

**INSTALLATION AND
MAINTENACE MANUAL**

FOR

GROUND MONITOR

GM-200

Patent #4153923

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1. GENERAL DESCRIPTION

I.A. INTRODUCTON

The AMR AC Frame Ground Monitor is a solid state frequency controlled system whose purpose is to monitor the continuity of the AC frame ground conductor on three phase equipment. It is a continuity monitor system that has a maximum allowable trip resistance of 75 ohms. The monitor can be operated pilotless, or with a pilotwire.

The GM-200 system is a single circuit monitor that was specifically designed for monitoring on modular output panels of today's modern power distribution equipment. The unit is very versatile in that it allows the operator many options to provide the most reliable and economical ground monitoring system available. The GM-200 contains all the features found on other AMR ground monitors that reduce nuisance tripping due to low voltage or intermittent conditions in the cable. The circuit description and installation instructions are given in the following pages.

I.B. CIRCUIT

The AMR ground check monitor is composed of the following basic functional components:

- Power supply
- Transmitter
- Receiver
- Current Transformer
- Two three-phase filters or one set of pilot wire filters

I.C. OPERATION

The AMR Ground Monitor system utilizes an audio frequency signal to monitor the continuity of the ground conductor. An

audio signal is generated by the transmitter section. This signal is coupled onto the three phase power conductors going to the equipment being monitored by one of the three phase filters. The signal then travels up the three conductors to the monitored piece of equipment. The signal is then coupled from the three phase lines to the ground conductor by the second three phase filter. The audio signal travels back to the power center through the ground conductor and passes through the current transformer to frame ground and the common side of the transmitter output. The current transformer couples the audio signal from the ground line to the receiver. The receiver then detects this signal and closes a relay which is part of the hold-in circuit for the three phase circuit breaker feeding the monitored equipment. If the audio signal is lost for any reason due to a broken ground conductor or any open in the above transmissions circuit, the relay is released and power is shut off to the machine being monitored.

II. INSTALLATION AND CHECKOUT PROCEDURE

II.A. GENERAL INSTALLATION DIRECTIONS

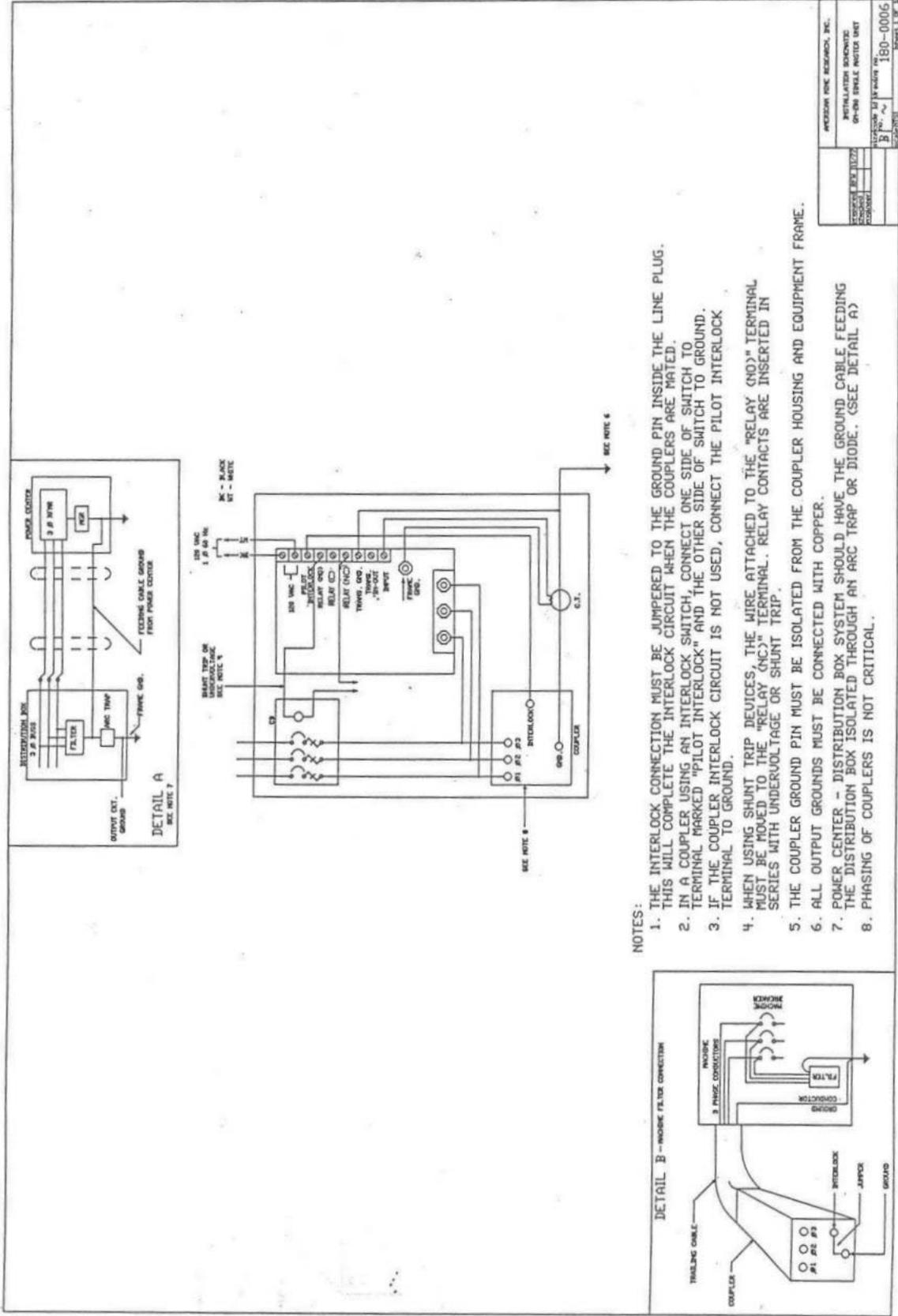
- All installation wiring shall be performed according to applicable codes.
- All hookup wiring should be at least 18 AWG, type, THHN, or Equivalent insulations, except the transmitter output lead, which should be at least 14 AWG. It may be preferable to use a larger size wire for mechanical strength reasons.
- All terminations and connections shall be made using approved termination and splice connectors.
- The MAIN AC power and the MAIN DC power should be visibly disconnected, locked and tagged out before and during installation of this equipment.

II.B. INSTALLATION INSTRUCTION FOR LOW VOLTAGE PILOTLESS SYSTEM

The installation of the AMR GM-200 Ground Monitoring System consists mainly of the mounting and wiring of the following pieces of equipment:

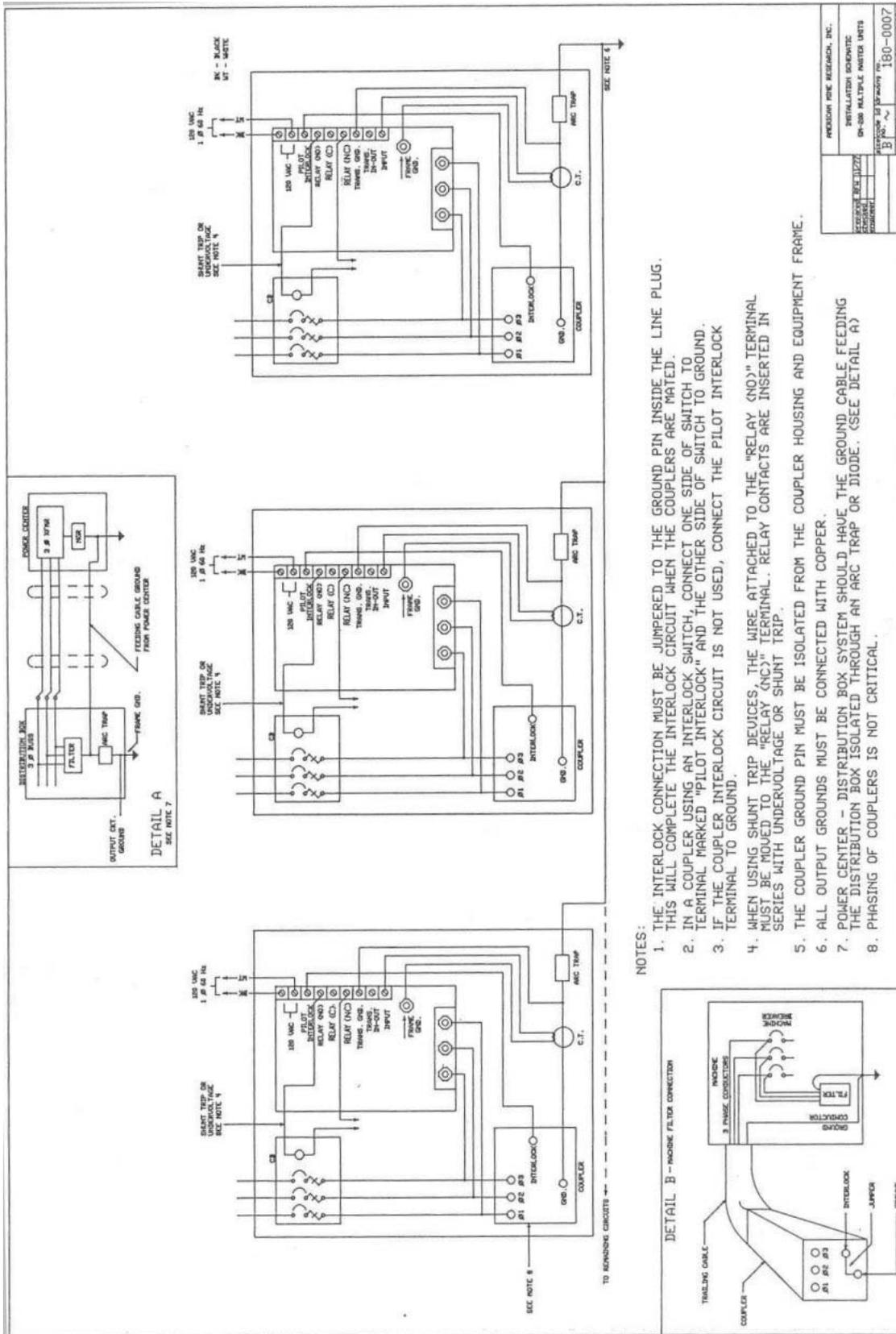
- Master monitor enclosure
- A receiver current transformer on the ground line of the AC outlet to be monitored.
- One three phase filter on the piece of equipment to be monitored

The wiring schematic for the GM-200 single unit monitor is shown in Figure 1. Figure 2 and 3 are wiring schematics for installations with more than one monitor. These schematics should be referred to while installing the GM-200 units.



NOTES:

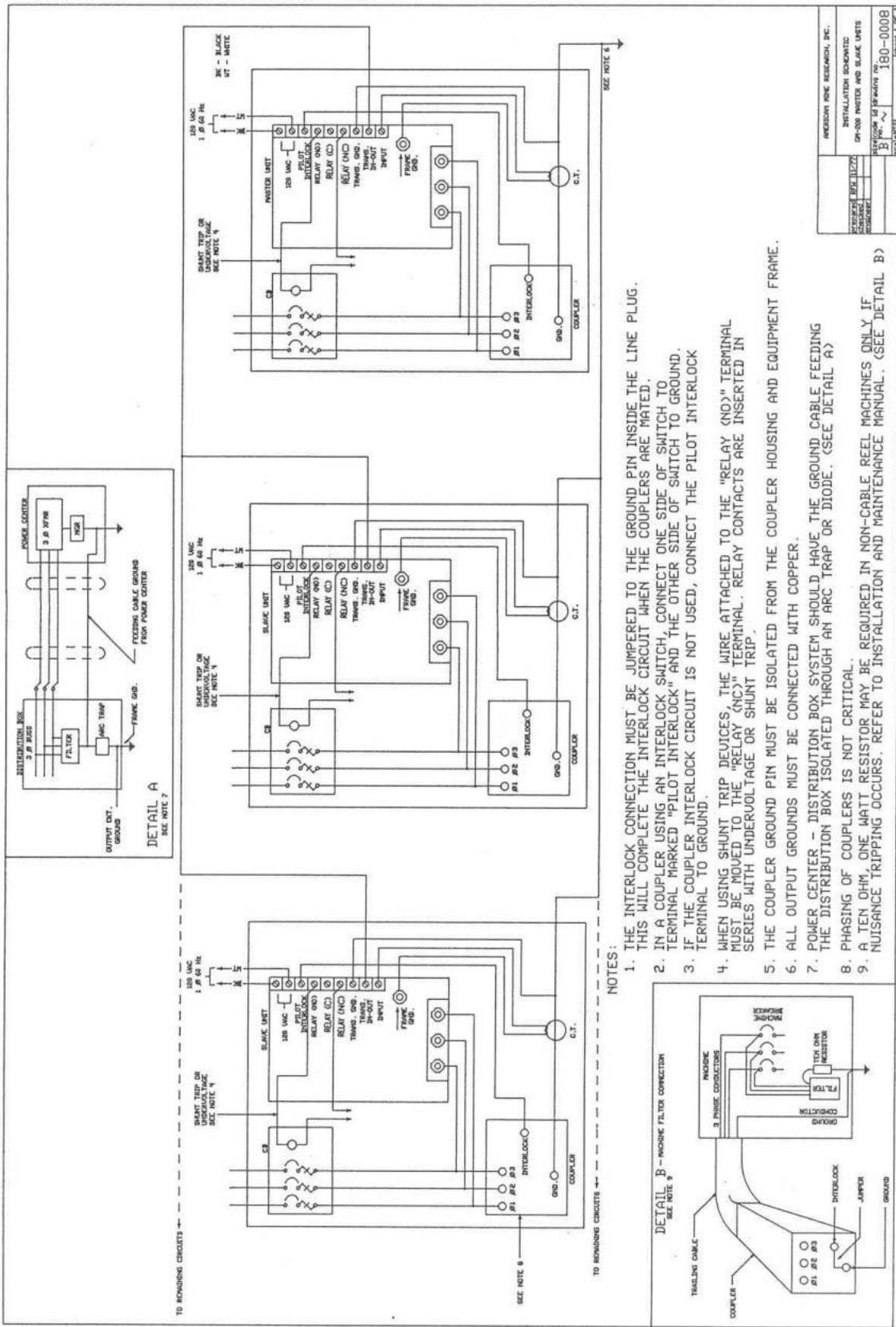
1. THE INTERLOCK CONNECTION MUST BE JUMPED TO THE GROUND PIN INSIDE THE LINE PLUG. THIS WILL COMPLETE THE INTERLOCK CIRCUIT WHEN THE COUPLERS ARE MATED.
2. IN A COUPLER USING AN INTERLOCK SWITCH, CONNECT ONE SIDE OF SWITCH TO TERMINAL MARKED "PILOT INTERLOCK" AND THE OTHER SIDE OF SWITCH TO GROUND.
3. IF THE COUPLER INTERLOCK CIRCUIT IS NOT USED, CONNECT THE PILOT INTERLOCK TERMINAL TO GROUND.
4. WHEN USING SHUNT TRIP DEVICES, THE WIRE ATTACHED TO THE "RELAY (NO)" TERMINAL MUST BE MOVED TO THE "RELAY (NC)" TERMINAL. RELAY CONTACTS ARE INSERTED IN SERIES WITH UNDERVOLTAGE OR SHUNT TRIP.
5. THE COUPLER GROUND PIN MUST BE ISOLATED FROM THE COUPLER HOUSING AND EQUIPMENT FRAME.
6. ALL OUTPUT GROUNDS MUST BE CONNECTED WITH COPPER.
7. POWER CENTER - DISTRIBUTION BOX SYSTEM SHOULD HAVE THE GROUND CABLE FEEDING THROUGH THE DISTRIBUTION BOX ISOLATED THROUGH AN ARC TRAP OR DIODE. (SEE DETAIL A)
8. PHASING OF COUPLERS IS NOT CRITICAL.



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| MOORE RESEARCH, INC. |
| INSTALLATION SCHEMATIC |
| ON-ON MULTIPLE MASTER UNITS |
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II.C. INSTALLATION OF MAIN MONITOR ENCLOSURE

The first step of the installation process is to determine where the GM-200 main enclosure will be mounted. The unit is designed to be panel mounted in either the standard Line Power Inc. cutout (Figure 4) or the standard Ensign cutout (Figure 5). If a standard mounting cutout is not already available, the six 1/4" holes should be drilled in the panel as indicated in Figure 4, and the proper cutout should be made.

Once a panel is properly prepared, remove the front cover from the monitor chassis by removing the tow cover mounting screws as shown in Figure 6. The cover can then be completely disconnected by unplugging it from the main chassis circuit board. Once the cover is removed, you will see four 8/32 machine screws that should be removed from the monitor frame and used for mounting the GM-200 to the output panel. Mount the main frame of the monitor to the back side of the panel by screwing the 8/32 screws through the panel into the main frame of the monitor. Once the monitor frame is securely mounted, the cover can be plugged back into the main frame and screwed in place. This completes the mechanical mounting of the monitor main assembly.

The wiring connections for the GM-200 series monitor are made on the terminal strip at the rear of the unit. This is shown in Figure 7. The top two terminals on the GM-200 are for supplying the unit with 120 VAC. Locate a point on the power center where 120 VAC is available. On most modern equipment, 120 VAC control voltage should already be available on the output panels.

The GM-200 system provides a pilot interlock feature that will satisfy the MSHA Regulations requiring the circuit breaker to open if the machine plug is accidentally removed while under load. This disconnect feature of the GM-200 does not contain the 250 millisecond time delay that is allowed in the approved monitor circuitry. This pilot interlock gives an immediate trip upon removal of the three phase machine plug. If the pilot interlock feature is desired, connect a wire from the terminal marked Pilot Interlock to the pilot pin on the back of the power receptacle. This connection is shown in Figure 1. Each three phase plug that is used in any of the monitored outlets must

Figure 6, Cover for GM-200

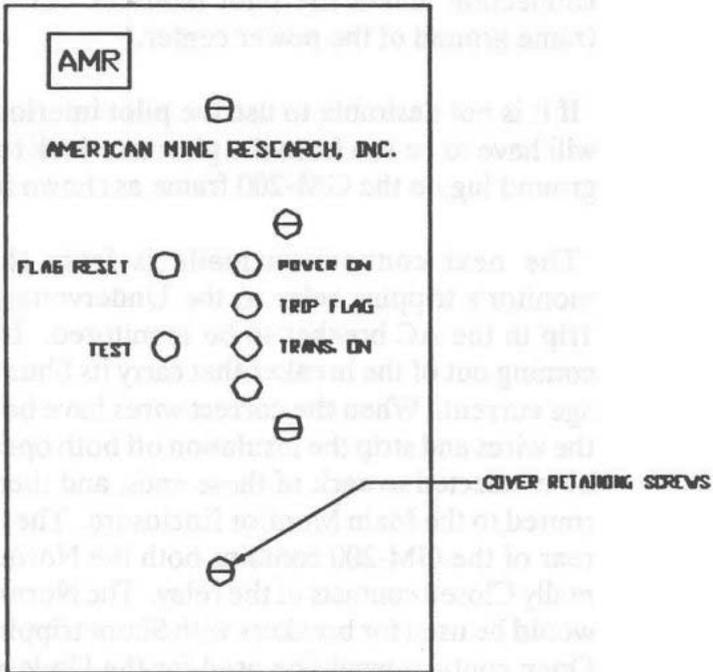
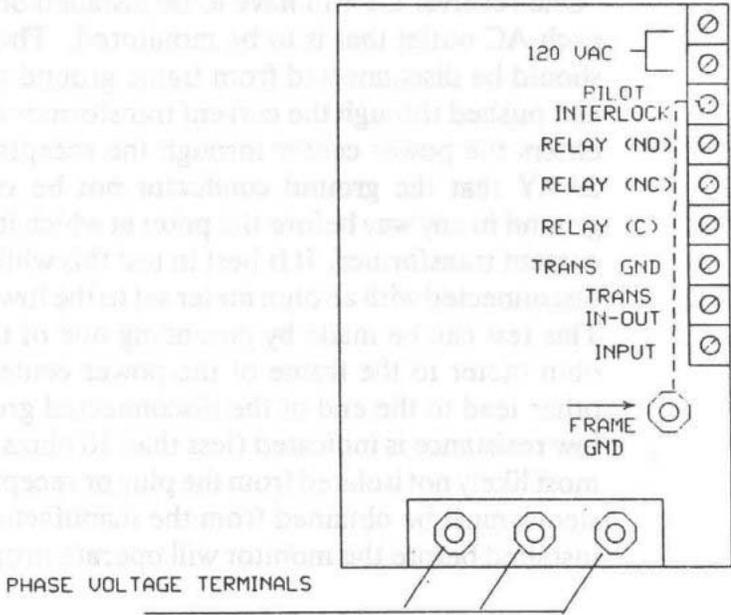


Figure 7, Back of GM-200



contain a jumper wire that connects the pilot in the plug to the ground pin. This connection allows the pilot interlock to flow into the frame ground of the power center.

If it is not desirable to use the pilot interlock feature, a jumper will have to be run from the pilot interlock terminal to the frame ground lug on the GM-200 frame as shown in Figure 7.

The next connection made is from the contacts of the monitor's tripping relay to the Under-voltage Release or Shunt Trip in the AC breaker to be monitored. Locate the two wires coming out of the breaker that carry its Shunt Trip or Under-Voltage current. When the correct wires have been found, cut one of the wires and strip the insulation off both open ends. A wire must be connected to each of these ends, and then each wire must be routed to the Main Monitor Enclosure. The terminal strip on the rear of the GM-200 contains both the Normally Open and Normally Closed contacts of the relay. The Normally Closed contacts would be used for breakers with Shunt tripping and the Normally Open contacts would be used for the Under-voltage trip devices. Connect one wire to the terminal marked (C) for common and the other lead to the correct Normally Open or Normally Closed contact. This will complete the hookup of the tripping circuit.

One receiver CT will have to be installed on the ground line of each AC outlet that is to be monitored. The ground conductor should be disconnected from the frame ground of the power center and pushed through the current transformer immediately after it enters the power center through the receptacle. It is NECESSARY that the ground conductor not be connected to frame ground in any way before the point at which it passes through the current transformer. It is best to test this while the ground line is disconnected with an ohm meter set to the lowest resistance scale. This test can be made by grounding one of the test leads of the ohm meter to the frame of the power center and touching the other lead to the end of the disconnected ground line. If a very low resistance is indicated (less than 10 ohms), the ground line is most likely not isolated from the plug or receptacle. An insulating sleeve must be obtained from the manufacturer of the plug and installed before the monitor will operate properly. Once the CT is properly installed, the ground should

be connected back to the frame of the power center.

Two pieces of wire should be cut that are long enough to get from the CT lead to the GM-200 enclosure. Each wire should be crimped to the CT output leads with the terminals that are already installed on the leads. The wire should then be neatly routed and tied down through the power center to the GM-200 enclosure. One wire should be connected to the terminal marked input, and the other lead should be connected to the frame ground bolt below the terminal strip on the back of the unit. Since the CT is not polarized, each wire can be connected to either the terminal strip “input” or the Frame Ground lug.

Three high voltage terminals can be seen in the bottom of Figure 7. A wire should be run from each of ht terminals to the plug receptacle. The three phase connections must be connected on the machine side of the breaker so that monitoring can continue when the machine does not have power unit. This completes wiring of ht Main Enclosure except for the transmitter, which will be covered in the next section.

II.D. TRANSMITTER CONNECTION

The GM-200 can be installed with one transmitter supplying all the circuits of the Power Center, or with a transmitter on each individual circuit. There are advantages and disadvantages to both system which should be carefully evaluated before deciding which method is best for you application. Figure 3 shows all connections that need to be made for a three circuit application using only one transmitter. The unit that contains the transmitter is labeled the Master Unit and the other two monitors that contain receivers only are labeled Slave Units.

To connect the units for this type of application, a wire would have to be connected from the terminal marked “Trans. Gnd” on the Master unit only to frame ground of the power center. A second wire would run from the terminal marked “Trans In/Out” on the Master unit to the “Trans In/Out” on all the Slave units. This connects the Master unit’s transmitter to the phase filter in each of the slave units.

The circuit of Figure 2 shows three GM-200 monitors connected as individual circuit monitors. Each unit has its own transmitter and requires an Arc Trap or Blocking Inductor in the ground line of each circuit to reduce cross talk between the individual transmitters. If only one monitor was to be used, then the Arc Trap could be eliminated.

To connect the monitor for this type of operation, connect a wire from the terminal marked "Trans Gnd" to the ground bolt on the back of the power receptacle. The "Trans In/Out" terminal would not have any wires connected to it for this type of operation.

II.E. INSTALLATION OF THREE-PHASE FILTERS ON EQUIPMENT BEING MONITORED

The three-phase filter should be installed inside the electrical box on the equipment being monitored. The unit should be securely mounted to the piece of equipment using large wire ties. The green wire of the phase filter should be connected to frame ground of the equipment. The three Black wires should be connected to the power phase lines as shown in Figure 1. It is necessary for this connection to be made at a point on the line side of the equipment disconnect device, so that the monitor will be able to continue monitoring when the equipment is shut down. One three-phase filter must be installed on each piece of equipment being monitored.

II.F. INSTALLATION INSTRUCTIONS FOR LOW VOLTAGE PILOT WIRE SYSTEM

The installation and checkout procedures described in pilotless installation will apply to pilot wire installations. The major differences are explained in the following section.

The GM-200 can monitor trailing cable grounds using a pilot wire. Two methods are accepted at present.

The first method involves the use of a tuned filter pair (see Figure 8). The transmitter output is connected to a power center filter (PF-162-A, AMR P/N 270-0024A). No polarity needs to be observed in the filter hookup. The other lead of this filter is

connected to the pilot pin. The machine filter (PF162-B, AMR P/N 270-0025B) is connected between the pilot wire and frame ground. Again, this filter is not polarized. These two filters in series create a tuned circuit having a low impedance to the monitor frequency while reducing induced 60 cycle current. This approach is preferred, since it is able to detect pilot-to-ground shorts in the cable.

If there is not sufficient room to mount to a machine filter (such as in pumps), the second approach is to simply run the monitor signal through the pilot wire directly to ground at the machine (see Figure 9). A 1000 VAC phase filter (PF160, AMR P/N 270-0002) is placed in series with the pilot wire to reduce 60 cycle induced currents and to protect the ground monitor. This method is unable to detect pilot-to ground shorts, as is the case with many impedance type monitors. When no filter pair is used, and monitor is used on non-cable reel equipment with cables shorter than 250 ft., a 10 ohm resistor (RK-1, AMR P/N 270-0008) is inserted in series as in Figure 9.

Figure 8, GM-200 Pilot Wire Monitor – Tuned Filter Pair

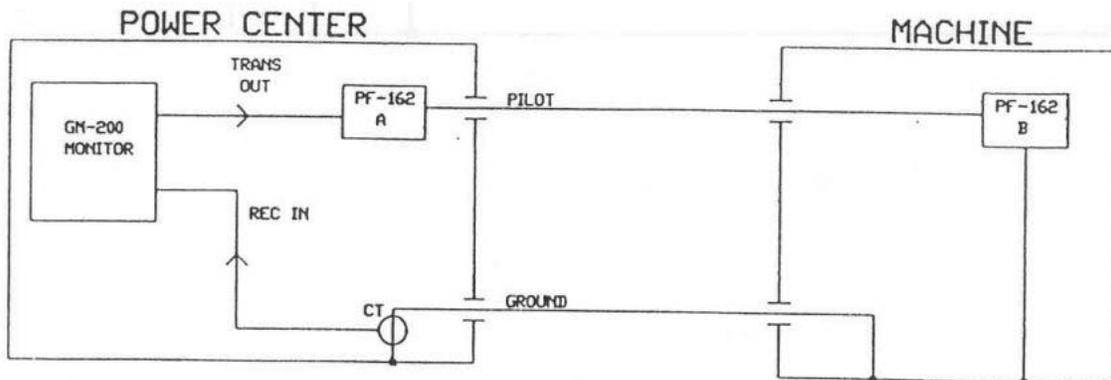
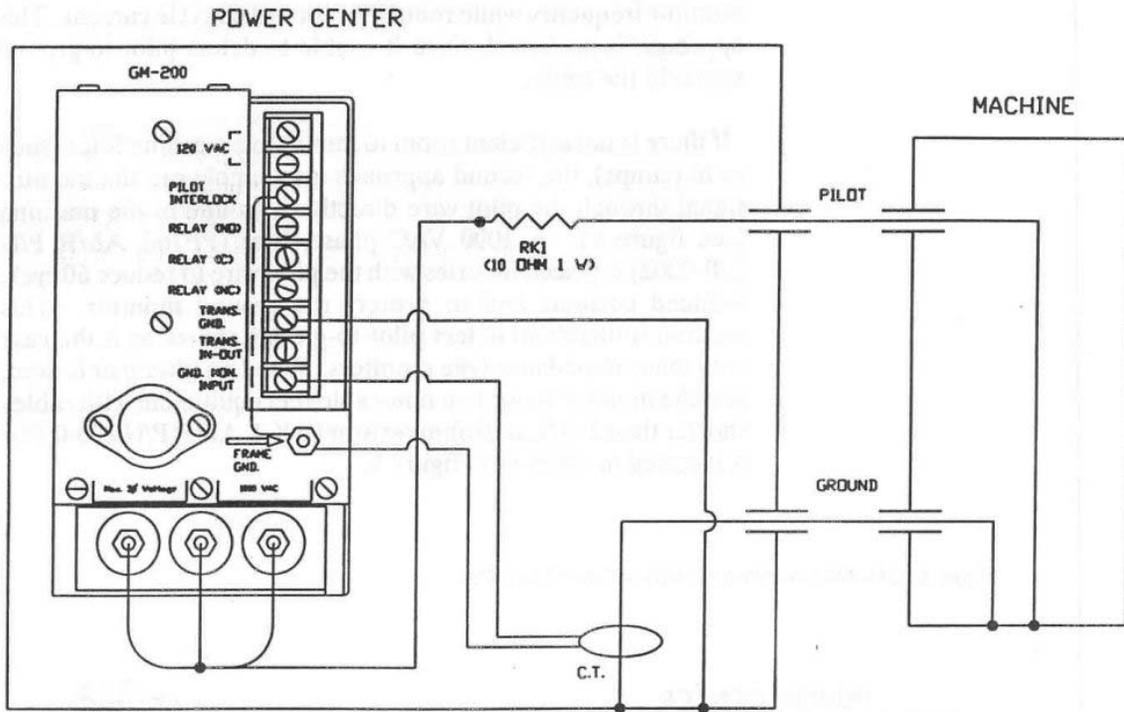


Figure 9, GM-200 pilot Wire Monitor – No Tuning

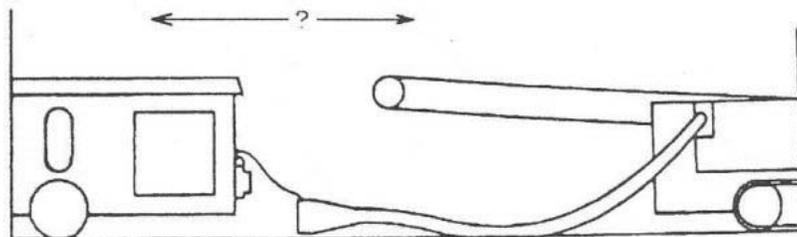


III. TROUBLE SHOOTING

Experience indicates that the most common problems encountered are faulty wiring connections, broken or intermittent connections in the trailing cable or ground wires not isolated from the frame before passing through the receiver CT. Before going into the detailed Trouble Shooting Procedures outlined below, all wiring should be verified to the correct according to the electrical schematics, and examined to insure proper electrical and mechanical integrity.

The Trouble Shooting Procedure for the AMR Ground Monitoring System is a simple process of elimination. The idea is to eliminate as quickly as possible the different components of the system to pinpoint the problem area. The following procedure should quickly lead to the source of the trouble.

Step 1. Determine Location of Problem



- A. Remove power from the circuit under test by opening the circuit breaker at the power center feeding that piece of equipment.
- B. Remove the machine cable plug from the power center.
- C. Verify that the power has been removed by using a volt-ohm meter (VOM).
- D. Connect the three phase conductors to the ground conductor at the receptacle outlet on the power center. This can be done by using the phase filter found in the TK-150 Test Kit or a piece of bare wire that can be bent

to connect the three phase terminals to the ground terminal of the receptacle. If the pilot interlock feature is being used. It will also be necessary to connect a jumper from the pilot pin to the ground pin.

- E. If the red trip indicator light for this circuit now stays out when the reset button is pressed, this indicates that all the monitor equipment in the power center is working and the problem is limited to the following areas:
- In the trailing cable or on the machine being monitored. (see Step #3 in this section).
 - The monitor is out of calibration. (see Step #4 in this Section).
- F. If the red trip indicator light can not be reset after the jumpers are installed, this indicates the problem is within the power center and you should proceed with Step #2.

Step 2. Location of Problem within the Power Center

A. Remove power from the power center and visually check all wiring connections from the ground monitor to the phase filter, current transformer (CT), and to the phase, ground, and pilot connections. If any wiring errors are suspected, the following checks can be made with a volt-ohm meter to verify correct wiring.

- With the volt-ohm meter set to the lowest resistance scale, place one probe on the pilot interlock terminal on the back of the GM-200 and the other probe on the pilot to ground jumper that is plugged into the power receptacle for this circuit, the resistance read should not be more than one or two ohms. If a higher resistance is read, this indicates that the Pilot Interlock circuit is not wired correctly, or that the monitor is not properly grounded.
- With the Volt-ohm meter still set on the lowest resistance scale, place one probe on the transmitter ground terminal and the other probe on the frame of the power center. The meter should indicate a low value of resistance if the transmitter is properly grounded.

- With the volt-ohm meter still set for the lowest resistance scale, place one probe on the input terminal and one probe on the ground bolt of the back of the GM-200. If a low resistance is indicated (less than 5 ohms), then the receiver current transformer can be assumed to be good.
 - Set the Volt-ohm meter on a scale sufficient to measure the tripping voltage (117 VAC for most Under-voltage trip Circuits) and then place one probe on each of the two wires coming to the monitor's trip contacts. If the correct voltage is not found, trace the wiring to the correct breaker to identify the problem.
- B. To determine if the transmitter is operating, check the cover of the Master unit to see if the yellow "Trans On" light is on. If this light is not on, remove the access cover on the side of the monitor by its one screw. If all lights are out on the monitor, depress the red reset button on the small circuit breaker to the left of the large power transformer. Press this button several times to insure that the breaker has been reset. If service has not been restored, check the 2 amp glass fuse on the transmitter board to see if it's blown. If it is, replace it with a comparable 2 amp SLOW_BLO fuse. After replacement, again check to see if the "Trans On" light is now on. If it is not on, remove and replace the larger transmitter PC board with the spare board found in the TK-200 trouble shooting kit. If the "Trans On" indicator now lights, the old transmitter board has failed and it should be returned to AMR for repair.
- C. If the "Trans On" light was found to be on, but the monitor will not pick up, replace the receiver board with the spare found in the TK-200 shooting kit. This board can be identified by the calibration control that is facing out. If the monitor now picks up, the receiver board should be returned to AMR for repair.
- D. If none of the above measures work, return the GM-200 for service, the entire unit should be removed and replaced. The defective unit should then be returned to AMR for repair.

Step 3. Location of Problem in the Trailing Cable or on Machine

- A. Remove all power from the machine and leave the cable plug disconnected from the power center so as to have visual disconnect.
- B. With an ohm meter set to the lowest ohms scale, check to see if the ground pin is isolated from the frame of the plug. This can be done by placing the probe on the ground pin and the other on the frame of the plug. Move the cable at the strain relief as much as possible and if the meter indicates a low resistance (less than 10 ohms), the plug must be taken apart and the ground wires isolated from the cable plug frame. If the pilot interlock feature is being used, place one probe on the ground pin and one probe on the pilot pin of the plug. There should be a low resistance short in this circuit (less than 2 ohms) indicating that the correct jumper has been installed in the plug between pilot and ground. On the newer pieces of distribution equipment, the entire power receptacle may be isolated from the frame of the equipment by mounting the receptacle on an insulated board. If this is the case with the unit you are working on, it will not be necessary or advisable to isolate the ground through the plug and the receptacle.
- C. Visually inspect the cable for cuts or bad splices. The probability is high that the problem will be in the cable.
- D. Remove the cover from the control box on the piece of equipment and visually check all connections.
- E. Leaving one person to observe the red trip indicator light on the monitor, go up and short the four terminals of the phase filter on the machine.
- F. Return the cable plug to the power center and lock out the circuit breaker so that power can not be placed on the machine.

G. If the red trip indicator light now goes out, when the reset button is pushed, this indicates that the machine filter is bad and should be replaced.

H. If the red trip indicator light stays on when reset, this indicates that the problem is in the cable or the associated wiring on the machine.

I. The cable or machine wiring can be checked by using a jumper to short one phase to ground at the three phase filter on the machine. Place the probe of a volt-ohm meter, set to the lowest resistance scale, on the ground pin of the machine cable plug at the power center end of the cable. With the other probe, find the phase pin in the plug which contains the short. This resistance should be less than 4 to 5 ohms on machines that do not have cable take-up reels. If the machine does have a take-up reel, hold the ohm meter on the phase and ground pins while another person slowly pulls the cable off the reel. This resistance should not exceed 5-35 ohms. If a higher resistance is measured, the cable reel brushes should be serviced. All three phases should be checked in this manner to further isolate the problem.

Step 4. CALIBRATION

A. The calibration of the GM-200 Ground Monitoring System can easily be checked by using the Test Button found on the cover of the Master unit. The following procedure will determine if the monitor is correctly set at its maximum trip resistance setting.

B. Remove all machine plugs from the Power Center. On the receptacle of the circuit that you wish to calibrate, short the three phase pins to the ground pin. If the pilot interlock feature is being used, it will also be necessary to short the pilot pin of the receptacle to ground.

C. After the monitor has had at least 15 minutes to warm up, remove the access cover from the side of the unit by its one screw. Located the sensitivity control that is on the top of the receiver board.

D. Press the test button on the Master unit and hold it in. This button places a 75 ohm test resistor in the output of the transmitter and monitor should now trip and turn the trip indicator light on. You should also be able to observe the relay for the circuit under test opening. With a small screwdriver adjust the sensitivity control on the receiver card counter-clockwise to increase the trip resistance of the receiver. Continue to hold the test button in and turn the sensitivity control till either the relay picks up or you reach the maximum sensitivity position of the receiver board. If the relay picks up, slowly turn the sensitivity control back in the clockwise direction until the relay drops back out. If the relay did pick up when the receiver was turned to its maximum position, replace the receiver card return the defective one to AMR for repair.

WARRANTY

American Mine Research Inc., warrants that each product manufactured by it is free from defects in material and workmanship under normal usage and service. The obligation under this warranty shall be limited to the repair or exchange of any part or demonstrated to be defective; provided, such part or parts is returned to American Mine Research, Inc.'s plant or to an authorized agent of American Mine Research, Inc., within ninety (90) days after delivery of the product to the original purchaser; such return to be made at the sole expense of the original purchaser.

THE WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, AND OF ANY AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF AMERICAN MINE RESEARCH, INC. AMERICAN MINE RESEARCH, INC. NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY LIABILITY OTHER THAN THIS WARRANTY IN CONNECTION WITH THE SALE OF ITS PRODUCTS OR ANY PART OR PARTS THEREOF.

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