INSTALLATION AND MAINTENANCE MANUAL

FOR

GROUND MONITOR

GM-300

American Mine Research, Inc

Manual Part Number 160-0094

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NOT TO BE CHANGED WITHOUT MSHA APROVAT.

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AMR Ground Check System – GM-300

INTRODUCTION

The American Mine Research GM-300 Ground Check System is intended for use on all systems where pilot and ground wire loop resistance is at least 4 ohms and not greater than 14 ohms.

Ground check systems using GM-300 are auditable for application on power systems up to 25 KV A.C. including low and medium voltages. For power systems over 25 KV contact AMR for recommendations.

The following describes ground check systems using the GM-300.

Complete GM-300 package for 129 volt input is comprised of the following typical components:

1 120/24V single phase, dry control transformer with ¾ A fuse and holder. Min, 50 VA), 4.5 Ohm resistor.
1 MOV
1 130V MOV
1 Test push button switch.
1 Flush mounted module

For installation with more than 14 ohm total resistance special design consideration are recommended to suit customer requirements. Unless specified by the customer, the standard package for 120V input will be furnished.

In a standard GM-300 Package, the MOV, control transformer, test button, 130V MOV, load resistor, fuse and fuse holder will be shipped loose. All components are to be installed and wired in the field by the customer in accordance with AMR drawing number 180-0096. This arrangement is provided to facilitate installation on customer's existing control panels where sufficient space may be available to install all components in on location. The resistor will be mounted at the load termination compartment. The MOV may be mounted in the cable terminating compartment of the switch-gear.

OPERATION

Typical a schematic diagram of the GM-300 is shown on AMR drawing number 180-0096.

Step by step operating procedures for the GM-300 are as follows;

1. Make sure all connections are correct.
2. For initial operation, disconnect external leads to the transformer secondary. Turn on 120V AC power supply and measure transformer secondary volts. This should read 24V AC = 10% to -20%.
   EXCESS VOLTAGE AT THIS POINT COULD DAMAGE THE GM-300!
   Turn off the 120V AC power supply and reconnect external secondary leads of transformer.
3. Turn balance knob counter-clockwise the way. Balance will now point to or read 4.
4. Turn on 120V AC power supply. The -1.5 OHMS light will be "ON". The High CIRCUIT OHMS FAULT light will be blinking.

Turn balance clockwise gradually until +1.5 OHMS light is "ON". The minus light will stay "ON". Note the reading on dial at the point where is cuts off the GM-300. With minus and plus light "ON", continue to turn balance clockwise until the -1.5 light goes "OFF". The Low Circuit OHMS FAULT light now will be blinking also. Note the balance reading at the cutoff point of minus light.

Balance reading at minus light cutoff point is the total external resistance between the ground and pilot terminals of the GM-300 with all wires in place.

The difference between the minus light cutoff point and the plus light cutoff point is the adjustment range – window width – of the GM-300. The value should be three (3) OHMS. When balance is set on the center of the window width, the CENTER light will be on (as well as the plus and minus lights). The CENTER window width is approximately on (1) OHM. This is the normal "normally closed" contacts will be closed when both the 1.5 and +1.5 lights are "on", even thought the center lights will go off. Set balance desired sensitivity, CENTER light on. Refer to description on sensitivity.

If the output relay contacts are wired for proper circuit breaker operation the GM-300 is working.

> NOTE: The GM-300 is supplied with one (1) "normally open" and one (1) "normally closed" contact. See AMR drawing number 180-0096.

TEST SWITCH

The standard GM-300 package is supplied with a momentary push-button switch with one (1) normally open and one (1) normally closed contact.

The normally closed contact is wired between the pilot wire and the pilot connection to the GM-300. This connection is a short wire connected to resistor R-A mounted on the rear of the GM-300 and for this reason the test switch should be mounted with in six (6) inches of the top the GM-300. The normally open contact is wired between the ground terminal and the pilot connection the GM-300. See AMR drawing number 180-0096.

To test the GM-300, press the test push-button. As the normally closed contact breaks, the GM-300 will detect an open circuit, one PLUS LIGHTs go out, and the "HIGH" ohms light will blink; then the normally open contact will make and a 9 ohms test resistor will be connected in the circuit. Turn balance to 11, the MINUS LIGHTS will go out and the "LOW" ohms light will blink. While maintaining the push-button in the depressed position, re-position the selector knob to 9 ohms and push "Reset" button on upper center face plate. The HIGH and LOW lights should go out and the window light remains on. If this occurs, the GM-300 is functioning properly.

SENSITIVITY

Assume that a GM-300 has been placed in operation as described earlier, and a operating window width of 3 ohms is available.

If the balance is set in the middle of the window with, the CENTER light on, the operating relay will drop out if the circuit resistance goes up by 1 ½ ohm or goes down by 1 ½ ohm. A one ohm drift is either direction will merely turn off the CENTER light without output relay operation.

If the balance knob is set above the minus light cutoff point and the CENTER light is off, the relay will drop out it the circuit resistance goes down by ½ ohm or goes up by 2 ½ ohms.

GENERAL INFORMATION

The indicating lights on the GM-300 are light emitting diodes with extremely long life and sharp cutoff point. These lights will not require replacement during the life of the GM-300.

The GM-300 is designed for a window width of about 3 ohms.

The window range is rated at 4 to 14 circuit ohms. Slight difference in window widths can be expected between various GM-300 units. This is due to component tolerances and will not affect the operation of the system.

The circuit ohm is the total resistance of the following in ohms:

Cable ground wire resistance
Plus
Pilot wire resistance
Plus
Contact resistance, if any.

The GM-300 is field repaired down to the board level. Appendix B lists the assemblies that can be replaced.

The LOW CIRCUIT OHMS light trigger point is meant to detect accidental pilot to ground shorts in the cable. The HIGH CIRUIT OHMS light tripper point is meant to detect an increase in ground circuit resistance, including the pilot wire circuit.

When properly connected and operated, the GM-300 senses the external resistance between its ground and pilot terminals. This includes the resistance of the pilot wire, ground wire, and any other resistance in the electrical path of these wires, including bad connections, and contacts on relays, door switches, etc.

Refer to AMR drawing 180.0096

The ground terminal should always be connected to cable ground close to the cable terminating point, by a separate insulated copper wire.

The “HIGH CIRCUIT OHMS” light above the +1.5 light and the “LOW CIRCUIT OHMS” light above the -1.5 light are provided for trouble indication.

If the GM-300 trips out under high resistance conditions (including open pilot/ground circuit), the +1.5 light will go out and the "HIGH CIRCUIT OHMS" light will begin to blink. If the cause of high resistance disappears, the +1.5 light will come back "on" and the ground check system will become operational automatically. The "HIGH CIRUIT OHMS" light will continue to blink until the reset button is pressed. Typical examples of "HIGHT CIRCUIT OHMS" conditions are loose contacts or door interlocks, loose connections, bad ground or pilot wire splices, etc.

The "LOW CIRCUIT OHMS" light operates similarly except that it si activated under low resistance condition. Typical example of "LOW CIRCUIT OHMS" condition is ground to pilot wire short circuit.

OPTIONAL TRIP INDICATOR

The trip indicator is mounted and pre-wired to the GM-300. The purpose of it is to indicate a trip even if power to the GM-300 is lost.

To reset the indicator turn it clockwise until the flag disappears.

OPTIONAL BATTERY

If the optional battery (AMR #275-0007, 12VDC 12 amp/hour re-chargeable or equivalent) is used in the system, the "HIGH-LOW" lights will provide indication for several hours even if the AC power is lost.

TROUBLE SHOOTING

Only a standard volt-ohm meter - such as Simpson, Triplett or similar meter - is required for normal field checking the trouble shooting on GM-300's. All readings indicated in this manual are based on a Simpson meter. Typical functions are reading s on various terminals of the GM-300 are as follows:

GM-300 TERMINALS

Case, (14)	See Section "General Information" and refer to AMR drawing number 180-0096.
Ground, (12)	
Pilot (Resistor R-A)	Ground terminal is common with negative connection for battery (11) when optional battery is used.
Test (13)	For factory and field testing, see page 4, "Test Switch".

TYPICAL TEST READINGS

External Circuit Resistance	Disconnect 120V AC power supply to the GM-300. Remove the external wires connected to ground and pilot terminals. Read resistance between the above to wires not the GM-300 terminals. The reading should be 4 to 14 ohms for the GM-300 to operate correctly.
Input Voltage (2), (3)	With the GM-300 connected to proper 120V power supply, the voltage across terminals (2) and (3) should be approximately 24V AC. This value can change between 19 and 26.5 volts without malfunction. This voltage should not drop below 19 volts even under machine start-up or other conditions. This voltage should not rise above 26.5 volts even at low power system load hours such as during nights or holidays.

Output Contacts

N.C. (14) N.O. (15) Common (6)	One of the two 10A, 250V AC GM-300 output contacts should be wired into the system circuitry, such that if the GM-300 fails or a power failure occurs, The de-energized position controlled breaker tripping circuit will be N.C., breaker directly.

Battery Voltage

Plus VDC (7) Minus VDC (11)	DC input to GM-300. When the optional battery is used, automatic charging power for the battery is provided through the GM-300 terminals (7) (+, red) and (11) (-, black). Normal reading between terminals (7) and (11) should be approximately 11.5 (+) or (-) 1 V DC, with battery disconnected. IF the battery is connected, this voltage will vary depending on the charge condition of the battery. No other readings are required of recommended in the field.
Terminals (1), (8), (9), (10), (15), (16)	Not for external use.

PROBLEM / SOLUTIONS

1. No Lights

Check connections. Check input voltage across plus VDC, minus VDC terminals. If no voltage or voltage to low, check input VA transformer and / or power supply fuse. Check 120 volt input source.

2. No PLUS LIGHT

Perform TEST as outlined earlier on page 4. This will indicate if light is operative. Check external ground pilot circuit resistance. See Section "Test Readings" on page 7. If external circuit resistance is beyond GM-300 range. Contact AMR with complete cable data and length of cable.

3. No MINUS Light at 4 OHM Dial Setting

Perform TEST as outlined earlier; this will indicate if light is operative. Check external circuit resistance as explained earlier.
In case of troubles 2 and 3 above, disconnect external wires at GM-300 ground and pilot terminals. Check external ground/pilot circuit including parallel paths, door switches, coupler pins, connections, etc.

4. Nuisance Trips When Soil Gets Dry or Wet.

GM-300 ground circuit is through natural earth and not through cable ground wire or bad connections on ground wire. Figure out total circuit resistance which can be expected by adding resistance of ground wires and pilot wire using simple resistance tables. If GM-300 dial reading at high cutoff point is considerably different from the above figure, double check cable ground and pilot wires.

5. Nuisance Trip During Hot and Cold Hours of Day (not dry or wet weather).

This trouble is very infrequent and can be expected only under certain extreme ambient conditions in areas where the temperature differential between day and night will be in the range of about 40 degree F. or more. Contact AMR for further information.

6. Frequent GM-300 Failure at One Location.

Made sure connection on ground terminals are per AMR drawing number 180-0096. on main substations where primary supply to the power transformer is received through overhead lines, GM-300 failures during storms may be caused by lightning discharges to the overhead phase conductors. Make sure all over head lines are protected by static wires or other means. Check all ground pits, electrodes and associated connections.

7. MOV Device Failure

The MOV device is provided for protection against short time high voltage spikes. The MOV device will be damaged if subjected to extremely high voltages or voltages above its rating for longer periods, After power failures due to lightning storms or H.V. cable faults, check MOV devices for visible damage or discoloration. Normal resistance reading with a volt/ohm meter across an MOV device (disconnected) will be infinity. Routine inspection of the switch-gear equipment should include visually checking all MOV devices.

8. High/Low Lights Will Not Blink When GM-300 Trips Out and A.C. Power Supply to GM-300 Fails (Optional Battery).

Check battery voltage and make sure that the battery is getting charged. (This is an optional feature).

9. Random Nuisance Trips

If construction and welding activities are taking place in the areas of power distribution system, nuisance trips can occur for no apparent reason. Such nuisance trips take place due to welding currents returning through cable ground wires, giving false signal to GM-300. Under severe conditions, welding currents can be so high as to cause GM-300 burnout even though the circuitry is protected for this condition. Check if welding or similar operations are taking place in the distribution system area. Make sure sufficiently large return conductors are provided on all welding machines and take appropriate steps to prevent current returns through cable ground wire.
Careful study of the physical layout of equipment and possible return paths may be necessary to eliminate this problem.

10. GM-300 Burns Out When AC Power Supply is Applied

Disconnect terminals (2) and (3) wires from GM-300 and check boltage between the disconnected leads. If the voltage is within the limits specifed under “Typical Test Readings”, check voltage between wire (2) to ground and (3) to ground. If wire (2) to ground and/or wire (3) to ground reading is higher than 26.5 volts, check power supply, wiring and components. Typical troubles can be partial ground on primary, primary to secondary short circuit on ground check transformer, or underground main control power transformer or similar equipment.

11. GM-300 Shows Low Ohms for All Dial Settings

Phase to pilot faults for sustained periods cause resistor R-A and/or R-B to open. With a load of 4 to 8 ohms a voltmeter will indicate approximately on (1) volt. Both R-A and R-B should measure 25 ohms. Should either resistor indicate fault, they may be replaced in the field. Contact AMR for these replacement parts.

SPECIFICATIONS

Electrical

1. Input power: 120 VAC, +10%, _30% at ¾ amp
2. Control Relay Contacts: 250v A.C. at 10 amps
3. Indicators: -1.5, +1.5, High, Low, and Center

Environmental

1. Operating Temperature: -20 degrees to +70 degrees C. (-4 degrees to +158 degrees F.)
2. Humidity: 0 to 90 percent R.H.

Mechanical

1. Size: 9 ½ X 7 X 6 inches
2. Weight: 6 pounds

Appendix A
TYPICAL OHMIC VALUES FOR POWER CABLE

(Copper Conductor at 25 Degree C, 77 Degree F)

Size AWG or MCM	Max Ohms * per 1000 ft.
1000	.0108
950	.0114
900	.0120
850	.0127
800	.0135
750	.0144
700	.0154
650	.0166
600	.0180
550	.0196
500	.0216
450	.0240
400	.0270
350	.0308
300	.0360
250	.0431
0000	.0509
000	.0642
00	.0811
0	.102
1	.129
2	.162
3	.205
4	.259
5	.326
6	.410
7	.519
8	.654
10	1.039
12	1.652
14	2.626
16	4.176

* When two wires of the same size are in parallel, divide values given by two for total resistance.

Example:

Find total resistance of 1000 ft. cable with

Two 4/0 Ground Wires and

One No. 10 Pilot wire

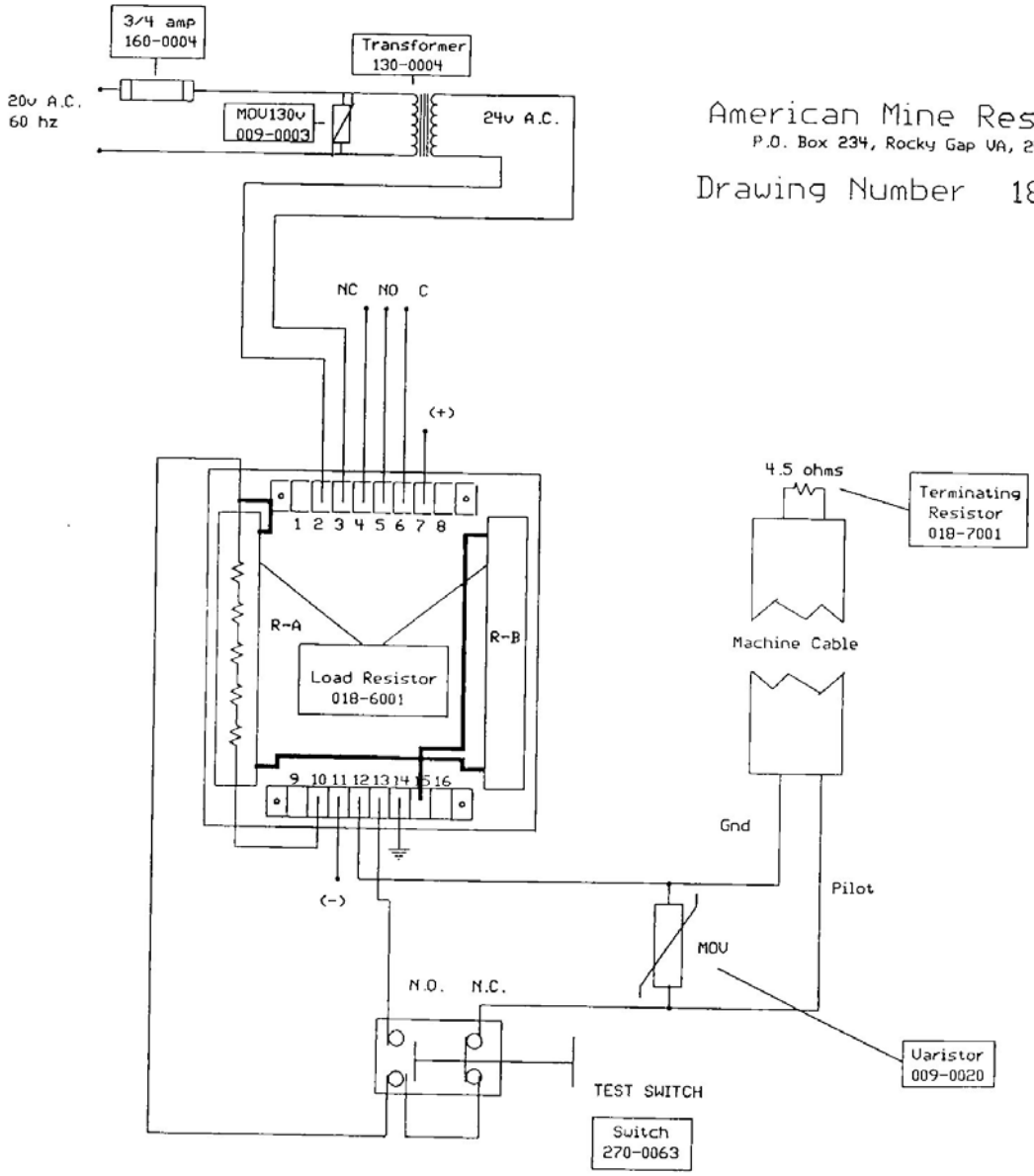
Resistance of ground wires $\frac{.0509}{2}$ = .02549 ohm

Resistance of pilot wire = 1.039 ohm

Total Resistance 1.06445 ohm

Appendix B
Replacement Parts

Ground Monitor PCB	253-0131
Front Panel Assembly	141-0068
Load Resistor (2 Per Unit)	018-6001
Varistor	009-0020
Varistor (130 Volt)	009-0003
Terminating Resistor	018-7001
Test Switch	270-0063
Transformer	130-0004
Fuse (3/4 Amp)	160-0004
Re-chargeable Battery (Optional)	275-0007



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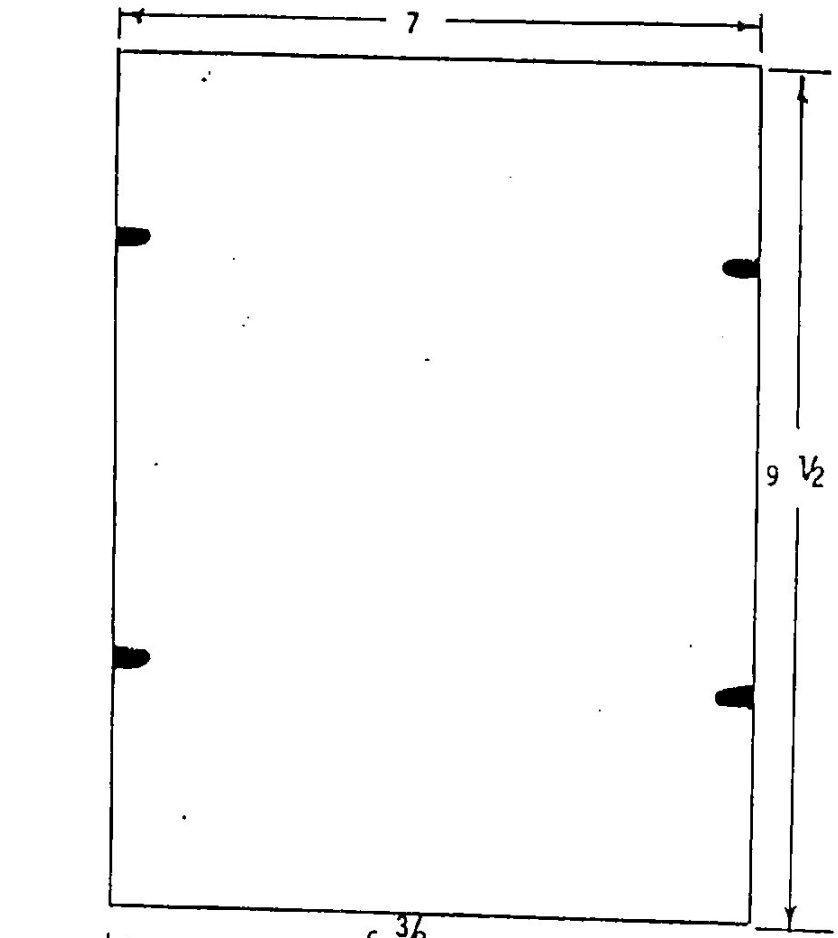
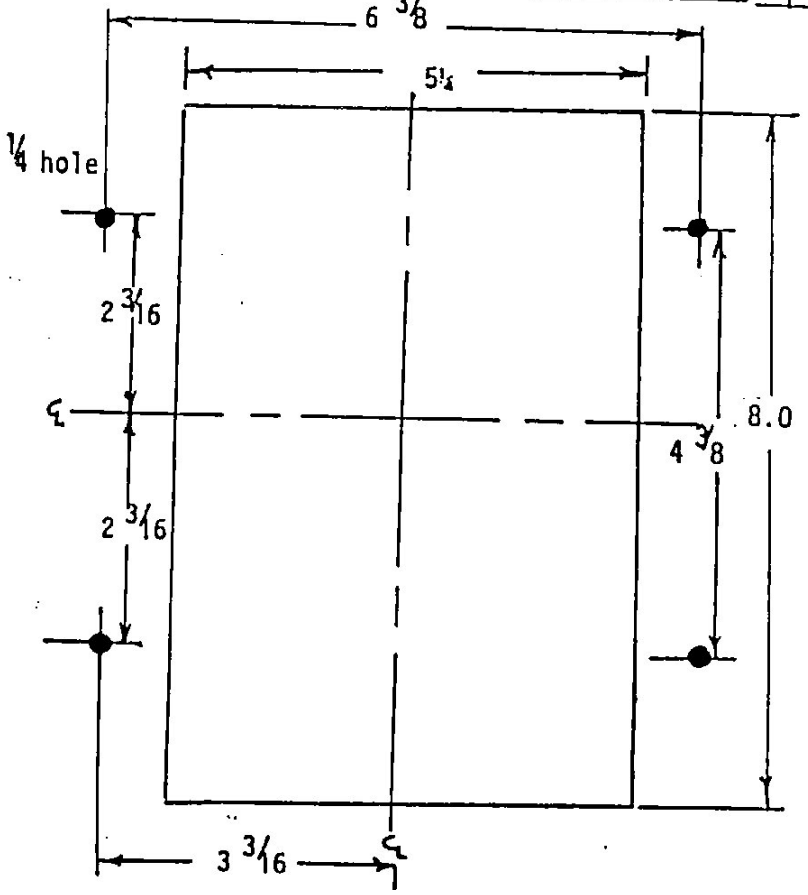
Drawing Number 180-009



PANEL FRONT VIEW



PANEL CUT OUT

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