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Power Distribution

PREVENTIVE MAINTENANCE MANUAL

Document Number
PDU-PM01

This Preventive Maintenance Manual is intended for professional use only
Read this entire document before inspecting, repairing, or performing preventive Maintenance on Portable Power Distribution Products
■ORIGINAL INSTRUCTIONS

Part Number: PDU-PM01
Release: (October] [2019]

Original Instructions
Power Distribution Preventive Maintenance Manual
Rev A
Released [10-2019]

We have checked that the contents of this document correspond to the device described.
There may be discrepancies nevertheless, and no guarantee can be given that they are completely identical.
The information contained in this document is reviewed regularly and any necessary changes will be included in the next edition.

We welcome suggestions for improvement.

Motion Laboratories Inc. intends this document, whether printed or electronic, to be provided in its entirety.

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The purpose of this document is to define the procedures for preventive maintenance (PM) on portable power distribution equipment.

PM work detailed in this document is restricted to modular power distribution equipment supplied in ATA-style road cases, either single or double sided.

REGIONAL CONTACTS

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- **GENERAL INFORMATION**

Keeping your equipment operating properly and performing safely is a simple process. PM work for portable power distribution products involves two basic areas: visual inspection followed by routine maintenance or repair.

Following these recommended procedures will ensure many years of trouble-free operation.

Confirming that all connections, mechanical or electrical, are tight is a major component of preventive maintenance. Unlike repair-and-replace procedures, the specified torque values for preventive maintenance are for reference unless otherwise noted and it is not necessary to re-tighten all fasteners to the specified value.

CAUTION Most Power Distribution Units (PDU) weigh more than 50 lbs. Care should be taken to use proper procedures when handling equipment to minimize the risk of injury.

- **TOOL SELECTION**

For proper service, a selection of hand tools will be required to accomplish the tasks outlined in this manual. The list includes but is not limited to the following items:

- Several sizes of Phillips screwdriver, #1 and #2
- A selection of straight blade screwdrivers
- A selection of Allen wrenches, either a standard L shaped wrench set or specific Tee handle. Include 1/16”, 3/32”, 1/8”, 5/32” and 5mm at a minimum.
- A selection of combination wrenches, specifically 1/4”, 11/32”, 5/16”, 3/8” and 7/16”
- A 3/8” drive ratchet and a 3/8” drive torque wrench with a 3/4” socket and a selection of Allen sockets that include 3/16”, 3/8”, 5/16” and 1/2".
- A multimeter with voltage, resistance and continuity capability.

- **FLEXIBLE WIRE STRAND INFORMATION**

Traditionally, bare wire terminals used on power blocks, fuse holders and breakers have only been evaluated for use with (Class B and C) wire. More and more terminals are being evaluated for use with flexible high stranded wire classes such as Class G, H, I (DLO) and K per UL 486A-B. If the connection is not identified for use with classes of wire other than B and C but is being used with high strand count classes such as G, H, I (DLO) or K, it is imperative that you use either a copper foil or a suitable ferrule around the copper conductors. This is done to protect the finer strands from the forces of the screw and to prevent the fine strands from becoming entwined in the threads of the connection, which can affect the torque value.

Flexible stranded wire classes also bring additional considerations to address such as an increase in wire diameter and the number of strands per a given wire size. The photo below shows two 250 MCM wires of different classes. The one on the left is the traditional Class B with 37 strands. The one on the right is a finely stranded Class K. Although they are the same wire classification of 250, you can see the Class K is larger in diameter. This illustrates the need to specify a terminal to accept a larger standard wire size. The table below shows the increase in strand count per each wire size.

Flexible Stranded Wire Table

Wire Gauge	AWG/kcmil							Wire Gauge
	Rigid Stranded			Flexible Stranded				
	CSA Compact	Class B	Class C	Class G	Class H	Class I (DLO)	Class K	
	Number of Strands*							
#20 AWG	--	7	19	--	--	--	10	#20 AWG
#18	--	7	19	--	--	--	16	#18
#16	--	7	19	--	--	--	26	#16
#14	--	7	19	--	--	19	41	#14
#12	--	7	19	--	--	19	65	#12
#10	--	7	19	--	--	27	104	#10
#8	7	7	19	49	133	41	168	#8
#6	7	7	19	49	133	63	266	#6
#4	7	7	19	49	133	105	420	#4
#2	7	7	19	49	133	161	665	#2
#1	19	19	37	133	259	210	836	#1
1/0	19	19	37	133	259	266	1064	1/0
2/0	19	19	37	133	259	342	1323	2/0
3/0	19	19	37	133	259	418	1666	3/0
4/0	19	19	37	133	259	532	2107	4/0

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- **SYMBOLS**

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
Used without a safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

- **DON'Ts**

DANGER Do NOT work on equipment while energized.

DANGER Do Not connect or disconnect equipment while energized.

DANGER Do Not connect or disconnect equipment under load.

CAUTION Do NOT work on equipment without proper safety equipment.

CAUTION Do NOT work on equipment without a full understanding of the operating principles.

WARNING Do NOT remove equipment from its enclosure with the equipment energized.

WARNING Do NOT check torque on an electrical connection with the equipment energized.

- **DEFINITIONS**

The following is a list of definitions to help understand terms and concepts.

MECHANICAL CONNECTION – The joining of two or more elements by mechanical fasteners such as bolts, rivets, or screws (but not by non-mechanical means, such as adhesives).

ELECTRICAL CONNECTIONS - The joining of two or more elements by wire, busbar or similar material that intentionally allows electricity to flow through it. This includes connections in the grounding system (including all bonding connections) which are not intended for transmission of electricity under normal conditions.

THERMAL RUNAWAY – A situation where an increase in temperature changes the conditions in a way that causes a further increase in temperature, often leading to destructive results

1/4 TURN PAST SNUG – A variation of Turn-of Nut Bolting Method performed by rotating the nut or bolt of a fastener assembly a specific turn angle based on the fasteners length and diameter while restraining the unturned element from rotating. Can only be performed after the connection has been drawn into firm contact (snug-tightened). Snug tightened is defined as finger tight. For our purposes the amount of turn is 1/4 or 90 degrees.

RU- An abbreviation for the term Rack Unit is a unit of measure defined as 1.75inches (44.45mm). It is most frequently used as a measurement of height of 19-inch rack frames as well as the height of the equipment that mounts in these frames, whereby the height of the frame is expressed in multiples of rack units.

- **INSPECTION CYCLES**

Depending on your production schedules, periodic inspection will be adequate to keep your equipment operating properly. Annual inspections should be sufficient for most applications. More frequent inspections may be required if the equipment is subject to the following:

- Equipment subject to a more rigorous schedule such as daily truck packs or more extreme weather or environmental issues should be inspected quarterly.
- Equipment that shows signs of abuse or having obvious mechanical flaws should be taken out of service immediately. Some good examples of this are:
    1. Cable assemblies where the outer jacket has pulled out of the strain relief.
    2. Duplex connectors that have become loose or fallen into the panel.
    3. Broken or missing breaker tie hardware.
    4. Broken breaker handles.
    5. Twist-Lock connectors where the insert has become loose.
    6. Connectors that show signs of burnt contacts or overheating.

- **VISUAL INSPECTION, EXTERNAL**

Before disassembling any unit, perform a full visual inspection of the exterior for damaged parts, loose or missing hardware, or broken or missing cover plates. Make notes of all missing parts that need to be replaced.

LABELS AND MARKINGS. Check the unit to ensure that all pinout, rating and caution labels are intact. You should have a product schematic package that details the panel layout and indicates the position of all labels and markings. Call a customer service agent if you need additional copies.

Rating labels are generally on the right-hand side of the modular panel assembly and provide important information regarding voltage and amperage capacities.

Pinout labels are located near specific connectors that have pin assignments that need to be identified on equipment to ensure compatibility with mating components.

Caution labels are provided to alert the user about use and procedures that require special attention and understanding in order to safely install and operate.

Due to production changes and process development, most new portable power distribution equipment produced by Motion Laboratories now has laser engraved labels and markings. Some older equipment used stick on labels. These are a specific permanently marled mylar product that was designed for the application. They can however become damaged, illegible (due to chemical reactance from some cleaning agents) or otherwise compromised. If this occurs, you should replace them. Contact a customer service agent to order replacements.

SURFACE CONDITIONS. If hardware is found to be developing rust, wipe down with WD-40 applied to a cleaning rag.

All openings have proper covers installed to restrict accessibility during use.

CONNECTORS. Check all connectors for signs of arcing or overheating.

Look at the surface of all twist-locks for any discoloration caused by overheating. Make notes and investigate the connection terminals once you move to the internal inspection operation. If there are signs that overheating has occurred, you should replace the connector and possibly the conductors serving it.

Inspect the surface of all multipin connectors such as 19 pin VSC (Veam Socapex Compatible) for signs of arcing deposits. If this is apparent, a closer inspection of the connector's components is required to determine if pitting damaged has occurred to the pins which could require replacement of the connector. Most of this is the result of connecting and disconnecting the connector under load and should be addressed with the user. These deposit buildups alone can become a source of failure and should be cleaned off using isopropyl alcohol or an electronic component cleaner.

CAUTION Follow manufactures recommendations for application and use of cleaning product.

HARDWARE. The most common hardware issues involve rack mounting hardware and breaker tie hardware.

Rack mount hardware should be as per spec drawing. The hardware package for rack mounted distro components comprises the M5 hex drive socket head fastener in bright stainless, a #10 flat brass washer and a #10 flat zinc washer. This combination creates a locking-type feature that is not abrasive to the finish of the metalwork. Please note that although not covered here it is worth noting that for auxiliary power distribution products such as the Stackable, the rack mount hardware uses a steel 10-32 hex drive socket head fastener in black finish (otherwise the hardware package is the same).

If replacements need to be ordered, they are available as repair items: P/N 1910-RAHK-01 for the M5 version and 1910-RAHK for the 10-32 version.

Breaker handle tie hardware should be as per the spec drawing. There are two versions: one for two-pole devices and one for three-pole devices.

WARNING The use of breaker handle tie hardware is crucial for safety in single-phase slant-rated applications as it ensures that when the breaker is turned off, all circuits to the multi-circuit branch output device are de-energized.

If replacements need to be ordered, they are available as repair items: P/N 1910-2PBTK for the two-pole version and 1910-3PBTK for three pole version or 1910-3PBTK-01 for the three-pole version with a recessed breaker kit.

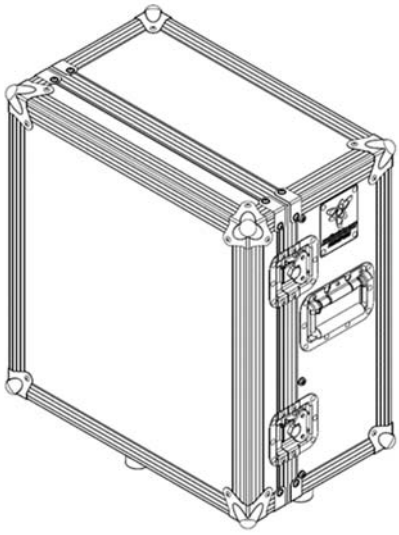
All relevant hardware items are detailed in the Spare Parts and Disposal section**.**

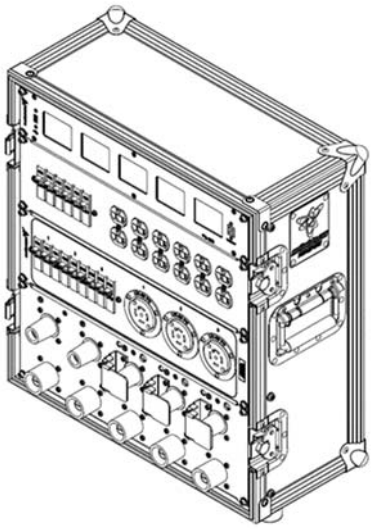
- **POST VISUAL INSPECTION, EXTERNAL**

Once the external inspection is complete, the unit should be removed from the case for internal inspection.

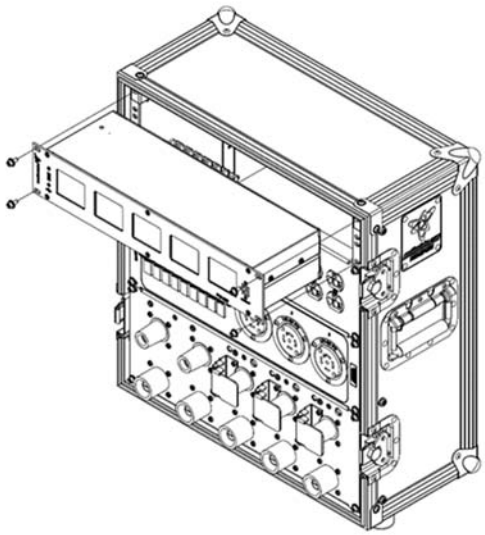
WARNING Ensure that all power has been removed before beginning.

Remove the lid from the case





- **REMOVAL**



If the unit is equipped with a Power Meter, remove the meter by taking out the four rack screws, sliding out the Power Meter and disconnecting the current transformer and power connectors on the back. If the unit is older and equipped with a Digital Volt-Amp meter (DVA legacy product), the DVA cannot be removed separately and must come out with the panel assembly.

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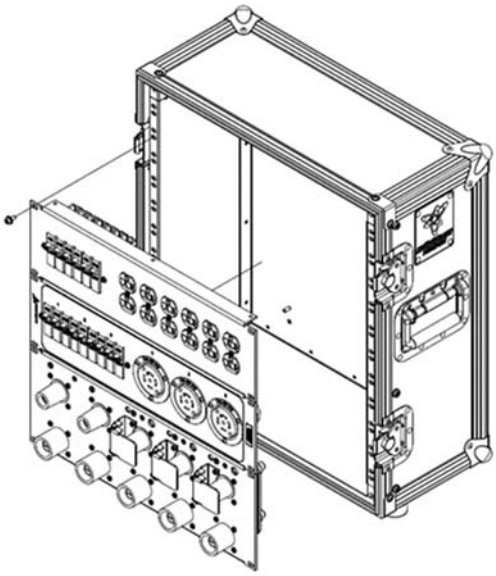
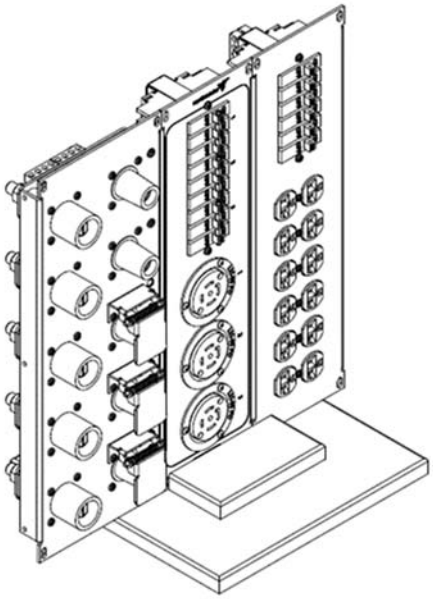
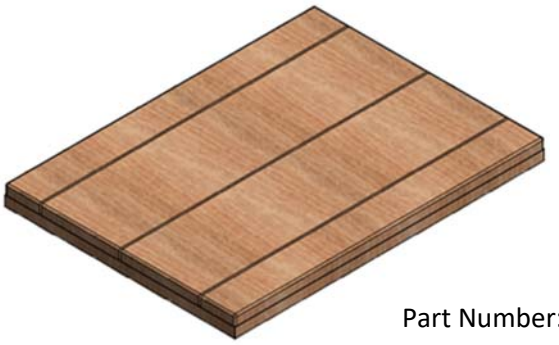


Remove remaining rack hardware and pull the unit from the case, leaving the steel liner in place. Detach the steel liner grounding wire from the ground terminal block. If the ground wire is attached to the bus system in such a fashion that makes it inconvenient to remove, detach from the ground stud on the steel liner.

Set the distro onto a support device such as the item shown below so that it may be manipulated and moved around for inspection and service.



Part Number: A-50-004-0002
Part can be ordered or request free plans from your sales rep.



Part Number: A-50-004-0001
Part can be ordered or request free plans from your sales rep.

Installation is the reverse order.

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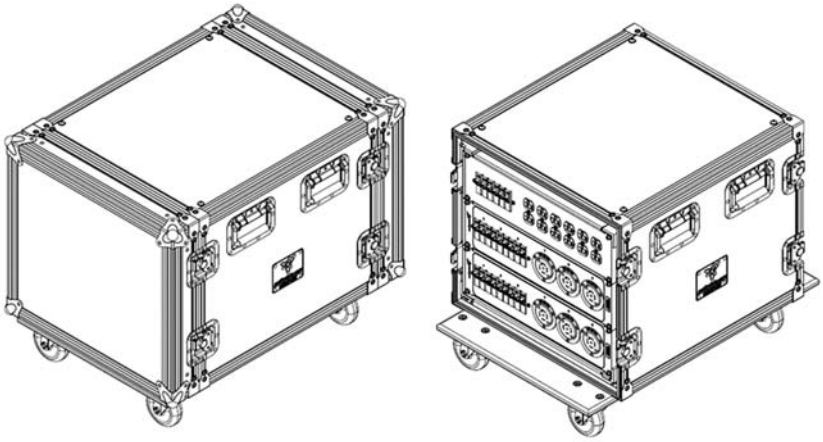
- **POST VISUAL INSPECTION, EXTERNAL**

Once the external inspection is complete, the unit should be removed from the case for internal inspection.

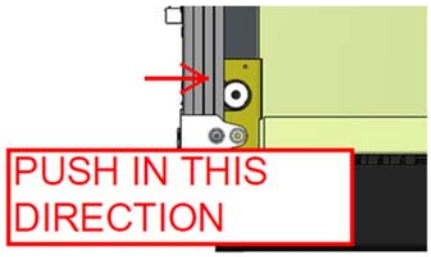
WARNING Ensure that all power has been removed before beginning.

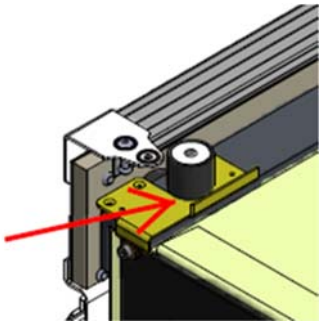
Remove lids from the case



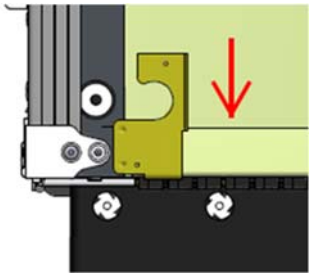
- **REMOVE YELLOW STEEL LINER CLIPS**

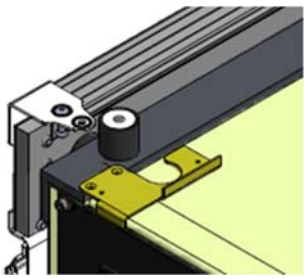
Begin by prying /pushing the clip towards the center of the case. A long screwdriver placed between the rubber bumper and the clip edge should work.

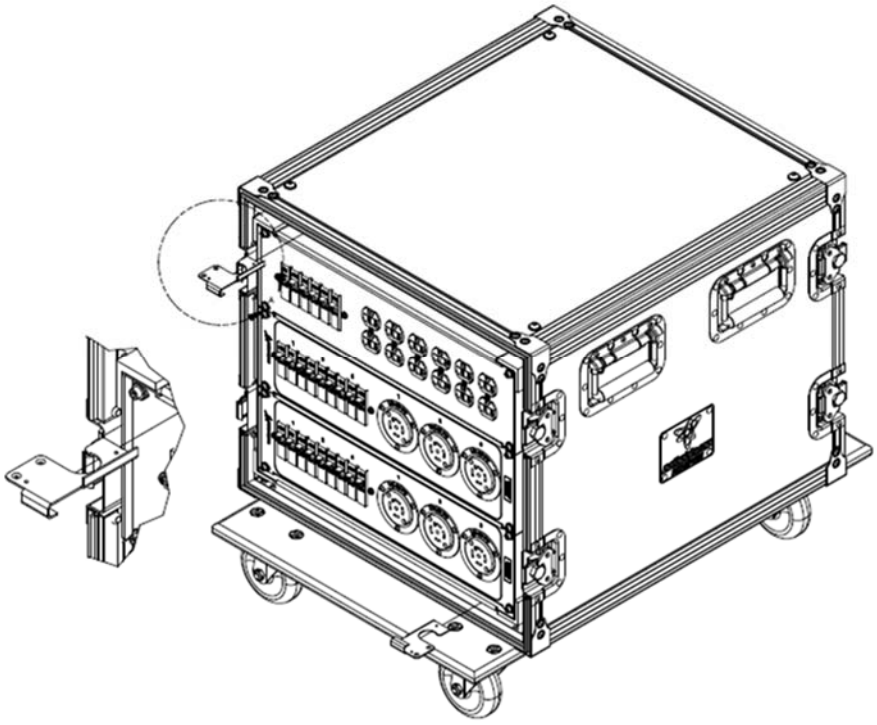




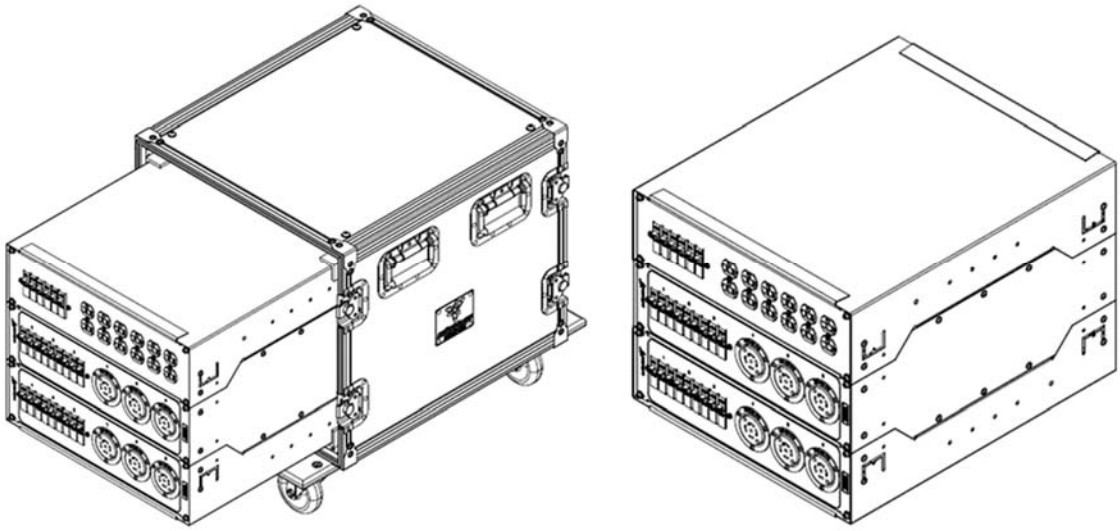
Once clear of the bumper, pull straight out



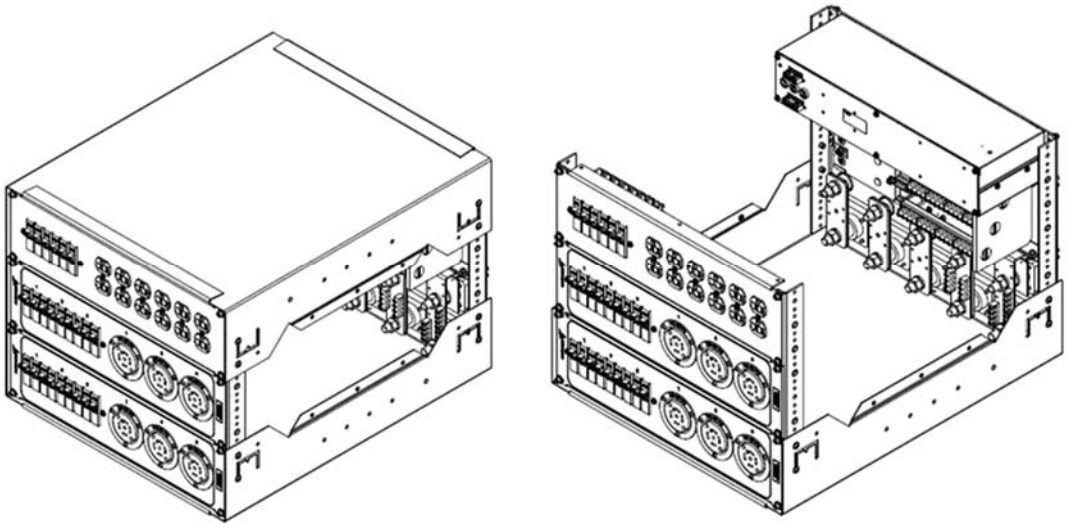




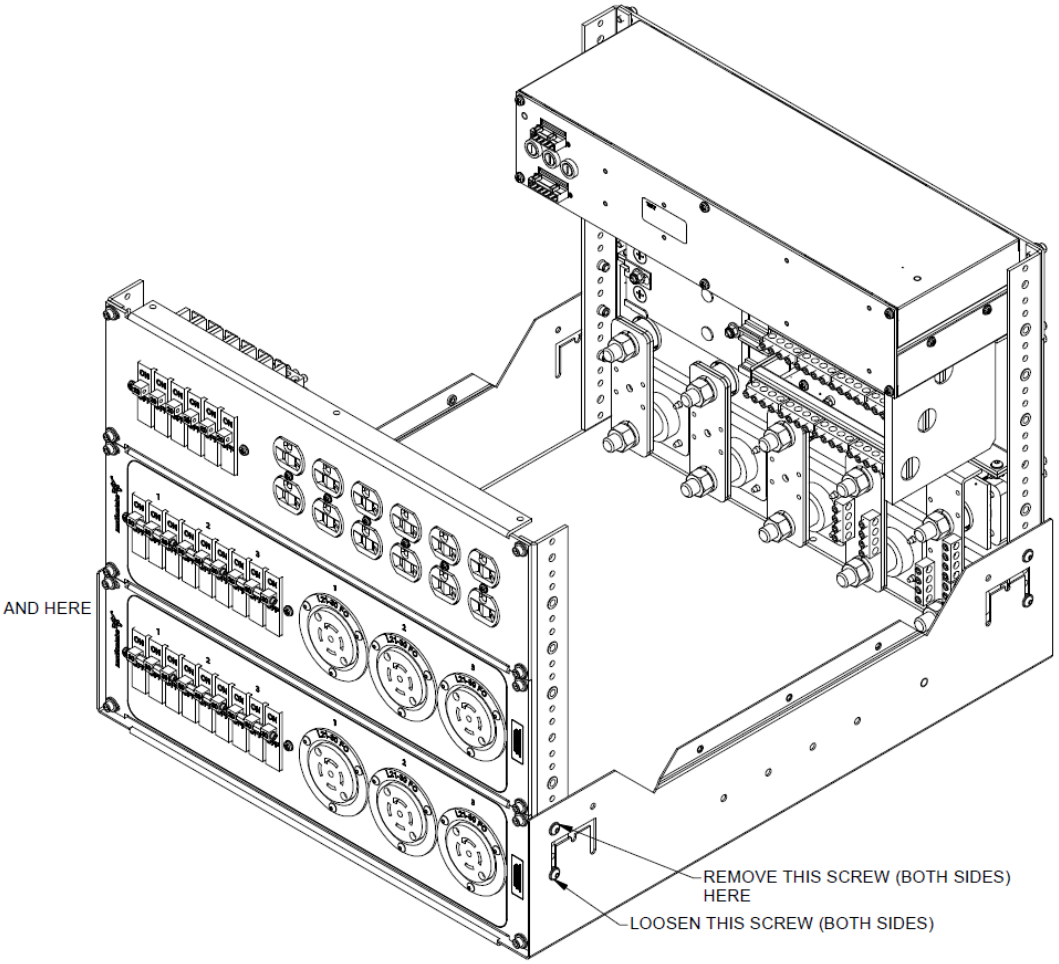
For units up to 14 RU, there should be two clips per side, diagonally opposed. For units 15 RU and larger, there should be four clips per side. Once all clips are out, slide the distro out of the case (with steel liner) and set on a secure work surface.



Remove the steel liner side panels and top.

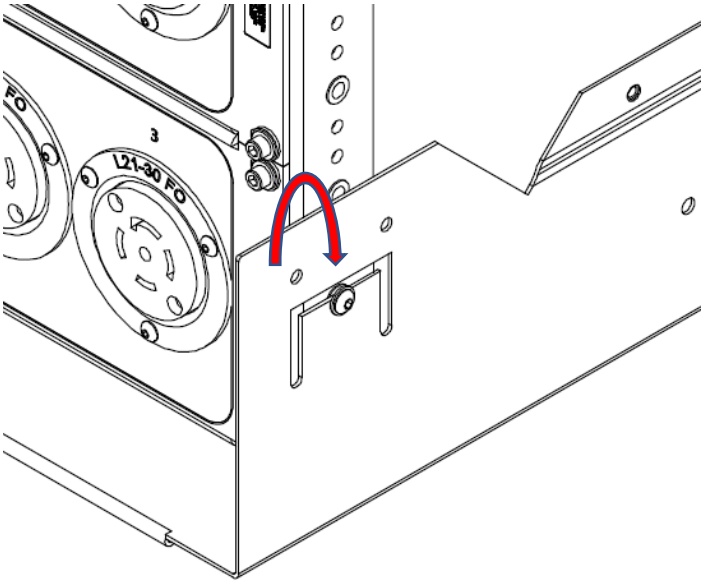


Remove the top two screws and loosen the bottom two screws from the bottom liner as shown below.

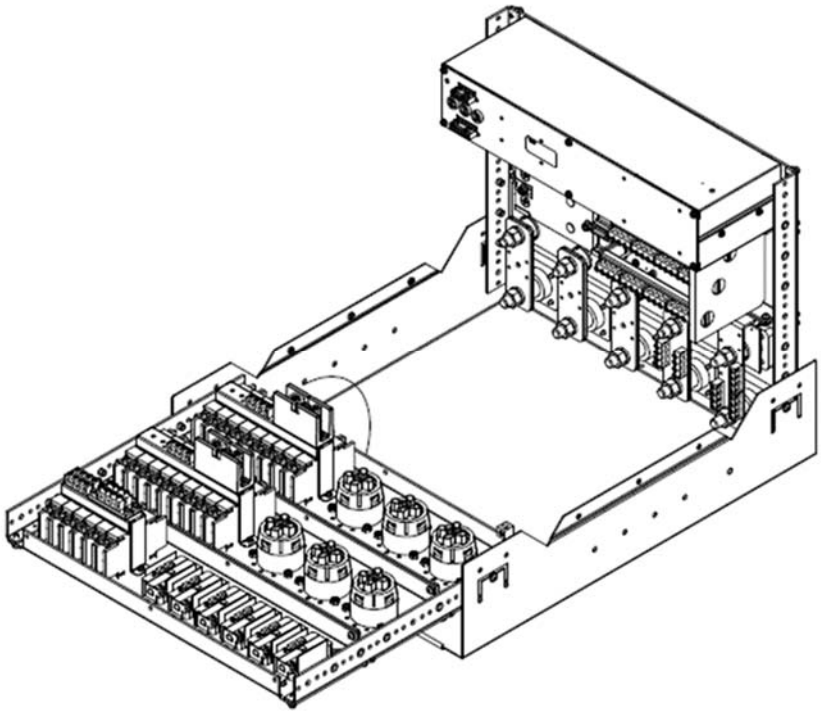


IMPORTANT!

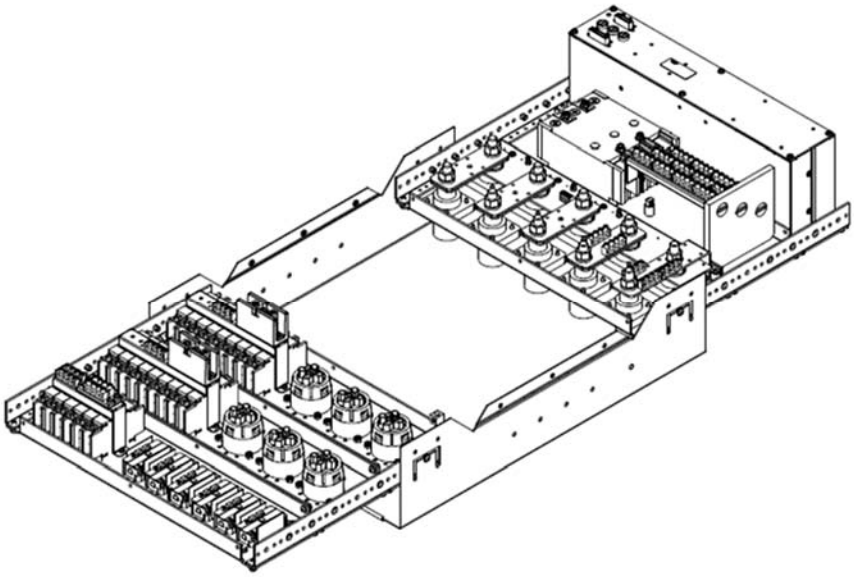
Once done, lift the entire rack panel assembly (panels and rack rail) up and set into the service position as shown.



Once the panels are in place, tilt and lower the entire assembly down.



Depending on the type of build you have (or the maintenance you wish to perform), the other panel assembly may be left upright or laid down using the same process



Installation is the reverse order.

- **INTERNAL INSPECTION**

Once the unit is out of the case and properly secured for service, inspect all internal components.

CAUTION, before beginning inspection, make sure that all power has been removed from the unit.

Start by inspecting for debris. It is recommended that equipment be blown out and/or vacuumed at every inspection. Look for the following:

Dirt and airborne particulates can cause damage due to heat buildup and short-circuiting.

Check for and remove any metallic debris such as hardware that may have become dislodged. This debris may fall into places that can compromise the electrical integrity of the unit causing short circuits or improper operation.

Check for signs of liquid ingress and clean as required.

Check the ground integrity of all connections on the power distribution equipment. Place one multimeter probe (set to resistance mode or continuity buzzer/light) onto the main ground input test point to verify continuity with the input ground contact. Then ensure continuity with all output receptacle ground terminals, any additional grounding terminations, all ground bus points and all panels, covers and exposed metalwork. Make any corrections as required.

Check all internal components. Look at breaker supports, terminal block supports, etc.

Tightening loose hardware will:

- Prevent hardware from falling out and becoming a source of failure.
- Prevent components from becoming damaged or inoperable.
- Prevent compromised ground integrity.

When re-tightening loose mechanical mounting hardware, it is a rule of thumb to use the 1/4 turn past snug method instead of specified torque values. This will ensure compliance without taking extended time for the procedure. Supplied torque specifications will be used for repair-and-replace procedures.

Check internal wiring harnesses. All conductors should be routed to avoid sharp edges and scraping that could wear the insulation. All conductors shall be dressed neatly and bundled to provide proper support.

Check for loose electrical connections. Look at all breaker, terminal block and connector terminals.

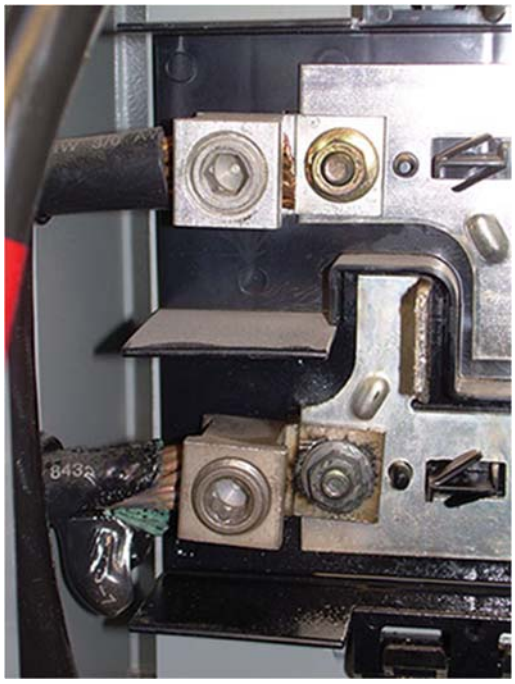
Look for signs of overheating. One of the most prevalent problems, loose electrical connections, can be detected by a preventive maintenance inspection. These can be indicated by signs of overheating, which include discoloration or burn marks.

Loose connections may operate satisfactorily for a time, but eventually they will experience thermal runaway that will result in extremely high temperatures causing equipment damage and, in some cases, fires. The most effective method to ensure that electrical connections are properly tightened is to use torque tools to apply the correct amount of pressure.

In addition to installing equipment according to the listing and labeling requirements as required by NEC 110.3(B), there are several reasons connections should be torqued.

Loose connections can cause a point of high impedance, causing the circuit to operate inefficiently and overheat. Loss of energy can be prevented when connections are made tight.

Fire prevention is another great reason to torque connections. When the conductors are not making good contact, they can create arcing, sparking and overheating, with the result being equipment failure and/or fire. See below.



Check all connections for proper torque.

NOT TOO MUCH and NOT TOO LITTLE. Overtightening an electrical connection can cause as much trouble as not being tight enough.

- **TORQUE**

While most commonly used torque values are provided in supporting documents, torque values can also be procured from manufacturers' spec sheets or labels on the individual components. Some examples are shown below.

FLANGED INLETS, FLANGED OUTLETS
4 POLE, 5 WIRE • INSULGRIP®

Installation Instructions

English

1. **NOTICE**: For installation by a qualified electrician in accordance with national and local electrical codes and the following instructions.
2. **CAUTION: RISK OF ELECTRIC SHOCK. Disconnect power before installing.**
3. Check that the device's rating is suitable for the application.
4. **CAUTION: USE COPPER CONDUCTORS ONLY.**
5. Select conductors having 90°C or higher rated insulation and sufficient ampacity in accordance with the 60°C column of National Electrical Code® Table 310-16 or Canadian Electrical Code Table 2.
6. Terminal capacity: 16 AWG to 8 AWG.
7. Use stranded conductors only.
8. Remove insulation from: GREEN CONDUCTOR, 7/16" (11 mm)
   OTHER CONDUCTORS, 11/16" (18 mm)
9. **DO NOT TIN CONDUCTORS**
10. Loosen terminal screws. Insert conductors fully into proper terminals as identified in the chart.

TERMINAL	CONDUCTOR
Green Hex Head Screw	Equipment grounding conductor (green or green/yellow)
White Screw	Grounded circuit conductor, Neutral (white or gray)
Brass/Black Screw	Ungrounded circuit conductor, Line (NOT white, NOT green)

11. **TAKE CAUTION THAT THERE ARE NO STRAY WIRE STRANDS.**
12. Tighten terminal screws to 18 lb•in (2.1 N•m) of torque.

120°

When performing preventive maintenance, there is no need to use the specified torque value and risk overtightening a connection. Instead, choose a value slightly lower than the spec. (ten percent below the torque specifications, especially on old equipment, is a good place to start). If the torque tool "clicks" without moving the screw, you are good to go. If the torque tool moves the screw before clicking, then adjust the tool to the specified value and re-tighten.

The specified torque value should never be exceeded. The theory of "more torque is better" is just not true. Applying a higher torque value than is specified may cause damage to the connection or equipment.

Standard fastener torque values.

18-8 & 316 S/S, Brass, Aluminum, Monel, Silicon Bronze Torque Specifications

Bolt Size Inches or #	Threads Per Inch	Standard Dry Torque in Inch-Pounds					
		18-8 Stainless Steel	Brass	Silicon Bronze	2024-T4 Aluminum	316 Stainless Steel	Monel
#2	56	2.5	2.0	2.3	1.4	2.6	2.5
	64	3.0	2.5	2.8	1.7	3.2	3.1
#3	48	3.9	3.2	3.6	2.1	4.0	4.0
	56	4.4	3.6	4.1	2.4	4.6	4. 5
#4	40	5.2	4.3	4.8	2.9	5.5	5.3
	48	6.6	5.4	6.1	3.6	6.9	6.7
#5	40	7.7	6.3	7.1	4.2	8.1	7.8
	44	9.4	7.7	8.7	5.1	9.8	9.6
#6	32	9.6	7.9	8.9	5.3	10.1	9.8
	40	12.1	9.9	11.2	6.6	12.7	12.3
#8	32	19.8	16.2	18.4	10.8	20.7	20.2
	36	22.0	18.0	20.4	12.0	23.0	22.4
#10	24	22.8	18.6	21.2	13.8	23.8	25.9
	32	31.7	25.9	29.3	19.2	33.1	34.9

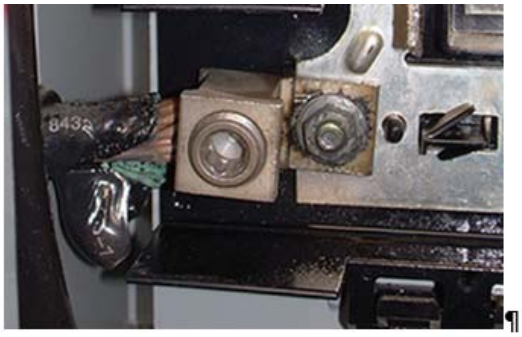
See annex at the end of this document for specified torque values based on manufacturers' specifications.

Torque values can be affected by the condition of the fastener. The following suggestions might help:

- Repair holes for screws and lugs with a tap that will clean out rust dirt or paint.
- Scrub off dirt using a parts cleaning brush
- Spray silicone lubricant on a paper towel or parts brush to assist in cleaning threads.

- **REPAIR / REPLACEMENT**

CAUTION Use only authorized MLI repair parts. If in doubt concerning a replacement item, contact your customer service agent.



Once a “hot” (overheated) connection is detected during an infrared or visual inspection as shown above, simply tightening the connection will not correct the deficiency. The connection must be disassembled, cleaned and reassembled with the proper tool and torque. Additionally, cutting off the previously connected end of the wire and making the connection with an unused section of wire is the safest solution.

When cutting back wire to make the above type of repair, ensure that the wire lay remains intact. If the wire is too short to remain in the bundle, you may need to replace it entirely.

CAUTION If conductor replacement is necessary, always replace with the same conductor type and assembly method. Make sure to maintain all specifications. All internal power wiring must comply with the following:

- Be of copper conductors;
- Be the correct gauge (AWG) for the application;
- Have insulation rated 90 deg C (194 deg F);
- Be rated for 600 volts; and
- Be a Class C strand count (NO SOLID COPPER) for 14 AWG to 4 AWG and Class H or K for 1 AWG to 4/0 AWG.

Solid wire or class B (7 conductors) will not be as road worthy as Class C, H or K. When replacing or repairing 1AWG to 4/0 AWG type H or K, be sure to use copper foil or a suitable ferrule around the conductor when inserting into the lug and torque the connection twice at least five minutes apart.

Replace any broken components or missing hardware found during visual inspections.

- **TESTING**

Once a repair is done or any inspection work has been satisfactorily completed, the unit should be fully tested. This testing work should be done with the unit in the most complete state but still open for visual verification if needed. If any further work is required, the equipment must first be de-energized.

Verify that all breakers are in the “OFF” position. Supply the PDU with the proper power. Reference the voltage rating on the input panel rating label such as 120/208 VAC WYE.

CAUTION Whenever possible use a power source that is GFCI protected to limit the risk of electric shock hazard.

CAUTION During testing procedures described below, live parts may be accessible. Always use appropriate PPE when testing energized equipment as there is a risk of exposure.

Energize the power to the distro. Verify that all indicator lights are lit and ensure that all breakers are in the “OFF” position.

Verify on the Power Meter (if equipped) or by using a multimeter that all readings are correct. If the readings you see are not what is expected, disconnect power and re-inspect the supply or move to a corrected power source.

The system being tested in the example above is a 120/208VAC WYE three phase system.

You should validate that:

- Ground to neutral voltage is zero,
- X phase (L1) to neutral, Y phase (L2) to neutral and Z phase (L3) to neutral are each approximately 120 VAC and
- L1 to L2, L2 to L3 and L3 to L1 line to line voltages are each approximately 208 VAC.

Once you have verified that the input voltage is ok and all test points, indicator lights and power meter are functional you can turn on the main breaker to begin verifying circuits.

Do the following one circuit at a time. Verify each branch circuit breaker and output combination by switching the branch breaker on and verify the voltage and pinout at the corresponding output connector. Switch the breaker off and repeat for every circuit.

On multi-circuit-devices, verify the pinout of each output, including that the correct phase is on the correct pin per the pinout. (The pinout is marked on the panel near the output devices.)

The circuits can be verified with a multimeter and probes or you can use various circuit detection and analyzing equipment identified below.

Edison circuit analyzer

L21, L14, L5, L6 circuit analyzer

Twist-Lock® Circuit Testers

Description	Rating	20 Amp Configuration	20 Amp Catalog Number	30 Amp Configuration	30 Amp Catalog Number
Marine	125V			NEMA L5-30P	**HBLT26CM11**
3-Phase Circuit Tester	3Ø 120/208V AC Min. Voltage: 90V AC	NEMA L21-20P	1006-40-58-09-001	NEMA L21-30P	1006-40-58-11-001
Circuit Tester	125V	NEMA L5-20P	1006-40-50-09-001	NEMA L5-30P	1006-40-50-11-001
	250V	NEMA L6-20P	1006-40-51-09-001	NEMA L6-30P	1006-40-51-11-001
	277V	NEMA L7-20P	**HBLT2331**		
	125/250V	NEMA L14-20P	1006-40-53-09-001	NEMA L14-30P	1006-40-53-11-001

1006-40-58-11-001

HBLT26CM11

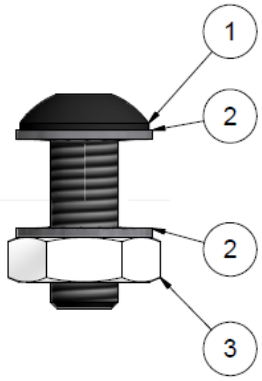
19 Pin 6 circuit voltage indicator: P/N A-02-001-0001

Once all circuits have been verified you can select a circuit to test and connect a load with a known value to the selected output device. Switch the corresponding branch breaker on. Verify that the expected amp draw appears on the meter between the expected conductors. Switch the branch breaker off and repeat this procedure for the next circuit.

Once all circuits have been checked and all issues have been found and documented, switch all breakers off and disconnect power.

- **SPARE PARTS**

Below is the fastener assembly used to attach each flanged panel to the next

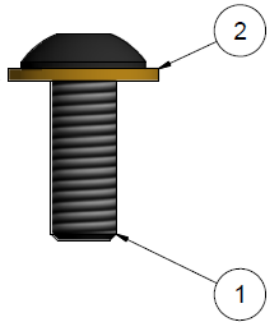


ITEM	QTY	PART NUMBER	DESCRIPTION
3	1	1900-04-01-02-001	HN, 10-32, Stainless Steel
2	2	1900-04-04-04-003	SW, #10, Steel Zinc, Internal Tooth
1	1	1900-04-02-05-002	BHCS, 10-32 X 1/2", Hex, Steel Black

PARTS LIST

1910-1-6-FAHK
ENCLOSURE HARDWARE, PANEL MOUNTING

Below is the fastener assembly used to attach the steel liner side panels to the rack rail

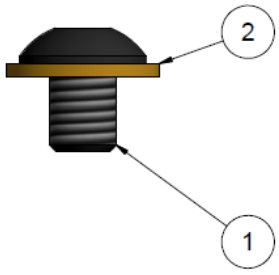


ITEM	QTY	PART NUMBER	DESCRIPTION
2	1	1900-04-04-01-001	FW, #10, Brass
1	1	1900-04-02-05-002	BHCS, 10-32 X 1/2", Hex, Steel Black

PARTS LIST

1910-1-7-FAHK
ENCLOSURE HARDWARE, SIDE MOUNT, LONG

Below is the fastener assembly used to secure the steel liner side panel to the steel liner top and bottom



ITEM	QTY	PART NUMBER	DESCRIPTION
2	1	1900-04-04-01-001	FW, #10, Brass
1	1	1900-04-02-05-012	BHCS, 10-32 X 1/4", Hex, Steel Black

PARTS LIST

1910-1-8-FAHK
ENCLOSURE HARDWARE, SIDE MOUNT, SHORT

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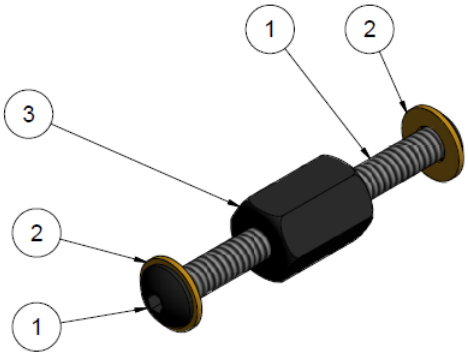
Below is the hardware assembly used to tie two breaker poles together for a slant rated application

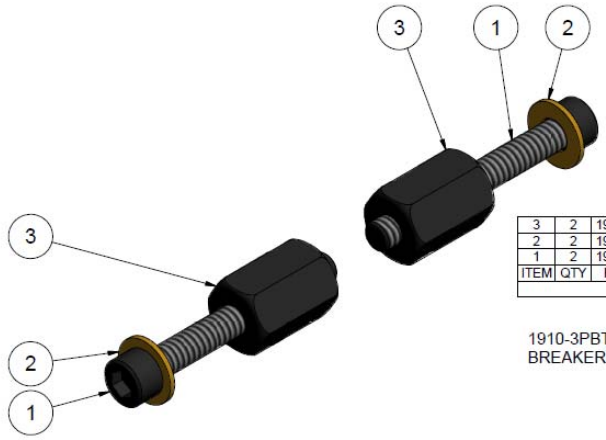


ITEM	QTY	PART NUMBER	DESCRIPTION
3	1	1900-01-05-08-003	SO, 4-40 X 3/8", Hex, Aluminum Black, FXF
2	2	1900-01-04-01-001	FW, #4, Brass
1	2	1900-01-02-05-001	BHCS, 4-40 X 1/2", Hex, Stainless Steel, Black

PARTS LIST

1910-2PBTK
BREAKER TIE HARDWARE, 2POLE

Below is the hardware assembly used to tie three breaker poles together for a slant rated application

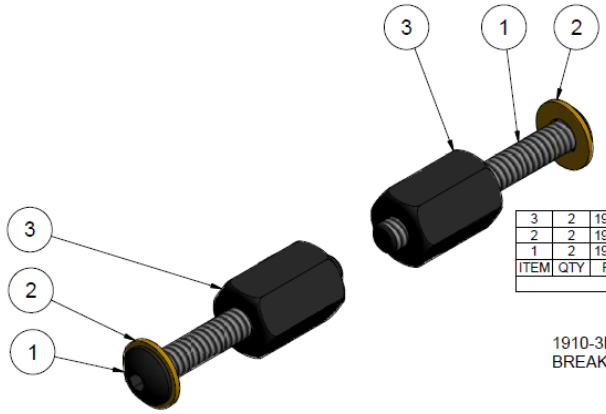


ITEM	QTY	PART NUMBER	DESCRIPTION
3	2	1900-01-05-08-003	SO, 4-40 X 3/8", Hex, Aluminum Black, FXF
2	2	1900-01-04-01-001	FW, #4, Brass
1	2	1900-01-02-05-008	SHCS, 4-40 X 7/8", Hex, Steel Black

PARTS LIST

1910-3PBTK
BREAKER TIE HARDWARE, 3 POLE

Below is the hardware assembly used to tie three breaker poles together for a slant rated application in a recessed breaker application



ITEM	QTY	PART NUMBER	DESCRIPTION
3	2	1900-01-05-08-003	SO, 4-40 X 3/8", Hex, Aluminum Black, FXF
2	2	1900-01-04-01-001	FW, #4, Brass
1	2	1900-01-02-05-006	BHCS, 4-40 X 7/8", Hex, Steel, Black

PARTS LIST

1910-3PBTK -01
BREAKER TIE HARDWARE, 3 POLE, RECESSED

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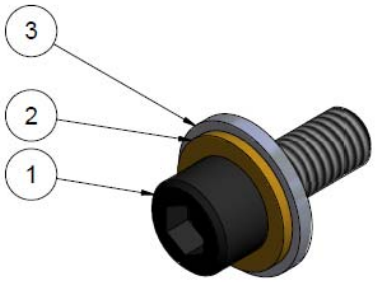
Below is the fastener assembly used to secure panels to stackable enclosures

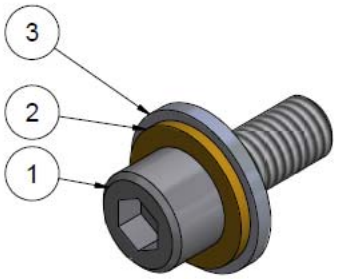


ITEM	QTY	PART NUMBER	DESCRIPTION
3	1	1900-04-04-04-001	FW, #10, Steel Zinc. .5" OD
2	1	1900-04-04-01-001	FW, #10, Brass
1	1	1900-04-02-05-010	SHCS, 10-32 X 1/2", Hex, Steel Black

PARTS LIST

1910-RAHK
RACK HARDWARE, 10-32, STEEL, BLACK

Below is the fastener assembly used to secure panels to rack rail

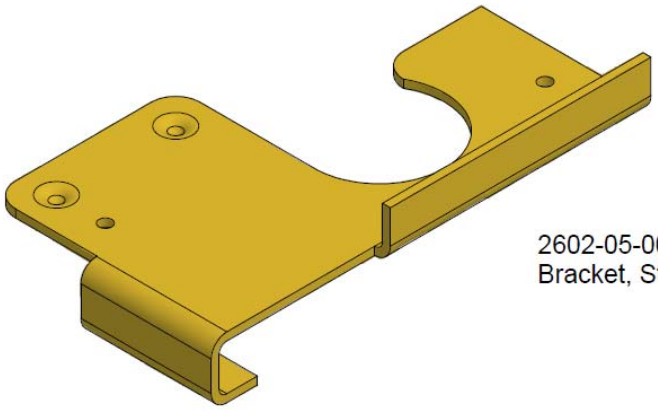


ITEM	QTY	PART NUMBER	DESCRIPTION
3	1	1900-04-04-04-001	FW, #10, Steel Zinc. .5" OD
2	1	1900-04-04-01-001	FW, #10, Brass
1	1	1900-33-02-02-001	SHCS, M5-.8 x 12mm, Stainless Steel

PARTS LIST

1910-RAHK-01
RACK HARDWARE, M5, STAINLESS STEEL

Below are the double-sided distro steel liner clips, left and right side.



2602-05-00-25-001
Bracket, Steel Liner Stop, Left

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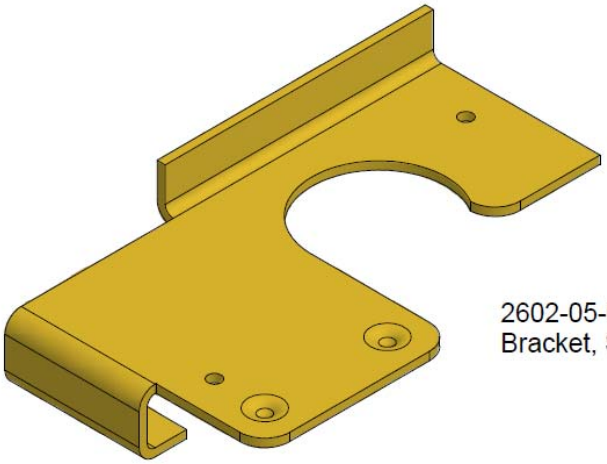

2602-05-00-25-002
Bracket, Steel Liner Stop, Right

- **DISPOSAL**

Almost all products eventually reach their natural end-of-life. So, it becomes your responsibility to take the product (or parts) through the phase out or sun-setting process. There may be any number of causes and the scenarios are never going to be clear cut but usually you will find that:

- The product may cost more to repair than replace.
- You may wish to upgrade to a larger or more complex system.

Whether its an entire unit or simply disposing of replacement parts, it is good policy to have a plan of action to properly dispose of all materials in a responsible manner.

When disposing of a complete distro, completely disassemble and separate all like materials which can be categorized in the following manner:

- Aluminum
- Steel
- Copper
- Insulated wire
- Electronic waste
- Standard waste

Once all materials are separated you can take them to the appropriate recyclers, some will net payback others (like electronic waste) will require a fee. If you need help, you can contact your sales rep and we can make arrangements to provide disposal services for you.

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Preventive Maintenance records should be maintained so you can track inspection periods, repairs of product as well as product performance. Implementing proper PM documentation will assist you to:

- Know when a system requires service or is likely to fail.
- Aid in the decision on when preventive maintenance should be performed.
- Can aid in providing maintenance history in the event of an audit.

SAMPLE FORM

FORM NUMBER: PDU-PM-01

EQUIPMENT MAINTENANCE LOG

EQUIPMENT INFORMATION	
Company Name: Click here to enter name.	Department: Click here to enter name.
Equipment Description: Click here to enter description.	
Model Number: Click here to enter model number.	
Serial Number: Click here to enter serial number.	

5 STEP PROCESS					
STEP	1	2	3	4	5
DESCRIPTION	OBSERVE	DEFINE PROBLEM AREA	IDENTIFY POSSIBLE CAUSES	DETERMINE MOST PROBABLE CAUSE	TEST AND REPAIR

RECORDS		
DATE OF SERVICE	ACTION TAKEN/COMMENTS BELOW	INITIAL
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
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Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	
Comments: Click here to enter comments.		
Date: Enter or select date.	Action Taken enter action.	

FORM LAST REVISED: 10/19/2017

Panel Assembly Torque Values

Category	Subcategory	Amperage	Manufacturer	Electrical Connections	Mechanical Connections
Breaker	QBL	200 A	Square D	Line/Load Side single lug = 250 in*/bs Load side Bus bar mount = 72 in*lbs When using D-01 block distribution reference D-01 torque values.	Panel Mount, Torque Limited, Criteria: Crush Point of Nlyon Spacer, = 12 in*lbs
	QCF	15-30 A	Eaton	14AWG - 10AWG = 20 in*lbs. 8AWG = 25 in*lbs. 6AWG - 4AWG = 27 in*lbs.	N/R Din Rail Mount Only
	QOU	10-60 A	Square D	45 in*lbs	QOU Foot Mount Bracket onto panel = 20 in*lbs
	QOU	70-100 A	Square D	50 in*lbs	QOU Foot Mount Bracket onto panel = 20 in*lbs
Connector	Multi-Pin, 1/4 turn, Bayonett Style, 14 Pin	N/A	Souriau	Crimp Only	Panel Mount = 10 in*lbs.
	Multipin, Circular, C7	N/A	Phase 3	Solder Only	Mount to Panel = 5 in*lbs
	Single Pole	400 A	Hubbell	Threaded stud = 410 in*lbs When using D-01 block distribution reference D-01 torque values.	panel mount screws = 20 in*lbs
	Straight Blade Duplex	15/20 A	Hubbell	12 in*lbs	Panel Mount, Torque Limited, Criteria: Fastener = 12 in*lbs
	Twistlock and Straight Blade	15 A	Hubbell	12 in*lbs	Panel Mount, Torque Limited, Criteria: Crush Point of Nlyon Material, Connector Body = 12 in*lbs
	Twistlock and Straight Blade	20 A	Hubbell	18 in*lbs	Panel Mount, Torque Limited, Criteria: Crush Point of Nlyon Material, Connector Body = 12 in*lbs
	Twistlock and Straight Blade	30 A	Hubbell	18 in*lbs	Panel Mount, Torque Limited, Criteria: Crush Point of Nlyon Material, Connector Body = 12 in*lbs
	Twistlock and Straight Blade	30 A	Leviton	18 in*lbs	Panel Mount, Torque Limited, Criteria: Crush Point of Nlyon Material, Connector Body = 12 in*lbs
	Twistlock and Straight Blade	50 A	Hubbell	25 in*lbs	Mount to Panel = 20 in*lbs

Category	Subcategory	Amperage	Manufacturer	Electrical Connections	Mechanical Connections
Connector	Twistlock and Straight Blade	50 A	Marinco	25 in*lbs	Mount to Panel = 20 in*lbs
Contactor	DP	40 A	Cutler Hammer	Power Circuits = 20 in*-lbs.	Mechanical Mounting = 9 in*lbs.
	DP	40 A	Seimens	Power Circuits = 20 in*lbs.	Mechanical Mounting = 9 in*lbs.
	DP	50A	Cutler Hammer	Power Circuits = 70 in*lbs	N/A
	IEC	32 A	TysT	20 in*lbs.	N/A
	IEC	50 A	TysT	Power Circuits = 70 in*lbs. Control Circuits = 15 in*lbs.	Mechanical Mounting = 9 in*lbs.
	IEC	65 A	TysT	Power Circuits = 70 in*lbs. Control Circuits = 15 in*lbs.	Mechanical Mounting = 9 in*lbs.
Terminal Block	142 Series	115 A	Marathon	MAIN SIDE (1) 6AWG - 2/0 = 120 in*lbs 8AWG = 40 in*lbs 14AWG - 10AWG = 35 in*lbs BRANCH SIDE (4) 14AWG - 4AWG = 35 in*lbs	Panel Mount, Torque Limited, Criteria: Fracture limit of insulator = 35 in*lbs
	4 Position	N/A	MLI	16AWG - 12AWG = 20 in*lbs 10AWG - 8AWG = 25 in*lbs 6AWG - 4AWG = 35 in*lbs	Mounting D-Block to bus bar = 12 in*lbs
	GP985	85 A	Marathon	16 in*lbs	Mechanical Mounting = 10 in*lbs.

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Cable Assembly Torque Values

Category	Subcategory	Amperage	Manufacturer	Electrical Connections	Mechanical Connections
Connector	Multi-Pin, 1/4 turn, Bayonett Style, 14 Pin	N/A	Souriau	Crimp Only	Back shell = 1/4 Turn Past Snug
	Single Pole	200 A	Hubbell	Set Screw = 200 in*lbs	N/A
	Single Pole	400 A	Hubbell	Set Screw = 200 in*lbs	N/A
	Twistlock and Straight Blade	15 A	Hubbell	12 in*lbs	Back shell torque = 10 in*lbs strain relief torque = 10 in*lbs
	Twistlock and Straight Blade	15/20 A	Hubbell	12 in*lbs	Back shell torque = 10 in*lbs strain relief torque = 10 in*lbs
	Twistlock and Straight Blade	20 A	Hubbell	18 in*lbs	Back shell torque = 10 in*lbs strain relief torque = 20 in*lbs
	Twistlock and Straight Blade	30 A	Hubbell	18 in*lbs	Back shell torque = 10 in*lbs strain relief torque = 20 in*lbs
	Twistlock and Straight Blade	30 A	Leviton	18 in*lbs	Back shell torque = 10 in*lbs strain relief torque = 20 in*lbs
	Twistlock and Straight Blade	50 A	Hubbell	50 in*lbs	Strain Relief = 20 in*lbs
	Twistlock and Straight Blade	50 A	Marinco	50 in*lbs	Strain Relief = 20 in*lbs

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