MEI

MESTA ELECTRONICS, INC.

D P M

2nd Generation Active Harmonic Filter
All Models

Owner's Manual

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

11020 Parker Drive ■ N. Huntingdon, PA 15642
412/754-3000

Table of Contents

List of Illustrations

List of Tables

1. INTRODUCTION

1.1. INTRODUCTION TO THE MESTA DPM

The ***Mesta Digital Power Factor and Harmonic Manager*** (Mesta DPM) is an active harmonic filter that filters “undesirable by-product” harmonic currents drawn by 3-phase delta non-linear loads, so the power source (electric utility or on-site generator) does not have to supply them. In addition, the Mesta DPM can also provide “undesirable” reactive fundamental currents drawn by 3-phase delta loads, so they too do not have to be supplied by the power source. The elimination of these “undesirable” current components results in a nearly pure sinusoidal current with a reduced rms magnitude drawn from the power source. This can result in substantial overall power savings, increased reliability of power distribution equipment, and conformance to ANSI/IEEE 519-1992.

The Mesta DPM has several features to easily adapt it to a variety of installations. These include:

1) Units may be supplied in NEMA1 wall mount or floor mount stand-alone units, or as panel mount units that can be installed in customer specified enclosures.
2) Units are small in size allowing easier installation in tight spots.
3) Exhibit industry leading high operating efficiency, resulting in reduced power utility costs, reduced air conditioning needs, and higher system reliability.
4) Wiring to units can be from either the top or the bottom of the unit.
5) Units can be paralleled (up to several units) to provide higher current capacities.
6) Units will continue to operate indefinitely if overloaded. If the load draws more harmonic current (and/or reactive current if unit is being relied on to correct linear displacement as well as harmonic currents) than the unit is rated for, unit will electronically self-limit its correction current to its rated capacity. The excess harmonic or reactive current that is beyond its rated current would come from the utility.
7) External Current Transformers (CTs) come in a variety of shapes and sizes, and can be installed on either the line or load side. Note: paralleled DPMs must have CTs installed on the load side.
8) A large amount of operating information and several operator configurable parameters can be communicated with the unit in multiple ways:
    - Via the 5” diagonal 240x128 pixel, backlit, resistive touch-screen display.
    - From a computer using RS-232 serial communications.
    - From a computer using Ethernet.
    - Over an Ethernet/IP or MODBUS/TCP industrial Ethernet network.
9) The ability to disable a unit from running via the touch-screen display, via RS-232 or Ethernet communications, or with an externally generated dry contact.
10) Systems save “historical” operational information in battery-backed-up memory to greatly assist in diagnosing a problem (both internal and external to the unit), should one occur.

Later sections of this manual contain details of how to take advantage of these features.

1.2. INTRODUCTION TO HARMONIC CURRENTS

Electronic equipment and controls, such as computers, computer peripherals, AC and DC motor drives and many other commonly used electronic hardware in the market place today, can overburden the electric utilities with various harmonic distortions. Such equipment (referred to as nonlinear loads) is characterized by high current crest factors (C.F.) and low power factor (P.F.). Such loads are referred to as non-linear because they draw harmonic currents in addition to the fundamental current. The fundamental current is at the same frequency (e.g. 60 Hz) as the voltage supply. These harmonic currents drawn by 3-phase loads are at integer multiples (predominantly odd integer multiples, not divisible by 3) of the fundamental frequency, and are superimposed onto the fundamental current. Examples of these harmonic currents in a 60 Hz supply are the 5^{th} harmonic (at 300 Hz frequency), 7^{th} (420 Hz), 11^{th} (660 Hz), 13^{th} (780 Hz), etc. Since these current components are at a different frequency than the 60 Hz voltage supply, they do not contribute at all to the useful work done by the load. These "extra" harmonic current components have the following adverse effects on the power grid that has to supply them:

1) Harmonic currents cause distortion in the voltage signal. This voltage distortion can result in adverse effects on other loads powered from the grid, especially equipment that expects to see a sine-wave voltage. For example, the distorted voltage could cause AC motors powered directly from the grid to have higher losses and possibly experience torque pulsations.
2) The total rms current drawn from the power grid is increased. The increased current will increase the losses in transmission lines, transformers, breakers, etc. that supply the nonlinear loads. These undesirable harmonic currents are at much higher frequencies than the useful fundamental current these components are designed for. Higher frequency currents cause disproportionately higher losses than the fundamental current, especially in transformers, thus placing a much higher burden on those components. These extra "transmission" losses will cause extra heating along the transmission path, resulting in additional cost due to "lost" power and premature failures in the transmission equipment.

To combat this additional cost, electric utilities are using more sophisticated metering equipment to monitor for harmonics in addition to the traditional power usage and displacement power factor monitoring. This can result in substantial penalty charges on a plant's electric bill, or in some cases being dropped from the grid until the problem is corrected. Power consultants, computer and communications specialists are therefore compelled to include in their specifications compliance to ANSI/IEEE 519-1992 stringent requirements, which define the maximum amount of harmonic distortion that newly installed equipment and controls are allowed to inject into the utility lines.

Many approaches have been devised in the past, aimed to minimize the harmonic distortion. Special zigzag transformers, phase shift transformers, and passive filters have all brought some type of harmonic relief, but not without severe limitations. Since the generated harmonics are a function of the actual load, and can vary during the course of the operation, it is very difficult to design such a filter in advance, which will cover any and all loads (both present and future) and the corresponding harmonic conditions.

1.3. HOW THE MESTA DPM WORKS

Unlike the passive harmonic correction methods listed in the previous section, the ***Mesta Digital Power Factor and Harmonic Manager*** (Mesta DPM) is a true active filter. Its design does not necessitate extensive knowledge regarding the harmonic profile of the load or electrical characteristics of the environment. Only the Total Current Distortion and phase displacement are required in sizing the DPM to an existing or proposed non-linear load.

The Mesta DPM is wired in parallel with the loads it is correcting the harmonics and/or correcting linear power factor for. Since it is in parallel with the load, and not in series with the load, as is required for many other harmonic correction methods, the DPM can be turned off for maintenance or repair without affecting the operation of the load. A simplified 1-line diagram of a DPM correcting a Non-linear load is shown in Figure 1.1**Error! Reference source not found.**. Without the DPM present, the current drawn by the load (I_Load) is supplied totally by the utility (I_Line). In this case I_Line = I_Load, so whatever undesirable harmonic and/or reactive currents the Non-linear load draws must come from the utility.

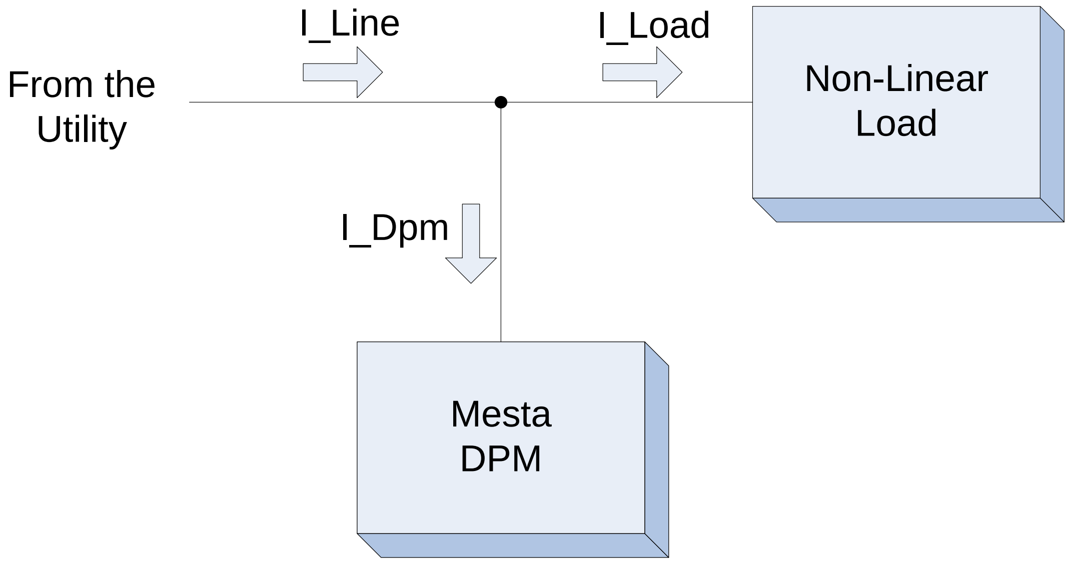


Figure 1.1: Simplified 1-line Diagram of a DPM Installation

A DPM installed in parallel with the load changes the situation. The DPM provides a path for these undesirable harmonic and/or reactive currents, so the utility no longer needs to supply them. In Figure 1.1 the DPM draws a current I_Dpm which is effectively the opposite of those undesirable currents drawn by the load. Since I_Line = I_Load + I_Dpm, the resultant I_Line current coming from the utility consists primarily of just the "useful" in-phase fundamental portion of the current drawn by the load.

Figure 1.2, Figure 1.3, and Figure 1.4 that follow are current waveforms taken from a system that consists of a very harsh 3-phase non-linear load (similar to a motor drive with very little DC choke or AC line reactor inductance) and a 300 amp Mesta DPM powered from 3-phase, 480 Vac, 60 Hz utility power. Only the current of one of the three phases is shown for simplicity; however, the other 2 phases are very similar to this phase. The load is drawing harmonic currents that are between 60 and 65% of the total load current. This is referred to as having a current THDR (Total harmonic distortion in reference to total rms) of between 60 and 65%. Most non-linear loads will have higher inductance in their input circuitry, resulting in a much lower THDR of between 30 and 40%, and thus easier to correct for; however, this very harsh load was selected to demonstrate how effective the Mesta DPM is in correcting harmonic currents. To correct this load current, the 300 amp DPM is utilizing about 2/3 of its 300 amp capacity or about 200 amps of correction.

Figure 1.2 shows the load current over two 60 Hz periods. The load, having a rectifier bridge at its input to convert the AC voltage to a DC voltage, draws high peak currents instead of a nice sine-wave current. The difference between the waveform displayed and a sine-wave are made up of the harmonic currents (5^{th}, 7^{th}, 11^{th}, 13^{th}, etc. harmonics). The primary task of the DPM is to draw current that is equal and opposite to these harmonic currents, so the resultant current supplied by the utility does not need to provide them. Figure 1.3 shows the current drawn by the DPM. At the start of the waveform, the DPM draws current from the line, reaching a peak of about 250 amps. During this time, the load is drawing no current. Then the load draws a spike of current reaching a peak of 650 amps. During this time, the DPM draws the opposite of this spike in order to cancel its affect. Figure 1.4 shows the resultant I_Line current (I_Load + I_Dpm) drawn from the utility – the desired sine-wave with the harmonic currents reduced to a little over 3%. Without the DPM, the current from the utility would look like the I_Load current waveform. Since we've effectively removed the harmonic current components from the line current, the line current is reduced to 260 amps rms even though the load current is at about 325 amps rms. The power factor of the line improved from about 0.8 to more than 0.99.

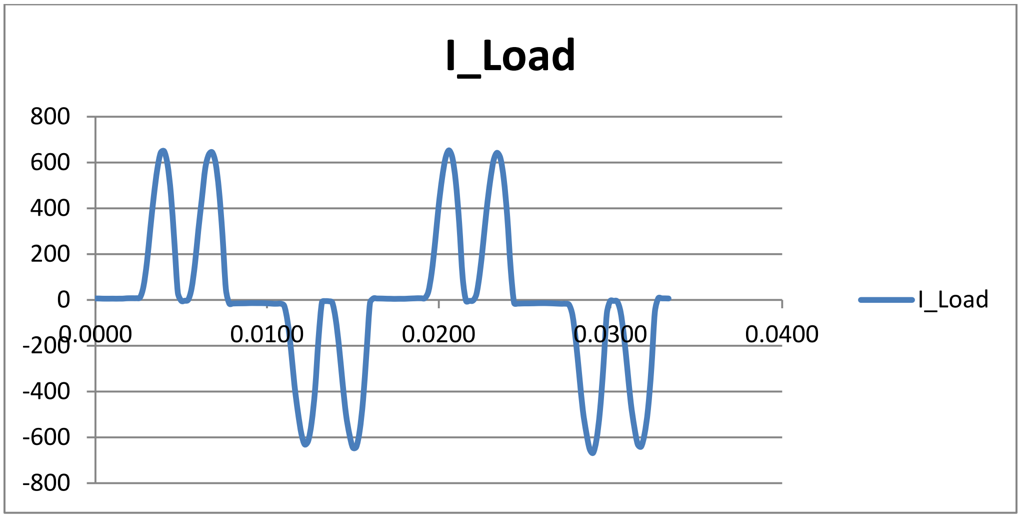


Figure 1.2: Load Current Waveform

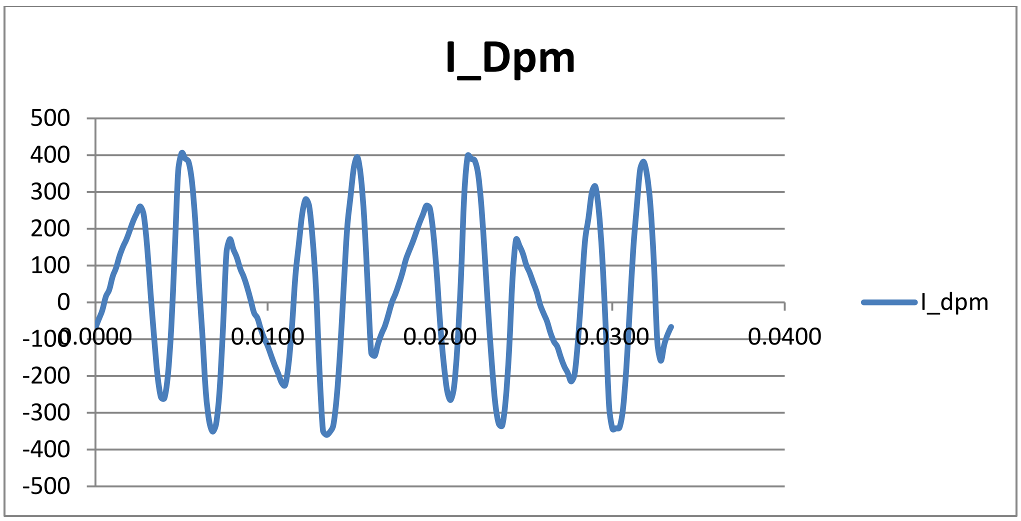


Figure 1.3: DPM Current Waveform

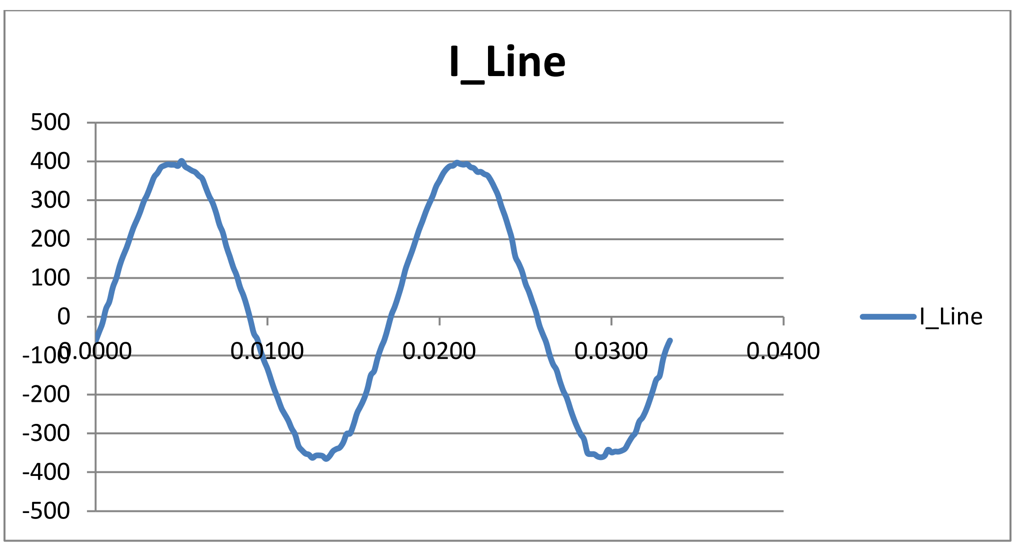


Figure 1.4: Line Current Waveform

The Mesta DPM uses a four quadrant inverter, utilizing a modulation frequency of many thousand cycles per second, to produce the current waveform shown in Figure 1.3 that accurately cancels the currents drawn by the load so that the utility doesn't have to supply them. The DPM uses a sophisticated hybrid control that uses a combination of fast immediate response along with information stored from the recent past to accomplish the extremely fast current changes needed. In the example waveforms for the harsh 60-65% harmonic load just examined, the DPM had to change its current output at times as much as 500 amps in .0005 seconds to cancel the harmonic currents drawn by this load.

Another advantage of an Active Harmonic Filter over passive solutions is that if the harmonic currents present exceed the capabilities of the Active Filter, it simply limits its corrective current to its rating by adjusting its control. The remaining harmonic current that is beyond the rating of the Active Filter then must be supplied by the utility. The Passive Filter has no means to limit itself; therefore the currents increase until the circuit protection breakers trip or fuses open. If the Passive Filter is in series with the load, the load goes down with the filter.

1.4. POWER SAVING FEATURES OF THE MESTA DPM

Not only does the Mesta DPM have extremely high performance, but it achieves it at industry leading power efficiency. A 300 Amp DPM operating at full capacity of cancelling 300 amps of harmonics on all 3 lines typically dissipates 5100 watts of power. Other Active Harmonic Filter systems on the market dissipate as much as an additional 5000 watts or more under the same conditions. A Mesta unit operating 24/7 at these conditions results in almost 44,000 KW-hrs less in power losses in a year. At an average rate of 10 cents per KWH, this represents a savings of $4,400 in utility costs in a year. Of course, you may not need the full rated capabilities of the DPM 24/7. In the case of a system operating at less than full operating capacity, the Mesta DPM still offers industry leading efficiencies. Figure 1.5 shows typical Losses vs. Output Current. In this graph, the horizontal axis shows the Output Current of a DPM normalized to the full load current (e.g. for a 300 amp DPM, 1 represents 300 amps, 0.5 represents 150 amps, etc.). The vertical axis shows the Losses of a DPM normalized to the full load losses (e.g. for a 300 amp DPM, 1 represents 5100 watts, 0.5 represents 2550 watts, etc.). This graph shows that a system operating at 50% of the rated current will have about 50% of the full rated power losses.

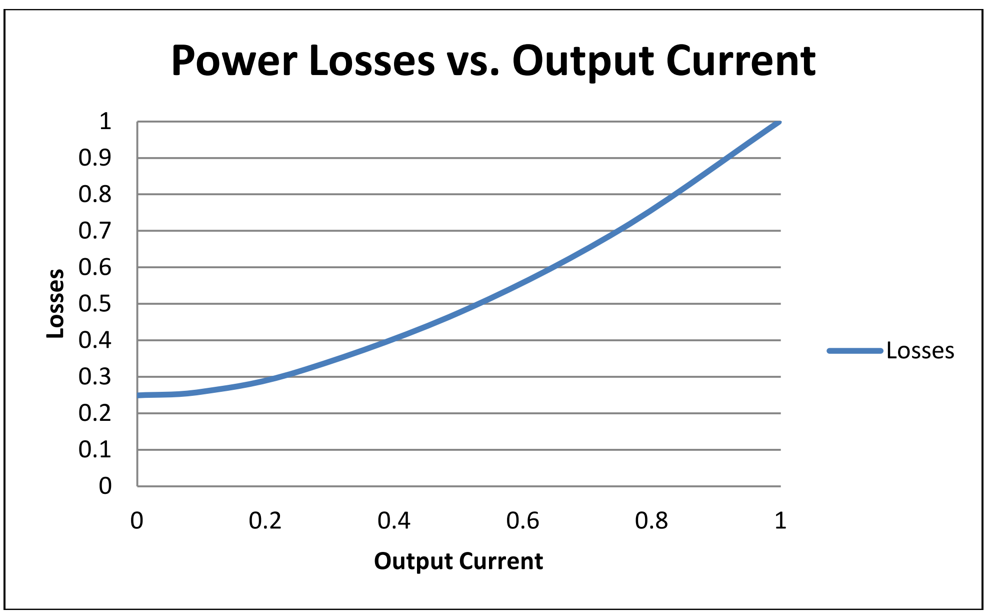


Figure 1.5: Power Losses vs. Output Current

There is also the case where a facility may shut down for several hours in a day. As can be seen in Figure 1.5 there are appreciable losses when no corrective current is being supplied by the DPM. Such losses in the Mesta DPM are lower than the industry norm for active harmonic filters; however, they do represent losses for doing little or no useful current correction. For such a condition, Mesta offers a power saving mode that can be programmed by an operator via the front panel or over the serial link. If this feature is selected, when the load is shut off or greatly reduced, the DPM will shut off its power inverter and cooling fans, but keep its internal components charged and ready to go. When the load returns, the system will automatically start full operation within a fraction of a second (no initialization or pre-charging cycle required). While in this “idle” state, the system’s losses are reduced to about 100 watts or less for all models. The Front Panel will display “IDLE” as the control mode while in this state. To utilize this power saving mode, should your facility have significant periods of time when the load the DPM is correcting for is shut off, see the “UNIT DISABLED IF LOAD POWER BELOW THIS %” parameter in section 5.6 of this manual for information on setting up this feature.

2. SAFETY PRECAUTIONS

This equipment should be installed, operated and maintained only by **qualified personnel**. The only time that the unit should be opened is for initial installation or routine maintenance. The following warnings apply to the equipment and should be read and fully understood by qualified personnel before they begin working on the unit:

WARNING
Risk of Electric Shock exists inside the Digital Power Manager (DPM) enclosure. The AC Disconnect should be in the OFF position for 5 minutes prior to opening the door of the unit. For additional safety, if possible, the external AC breaker feeding the DPM should also be locked in the OFF position. If not, the top terminals of the disconnect inside the unit will be electrically hot, and must be avoided. Even with the disconnect turned off, hazardous voltages may exist within the unit for several minutes after the disconnect is turned off. THESE HAZARDOUS VOLTAGES REPRESENT A POSSIBLE SHOCK HAZARD THAT COULD RESULT IN DEATH OR INJURY TO PERSONNEL.

WARNING
Always keep the front door closed and locking screws in the locked position. Leaving the unit's door open may expose personnel to an electrical shock hazard that could result in death or injury, or damage to the equipment. The AC Disconnect MUST remain in the OFF position at all times while the door to the system is open. Turning the AC Disconnect on after the door has been opened will result in hazardous voltages being present at many locations within the unit. SUCH HAZARDOUS VOLTAGES COULD CAUSE ELECTRIC SHOCK THAT COULD RESULT IN DEATH OR INJURY.

WARNING
The Digital Power Manager (DPM) contains capacitive components that remain energized for several minutes after power to the DPM has been removed. The AC disconnect should be in the OFF position for 5 minutes prior to opening the door of the unit. Of particular interest are the large can capacitors mounted in front of the heat sink. Two red lights mounted on the High Voltage Interface PC Board indicate if these capacitors are charged to hazardous levels. If either of these two red lights is lit, potentially deadly voltage exists on these capacitors. While these capacitors are charged, hazardous voltage exists in several places within the unit (including, but not limited to all DC filter capacitors; bus bars associated with the capacitors; the components on the heatsink; several other components located on the back panel; and the High Voltage Interface PC Board). The capacitors have circuits to discharge them. Do not proceed into the unit until the capacitors have been sufficiently discharged, signified by both red lights being off. Once the red lights are off, carefully measure the voltage across a far left capacitor and the capacitor directly to the right of that capacitor using a DC voltmeter, making sure you do not come in contact with any other metal objects within the cabinet. Make certain that both voltages you have measured are below 10 vdc before proceeding within the cabinet.

WARNING
Do not rely entirely on the red lights for safety. A failure in the lights or circuits that drive the lights could result in no lights being lit when a hazardous voltage exists. However, never proceed into the unit if the lights are on. Always use a DC voltmeter to measure the actual capacitor voltage once the lights are dim or off. Do not come in contact with any metal objects that are not grounded to the frame while making this measurement.

WARNING

Do not open the output circuit of a current transformer (CT) unless the circuit the CT monitoring is de-energized or the CT has been physically removed from the circuit. This includes not removing any connections from, or the connectors themselves from P1 or P2 of the CT Interface boards inside the DPMs. Opening the output circuit of a CT could result in very high voltage that can cause the CT to fail and represent an extremely dangerous condition to personnel. Exception: If CTs are first connected to a shorting terminal block prior to being wired to a DPM, and shorts are applied across each CT's pair of output wires on that block, then CT related wiring continuing from the block to the DPM may be opened without harm.

3. INSTALLATION

This section contains instructions for installing self-contained NEMA1 enclosed wall-mount or floor-mount DPMs, or installing open panels inside an industrial enclosure. NEMA1 enclosed systems are identified by a -1 suffix in the model number and open panel systems are identified by a -0 suffix in the model number (e.g. 3AC2DPM100-480-1 is a 100 amp, 480 volt NEMA1 enclosed system. An open panel system would simply substitute the -1 with a -0).

During the installation, please find and consult in section 10 of this manual the drawings pertaining to your particular system. Section 3.1 should be consulted for all systems. Consult Section 3.2 if installing a NEMA1 enclosed systems or Section 3.3 if installing a panel inside your own enclosure. Section 3.4 is to be consulted for all systems and contains instructions for connecting the power wires and external current transformers (CTs) to your DPM. Finally Section 3.5 contains information about using and connecting to optional control inputs & outputs.

3.1. PRE-INSTALLATION PLANNING

Prior to installation and even procuring a Mesta DPM, perform the following checklist:

- Make sure that the voltage rating of the Mesta DPM matches the voltage rating of the AC power driving the loads.
- Make sure that the current rating of the Mesta DPM is adequate to correct enough of the harmonics (and reactive currents if so desired) drawn by the load to reduce these undesirable current components to the necessary levels. Multiple DPMs can be installed in parallel to increase the corrective current capability. Also, if there is room for external line reactors to be installed in front of the non-linear loads, and adding such reactors is cost effective, the additional inductance provided by such reactors will reduce the harmonic currents drawn by the loads, which may result in a lower number of DPMs required or a smaller sized DPM needed.
- The CTs need to be selected. CT current ratios are specified as n/5 where 5 represents 5 amps of output current when “n” amps of current is being monitored. “n” should be chosen so that it is greater than or equal to the maximum rms of the current that can flow in the wire being monitored. Usually, select “n” to be equal to or greater than the breaker rating protecting that wire. There exist conditions, such as CT wiring distance, that may warrant a higher “n” value being chosen. Refer to section 3.4 for additional information. If using flexible CTs from Mesta, “n” should normally be at least 600, as CTs with ratios less than 600/5 have lower accuracy and are difficult to extend the lead wires due to their low VA power capability. If using other CTs, the CTs should be “meter” grade or at least be capable of accurately reading 400 Hz current. The tradeoff of using higher current ratios CTs will be reduced resolution of the current produced by the CT (e.g. a 2000/5 CT produces only half of the signal that a 1000/5 CT produces). However, the Mesta DPM is designed with excellent current resolution. Even 50 amp DPMs have been shown to operate well with 2000/5 CTs. At all times, the “n” value in the n/5 ratio should be never be less than the maximum rms current that can flow in the wires being monitored by the CTs.
- Units should be installed where they will NOT be exposed to rain or dripping liquids, corrosive gases or liquids, conductive airborne particles, or excessive dirt and dust.
- Make sure the space allocated for the unit(s) is adequate to accommodate the dimensions of the unit while maintaining the necessary clearances around the unit as specified in a later section.
- The ambient temperature where the unit(s) is to be placed should be maintained between 0 and 40ºC. It is possible to operate the systems in temperatures that exceed this range; however, de-

rating and other means may need to be implemented which will require contacting the factory for assistance.

- If air conditioning is needed to cool the room where the unit is to be installed, make sure the power losses of the unit are incorporated into the air conditioning needs. Power losses of the unit at full load can be found in the specifications for the unit. In addition, if the unit will operate at less than full load, Figure 1.5 can be used in conjunction with the full load loss information to determine actual power losses.
- Determine number of, model of, and eventual placement of Current Transformers (CTs) that will be needed with the DPM(s). This is highly dependent on how the DPM(s) will be installed as discussed in following sections of this manual.

The Mesta DPM works very well with a variety of loads; however, there are some instances where special considerations are needed:

- If line-to-neutral loads exist along with the 3-phase loads, external CTs monitoring all 3 line phases may be needed instead of the usual 2. If line-to-neutral loads draw appreciable current (more than 25% of the rated DPM current) through the neutral, some or all of those loads may need to be removed from the current that the CTs monitor. If you think this is a possible issue, contact the factory for assistance.
- Make sure there are no power factor corrective capacitors, passive filters (other than simple line reactors), harmonic trap filters, or other equipment containing sizable AC capacitor components in the load. Small amounts of line-to-line AC capacitance (e.g. used for emc reduction in some equipment) are acceptable. If you believe this is a possible issue, contact the factory for assistance.
- If operating from a generator or other high impedance source, sizable phase controlled loads (e.g. soft starters, some DC drives, etc.) may present a challenge. Also, very large types of these loads from even lower impedance sources may also present a challenge. If such loads are present, contact the factory for assistance.

3.2. PLACING AND WIRING A NEMA1 ENCLOSED MESTA DPM

This equipment should only be installed by qualified personnel that have been trained to work with potentially hazardous voltages and associated electrical equipment.

The NEMA1 enclosed DPM may be placed in an industrial environment that is protected from water, metal filings or other conductive impurities and corrosive chemicals. The area should not be subjected to an overwhelming amount of dust or dirt; otherwise, frequent cleaning of the system and replacement of the input air filter will be required.

Wall mounted systems must be mounted to a sturdy wall. They have 2 tabs on the top and 2 tabs on the bottom of the unit, on the back of the enclosure for bolting the unit to the wall. If a sturdy wall is not available, as an alternative, wall mounted systems may be bolted to a stand. Units bolted to a floor stand and floor-standing units (300 Amp DPMs) must be placed on a level surface. To provide mechanical stability, either the stand or floor-standing unit should be bolted to the floor using the holes provided, or the unit should otherwise be secured to insure the unit cannot tip over.

The wall-mounted units should be mounted so that there is a gap of at least 9” between the bottom of the enclosure and the floor. This distance is necessary to insure sufficient airflow into the box from the bottom. All units need a minimum of 9 inches of clearance between the top of the enclosure and any significant obstructions to allow adequate airflow out of the top of the box. The box should be positioned so that AC, chassis ground, and control wires can readily enter the top or bottom of the box on the right and left sides, indicated in the wiring instructions that follow. A minimum of 36” for a 300 amp, 30” for a 150 or 200 amp, and 24” for a 50 or 100 amp DPM of clearance in front of the unit is necessary to allow opening the door sufficiently to service the unit. A minimum of 1 inch of clearance is required on the left and right sides of all units.

Power wiring (consisting of conductors for the 3 phases and a chassis grounding wire) may enter the cabinet from either the top or the bottom of the enclosure. Top entry is preferred, but bottom entry is also acceptable. Wire sizes and conduit needs should be selected referring to Table 3.1 and to applicable electrical codes. Any power or ground wire selected that is larger than 3 awg should be derated, according to National Electric Code, to allow for the high frequency (400Hz) current produced by the DPM. CT wiring (and other optional control wiring) can also enter the cabinet from either the top or bottom of the enclosure. Again, top entry is preferred, but bottom entry is also acceptable. Figure 3.1 reviews all of the clearance specifications and shows top and bottom wire entry options into the enclosures.

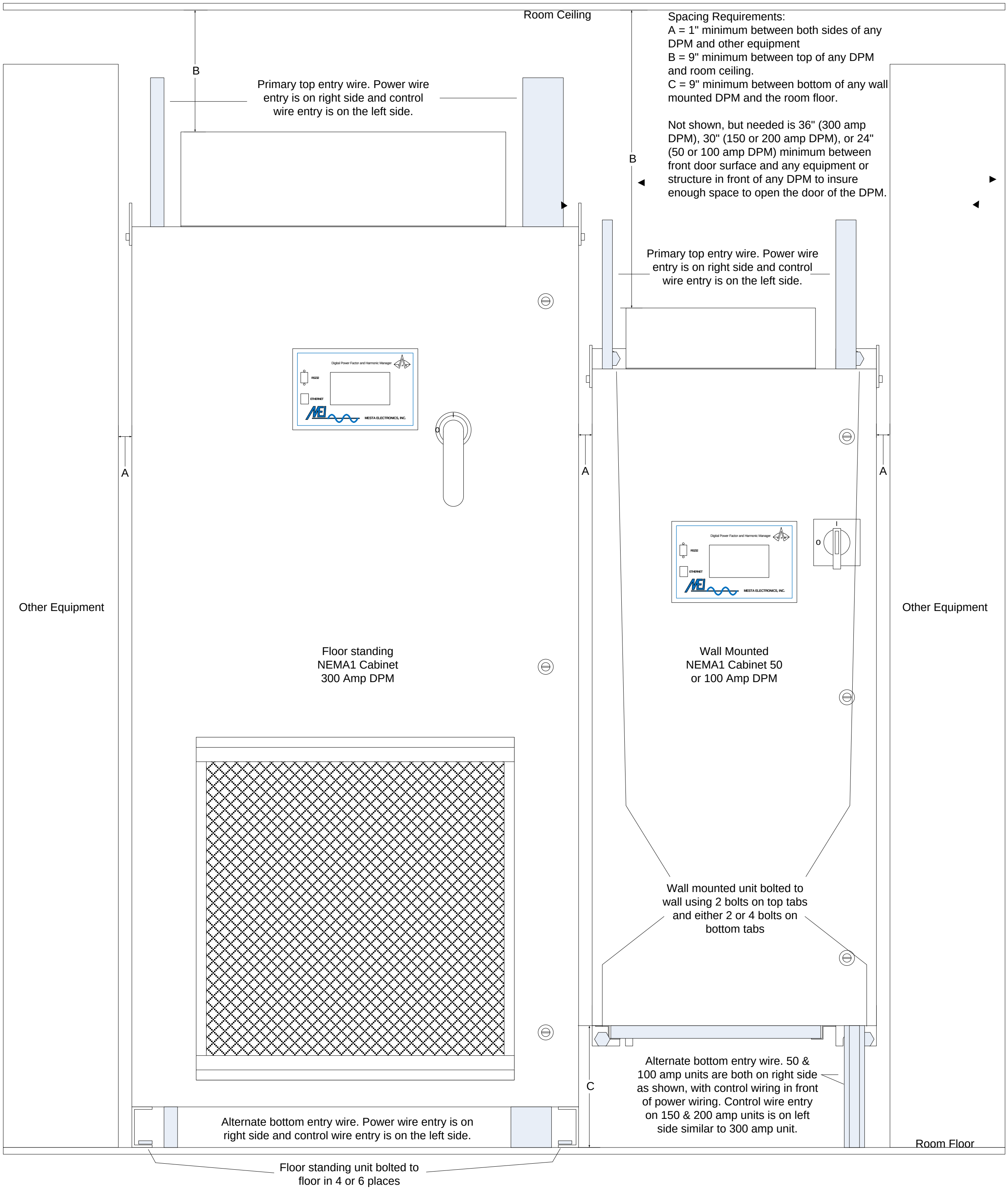


Figure 3.1: Installation Showing Clearances and Wire Entry

Pilot holes exist where the entrance to the enclosure for all wiring is to occur. These pilot holes can be enlarged, using a standard punch, to accommodate conduit fittings for the power and/or CT wiring to be used. Drilling or filing should be avoided, as any metal particles that fall inside the unit could interfere with the operation of the electrical/electronic components of the system. Although the NEMA1 enclosed DPMs have UL listed power fuses and a disconnect switch, electrical codes will probably require a 3-phase breaker or a fused disconnect at the point 3-phase power is tapped for the DPM to protect the wiring between the tapped point and the DPM. Table 3.1 includes power wiring information for all NEMA1 packaged DPMs. The 2nd column contains the rating of the internal power fuses, which is also the recommended rating of the external feeder breaker or fuses to use.

The 3rd column shows the maximum size wire that the unit can accommodate. In the case of the 300 amp system, if conductors larger than 300kcmil need to be used, 2 equal sized conductors (each up to 300kcmil in size) must be used for each phase instead of a single very large conductor. The 300 amp DPM power switch requires the wires to be terminated with ring-type terminals. If using more than one conductor per phase, one wire gets bolted to the front of the switch terminal and the 2nd wire to the back of the switch terminal. All other units use one wire (with no terminal) per phase.

If electrical code requires the wires to be housed within conduit, the 4th and 5th columns show the maximum amount the diameter that any conduit hardware can occupy before that hardware could start to interfere with enclosure items. The 4th column is for wires/conduit entering from the top and the 5th column is for wires/conduit entering from the bottom of the enclosure. These dimensions assume that the pilot hole is enlarged so that the center of the enlarged hole is the same as the center of the original pilot hole. Slightly less room is available when using bottom entry for units up to 200 amps because of the bottom mounted filter on those units. The 6th column indicates the maximum conduit trade size that “should” be able to be used without the conduit hardware interfering with enclosure items. The conduit size shown again assumes concentrically enlarged pilot holes and use of “standard” conduit hardware. Before settling on a conduit size, make sure all of the conduit hardware will fit within the diameter shown in column 4 or 5. For the 300 amp DPM, 2 conduit pilot holes are provided on both the top and bottom of the unit for the power wiring. The 7th column indicates the torque needed to properly tighten the power wires to the power switch. The 8th column indicates the torque needed to bolt the power fuses to the blocks.

The following sub-sections provide details about wire entry into and within the enclosure for the 3 different enclosure sizes: 50 or 100 amp, 150 or 200 amp, and 300 amp systems. Refer to section 3.4 for details of where to connect the power wires and the CT wires.

DPM Size (Amps)	**Circuit breaker or fused current rating**	**Maximum Wire Gage (Use 75C or equiv. copper wire only)**	**Max. Conduit hardware Dia. box allows**		**Maximum Conduit Size***	**Torque (in-lbs)**	
			Top Entry	**Bottom Entry**		**Power Switch**	**Bolts for power fuses**
50	70	1/0	4.3”	3.8”	2 ½ - 3	27	72
100	125	3/0	4.3”	3.8”	2 ½ - 3	132	132
150	200	250kcmil	4.8”	4.5”	3 - 3 ½	132	132
200	250	250kcmil	4.8”	4.5”	3 - 3 ½	228	228
300	400	2 conductors, each 300kcmil max	5.0”	5.0”	3 ½ - 4	228	228
*Make sure conduit hardware will fit in “Max. Conduit hardware Dia. box allows” for your unit.							

Table 3.1: NEMA1 Enclosure Power Wiring Information

3.2.1. WIRING A 50 OR 100 AMP NEMA1 ENCLOSED DPM

Figure 3.2 shows the position of the pilot holes in the top of the 50 or 100 amp DPM enclosure when using top entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). Top entry is preferred over bottom entry because the wiring for both the power and CTs is a direct shot. The 1.125” diameter pilot hole on the right side is for the 3 power wires and the chassis ground, and is large enough for ¾” conduit. This will have to be enlarged to the size needed to meet the electrical code using a punch. Care should be taken that no metal shavings are allowed to fall into the interior of the enclosure when using the punch. The punch should be centered within the pilot hole to insure that the new hole has its center in the same place. Failing to center the punch may result in less space being available for conduit mounting hardware. Power wires will be connected, in almost a straight shot, from this opening to the top terminals of the power switch. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the upper right side of the cabinet for connecting this chassis ground wire.

The 7/8" diameter pilot hole on the left side is for CT wiring (and possibly other optional control wiring) to enter the box, and is large enough for ½" conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring will be connected, in almost a straight shot, from this opening to the green P1 connector on the CT Interface PC board.

Figure 3.3 shows the position of the pilot holes in the bottom of the 50 or 100 amp DPM enclosure when using bottom entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). If using bottom entry power wiring, the back 7/8" pilot hole on the right side of the bottom will need to be enlarged with a punch to the size needed. The power wires and chassis ground should be routed from this enlarged opening as follows. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the lower right side of the cabinet for connecting this chassis ground wire. The power wires should be routed up the right side of the rear of the enclosure to beyond the top of the power switch. Utilize the space above the power switch to bend the wires so they may be connected into the top terminals of the switch. Figure 3.8 shows the power wire routing in a 300 amp DPM. The internal power wire routing is similar for the 50 or 100 amp unit as well.

On the way up to the power switch, the power wires need to pass behind the "Divider panel" within the unit. The section above this panel has warmer air that will be exhausted out the top of the enclosure, while the section below this panel has cooler air drawn in through the unit's air filter. This panel acts as a barrier to prevent the warm air remixing with the cooler input air. Figure 3.9 shows a top view of this divider. To make room for the power wires to pass, a section "B", of the rubber insulation material will have to be removed. In addition, a portion of the insulating piece "A (right)", marked "C" in the figure may need to be trimmed off. If so, remove screw holding "A (right)", trim only enough off the end indicated by "C" in the figure using tin-snips or heavy-duty scissors, then re-attach "A (right) with the screw.

The front 7/8" diameter pilot hole on the right side of the bottom is for CT wiring (and possibly other optional control wiring), and is large enough for ½" conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring should be immediately routed over to the internal left side and up the left side of the rear of the enclosure to the CT Interface board. This path is very similar to the one shown in Figure 3.8, except the pilot hole for the CT Interface wires is on the right side of the bottom in the 50 or 100 amp DPM and on the left side on the bottom in the 300 amp DPM. A portion of the rubber insulation, marked "D" in Figure 3.9, will need to be removed to accommodate the wiring to pass behind the "Divider Panel".

Any optional control wires can be either routed on the left side of the back panel, up to the top of the unit for top entry or down to the bottom for bottom entry similar to what is shown in Figure 3.8. The CT and optional control wires should not enter/exit the enclosure through the same hole as the power wiring. The optional control wires may enter/exit the enclosure through a different hole than the CT wiring. Neither the CT or optional control wires have to enter the same end (top or bottom) that the power wiring enters.

Units equipped with floor stands do not normally have bottom entry for wiring as a possibility. Consult the factory beforehand if bottom entry for a system to be equipped with a floor stand is needed.

3.2.2. WIRING A 150 OR 200 AMP NEMA1 ENCLOSED DPM

Figure 3.4 shows the position of the pilot holes in the top of the 150 or 200 amp DPM enclosure when using top entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). Top entry is preferred over bottom entry because the wiring for both the power and CTs is a direct shot. The 1.375" diameter pilot hole on the right side is for the 3 power wires and the chassis ground, and is large enough for 1" conduit. This will have to be enlarged to the size needed to meet the electrical code using a punch. Care should be taken that no metal shavings are allowed to fall into the interior of the enclosure when using the punch. The punch should be centered within the pilot hole to insure that the new hole has its center in the same place. Failing to center the punch may result in less space being available for conduit mounting hardware. Power wires will be connected, in almost a straight shot, from this opening to the top terminals of the power switch. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the upper right side of the cabinet for connecting this chassis ground wire.

The 7/8" diameter pilot hole on the left side is for CT wiring (and possibly other optional control wiring) to enter the box, and is large enough for ½" conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring will be connected, in almost a straight shot, from this opening to the green P1 connector on the CT Interface PC board.

Figure 3.5 shows the position of the pilot holes in the bottom of the 150 or 200 amp DPM enclosure when using bottom entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). If using bottom entry power wiring, the 7/8" pilot hole on the right side of the bottom will need to be enlarged with a punch to the size needed. The power wires and chassis ground should be routed from this enlarged opening as follows. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the lower right side of the cabinet for connecting this chassis ground wire. The power wires should be routed up the right side of the rear of the enclosure to beyond the top of the power switch. Utilize the space above the power switch to bend the wires so they may be connected into the top terminals of the switch. Figure 3.8 shows the power wire routing in a 300 amp DPM. The internal power wire routing is similar for the 150 or 200 amp unit as well.

On the way up to the power switch, the power wires need to pass behind the "Divider panel" within the unit. The section above this panel has warmer air that will be exhausted out the top of the enclosure, while the section below this panel has cooler air drawn in through the unit's air filter. This panel acts as a barrier to prevent the warm air remixing with the cooler input air. Figure 3.10 shows a top view of this divider. To make room for the power wires to pass, a section "B", of the rubber insulation material will have to be removed. In addition, a portion of the insulating piece "A (right)", marked "C" in the figure may need to be trimmed off. If so, remove screw holding "A (right)", trim only enough off the end indicated by "C" in the figure using tin-snips or heavy-duty scissors, then re-attach "A (right) with the screw.

The 7/8" diameter pilot hole on the left side of the bottom is for CT wiring (and possibly other optional control wiring), and is large enough for ½" conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring should be routed up the left side of the rear of the enclosure to the CT Interface board. This path is very similar to the one shown in Figure 3.8 for a 300 amp DPM. A portion of the rubber insulation, marked "D" in Figure 3.10, will need to be removed to accommodate the wiring to pass behind the "Divider Panel".

Any optional control wires can be either routed on the left side of the back panel, up to the top of the unit for top entry or down to the bottom for bottom entry similar to what is shown in Figure 3.8. The CT and optional control wires should not enter/exit the enclosure through the same hole as the power wiring. The optional control wires may enter/exit the enclosure through a different hole than the CT wiring. Neither the CT or optional control wires have to enter the same end (top or bottom) that the power wiring enters.

Units equipped with floor stands do not normally have bottom entry for wiring as a possibility. Consult the factory beforehand if bottom entry for a system to be equipped with a floor stand is needed.

3.2.3. WIRING A 300 AMP NEMA1 ENCLOSED DPM

Figure 3.6 shows the position of the pilot holes in the top of the 150 or 200 amp DPM enclosure when using top entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). Top entry is preferred over bottom entry because the wiring for both the power and CTs is a direct shot. The 1.375" diameter pilot hole on the right side is for the 3 power wires and the chassis ground, and is large enough for 1" conduit. This will have to be enlarged to the size needed to meet the electrical code using a punch. Care should be taken that no metal shavings are allowed to fall into the interior of the enclosure when using the punch. The punch should be centered within the pilot hole to insure that the new hole has its center in the same place. Failing to center the punch may result in less space being available for conduit mounting hardware. Since the power wires for a 300 Amp DPM will undoubtedly consist of two paralleled wires per phase, the option exists for bringing all six power conductors and the chassis ground through either one large conduit/hole or 2 smaller conduits/holes. If 2 are to be used, a 2nd pilot hole (7/8" diameter) is provided behind the 1.375" diameter pilot hole which can be enlarged with a punch. When using 2 conduits to bring in the power wires, one set of all 3 phases should occupy one conduit and the 2nd (paralleled) set of 3 phases should occupy the other conduit. This will minimize lead inductance compared to splitting the phases between the 2 conduits. Power wires will be connected, in almost a straight shot, from this opening to the top terminals of the power switch. All wires will need to be terminated with 3/8" ring terminals or equivalent. The 2 wires of each phase will be bolted to a power switch terminal such that one wire is mounted to the front of the terminal and the other is mounted to the back of the terminal. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the upper right side of the cabinet for connecting this chassis ground wire.

The 7/8" diameter pilot hole on the left side is for CT wiring (and possibly other optional control wiring) to enter the box, and is large enough for ½" conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring will be connected, in almost a straight shot, from this opening to the green P1 connector on the CT Interface PC board.

Figure 3.7 shows the position of the pilot holes in the bottom of the 300 amp DPM enclosure when using bottom entry into the enclosure for both the power and CT wiring (and possibly other optional control wiring). Two 7/8" pilot holes are provided on the right side of the bottom panel for power wiring entry. If only one large conduit is used for the power wiring, either pilot hole can be enlarged for that conduit. If 2 smaller conduits are used for the power wiring, both will need to be enlarged for power wire entry. When using 2 conduits to bring in the power wires, one set of all 3 phases should occupy one conduit and the 2nd (paralleled) set of 3 phases should occupy the other conduit. This will minimize lead inductance compared to splitting the phases between the 2 conduits. The power wires and chassis ground should be routed from this enlarged opening(s) as follows. The chassis ground wire should be terminated to a ¼" ring terminal or similar. A ¼-20 stud is available inside the lower right side of the cabinet for connecting this chassis ground wire. The power wires should be routed up the right side of the rear of the enclosure to beyond the top of the power switch. Utilize the space above the power switch to bend the wires so they may be connected into the top terminals of the switch. Figure 3.8 shows the power wire routing in a 300 amp DPM.

On the way up to the power switch, the power wires need to pass behind the "Divider panel" within the unit. The section above this panel has warmer air that will be exhausted out the top of the enclosure, while the section below this panel has cooler air drawn in through the unit's air filter. This panel acts as a barrier to prevent the warm air remixing with the cooler input air. Figure 3.11 shows a top view of this divider. To make room for the power wires to pass, a section "B", of the rubber insulation material will have to be removed. In addition, a portion of the insulating piece "A (right)", marked "C" in the figure may need to be trimmed off. If so, remove screw holding “A (right)”, trim only enough off the end indicated by “C” in the figure using tin-snips or heavy-duty scissors, then re-attach “A (right) with the screw.

The 7/8” diameter pilot hole on the left side of the bottom is for CT wiring (and possibly other optional control wiring), and is large enough for ½” conduit. If necessary, this hole can also be enlarged using a punch to accommodate a larger conduit size. CT wiring should be routed up the left side of the rear of the enclosure to the CT Interface board. This path is shown in Figure 3.8 for a 300 amp DPM. A portion of the rubber insulation, marked “D” in Figure 3.11, will need to be removed to accommodate the wiring to pass behind the “Divider Panel”.

Any optional control wires can be either routed on the left side of the back panel, up to the top of the unit for top entry or down to the bottom for bottom entry as shown in Figure 3.8. The CT and optional control wires should not enter/exit the enclosure through the same hole as the power wiring. The optional control wires may enter/exit the enclosure through a different hole than the CT wiring. Neither the CT or optional control wires have to enter the same end (top or bottom) that the power wiring enters.

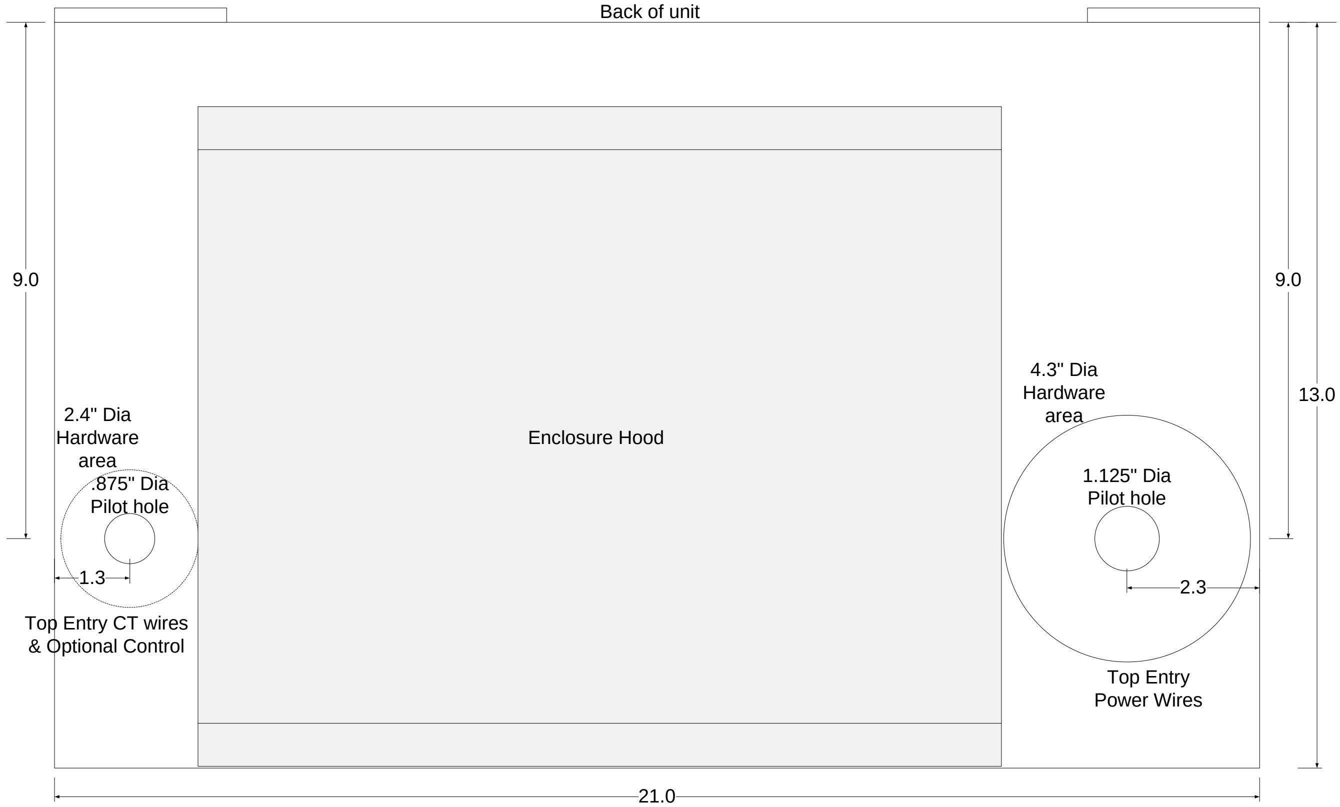


Figure 3.2: 50 or 100 Amp DPM NEMA1 Cabinet Top Wire Entry

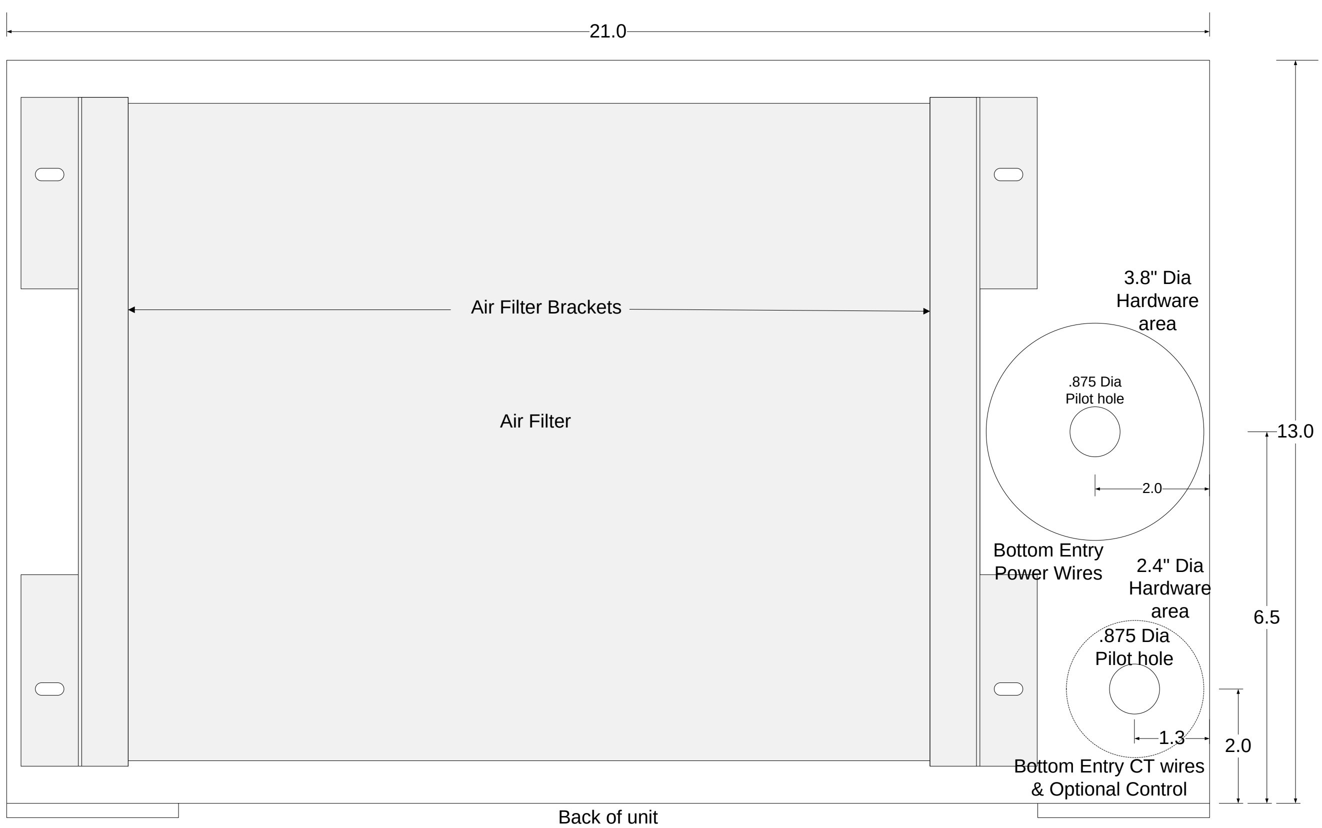


Figure 3.3: 50 or 100 Amp DPM NEMA1 Cabinet Bottom Wire Entry

Figure 3.4: 150 or 200 Amp DPM NEMA1 Cabinet Top Wire Entry

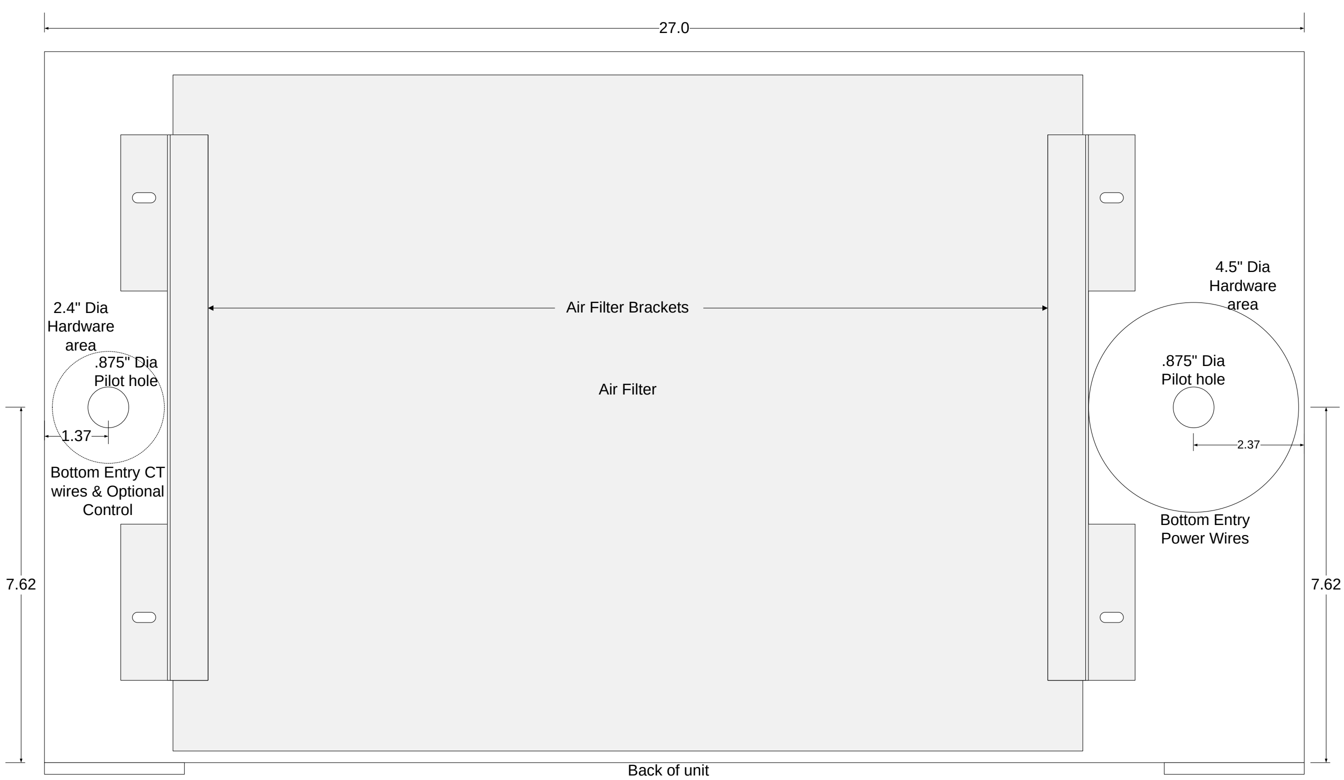


Figure 3.5: 150 or 200 Amp DPM NEMA1 Cabinet Bottom Wire Entry

Figure 3.6: 300 Amp DPM NEMA1 Cabinet Top Wire Entry

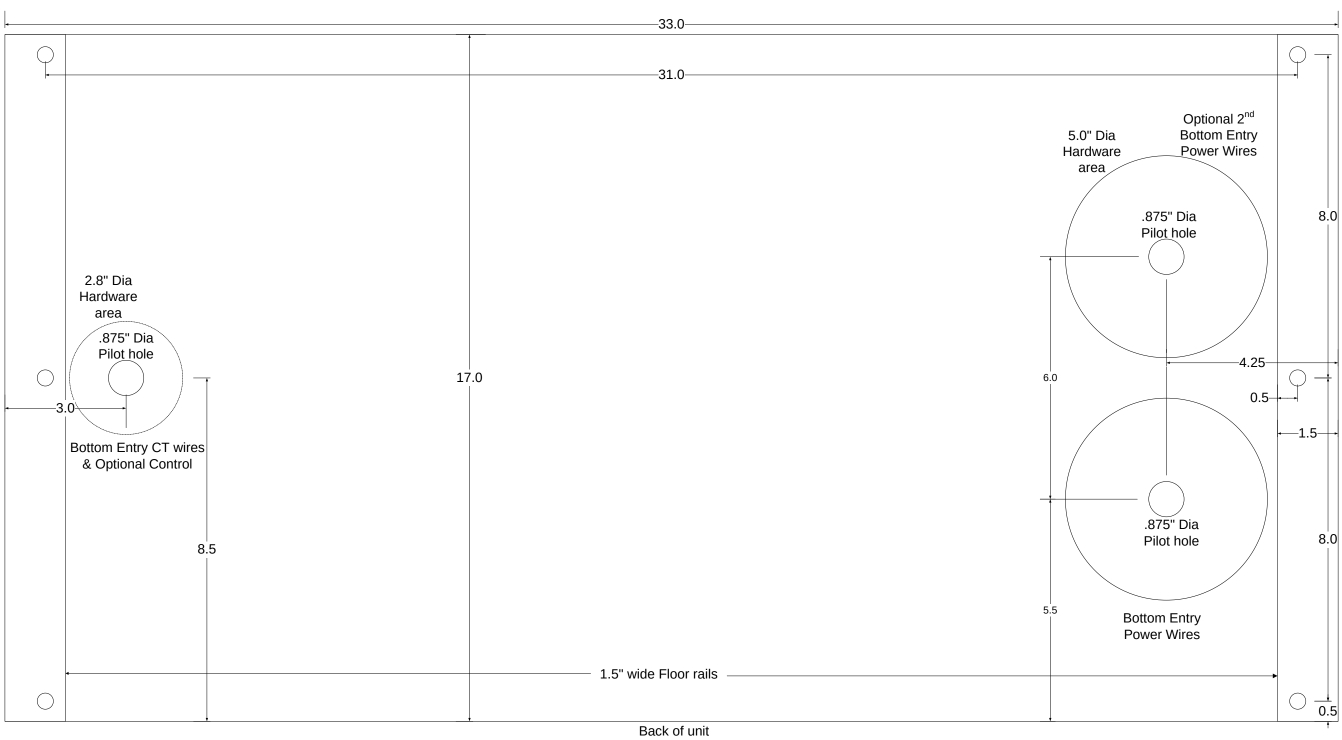


Figure 3.7: 300 Amp DPM NEMA1 Cabinet Bottom Wire Entry

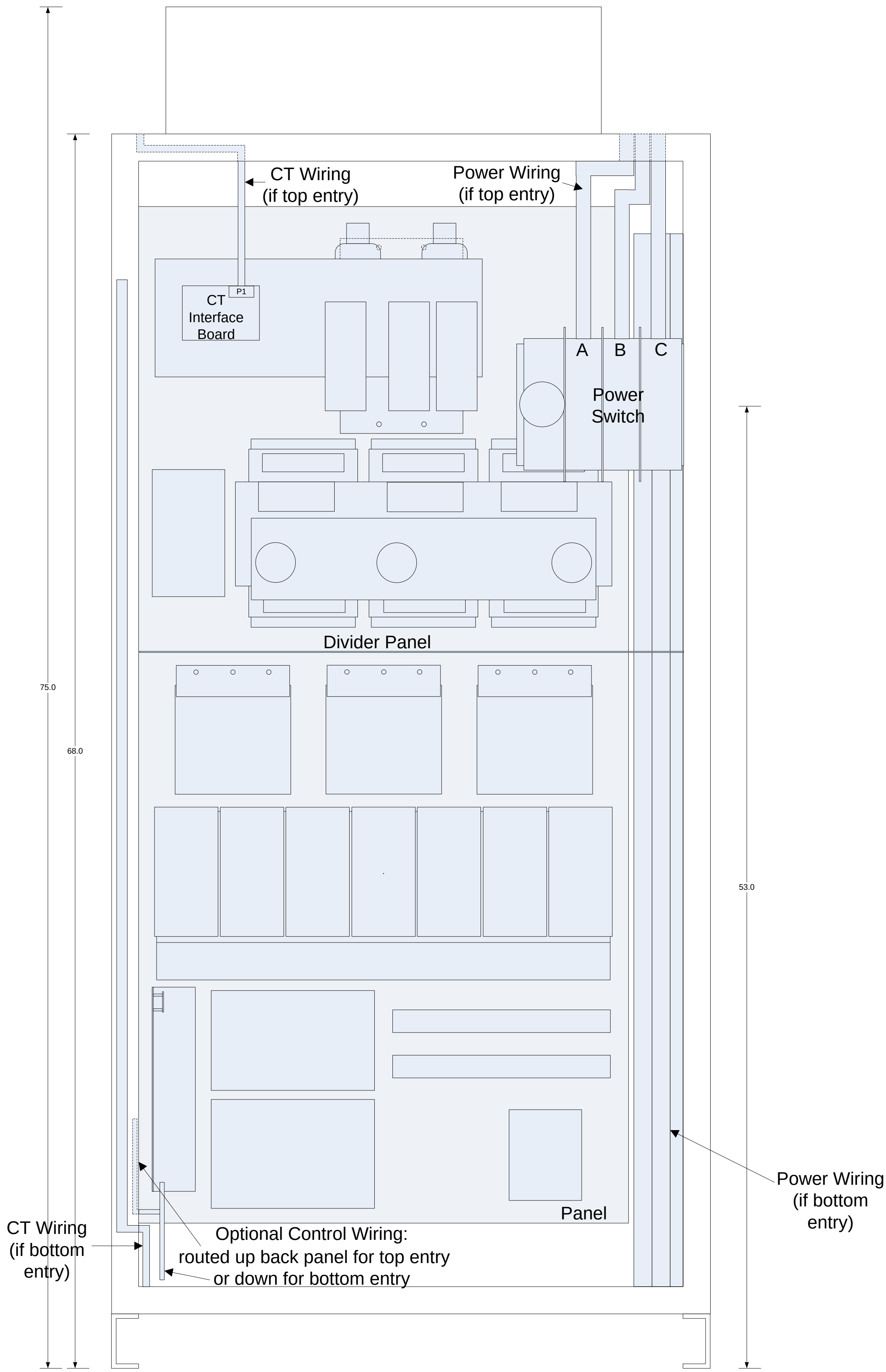


Figure 3.8: NEMA1 Enclosure Wire Routing

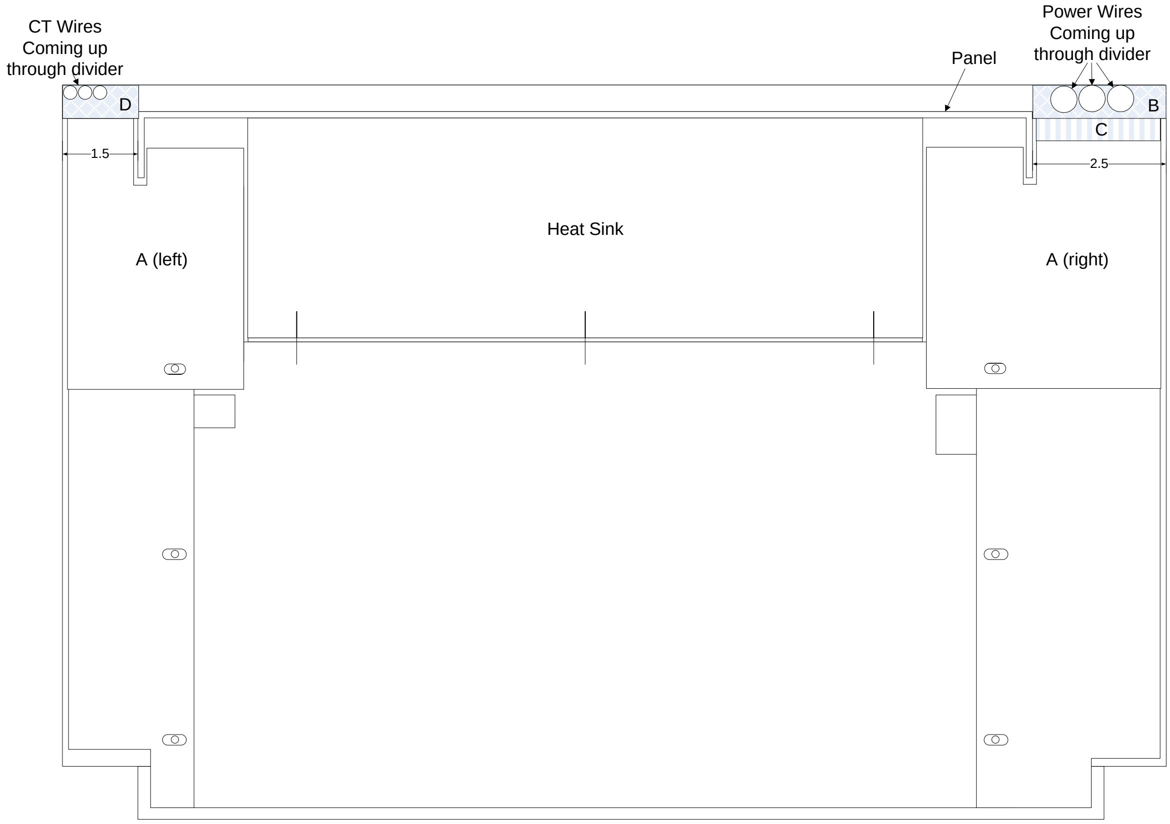


Figure 3.9: 50 or 100 Amp DPM NEMA1 Wire Passage Through Divider Panel

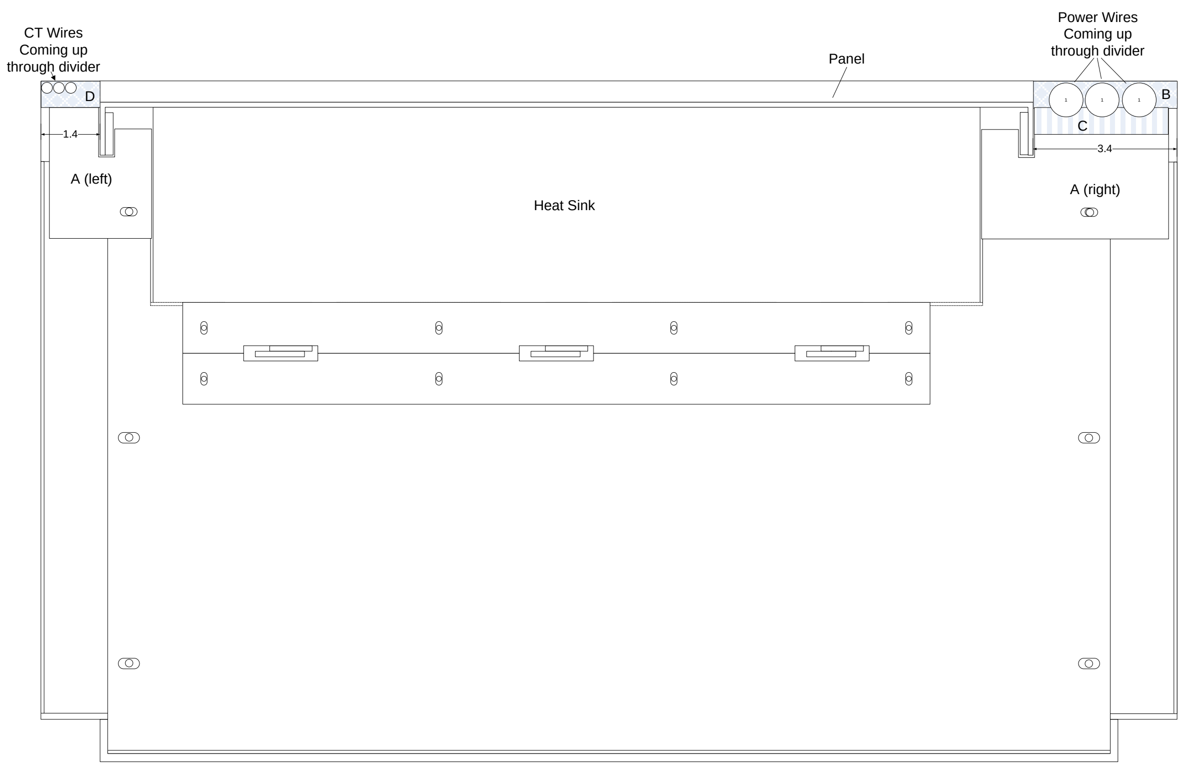


Figure 3.10: 150 or 200 Amp DPM NEMA1 Wire Passage Through Divider Panel

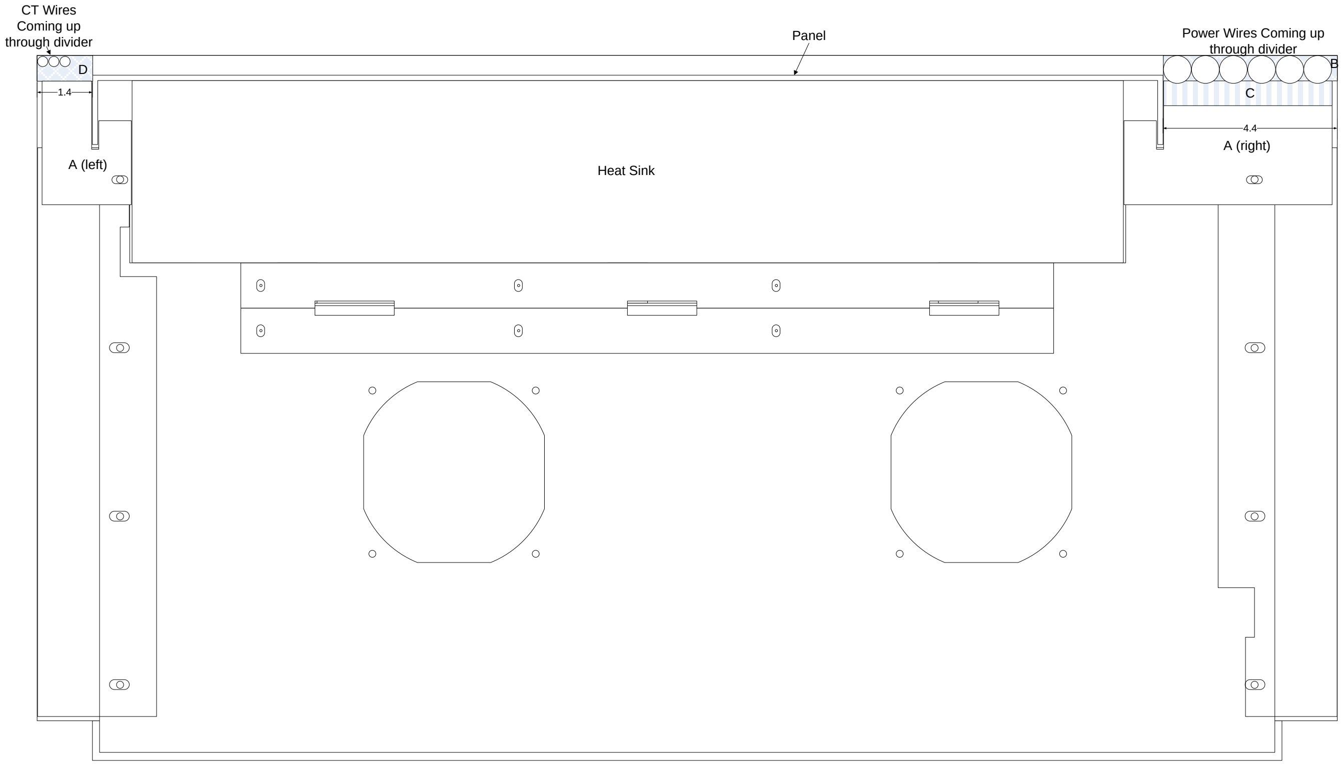


Figure 3.11: 300 Amp DPM NEMA1 Wire Passage Through Divider Panel

3.3. INSTALLING AND WIRING A DPM PANEL

DPM panels must be installed inside an industrial enclosure such as an MCC cabinet before they can be used. A panel is mounted inside an enclosure using the 6 holes in the panel. Machine screws holding DPM components to the panel may protrude up to 0.23” beyond the back surface of the panel. Because of this, at least ¼” thick spacers may need to be added between the rear surface of the panel and the mounting surface of the enclosure to avoid any of these protruding screws from preventing the panel from being tightened down. When installed, no ungrounded bare metal (e.g. power fuses and fuse blocks, aluminum bus-work connecting the large cylindrical Electrolytic capacitors together, etc.) on the DPM panel should come within 1” of any enclosure metal. Refer to the panel layout for your particular panel in Section 10 for panel dimensions and locations of ungrounded bare metal to avoid.

An LCD front panel is provided with each DPM panel. The front door of the enclosure should have the rectangular cutout and 6 holes shown in Figure 3.12 to accommodate this panel, which is mounted from the exterior. The LCD front panel’s protective “box” protrudes 1.5” beyond the inside surface of the door. Because of this, the placement of the panel should be such that no part of this protruding portion of the front panel box comes within 1” of any ungrounded metal on the DPM panel. Figure 3.13 shows the dimensions and location of the box within the front panel. A 300 amp panel has the additional requirement that the box should not come within 1.5” of the 3 drum inductors when the door of the enclosure is closed.

Table 3.2, Figure 3.14 (if panel is a 50, 100, 150, or 200 amp DPM) or Figure 3.15 (if panel is a 300 amp DPM), and the panel layout drawing for your panel found in Section 10 can be used to determine where the front panel is allowed to be located vertically on your enclosure’s door. If the dimension “A”, the distance between the back surface of the DPM panel and the inside surface of the enclosure door is less than the distance indicated in Table 3.2 where there is no restriction on the vertical location of the front panel, the front panel must be located in the vertical areas indicated in the table and referenced figures. An alternative would be to make a frame that protrudes out the front of your enclosure that houses the display so that the display back doesn’t protrude into the cabinet.

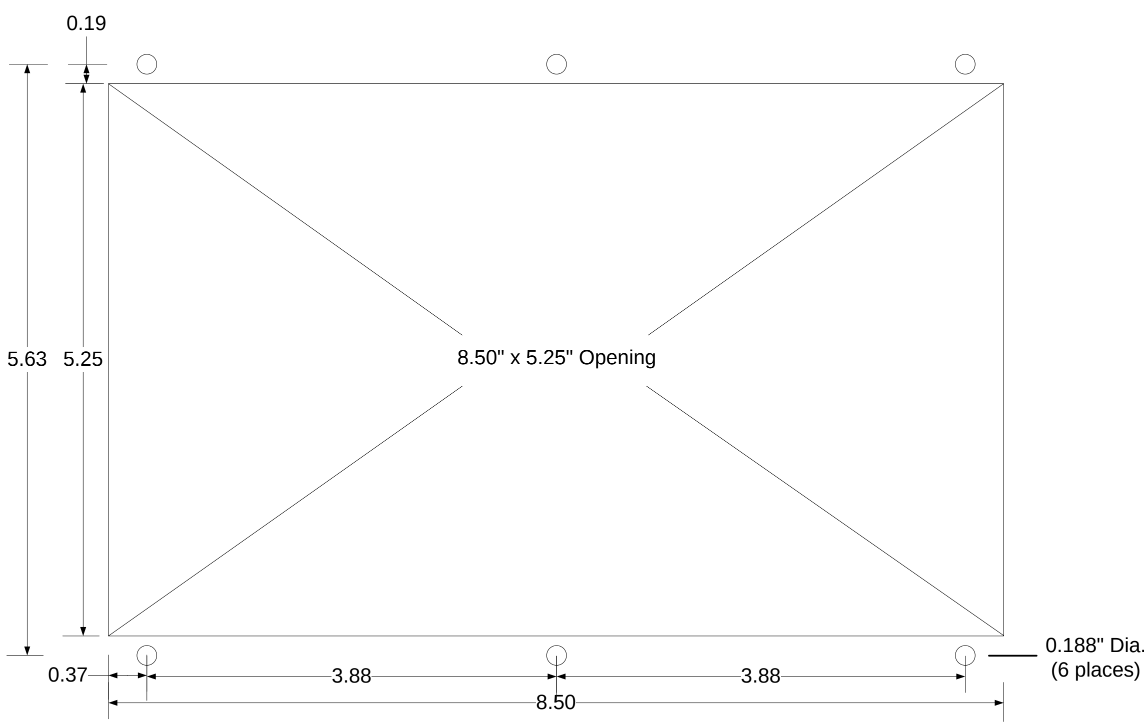


Figure 3.12 LCD Front Panel Cutout Pattern

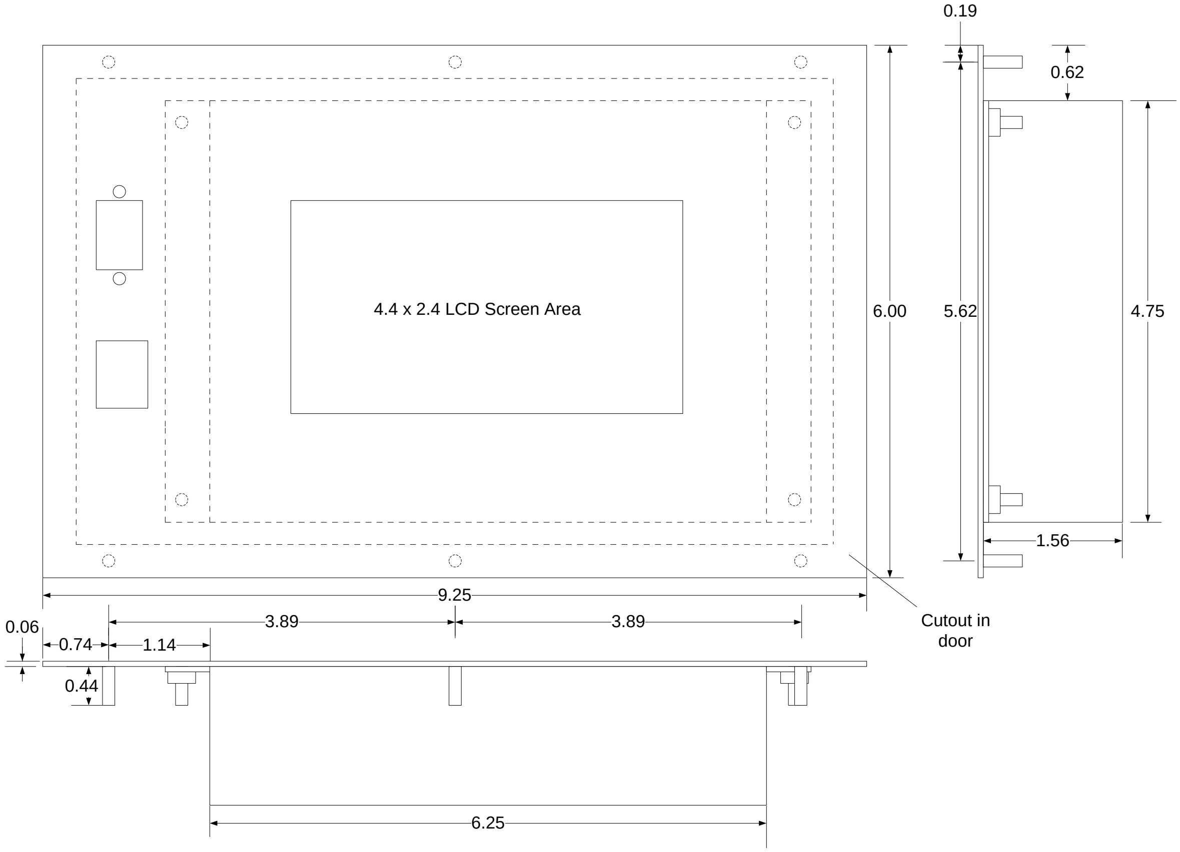


Figure 3.13: LCD Front Panel Dimensions

Table 3.2: Cabinet Depth Design Guidelines for Panels Refer to Figure 3.14 for 50-200 amp panels or Figure 3.15 for 300 amp panels for definition of dim. A and areas B through G; and refer to panel layout drawing for your size panel in section 10 to determine location and vertical size of areas.		
DPM Size (Amps)	**Distance from back surface of panel to inside surface of door (dim. A)**	**Vertical location of LCD front panel 6.25” x 4.75” box that protrudes into the cabinet enclosure**
300	14”	Minimum allowed distance for this panel
	≥ 14” and < 15.13”	Box must be located within area B, C, or E
	≥ 15.13” and < 15.5”	Box must be located in area B, C, D, or E
	≥ 15.5”	No restrictions on position of front panel
200	13.7”	Minimum allowed distance for this panel
	≥ 13.7 and < 14.12”	Box must be located in area B or G
	≥ 14.12” and < 15.34”	Box must be located in area B, F or G
	≥ 15.34”	No restrictions on position of front panel
150	13.0”	Minimum allowed distance for this panel
	≥ 13.0 and < 14.12”	Box must be located in area B or G
	≥ 14.12” and < 14.45”	Box must be located in area B, F or G
	≥ 14.45”	No restrictions on position of front panel
100	13.0”	Minimum allowed distance for this panel
	≥ 13.0 and < 14.12”	Box must be located in area B or G
	≥ 14.12” and < 14.73”	Box must be located in area B, F or G
	≥ 14.73”	No restrictions on position of front panel
50	13.0”	Minimum allowed distance for this panel
	≥ 13.0 and < 13.62”	Anywhere except area F
	≥ 13.62”	No restrictions on position of front panel

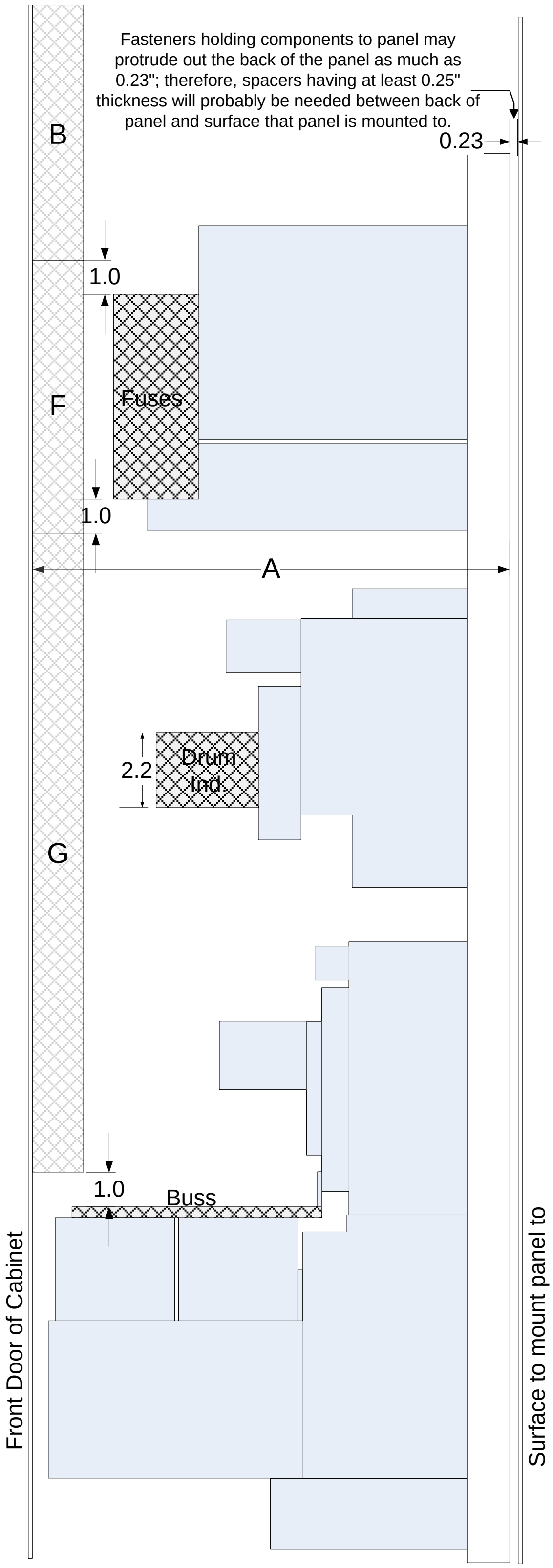


Figure 3.14: 50-200 Amp Panel to Cabinet Front Door Dimensions

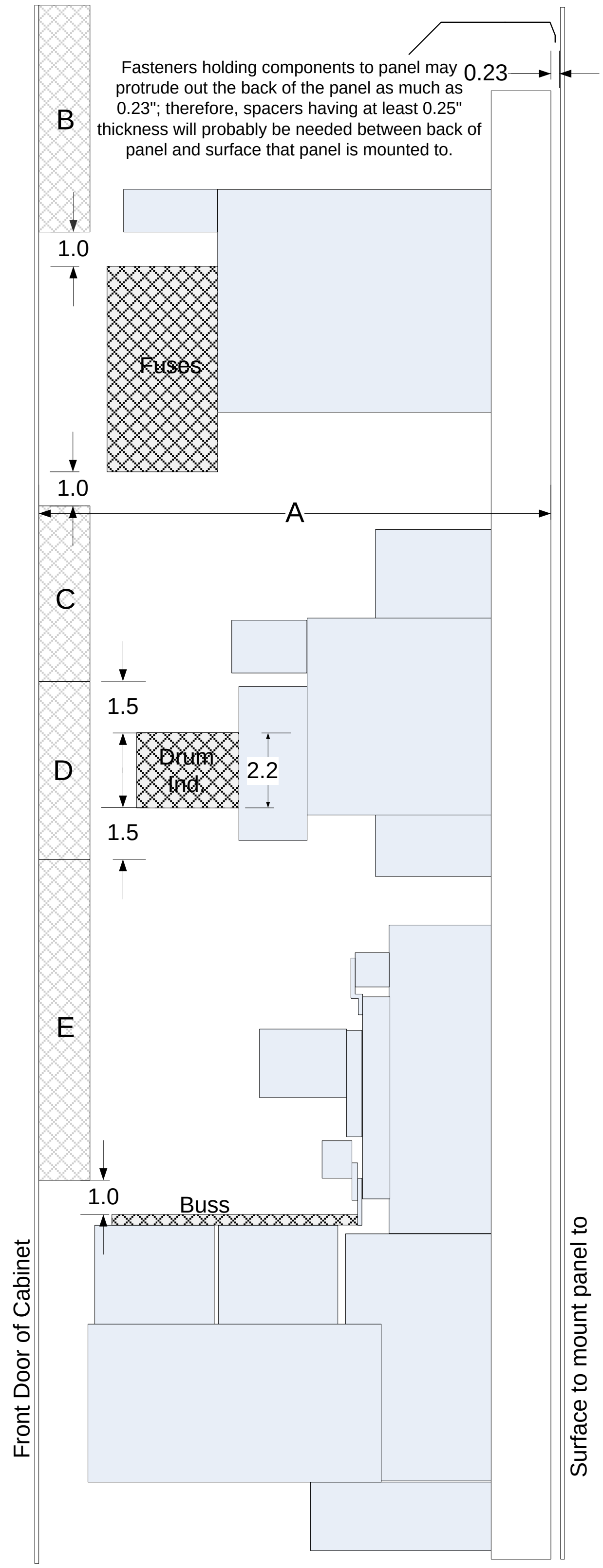


Figure 3.15: 300 Amp Panel to Cabinet Front Door Dimensions

The Ethernet CAT-5, ribbon, and 4-wire Front Panel cables need to be routed to connectors P6, P1, and P7, respectively, of the PC-I board (see Figure 3.23) located in the bottom part of the DPM panel. If the DPM is equipped with Ethernet/IP instead of Ethernet, the CAT-5 cable will connect to the Ethernet/IP module's RJ-45 connector instead of the PC-I board. A recommended routing path for the wiring down the inside of the enclosure door, that minimizes noise interference, is shown in Figure 3.16.

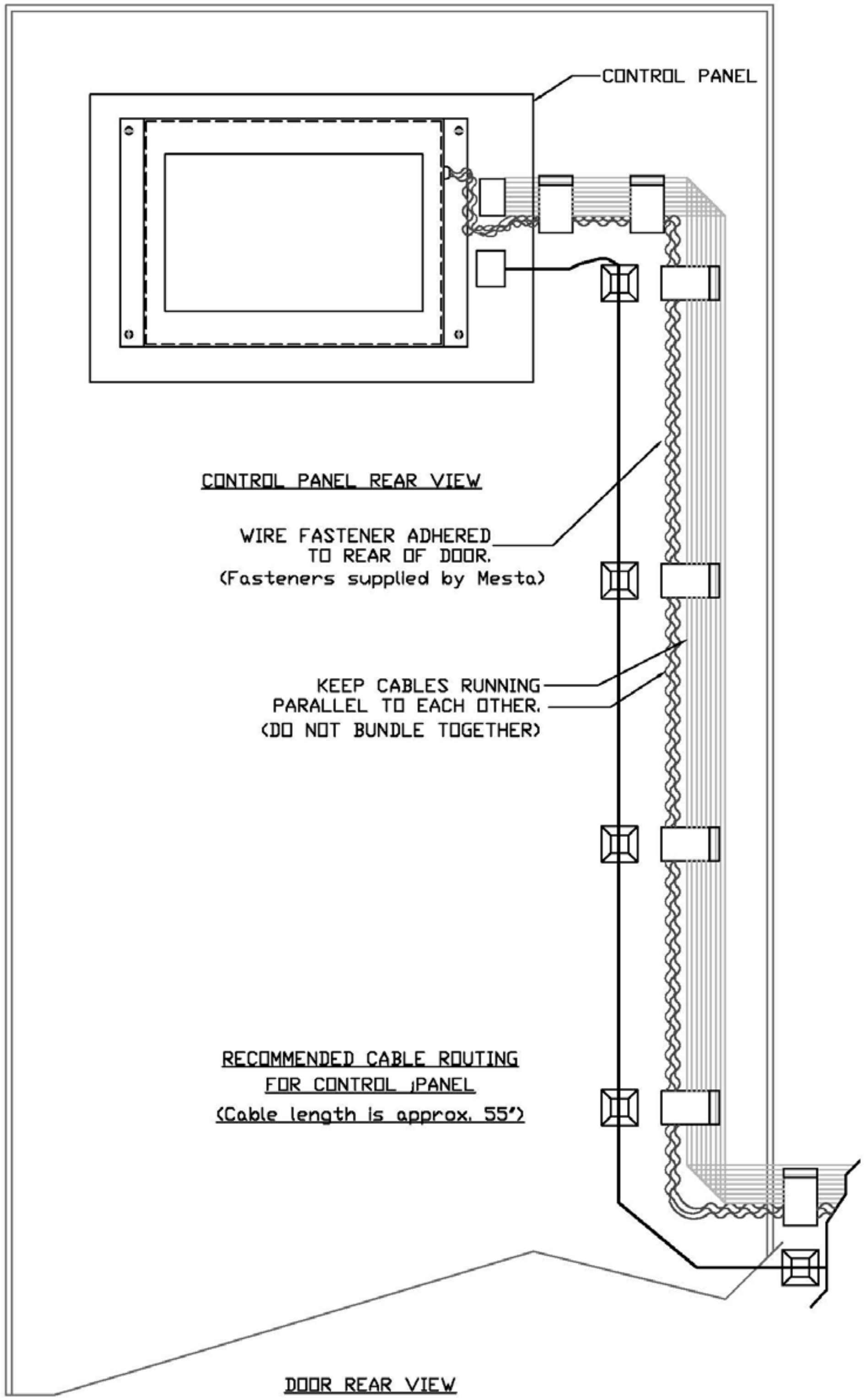


Figure 3.16: Recommended Wire Path for Front Panel Cables

Panels do not come with disconnect switches like the NEMA1 enclosed systems. A disconnect switch will need to be added in line with the power wires to the DPM, following electrical code requirements. The output of the disconnect switch is then wired to the 3 power fuses of the DPM. Unless wiring between the fuses and the added disconnect switch or between the disconnect switch and the place where the power is tapped from are long, electrical codes will normally allow you to rely on the UL listed fuses in the DPM to over-current protect your wiring and switch; however, check your applicable electrical codes to confirm this.

Either input or exhaust fans will need to be added to the enclosure to ensure the air exchange rate shown in the specification table for your size DPM, located in Section 10, is met. If input fans are used, they should be located near the bottom of the enclosure with exhaust vents located near the top of the enclosure. If exhaust fans are used, they should be located near the top of the enclosure with intake vents located near the bottom of the enclosure. Air brought into the enclosure should be appropriately filtered so that large dirt build-up does not occur in the DPM panel that would impair the airflow through vital components. The airflow specified in the specification table should be achieved at the pressure created by the vents and filtering in the enclosure. Power for these fans will have to be derived from either the incoming power to the enclosure or some other external source, as the DPM panel does not provide a power source.

Table 3.3 provides power wiring information for all of the DPM panels. Power wiring is needed between the output of the user-provided disconnect switch to the bottom terminals of the power fuse blocks on the panel. Care should be taken so this power wiring is routed so that the integrity of components on the DPM panel are not compromised. Welding wire is recommended (but not required) because of its flexibility.

DPM Size (Amps)	Fused Current Level	Wire Range (Use 75C or equiv. Copper wire only)	Torque (in-lbs) at Power Fuse Blocks	
			Wire Connection	Fuse Bolt
50	70	#8-2/0	120	72
100	125	#4 – 350kcmil	275	132
150	200	#2 – 350kcmil	275	132
200	250	1/0 – 600kcmil	600	228
300	400	3/0 – 600kcmil	600	228

Table 3.3: DPM Panel Power Wiring Information

3.4. CONNECTING POWER WIRES AND CT WIRES TO THE DPM

There are several different possible implementations of a Mesta DPM. Many are described in the sub-sections that follow. The basic interface to the DPM consists of 3 power wires, a chassis ground wire, and a set of 2 or 3 current transformers (CTs) to each DPM. The 3 power wires conduct the corrective current produced by the DPM to the loads (and line). To determine what corrective current is needed, the CTs are mounted to monitor the currents coming from the utility (or line), or the currents going to the loads that are drawing the harmonic currents. As mentioned earlier, the “line” current consists of the current to the loads plus the current to the DPM, whereas the “load” current consists of only the current to the loads.

Up to several DPMs may be paralleled to achieve higher current correction than a single system is capable of. Although more than 10 could theoretically be paralleled together, paralleling more than a few usually becomes physically difficult to realize. Instead, it is normally better to break up the loads into more manageable groups, and assign 1 or small groups of paralleled DPMs to each group of loads.

If multiple DPMs are used in parallel, the CTs MUST monitor the “load” currents. If a single DPM is used, either the “line” or the “load” currents may be monitored with the CTs. The DPM must be configured to match where the CTs are located (“line” or “load” side) via the LCD front panel.

Split core CTs purchased from Mesta come with 12 feet of twisted pair wire leads. These wires may need to be lengthened to meet your needs. Total wire length that can be used depends on the following factors:

- Burden capacity of the CTs in volt-amperes (VA).
- Gauge of wire used (AWG) including the wire supplied with the CT, wire used to extend that length, wire used to daisy-chain between DPMs that are paralleled, etc.

A CT is capable of driving a particular maximum load in volt-amperes (VA), depending on the CT’s design. If the load draws more power than this value, the output of the CT will be distorted. A DPM or multiple DPMs (if units are paralleled) monitoring the CT outputs, present a negligible load for the CTs compared to the wire leads. If the CT is producing its maximum rms output of 5 amps, the leads present a load of I^2*R to the CT, where I is 5 amps and R is the wiring resistance. Heavier wire has lower resistance, resulting in a longer wire length being able to be used. Table 3.4 can be used to determine how long the wires of a CT may be extended. In this table, VA indicates the volt-amp capability of the CT, VA_loss indicates the losses due to the leads that come with the CT at 5 amps rms current, and Wire Gage is that of the wire the CT leads are being extended with. These calculations have a constant K. If a higher CT ratio is chosen so that the CT output current is less than 5 amps when the line being monitored is carrying its maximum possible current (normally equal to the circuit breaker rating protecting the line), K is calculated to be $(i/5)^2$, where i is the current produced by the CT when the line is operating at maximum possible current. As an example, if a 1200/5 CT is used on a line protected by a 1000 amp breaker, a 1200/5 CT will produce 4.167 amps of current at 1000 amps of line current. K is calculated to be $(4.167/5)^2$ or 0.695. It is recommended that despite what the calculation yields in length that the total wire length does not exceed 100 ft. Beyond 100 ft, the inductance of the wire can cause excessive distortion to the signal, which will adversely affect performance.

Table 3.4: Maximum lengths for CT leads

Wire Gage (AWG)	Maximum Additional Wire Length (ft)
16	(VA-(VA_loss*K))*(4.4/K)
14	(VA-(VA_loss*K))*(7.1/K)
12	(VA-(VA_loss*K))*(11.2/K)
10	(VA-(VA_loss*K))*(17.8/K)

As an example, if a CT is rated for 5 VA, has 12 ft of 12 AWG leads, and has an output of 5 amps rms at the highest current that the line it is monitoring can possibly carry: VA=5, K=1, and VA_loss = 1.1

(VA loss of 12 ft of twisted pair 12 AWG wire carrying 5 amps of current). Using 12 AWG wire to extend the leads with twisted pair wire results in (5-1.1)*11.2 = 44 ft. Using a higher CT ratio will result in a longer possible distance because K will be less than 1 in the equations in this table.

Table 3.5 shows a list of possible standard split core CTs available from Mesta. Included in the table are the VA capacity of the CT, the gage of the 12 ft. of twisted pair wire leads the CTs come with, and the VA_loss of those wire leads. These VA and VA_loss values can be used with equations in Table 3.4 to calculate the length that the CT leads may be extended. If the CT chosen produces 5 amps at the maximum current the line can carry, the values listed in the wire AWG columns can be used to determine the maximum lengths that can be added.

Table 3.5: Lengths that leads on Mesta supplied CTs may be extended

CT Current Ratio	VA capacity of CT	Wire AWG of CT leads	VA_loss for 12 ft. supplied length @ 5 amps	Maximum extra length of wire that can be added to 12 ft. leads using indicated wire gage @ 5 amps			
				16 AWG	14 AWG	12 AWG	10 AWG*
200/5 – 400/5	2	12	1.1	4.0	6.4	10.1	16
500/5	3	12	1.1	8.4	13.5	21	34
600/5 – 800/5	5	12	1.1	17	28	44	69
1000/5 – 1200/5	5	16	2.8	9.7	15.5	25	39
1500/5 – 1600/5	15	16	2.8	54	87	88	88
2000/5	25	16	2.8	88	88	88	88
2400/5	35	16	2.8	88	88	88	88
3000/5 – 6000/5	45	16	2.8	88	88	88	88

*If 10 AWG wire is to be used, you must transition back to 12 AWG or smaller for a short distance prior to terminating wires in the CT Interface board terminals in all DPMs, as those terminals are not large enough to reliably accept larger wire than 12 AWG.

In this table, no lengths are shown greater than 100 feet. Beyond 100 ft, wiring inductance, which distorts the signal seen by the DPM or paralleled DPMs, becomes a concern. From this table, we note the following:

- Higher current ratio CTs have higher VA capacities, so can drive higher loads (i.e. longer wire lengths). Also, using higher current ratio CTs will result in lower VA loads caused by the leads, since the CT will produce less than 5 amps at the maximum current seen. For example, if a 1200/5 CT is used instead of a 1000/5 CT on a line that can carry no more than 1000 amps, The diA tradeoff of using higher current ratios CTs will be reduced resolution of the current produced by the CT (e.g. a 2000/5 CT produces only half of the signal that a 1000/5 CT produces). However, the Mesta DPM is designed with excellent current resolution. Even 50 amp DPMs have been shown to operate well with 2000/5 CTs. At all times, the “n” value in the n/5 ratio should be greater than the maximum rms current that can flow in the wires being monitored by the CTs.
- The 12’ leads supplied on 1000/5 and 1200/5 CTs are 16 AWG. If using these CTs and planning to extend these leads, you may need to consider either going to a higher CT ratio (thus increasing the VA capability of the CT), or cutting much of the supplied 12’ length off and replacing with heavier gage wire that is being used to extend the lead length.

After consulting the subsections that follow showing different possible implementations of a Mesta DPM or DPMs, the following procedure should be used to connect power wires and CT wires to the DPM or DPMs:

1) It is highly recommended for safety reasons to turn off power feeding the circuit that powers the DPM and the lines to be monitored by the CTs. If split-core CTs are to be installed on live lines,

the secondaries of the CTs MUST be terminated prior to installing the CTs on the live lines. Termination should be either to the terminals inside the DPM or to a shorting block with shorting bars engaged. Shorting bars should not be removed until connections are made between the shorting block and the DPM.

2) Designate the 3 phases of your power circuit as phases A, B, and C. Phase rotation is not a concern, so the designation you make is arbitrary, and has nothing to do with physical wire or bus positions. Phase A will be the phase you decide to put CT A on, phase B will be the phase you decide to put CT B on, and phase C is the remaining phase (it will need to have CT C on it if 3 CTs are to be installed). All CTs should be placed on either the “line” side or the “load” side, whichever positioning is required or optimal for your situation.
3) If the DPM is an enclosed unit, connect the power wiring to the switch inside the DPM via an external breaker or fused switch. In certain cases, the electrical code may allow direct wiring without going through a breaker or fused switch. If the DPM is a panel unit, connect the wiring through a switch (or breaker) to the power fuse blocks on the panel. The electrical code will usually allow the switch to rely on the fuses in the DPM for protection. Wire the power wiring from your designated phase A to the left-most terminal of the DPM’s switch or left-most fuse block, wire your designated phase B to the middle terminal or middle fuse block, and phase C to the right-most terminal of the switch or right-most fuse block. If multiple DPM units are paralleled, repeat for all units. If external over-current protection is required, each paralleled DPM will need its own external protection sized to protect the wiring to each unit.
4) Terminate the secondary leads of CT A to A+ and A- terminals, CT B to B+ and B- terminals, and CT C (If used) to C+ and C- of P1 of the CT Interface board inside the DPM enclosure. If using CTs supplied by Mesta, the black lead is the “+” lead and the white lead is the “-“ lead. Use a tightening torque of 4 in. lb. Also, use the provided mounting points and wire ties to route the CT wires and provide strain relief.
5) If the DPM is a single unit with no other units in parallel with it, make sure the P2 connector with the 3 shorting jumpers is in place on the CT Interface Board. If additional units exist to be paralleled with this DPM, jumper from P2 from this DPM to P1 of the next DPM as described in the paralleled DPM example. Jumpering of P2 from one DPM to the P1 of the next DPM is continued until the last DPM to be paralleled. That last DPM must have the 3 shorting jumpers in place on its P2 connector.
6) Encircle the conductor(s) you designated as phase A of your power circuit that feed both the DPM and the loads to be corrected with the CT marked “A”. Make sure to orient the CT so that its arrow is in the direction pointing from the utility to the load. Repeat for phase B, and then for phase C, if the optional phase C CT is being used.

WARNING:
Once the circuitry that the CTs are monitoring is energized, DO NOT disconnect secondary wires of the CTs from P1 or remove P1 or P2 from the CT Interface Board from any DPMs monitoring those CTs. Power feeding the circuitry monitored by the CTs must be turned off before any P1 or P2 connections are removed. Circuitry should not be re-energized until either the CTs are removed or the secondary wires are properly terminated. (Exception: if CTs are first wired to a shorting block prior to the DPM or paralleled DPMs, and shorts are applied on the shorting block to all CTs, then the wiring to P1 or P2 of the CT Interface board(s) downstream may be disconnected without de-energizing the circuitry monitored by the CTs). CTs should never be installed on live circuitry if the secondary wires are not properly terminated. Open circuit terminals of a CT monitoring a live circuit may develop a lethal voltage across the secondary wires.

FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH.

Once all the power and signal connections have been made to the DPM or paralleled DPMs, the electrical service can be re-established to the node. The DPM should have its disconnect switch turned off when it is first installed and the power is re-established.

The following sub-sections show power wiring to a NEMA1 enclosed DPM or paralleled DPMs, showing the power wires coming into the power switch of such units. Panel DPMs will include a user-supplied disconnect switch wired to the power fuses on the DPM panel.

3.4.1. SINGLE DPM MONITORING "LINE" SIDE CURRENT

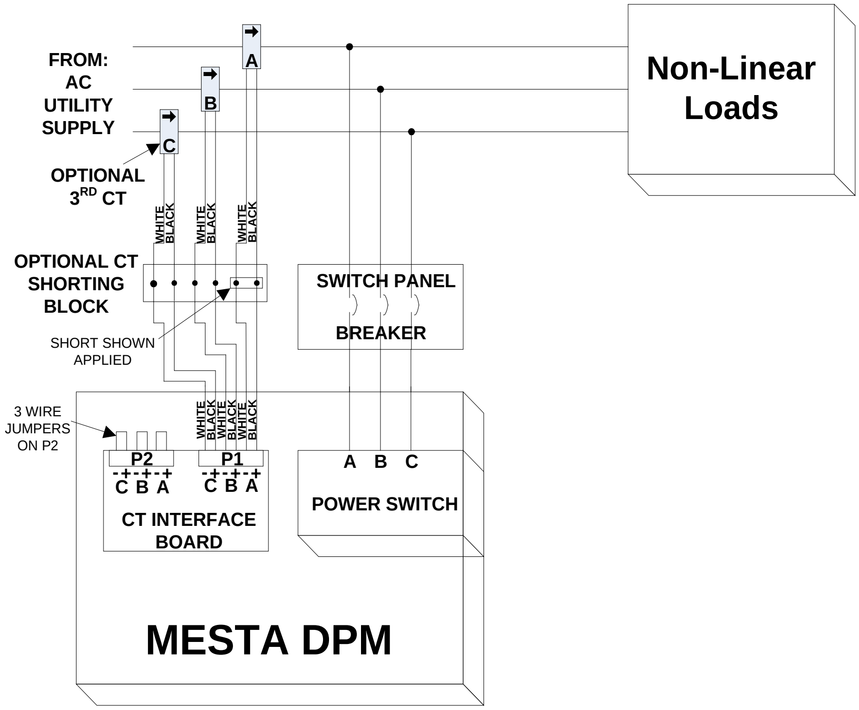


Figure 3.17: Single DPM with Line Side CTs

The most common implementation of a Mesta DPM is a single system having 2 CTs, with some systems having a 3rd CT, monitoring the "line" side current as shown in Figure 3.17. A common setup consists of the input current to a distribution panel being monitored by the CTs, with breakers, feeding both the loads and the DPM, installed in the distribution panel. This example shows CTs wired to an optional shorting block; however, CTs could also be wired directly to the CT Interface board in the DPM. Since a single DPM is employed, P2 on the CT Interface board must contain jumpers as shown.

3.4.2. SINGLE DPM MONITORING "LOAD" SIDE CURRENT

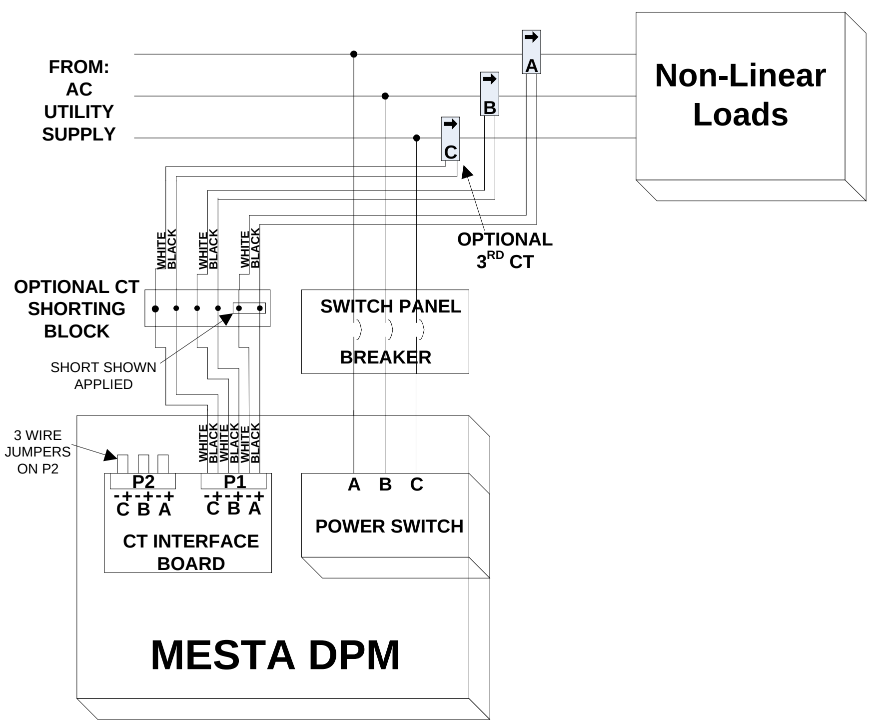


Figure 3.18: Single DPM with Load Side CTs monitoring one load

Another common implementation is a single system having 2 CTs (with an optional 3rd), monitoring the "load" side current as shown in Figure 3.18. A common setup consists of the DPM and a single load (or an entire MCC section downstream) being supplied via breakers in a distribution panel. The CTs are monitoring the current in the wires going to the load (or an entire MCC section downstream). If 2 loads exist with separate feed wires, the current going to both loads must be measured. This can be done by either routing the conductors to both loads through the set of CTs as shown in Figure 3.19, or by adding a 2nd set of CTs to monitor the current going to the 2nd load as shown in Figure 3.20. If a 2nd set of CTs is used, the current ratio of those CTs must be identical to the ratio of the first set of CTs. For example, if 1000:5 CTs are used for the first set of CTs, 1000:5 CTs must also be used for the 2nd set. The arrows on both sets of CTs must point towards the load they are monitoring. Make sure CT “A” of the 2nd set is on the same phase as CT “A” of the 1st set; and CT”B” of the 2nd set is on the same phase as CT “B” of the 1st set. If a CT “C” is present in the 1st set, there must be a CT “C” in the 2nd set measuring the same phase. A CT shorting block is now required, as both sets of CTs must be wired together into the block as shown. The connector on the CT Interface board in the DPM will not accommodate more than one wire reliably in each terminal of the P1 block. Either concept can also be used for more than 2 loads.

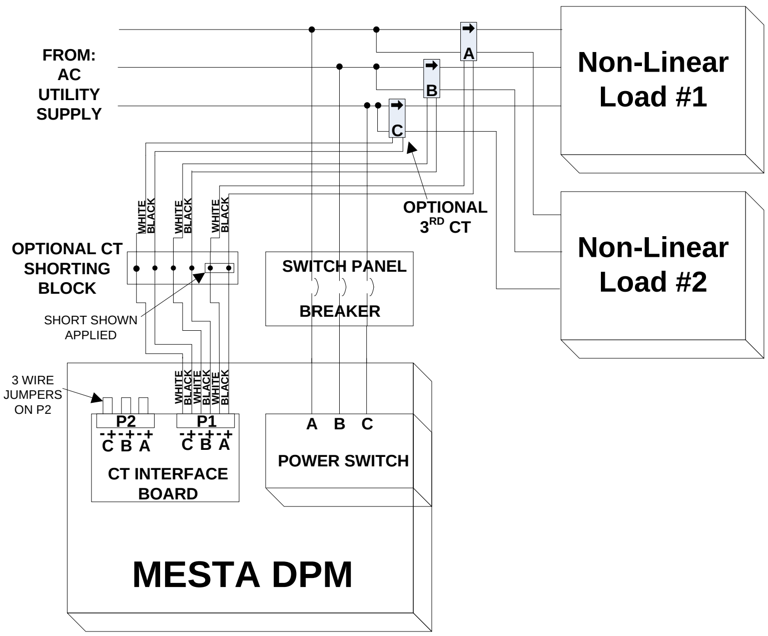


Figure 3.19: Single DPM with 1 set of Load Side CTs monitoring 2 loads

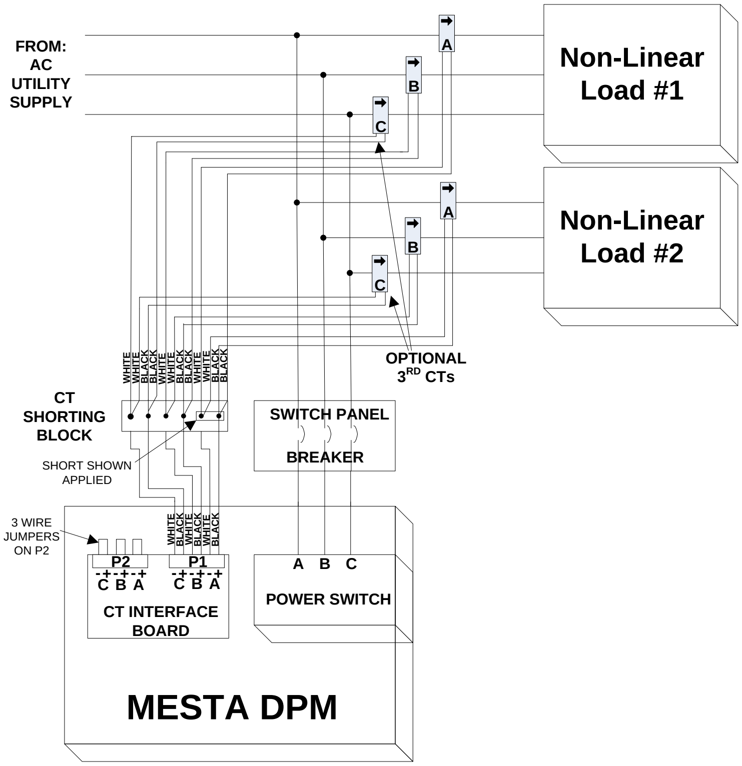


Figure 3.20: Single DPM with 2 sets of Load Side CTs monitoring 2 loads

3.4.3. PARALLELED DPMS TO CORRECT HIGHER CURRENTS

DPMs may be paralleled to increase the amount of harmonic current to be corrected. When DPMs are paralleled, the CTs must measure the “load” side current, and not the “line” side current. Figure 3.21 shows the wiring needed to parallel 2 DPMs. As can be seen, the CTs are measuring the “load” side current. The output wires of the CTs are wired to an optional CT shorting block. The shorting block is then wired to connector P1 on the CT Interface board in DPM#1 in an identical manner to when only a single DPM is used. The CT shorting block is optional; therefore the CT output wires could have been wired directly to the CT Interface board in DPM#1. The 3 jumper wires on P2 of this same board are removed. Six wires are needed to connect the 6 terminals on P2 of the DPM#1 CT Interface board with the same 6 terminals on P1 of the DPM#2 CT Interface board as shown. The A+ and A- connecting wires should be of different color (e.g. black and white as shown) and twisted together to minimize inductance and noise sensitivity. Likewise, the B+ and B- pair of wires and the C+ and C- pair of wires. Even if only 2 CTs (A and B) are used in your setup, you should wire the C+ and C- wires between DPMs in case at a later date a 3rd “C” CT is added. When done, you should have three pairs of black and white twisted wires going from P2 in DPM#1 to P1 in DPM#2. DPM#2 should have its P2 connector with the 3 jumper wires as shown.

Each DPM needs its own external breaker (if a breaker is required by code). The power wires going to each DPM are wired the same as if they were single DPMs, making sure the wire going to the left terminal inside the DPM is connected to the same phase that CT “A” is on, the wire going to the middle terminal is connected to the same phase that CT “B” is on, and the wire going to the right terminal is connected to the remaining phase. All power wires going to both DPMs must connect to the line (AC utility supply) side of where the CTs are located.

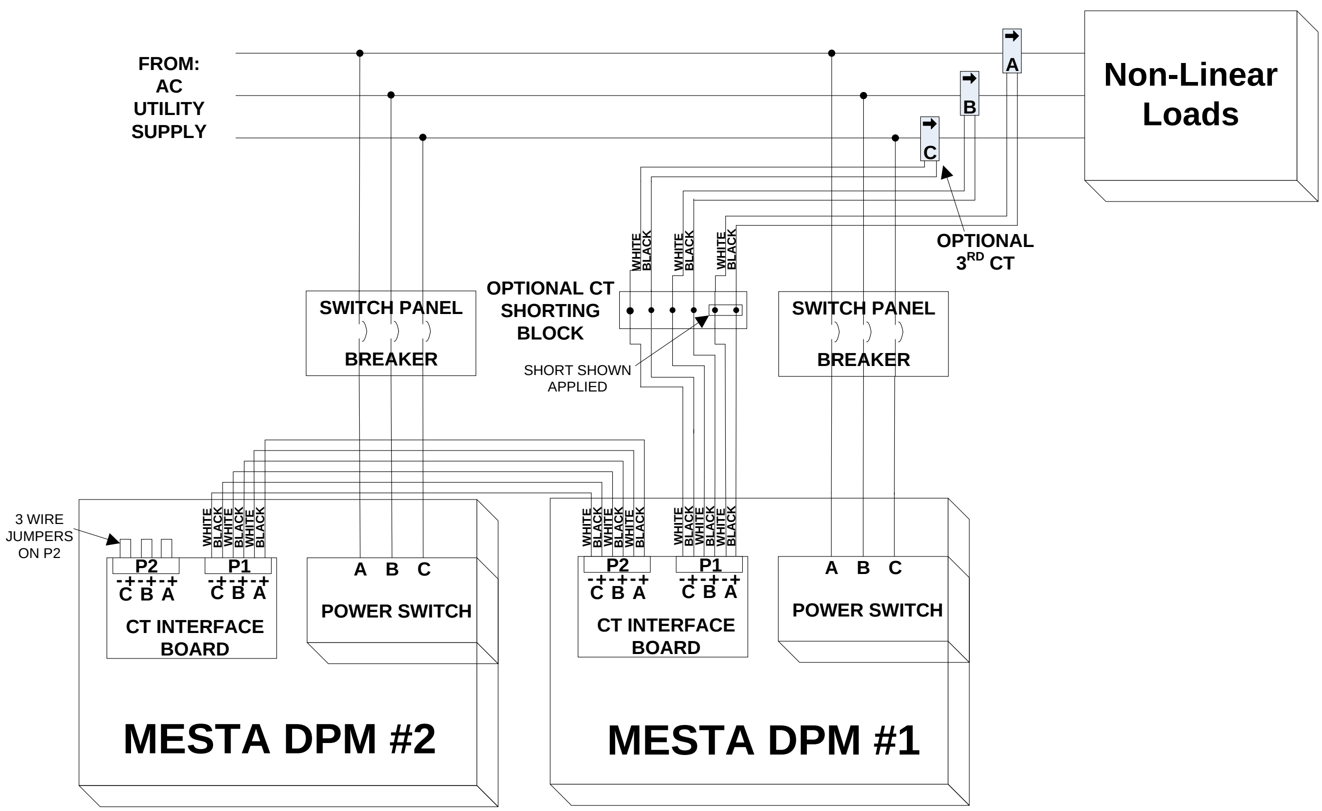


Figure 3.21: Paralleling 2 DPMs

To parallel a 3rd DPM, remove the 3 wire jumpers from P2 in DPM#2. Connect the same 6 terminals on P2 in DPM#2 to P1 in DPM#3 in the same manner that you connected P2 in DPM#1 to P1 in DPM#2. P2 in DPM#3 will now have the 3 wire jumpers shorting + to – terminals of A, B, and C. Power is connected to DPM#3 identical to how it was connected to the first two DPMs.

You could continue paralleling DPMs until the wire resistance of all of the CT runs (from CT to shorting block, from shorting block to DPM#1, from DPM#1 to DPM#2, etc.) presents too much of a load for the CTs to adequately drive. The CT Interface boards are a negligible load on the CTs compared to the wire resistance, so can be ignored. In reality room space, space for breakers in the distribution panel, etc. will probably limit the number of paralleled DPMs to some practical number.

DPMs set up to operate in parallel operate independently, and without knowledge about each other. This allows DPMs to continue operating when others in the paralleled arrangement are turned off. Since they operate without knowledge about each other, each paralleled unit must be programmed to correct the portion of the load harmonics that it is responsible for. For example, if two 300 amp systems are paralleled, each must be programmed to correct ½ of the harmonic currents in the load. Programming each DPM is done via the “%LOAD TO BE CORRECTED” parameter accessible via its front panel. See section 5.6.3 for details on setting this parameter to a value from 1 to 100%. The values put in for all of the DPMs paralleled together must sum to a value of 100. If they sum to less than 100% or more than 100% harmonics the paralleled DPMs will not correct harmonics properly.

The following equation should be used to calculate the %LOAD for each DPM that is paralleled:

$$\%LOAD = 100 * D/D\_total$$

where: D = the amp rating of that DPM and D_total = total amp rating of all DPMs paralleled.

The calculated %LOAD value is rounded off to the nearest integer. After calculating the %LOAD values for all DPMs to be paralleled, add the numbers together. If the sum is not 100%, add or subtract 1 from units (starting with the larger units) until the %LOADs sum to 100.

Example: two 300 amp and one 200 amp DPMs are to be paralleled:

1) D_total = 2*300 + 200 = 800
2) %LOAD (1st 300) = 100 * 300/800 = 37.5 which rounds to 38.
3) %LOAD (2nd 300) = 100 * 300/800 = 37.5 which rounds to 38.
4) %LOAD (200) = 100 * 200/800 = 25.
5) 38+38+25 = 101; Therefore, subtract 1 from %LOAD from 1st 300, reducing it from 38 to 37.
6) 37+38+25 = 100.
7) Program %LOAD of 37, 38, and 25 into the two 300’s and one 200 amp DPMs, respectively.

It should be noted that the Line current THD displayed on the LCD displays of all paralleled units assumes that all units are programmed with the correct %LOAD value and all are fully operational. If not, actual line current THD will be higher. If all are correctly programmed and fully operational, actual current THD will be slightly better than what is displayed.

3.4.4. USING “LINE” SIDE CTS TO PRODUCE “LOAD” SIDE CURRENTS

If you really need to measure “Load” side currents such as is the case when paralleling DPMs, but that point is either inaccessible or there are many loads requiring many sets of CTs to monitor all of them, you can instead monitor both the line current and the current from the DPMs as in the paralleled system shown in Figure 3.22. A single DPM system would never need to do this, as it is capable of operating with either line or load side CTs.

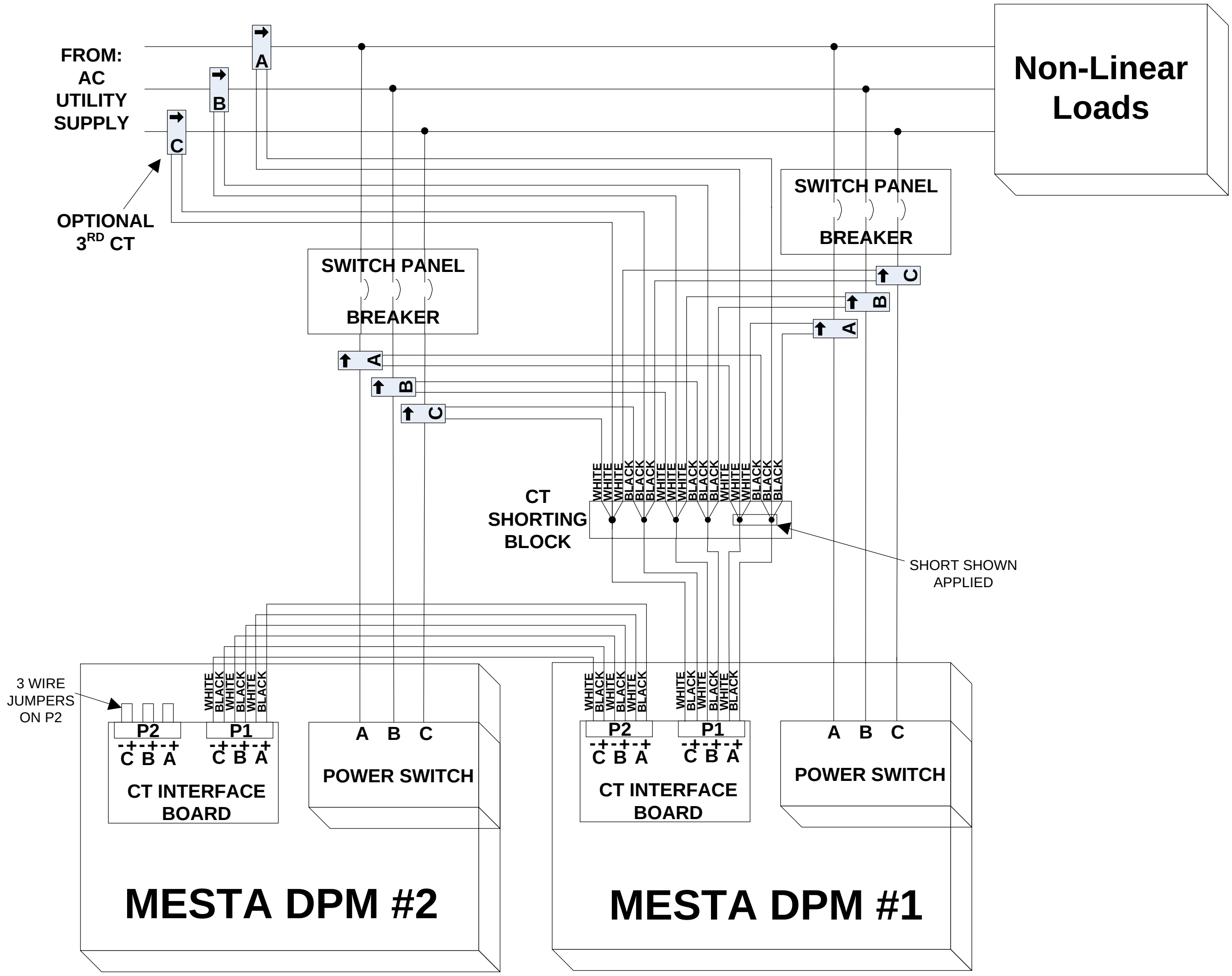


Figure 3.22 Using "Line" side CTs to produce "Load" side currents

This CT arrangement is possible because the load current is equal to the sum of the line current and the DPM currents. All of the CTs must have the same current ratio (e.g. 1000/5, etc.). The arrows on the line CTs must point towards the loads and the arrows on the DPM currents must point away from the DPMs as shown in the figure. CT "A" on the wire to each DPM must be on the wire going to the left terminal on the power switches of both DPMs and CT "A" on the line must be on the same phase coming from the utility. CT "B" on the wire to each DPM must be on the wire going to the middle terminal on the power switches of both DPMs and CT "B" on the line must be on the same phase coming from the utility. If "C" CTs are used, they must match up similarly. A CT shorting block is required to connect the output wires from all of the "A" CTs, all of the "B" CTs, and (if used) all of the "C" CTs as shown in the figure. If you can run the same phase power wires of each DPM together at some point, you could use one set of CTs to measure all of the DPM currents, thus cutting down on the number of CTs required. This arrangement will work for more than 2 paralleled DPMs as well.

3.5. OPTIONAL ADDITIONAL CONTROL WIRING

There are additional control related functions that can be externally wired to, if so desired, as an option. These optional functions are located on the Customer Interface PC Board (referred to as PC-I). Refer to the panel layout drawing for your system in Section 10 to locate this board in your system. All wiring to this board that is to leave the cabinet, should be routed either up or down the left side interior of the enclosure in order to keep it separated from the power wiring (refer to Figure 3.8 to see wiring path).

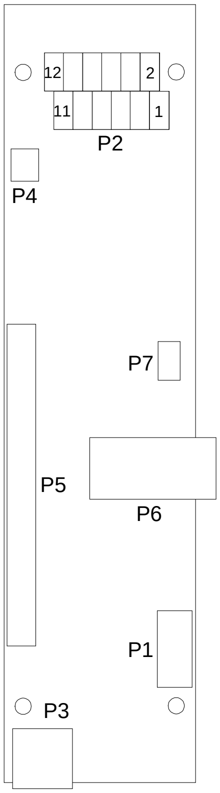


Figure 3.23: Customer Interface PC Board

The LCD front panel is wired to connectors P7 (the LCD display), P6 (Ethernet cable), and P1 (RS-232 ribbon cable) on PC-I. In systems equipped with Ethernet/IP instead of Ethernet, the P6 RJ-45 Ethernet connector is replaced with a 3 pin connector that connects to the Ethernet/IP module through a 3-wire interface, which then connects to the RJ-45 Ethernet connector on the front panel.

If one desires to route the Ethernet cable through a conduit instead of connecting to the RJ-45 on the front panel, disconnect the Ethernet cable going to P6 of PC-I (ot to the RJ-45 connector on the Ethernet/IP module if equipped for Ethernet/IP and replace it with your own Ethernet cable. For NEMA1 enclosed systems, route your Ethernet cable to either the “control” pilot holes in the top or bottom of the enclosure. Any other control related wires connecting to this board should be similarly routed.

Note that connector P3 on this PC-I board is NOT the Ethernet connection even though it, too, is an RJ-45 connector. It connects to the CT Interface Board, bringing the CT signals to the control, and is NOT compatible with Ethernet.

The following sub-sections describe additional control related signals available via the green 12 pin terminal block P2 on the Customer Interface PC Board.

3.5.1. CONTROL STATUS RELAY CONTACTS

The PC-I board has three status relays whose contacts can be accessed via the P2 terminal block. If desired, these signals can be wired to external circuitry supplied by the end user for purpose of monitoring status of the system.

- The first status relay uses pins 1 (common), 2 (normally open contact), and 3 (normally closed contact) of the connector.
- The second status relay uses pins 4 (common), 5 (normally open contact), and 6 (normally closed contact).
- The third status relay uses pins 7 (common), 8 (normally open contact), and 9 (normally closed contact).

If the unit is fully operational and correcting harmonics, the first status relay will be energized (pins 1 and 2 of the connector will be shorted, pins 1 and 3 will be open). If a diagnostic or warning condition exists, the second status relay will be energized (pins 4 and 5 of the connector will be shorted, pins 4 and 6 will be open). If the unit is operating at maximum capacity, the third status relay will be energized (pins 7 and 8 of the connector will be shorted, pins 7 and 9 will be open). The maximum rating of each contact is 0.5 amps @ 125 VAC or 1.0 amps @ 24 VDC.

3.5.2. EXTERNAL HARDWARE ENABLE

It is possible to externally enable or disable the DPM by using pins 11 and 12 of this connector. By changing the “EXTERNAL ENABLE” parameter on the touchscreen display it is possible to enable or disable the DPM by shorting or opening pins 11 and 12. In this way an external processor or signal can enable or disable the DPM system if this function is required. Refer to section 5.6 for details on how to change this parameter. Connect either a dry contact (relay contacts or manual switch contacts) across pins 11 and 12.

4. STARTING UP THE UNIT FOR THE FIRST TIME

Starting up the Mesta Digital Power Manager (DPM) for the first time requires a simple procedure to be followed to verify that the unit has been installed correctly. Once all the power and CT (current transformer) sensor connections have been made, as described in the previous section, and the electrical service re-established, the DPM can be turned on and tested for proper installation. For complete testing, a load should be present in the circuit that the DPM is correcting harmonics for.

For maximum accuracy, the load used during this test should predominately be 3-phase with a high linear power factor. Moderately to heavily loaded AC motor drives are the best loads to perform this test with as they will appear as only slightly inductive. Highly capacitive or inductive loads should be eliminated or minimized. Load must result in phase shifts between currents and corresponding line-to-neutral voltages between -10 degrees (not too capacitive) and +30 degrees (not too inductive). Loads (if they represent a sizeable portion of the overall load) that should be taken off line during the testing of the CTs are as follows:

1) Motors driven directly from the line (with or without soft-starters) – May appear too inductive, especially if motor is lightly loaded.
2) Equipment with EMC filters, unless being operated at moderate load – May appear too capacitive or inductive.
3) AC Motor drives operating at very light loads.
4) DC Motor drives (or other phase control input equipment) that is not at least moderately loaded – May appear too inductive.

These test results assume that the CTs are at least on different phases. Erroneously putting more than 1 CT on the same phase is not covered.

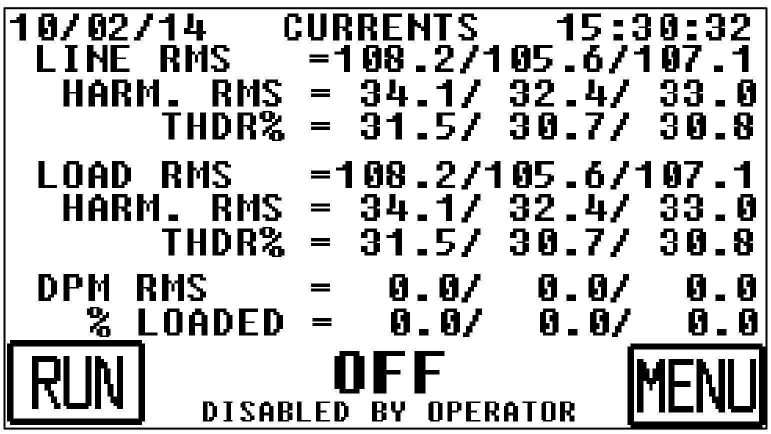
It is still possible to partially test the installation with insufficient load present. For this procedure, go to section 4.4.

Throughout the following sections, simulated displays of a 100 amp DPM are shown as examples. The displays you observe with your unit may differ somewhat.

4.1. TURNING ON THE UNIT TO CHECK FOR CORRECT CT PLACEMENT

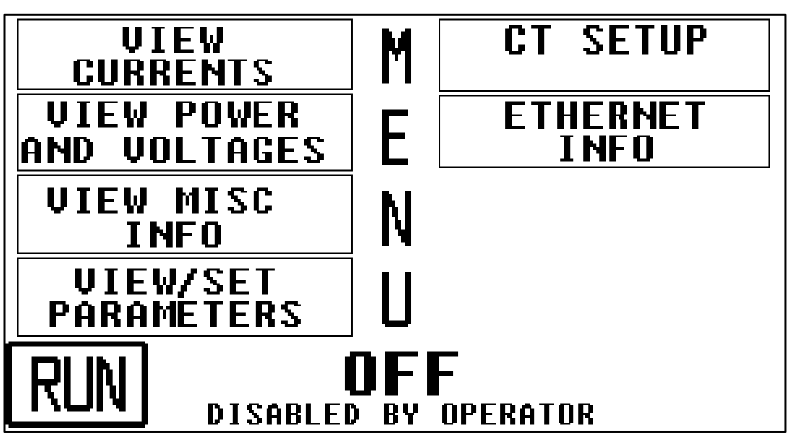
To energize the unit, switch on the Disconnect switch to the DPM. If the power is connected correctly, the touch screen display will turn on. It is assumed that you are familiar with the Touch Screen Display. Please refer to section 5 for additional details on using the display. While the display is booting up, the following splash screen will be displayed. The system is shipped in the disabled state, so even though power is applied, the DPM will not start correcting harmonics – only the controls will be powered. To enable the system, you will be instructed later in this procedure to RUN (enable) the system. Once, running, the system can be STOPPED (disabled) in a similar manner. If the power switch on the unit is powered off, whatever state the system is in, enabled or disabled, when the system is powered off, is what the system will be in the next time power again is supplied to the unit. For this reason, it is important that if the system either does not successfully pass this test or you do not wish the system to operate yet, one should make sure the system is disabled (using the STOP function) prior to turning off the power switch.

Do not press RUN when powering on the unit for the first time. After 5 seconds the “CURRENTS” display page will appear. Pressing the STOP button when the splash screen is displayed will immediately send you to the “CURRENTS” display instead of waiting the 5 seconds.

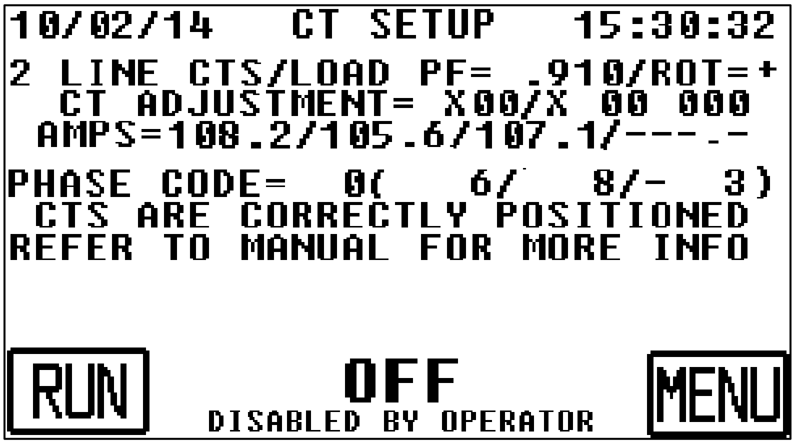


If the status shown in the center bottom of this display does not show OFF – DISABLED BY OPERATOR, press the STOP button displayed in the bottom left corner of the display, followed by an acknowledgement of the STOP button in the display that follows to disable the DPM from operating. After pressing the STOP button in the two displays, you will be returned to the “CURRENTS” display and the OFF – DISABLED BY OPERATOR status should be displayed.

We will next want to go to the “CT SETUP” screen on the display to check for proper CT installation. First, press the “MENU” button located in the extreme bottom right of the display. The main menu page will be displayed:



Press the “CT SETUP” button from the menu to view the “CT SETUP” display:



The first line of this display, displays the “CT SETUP” title along with the present date and time.

The 2nd line indicates how many CTs the system is programmed for (2 or 3), whether the system is programmed for LINE or LOAD side CTs, the present power factor of the load, and the phase rotation (“ROT=” + for ABC and – for CBA phase rotation). Verify that the number of CTs indicated and the position (LINE or LOAD) agrees with the number of physical CTs and location of those CTs you have wired into your system. If not, go to section 5.6 of this manual to correct these values. The power factor of the load (“LOAD PF”) should ideally be a positive number between about 0.7 and .999. If it is not, it is probably due to mis-positioned CTs; however, don’t worry about that at this time. The phase rotation is only important for advanced diagnosing, as the Mesta DPM automatically adjusts for either phase rotation. This example shows that the DPM is set up for 2 CTs located on the LINE side. Also, a power factor of 0.910 is indicated with a positive phase rotation.

The 3rd line titled “CT ADJUSTMENT” indicates any “programmed” adjustment that the DPM has been set up for to compensate for CTs that are not placed correctly. The firmware can allow for mis-positioned CTs to be compensated for without actually moving the CTs to their correct positions.

The 4th line shows how much current (AMPS) is presently being drawn by the load. The first 3 numbers, separated by “/” characters are the 3 phases A, B, and C. The 4th number indicates the neutral current. The neutral current is calculated by the DPM for systems that have 3 CTs. It is not possible to calculate the neutral current for 2 CT systems, so dashes will be displayed for such systems.

The first number in the 5th line is the “Phase code”. This value will be “0” if your CTs are installed correctly. A non-zero code between -28 and 43 indicates the CTs are not on the correct phases and/or are in the wrong direction. Any other code indicates the system is unable to determine the status of the CTs. Following the “Phase code”, are 3 values enclosed in braces “(“ and “)”. These 3 values are the phase shift (in degrees) between phase A, B, and C voltages and currents. When the CTs are positioned on the correct phases and in the correct direction, these values should all be between -10 and +30 degrees. If not, either a CT is in the wrong position or the load is too capacitive or inductive to easily evaluate the CT positions. Also, in order to determine the phase shift between the voltage and current for each phase, there must be some minimal load current present. If there is insufficient load current on any phase, dashes will be displayed for all phases that are not reading enough current. If you think you have load current, but dashes are displayed, one possibility is that you are using shorting blocks to wire your CTs to and have inadvertently left a short in place across one or more of the CTs. Also, if 3 CTs are indicated in the 2nd line and the 3rd phase shift number is the only value displaying dashes, check to make sure your system does indeed have 3 CTs.

Depending on the value of the “Phase code” in line 5, a status message will be displayed on the 6^{th} line of this display. Table 4.1 contains the possible status messages, their explanation, and action you need to take.

CT SETUP Message	**Explanation and Action to Take**
LOAD CURRENT TOO LOW	Insufficient load current to determine if CTs are placed correctly. Continue with this present section.
LOAD TOO CAPACITIVE/INDUCTIVE	Load current is high enough; however, load is either too capacitive or inductive to correctly determine if CTs are placed correctly. Continue with this present section.
CTS ARE CORRECTLY POSITIONED	**CTs are on the correct phases and in the correct direction. CTs are correctly configured, go to section 4.3.**
CTS ARE CORRECTLY ADJUSTED	**CTs are not on the correct phases or in the correct direction; however, a programmed “CT ADJUSTMENT” has been entered that corrects the situation. CTs are correctly configured, go to section 4.3.**
ERRONEOUS PHASE CODE	Should not see this message. Stop and contact factory if you do see it.
2 CTS ON A&C. MUST BE ON A&B	When using 2 CTs, they must be located on phases A and B. Go to section 4.2 to correct.
2 CTS ON B&C. MUST BE ON A&B	When using 2 CTs, they must be located on phases A and B. Go to section 4.2 to correct.
FIX CTS OR ADJUST HERE	CTs are not on the correct phases and/or are in the wrong direction. Go to section 4.2 to correct.

Table 4.1: CT SETUP Status Messages

If you observe either of the first 2 messages in this table, you can NOT proceed to the next sections (4.2 or 4.3) of this CT test until you remedy the situation.

If you see the “LOAD CURRENT TOO LOW” message, the CTs are not sensing enough current on one or more phases to determine the phase shift between the voltage and current. The 3 numbers enclosed in braces “(“ and “)” in the 5^{th} line will have dashes instead of the angular phase shift in degrees for all phases that are not sensing sufficient current. If your load is very small, you will have this situation. The line titled “AMPS” will tell you the current being sensed by the CTs. If you know that the current should be much higher than any of these values, you may have a problem with your CTs. If such is the case check for the following:

- If you have wired your CTs into shorting blocks, you may have inadvertently left one or more CTs shorted.
- If you have 3 CTs indicated on the 2^{nd} line of this display, but only have 2 physical CTs wired into your system, you will either need to add a 3^{rd} physical CT or change the DPM setting to 2 CTs (see section 5.6 for details).
- If your CTs are NOT installed to properly read the LINE or LOAD current, you will need to correct this. WARNING: if the CTs are installed around a wire with current flowing in it, but the output wires of the CTs are not properly connected, do NOT touch the CT output wires until all power is shut off to the loads and no current is flowing in the wire being measured by the CT; otherwise, deadly voltage may be present on those output wires.

If you confirm that the reason for not reading much current is due to there not being much load operating, increase the load. If the load cannot yet be increased because it is not yet operational, you will not be able to continue with this test. Instead, go to section 4.4 to perform a less comprehensive “No load” test.

If you see the “LOAD TOO CAPACITIVE/INDUCTIVE” message displayed, your load is either too capacitive or inductive for the DPM to accurately determine if the CTs are correctly positioned. Determine the loads that are presently running. If possible, remove any that might be highly capacitive or inductive (see beginning of section 4 to identify such loads). If removing such loads is not possible, consult Mesta Electronics for additional assistance. Take a picture of the CT SETUP display while it is showing this message for the purpose of emailing the picture to Mesta for evaluation.

4.2. CORRECTING CTS THAT ARE INCORRECTLY INSTALLED

If the status message on the CT SETUP display is either “2 CTS ON A&C. MUST BE ON A&B”, “2 CTS ON B&C, MUST BE ON A&B”, or “FIX CTS OR ADJUST HERE” message, the CTs have been installed incorrectly on the wrong phases and/or in the wrong direction. If you have a system configured for 2 CTs, use Table 4.2 to determine how your CTs are incorrectly installed. If you have a system configured for 3 CTs, use Table 4.3 to determine how your CTs are incorrectly installed. The PHASE CODE value on the 5th line of the CT SETUP display will be a number ranging from -28 to 43. This number is referred to as your “Phase Code”. This number corresponds to how your CTs are actually positioned. Go down the “Phase Code” column in the applicable table until you find the number that matches the number observed on the CT SETUP display. There are 3 columns in the table labeled A, B, and C under the title “LINE”. On the line of the table having your “Phase Code” will be letters A, B, or C (C is only present in 3 CT systems) in these columns. These letters may or may not have a “-“ minus sign after them. These letters refer to CTs “A”, “B”, and “C”. A “-“ after the letter indicates the CT is installed backwards. For the DPM to work properly, you need to have an “A” in the “LINE A” column, a “B” in the “LINE B” column, and (for 3 CT systems only) a “C” in the “LINE C” column, with no “-“ minus signs. This only occurs in the ***BOLDED, ITALISIZED*** line when the Phase Code is 0.

For all other cases, either the CTs or the lines must be changed so that the CTs and the lines match each other. There are 3 different courses of action that can be taken to achieve this correction. Each is described in the 3 subsections that follow. Read all 3 options, and select the option that is best for your situation. These 3 subsections are followed by a 4th subsection with some examples. After you have corrected your CT situation and now observe the message “CTS ARE CORRECTLY POSITIONED” or “CTS ARE CORRECTLY ADJUSTED”, proceed to section 4.3.

4.2.1. CORRECTING CT PLACEMENT BY PHYSICALLY MOVING THE CTS

The column titled “Corrective Action to move CTs to match Power Wires” in the tables indicates how to move the CTs to fix the problem. If your CTs are accessible and fairly easy to move safely to the correct position, then choose that route. If the CTs are not physically accessible or it is not practical to physically move the CTs, one of the other 2 options may make more sense.

If you have paralleled DPMs, choosing this method of correcting the CTs may only involve moving the 2 or 3 CTs. Selecting either of the remaining 2 options requires corrections done to all of the DPMs that are paralleled.

4.2.2. CORRECTING CT PLACEMENT BY MOVING THE POWER WIRES TO THE DPM

Another column titled “Or Corrective Action to move Power Wires to match CTs” indicates how to move the power wires coming into the DPM to fix the problem. When moving the power wire connections in the DPM, wires 1, 2, and 3 in the charts refer to the wires connected to the left, center, and right power switch terminals (or fuseblocks). The letters A, B, and C in the charts refer to the left, center, and right power switch terminals (or fuseblocks). Prior to any wire movements, wire 1 is connected to A, wire 2 is connected to B, and wire 3 is connected to C. The wire movement instructions in the tables will result in 2 or 3 wires being moved to different terminals.

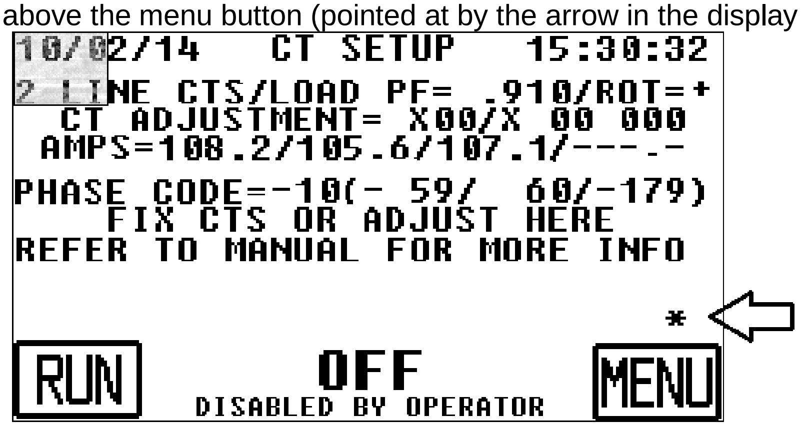
If the power wires coming into the DPM’s power switch terminals (or fuseblocks) are easier to change than physically moving the CTs, you may want to select this option. Prior to moving the power wires, remove voltage from those wires. Note that switching the power wire connections cannot fix a CT that is installed backwards. To fix a backwards CT, the CT must be removed from the wire and reinstalled in the opposite direction, or the output wires of the CT must be reversed, or the “AUTO ADJUST” function on the CT SETUP display described in the next subsection can be used. On Mesta supplied CTs, reversing the output wires of the CT means swapping the black and white wires so the white wire becomes the positive (+) wire and the black wire becomes the negative (-) wire. **WARNING: DO NOT DISCONNECT CT OUTPUT WIRES WHILE CURRENT IS FLOWING IN THE WIRE MONITORED BY THE CT. DOING SO COULD RESULT IN LETHAL VOLTAGE AT THE CT OUTPUT WIRES. LINE VOLTAGE MUST BE REMOVED FROM THE CIRCUIT MONITORED BY THE CT PRIOR TO DISCONNECTING THE CT OUTPUT WIRES.** (Exception: if the CT output wires are brought to a shorting block, a short may be applied to that block to short both CT output wires together. Then the 2 wires for that CT connecting the shorting block to the DPM's CT Interface board may be swapped at the DPM's CT Interface board. Once the wires are re-secured, the short must be removed from the block.)

4.2.3. CORRECTING CT PLACEMENT VIA THE CT SETUP DISPLAY

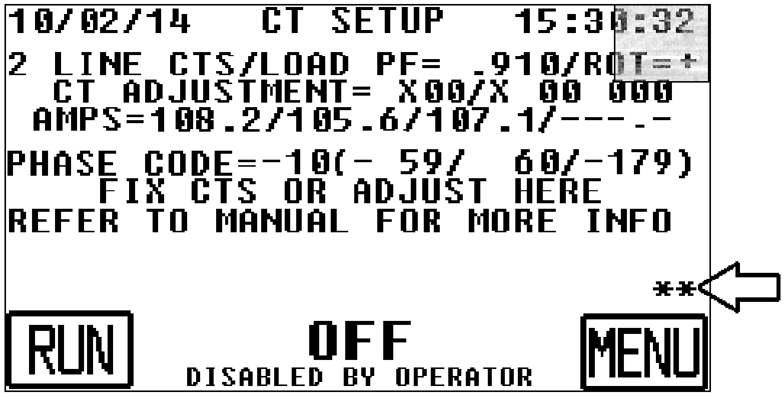
This 3rd method will normally be the easiest of the 3 methods to correct incorrectly placed CTs. If your setup uses 3 CTs, you can use this method to correct all cases. If the message "FIX CTS OR ADJUST HERE" is displayed on the 6th line of the CT SETUP display, you can fix the problem from this display screen. If your setup uses 2 CTs, you may instead observe the message "2 CTS ON A&C. MUST BE ON A&B" or "2 CTS ON B&C. MUST BE ON A&B". When using 2 CTs, the CTs must be located on the 2 phases that connect to the left and center terminal of your power switch and/or fuseblock in the DPM. These 2 messages indicate that is not your case. You must first move the power wires as indicated using the method in section 4.2.2. If that corrects your CT problem, you are done. If that results in still having a problem (due to a CT being installed backwards), but now observe the message "FIX CTS OR ADJUST HERE", you can finish fixing the problem using the method described in this section.

This function is "hidden" to protect against someone unauthorized from activating it. This function becomes viewable, by pressing 3 areas of the display in a particular order as follows (you have up to 3 seconds between successive presses):

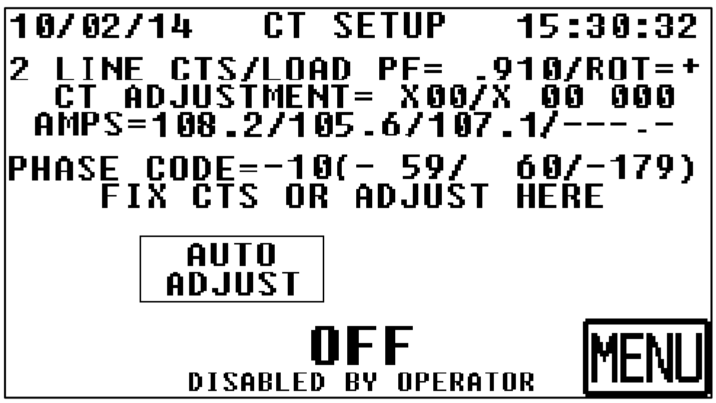
1) Press the upper left corner of the display (anywhere within ½" of the upper left corner of the display as shown by the shaded square in the following display example) until an "*" appears just above the menu button (pointed at by the arrow in the display example):



2) Next, press the upper right corner of the display (as shown by the shaded square in the following display example). If you press the correct area, a 2nd "*" will appear next to the 1st (pointed at by the arrow in the display example). If instead, the first "*" disappears, go back to step 1. If the first "*" stays displayed, but no 2nd "*" appears you may not have pressed hard enough – therefore, press the upper right corner of the display again.



3) Once you have 2 "*" characters, press the upper left corner of the display again. If you hit the correct spot, the "*" characters will disappear, and within about 1 second, the "REFER TO MANUAL FOR MORE INFO" message and RUN button will disappear. If this doesn't happen, but the two "*" characters disappear, you must have pressed an area outside of the upper left corner – you will need to go back to step 1 to start over. If both "*" characters remain displayed, you did not press hard enough – therefore, press the upper left corner of the display again. The resultant display appears as follows:



Press the AUTO ADJUST button. Within a second or two, the PHASE CODE will change to 0 and the "FIX CTS OR ADJUST HERE" message will change to "CTS ARE CORRECTLY ADJUSTED". You will also notice that the CT ADJUSTMENT value now has some 1's in it in place of the 0's. Also the AUTO ADJUST button will be replaced by a REMOVE ADJUST button. Pressing this button will remove the adjustment you made. If in the future you move your CTs or power wires to your DPM and now have the wrong adjustment, you will first have to remove the adjustment by pressing the REMOVE ADJUST button, and then if a different adjustment is needed, press the AUTO ADJUST button.

The only downfall with using this method of CT correction vs. the other methods is if for some reason you need to change the control board in your system, you will need to go through this procedure again as this information is stored in non-volatile memory on the control board.

Table 4.2: Incorrect CT Placement and Corrective Action Needed for a 2 CT System

Phase Code	LINE A	LINE B	LINE C	Corrective Action to move CTs to match Power Wires	Or Corrective Action to move Power Wires to match CTs (See Note 1)
-28	B		A	Move “B” CT to wire without a CT, then move “A” CT to wire that “B” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-24		B	A	Move “A” CT to wire without a CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-22	B-		A	Move “B” CT (and flip direction) to wire without a CT, then move “A” CT to wire that “B” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-18		B-	A	Move “A” CT to wire without a CT, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-16	B	A-		Swap wires that “A” and “B” CTs are on and flip direction of “A” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-14		A-	B-	Move “A” CT (and flip direction) to wire without a CT, then move “B” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-10	B-	A-		Swap wires that “A” and “B” CTs are on and flip direction of both CTs.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-8		A-	B	Move “A” CT (and flip direction) to wire without a CT, then move “B” CT to wire that “A” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-2	A		B-	Move “B” CT (and flip direction) to wire without a CT.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
0	***A***	***B***		***CORRECT INSTALLATION***	***CORRECT INSTALLATION***
4	A		B	Move “B” CT to wire without a CT.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
6	A	B-		Flip direction of “B” CT.	No power wire changes
8	B		A-	Move “B” CT to wire without a CT, then move “A” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
12		B	A-	Move “A” CT (and flip direction) to wire without a CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
14	B-		A-	Move “B” CT (and flip direction) to wire without a CT, then move “A” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
18		B-	A-	Move “A” CT (and flip direction) to wire without a CT, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
20	B	A		Swap wires that “A” and “B” CTs are on.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
22		A	B-	Move “A” CT to wire without a CT, then move “B” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
26	B-	A		Swap wires that “A” and “B” CTs are on and flip direction of “B” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
28		A	B	Move “A” CT to wire without a CT, then move “B” CT to wire that “A” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
34	A-		B-	Flip direction of “A” CT, then move “B” CT (and flip direction) to wire without a CT.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
36	A-	B		Flip direction of “A” CT.	No power wire changes
40	A-		B	Flip direction of “A” CT, then move “B” CT to wire without a CT.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
42	A-	B-		Flip direction of both “A” and “B” CTs.	No power wire changes

Note 1: If Power wires are being moved to correct the incorrect CT installation and either (or both) of the letters “A” and “B” in the LINE columns have a “-“ sign after the letter, that CT is in the wrong direction. Besides moving the power wires as indicated, the direction of that CT will have to be fixed using one of the three methods described in section 4.2.2.

Table 4.3: Incorrect CT Placement and Corrective Action for a 3 CT System (page 1 of 2)

Phase Code	LINE			Corrective Action to move CTs to match Power Wires	Or Corrective Action to move Power Wires to match CTs (See Note 1)
	A	**B**	**C**		
-28	B	C	A	Move “B” CT to wire that “C” CT is on, then move “A” CT to wire that “B” CT was previously on, then move “C” CT to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-27	B	C-	A	Move “B” CT to wire that “C” CT is on, then move “A” CT to wire that “B” CT was previously on, then move “C” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-24	C-	B	A	Swap wires that “A” and “C” CTs are on, flipping direction of “C”.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-23	C	B	A	Swap wires that “A” and “B” CTs are on.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-22	B-	C	A	Move “B” CT (and flip direction) to wire without a CT, then move “A” CT to wire that “B” CT was previously on, then move “C” CT to wire that “A” CT was previously on..	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-21	B-	C-	A	Move “B” CT (and flip direction) to wire without a CT, then move “A” CT to wire that “B” CT was previously on, then move “C” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
-18	C-	B-	A	Swap wires that “A” and “C” CTs are on, flipping direction of “C” CT, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-17	C	B-	A	Swap wires that “A” and “C” CTs are on, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
-16	B	A-	C	Swap wires that “A” and “B” CTs are on, flipping direction of “A”.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-15	B	A-	C-	Swap wires that “A” and “B” CTs are on, flipping direction of “A”, then flip direction of “C” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-14	C-	A-	B-	Move “A” CT (and flip direction) to wire that “C” CT is on, then move “B” CT (and flip direction) to wire that “A” CT was previously on, then move “C” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-13	C	A-	B-	Move “A” CT (and flip direction) to wire that “C” CT is on, then move “B” CT (and flip direction) to wire that “A” CT was previously on, then move “C” CT to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-10	B-	A-	C	Swap wires that “A” and “B” CTs are on and flip direction of both CTs.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-9	B-	A-	C-	Swap wires that “A” and “B” CTs are on and flip direction of both CTs, then flip direction of “C” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
-8	C-	A-	B	Move “A” CT (and flip direction) to wire that “C” CT is on, then move “B” CT to wire that “A” CT was previously on, then move “C” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-7	C	A-	B	Move “A” CT (and flip direction) to wire that “C” CT is on, then move “B” CT to wire that “A” CT was previously on, then move “C” CT to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
-2	A	C	B-	Swap wires that “B” and “C” CTs are on, flipping direction of “B”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
-1	A	C-	B-	Swap wires that “B” and “C” are on, flipping direction of both “B” and “C”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
0	***A***	***B***	***C***	***CORRECT INSTALLATION***	***CORRECT INSTALLATION***
1	A	B	C-	Flip direction of “C” CT.	No power wire changes
4	A	C	B	Swap wires that “B” and “C” CTs are on.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C
5	A	C-	B	Swap wires that “B” and “C” CTs are on, flipping direction of “C”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C
6	A	B-	C	Flip direction of “B” CT.	No power wire changes
7	A	B-	C-	Flip direction of both “B” and “C” CTs.	No power wire changes

Note 1: If Power wires are being moved to correct the incorrect CT installation and either (or both) of the letters “A” and “B” in the LINE columns have a “-“ sign after the letter, that CT is in the wrong direction. Besides moving the power wires as indicated, the direction of that CT will have to be fixed using one of the three methods described in section 4.2.2.

Possible CT Placement and Corrective Action for a 3 CT System (page 2 of 2)

Phase Code	LINE A	LINE B	LINE C	Corrective Action to move CTs to match Power Wires	Or Corrective Action to move Power Wires to match CTs (See Note 1)
8	B	C	A-	Move “B” CT to wire that “C” CT is on, then move “A” CT (and flip direction) to wire that “B” CT was previously on, then move “C” CT to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
9	B	C-	A-	Move “B” CT to wire that “C” CT is on, then move “A” CT (and flip direction) to wire that “B” CT was previously on, then move “C” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
12	C-	B	A-	Swap wires that “A” and “C” CTs are on, flipping direction of both “A” and “C” CTs.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
13	C	B	A-	Swap wires that “A” and “C” CTs are on, flipping direction of “A” .	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
14	B-	C	A-	Move “B” CT (and flip direction) to wire that “C” CT is on, then move “A” CT (and flip direction) to wire that “B” CT was previously on, then move “C” CT to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
15	B-	C-	A-	Move “B” CT (and flip direction) to wire that “C” CT is on, then move “A” CT (and flip direction) to wire that “B” CT was previously on, then move “C” CT (and flip direction) to wire that “A” CT was previously on.	Move wire 3 from C to A. Move wire 1 from A to B. Move wire 2 from B to C.
18	C-	B-	A-	Swap wires that “A” and “C” CTs are on, flipping direction of both “A” and “C” CTs, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
19	C	B-	A-	Swap wires that “A” and “C” CTs are on, flipping direction of “A” CT, then flip direction of “B” CT.	Exchange wires 1 and 3, so 3 goes to A and 1 goes to C.
20	B	A	C	Swap wires that “A” and “B” CTs are on.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
21	B	A	C-	Swap wires that “A” and “B” CTs are on, then flip direction of “C” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
22	C-	A	B-	Move “A” CT to wire that “C” CT is on, then move “B” CT (and flip direction) to wire that “A” CT was previously on, then move “C” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
23	C	A	B-	Move “A” CT to wire that “C” CT is on, then move “B” CT (and flip direction) to wire that “A” CT was previously on, then move “C” CT to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
26	B-	A	C	Swap wires that “A” and “B” CTs are on, flipping direction of “B” .	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
27	B-	A	C-	Swap wires that “A” and “B” CTs are on and flip direction of “B” CT, then flip direction of “C” CT.	Exchange wires 1 and 2, so 2 goes to A and 1 goes to B.
28	C-	A	B	Move “A” CT to wire that “C” CT is on, then move “B” CT to wire that “A” CT was previously on, then move “C” CT (and flip direction) to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
29	C	A	B	Move “A” CT to wire that “C” CT is on, then move “B” CT to wire that “A” CT was previously on, then move “C” CT to wire that “B” CT was previously on.	Move wire 2 from B to A. Move wire 3 from C to B. Move wire 1 from A to C.
34	A-	C	B-	Flip direction of “A” CT, then swap wires that “B” and “C” CTs are on, flipping direction of “B”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
35	A-	C-	B-	Flip direction of “A” CT, then swap wires that “B” and “C” CTs are on, flipping direction of both “B” and “C”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
36	A-	B	C	Flip direction of “A” CT.	No power wire changes
37	A-	B	C-	Flip direction of both “A” and “C” CTs.	No power wire changes
40	A-	C	B	Flip direction of “A” CT, then swap wires that “B” and “C” CTs are on.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
41	A-	C-	B	Flip direction of “A” CT, then swap wires that “B” and “C” CTs are on, flipping direction of “C”.	Exchange wires 2 and 3, so 3 goes to B and 2 goes to C.
42	A-	B-	C	Flip direction of both “A” and “B” CTs.	No power wire changes
43	A-	B-	C-	Flip direction of all 3 CTs.	No power wire changes

Note 1: If Power wires are being moved to correct the incorrect CT installation and either (or both) of the letters “A” and “B” in the LINE columns have a “-“ sign after the letter, that CT is in the wrong direction. Besides moving the power wires as indicated, the direction of that CT will have to be fixed using one of the three methods described in section 4.2.2.

4.2.4. EXAMPLES OF CORRECTING CT PROBLEMS

Following are a few examples of CTs that are not correctly positioned that must be fixed:

Example #1:

A Phase Code of 4 is observed on the CT SETUP display for a system with 2 CTs. “2 CTS ON A&C. MUST BE ON A&B” message will also be displayed on the CT SETUP display. Since this system has 2 CTs, Table 4.2 is used to determine what the problem is and how to correct the problem. We first go down the Phase Code column until we locate the Phase Code value of 4. We then look at the 3 LINE columns A, B, and C and find that CT “A” is correctly in column A, but CT “B” is in column C instead of column B. We have 2 options to correct the situation. We could move CT “B” from where it is to the wire that does not have a CT presently on it as instructed in the “Corrective Action to move CTs to match Power Wires” column or we could remove power from the power wires coming into the DPM, then swap power wires 2 & 3 coming into the DPM’s power switch (or power fuseblock) as instructed in the “Or Corrective Action to move Power Wires to match CTs” column. If the CTs are accessible, we could select to move the CT. However, if the CTs are not accessible or it is very difficult to move the CT (possibly power to the entire MCC must be shut down or there is not enough room around the other wire for the CT, we may instead opt for swapping the power wires coming into the DPM. If so, assign the numbers 1, 2, and 3, to the wires coming into the left (A), center (B), and right (C) terminals, respectively, of either the DPM’s input power switch or the DPM’s input power fuse block. Swapping wires 2 and 3 at either the power switch or the fuse block so that wire 2 now connects to the right (C) terminal and wire 3 now connects to the middle (B) terminal will correct the problem.

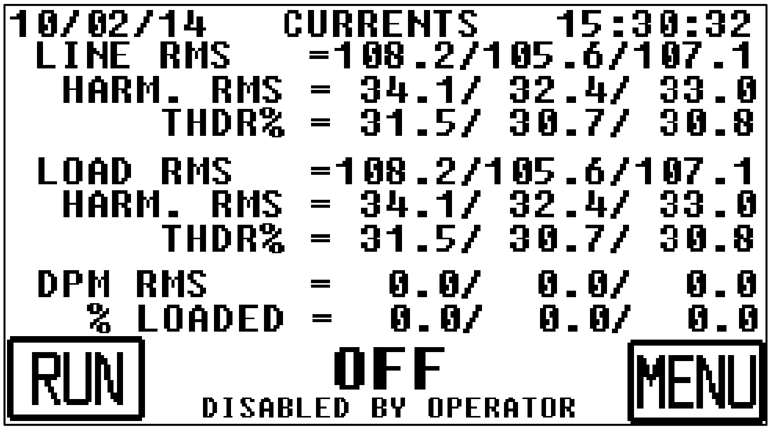
Example #2:

A Phase Code of 40 is observed on the CT SETUP display for a system with 3 CTs. “FIX CTS OR ADJUST HERE” message will also be displayed on the CT SETUP display. Since this system has 3 CTs, Table 4.3 is used to determine what the problem is and how to correct the problem. We first go down the Phase Code column until we locate the Phase Code value of 40. This table occupies 2 pages, and we find the value of 40 on the 2nd page. A-, C, and B are listed in the 3 LINE columns A, B, and C. This indicates that CT “A” is correctly installed on the correct line, but the “-“ sign indicates it is installed backwards. CT “B” and CT “C” are installed on the opposite lines, but since no “-“ sign exists, they are in the correct direction. If the CTs are easily accessible and can safely be removed and installed on each other’s line, we could opt for this solution that is given in the “Corrective Action to move CTs to match Power Wires” column. We would also need to remove CT “A” from its line, and reinstall it in the opposite direction. However, it the CTs cannot be easily or safely moved, we could opt for the solution given in the “Or Corrective Action to move Power Wires to match CTs” column. This solution requires the same swapping of wires that was done in Example 1, after power is removed, so that wire 2 is moved to the right (C) power terminal of the power switch of fuseblock and wire 3 is moved to the middle (B) terminal. We will also have to correct for CT “A” being installed backwards by swapping the white and black wires from CT “A” at the CT Interface board in the DPM**. WARNING: DO NOT DISCONNECT CT OUTPUT WIRES WHILE CURRENT IS FLOWING IN THE WIRE MONITORED BY THE CT. DOING SO COULD RESULT IN LETHAL VOLTAGE AT THE CT OUTPUT WIRES. LINE VOLTAGE MUST BE REMOVED FROM THE CIRCUIT MONITORED BY THE CT PRIOR TO DISCONNECTING THE CT OUTPUT WIRES.** (Exception: if the CT output wires are brought to a shorting block, a short may be applied to that block to short both CT output wires together. Then the 2 wires for that CT connecting the shorting block to the DPM’s CT Interface board may be swapped at the DPM’s CT Interface board. Once the wires are re-secured, the short must be removed from the block.

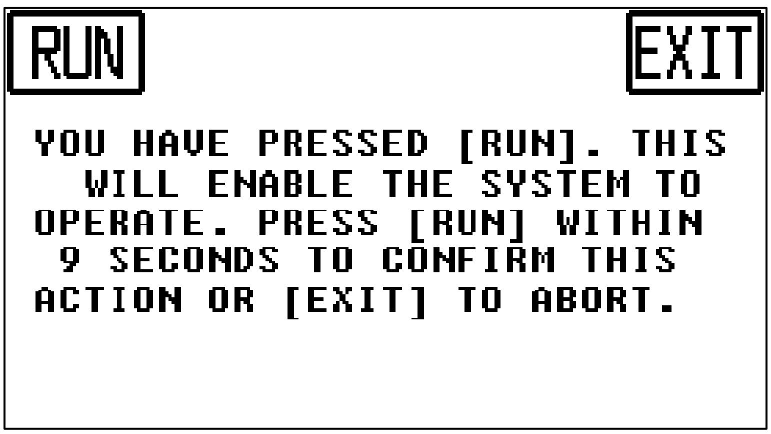
The problem described in this example could also be corrected using the “AUTO ADJUST” feature of the CT SETUP display. First, make this feature viewable by pressing the “password” sequence of screen areas described in section 4.2.3. Once the “AUTO ADJUST” button is displayed on the LCD display, press it to perform the adjustment. In this example, this corrective procedure is much easier to implement than either of the other two corrective options.

4.3. ENABLING DPM AFTER CTS HAVE BEEN VERIFIED

If the message “CTS ARE CORRECTLY POSITIONED” or “CTS ARE CORRECTLY ADJUSTED” is shown on the CT SETUP display, it is now time to enable the DPM to start correcting harmonics. Exit the CT SETUP display by pressing the MENU button in the bottom right corner of the display. Then press the VIEW CURRENTS button on the MENU display to bring up the CURRENTS display:

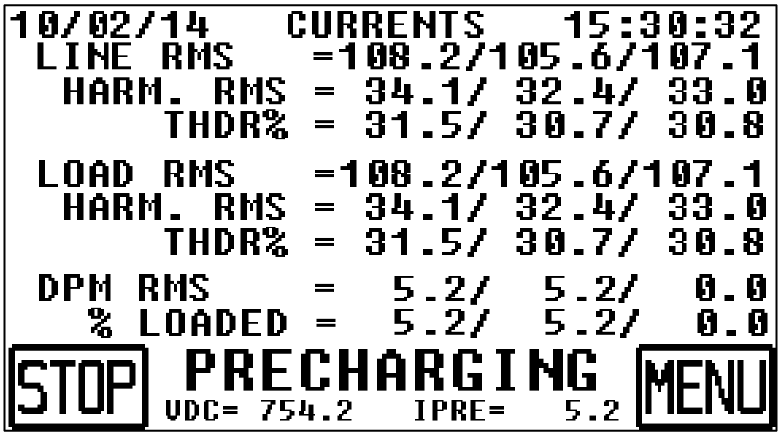


To enable the system, press the “RUN” button in the bottom left corner of the CURRENTS LCD display page. This will result in the following display:



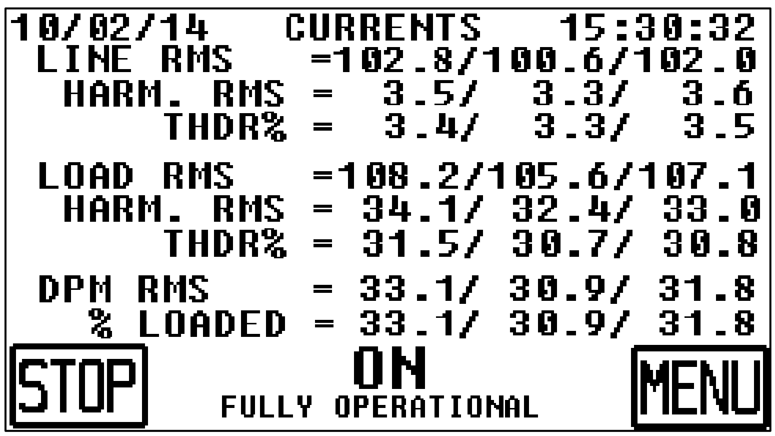
This screen allows the operator to confirm the “RUN” command, or exit without enabling the system in case the “RUN” button was pressed accidentally. The operator has 10 seconds to make a decision. Pressing the “EXIT” button will bring up the previous display page without enabling the system. If the “RUN” button is not pressed within 10 seconds, the effect will be the same as pressing the “EXIT” button. If the “RUN” button is pressed within 10 seconds, the DPM system will be enabled and begin to operate.

The DPM will begin charging the internal DC bus. This is indicated by a “PRECHARGING” message on the display. The precharging voltage and current are displayed at the bottom of the screen. This can be seen in the sample screen that follows.



Note that once the DPM is told to RUN, the place where the RUN button was previously located, there is now a STOP button. Since the DPM is already "running", there is no need to command it to run; however, now there may be a need to "stop" or disable the DPM from running; hence a STOP button is provided to allow that action.

When the DC voltage bus has been completely pre-charged and the control determines it is OK to proceed, the DPM begins correcting the harmonics and power factor of the line and the display will indicate that the unit is operating. This is indicated by the "ON" status as shown in the following screen:



If the system is working correctly, the LOAD THDR% (total harmonic current distortion of the current fed to the loads) will still be relatively high (30.7 – 31.5% in this example); however, the LINE THDR% (total harmonic current distortion of the current drawn from the line) will be low (3.3 – 3.5% in this example). For most loads and line conditions, as long as the DPM is loaded to at least 15-20% (30.9 – 33.1% in this 100 Amp DPM example as seen in the DPM % LOADED line), you should be able to achieve less than 5% THDR% on the LINE. The load requiring more harmonic current correction than the unit can deliver, very high THDR loads, highly distorted line voltage, or high impedance in the line feeds could result in a higher THDR% from the line.

If substantially lower THDR% is not observed in the LINE THDR% displayed compared with the LOAD THDR% and the DPM is loaded to at least 5-10%, you probably have an installation problem. Disable the DPM by pressing the STOP button. When the next display asks you to confirm the STOP command, press the STOP button on that display as well. If the unit detects that it is not correcting harmonics satisfactorily, it may shut itself down. It will then attempt to reset (indicated by the splash screen being displayed). It could perform this cycle a few times before "giving up". If it reaches this point, the CURRENTS display will indicate a status of OFF and the reason for the problem underneath this OFF status.

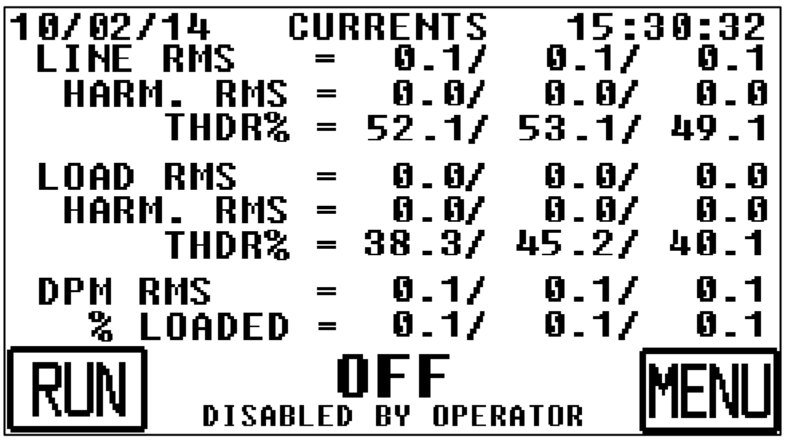
Even if your CTs are placed on the correct lines and in the correct direction, if you have them placed on the LOAD side, but have told the DPM they are on the LINE side, or vice-versa, the system will not operate correctly. Recheck your CT locations. If your CTs are on the line side, make sure the DPM is set up for CTs on the line side. If your CTs are on the load side, make sure the DPM is set up for CTs on the load side. If all CTs and settings seem to be correct, consult the factory for additional assistance. On the previous simulated display, “FULLY OPERATIONAL” was displayed under the ON status. “REDUCED LINEAR PF MODE” is also an acceptable message that might be displayed.

If you run into problems enabling the system, contact the factory. The factory may instruct you to use a laptop with an RS-232 serial link or Ethernet connection to obtain additional information not available via the LCD display. If you have access to such equipment, please have it ready when you call for assistance.

4.4. CHECKING CTS WITH NO LOAD AVAILABLE

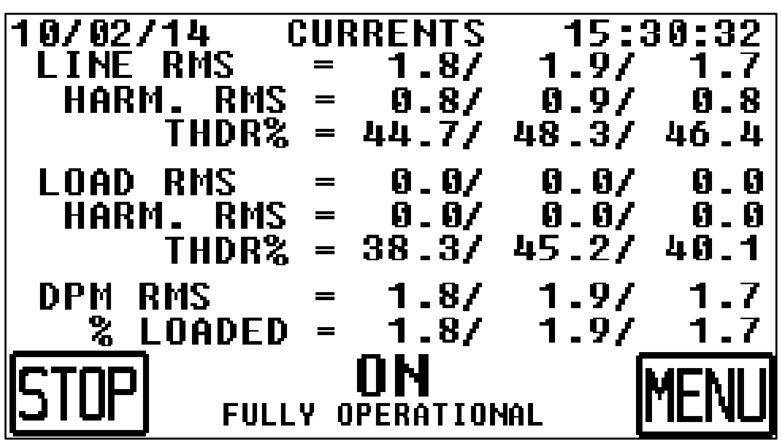
If you are powering up the DPM for the first time and you do not have sufficient load present to perform the CT test outlined in the previous sections, you can still at least partially verify the unit is installed correctly by following the procedure outlined in this section.

Make sure you are displaying the CURRENTS display. If not, press the MENU button on the bottom right of the display and select VIEW CURRENTS from the main menu display. It will look similar to:



Very little current should be displayed. It should be noted that the THDR% values displayed may seem quite large; however, they are at extremely low current and, therefore, are of little importance.

Similar to what you would have done in section 4.3 if an adequate load was present, press the RUN button on this display. When the next “confirming” display appears, press RUN on that display as well to confirm the command. The CURRENTS display will reappear; however, the OFF indication at the bottom of the CURRENTS display will now display PRECHARGING and the precharging voltage and current will be displayed underneath. The RUN button will also be replaced with a STOP button. Once the DPM’s internal capacitance is fully charged, the system will start full operation and the display will look similar to the sample display that follows:



At this point, 1 of 3 possible situations will arise.

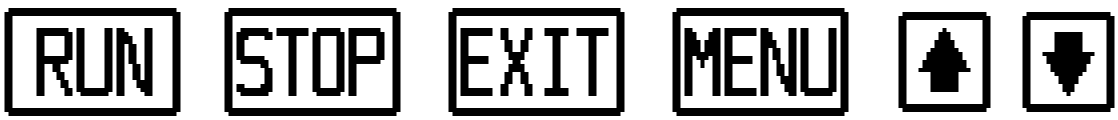
- If your CTs are correctly positioned, the load current should remain nominally around 0; however, the LINE RMS and DPM RMS currents should go to some small values. The DPM % LOADED should all remain below 5% (1.7 – 1.9% are shown in this example) if there truly is no load. If a small load is present, this could inch up a bit.
- If you do not observe low DPM % LOADED values, you have an installation problem.
- The system may shut down. This will be noted by the status changing to OFF along with a message underneath indicating the reason. This will be followed by a system reset, indicated by the “MESTA ELECTRONICS” splash screen being displayed. It will do this about 4 times. At first, the reset will occur immediately after the system goes OFF; however, each successive time, there will be a longer delay between when the system shuts down and when it resets. After about 4 shut downs, the system will stop resetting and retrying, requiring a power cycling of the system to reset the fault. If this set of events is observed, the CTs are sufficiently out of place as to cause the system to operate erratically. It is, therefore, shutting down to prevent erroneous harmonic current correction.

If either the 2nd or 3rd situation is observed, press the STOP button on this display, followed by pressing the STOP button on the confirming display that follows to disable the DPM from operating. Check to make sure your CTs are indeed wired as instructed in section 3. If you can’t find a problem, you will need to wait until you have a load to troubleshoot the installation. Even if this test has positive results, the DPM should be disabled, turned off, and retested at a later date using the CT SETUP display when a sizable load is present. On the previous simulated display, “FULLY OPERATIONAL” was displayed under the ON status. “REDUCED LINEAR PF MODE” is also an acceptable message that might be displayed.

5. FRONT PANEL TOUCH SCREEN DISPLAY

The DPM is equipped with a 4.8" diagonal 240x128 pixel resistive touch screen display. Being a resistive touch screen, moderate pressure is required when pressing buttons. In addition, gloves may be worn or a stylus may be used to activate buttons on the display. If a stylus is used, make sure it does not have a sharp point that could poke a hole in the protective overlay. The display is equipped with a backlight that comes on the when unit is powered up or when the screen is touched. If the screen is not touched for 10 minutes, the backlight will go off in order to preserve the life of the light.

There are several different screens of information that can be displayed. Along with information displayed, the screens contain buttons that can be pressed that change the displays, change the enable/disable run status of the system, change internally stored parameters, etc. These buttons are displayed as rectangles containing the function that pressing the button will achieve. Examples of buttons are:



5.1. POWER-UP SPLASH DISPLAY

When the system first powers up, the following splash display is shown for up to 5 seconds:

In this case, the unit is powering up DISABLED, indicating it will not operate until the RUN button is pressed. The system will power up (DISABLED or ENABLED) in the same state that it was in when it was last powered down. When this splash screen appears, pressing the RUN button will allow the system to start operating, while pressing the STOP button will keep the system from operating. If neither the STOP nor RUN buttons are pressed within the first 5 seconds, the system will stay in the state it powered up in (in this case DISABLED). Once the STOP or RUN button is pressed, or the 5 seconds expires, the "CURRENTS" display will replace the splash display.

5.2. "VIEW CURRENTS" DISPLAY

The default display that appears on the screen following the splash display is the "CURRENTS" display. This display along with several other information displays, have the following 3 primary sections:

1. The "Title" line – The Top line of the display that displays the date, the title of the display "CURRENTS", and the time displayed as a 24 hour clock. The date and time are internally kept by the unit by a running clock that keeps time whether the system is powered or not. The clock will automatically correct for leap years, but will not automatically correct for time-zone changes or daylight savings time. In addition, although the clock is crystal controlled, it may gain or lose time after awhile. If you desire to have the time always representative of the actual local time, you will need to periodically adjust it for these changes.

2. The informational section – This display's information consists of RMS current values for the Line, the Load, and the DPM itself.

3. The "Status" section – Located at the bottom of the screen. The middle section contains the present status of the unit. In large letters will appear the operational status of the unit. Underneath this status, appearing in a smaller font, is additional operational information (see the troubleshooting section for more information on these messages. Possible common operational status indications are listed:

   - OFF – System is not running. The line below will indicate why. In the example screen that follows, the system is OFF because it is presently "DISABLED BY OPERATOR", indicating that you need to press the RUN button if you desire to have the system run.

   - PRECHARGING – This will be displayed for up to several seconds when transitioning from OFF to ON. The DPM contains a large bank of capacitance that must be "pre-charged" prior to starting operation. While in this interim state, the line underneath will contain the voltage across this capacitance and the charging current. While "PRECHARGING", the voltage can be observed to be increasing steadily until it reaches its goal of a bit over 800 volts. The charging current will remain in a range from a couple of amps to a bit less than 10 amps.

   - ON – System is running. Normal lines underneath this indication are "FULLY OPERATIONAL" or "REDUCED LINEAR PF MODE". Other information displayed might indicate attention is needed. See the troubleshooting section for more information.

   - ON: MAX LOAD – System is running, but is at maximum output. The load is requiring more harmonic and/or linear current correction than the unit is rated for. The system will self-limit itself to provide its maximum capability, with the remainder having to come from the utility. The system is designed to operate continuously under these conditions, so this condition is not usually a concern. There are a couple of instances where this may be a concern. First, if there is an installation or some other problem, the DPM could possibly run at max load and not performing properly. If the line harmonic currents are not substantially lower than the load harmonic currents, there could be a problem that should be investigated. Another time it could be a concern is if the unit is so undersized for the load it is meant to correct that the remaining amount of harmonic and/or linear current correction that still needs to come from the utility is above that which can be tolerated. In such a case the only recourse is to either replace the DPM with a larger DPM or add a 2nd DPM in parallel with the 1st unit.

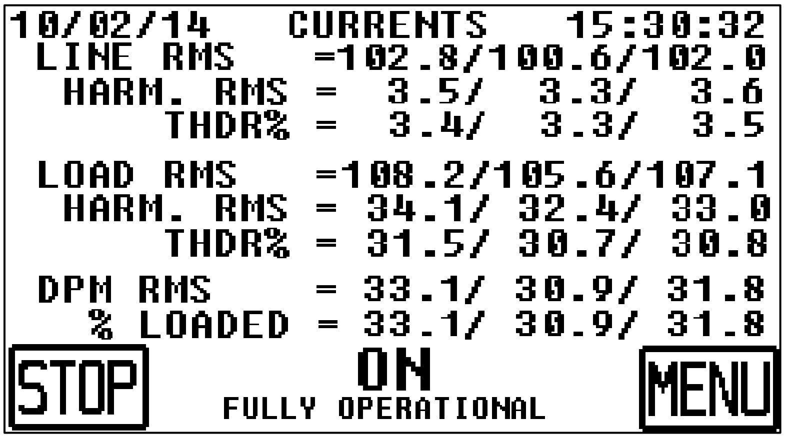
   - IDLE – System is idling. If the "UNIT DISABLED IF LOAD POWER BELOW THIS %" setting in the "Set Parameters" is set to a value other than zero, and the load power is below this set value, the DPM will go to an "idle" state and display this status. While in this state, the DPM will keep its internal DC link capacitors charged. When the load power increases, the DPM can quickly start operating again. Normally, the message "LOAD TOO LOW" will appear under the IDLE status indicator.

- "IDLE"- this is displayed if the "UNIT DISABLED IF LOAD POWER BELOW THIS %" parameter is set to something other than zero and the load power is below the set value. No additional message below will be displayed.

  To the left of the Status information will appear a "RUN" button if the system is currently disabled, thus giving the operator the opportunity to enable the system; or a "STOP" button if the system is currently enabled, thus giving the operator the opportunity to disable the system.

  To the right of the Status information is a "MENU" button. Pressing the "MENU" button will display the main menu, where the operator can select a different display.

An example of a "CURRENTS" display for a 100 amp DPM that is running follows:



The first 3 lines in the “informational section” contain “line current” information. The line current is the current measured coming from the utility. When the DPM is operating, this current represents the corrected current. Since the DPM supplies the harmonic currents to the load when the DPM is operating, these harmonic currents no longer come from the line (utility), so the harmonic content of these line currents will be greatly reduced. When the DPM is not operating, these “line currents” will essentially be equal to the “load currents”. The first of these 3 lines displays the rms current of all 3 phases. The 2nd line displays the rms harmonic current of the same 3 phases. The 3rd line displays the “total harmonic distortion” in the 3 phases. Either THDR (equal to HARM. RMS/LINE RMS) or THDF (equal to HARM. RMS/Fundamental RMS) will be displayed depending on the THDR/THDF setting in the “Set Parameters” function.

The next 3 lines contain “load current” information. The load current is the current measured going to the loads (motor drives, etc.). The load will draw harmonic currents whether the DPM is on or off, so the “load currents” will have harmonics present when the load is operating. Like the “line current” section, the “load current” section contains a line for rms of the current going to the load, a line for the rms of the harmonic current going to the load, and a line for the THDR or THDF total harmonic distortion of the current going to the load.

The last 2 lines contain “DPM current” information. The first of these lines displays the rms of the 3 phases of current supplied by the DPM. This is the current supplied by the DPM (both harmonics and out-of-phase linear current) to cancel those drawn by the load, so that the current does not have to come from the line (or utility). The “% LOADED” line indicates the percent loading on the DPM. A fully loaded DPM would have values around 100% in this line. Since this example is for a 100 amp DPM, the “% LOADED” values are identical to the “DPM RMS” values (note: 100 amps = 100% loaded). For a DPM rated for 300 amps, the “% LOADED” values would be 1/3 of the “DPM RMS” values, since 300 amps = 100% loaded for a 300 amp DPM.

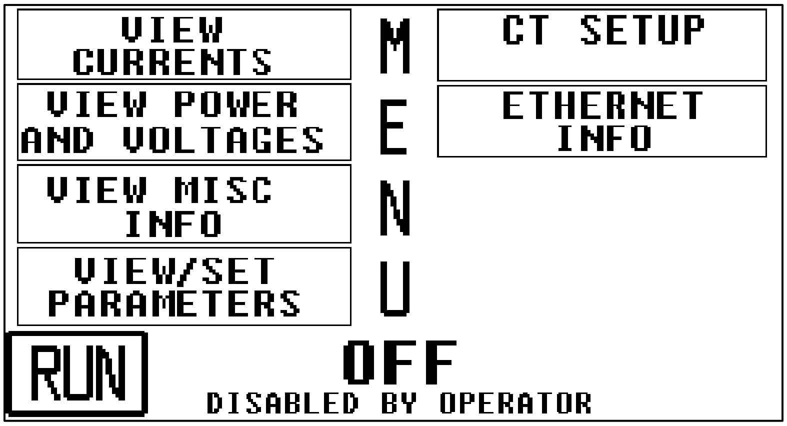
One will notice in this example display that the “LOAD” currents contain sizable harmonic currents, and that the “LINE” currents contain greatly reduced harmonic currents. This 100 amp DPM is supplying about 1/3 of its capability in providing this correction. For most situations, you should observe the line THDR being less than 5% (in many cases much less) when the DPM is 15% loaded or higher. Some exceptions would be if the line voltages are highly distorted, the TDHR of the load is higher than normal, or if there is high impedance upstream (on the line side). The higher the DPM is loaded, the lower the resulting line THDR will be, up until the point that the DPM is 100% loaded.

5.3. “MENU” DISPLAY

Pressing the “MENU” button on a display will bring up the MENU display:

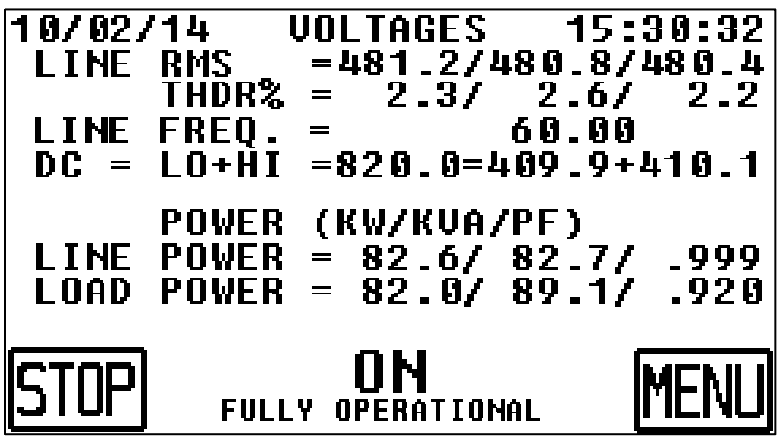
This display has the same “status section” at the bottom of the display as the CURRENTS display; however, it lacks the MENU button for obvious reasons, but does have the RUN or STOP button. This display also does not have the “Title” line as its top line.

This display offers 6 choices for screens to be displayed. They are enclosed by rectangles indicating that they are buttons that can be pressed. To select the desired screen, press within the rectangle.



5.4. “VIEW POWER AND VOLTAGES” DISPLAY

Similar to the CURRENTS display, the POWER and VOLTAGES display has 3 primary sections: The “Title” line, the “Status” section, and the information area. The information area is the only section that differs from the CURRENTS display. An example of a VOLTAGES display (which actually contains power information along with voltage information) for a 100 amp DPM is shown below:



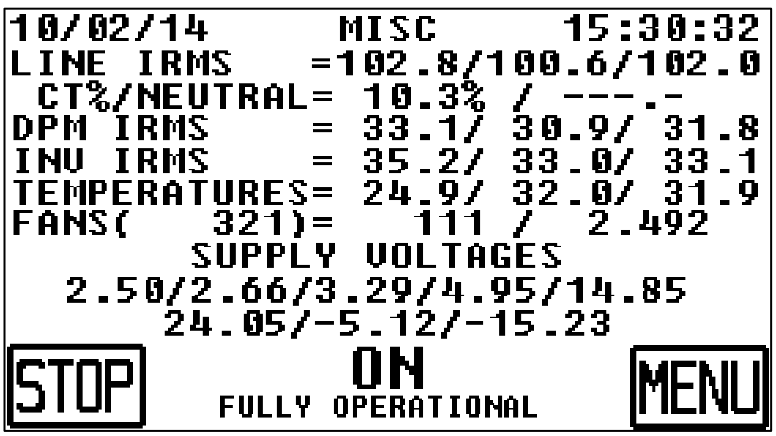
The first line of voltage/power information contains the line-to-line voltages for all 3 phases. Both the line side and load side are at the exact same voltage, so, unlike with the currents, there is not a need to list the line and load side separately. The 2nd line displays the “total harmonic distortion” in the 3 voltage phases. Either THDR (equal to HARM. RMS/LINE RMS) or THDF (equal to HARM. RMS/Fundamental RMS) will be displayed depending on the THDR/THDF setting in the “Set Parameters” function. The 3rd line is the line frequency in Hz. The 4th line is the DC link voltage. This is the voltage across the inverter DC link bank of capacitors. The nominal DC link voltage for this 3-phase, 480 VAC DPM is 820 volts. The capacitance consists of 2 banks of capacitors with the two banks wired in series. There is a lower and upper bank, signified by the LO and HI labels. The total DC voltage of 820 volts will nominally be split equally between the 2 banks.

The next 3 lines are related to the line and load power, with the first of these lines “POWER (KW/KVA/PF)” being a title for this section, indicating the information in the following 2 lines are arranged as KW (kilowatts of power), KVA (kilo-volt-amps), and PF (power factor). PF is simply the ratio of KW divided by KVA. The ideal optimum power factor is 1.0. Such an ideal power factor would result if there are no harmonic currents or voltages, there are no reactive (out-of-phase) fundamental current, and all of the phase rms currents and voltages were identical. Normally, with the DPM operating, one would see here that the KVA of the load is higher than that of the line. Since the voltages of the line and load are identical, the difference is due to the load having a higher rms current due to the existence of much higher harmonic currents going to the load than what is coming from the line, and due to some higher out-of-phase current drawn by the load than is drawn from the line. Since the DPM is supplying these undesirable “extra” currents that the load draws, they do not need to come from the line, so total line current is lower than that of the load. Reducing the current coming from the line by eliminating these undesirable “extra” currents also results in a vastly improved power factor from the line.

Although the line KVA is lower than the load KVA, you will notice that the Line KW is a little higher than the Load KW. The difference of 0.6 KW shown between the Line and Load power represents the losses of the DPM in providing the harmonic currents and reactive current drawn by the load. This 100 amp DPM was only loaded to a little more than 30%. As the load on the DPM goes up, the losses will also increase.

5.5. “VIEW MISC” DISPLAY

Similar to the CURRENTS display, the MISC display has 3 primary sections: The “Title” line, the “Status” section, and the information area. The information area is the only section that differs from the CURRENTS display. An example of a MISC display for a 100 amp follows:



The first line “ILINE IRMS” is a repeat of the same line on the CURRENTS display. The 2nd line displays 2 parameters, “CT%” and “NEUTRAL”. CT% represents the percentage of the externally located line or load CTs that the CT is loaded to. In this case, the line CTs are scaled to 1000/5, so that 1000 amps produces 5 amps in the output of the CT. 102.8 amps is the highest current being monitored by these CTs located on the line side. 102.8 amps represents 10.3% of the full 1000 amps rms that the CTs can monitor. This value should not reach more than about 80%, otherwise, some distortion could occur in some instances. If this reaches 80%, a higher ratio CT may need to be considered. The NEUTRAL current will only display a reading if 3 external CTs are being used in cases where a neutral current is possible. In such a case, the neutral current will be displayed here in amps rms. Dashes, as shown in this example, indicate only 2 CTs are used; therefore, neutral current cannot be calculated.

“DPM IRMS” is a repeat of the same line on the CURRENTS display. “INV IRMS” is an internal current that will be similar in magnitude to the DPM IRMS currents at all but lower currents. At lower current levels, INV IRMS currents could be several amps higher.

“TEMPERATURES” are internal temperatures in degrees Centigrade. The first value (24.9 in the example) is a temperature on the main control board. For units shipped by Mesta as Nema1 systems, this temperature should be fairly close to the room temperature, as it should reflect the air temperature coming into the enclosure. For units shipped as panels and installed into cabinets by a 3rd party, the value of this temperature could be a bit higher, depending on the airflow amount and arrangement in the cabinet. The 2nd and 3rd temperatures are that of the heatsink that contains the system’s inverter.

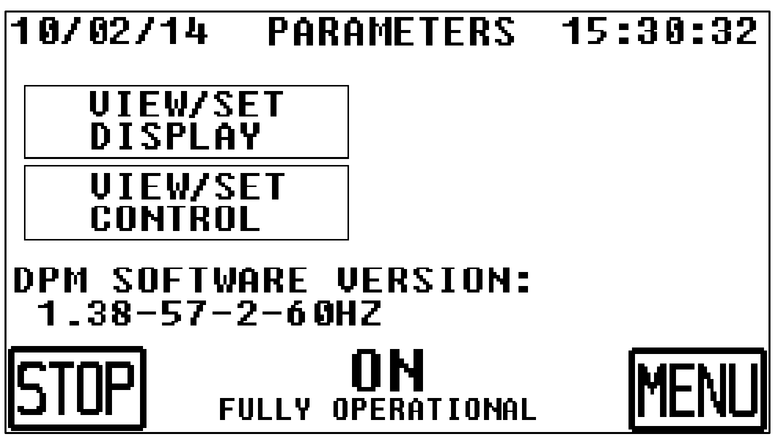
The 2nd temperature is monitoring the left side of the heatsink, while the 3rd temperature is monitoring the right side of the heatsink. These temperatures are normally around 15-25 degrees higher than the room temperature when the DPM is at full load. At the 1/3 load this example DPM is operating at, the heatsink temperatures are only about 7 C higher than the ambient. If all fans are not operational or input filters are dirty, higher temperatures will result. At some point, a high temperature warning will occur (indication under the ON status in place of the FULLY OPERATIONAL). If temperatures continue to climb, the unit will shut down.

"FANS" is an indication of the operation of the internal 24 Volt DC powered cooling fans. The numbers inside the brackets "(" and ")" indicates fans that are present in the system. The 50 and 100 amp DPMs have 3 fans, so will list 321 here, as in this 100 Amp DPM example. The 150 and 200 amp DPMs have 3 fans or 4 fans, so will list 4321, and the 300 amp DPM has 4 or 6 fans, so will list 54321 (fans 5 and 6 are driven together, so count as one fan). Units shipped as Nema1 systems by Mesta, have all of the fans previously listed. Units shipped as panels by Mesta may only have the lower number of fans indicated, as the integrator may use other additional fans powered by external means. The numbers after the "=" will consist of 1's or 0's. Each 1 or 0 corresponds to the fan number, and indicates if that fan is being turned on (1) or kept off (0). In the example display, there are three 1's indicating all 3 fans are being turned on. The value after the "/" indicates the current drawn by the fans. If this value drops from its value when the system is new, it indicates that one or more fans may not be operating correctly. A Fan test described in the Troubleshooting section of this manual can be performed to see which fan(s) is not drawing the correct current.

"SUPPLY VOLTAGES" are 8 internal supply voltages. They should all be within 5% of their nominal values of 2.5, 2.66, 3.3, 5.0, 15.0, 24.0, -5.0, and -15.0. If not, there is an internal problem.

5.6. "VIEW/SET PARAMETERS" DISPLAY

Similar to the CURRENTS display, the PARAMETERS display has 3 primary sections: The "Title" line, the "Status" section, and the information area. The information area is the only section that differs from the CURRENTS display. An example of a PARAMETERS display follows:

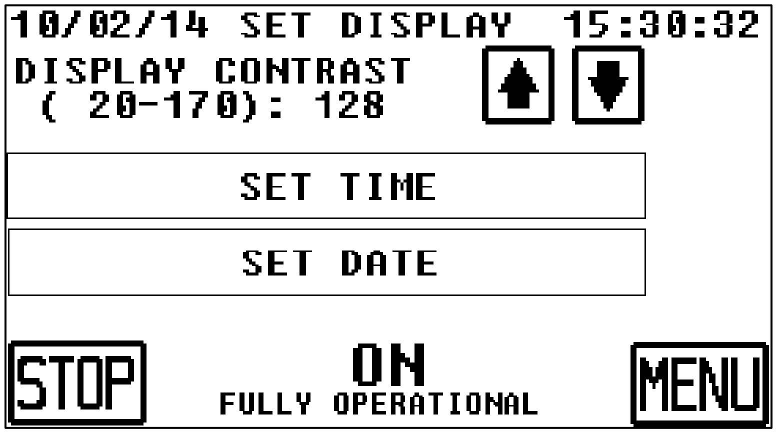


In the information area of this display are two buttons. Press the VIEW/SET DISPLAY button if a "display" related parameter (contrast, time, or date change) is desired. Press the VIEW/SET CONTROL button if a "control" related parameter is desired.

Also, in the information area is the software version/revision installed in the system.

5.6.1. "VIEW/SET DISPLAY" DISPLAY

If the VIEW/SET DISPLAY button was pressed on the PARAMETERS display, the following example display will appear:



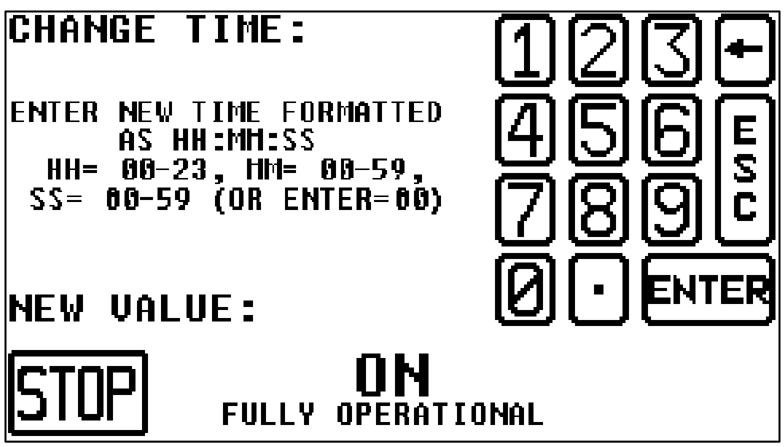
Like the CURRENTS display, this display has the similar Title line, Status section, and an information section.

At the top of the information section is the “DISPLAY CONTRAST” function indicating an allowed value between 20 and 170. In this example, a value for the contrast of 128 is shown. This value controls the contrast (or darkness) of the display – the higher the value, the darker the display. Too high of a number will result in the background of the display being darkened along with the text. Too low of a number will result in the text being too light. Up and Down arrows are provided to increase or decrease the contrast value, respectively. Each time an arrow is pressed, the contrast value will increment or decrement by one. Repeatedly press and release an arrow until the desired contrast is achieved. The optimum contrast is affected by the temperature that the LCD display is exposed to. At higher temperatures, the same contrast value will result in a darker display; therefore, it may be necessary to adjust the contrast as the ambient temperature changes in order to view the optimum display.

The “SET TIME” and “SET DATE” buttons may be pressed if the time or date needs to be altered.

5.6.1.1. “SET TIME” DISPLAY

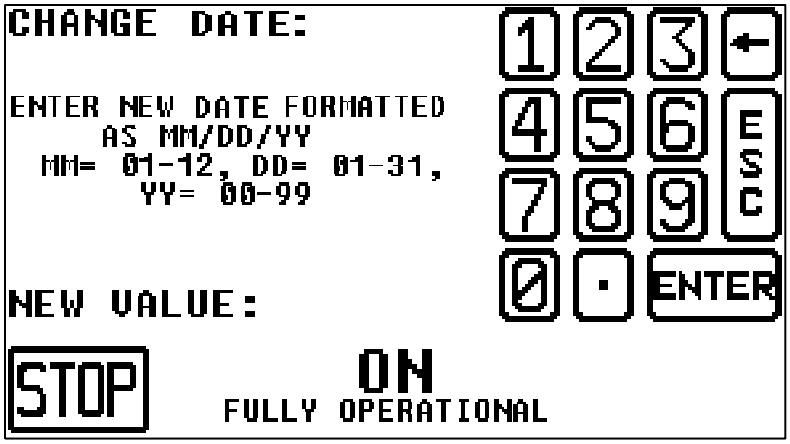
Pressing the “SET TIME” button will result in a display similar to the one here being displayed:



On this display, the Title line has been removed, along with the MENU button down in the Status section; however, the status information remains along with the RUN or STOP button. The “CHANGE TIME:” message is displayed indicating you are in this function. Also, a set of instructions appear. To the right is a keypad for you to use to enter in a time. To change the time, use the keypad to enter 2 digits for the hours in military time format (hours 00-11 = AM, 12-23 = PM). After these 2 digits are entered a “:” will be displayed. After the “:” enter the minutes (00-59). After the minutes are entered, a 2nd “:” will be displayed. Now you can either enter the seconds (00-59) or press the ENTER key on the keypad, to select 00 seconds. Pressing the ENTER key will change the time to what was entered, and revert back to the “VIEW/SET DISPLAY” display. The back arrow key can be used to erase the last key entered. The ESC (escape) key exits the “CHANGE TIME” display without making any changes to the time. It is important to note that leading zeros must be typed, as all entries require 2 digits to be entered. The system does not adjust automatically for time zone changes or daylight savings time.

5.6.1.2. “SET DATE” DISPLAY

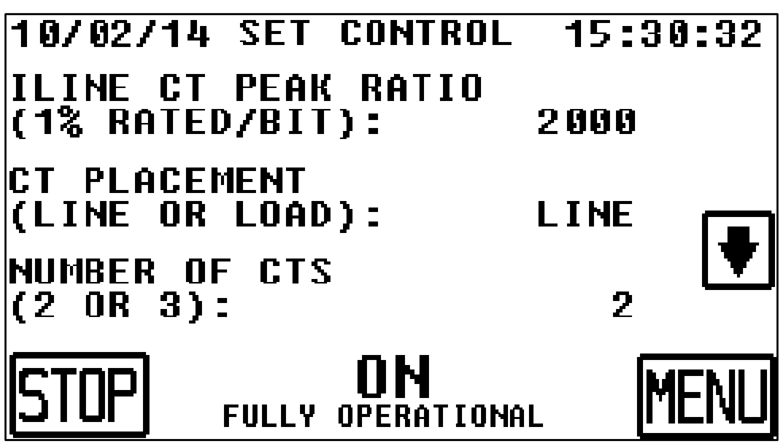
Pressing the “SET DATE” button will result in a display similar to the one here being displayed:



On this display, the Title line has been removed, along with the MENU button down in the Status section; however, the status information remains along with the RUN or STOP button. The “CHANGE DATE:” message is displayed indicating you are in this function. Also, a set of instructions appear. To the right is a keypad for you to use to enter in a date. To change the date, use the keypad to enter 2 digits for the month (01-12). After these 2 digits are entered a “/” will be displayed. After the “/” enter the day of the month (01-31). After the minutes are entered, a 2nd “/” will be displayed. Now enter the year (00-99). Pressing the ENTER key will change the date to what was entered, and revert back to the “VIEW/SET DISPLAY” display. The back arrow key can be used to erase the last key entered. The ESC (escape) key exits the “CHANGE DATE” display without making any changes to the date. It is important to note that leading zeros must be typed, as all entries require 2 digits to be entered. The system will adjust automatically for leap years.

5.6.2. “VIEW/SET CONTROL” DISPLAY – 1ST SET OF 3 PARAMETERS

If the VIEW/SET CONTROL button was pressed on the PARAMETERS display, the following example display will appear:



As in the CURRENTS display, there is a Title line as the first line, the Status section at the bottom, and an Information section in between. In the information section are the first 3 control parameters that can be changed along with their present value:

- ILINE CT PEAK RATIO – The value of this parameter tells the system the current ratio of the external CTs being used on either the line or the load. This value is calculated using the following equation:

  ILINE CT PEAK RATIO = 200 * C / D where:

  C = CT rms current that produces 5 amps rms CT output.

  D = Rated current of the DPM.

  Calculated RATIO must lie between 300 and 30,000.

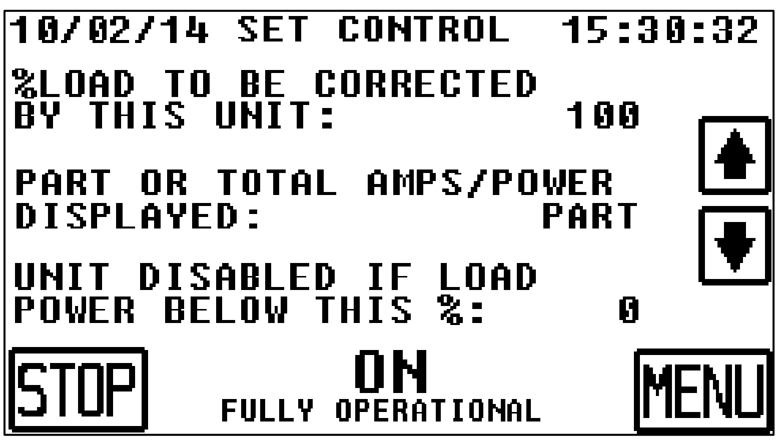
  For example, if 1000/5 CTs are used with a 100 amp DPM, C=1000 and D=100, which results in an ILINE CT PEAK RATIO = 200 * 1000 / 100 = 2000.

- CT PLACEMENT – This value is either LINE or LOAD. The value entered here must agree with where the external CTs are placed – on the line side or the load side. See section 3 for further information.
- NUMBER OF CTS – This value is either 2 or 3 and relates to the number of phases monitored by external CTs. Most installations only need 2 CTs; however, if loads exist that draw sufficient current through the neutral power wire, 3 should be used. The value of 3 should be entered here ONLY if all 3 phases are being monitored with the external CTs.

The button on the right side of the screen indicates additional parameters exist. Press this button to scroll through additional parameters.

5.6.3. "VIEW/SET CONTROL" DISPLAY – 2ND SET OF 3 PARAMETERS

If in the SET CONTROL display and the button is pressed once, the 2nd set of 3 parameters will be displayed as shown in the following sample display:



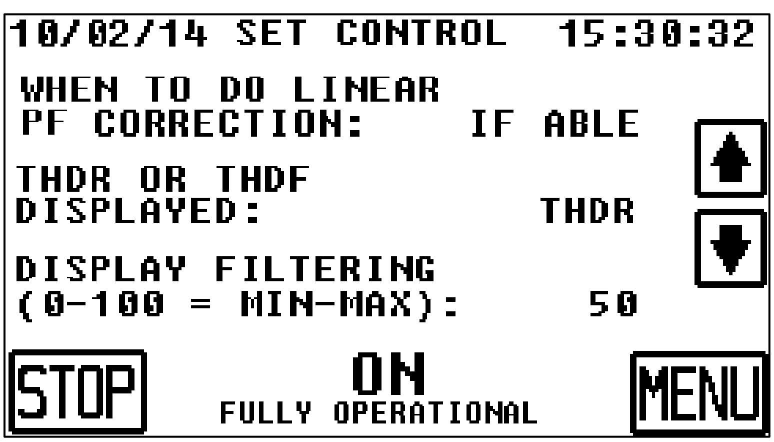
This display is very similar to that showing the 1st set of 3 parameters, except parameters 4 through 6 are displayed. Also, a scroll up button is present on the screen indicating there are additional preceding parameters that exist. The indicates additional parameters exist below. In the information section are the 2nd set of 3 control parameters that can be changed:

- %LOAD TO BE CORRECTED BY THIS UNIT – This parameter only has meaning if the external CTs are on the load side. It is totally ignored if the external CTs are on the line side. If DPMs are operated in parallel (see section 3 for additional information), the external CTs must be installed on the load side. This parameter is then used to indicate what percentage of the load distortion current is to be corrected by this unit. The percentages of all units paralleled should add up to 100%. For example if three 300 amp DPMs are paralleled, two should have this value set to 33% and the 3rd should be set to 34%. The DPMs then work independently to correct their portion of the distortion. If paralleled units are different sizes, such as using a 200 amp system in parallel with a 300 amp system. The percentage selected for each unit should be proportionally divided so that the 200 amp system provides 40% (200/(200+300)) and the 300 amp system provides 60% (300/(200+300)). If only one DPM is used and the CTs are on the load side, this %LOAD value should be set to 100%; otherwise, all of the load distortion will not be corrected.

- PART OR TOTAL AMPS/POWER DISPLAYED – This parameter only has meaning if the external CTs are on the load side. It is totally ignored if the external CTs are on the line side. If DPMs are operated in parallel (see section 3 for additional information), the external CTs must be installed on the load side. The line and load current and power values displayed on the LCD or received serially or over the Ethernet can either represent the total current and power seen by all of the paralleled systems or the part of the current and power that each unit is responsible for. For example, if 4 equally sized units are paralleled, each would be set to correct 25% of the harmonics. If this parameter is set to TOTAL, the total line and load currents and power will be shown. If this parameter is set to PART, only 25% of the line and load currents and power will be shown, as the unit is only responsible for 25% of the total.
- UNIT DISABLED IF LOAD POWER BELOW THIS % - If the load power drops below this value, the DPM will stop operating and go into an IDLE state. While in the IDLE state, the DPM will keep its internal DC link capacitors charged and ready to go, but will not operate its inverter. As soon as the load power increases above this threshold value + 3% (3% added for hysteresis), the DPM's inverter will begin operating again to correct the distortion in the load current. The percentage entered is equivalent to P * D * 0.000831 KW of load, where P is the percentage and D the current rating of the DPM. As an example, if this percentage is set to 2%, a 300 amp DPM will stop and enter the IDLE state when the load power drops below 2 * 300 * .00831 = 4.99 KW. This 300 amp DPM would start operating when the load power increases above (2+3) * 300 * .00831 = 12.465 KW. This is a power saving feature for installations that don't run 24 hrs/day, 7 days per week. Even with its very high efficiency, a fully operating 300 amp DPM with no load has losses of around 1200 watts. When in the IDLE mode, the inverter and cooling fans turn off, reducing losses to around 100 watts. At the same time, the internal DC capacitors remain fully charged, so that when the load is again present, the inverter can start very quickly – no waiting for capacitors to charge. A value of 0 entered for this parameter, as shown on the sample display results in this function being disabled – in other words, the DPM will operate continuously despite what the load power drops to. A value between 0 and 50% may be entered for this parameter.

5.6.4. "VIEW/SET CONTROL" DISPLAY – 3RD SET OF 3 PARAMETERS

If in the SET CONTROL display and the button is pressed twice, the 3rd set of 3 parameters will be displayed as shown in the following sample display:



This display is very similar to those showing the 2nd set of 3 parameters, except parameters 7 through 9 are displayed. Both a scroll up button and scroll down are present indicating additional parameters exist both before and after these parameters. In the information section are the 3rd set of 3 control parameters that can be changed:

- WHEN TO DO LINEAR PF CORRECTION – This parameter has 3 values: NEVER, IF ABLE, and ALWAYS. The DPM can correct harmonic currents, out of phase 60 Hz current, and unbalanced current drawn by the load. The out of phase 60 Hz and unbalanced current corrections are referred to as linear PF correction. Through this parameter, you have the opportunity to select when to do this linear PF correction. If “NEVER” is selected, only harmonic current correction will be performed.

  If “IF ABLE” is selected, linear PF correction will be performed if, after correcting harmonics, there remains current capacity left over to perform the linear PF correction. If the load is high enough to cause the DPM to reach its current limit, the linear PF correction will decrease first to get the current down to the DPM’s rated level.

  If ALWAYS is selected and the DPM is overloaded, both the linear PF correction current and the harmonic currents will be phased back together until the current from the DPM is within the rated level.

  Most DPMs are installed to correct harmonics drawn by motor drives. Since motor drives don’t usually draw much out-of-phase current, the linear PF is usually quite high; therefore, there is not much to be gained by correcting it. Because of this, the default setting from the factory is NEVER for this parameter. Correcting the linear PF does require some of the control to divert some of its control capacity from harmonics to linear correction. In some cases this may result in slightly poorer harmonic correction when a selection other than NEVER is selected. If a site would benefit from some linear correction, then the “IF ABLE” option can be selected. A check should be made to make sure the harmonic correction is still acceptable when the “IF ABLE” option is selected compared to the “NEVER” option. A site that is relying on the DPM to correct linear PF displacement as much as harmonics could select the “ALWAYS” option, but this situation will be rare.

  If the “NEVER” option is selected or the “IF ABLE” option is selected and the DPM is phasing back correcting linear PF due to it being overloaded, the message “REDUCED LINEAR PF MODE” will be displayed in the “Status section” of the display instead of “FULLY OPERATIONAL”; however, this should be of little concern.

- THDR OR THDF DISPLAYED – The setting of this parameter determines whether THDR or THDF is calculated for all “total harmonic distortion” values displayed on any screens. THDR is calculated as the rms value of all harmonic components divided by the rms value of the total current (or voltage if doing voltage distortion). THDF is calculated as the rms value of all harmonic components divided by the rms value of the fundamental current (or voltage if doing voltage distortion). THDR can be in the range of 0 to 100%, 0 indicating no harmonics present and 100% indicating all of the current or voltage is composed of harmonics. THDF can range from 0% to higher than 100%. A value higher than 100% is possible if the rms of the harmonics is greater than that of the fundamental, which can occur with current drawn by loads that draw high harmonic currents. The fundamental component is the current (or voltage) that is at the same frequency as the utility supply (60 or 50 Hz).

- DISPLAY FILTERING – This setting affects the display of rms currents, rms voltages, power, etc. that occur throughout all screens and sent over the serial and Ethernet interfaces. A higher value means that the displayed value is more heavily filtered. Loads may constantly change, resulting in constantly changing rms values. This would result in the displayed values jumping all over the place. These jumping values may be hard to read; therefore some filtering is needed to “smooth them out” so they can be better comprehended by an observer. This parameter accomplishes this task. A value of 50 is the default, as it provides the optimum filtering in most cases. It should be noted that the amount of filtering is not a linear function of this number. For example, a very high number such as 99 has extremely high filtering, many times more than a value of 90 has.

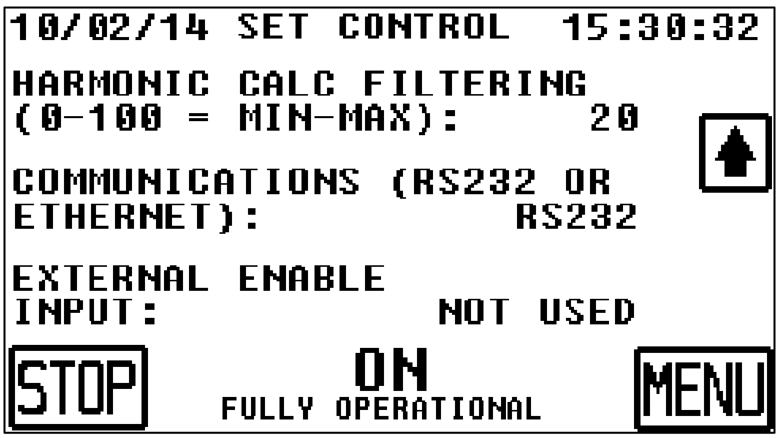
It should be noted that changing the DISPLAY value has NO affect on the actual operation of the DPM – this value simply affects the displayed values and values sent over the serial or Ethernet interface. The DPM will continue to perform the same fast correction independent of these values.

5.6.5. "VIEW/SET CONTROL" DISPLAY – 4TH SET OF PARAMETERS

The 4th set of parameters is different for systems equipped with Ethernet vs. systems equipped with Ethernet/IP.

5.6.5.1. 4TH SET OF PARAMETERS IN ETHERNET EQUIPPED SYSTEMS

If in the SET CONTROL display and the button is pressed three times, the 4th set of parameters will be displayed as shown in the following sample display for Ethernet equipped systems:



This display is very similar to those showing the other sets of 3 parameters, except parameters 10 through 12 are displayed. Only a scroll up button is present indicating additional parameters exist only before and no additional parameters exist after these. In the information section are the following control parameters that can be changed:

- HARMONIC CALC FILTERING – This setting is similar to DISPLAY FILTERING, but affects just the harmonic and harmonic distortion values. Here, a value of 20 is the default, as it provides the optimum filtering in most cases.

  It should be noted that changing the HARMONIC CALC FILTERING value has NO affect on the actual operation of the DPM – this value simply affects the displayed values and values sent over the serial or Ethernet interface. The DPM will continue to perform the same fast correction independent of these values.

- COMMUNICATIONS (RS232 OR ETHERNET) – The system has the capability to communicate with an external computer over RS-232 serial communications or over Ethernet (but not both at the same time). This setting determines which method is to be used.

- EXTERNAL ENABLE INPUT – The DPM has the capability of being externally enabled by an externally driven dry contact. There is an input on the Interface board (PC-I) where this dry contact can be wired to (pins 11 and 12 of terminal block P2 on this board). This parameter has the following 3 possible values:

  NOT USED – The default. Indicates that the "external enable input" is not being monitored.

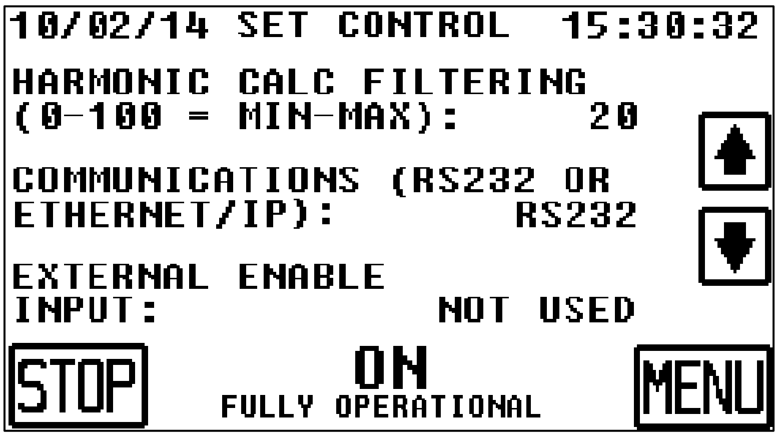
SHORT=EN – Pins 11 and 12 on the terminal block must be shorted together (by an external dry contact) for the DPM to operate.

OPEN=EN – Pins 11 and 12 on the terminal block must have no connection across them for the DPM to operate. Shorting the two pins together will cause the DPM to stop operating.

Note that if this function is used, having the external enable present will NOT override an internal condition that is preventing the DPM from operating. It is simply an additional condition that is needed for the DPM to operate.

5.6.5.2. 4TH SET OF PARAMETERS IN ETHERNET/IP EQUIPPED SYSTEMS

If in the SET CONTROL display and the button is pressed three times, the 4th set of parameters will be displayed as shown in the following sample display for Ethernet/IP equipped systems:



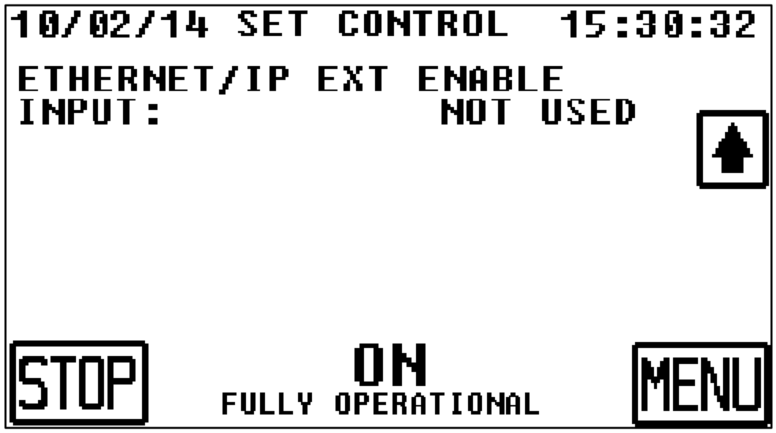
This display is almost identical to the one in the preceding section for Ethernet equipped systems, except for 2 items:

1) The Communications parameter has Ethernet/IP as an option instead of Ethernet.
2) There is a scroll down button because the Ethernet/IP equipped systems have an additional 5th set of parameters.

Refer to the preceding section for "4th set of parameters" in Ethernet equipped systems for an explanation of the parameters on this display.

5.6.6. "VIEW/SET CONTROL" DISPLAY – 5TH SET OF PARAMETERS

There is a 5th set of parameters for systems equipped with Ethernet/IP. There is not a 5th set of parameters for systems equipped with Ethernet. This 5th set of parameters is reached by pressing the button four times while in the SET CONTROL display. Following is a sample display:



Only a scroll up button is present indicating additional parameters exist only before and no additional parameters exist after these. In the information section is the last control parameter (Ethernet/IP equipped systems only) that can be changed:

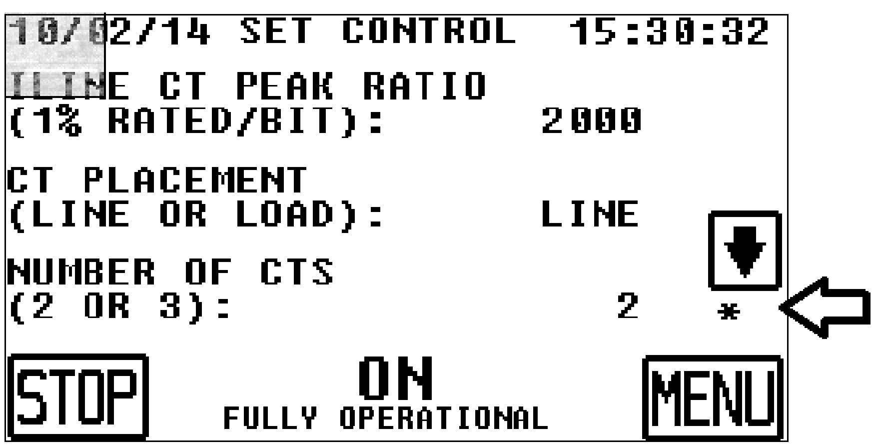
- ETHERNET/IP EXT ENABLE – The DPM has the capability of being externally enabled and disabled over the Ethernet/IP network by an external control (e.g. a PLC). The external control sends a code word of 1 to enable the DPM and a code word of 0 to disable the DPM if this parameter is set to "USED". If this parameter is set to "NOT USED", the DPM will ignore the code word sent to it.

  Note that if this function is used, receiving the Ethernet/IP enable code over the network will NOT override an internal condition that is preventing the DPM from operating. It is simply an additional condition that is needed for the DPM to operate.

5.6.7. CHANGING THE SETTING OF A CONTROL PARAMETER

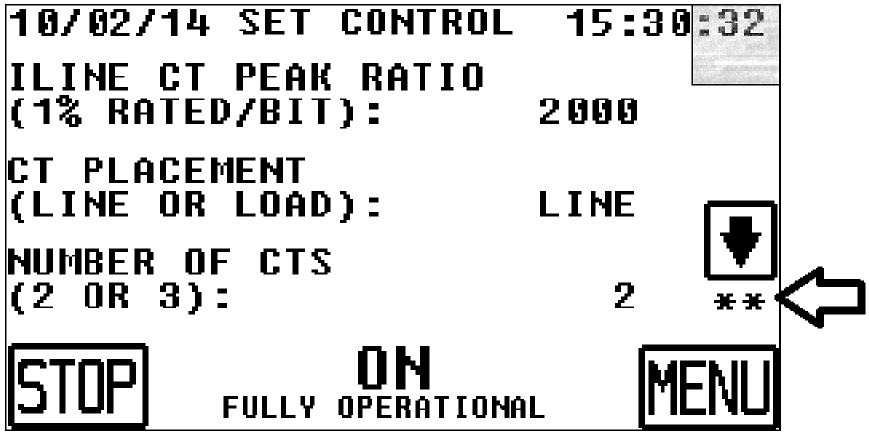
To protect against someone unauthorized from changing a parameter, parameters are not allowed to be changed until the operator performs a hidden function. Once this hidden function is performed, all parameters are enabled to be altered. This hidden function consists of pressing 3 areas of the display in a particular order as follows:

4) Press the upper left corner of the display (anywhere within ½" of the upper left corner of the display as shown by the shaded square in the following display example) once, and only once, an "*" will appear just below the down arrow key (pointed at by the arrow in the display example):

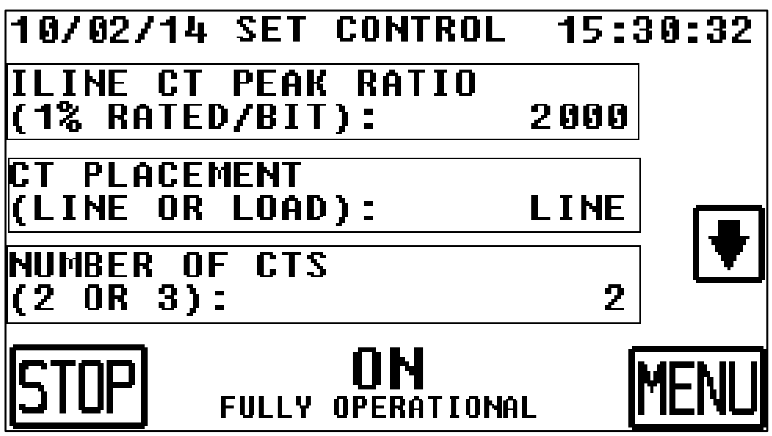


5) Next, press the upper right corner of the display once (as shown by the shaded square in the following display example), and only once. If you press the correct area, a second "*" will appear just below the down arrow key (pointed at by the arrow in the display example). If

instead the first “*” disappears, go back to step 1. If the first “*” stays displayed, but no 2nd “*” appears you may not have pressed hard enough – therefore, press the upper right corner of the display again.

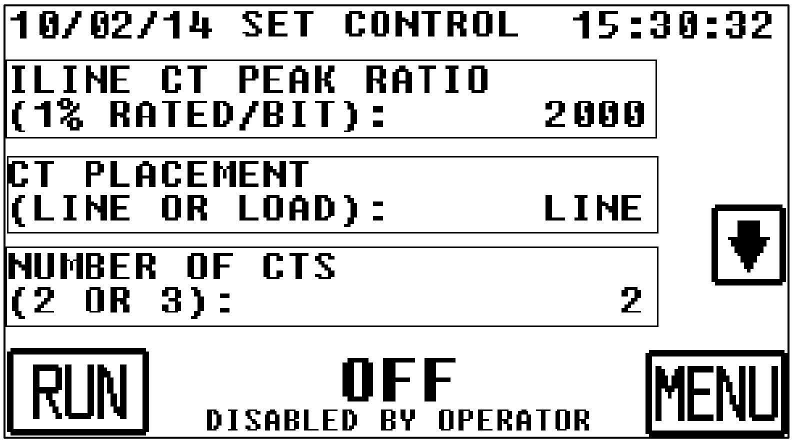


6) Once you have 2 “*” characters, press the upper left corner of the display again. If you hit the correct spot, the “*” characters will disappear, and within about 1 second, boxes will appear around each of the displayed parameters. If no boxes appear, but the two “*” characters disappear, you must have pressed an area outside of the upper left corner – you will need to go back to step 1 to start over. If both “*” characters remain displayed, you did not press hard enough – therefore, press the upper left corner of the display again. The resultant display with the boxes now around the displayed parameters appears as follows:

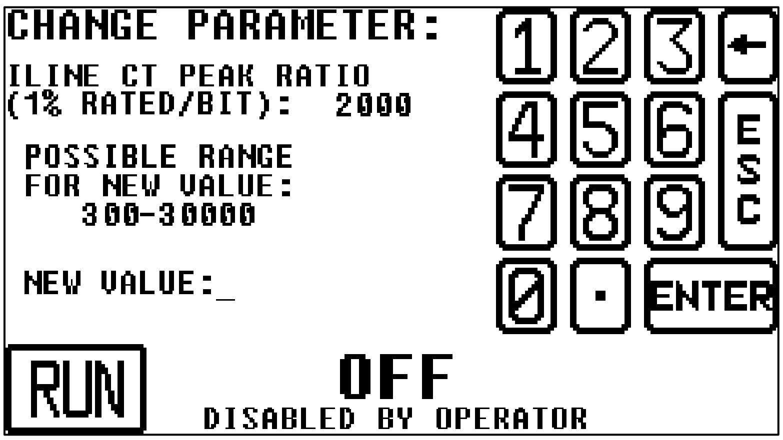


The box-outlined parameters are now keys that can be pressed. Pressing one of these will open up a display that will allow you to change the value of that parameter. The parameters will remain in this “edit-enabled” mode until you exit the “SET CONTROL PARAMETERS” function or the system times out (in about 30 minutes). If the system times out prior to changes being saved, all changes made will be discarded.

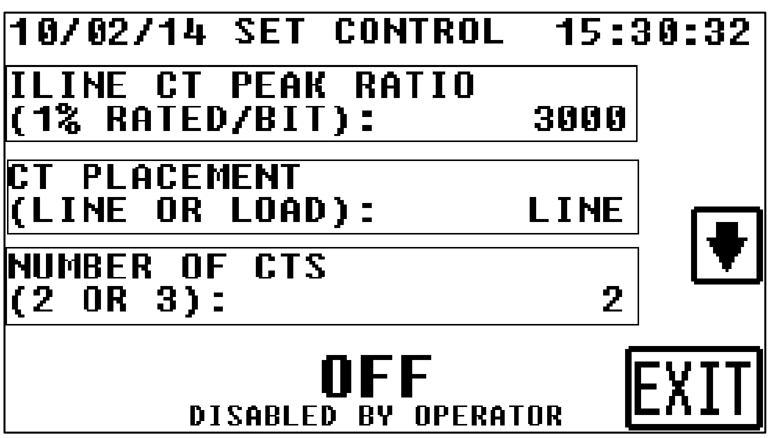
All parameters except the first 3 shown on the first page (the page shown in this example) can be changed with the DPM running (enabled) or when the DPM is shut down (disabled). To change these 3 parameters, the DPM must be disabled. These 3 parameters involve the CTs, so if they are not the correct value and, therefore, need to be changed, the unit should not be running in the first place, as doing so would cause erroneous operation. The system must be disabled (not just OFF for some other reason) to change one of these 3 parameters. If the button in the bottom left of the display is the STOP button as in our example, the system is not disabled. This button should say RUN if the system is disabled. In our example, we will change the ILINE CT PEAK RATIO parameter and we will assume the DPM has now been disabled making our screen now appear as follows:



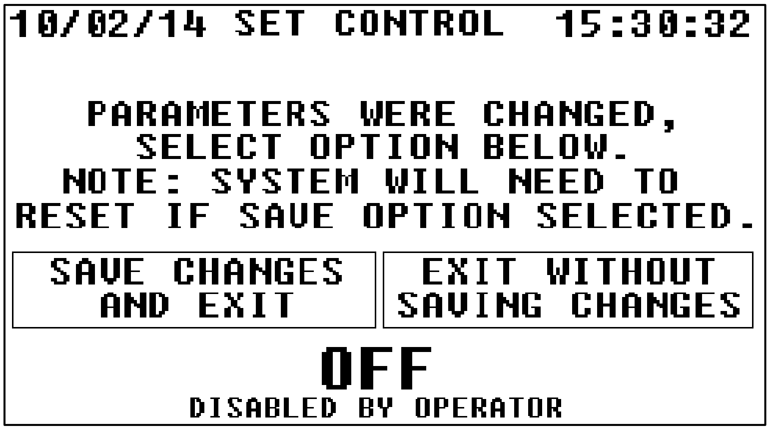
Pressing within the outline box containing the ILINE CT PEAK RATIO title results in the following display popping up:



A new value can be entered using the displayed keypad. The back arrow key can be used to delete an entered character. The escape (ESC) key can be used to exit this parameter without making any changes, Once you are satisfied with the changed value, press the ENTER key to exit this screen. Assuming a new value of 3000 has been entered, after pressing the ENTER key, our SET CONTROL screen now looks like:

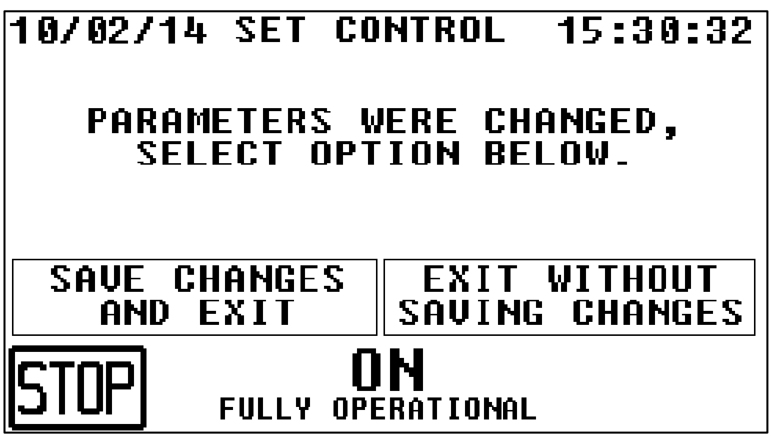


A few things have changed on this display. We have changed the value for ILINE CT PEAK RATIO to 3000; however, this value (along with all other parameter changes) will not be implemented until after we save all of the parameters. Also, the MENU button has been replaced by an EXIT button on the bottom right of the screen. To leave this display, we will need to press the EXIT button in order to tell the system what we want to do with the changes we made. Lastly, there no longer is a RUN button in the bottom left of the screen. Since we have changed a CT related parameter, the RUN option has been taken away. All other parameter changes besides these 3 CT related ones will not result in the removal of the RUN or STOP button. At this point other parameters may be changed or the EXIT button may be pressed to exit the SET parameters function. Pressing the EXIT button will result in a display similar to the following example:



The only options with this EXIT display are to “SAVE CHANGES AND EXIT” or “EXIT WITHOUT SAVING CHANGES”. If the first option to save changes is chosen, all changes to parameters that were made during this session will be saved and the system will implement those changed parameters. In addition, since CT related parameters were changed, the system will need to reset, as such changes require the system to reconfigure itself. Since the system will reset, the initial power-up “splash” screen will be the next display seen.

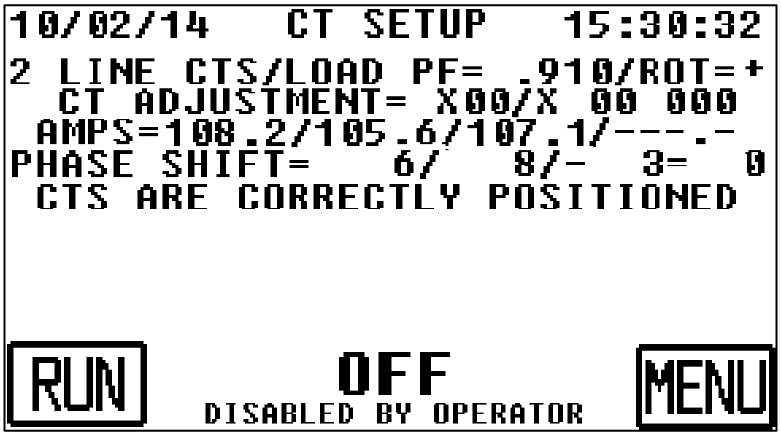
If changes were made to only non-CT related parameters (all parameters beyond the first 3), a display similar to the following will be displayed:



Since a CT related parameter was not changed, the system will not need to reset if changes are to be saved. During the time of pondering whether to save the changes or not, the option remains to change the enable status of the system. In this example the system is ON (enabled), so a change to disabled could be implemented by pressing the STOP button. If the system was disabled, the RUN button would be the option. After one of the EXIT options is chosen, the MENU page will next be displayed.

5.7. “CT SETUP” DISPLAY

Pressing the “CT SETUP” button on the MAIN MENU display will result in the CT SETUP screen being displayed:



This display is very useful in determining if the external LINE or LOAD placed current transformers (CTs) are placed on the correct phases and in the correct direction. Section 4.1 of this manual covers how to use this display to check the placement of the CTs.

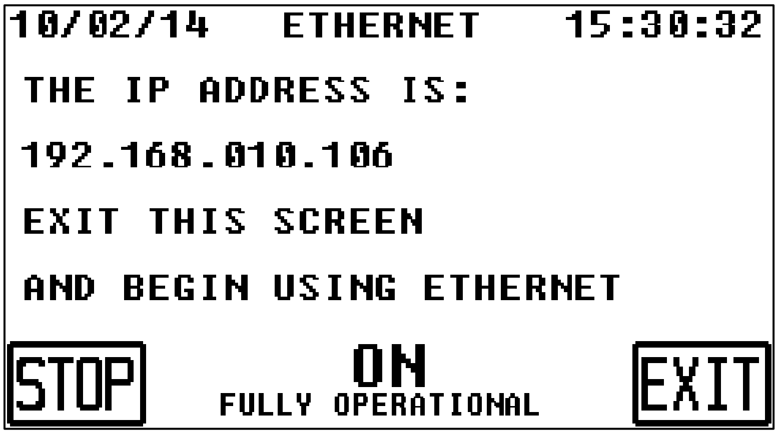
5.8. “ETHERNET INFO” OR “ETHERNET/IP INFO” DISPLAY

Systems equipped with Ethernet capability will have an “ETHERNET INFO” display option in the main menu. Systems equipped with Ethernet/IP capability will have an “ETHERNET/IP INFO” display option instead.

5.8.1. “ETHERNET INFO” DISPLAY IN ETHERNET EQUIPPED SYSTEMS

Prior to selecting the “ETHERNET INFO” display, the Ethernet port should be connected to a switch, hub, etc. in your network via an Ethernet patch cable, or connected directly to a powered computer using a crossover Ethernet cable. Your system is shipped with its Ethernet DHCP enabled. This will allow your network (or computer) to assign an IP address to the Ethernet port in the DPM that is compatible with it. In order to communicate over the network or from a computer using a crossover cable, you will need to know what IP address was assigned to the unit. This function will display that IP address. Please see 5.8.1.1 “SETTING STATIC IP ADDRESS IN ETHERNET EQUIPPED SYSTEMS to set a static IP address.

Similar to the CURRENTS display, the “ETHERNET INFO” display has 3 primary sections: The “Title” line, the “Status” section, and the information area. The information area is the only section that differs from the CURRENTS display. If RS-232 is selected instead of Ethernet communications in the “Set Parameters” for your system, the information area of the “ETHERNET INFO” display will display the message “ETHERNET DISABLED”. If Ethernet communications has been selected in the “Set Parameters”, the information area will initially contain the statements “GETTING IP ADDRESS” and “PLEASE WAIT…”. After 5-10 seconds, the IP address assigned to the system should be displayed as shown in the following example screen:

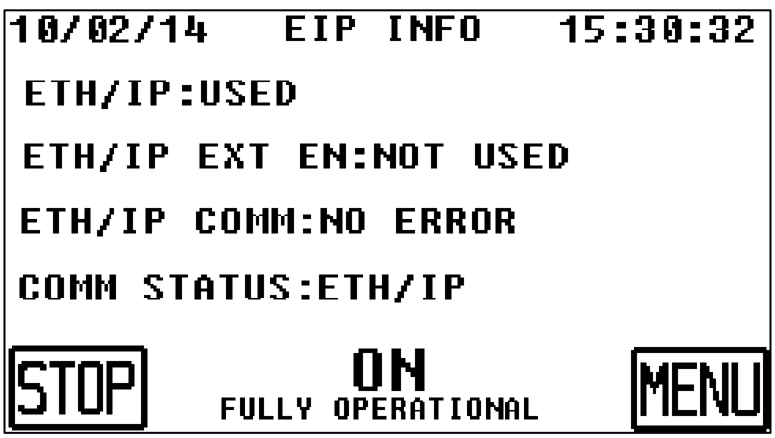


You can then use this Ethernet IP address to access the system over your Ethernet network or via a cross-over Ethernet cable to a computer. If the unit cannot retrieve an IP address, a "COMMUNICATION ERROR" message will eventually be displayed, indicating there is an internal problem with the system. In all cases, exit this screen by pressing the EXIT button.

5.8.2. "ETHERNET/IP INFO" DISPLAY IN ETHERNET/IP EQUIPPED SYSTEMS

Systems equipped with ETHERNET/IP capability have this information display to provide some operational information concerning the ETHERNET/IP function.

Similar to the CURRENTS display, the "ETHERNET/IP INFO" display has 3 primary sections: The "Title" line, the "Status" section, and the information area. The information area is the only section that differs from the CURRENTS display. An example of this "ETHERNET/IP INFO" display follows:



The information area of this display has four lines of Ethernet/IP related information. This information can be used to help troubleshoot problems you might be having communicating with the DPM over the Ethernet/IP network. The following four lines of information are displayed on this screen.

- ETH/IP: – Following this label will be the word "USED" if Ethernet/IP is selected as the desired communications mode via the "COMMUNICATIONS (RS232 OR ETHERNET/IP)" "set parameter". If RS-232 is selected via this "set parameter", "NOT USED" will be displayed. If you desire the DPM to communicate over an Ethernet/IP network, the display here must indicate "USED".
- ETH/IP EXT EN: – Following this label will be the word "USED" if the "set parameter" "ETHERNET/IP EXT ENABLE INPUT" is set to "USED", indicating the system can be enabled or disabled over the Ethernet/IP network if Ethernet/IP communications is indicated in the

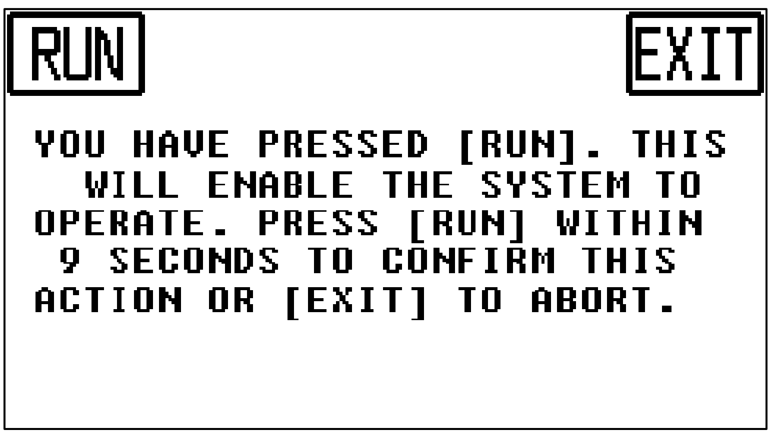
"COMM STATUS:" line of this display. The words "NOT USED" will be displayed if the "set parameter" "ETHERNET/IP EXT ENABLE INPUT" is set to "NOT USED", indicating the system will ignore the enable/disable command sent over the Ethernet/IP network.

- ETH/IP COMM: – If Ethernet/IP is selected as the COMMUNICATIONS mode, and the internal DPM control is having problems communicating with the internal Ethernet/IP module, "ERROR" will be displayed following this label.
- COMM STATUS: – This line indicates the communications mode being used by the DPM. It will indicate "RS-232" if the RS-232 serial communications is being used or "ETH/IP" if Ethernet/IP is being used.

  If the "ETH/IP:" status line on this display indicates "USED" and "RS-232" is displayed on this line, either the communications jumper J1 on the PC-I board is in the "R" position (hardware override that sets the communications mode to RS-232 even if the Ethernet/IP mode is requested via the "COMMUNICATIONS (RS232 OR ETHERNET/IP)" "set parameter", or there is an internal problem on either the PC-I or PC-C control boards.

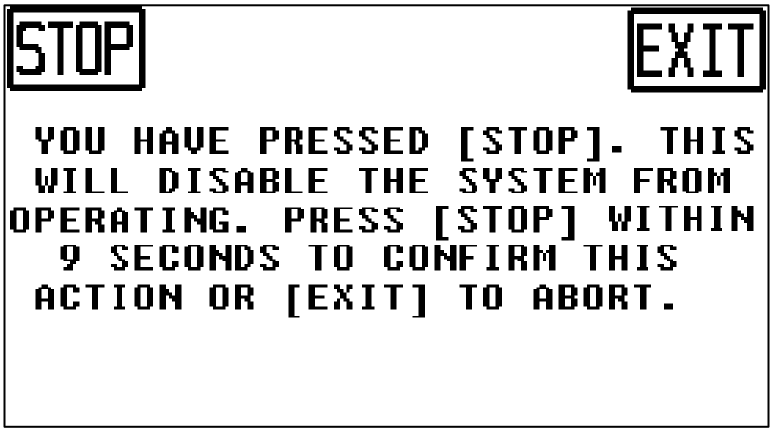
5.9. ENABLING OR DISABLING THE DPM USING THE RUN OR STOP BUTTONS

The system can be enabled or disabled by pressing the "RUN" or "STOP" buttons located in the "Status" section on the touch screen. All screens will have one of these buttons. If the system is presently disabled, the "RUN" button will be present on the screen. The operator can enable the system by pressing this "RUN" button. The following "confirmation" display will appear once the "RUN" button is pressed:



The "RUN" button on this display will have to be pressed before the 10 second timer on this display expires, for the system to become enabled. Pressing the "EXIT" button on this display will result in immediately going back to the previous display without enabling the system. Once a system is enabled, a "STOP" button will appear on all "Status" sections of displays in place of the "RUN" button. Enabling a system does not necessarily result in a system running. There may be other conditions that prevent a unit from running.

If the system is presently enabled, the "STOP" button will be present in the "Status" section of all displays. The system may not necessarily be running ("ON" status), as some condition may be keeping the system from running. The following "confirmation" display will appear once the "STOP" button is pressed:



The “STOP” button on this display will have to be pressed before the 10 second timer on this display expires, for the system to become disabled. Pressing the “EXIT” button on this display will result in immediately going back to the previous display without disabling the system. Once a system is disabled, a “RUN” button will appear on all “Status” sections of displays in place of the “STOP” button. Disabling a system will immediately stop a system from running.

6. SERIAL/ETHERNET COMMUNICATIONS

Serial and Ethernet communications interfaces are provided on the front of the DPM to allow the unit to be configured and data collected from the unit. The serial communications interface conforms to the RS-232C signal specification. The Ethernet interface is capable of 10/100 Mbps and uses TCP/IP protocol. The DPM can be configured via the front panel LCD touchscreen display (see section 5.6 of this manual) or using the KSET command over the serial/Ethernet communications (see section 6.3.4) for either RS-232 or Ethernet communications, but not both at once. Note: your system is normally shipped with the RS232 mode enabled.

6.1. USING THE RS-232 SERIAL COMMUNICATIONS INTERFACE

To communicate to the DPM using the RS-232 serial communications interface, you will need a “straight-through” (make sure it is not a NULL cable) DB9 M/F serial cable. These cables come in various lengths and can be readily purchased from many internet sites or from some retail stores. For basic communications with the DPM, at least the following wires must be present in the cable:

Table 6.1: RS232 Pin Configuration

Pin	Description
PIN 2	Transmit Data (data is transmitted from the unit to the terminal on this pin)
PIN 3	Receive Data (data is received by the unit from the terminal on this pin)
PIN 5	Signal Ground (reference for transmit and receive data, connected to earth ground within the terminal)

Cables purchased will have additional pins other than these primary ones wired as well. For all communications other than reprogramming the firmware in the DPM’s flash memory, just the 3 connections shown in Table 6.1 are required; however, a full cable is required to reprogram the firmware, as additional lines are used in the cable for the required hardware handshaking.

In the past, most computers came with native RS-232 serial ports; however, that is no longer true. If your computer does not have a native RS-232 serial port, you will need to obtain a USB to RS-232 serial port converter to convert one of your computer’s USB ports to an RS-232 serial port. There are many choices in the marketplace that accomplish this. Almost all will work well with basic communications; however, not all correctly implement the hardware handshaking that is needed for updating the firmware in the DPM’s flash memory. Two models tested by Mesta that do perform the hardware handshaking correctly are “Tripp-lite Keyspan USA-19HS” and “Startech ICUB2321F”.

Connect the 9-pin male D-connector end of the DB9 M/F serial communications cable to the connector on the front panel of the DPM. Connect the other end of the cable to a computer running a terminal program set up with the proper protocol. One such terminal program on many Windows based computers is Hyperterminal. Unfortunately, WindowsXP was the last Windows operating system that this terminal program was provided free with the operating system. Other free, open source terminal programs exist that can be downloaded for free over the internet. One such program that works quite well is Tera Term. Mesta Electronics provides separate documentation containing instructions of how to acquire and install Tera Term. Please check Mesta’s website (www.mesta.com) or contact Mesta for this documentation. After obtaining a suitable terminal program, you will need to set it up with the proper signaling protocol that follows in order to communicate with the DPM:

Table 6.2: Serial Communications Protocol	
Definition	**Description**
FORMAT	ASCII, 1 start bit, 8 data bits, 1 stop bit, no parity
BAUD RATE	9600
DUPLEX	Full
HANDSHAKING	No hardware or software handshaking is used. Interface is simple 3 wire (RXDATA, TXDATA, and GND)

Once the connection is made between the equipment and the terminal, the DPM is powered, and your computer is running a terminal program with the correct protocol selected, press the <Esc> key on your computer a few times. The monitor of the terminal should display "<ESC>" every time you press the <Esc> key. If not, recheck your wiring and protocol setup.

6.2. USING THE ETHERNET COMMUNICATIONS INTERFACE

To activate the Ethernet interface (in place of the RS232 serial interface) select the Ethernet option for the "Communications" via the front panel LCD touchscreen display (see section 5.6) or using the KSET command over the serial/Ethernet communications (see section 6.3.4). Connect a patch cable between the RJ45 connector on the front panel of the DPM and an Ethernet switch, hub, etc. in your local area Ethernet network. As an alternative, an Ethernet connection can be made directly to a computer using a cross-over Ethernet cable. If a more permanent connection to the DPM is desired, the connection to the DPM can be made directly to the Ethernet module located on the customer interface board (Refer to installation diagram in appendix C) instead of the RJ45 connector on the front panel. The Ethernet interface is initially set up for DHCP (Dynamic Host Configuration Protocol). To set a static IP address, see section 6.2.1 **"**SETTING STATIC IP ADDRESS IN ETHERNET EQUIPPED SYSTEMS. Once connected to your Ethernet network, your network's DHCP server should allocate an IP address to the DPM. If directly connected to a computer via a cross-over cable, that computer should allocate an IP address to the DPM. Each DPM is configured with a unique Ethernet Hardware MAC address (as are all other Ethernet compatible equipment). This address is printed in two locations on your equipment. It is on the back of the LCD display enclosure and also on the actual Ethernet module located on the 2" x 8" Interface board in the system. The address is a series of 6 pairs of hexadecimal numbers (0-9 or A-F) separated by "-" or "." Characters (e.g. 00-20-4A-B0-31-06). You may need this information for your DHCP server.

Before you can begin communicating over Ethernet to the DPM, you will need to determine the IP address that gets assigned to it by your server or computer. There are a few ways to determine this IP address:

1) Using the front panel LCD screen, go to the main MENU and select the "ETHERNET INFO" display. This will display the IP address on the LCD display. See section 5.8.1 for additional information.
2) Perform an internet search for Lantronix DeviceInstaller. Download and run this free software on a computer connected to the Ethernet network the DPM is on. This software will detect all DPMs connected to your network. If you have more than one DPM connected, you will need to know the MAC address of the DPM you wish to communicate with.
3) Your system administrator may be able to tell you the IP address that the server assigned.

The assigned IP address is “dynamic”. If the DPM is taken off the network or powered down for several days, the DHCP server may assign a different IP address when the DPM is once again connected to the network. To avoid going through the above procedure every time this happens, a static IP address should be assigned to each DPM. Assigning a static IP address can be done a few different ways. One way is to have your DHCP server allocate a fixed IP address for each DPM. Another way is to use the Lantronix DeviceInstaller software mentioned earlier to disable the DHCP capability of the DPM and instead assign a fixed IP address to the DPM. Note that the assigned IP address must be compatible with your network or your network will not be able to communicate with the DPM.

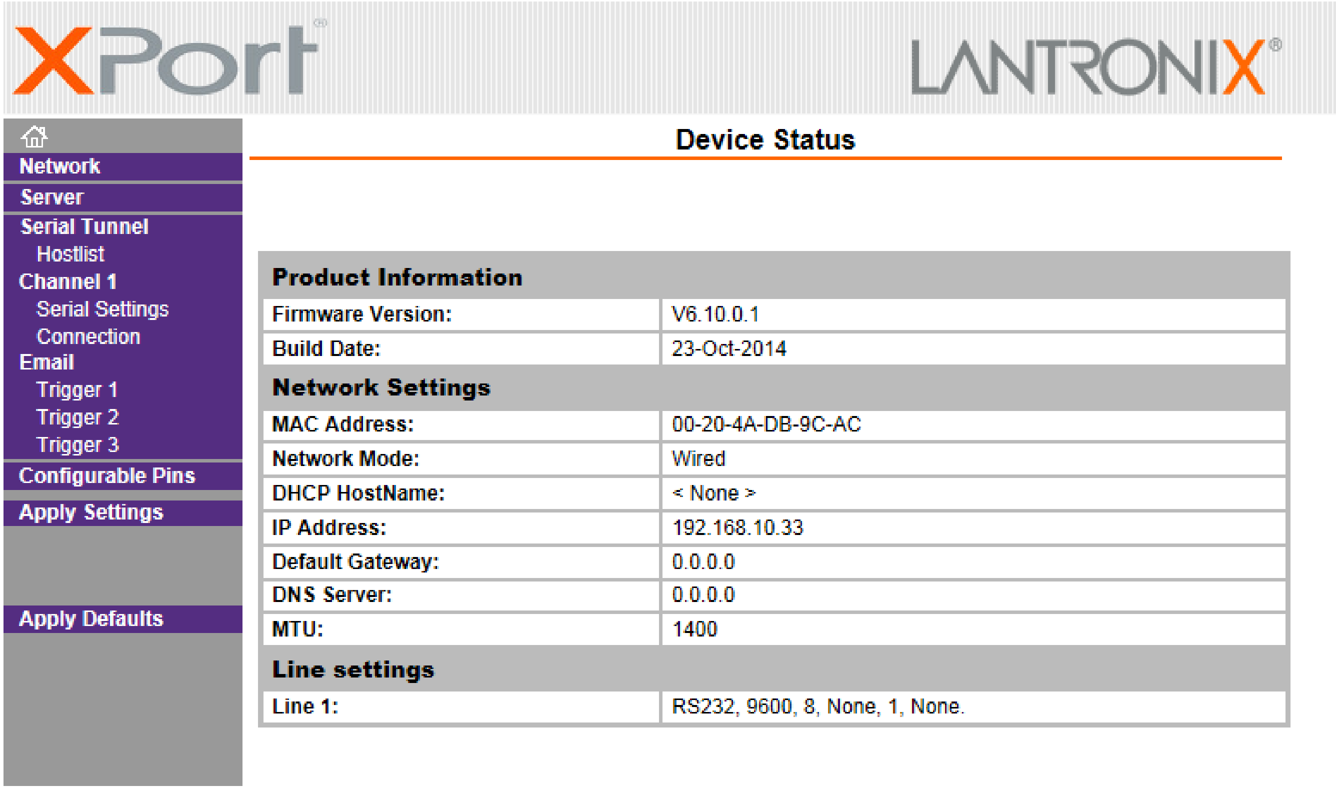
Once you have the IP address for the DPM, you can access it from any computer on the network in various ways. One way is through a terminal program such as Hyperterminal or Tera Term similar to the method described earlier in this section used to communicate over the RS-232 serial communications. Set up Hyperterminal properties to “Connect using” TCP/IP. Input the IP address for the DPM as the “Host Address” (format xxx.xxx.xxx.xxx where you put in the actual IP address in place of the x’s – e.g. 192.168.10.20). Finally, input 10001 as the port address. This will allow you to communicate with the DPM similar to the RS232 serial interface using the exact same commands, but from anywhere in your network. For using Tera Term, consult the same documentation cited earlier for installing/configuring Tera Term.

Another means of communicating with the DPM is through TELNET (a DOS based interface) by typing “TELNET xxx.xxx.xxx.xxx 10001” at the DOS prompt (where xxx.xxx.xxx.xxx is replaced with your actual IP address). This method may have the unfortunate side-affect of having a local echo which results in double characters being displayed every time you type a character.

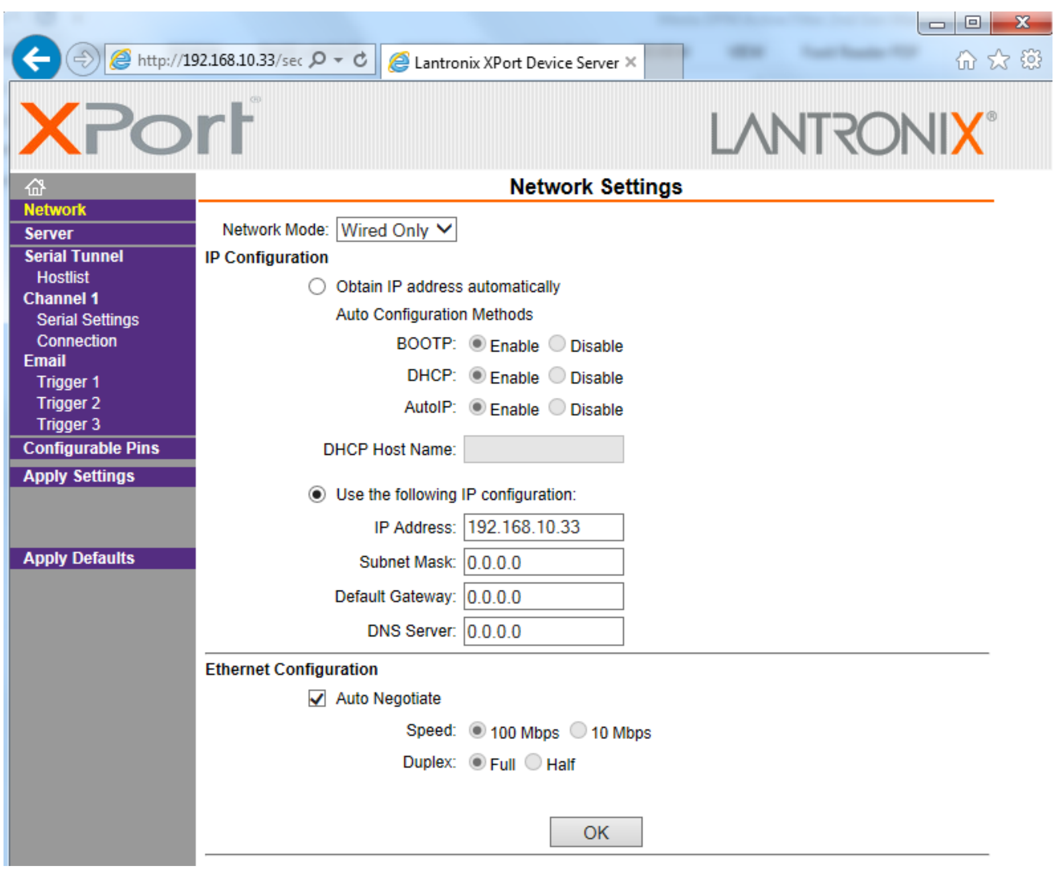
The Ethernet interface in the DPM is also equipped with a web server. This allows a third method using a browser such as Internet explorer and entering the address “http://xxx.xxx.xxx.xxx/main.html” (again, use the actual IP address in place of the xxx.xxx.xxx.xxx). A window titled “TCP/IP connection 10001 status: Connected” should pop up. Click within the window and you should start communicating. This method requires you to have java installed on your computer (this can be downloaded free from the java.com website should your computer not already have this capability).

6.2.1 “SETTING STATIC IP ADDRESS IN ETHERNET EQUIPPED SYSTEMS

It is possible to set a static IP address for the system. First determine the DHCP assigned IP address by following the steps in section 5.8.1 “ETHERNET INFO” DISPLAY IN ETHERNET EQUIPPED SYSTEMS”. Now open an internet browser such as Internet Explorer, Google Chrome, Firefox, etc. In the address bar, enter the IP address. For example enter “192.168.010.33” in the browser address bar. Press enter. The following page should open up:



This page shows various system networking information. It is possible to change many settings to better fit your network. In order to set a static IP address, click on Network. The following page will be displayed:



Choose “Use the following IP configuration:” and enter the desired IP address, Subnet Mask, Gateway, and DNS Server information. Click **OK and** then click **Apply Settings**. Now wait for the message “Please wait while the configuration is saved… The unit will reboot in order for the settings to be applied”. Eventually the message “Network Connectivity settings have been modified” will appear. Now the system is setup with the new static IP address.

6.3. SERIAL COMMUNICATIONS COMMANDS

These commands can be used either over the RS-232 or Ethernet communications. Once you receive the prompt character “>“, you may enter a command to obtain information that you desire from the unit. Each command begins with a letter followed by additional parameter characters, terminated with the **<Enter>** key. Either upper or lower case characters may be used as the interface is not case-sensitive. The following keyboard keys have special meaning:

<Esc> The escape key can be pressed at any time to abort any command. After pressing the escape key, the unit will display **<ESC>** to indicate such a key was pressed followed by a new ">" prompt. At such a time a new command can be entered.

<Enter> The “Enter” key is pressed to send the command to the DPM. Up until the “Enter” key is pressed, the command may be typed and altered using the “Backspace” key. No action will be taken by the DPM on the command until the “Enter” key is pressed.

Commands begin with a letter, with the most commonly used summarized in Table 6.3. Additional information about these commands appears in subsequent sections. In the format for these commands, items contained within brackets “[“ and “]” are optional parameters that may be entered. A value “n” is a one digit number and “nn” is a one or two digit number. “hh”, “mm”, and “ss” are two digit numbers for hours (00-23), minutes (00-59), and seconds (00-59). “mm”, “dd”, and “yy” are two digit numbers for month (01-12), day (00-31), and year (00-99). On-line command help is available. A **?** command entered will display the list of available command letters. The command letter listed followed by a **?** will display information about that command. For example sending a **?** command will display:

```
AVAILABLE COMMANDS:
A, E, H, K, L, O, Q, S, T, V, Z
```

Following this up by sending an **A?** command results in the following on-line information being displayed:

```
(A)CEN/(A)CDIS command. Enables/Disables the DPM.
 Command format is:
 >ACEN
     Enables the DPM.
 >ACDIS
     Disables the DPM.
```

Table 6.3: Serial Communications Commands

Command	Format	Function
A	ACEN or ACDIS	Enables or disables operation of the unit
E	ES[-[n]] or EB	Extra history buffers used for debugging purposes
H	HO[-[nn]][,V] or HR[-[nn]]	HO is the “on/off” history HR is the “reset” history
K	KSET	Displays programmable parameter values
L	L	Displays additional status information
O	OPT	Displays firmware version and system options configuration

Q	QOFF	Displays measured DC content in several monitored parameters
S	S[x]	Status display. Displays operational values.
T	TI or TT=hh:mm[:ss] or TD=mm/dd/yy	TI displays current date and time. TT sets time. TD sets date.
V	V[x]	Similar to S command, but continuously displays values until **<Esc>** key is pressed.
Z	ZCAL	Displays readings of parameters measured by the system.
?	?	Displays list of available command letters

6.3.1. "A" ACEN/ACDIS SERIAL COMMAND

Sending the ACEN command is identical to pressing the "RUN" button on the LCD touchscreen display. If other operating conditions are OK for the system to operate, sending the ACEN command will allow the system to start operating. Sending the ACDIS command is identical to pressing the "STOP" button on the LCD touchscreen display. If the system was operating the ACDIS will shut it down and the system will not run again until either the ACEN command is sent or the "RUN" button on the LCD touchscreen display is pressed. The last entered command is "remembered" through power off/power on cycles. If an ACDIS command was last sent or "STOP" button was last pressed prior to removing power to the unit (by either turning off the front power switch or loss of utility power), the next time power is reapplied to the unit, the unit will stay in the disabled state and will not operate until enabled. If an ACEN command was last sent or "RUN" button was last pushed prior to removing power to the unit, the next time power is reapplied to the unit, the unit will be in the enabled state and will operate if all other conditions are OK for the system to operate.

6.3.2. "E" EXTRA HISTORY COMMAND

This is a troubleshooting tool that you may be instructed to perform by a factory representative should you be experiencing a possible problem.

6.3.3. "H" HISTORICAL EVENT DATABASE DISPLAY COMMAND

The DPM provides two event historical databases – an "On/Off" and a "Reset" database. Records of both the databases are numbered starting with 1. Up to 99 "On/Off" events and 30 "Reset" events are stored. Once the limit is reached, the oldest event is discarded to make room for the newest event. The events are numbered with 1 being the most recent event, followed sequentially by earlier recorded events. These recorded events are saved in battery backed up memory, so loss of power to the unit will not result in any events being lost.

6.3.3.1. "HO" HISTORICAL ON/OFF EVENT DATABASE DISPLAY COMMAND

The first of these databases contains the date and time the system starts operating (correcting harmonics, etc.) and stops operating. The reason for a unit to stop operating could be intentional (system is disabled) caused by an operator pressing the STOP button on the front panel LCD display, by an operator issuing an ACDIS command over the communications connection, or by receiving an external disable signal (if that feature is activated). The reason for a unit to stop operating could be due to an unavoidable external condition such as loss of utility voltage (or dropping out of tolerance) either due to unit being powered off via the front power switch or a utility interruption. The reason for a shutdown could be due to a temporary condition that the unit was unable to deal with requiring the unit to shut down and restart, such as a hardware current trip. Also, the reason could be due to a problem such as over-temperature (dirty filter or inoperable fan) or internal problem detected. Each time the DPM's power inverter shuts down, a snapshot of several operating parameters (voltages, currents, temperature, etc.) are saved along with the reason for the shutdown. The last 99 "on-off" events are stored in battery-backed up memory inside the DPM, thus this information is preserved even when the unit is totally powered down.

The information in this database may be viewed by using the "HO" command issued of the communications interface. The full format of the command is **HO-n[,V]** where n is a number from 1 to 99, indicating the number of stored events to be sent. The optional "**,V**" attribute may be added to the command to display the "verbose" data. Without the "**,V**" suffix added, only the date and time for when the system started and stopped, and the reason for the system stopping will be displayed. Adding the "**,V**" suffix results in all of the parameters saved at the time of the shutdown to be displayed as well. Acceptable commands include **HO-10** and **HO-99,V**. The **HO-10** will just send the last 10 on/off events with no additional parameters being sent over the communications. The **HO-99,V** will send all 99 on/off events and all operating parameters stored at the time of each shut down being sent over the communications interface. The most recent event will be numbered 1 with older events sequentially numbered 2 and up. The command **HO-4** would produce the following example output:

```
         OPERATIONAL HOURS =         30, ON/OFF EVENTS = 29
 1. ON 10/13/14 09:36:47 TO 10/14/14 10:38:53, OPERATOR DISABLED INVERTER
 2. ON 10/13/14 09:36:29 TO 10/13/14 09:36:41, OPERATOR DISABLED INVERTER
 3. ON 10/13/14 09:33:31 TO 10/13/14 09:34:06, OPERATOR DISABLED INVERTER
 4. ON 10/13/14 09:30:45 TO 10/13/14 09:33:24, OPERATOR DISABLED INVERTER
```

It begins with the number of OPERATIONAL HOURS. This is a tally of the cumulative number of hours the DPM has been operating (producing correction current, not just powered up). ON/OFF EVENTS indicates the number of ON/OFF events that have been recorded. Once the maximum of 99 is reached, the oldest records are discarded as new events occur, resulting in the newest 99 events being kept. This is followed by one line for each stored event. Each line contains the date and time the unit started operating, followed by the date and time the unit shut down, followed by the reason the unit shut down. The time that the unit ran last (in record 1) was 1 day, 1 hour, 2 minutes, 6 seconds (10/14/14 10:38:53 minus 10/13/14 09:36:47) before an operator disabled the system by either sending an ACDIS command over the communications interface or pressing the STOP button on the LCD touchscreen. Prior to this event, event 2 indicates the unit ran for 12 seconds, again being shut down by an operator. In between events 2 and 1, the unit stayed off for 6 seconds (10/13/14 09:36:47 minus 10/13/14 09:36:41).

An example of a stored event recalled with the "**,V**" option follows:

```
         OPERATIONAL HOURS =        305, ON/OFF EVENTS = 29
 1. ON 10/13/14 09:36:47 TO 10/14/14 14:38:53, OPERATOR DISABLED INVERTER

   LINE_VOLT AB/BC/CA=481.2/480.8/480.4  LINE_VOLTS INST=-430.8/-238.5/ 669.3
   LINE_AMPS  A/B/C  =102.8/100.6/102.0  LINE_AMPS INST =-133.4/  22.4/ 111.0
   DPM_AMPS   A/B/C  = 33.1/ 30.9/ 31.8  DPM_AMPS INST  =  30.9/  16.4/- 47.3
   DPM_HFAMPS A/B/C  =  0.3/  0.2/  0.3  DPM_DCAMPS     =   0.4/-  0.3/-  0.1
   LOAD_AMPS  A/B/C  =108.2/105.6/107.1  LOAD_AMPS INST =-154.2/   5.9/ 148.3
   INV1_AMPS  A/B/C  = 35.2/ 33.0/ 33.1  INV1_AMPS INST =  30.9/  17.3/- 48.3
   LINE_FREQUENCY(HZ)=      60.00        AC LINE RMS LEVEL = OK
   DC_VOLT DES/ACTUAL=   821.3/819.7     DC_VOLT INST LO/HI=   410.1/409.7
   DC_VOLT FILT LO/HI=   410.1/409.7     TEMP PCB/HS1A/HS1B= 24.9/32.0/31.9
   LINE_AMPS HARMONIC=  3.4/  3.3/  3.6  LOAD_AMPS HARMONIC= 34.1/ 32.4/ 33.0
   LINE_PWR KW/KVA/PF= 82.6/ 82.9/ .999  LOAD_PWR KW/KVA/PF= 82.0/ 89.1/ .920
   LINE_VOLT HARMONIC=  2.3/  2.6/  2.2  DPM-INV RMS AMPS  = 12.0/ 11.8/ 12.2
   HPP COUNTS OFF/RUN=20001(S)/20000(S)
```

Along with the OPERATIONAL HOURS header line and the ON/OFF/shutdown reason line, there are 11 additional lines containing operational information at the time the unit shut down.

The first additional line contains line-to-line voltage information for all 3 phases Vab, Vbc, and Vca. On the left side are the rms values of these voltages and on the right side are the instantaneous values of these voltages. Since the voltages are sinusoidal and vary between – and + values, the instantaneous voltages will have both positive and negative values, whereas the rms values will always be positive.

The next 4 lines are currents for all 3 phases A, B, and C. LINE_AMPS are the currents from the utility, LOAD_AMPS are the currents drawn by the load, DPM_AMPS are the currents drawn by the DPM, and INV1_AMPS are internal currents produced by the DPM, which will be fairly similar to the DPM currents. Similar to the line voltages, the left side of the LINE, DPM, LOAD, and INV main currents are rms values and the right side are instantaneous values. DPM_HFAMPS indicates the amount of high frequency current the DPM is emitting to the line. This value should be less than 1% of the DPM current rating. If not, it could indicate a problem with the high frequency filtering in the unit. DPM_DCAMPS is the amount of DC current the DPM is emitting into the line. These values will normally swing within +/- 1% of the DPM current rating. Higher values that remain positive or negative indicate a possible problem with the inverter or the DPM current sensors.

LINE_FREQUENCY is the frequency of the line voltage. AC LINE RMS LEVEL indicates the status of the AC line at the time of the shutdown.

DC_VOLT DES/ACTUAL are the DC voltage that the system is trying to maintain (DES short for desired) and the ACTUAL DC voltage across the DC Link capacitors averaged over the last AC line period. DC_VOLT INST is the instantaneous voltage across the lower and upper halves of the DC Link capacitance. DC_VOLT FILT voltages represent slightly filtered versions of the instantaneous DC link voltages, but not nearly as filtered as the DC_VOLT ACTUAL voltage.

TEMP PCB is the temperature on the control board. This will usually be close to the room ambient temperature as it is close to the air intake to the DPM. HS!A and HS1B are temperatures on the left and right side of the heatsink. They normally will be close in value to each other, but several degrees higher than the PCB temperature unless the unit is not running or is very lightly loaded.

LINE_AMPS and LOAD_AMPS HARMONIC are the harmonic current content in rms amps of the currents drawn from the line and currents delivered to the load side.

LINE_PWR and LOAD_PWR are the KW (power in kilowatts), KVA (kilovolt-amperes), and power factor of the power drawn from the line and power delivered to the load.

LINE_VOLT HARMONIC are the line-to-line voltage harmonic content in rms volts of the line voltages.

DPM-INV RMS AMPS are the rms values of the difference between the DPM and INV currents. The INV currents are similar to the DPM currents except they contain high frequency currents produced by the switching of the inverter. It is necessary to keep these high frequency current components from reaching the line, so they are removed by internal power filtering components prior to the point where the DPM currents are measured. These values are normally about 10-15% of the current rating of the DPM. Values higher than this indicate a problem with either the DPM or INV current sensors.

The internal clock in the DPM has a resolution of 2 seconds. For very short times ON or times OFF, HPP COUNTS is used to determine how long a system ran once it came on or how long a system was OFF since the prior shutdown event. Each count represents 1/20000th of a second. The first number represents the number of counts that the inverter was off prior to turning on. The 2nd number represents the number of counts that the inverter ran for. If a count is up around 20000, the system was off or on at least 1 second, and the count is, therefore, not applicable – instead, the time ON or time OFF should be calculated as was done earlier in the HO-4 example.

6.3.3.2. “HR” HISTORICAL RESET EVENT DATABASE DISPLAY COMMAND

A second database contains information about each time the DPM microcontroller is reset. Information recorded includes date and time when the event occurred and the cause of the reset. A processor reset occurs every time power is applied to the unit; therefore, most resets that appear in this data base will be “POWER-UP” resets. However, the appearance of abnormal resets may be useful in diagnosing a possible problem. The last 30 “Reset” events are stored in battery-backed up memory. To obtain “Reset” records over the communications interface, use the HR-n where n is a number from 1 to 30, indicating the number of stored reset events to be sent. The command **HR-4** would result in information similar to the following being displayed:

```
        OPERATIONAL HOURS =         30, RESET EVENTS =  30
 1. 10/14/14 09:12:23,   RESET: POWER UP          0000/0000/0000
 2. 10/13/14 17:00:49,   RESET: POWER UP          0000/0000/0000
 3. 10/09/14 09:39:53,   RESET: POWER UP          0000/0000/0000
 4. 10/09/14 08:51:28,   RESET: POWER UP          0000/0000/0000
```

Each line contains one reset event containing the date and time of the reset, the reason for the reset, and some additional debugging information.

6.3.4. “K” KSET (SYSTEM OPERATING PARAMETERS) SERIAL COMMAND

The DPM has several customer accessible parameters that can be altered in the field. These parameters may have to be altered to adapt your system to your particular application. These changes can be made either using the LCD front panel touchscreen “VIEW/SET PARAMETERS” displays or over the communications link using the **KSET** command. Typing in the **KSET** command will result in information similar to the following list being displayed:

```
CUSTOMER SETUP CONFIGURATION

ILINE CT PEAK RATIO (1% RATED/BIT):                    1000
CT PLACEMENT (LINE OR LOAD):                           LINE
NUMBER OF CTS (2 OR 3):                                   2
%LOAD TO BE CORRECTED BY THIS UNIT:                     100
PART OR TOTAL AMPS/POWER DISPLAYED:                    PART
UNIT DISABLED IF LOAD POWER BELOW THIS %:                 0
WHEN TO DO LINEAR PF CORRECTION:                      NEVER
THDR OR THDF DISPLAYED:                                THDR
DISPLAY FILTERING (0-100 = MIN-MAX):                     50
HARMONIC CALC FILTERING (0-100 = MIN-MAX):               20
COMMUNICATIONS (RS232 OR ETHERNET):                ETHERNET
EXTERNAL ENABLE INPUT:                             NOT USED
LCD CONTRAST ( 20-170 = MIN-MAX)                        128
```

Changing these parameters is password protected to prevent unauthorized personnel from making changes. In order to change the customer accessible parameters under the Customer Setup Configuration you must perform the following numbered steps listed below. The **<enter>** designation is instructing you to hit the enter key. You may type either capital letters or lower case letters, the system is not sensitive to the case used. If you make a mistake during this procedure, you may hit the **<Esc>** key on your computer’s keyboard to abort the procedure. Aborting the procedure will result in no changes to any of the parameters being saved as no changes are actually implemented until you go through all of the parameters and exit the procedure normally (indicated by the **>** prompt once again being displayed).

Note: The first three parameters (all having to do with the CT setup) listed in the Customer Setup Configuration cannot be changed unless the DPM is disabled either via the ACDIS command over the communications link or by pressing the “STOP” button on the LCD display. Also, if the LCD display is presently in the “VIEW/SET PARAMETERS” screens, the KSET command will not allowed and if in the KSET;CH command, the “VIEW/SET PARAMETERS” LCD screen will not be allowed.

1. Type **DCS <enter>**
2. System should respond with “access OK”
3. Type **KSET;CH <enter>**

4. System should respond with “CUSTOMER SETUP CONFIGURATION:” and then start listing each customer accessible parameter individually followed by the question “ADJUST (Y/N)?”
5. Type **N<enter>**until you reach the parameter you want to change
6. When you have reached the parameter you want to change type **Y<enter>**
7. If there are only two available choices for this parameter, the system will change the parameter and move on to the next line. If there are more than two choices for a parameter, the system will respond with “New Value” followed by a “_” prompt, or several numbered options to choose from. At this point you can respond by typing a numeric value after the “_” prompt followed by **<enter>**, or type in the number that corresponds to one of the choices followed by **<enter>.**
8. Answer **N <enter>**to all remaining “ADJUST (Y/N)?” questions until the “>” prompt is displayed indicating you have exited the parameter setup function
9. Type **kset<enter>** to verify that the parameter you selected has been changed

For detailed descriptions of each of these parameters, please see section 5.6 of this manual along with the following comments:

There are a couple of differences between setting parameters over the communication link and setting them via the LCD touchscreen:

1) The KSET serial command adds the parameter “LCD CONTRAST”. In case you accidentally set the display contrast so low or so high that it is very difficult to view the display to get to the contrast adjustment display, you can set the contrast via the KSET;CH command to a reasonable level (128 should work OK). This will allow you to “see” the display again.
2) When using KSET;CH command to change the COMMUNICATIONS between RS-232 and ETHERNET, once you exit the KSET procedure, you will lose communications since the other mode will now be active.

6.3.5. “L” ADDITIONAL STATUS SERIAL COMMAND

The L command lists additional status information that may be useful when troubleshooting potential problems with a system.

6.3.6. “O” OPT (OPTIONS CONFIGURATION) SERIAL COMMAND

This command lists the firmware version programmed into the control’s flash memory along with factory programmed options. An example of information sent in response to an OPT command is:

```
DPM SOFTWARE VERSION:   1.37-57-2-60HZ
RATED VOLTAGE (V):       480
RATED CURRENT/INV (A):   100
MAX 1PH CURRENT (%):     105
```

This information indicates that the system is set up for 480 Vac nominal voltage and is a 100 amp capacity DPM. The 100 amp capacity and MAX 1PH CURRENT of 105% indicate that the average rms current correction supplied by the DPM (of all 3 phases) will be limited to 100 amps with no single phase allowed to exceed 105% of this 100 amp rating, or 105 amps.

6.3.7. “Q” QOFF SERIAL COMMAND

The QOFF command displays DC offsets of several parameters monitored by the control. All but the VHI and VLO will normally be around 0. This is sometimes a useful diagnostic tool.

6.3.8. “S” OR “V” STATUS SERIAL COMMANDS

An **S** or **V** followed by an optional single letter command corresponding to a particular parameter may be sent to the DPM to obtain operating status. The following summarizes these commands:

Commands: DPM status information may be examined using the following commands:

Sn **Status** command displays the present status of a parameter. To display the status of a particular parameter, type **Sn<enter>.** "**S**" indicates the status command, "**n**" represents a character (letter or number) designating the parameter you desire to observe, and **<enter>** indicates an enter key, which is used to terminate the command. Table 6.4 contains the list of available parameters that may be examined. As an example, if the present AC line voltage is to be examined, one would type **SA** followed by striking the **<enter>** key. One can also just enter **S<enter>** with no parameter letter and obtain a status update of the most useful parameters all at once.

Vn **View** command is similar to the Status command except the View command will continually display the status of the selected parameter until one presses the escape key on the computer keyboard. To continually view the status of a particular parameter, type **Vn<enter>**. "**V**" indicates the View command, **"n"** represents a character designating the parameter to be viewed, and **<enter>** indicates a carriage return (or Enter key) which is used to terminate the command. Again, Table 6.4 contains the list of available parameters that may be examined. As an example, if the AC line voltage is to be viewed continuously, one would type **VA** followed by striking the **<enter>** key. One can also just enter **V<enter>** with no parameter letter and continually view the status of the most useful parameters all at once.

Table 6.4: Status Display Parameters

S/V option	Status Parameter	Units
A	AC Line Voltages	RMS volts
B	Line Frequency	Hertz
C	Line THDR (or THDF) percent voltage harmonic distortion on the line	% of line voltage
D	DPM Currents	RMS amperes
E	CT% (% of line CT rating that current thru the CTs represents) / Neutral Amps (Neutral current – only valid if 3 line CTs are used)	% of rating / RMS amperes
F	DPM Loading for each phase	% of rating
G	Line Currents (Current drawn from the utility)	RMS amperes
H	Load Currents (Current drawn by the load)	RMS amperes
I	Line_THDR (or THDF) percent current harmonic distortion on the line	% of line current
J	Load_THDR (or THDF) percent current harmonic distortion on the load	% of load current
K	Total current harmonics drawn from the utility	RMS amperes
L	Total current harmonics drawn by the load	RMS amperes
M	Line Power (Real Power/ Kvolt-amps/ power factor) drawn from the utility)	KW/KVA/PF
N	Load Power (Real Power/ Kvolt-amps/ power factor) drawn by the load)	KW/KVA/PF
O	Temperature (Ambient/Heatsink 1/Heatsink 2)	ºC
P	DC Capacitor Bus Voltage (sum of lower half + upper half of capacitor bank	Volts DC
Q	DPM Mode	
R	DPM Status	
S	DC Fan status and current	Fan status/ DC Amps

U	Inverter Currents – internal parameter roughly equal to DPM Currents	RMS amperes
V	Amount of high frequency current produced by DPM (should be less than 1% of the DPM current rating)	RMS amperes
W	Amount of DC produced by DPM (should be less than 1% of the DPM current rating)	DC Amps
X	Internal voltages	Volts DC
Y	Internal voltages	Volts DC
Z	Internal voltages	Volts DC
0	(Dpm – Inv) currents (should be around 10-15% of the DPM current rating)	RMS amperes
1	Phase shifts between voltage and load current for the 3 phases, followed by # of CTs used (2 or 3) and phase rotation (+ or -)	Degrees
None	Parameters A through S displayed all at once	

These parameters are identical to parameters displayed on the LCD display via the CURRENTS, POWER and VOLTAGES, and MISC displays. For additional explanations on a parameter, please see the description of that parameter in section 5 of this manual.

If an **S** (or **V**) command without a following letter is entered, parameters A through R will be displayed as a page of data similar to the screen shot shown in the example that follows. The group of parameters displayed are considered the most useful parameters to observe.

```
                  *** MESTA DPM STATUS (10/02/14, 15:30:32)***

LINE_VOLT AB/BC/CA= 481.2/480.8/480.4   LINE_FREQUENCY(HZ)=       60.00
VLT_THDR% AB/BC/CA=   2.3/  2.6/  2.2   DPM_AMPS    A/B/C =  33.1/ 30.9/ 31.8
CT% / NEUTRAL AMPS=    10.3% / ----.-   DPM_LOAD%   A/B/C =  33.1/ 30.9/ 31.8
LINE_AMPS   A/B/C = 102.8/100.6/102.0   LOAD_AMPS   A/B/C = 108.2/105.6/107.1
LINE_THDR% A/B/C  =   3.4/  3.3/  3.5   LOAD_THDR%  A/B/C =  31.5/ 30.7/ 30.8
LINE_AMPS HARMONIC=   3.5/  3.3/  3.6   LOAD_AMPS HARMONIC=  34.1/ 32.4/ 33.0
LINE_PWR KW/KVA/PF=  82.6/ 82.7/ .999   LOAD_PWR KW/KVA/PF=  82.0/ 89.1/ .920
TEMP PCB/HS1A/HS1B=  24.9/ 32.0/ 31.9   DC_VOLT(LO+HI=SUM)= 409.9+410.1=820.0
MODE = ON –   FULLY OPERATIONAL         STATUS =    FULLY OPERATIONAL
FANS(   321)      =    111 /  2.492
```

S Command Sample Output

6.3.9. “T” DATE AND TIME COMMAND

The DPM has a timekeeper that is used to timestamp when events occur. The time is not used in any critical systems in the DPM and will not affect its performance. To display the current time setting, enter TI at the command prompt. The current date and time will be displayed in 24 hour format (0-11 hours are AM, 12-23 hours are PM).

To change the date of the DPM, use the TD command. The complete date must be entered in month/day/year format, using a backslash as a delimiter. Each value must be exactly 2 characters long. For example, if the date is June 22, 2014, the following command needs to be entered:

TD=06/02/14

To change the time of the DPM, use the TT command. The complete time (seconds may be left off) must be entered in hours:minutes:seconds format, using a colon as a delimiter. Each value must be exactly 2 characters long. For example, if the time to be entered is 2:40PM, the following command needs to be entered:

TT=14:40:00 or **TT=14:40**

Please see 5.6.1 section for additional details.

6.3.10. “Z” ZCAL COMMAND

The ZCAL command displays several parameters monitored by the control. This is sometimes a useful diagnostic tool.

7. ETHERNET/IP AND MODBUS TCP FOR ETHERNET/IP EQUIPPED SYSTEMS

The Ethernet/IP version of the DPM is capable of Implicit I/O data communication with a PLC, HMI, SCADA or other Ethernet/IP scanner device. DPM status and troubleshooting information can be sent to a scanner device, and the DPM can be enabled or disabled by a scanner device via Ethernet/IP. The Ethernet/IP communications is implemented using “Anybus Communicator Ethernet/IP and Modbus-TCP” from HMS. It is fully ODVA compliant.

The DPM can communicate with an Ethernet/IP device via Implicit or I/O messaging at a periodic rate of up to 5Hz (200mS).During such a connection, a scanner device (PLC/HMI/SCADA) can periodically scan the adapter device (DPM) for operating status, attention code, voltage, current, power, and other status information. Please see Table 7.2 for a list of the available status data registers. The DPM can be actively monitored in real time using such input assembly data. In addition the scanner device (PLC/HMI/SCADA) can periodically send the enable/disable signal to the adapter device (DPM). The DPM can be enabled or disabled via Ethernet/IP using such output assembly data. Please see Figure 7.1 for a graphic representation of assembly data transfer via Ethernet/IP.

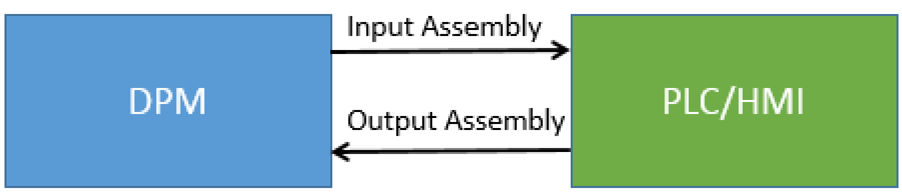


Figure 7.1: Ethernet/IP I/O Assembly

7.1. ETHERNET/IP DATA INFORMATION

The following tables show the input assembly data which is available to be read from the DPM by the Ethernet/IP Scanner device. It consists of 51 (16 bit) registers.

The Operating Status register is a signed 16 bit data field, but each individual bit has a different meaning, so that it’s recommended to create a separate data type consisting of BOOL types and name each individual bit in a PLC programming software such as RSLogix5000. Please see section 7.3 for more information

The Attention Code register is a signed 16 bit data field. Each value has a different meaning and represents a different attention code. Please see Table 7.3 for the meaning of each attention code.

Registers 2-50 represent sampled real numbers such as voltage, current, power, etc. Please see the “value/bit” to properly convert and display these values in volts, amps, watts, and etc.

INPUT ASSEMBLY (READ DATA)

Table 7.1: Ethernet/IP parameters for Input Assembly Data Note: This applies to all 102 bytes					
INSTANCE Input (T->0)	**ATTRIBUTE**	**CLASS**	**SERVICE TYPE**	**MESSAGE TYPE**	**MAXIMUM REQUESTED PACKET INTERVAL (RPI)**
100	3	4	GET ATTRIBUTE SINGLE	CIP GENERIC	5 Hz (200ms)

Table 7.2: DPM Ethernet/IP Input Assembly Data			
Bytes	**Name**	**Info**	**Data Type**
0-1	Operating Status	0=off, 1=precharging, 2=idle, 3=on-less than max, 4=on-max	Custom Data Type of 16 BOOL types
2-3	Attention Code	0=OK, non-zero value indicates attention needed (see Note 1)	INT (Signed Integer, 16 bits)
4-5	Line Volts (avg)	Avg of all 3 line-to-line rms voltages (.1 volt/bit)	
6-7	Line Amps (avg)	Avg of all 3 line rms currents (.1 amp/bit)	
8-9	Load Amps (avg)	Avg of all 3 load rms currents (.1 amp/bit)	
10-11	DPM % Loaded	DPM % loaded (.1 %/bit)	
12-13	Line Harm Amps (avg)	Avg of all 3 line harmonic rms currents (.1 amp/bit)	
14-15	Line Harm THDR/F%	THDF or THDR of line harmonics (.1%/bit)	
16-17	Load Harm Amps (avg)	Avg of all 3 load harmonic rms currents (.1 amp/bit)	
18-19	Load Harm THDR/F%	THDF or THDR of load harmonics (.1%/bit)	
20-21	Volt Harm THDR/F%	THDF or THDR of voltage harmonics (.1%/bit)	
22-23	Line KVA	Line KVA (.1 KVA/bit)	
24-25	Line KW	Line KW (.1 KW/bit)	
26-27	Line PF	Line PF (.001/bit)	
28-29	Load KVA	Load KVA (.1 KVA/bit)	
30-31	Load KW	Load KW (.1 KW/bit)	
32-33	Load PF	Load PF (.001/bit)	
34-35	Line Freq	Line Frequency (.01 Hz/bit)	
36-37	Neutral Amps	Neutral amps (.1 amp/bit) [0 if only 2 line/load CTs]	
38-39	Temperature – PCB	Control PC board temperature (.01 C/bit)	
40-41	Temperature – HSA	Heatsink (left side) temperature #1 (.01 C/bit)	
42-43	Temperature – HSB	Heatsink (right side) temperature #2 (.01 C/bit)	
44-45	DC Fan Amps	DC Fan current (.001 amps/bit)	
46-47	DC Bus Voltage	DC Bus Voltage (.1 volt/bit)	
48-49	Line Volts (Vab)	Vab Line-to-line rms voltage (.1 volt/bit)	

50-51	Line Volts (Vbc)	Vbc Line-to-line rms voltage (.1 volt/bit)	
52-53	Line Volts (Vca)	Vca Line-to-line rms voltage (.1 volt/bit)	
54-55	Line Amps (A)	Phase A Line rms current (.1 amp/bit)	
56-57	Line Amps (B)	Phase B Line rms current (.1 amp/bit)	
58-59	Line Amps (C)	Phase C Line rms current (.1 amp/bit)	
60-61	Load Amps (A)	Phase A Load rms current (.1 amp/bit)	
62-63	Load Amps (B)	Phase B Load rms current (.1 amp/bit)	
64-65	Load Amps (C)	Phase C Load rms current (.1 amp/bit)	
66-67	DPM% Load (A)	Phase A DPM % loaded (.1%/bit)	
68-69	DPM% Load (B)	Phase B DPM % loaded (.1%/bit)	
70-71	DPM% Load (C)	Phase C DPM % loaded (.1%/bit)	
72-73	Line Harm Amps (A)	Phase A Line Harmonic rms current (.1 amp/bit)	
74-75	Line Harm Amps (B)	Phase B Line Harmonic rms current (.1 amp/bit)	
76-77	Line Harm Amps (C)	Phase C Line Harmonic rms current (.1 amp/bit)	
78-79	Line Harm THDR/F% (A)	Phase A Line current Harmonic THDR or THDF (.1%/bit)	
80-81	Line Harm THDR/F% (B)	Phase B Line current Harmonic THDR or THDF (.1%/bit)	
82-83	Line Harm THDR/F% (C)	Phase C Line current Harmonic THDR or THDF (.1%/bit)	
84-85	Load Harm Amps (A)	Phase A Load Harmonic rms current (.1 amp/bit)	
86-87	Load Harm Amps (B)	Phase B Load Harmonic rms current (.1 amp/bit)	
88-89	Load Harm Amps (C)	Phase C Load Harmonic rms current (.1 amp/bit)	
90-91	Load Harm THDR/F% (A)	Phase A Load current Harmonic THDR or THDF (.1%/bit)	
92-93	Load Harm THDR/F% (B)	Phase B Load current Harmonic THDR or THDF (.1%/bit)	
94-95	Load Harm THDR/F% (C)	Phase C Load current Harmonic THDR or THDF (.1%/bit)	
96-97	Volt Harm THDR/F% (Vab)	Vab Line-to-line Harmonic THDR or THDF (.1%/bit)	
98-99	Volt Harm THDR/F% (Vbc)	Vbc Line-to-line Harmonic THDR or THDF (.1%/bit)	
100-101	Volt Harm THDR/F% (Vca)	Vca Line-to-line Harmonic THDR or THDF (.1%/bit)	

Table 7.3: Meaning of DPM Attention Code Register		
Attention_code	**Condition**	**Course of action**
0	No attention needed	None – DPM on, operating without a problem
1	Software problem	Should not occur
2	In Power-up delay	None – temporary condition
3 - 8	Nvram problem	Internal problem – PC-C board
9	DSP communication problem	Internal problem – PC-C board
10	Diagnostic 1.x	Spare code – reserved for future
11	Diagnostic – Upper Cap Vdc too high	Internal problem – Upper half of DC link capacitors at a much higher voltage than the lower half. Problem with discharge resistors R1 & R2, or PC-H or PC-C boards.
12	Diagnostic – Lower Cap Vdc too high	Internal problem – Lower half of DC link capacitors at a much higher voltage than the upper half. Problem with discharge resistors R1 & R2, or PC-H or PC-C boards.
13	Diagnostic – Too many bad shutdowns	Look at “history” to determine cause of excessive number of shutdowns in a short period of time.
14	Diagnostic – DSP Communication Failure	Internal problem – PC-C board
15	Diagnostic – Precharge Failure	Precharge failure – check fuse F1 on PC-H board
16	Diagnostic – PWM min free time problem	Internal problem – should not occur
17	Diagnostic – C167 DSP Handshake count	Internal problem – PC-C board
18	Diagnostic – DSP diagnostic	Internal problem – PC-C board
19	Diagnostic – Flash firmware checksum problem	Internal problem – PC-C board – try re-flashing the firmware
20	Diagnostic – DSP data checksum problem in data transfer from DSP to microcontroller	Internal problem – PC-C board
21	Diagnostic – DSP 2nd data checksum problem in data transfer from DSP to microcontroller	Internal problem – PC-C board
22	Diagnostic – Too many inverter current trips	If unit is not newly installed: Internal problem – Inverter, gate drives, or PC-C board – try performing low power inverter test. If unit is newly installed: Possible external wiring problem – check startup procedure in manual.
23	Diagnostic – Too many inverter pole trips	Internal problem – Inverter, gate drives, or PC-C board – try performing low power inverter test.
24	Diagnostic – Power AC Contactor problem	Internal problem – Power fuse, Contactor, or PC-C board.

25	Diagnostic – Problem with internal DPM current sensor(s)	Internal problem – Internal DPM current sensors or PC-C board.
26	Diagnostic – Problem with external CT(s) used to measure line or load current	Turn on power to the system, but don't RUN the power inverter. Check line current on front display. If load is present, all line and load currents should display rms values that are not close to 0. Current(s) that are close to 0 indicate CT(s) may be bad or have a shorting terminal in place. Could also be due to an internal problem with PC-R, PC-I, or PC-C boards.
27	Diagnostic 2.x	Spare code – reserved for future
28	Diagnostic – High frequency detected in DPM current	Internal problem – PC-T failure and/or blown protection fuses (F4 – F6). Look at DPM_HFAMPS in history to determine phase(s) that caused the fault.
29	Diagnostic – DC detected in DPM current	Internal problem – IGBT device firing problem. Look at DPM_DCAMPS in history (largest value may indicate pole that device is in that is at fault)
30	Diagnostic – Difference detected between DPM and Inverter current sensors.	Internal problem – Possible failure in either one or more current sensors CS1-CS4 or PC-C board. Look at DPM-INV RMS AMPS in history to determine phase(s) that caused the fault.
31	Diagnostic – DPM is ineffective at correcting harmonics	Problem with CTs being incorrectly positioned or a system resonance exists, resulting in current produced by DPM not effectively reducing harmonic currents in the line current. Check CTs using CT Setup LCD screen. Make sure CT physical locations (line or load side) agree with location programmed into system.
32	Diagnostic 2.11	Spare code – reserved for future
33	Diagnostic 2.10	Spare code – reserved for future
34	Diagnostic 2.9	Spare code – reserved for future
35	Diagnostic 2.8	Spare code – reserved for future
36	Diagnostic 2.7	Spare code – reserved for future
37	Diagnostic 2.6	Spare code – reserved for future
38	Diagnostic 2.5	Spare code – reserved for future
39	Diagnostic 2.4	Spare code – reserved for future
40	Diagnositc 2.3	Spare code – reserved for future
41	Diagnostic 2.2	Spare code – reserved for future
42	Diagnostic 2.1	Spare code – reserved for future
43	Diagnostic 2.0	Spare code – reserved for future

44	Over-temperature occurred	System shut down due to over-temperature and must be power-cycled to restart. Check history to view temperatures recorded at the time of the shutdown to help determine the possible cause. Make sure air filters are clean and internal fans are all operating via DC fan current on front display. If operating in a high altitude and high ambient temperature environment, may need to relax temperature limits (consult factory).
45	Reserved (low Vsupply on Gen 1 units)	Not used in Gen 2 units.
46	Too much DPM current detected when AC contactor is open.	Possible internal problem with AC contactor, DPM current sensors, or PC-C.
47	Not enough DPM current detected when AC contactor is closed.	None – usually a temporary condition. If condition persists, will be followed by DIAGNOSTIC indication.
48	Not enough line current detected when AC contactor is closed.	Some minimal line current should register when AC contactor is closed and inverter is not yet operating. If not, external CTs may not be properly located or may have shorting strips in place, shorting their output. If this is not the case, a possible internal problem could exist with PC-R, PC-I, PC-C or cables interconnecting these.
49	Inverter Current trip shut down the inverter.	Temporary condition - Current trips can occur occasionally due to power interruptions or very rapid load changes. Check history to see if an inordinate number of such shutdowns are occurring. Contact factory if they are.
50	Inverter Pole trip shut down the inverter.	Temporary condition - A pole trip can occur occasionally due to electrical "noise" in the environment. Check history to see if an inordinate number of such shutdowns are occurring. Contact factory if they are.
51	System's power inverter disabled by operator	Press the RUN button on the touchscreen display to enable the system.
52	Power inverter not ready to run	None – temporary condition
53	DC caps are pre-charging.	None – temporary condition
54	Power AC contactor is closing	None – temporary condition
55	Power AC contactor is opening	None – temporary condition
56	Reserved (low power inverter test in progress)	Should not occur – won't see this unless performing a low power inverter test.
57	Reserved (low power thyristor test in progress)	Should not occur – won't see this because it is a factory test
58	Reserved (AC contactor test in progress)	Should not occur – won't see this because it is a factory test
59	Reserved (DC link capacitor calibration in progress)	Should not occur – won't see this because it is a factory calibration mode.

60	DC voltage across DC link capacitors too high	None – temporary condition caused by a line abnormality or very large fast load change.
61	Reserved (bad test flags encountered)	Should not occur.
62	No enable from DSP for unknown reason	Should not occur.
63	DC link capacitor voltage too low	None – temporary condition.
64	DC link capacitor voltage too high	None – temporary condition.
65	Peak of an AC line voltage too low	None – temporary condition.
66	Peak of an AC line voltage too high	None – temporary condition.
67	AC line rms voltage too low or too high to run	None – temporary condition. If it persists and line voltage does indeed exist within acceptable limits, could be due to a blown power fuse or faulty PC-H or PC-C board.
68	System can't phaselock to the AC line	None – temporary condition.
69	DSP has detected a diagnostic condition	None – temporary condition. If it persists or history indicates it is occurring multiple times, contact the factory.
70	Reserved (Pwm misc reason for shutdown)	Should not occur.
71	Current sensor problem detected	None – temporary condition that will be followed by another Attention_code.
72	Internal control voltage too low	Usually a temporary condition; however, if it persists could be an internal problem, due to a faulty PC-C board.
73	Load power too low to operate	If "UNIT DISABLED IF LOAD POWER BELOW THIS %" parameter is set to a non-zero value, system is in "IDLE" mode because load power is too low for system to power its inverter. Once load power is detected, inverter will start running again. This is normal operation unless the load is actually high enough but the line/load CTs are not reading current correctly.
74	Unknown pole trip occurred	Pole trip occurred and system is an older system with 45400058 gate drive boards where the source of the pole trip could not be determined by the control.
75	Pole trip occurred, but control can't reset the control board latch	Internal problem – PC-C board
76	Pole trip occurred, but can't clear the fault at the gate drive board	Internal problem – Inverter, gate drives, or PC-C board
77	Pole trip received from A- IGBT	Check unit's "History" to see if an inordinate number of these have been occurring. If so, a possible problem with the Inverter, gate drives, or PC-C board exists.
78	Pole trip received from B- IGBT	
79	Pole trip received from C- IGBT	
80	Pole trip received from A+ IGBT	
81	Pole trip received from B+ IGBT	
82	Pole trip received from C+ IGBT	

83	System externally disabled	If “EXTERNAL ENABLE INPUT” parameter is enabled, the external enable signal is missing. If an external enable signal is not being provided either provide one or disable this parameter using the touchscreen display.
84	System externally disabled by Ethernet/IP	If “ETH/IP EXT EN” parameter is enabled, no enable command is being sent to the unit over Ethernet/IP. Either send such a command or disable this parameter using the touchscreen display.
241	Undefined warning exists	Should not occur – contact factory if it does.
252	Warning – High Control board temperature	Temperature monitored on the main control board (PC-C board) is at a higher temperature than it should be. This temperature is normally close to the ambient room temperature unless air filter is dirty or fans are not fully operational. If problem persists and temperature continues to rise, system may shut down, resulting in a code 28.
253	Warning – High heatsink temperature	Heatsink operating at a higher temperature than it should be. If problem persists and temperature continues to rise, system may shut down, resulting in a code 28.
254	Warning – Lower Cap Vdc high	Internal problem – system unable to reduce voltage across lower half of DC link capacitors down to the voltage across the upper half. Code 12 may eventually occur if problem persists.
255	Warning – Upper Cap Vdc high	Internal problem – system unable to reduce voltage across upper half of DC link capacitors down to the voltage across the lower half. Code 11 may eventually occur if problem persists.

The following tables show the output assembly data which is available to be written to the DPM by the Ethernet/IP Scanner device. It consists of 1 (16 bit) register.

This register is sent by the PLC/HMI device to Enable or Disable the DPM. Please see Table 7.5 for more information.

Table 7.4: (Ethernet/IP parameters for Output Assembly Data) Note: This applies to all 2 bytes					
INSTANCE Input (T->0)	**ATTRIBUTE**	**CLASS**	**SERVICE TYPE**	**MESSAGE TYPE**	**MAXIMUM REQUESTED PACKET INTERVAL (RPI)**
150	3	4	SET ATTRIBUTE SINGLE	CIP GENERIC	5 Hz (200ms)

OUTPUT ASSEMBLY (WRITE DATA)

Table 7.5: DPM Ethernet/IP Output Assembly Data		
Bytes	**Register Name**	**Info**
0-1	DPM_EIP_ENABLE	Disable DPM= hex 0000 Enable DPM = hex 0001

7.2. IP ADDRESS CONFIGURATION FOR ETHERNET/IP

In order to use Ethernet/IP with a PLC/HMI/SCADA device, the DPM needs an IP address. These steps explain how to obtain the IP address via DHCP and set it static for use in your Ethernet/IP network. These steps assume that the DPM unit is energized but may or may not be enabled and correcting harmonics.

Please refer to sections 5.6.5.2 and 5.6.7 to enable Ethernet/IP on the unit.

After enabling Ethernet/IP, please open the ETHERNET/IP INFO screen as explained in section 5.8.2.

ETH/IP should say USED and ETH/IP COMM should say NO ERROR. This indicates that Ethernet/IP was correctly enabled on the DPM and is functioning correctly.

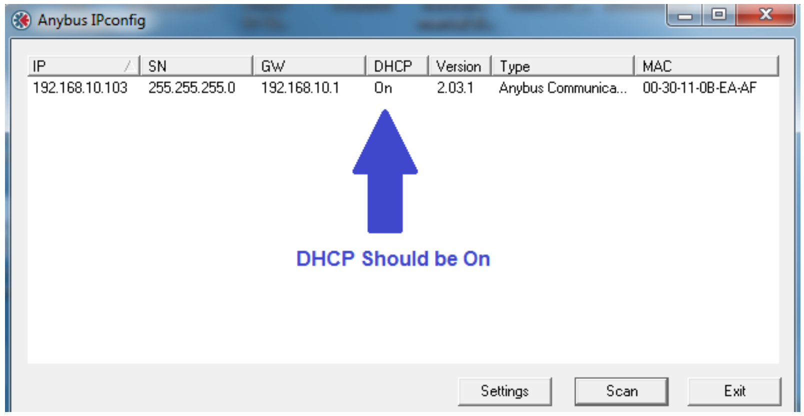
Please follow these steps to obtain the DPM IP address to be used for Ethernet/IP.

1. Download the Anybus IPconfig tool at the following link.
   http://www.anybus.com/support/support.asp?PID=509&ProductType=Support%20Tools
   Note: The exact link may change in the future, please use a search engine to find Anybus IPconfig tool. If you are unable to find this tool, please contact Mesta Electronics.

2. Install the Anybus IPconfig tool on your computer or laptop.

3. Make sure that the Ethernet cable coming from the DPM is already connected to the Ethernet/IP Local Area Network (LAN). Connect your computer or laptop to the same LAN that the DPM is connected to. Make sure that your LAN has a DHCP server. If it does not, please contact Mesta Electronics for instructions on how to set a static IP address.

4. Open Anybus IPconfig tool. You should see something similar to the following screen.



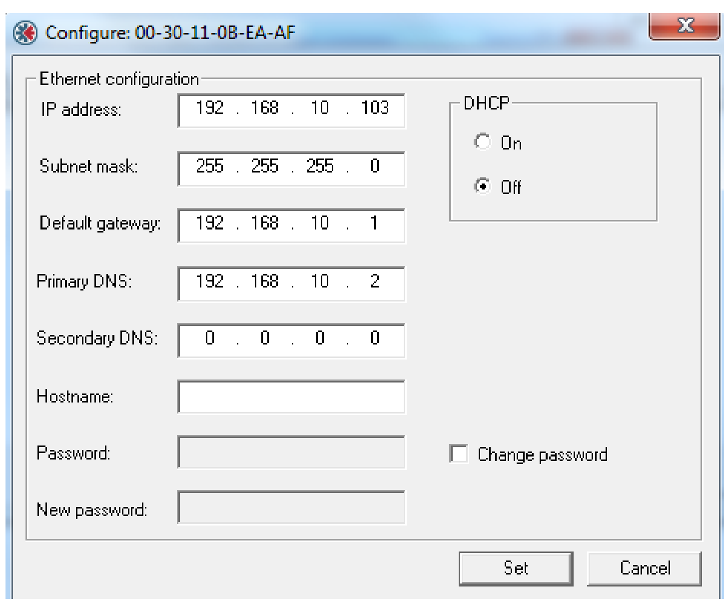
DHCP should say “On”. If this is true, go to step 5, else see Troubleshooting Notes below.

Troubleshooting Notes: If DHCP does not say “On”, double click on the field where the arrow points in the screenshot above. A window will open which will allow you to set DHCP to “On”. Click on Set. DHCP should now say “On”. If the Ipconfig tool does not detect Anybus Communicator, click on Scan. Try closing and opening the tool. Make sure the Ethernet cable is properly connected to the network. If all else fails, contact Mesta Electronics.

5. The IP address displayed with the tool, is the DHCP automatically determined IP address. Please check with your network administrator to verify that this IP address is correct for your subnet. Please write down this IP address and use it when setting up your Ethernet/IP network. Go to step 6.

6. Now you will use the automatically determined IP address to set a static IP address for the DPM unit. This is important because if the DPM loses power or is manually turned off, the IP address of the DPM may change, and this will affect the PLC/HMI/SCADA or Ethernet/IP scanner device which is communicating with the DPM. Setting a static IP address will prevent this problem.

   Double click on the field where the arrow points in the screenshot of step 4. A screen similar to the following should appear.



7. Select “Off” for DHCP, and click on Set.

This configures Anybus Communicator to set a static IP address. In this case its using the IP address that was automatically determined via DHCP. Its also possible to enter the IP address and networking information manually, and then click Set, making sure that DHCP is set to Off.

8. Use the automatically determined IP address or manually set with the Anybus IPconfig tool in your Ethernet/IP network when setting up your PLC/HMI/SCADA via RSLogix5000 or other PLC/Ethernet/IP software.

7.3. USING DPM WITH RSLOGIX 5000 VIA ETHERNET/IP

This example will walk you through setting up RSLogix 5000 to enable a generic PLC to communicate with the DPM via Ethernet/IP. This is a generic example which should be used as a guide when setting up your system. If you have further questions, please see the RSLogix 5000 user manual or contact Mesta Electronics.

Throughout this example, the document "How to configure an EtherNet/IP adapter module with RSLogix 5000" from HMS will be referred to.

It is currently available at the following link.

http://www.anybus.com/upload/353-7619-EtherNetIP_%20adapter_RSLogix_2.03.zip

If the link changes in the future, do a search engine search for this document.

This application note assumes that RSLogix5000 and ControlLogix5000 with an EtherNet/IP module/bridge are set up and working correctly. It also assumes you are using an Ethernet/IP capable PLC or HMI or both.

7.3.1. REQUIRED MATERIALS

1. Ethernet/IP Enabled Mesta Electronics DPM connected to the Ethernet/IP network.
2. RSLogix5000 on a PC or laptop.
3. Ethernet/IP capable PLC or HMI device of your choice

Note: Before you begin, please make sure that Ethernet/IP has been enabled on the DPM and that "EIP INFO" screen says "NO ERROR" for the "ETH/IP COMM" field as described in section 7.2. Also make sure that you have determined the proper IP address via DHCP and set it as static as described in section 7.2. The Ethernet cable should be connected to the DPM and to the Ethernet/IP network.

7.3.2. RSLOGIX 5000 CONFIGURATION

1. Open the document "How to configure an EtherNet/IP adapter module with RSLogix 5000" from HMS

2. Follow the instructions in the document until you get to "4.2. EtherNet/IP network configuration". Follow the instructions on page 8, but on page 9, when setting up the Generic Ethernet Module, **(1)** enter "DPM" for the name, **(2)** choose Data-INT for Comm Format, **(3)** Input Assembly Instance is 100, Output Assembly Instance is 150, **(4)** 51 for the Input Size i.e. 102 bytes or 51 (16 bit) registers. 1 for the Output Size i.e. 2 bytes or one 16 bit register. **(5)** Configuration is 1. **(6)** size is 0. **(7)** The IP address should be obtained with the Anybus IPconfig tool in section 7.2 of the DPM user manual.

3. On page 10, where it says Module properties the Requested packet interval (RPI) should be chosen according to how often the DPM status information is desired. This number should not be smaller than 200mS. The DPM data is requested by Anybus at 5Hz (200mS), thus if the PLC/HMI requests Anybus data faster than 5Hz (smaller than 200mS), the real time values will not be updated that often.

4. Go to section 4.3 “Downloading the configuration to the PLC”. Proceed and download the configuration. Make sure there are no errors. When you get to section 5 “Anybus Configuration”, **STOP**. At this point, the document “How to configure an EtherNet/IP adapter module with RSLogix 5000” will no longer be used.

5. Now Controller Tags and Program tags will be created so that the DPM data can be easily used in a ladder logic program.

6. Under “Controller CLOGIX5000” you will see Controller Tags. Double-click on “Controller Tags” in the organizer window. A window opens showing all of the existing controller tags. With the new Ethernet module, the controller tags were also created.

7. You should see DPM:C, DPM:I, DPM:O Controller tags. In the “Data Type” field you should see AB:ETHERNET_MODULE_INT_102BytesI:0 and AB:ETHERNET_MODULE_INT_2BytesO:0. Click the ‘+’ next to each tag to expand the bytes. The data tags are listed numerically.

8. Now we will create user defined data types that reflect better naming conventions. Program tags will be created for the 51 Input registers and 1 output register.

9. Under Controller CLOGIX5000, under Data Types, right click on “User-Defined” and select “New Data Type”. Name the Data type “Operating Status”. Create 5 BOOL Data types and name them “Off”, “Precharging”, “Idle”, “On less than max”, “on max”. Bytes 0 and 1 of Instance 100 represent the Operating Status register, but only 5 bits (bits 0-4 of the first byte) are actually used. The remaining bits should always be zero, unless there is a communication error. Please refer to Table 7.2.

   For example, if the “Off” bit is high, this indicates that the DPM is Off and not correcting harmonics. If the “Off” bit is low, this indicates that the DPM is On. If the “Precharging” bit is high, this means that the DPM is precharging, and if low, the DPM is not precharging, and so on.

   Each bit in the “Operating Status” register (bytes 0-1 of instance 100) represents a particular DPM status. The “Operating Status” data type is created so each status can be easily referenced by name instead of by bit number when a ladder logic program is defined. Give each member a name, data type, and style to display a formatted number.

10. The previously created data type “Operating Status” will now be used within our next data type. Create a data type called “DPM Inputs”. Add the “Operating Status” member using user defined data types. The other members can be created using the standard data type INT. There should be 51 members within the “DPM Inputs” data type. These represent the 102 bytes of Table 7.2. Please name each member the same name as the registers in Table 7.2.

11. Now create another data type called “DPM Outputs”. Use the standard data type INT. There should only be one member in “DPM Outputs” data type. Please name it “DPM EIP Enable”. This represents bytes 0-1 of instance 150 in Table 7.5.

12. Open controller tags under Controller CLOGIX5000. Click on the edit tab. Add “DPM Inputs” and “DPM Outputs” as the new data types just created.

13. Under Tasks/Main Task/Main Program, double-click on ‘Main Routine’ to enter the ladder logic program window. Insert ‘Synchronous Copy File’ instructions to copy the program tags to the controller tags. Download the instructions to the PLC and run the program.

14. Turn on the PLC. The program should be running.

15. Under Controller Tags, you should see the “DPM Inputs” data tags. If the PLC is running, and Ethernet/IP is enabled on the DPM, these tags should be updated with real time status data from the DPM. Choose Hex for the Style field of “Operating Status”, and choose Decimal for the Style field of the other 50 registers. Please refer to Table 7.2 and Table 7.3 to decode the meaning of each register. Registers 2-50 require a value/bit conversion to read the data in the correct format.

16. Now we will enable the DPM via RSLogix5000. Please follow the steps in section 5.6.7 CHANGING THE SETTING OF A CONTROL PARAMETER and 5.6.5.2 4th SET OF PARAMETERS IN ETHERNET/IP EQUIPPED SYSTEMS to set ETHERNET/IP EXT ENABLE to USED.

17. After having pressed “SAVE CHANGES AND EXIT”, go to the EIP INFO screen as described in section 5.8.2“ETHERNET/ip INFO” DISPLAY in Ethernet/ip equipped systems”, and make sure that ETH/IP EXT EN is set to USED. This indicates that the DPM can be enabled via Ethernet/IP.

If the DPM is already enabled, as described in section 5.9 enabling or disabling the dpm using the run or stop buttons, you may see DISABLED BY ETHERNET/IP under the OFF status. The DPM will not run until an Ethernet/IP scanner device sends the enable signal via Ethernet/IP. If the DPM is not yet enabled, press the RUN button. After confirming that you want to RUN, you will see DISABLED BY ETHERNET/IP under the OFF status.

18. In RsLogix5000, under Controller Tags, you should see “DPM Outputs” data tags. Write a “1” in the “DPM EIP Enable” data tag. You should see PRECHARGING message on the DPM LCD screen, and then shortly after, you will see ON. This indicates that the DPM was enabled and is now correcting harmonics. Write a “0” in the “DPM EIP Enable” data tag. You should see DISABLED BY ETHERNET/IP under the OFF status. This demonstrates how the DPM can be enabled or disabled via Ethernet/IP.

7.4. MODBUS/TCP FOR ETHERNET/IP EQUIPPED SYSTEMS

Modbus TCP (Modbus TCP/IP) is the Modbus RTU protocol sent over the network via Ethernet. The “Anybus Communicator Ethernet/IP and Modbus-TCP” AB7007-C used inside the DPM automatically supports both Ethernet/IP and Modbus-TCP. Any Modbus-TCP enabled PLC/HMI/SCADA will be able to communicate with the DPM. The same Input and Output data defined for Ethernet/IP is available for Modbus-TCP. Please refer to Table 7.2 and Table 7.5.

The following example will show how to communicate with the DPM via Modbus-TCP. This example uses a free Modbus Master Simulator tool which will simulate a Modbus-TCP enabled PLC.

It can be downloaded free of charge at the following link.
http://en.radzio.dxp.pl/modbus-master-simulator/

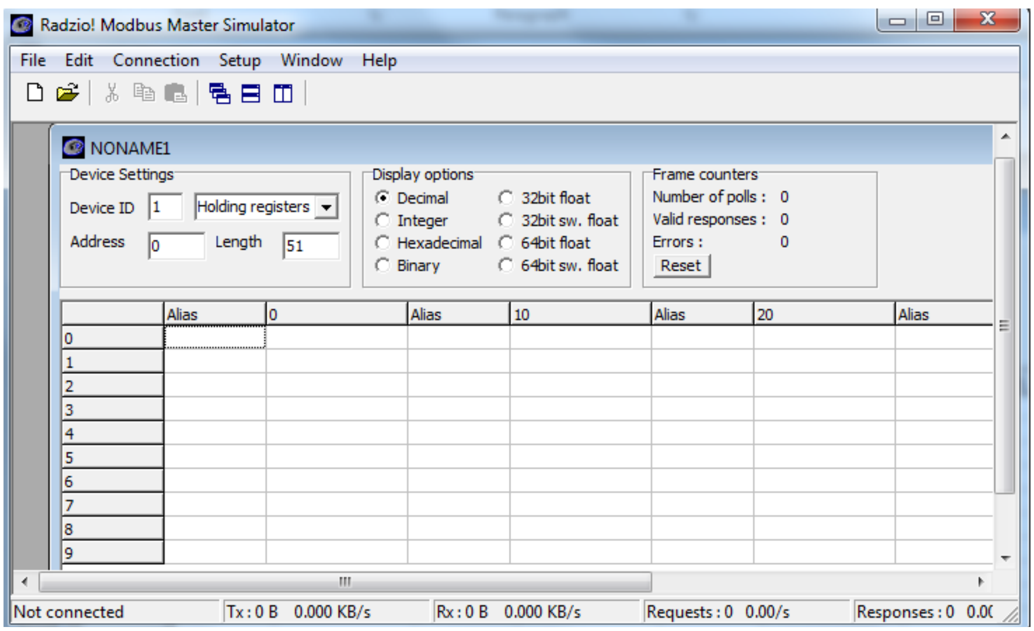
7.4.1. REQUIRED MATERIALS

1. Ethernet/IP Enabled Mesta Electronics DPM connected to the Modbus-TCP network.
2. Radzio! Modbus Master Simulator on a PC or laptop.

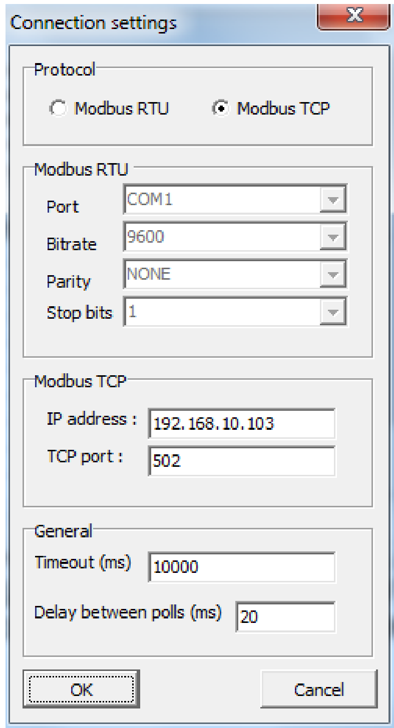
Note: In Modbus-TCP Mode, the DPM will be configured for Ethernet/IP. Before you begin, please make sure that Ethernet/IP has been enabled on the DPM and that “EIP INFO” screen says “NO ERROR” for the “ETH/IP COMM” field as described in section 7.2. Also make sure that you have determined the proper IP address via DHCP and set it as static as described in section 7.2. The Ethernet cable should be connected to the DPM and to the network.

7.4.2. MODBUS-TCP EXAMPLE

1. Install Radzio! Modbus Master Simulator on your PC or laptop and plug your computer Ethernet cable into the network.
2. Open Radzio! Modbus Master Simulator
3. Go to File/New. Select Holding Registers and enter 51 for the length. Device ID should be 1. Address should be 0. See screenshot below.



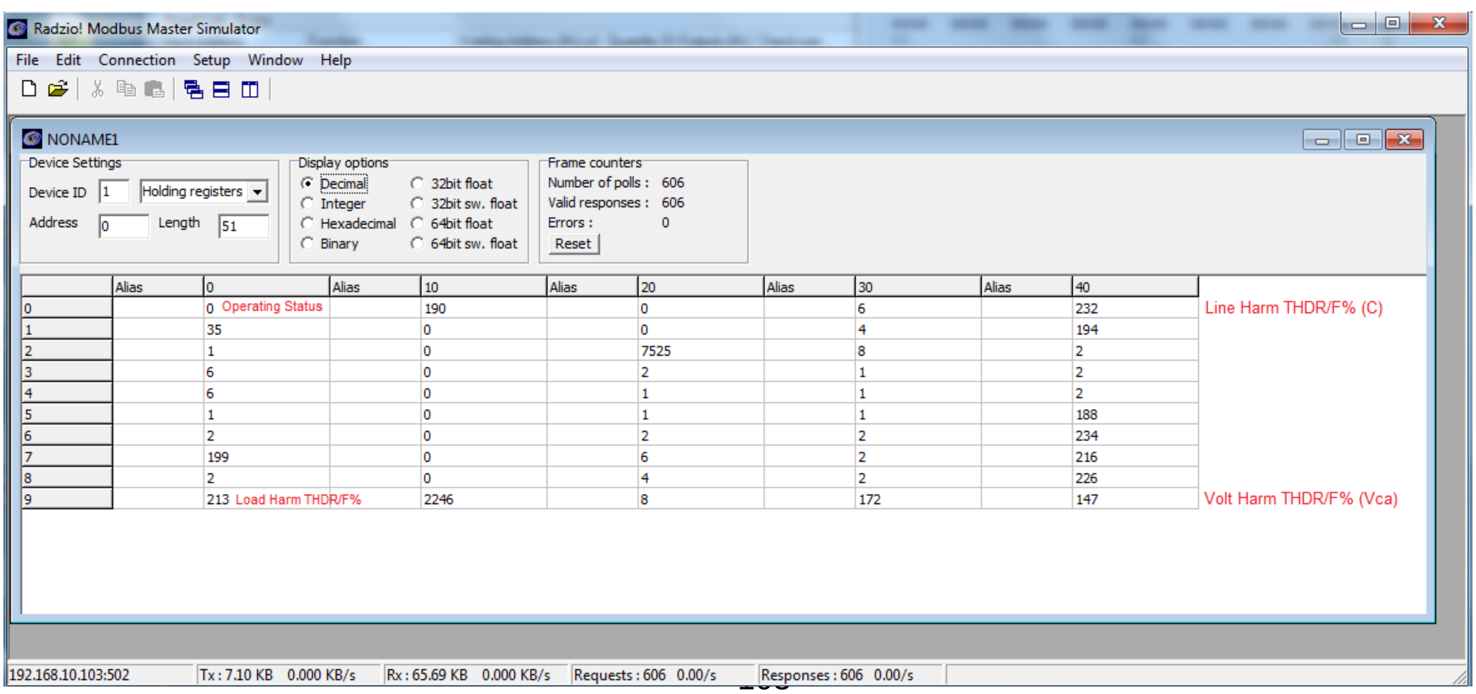
4. Go to Connection/Settings and select Modbus TCP. Enter the IP address that you found in section 7.2 IP ADDRESS CONFIGURATION FOR ETHERNET/IP. Click Ok. See screenshot below.



5. Go to Setup/Data definition, and for the Scan rate, enter the rate at which you would like to periodically request data from the DPM. The fastest rate at which you can poll the DPM is 5Hz, so the smallest number you can enter is 200mS.

6. Go to Connection/Connect.

7. You should now see the DPM status data updated in real time on the screen. See screenshot below.



The data in the screenshot above represents the 51 registers of Table 7.2.

In order to enable or disable the DPM via Modbus-TCP, send a Modbus “write single register” command and send a “1” to enable the DPM and a “0” to disable the DPM.

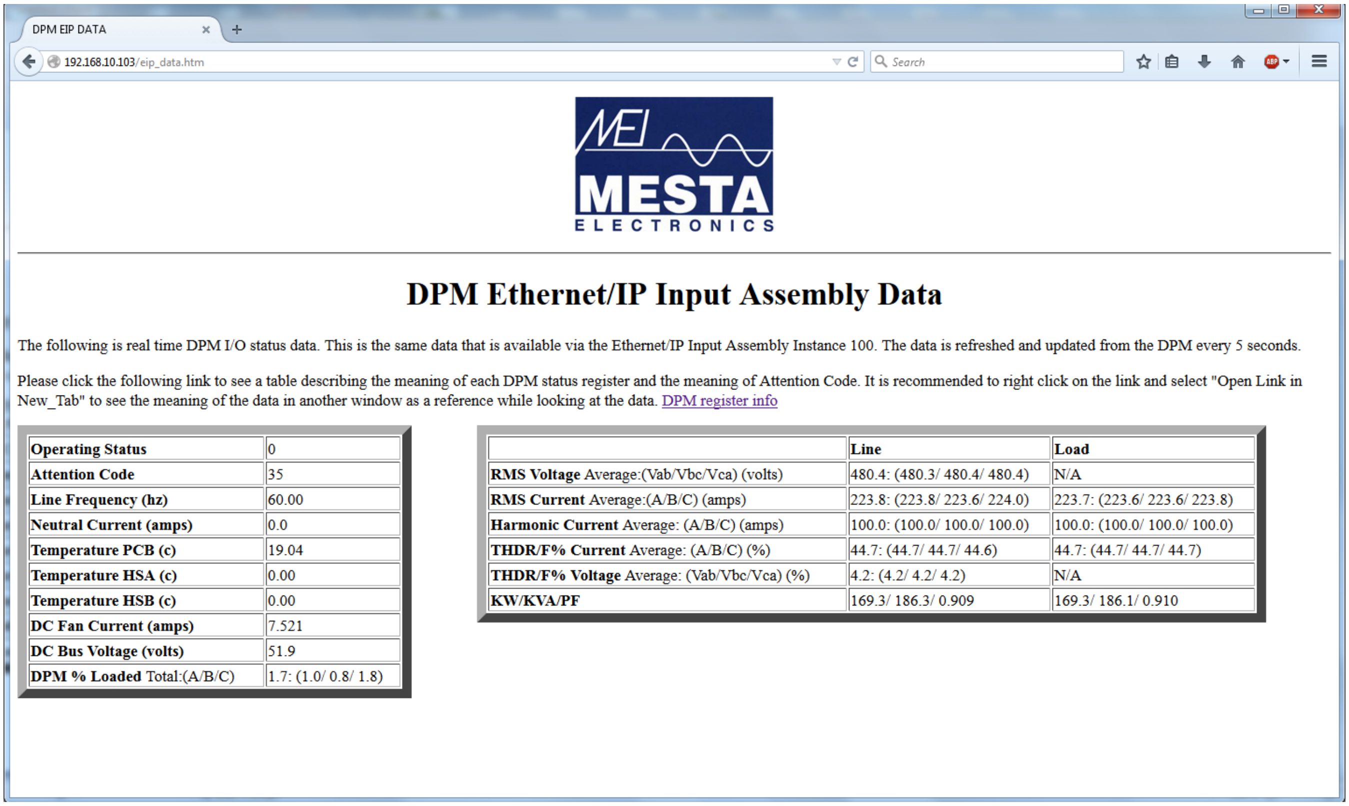
This example shows how the DPM can be used to communicate with a Modbus-TCP master device such as a PLC/HMI/SCADA. Please use this example as a guide when setting up your Modbus-TCP network. If you have further questions, please contact Mesta Electronics.

7.5. VIEWING ETHERNET/IP DATA ON A WEBSITE

The DPM has an optional capability to view the Ethernet/IP Input Assembly Data by using a website via regular Ethernet on port 80. This eliminates the need for a PLC/HMI in order to access the same data that can be accessed via Ethernet/IP.

To view the data on a website follow these steps:

1. Make sure that the DPM is connected to the Ethernet network via an Ethernet cable. This can be the same network as you use for Ethernet/IP. Connect a desktop or laptop computer to the network.
2. Before you begin, please make sure that Ethernet/IP has been enabled on the DPM and that “EIP INFO” screen says “NO ERROR” for the “ETH/IP COMM” field as described in section 7.2. Also make sure that you have determined the proper IP address via DHCP and set it as static as described in section 7.2. The Ethernet cable should be connected to the DPM and to the Ethernet/IP network.
3. Open a web browser such as Internet Explorer or Firefox and in the address bar, type in the following: IP_ADDRESS/eip_data.htm where IP_ADDRESS is the address you found in section 7.2 IP ADDRESS CONFIGURATION FOR ETHERNET/IP. You should see the following website open up.



DPM EIP DATA

192.168.10.103/eip_data.htm

MESTA ELECTRONICS

DPM Ethernet/IP Input Assembly Data

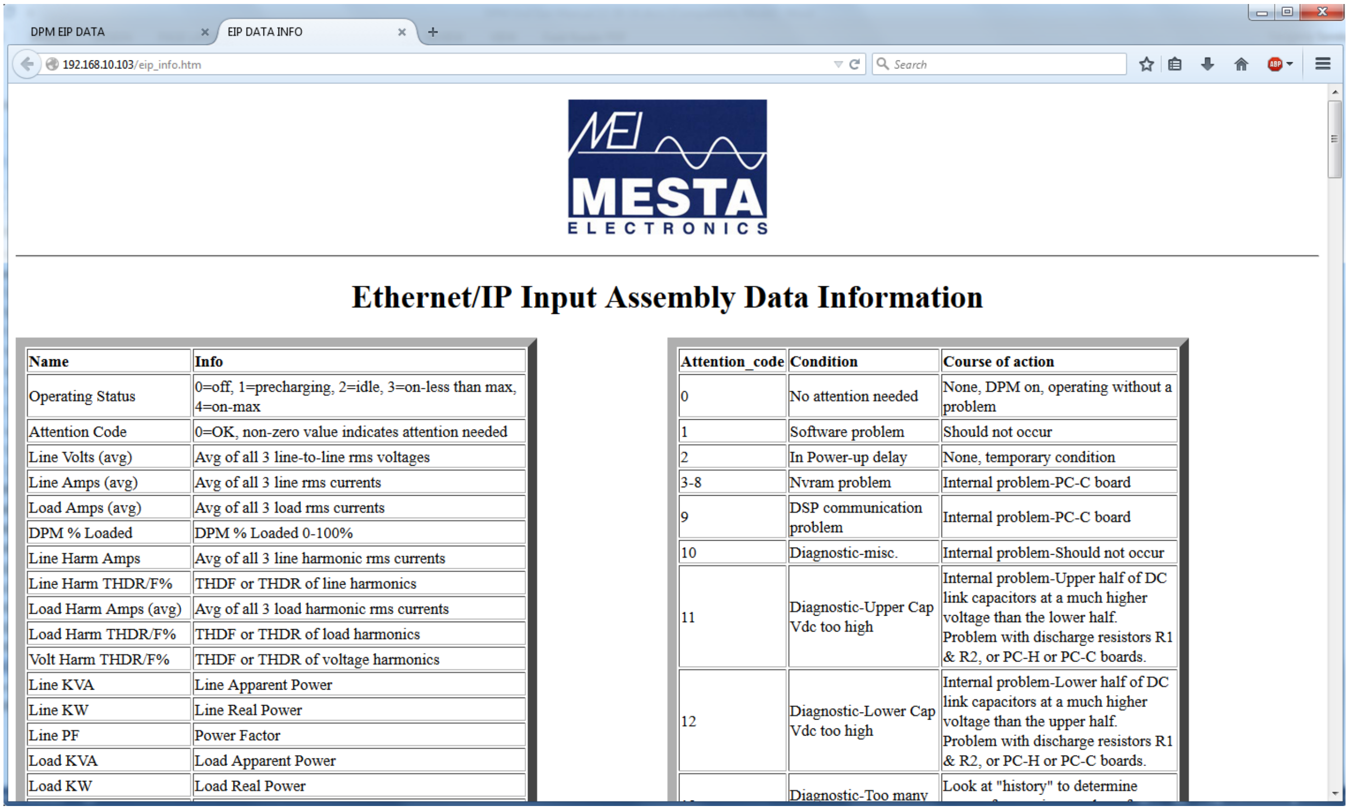
The following is real time DPM I/O status data. This is the same data that is available via the Ethernet/IP Input Assembly Instance 100. The data is refreshed and updated from the DPM every 5 seconds.

Please click the following link to see a table describing the meaning of each DPM status register and the meaning of Attention Code. It is recommended to right click on the link and select "Open Link in New_Tab" to see the meaning of the data in another window as a reference while looking at the data. DPM register info

Operating Status	0
Attention Code	35
Line Frequency (hz)	60.00
Neutral Current (amps)	0.0
Temperature PCB (c)	19.04
Temperature HSA (c)	0.00
Temperature HSB (c)	0.00
DC Fan Current (amps)	7.521
DC Bus Voltage (volts)	51.9
DPM % Loaded Total:(A/B/C)	1.7: (1.0/ 0.8/ 1.8)

	Line	**Load**
RMS Voltage Average:(Vab/Vbc/Vca) (volts)	480.4: (480.3/ 480.4/ 480.4)	N/A
RMS Current Average:(A/B/C) (amps)	223.8: (223.8/ 223.6/ 224.0)	223.7: (223.6/ 223.6/ 223.8)
Harmonic Current Average: (A/B/C) (amps)	100.0: (100.0/ 100.0/ 100.0)	100.0: (100.0/ 100.0/ 100.0)
THDR/F% Current Average: (A/B/C) (%)	44.7: (44.7/ 44.7/ 44.6)	44.7: (44.7/ 44.7/ 44.7)
THDR/F% Voltage Average: (Vab/Vbc/Vca) (%)	4.2: (4.2/ 4.2/ 4.2)	N/A
KW/KVA/PF	169.3/ 186.3/ 0.909	169.3/ 186.1/ 0.910

As can be seen in the screenshot above, this website displays DPM status data. Operating Status and Attention Code indicate the state of the system. To see the meaning of each status register, right click on DPM_register_info and open the link in a new tab.



DPM EIP DATA | EIP DATA INFO

192.168.10.103/eip_info.htm

MESTA ELECTRONICS

Ethernet/IP Input Assembly Data Information

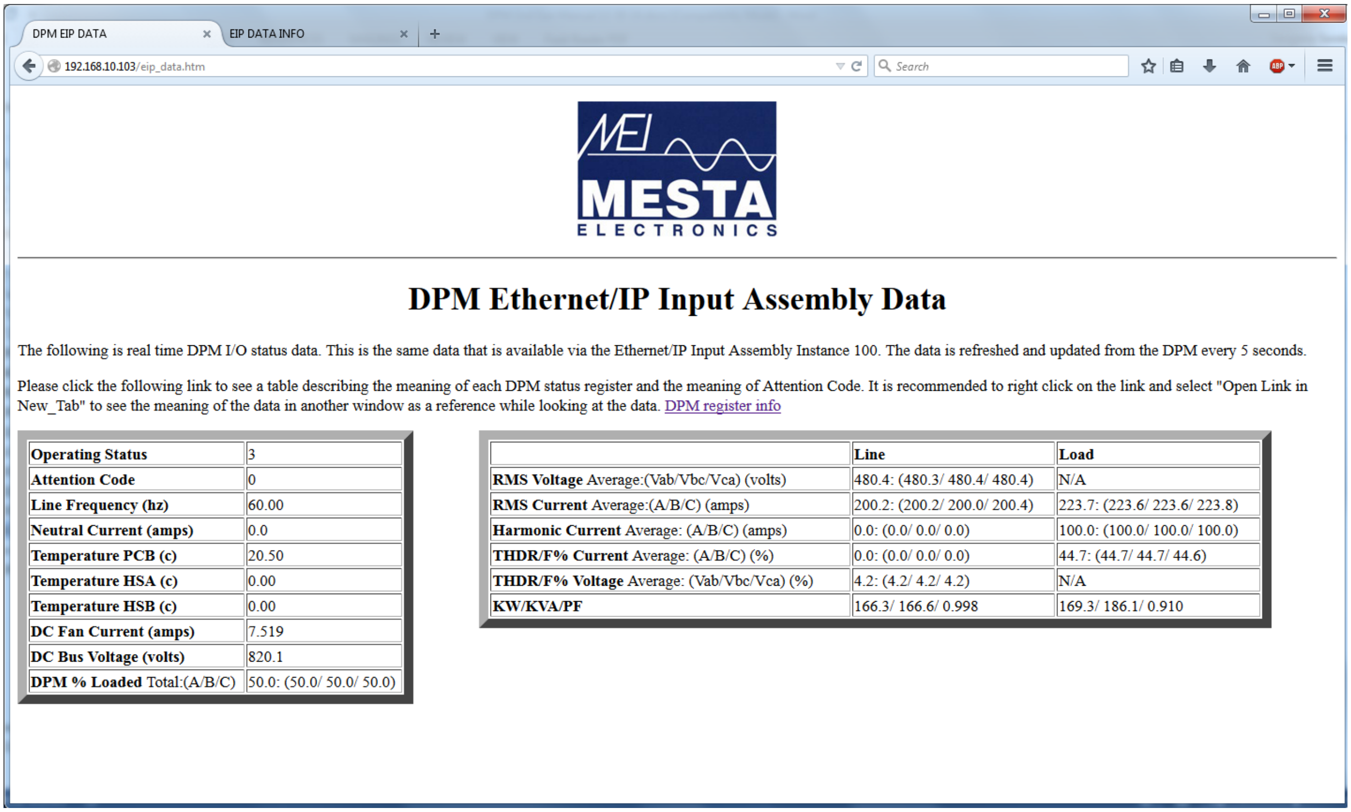
Name	**Info**
Operating Status	0=off, 1=precharging, 2=idle, 3=on-less than max, 4=on-max
Attention Code	0=OK, non-zero value indicates attention needed
Line Volts (avg)	Avg of all 3 line-to-line rms voltages
Line Amps (avg)	Avg of all 3 line rms currents
Load Amps (avg)	Avg of all 3 load rms currents
DPM % Loaded	DPM % Loaded 0-100%
Line Harm Amps	Avg of all 3 line harmonic rms currents
Line Harm THDR/F%	THDF or THDR of line harmonics
Load Harm Amps (avg)	Avg of all 3 load harmonic rms currents
Load Harm THDR/F%	THDF or THDR of load harmonics
Volt Harm THDR/F%	THDF or THDR of voltage harmonics
Line KVA	Line Apparent Power
Line KW	Line Real Power
Line PF	Power Factor
Load KVA	Load Apparent Power
Load KW	Load Real Power

Attention_code	**Condition**	**Course of action**
0	No attention needed	None, DPM on, operating without a problem
1	Software problem	Should not occur
2	In Power-up delay	None, temporary condition
3-8	Nvram problem	Internal problem-PC-C board
9	DSP communication problem	Internal problem-PC-C board
10	Diagnostic-misc.	Internal problem-Should not occur
11	Diagnostic-Upper Cap Vdc too high	Internal problem-Upper half of DC link capacitors at a much higher voltage than the lower half. Problem with discharge resistors R1 & R2, or PC-H or PC-C boards.
12	Diagnostic-Lower Cap Vdc too high	Internal problem-Lower half of DC link capacitors at a much higher voltage than the upper half. Problem with discharge resistors R1 & R2, or PC-H or PC-C boards.
	Diagnostic-Too many	Look at "history" to determine

For the example in the above screenshot, if you look in Table 7.3, Code 35 means System's power inverter disabled by operator. The DPM is not enabled and not correcting harmonics. Operating Status 0 means the DPM is off, or not enabled.

The values on the website are updated in real time, every 5 seconds. With a PLC/HMI these values can be updated every 200mS (Maximum RPI).

If the system is enabled via the RUN button the DPM LCD screen, the data will be updated and look similar to the following screenshot.



DPM EIP DATA

EIP DATA INFO

192.168.10.103/eip_data.htm

MEI MESTA ELECTRONICS

DPM Ethernet/IP Input Assembly Data

The following is real time DPM I/O status data. This is the same data that is available via the Ethernet/IP Input Assembly Instance 100. The data is refreshed and updated from the DPM every 5 seconds.

Please click the following link to see a table describing the meaning of each DPM status register and the meaning of Attention Code. It is recommended to right click on the link and select "Open Link in New_Tab" to see the meaning of the data in another window as a reference while looking at the data. DPM register info

Operating Status	3
Attention Code	0
Line Frequency (hz)	60.00
Neutral Current (amps)	0.0
Temperature PCB (c)	20.50
Temperature HSA (c)	0.00
Temperature HSB (c)	0.00
DC Fan Current (amps)	7.519
DC Bus Voltage (volts)	820.1
DPM % Loaded Total:(A/B/C)	50.0: (50.0/ 50.0/ 50.0)

	Line	**Load**
RMS Voltage Average:(Vab/Vbc/Vca) (volts)	480.4: (480.3/ 480.4/ 480.4)	N/A
RMS Current Average:(A/B/C) (amps)	200.2: (200.2/ 200.0/ 200.4)	223.7: (223.6/ 223.6/ 223.8)
Harmonic Current Average: (A/B/C) (amps)	0.0: (0.0/ 0.0/ 0.0)	100.0: (100.0/ 100.0/ 100.0)
THDR/F% Current Average: (A/B/C) (%)	0.0: (0.0/ 0.0/ 0.0)	44.7: (44.7/ 44.7/ 44.6)
THDR/F% Voltage Average: (Vab/Vbc/Vca) (%)	4.2: (4.2/ 4.2/ 4.2)	N/A
KW/KVA/PF	166.3/ 166.6/ 0.998	169.3/ 186.1/ 0.910

In particular the Operating Status is 3, which means that the system is on-less than max. The Line Harmonic Current is 0% (this is an ideal situation, in reality it would be at least lower than 5%). The first number is the average of all 3 lines, and the numbers in parentheses are the individual line A/B/C values.

8. PREVENTATIVE MAINTENANCE

WARNING: Operating a system continuously with dirty air filters, inoperable fans, or in a high room ambient temperature may decrease the operational life of any electrical equipment, including your DPM.

The following preventative maintenance items should be performed on a monthly basis or as needed, depending on the environment that the unit is installed.

- Check installation environment to verify that it is free from water, metal filings, excessive dust or other conductive impurities and corrosive chemicals.
- Clean or change the intake air filter(s) as required, depending on the environmental conditions. NEMA1 units use air filter media housed in reusable metal frames. Clean or replace fiberglass filter media with media shown in Table 8.1 or equivalent.

Table 8.1: Replacement Air Filter Media for NEMA1 Enclosed DPMs

DPM Size (Amp rating)	Media Size (inches)	Mesta part #	McMaster-Carr part #
50 or 100	12x16x1	00002749.00	2173K4*
150 or 200	16x20x1**	00002750.00	2173K3
300	24x24x1	00002751.00	2173K7

*2173K4 comes as 16x25 piece. Cut off 1" to make it 16x24, then cut in half to make two 12x16 pieces. Use one piece now and save the other for later.

**2 pieces required per 150 or 200 Amp DPM, as these DPMs have front and bottom intake air filters.

- Make sure all air inlet and exhaust openings are clear and free from any obstructions.
- Check the fan current on the LCD display. If DPM is enabled and running, a lower than normal fan current being displayed may indicate a fan needs to be replaced. See "VIEW MISC DISPLAY" section for additional information.

Once or twice per year (depending on the environment), it is recommended that a qualified technician, exercising proper safety procedures (See "Safety Precautions" section) perform the following preventive maintenance inside the enclosure:

- Check for excessive dust/dirt buildup inside system. Clean as necessary.
- Check interior of unit for indication of overheated components and/or connections or any signs of corrosion.

Any preventative or corrective maintenance performed inside the cabinet should only be performed by a qualified technician, exercising proper safety procedures.

9. TROUBLESHOOTING

✋WARNING
Risk of ***Electric Shock***. Only qualified personnel should open a DPM system and attempt to repair it. Personnel entering the cabinet may be exposed to an electrical shock hazard that could result in death or injury or further damage to the DPM. It is highly advised to contact factory if you suspect a problem with your system.

Your DPM is equipped with extensive diagnostic capabilities. It will convey problems detected via messages displayed on the LCD display, over the serial, Ethernet, or Ethernet/IP connections. At the center, bottom of almost all LCD display pages is a status indication (ON, OFF, PRECHARGING, etc.). For additional information on this status indication, refer to section 5.2.

Below this status indication will appear another message in smaller font, elaborating on the status. When operating normally, the status will display “ON” and the message underneath will be either “FULLY OPERATIONAL” or “REDUCED LINEAR PF MODE”. The latter of these two messages is displayed if either “NEVER” is selected for the “WHEN TO DO LINEAR PF CORRECTION” parameter option or “IF ABLE” or “ALWAYS” is selected and the unit is operating at MAX LOAD. See section 5.6.4 for additional information on these setting. The “REDUCED LINEAR PF MODE” simply indicates the the unit is not presently fully correcting any “out of phase” current drawn by the load. Any other messages displayed might require attention. These “fault” messages are displayed in the following Table 9.1. It is possible that a problem may be detected that is due to some temporary condition, that once that condition passes, the system can return to normal operation. Your DPM has the capability in most cases to “forgive” faults in hopes that the condition passes; therefore, simply getting one to a few of these fault messages may not necessarily mean that there is a definite problem. If a “fault” occurs, the system will attempt to try operating again. In many cases, it will perform a full system reset. This full system reset can be noticed because the initial “MESTA ELECTONICS …” splash screen will appear on the LCD display and the initial serial communications message will be displayed over the serial interface. Also a system reset record will be saved in the History Reset storage data base (HR). Such “temporary” faults do not necessarily indicate a problem exists with your system; however, if faults begin to appear in numbers, action may need to be taken to correct the situation.

In this table, a fault identified as “Should not occur” indicates you should never see this fault. There is no foreseeable reason for this fault to occur, so if it does, contact the factory for assistance, as a firmware upgrade may be needed to resolve the situation. Faults identified as “Unlikely to occur” are possible to occur, but are highly unlikely, and will only occur under extremely special circumstances.

Table 9.1: Fault Messages

LCD Message	Comments	Action to Take
UPPER>LOWER DC CAP VOLTS	Voltage across upper half of DC link caps much higher than lower half. If this continues, DIAG: UPPER CAP VDC HIGH will shut down unit.	See DIAG: UPPER CAP VDC HIGH Remedy.
LOWER>UPPER DC CAP VOLTS	Voltage across lower half of DC link caps much higher than upper half. If this continues, DIAG: LOWER CAP VDC HIGH will shut down unit.	See DIAG: LOWER CAP VDC HIGH Remedy.
HEATSINK TEMP HIGH	One or both of the heatsink temperatures approaching point where unit will shut down.	If room temperature close to or above 40C and unit is operating near capacity, may be normal. If not, check input filter and clean or change if dirty. Also check fans to make sure they are all operating.
AMBIENT TEMP HIGH	Temperature measured on PC-C approaching point where unit will shut down.	If room temperature close to or above 40C, may be normal. If not, check input filter and clean or change if dirty. Also check fans to make sure they are all operating.

SOFTWARE MISSING	Internal firmware problem	Contact factory
POWER-UP DELAY	Normal system power up delay	None – temporary condition
NVRAM NOT INITIALIZED	Internal problem with PC-C	Contact factory
BAD NVRAM OPTIONS DATA	Internal problem with PC-C	Contact factory
BAD NVRAM OFFSET DATA	Internal problem with PC-C	Contact factory
BAD NVRAM B-SETUP DATA	Internal problem with PC-C	Contact factory
DSP COMMUNICATIONS FAULT	Internal problem with PC-C	Contact factory
DIAG: UPPER CAP VDC HIGH	Voltage across upper half of DC link caps went too much higher than voltage across lower half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
DIAG: LOWER CAP VDC HIGH	Voltage across lower half of DC link caps went too much higher than voltage across upper half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
DIAG: TOO MANY SHUTDOWNS	Too many shutdowns occurred in a short time.	View history HO command via serial communications to determine reasons for shutdowns.
DIAG: DSP COMMUNICATIONS	Internal problem with PC-C	Could occur sporadically due to electrical noise. Contact factory if occurring more often than sporadically.
DIAG: PRECHARGE FAILURE	Unit Failed to Precharge	You should get one of the following DIAG:PRE messages instead of this with more detailed info. If not, contact factory.
DIAG:PRE-NO DSP ENABLE	Lost enable from DSP while precharging.	External event occurred that resulted in precharge having to stop. System will try again. If problem persists, contact factory.
DIAG:PRE-NO THYRISTOR	Could not attempt thyristor firing during precharge operation.	External event occurred that resulted in precharge having to stop. System will try again. If problem persists, contact factory.
DIAG:PRE-UP CAP VDC HI	Precharge failed because voltage across upper half of DC link caps went too much higher than voltage across lower half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
DIAG:PRE-LOW CAP VDC HI	Precharge failed because voltage across lower half of DC link caps went too much higher than voltage across upper half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
DIAG:PRE-VDC < 10%	Vdc failed to reach 10% voltage in a specified time period.	Internal failure – contact factory - Blown F1 fuse on PC-H. If fuse is blown, replace once. If fuse blows again, replace PC-H. If fuse not blown, could be PC-H, PC-C, ribbon cable between PC-H and PC-C, or wiring from PC-H-P2 and contactor K1.
DIAG:PRE-TIMEOUT	Precharge took too long and timed out	Unlikely to occur – contact factory if it does.
DIAG:PRE-OPER. DISABLE	Operator disabled system while precharging.	Re-enable system by pressing RUN button on LCD display, then confirming by pressing RUN button again.
DIAG:PRE-PRECH DATA FLAG	Software error detected while precharging.	Should not occur – contact factory if it does.
DIAG:PRE-SW OVERFLOW #1	Software error detected while precharging.	Should not occur – contact factory if it does.
DIAG:PRE-SW OVERFLOW #2	Software error detected while precharging.	Should not occur – contact factory if it does.
DIAG:PRE-VA PEAK TOO LO	AC line peak voltage too low while precharging	Unlikely to occur – Could be due to a highly distorted AC line voltage – contact factory for assistance.
DIAG:PRE-VA PEAK TOO HI	AC line peak voltage too low while precharging	Unlikely to occur – Could be due to a highly distorted AC line voltage – contact factory for assistance.
DIAG:PRE-HI DPM CURRENTS	High current coming into DPM sensed while precharging	Unlikely to occur – Could be due to a highly distorted AC line voltage – contact factory for assistance.
DIAG:PRE-CURRENT TRIP	Current trip occurred while precharging	Unlikely to occur – No action if it occurs only a couple of times, else contact factory for assistance.
DIAG:PRE-LOW LINE VOLTS	Line voltage went too low while precharging	Probably caused by a voltage fluctuation on the AC line. System will reattempt precharge.
DIAG:PRE-HIGH LINE VOLTS	Line voltage went too high while precharging	Probably caused by a voltage fluctuation on the AC line. System will reattempt precharge.

DIAG:PRE-CHOP. OVERFLOW	Software error detected while precharging.	Should not occur – contact factory if it does.
DIAG:PRE-POLE TRIP: xxxx	Pole trip occurred while precharging.	Internal problem – Inverter, gate drives, or PC-C. Perform low power inverter test to isolate problem.
DIAG: PWM CALC PROBLEM	Firmware problem	Unlikely to occur – contact factory if it does.
DIAG: C167/DSP HANDSHAKE	Internal problem with PC-C	Could occur sporadically due to electrical noise. Contact factory if occurring more often than sporadically.
DIAG: DSP DIAGNOSTIC	Internal problem with PC-C	Unlikely to occur – contact factory if it does.
DIAG: FLASH CHECKSUM	Firmware problem	Re-flash firmware into PC-C. If this doesn't solve problem, replace PC-C.
DIAG: DSP DATA CHECKSUM	Internal problem with PC-C	Could occur sporadically due to electrical noise. Contact factory if occurring more often than sporadically.
DIAG: DSP DATA CHKSUM#2	Internal problem with PC-C	Could occur sporadically due to electrical noise. Contact factory if occurring more often than sporadically.
DIAG: TOO MANY ITRIPS	Too many inverter current trips	If unit is not newly installed, could be a system resonance problem or an internal problem due to fault in PC-C, inverter, or gate drives in inverter. If system resonance ruled out, perform low power inverter test to try to isolate problem.
DIAG: TOO MANY PTRIPS	Too many inverter pole trips	Internal problem – Inverter, gate drives, or PC-C. Perform low power inverter test to isolate problem.
DIAG: BAD CONTACTOR	AC contactor failed to close	Internal problem – K1, PC-C, internal current sensors, or wiring.
DIAG: DPM ISENSOR	Not enough DPM current detected when AC contactor is closed.	Internal problem – Internal current sensor, C4-C6, PC-T, F4-F6, PC-C.
DIAG: LINE ISENSOR	Not enough current detected in external CTs	External CTs may not be installed correctly or shorting bars may be installed shorting their output. Also possible internal problem, involving PC-R, PC-I, PC-C, or cables connecting these 3 boards together.
DIAG: HI FREQ IN IDPM	High frequency detected in DPM current	Internal problem – PC-T failure and/or blown protection fuses (F4 – F6). Look at DPM_HFAMPS in history to determine phase(s) that caused the fault.
DIAG: DC IN IDPM	DC detected in DPM current	Internal problem – IGBT device firing problem. Look at DPM_DCAMPS in history (largest value may indicate pole that device is in that is at fault)
DIAG: DPM/INV ISENSOR	Difference detected between DPM and Inverter current sensors.	Internal problem – Possible failure in either one or more current sensors CS1-CS4 or PC-C board. Look at DPM-INV RMS AMPS in history to determine phase(s) that caused the fault.
DIAG: DPM INEFFECTIVE	Diagnostic – DPM is ineffective at correcting harmonics	Problem with CTs being incorrectly positioned or a system resonance exists, resulting in current produced by DPM not effectively reducing harmonic currents in the line current. Check CTs using CT Setup LCD screen. Make sure CT physical locations (line or load side) agree with location programmed into system.
OVER-TEMPERATURE	Over-temperature occurred	System shut down due to over-temperature and must be power-cycled to restart. Check history to view temperatures recorded at the time of the shutdown to help determine the possible cause. Make sure air filters are clean and internal fans are all operating via DC fan current on front display. If operating in a high altitude and high ambient temperature environment, may need to relax temperature limits (consult factory).
IDPM TOO HIGH WHEN ROFF	Too much DPM current detected when AC contactor is open.	Possible internal problem with AC contactor, DPM current sensors, or PC-C. Observe DPM currents on LCD display to determine which phase problem is with.
IDPM TOO LOW WHEN RON	Not enough DPM current detected when AC contactor is closed.	None – usually a temporary condition. If condition persists, will be followed by DIAG: DPM ISENSOR indication.
LINE CURRENT TOO LOW	Not enough line current detected when AC contactor is closed and inverter not yet operating.	Some minimal line current should register when AC contactor is closed and inverter is not yet operating. If not, external CTs may not be properly located or may have shorting strips in place, shorting their output. If this is not the case, a possible internal problem could exist with PC-R, PC-I, PC-C or cables interconnecting these.

CURRENT TRIP SHUTDOWN	Inverter Current trip shut down the inverter.	Temporary condition - Current trips can occur occasionally due to power interruptions or very rapid load changes. Check history to see if an inordinate number of such shutdowns are occurring. Contact factory if they are.
POLE TRIP SHUTDOWN DPM	Inverter Pole trip shut down the inverter.	Temporary condition - A pole trip can occur occasionally due to electrical "noise" in the environment. Check history to see if an inordinate number of such shutdowns are occurring. Contact factory if they are.
DISABLED BY OPERATOR	System's power inverter disabled by operator	Press the RUN button on the touchscreen display to enable the system.
NO INVERTERS ENABLED	Power inverter not ready to run	None - temporary condition
CONTACTOR CLOSING	AC contactor K1 is in the process of closing	None - temporary condition
CONTACTOR OPENING	AC contactor K1 is in the process of closing	None – temporary condition
INVERTER TEST	System is in inverter test mode	Only occurs if test mode requested via serial comm.
THYRISTOR TEST	System is in thyristor test mode	Only occurs if test mode requested via serial comm.
CONTACTOR TEST	System is in contactory test mode	Only occurs if test mode requested via serial comm.
VDC TEST	System is in DC voltage test mode	Only occurs if test mode requested via serial comm.
BAD TEST MODE	System is in unknown test mode	Should not occur – contact factory if it does
DSP UNKNOWN REASON	Internal problem with PC-C	Should not occur – contact factory if it does
DC CAP VOLTAGE TOO LOW	DC Caps are in the process of charging	None - temporary condition
DC CAP VOLTAGE TOO HIGH	DC Cap voltage went too high to continue operation	None – temporary condition. Some anomaly occurred externally that cause DC voltage to spike. As soon as DC voltage reduces, system will start operating again.
LINE PEAK VOLTS TOO LOW	AC line peak voltage too low to operate	None - temporary condition – system will operate again when AC line returns to within operational specifications.
LINE PEAK VOLTS TOO HIGH	AC line peak voltage too high to operate	None - temporary condition – system will operate again when AC line returns to within operational specifications.
LINE RMS VOLTS BAD	AC line rms voltage too high or too low to operate	None - temporary condition – system will operate again when AC line returns to within operational specifications.
NOT PHASELOCKED TO LINE	System not phaselocked to AC line	None – temporary condition – Either system is in process of phaselocking to AC line or frequency of line is presently outside operational specifications.
DSP DIAGNOSTIC	Internal problem with PC-C	Could occur sporadically due to electrical noise. If it occurs more often try re-flashing firmware or contact factory.
PWM SHUTDOWN	Internal problem with PC-C	Should not occur – contact factory if it does.
OVER_CURRENT SHUTDOWN	Inverter shut down due to an anomaly in the power source or extreme change in load current that occurred so quickly that system's control could not react fast enough to correct.	None – temporary condition, system will quickly restart. If problem persists, will be replaced by a different message.
ALLVOK# SET	An internal control voltage is too low	Usually a temporary condition; however, if it persists could be due to a faulty PC-C or PS1 (24V system supply).
LOAD TOO LOW	Load power too low to operate	If "UNIT DISABLED IF LOAD POWER BELOW THIS %" parameter (see section 5.6.3) is set to a non-zero value, system is either OFF if not previously operating of IDLE if previously operating because load power is too low. Once load power increases, unit will resume operation. This is normal operation unless the load is actually high enough but the external line/load CTs are not reading current correctly (see section 4).
POLE TRIP – MISC CAUSE	Pole trip occurred, but cause could not be determined.	Older systems with 45400058 gate drive boards could not isolate a cause of a pole trip, so display this message if a pole trip occurs.
POLE TRIP – CTRL FAULT	Internal problem. Pole trip occurred, but control could not reset the control board latch	Contact factory. Problem with PC-C.

POLE TRIP – GATE FAULT	Internal problem. Pole trip occurred, but control could not clear the fault at the gate drive board.	Contact factory. Possible problem with gate drive, inverter, or PC-C or inter-connections between these.
POLE TRIP – A-DEVICE	Pole trip received from A- IGBT	Check unit's "History" to see if an inordinate number of these have been occurring. If so, a possible problem with the inverter, gate drives, or PC-C board may exist.
POLE TRIP – B-DEVICE	Pole trip received from B- IGBT	
POLE TRIP – C-DEVICE	Pole trip received from C- IGBT	
POLE TRIP – A+ DEVICE	Pole trip received from A+ IGBT	
POLE TRIP – B+ DEVICE	Pole trip received from B+ IGBT	
POLE TRIP – C+ DEVICE	Pole trip received from C+ IGBT	
DISABLED EXTERNALLY	External disable capability selected (see section 5.6.5) and externally generated signal connected to PC-I-P2 is disabling DPM.	Either provide correct signal to PC-I-P2 to enable DPM or deselect external disable capability via LCD display.
DISABLED BY ETHERNET/IP	External disable via Ethernet/IP capability selected (see section 5.6.5.2) and enable command has not been received via Ethernet/IP.	Disable this feature via the LCD front panel (see section 5.6.5.2) or change firmware in your PLC to send an enable to the DPM via the Ethernet/IP network.

A very useful tool for diagnosing problems occurring with a DPM is the "History" database storage. This function is accessed over the serial communications as indicated in section 6.3.3. Every time a DPM starts performing current correction, an entry is created in the "ON/OFF" database, storing the date and time the DPM started. When the DPM eventually stops performing current correction, this entry in the data base is closed. At this time, the date and time the DPM stopped and the reason for the DPM having to stop is saved. Also, dozens of operating parameters (see section 6.3.3.1 for details) are also stored. This information can be displayed over the serial link, and can be analyzed to determine if a problem exists and if so what that problem is. This analysis can then be used to determine corrective action to fix the problem. Table 9.2 contains shutdown reasons that can be displayed by the "HO" history command.

In this table, a shutdown reason identified as "Should not occur" indicates you should never see this reason. There is no foreseeable reason for this shutdown to occur, so if it does, contact the factory for assistance, as a firmware upgrade may be needed to resolve the situation. Shutdown reasons identified as "Unlikely to occur" are possible to occur, but are highly unlikely, and will only occur under extremely special circumstances.

Table 9.2: Shutdown Reasons

Shutdown Reason	Comments	Action to Take
OPERATOR DISABLED INVERTER	System's power inverter disabled by operator	Press the RUN button on the touchscreen display to re-enable the system to run again.
EXTERNAL ENABLE LOST	External disable capability selected (see section 5.6.5) and externally generated signal connected to PC-I-P2 disabled DPM.	System will shut down when externally generated disable signal is present on PC-I-P2 to enable DPM AND external disable capability is selected via LCD display.
VDC WENT TOO HIGH	DC Cap voltage went too high to operate inverter.	Can happen if extreme changes in load power occur. Such instances will be temporary with system restarting automatically. If several occur, could be due to external CTs not properly placed or working, or an internal problem with PC-H, PC-C, or wiring.

VDC WENT TOO LOW	DC Cap voltage dropped too low to operate inverter.	Could be due to external CTs not properly placed or working, or an internal problem with PC-H, PC-C, or wiring.
VDC TEST MODE ENTERED	A request to enter a special Vdc test mode was received over the serial link.	Should not occur unless you were directed by the factory to enter this test mode.
OVER-TEMPERATURE OCCURRED	Either the ambient (located on PC-C) or one of the two heatsink temperature sensors exceeded the maximum temperature allowed.	System shut down due to over-temperature and must be power-cycled to restart. Check history to view temperatures recorded at the time of the shutdown to help determine the possible cause. Make sure air filters are clean and internal fans are all operating via DC fan current on front display. If operating in a high altitude and high ambient temperature environment, may need to relax temperature limits (consult factory).
DC SUPPLY VOLTAGE TOO LOW	Gen 1 systems only. DC voltage input to 24V power supply dropped below operational limits.	Loss of line voltage could cause this; however, other reasons will probably occur first.
LOAD TOO LOW	Load power too low to operate	If "UNIT DISABLED IF LOAD POWER BELOW THIS %" parameter (see section 5.6.3) is set to a non-zero value, system is either OFF if not previously operating of IDLE if previously operating because load power is too low. Once load power increases, unit will resume operation. This is normal operation unless the load is actually high enough but the external line/load CTs are not reading current correctly (see section 4).
VDC UPPER CAP >> VDC LOWER CAP	Voltage across upper half of DC link caps went too much higher than voltage across lower half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
VDC LOWER CAP >> VDC UPPER CAP	Voltage across lower half of DC link caps went too much higher than voltage across upper half.	Internal failure – contact factory – PC-H, PC-C, R1 (upper bleeder), R2 (lower bleeder), ribbon cable between PC-H and PC-C, or wiring between PC-H, R1, R2, and DC link caps.
FLASH DATA CHECKSUM MISMATCH	Firmware problem	Re-flash firmware into PC-C. If this doesn't solve problem, replace PC-C.
UNKNOWN DIAGNOSTIC OCCURRED	An undocumented diagnostic occurred.	Should not occur – contact factory if it does.
DPM CURRENTS TOO LOW	Reserved.	Should not occur – contact factory if it does.
LINE CURRENTS TOO LOW	Reserved.	Should not occur – contact factory if it does.
DPM CURRENTS > RATED VALUE	Rms of a DPM current exceeded 125% or avg of all DPM currents exceeded 115% rated for several cycles.	Extremely fast changes in line voltage and/or load current could be faster than the system is capable of correcting for. To protect itself, system will shut down, wait for this transient to pass, then restart.
DPM CURRENTS >> RATED VALUE	Rms of a DPM current exceeded 150% rated.	
LINE CURRENTS > LOAD CURRENTS	Reserved.	Should not occur – contact factory if it does.
DPM CURRENTS > LOAD CURRENTS	Reserved.	Should not occur – contact factory if it does.
POLE TRIP – MISC CAUSE	Pole trip occurred, but cause could not be determined.	Older systems with 45400058 gate drive boards could not isolate a cause of a pole trip, so display this message if a pole trip occurs.
POLE TRIP – CONTROL PCB FAULT	Internal problem. Pole trip occurred, but control could not reset the control board latch	Contact factory. Problem with PC-C.
POLE TRIP – GATE DRIVE FAULT	Internal problem. Pole trip occurred, but control could not clear the fault at the gate drive board.	Contact factory. Possible problem with gate drive, inverter, or PC-C or inter-connections between these.
POLE TRIP – A-	Pole trip received from A- IGBT	Check unit's "History" to see if an inordinate number of these have been occurring. If so, a possible problem with the inverter, gate drives, or PC-C board may exist.
POLE TRIP – B-	Pole trip received from B- IGBT	
POLE TRIP – C-	Pole trip received from C- IGBT	
POLE TRIP – A+	Pole trip received from A+ IGBT	
POLE TRIP – B+	Pole trip received from B+ IGBT	
POLE TRIP – C+	Pole trip received from C+ IGBT	

DISABLED BY ETHERNET/IP	External disable via Ethernet/IP capability selected (see section 5.6.5.2) and enable command has not been received via Ethernet/IP.	Disable this feature via the LCD front panel (see section 5.6.5.2) or change firmware in your PLC to send an enable to the DPM via the Ethernet/IP network.
HI FREQ FOUND IN IDPM	High frequency detected in DPM current	Internal problem – PC-T failure and/or blown protection fuses (F4 – F6). Look at DPM_HFAMPS in history to determine phase(s) that caused the fault.
DC FOUND IN IDPM	DC detected in DPM current	Internal problem – IGBT device firing problem. Look at DPM_DCAMPS in history (largest value may indicate pole that device is in that is at fault)
DPM/INV ISENSOR MISMATCH	Difference detected between DPM and Inverter current sensors.	Internal problem – Possible failure in either one or more current sensors CS1-CS4 or PC-C board. Look at DPM-INV RMS AMPS in history to determine phase(s) that caused the fault.
DPM IS INEFFECTIVE	Diagnostic – DPM is ineffective at correcting harmonics	Problem with CTs being incorrectly positioned or a system resonance exists, resulting in current produced by DPM not effectively reducing harmonic currents in the line current. Check CTs using CT Setup LCD screen. Make sure CT physical locations (line or load side) agree with location programmed into system.
MISSING SOFTWARE	Internal firmware problem	Should not occur - contact factory if it does.
RESET: MAIN WATCHDOG	Internal PC-C problem	Unlikely to occur – Sporadic occurrences possible due to electrical noise - contact factory if more often than sporadic, which could be due to possible PC-C or electrical noise problem.
RESET: ADSUM WATCHDOG	Internal firmware problem	Should not occur - contact factory if it does.
RESET: ALLVOK# SET	Lost a control voltage	Could occur during loss of utility power, but usually some other reason will shut down system first. Sporadic occurrences are not a problem – contact factory if more than sporadic - possible problem with PC-P, PC-I, PS1, or wiring.
RESET: NMI RESET: STACK OVERFLOW RESET: STACK UNDERFLOW RESET: UNKNOWN CLASS B RESET: ILGL EXTBUS ACC RESET: ODD BYTE BRANCH RESET: ODD ADDR WORD RESET: PROTECTED INSTR RESET: INVALID OP-CODE RESET: POWER UP RESET: WATCHDOG TIMER RESET: BAD PWMINIT INT RESET: BAD PWM FF INT RESET: LATE PP3 UPDATE RESET: DSP ACCESS WDOG RESET: EXTERN HARDWARE	Internal PC-C problem	Unlikely to occur – Sporadic occurrences possible due to electrical noise - contact factory if more often than sporadic, which could be due to possible PC-C or electrical noise problem.
ERROR WRITING CALIB. VAR TO DSP	Error occurred during a recalibration event	Should not occur – contact factory if it does.

CALIB. TIMEOUT WAITING FOR DSP	Error occurred during a recalibration event	Should not occur – contact factory if it does.
DSP DID NOT GRANT ITS BUS	Communication problem on PC-C	Could occur sporadically due to electrical noise. If it occurs more often, contact factory.
C167/DSP HSHAKE COUNT MISMATCH	Communication problem on PC-C	Could occur sporadically due to electrical noise. If it occurs more often, contact factory.
C167/DSP 2 BAD DATA CHECKSUMS	Communication problem on PC-C	Could occur sporadically due to electrical noise. If it occurs more often, contact factory.
INVERTER HARDWARE CURRENT TRIP	Inverter shut down due to an anomaly in the power source or extreme change in load current that occurred so quickly that system's control could not react fast enough to correct.	None – temporary condition, system will quickly restart. If problem persists, a more serious diagnostic will be declared. A large number of current trips could indicate either a problem with the external CTs or an internal problem.
RTC SOFTWARE REQUESTED SHUTDOWN	Reserved	Should not occur – contact factory if it does.
NO TIME TO ADJUST PWM TIMERS	Internal firmware problem	Should not occur - contact factory if it does.
MISSING INV. HARDWARE ENABLE(S)	Lost inverter hardware enable on PC-C.	Unlikely to occur – contact factory if it does - possible PC-C or electrical noise problem.
LOST DSP_PWM_-ON_REQUEST		
LOW INSTANTANEOUS VDC DETECTED	DC Cap voltage dropped too low to operate inverter.	Could be due to external CTs not properly placed or working, or an internal problem with PC-H, PC-C, or wiring.
HIGH INSTANTANEOUS VDC DETECTED	DC Cap voltage went too high to operate inverter.	Can happen if extreme changes in load power occur. Such instances will be temporary with system restarting automatically. If several occur, could be due to external CTs not properly placed or working, or an internal problem with PC-H, PC-C, or wiring.
VRMS TOO LOW/HIGH TO RUN	AC RMS Line voltage either dropped too low or went to high.	None – system will resume operation when AC line is within operational tolerance again.
NOT PHASE-LOCKED W/SOURCE VOLT.	DPM lost sync with AC line voltage, probably due to AC line falling out of tolerance.	None – system will resume operation when AC line is within operational tolerance again.
DSP DETECTED UNSPECIFIED DIAG	Internal PC-C problem	Unlikely to occur – Sporadic occurrences possible due to electrical noise - contact factory if more often than sporadic, which could be due to possible PC-C or electrical noise problem.
DSP ADSUM ROUTINES OVERLAPPED		
BAD NV INDEX PASSED TO DSP		
BAD CAL INDEX PASSED TO DSP		
DSP CONSTANTS CHECKSUM MISMATCH		
DSP CODE CHECKSUM MISMATCH		
DSP IRQ0 INTRPT BUS ERROR		
UNDEFINED PWMDSP CODE nn	Reserved.	Should not occur – contact factory if it does.
UNDEFINED PWMDSP DIAG nn	Reserved.	Should not occur – contact factory if it does.
Any other message		Contact factory

10. DPM SPECIFICATIONS AND DRAWINGS

Note: Specifications are subject to change

Table 10.1: Specifications for 50 Amp DPM (3AC2DPM050-nnn -0 or -1)
nnn = voltage rating of unit (240 or 480)

Parameter	Symbol	Condition	Min.	Nom.	Max.	Unit
Power (3Φ Delta):						
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 208 selected as nom volt.	177	208	233	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 240 selected as nom volt.	204	240	269	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 400 selected as nom volt.	340	400	448	Volts
Frequency	F_{line}		45	50	55	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 480 selected as nom volt.	408	480	538	Volts
Frequency	F_{line}		55	60	65	Hz
Correction Current (see note 1)	I_{DPM} (rms)	Average of all 3 phases			50	Amps
Correction Current	I_{DPM} (rms)	Any single phase			52.5	Amps
Correction Current	I_{DPM} (peak)	Any phase	-150		+150	Amps
Full load Efficiency	Eff	I_{DPM}(rms)= Max., V_{line}= Nom		98		%
Full load Losses	P_{Loss}			900		Watts
Performance:						
Resultant Line Current Distortion (see notes 1 & 2)	I_{line} thdr	I_{load} harmonics = I_{DPM} Max.		3.0	5.0	%thdr
Resultant Power Factor (linear correction enabled)	I_{line} pf	I_{load} harmonics and reactive < I_{DPM} Max.	0.998			
Physical:						
Operating Temperature	T_{oper}	Ambient (see note 3)	0		40	°C
Storage Temperature	T_{st}	Ambient	-20		60	°C
Altitude above sea level	Alt	(see note 3)			5000	ft
Audible Noise produced					60	dBA
NEMA1 Enclosed:	3AC2DPM050-nnn-1					
Enclosure Height	Power switch protrudes 2.13" out from front surface of enclosure. Height does not include 1" air filter on bottom of unit. See drawings that follow for additional dimensions.				53	inches
Enclosure Width					21	inches
Enclosure Depth					14.25	inches
Panel Weight					230	lbs.
Open Panel:	3AC2DPM050-nnn-0					
Panel Height	Depth of panel varies – only maximum depth is shown in this table (depth may need to increase 0.25" for screws protruding out of panel). See drawings that follow for additional dimensions.				45	inches
Panel Width					16.9	inches
Panel Depth					12.71	inches
Panel Weight					135	lbs.
Cabinet Air flow needed	Supplied by Integrator		375			cfm

Table 10.2: Specifications for 100 Amp DPM (3AC2DPM100-nnn -0 or -1) nnn = voltage rating of unit (240 or 480)						
Parameter	**Symbol**	**Condition**	**Min.**	**Nom.**	**Max.**	**Unit**
Power (3Φ Delta):						
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 208 selected as nom volt.	177	208	233	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 240 selected as nom volt.	204	240	269	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 400 selected as nom volt.	340	400	448	Volts
Frequency	F_{line}		45	50	55	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 480 selected as nom volt.	408	480	538	Volts
Frequency	F_{line}		55	60	65	Hz
Correction Current (see note 1)	I_{DPM} (rms)	Average of all 3 phases			100	Amps
Correction Current	I_{DPM} (rms)	Any single phase			105	Amps
Correction Current	I_{DPM} (peak)	Any phase	-300		+300	Amps
Full load Efficiency	Eff	I_{DPM}(rms)= Max., V_{line}= Nom		98		%
Full load Losses	P_{Loss}			1700		Watts
Performance:						
Resultant Line Current Distortion (see notes 1 & 2)	I_{line} pf	I_{load} harmonics = I_{DPM} Max.		3.0	5.0	%thdr
Resultant Power Factor (linear correction enabled)		I_{load} harmonics and reactive < I_{DPM} Max.	0.998			
Physical:						
Operating Temperature	T_{oper}	Ambient (see note 3)	0		40	°C
Storage Temperature	T_{st}	Ambient	-20		60	°C
Altitude above sea level	Alt	(see note 3)			5000	ft
Audible Noise produced					60	dBA
NEMA1 Enclosed:	3AC2DPM100-nnn-1					
Enclosure Height	Power switch protrudes 2.13" out from front surface of enclosure. Height does not include 1" air filter on bottom of unit. See drawings that follow for additional dimensions.				53	inches
Enclosure Width					21	inches
Enclosure Depth					14.25	inches
Panel Weight					270	lbs.
Open Panel:	3AC2DPM100-nnn-0					
Panel Height	Depth of panel varies – only maximum depth is shown in this table (depth may need to increase 0.25" for screws protruding out of panel). See drawings that follow for additional dimensions.				45	inches
Panel Width					12.9	inches
Panel Depth					12.83	inches
Panel Weight					175	lbs.
Cabinet Air flow needed	Supplied by Integrator		500			cfm

Table 10.3: Specifications for 150 Amp DPM (3AC2DPM150-nnn -0 or -1) nnn = voltage rating of unit (240 or 480)						
Parameter	**Symbol**	**Condition**	**Min.**	**Nom.**	**Max.**	**Unit**
Power (3Φ Delta):						
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 208 selected as nom volt.	177	208	233	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 240 selected as nom volt.	204	240	269	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 400 selected as nom volt.	340	400	448	Volts
Frequency	F_{line}		45	50	55	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 480 selected as nom volt.	408	480	538	Volts
Frequency	F_{line}		55	60	65	Hz
Correction Current (see note 1)	I_{DPM} (rms)	Average of all 3 phases			150	Amps
Correction Current	I_{DPM} (rms)	Any single phase			157.5	Amps
Correction Current	I_{DPM} (peak)	Any phase	-450		+450	Amps
Full load Efficiency	Eff	I_{DPM}(rms)= Max., V_{line}= Nom		98		%
Full load losses	P_{Loss}			2500		Watts
Performance:						
Resultant Line Current Distortion (see notes 1 & 2)	I_{line} pf	I_{load} harmonics = I_{DPM} Max.		3.0	5.0	%thdr
Resultant Power Factor (linear correction enabled)		I_{load} harmonics and reactive < I_{DPM} Max.	0.998			
Physical:						
Operating Temperature	T_{oper}	Ambient (see note 3)	0		40	°C
Storage Temperature	T_{st}	Ambient	-20		60	°C
Altitude above sea level	Alt	(see note 3)			5000	ft
Audible Noise produced					65	dBA
NEMA1 Enclosed:	3AC2DPM150-nnn-1					
Enclosure Height	Power switch protrudes 2.13" out from front surface of enclosure. Height does not include 1" air filter on bottom of unit. See drawings that follow for additional dimensions.				63.5	inches
Enclosure Width					27	inches
Enclosure Depth					16.5	inches
Panel Weight					440	lbs.
Open Panel:	3AC2DPM150-nnn-0					
Panel Height	Depth of panel varies – only maximum depth is shown in this table (depth may need to increase 0.25" for screws protruding out of panel). See drawings that follow for additional dimensions.				54	inches
Panel Width					22	inches
Panel Depth					12.54	inches
Panel Weight					245	lbs.
Cabinet Air flow needed	Supplied by Integrator		800			cfm

Table 10.4: Specifications for 200 Amp DPM (3AC2DPM200-nnn -0 or -1)

nnn = voltage rating of unit (240 or 480)

Parameter	Symbol	Condition	Min.	Nom.	Max.	Unit
Power (3Φ Delta):						
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 208 selected as nom volt.	177	208	233	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 240 selected as nom volt.	204	240	269	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 400 selected as nom volt.	340	400	448	Volts
Frequency	F_{line}		45	50	55	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 480 selected as nom volt.	408	480	538	Volts
Frequency	F_{line}		55	60	65	Hz
Correction Current (see note 1)	I_{DPM} (rms)	Average of all 3 phases			200	Amps
Correction Current	I_{DPM} (rms)	Any single phase			210	Amps
Correction Current	I_{DPM} (peak)	Any phase	-600		+600	Amps
Full load Efficiency	Eff	I_{DPM}(rms)= Max., V_{line}= Nom		98		%
Full load losses	P_{Loss}			3300		Watts
Performance:						
Resultant Line Current Distortion (see notes 1 & 2)	I_{line} pf	I_{load} harmonics = I_{DPM} Max.		3.0	5.0	%thdr
Resultant Power Factor (linear correction enabled)		I_{load} harmonics and reactive < I_{DPM} Max.	0.998			
Physical:						
Operating Temperature	T_{oper}	Ambient (see note 3)	0		40	°C
Storage Temperature	T_{st}	Ambient	-20		60	°C
Altitude above sea level	Alt	(see note 3)			5000	ft
Audible Noise produced					65	dBA
NEMA1 Enclosed:	3AC2DPM200-nnn-1					
Enclosure Height	Power switch protrudes 2.13” out from front surface of enclosure. Height does not include 1” air filter on bottom of unit. See drawings that follow for additional dimensions.				63.5	inches
Enclosure Width					27	inches
Enclosure Depth					16.5	inches
Panel Weight					480	lbs.
Open Panel:	3AC2DPM200-nnn-0					
Panel Height	Depth of panel varies – only maximum depth is shown in this table (depth may need to increase 0.25” for screws protruding out of panel). See drawings that follow for additional dimensions.				54	inches
Panel Width					22	inches
Panel Depth					13.54	inches
Panel Weight					280	lbs.
Cabinet Air flow needed	Supplied by Integrator		900			cfm

Table 10.5: Specifications for 300 Amp DPM (3AC2DPM300-nnn -0 or -1)

nnn = voltage rating of unit (240 or 480)

Parameter	Symbol	Condition	Min.	Nom.	Max.	Unit
Power (3Φ Delta):						
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 208 selected as nom volt.	177	208	233	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=240 in part# & 240 selected as nom volt.	204	240	269	Volts
Frequency	F_{line}		55	60	65	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 400 selected as nom volt.	340	400	448	Volts
Frequency	F_{line}		45	50	55	Hz
RMS Voltage (Line-to-line)	V_{line}	nnn=480 in part# & 480 selected as nom volt.	408	480	538	Volts
Frequency	F_{line}		55	60	65	Hz
Correction Current (see note 1)	I_{DPM} (rms)	Average of all 3 phases			300	Amps
Correction Current	I_{DPM} (rms)	Any single phase			315	Amps
Correction Current	I_{DPM} (peak)	Any phase	-900		+900	Amps
Full load Efficiency	Eff	I_{DPM}(rms)= Max., V_{line}= Nom		98		%
Full load losses	P_{Loss}			5100		Watts
Performance:						
Resultant Line Current Distortion (see notes 1 & 2)	I_{line} thdr	I_{load} harmonics = I_{DPM} Max.		3.0	5.0	%thdr
Resultant Power Factor (linear correction enabled)	I_{line} pf	I_{load} harmonics and reactive < I_{DPM} Max.	0.998			
Physical:						
Operating Temperature	T_{oper}	Ambient (see note 3)	0		40	°C
Storage Temperature	T_{st}	Ambient	-20		60	°C
Altitude above sea level	Alt	(see note 3)			5000	ft
Audible Noise produced					65	dBA
NEMA1 Enclosed:	3AC2DPM300-nnn-1					
Enclosure Height	Power switch protrudes 1.75" out from front surface of enclosure. See drawings that follow for additional dimensions.				75	inches
Enclosure Width					33	inches
Enclosure Depth					18	inches
Panel Weight					630	lbs.
Open Panel:	3AC2DPM300-nnn-0					
Panel Height	Depth of panel varies – only maximum depth is shown in this table (depth may need to increase 0.25" for screws protruding out of panel). See drawings that follow for additional dimensions.				56	inches
Panel Width					27	inches
Panel Depth					13.56	inches
Panel Weight					400	lbs.
Cabinet Air flow needed			1300			cfm

Notes pertaining to all previous specification tables:

1. System will automatically current limit at max. rms and peak values shown. If load requires correction exceeding these values, excess amount will come from utility. This automatic limiting will allow the system to continuously run at max. output, providing its maximum amount of correction; however, the line current (I_{line}) thdr will increase as the excess current that is needed increases, and will soon exceed the max. %thdr listed.
2. Depending on the severity of the harmonic currents drawn by the load, and how loaded the DPM is, the resultant line current distortion will vary. The maximum 5% THDR shown is achievable down to as low as 15-20% DPM loading for normal loads (30-35% THDR). Higher distorted loads will require the DPM to be loaded a bit more to attain the 5% max. line THDR.

3. Standard maximum operating ambient room temperature is 40 degrees C. On request, if higher ambient temperatures are anticipated, systems can be configured for operating in up to a 50 degree C room ambient. Above 40 degrees, system will “self de-rate” at about 2.5% per degree, so that when the room ambient is at 50 degrees, system will limit itself to produce about 75% of its rated output current. When operating at 40 degrees or lower, system will produce full rated current. Also, equipment can operate at higher altitudes at full rated current if ambient operating temperature is kept lower than 40C. At ambient temperatures approaching 40 C and higher altitudes, system will “self de-rate” its output current, thus allowing operation to continue, but at a reduced maximum current. It is not recommended to operate at both higher altitudes and higher than 40C ambient temperatures.

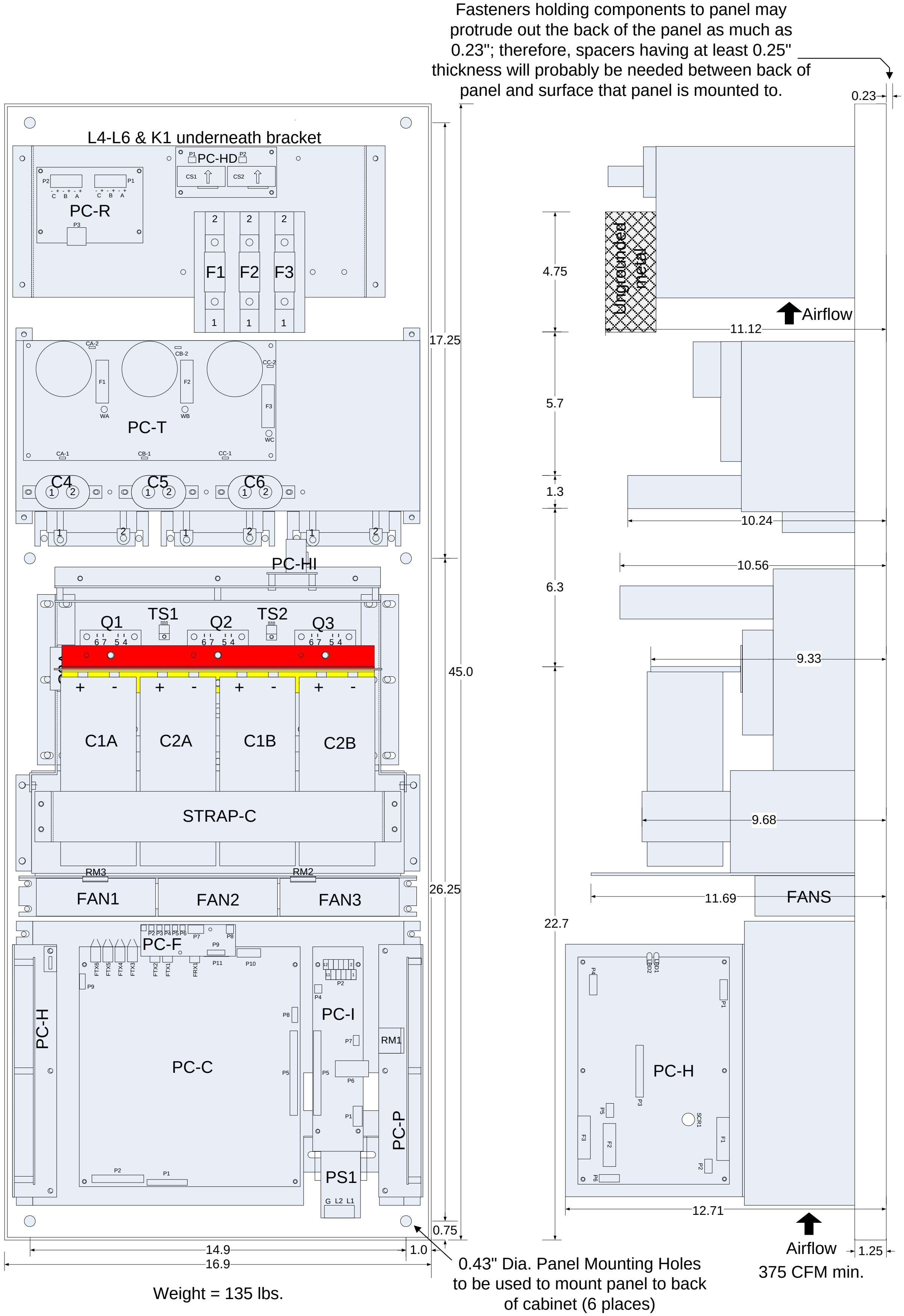


Figure 10.1: 50 Amp DPM Panel Layout Drawings

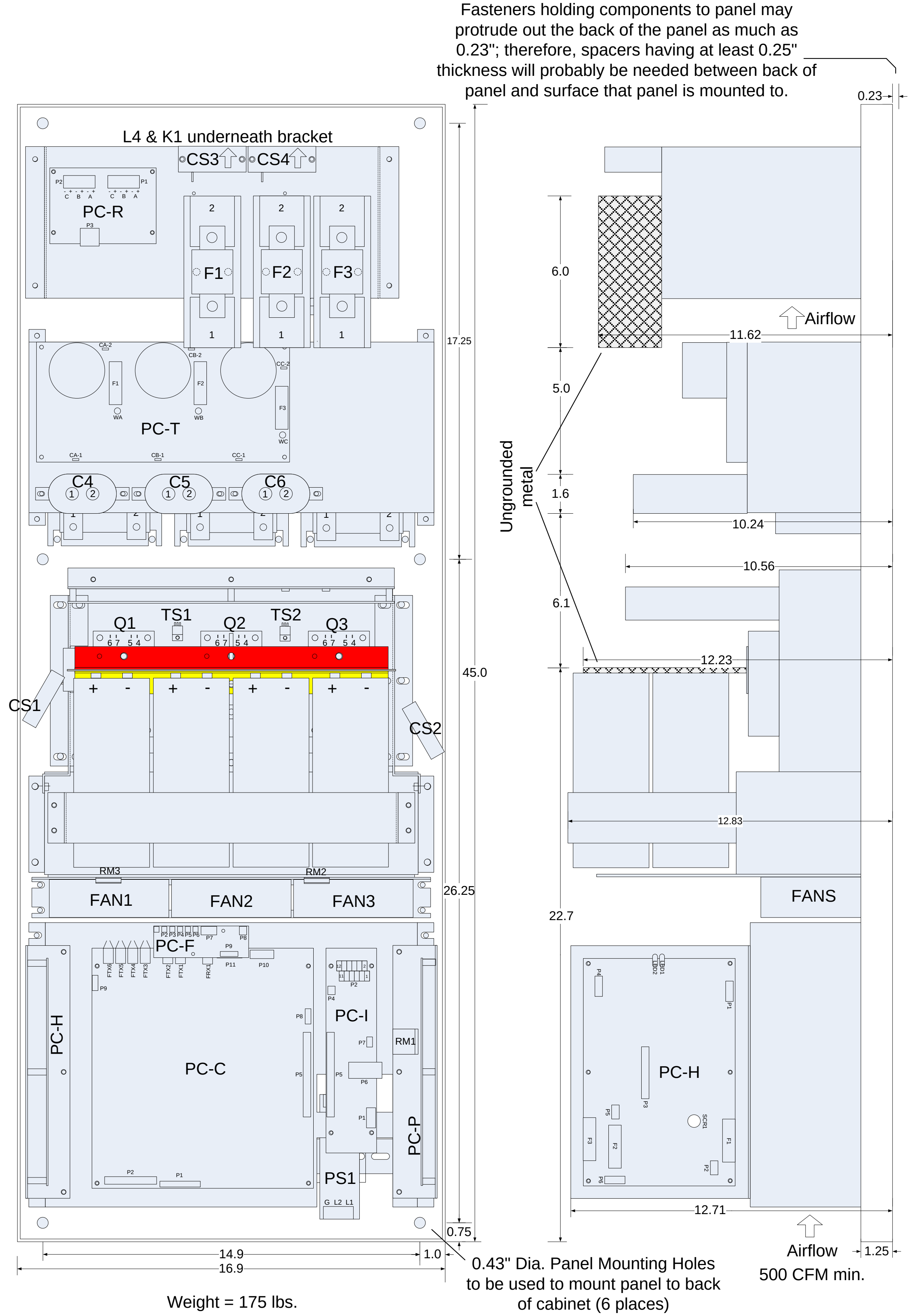


Figure 10.2: 100 Amp DPM Panel Layout Drawings

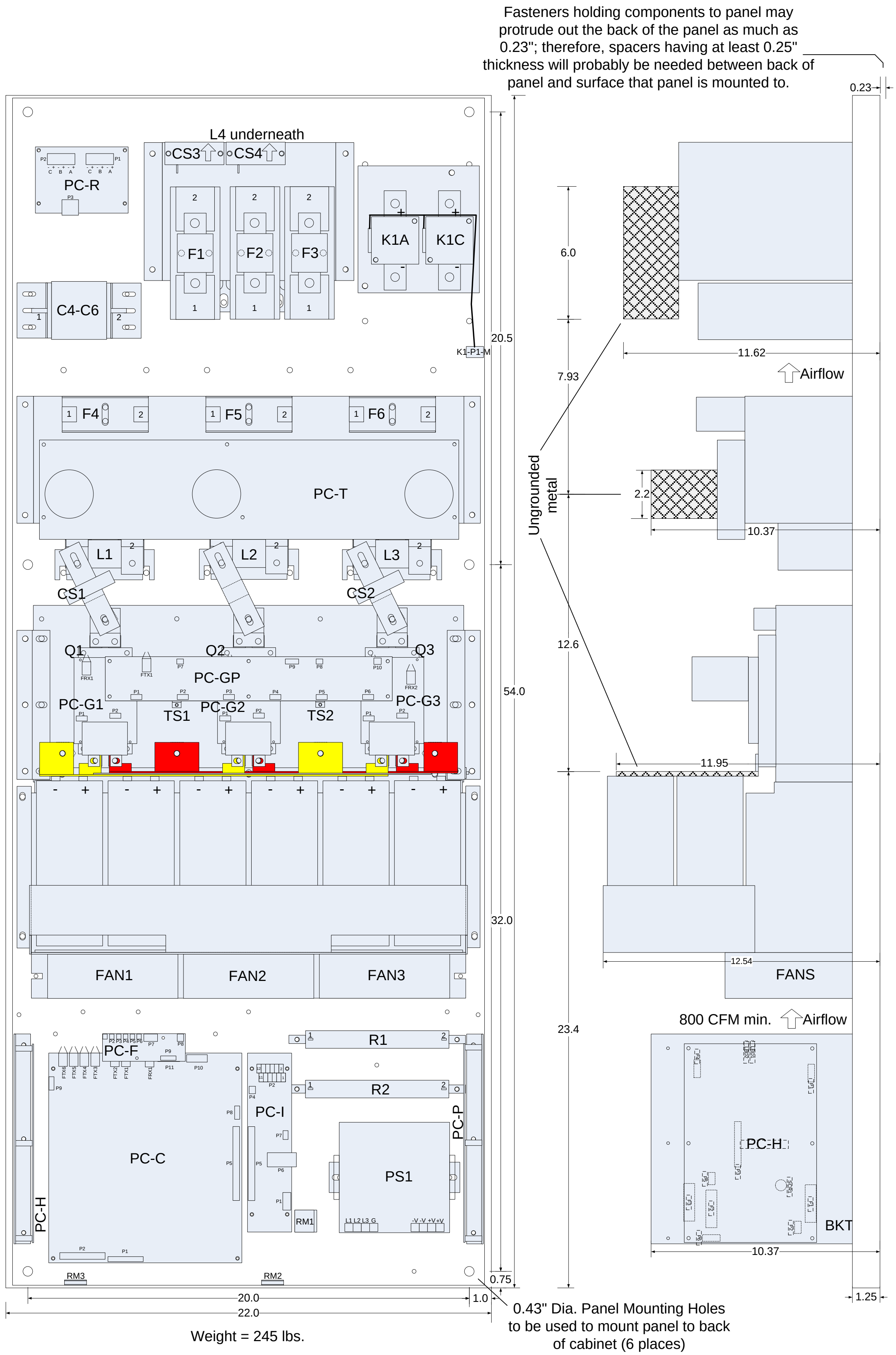


Figure 10.3: 150 Amp DPM Panel Layout Drawings

Figure 10.4: 200 Amp DPM Panel Layout Drawings

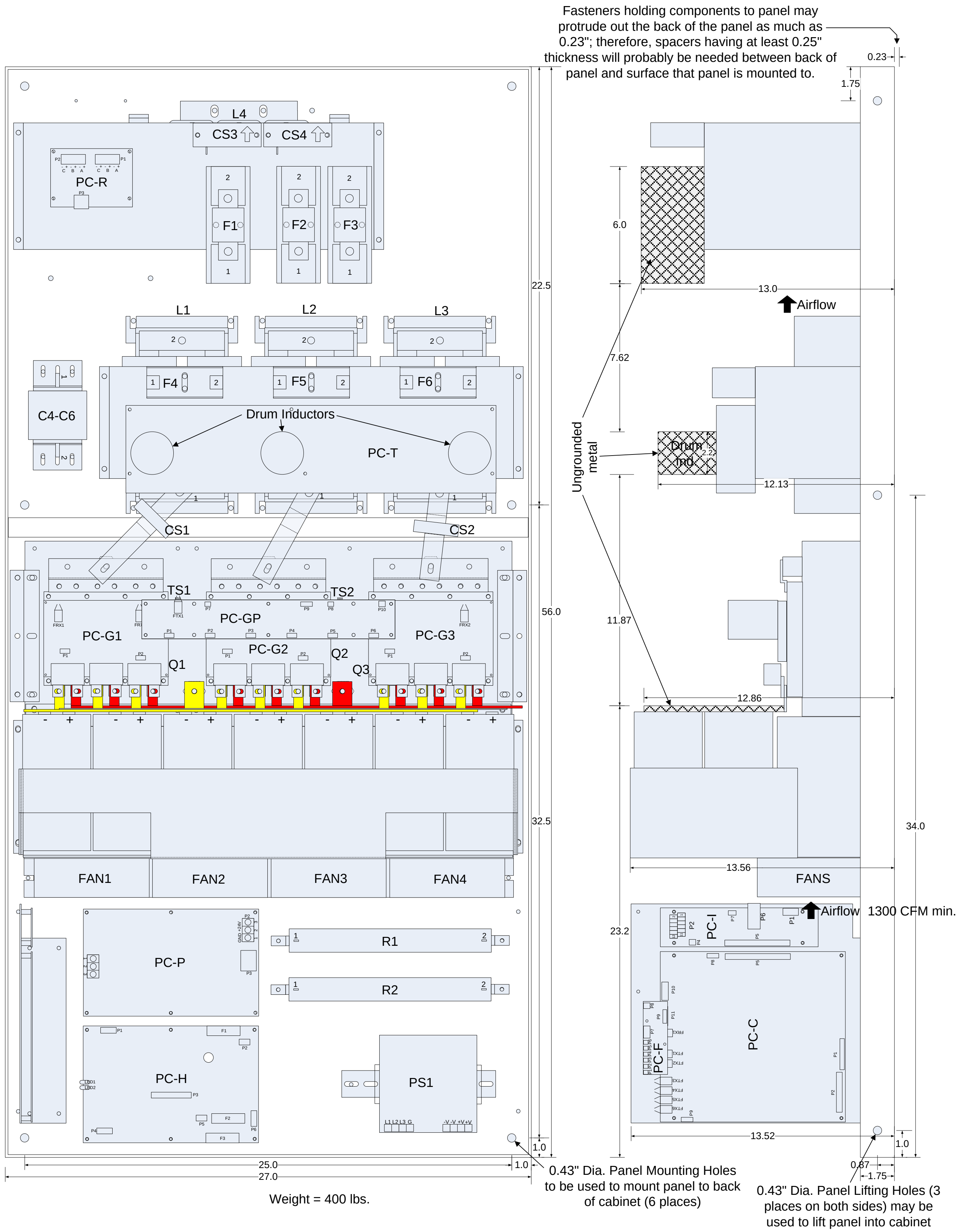


Figure 10.5: 300 Amp DPM Panel Layout Drawings

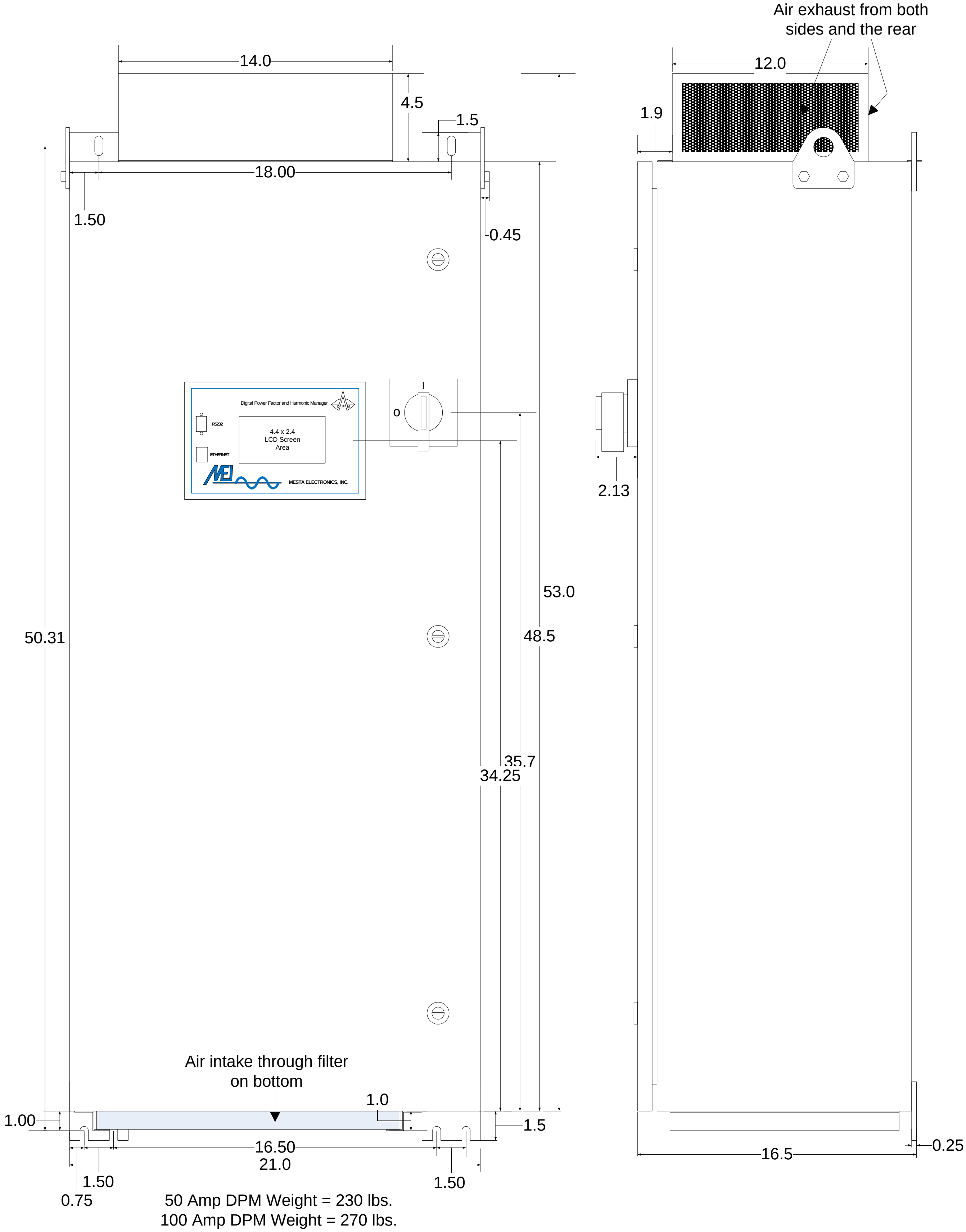
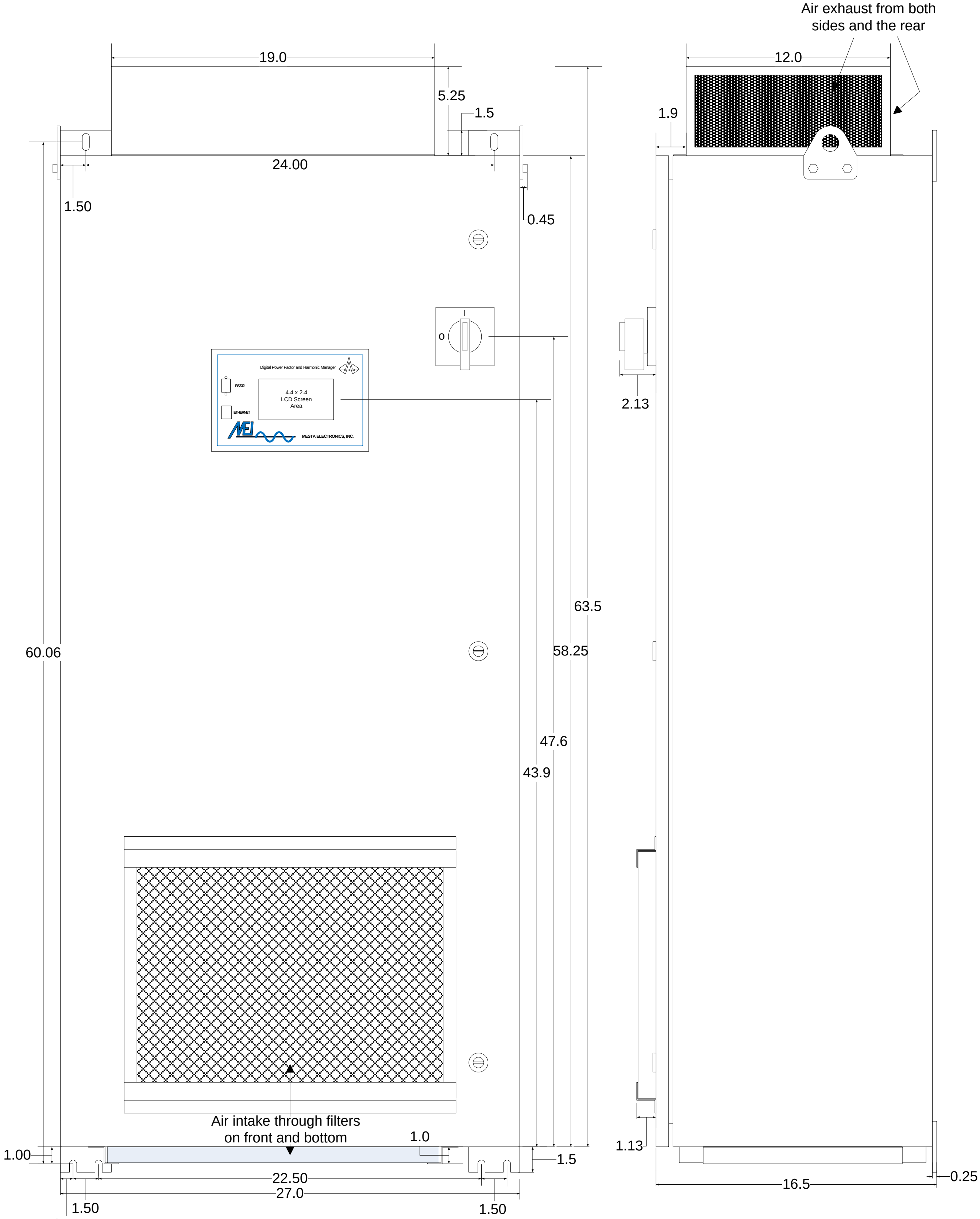
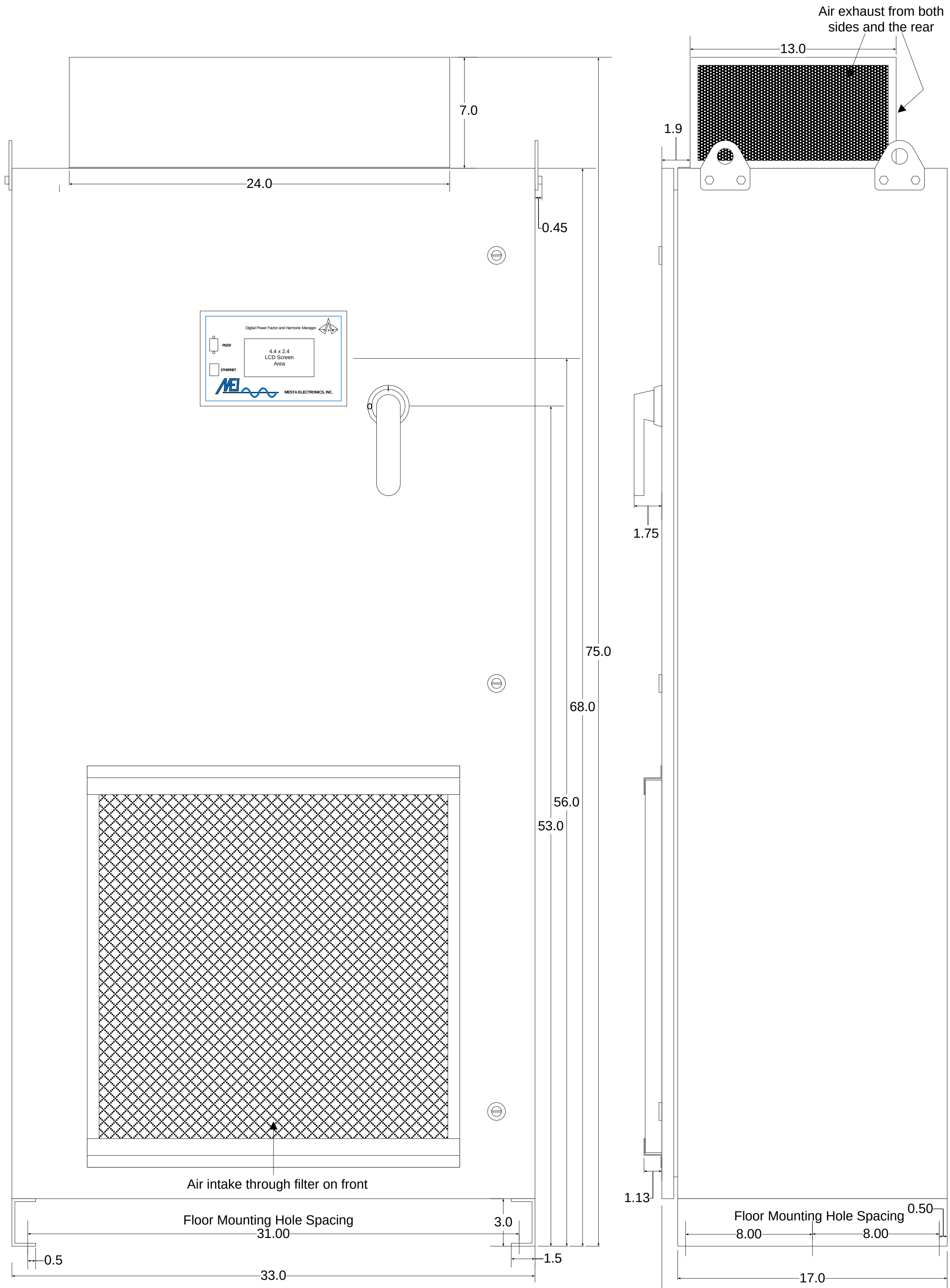


Figure 10.6: 50 & 100 Amp NEMA1 Enclosed DPM Drawings



150 Amp DPM Weight = 440 lbs.
200 Amp DPM Weight = 480 lbs.

Figure 10.7: 150 & 200 Amp NEMA1 Enclosed DPM Drawings



300 Amp DPM Weight = 630 lbs.

Figure 10.8: 300 Amp NEMA1 Enclosed DPM Drawings

11. WARRANTY/SERVICE AND REPAIR

⮜LIMITED WARRANTY POLICY⮞

Mesta Electronics, Inc. warrants its Digital Power Factor and Harmonics Manager (DPM) to be free from defects in materials and workmanship for a period of 18 months from the date of original shipment from the factory or 12 months from the verified date of startup, whichever comes first, provided the DPM has not been abused, misused, or used outside of the specified conditions. Mesta Electronics, Inc. will be the sole determiner as to whether the unit has been abused or misused. If found to be defective, the unit will be repaired or replaced at the discretion of Mesta Electronics, Inc. Unless specified by contract, warranty service can only be obtained by returning the equipment to the Mesta factory.

Before returning any unit, in or out of warranty, to Mesta Electronics, purchaser must contact Mesta's Customer Service Department. Any UNAUTHORIZED return of a unit to Mesta Electronics for in-warranty or out-of-warranty repairs will be subject to an inspection and handling charge, in addition to all associated repair and transportation costs. Mesta Electronics, Inc. will be in no way responsible for any consequential damages of any kind or nature whatsoever resulting from the use of its unit in any manner whatsoever and/or from the breach of any warranty, express or implied.

12. REVISION HISTORY

Rev. 2.0 4/15/15 – Totally revamped interim manual updated for units equipped with firmware revision 1.42.

Rev. 2.01 4/20/15 – Added instructions for the operator to correct for CTs installed on the wrong phase and/or in the wrong direction via the “AUTO ADJUST” button on the “CT SETUP” display (firmware rev 1.43). Phase code and phase shift line on the “CT SETUP” changed so that code now appears 1st followed by the phase shifts of the 3 phases instead of the opposite and some space appears between this line and previous lines on this display (firmware rev 1.45), so the information stands out better. Rearranged “Incorrect CT placement…” tables so that “Phase Code” is now in the first column. Added airflow and airflow direction arrows to panel drawings. Altered note 3 for Specifications to include new “self de-rate” feature (firmware rev 1.43).

Rev. 2.02 5/26/15 – Added that power wire used to connect to DPM should be rated 75C or equiv. to Tables 3.1 and 3.3.

Rev. 2.03 7/2/15 – Added instructions for the operator to set a static IP address for the Lantronix Ethernet module in Ethernet enabled systems.

➤Mesta Electronics, Inc➤

Pioneers in Power Electronics!

MESTA ELECTRONICS, INC.
11020 Parker Drive ■ N. Huntingdon, PA 15642
412/754-3000