

Medium Voltage Across-the-Line Starters

Operator's Guide and Instruction Manual

MVATL / JAN 05



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Conventions used in this manual

Symbols

The following list contains an explanation of the symbols used in this document.



NOTE:

This symbol is used when there is information you might find especially useful. The information may also warn you about possible problems you could encounter.



CAUTION!

This symbol is used when there is important information that can help you avoid potential injury.



DANGER!

This symbol is used when there is important information that can help you avoid the risk of serious personal injury or death.



WARNING!

This symbol is used when there is important information that can help you avoid the risk of serious personal injury or death.

Disclaimers

NOTE:

The information contained herein is not intended as a training manual for unqualified personnel. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased or in personnel safety precautions. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary information supplied with this equipment, the latter shall take precedence.

RAM Industries reserves the right to make changes in specifications shown herein or add improvements at any time without notice or obligation.



WARNING
Disconnect all Sources of Power and Lockout
Before Servicing This Equipment

This equipment should be installed and maintained by qualified personnel only, in accordance with recognized safety standards and applicable electrical or building codes. The manufacturer is not responsible for damages or injuries resulting from improper installation or use.

For the purposes of this manual, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- a) Is trained and authorized to energize, de-energize, clear, ground, and tag medium voltage circuits and equipment in accordance with established safety practices.
- b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- c) Is trained and authorized to work near exposed parts that may be energized.
- d) Is trained in rendering first aid.

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Handling and Storage

Handling

- Strap or brace the MVATL controller prior to moving it.
- Do not top-stack MVATL controllers.
- Do not remove MVATL controller from skid or unpack it until final installation, if possible.
- Packaged MVATL controllers should be moved with a forklift and tethered with safety straps.
- Top-lifting should be done only with suitable lifting eyes attached to mounting brackets when provided.

Storage

If the MVATL controller will be stored for an extended period before installation:

- Inspect for possible damage incurred in transit.
- Re-package after inspection.
- Store in clean, dry environment with a uniform temperature to prevent condensation inside the controller.
- Cover the controller to protect from dust, moisture, and falling objects.

Main Door and Main Disconnect Switch Operation

Disconnect Handle Positions

The main disconnect switch has three positions:

- (1) The **ON** position means the main disconnect switch is closed and power can be applied to the unit.
- (2) The **OFF** position means the main disconnect switch is open and power has been killed to the unit.

WARNING: The incoming power terminals will still be hot unless an upstream disconnecting means has been opened.

- (3) The **OPEN/CLOSE** position is used to open or close the main door. In this position, the disconnect switch handle must be fully counterclockwise.

To Open the Main Door/Open Main Disconnect Switch

- (1) Rotate all main door latches away from the main door.
- (2) Rotate handle into OFF position.

NOTE: The main disconnect switch blades should now be in the open position. Verify via the disconnect switch viewing window.

- (3) Move handle into fully counterclockwise position (OPEN/CLOSE) until mechanical interlock releases.
- (4) Open door.

To Close the Main Door/Close Main Disconnect Switch

- (1) Move handle into fully counterclockwise position (OPEN/CLOSE) to engage the mechanical interlock.

NOTE: This step is necessary in order to fully close the main door.

- (2) Ensure the main door is in the fully seated against body of enclosure.
- (3) Release handle.
- (4) Rotate handle into clockwise position (ON) to close the disconnect switch.

NOTE: The main disconnect switch should now be in the closed position. Verify via the disconnect switch viewing window.

NOTE: The above 4 steps should be done before securing the main door latches (9 total).

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1.0 DESCRIPTION

1.1 OVERVIEW

The RAM MV ATL starter is suitable for starting medium voltage class induction motors. When a start command is issued, the vacuum starting contactor closes and applies full voltage to the motor.

1.2 STANDARD FEATURES

Isolating Disconnect Switch: A 400, 5kV load make/load break disconnect switch is provided. This disconnect switch has the following standard features:

- Mechanically interlocked with the medium voltage access door to prevent entry with the switch in the ON position
- Grounded in the OFF position
- Viewing window provided to determine status of the disconnect blades
- Provision for pad locks in the OFF position

Medium Voltage Section: Standard components in the medium voltage starting section include:

- Class R-rated motor fuses
- Vacuum starting contactor
- Control power transformer
- Current transformers for overload sensing

Low Voltage Section: The following is included in the low voltage section, which is built into the main access door:

- Motor overload protection relay
- Start/Stop control logic

1.3 OPTIONAL FEATURES

Incoming Power Horizontal Bus: Incoming power horizontal bus can be provided. Otherwise, incoming power connections are made directly to the top of the isolating disconnect switch.

Motor Connecting Bus: Motor connection output bus can be provided. Otherwise, motor power connections are made directly to the vacuum contactor.

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2.0 SPECIFICATIONS

TABLE 1 MVATL SPECIFICATIONS

AC Power Supply	2300V / 3300V / 4160V RMS (Refer to schematics supplied with job)
Current Capacity	Refer to schematics supplied with job
Control Voltage	115 VAC, +/-15% NOTE: 115V Control power is derived from the 3-phase power source.
Line Frequency	50 or 60 HZ
Operating Temperature	0 to 50 Degrees C
Storage Temperature	-40 to 65 Degrees C
Starting Mode	Full Voltage
Standard User Accessible Relays	Run Relay: (1) SPST Normally Open Contacts - 10 AMPS @ 250 VOLT AC, Inductive Rating
Short Circuit Interruption Level	280 MVA Minimum up to 400 MVA (model dependent) Tested per UL347 requirements.
Impulse Withstand Level (BIL)	45kV impulse withstand level. Tested per UL347 requirements.

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3.0 RECEIVING & INSTALLATION

3.1 RECEIVING

- Upon receipt of the MVATL controller, immediately unpack it and look for any shipping damages. If any shipping damages are encountered, file a claim with the freight carrier within 15 days of receipt.
- Verify that the ratings sticker on the MVATL chassis matches the motor's HP, current, and voltage rating for the installation.
- Check for loose mechanical connections and assemblies, and wires which may have broken or loosened during shipping and installation.
- Manually exercise all electromechanical devices to make sure they work freely.

3.2 MOUNTING & CLEANING

- Make sure that the manner in which the controller is mounted meets the latest requirement of the National Electrical Code and any other local code requirements for working space (NEC Code Articles 110-13 and 110-16).
- Freestanding controllers should be securely mounted to a flat, level, base using mounting holes provided.
- Remove access plates prior to drilling or punching holes to prevent metal filings and debris from causing short circuits or reducing electrical clearances.



WARNING! Remove all sources of power before cleaning controller.

- After mounting and wiring is completed, thoroughly clean and vacuum the enclosure, and make sure that all filings, metal chips, and other materials are removed before start-up.

3.3 ENVIRONMENT

The MVATL controller may be installed and operated at nameplate rating in an area where the following conditions exist:

- Ambient Temperature shall not exceed 50 degrees C (122 degrees F) with a 15 degree C rise inside the enclosure as maximum.
- Ambient Temperature shall not be less than 0 degrees C (32 degrees F).
- Altitude above sea level shall be 6000-ft. (2000 m.) or less.
- Ambient air is reasonably clean, dry, and free of flammable or combustible vapors, steam, or corrosive gases.

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3.4 DERATING FACTOR



WARNING! When an MVATL enclosure is in an environment not in accordance with Paragraph 3.3 as described above, it must be derated as follows:

- Derate starter size 1.5% per degree C above 50 degrees C Ambient Temperature or 0.75% per degrees F above 122 degrees F Ambient Temperature.
- Derate starter size 1% for every 100m above 2000m or every 300 ft. above 6000 ft. elevation.

4.0 WIRING

The MVATL controller shall be wired in accordance with the National Electrical Code and any local codes that may apply.

Copper conductors for 90 deg. C (min.) shall be used for power and control wiring unless specified otherwise.

Minimum recommended wire sizes are #14 AWG for control circuits

Tighten connections per torque values shown on devices. Otherwise, refer to torque values in Table 2.

4.1 INCOMING POWER

Connect properly sized power wires to the input terminals on the MVATL marked L1, L2, & L3.

Refer to the National Electrical Code for wire sizing.

TABLE 2 RECOMMENDED TIGHTENING TORQUE

UNLESS OTHERWISE NOTED ON INDIVIDUAL DEVICE

WIRE SIZE (AWG or kcmil)	TORQUE - IN/LB		
	SLOTTED HEAD NO. 10 AND LARGER		HEX HEAD OR SCREWS SOCKET HEAD
	SLOT WIDTH $\leq 3/64$ IN SLOT LENGTH $\leq 1/4$ IN	SLOT WIDTH $> 3/64$ IN SLOT LENGTH $> 1/4$ IN	
18-10	20	35	75
8	25	40	75
6-4	35	45	110
3	35	50	150
2	40	50	150
1		50	150
1/0 - 2/0		50	180
3/0 - 4/0		50	250
250 - 400		50	325
500 - 750		50	375

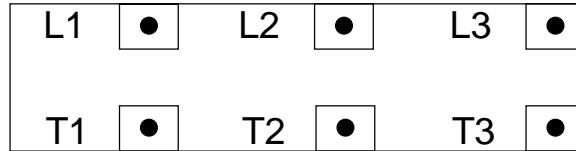
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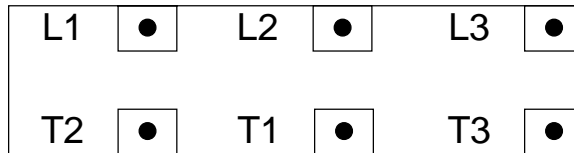
4.2 MOTOR CONNECTION

Connect properly sized motor leads to terminals T1, T2, and T3 as specified on the drawings. If motor rotation needs to be reversed, swap the position of any two motor leads. See Figure 1.

FIGURE 1 FORWARD AND REVERSE MOTOR CONNECTIONS



FORWARD



REVERSE

4.3 CONTROL

Customer control wiring is to be connected to the controller's terminal block in accordance with RAM wiring diagram supplied.



CAUTION! For two-wire control circuits: Two-wire connection must be opened (switched off) when a trip occurs in order prevent the motor from restarting when the trip is cleared.

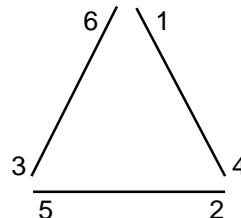
4.4 GROUNDING

Connect properly sized ground cable to the starter ground terminal. Refer to the National Electrical Code for proper size, and make sure the ground conductor is connected to a solid earth ground.

**FIGURE 2 TYPICAL MOTOR CONNECTIONS
DUAL VOLTAGE SIX-LEAD DELTA / WYE
CONNECTED MOTORS**

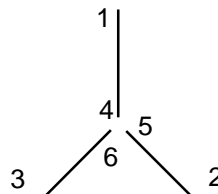
**Lower Voltage
Delta Connection**

L1	L2	L3
1, 6	2, 4	3, 5



**Higher Voltage
Wye Connection**

L1	L2	L3	JOIN
1	2	3	4 & 5 & 6



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5.0 SET UP INSTRUCTIONS



CAUTION! Equipment is at lethal AC line voltage when AC power is connected. All phases must be disconnected by shutting down main power feed to this unit before it is safe to touch motor terminals or control equipment parts.

5.1 INSPECTION

- Ensure that the starter has been installed according to the preceding guidelines.
- Ensure that the controller has been wired according to the schematics and all electrical codes.
- Check that all connections are tight. Ensure that motor shaft rotates freely.



CAUTION! Before power is applied to the starter, the following settings and adjustments should be reviewed and appropriate changes made as required.

5.2 OVERLOAD SET UP

The motor protection relay must be configured for the motor's nameplate full-load current. The current transformer ratio is required. This ratio is marked on the current transformers, and on the wiring diagrams supplied with the job.

Obtain the overload setting by dividing the motor full load amps (FLA) by the current transformer (CT) ratio.

Example: Motor FLA = 100 Amps
 CT Ratio = 200:5

The required overload setting would be as follows:
O/L Setting = $100 / (200:5) = 100 / 40 = 2.5$ Amps

Therefore, the overload relay would be set to 2.5 Amps as close as possible.

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6.0 START-UP INSTRUCTIONS

6.1 PRELIMINARY INSPECTION



CAUTION! Equipment is at lethal AC line voltage when AC power is connected. All Phases must be disconnected by shutting down main power feed to this unit before it is safe to touch motor terminals or control equipment parts.

1. Verify that incoming supply voltage matches the rated supply voltage of the MVATL unit. Per NEMA MG1, for long motor life, voltage unbalance should not exceed 5%.
2. Verify that full-load amps (FLA) of motor does not exceed the FLA rating of the MVATL being used.
3. Follow the Setup Instructions in Section 5.2 and verify that the overload is correctly adjusted.
4. Verify that properly sized power leads are connected to MVATL incoming terminals L1, L2, and L3.
5. Verify that properly sized ground cable is connected to Ground Terminal on MVATL.
6. Check motor lead connections and verify that proper power leads are connected to MVATL as shown in Section 4, Figure 1, depending on rotation of motor.
7. Verify that control wire connections are made per RAM wiring diagram.

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6.2 START-UP



DANGER! Fuse barriers and removeable panels must be in place before applying power to the starter.

- 1) Pre-start adjustments have been checked and confirmed.
- 2) Make certain all personnel, tools, and equipment are clear of controller and motor-driven moving parts.
- 3) If the motor is remotely located, it is essential to have another person stand by the motor to verify direction of motor rotation.
- 4) Apply power; close main disconnect switch on starter.



WARNING! Do not manually operate contactor to jog motor. **SERIOUS PERSONAL INJURY OR EQUIPMENT DAMAGE MAY RESULT!**

- 5) Make sure the motor is ready to be started in an unloaded condition.
- 6) Energize the "Start" circuit; motor will begin to accelerate until it reaches full speed.



CAUTION! Do not allow motor to remain energized if it stalls. If the motor fails to accelerate, immediately de-energize the motor by local, remote, or manual stop control.

- 7) If at any time during the starting cycle the motor does not accelerate or stops, disconnect power to the control circuit and open the line disconnect.
- 8) Check wiring and overload setting. Repeat starting procedure.
- 9) Should the motor still fail to start, consult Section 7.0, Troubleshooting.

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7.0 TROUBLESHOOTING



CAUTION! Equipment is at lethal AC line voltage when AC power is connected. All Phases must be disconnected by shutting down main power feed to this unit before it is safe to touch motor terminals or control equipment parts.



NOTE! Ensure the main disconnect switch is open before using the Test Mode or servicing this equipment. Verify through the disconnect viewing window, that the main disconnect blades are fully seated against the switch grounding bar.



WARNING! When the main disconnect switch is open, the primary line terminals may be still be energized by circuits upstream.

7.1 TEST MODE

The Test Mode can assist in verifying the proper operation of the MVATL. Enter and run the MVATL Test Mode as follows:

Enter and Run the Test

- Open the main disconnect switch. The Test Mode cannot be enabled with the main disconnect closed.
- Insert a 120Vac supply into the receptacle in the low voltage control cabinet.
- Put the control panel Test/Run switch in "Test."
- In this mode, the line contactor may be safely operated to ensure it is functional.



NOTE! An ohmmeter can be used to verify closure of the contactor by monitoring the contactor auxiliary contacts. Refer to the schematics supplied with the job for terminal block points to monitor. When the contactor closes, the meter will read near zero ohms (short). When the contactor opens, the meter will read infinite impedance.

- Note any problems encountered, and refer to Table 3 for Diagnostics and Troubleshooting suggestions.

Exit the Test

- Remove the 120Vac supply from the control panel.
- Put the control panel Test/Run switch in "Run."

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7.2. START-UP PROBLEMS

TABLE 3 DIAGNOSTICS & TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	SOLUTION
1. Motor will not start.	1. Start circuit wired incorrectly. 2. No start input signal.	1. Remove power; correct wiring. 2. Check fuses.

8.0 MAINTENANCE



WARNING: Disconnect all incoming power to this equipment and lock-out and tag circuits prior to performing preventive maintenance. Discharge capacitors, if present. Positively ascertain that the equipment is totally de-energized, including possible foreign sources by using appropriate metering.



NOTE: Ensure the main disconnect switch is open. Verify through the disconnect viewing window, that the main disconnect switch blades are fully seated against the switch grounding bar.



WARNING: When the main disconnect switch is open, the primary line terminals may still be energized by circuits upstream.

- For equipment to operate properly, and to reduce unscheduled down-time, a periodic maintenance program should be established.
- It is recommended that at least once each year the following steps be taken.

ENCLOSURES

- Carefully inspect all enclosure surfaces for signs of excessive heat. As a general rule of thumb, any temperature which the palm of the hand cannot stand for about 3 seconds may indicate a problem.
- Check all cabinet doors to assure proper operation and that all door latching and/or locking devices are in proper working order.
- Look inside cabinets for any signs of moisture, dripping, or condensation. Seal off any conduits which may have dripped condensate or provide an alternate means for drainage. Seal off any cracks or openings which may have allowed moisture to enter the enclosure and eliminate the source of moisture on the outside of the enclosure.
- Thoroughly dry all cabinet surfaces which may be damp or wet. If accumulated deposits are apparent, conduct an electrical insulation test to assure proper insulation integrity.
- If there is an accumulation of dust, remove with a vacuum cleaner or clean with lint-free rags. Do not attempt to use compressed air as it may contaminate other internal components.

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WIRING

- Inspect all accessible wiring for signs of looseness or overheating. Re-tighten to proper torque values as required. If major discoloration of wire insulation or cable damage is apparent, replace the affected cable.
- Identify and re-mark all cables in accordance with equipment drawings where required.

DISCONNECTING MEANS

- Operate main disconnect to assure proper operation of disconnect and mechanical interlock.

FUSES

- Examine all fuse clips and fuse blocks for signs of overheating or looseness. If there is any indication of reduced spring tension or overheating, replace the fuse clips or fuse block assembly.
- Assure that all fuses are the correct type and the proper size as listed on devices and applicable drawings.

CONTACTORS

- If there is an accumulation of dust, remove with a vacuum cleaner or clean with lint-free rags. Do not attempt to use compressed air as it may contaminate other internal components.
- Operate the starting contactor via the Test Mode (Section 7.1) to ensure proper operation.

GENERAL

- List all component part numbers which may be showing signs of wear, and order replacements for installation at next scheduled shut-down period.
- Note any equipment additions and/or wiring modifications on the appropriate drawings, for maintenance use and troubleshooting.

MAINTENANCE AFTER A FAULT HAS OCCURRED



CAUTION! After a fault has occurred, all equipment must be de-energized, disconnected, and isolated to prevent accidental contact with live parts. Check voltage on all terminals before touching or working on equipment. Only qualified individuals should be involved in the inspection and repair procedures and all safety precautions must be observed.

- The excessive currents occurring during a fault may result in enclosure, component, and/or conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. After a fault, determine the cause, inspect, and make any necessary repairs or replacements prior to re-commissioning this equipment. The following procedure is recommended for this inspection.

ENCLOSURE

- Check cabinet exterior for any signs of deformation or heat damage. Assure that all hinges and cabinet latching and/or locking mechanisms are in working order. Replace affected parts if required.

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DISCONNECTING MEANS

- Operate main disconnect to assure proper operation of disconnect and mechanical interlock.

FUSES

- Always replace all three fuses in a three phase circuit, even though only one or two are open. Possible heat damage in the remaining fuse(s) could result in a subsequent shutdown.

TERMINALS AND INTERNAL CONDUCTORS

- Replace all damaged parts which show signs of discoloration, melting, or arcing damage.

CONTACTORS

- Operate the starting contactor via the Test Mode (Section 7.1) to ensure proper operation.

RESTORING TO SERVICE

- Before restoring the equipment to service, it is recommended that the steps outlined in procedures for START-UP are followed.



DANGER! Fuse barriers and removable panels must be in place before applying power to the starter.

NOTES



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