
Middletown, PA 17057, United States
(+717) 944-1300
info@phoenixcon.com

# Uninterruptible power supply - QUINT-UPS/ 24DC/ 24DC/10

2320225

https://www.phoenixcontact.com/us/products/2320225

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Uninterruptible power supply with IQ technology for DIN rail mounting, input: 24 V DC, output: 24 V DC/10 A, including mounted universal DIN rail adapter UTA 107/30

## Product Description

The UPS module for 24 V DC with output currents ranging from 5 to 40 A allows you to create a custom solution combining a power supply, UPS module, and energy storage.

## Your advantages

- Easy handling thanks to automatic battery detection, tool-free battery replacement during operation, and communication via the IFS interface
- Optimum use of the buffer time and preventive monitoring of the energy storage
- Rapid battery charging
- Comprehensive signaling and parameterization
- Fast tripping of standard circuit breakers with SFB (selective fuse breaking) technology
- Reliable starting of difficult loads with the static POWER BOOST power reserve with up to 1.5 times the nominal current permanently

## Commercial Data

| | |
|---|---|
| Item number | 2320225 |
| Packing unit | 1 pc |
| Minimum order quantity | 1 pc |
| Sales Key | C17 |
| Product Key | CMUQ43 |
| Catalog Page | Page 275 (C-4-2017) |
| GTIN | 4046356554206 |
| Weight per Piece (including packing) | 637.7 g |
| Weight per Piece (excluding packing) | 500 g |
| Customs tariff number | 85371091 |
| Country of origin | CN |

## Technical Data

### Input data

DC operation

| | |
|---|---|
| Input voltage | 24 V DC |
| Nominal input voltage range | 24 V DC |
| Input voltage range | 18 V DC ... 30 V DC |
| Input voltage range DC | 18 V DC ... 30 V DC |
| Voltage type of supply voltage | DC |
| Buffer period | 3 h (With battery module 38 AH) |
| Current consumption | 19 A (maximum, mains operation) |
| | 10.4 mA (No load, mains operation) |
| | 4 A (Charging, mains operation) |
| Fixed backup threshold | ≤ 22 V DC |
| Variable connect threshold | 1 V/0.1 s |

### Output data

| | |
|---|---|
| Efficiency | > 98 % (Mains operation, with charged energy storage) |
| | > 98 % (Battery operation) |
| Nominal output voltage | 24 V DC |
| Output voltage range | 18 V DC ... 30 V DC |
| Nominal output current ($I_N$) | 10 A (-25 °C ... 50 °C) |
| Output current limit | In mains mode according to connected upstream current limiting device |
| | > 15 A (Battery operation) |
| Bridging time | 10800 s |
| Derating | 60 °C ... 70 °C (2.5%/K) |
| | 60 °C ... 70 °C (2.5%/K) |
| Output power | 240 W |
| Power dissipation | 2.6 W (Mains operation) |
| | 4.6 W (Mains operation) |
| | 2.9 W (Battery operation) |
| | 5.27 W (Battery operation) |
| Connection in parallel | yes, up to 2 modules with redundancy module |
| Connection in parallel | 2 (Devices) |
| Connection in series | No |
| Connection in series | no |

Mains operation

| | |
|---|---|
| Nominal output voltage | 24 V DC |
| Output voltage range | 18 V DC ... 30 V DC |
| Nominal output current ($I_N$) | 10 A (-25 °C ... 60 °C) |
| POWER BOOST ($I_{Boost}$) | 15 A (-25°C ... 40°C) |

| | |
|---|---|
| Selective Fuse Breaking ($I_{SFB}$) | 60 A (-25 °C ... 60 °C) |
| Duration | 12 ms (SFB technology) |

Battery operation

| | |
|---|---|
| Nominal output voltage | 24 V DC |
| Output voltage range | 19.2 V DC ... 27.6 V DC ($U_{OUT}$ = $U_{BAT}$ - 0,5 V DC) |
| Nominal output current ($I_N$) | 10 A (-25 °C ... 60 °C) |
| POWER BOOST ($I_{Boost}$) | 15 A (-25°C ... 40°C) |
| Selective Fuse Breaking ($I_{SFB}$) | 65 A (-25 °C ... 60 °C) |
| Duration | 15 ms (SFB technology) |

Signal: Alarm

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Continuous load current | ≤ 100 mA |

Signal: Battery charge

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Battery mode

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Alarm

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Continuous load current | ≤ 100 mA |

Signal: Battery charge

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Battery mode

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Alarm

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |

| | |
|---|---|
| Continuous load current | ≤ 100 mA |

Signal: Battery charge

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Battery mode

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Alarm

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Continuous load current | ≤ 100 mA |

Signal: Battery charge

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

Signal: Battery mode

| | |
|---|---|
| Output description | Relay (floating) |
| Maximum switching voltage | ≤ 30 V AC/DC |
| Output voltage | 24 V |
| Continuous load current | ≤ 100 mA |

## Energy storage

| | |
|---|---|
| Nominal voltage $U_N$ | 24 V DC |
| End-of-charge voltage | 24 V DC ... 29 V DC (temperature compensated) |
| Charge current | 0.2 A ... 2.88 A |
| Nominal capacity range | 1.3 Ah ... 140 Ah |
| Battery presence check/time interval | 1 min. |
| Battery presence check (cyclic) | 60 s |
| IQ technology | Yes |
| Temperature compensation | 42 mV/K (preset) |
| Temperature compensation (preset) | 42 mV/K |
| Network management | Yes |

## Connection data

Input

| | |
|---|---|
| Connection method | Pluggable screw connection |

| | |
|---|---|
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 16 |
| Conductor cross section AWG max. | 12 |
| Stripping length | 7 mm |
| Screw thread | M4 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

Output

| | |
|---|---|
| Connection method | Pluggable screw connection |
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 16 |
| Conductor cross section AWG max. | 12 |
| Stripping length | 7 mm |
| Screw thread | M4 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

Signal

| | |
|---|---|
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section flexible min. | 0.2 mm² |
| Conductor cross section flexible max. | 2.5 mm² |
| Conductor cross section AWG min. | 24 |
| Conductor cross section AWG max. | 12 |
| Screw thread | M4 |
| Tightening torque, min | 0.5 Nm |
| Tightening torque max | 0.6 Nm |

## Interfaces

| | |
|---|---|
| Interface | IFS (Interface system data port) |

## LED signaling

| | |
|---|---|
| Types of signaling | LED |
| | Relay contact |
| | Interface/software |

Signal output

| | |
|---|---|
| Signalization designation | Power In OK |

| | |
|---|---|
| Status display | LED |
| Note on status display | Static to |
| | Static to |

Signal output: Switching output

| | |
|---|---|
| Signalization designation | Alarm |
| Status display | LED |
| Note on status display | Static to |
| Color | red |
| Note on status display | Static to |

Signal output: Switching output

| | |
|---|---|
| Signalization designation | Battery charge |
| Status display | LED bar graph |
| Note on status display | dynamic |
| Color | green/red |
| Note on status display | dynamic |

Signal output: Switching output

| | |
|---|---|
| Signalization designation | Battery mode |
| Status display | LED |
| Note on status display | Static to |
| Color | yellow |
| Note on status display | Static to |

## Electrical properties

| | |
|---|---|
| Insulation voltage input/output | 500 V DC |
| Insulation voltage input, output / housing | 750 V DC |

## Product properties

| | |
|---|---|
| Product type | Uninterruptible power supply |
| IQ technology | Yes |
| MTBF (IEC 61709, SN 29500) | > 500000 h (40 °C) |

Insulation characteristics

| | |
|---|---|
| Protection class | III |

Life expectancy (electrolytic capacitors)

| | |
|---|---|
| Time | 295585 h |

## Dimensions

| | |
|---|---|
| Width | 35 mm |
| Height | 130 mm |
| Depth | 125 mm |

Installation dimensions

| | |
|---|---|
| Installation distance right/left | 5 mm / 5 mm |

| | |
|---|---|
| Installation distance top/bottom | 50 mm / 50 mm |

Alternative assembly

| | |
|---|---|
| Width | 123 mm |
| Height | 130 mm |
| Depth | 39 mm |

## Mounting

| | |
|---|---|
| Mounting type | DIN rail mounting |
| Assembly instructions | alignable: horizontal 5 mm, vertical 50 mm |
| Mounting position | horizontal DIN rail NS 35, EN 60715 |

## Material specifications

| | |
|---|---|
| Color | aluminium |
| Housing material | Metal |
| Type of housing | Aluminum (AlMg3) |
| Hood version | Galvanized sheet steel, free from chrome (VI) |
| Housing material | Steel sheet, zinc-plated |

## Environmental and real-life conditions

Ambient conditions

| | |
|---|---|
| Degree of protection | IP20 |
| Ambient temperature (operation) | -25 °C ... 70 °C |
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
| Climatic class | 3K3 (in acc. with EN 60721) |
| Max. permissible relative humidity (operation) | ≥ 95 % (25 °C, non-condensing) |
| Shock | 18 ms, 30g, in each space direction (according to IEC 60068-2-27) |
| Vibration (operation) | < 15 Hz, amplitude ±2.5 mm (according to IEC 60068-2-6) |
| | 15 Hz ... 150 Hz, 2.3g $t_v$ = 90 min. |

## Standards and regulations

| | |
|---|---|
| Rail applications | EN 50121-4 |
| Standard – Electronic equipment for use in electrical power installations and their assembly into electrical power installations | EN 50178/VDE 0160 (PELV) |
| Standard - Electrical safety | EN 60950-1/VDE 0805 (SELV) |

## Approval data

| | |
|---|---|
| UL approvals | UL Listed UL 508 |
| | UL/C-UL Recognized UL 60950-1 |
| | UL ANSI/ISA-12.12.01 Class I, Division 2, Groups A, B, C, D (Hazardous Location) |

## EMC data

| | |
|---|---|
| Low Voltage Directive | Conformance with Low Voltage Directive 2014/35/EC |
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |

| | |
|---|---|
| EMC requirements for noise emission | EN 61000-6-3 |
| | EN 61000-6-4 |
| EMC requirements for noise immunity | EN 61000-6-1 |
| | EN 61000-6-2 |
| Noise immunity | EN 61000-6-2:2005 |

Electrostatic discharge

| | |
|---|---|
| Standards/regulations | EN 61000-4-2 |

Electrostatic discharge

| | |
|---|---|
| Contact discharge | 8 kV (Test Level 4) |
| Discharge in air | 15 kV (Test Level 4) |
| Comments | Criterion A |

Electromagnetic HF field

| | |
|---|---|
| Standards/regulations | EN 61000-4-3 |

Electromagnetic HF field

| | |
|---|---|
| Frequency range | 80 MHz ... 1 GHz |
| Test field strength | 20 V/m |
| Frequency range | 1 GHz ... 3 GHz |
| Test field strength | 10 V/m |
| Frequency range | 2 GHz ... 3 GHz |
| Test field strength | 3 V/m |
| Comments | Criterion A |

Fast transients (burst)

| | |
|---|---|
| Standards/regulations | EN 61000-4-4 |

Fast transients (burst)

| | |
|---|---|
| Input | 2 kV (Test Level 3 - asymmetrical) |
| Output | 2 kV (Test Level 3 - asymmetrical) |
| Signal | 2 kV (Test Level 4 - asymmetrical) |
| Comments | Criterion A |

Surge voltage load (surge)

| | |
|---|---|
| Standards/regulations | EN 61000-4-5 |
| Input | 1 kV (Test Level 2 - symmetrical) |
| | 2 kV (Test Level 3 - asymmetrical) |
| Output | 1 kV (Test Level 2 - symmetrical) |
| | 2 kV (Test Level 3 - asymmetrical) |
| Signal | 1 kV (Test Level 2 - asymmetrical) |
| Comments | Criterion A |

Conducted interference

| | |
|---|---|
| Standards/regulations | EN 61000-4-6 |

Conducted interference

| | |
|---|---|
| I/O/S | asymmetrical |
| Frequency range | 0.15 MHz ... 80 MHz |
| Comments | Criterion A |
| Voltage | 10 V (Test Level 3) |

Emitted interference

| | |
|---|---|
| Standards/regulations | EN 61000-6-3 |
| Radio interference voltage in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |
| Emitted radio interference in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |
| Criterion A | Normal operating behavior within the specified limits. |
| Criterion B | Temporary impairment to operational behavior that is corrected by the device itself. |




Phoenix Contact USA
586 Fulling Mill Road
Middletown, PA 17057, United States
(+717) 944-1300
info@phoenixcon.com

# Energy storage - UPS-BAT/PB/24DC/7AH

1274118

https://www.phoenixcontact.com/us/products/1274118

Please be informed that the data shown in this PDF document is generated from our Online Catalog. Please find the complete data in the user documentation. Our General Terms of Use for Downloads are valid.

Energy storage, VRLA-AGM, 24 V DC, 7 Ah, automatic detection and communication with QUINT UPS-IQ

## Product Description

For continuous monitoring and intelligent management, there is constant communication with the QUINT UPS. Thanks to automatic detection of the energy storage, and tool-free switching during operation, quick installation is possible. The QUINT UPS with IQ technology energy storage leaves the warehouse fully charged.

## Your advantages

- Maximum buffer times
- Lead AGM (Absorbent Glass Mat) technology

## Commercial Data

| | |
|---|---|
| Item number | 1274118 |
| Packing unit | 1 pc |
| Sales Key | C17 |
| Product Key | CMUEV3 |
| GTIN | 4063151466428 |
| Weight per Piece (including packing) | 6,600 g |
| Weight per Piece (excluding packing) | 5,900 g |
| Customs tariff number | 85072080 |
| Country of origin | CN |

## Technical Data

### Energy storage

| | |
|---|---|
| Input voltage | 24 V DC (SELV) |
| End-of-charge voltage | 27.6 V DC (20 °C) |
| Output current $I_{max}$ | 50 A |
| Charge current | 2.1 A |
| Nominal capacity | 7 Ah |
| Buffer time | 10 min. (20 A) |
| | 3 min. (40 A) |
| Accumulator module service life (according to Eurobat) | 6 (20 °C) |
| Latest startup date (battery only) | 12 Months (0 °C ... 20 °C) |
| Latest startup (battery only) - range | 9 Months ... 12 Months (20 °C ... 30 °C) |
| | 6 Months ... 9 Months (30 °C ... 40 °C) |
| Battery type | BB Battery<br>BP7-12FR |
| Battery technology | VRLA-AGM |
| Size designation | Block |
| Battery pack | yes |
| Disposal | Used batteries must not be thrown away with household waste, they should instead be disposed of in accordance with applicable national regulations. |
| Connection in parallel | yes |
| Connection in series | No |
| IQ-Technology | yes |
| Temperature sensor | yes |
| Suitable for fast charging | yes |
| Output fuse | 2x 25 A |

### Connection data

Conductor connection

| | |
|---|---|
| Connection method | Screw connection |
| rigid | 10 mm² ... 16 mm² |
| flexible | 10 mm² ... 16 mm² |
| rigid (AWG) | 8 ... 6 (Cu) |
| Stripping length | 10 mm |
| Torque | 1.2 Nm ... 1.5 Nm |
| Drive form screw head | Slotted L |

### Product properties

| | |
|---|---|
| Product type | Battery unit |
| Disposal | Used batteries must not be thrown away with household waste, they should instead be disposed of in accordance with applicable national regulations. |

Insulation characteristics

| | |
|---|---|
| Protection class | III |
| Degree of pollution | 2 |

## Dimensions

| | |
|---|---|
| Width | 135 mm |
| Height | 202 mm |
| Depth | 110 mm |

Installation dimensions

| | |
|---|---|
| Installation distance right/left | 0 mm / 0 mm |
| Installation distance top/bottom | 50 mm / 50 mm |

## Mounting

| | |
|---|---|
| Mounting position | horizontal DIN rail NS 35, EN 60715 |

## Material specifications

| | |
|---|---|
| Housing material | Metal |
| Type of housing | Galvanized sheet steel, powder-coated |

## Environmental and real-life conditions

Ambient conditions

| | |
|---|---|
| Degree of protection | IP20 |
| Ambient temperature (storage/transport) | -20 °C ... 40 °C |
| Ambient temperature (charge) | 0 °C ... 40 °C |
| Ambient temperature (discharge) | -20 °C ... 50 °C |
| Max. permissible relative humidity (operation) | ≤ 95 % |
| Shock | 18 ms, 30g, in each space direction (according to IEC 60068-2-27) |
| Vibration (operation) | < 15 Hz, amplitude ±2,5 mm, 15 Hz ... 150 Hz, according to IEC 60068-2-6 |
| | 15 Hz ... 150 Hz, 2.3g, 90 min. |

## Ex data

| | |
|---|---|
| Suited for EX-applications | No |




Phoenix Contact USA
586 Fulling Mill Road
Middletown, PA 17057, United States
(+717) 944-1300
info@phoenixcon.com

# MasterPact™ NT and NW Universal Power Circuit Breakers

## Class 0613

## Catalog

0613CT0001
R12/19

www.se.com

# MasterPact™ Circuit Breakers

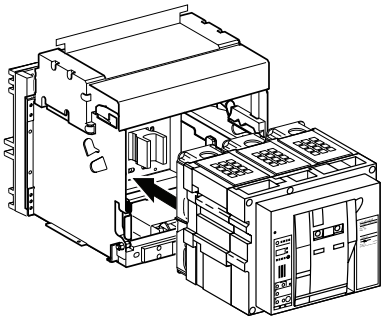
## Introduction

**800–1600 A MasterPact NT Drawout Circuit Breaker**

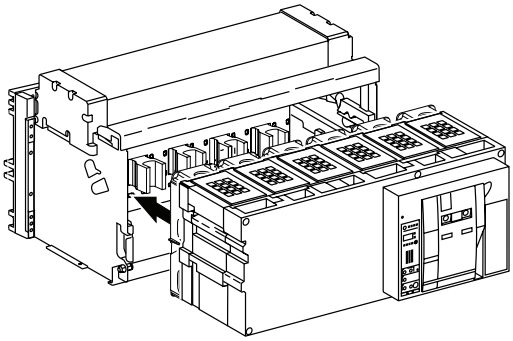
MasterPact™ NT/NW Universal Power Circuit Breakers are designed to protect electrical systems from damage caused by overloads, short circuits and equipment ground faults. All MasterPact circuit breakers are designed to open and close a circuit manually, and to open the circuit automatically at a predetermined overcurrent setting. MasterPact circuit breakers can also:

- Enhance coordination by their adjustability.
- Provide integral ground-fault protection for equipment.
- Provide high interrupting ratings and withstand ratings.
- Provide communications.
- Provide power monitoring.
- Provide protective relaying functions.
- Provide zone-selective interlocking (ZSI) which can reduce damage in the event of a fault.

**Figure 1 - MasterPact NW Drawout Circuit Breakers**



**800–3200 A MasterPact NW Drawout Circuit Breaker**



**4000–6300 A MasterPact NW Drawout Circuit Breaker**

## Codes and Standards

MasterPact circuit breakers are manufactured and tested in accordance with the following standards:

| Low-Voltage Power Circuit Breaker | Insulated Case Circuit Breaker | IEC Rated Circuit Breaker | IEC Extreme Atmospheric Conditions |
|---|---|---|---|
| ANSI C37.13<br>ANSI C37.16<br>ANSI C37.17<br>ANSI C37.50<br>UL 1066 (cULus Listed)<br>NEMA SG3 | UL 489 (UL Listed)<br>NEMA AB1<br>CSA C22.2 No. 5<br>NMX J-266-ANCE | IEC 60947-2<br>IEC 60947-3 | IEC 68-2-1: Dry cold at –55°C<br>IEC 68-2-2: Dry heat at +85°C<br>IEC 68-2-30: Damp heat (temp. +55°C, rel. humidity 95%)<br>IEC 68-2-52 Level 2: Salt mist |

**NOTE:** Throughout this document, the phrase “ANSI® Certified” means the product meets the requirements of UL 1066 and ANSI C37. When “UL® Listed” appears, the product meets the requirements of UL 489.

The 800–2000 A ANSI Low Voltage Power Circuit Breakers type L1F and Insulated Case Circuit Breaker type LF are tested to show the arc flash hazard risk category as referenced by NFPA® 70E.

Circuit breakers should be applied according to guidelines detailed in the National Electrical Code® (NEC®) and other local wiring codes.

MasterPact circuit breakers are available in Square D™ or Schneider Electric™ brands.

**UL File Numbers:**

- MasterPact NW: E161835 Vol. 2 Sec. 1
- MasterPact NT: E161835 Vol. 2 Sec. 2

## Features and Benefits

**High Ampere Interrupting Rating (AIR)**: ANSI Certified MasterPact NW circuit breakers have an interrupting rating of 200,000 A at 508 Vac without fuses.

**High Short-Time Current Rating**: MasterPact NW circuit breakers have exceptional short-time ratings—up to 100,000 A.

**100% Rated Circuit Breaker**: MasterPact circuit breakers are designed for continuous operation at 100% of their current rating.

**Reverse Fed Circuit Breaker**: MasterPact circuit breakers can be fed either from the top of the circuit breaker or from the bottom.

**Two-Step Stored Energy Mechanism**: MasterPact circuit breakers are operated via a stored-energy mechanism which can be charged manually or by a motor. The closing time is less than five cycles. Closing and opening operations can be initiated by remote control or by push buttons on the circuit breaker front cover. An O–C–O cycle is possible without recharging.

**Drawout or Fixed Mount, 3-Pole (3P) or 4-Pole (4P) Construction**: ANSI Rated, UL Listed and IEC Rated MasterPact circuit breakers are available in drawout or fixed mounts, with either three-pole or four-pole construction.

**Field-Installable Trip Units, Sensor Plugs and Accessories**: Trip units, sensor plugs and most accessories are field installable with only the aid of a screwdriver and without adjusting the circuit breaker. The uniform design of the circuit breaker line allows most accessories to be common for the whole line.

**Reinforced Insulation**: Two insulation barriers separate the circuit breaker front from the current path.

**Isolation Function by Positive Indication of Contact Status**: The mechanical indicator is truly representative of the status of all the main contacts.

**Segregated Compartment**: Once the accessory cover has been removed to provide access to the accessory compartment, the main contacts remain fully isolated. Furthermore, interphase partitioning allows full insulation between each pole even if the accessory cover has been removed.

**Front Connection of Secondary Circuits**: All accessory terminals (ring terminals are available as an option) are located on a connecting block which is accessible from the front in the connected, test and disconnected positions. This is particularly useful for field inspection and modification.

**Anti-Pumping Feature**: All MasterPact NT and NW circuit breakers are designed with an anti-pumping feature that causes an opening order to always takes priority over a closing order. Specifically, if opening and closing orders occur simultaneously, the charged mechanism discharges without any movement of the main contacts keeping the circuit breaker in the open (OFF) position.

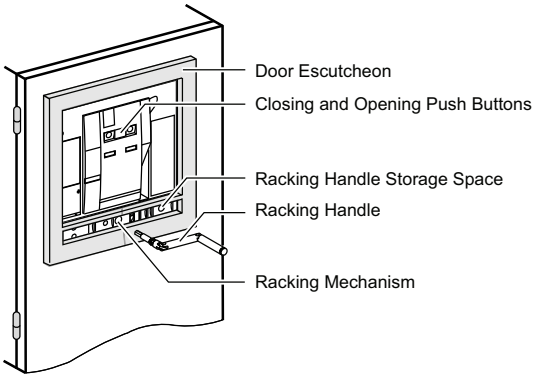
In the event that opening and closing orders are simultaneously maintained, the standard mechanism provides an anti-pumping function which continues to keep the main contacts in the open position.

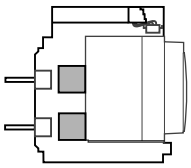
In addition, after fault tripping or opening the circuit breaker intentionally (using the manual or electrical controls and with the closing coil continuously energized) the circuit breaker cannot be closed until the power supply to the closing coil is discontinued and then reactivated.

**NOTE:** When the automatic reset after fault trip (RAR) option is installed, the automatic control system must take into account the information supplied by the circuit breaker before issuing a new closing order or before blocking the circuit breaker in the open position. The information is on the type of fault, e.g. overload, short-circuit or ground fault.

**Disconnection Through the Front Door**: The racking handle and racking mechanism are accessible through the front door cutout. Disconnecting the circuit breaker is possible without opening the door and exposing live parts.

**Figure 2 - Racking Handle and Mechanism**



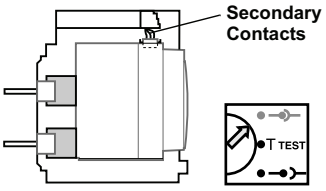



**Disconnected Position (Cluster Shield Not Shown)**

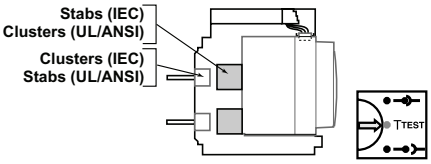
**Drawout Mechanism**: The drawout assembly mechanism allows the circuit breaker to be racked in four positions (connected, test, disconnected, or withdrawn), as shown in the figure below.

**NOTE:** For UL/ANSI circuit breakers, the clusters are mounted on the circuit breaker; for IEC circuit breakers, the clusters are mounted on the cradle.

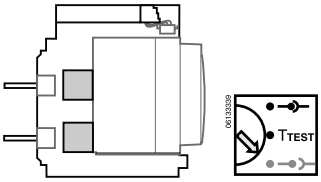
**Figure 3 - Racking Positions (Cluster Shield Not Shown)**



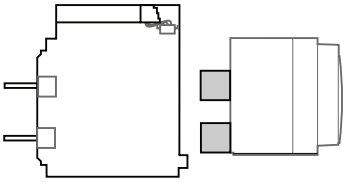

**Connected Position**




**Test Position**




**Disconnected Position**



**Withdrawn Position**

**Maintenance:** To maintain MasterPact's operating and safety characteristics from the beginning to the end of its service life, Schneider Electric recommends that systematic checks and periodic on-site maintenance be carried out by qualified personnel, as indicated in bulletin *0613IB1202*, "Maintenance and Field Testing Guide for MasterPact NT and NW Circuit Breakers".

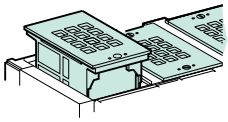
Schneider Electric Field Services offers a wide portfolio of field maintenance services named ONSITE MAINTENANCE which offers four types of services:

- OnSite Repair, which repairs a system in view of fulfilling a required function
- OnSite Preventive Maintenance, which carries out, at predetermined intervals, checks intended to reduce the probability of a failure or deterioration in the operation of a system
- Onsite Condition Maintenance, based on the recording and analysis of system parameters in addition to preventive checks, detects drift from the initial state and/or significant trends in performance. Using OnSite Condition Maintenance makes it possible to anticipate any necessary corrective action required to ensure equipment safety and continuity of service, and make repairs immediately if spare parts are onsite, or to plan the repair for a more convenient time.
- On-Site Asset Diagnostic, which is used to identify symptoms of malfunction or degradation before problems occur, things not possible to detect during standard preventive maintenance. It detects functional deviations versus original (new device) specifications. A repair plan is recommended to recover the original conditions when deviations are diagnosed.

The Maintenance Guide is available on the Internet (*www.se.com*) and provides detailed information on:

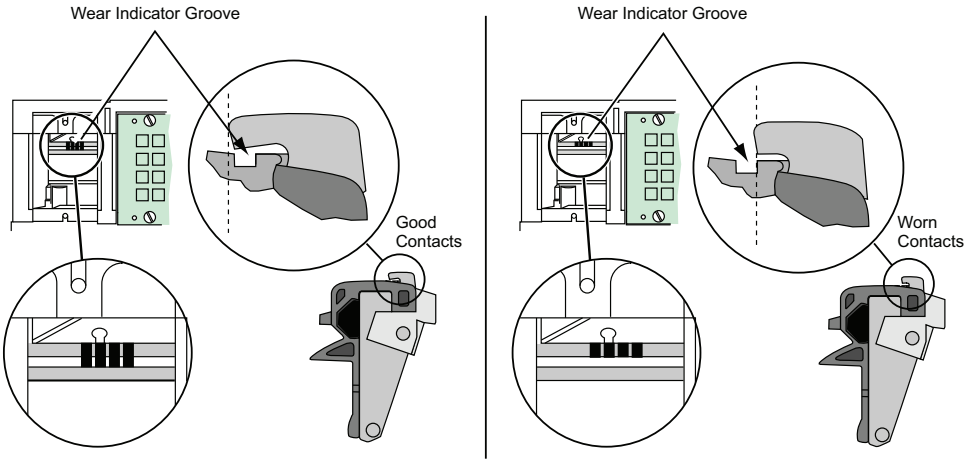
- types of maintenance required, depending on the criticality of the protected circuit, risks involved if the component ceases to operate correctly,
- what is understood by the terms normal, improved and severe environment and operating conditions,
- periodic preventive maintenance operations that should be carried out under normal environment and operating conditions as well as the level of competence required for the operations,
- the environment and operating conditions that accelerate device aging,
- the recommended timing of on-site maintenance according to equipment criticality and the environmental conditions in which the equipment operates.

**Arc Chamber**



An example of preventive maintenance: the arc chambers are removed to allow visual inspection of the contacts and wear indicator groove (see *Contact Wear Indicators, page 12* for how wear is indicated). The operation counter can also indicate when inspections and possible maintenance should be done. The life of the circuit breaker may be extended by replacing the arc chamber and/or spring-charging motor of ANSI Certified circuit breakers. See bulletin 0613IB1202, available at *www.se.com*, for information on normal and adverse operating conditions.

**Figure 4 - Contact Wear Indicators**



**Ambient Temperature:**

MasterPact circuit breakers can operate under the following temperature conditions:

- The electrical and mechanical characteristics are stipulated for an ambient temperature between -13°F (25°C) and 158°F (70°C).
- Mechanical closing of the circuit breaker (by pushbutton) is possible down to -31°F (-35°C) and at an altitude up to +13,000 ft. (3900 m).

MasterPact circuit breakers have been tested for operation in industrial atmospheres. It is recommended that the equipment be cooled or heated to the proper operating temperature and kept free of excessive vibration and dust. Operation at temperatures above 104°F (40°C) may require derating or overbussing the circuit breaker. See the appropriate instruction bulletin and *Temperature Correction Factors, page 25* of this catalog for additional information.

**Storage Temperature**

Circuit breakers with trip units without LCD displays may be stored in the original packaging at temperatures between -40°F (-40°C) and 185°F (85°C).

For circuit breakers with trip units with LCD displays, this range is -13°F (-25°C) to 185°F (85°C).

**Altitude:**

MasterPact circuit breakers are suitable for use at altitudes of 13,000 ft. (3900 m) and below. See *Altitude Correction Factors per ANSI C37.20.1 par. 7.1.4.1 (Table 10), page 25* for altitude correction factors.

**Vibration:**

MasterPact circuit breakers meet IEC 60068-2-6 Standards for vibration.

- 2 to 13.2 Hz and amplitude 0.039 in. (1 mm)
- 13.2 to 100 Hz constant acceleration 0.024 oz. (0.7 g)

**Humidity:**

MasterPact circuit breakers have been tested to the following:

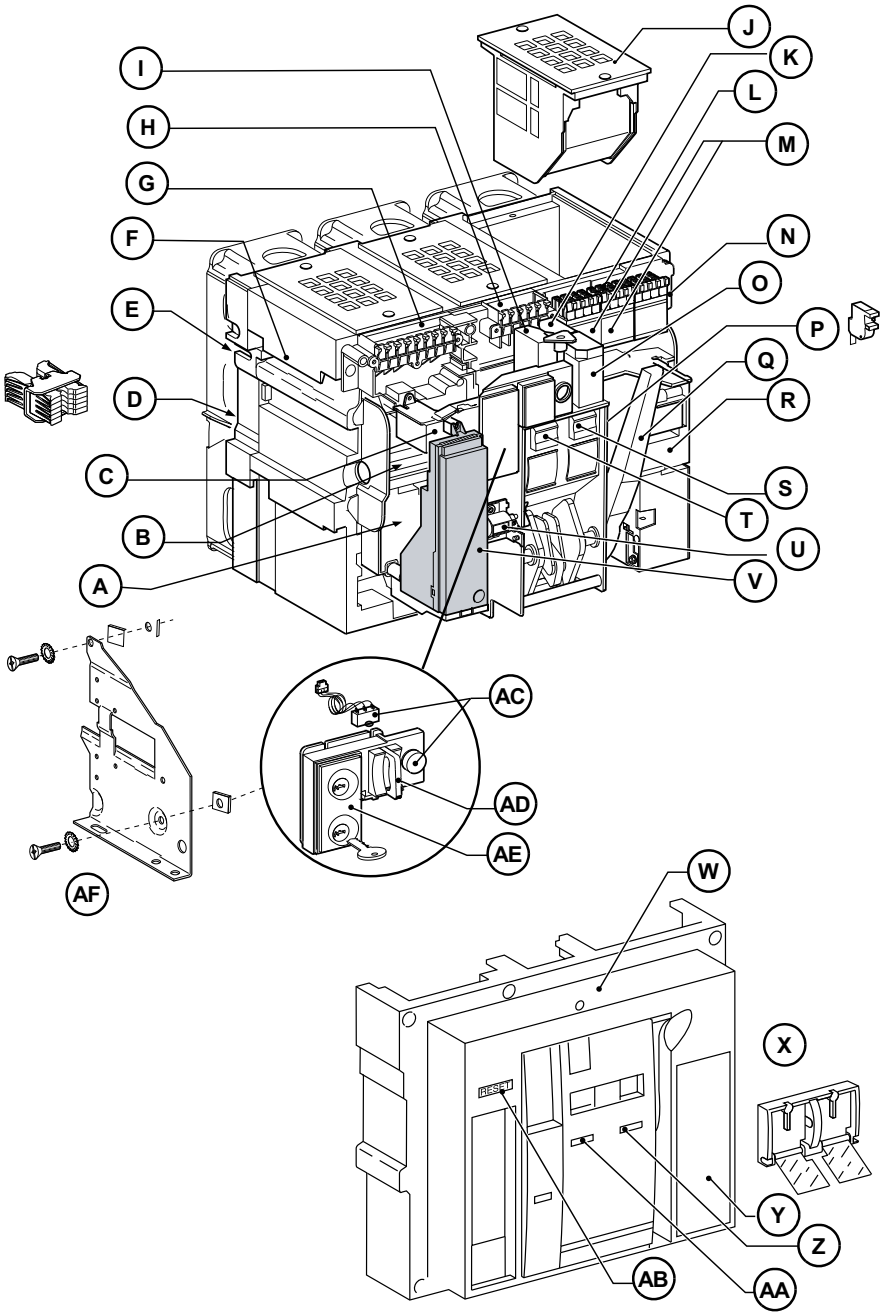
- IEC68-2-30—damp heat (temperature +55°C and relative humidity of 95%)
- IEC 68-2-52 level 2—salt mist

The materials used in MasterPact NT and NW circuit breakers will not support the growth of fungus and mold.

# MasterPact NW Circuit Breaker Design

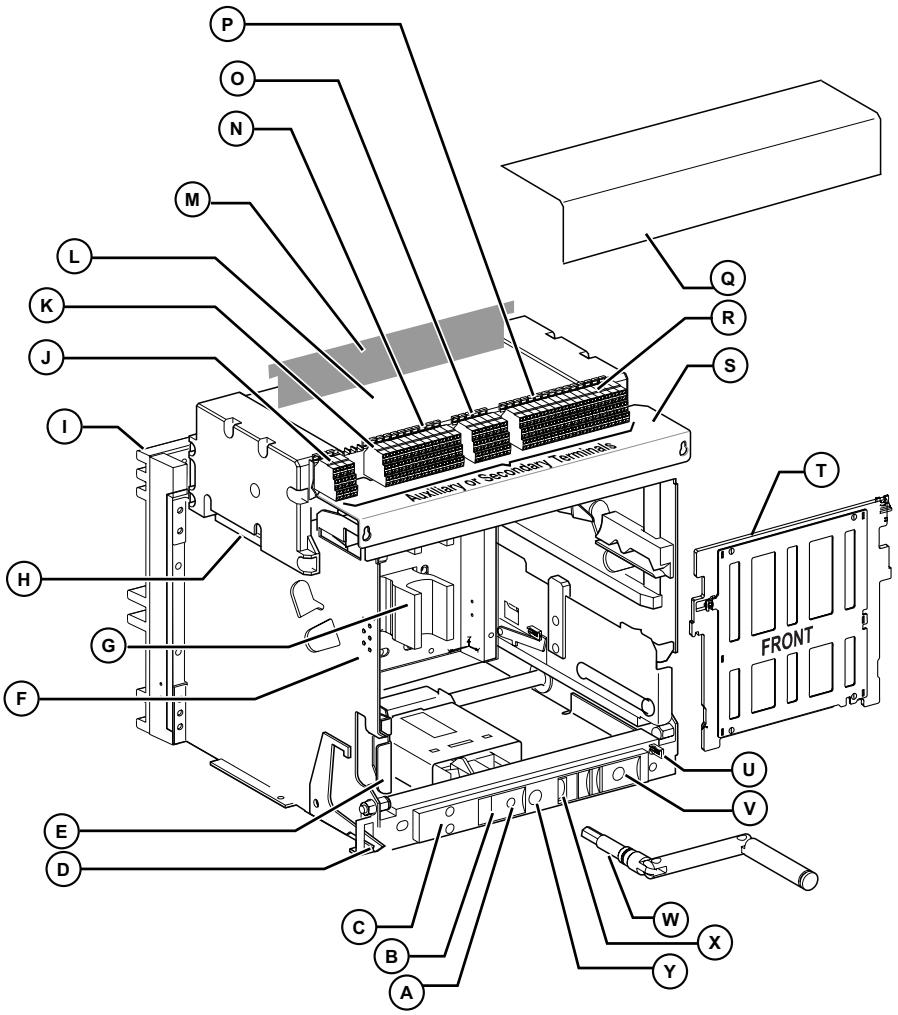
**NOTE:** For UL Listed and ANSI Certified circuit breakers, the clusters are mounted on the circuit breaker; for IEC Rated circuit breakers, the clusters are mounted on the cradle.

| | |
|---|---|
| A | Overcurrent Trip Switch (SDE1) |
| B | Circuit Breaker Communication Module |
| C | Overcurrent Trip Switch (SDE2) or Electric Reset |
| D | Cluster |
| E | Cradle Rejection Kit |
| F | Lifting Tab |
| G | Trip Connection to Overcurrent Trip Switch |
| H | Auxiliary Control Connection |
| I | Shunt Trip (MX2) or Undervoltage Trip Device |
| J | Arc Chamber |
| K | Shunt Trip (MX1) |
| L | Auxiliary Contact Connection |
| M | Two Blocks of Four Additional Switches (OF) or Combined “Connected,Closed” Switches (EF) |
| N | Block of Four Form C Auxiliary Contacts (OF) |
| O | Shunt Close (XF) |
| P | Ready-to-Close Contact (PF) |
| Q | Charging Handle |
| R | Spring-Charging Motor (MCH) |
| S | Closing Push Button |
| T | Opening Push Button |
| U | Operations Counter |
| V | Trip Unit |
| W | Accessory Cover |
| X | Open/Close Push Button Close (Lockable with Padlock) |
| Y | Faceplate |
| Z | Charged/Discharged Indicator |
| AA | Open/Close Indicator |
| AB | Push-to-Reset on Fault Trip |
| AC | Electrical Close Push Button (BPFE) |
| AD | Padlock Attachment |
| AE | Key Interlock |
| AF | Mounting Plate for Fixed Circuit Breaker |



# MasterPact NW Cradle Design

| | |
|---|---|
| A | Stop Release Button |
| B | Padlock Provision |
| C | Key Interlock |
| D | Door Interlock for Connected Device |
| E | Pull-Out Hand Grip |
| F | Rejection Feature |
| G | Primary Stabs (UL)/Clusters (IEC) |
| H | Lifting Tab |
| I | Cradle Back Mold |
| J | Position Indicating Contact Terminal Block |
| K | Overcurrent Trip Switch Terminal Block |
| L | Arc Chamber Cover |
| M | Tool Shield |
| N | Position Indicating Contact Terminal Block |
| O | Accessory Control Terminal Block |
| P | Auxiliary Contact Terminal Block |
| Q | Terminal Cover |
| R | Position Indicating Contact Terminal Block |
| S | Wiring Cover |
| T | Shutter |
| U | Racking Interlock for Open Door |
| V | Crank Storage Space |
| W | Racking Crank |
| X | Position Indicator |
| Y | Crank Insertion Opening |



# MasterPact NW with ArcBlock™ Technology

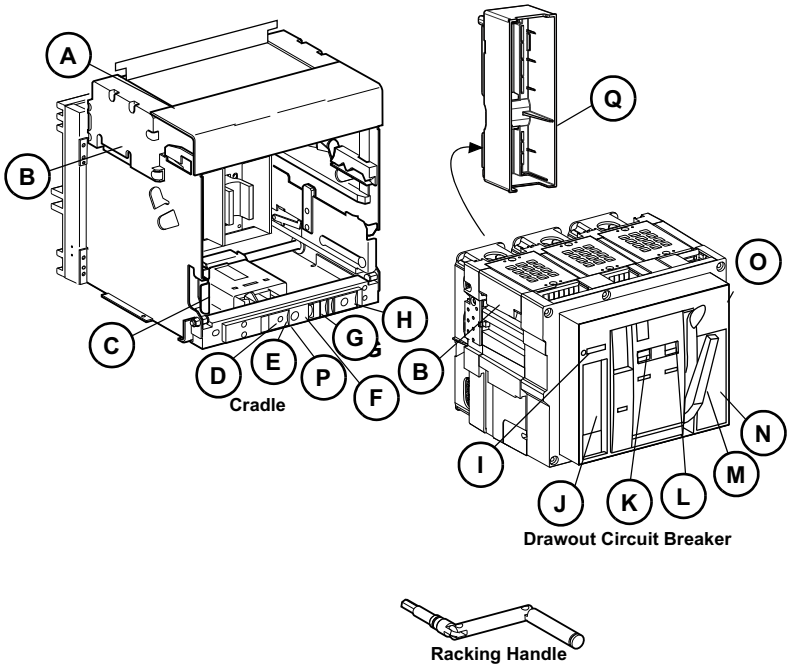
The MasterPact NW low-voltage power circuit breaker and insulated case circuit breaker are available with ArcBlok technology designed to mount in an ArcBlok drawout cradle.

The MasterPact NW with ArcBlok technology interfaces with the ArcBlok cradle to prevent arcing events by enclosing the phases at the primary connection of the cradle. If for any reason an arcing event happens, with the separation between phase to phase and phase to ground, the arc is extinguished in less than 12 ms to reduce arc flash energy.

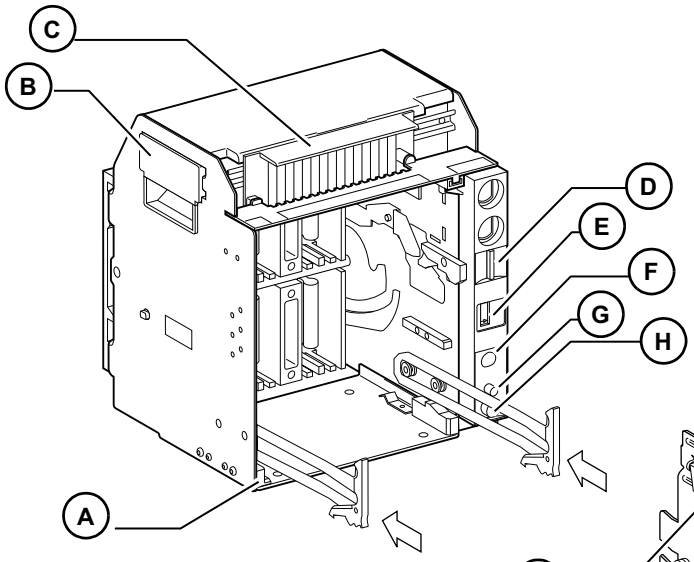
The MasterPact NW with ArcBlok technology is tested as part of Arc Resistant Equipment to ANSI C37.20.7.

| | |
|---|---|
| A | Terminal Cover |
| B | Lifting Flanges |
| C | Extension Rail Handle |
| D | Padlock Provision |
| E | Stop Release Button |
| F | Racking Handle Insertion Opening |
| G | Position Indicator |
| H | Racking Handle Storage Space |
| I | Fault Trip Reset Button |
| J | Trip Unit |
| K | Push to Open Button |
| L | Push to Close Button |
| M | Charging Handle |
| N | Faceplate |
| O | Accessory Cover |
| P | Cradle Date Code |
| Q | ArcBlok Shield (rotated for clarity) |

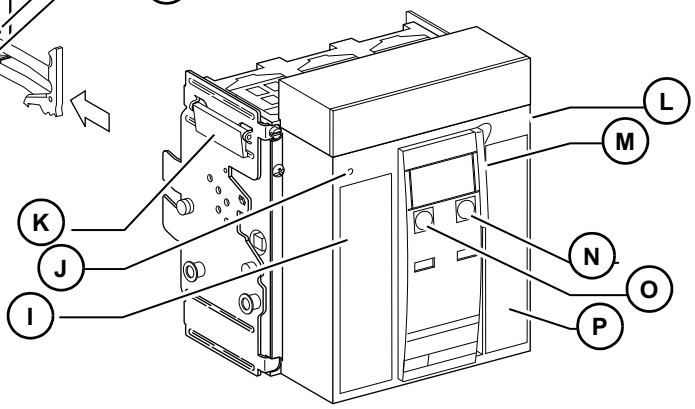
**Figure 5 - MasterPact NW Circuit Breaker and Cradle with ArcBlok Technology**



# MasterPact NT Circuit Breaker and Cradle Design

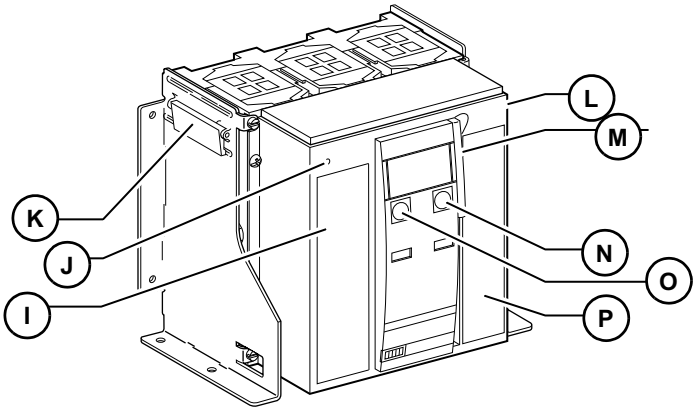



**NT Cradle**




**NT Drawout Circuit Breaker**

| | |
|---|---|
| A | Extension Rail Handle |
| B | Lifting Handle |
| C | Terminal Cover |
| D | Padlock Provision |
| E | Position Indicator |
| F | Racking Handle Insertion Opening |
| G | Stop Release Button |
| H | Racking Handle Storage Space |
| I | Lifting Tab |
| J | Fault Trip Reset Button |
| K | Trip Unit |
| L | Accessory Cover |
| M | Charging Handle |
| N | :Push-to-close” Button |
| O | “Push-to-open” Button |
| P | Faceplate |




**NT Fixed Circuit Breaker**

# Ratings

### Table 1 - Ratings for ANSI C37 Certified MasterPact NW Circuit Breakers 800–2000 A

| Frame Rating | | 800/1600 A | | | | | | 2000 A | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | N1 | H1 | H2 | H3 | L1[12] | L1F[2] | H1 | H2 | H3 | L1[12] | L1F[2] |
| Interrupting Current (kAIR) | 254 Vac 50/60 Hz | 42 | 65 | 85 | 100 | 200 | 200 | 65 | 85 | 100 | 200 | 200 |
| | 508 Vac 50/60 Hz | 42 | 65 | 85 | 100 | 200 | 200 | 65 | 85 | 100 | 200 | 200 |
| | 635 Vac 50/60 Hz | 42 | 65 | 85 | 85 | 130 | 130 | 65 | 85 | 85 | 130 | 130 |
| Short-Time Withstand Current (kA) | Vac 50/60 Hz, 0.5 s | 42 | 65 | 85 | 85 | 30 | 22 | 65 | 85 | 85 | 30 | 22 |
| Built In Instantaneous Override (Peak kA ±10%) | | —[3] | —[3] | —[3] | 190 | 805 | 55 | — | — | 190 | 80 | 55 |
| Close and Latch Ratings (Peak kA) | Vac 50/60 Hz | 90 | 150 | 90 | 90 | 55 | 50 | 150 | 90 | 90 | 55 | 50 |
| Tested to show arc flash hazard risk category as referenced by NFPA70E | | — | — | — | — | — | Yes | — | — | — | — | Yes |
| Breaking Time | | 25 to 30 ms (with no intentional delay) 9 ms for L1 and L1F | | | | | | | | | | |
| Closing Time | | 70 ms | | | | | | | | | | |
| Sensor Rating | | 100–800 A<br>800–1600 A | | | | | | 1000–2000 A | | | | |
| Endurance Rating (C/O Cycles) (with no maintenance) | Mechanical | 12,500 | | | | | | 10,000 | | | | |
| | Electrical | 2800 | | | | | | 1000 | | | | |

### Table 2 - Ratings for ANSI C37 Certified MasterPact NW Circuit Breakers 3200–6000 A

| Frame Rating | | 3200/4000 A[4] | | | | 4000/5000/6000 A[5] | | |
|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | H1 | H2 | H3 | L1[12] | H2 | H3 | L1[12] |
| Interrupting Current (kAIR) | 254 Vac 50/60 Hz | 65 | 85 | 100 | 200 | 85 | 100 | 200 |
| | 508 Vac 50/60 Hz | 65 | 85 | 100 | 200 | 85 | 100 | 200 |
| | 635 Vac 50/60 Hz | 65 | 85 | 85 | 130 | 85 | 85 | 130 |
| Short-Time Withstand Current (kA) | Vac 50/60 Hz, 0.5 s | 65 | 85 | 85 | 100 | 85 | 85 | 100 |
| Built In Instantaneous Override (Peak kA ±10%) | | — | — | 190 | 270 | — | — | 270 |
| Close and Latch Ratings (Peak kA) | Vac 50/60 Hz | 150 | 90 | 90 | 90 | 170 | 170 | 90 |

1. Interrupting ratings (kAIR) at 50 Hz: 200 kA (254 Vac), 150 kA (508 Vac), 100 kA (635 Vac).
2. The interrupting ratings L1 and L1F are available only in 3P, drawout construction.
3. 55 kA for 800 A circuit breaker frame with 100 A or 250 A sensor.
4. 4000 A standard width circuit breaker is not available in L1 interrupting rating code or drawout construction.
5. ArcBlok circuit breakers are available only to 5000 A.

### Table 2 - Ratings for ANSI C37 Certified MasterPact NW Circuit Breakers 3200–6000 A (Continued)

| Frame Rating | | 3200/4000 A[6] | | | | 4000/5000/6000 A[7] | | |
|---|---|---|---|---|---|---|---|---|
| Tested to show arc flash hazard risk category as referenced by NFPA70E | | — | — | — | — | — | — | — |
| Breaking Time | | | | | | | | |
| Closing Time | | | | | | | | |
| Sensor Rating | | 1600–4000 A | | | | 2000–4000 A<br>2500–5000 A<br>3000–6000 A | | |
| Endurance Rating (C/O Cycles) (with no maintenance) | Mechanical | 10,000 | | | 5000 | 5000 | | |
| | Electrical | 1000 | | | 1000 | 1000 | | |

### Table 3 - Ratings for ANSI C37 Certified MasterPact NW Non-Automatic Switches

| Frame Rating | | 800 A | 1600 A | 2000 A | 3200 A | 4000 A | 5000 A |
|---|---|---|---|---|---|---|---|
| Withstand Rating Code | | HA | HA | HA | HA | HA | HA |
| Breaking Capacity with External Relay (kA), 50/60 Hz | 254 Vac | 65 | 65 | 65 | 65 | 85 | 85 |
| | 508 Vac | 65 | 65 | 65 | 65 | 85 | 85 |
| | 635 Vac | 65 | 65 | 65 | 65 | 85 | 85 |
| Short-Time Withstand Current (kA) Vac 50/60 Hz, 0.5 s | | 65 | 65 | 65 | 65 | 85 | 85 |

### Table 4 - Ratings for ANSI C37 Certified MasterPact NW Automatic Switches

| Frame Rating | | 800 A | | 1600 A | | 2000 A | | 3200 A | | 4000 A[8] | | 5000 A | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Withstand Rating Code | | HF | HC | HF | HC | HF | HC | HF | HC | HF | HC | HF | HC |
| Breaking Capacity with External Relay (kA), 50/60 Hz | 254 Vac | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 |
| | 508 Vac | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 | 100 | 200 |
| | 635 Vac | 85 | 130 | 85 | 130 | 85 | 130 | 85 | 130 | 85 | 130 | 85 | 130 |
| Short-Time Withstand Current (kA) 50/60 Hz, 1.5 s | | 85 | 30 | 85 | 30 | 85 | 30 | 85 | 100 | 85 | 100 | 85 | 100 |

### Table 5 - Ratings for UL 489 Listed MasterPact NW Circuit Breakers

| Frame Rating | | 800/1200/1600/2000 A | | | | 2500/3000 A | | 4000/5000/6000 A | |
|---|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | N | H | L | LF | H | L | H | L |
| Interrupting Current (kAIR) | 240 Vac 50/60 Hz | 65 | 100 | 200 | 200 | 100 | 200 | 100 | 200 |
| | 480 Vac 50/60 Hz | 65 | 100 | 150 | 150 | 100 | 150 | 100 | 150 |
| | 600 Vac 50/60 Hz | 50 | 85 | 100 | 100 | 85 | 100 | 85 | 100 |
| Short-Time Withstand Current (kA) | Vac 50/60 Hz, 0.5 s | 42[9] | 65[9] | 30[9][10] | 22 | 65 | 65 | 85 | 100 |
| Built-In Instantaneous Override (Peak kA ±10%) | | 90 | 90 | 80[11][12] | 55 | 150 | 150 | 170 | 170 |

6. 4000 A standard width circuit breaker is not available in L1 interrupting rating code or drawout construction.
7. ArcBlok circuit breakers are available only to 5000 A.
8. 4000 A standard width automatic switch is not available in HC withstand rating code or drawout construction.
9. 24 kA for 800 A circuit breaker frame with 100 A or 250 A sensor.
10. 65 kA for 2000 A.
11. 55 kA for 800 A circuit breaker frame with 100 A or 250 A sensor.
12. 150 kA for 200 A sensor.

### Table 5 - Ratings for UL 489 Listed MasterPact NW Circuit Breakers (Continued)

| Frame Rating | | 800/1200/1600/2000 A | | | | 2500/3000 A | | 4000/5000/6000 A | |
|---|---|---|---|---|---|---|---|---|---|
| Close and Latch Ratings (Peak kA) | Vac 50/60 Hz | 90 | 90 | 55[13] | 50 | 90 | 90 | 90 | 90 |
| Tested to show arc flash hazard risk category as referenced by NFPA70E | | — | — | — | Yes | — | — | — | — |
| Breaking Time | | 25 to 30 ms (with no intentional delay) 9 ms for L and LF | | | | | | | |
| Closing Time | | 70 ms | | | | | | | |
| Sensor Rating | | 100–250 A / 400–800 A / 600–1200 A / 800–1600 A / 1000–2000 A | | | | 1200–2500 A / 1600–3000 A | | 2000–4000 A / 2500–5000 A / 3000–6000 A | |
| Endurance Rating (C/O Cycles) (with no maintenance) | Mechanical | 12,500[14] | 12,500[14] | 12,500[14] | 12,500[14] | 10,000 | 10,000 | 5000 | 5000 |
| | Electrical | 2800[14] | 2800[14] | 2800[14] | 2800[14] | 1000 | 1000 | 1000 | 1000 |

### Table 6 - Ratings for UL 489 Listed MasterPact NW Automatic Switches

| Frame Rating | | 800 A | | 1200 A | | 1600 A | | 2000 A | | 2500 A | | 3000 A | | 4000 A | | 5000 A | | 6000 A | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Withstand Rating Code | | HF | HB | HF | HB | HF | HB | HF | HB | HF | HB | HF | HB | HF | HB | HF | HB | HF | HB |
| With-stand Ratings[15] (kA) Vac, 50/60 Hz | 240 | 10-0 | 200 | 100 | 200 | 10-0 | 200 | 100 | 20-0 | 100 | 20-0 | 100 | 20-0 | 100 | 200 | 100 | 20-0 | 100 | 200 |
| | 480 | 10-0 | 150 | 100 | 150 | 10-0 | 150 | 100 | 15-0 | 100 | 15-0 | 100 | 15-0 | 100 | 150 | 100 | 15-0 | 100 | 150 |
| | 600 | 85 | 100 | 85 | 100 | 85 | 100 | 85 | 10-0 | 85 | 10-0 | 85 | 10-0 | 85 | 100 | 85 | 10-0 | 85 | 100 |
| Instantaneous Override (Peak kA) | | 90 | 80 | 90 | 50 | 90 | 80 | 90 | 80 | 150 | 15-0 | 150 | 15-0 | 170 | 170 | 170 | 17-0 | 170 | 170 |

### Table 7 - Ratings for IEC 60947-2 Rated MasterPact NW Circuit Breakers 800–2000 A

| Frame Rating | | | 800/1000/1250/1600 A | | | | | 2000 A | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | | N1 | H1 | H2 | L1 | H10 | N1 | H1 | H2 | H3 | L1 | H10 |
| Ultimate Breaking Capacity (kA) 50/60 Hz | $I_{cu}$ | 220/415 Vac | 42 | 65 | 100 | 150 | — | 42 | 65 | 100 | 150 | 150 | — |
| | | 440 Vac | 42 | 65 | 100 | 150 | — | 42 | 65 | 100 | 150 | 150 | — |
| | | 525 Vac | 42 | 65 | 85 | 130 | — | 42 | 65 | 85 | 130 | 130 | — |
| | | 690 Vac | 42 | 65 | 85 | 100 | — | 42 | 65 | 85 | 100 | 100 | — |
| | | 1150 Vac | — | — | — | — | 50 | — | — | — | — | — | 50 |
| Service Breaking Capacity | $I_{cs}$ | %Icu | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Short-Time Withstand Current (kA) | $I_{cw}$ | Vac 50/60 Hz, 1 s | 42 | 65 | 85 | 30 | 50 | 42 | 65 | 85 | 65 | 30 | 50 |
| | | Vac 50/60 Hz, 3 s | 22 | 36 | 50 | 30 | 50 | 22 | 36 | 75 | 65 | 30 | 50 |
| Built-In Instantaneous Override (Peak kA ±10%) | | | — | — | 190[16] | 80[16] | — | — | — | 190 | 150 | 80 | — |
| Rated making Current (Peak kA)50/60 Hz | $I_{cm}$ | 220/415 Vac | 88 | 143 | 220 | 330 | — | 88 | 88 | 220 | 330 | 330 | — |
| | | 440 Vac | 88 | 143 | 220 | 330 | — | 88 | 88 | 220 | 330 | 330 | — |

13. 90 kA for 2000 A.
14. The endurance rating for 2000 A, N/H/L/LF is 10,000 for mechanical and 1000 for electrical.
15. The withstand rating is the fault current (at rated voltage) that the switch will withstand without damage when protected by a circuit breaker with an equal continuous current rating.
16. 55 kA for 800 A circuit breaker frame with 100 A or 250 A sensor.

### Table 7 - Ratings for IEC 60947-2 Rated MasterPact NW Circuit Breakers 800–2000 A (Continued)

| Frame Rating | | | 800/1000/1250/1600 A | | | | | 2000 A | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 525 Vac | 88 | 143 | 187 | 286 | — | 88 | 88 | 187 | 286 | 286 | — |
| | | 690 Vac | 88 | 143 | 187 | 220 | — | 88 | 88 | 187 | 220 | 220 | — |
| | | 1150 Vac | — | — | — | — | 105 | — | — | — | — | — | 105 |
| Break Time | | ms | 25 | | | | | 25 | | | | | |
| Closing Time | | ms | < 70 | | | | | < 70 | | | | | |
| Endurance Rating (with no maint.) C/O Cycles x 1000 | | Mechani-cal | 12.5 | | | | | 10 | | | | | |
| | | Electrical 440 V | 10 | 10 | 10 | 3 | — | 8 | 8 | 8 | 3 | 3 | — |
| | | Electrical 1150 V | — | — | — | — | 0.5 | — | — | — | — | — | 0.5 |

### Table 8 - Ratings for IEC 60947-2 Rated MasterPact NW Circuit Breakers 2500–6300 A

| Frame Rating | | | 2500/3200/4000 A | | | | 4000B/5000/6300 A | |
|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | | H1 | H2 | H3 | H10 | H1 | H2 |
| Ultimate Breaking Capacity (kA) 50/60 Hz | $I_{cu}$ | 220/415 Vac | 65 | 100 | 150 | — | 100 | 150 |
| | | 440 Vac | 65 | 100 | 150 | — | 100 | 150 |
| | | 525 Vac | 65 | 85 | 130 | — | 100 | 130 |
| | | 690 Vac | 65 | 85 | 100 | — | 100 | 100 |
| | | 1150 Vac | — | — | — | 50 | — | — |
| Service Breaking Capacity | $I_{cs}$ | %Icu | 100% | 100% | 100% | 100% | 100% | 100% |
| Short-Time Withstand Current (kA) | $I_{cw}$ | Vac 50/60 Hz, 1 s | 65 | 85 | 65 | 50 | 100 | 100 |
| | | Vac 50/60 Hz, 3 s | 65 | 75 | 65 | 50 | 100 | 100 |
| Built-In Instantaneous Override (Peak kA ±10%) | | | — | 190 | 150 | — | — | 117 |
| Rated making Current (Peak kA) 50/60 Hz | $I_{cm}$ | 220/415 Vac | 143 | 220 | 330 | — | 220 | 330 |
| | | 440 Vac | 143 | 220 | 330 | — | 220 | 330 |
| | | 525 Vac | 143 | 189 | 286 | — | 187 | 286 |
| | | 690 Vac | 143 | 189 | 220 | — | 187 | 220 |
| | | 1150 Vac | — | — | — | 105 | — | — |
| Break Time | | ms | 25 | | | | 25 | |
| Closing Time | | ms | < 70 | | | | < 80 | |
| Endurance Rating (with no maint.) C/O Cycles x 1000 | | Mechanical | 10 | | | | 5 | |
| | | Electrical 440 V | 5 | 5 | 1.25 | — | 1.5 | 1.5 |
| | | Electrical 1150 V | — | — | — | 0.5 | — | — |

### Table 9 - Ratings for IEC 60947-3 Rated MasterPact NW Switches

| Frame Rating | | | 800/1000/1250/1600 A | | | | 2000 A | | | 2500/3200/4000 A | | | 4000B/ 5000/6300 A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Withstand Rating Code[17] | | | NA | HA | HF | HA10 | HA | HF | HA10 | HA | HF | HA10 | HA |
| Rated Making Current (Peak kA) | $I_{cm}$ | 220/415 Vac, 50/60 Hz | 88 | 105 | 187 | — | 105 | 187 | — | 121 | 189 | — | 187 |
| | | 440 Vac, 50/60 Hz | 88 | 105 | 187 | — | 105 | 187 | — | 121 | 189 | — | 187 |
| | | 500/690 Vac, 50/60 Hz | 88 | 105 | 187 | — | 105 | 187 | — | 121 | 189 | — | 187 |

17. NA, HA, and HA10 are non-automatic switches; HF is an automatic switch.

### Table 9 - Ratings for IEC 60947-3 Rated MasterPact NW Switches (Continued)

| Frame Rating | | | 800/1000/1250/1600 A | | | | 2000 A | | | 2500/3200/4000 A | | | 4000B/ 5000/6300 A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1150 Vac, 50/60 Hz | — | — | — | 105 | — | — | 105 | 121 | — | 105 | — |
| Short-Time Withstand Current (kA) | $I_{cw}$ | Vac 50/60 Hz, 1 s | 42 | 50 | 85 | 50 | 50 | 85 | 50 | 50 | 85 | 50 | 85 |
| Ultimate Breaking Capacity (with external protection relay) (kA) | $I_{cu}$ | Maximum Delay 350 ms | 42 | 50 | 85 | 50 | 50 | 85 | 50 | 50 | 85 | 50 | 85 |

### Table 10 - Ratings for ANSI C37 Certified MasterPact NT Circuit Breakers

| Frame Rating | | 800 A |
|---|---|---|
| Interrupting Rating Code | | N1 |
| Interrupting Current (kAIR) | 254 Vac 60 Hz | 42 |
| | 508 Vac 60 Hz | 42 |
| | 635 Vac 60 Hz | N/A |
| Short-Time Withstand Current (kA) | ac 60 Hz, 0.5 s | 42 |
| Built-In Instantaneous Override (Peak kA ±10%) | | — |
| Close and Latch Ratings (Peak kA) | ac 60 Hz | 90 |
| Tested to show arc flash hazard risk category as referenced by NFPA70E | | — |
| Breaking Time | | 25 to 30 ms (with no intentional time delay) |
| Closing Time | | < 50 ms |
| Sensor Rating | | 100 to 250 A / 400 to 800 A |
| Endurance Rating (C/O Cycles) (with no maintenance) | Mechanical | 12,500 |
| | Electrical | 2800 |

### Table 11 - Ratings for ANSI C37 Certified MasterPact NT Non-Automatic Switches

| Frame Rating | | 800 A |
|---|---|---|
| Withstand Rating Code | | NA |
| Short-Time Withstand Current Rating (kA) | Vac 50/60 Hz, 0.5 s | 42 |
| Breaking Capacity (with external protection relay) (kA) | 254/508/635 Vac, 60 Hz | 42/42/NA |

### Table 12 - Ratings for UL 489 Listed MasterPact NT Circuit Breakers

| Frame Rating | | 800 A | | | | | 1200 A | | | | | 1600 A[18] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | N | H | L1 | L | LF | N | H | L1 | L | LF | N | H | L1 | L |
| Interrupting Current (kAIR) | 240 Vac, 60 Hz | 50 | 65 | 100 | 200 | 200 | 50 | 65 | 100 | 200 | 200 | 50 | 65 | 100 | 200 |
| | 480 Vac, 60 Hz | 50 | 50 | 65 | 100 | 100 | 50 | 50 | 65 | 100 | 100 | 50 | 50 | 65 | 100 |
| | 600 Vac, 60 Hz | 35 | 50 | N/A | N/A | N/A | 35 | 50 | N/A | N/A | N/A | 35 | 50 | N/A | N/A |

18. Fixed-mounted only. 1600 A UL489 drawout circuit breakers are not available.

### Table 12 - Ratings for UL 489 Listed MasterPact NT Circuit Breakers (Continued)

| Frame Rating | | 800 A | | | | | 1200 A | | | | | 1600 A[19] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Short-Time Withstand Current Rating (kA) | Vac 60 Hz, 0.5 s | 35 | 35 | 10 | 10 | 10 | 35 | 35 | 10 | 10 | 10 | 35 | 35 | 10 | 10 |
| Built-In Instantaneous Override (Peak kA ±10%) | | 90 | 90 | 22 | 22 | 22 | 90 | 90 | 22 | 22 | 22 | 90 | 90 | 22 | 22 |
| Close and Latch Ratings (Peak kA) | Vac 60 Hz | 55 | 55 | 22 | 22 | 22 | 55 | 55 | 22 | 22 | 22 | 55 | 55 | 22 | 22 |
| Tested to show arc flash hazard risk category as referenced by NFPA70E | | — | — | — | — | Yes | — | — | — | — | Yes | — | — | — | — |
| Breaking Time | | 25 to 30 ms (with no intentional time delay)<br>9 ms for L and LF | | | | | | | | | | | | | |
| Closing Time | | < 50 ms | | | | | | | | | | | | | |
| Sensor Rating | | 100–250 A / 400–800 A | | | | | 600–1200 A | | | | | 800–1600 A | | | |
| Endurance Rating (C/O Cycles) (with no maintenance) | Mechanical | 12,500 | | | | | | | | | | | | | |
| | Electrical | 2800 | | | | | | | | | | | | | |

### Table 13 - Ratings for UL 489 Listed MasterPact NT Automatic Switches

| Frame Rating | | 800 A | | 1200 A | | 1600 A | |
|---|---|---|---|---|---|---|---|
| Withstand Rating Code | | HF | HB | HF | HB | HF | HB |
| Withstand Rating[20] (kA) Vac, 50/60 Hz | 240 | 65 | 200 | 65 | 200 | 65 | 200 |
| | 480 | 50 | 100 | 50 | 100 | 50 | 100 |
| | 600 | 50 | NA | 50 | NA | 50 | NA |
| Instantaneous Override (Peak kA) | | 90 | 22 | 90 | 22 | 90 | 22 |

19. Fixed-mounted only. 1600 A UL489 drawout circuit breakers are not available.
20. The withstand rating is the fault current (at rated voltage) that the switch will withstand without damage when protected by a circuit breaker with an equal continuous current rating.

## Table 14 - Ratings for IEC 60947-2 Rated MasterPact NT Circuit Breakers

| Frame Rating | | | 800/1000 A | | | 1250/1600 A | |
|---|---|---|---|---|---|---|---|
| Interrupting Rating Code | | | H1 | H2 | L1 | H1 | H2 |
| Ultimate Breaking Capacity (kA) | $I_{cu}$ | 220/415 Vac, 50/60 Hz | 42 | 50 | 150 | 42 | 50 |
| | | 440 Vac, 50/60 Hz | 42 | 50 | 130 | 42 | 50 |
| | | 525 Vac, 50/60 Hz | 42 | 42 | 100 | 42 | 42 |
| | | 690 Vac, 50/60 Hz | 42 | 42 | 25 | 42 | 42 |
| | | 1000 Vac, 50/60 Hz | — | — | — | — | — |
| Service Breaking Capacity (kA) | $I_{cs}$ | $\%I_{cu}$ | 100% | 100% | 100% | 100% | 100% |
| Short-Time Withstand Current (kA) | $I_{cw}$ | Vac 50/60 Hz, 1 s | 42 | 42 | 10 x $I_n$[21] | 42 | 36 |
| Built-In Instantaneous Override (kA ±10%) | | | — | 90 | 10[22] | — | — |
| Rated Making Capacity (Peak kA) | $I_{cm}$ | 220/415 Vac, 50/60 Hz | 88 | 105 | 330 | 88 | 105 |
| | | 440 Vac, 50/60 Hz | 88 | 105 | 286 | 88 | 105 |
| | | 525 Vac, 50/60 Hz | 88 | 88 | 220 | 88 | 88 |
| | | 690 Vac, 50/60 Hz | 88 | 88 | 52 | 88 | 88 |
| | | 1000 Vac, 50/60 Hz | — | — | — | — | — |
| Break Time | | ms | 25 | 25 | 9 | 25 | 25 |
| Closing Time | | ms | 50 | 50 | 50 | 50 | 50 |
| Endurance Rating (C/O cycles) (with no maintenance) | | Mechanical | 12,500 | 12,500 | 12,500 | 12,500 | 12,500 |
| | | Electrical 440 V | 6000 | 6000 | 3000 | 6000[23] | 6000[23] |
| | | Electrical 1000 V | — | — | — | — | — |

## Table 15 - Ratings for IEC 60947-3 Rated Non-Automatic MasterPact NT Switches

| Frame Rating | | | 800/1000 A | 1250/1600 A |
|---|---|---|---|---|
| Withstand Rating Code | | | HA | HA |
| Rated Making Capacity (Peak kA) | $I_{cm}$ | 220/415 Vac, 50/60 Hz | 75 | 75 |
| | | 440 Vac, 50/60 Hz | 75 | 75 |
| | | 500/690 Vac, 50/60 Hz | 75 | 75 |
| | | 1000 Vac, 50/60 Hz | — | — |
| Short-Time Withstand Current (kA) | $I_{cw}$ | Vac 50/60 Hz, 0.5 s | 36 | 36 |
| Breaking Capacity (kA at 690 Vac) (with external protection relay) | $I_{cu}$ | maximum delay 350 ms | 36 | 36 |

21. For Icw, 10 kA is for 0.5 s.
22. SELLIM system.
23. 1600 A at 690 V is 3000 electrical operations.

# MicroLogic Trip Units—Overview

## True RMS Current Sensing

The sensing system responds to the flow of current through the circuit breaker. Electronic trip circuit breakers are limited to ac systems because the electronic trip system uses current transformers to sense the current. The MicroLogic trip unit samples the current waveform to provide true RMS protection through the 15th harmonic.

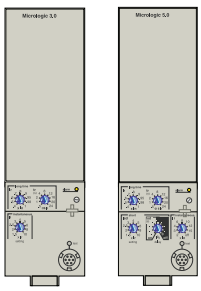
This true RMS sensing gives accurate values for the magnitude of a non-sinusoidal waveform. Therefore, the heating effects of harmonically distorted waveforms are accurately evaluated.

The MicroLogic H trip unit provides additional sampling of the waveforms to measure and provide waveform capture of harmonic distortion to the 31st harmonic.

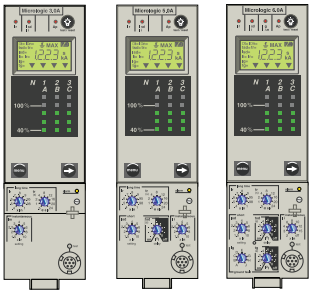
MasterPact universal power circuit breakers use MicroLogic electronic trip systems to sense overcurrents and trip the circuit breaker. The MicroLogic basic trip unit is standard and all MasterPact circuit breakers can be equipped with the optional MicroLogic trip systems listed below:

- MicroLogic Basic Trip Unit (standard).
  - — 2.0 basic protection (LS0, IEC)
  - — 3.0 basic protection (LI, UL®/ANSI)
  - — 5.0 selective protection (LSI)
- MicroLogic A: Trip Unit with Ammeter.
  - — 2.0A basic protection (LS0, IEC)
  - — 3.0A basic protection (LI, UL/ANSI)
  - — 5.0A selective protection (LSI)
  - — 6.0A selective protection with ground-fault protection for equipment (LSIG)
- MicroLogic P: Trip Unit with Power Metering.
  - — 5.0P selective protection (LSI)
  - — 6.0P selective protection with ground-fault protection for equipment (LSIG)
- MicroLogic H: Trip Unit with Harmonic Metering.
  - — 5.0H selective protection (LSI)
  - — 6.0H selective protection with ground-fault protection for equipment (LSIG)

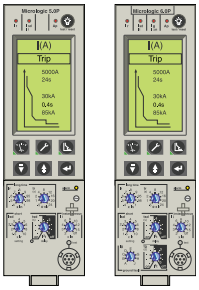
**MicroLogic 3.0 and 5.0 Basic Trip Units**



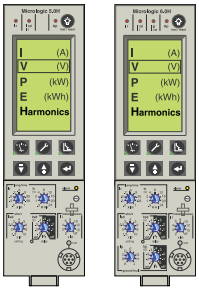
**MicroLogic 3.0A, 5.0A and 6.0A Trip Units**



**MicroLogic 5.0P and 6.0P Trip Units**



**MicroLogic 5.0H and 6.0H Trip Units**



### Table 24 - MicroLogic Trip Unit Features

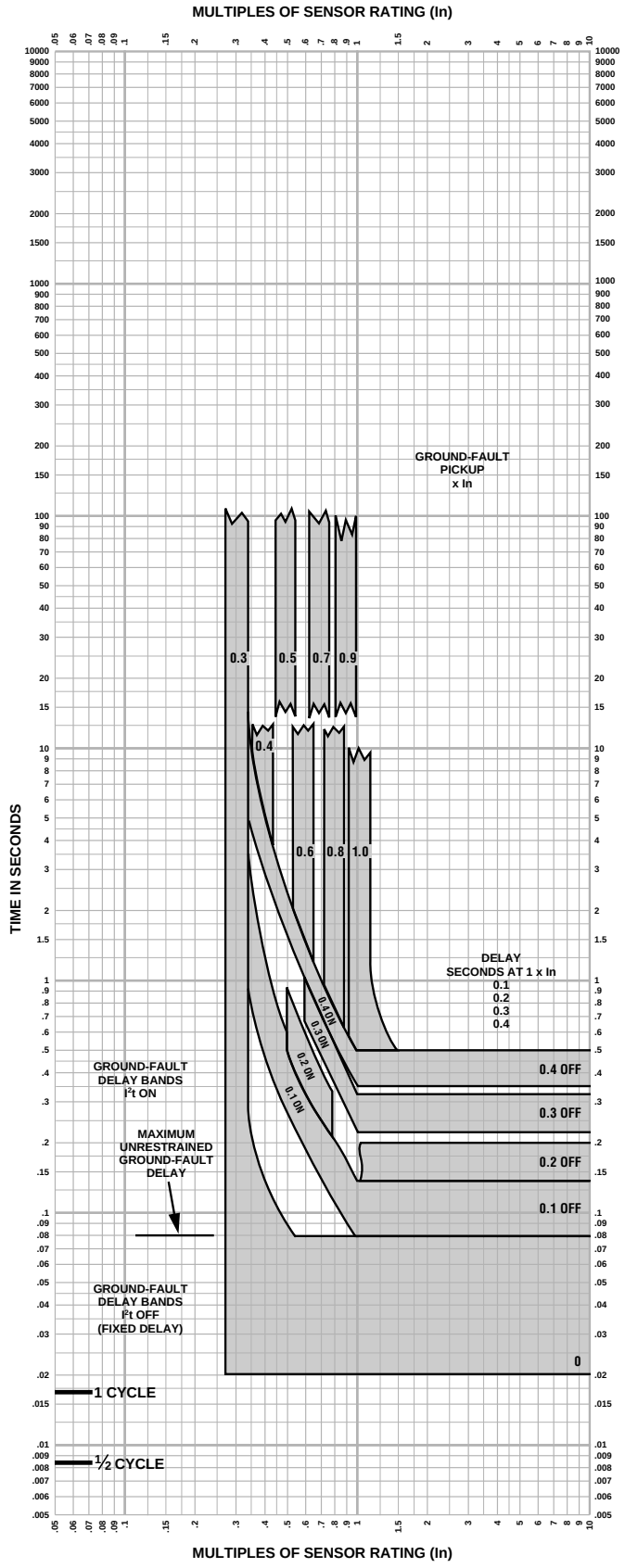
| | MicroLogic Trip Unit (X = Standard Feature O = Available Option) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Standard | | | Ammeter | | | | Power | | Harmonics | |
| Feature | 2 | 3 | 5 | 2.0A | 3.0A | 5.0A | 6.0A | 5.0P | 6.0P | 5.0H | 6.0H |
| LI | | X | | | X | | | | | | |
| LS0 | X | | | X | | | | | | | |
| LSI | | | X | | | X | | X | | X | |
| LSIG/Ground-Fault Trip | | | | | | | X | | X | | X |
| Ground-Fault Alarm/No Trip[30, 31] | | | | | | | | X | | X | |
| Ground-Fault Alarm and Trip[30, 31] | | | | | | | | | X | | X |
| Adjustable Rating Plugs | X | X | X | X | X | X | X | X | X | X | X |
| True RMS Sensing | X | X | X | X | X | X | X | X | X | X | X |
| UL Listed | | X | X | | X | X | X | X | X | X | X |
| Thermal Imaging | X | X | X | X | X | X | X | X | X | X | X |
| Phase-Loading Bar Graph | | | | X | X | X | X | X | X | X | X |
| LED for Long-Time Pick-Up | X | X | X | X | X | X | X | X | X | X | X |
| LED for Trip Indication | | | | X | X | X | X | X | X | X | X |
| Digital Ammeter | | | | X | X | X | X | X | X | X | X |
| Zone-Selective Interlocking[32] | | | | X | | X | X | X | X | X | X |
| Communications | | | | O | O | O | O | X | X | X | X |
| LCD Dot Matrix Display | | | | | | | | X | X | X | X |
| Advanced User Interface | | | | | | | | X | X | X | X |
| Protective Relay Functions | | | | | | | | X | X | X | X |
| Neutral Protection[30] | | | | | | | | X | X | X | X |
| Contact Wear Indication | | | | | | | | X | X | X | X |
| Incremental Fine Tuning of Settings | | | | | | | | X | X | X | X |
| Selectable Long-Time Delay Bands | | | | | | | | X | X | X | X |
| Power Measurement | | | | | | | | X | X | X | X |
| Power Quality Measurements | | | | | | | | | | X | X |
| Waveform Capture | | | | | | | | | | X | X |

30. Requires neutral current transformer on three-phase four-wire loads.
31. Requires the M2C/M6C Programmable Contact Module.
32. Not available for 2.0A trip unit as upstream devices.

# Trip Curves

## MicroLogic 6.0 A/P/H Trip Units

**Figure 183 - MicroLogic 6.0 A/P/H Trip Units: $I_n \leq 400$ A**

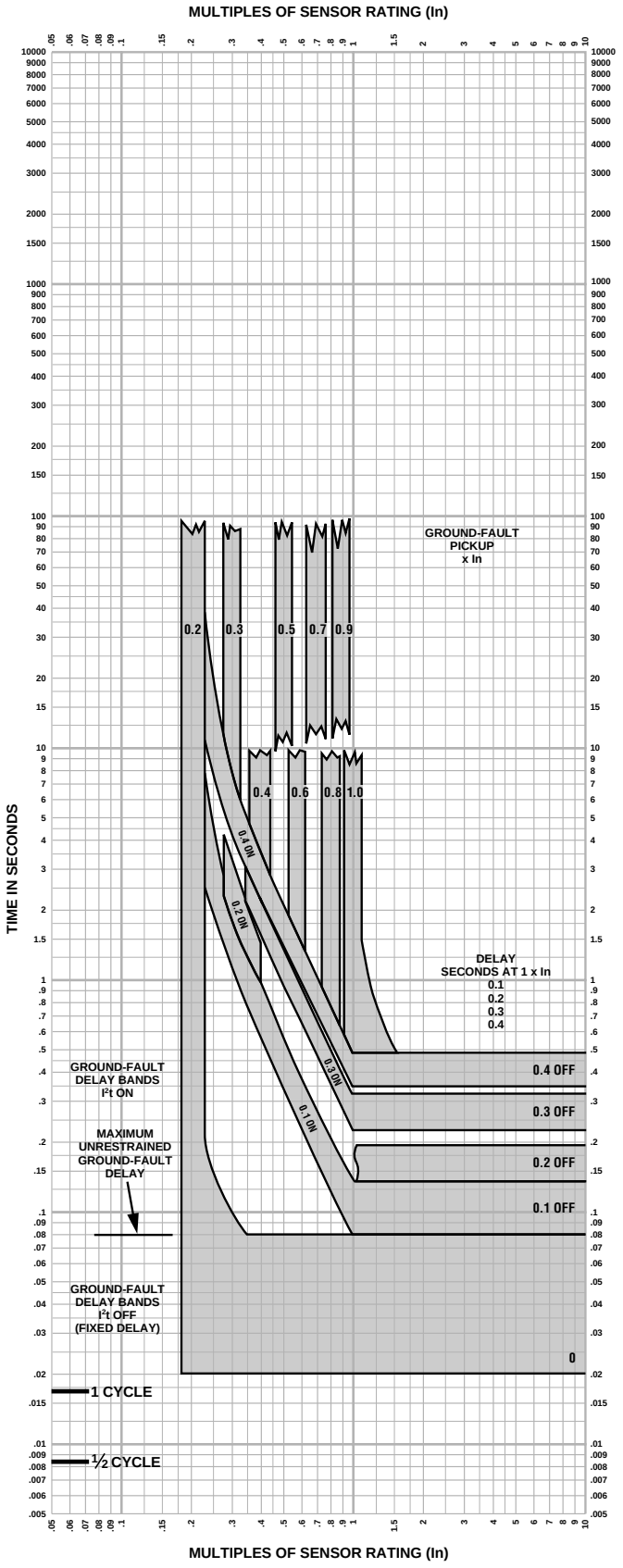



**MicroLogic 6.0 A/P/H Trip Units with Adjustable Ground-Fault Pickup and Delay**
**Characteristic Trip Curve No. 613-1**
Ground Fault $I^2t$ OFF and ON
**$I_n \leq 400$ A**

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**Figure 184 - MicroLogic 6.0 A/P/H Trip Units: 400 A < $I_n$ ≤ 1200 A**

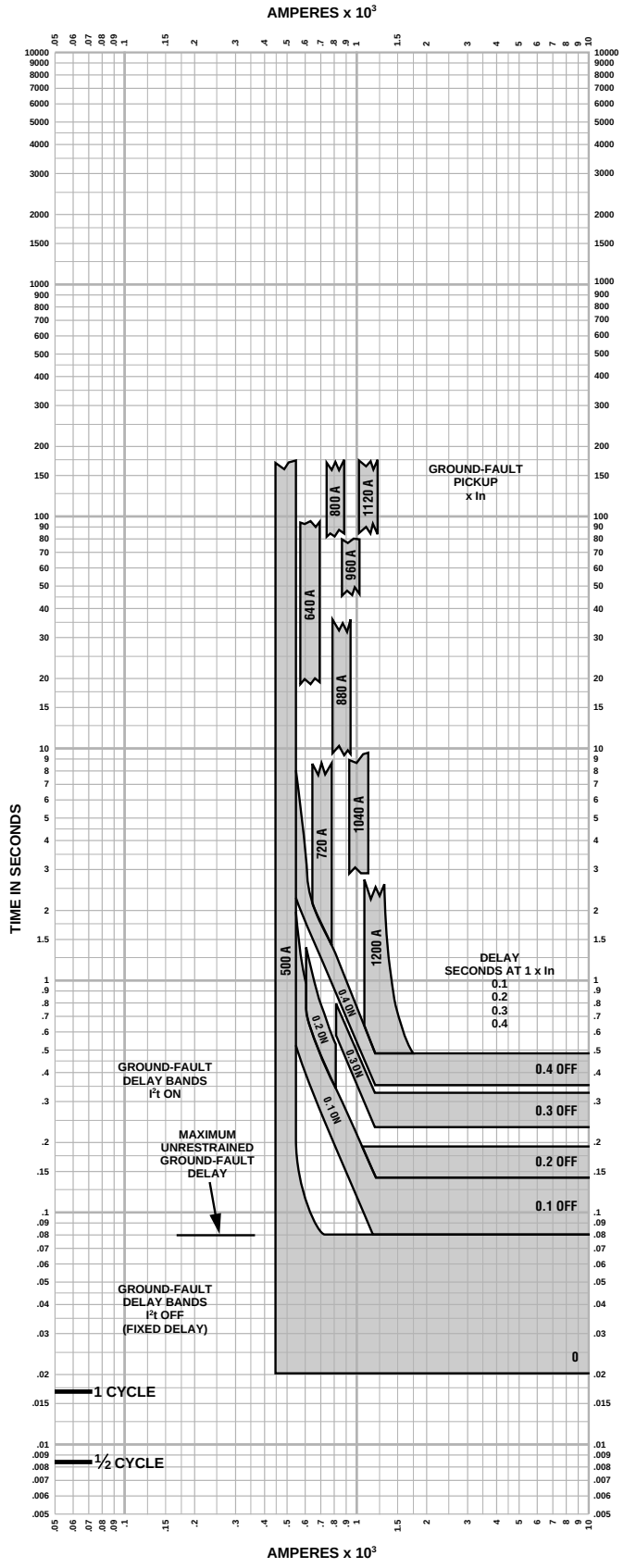



**MicroLogic 6.0 A/P/H Trip Units with Adjustable Ground-Fault Pickup and Delay Characteristic Trip Curve No. 613-2**
Ground Fault $I^2t$ OFF and ON
**400 A < $I_n$ ≤ 1200 A**

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**Figure 185 - MicroLogic 6.0 A/P/H Trip Units: $I_n$ > 1200 A**



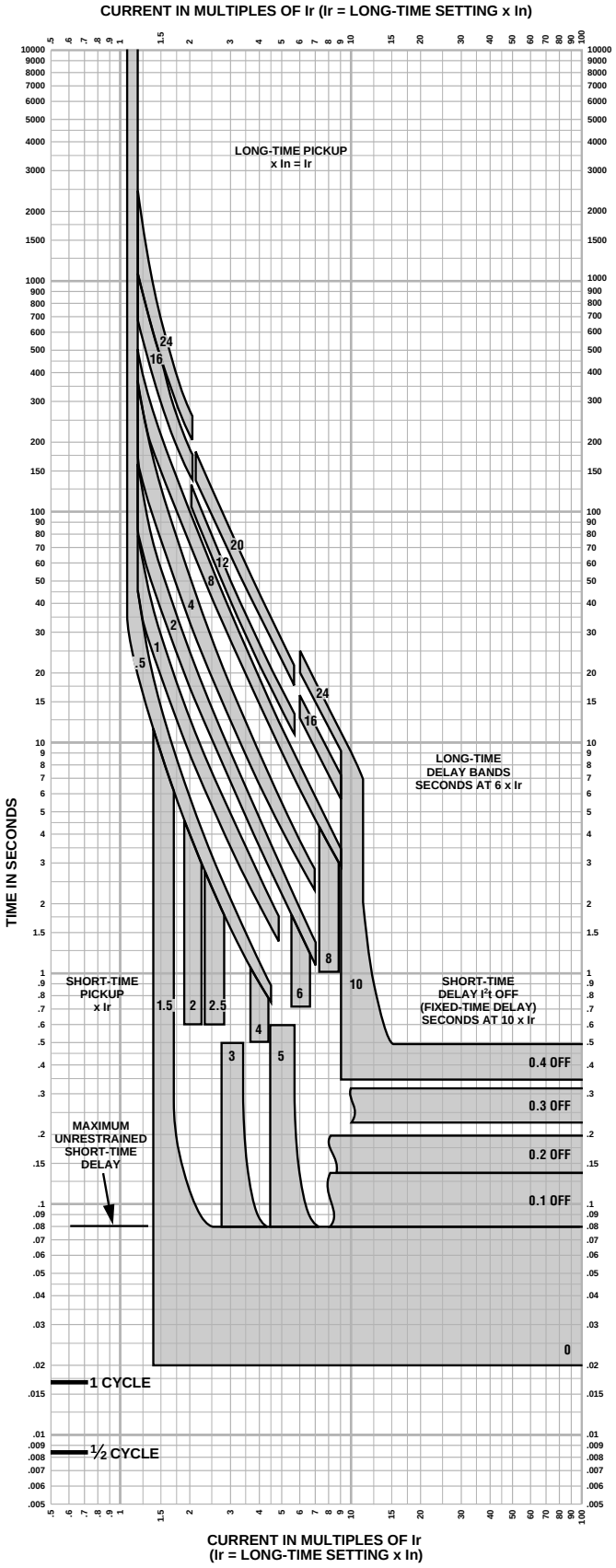

**MicroLogic 6.0 A/P/H Trip Units with Adjustable Ground-Fault Pickup and Delay Characteristic Trip Curve No. 613-3**
Ground Fault I²t OFF and ON
**$I_n$ > 1200 A**

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

# MicroLogic 5.0/6.0 A/P/H Trip Unit

**Figure 186 - MicroLogic 5.0/6.0 A/P/H Trip Units: Long-Time Pickup and Delay, Short-Time Pickup, and I²t OFF Delay**




**MicroLogic 5.0/6.0 A/P/H Trip Units**
**Characteristic Trip Curve No. 613-4**
Long-Time Pickup and Delay
Short-Time Pickup and I²t OFF Delay

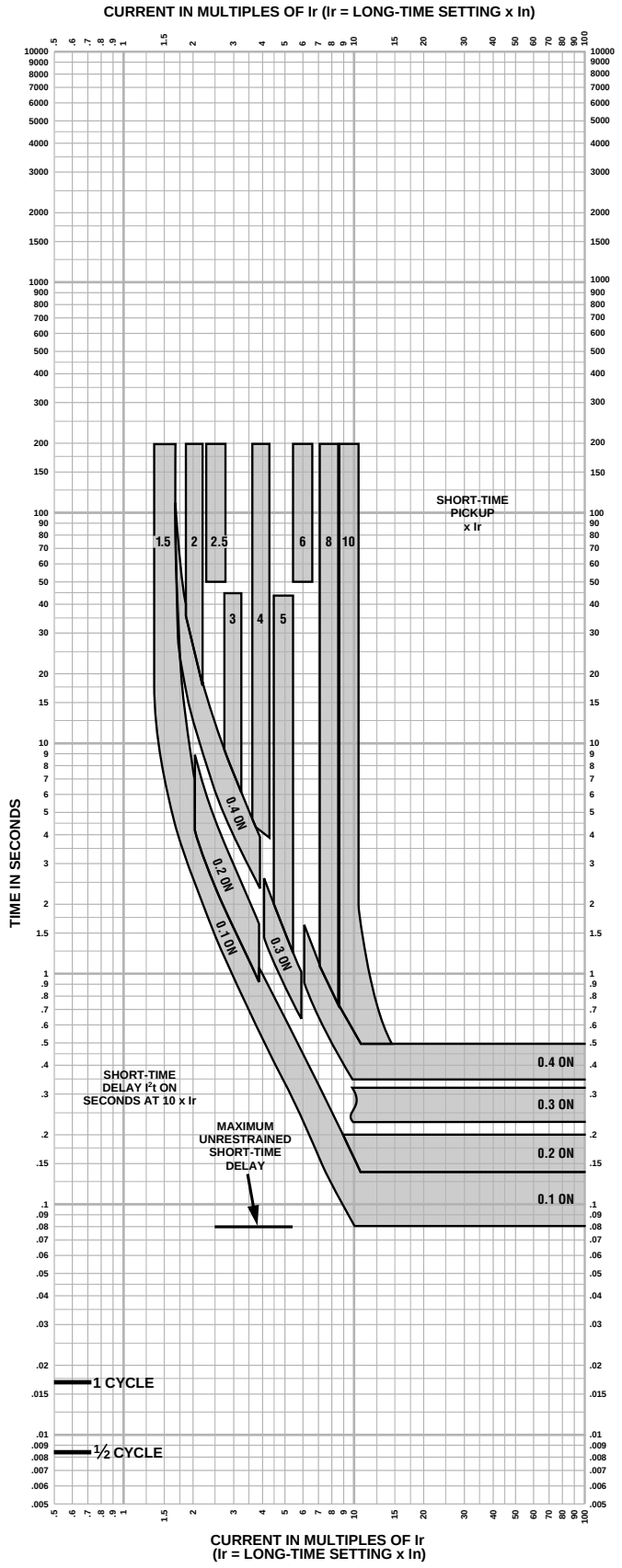
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**NOTE:**

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for instantaneous trip curve. See trip curve 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

**Figure 187 - MicroLogic 5.0/6.0 A/P/H Trip Units: Short-Time Pickup and I²t ON Delay**




**MicroLogic 5.0/6.0 A/P/H Trip Units**
**Characteristic Trip Curve No. 613-5**
Short-Time Pickup and I²t ON Delay

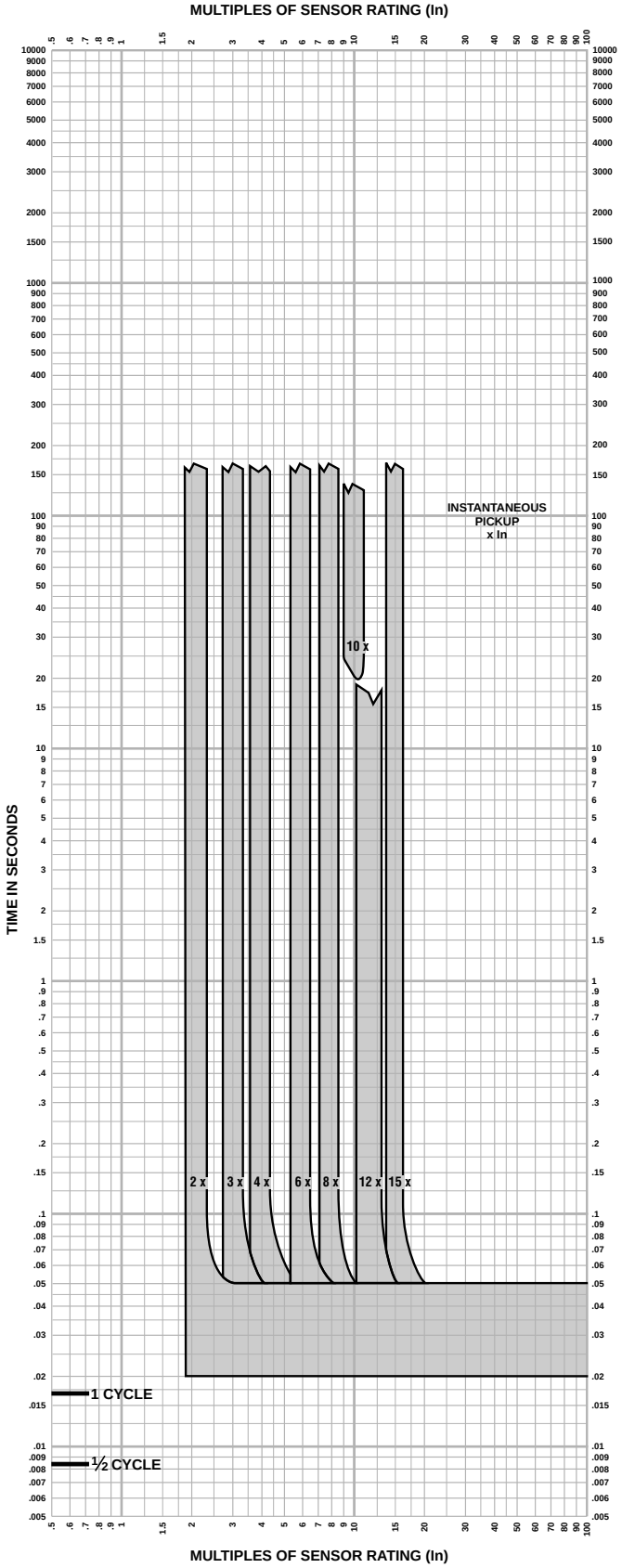
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**NOTE:**

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
5. For withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for instantaneous trip curve. See trip curve 613-10 for instantaneous override values.
6. See trip curve 613-4 for long-time pickup and delay trip curve.

**Figure 188 - MicroLogic 5.0/6.0 Trip Units: Instantaneous Pickup, 2x to 15x and OFF**




**MicroLogic 5.0/6.0 A/P/H Trip Units**
**Characteristic Trip Curve No. 613-7**
Instantaneous Pickup
2x–15x and OFF

The time-current curve information is to be used for application and coordination purposes only.

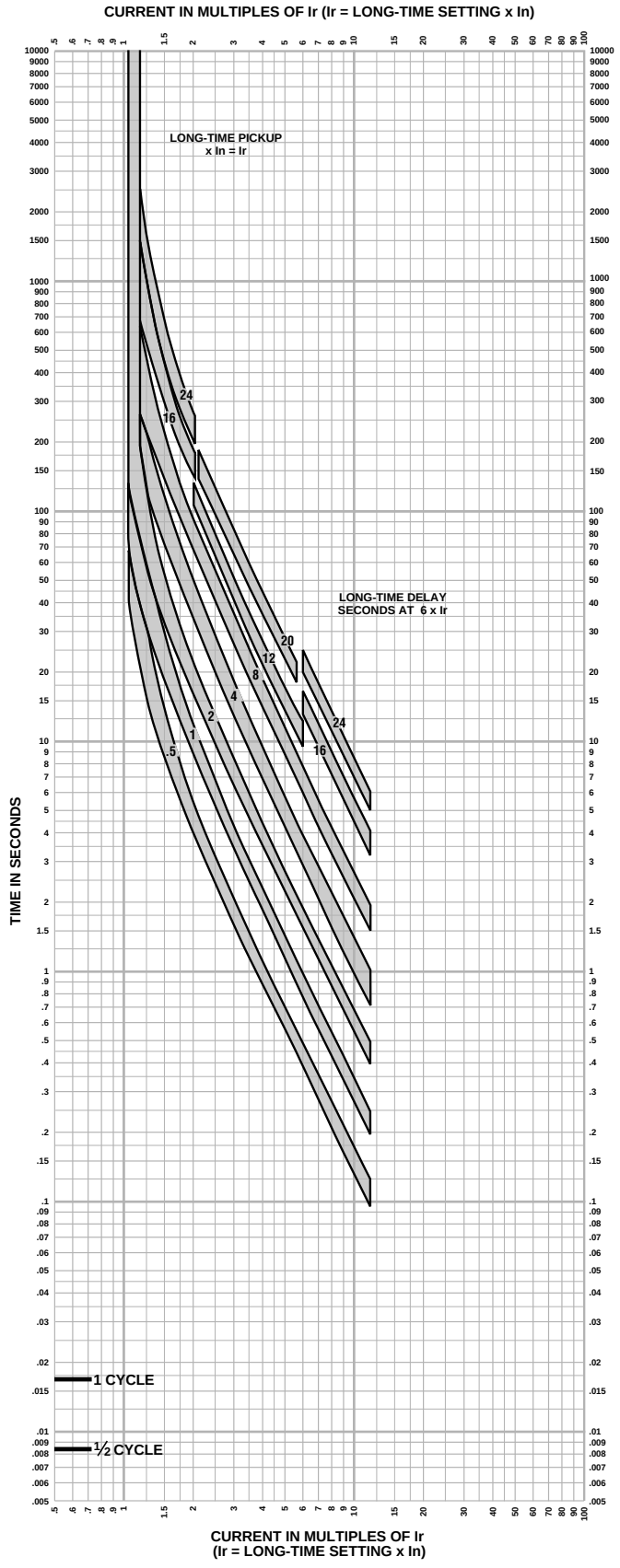
Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**NOTE:**

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
4. For withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-10 for instantaneous override values.
5. See trip curve 613-4 and 613-5 for long-time pickup, long-time delay, short-time pickup, and short-time delay trip curve.

# MicroLogic 3.0 Trip Units

**Figure 189 - MicroLogic 3.0A Trip Unit: Long-Time Pickup and Delay**




**MicroLogic 3.0 Trip Unit**
**Characteristic Trip Curve No. 613-6**
Long-Time Pickup and Delay

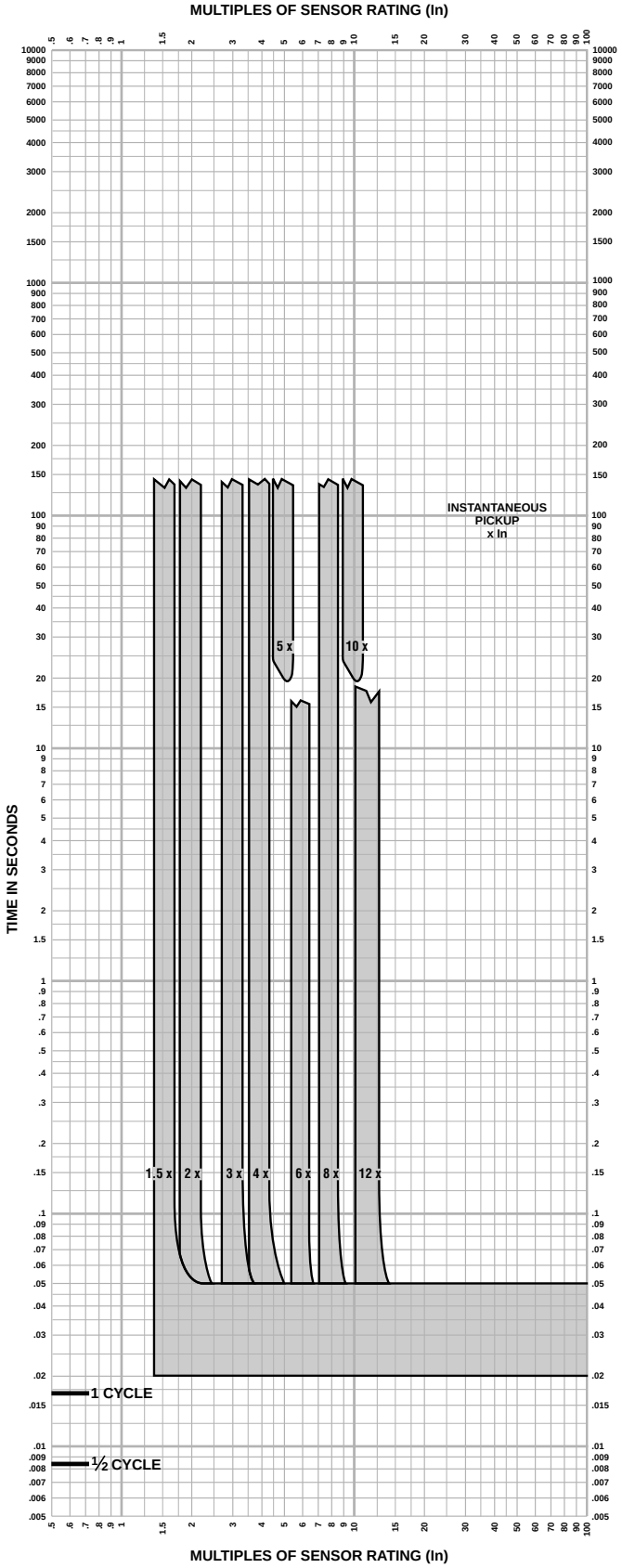
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

**NOTE:**

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the instantaneous setting of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
4. See trip curve 613-8 for instantaneous pickup trip curve.

**Figure 190 - MicroLogic 3.0A Trip Unit: Instantaneous Pickup, 1.5X to 12X**




**MicroLogic 3.0 Trip Units**
**Characteristic Trip Curve No. 613-8**
Instantaneous Pickup
1.5x–12x

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

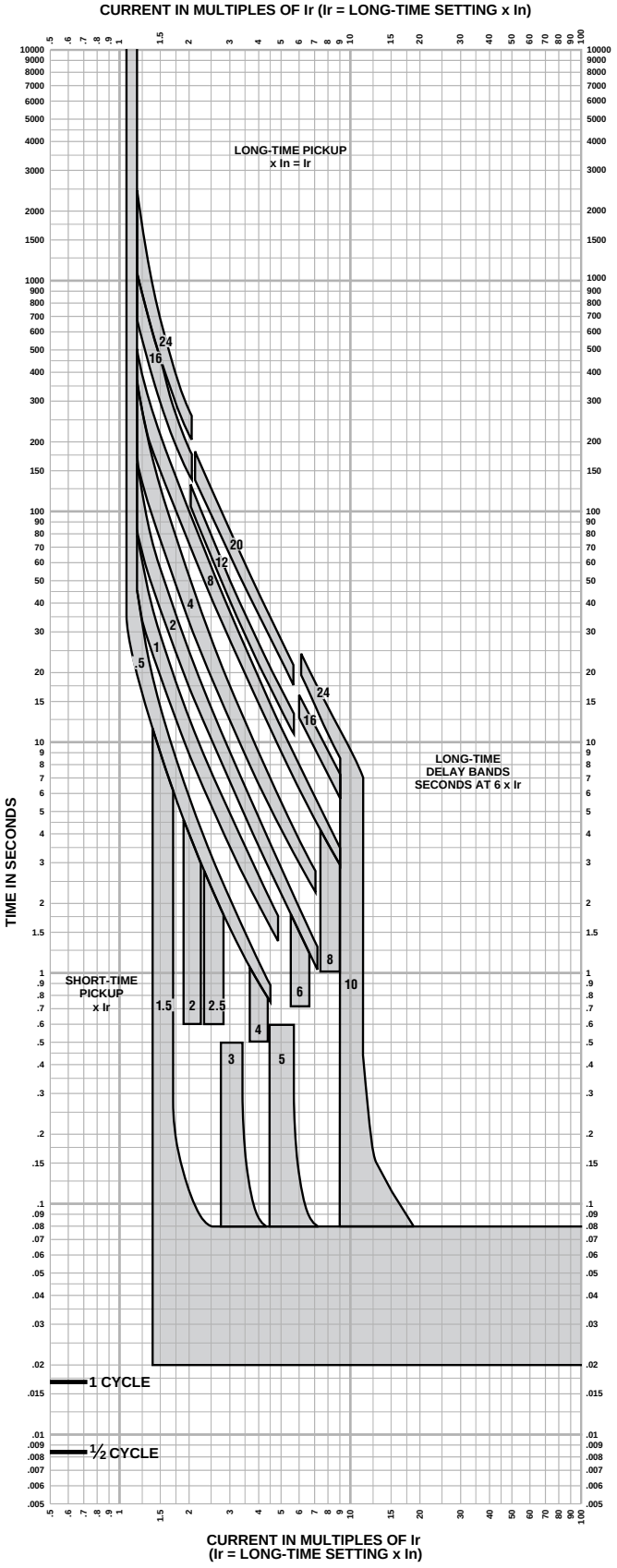
Instantaneous override values are given on 613-10.

**NOTE:**

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
4. See trip curve 613-6 for long-time pickup delay trip curve.

# MicroLogic 2.0A Trip Unit

**Figure 191 - MicroLogic 2.0A Trip Unit**




**MicroLogic 2.0 A Trip Unit**
**Characteristic Trip Curve No. 613-9**
Long-Time Pickup and Delay
Short-Time Pickup with No Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -25°C to +70°C (-13°F to +158°F) ambient temperature.

**NOTE:**

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the short-time setting.
3. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
4. Overload indicator illuminates at 100%.

# MicroLogic 2.0/3.0/5.0/6.0 A/P/H Trip Unit Instantaneous Override Values

## Instantaneous Override Values No. 613.10

**MasterPact NW/NT**

| ANSI CB Model No. | Inst. Override (kA Peak) +/- 10% |
|---|---|
| NW08N1 ★ | 55 |
| NW08N1 | None |
| NW16N1 | None |
| NW08H1 ★ | 55 |
| NW08H1 | None |
| NW16H1 | None |
| NW20H1 | None |
| NW32H1 | None |
| NW08H2 ★ | 55 |
| NW08H2 | None |
| NW16H2 | None |
| NW20H2 | None |
| NW32H2 | None |
| NW40H2 | None |
| NW50H2 | None |
| NW60H2 | None |
| NW08H3 ★ | 55 |
| NW08H3 | 190 |
| NW16H3 | 190 |
| NW20H3 | 190 |
| NW32H3 | 190 |
| NW40H3 | 190 |
| NW50H3 | 190 |
| NW60H3 | 190 |
| NW08L1 ★ | 55 |
| NW08L1 | 80 |
| NW08L1F | 55 |
| NW16L1 | 80 |
| NW16L1F | 55 |
| NW20L1 | 80 |
| NW20L1F | 55 |
| NW32L1 | 270 |
| NW40L1 | 270 |
| NW50L1 | 270 |
| NW60L1 | 270 |
| NW08HA | None |
| NW16HA | None |
| NW20HA | None |
| NW32HA | None |
| NW40HA | None |
| NW50HA | None |
| NW60HA | None |
| NW08HF | 190 |
| NW16HF | 190 |
| NW20HF | 190 |
| NW32HF | 190 |
| NW40HF | 190 |
| NW50HF | 190 |
| NW60HF | 190 |
| NW08HC | 80 |
| NW16HC | 80 |
| NW20HC | 80 |
| NW32HC | 270 |
| NW40HC | 270 |
| NW50HC | 270 |
| NW60HC | 270 |
| NT08N1 ★ | 55 |
| NT08N1 | None |
| NT08H1 ★ | 55 |
| NT08H1 | None |
| NT08L1F | 22 |
| NT08NA | None |

**MasterPact NW/NT**

| UL CB Model No. | Inst. Override (kA Peak) +/- 10% |
|---|---|
| NW08N ★ | 55 |
| NW08N | 90 |
| NW12N | 90 |
| NW16N | 90 |
| NW20N | 90 |
| NW08H ★ | 55 |
| NW08H | 90 |
| NW12H | 90 |
| NW16H | 90 |
| NW20H | 90 |
| NW25H | 150 |
| NW30H | 150 |
| NW40H | 170 |
| NW50H | 170 |
| NW60H | 170 |
| NW08L ★ | 55 |
| NW08L | 80 |
| NW08LF | 55 |
| NW12L | 80 |
| NW12LF | 55 |
| NW16L | 80 |
| NW16LF | 55 |
| NW20L | 150 |
| NW20LF | 55 |
| NW25L | 150 |
| NW30L | 150 |
| NW40L | 170 |
| NW50L | 170 |
| NW60L | 170 |
| NW08HF | 90 |
| NW12HF | 90 |
| NW16HF | 90 |
| NW20HF | 90 |
| NW25HF | 150 |
| NW30HF | 150 |
| NW40HF | 170 |
| NW50HF | 170 |
| NW60HF | 170 |
| NW08HB | 80 |
| NW12HB | 80 |
| NW16HB | 80 |
| NW20HB | 150 |
| NW25HB | 150 |
| NW30HB | 150 |
| NW40HB | 170 |
| NW50HB | 170 |
| NW60HB | 170 |
| NT08N ★ | 55 |
| NT08N | 90 |
| NT12N | 90 |
| NT16N | 90 |
| NT08H ★ | 55 |
| NT08H | 90 |
| NT12H | 90 |
| NT16H | 90 |
| NT08L1 | 22 |
| NT12L1 | 22 |
| NT16L1 | 22 |
| NT08L | 22 |
| NT08LF | 22 |
| NT12L | 22 |
| NT16L | 22 |
| NT12LF | 22 |
| NT08HF | 90 |
| NT12HF | 90 |

★ Maximum sensor plug 250 A

**MasterPact NW/NT**

| IEC CB Model No. | Inst. Override (kA Peak) +/- 10% |
|---|---|
| NW08N1 | None |
| NW10N1 | None |
| NW12N1 | None |
| NW16N1 | None |
| NW08H1 | None |
| NW10H1 | None |
| NW12H1 | None |
| NW16H1 | None |
| NW20H1 | None |
| NW25H1 | None |
| NW32H1 | None |
| NW40H1 | None |
| NW40bH1 | None |
| NW50H1 | None |
| NW63H1 | None |
| NW08H2 ★ | 55 |
| NW08H2 | 190 |
| NW10H2 | 190 |
| NW16H2 | 190 |
| NW20H2 | 190 |
| NW25H2 | 190 |
| NW32H2 | 190 |
| NW40H2 | 190 |
| NW40bH2 | 190 |
| NW50H2 | 270 |
| NW63H2 | 270 |
| NW20H3 | 150 |
| NW25H3 | 150 |
| NW32H3 | 150 |
| NW40H3 | 150 |
| NW08L1 ★ | 55 |
| NW08L1 | 80 |
| NW10L1 | 80 |
| NW12L1 | 80 |
| NW16L1 | 80 |
| NW20L1 | 80 |
| NW08H10 | None |
| NW10H10 | None |
| NW12H10 | None |
| NW16H10 | None |
| NW20H10 | None |
| NW25H10 | None |
| NW32H10 | None |
| NW40H10 | None |
| NW08NA | None |
| NW10NA | None |
| NW16NA | None |
| NW08HA | None |
| NW10HA | None |
| NW12HA | None |
| NW16HA | None |
| NW20HA | None |
| NW25HA | None |
| NW32HA | None |
| NW40HA | None |
| NW40bHA | None |
| NW50HA | None |
| NW63HA | None |
| NW08HF | 190 |
| NW10HF | 190 |
| NW12HF | 190 |
| NW16HF | 190 |
| NW20HF | 190 |
| NW25HF | 190 |
| NW32HF | 190 |
| NW40HF | 190 |
| NW08HA10 | None |
| NW10HA10 | None |
| NW12HA10 | None |
| NW16HA10 | None |
| NW20HA10 | None |
| NW25HA10 | None |
| NW32HA10 | None |
| NW40HA10 | None |
| NT08H1 | None |
| NT10H1 | None |
| NT12H1 | None |
| NT16H1 | None |
| NT08L1 | 22 |
| NT08H10 | None |
| NT10H10 | None |
| NT12H10 | None |
| NT16H10 | None |
| NT08HA | None |
| NT10HA | None |
| NT12HA | None |
| NT16HA | None |
| NT08HA10 | None |
| NT10HA10 | None |
| NT12HA10 | None |
| NT16HA10 | None |

**PowerPact / ComPact**

| UL/IEC CB Model No. | Inst. Override (kA Peak) +/- 10% |
|---|---|
| RG600 | 130 |
| RG800 | 130 |
| RG1000 | 130 |
| RG1200 | 130 |
| RG1600 | 130 |
| RG2000 | 130 |
| RG2500 | 130 |
| RJ600 | 110▲ |
| RJ800 | 110▲ |
| RJ1000 | 110▲ |
| RJ1200 | 110▲ |
| RJ1600 | 110▲ |
| RJ2000 | 110▲ |
| RJ2500 | 110▲ |
| RK600 | 130 |
| RK800 | 130 |
| RK1000 | 130 |
| RK1200 | 130 |
| RK1600 | 130 |
| RK2000 | 130 |
| RK2500 | 130 |
| RL600 | 110▲ |
| RL800 | 110▲ |
| RL1000 | 110▲ |
| RL1200 | 110▲ |
| RL1600 | 110▲ |
| RL2000 | 110▲ |
| RL2500 | 110▲ |
| PG250 | 55 |
| PG400 | 55 |
| PG600 | 55 |
| PG800 | 55 |
| PG1000 | 55 |
| PG1200 | 55 |
| PJ250 | 15 |
| PJ400 | 22 |
| PJ600 | 22 |
| PJ800 | 22 |
| PJ1000 | 22 |
| PJ1200 | 22 |
| PK250 | 55 |
| PK400 | 55 |
| PK600 | 55 |
| PK800 | 55 |
| PK1000 | 55 |
| PK1200 | 55 |
| PL250 | 15 |
| PL400 | 22 |
| PL600 | 22 |
| PL800 | 22 |
| PL1000 | 22 |
| PL1200 | 22 |

| IEC CB Model No. | Inst. Override (kA Peak) +/- 10% |
|---|---|
| NS800bN | 130 |
| NS1000bN | 130 |
| NS1250bN | 130 |
| NS1600bN | 130 |
| NS2000N | 130 |
| NS2500N | 130 |
| NS3200N | 130 |
| NS800bH | 110▲ |
| NS1000bH | 110▲ |
| NS1250bH | 110▲ |
| NS1600bH | 110▲ |
| NS2000H | 110▲ |
| NS2500H | 110▲ |
| NS3200H | 110▲ |
| NS630bN | 55 |
| NS800N | 55 |
| NS1000N | 55 |
| NS1250N | 55 |
| NS1600N | 55 |
| NS630bH | 55 |
| NS800H | 55 |
| NS1000H | 55 |
| NS1250H | 55 |
| NS1600H | 55 |
| NS630bL | 55 |
| NS800L | 55 |
| NS1000L | 55 |
| NS1250L | 55 |
| NS1600L | 55 |

▲ Tolerance +/- 15%

**Note:**
Faults at or above instantaneous override value will be cleared at 25 msec or less.

# MasterPact NW/NT Low Arc Flash Circuit Breakers

**Figure 192 - MasterPact NW Low Arc Flash Circuit Breaker: L1F and LF**

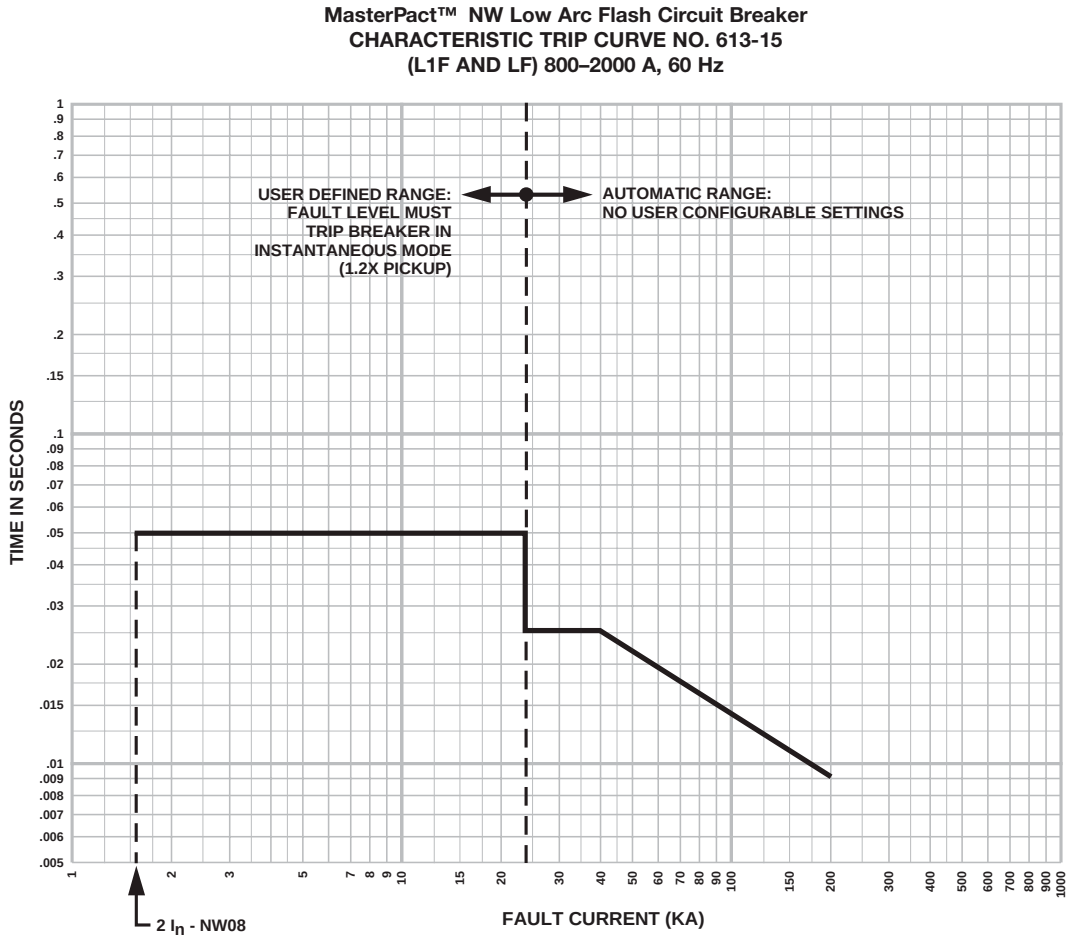
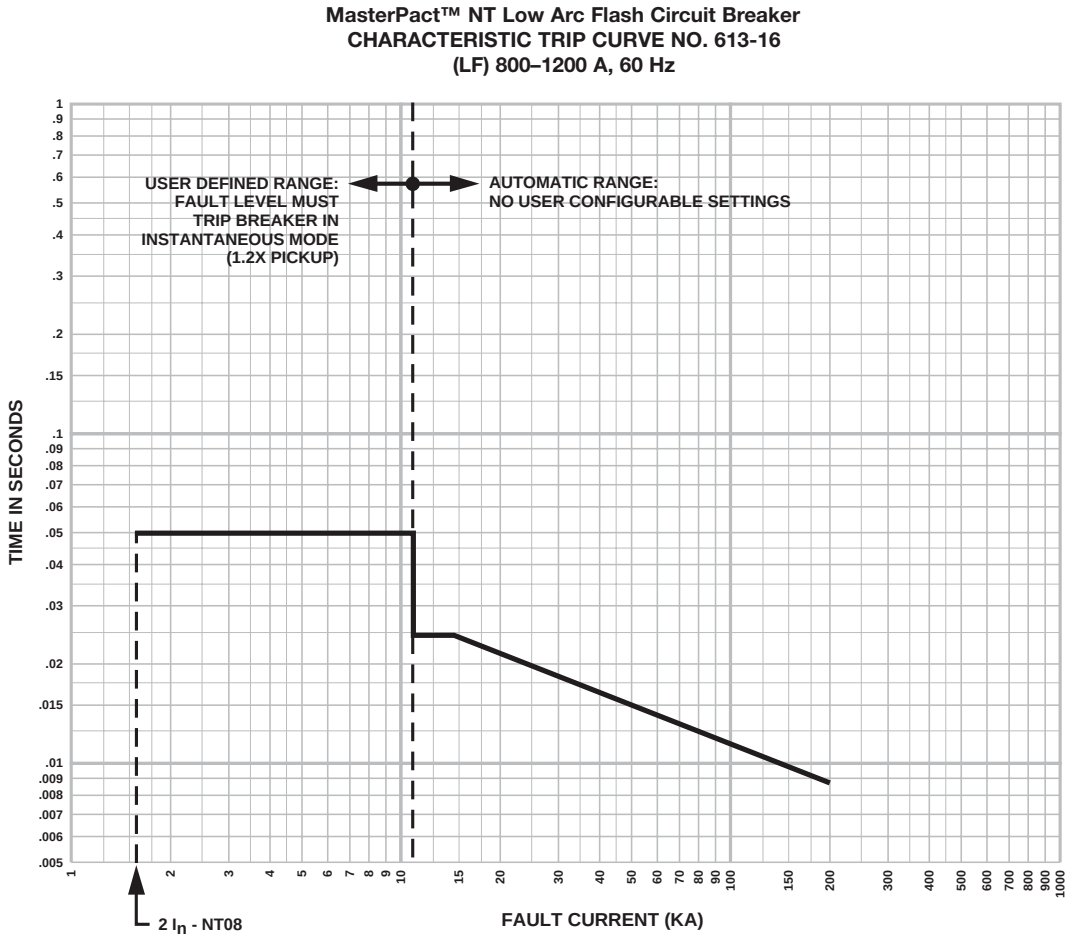


**Figure 193 - MasterPact NT Low Arc Flash Circuit Breaker: L1F and LF**



Schneider Electric
800 Federal Street
Andover, MA 01810
USA

888–778–2733

www.se.com

As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.



0613CT0001

# SEL-751 Feeder Protection Relay

## Directional Overcurrent, Arc-Flash Detection, and High-Impedance Fault Detection


Five-Inch, Color Touchscreen Display Model With Four Pushbuttons


Five-Inch, Color Touchscreen Display Model With Eight Pushbuttons


Two-Line Display Model With Four Pushbuttons


Two-Line Display Model With Eight Pushbuttons

## New Features

- Extended support for LEA voltage sensor inputs and Rogowski coil or low-power current transformer (LPCT) inputs. The optional Slot Z card allows low-energy voltage and currents analogs selection.
- Added a new optional Slot E card that provides Vsync/Vbat and 7 additional digital inputs.
- Added phase discontinuity detection to detect open phase condition based on unbalanced currents.
- Added the broken conductor algorithm to detect faults due to a broken conductor on single-circuit lines based on the charging current of the line.
- Added the cold-load pickup element to prevent an overcurrent condition caused by re-energizing a distribution circuit after an extended outage.

- ➤ Added a setting selection for choosing any phase-to-neutral or phase-to-phase voltage for single-phase application.
- ➤ Enhanced the incipient cable fault detection logic to monitor the neutral current input.
- ➤ Added analog quantities that accurately show the breaker operate times for opening and closing of the breaker.

# Major Features and Benefits

The SEL-751 Feeder Protection Relay provides a comprehensive combination of protection, fault-locating features, monitoring, control, and communication in an industrial package.

The SEL-751 protection features depend on the model selected. The models are configured with specific current/voltage input cards. *Table 1* shows current (ACI) and voltage (AVI) card selections for the SEL-751 models.

**Table 1 Current (ACI) and Voltage (AVI) Card Selection for SEL-751 Models**

| Model Description | Slot Z Card Option (MOT String Digital Number 14, 15) | Slot Z Inputs | Slot E Card Option (MOT String Digits Number 12, 13) | Slot E Inputs |
|---|---|---|---|---|
| Base SEL-751 AC Currents Only | 4 ACI (A1, A2, A3, A5, A6, A7) | IA, IB, IC, IN | None (0X) | None |
| SEL-751 With AC Voltages (300 Vac) | 4 ACI/3 AVI (81, 82, 83, 85, 86, 87) | IA, IB, IC, IN, VA, VB, VC | None (0X) | None |
| SEL-751 With LEA AC Voltages (8 Vac) | 4 ACI/3 AVI (L1, L2, L3, L5, L6, L7) | IA, IB, IC, IN, VA, VB, VC | None (0X) | None |
| SEL-751 With AC Phase Voltages (300 Vac), Vsync (300 Vac), Vbat (300 V) Input, and 4 Arc-Flash Detection Inputs | 4 ACI/3 AVI (81, 82, 83, 85, 86, 87) | IA, IB, IC, IN, VA, VB, VC | 2 AVI/4 AFDI (70) | VS, VBAT, AF1, AF2, AF3, AF4 |
| SEL-751 With LEA AC Phase Voltages (8 Vac), LEA Vsync (8 Vac), Vbat (300 V) Input, and 4 Arc-Flash Detection Inputs | 4 ACI/3 AVI (L1, L2, L3, L5, L6, L7) | IA, IB, IC, IN, VA, VB, VC | 2 AVI/4 AFDI (L0) | VS, VBAT, AF1, AF2, AF3, AF4 |
| SEL-751 With LEA Voltage Sensor Inputs, Rogowski Coil or Low Power Current Inputs, 200 mA Neutral Inputs, and 7 Digital Inputs | 4 ACI/3 AVI (7L) | IA, IB, IC, IN, VA, VB, VC | 2 AVI/7 DI (LA, LB, LC, LD, LG, LH) | VS, VBAT, 7 DI |

The SEL-751 supports current and voltage sensor inputs. The current sensors are based on Rogowski coils/low-power current transformers (LPCT), and the voltage sensors are based on resistive or capacitive voltage dividers.

A Rogowski coil is a toroidal coil, without an iron core, that is placed around the primary conductor. The core, therefore, is pure air versus the ferromagnetic core used in traditional current transformers. The output signal of a Rogowski coil is a voltage that is then processed and integrated by the relay. The Rogowski coil operates linearly over a wide dynamic range from metering to protection. It completely eliminates the primary issues associated with inductive open circuits and saturation during fault conditions for traditional CTs.

*Figure 1* shows Slot Z LEA current input with Rogowski coil connection.

**Figure 1**

The SEL-751 offers an extensive variety of protection features, depending on the model and options selected. *Table 2* lists the protection features available in each model.

**Table 2 SEL-751 Protection Elements** (Sheet 1 of 2)

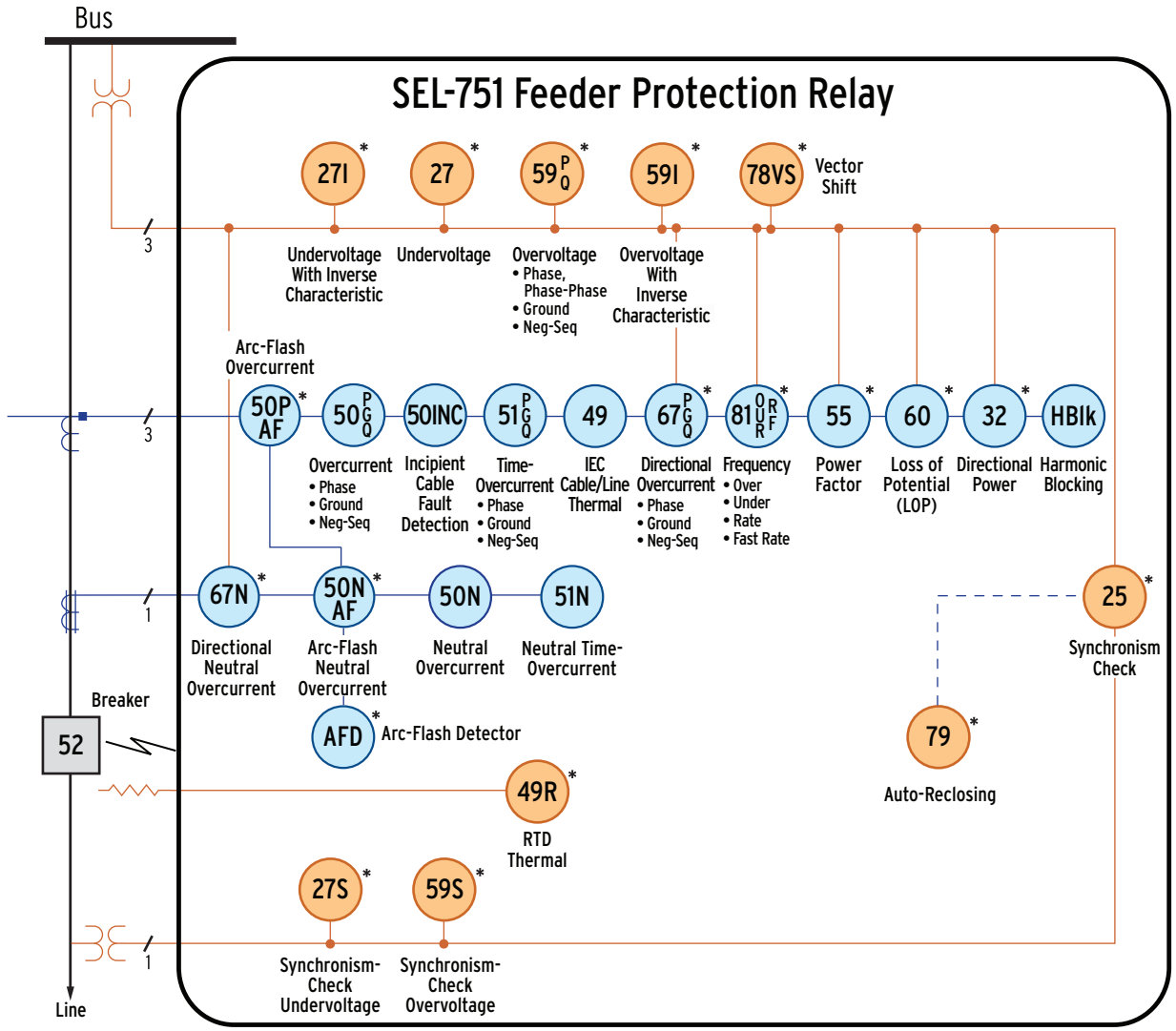
| Protection Element | | Slot Z 4 ACI Card (Current Only Model) With 1 A or 5 A Neutral Channel | Slot Z 4 ACI/ 3 AVI Card With 1 A or 5 A Neutral Channel | Slot Z 4 ACI/ 3 AVI Card With 200 mA Neutral Channel | Slot Z 4 ACI/ 3 AVI LEA Card With 200 mA Neutral Channel |
|---|---|---|---|---|---|
| 50P | Max. Phase Overcurrent | X | X | X | X |
| 67P | Max. Phase Overcurrent With Directional Control | | X[a] | X[b] | X[b] |
| 50Q | Neg.-Seq. Overcurrent | X | X | X | X |
| 67Q | Neg.-Seq. Overcurrent With Directional Control | | X[a] | X[b] | X[b] |
| 50G | Residual Overcurrent | X | X | X | X |
| 67G | Residual Overcurrent With Directional Control | | X[a] | X[b] | X[b] |
| 50N | Neutral Overcurrent | X | X | X | X |
| 67N | Neutral Overcurrent With Directional Control | | | X[b] | X[b] |
| 50INC | Incipient Cable Fault Detection | X | X | X | X |
| 51*m*P | Phase Time Overcurrent (*m* = A, B, C) | X | X | X | X |
| 51P | Max. Phase Time Overcurrent | X | X | X | X |
| 51P | Max. Phase Time Overcurrent With Directional Control | | X[a] | X[b] | X[b] |
| 51G | Residual Time Overcurrent | X | X | X | X |
| 51G | Residual Time Overcurrent With Directional Control | | X[a] | X[b] | X[b] |

**Table 2 SEL-751 Protection Elements** (Sheet 2 of 2)

| Protection Element | | Slot Z 4 ACI Card (Current Only Model) With 1 A or 5 A Neutral Channel | Slot Z 4 ACI/ 3 AVI Card With 1 A or 5 A Neutral Channel | Slot Z 4 ACI/ 3 AVI Card With 200 mA Neutral Channel | Slot Z 4 ACI/ 3 AVI LEA Card With 200 mA Neutral Channel |
|---|---|---|---|---|---|
| 51Q | Neg.-Seq. Time Overcurrent | X | X | X | X |
| 51Q | Neg.-Seq. Time Overcurrent With Directional Control | | X[a] | X[b] | X[b] |
| 51N | Neutral Time Overcurrent | X | X | X | X |
| 51N | Neutral Time Overcurrent With Directional Control | | | X[b] | X[b] |
| SEF | Sensitive Earth Fault | | | X | X |
| HBL | Second- and Fifth-Harmonic Blocking | X | X | X | X |
| FLOC | Fault Locator | | X | X | X |
| 27 | Undervoltage (Phase, Phase-to-Phase, Vsync) | | X | X | X |
| 59 | Overvoltage (Phase, Phase-to-Phase, Seq., Vsync) | | X | X | X |
| 27I | Inverse Time Undervoltage | | X | X | X |
| 59I | Inverse Time Overvoltage | | X | X | X |
| 60LOP | Loss of Potential | | X | X | X |
| 32 | Directional Power | | X | X | X |
| 49T | IEC Thermal (Line/Cable) | X | X | X | X |
| 55 | Power Factor | | X | X | X |
| 78VS | Vector Shift | | X | X | X |
| 81 | Over- and Underfrequency | X | X | X | X |
| 81R | Rate-of-Change of Frequency | | X | X | X |
| 81RF | Fast Rate-of-Change of Frequency | | X | X | X |
| 25 | Synchronism Check | | X[c] | X[c] | X[c] |
| BF | Breaker Failure | X | X | X | X |
| 49RTD | Resistance Temperature Detectors (RTDs) | X[d] | X[d] | X[d] | X[d] |
| 79 | Reclosing | X[d] | X[d] | X[d] | X[d] |
| HIF AST | High-Impedance Fault Detection With Arc Sense Technology | | X[d] | X[d] | X[d] |
| AFT | Arc-Flash Detection | X[d] | X[d] | X[d] | X[d] |
| PPD | Phase Discontinuity Detection | | X | X | X |
| BCD | Broken Conductor Detection | | X[d, e] | X[d, e] | X[d, e] |
| CLPU | Cold-Load Pickup Element | X | X | X | X |

[a] Available when ordered with the directional option. The 1 A/5 A neutral channel is suitable for solidly grounded systems and also impedance-grounded systems, depending on the available fault current level.
[b] Available when ordered with the directional option. The 200 mA neutral channel is suitable for ungrounded, low-impedance grounded, high-impedance grounded, and Petersen coil-grounded applications.
[c] Available with the 2 AVI/4 AFDI or 2 AVI/7 DI card in Slot E.
[d] Available as ordering options.
[e] Available only for models with Arc Sense technology.

# Functional Overview




- Low-Energy Analogs (LEA) for AC Voltage Inputs (8 Vac RMS)*
- LEA Voltage Sensor Inputs, Rogowski Coil/LPCT Current Inputs, and Conventional 200 mA Sensitive Neutral Input
- Sequential Events Recorder
- Event Reports and Load Profile
- Web Server
- SEL ASCII, Modbus RTU, Ethernet*, Modbus TCP*, IEC 61850 Edition 2*, DNP3 LAN/WAN*, DNP3 Serial*, SNTP*, IEEE 1588-2008 firmware-based PTP*, Telnet*, IEC 60870-5-103*, EtherNet/IP*, PRP*, FTP*, and DeviceNet Communications*
- Event Messenger Compatible
- Two Inputs and Three Outputs Standard
- I/O Expansion*–Additional Contact Inputs/Outputs, Analog Inputs/Outputs, and RTD Inputs
- ST Fiber-Optic Communications Port*
- Single or Dual Ethernet, Copper or Fiber-Optic Communications Port*
- Battery-Backed Clock, IRIG-B Time Synchronization
- Instantaneous Metering
- Four or Eight Programmable Front-Panel Pushbuttons and Tricolor LED Indicators
- Advanced SELogic® Control Equations
- 32 Programmable Display Messages
- Station Battery Monitor*
- Breaker Wear Monitoring
- Synchrophasor Protocol (IEEE C37.118-2005)
- Arc-Flash Protection*
- Peak Demand, Demand Metering
- Cold Load Pickup
- Load Encroachment
- High-Impedance Fault Detection*
- Phase Discontinuity Detection
- Broken Conductor Detection*
- Fault Locator
- Directional Protection*
- Mirrored Bits Communications
- Front-Panel Tricolor LED Programmable Targets
- Front-Panel HMI With 2 x 16-Character LCD
- 5-Inch, Color, 800 x 480-Pixel Touchscreen Display*

*Optional Functions

**Figure 2 Functional Diagram**

# Hardware Overview

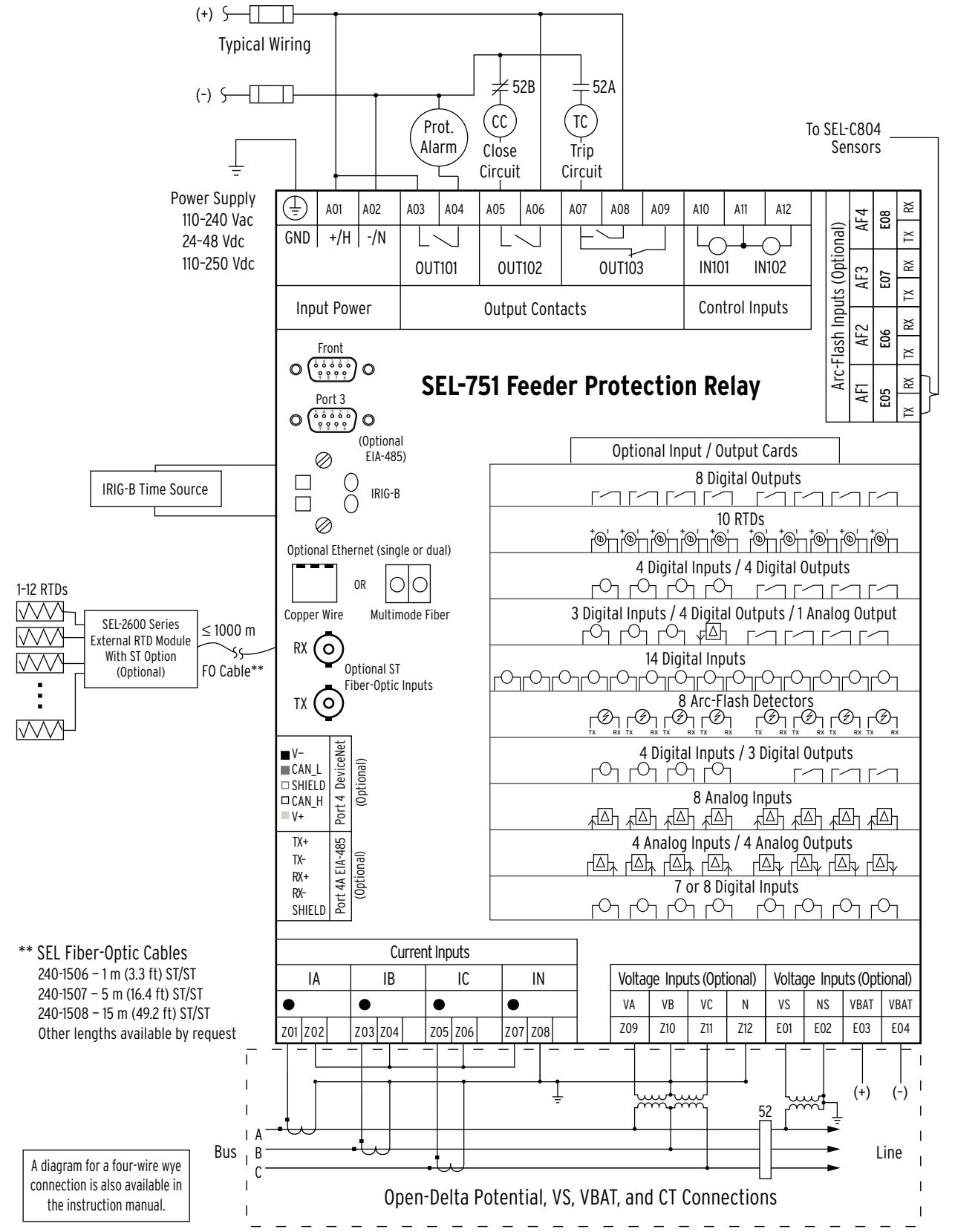



**Figure 35 SEL-751 Wiring Diagram**

# Relay Panel Diagrams

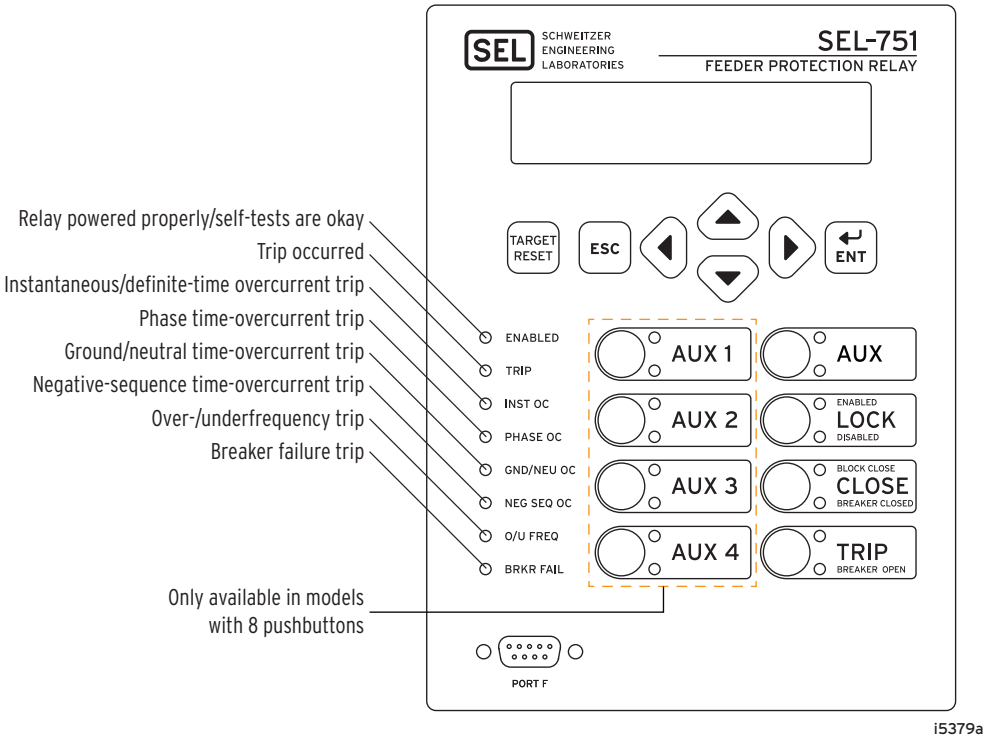
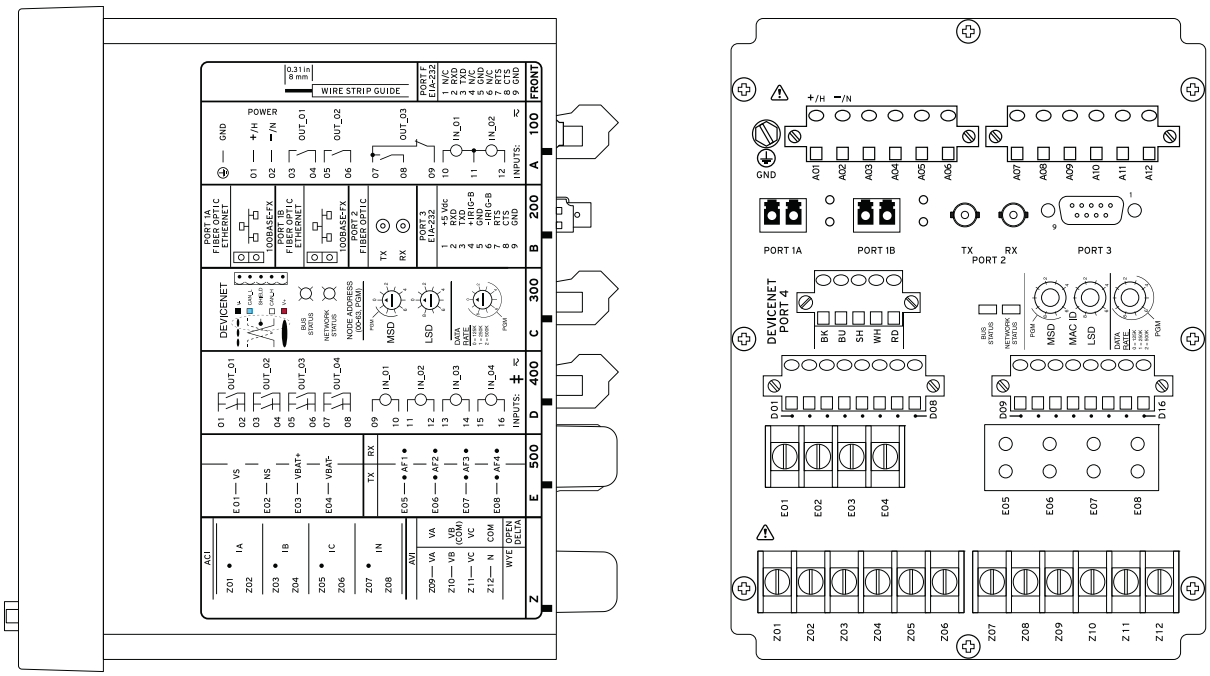



**Figure 36 Front Panel With Default Configurable Labels**

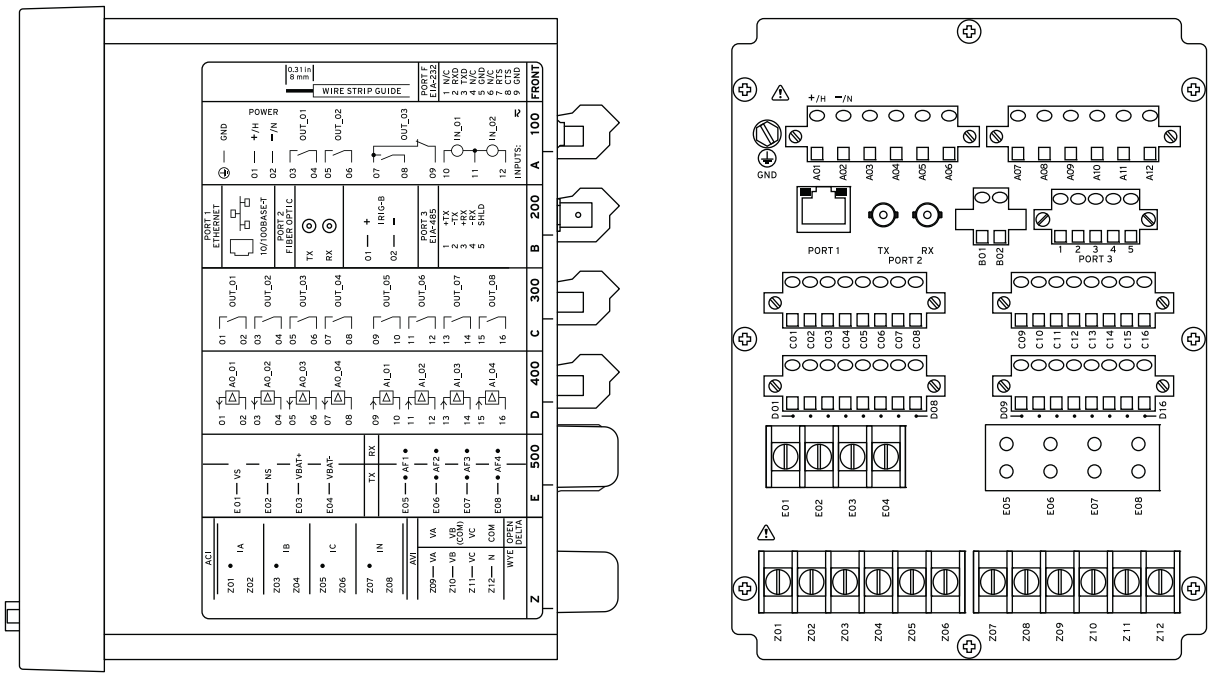



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 37 Dual Fiber Ethernet With 2 AVI/4 AFDI Voltage Option With Arc-Flash Detector Inputs, DeviceNet Card, and Fast Hybrid 4 DI/4 DO Card (Relay MOT 751501AA3CA70850830)**

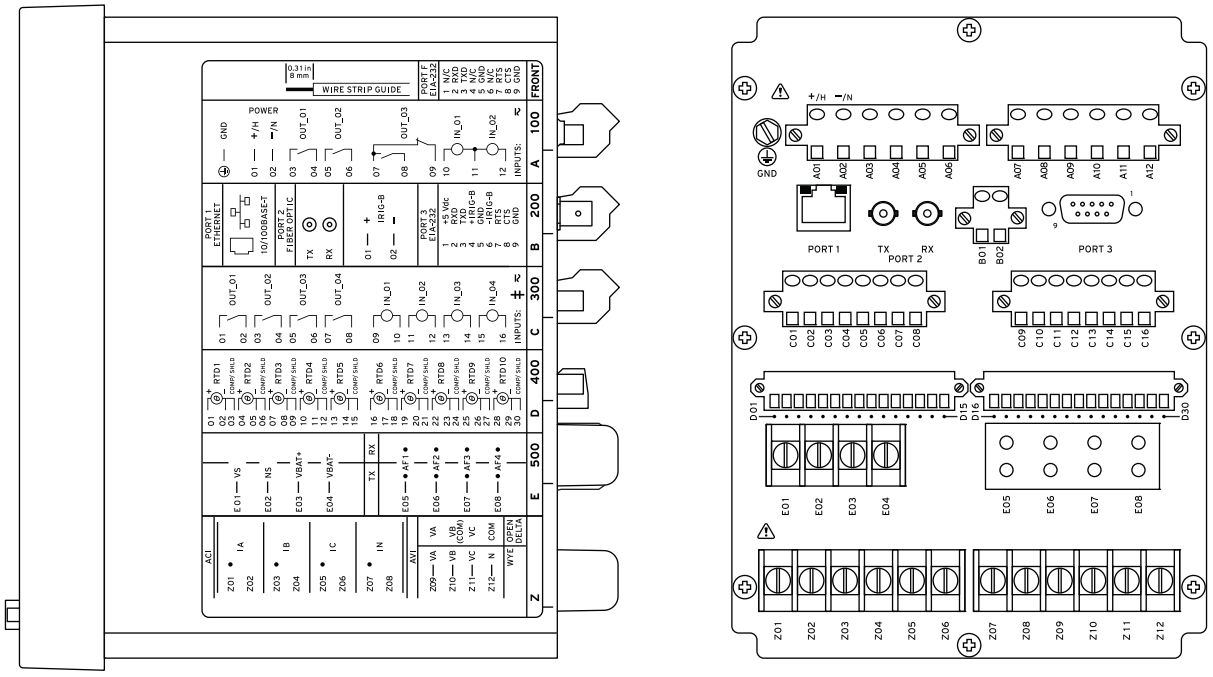



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 38 Single Copper Ethernet, EIA-485 Communication, 8 DO (Form A) Card, 4 AI/4 AO Card, and 2 AVI/4 AFDI Voltage Option With Arc-Flash Detector Inputs (Relay MOT 751201A2A6X70810320)**

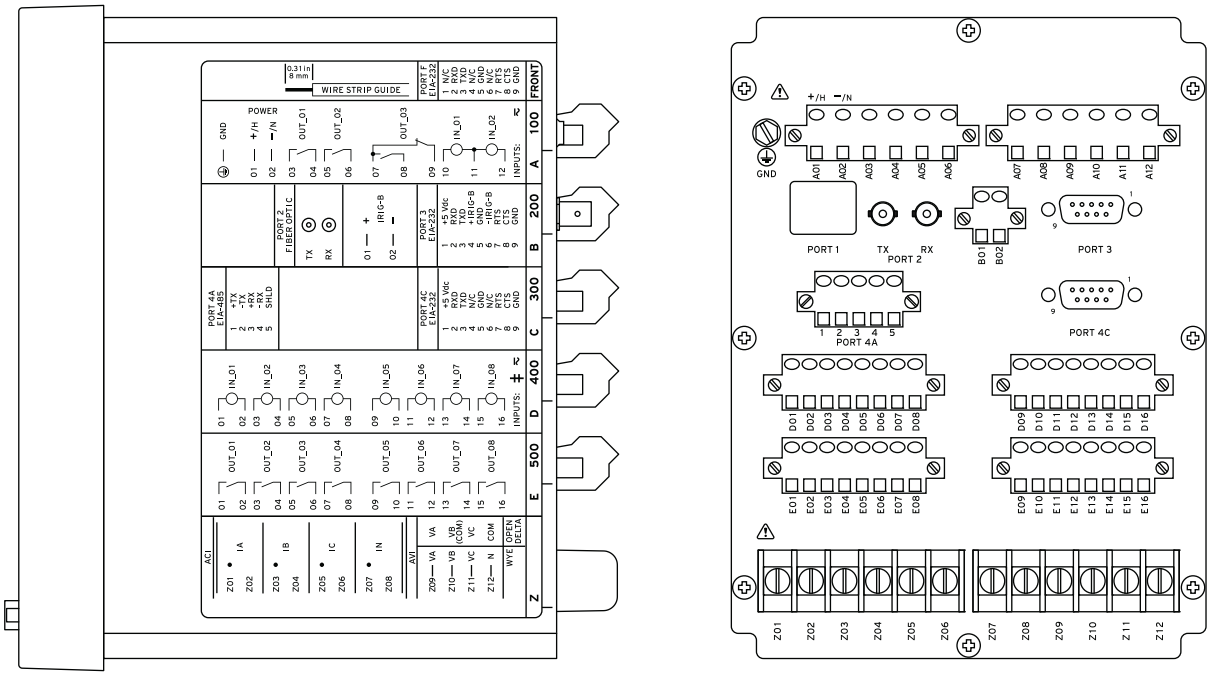



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 39 Single Copper Ethernet With EIA-232 Communication, 10 RTD Card, 4 DI/4 DO Card, and 2 AVI/4 AFDI Voltage Option Card With Arc-Flash Detector Inputs (Relay MOT 751501A1A9X70850230)**

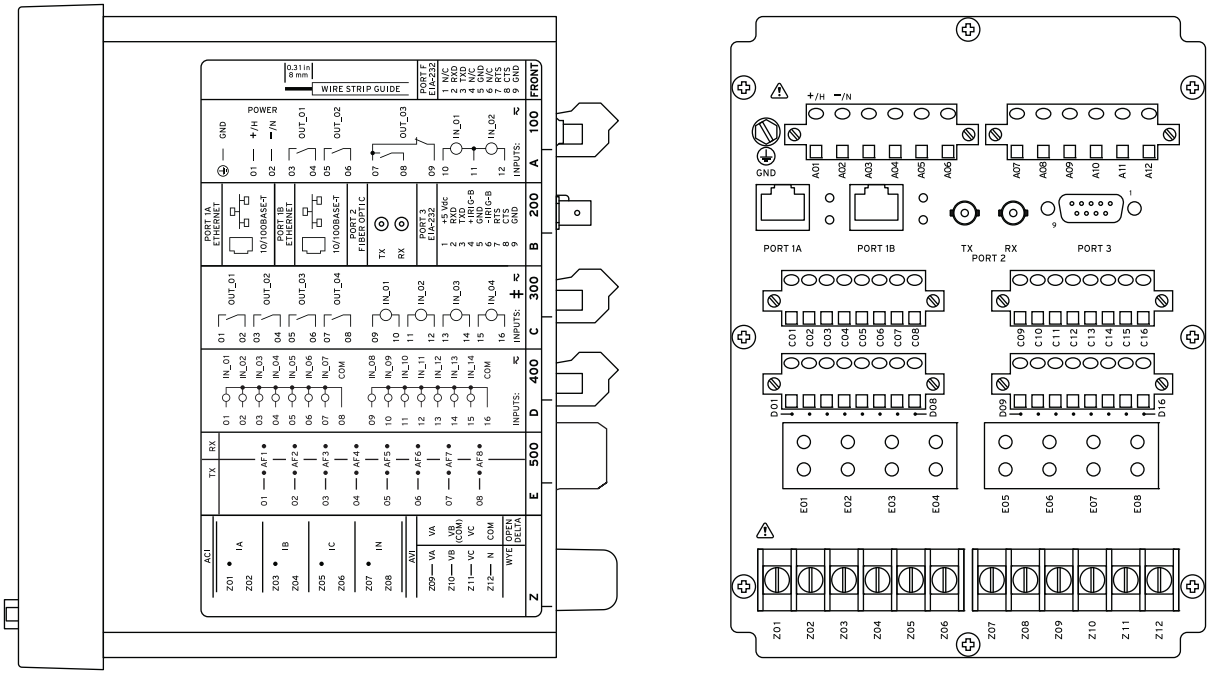



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 40 No Ethernet, EIA-232 Serial Communications, EIA-232/EIA-485 Communications Card, 8 DI Card, and 8 DO Card (Form A) (Relay MOT 751401AA03A2A850000)**

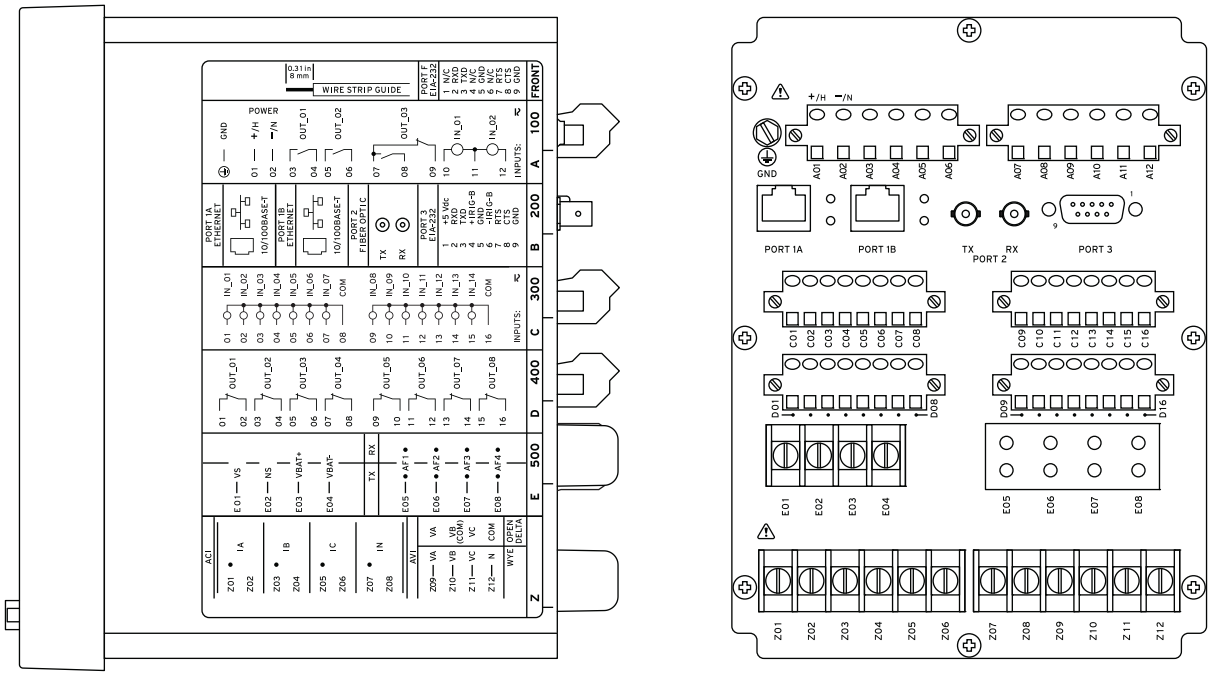



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 41 Dual Copper Ethernet, 4 DI/4 DO Card, 14 DI Card, 8 AFDI Card With Arc-Flash Detector Inputs, 4 ACI/3 AVI Card With 5 A Phase, 200 mA Neutral, and 3-Phase AC Voltage Inputs (300 Vac) (Relay MOT 7515S1A1A4A77870671)**

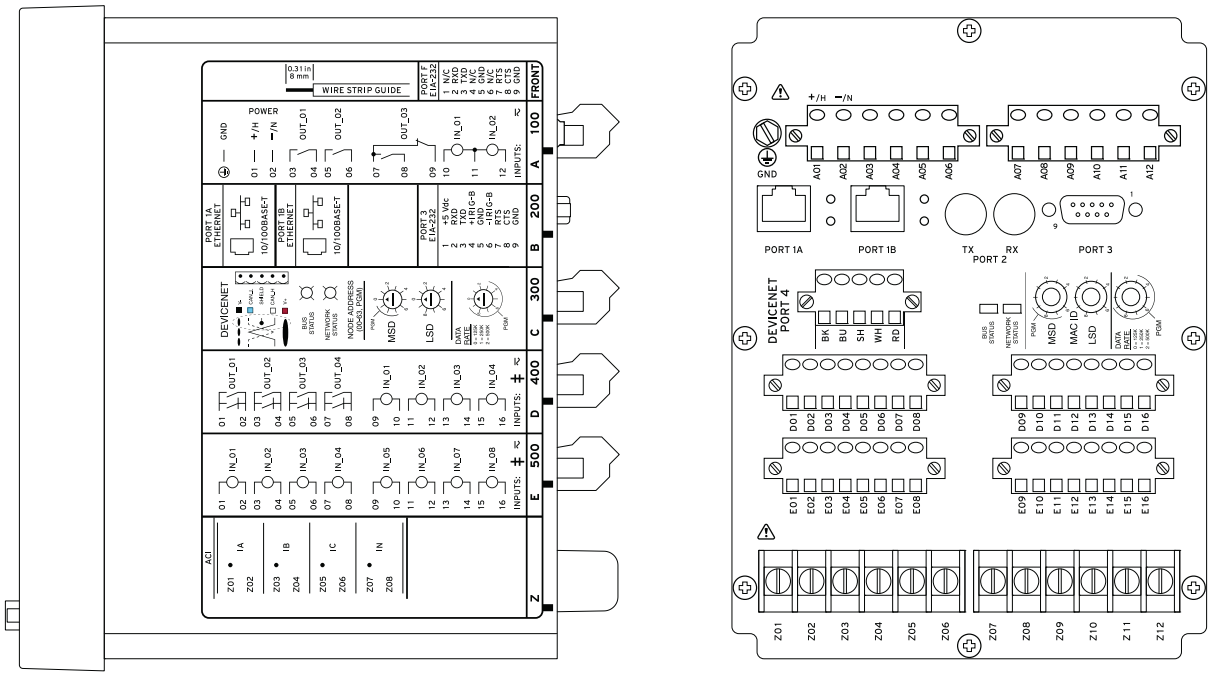



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 42 Dual Copper Ethernet, 14 DI Card, 8 DO (Form B) Card, 2 AVI/4 AFDI Card With LEA Vsync, Vbat Inputs, and 4 Arc-Flash Detection Inputs, 4 ACI/3 AVI Card With 5 A Phase, 200 mA Neutral, and 3-Phase LEA Voltage Inputs (8 Vac) (Relay MOT 751501A4A2BL0L70671)**

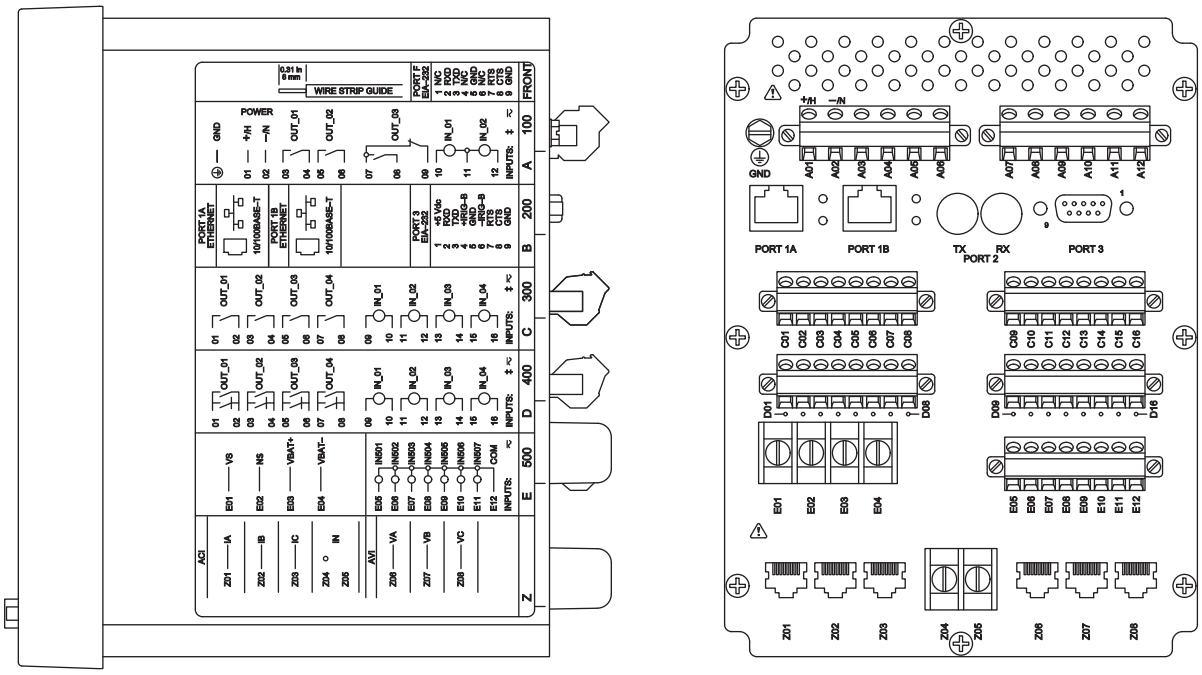



‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 43 Dual 10/100 Base-T Ethernet, EIA-232 Rear Port, Without Single Multimode ST Fiber-Optic Serial Port Rear, With DeviceNet Card, Fast Hybrid 4 DI/4 DO Card, 8 DI Card, and 4 ACI Card (No Voltage Inputs) (Relay MOT 751001AA3CA3AA50F30)**




‡ SEE DOCUMENTATION FOR INPUT VOLTAGE RATING

(A) Side-Panel Input and Output Designations

(B) Rear-Panel Layout

**Figure 44 Dual 10/100 Base-T Ethernet, EIA-232 Rear Port, 4 DI/4 DO Card, Fast Hybrid 4 DI/4 DO Card, LEA Vsync/ Vbat (300 Vdc) 7 DI Card, and 4 ACI/3 AVI LEA Card (Relay MOT 751001A1ACALA7LAF30)**

# Applications

*Figure 45* shows some typical protection applications for the SEL-751. You can use the SEL-751 directional and non-directional overcurrent functions to protect virtually any power system circuit or device including lines, feeders, transformers, capacitor banks, reactors, and generators. Over- and underfrequency, over- and undervoltage, vector shift elements, rate-of-change-of-frequency elements, and synchronism-check elements are well suited for applications at distributed generation sites. Directional power elements make the relay suitable for utility and customer interface protection in applications with customer generation. IEC cable/line thermal elements can be used to prevent insulation damage.

Special relay versions can be ordered to provide sensitive earth fault (SEF) protection on high-impedance grounded systems, and directional overcurrent ground fault protection on ungrounded, high-impedance grounded and tuned reactance (Petersen coil) grounded systems.

You can use powerful SELOGIC control equations in all SEL-751 models for custom protection and control applications. SEL application guides and technical support personnel are available to help with unique applications.

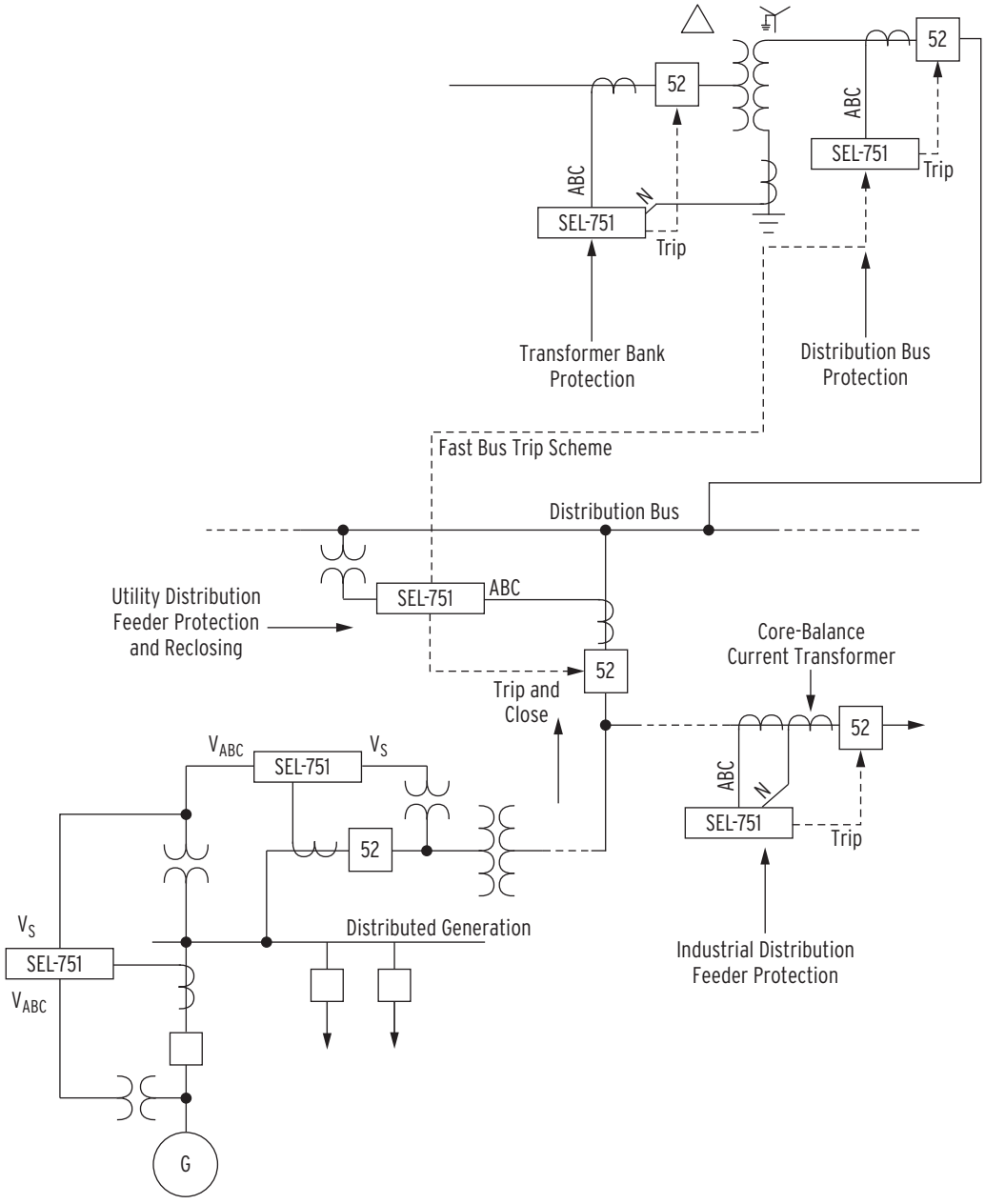



**Figure 45 SEL-751 Feeder Protection Relay Applied Throughout the Power System**

# Specifications

## Compliance

Designed and manufactured under an ISO 9001 certified quality management system

47 CFR 15B, Class A

**Note**: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### Normal Locations

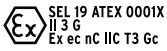
UL Listed to U.S. and Canadian safety standards (File E212775, NRGU, NRGU7)

**Note**: UL has not yet developed requirements for products intended to detect and mitigate an arc flash; consequently, UL has not evaluated the performance of this feature. While UL is developing these requirements, it will place no restriction on the use of this product for arc-flash detection and mitigation. For test results performed by an independent laboratory and other information on the performance and verification of this feature, please contact SEL customer service.

### Hazardous Locations

UL Certified for Hazardous Locations to U.S. and Canadian standards CL 1, DIV 2; GP A, B, C, D; T3C, maximum surrounding air temperature of 50°C (File E470448)

EU




EN 60079-0:2012 + A11:2013, EN 60079-7:2015, EN 60079-15:2010, EN 60079-11:2012

CE Mark in accordance with the requirements of the European Union

Ambient air temperature shall not exceed –20°C ≤ Ta ≤ +50°C

RCM Mark in accordance with the requirements of Australia

**Note**: Where so marked, ATEX and UL Hazardous Location Certification tests are applicable to rated supply specifications only and do not apply to the absolute operating ranges, continuous thermal, or short circuit duration specifications.

## General

### AC Current Input

$I_{NOM}$ = 200 mA, 1 A, or 5 A secondary, depending on the model.

Measurement Category: II

Phase and Neutral Currents

**$I_{NOM}$ = 5 A**

| | |
|---|---|
| Continuous Rating: | 3 • $I_{NOM}$ @ 85°C<br>4 • $I_{NOM}$ @ 55°C |
| A/D Measurement Limit: | 217 A peak (154 Arms symmetrical) |
| Saturation Current Rating: | Linear to 96 A symmetrical |
| 1-Second Thermal: | 500 A |
| Burden (per phase): | <0.1 VA @ 5 A |

**$I_{NOM}$ = 1 A**

| | |
|---|---|
| Continuous Rating: | 3 • $I_{NOM}$ @ 85°C<br>4 • $I_{NOM}$ @ 55°C |
| A/D Measurement Limit: | 43 A peak (31 Arms symmetrical) |
| Saturation Current Rating: | Linear to 19.2 A symmetrical |
| 1-Second Thermal: | 100 A |
| Burden (per phase): | <0.01 VA @ 1 A |

**$I_{NOM}$ = 200 mA**

| | |
|---|---|
| Continuous Rating: | 4 A |
| A/D Measurement Limit: | 8.4 A peak (6 Arms symmetrical) |
| Saturation Current Rating: | Linear to 4 A symmetrical |
| 1-Second Thermal: | 500 A |
| Burden (per phase): | <0.01 VA @ 0.2 A |

### Rogowski Coil-Based AC Current Inputs—Phase Currents

| | |
|---|---|
| Continuous Rating: | 30 Vrms |
| Nominal Input Voltage: | 65 mV to 4.16 Vrms |
| Number of Gain Ranges: | 6 |
| Full Scale Voltage: | 4, 8, 16, 32, 64, 128 Vrms |
| A/D Measurement Limit: | ±185 $V_{peak}$ |
| 10-Second Thermal: | 200 Vac |
| Input Impedance: | 2 MΩ‖50 pF |
| Standard Compliance: | IEC 61869-6<br>IEC 61869-13 |

### Low-Power Current Transformer (LPCT) Inputs—Phase Currents

| | |
|---|---|
| Continuous Rating: | 4 Vrms |
| Nominal Input Voltage: | 16 mV to 260 mVrms |
| Number of Gain Ranges: | 4 |
| Full Scale Voltage: | 1, 2, 4, 8 Vrms |
| A/D Measurement Limit: | ±11.3 $V_{peak}$ |
| 10-Second Thermal: | 200 Vac |
| Input Impedance: | 2 MΩ‖50 pF |
| Standard Compliance: | IEC 61869-6<br>IEC 61869-13 |

### AC Voltage Input

| | |
|---|---|
| $V_{NOM}$ (L-L) Setting Range: | 20–250 V (if DELTA_Y := DELTA)<br>20–480 V (if DELTA_Y := WYE) |

300 Vac Voltage Inputs

| | |
|---|---|
| Rated Continuous Voltage: | 300 Vac (phase-to-neutral) |
| 10-Second Thermal: | 600 Vac (phase-to-neutral) |

| | Burden | Input Impedance (Per Phase) | Input Impedance (Phase-to-Phase) |
|---|---|---|---|
| Vphase | 0.008 VA @ 120 Vac | 2 MΩ | 4 MΩ |
| Vbat/Vs | 0.003 VA @ 120 Vac | 5 MΩ | |

Low-Energy Analog (LEA) Voltage Inputs (Euro Connector Input)

| | |
|---|---|
| Rated Continuous Voltage: | 8 Vac (phase-to-neutral) |
| Nominal LEA Voltage: | 0.5–6.8 Vrms (phase-to-neutral) |
| Input Range: | ±12 $V_{peak}$ |
| 10-Second Thermal: | 300 Vac (phase-to-neutral) |
| Input Impedance: | 2 MΩ single-ended (phase-to-neutral)<br>4 MΩ differential (phase-to-phase) |

### Low-Energy Analog Voltage Sensor Inputs (RJ45 Input)

| | |
|---|---|
| Continuous Rating: | 8 Vrms |
| Nominal Input Voltage: | 0.5–6.8 Vrms |
| Full-Scale Voltage: | 8 Vrms |
| A/D Measurement Limit: | ±12 $V_{peak}$ |
| 10-Second Thermal: | 200 Vac |
| Input Impedance: | 2 MΩ/50 pF |
| Standard Compliance: | IEC 61869-6<br>IEC 61869-13 |

### Power Supply

| | |
|---|---|
| Relay Start-Up Time: | Approximately 5–10 seconds (after power is applied until the **ENABLED** LED turns on) |

#### High-Voltage Supply

| | |
|---|---|
| Rated Supply Voltage: | 110–240 Vac, 50/60 Hz<br>110–250 Vdc |
| Input Voltage Range (Design Range): | 85–264 Vac<br>85–300 Vdc |
| Power Consumption: | <55 VA (ac)<br><25 W (dc) |
| Interruptions: | 50 ms @ 125 Vac/Vdc<br>100 ms @ 250 Vac/Vdc |

#### Low-Voltage Supply

| | |
|---|---|
| Rated Supply Voltage: | 24–48 Vdc |
| Input Voltage Range (Design Range): | 19.2–60.0 Vdc |
| Power Consumption: | <25 W (dc) |
| Interruptions: | 10 ms @ 24 Vdc<br>50 ms @ 48 Vdc |

### Fuse Ratings

#### Low-Voltage Power Supply Fuse

| | |
|---|---|
| Rating: | 3.15 A |
| Maximum Rated Voltage: | 300 Vdc, 250 Vac |
| Breaking Capacity: | 1500 A at 250 Vac |
| Type: | Time-lag T |

#### High-Voltage Power Supply Fuse

| | |
|---|---|
| Rating: | 3.15 A |
| Maximum Rated Voltage: | 300 Vdc, 250 Vac |
| Breaking Capacity: | 1500 A at 250 Vac |
| Type: | Time-lag T |

### Output Contacts

#### General

The relay supports Form A, B, and C outputs.

| | |
|---|---|
| Dielectric Test Voltage: | 2500 Vac |
| Impulse Withstand Voltage ($U_{IMP}$): | 5000 V |
| Mechanical Durability: | 100,000 no-load operations |

#### Standard Contacts

| | |
|---|---|
| Pickup/Dropout Time: | ≤8 ms (coil energization to contact closure) |

**DC Output Ratings**

| | |
|---|---|
| Rated Operational Voltage: | 250 Vdc |
| Rated Voltage Range: | 19.2–275 Vdc |
| Rated Insulation Voltage: | 300 Vdc |
| Make: | 30 A @ 250 Vdc per IEEE C37.90 |
| Continuous Carry: | 6 A @ 70°C<br>4 A @ 85°C |
| 1-Second Thermal: | 50 A |
| Contact Protection: | 360 Vdc, 115 J MOV protection across open contacts |

Breaking Capacity (10,000 Operations) per IEC 60255-0-20:1974:

| | | |
|---|---|---|
| 24 Vdc | 0.75 A | L/R = 40 ms |
| 48 Vdc | 0.50 A | L/R = 40 ms |
| 125 Vdc | 0.30 A | L/R = 40 ms |
| 250 Vdc | 0.20 A | L/R = 40 ms |

Cyclic (2.5 Cycles/Second) per IEC 60255-0-20:1974:

| | | |
|---|---|---|
| 24 Vdc | 0.75 A | L/R = 40 ms |
| 48 Vdc | 0.50 A | L/R = 40 ms |
| 125 Vdc | 0.30 A | L/R = 40 ms |
| 250 Vdc | 0.20 A | L/R = 40 ms |

**AC Output Ratings**

| | |
|---|---|
| Maximum Operational Voltage ($U_e$) Rating: | 240 Vac |
| Insulation Voltage ($U_i$) Rating (excluding EN 61010-1): | 300 Vac |
| 1-Second Thermal: | 50 A |
| Contact Rating Designation: | B300 |

| B300 (5 A Thermal Current, 300 Vac Max) | | | |
|---|---|---|---|
| | Maximum Current | | Max VA |
| Voltage | 120 Vac | 240 Vac | — |
| Make | 30 A | 15 A | 3600 |
| Break | 3 A | 1.5 A | 360 |
| PF < 0.35, 50–60 Hz | | | |

Utilization Category: AC-15

| AC-15 | | |
|---|---|---|
| Operational Voltage (Ue) | 120 Vac | 240 Vac |
| Operational Current (Ie) | 3 A | 1.5 A |
| Make Current | 30 A | 15 A |
| Break Current | 3 A | 1.5 A |
| Electromagnetic loads > 72 VA, PF < 0.3, 50–60 Hz | | |

| | |
|---|---|
| Voltage Protection Across Open Contacts: | 270 Vac, 40 J |

#### Fast Hybrid (High-Speed, High-Current Interrupting)

**DC Output Ratings**

| | |
|---|---|
| Rated Operational Voltage: | 250 Vdc |
| Rated Voltage Range: | 19.2–275 Vdc |
| Rated Insulation Voltage: | 300 Vdc |
| Make: | 30 A @ 250 Vdc per IEEE C37.90 |
| Carry: | 6 A @ 70°C<br>4 A @ 85°C |
| 1-Second Thermal: | 50 A |
| Open State Leakage Current: | <500 µA |
| MOV Protection (maximum voltage): | 250 Vac/330 Vdc |
| Pickup Time: | <50 µs, resistive load |
| Dropout Time: | <8 ms, resistive load |

Breaking Capacity (10,000 Operations):

| | | |
|---|---|---|
| 48 Vdc | 10.0 A | L/R = 40 ms |
| 125 Vdc | 10.0 A | L/R = 40 ms |
| 250 Vdc | 10.0 A | L/R = 20 ms |

Cyclic Capacity (4 Cycles in 1 Second, Followed by 2 Minutes Idle for Thermal Dissipation):

| | | |
|---|---|---|
| 48 Vdc | 10.0 A | L/R = 40 ms |
| 125 Vdc | 10.0 A | L/R = 40 ms |
| 250 Vdc | 10.0 A | L/R = 20 ms |

#### AC Output Ratings

See *AC Output Ratings* for *Standard Contacts*.

### Optoisolated Control Inputs

When Used With DC Control Signals

| | |
|---|---|
| Pickup/Dropout Time: | Depends on the input debounce settings |
| 250 V: | ON for 200.0–312.5 Vdc<br>OFF below 150 Vdc |
| 220 V: | ON for 176–275 Vdc<br>OFF below 132 Vdc |
| 125 V: | ON for 100.0–156.2 Vdc<br>OFF below 75 Vdc |
| 110 V: | ON for 88.0–137.5 Vdc<br>OFF below 66 Vdc |
| 48 V: | ON for 38.4–60.0 Vdc<br>OFF below 28.8 Vdc |
| 24 V: | ON for 15–30 Vdc<br>OFF below 5 Vdc |

When Used With AC Control Signals

| | |
|---|---|
| Pickup Time: | 2 ms |
| Dropout Time: | 16 ms |
| 250 V: | ON for 170.6–312.5 Vac<br>OFF below 106 Vac |
| 220 V: | ON for 150.2–275 Vac<br>OFF below 93.3 Vac |
| 125 V: | ON for 85–156.2 Vac<br>OFF below 53 Vac |
| 110 V: | ON for 75.1–137.5 Vac<br>OFF below 46.6 Vac |
| 48 V: | ON for 32.8–60 Vac<br>OFF below 20.3 Vac |
| 24 V: | ON for 14–30 Vac<br>OFF below 5 Vac |
| Current Draw at Nominal DC Voltage: | 2 mA (at 220–250 V)<br>4 mA (at 48–125 V)<br>10 mA (at 24 V) |
| Rated Impulse Withstand Voltage ($U_{imp}$): | 4000 V |

### Analog Output (Optional)

| | **1 A0** | **4 A0** |
|---|---|---|
| Current: | 4–20 mA | ±20 mA |
| Voltage: | — | ±10 V |
| Load at 1 mA: | — | 0–15 kΩ |
| Load at 20 mA: | 0–300 Ω | 0–750 Ω |
| Load at 10 V: | — | >2000 Ω |
| Refresh Rate: | 100 ms | 100 ms |
| % Error, Full Scale, at 25°C: | <±1% | <±0.55% |
| Select From: | Analog quantities available in the relay | |

### Analog Inputs (Optional)

| | |
|---|---|
| Maximum Input Range: | ±20 mA<br>±10 V<br>Operational range set by user |
| Input Impedance: | 200 Ω (current mode)<br>>10 kΩ (voltage mode) |
| Accuracy at 25°C | |
| With User Calibration: | 0.05% of full scale (current mode)<br>0.025% of full scale (voltage mode) |
| Without User Calibration: | Better than 0.5% of full scale at 25°C |
| Accuracy Variation With Temperature: | ±0.015% per °C of full-scale (±20 mA or ±10 V) |

### Arc-Flash Detectors (Optional)

Multimode fiber-optic receiver/transmitter pair

| | |
|---|---|
| Fiber Type: | 1000 µm diameter, 640 nm wavelength, plastic, clear-jacketed, or black-jacketed |
| Connector Type: | V-pin |

### Frequency and Phase Rotation

| | |
|---|---|
| System Frequency: | 50, 60 Hz |
| Phase Rotation: | ABC, ACB |
| Frequency Tracking: | 15–70 Hz |

### Time-Code Input

| | |
|---|---|
| Format: | Demodulated IRIG-B |
| On (1) State: | $V_{ih} \geq 2.2$ V |
| Off (0) State: | $V_{il} \leq 0.8$ V |
| Input Impedance: | 2 kΩ |
| Synchronization Accuracy | |
| Internal Clock: | ±1 µs |
| Synchrophasor Reports (e.g., **MET PM**): | ±10 µs |
| All other reports: | ±5 ms |
| SNTP Accuracy: | ±1 ms (in an ideal network) |
| PTP Accuracy: | ±1 ms |
| Unsynchronized Clock Drift Relay Powered: | 2 minutes per year typical |

### Communications Ports

Standard EIA-232 (2 ports)

| | |
|---|---|
| Location: | Front Panel<br>Rear Panel |
| Data Speed: | 300–38400 bps |

EIA-485 Port (optional)

| | |
|---|---|
| Location: | Rear panel |
| Data Speed: | 300–19200 bps |

Ethernet Port (optional)

Single/Dual 10/100BASE-T copper (RJ45 connector)
Single/Dual 100BASE-FX (LC connector)

EIA-232 Multimode Fiber-Optic Port (Optional)

| | |
|---|---|
| Location: | Rear panel |
| Data Speed: | 300–38400 bps |

### Fiber-Optic Ports Characteristics

#### Port 1 (or 1A, 1B) Ethernet

| | |
|---|---|
| Wavelength: | 1300 nm |
| Optical Connector Type: | LC |
| Fiber Type: | Multimode |
| Link Budget: | 16.1 dB |
| Typical TX Power: | –15.7 dBm |
| RX Min. Sensitivity: | –31.8 dBm |
| Fiber Size: | 62.5/125 µm |
| Approximate Range: | ~6.4 km |
| Data Rate: | 100 Mbps |
| Typical Fiber Attenuation: | –2 dB/km |

#### Port 2 Serial

| | |
|---|---|
| Wavelength: | 820 nm |
| Optical Connector Type: | ST |
| Fiber Type: | Multimode |
| Link Budget: | 8 dB |
| Typical TX Power: | –16 dBm |
| RX Min. Sensitivity: | –24 dBm |
| Fiber Size: | 62.5/125 µm |
| Approximate Range: | ~1 km |
| Data Rate: | 5 Mbps |
| Typical Fiber Attenuation: | –4 dB/km |

#### Channels 1-8 Arc-Flash Detectors (AFDI)

| | |
|---|---|
| Diagnostic Wavelength: | 640 nm |
| Optical Connector Type: | V-pin |
| Fiber Type: | Multimode |
| Typical TX Power: | –12 dBm |

#### Point Sensor

| | |
|---|---|
| Minimum Receive Sensitivity: | –52.23 dB |
| Point Sensor Diagnostic Worst Case Loss: | –28 dB |
| Link Budget: | 12.23 dB |
| Black-Jacketed Fiber Worst Case Loss: | –0.19 dBm |
| Black-Jacketed Fiber Typical Loss: | –0.17 dBm |
| ST or V-Pin Connector Splice Loss: | –2.00 dB |
| Approximate Range: | As much as 35 m |

#### Fiber Sensor

| | |
|---|---|
| Minimum Receive Sensitivity: | –29.23 dB |
| Link Budget: | 17.23 dB |
| Clear-Jacketed Fiber Worst Case Loss: | –0.19 dBm |
| Clear-Jacketed Fiber Typical Loss: | –0.17 dBm |
| ST or V-Pin Connector Splice Loss: | –2.00 dB |
| Approximate Range: | As much as 70 m |

### Optional Communications Cards

| | |
|---|---|
| Option 1: | EIA-232 or EIA-485 communications card |
| Option 2: | DeviceNet communications card |

### Communications Protocols

SEL, Modbus RTU and TCP/IP, DNP3 serial and LAN/WAN, FTP, Telnet, SNTP, IEEE 1588-2008 firmware-based PTP, IEC 61850 Edition 2, IEC 60870-5-103, EtherNet/IP, PRP, MIRRORED BITS, EVMSG, IEEE C37.118 (synchrophasors), and DeviceNet

### Operating Temperature

| | |
|---|---|
| IEC Performance Rating: | –40° to +85°C (–40° to +185°F) (per IEC/EN 60068-2-1 and IEC/EN 60068-2-2) |

**Note:** Not applicable to UL applications.
**Note:** The front-panel display is impaired for temperatures below –20°C and above +70°C.

| | |
|---|---|
| DeviceNet Communications Card Rating: | +60°C (+140°F) maximum |
| Optoisolated Control Inputs: | As many as 26 inputs are allowed in ambient temperatures of 85°C or less<br>As many as 34 inputs are allowed in ambient temperatures of 75°C or less<br>As many as 44 inputs are allowed in ambient temperatures of 65°C or less |

### Operating Environment

| | |
|---|---|
| Insulation Class: | 1 |
| Pollution Degree: | 2 |
| Overvoltage Category: | II |
| Atmospheric Pressure: | 80–110 kPa |
| Relative Humidity: | 5%–95%, noncondensing |
| Maximum Altitude Without Derating (Consult the Factory for Higher Altitude Derating): | 2000 m |

### Dimensions

144.0 mm (5.67 in) x 192.0 mm (7.56 in) x 147.4 mm (5.80 in)

### Weight

2.7 kg (6.0 lb)

### Relay Mounting Screw (#8-32) Tightening Torque

| | |
|---|---|
| Minimum: | 1.4 Nm (12 in-lb) |
| Maximum: | 1.7 Nm (15 in-lb) |

### Terminal Connections

#### Terminal Block

| | |
|---|---|
| Screw Size: | #6 |
| Ring Terminal Width: | 0.310-inch maximum |

#### Terminal Block Tightening Torque

| | |
|---|---|
| Minimum: | 0.9 Nm (8 in-lb) |
| Maximum: | 1.4 Nm (12 in-lb) |

#### Compression Plug Tightening Torque

| | |
|---|---|
| Minimum: | 0.5 Nm (4.4 in-lb) |
| Maximum: | 1.0 Nm (8.8 in-lb) |

Compression Plug Mounting Ear Screw Tightening Torque

| | |
|---|---|
| Minimum: | 0.18 Nm (1.6 in-lb) |
| Maximum: | 0.25 Nm (2.2 in-lb) |

## Product Standards

| | |
|---|---|
| Electromagnetic Compatibility: | IEC 60255-26:2013 |
| Safety Standards: | IEC 60255-27:2013<br>UL 508<br>CSA C22.2 No. 14-05 |

## Type Tests

### Environmental Tests

| | |
|---|---|
| Enclosure Protection: | IEC 60529:2001 + CRDG:2003<br>IP65 enclosed in panel (2-line display models)<br>IP54 enclosed in panel (touchscreen models)<br>IP50 for terminals enclosed in the dust-protection assembly (protection against solid foreign objects only) (SEL Part #915900170). The 10°C temperature derating applies to the temperature specifications of the relay.<br>IP20 for terminals and the relay rear panel |
| Vibration Resistance: | IEC 60255-21-1:1988<br>IEC 60255-27:2013, Section 10.6.2.1<br>Endurance: Class 2<br>Response: Class 2 |
| Shock Resistance: | IEC 60255-21-2:1988<br>IEC 60255-27:2013, Section 10.6.2.2<br>IEC 60255-27:2013, Section 10.6.2.3<br>Withstand: Class 1<br>Response: Class 2<br>Bump: Class 1 |
| Seismic (Quake Response): | IEC 60255-21-3:1993<br>IEC 60255-27:2013, Section 10.6.2.4<br>Response: Class 2 |
| Cold: | IEC 60068-2-1:2007<br>IEC 60255-27:2013, Section 10.6.1.2<br>IEC 60255-27:2013, Section 10.6.1.4<br>–40°C, 16 hours |
| Dry Heat: | IEC 60068-2-2:2007<br>IEC 60255-27:2013, Section 10.6.1.1<br>IEC 60255-27:2013, Section 10.6.1.3<br>85°C, 16 hours |
| Damp Heat, Steady State: | IEC 60068-2-78:2001<br>IEC 60255-27:2013, Section 10.6.1.5<br>40°C, 93% relative humidity, 10 days |
| Damp Heat, Cyclic: | IEC 60068-2-30:2001<br>IEC 60255-27:2013, Section 10.6.1.6<br>25° to 55°C, 95% relative humidity, 6 cycles |
| Change of Temperature: | IEC 60068-2-14:2009<br>IEC 60255-1:2010, Section 6.12.3.5<br>–40° to +85°C, ramp rate 1°C/min, 5 cycles |

### Dielectric Strength and Impulse Tests

| | |
|---|---|
| Dielectric (Hi-Pot): | IEC 60255-27:2013, Section 10.6.4.3<br>IEEE C37.90-2005<br>1.0 kVac on analog outputs, Ethernet ports<br>2.0 kVac on analog inputs, IRIG<br>2.5 kVac on contact I/O<br>3.6 kVdc on power supply, IN and VN terminals |
| Impulse: | IEC 60255-27:2013, Section 10.6.4.2<br>0.5 J, 5 kV on power supply, contact I/O, ac current, and voltage inputs<br>0.5 J, 530 V on analog outputs<br>IEEE C37.90:2005<br>0.5 J, 5 kV<br>0.5 J, 530 V on analog outputs |

### RFI and Interference Tests

| | |
|---|---|
| Electrostatic Discharge Immunity: | IEC 61000-4-2:2008<br>IEC 60255-26:2013; Section 7.2.3<br>IEEE C37.90.3:2001<br>Severity Level 4<br>8 kV contact discharge<br>15 kV air discharge |
| Radiated RF Immunity: | IEC 61000-4-3:2010<br>IEC 60255-26:2013; Section 7.2.4<br>10 V/m<br>IEEE C37.90.2-2004<br>20 V/m |
| Fast Transient, Burst Immunity[a]: | IEC 61000-4-4:2011<br>IEC 60255-26:2013; Section 7.2.5<br>4 kV @ 5.0 kHz<br>2 kV @ 5.0 kHz for comm. ports |
| Surge Immunity[a]: | IEC 61000-4-5:2005<br>IEC 60255-26:2013; Section 7.2.7<br>2 kV line-to-line<br>4 kV line-to-earth<br>LEA ports compliant with<br>IEC 61869-13 tested to 1 kV, 1 MHz line-to-earth only |
| Surge Withstand Capability Immunity[a]: | EN 61000-4-18:2010<br>IEC 60255-26:2013; Section 7.2.6<br>2.5 kV common mode<br>1 kV differential mode<br>1 kV common mode on comm. ports<br>IEEE C37.90.1-2002<br>2.5 kV oscillatory<br>4 kV fast transient |
| Conducted RF Immunity: | IEC 61000-4-6:2008<br>IEC 60255-26:2013; Section 7.2.8<br>10 Vrms |
| Magnetic Field Immunity: | IEC 61000-4-8:2009<br>IEC 60255-26:2013, Section 7.2.10<br>Severity Level:<br>1000 A/m for 3 seconds<br>100 A/m for 1 minute; 50/60 Hz<br>IEC 61000-4-9: 2001<br>Severity Level: 1000 A/m<br>IEC 61000-4-10:2001<br>Severity Level: 100 A/m (100 kHz and 1 MHz) |
| Power Supply Immunity: | IEC 61000-4-11:2004<br>IEC 61000-4-17:1999<br>IEC 61000-4-29:2000<br>IEC 60255-26:2013, Section 7.2.11<br>IEC 60255-26:2013, Section 7.2.12<br>IEC 60255-26:2013, Section 7.2.13 |

EMC Emissions

| | |
|---|---|
| Conducted Emissions: | IEC 60255-26:2013 Class A<br>FCC 47 CFR Part 15.107 Class A<br>CAN ICES-001 (A) / NMB-001 (A)<br>EN 55011:2009 + A1:2010 Class A<br>EN 55022:2010 + AC:2011 Class A<br>EN 55032:2012 + AC:2013 Class A<br>CISPR 11:2009 + A1:2010 Class A<br>CISPR 22:2008 Class A<br>CISPR 32:2015 Class A |
| Radiated Emissions: | IEC 60255-26:2013 Class A<br>FCC 47 CFR Part 15.109 Class A<br>CAN ICES-001 (A) / NMB-001 (A)<br>EN 55011:2009 + A1:2010 Class A<br>EN 55022:2010 + AC:2011 Class A<br>EN 55032:2012 + AC:2013 Class A<br>CISPR 11:2009 + A1:2010 Class A<br>CISPR 22:2008 Class A<br>CISPR 32:2015 Class A |

## Processing Specifications and Oscillography

| | |
|---|---|
| AC Voltage and Current Inputs: | 32 samples per power system cycle |
| Frequency Tracking Range: | 15–70 Hz |
| Digital Filtering: | One-cycle cosine after low-pass analog filtering. Net filtering (analog plus digital) rejects dc and all harmonics greater than the fundamental. |
| Protection and Control Processing: | Processing interval is 4 times per power system cycle (except for math variables and analog quantities, which are processed every 25 ms). Analog quantities for rms data are derived from data averaged from the previous 8 cycles. |
| Arc-Flash Processing: | Arc-Flash light is sampled 32 times per cycle<br>Arc-Flash current, light, and 2 fast hybrid outputs are processed 16 times per cycle |
| Phase Discontinuity Detection: | Processing rate is once every 2 power system cycles. |
| Cold Load Pickup: | Processing rate is once every 2 power system cycles. |

### Oscillography

| | |
|---|---|
| Length: | 15, 64, or 180 cycles |
| Sampling Rate: | 32 samples per cycle unfiltered<br>4 samples per cycle filtered |
| Trigger: | Programmable with Boolean expression |
| Format: | ASCII and Compressed ASCII<br>Binary COMTRADE (32 samples per cycle unfiltered) |

**Note:** Binary COMTRADE format as per IEEE C37.11-1999, IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems.

| | |
|---|---|
| Time-Stamp Resolution: | 1 ms |
| Time-Stamp Accuracy: | ±5 ms |

### Sequential Events Recorder

| | |
|---|---|
| Time-Stamp Resolution: | 1 ms |
| Time-Stamp Accuracy (With Respect to Time Source) for all Relay Word bits except those corresponding to digital inputs (IN*xxx*) and arc-flash elements (TOL*x*/50*x*AF/OUT*xxx*): | ±5 ms |
| Time-Stamp Accuracy (With Respect to Time Source) for Relay Word bits corresponding to digital inputs (IN*xxx*) and arc-flash elements (TOL*x*/50*x*AF/OUT*xxx*): | 1 ms |

## Relay Elements

### Instantaneous/Definite-Time Overcurrent (50P, 50G, 50N, 50Q)

Pickup Setting Range, A Secondary:

| | |
|---|---|
| 5 A models: | 0.25–100.00 A, 0.01 A steps |
| 1 A models: | 0.05–20.00 A, 0.01 A steps |
| 200 mA model: | 0.010–4.000 A, 0.001 A steps (50N) |
| Accuracy: | ±3% of setting plus ±0.02 • $I_{NOM}$ A secondary (steady state)<br>±5% of setting plus ±0.02 • $I_{NOM}$ A secondary (transient)<br>±6% of setting plus ±0.02 • $I_{NOM}$ A secondary (transient for 50Q) |
| Time Delay: | 0.00–400.00 seconds, 0.01 seconds steps |
| Pickup/Dropout Time: | <1.5 cycles |

### Arc-Flash Instantaneous Overcurrent (50PAF, 50NAF)

Pickup Setting Range, A Secondary:

| | |
|---|---|
| 5 A models: | 0.50–100.00 A, 0.01-A steps |
| 1 A models: | 0.10–20.00 A, 0.01 A-steps |
| Accuracy: | 0 to +10% of setting plus ±0.02 • $I_{NOM}$ A secondary (steady state pickup) |
| Pickup/Dropout Time: | 2–5 ms/1 cycle |

### Arc-Flash Time-Overlight (TOL1–TOL8)

| | |
|---|---|
| Pickup Setting Range, % of Full Scale: | 3.0–80.0% (point sensor)<br>0.6–80.0% (fiber sensor) |
| Pickup/Dropout Time: | 2–5 ms/1 cycle |

### Inverse-Time Overcurrent (51P, 51G, 51N, 51Q)

Pickup Setting Range, A Secondary:

| | |
|---|---|
| 5 A models: | 0.25–24.00 A, 0.01 A steps |
| 1 A models: | 0.05–4.80 A, 0.01 A steps |
| 200 mA models: | 10.00–960.00 mA, 0.01 mA steps (51N) |
| Accuracy: | ±5% of setting plus ±0.02 • $I_{NOM}$ A secondary (steady state pickup) |
| Time Dial | |
| U.S.: | 0.50–15.00, 0.01 steps |
| IEC: | 0.01–1.50, 0.01 steps |
| Accuracy: | ±1.5 cycles, plus ±4% between 2 and 30 multiples of pickup (within rated range of current) |

### Breaker Failure Instantaneous Overcurrent

| | |
|---|---|
| Pickup Setting Range, A Secondary: | |
| 5 A models: | 0.10–10.00 A, 0.01 A steps |
| 1 A models: | 0.02–2.00 A, 0.01 A steps |
| Accuracy: | ±3% of setting plus ±0.02 • $I_{NOM}$ A secondary (steady state) |
| Time Delay: | 0.00–2.00 seconds, 0.01 second steps |
| Pickup Time: | <1.5 cycles |
| Dropout Time: | <1 cycle |

### IEC Thermal Element (49IEC)

| | |
|---|---|
| Setting Range: | Trip pickup, 1%–150%<br>Alarm pickup, 1%–100% |
| Pickup Accuracy: | ±2% (for I ≥ $I_{NOM}$)<br>±5% (for 0.4 • $I_{NOM}$ < I < $I_{NOM}$) |
| Time to Trip/Reset Accuracy: | ±5% plus ±0.5 s of the calculated value |

### Undervoltage (27P, 27PP, 27S)

| | |
|---|---|
| Setting Range: | OFF, 2.00–300.00 V (phase elements, phase-to-phase elements with delta inputs or synchronism voltage input)<br>OFF, 2.00–520.00 V (phase-to-phase elements with wye inputs) |
| Accuracy: | ±1% of setting plus ±0.5 V |
| Time Delay: | 0.00–120.00 seconds, 0.01-second steps |
| Pickup/Dropout Time: | <1.5 cycles |

### Overvoltage (59P, 59PP, 59G, 59Q, 59S)

| | |
|---|---|
| Setting Range: | OFF, 2.00–300.00 V (phase elements, phase-to-phase elements with delta inputs or synchronism voltage input)<br>OFF, 2.00–520.00 V (phase-to-phase elements with wye inputs) |
| Accuracy: | ±1% of setting plus ±0.5 V |
| Time Delay: | 0.00–120.00 seconds, 0.01-second steps |
| Pickup/Dropout Time: | <1.5 cycles |

### Incipient Cable Fault (50INC)

| | |
|---|---|
| Pickup Setting Range, A Secondary: | OFF, 0.50–50.00 A (phase), 0.01-A steps for 5 A<br>OFF, 0.10–10.00 A (phase), 0.01-A steps for 1 A |
| Accuracy: | ±5% of setting A secondary |
| Pickup time: | <1/2 cycle |

### Inverse-Time Undervoltage (27I)

| | |
|---|---|
| Setting Range: | OFF, 2.00–300.00 V (phase elements, positive-sequence elements, phase-to-phase elements with delta inputs or synchronism-check voltage input)<br>OFF, 2.00–520.00 V (phase-to-phase elements with wye inputs) |
| Accuracy: | ±1% of setting plus ±0.5 V |
| Time Dial: | 0.00–16.00 s |
| Accuracy: | ±1.5 cyc plus ±4% between 0.95 and 0.1 multiples of pickup |

### Inverse-Time Overvoltage (59I)

| | |
|---|---|
| Setting Range: | OFF, 2.00–300.00 V (phase elements, sequence elements, or phase-to-phase elements with delta inputs or synchronism voltage input)<br>OFF, 2.00–520.00 V (phase-to-phase elements with wye inputs) |
| Accuracy: | ±1% of setting plus ±0.5 V |
| Time Dial: | 0.00–16.00 s |
| Accuracy: | ±1.5 cyc plus ±4% between 1.05 and 5.5 multiples of pickup |

### Harmonic Blocking

| | |
|---|---|
| Pickup Range (% of fundamental): | 5%–100% |
| Pickup Accuracy (A secondary): | |
| 5 A models: | ±5% plus ±0.10 A of harmonic current |
| 1 A models: | ±5% plus ±0.02 A of harmonic current |
| Time Delay Accuracy: | ±0.5% plus ±0.25 cycle |

### Vector Shift (78VS)

| | |
|---|---|
| Pickup Setting Range: | 2.0°–30.0°, 0.1-degree increment |
| Accuracy: | ±10% of the pickup setting, ±1 degree |
| Voltage Supervision Threshold: | 20.0%–100.0% • VNOM |
| Pickup Time: | <3 cycles |

### Power Elements (32)

| | |
|---|---|
| Instantaneous/Definite Time, Three-Phase Elements Type: | +W, –W, +VAR, –VAR |
| Pickup Setting Range, VA Secondary: | |
| 5 A models: | 1.0–6500.0 VA, 0.1 VA steps |
| 1 A models: | 0.2–1300.0 VA, 0.1 VA steps |
| Accuracy: | ±0.10 A • (L-L voltage secondary) plus ±5% of setting at unity power factor for power elements and zero power factor for reactive power elements (5 A nominal)<br>±0.02 A • (L-L voltage secondary) plus ±5% of setting at unity power factor for power elements and zero power factor for reactive power elements (1 A nominal) |
| Time Delay: | 0.0–240.0 seconds, 0.1-second steps |
| Pickup/Dropout Time: | <10 cycles |

### Power Factor (55)

| | |
|---|---|
| Setting Range: | OFF, 0.05–0.99 |
| Accuracy: | ±5% of full scale for current ≥ 0.5 • $I_{NOM}$ |
| Time Delay: | 1–240 seconds, 1-second steps |

### Frequency (81)

| | |
|---|---|
| Setting Range: | Off, 15.00–70.00 Hz |
| Accuracy: | ±0.01 Hz (V1 >60 V) with voltage tracking<br>±0.05 Hz (I1 >0.8 • $I_{NOM}$) with current tracking |
| Time Delay: | 0.00–400.00 seconds, 0.01-second steps |
| Pickup/Dropout Time: | <4 cycles |

### Rate-of-Change of Frequency (81R)

| | |
|---|---|
| Setting Range: | OFF, 0.10–15.00 Hz/s |
| Accuracy: | ±100 mHz/s, plus ±3.33% of pickup |
| Time Delay: | 0.10–60.00 seconds, 0.01-second steps |

### Synchronism Check (25)

| | |
|---|---|
| Pickup Range, Secondary Voltage: | 0.00–300.00 V |
| Pickup Accuracy, Secondary Voltage: | ±1% plus ±0.5 V (over the range of 2–300 V) |
| Slip Frequency Pickup Range: | 0.05 Hz–0.50 Hz |
| Slip Frequency Pickup Accuracy: | ±0.02 Hz |
| Phase Angle Range: | 0°–80° |
| Phase Angle Accuracy: | ±4° |

### Load-Encroachment Detection

Pickup Setting Range

| | |
|---|---|
| 5 A Model: | 0.10–128.00 Ω secondary, 0.01 Ω steps |
| 1 A Model: | 0.50–640.00 Ω secondary, 0.01 Ω steps |
| Forward Load Angle: | –90° to +90° |
| Forward Load Angle: | +90° to +270° |

Accuracy

| | |
|---|---|
| Impedance Measurement: | ±5% plus ±0.5 Ω |
| Angle Measurement: | ±3° |

### Phase Discontinuity Detection

| | |
|---|---|
| Pickup Setting Range: | 0.01–1.00 pu, 0.01 steps |
| Accuracy: | ±5% of setting above 0.15 pu |
| Processing rate: | Once every 2 power system cycles |

### Broken Conductor Detection

| | |
|---|---|
| Sensitivity (Minimum Line Charging Current Required for Broken Conductor Detection): | 15 mA secondary for 5 A<br>3 mA secondary for 1 A |
| Minimum Operating Time (After the Conductor Breaks and Series Arc Extinguishes): | 8 cycles |
| Time Delay for Zone 2: | OFF, 0–600 cycles, 1-cycle steps |
| Timer Accuracy: | ±2 cycles |

### Cold-Load Pickup

| | |
|---|---|
| Pickup Setting Range: | 0–500 minutes, 1-minute steps |
| Accuracy: | 0.5% ±2 cycles |
| Processing rate: | Once every 2 power system cycles |

### Station Battery Voltage Monitor

| | |
|---|---|
| Operating Range: | 0–350 Vdc (300 Vdc for UL purposes) |
| Pickup Range: | 20.00–300.00 Vdc |
| Pickup accuracy: | ±2% of setting plus ±2 Vdc |

### Timers

| | |
|---|---|
| Setting Range: | Various |
| Accuracy: | ±0.5% of setting plus ±1/4 cycle |

### RTD Protection

| | |
|---|---|
| Setting Range: | Off, 1°–250°C |
| Accuracy: | ±2°C |
| RTD Open-Circuit Detection: | >250°C |
| RTD Short-Circuit Detection: | <–50°C |
| RTD Types: | PT100, NI100, NI120, CU10 |
| RTD Lead Resistance: | 25 Ω max. per lead |
| Update Rate: | <3 s |
| Noise Immunity on RTD Inputs: | As high as 1.4 Vac (peak) at 50 Hz or greater frequency |
| RTD Fault/Alarm/Trip Time Delay: | Approx. 12 s |

## Metering

Accuracies are specified at 20°C, nominal frequency, ac currents within (0.2–20.0) • $I_{NOM}$ A secondary, and ac voltages within 50–250 V secondary (1.33–6.67 V secondary with 8 V LEA option), unless otherwise noted.

| | |
|---|---|
| Phase Currents: | ±1% of reading, ±1° (±2.5° at 0.2–0.5 A for relays with $I_{NOM}$ = 1 A) |
| Three-Phase Average Current: | ±1% of reading |
| IG (Residual Current): | ±2% of reading, ±2° (±5.0° at 0.2–0.5 A for relays with $I_{NOM}$ = 1 A) |
| IN (Neutral Current): | ±1% of reading, ±1° (±2.5° at 0.2–0.5 A for relays with $I_{NOM}$ = 1 A)<br>±1.6 mA and ±1% (0.04–4.0 A) (0.2 A nominal channel IN current input) |
| I1 Positive-Sequence Current: | ±2% of reading |
| 3I2 Negative-Sequence Current: | ±2% of reading |
| System Frequency: | ±0.01 Hz of reading for frequencies within 15–70 Hz (V1 > 60 V) |
| Line-to-Line Voltages: | ±1% of reading, ±1° for voltages |
| Three-Phase Average Line-to-Line Voltage: | ±1% of reading for voltages within 24–264 V |
| Line-to-Ground Voltages: | ±1% of reading, ±1° for voltages within 24–264 V (0.64–7.04 V for LEA inputs) |
| Three-Phase Average Line-to-Ground Voltages: | ±1% of reading for voltages within 24–264 V (0.64–7.04 V for LEA inputs) |
| Voltage Imbalance (%): | ±2% of reading |
| V1 Positive-Sequence Voltage: | ±2% of reading for voltages within 24–264 V (0.64–7.04 V for LEA inputs) |
| 3V2 Negative-Sequence Voltage: | ±2% of reading for voltages within 24–264 V (0.64–7.04 V for LEA inputs) |
| Real Three-Phase Power (kW): | ±3% of reading for 0.10 < pf < 1.00 |
| Reactive Three-Phase Power (kVAR): | ±3% of reading for 0.00 < pf < 0.90 |
| Apparent Three-Phase Power (kVA): | ±3% of reading |
| Power Factor: | ±2% of reading |
| RTD Temperatures: | ±2°C |

### Energy Meter

| | |
|---|---|
| Accumulators: | Separate IN and OUT accumulators updated once per second, transferred to nonvolatile storage 4 times per day |
| ASCII Report Resolution: | 0.001 MWh |
| Accuracy: | The accuracy of the energy meter depends on applied current and power factor as shown in the power metering accuracy specifications above. The additional error introduced by accumulating power to yield energy is negligible when power changes slowly compared to the processing rate of once per second. |

## Synchrophasor Accuracy

### Maximum Message Rate

| | |
|---|---|
| Nominal 60 Hz System: | 60 messages per second |
| Nominal 50 Hz System: | 50 messages per second |

The voltage accuracy specifications are only applicable for the model options with standard voltage inputs (not applicable to LEA option).
The current accuracy specifications are applicable for all 1 A and 5 A options.
**Note**: For the SEL-751 current only model, the accuracy specifications for currents are only applicable when the applied signal frequency equals FNOM.

### Accuracy for Voltages

Level 1 compliant as specified in IEEE C37.118 under the following conditions for the specified range.

Conditions

- At maximum message rate
- When phasor has the same frequency as the positive-sequence voltage
- Frequency-based phasor compensation is enabled PHCOMP := Y)
- The narrow bandwidth filter is selected (PMAPP := N)

Range

| | |
|---|---|
| Frequency: | ±5.0 Hz of nominal (50 or 60 Hz) |
| Magnitude: | 30 V–250 V |
| Phase Angle: | –179.99° to 180.00° |
| Out-of-Band Interfering Frequency (Fs): | 10 Hz ≤ Fs ≤ (2 • FNOM) |

### Accuracy for Currents

Level 1 compliant as specified in IEEE C37.118 under the following conditions for the specified range.

Conditions

- At maximum message rate
- When phasor has the same frequency as the positive-sequence voltage
- Frequency-based phasor compensation is enabled (PHCOMP := Y)
- The narrow bandwidth filter is selected (PMAPP := N)

Range

| | |
|---|---|
| Frequency: | ±5.0 Hz of nominal (50 or 60 Hz) |
| Magnitude: | (0.4–2) • $I_{NOM}$ ($I_{NOM}$ = 1 A or 5 A) |
| Phase Angle: | –179.99° to 180.00° |
| Out-of-Band Interfering Frequency (Fs): | 10 Hz ≤ Fs ≤ (2 • FNOM) |

[a] Front port serial cable (non-fiber) lengths assumed to be <3 m.

# Notes

SCHWEITZER ENGINEERING LABORATORIES, INC.
2350 NE Hopkins Court • Pullman, WA 99163-5603 U.S.A.
Tel: +1.509.332.1890 • Fax: +1.509.332.7990
selinc.com • info@selinc.com

*PDS751-01*

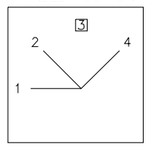
CONTACT DIAGRAM

| DECK | CONTACTS | POSITION TRIP | POSITION RESET |
|---|---|---|---|
| 1 | 11 ○—\| \|—○ 13 | | X |
| | 12 ○—\| \|—○ 18 | X | |
| | 15 ○—\| \|—○ 17 | | X |
| | 14 ○—\| \|—○ 16 | X | |
| 2 | 21 ○—\| \|—○ 23 | | X |
| | 22 ○—\| \|—○ 28 | X | |
| | 25 ○—\| \|—○ 27 | | X |
| | 24 ○—\| \|—○ 26 | X | |
| 3 | 31 ○—\| \|—○ 33 | | X |
| | 32 ○—\| \|—○ 38 | X | |
| | 35 ○—\| \|—○ 37 | | X |
| | 34 ○—\| \|—○ 36 | X | |
| 4 | 41 ○—\| \|—○ 43 | | X |
| | 42 ○—\| \|—○ 48 | X | |
| | 45 ○—\| \|—○ 47 | | X |
| | 44 ○—\| \|—○ 46 | X | |

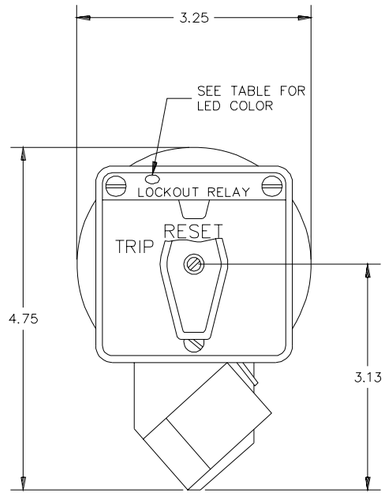
(TYPICAL)

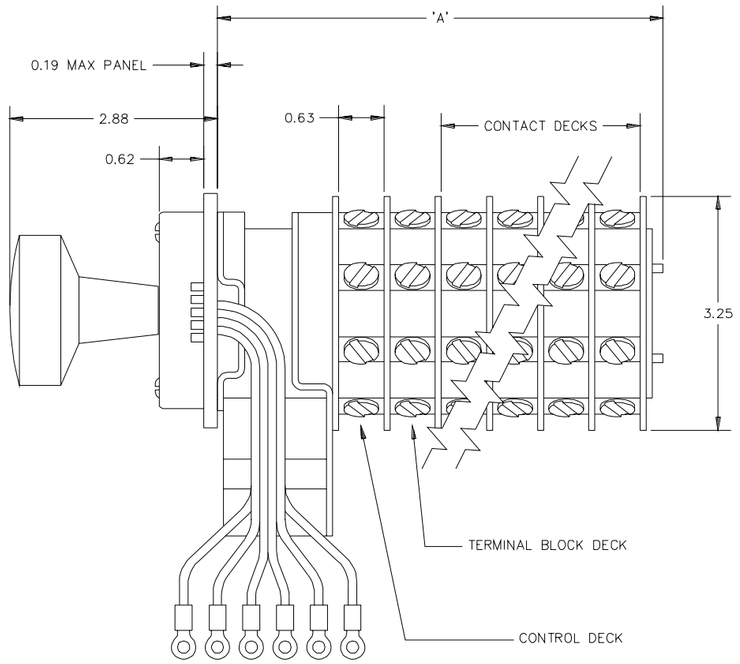
USED FOR LAMP

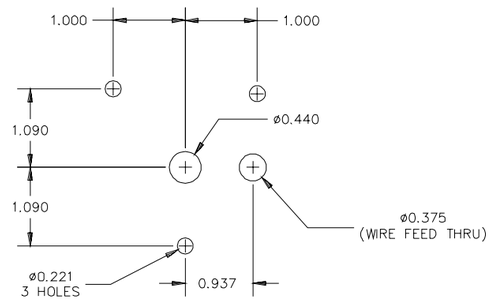
HANDLE POSITION

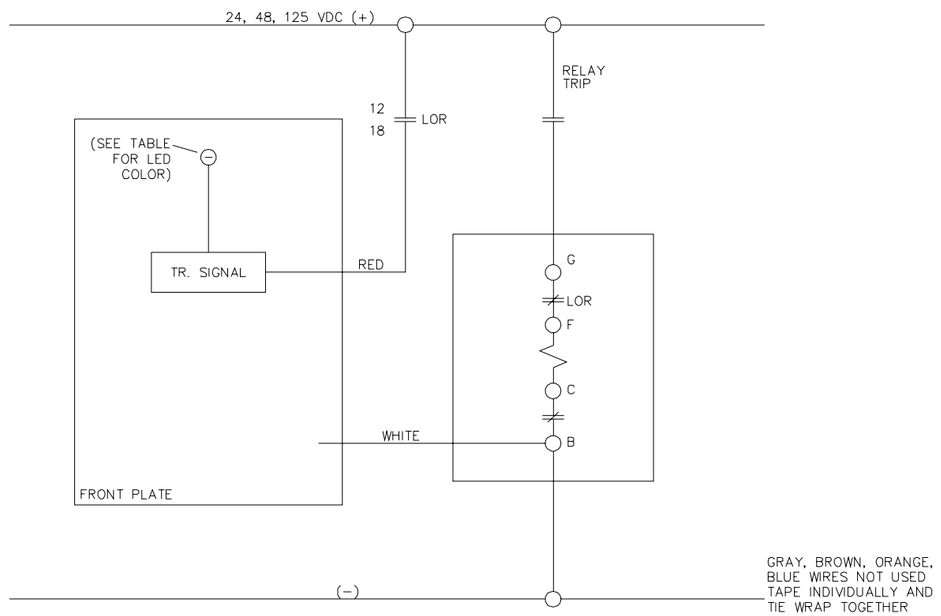



☒ TARGET




GRAY, BROWN, ORANGE, BLUE WIRES NOT USED TAPE INDIVIDUALLY AND TIE WRAP TOGETHER

TABULATION

| ONAN P/N | ECO NUMBER | VENDOR P/N | COIL VOLTAGE | DIM 'A' | NUMBER OF DECKS | LED COLOR |
|---|---|---|---|---|---|---|
| 307–2981–01 | FRD17660 | 78PJ02A–011 | 24VDC | 5.03 | 2 | RED |
| 307–2981–02 | FRD17660 | 78PJ03A–011 | 24VDC | 5.40 | 3 | RED |
| 307–2981–03 | FRD17660 | 78PJ04A–011 | 24VDC | 6.15 | 4 | RED |
| 307–2981–04 | FRD17660 | 78PA02C–011 | 48VDC | 5.03 | 2 | RED |
| 307–2981–05 | FRD17660 | 78PA03C–011 | 48VDC | 5.40 | 3 | RED |
| 307–2981–06 | FRD17660 | 78PA04C–011 | 48VDC | 6.15 | 4 | RED |
| 307–2981–07 | FRD17660 | 78PA02D–011 | 125VDC | 5.03 | 2 | RED |
| 307–2981–08 | FRD17660 | 78PA03D–011 | 125VDC | 5.40 | 3 | RED |
| 307–2981–09 | FRD17660 | 78PA04D–011 | 125VDC | 6.15 | 4 | RED |
| 307–2981–10 | FRD17660 | 78PA06D–011 | 125VDC | 7.27 | 6 | RED |
| 307–2981–11 | FRD17660 | 78PA08D–011 | 125VDC | 8.39 | 8 | RED |
| 307–2981–12 | FRD17660 | 78PA10D–011 | 125VDC | 9.51 | 10 | RED |
| 307–2981–13 | FRD17660 | 78PA06C–011 | 48VDC | 7.27 | 6 | RED |
| 307–2981–14 | FRD17660 | 78PA08C–011 | 48VDC | 8.39 | 8 | RED |
| 307–2981–15 | FRD17660 | 78PA10C–011 | 48VDC | 9.51 | 10 | RED |
| 307–2981–16 | FRD20340 | 78PJ04A–001 | 24VDC | 6.15 | 4 | WHITE |
| 307–2981–17 | FRD20340 | 78PA04C–001 | 48VDC | 6.15 | 4 | WHITE |
| 307–2981–18 | FRD20340 | 78PA04D–001 | 125VDC | 6.15 | 4 | WHITE |

NOTE:
1. SUPPLIER PROCURED FROM: ELECTROSWITCH CORPORATION WEYMOUTH, MASSACHUSETTS
2. VENDOR PART: SEE TABULATION
3. CONTACT RATING: 20A, 600V
4. MAINTAINED CONTACTS
5. CONTROL VOLTAGE: SEE TABULATION
6. OVAL HANDLE
7. UL RECOGNIZED
8. REF REPLACEMENT/SPARE LED 0322–0509–01.

| ECO NO. | LTR | NO. | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD20340 | E | 1 | ADD –16 THRU –18 | – | DJL | JA | JD | 06/30/04 |
| FRD17660 | D | 1 | ADD NOTE 8 | – | JA | HCS | HCS | 8/14/03 |
| FRD12881 | C | 1 | ADD 307–2981–10 THRU –15 | – | KM | JA | HCS | 5/16/02 |
| FRD10978 | B | 1 | RED WIRE WAS BLUE, ORANGE | – | – | – | – | – |
| | | | WIRE WAS WHITE | – | KM | JA | HCS | 11/01/01 |
| FRD9371 | A | 1 | PRODUCTION RELEASE | – | KM | JA | HCS | 6/20/01 |

PROJECT:

DISTRIBUTOR:

DO NOT SCALE PRINT

ANG TOL | DRAWN TO SCALE OF

AUTOCAD DWG

SIM TO | COPIED FROM | THIRD ANGLE PROJECTION



| PART NO. | DWG SIZE | DESCRIPTION OF MATERIAL | REV DES |
|---|---|---|---|
| NAME | | DATE | |
| DR K. MAAS | | 5/01/01 | |
| CHKR J. ANDERSON | | 6/12/01 | |
| MFG | | | |
| APPROVED H. CHANDRASHEKAR | | 6/18/01 | |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M–1982

MODEL FIRST USED ON: PCIL

SITE CODE: PGA

CUMMINS POWER GENERATION
1400 73rd AVE. NE
MINNEAPOLIS, MN 55432

TITLE: RELAY–LOCKOUT

DWG NO. 0307–2981

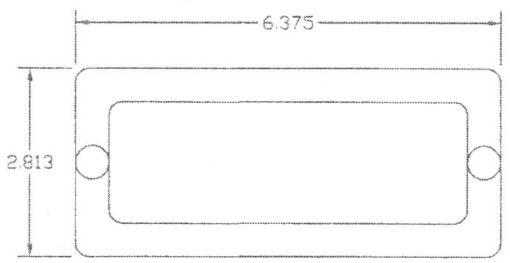
SHEET 1 of 1

DWG SIZE D

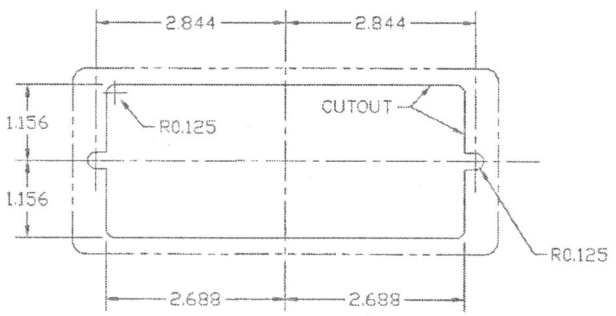
0308-1156 | C

| REL NO | LTR | NO | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD14391 | A | 1 | PRODUCTION RELEASE | – | KM | JA | HCS | 10/18/02 |
| FRD16288 | B | 1 | ADD -03, -04 | – | KM | JA | HCS | 04/09/03 |
| FRD32007 | C | 1 | ADD -05, -06 | – | CK | JA | BJ | 05/01/07 |

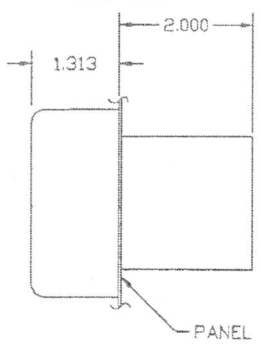
FRONT VIEW



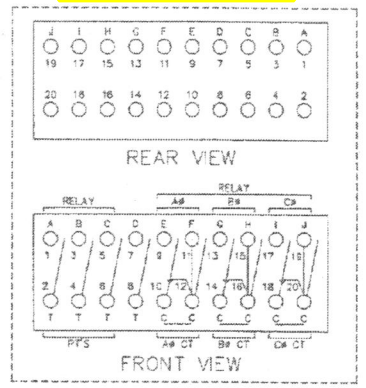

DRILLING PLAN



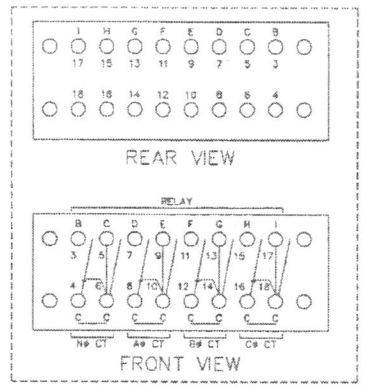

SIDE VIEW



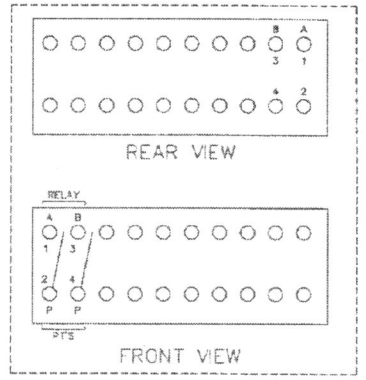

INTERNAL SCHEMATIC
0308-1156-01



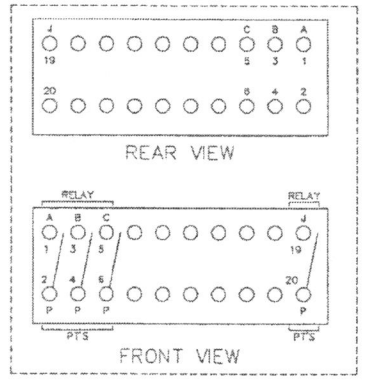

INTERNAL SCHEMATIC
0308-1156-02



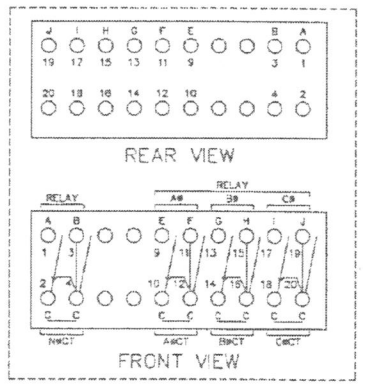

INTERNAL SCHEMATIC
0308-1156-03




INTERNAL SCHEMATIC
0308-1156-04




INTERNAL SCHEMATIC
0308-1156-05




INTERNAL SCHEMATIC
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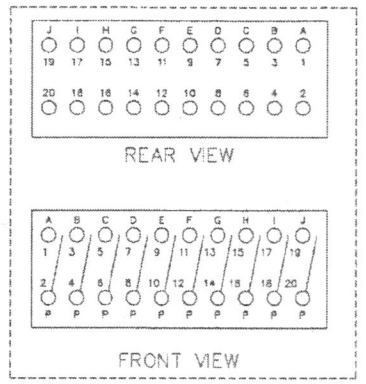
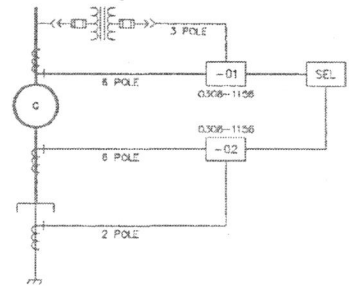



NOTES:
1. FIRST SUPPLIER PROCURED FROM ABB
2. VENDOR STYLE NO. SEE TABULATION
3. UL RECOGNIZED UNDER FILE NO E103204




V.O. DRAWING

TABULATION

| ONAN PART N.O. | ECO # | VENDOR STYLE N.O. | NO. OF CURRENT POLES | NO. OF POTENTIAL POLES |
|---|---|---|---|---|
| 0308-1156-01 | FRD14391 | 498A010G01 | 6 | 4 |
| 0308-1156-02 | FRD14391 | 129A517G01 | 8 | 0 |
| 0308-1156-03 | FRD16288 | 291B954G13 | 0 | 2 |
| 0308-1156-04 | FRD16288 | 498A022G01 | 0 | 4 |
| 0308-1156-05 | FRD32007 | 9672A10G01 | 8 | 0 |
| 0308-1156-06 | FRD32007 | 129A501G01 | 0 | 10 |

| QTY | ITEM | PART NO | DWG SIZE | DESCRIPTION OR MATERIAL | MFG DES |
|---|---|---|---|---|---|

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TOLERANCE UNLESS OTHERWISE SPECIFIED

| | mm | inch |
|---|---|---|
| DIM | X ± | X ± |
| | .X ± | .XX ± |
| | .XX ± | .XXX ± |
| HOLE | 0.09 – 4.99 +0.15/–0.08 | .004 – .200 +.006/–.003 |
| | 5.00 – 9.99 +0.20/–0.10 | .201 – .421 +.008/–.004 |
| | 10.00 – 17.49 +0.25/–0.13 | .422 – .703 +.010/–.005 |
| | 17.50 – 24.99 +0.30/–0.13 | .704 – .999 +.012/–.005 |

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FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M–1982

| | NAME | DATE |
|---|---|---|
| DR | K. MAAS | 10/18/02 |
| CHKR ☒ MFG ☐ | J. ANDERSON | 10/18/02 |
| APPROVED | H. CHANDRASHEKAR | 10/18/02 |

MODEL FIRST USED ON: PCIL/PCUL

SITE CODE: PGA

CUMMINS POWER GENERATION
1400 73RD AVE NE
MINNEAPOLIS, MINNESOTA 55432

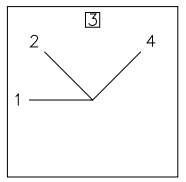
TITLE: SWITCH-SLIDE (RLY TEST SW)

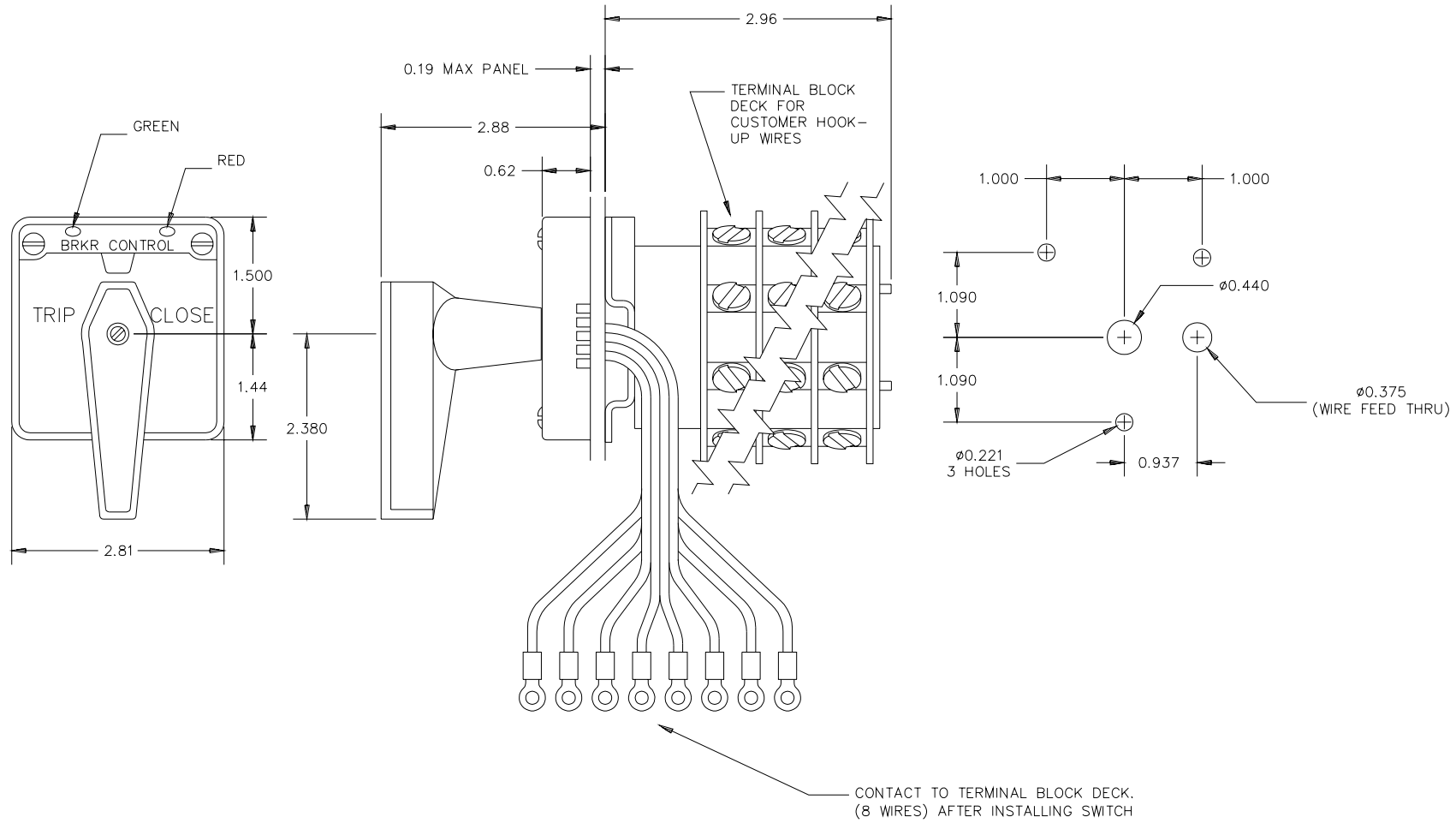
DWG NO: 0308-1156 | SHEET: 1 OF 1 | DWG SIZE: C

CONTACT DIAGRAM

| DECK | CONTACTS | POSITION TRIP | NORMAL | CLOSE |
|---|---|---|---|---|
| 1 | 11 ○—\| \|—○ 18 | X | | |
| | 16 ○—\| \|—○ 17 | | | X |

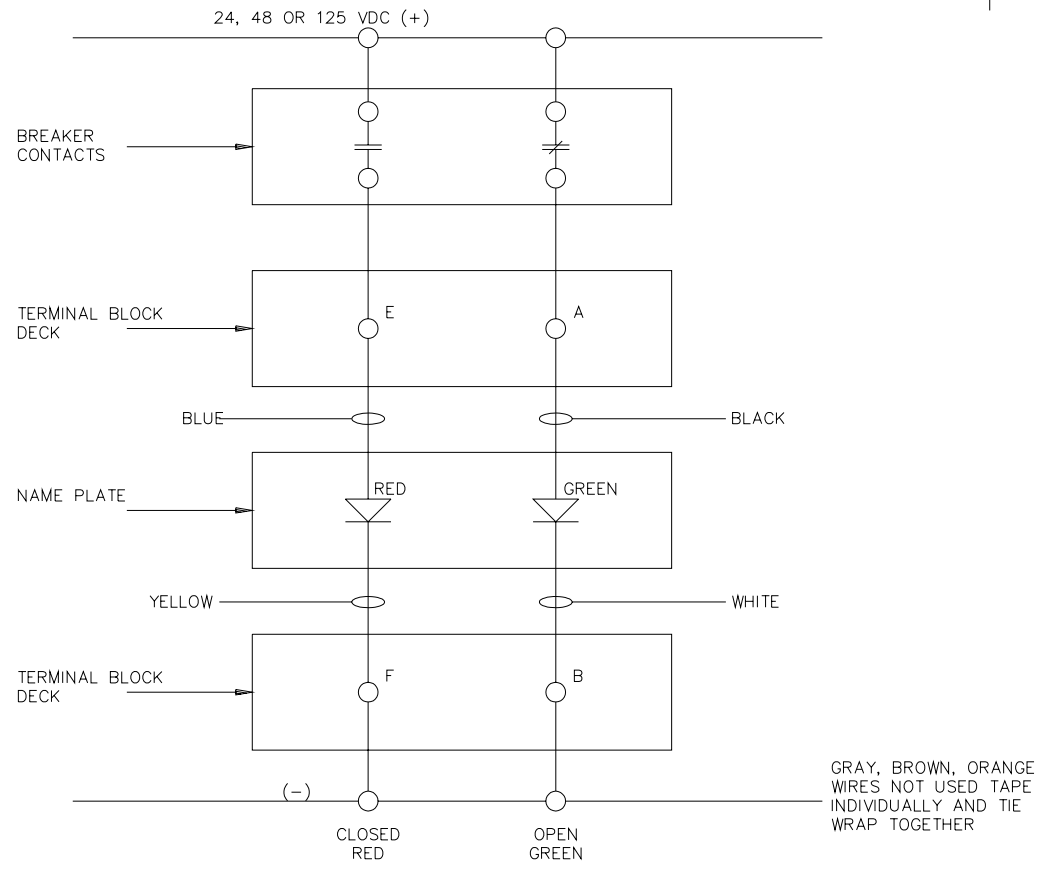
HANDLE POSITION










TABULATION

| ONAN P/N | ECO NUMBER | VENDOR P/N | COIL VOLTAGE | DECKS |
|---|---|---|---|---|
| 0308-1112-01 | FRD17660 | 24PK38D | 24VDC | 1 |
| 0308-1112-02 | FRD17660 | 24PB38D | 48-125 VDC | 1 |
| | | | | |

NOTE:
1. SUPPLIER PROCURED FROM: ELECTROSWITCH CORPORATION WEYMOUTH, MASSACHUSETTS
2. VENDOR PART: SEE TABULATION
3. CONTACT RATING: 20A, 600V
4. SPRING RETURN TO CENTER
5. CONTROL VOLTAGE: SEE TABULATION
6. PISTOL GRIP HANDLE
7. UL RECOGNIZED
8. REF REPLACEMENT/SPARE LED 0322-0509-01 & -03.

| ECO NO. | LTR | NO. | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD17660 | C | 1 | ADD NOTE 8 | – | JA | HCS | HCS | 8/13/03 |
| FRD10978 | B | 1 | RMV HANDLE POSITION 45° | – | KM | JA | HCS | 11/01/01 |
| FRD9371 | A | 1 | PRODUCTION RELEASE | – | KM | JA | HCS | 6/20/01 |

PROJECT:

DISTRIBUTOR:

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AUTOCAD DWG

SIM TO | COPIED FROM | THREE ANGLE PROJECTION



| PART NO. | DWG SIZE | DESCRIPTION OF MATERIAL | REF DES |
|---|---|---|---|

| | NAME | DATE |
|---|---|---|
| DR | K. MAAS | 5/01/01 |
| CHKR ☐ MFG ☐ | J. ANDERSON | 6/12/01 |
| APPROVED | H. CHANDRASHEKAR | 6/18/01 |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON: PCIL

SITE CODE: PGA

CUMMINS POWER GENERATION
1400 73rd AVE. NE
MINNEAPOLIS, MN 55432

TITLE: SWITCH-ROTARY (BRKR CNTL)

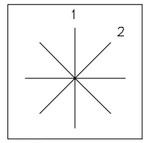
DWG NO. 0308-1112 | SHEET 1 of 1 | DWG SIZE D

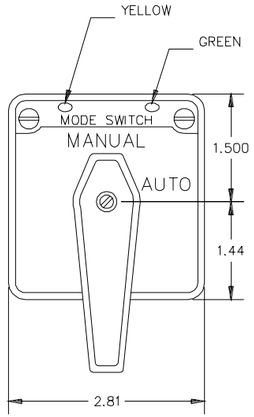
CONTACT DIAGRAM

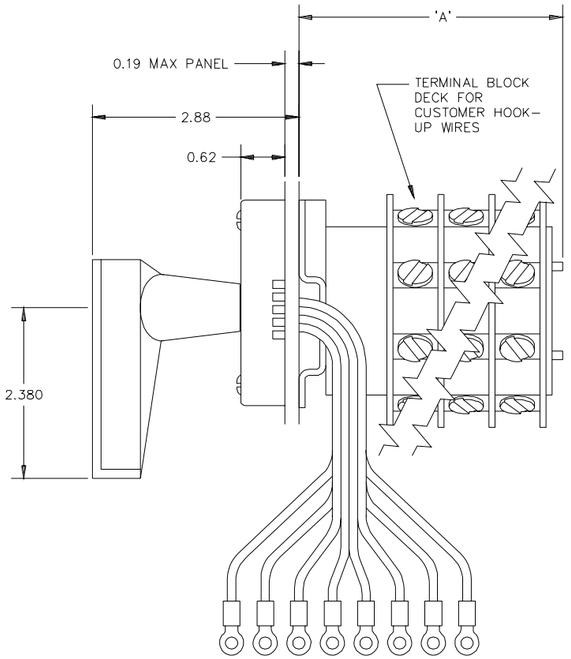
| DECK | CONTACTS HANDLE END | | POSITION 1 MANUAL | POSITION 2 AUTO |
|---|---|---|---|---|
| 1 | 12 | 11 | X | |
| | | 13 | | X |
| | 16 | 15 | X | |
| | | 17 | | X |
| 2 | 22 | 21 | X | |
| | | 23 | | X |
| | 26 | 25 | X | |
| | | 27 | | X |
| 3 | 32 | 31 | X | |
| | | 33 | | X |
| | 36 | 35 | X | |
| | | 37 | | X |
| 4 | 42 | 41 | X | |
| | | 43 | | X |
| | 46 | 45 | X | |
| | | 47 | | X |
| 5 | 52 | 51 | X | |
| | | 53 | | X |
| | 56 | 55 | X | |
| | | 57 | | X |
| 6 | 62 | 61 | X | |
| | | 63 | | X |
| | 66 | 65 | X | |
| | | 67 | | X |
| 7 | 72 | 71 | X | |
| | | 73 | | X |
| | 76 | 75 | X | |
| | | 77 | | X |
| 8 | 82 | 81 | X | |
| | | 83 | | X |
| | 86 | 85 | X | |
| | | 87 | | X |

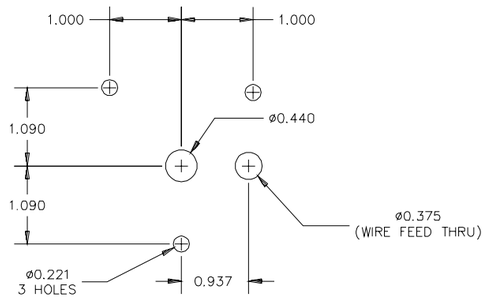
USED FOR LAMPS

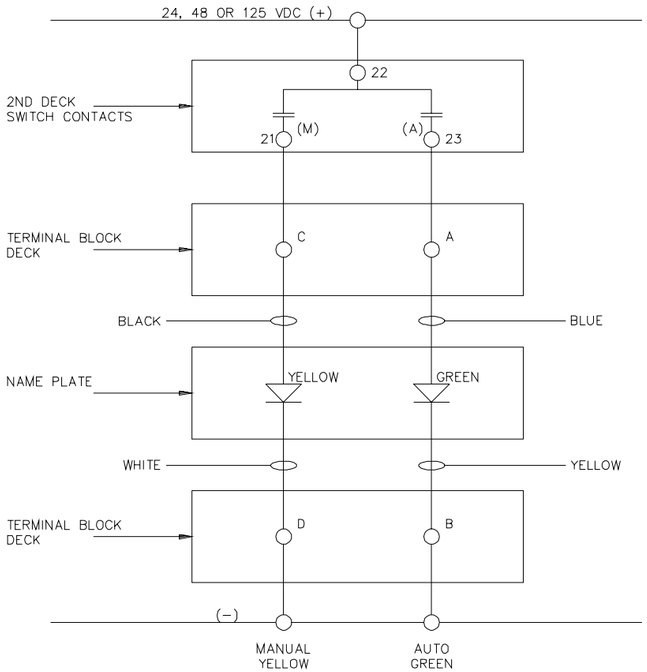
HANDLE POSITION




TABULATION

| ONAN P/N | ECO NUMBER | VENDOR P/N | COIL VOLTAGE | DECKS | DIM 'A' |
|---|---|---|---|---|---|
| 0308-1111-01 | FRD17660 | 24PK202LA | 24V DC | 2 | 3.68" |
| 0308-1111-02 | FRD17660 | 24PB202LB | 48-125 VDC | 2 | 3.68" |
| 0308-1111-03 | FRD17660 | 24PK203LA | 24 VDC | 3 | 4.20" |
| 0308-1111-04 | FRD17660 | 24PB203LA | 48-125 VDC | 3 | 4.20" |
| 0308-1111-05 | FRD17660 | 24PK204LA | 24 VDC | 4 | 4.80" |
| 0308-1111-06 | FRD17660 | 24PB204LC | 48-125 VDC | 4 | 4.80" |
| 0308-1111-07 | FRD17660 | 24PK206LA | 24V DC | 6 | 5.92" |
| 0308-1111-08 | FRD17660 | 24PB206LA | 48-125 VDC | 6 | 5.92" |
| 0308-1111-09 | FRD17660 | 24PK207LA | 24 VDC | 7 | 6.48" |
| 0308-1111-10 | FRD17660 | 24PB207LA | 48-125 VDC | 7 | 6.48" |
| 0308-1111-11 | FRD17660 | 24PK208LA | 24 VDC | 8 | 7.04" |
| 0308-1111-12 | FRD17660 | 24PB208LA | 48-125 VDC | 8 | 7.04" |

NOTE:
1. SUPPLIER PROCURED FROM: ELECTROSWITCH CORPORATION WEYMOUTH, MASSACHUSETTS
2. VENDOR PART: SEE TABULATION
3. CONTACT RATING: 20A, 600V
4. MAINTAINED CONTACTS
5. CONTROL VOLTAGE: SEE TABULATION
6. PISTOL GRIP HANDLE
7. UL RECOGNIZED
8. REF REPLACEMENT/SPARE LED 0322-0509-02 & -03.

| ECO NO. | LTR | NO. | REVISION | ZONE | DR | CHKR | APPROVED | DATE |
|---|---|---|---|---|---|---|---|---|
| FRD17660 | D | 1 | ADD NOTE 8 | – | JA | HCS | HCS | 8/13/03 |
| FRD12881 | C | 1 | ADD 0308-1111-07 THRU -12 | – | KM | JA | HCS | 5/16/02 |
| FRD10978 | B | 1 | RMV HANDLE POSITION TARGET | – | KM | JA | HCS | 11/01/01 |
| FRD9371 | A | 1 | PRODUCTION RELEASE | – | KM | JA | HCS | 6/20/01 |

PROJECT:

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THREE ANGLE PROJECTION



PART NO. | DWG SIZE | DESCRIPTION OF MATERIAL | REF DES

| | NAME | DATE |
|---|---|---|
| DR | K. MAAS | 5/01/01 |
| CHKR □ MFG □ | J. ANDERSON | 6/12/01 |
| APPROVED | H. CHANDRASHEKAR | 6/18/01 |

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON: PCIL

SITE CODE: PGA

CUMMINS POWER GENERATION
1400 73rd AVE NE
MINNEAPOLIS, MN 55432

TITLE: SWITCH-ROTARY(MODE SELECT)

DWG NO. 0308-1111 | SHEET 1 of 1 | DWG SIZE D

# Internal Modular SPDs

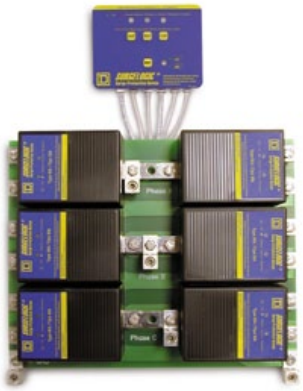
## Square D™ Internally Mounted Surge Protective Devices

Square D™ brand Surgelogic™ internal modular Surge Protective Devices (SPDs) deliver specification grade performance for service entrance or critical branch panel applications. This multi-phase system provides suppression for all critical modes inside electrical equipment and shorter lead lengths with superior SPD performance.

SQUARE D™

by Schneider Electric

# Internal Modular SPDs Features



Internal panel modular Surge Protective Devices (SPDs) provide superior design and service life for a wide variety of commercial, industrial, or institutional applications. Square D brand Surgelogic SPDs offer first-rate performance and surge suppression for demanding service entrance applications or as part of a suppression network. The robust modular construction reduces possible down time and maintenance costs.

## Superior Performance

Surgelogic SPDs utilize a high-energy suppression circuit that provides 10 modes of suppression from 120,000 to 480,000 peak Amps of surge current rating per phase. Modular SPDs feature circuity that provides not only transient surge suppression, but also noise filtration.

## Installation

Integral solutions come professionally pre-wired into electrical gear and panels from the factory insuring short lead lengths and high performance. All units are tested at the factory before delivery to their final destination, maintaining Square D brand's high standard of quality. There is also no need for additional enclosures or installation labor costs.

## Warranty

Surgelogic internal modular SPDs have a 10-year warranty.

| FEATURES | ADVANTAGES | BENEFITS |
|---|---|---|
| Integral to electrical gear and panels | SPDs are professionally installed inside electrical gear and panels | Delivers high levels of SPD performance and saves on enclosure and installation expenses |
| 120,000 to 480,000 Amp Capacity (depending on model) | Longer service life and suppression against high-energy lightning strikes | High performance surge suppression even in severe electrical conditions |
| EMI/RFI Noise Rejection | Increased transient suppression | Improves surge suppression to the equipment |
| Advanced Diagnostics | Allows for online testing of the suppressor's functionality | Provides immediate response if suppressor is damaged |
| Suppression Status Alarms | Allows multiple methods of alarm notification | Provides immediate notification through audible, visual and remote signaling if reduced suppression occurs |
| Coordinated Fuse Technology | Coordinated fusing allows disconnection methods for thermal and high-current events | Provides premium surge suppression while managing both thermal and high-current end-of-life events |

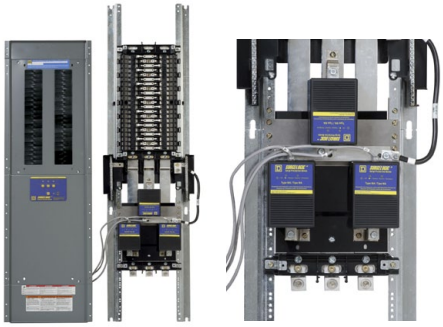
**Schneider Electric USA, Inc.** 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com



Document Number 9990-0116F December 2012 bw

# Internal Modular SPDs
## Features (continued)

### NQ/NF Panelboard



NQ and NF panelboards are primarily used for lighting and power distribution up to 600 Amps. These panelboards, following the 2008 National Electric Code changes, provide electrical capacity up to 84 circuit breakers. Both types of panels are designed with 200% rated copper neutrals for non-linear loads. (NQ max volts 240 Vac, NF max volts 600/347 Vac)

**SPD available surge current ratings:** 120, 160, 240 kA

### QED Switchboard

QED Switchboards are made for use as service entrance equipment or as distribution centers in commercial, institutional, and industrial applications. QEDs are extremely versatile providing front accessible load connections with multiple breaker and fusible switch options. QEDs enable easy access to power monitoring equipment such as products from our PowerLogic™ brand. (Max volts 600 Vac, max current 4,000 Amps)

**SPD available surge current ratings:**
120, 160, 240, 320, 480 kA

## Internal SPDs


### Performance

| | |
|---|---|
| Surge Current Rating per Phase | Up to 480kA |
| Short Circuit Current Rating | 200kA |
| Modes of Protection | 6, 10 |
| Fusing | Individually fused MOVs |
| Thermal Fusing | Yes |
| Overcurrent Fusing | Yes |
| Sine Wave Tracking | Yes |
| EMI/RFI Filtering | Up to -42 dB |
| Operating Frequency | 50/60 Hz |

### Mechanical Description

| | |
|---|---|
| Connection Method | #10-#2 AWG Terminals |
| Mounting Method/Circuit Type | Parallel |
| Operating Altitude | Sea Level-12,000' (3,658 m) |
| Storage Temperature | -40˚ F (-40˚ C) to 149˚ F (65˚ C) |
| Operating Temp. | -4˚ F (-20˚ C) to 149˚ F (65˚ C) |
| LCD Operating Temp. | 32˚ F (0˚ C) to 149˚ F (65˚ C) |
| Operating Humidity | 0 to 95% non-condensing |

### Diagnostics

Push to test diagnostic switches, red and green status LEDs per phase (internal redundant status LEDs are green), module status LEDs per mode, dry contacts, audible alarm with disable switch, surge counter.

### Options

- Remote monitor

### Safety and Performance

cULus Listed per UL1449 3rd Edition Type 2 SPD, UL 1283 5th Ed., and CAN/CSA C22.2 No. 8-M1986.

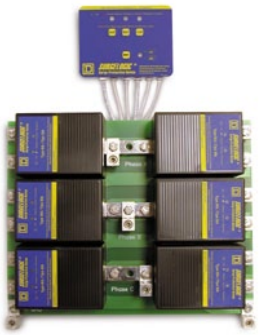
Complies with UL 96A 12th Ed. Master Label requirements for Lighting Protection Systems



**Schneider Electric USA, Inc.** 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com

# Internal Modular SPDs
# Features (continued)

## Power-Zone™ Switchgear



The Square D brand Power-Zone 4 low voltage metal-enclosed drawout switchgear is designed to provide superior electrical distribution and power quality management. Power-Zone 4 switchgear is designed to deliver maximum uptime, system selectivity, and ease of maintenance. All of these features are packed into one of the smallest footprints available for low voltage drawout switchgear. (Max volts 600 Vac, max current 5,000 Amps)

**SPD available surge current ratings:**
120, 160, 240, 320, and 480 kA

## QMB Panelboard

When specifications or electrical codes call for a fusible panelboard, the QMB family offers superior performance and time-saving installation features. The reliability of the QMB panelboard makes it the product of choice for large commercial and industrial applications. (Max volts 600 Vac, max current 400 Amps)

**SPD available surge current ratings:** 120, 160, 240 kA

## Motor Control Center

The feature-rich modular design minimizes space and maximizes ease-of-use and accessibility of motor control devices. The Model 6 MCC has integrated industry-leading components into the smallest and one of the most flexible footprints possible to meet industry's power, control, and automation needs. (Max volts 480 Vac, max current 2,500 Amps)

**SPD available surge current ratings:** 120, 160, 240 kA

## Busway


Square D brand I-Line™ Busway is engineered to replace old cable and conduit systems. This next-generation power distribution system is loaded with exceptional features, including a 200% neutral and a 100% isolated ground path. (Max volts 600 Vac, max current 5,000 Amps)

**SPD available surge current ratings:** 120, 160, 240 kA



**Schneider Electric USA, Inc.** 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com

# Internal Modular SPDs Specifications

## WYE Configured SPD Specifications

| Voltage | Surge Current per Phase | Modes of Protection | Configuration | Model Number | MCOV | $I_n$ | VPR L-N | VPR L-G | VPR L-L | VPR N-G |
|---|---|---|---|---|---|---|---|---|---|---|
| 120/240V | 120kA | 6 | 1 Ø, 3-wire+G | TVS1IMA12_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 208Y/120V ■ | 120kA | 10 | 3 Ø, Wye, 4-wire+G | TVS2IMA12_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 480Y/277V ▲ | 120kA | 10 | 3 Ø, Wye, 4-wire+G | TVS4IMA12_ | 320V | 20kA | 1200V | 1200V | 2000V | 1200V |
| 600Y/347V | 120kA | 10 | 3 Ø, Wye, 4-wire+G | TVS8IMA12_ | 420V | 20kA | 1500V | 1500V | 2500V | 1500V |
| 120/240V | 160kA | 6 | 1 Ø, 3-wire+G | TVS1IMA16_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 208Y/120V ■ | 160kA | 10 | 3 Ø, Wye, 4-wire+G | TVS2IMA16_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 480Y/277V ▲ | 160kA | 10 | 3 Ø, Wye, 4-wire+G | TVS4IMA16_ | 320V | 20kA | 1200V | 1200V | 2000V | 1200V |
| 600Y/347V | 160kA | 10 | 3 Ø, Wye, 4-wire+G | TVS8IMA16_ | 420V | 20kA | 1500V | 1500V | 2500V | 1500V |
| 120/240V | 240kA | 6 | 1 Ø, 3-wire+G | TVS1IMA24_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 208Y/120V ■ | 240kA | 10 | 3 Ø, Wye, 4-wire+G | TVS2IMA24_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 480Y/277V ▲ | 240kA | 10 | 3 Ø, Wye, 4-wire+G | TVS4IMA24_ | 320V | 20kA | 1200V | 1200V | 2000V | 1200V |
| 600Y/347V | 240kA | 10 | 3 Ø, Wye, 4-wire+G | TVS8IMA24_ | 420V | 20kA | 1500V | 1500V | 2500V | 1500V |
| 120/240V | 320kA | 6 | 1 Ø, 3-wire+G | TVS1IMA32_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 208Y/120V ■ | 320kA | 10 | 3 Ø, Wye, 4-wire+G | TVS2IMA32_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 480Y/277V ▲ | 320kA | 10 | 3 Ø, Wye, 4-wire+G | TVS4IMA32_ | 320V | 20kA | 1200V | 1200V | 2000V | 1200V |
| 600Y/347V | 320kA | 10 | 3 Ø, Wye, 4-wire+G | TVS8IMA32_ | 420V | 20kA | 1500V | 1500V | 2500V | 1500V |
| 120/240V | 480kA | 6 | 1 Ø, 3-wire+G | TVS1IMA48_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 208Y/120V ■ | 480kA | 10 | 3 Ø, Wye, 4-wire+G | TVS2IMA48_ | 150V | 20kA | 700V | 800V | 1200V | 700V |
| 480Y/277V ▲ | 480kA | 10 | 3 Ø, Wye, 4-wire+G | TVS4IMA48_ | 320V | 20kA | 1200V | 1200V | 2000V | 1200V |
| 600Y/347V | 480kA | 10 | 3 Ø, Wye, 4-wire+G | TVS8IMA48_ | 420V | 20kA | 1500V | 1500V | 2500V | 1500V |

■ 208Y/120 series also applies to the following voltage 220Y/127 ▲ 480Y/277 series also applies to the following voltages 380Y/220, 400Y/230, and 415Y/240

## High-Leg Delta (HLD) Configured SPD Specifications

| Voltage | Surge Current per Phase | Modes of Protection | Configuration | Model Number | MCOV | $I_n$ | VPR L-N | VPR H-N | VPR L-G | VPR H-G | VPR L-L | VPR H-L | VPR N-G |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 240/120HLD | 120kA | 10 | 3 Ø, HLD*, 4-wire+G | TVS3IMA12_ | 150V | 20kA | 700V | 1200V | 800V | 1200V | 1200V | 1500V | 700V |
| 240/120HLD | 160kA | 10 | 3 Ø, HLD*, 4-wire+G | TVS3IMA16_ | 150V | 20kA | 700V | 1200V | 800V | 1200V | 1200V | 1500V | 700V |
| 240/120HLD | 240kA | 10 | 3 Ø, HLD*, 4-wire+G | TVS3IMA24_ | 150V | 20kA | 700V | 1200V | 800V | 1200V | 1200V | 1500V | 700V |
| 240/120HLD | 320kA | 10 | 3 Ø, HLD*, 4-wire+G | TVS3IMA32_ | 150V | 20kA | 700V | 1200V | 800V | 1200V | 1200V | 1500V | 700V |
| 240/120HLD | 480kA | 10 | 3 Ø, HLD*, 4-wire+G | TVS3IMA48_ | 150V | 20kA | 700V | 1200V | 800V | 1200V | 1200V | 1500V | 700V |

Model numbers not recognized as line items in Schneider Electric ordering system until a suffix code is applied

WYE AND HLD MODEL NUMBER SUFFIX CODES

P NQ/NF panelboard *(Not available in 320 and 480 kA)*
B QED switchboard
Z PZ3/PZ4 switchgear *(Not available in TVS1 or TVS3)*
Q QMB switchboard *(Not available in 320 and 480 kA)*
M Motor Control Center *(Not available in 320 and 480 kA)*
O OEM kit *(Not available in 320 and 480 kA)*

SPD OPTIONS

Remote Monitor TVS12RMU



**Schneider Electric USA, Inc.** 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com

**SOME LIKE IT HOT**

Deka®

# fahrenheit®


## HT150ET

- **Helios™ Additive reduces float current up to 75% enhancing high temperature life**
- **Microcat® Catalyst lowers float current, mitigates thermal buildup and cell dryout**
- **Exclusive IPF® Technology optimizes power capacity,cell consistency, and long-term reliability**
- **TempX™ Alloy inhibits corrosion under the highest temperature extremes**
- Advanced AGM technology for superior power
- Puncture resistant micro-porous glass mat separators extend life
- Front access design for easy installation and maintenance
- Reinforced case resists bulging and meets safety requirements (UL 94 V-0)
- Case & cover heat sealed and 100% tested to prevent leaks
- Epoxy-sealed posts eliminate leaks
- Flame arresting, low pressure, self-sealing valves are 100% factory tested
- Computer-aided design and manufacturing control processes and standards to ensure quality products
- All batteries meet or exceed IEEE recommended practices
- Battery design and construction meet UL recognition requirements

### *SPECIFICATIONS*

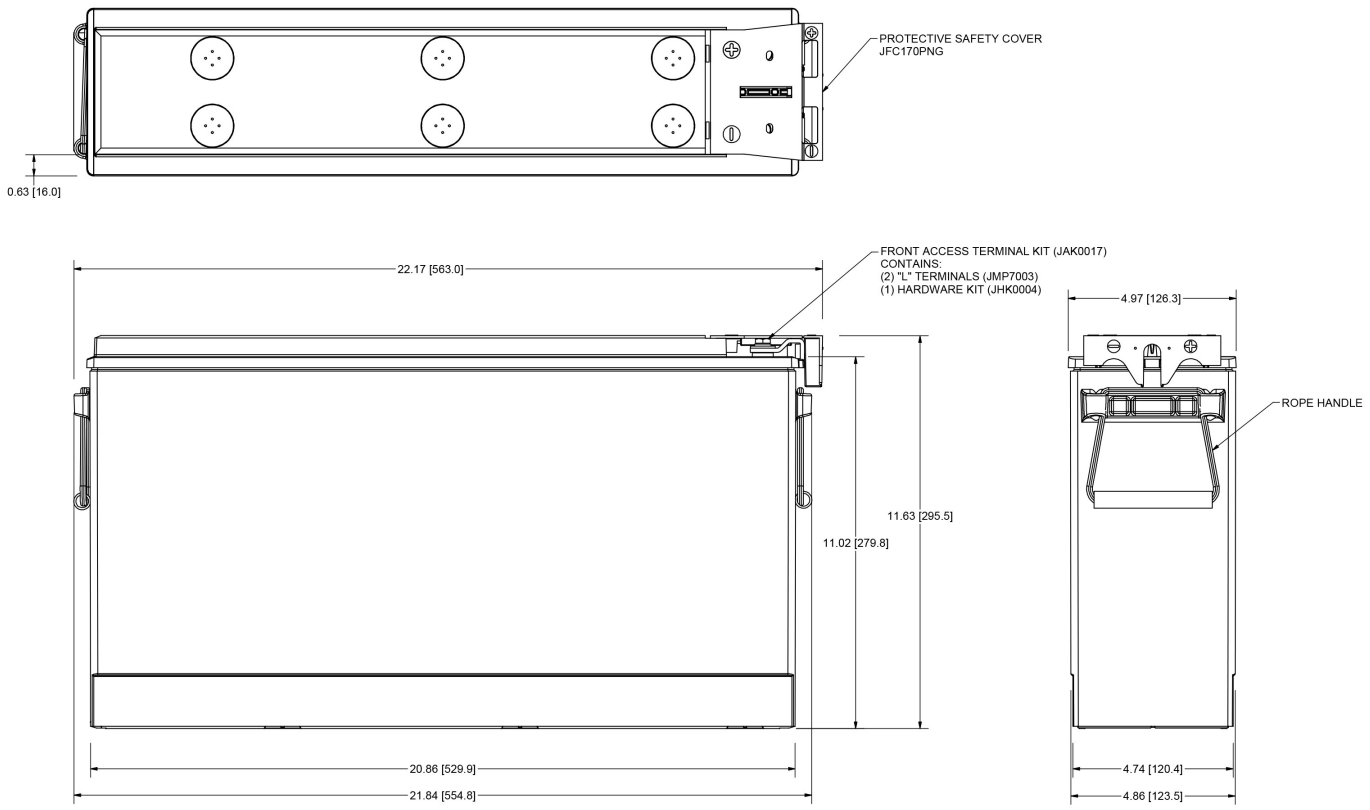
**Nominal Voltage:** 12-Volts
**Rating:** 145 Ampere-Hours @ 8 hr. rate to 1.75 V.P.C.
**Positive Plate:** >98% Pure lead with tin-calcium alloy
**Negative Plate:** Pure lead, calcium alloy
**Post Seal:** Epoxy-sealed
**Terminal:** Front access, 1/4" – 20 threaded insert
**Case/Cover:** Flame-retardant, Polypropylene – UL 94 V-0/>28% L.O.I.

**Catalyst:** Microcat®
**Safety Vent:** Low positive pressure, self-sealing w/ flame arrestor
**Float Voltage:** 2.25 V.P.C. ± 0.01 V.P.C. @ 77°F (25°C)
Range: (13.44V to 13.56V per battery)
**Design life:** 12 years in float applications @ 77°F (25°C)
**Dimensions:** Length - 22.17" (563 mm)
Width - 4.97" (126.3 mm)
Height - 11.63" (295.5 mm)
**Weight:** 103 lbs. (47 kg)

### *DISCHARGE RATE IN AMPS @ 77°F (25°C)†*

| Volts per Cell (V.P.C.) | 1 HR. | 2 HR. | 3 HR. | 4 HR. | 5 HR. | 8 HR. | 10 HR. |
|---|---|---|---|---|---|---|---|
| 1.75 | 93.4 | 53.6 | 39.3 | 31.2 | 26.2 | 18.1 | 15.0 |
| 1.80 | 89.9 | 52.4 | 38.5 | 30.6 | 25.7 | 17.8 | 14.8 |
| 1.85 | 83.9 | 49.6 | 36.7 | 29.2 | 24.8 | 17.1 | 14.2 |
| 1.88 | 78.6 | 47.1 | 35.0 | 28.0 | 23.8 | 16.4 | 13.7 |
| 1.90 | 74.4 | 45.3 | 33.6 | 26.9 | 22.9 | 15.8 | 13.1 |

*†Subject to change without notice.*




## INSTALLATION AND OPERATING INSTRUCTIONS

http://www.eastpennmanufacturing.com/wp-content/uploads/Fahrenheit-IO-Manual-2100.pdf

**PROPOSITION 65 WARNING:** Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. **WASH HANDS AFTER HANDLING.**

EASTPENN

www.dekabatteries.com

QUALITY SYSTEM CERTIFIED ISO 9001 IATF 16949 ENVIRONMENTAL SYSTEM CERTIFIED ISO 14001

UL Recognized Component

*East Penn Manufacturing Co.* Lyon Station, PA 19536-0147 Phone: 610-682-3263 Fax: 610-682-0891 e-mail: reservepowersales@dekabatteries.com

E.P.M. Form No. 2448 2/20

# IEEE-485 Summary Sheet HT145ET


| Period | Load(Amperes) | Change in Load(Amperes) | Duration of Period(Minutes) | Time to End of Section | Capacity at T Min Rate K Factor (Kt) | Required Section Size Rated Ah |
|---|---|---|---|---|---|---|
| **SECTION 1 ...** | | | | | | |
| 1 | A1 416.4 | A1-0 416.4 | M1 1 | T=M1+M1 1 | 0.29 | 120 |
| | | | | | | **120** |
| **SECTION 2 ...** | | | | | | |
| 1 | A1 416.4 | A1-0 416.4 | M1 1 | T=M1+...M2 5 | 0.37 | 155 |
| 2 | A2 23.5 | A2-1 -392.9 | M2 4 | T=M2+M2 4 | 0.35 | -138 |
| | | | | | | **17** |
| **SECTION 3 ...** | | | | | | |
| 1 | A1 416.4 | A1-0 416.4 | M1 1 | T=M1+...M3 35 | 1 | 414 |
| 2 | A2 23.5 | A2-1 -392.9 | M2 4 | T=M2+...M3 34 | 0.97 | -383 |
| 3 | A3 6 | A3-2 -17.5 | M3 30 | T=M3+M3 30 | 0.89 | -16 |
| | | | | | | **16** |

| SECTION 4 ... | | | | | | |
|---|---|---|---|---|---|---|
| 1 | A1 416.4 | A1-0 416.4 | M1 1 | T=M1+...M4 36 | 1.02 | 423 |
| 2 | A2 23.5 | A2-1 -392.9 | M2 4 | T=M2+...M4 35 | 1 | -391 |
| 3 | A3 6 | A3-2 -17.5 | M3 30 | T=M3+...M4 31 | 0.91 | -16 |
| 4 | A4 416.4 | A4-3 410.4 | M4 1 | T=M4+M4 1 | 0.29 | 119 |
| | | | | | | **135** |
| **SECTION 5 ...** | | | | | | |
| 1 | A1 416.4 | A1-0 416.4 | M1 1 | T=M1+...M5 40 | 1.1 | 458 |
| 2 | A2 23.5 | A2-1 -392.9 | M2 4 | T=M2+...M5 39 | 1.08 | -424 |
| 3 | A3 6 | A3-2 -17.5 | M3 30 | T=M3+...M5 35 | 1 | -17 |
| 4 | A4 416.4 | A4-3 410.4 | M4 1 | T=M4+...M5 5 | 0.37 | 153 |
| 5 | A5 23.5 | A5-4 -392.9 | M5 4 | T=M5+M5 4 | 0.35 | -138 |
| | | | | | | **31** |

**Maximum Section Size: 134.60 AH**

**Random Section Size: 0.00 AH**

**Uncorrected Size: 134.60 AH**

**Temperature Correction: 1.07**

**Design Margin: 1.10**

**Aging Factor: 1.25**

**Required Size: 198.21 AH**

**Required # of Strings: 2**

# DATA SHEET

| | |
|---|---|
| **Stand** | **1E1R060-41811A**, Range CLASSIC |
| Type No. | **1420000001811A** |
| Standtype | pluggable steel-stands, PE-coated, grey RAL 7001 |
| Layout | Floorstand, 1 Row |
| Stand-data | Length = 25,43 / Depth = 27,17 / Height = 7,52 / Height incl. battery = 30,98 in. |
| Battery | 4 x HT150ET (Basis for statics) |
| Weights | Stand 31 lb + Batteries 414 lb = Total 445 lb |
| Profile selection | Deflection of support profile 0,08 in./m |
| Max. ins.-load | 110 lb |
| Projected area load | 0,646 lb/sq.in. |
| Shipping-wooden-box | L/T/H: 764/800/400 in. (Height incl. vats) / Please ask for an inquiry<br>L/T/H: 800/915/460 in. incl. Acid-pan |

| | |
|---|---|
| **Battery** | **4 x HT150ET (Demand for stand calculation)** |
| Original-Dimension | Length = 5,00 / Depth = 22,1700 / Height = 23,4600 in. |
| Weight | 103,62 lb |
| Distances | L = 0,3900 / T = 0,3900 / H = 0,7100 in. |
| Type | VRLA |
| Array-demand | length / upright |

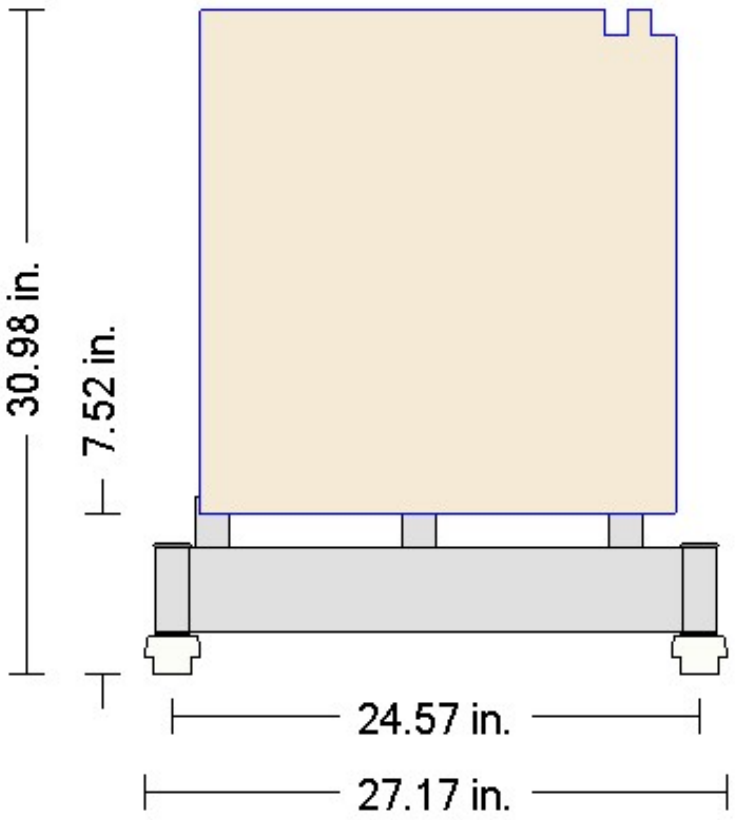
**Packing list**

| Pcs | Type No. | Description | |
|---|---|---|---|
| 0,25 | SGNAC-10051500 | 1 Box 4x RP Profile 600 mm | 4,19 |
| 0,5 | SGNAC-10061500 | 1 Box 4x SQ Profile 600 mm | 9,26 |
| 1 | SGNAC-10010400 | 1 Box 2x Side Support 2-Row 664 mm incl. Small Parts | 17,53 |

Disclaimer

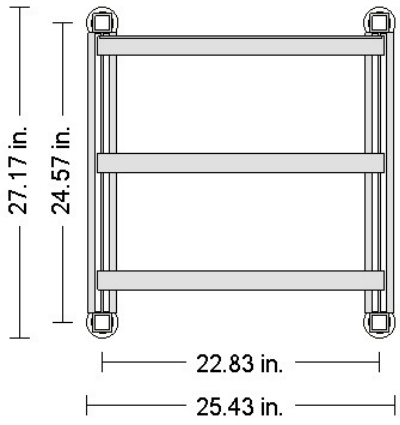
Please pay attention to our statement regarding EN 50272 in https://easy.aib-kunstmann.de/Content/Kunstmann/Gestelle-EN50272.pdf.
AIB Kunstmann GmbH does not take any responsibility that the battery-datas are up to date and specific details of the batteries are considered. The user has to confirm that the battery data's are correct and up to date.

**Side view**



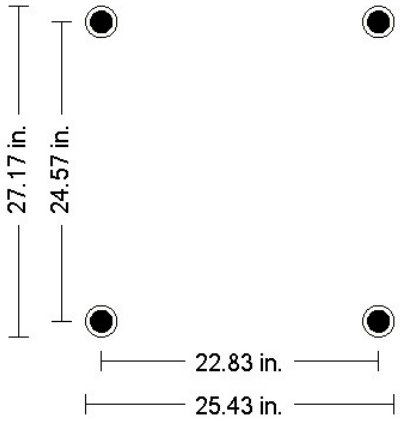

Type No.: 1420000001811A for 4 x HT150ET

**Top view**




Type No.: 1420000001811A for 4 x HT150ET

**Footprint**



# AT10.1 Series

## Float Battery Chargers


**5 Year Standard Warranty**

CSA-C22.2

Seismic Zone 4 Qualification

NRTL

Made in USA

saft

A combination of advanced technology microprocessor control and performance-engineered modular construction make AT10.1 Series chargers and rectifiers easy to set up, easy to operate, and easy to maintain.


## APPLICATIONS

### Utility & Communications
- Power Generation
- Substations
- Microwave Relay Sites
- Switchgear

### Manufacturing
- Emergency DC Power
- DC Operated Breakers
- Alarm Systems

### Commercial
- Alarm Systems
- Uninterruptible Power Systems
- DC Control Systems

### Transportation
- Signal Systems
- Switchgear
- Alarm Systems

## DESIGN FEATURES

### Modular Construction
- Rectifier, microprocessor control, input/output, power transformer, filter and alarm assemblies are all modular and easily replaceable.

### Thirty-Year Life
- All units are engineered for a greater than 30-year life with an MTBF of 100,000 hours.

### Field Service Less than 60 Minutes
- For fast service, enclosure and instrument panel are easily removable without disturbing chassis or installed conduit. Schematic and diagnostic information plates are mounted on enclosure. Modular construction and self-diagnostics result in an MTTR of less than 60 minutes.

### Install on Wall, Stand or Relay Rack
- Units are easily wall mounted, with the exception of larger units which are floor mounted. Floor stands or relay rack-mounting provisions are optional.

### Fast, Online Adjustment
- Control, alarm and operating level set points are adjusted digitally from the front panel while online, without the need to vary loads or external conditions.

### Engineered for Safety and Acceptance
Units are designed and tested for worldwide applications.

### 5 Year Standard Warranty
Chargers are warranted to be free from defects in material and workmanship for a perios of five (5) years from date of manufacture.

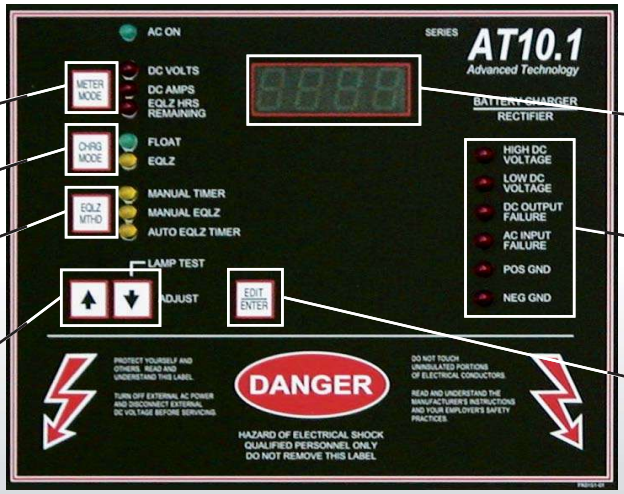
Microprocessor circuits control virtually all functions and settings through front panel switches.

Press to choose digital display of Volts/Amps/Equalize hours remaining.

Press to select float or equalize mode.

Choose from three equalize methods: continuous, timed, or automatically timed after AC interrupt.

Press to adjust voltage settings or timer hours when in EDIT mode. Press to test LED lamps when in normal mode.




1% digital meter shows voltage, amperage and hours. Also displays self-diagnostics error codes.

LED lamps indicate abnormal conditions. A summary relay contact or optional individual relay contacts provide remote indication.

Press to switch to EDIT mode and to ENTER voltage settings and timer hours.

**All controls can be disabled for tamper-free operation. Operational conditions remain displayed.**

# SPECIFICATIONS & STANDARD FEATURES

## SPECIFICATIONS

### AC Input

- **Group 1 (6-25 Adc) Voltage:**
  120/208/240Vac (multi-tap) 60Hz
  480Vac 60Hz
  220Vac, 380/416Vac 50/60Hz
  550-600 Vac 60Hz
- **Group 2 (30-100 Adc) Voltage:**
  120, 208, 240 or 480Vac 60Hz
  220Vac, 380 or 416Vac 50/60Hz
  550-600 Vac 60Hz
- **Input Voltage Tolerance:**
  +10%, -12%
- **Input Frequency Tolerance:**
  ±5%
- **Efficiency:**
  85-90% typical for 130Vdc at 50-100% load

### DC Output

- **Voltage Ratings:**
  12, 24, 48, or 130Vdc nominal
- **Current Ratings:**
  GROUP 1: 6, 12, 16, 20, 25Adc
  GROUP 2: 30, 40, 50, 75, 100Adc
- **Continuous Rating:**
  110% rated current at maximum equalize voltage at 50°C
- **Current Limit Adjustment Range:**
  50% to 110% rated output
- **Voltage Regulation:**
  ±0.25% for line, load and temp. variations
  *Regulation at max. equalize voltages may not meet ±0.25%
- **Electrical Noise:**
  32dBrnc
- **Ripple:**
  12/24/48Vdc
  · Unfiltered on battery 1% Vrms
  · Filtered on battery 30mVrms
  · Filtered off battery 1% Vrms
  · Battery Eliminator 30mVrms
  130Vdc
  · Unfiltered on battery 2% Vrms
  · Filtered on battery 100mVrms
  · Filtered off battery 2% Vrms
  · Battery Eliminator 100mVrms
- **Surge Withstand Capability:**
  Meets IEEE-472, ANSI C37.90a

### Safety and Acceptance

- Meets NEMA PE 5-1996, PE 5-1997(R2003) specification
- NEMA-1/IP20 type standard enclosure
- Third party agency approvals:
  - CSA C22.2 compliant
  - NRTL/C · UL 1012/UL 1564 compliant
  - Seismic qualified
  - ABS or CE certification available upon request.
- Made in the United States of America

### Environmental

- Operating Ambient Temperature 0°F to 122°F (-18°C to 50°C) w/o derating
- Operating Altitude 10,000 feet (3,000 meters) above sea level w/o derating
- Relative Humidity 0% to 95% (without condensation)
- Audible Noise Less than 65 dBA at any point 5ft (1.5m) from any vertical surface of enclosure

## STANDARD FEATURES

- **5 Year Product Warranty**
- **Universal main control board operates in any AT Series charger**
- **Alarm assembly with local LEDs and summary relay contact for AC Failure, DC Failure, High Vdc, Low Vdc, Positive(+) and Negative(-) ground fault**
- **High DC voltage shutdown**
- **Forced load share during parallel operation**
- **Float/equalize selector switch with indicating lights**
- **Manual equalize timer (0-255 hr.) with indicating lights**
- **AC line failure automatic equalize timer (0-255 hr.) with indicating light**
- **AC On indicating light**
- **1% Digital LED meter for Vdc, Adc, timer hours and alarm settings**
- **AC input and DC output circuit breakers**
- **Membrane front panel**
- **Front panel controls can be disabled for security**
- **A redundant analog circuit for LVDC alarm, independent of the microprocessor**
- **Redundant control loops for higher reliability**
- **Local or remote voltage sense with redundancy to protect against remote sense failure**
- **Self-diagnostics**
- **Input & output MOV surge suppressors**
- **Reverse polarity protection via free wheeling diodes**
- **CU-AL I/O compression lugs**
- **Switchboard wire, UL VW-1**
- **Enclosure pre-treated using a 5-stage iron phosphate process with baked epoxy powder coating in ANSI 61 gray**



Specifications subject to change.

# AT10.1 SERIES SPECIFICATION CHART

| | DC Output Rating | | AC Input Ampere Rating — Based on maximum rms value of the input current delivered to the charger under all operating conditions within manufacturer's specifications | | | | | | | | Battery Charger AC Circuit Breaker Ampere Rating (standard AIC breakers) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Amps | 120 Vac | 208 Vac | 220 Vac | 240 Vac | 380 Vac | 416 Vac | 480 Vac | 600 Vac | 120 Vac | 208 Vac | 220 Vac | 240 Vac | 380 Vac | 416 Vac | 480 Vac | 600 Vac |
| Float Adjust 11.0-14.5Vdc | 12Vdc GROUP 1 | 6 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 10 | 10 | 10 | 10 | 2 | 2 | 2 | 15 |
| | | 12 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 10 | 10 | 10 | 10 | 4 | 4 | 2 | 15 |
| | | 16 | 4 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 10 | 10 | 10 | 10 | 4 | 4 | 2 | 15 |
| | | 20 | 6 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 10 | 10 | 10 | 10 | 4 | 4 | 3 | 15 |
| Equalize Adjust 11.7-15.5.0Vdc | | 25 | 7 | 4 | 4 | 4 | 3 | 2 | 2 | 2 | 10 | 10 | 10 | 10 | 5 | 5 | 4 | 15 |
| | 12Vdc GROUP 2 | 30 | 9 | 6 | 5 | 5 | 3 | 3 | 3 | 2 | 15 | 10 | 10 | 10 | 5 | 5 | 5 | 15 |
| | | 40 | 11 | 7 | 6 | 6 | 4 | 3 | 3 | 3 | 20 | 10 | 10 | 10 | 5 | 5 | 5 | 15 |
| | | 50 | 14 | 8 | 8 | 7 | 5 | 4 | 4 | 3 | 20 | 15 | 15 | 15 | 10 | 10 | 5 | 15 |
| Extended Equalize to 16Vdc* | | 75 | 21 | 13 | 12 | 11 | 7 | 6 | 6 | 5 | 35 | 20 | 20 | 20 | 10 | 10 | 10 | 15 |
| | | 100 | 28 | 16 | 15 | 13 | 10 | 8 | 8 | 8 | 40 | 25 | 20 | 25 | 15 | 15 | 15 | 15 |
| Float Adjust 22.0-29.5Vdc | 24Vdc GROUP 1 | 6 | 5 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 10 | 10 | 10 | 10 | 3 | 3 | 3 | 15 |
| | | 12 | 8 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 10 | 10 | 10 | 10 | 4 | 4 | 3 | 15 |
| | | 16 | 9 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 15 | 15 | 15 | 15 | 6 | 6 | 4 | 15 |
| | | 20 | 11 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 15 | 15 | 15 | 15 | 8 | 8 | 6 | 15 |
| Equalize Adjust 23.4-31.0Vdc | | 25 | 14 | 9 | 8 | 7 | 6 | 4 | 4 | 4 | 20 | 20 | 20 | 20 | 8 | 8 | 6 | 15 |
| | 24Vdc GROUP 2 | 30 | 16 | 8 | 8 | 8 | 5 | 5 | 4 | 4 | 20 | 10 | 10 | 10 | 10 | 10 | 5 | 15 |
| | | 40 | 20 | 12 | 12 | 11 | 8 | 7 | 6 | 5 | 25 | 15 | 15 | 15 | 10 | 10 | 10 | 15 |
| | | 50 | 26 | 15 | 15 | 14 | 8 | 8 | 7 | 6 | 35 | 20 | 20 | 20 | 10 | 10 | 10 | 15 |
| Extended Equalize to 32Vdc* | | 75 | 42 | 26 | 23 | 22 | 14 | 13 | 11 | 10 | 70 | 35 | 30 | 35 | 20 | 20 | 15 | 15 |
| | | 100 | 51 | 25 | 24 | 22 | 14 | 12 | 11 | 11 | 80 | 35 | 30 | 35 | 25 | 25 | 20 | 15 |
| Float Adjust 44.0-58.0Vdc | 48Vdc GROUP 1 | 6 | 9 | 5 | 5 | 5 | 4 | 3 | 3 | 2 | 15 | 15 | 15 | 15 | 6 | 6 | 4 | 15 |
| | | 12 | 15 | 9 | 9 | 8 | 5 | 4 | 4 | 3 | 20 | 20 | 20 | 20 | 8 | 8 | 6 | 15 |
| | | 16 | 18 | 12 | 11 | 10 | 7 | 5 | 5 | 4 | 25 | 25 | 25 | 25 | 10 | 10 | 8 | 15 |
| | | 20 | 23 | 13 | 13 | 12 | 9 | 6 | 6 | 5 | 30 | 30 | 30 | 30 | 13 | 13 | 8 | 15 |
| Equalize Adjust 46.8-59.0Vdc | | 25 | 29 | 17 | 17 | 16 | 12 | 8 | 8 | 7 | 40 | 40 | 40 | 40 | 15 | 15 | 10 | 15 |
| | 48Vdc GROUP 2 | 30 | 28 | 16 | 16 | 15 | 8 | 8 | 7 | 6 | 35 | 20 | 20 | 20 | 15 | 15 | 15 | 15 |
| | | 40 | 38 | 22 | 19 | 19 | 12 | 11 | 9 | 8 | 50 | 30 | 25 | 30 | 15 | 15 | 15 | 15 |
| | | 50 | 52 | 28 | 28 | 26 | 16 | 15 | 12 | 11 | 70 | 35 | 35 | 35 | 20 | 20 | 15 | 15 |
| Extended Equalize to 61Vdc* | | 75 | 79 | 48 | 43 | 39 | 25 | 22 | 19 | 17 | 100 | 60 | 60 | 60 | 35 | 35 | 25 | 25 |
| | | 100 | 88 | 50 | 48 | 44 | 28 | 25 | 22 | 19 | 125 | 70 | 60 | 70 | 40 | 40 | 35 | 25 |
| Float Adjust 110.0-140.0Vdc | 130Vdc GROUP 1 | 6 | 15 | 9 | 8 | 8 | 5 | 5 | 4 | 4 | 20 | 20 | 20 | 20 | 8 | 8 | 8 | 15 |
| | | 12 | 32 | 18 | 16 | 15 | 10 | 9 | 8 | 7 | 40 | 40 | 40 | 40 | 13 | 13 | 13 | 15 |
| | | 16 | 34 | 20 | 18 | 17 | 11 | 10 | 9 | 8 | 50 | 50 | 50 | 50 | 13 | 13 | 13 | 15 |
| | | 20 | 40 | 24 | 23 | 23 | 15 | 14 | 12 | 11 | 60 | 60 | 60 | 60 | 20 | 20 | 20 | 15 |
| Equalize Adjust 117.0-143.0Vdc | | 25 | 50 | 30 | 28 | 27 | 18 | 16 | 14 | 12 | 70 | 70 | 70 | 70 | 25 | 25 | 20 | 15 |
| | 130Vdc GROUP 2 | 30 | 75 | 44 | 42 | 40 | 23 | 22 | 20 | 16 | 100 | 60 | 60 | 60 | 35 | 35 | 25 | 20 |
| | | 40 | 100 | 59 | 57 | 53 | 35 | 32 | 28 | 17 | 125 | 80 | 80 | 80 | 60 | 60 | 35 | 30 |
| | | 50 | N/A | 72 | 68 | 63 | 40 | 36 | 32 | 28 | N/A | 100 | 100 | 100 | 50 | 50 | 40 | 35 |
| Extended Equalize to 149Vdc* | | 75 | N/A | 100 | 83 | 81 | 52 | 47 | 40 | 36 | N/A | 125 | 125 | 125 | 70 | 70 | 50 | 50 |

*Regulation at max. equalize voltages may not meet ±0.25%

# HOW TO SIZE YOUR CHARGER

(simplified formula)

$$\left(\frac{Ah \times R}{t}\right) + L = \text{Continuous Charger Output Rating}$$

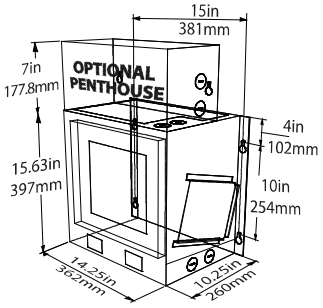
Ah=Ampere hours removed or Amp hour capacity of battery  R= Recharge factor (1.1 PB 1.2 S/PBE Nicad 1.4 PP Nicad)  L= Continuous load  t= Recharge time in hours

| DC Circuit Breaker Rating | Cabinet Style | Approx. Shipping Weights lbs.(kg) | Heat Loss Watts (BTU/hr) |
|---|---|---|---|
| 10 | 586 | 83 (38) | 31 (105) |
| 20 | 586 | 87 (40) | 58 (199) |
| 25 | 586 | 92 (42) | 77 (262) |
| 30 | 586 | 118 (54) | 95 (326) |
| 40 | 586 | 100 (46) | 119 (404) |
| 50 | 5017 | 184 (84) | 142 (483) |
| 60 | 5017 | 189 (86) | 188 (641) |
| 80 | 5017 | 194 (88) | 234 (798) |
| 100 | 5018 | 199 (91) | 350 (1192) |
| 150 | 5018 | 225 (103) | 465 (1587) |
| 10 | 586 | 99 (45) | 40 (136) |
| 20 | 586 | 109 (50) | 75 (255) |
| 25 | 586 | 115 (53) | 98 (334) |
| 30 | 586 | 119 (54) | 121 (413) |
| 40 | 586 | 136 (62) | 150 (512) |
| 50 | 5017 | 259 (118) | 179 (612) |
| 60 | 5017 | 267 (122) | 237 (810) |
| 80 | 5017 | 342 (156) | 295 (1008) |
| 100 | 5018 | 355 (162) | 441 (1503) |
| 150 | 5018 | 360 (164) | 586 (1999) |
| 10 | 586 | 105 (48) | 60 (203) |
| 20 | 586 | 120 (55) | 107 (365) |
| 25 | 594 | 155 (71) | 139 (473) |
| 30 | 594 | 170 (78) | 170 (581) |
| 40 | 594 | 180 (82) | 210 (717) |
| 50 | 5017 | 217 (99) | 250 (852) |
| 60 | 5017 | 225 (103) | 329 (1122) |
| 80 | 5017 | 250 (114) | 408 (1392) |
| 100 | 5018 | 433 (197) | 606 (2068) |
| 150 | 5018 | 450 (205) | 804 (2743) |
| 10 | 586 | 130 (59) | 99 (337) |
| 20 | 594 | 155 (71) | 167 (571) |
| 25 | 594 | 215 (98) | 213 (727) |
| 30 | 594 | 225 (103) | 259 (883) |
| 40 | 594 | 265 (120) | 316 (1078) |
| 50 | 5017 | 285 (130) | 373 (1273) |
| 60 | 5018 | 340 (155) | 484 (1664) |
| 80 | 5018 | 375 (171) | 602 (2054) |
| 100 | 5018 | 482 (219) | 888 (3030) |

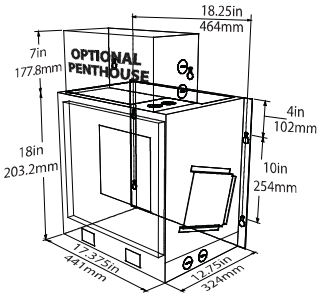
## GROUP 1

6-25Adc

Cabinet Style 586



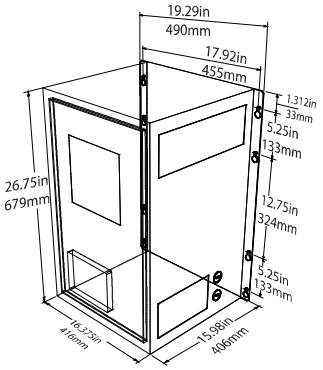

Cabinet Style 594



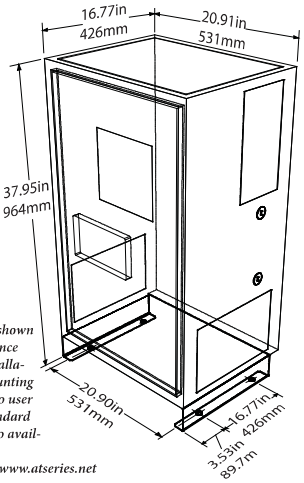

## GROUP 2

30-100Adc

Cabinet Style 5017




Cabinet Style 5018




*NOTE: Dimensions shown are for reference only; for installation and mounting please refer to user manual. Standard drawings also available at www.atseries.net*



Specifications subject to change.

# CUSTOMIZE YOUR AT10.1

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

## SUMMARY OF OPTIONS

- DC output filtering: per NEMA PE5 1996, standard and battery eliminator
- Medium & High AIC Breakers
- Auxiliary alarm relay board
- Copper ground bus
- AC lightning arrestor
- Fungus proofing (tropicalization)
- Static proofing
- Communications module: DNP3 Level 2 or MODBUS protocols
- Battery temperature compensation
- Fan control contactor
- Mechanical lock for front door
- Custom Paint
- NEMA 4 (12) type enclosure w/fan
- Relay rack mounting
- Wall mounting
- Floor mounting stand
- NEMA Type 2 Drip Shield
- Barrier type alarm terminal block
- Forced load share cable
- End of discharge alarm
- Battery discharge alarm
- Zero-center ground detection meter
- Analog AC voltmeter
- Analog AC ammeter
- Cabinet heater assembly
- CE marking upon request
- ABS certification upon request
- Custom drawing package w/ optional DWG and PDF files

### Filtering

**STANDARD**

Output filtering is essential whenever there is need for low ac ripple and low noise on the dc bus for critical loads. The standard dc output filtering limits ripple to no more than 30mV RMS on 12, 24 & 48Vdc units, and 100mV RMS on 130Vdc units, measured at the battery terminals. This feature meets the specifications of NEMA standard PE5-1996, and is recommended for installations using VRLA or gelled electrolyte batteries.

**BATTERY ELIMINATOR**

An additional "battery eliminator" feature is also available, meeting the specifications of NEMA standard PE5-1996 with no battery connected, measured at the dc output terminals. This feature is recommended for sites where the battery may occasionally be disconnected from the dc bus for maintenance. Additional filtering is essential to limit ac ripple and noise for critical dc loads.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **YES** | Field Installation Use Part Number<br>Group 1: EJ1072-9#<br>Group 2: EJ5023-9#<br>Contact manufacturer for specific part number. |

### Medium & High AIC Breaker

This feature provides thermal-magnetic circuit breakers with higher Ampere Interrupting Capacity ratings than the standard. See the tables on Page 10 and 11 for Group 1 and Group 2 medium and high AIC breaker ratings. For AT10.1 Group 1, ac and dc breakers ratings must be ordered together, and are supplied in a separate penthouse enclosure. For Group 2, ac and dc breakers can be specified separately and are supplied in the standard cabinet.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **NO** | NOT AVAILABLE FOR FIELD INSTALLATION |

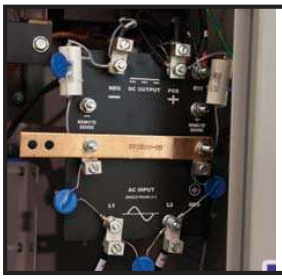
### Auxiliary Alarm Relay Board

The AT10.1 features several industry-standard alarms, with individual LED indicators on the front instrument panel, and are accessible to the user via one (1) Summary Alarm contact on the Main Control PC Board. This feature provides a separate user-accessed pc board, featuring discreet two (2) form-C relay contacts for all six (6) alarms. In AT10.1 Group 1 ratings, the board is supplied in an additional penthouse enclosure. **In AT10.1 Group 2 ratings, it is supplied within the standard enclosure.**

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **YES** | Field Installation Use Part Number<br>GROUP 1: EI0213-0#<br>Contact manufacturer for specific part number.<br>GROUP 2: EI0213-02 |

# CUSTOMIZE YOUR AT10.1

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!



## Copper Ground Bus

This option provides a convenient means to tie the AT10.1 to the site building ground. A copper ground bus bar is provided at the I/O terminal, with an extra CU-AL compression box lug.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **YES** | Field InstallationUse Part Number<br>Group 1: EI0195-00<br>Group 2: EI0195-02 |

## AC Lightning Arrestor

This options features an industrial-grade surge arrestor in polycarbonate housing, rated for 20,000 Amperes. It is recommended for installations with risk of frequent ac surges, such as high elevations or severe weather.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **YES** | Field Installation Use Part Number<br>Group 1: EJ1074-00<br>Group 2: EJ1074-01 |

## Fungus Proofing

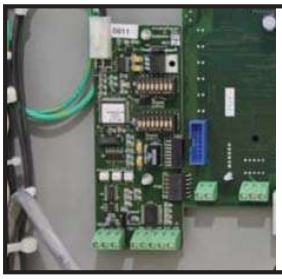
This treatment is also referred to as "tropicalization". It coats electrical components and internal wiring connections with a fungus-resistant, non-conductive film (approx. 1 mil thickness). User termination points are not coated, nor are relay contacts, and any electrical connectors where the spray would interfere with functionality. The application is fully cured at time of shipment.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **NO** | NOT AVAILABLE FOR FIELD INSTALLATION |

## Static Proofing

Used in "arid" environments, this treatment coats electrical components and connections with a static-resistant, non-conductive film (approx. 1 mil thickness). User termination points are not coated, nor are relay contacts, and any electrical connectors where the spray would interfere with functionality. The application is fully cured at time of shipment.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Specification Tables on pages 10 & 11 |
| AVAILABLE FOR FIELD INSTALLATION **NO** | NOT AVAILABLE FOR FIELD INSTALLATION |



## Communications

This option allows full remote monitoring of the AT10.1 and control of the front panel features, using MODBUS or DNP3 Level 2 protocols. Standard serial connections are provided for use with local SCADA systems.

Additional Ethernet and Fiber Optics Modem interfaces are also available for use with the AT Communications option. Contact factory for part number.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION **YES** | Factory Installation - Use Part Number when ordering<br>12Vdc: EJ5037-01<br>24Vdc: EJ5037-02<br>48Vdc: EJ5037-03<br>130Vdc: EJ5037-04 |
| AVAILABLE FOR FIELD INSTALLATION **YES** | Field Installation - Use Part Number<br>12Vdc: EJ5037-11<br>24Vdc: EJ5037-12<br>48Vdc: EJ5037-13<br>130Vdc: EJ5037-14 |



Specifications subject to change.

# CUSTOMIZE YOUR AT10.1

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

## Temperature Compensation

Supplied in a kit, this option adjusts the AT10.1 dc output voltage up or down, in response to battery temperature fluctuations. Temperature is measured by an epoxy-enclosed thermistor. This probe is mounted on or near the battery, and connected by a cable to the Main Control PC Board. It is compatible with both lead-acid and nickel-cadmium batteries, and recommended for VRLA batteries. Cable lengths of 25, 50, 100, and 200 ft are available.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION<br>NO | CAN BE ORDERED WITH CHARGER BUT MUST BE FIELD INSTALLED |
| AVAILABLE FOR FIELD INSTALLATION<br>YES | Field Installation Use Part Number<br>25ft: EJ5033-00<br>50ft: EJ5033-01<br>100ft: EJ5033-02<br>200ft: EJ5033-03 |

## Barrier Type Alarm Terminal Block

This option features a separate molded phenolic terminal block, wired directly to the Auxiliary Alarm Relay PC Board. It allows the user to connect remote alarm wiring with ring or fork type lugs. The terminals are rated for 20A at 150 Vac/Vdc, and accept wire sizes #16 to #14 AWG.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION<br>YES | Factory Installation use Part Number when ordering<br>1 FORM C: EJ5130-01<br>2 FORM C: EJ5130-02 |
| AVAILABLE FOR FIELD INSTALLATION<br>YES | Field Installation Use Part Number<br>1 FORM C: EJ5130-01<br>2 FORM C: EJ5130-02 |

## Mechanical Lock For Front Door

The AT10.1 front panel controls can be disabled by setting a jumper on the back of the Main Control PC board. For installations where extra security is required, the front instrument panel, or door, can be physically locked closed. This option provides a locking provision on the enclosure, a padlock, and two (2) keys. A fully installed door key lock is also available.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION<br>YES | Factory Installation – Use Part Number when ordering<br>Padlock 586/594: EI0215-00<br>Padlock 5017/5018: EI0215-01<br>Keylock 586/594: EI0215-10<br>Keylock 5017/5018: EI0215-11 |
| AVAILABLE FOR FIELD INSTALLATION<br>YES | |

## Custom Paint

AT10.1 NEMA Type 1 enclosures feature an ANSI 61 gray epoxy powdercoat finish. Custom exterior and interior (e.g. semigloss white) colors are available in ANSI, PMS, and RAL color codes to meet specific requirements..

| | ORDERING |
|---|---|
| FACTORY INSTALLATION<br>YES | EI5064-00<br>SPECIFY WHEN PLACING ORDER USING YOUR SPECIFIC PAINT REQUIREMENTS |
| AVAILABLE FOR FIELD INSTALLATION<br>NO | NOT AVAILABLE FOR FIELD INSTALLATION |

## NEMA Type 4 Cabinet

With this accessory, a fully assembled standard AT10.1 NEMA-1 vented enclosure is installed within another gasketed, sealed cabinet. The combined assembly meets the NEMA Type 4 (and therefore Type 12 and 13) enclosure specification. All ratings feature forced cooling, with user-supplied 120Vac for the fan.

| | ORDERING |
|---|---|
| FACTORY INSTALLATION<br>YES | Factory Installation – Use Part Number when ordering<br>STYLE 586: EI0214-00<br>STYLE 594: EI0214-00<br>STYLE 5017: EI5036-00<br>STYLE 5018: EI5037-00 |
| AVAILABLE FOR FIELD INSTALLATION<br>NO | NOT AVAILABLE FOR FIELD INSTALLATION |

# CUSTOMIZE YOUR AT10.1

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

## Relay Rack Mounting Brackets

These accessories are provided when the AT10.1 enclosure is to be installed into a standard EIA relay rack. Smaller AT10.1 models may be installed into 19in racks, and all AT10.1s may be installed into 23in or 24in relay racks. All hardware is included for assembling the brackets to the AT10.1. Relay rack mounting hardware is user-supplied.

| FACTORY INSTALLATION | ORDERING |
|---|---|
| YES | Factory & Field Installation use Part Number when ordering<br>Style-586 (19/23/24in): EI0193-00<br>Style-594 (23/24in): EI0193-00<br>Style-5017 (19in) : EI0193-01<br>Style-5017 (23/24in): EI0193-02<br>Style-5018 (23/24in): EI0193-03 |
| **AVAILABLE FOR FIELD INSTALLATION** | |
| YES | |

## Floor Stand

This accessory is provided with smaller wall-mounted AT10.1 chargers when a vertical surface is not desired. The assembly mounts the AT10.1 approximately 44in / 1.12m from the floor. The kit features mounting brackets, assembly hardware to secure the AT10.1 to the brackets, and user instructions with a drilling pattern. Floor mounting anchor bolts are still user-supplied.

| FACTORY INSTALLATION | ORDERING |
|---|---|
| YES | Factory Installation – Use Part Number when ordering<br>EI0192-00 |
| **AVAILABLE FOR FIELD INSTALLATION** | |
| YES | Field Installation Use Part Number<br>EI0192-00 |

## NEMA Type 2 Drip Shield

Standard AT10.1 battery chargers are supplied in NEMA Type 1 vented enclosures. The optional drip shield prevents overhead water and small falling particles from entering the top vented panels, protecting internal equipment from damage. The combined standard enclosure and drip shield meets the NEMA Type 2 specification.

| FACTORY INSTALLATION | ORDERING |
|---|---|
| YES | Factory & Field Installation use Part Number when ordering<br>STYLE 586: EI0191-00<br>STYLE 594: EI0191-00<br>STYLE 5017: EI0191-01<br>STYLE 5018: EI0191-02 |
| **AVAILABLE FOR FIELD INSTALLATION** | |
| YES | |

**SUPPLEMENTAL PRODUCT**

## Fan Control Contactor

Lead-acid batteries produce hydrogen gas. This small wall-mounted external accessory provides a relay contactor to activate a battery installation vent or exhaust fan. Available in 10A or 20A models, the accessory is factory-set to provide relay closure when the AT10.1 enters into Equalize mode.

| FACTORY INSTALLATION | ORDERING |
|---|---|
| NO | CAN BE ORDERED WITH CHARGER BUT MUST BE FIELD INSTALLED |
| **AVAILABLE FOR FIELD INSTALLATION** | |
| YES | Field Installation Use Part Number<br>10 Amp Rating: EJ5017-0#<br>20 Amp Rating: EJ5017-1#<br>Contact manufacturer for specific part number |

**SUPPLEMENTAL PRODUCT**

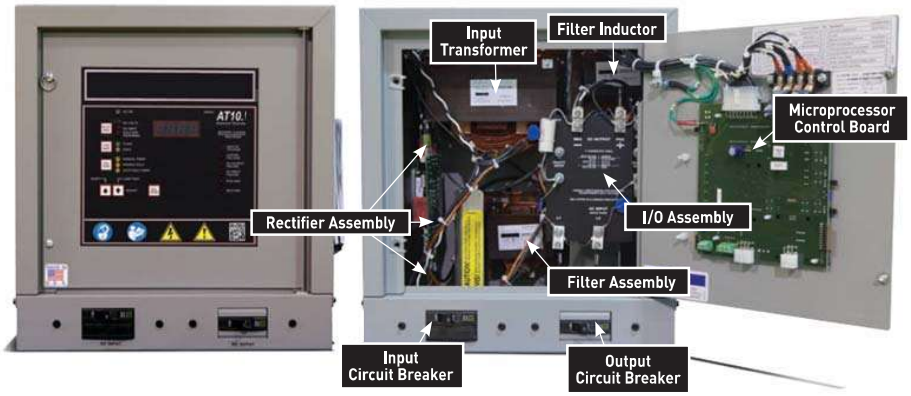
## DC-DP Distribution Panel

This product augments AT10.1 with a customized dc distribution panel for user-specified loads. The DC-DP is configurable to various combinations of main and branch breakers. The DC-DP panel is optimally supplied from the factory, mounted to the AT10.1 and pre-wired to the charger's dc output terminals. For additional product details, including applicable 3rd party agency approvals, contact Saft.

Sample DCDP-200M-6-30-DP
200 Amp main breaker with 6-30A branch breakers

| FACTORY INSTALLATION | ORDERING |
|---|---|
| YES | Factory & Field Installation use Part Number when ordering<br>DCDP<br>Rating of main breaker.<br>Qty and rating of branch breakers.<br>Can be supplied with or without main breaker. |
| **AVAILABLE FOR FIELD INSTALLATION** | |
| YES | |

# GROUP 1
## ( 6 - 25 Adc )




### Circuit Breaker AC & DC Ratings

**STANDARD**
Input: 10kAIC - 240Vac
10kAIC - 480Vac
Output: 10kAIC -125Vdc*

**MEDIUM**
Input: 25kAIC - 240Vac
18kAIC - 480Vac
18kAIC - 600Vac
Output: 10kAIC - 250Vdc

**HIGH**
Input: 65kAIC - 240Vac
25kAIC - 480Vac
18kAIC - 600Vac
Output: 20kAIC - 250Vdc

*For chargers 16Adc and larger; consult factory for other ratings.

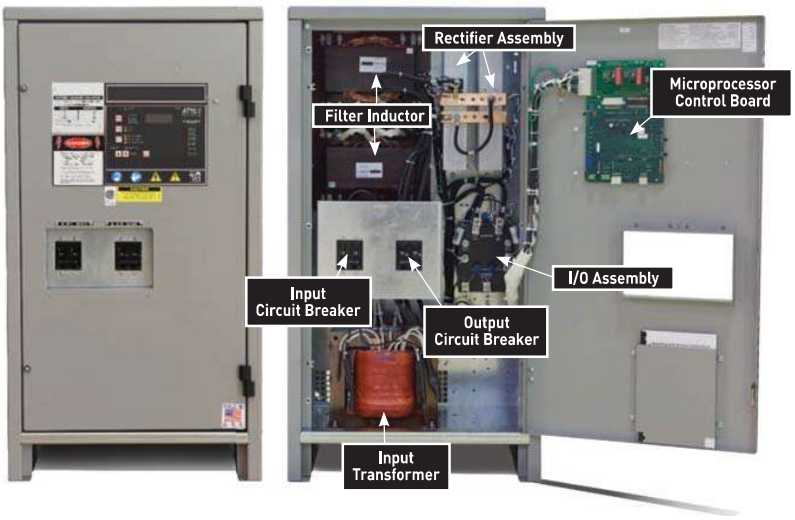
### GROUP 1 (6-25 Adc) - SPECIFICATION TABLE

| | A | B | | | C | | | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE | AT10 | 0 | 1 | 2 | 0 | 0 | 6 | 0 | 1 | 2 | 3 | 1 | 1 | 3 |
| YOUR CODE | AT10 | | | | | | | | | | | | | |

| | DESCRIPTION | CODE | FEATURE |
|---|---|---|---|
| A | | AT10 | AT10 SERIES |
| B | Nominal DC Output Voltage | 012 | 12Vdc |
| | | 024 | 24Vdc |
| | | 048 | 48Vdc |
| | | 130 | 130Vdc |
| C | Nominal DC Output Current | 006 | 6Adc |
| | | 012 | 12Adc |
| | | 016 | 16Adc |
| | | 020 | 20Adc |
| | | 025 | 25Adc |
| D | Standard AC Input Voltages | 0 | 120/240/208V 60Hz |
| | | 1 | 480V 60Hz |
| | Optional AC Input Voltages | 220 | 220V 50/60Hz |
| | | 380 | 380V 50/60Hz |
| | | 416 | 416V 50/60Hz |
| | | 600 | 550-600V 60Hz |
| E | Circuit Breaker Rating | 1 | Standard AIC |
| | | 2 | Medium AIC |
| | | 3 | High AIC |

| | DESCRIPTION | CODE | FEATURE |
|---|---|---|---|
| F | DC Output Filtering | 0 | Unfiltered |
| | | 1 | Filtered |
| | | 2 | Batt. Eliminator |
| G | Auxiliary Alarm Relay Board | 2 | Not Supplied |
| | | 3 | Installed |
| | | 4 | with Med/High AC Breakers |
| H | AC Lightning Arrestor | 1 | Installed |
| | | 0 | Not Supplied |
| I | Copper Ground Bus | 1 | Installed |
| | | 0 | Not Supplied |
| J | Fungus Proofing | 0 | No Treatment |
| | | 1 | Applied |
| | Static Proofing | 2 | Applied |
| | | 3 | Both Fungus and Static Applied |

**This ordering code is unique for AT10.1chargers rated 6-25A output.**




# GROUP 2

## ( 30 - 100 Adc )

### Circuit Breaker AC & DC Ratings

**STANDARD**
Input: 5kAIC - 120/208/240/480Vac
Output: 5kAIC -125Vdc

**MEDIUM**
Input: 25kAIC - 120/208/240/480Vac
18kAIC - 600Vac
Output: 10kAIC - 250Vdc

**HIGH**
Input: 65kAIC - 120/208/240/480Vac
18kAIC - 600Vac
Output: 20kAIC - 250Vdc

## GROUP 2 (30-100 Adc)- SPECIFICATION TABLE

| | A | B | | | C | | | D | | | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE | AT10 | 1 | 3 | 0 | 0 | 5 | 0 | 2 | 4 | 0 | 2 | 1 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 |
| YOUR CODE | AT10 | | | | | | | | | | | | | | | | | | | |

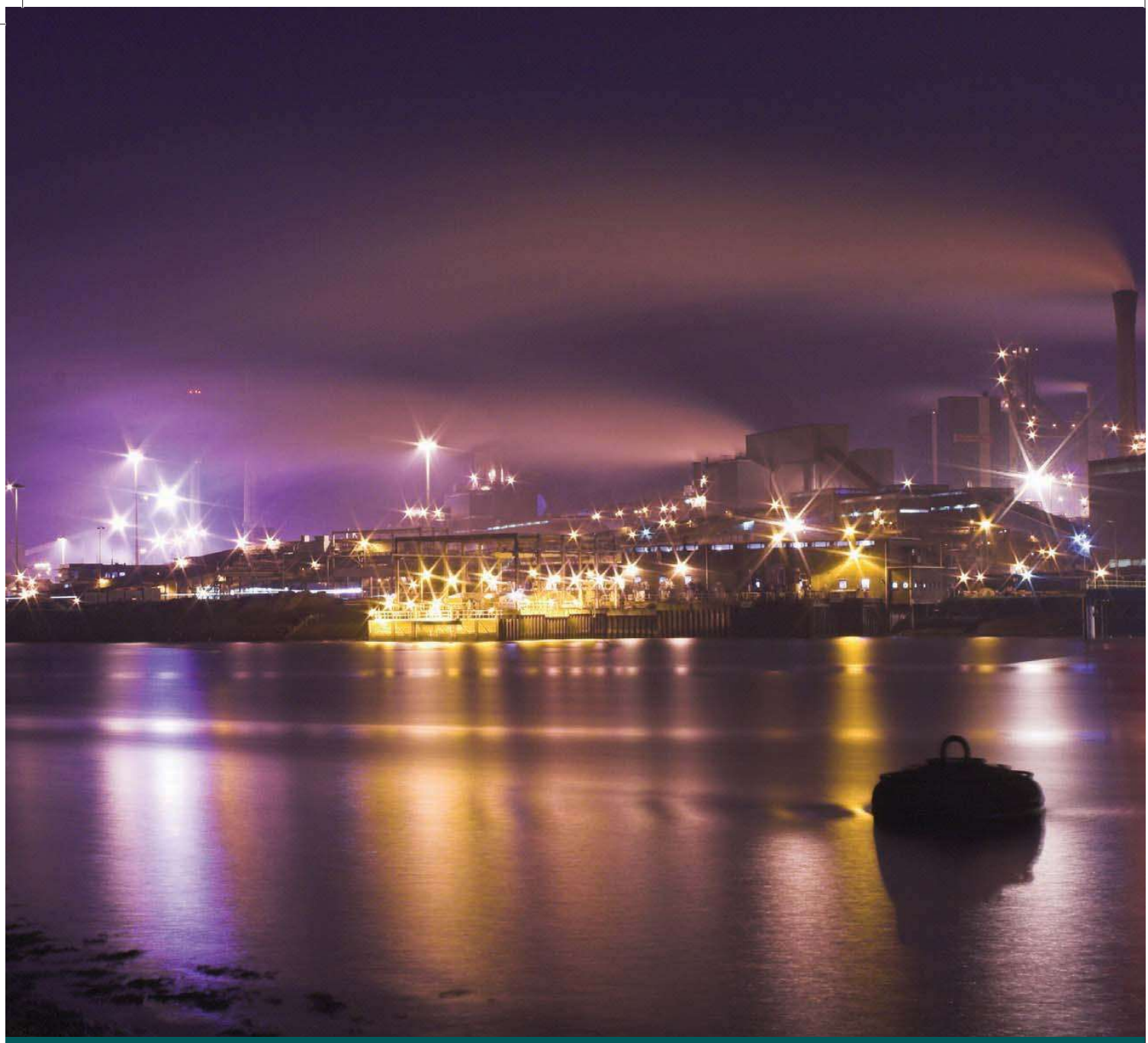
| | DESCRIPTION | CODE | FEATURE |
|---|---|---|---|
| A | | AT10 | AT10 SERIES |
| B | Nominal DC Output Voltage | 012 | 12Vdc |
| | | 024 | 24Vdc |
| | | 048 | 48Vdc |
| | | 130 | 130Vdc |
| C | Nominal DC Output Current | 030 | 30Adc |
| | | 040 | 40Adc |
| | | 050 | 50Adc |
| | | 075 | 75Adc |
| | | 100 | 100Adc |
| D | AC Input Voltage*<br>*Group 2 inputs cannot be retapped in field | 120 | 120V 60Hz |
| | | 208 | 208V 60Hz |
| | | 240 | 240V 60Hz |
| | | 480 | 480V 60Hz |
| | | 220 | 220V 50/60Hz |
| | | 380 | 380V 50/60Hz |
| | | 416 | 416V 50/60Hz |
| | | 600 | 550-600V 60Hz |
| E | DC Output Filtering | 0 | Unfiltered |
| | | 1 | Filtered |
| | | 2 | Batt. Eliminator |

This ordering code is unique for AT10.1chargers rated 30-100A output.

| | DESCRIPTION | CODE | FEATURE |
|---|---|---|---|
| F | AC Input Circuit Breaker Rating | 1 | Standard AIC |
| | | 2 | Medium AIC |
| | | 3 | High AIC |
| | | 0 | No Breaker |
| G | AC Input Fuses | 1 | Installed |
| | | 0 | Not Supplied |
| H | DC Output Circuit Breaker Rating | 1 | Standard AIC |
| | | 2 | Medium AIC |
| | | 3 | High AIC |
| | | 0 | No Breaker |
| I | DC Output Fuses | 1 | Installed |
| | | 0 | Not Supplied |
| J | Auxiliary Alarm Relay Board | 3 | Installed |
| | | 2 | Not Supplied |
| K | Copper Ground Bus | 1 | Installed |
| | | 0 | Not Supplied |
| L | AC Lightning Arrestor | 1 | Installed |
| | | 0 | Not Supplied |
| M | Fungus Proofing | 1 | Applied |
| | | 0 | Not Supplied |
| N | Static Proofing | 1 | Applied |
| | | 0 | Not Supplied |



Specifications subject to change.



**Saft America Inc.**
**3 Powdered Metal Drive**
**North Haven, Connecticut, 06473**
**Telephone: 203-985-2700**
**Facsimile: 203-985-2739**
**Email: saftfieldservices@saftbatteries.com**

**www.saftbatteries.com**

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