

FEMCO, A MARK IV INDUSTRIES COMPANY  
REFERENCE MANUAL GM8950 3-FREQUENCY GROUND CHECK MONITOR/  
GROUND FAULT RELAY

FREQUENCY	4000HZ	3125HZ	2250HZ
MONITOR	GM8900/4000	GM8900/3125	GM8900/2250
FILTER	F12559	F12569	F12567

Combined Unit GM8950/4000 GM8950/3125 GM8950/2250

This manual provides performance, applications, installation and operation for GM8950 Ground Monitor/Ground Fault Relay.

SECTION 1 - Performance Characteristics

Describes the general performance and applications of the product. Mechanical, electrical and environmental specification are included.

SECTION 2 - Installation

Covers site selection, wiring, adjustments, connections and outline and mounting dimensions.

If more detailed information is required, a complete maintenance manual can be obtained by contacting your sales representative or Headquarter Sales.

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Femco Ground Monitors should be returned to the manufacturer or authorized representative for service. Substitution of components not approved by M.S.H.A. will void M.S.H.A. Acceptance number.

Circuitry described in this manual is covered by Femco Patent Nos. 3,728,582 and 3,855,501.

ARC TRAP - Femco Registered Trademark  
GROUND SENTINEL - Femco Registered Trademark

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MSHA B.T.S. Acceptance No. 042390FE

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## INTRODUCTION

The Femco GM8950/\*\*\*\* combined Ground Check Monitor/Ground Fault Relay (GFR) consists of a GM8900/\*\*\*\* Ground Check Monitor (Ground Sentinel) and a GFR in a shared housing. They are intended to be used on the same three phase AC mine electrical circuit. The trip contacts of the Ground Sentinel and GFR are internally prewired for series or shunt trip of the mine circuit breaker.

The Femco Ground Sentinel along with the associated filters is designed to monitor the continuity of the ground circuit of electrical power circuits in mines. The three phase wires are used as a return signal path for the Ground Sentinel. If the ground circuit has fifteen ohms or less loop resistance, the internal relay will be energized and the circuit breaker that feeds power to the cable can be energized, if the Ground Fault Relay is not tripped. A disruption of the ground circuit that lasts longer than one fourth of a second will de-energize the relay and trip the circuit breaker. The time delay prevents false trips. Three LED's indicate the condition of the ground circuit and Ground Sentinel.

The three frequency system is intended for applications on circuits where the ground circuit can't be isolated by ARC TRAPS or elimination of two ARC TRAPS is desired.

The Femco GFR along with it's associated Femco Current Transformer is designed to trip when ground fault currents exceed preset thresholds. Trip occurs within a few cycles of the onset of the excessive ground fault current.

## SPECIFICATIONS

### Mechanical

Size LWH 7.46" x 2/32" x 5.62"  
(Fits on a GM1000 Foot Print) (189.5 x 58.9 x 142.7mm)

Construction Stainless Steel

Weight

Serviceability One plug-in assembly  
contains all electronics  
including the relay.

### GM8900 GROUND SENTINEL

#### Power

Supply Voltage 117V  $\pm$  15% 60 Hz  
(105 - 135)

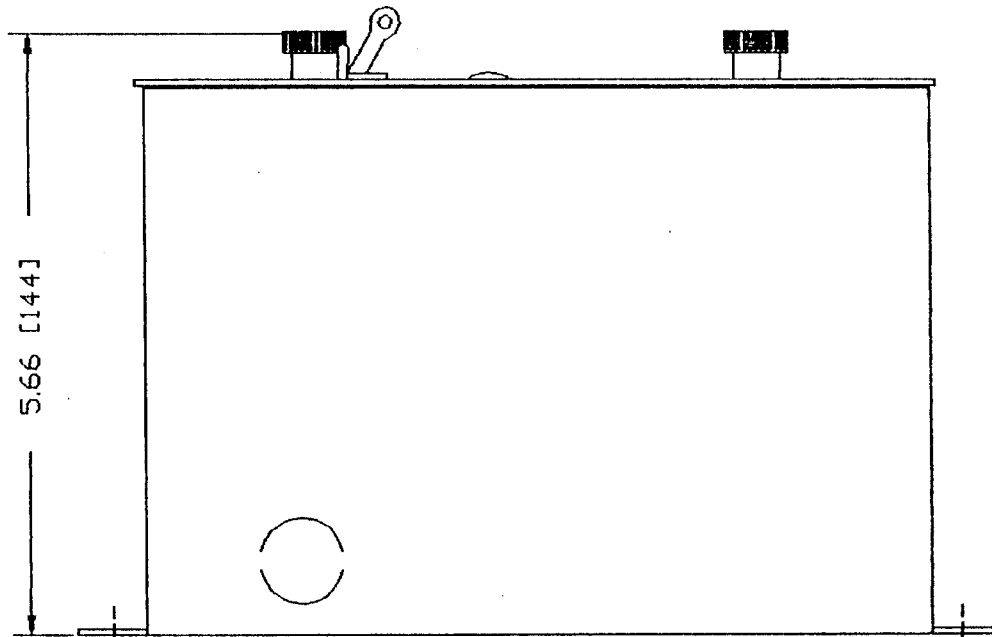
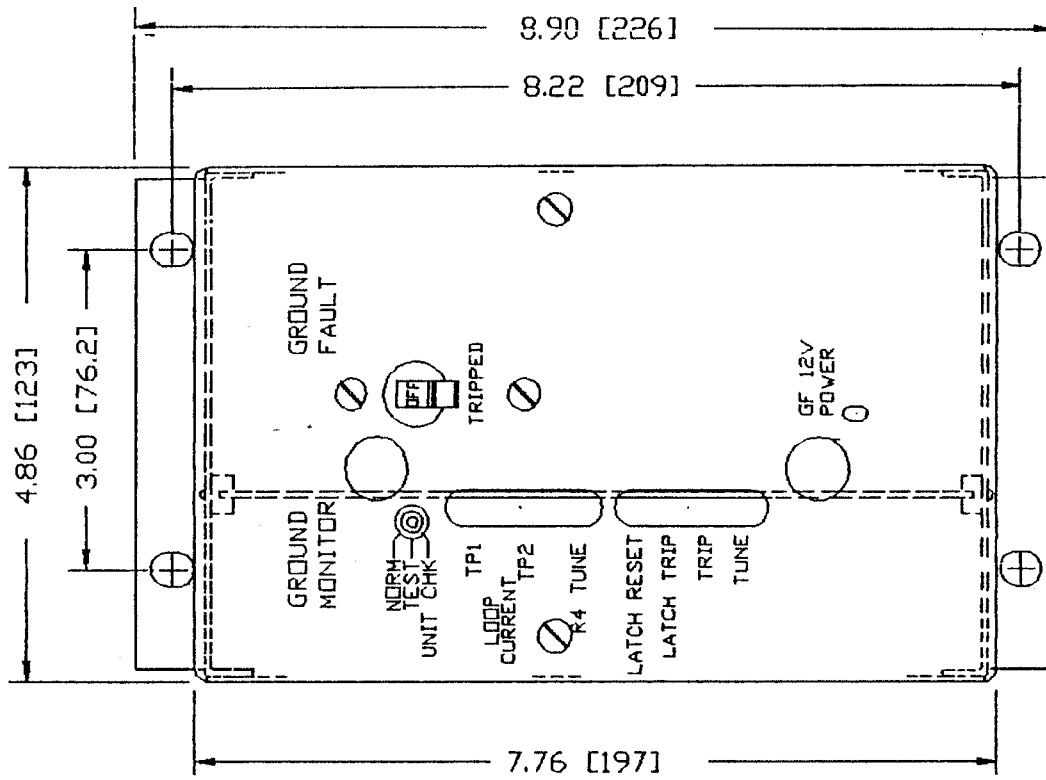
Supply Voltage Dip for one minute  
no trip w/good loop Down to 84V

Supply Current	60 ma with good ground loop 30 ma with 75 ohm ground loop
Supply Transient Rejection	1200V - 117V terminals 2400V - 117V to GW 2400V - 117V to case
Case Ground	Terminal provided
Circuit Isolation	2500V RMS from case
<u>Transmitter</u>	
Frequency	4000, 3125 or 2250 HZ (NOM)
Signal to loop	0.3A RMS $\pm$ 10%
Output Impedance	5 ohms
Withstand indefinite short on output terminals	
Transient Rejection	2400V
<u>Receiver</u>	
Loop Resistance for Trip (over voltage and temperature range)	15 ohms $\pm$ 2 ohms
Trip Time Delay (after loop opened)	250 msec (max)
Instantaneous Trip	Opens relay coil circuit
Loop Resistance for Pickup	13 ohms $\pm$ 2 ohms
Output Short Circuit Trip	0 - 1 ohm
Noise Rejection	Accomplished by filters
Transient Rejection	(same as transmitter)
Relay Contact Rating (UL) Potter & Brumfield T90 N5D12 24V or equivalent	Ind or Res Load 2-20A @12-240VAC N.O. 2-10A @12-240VAC N.C.
Loop Current Indication	YEL LED brightness proportional to loop resistance
Trip Indication	RD LED - on when relay tripped

Trip Flag Indication	RD LED - on after relay tripped until reset
3-Position Test Switch	<ol style="list-style-type: none"> <li>1. Normal position (Maintained)</li> <li>2. Test position (Maintained) - Trip due to 75 ohms inserted.</li> <li>3. Unit check (MOMENTARY) Trip due to shorted output detector.</li> </ol>

GROUND FAULT RELAY

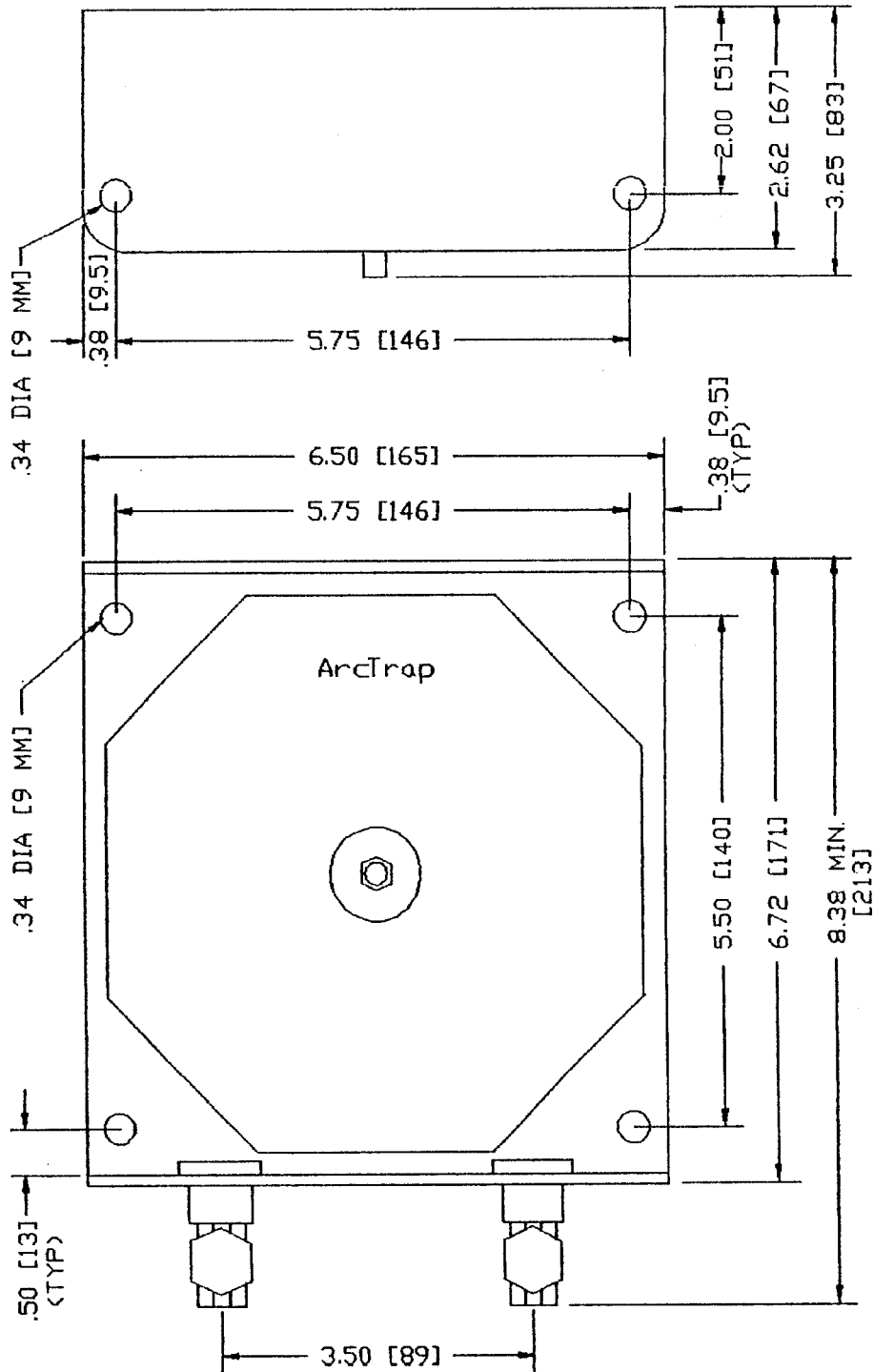
Power	84 - 135 vac
Supply Current	82 ma no fault 168 ma tripped
Trip Current (Jumper select)	5 or 7.5 Amps
Trip Time	2.5 cycles or 41.7 msec nominal
Trip Contact (Internally wired in series/parallel w/Ground Sentinel)	10 Amps, 250 VAC
Trip Indication/Reset	Circuit Breaker Lever
Electronics Power Indicator	LED
Two Current Transformer Window Sizes:	Three 500 MCM conductors with 2 KV insulation and three 1/0 conductions with 2 KV insulation



GM8950/\*\*\*\* OUTLINE

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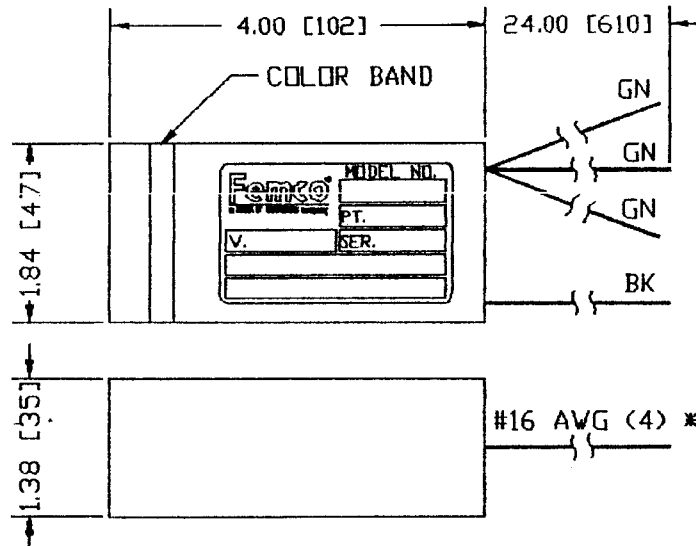


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OUTLINE - GROUND WIRE TRAP (GM1004)

FOR USE IN GROUND WIRES OF CABLES  
WITH 250 MCM OR SMALLER POWER CONDUCTORS

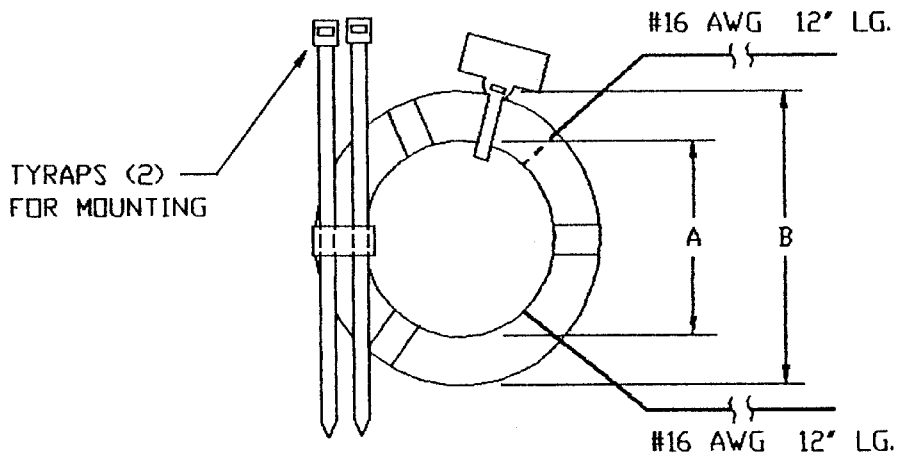
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PART NO.	FI2559	FI2569	FI2567	FI2560*
FREQUENCY	4000 Hz	3125 Hz	2250 Hz	4000 Hz
COLOR BAND	NONE	ORANGE	BLUE	NONE

\* PW FILTER HAS 2 BK LEADS ONLY, USED W/FI2558

OUTLINE-1000 VAC 3 PHASE FILTER & PW FILTER



PART NO.	DIM. A	DIM. B
C04449	1.62 MIN.	3.25 MAX.
C04450	3.12 MIN.	5.00 MAX.

OUTLINE - GF CURRENT TRANSFORMER

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## SECTION 2

Wireless Installation - GM8950/4000 HZ, /3125 HZ (ORANGE),  
or/2250 HZ (BLUE); FI2559 (4000 HZ), FI2569 (3125 HZ) (ORANGE),  
or FI2567 (2250 HZ) (BLUE); GM1004.

- A. GM8950\* System Installation in Power Center (see Page 12)  
Insure that the Ground Fault Relay (GFR) has been strapped  
for the correct trip circuit type (series or shunt) by  
checking the sticker on the front. If not strapped  
correctly, send to an authorized repair shop. Also, verify  
that the correct trip level (5 or 7.5 Amps) has been  
selected by checking the pin jumper on the GFR Printed  
Circuit Board. Pin jumper on E10 and E11 results in 5 amp  
trip and pin jumper on E10 and E13 results in 7.5 amp trip.
1. Prepare a place to mount the GM8950's either inside the  
power center or other enclosure.
  2. Connect terminal 10 of the GM8950 to the power center  
frame ground.
  3. Connect terminals 8 and 9 of the GM8950 to the 117 VAC  
control voltage source.
  4. Connect the instantaneous trip terminals 1 and 4 on the  
GM8950 to the interlock pins on the power center  
receptacle that break connection first when the plug is  
removed. The interlock pins on the plug must be  
jumpered together and must not be connected to any  
other pin or to the plug shell.
  5. Mount the approved filter\* to provide convenient wiring  
to the associated power center receptacle.
  6. Connect terminal 2 on the GM8950 to the GREEN wire of  
the filter. Connect the three BLACK wires of the  
filter to the phase wires on the load side of the  
circuit breaker. Exact phase identification is not  
necessary.
  7. Mount the ARC TRAP to provide convenient wiring to the  
power receptacles.
  8. Connect terminal 3 on the GM8950 to terminal T1 of the  
ARC TRAP.
  9. Connect trap terminal T1 to the power center's  
receptacle isolated ground pin. Connect the other  
terminal of the ARC TRAP to the power center AC ground.
    - a. Insure that the power receptacle's ground pin is  
isolated and not connected to the receptacle  
shell, for it will short circuit the ARC TRAP.

\*CAUTION: THE GM8950 AND FILTER FREQUENCY FOR A EACH CABLE MUST  
MATCH OR THE SYSTEM WILL NOT WORK. COLOR CODE IS: 4000HZ NONE;  
3125HZ ORANGE; AND 2250HZ BLUE.

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- b. Insure that the isolated ground pin on the electrical cable plug is not connected to the plug shell, for it will also short circuit the ARC TRAP.
  - c. Insure that the wire size used in Step 9 is equal to or greater than 1/2 the phase wire size.
  - d. You must ground the shell of plug to the frame of the power center with separate strap equal to or greater than 1/2 size of phase wire.
10. Connect the circuit breaker trip wires to GM8950 terminals 6 and 7.
  11. Pass the three phase wires through the GFR Current Transformer (C.T.) and mount the C.T. with the tyrap provided.
  12. Connect the C.T. output wires to GM8950 terminals 5 and 9 (no polarity).
  13. Mount the GM8950\* in the prepared space. Be sure that the chassis is securely grounded.
  14. Put the TEST switch in the "normal" position.

B. Machine Mounted Filter Installation\*

1. Select a mounting place for the filter\* inside a permissible electrical box on the machine.
2. Connect the GREEN wire of the filter to the machine frame ground under a different bolt than the ground wire.
3. Connect the three BLACK wires of the filter to the three phase wires. This must be wired to the POWER INPUT side of the machine circuit breaker. Exact phase identification is not necessary in connecting the filter.

C. Installation Testing - GM8900 (Set Ground Fault Relay Trip switch ON).

1. Apply power to the power center. If the GM8950 has been installed properly, both red indicators should be OFF and yellow tuning indicator should be ON. All controls have been factory set and do not require field adjustment.

\*CAUTION: THE GM8950 AND FILTER FREQUENCY FOR A EACH CABLE MUST MATCH OR THE SYSTEM WILL NOT WORK. COLOR CODE IS: 4000HZ NONE; 3125HZ ORANGE; AND 2250HZ BLUE.

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2. If neither red indicator is ON, remove power to the load by opening the power center load circuit breaker and disconnect the ground wire. If both red indicators come on, the installation is operating properly. The yellow tuning indicator should be OFF.
3. If both red indicators do not come on, put the TEST switch in the "TEST" position, the yellow tuning indicator should go OFF and the red indicators should come ON. Then hold the TEST switch in the "UNIT CHECK" position. The red trip indicator should go OFF momentarily and come back ON, the yellow tuning indicator will come on momentarily and then go back off. The red latching trip indicator will remain on. Return the TEST switch to the "NORMAL" position. Pushing the "LATCH RESET" button should cause the red latching trip indicator to go off. Operation as above indicates that the GM8950 is operating properly and any problems are a result of a bad cable, secondary ground paths, connector ground pins not isolated from the shell, or improper field wiring.
4. If the above procedure does not result in proper operation, see GM8900 Adjustment Procedure in this manual or refer to the maintenance manual for a detailed troubleshooting guide.

D. Installation Testing - Ground Fault Relay

GM8950 must indicate good ground circuit.

1. Verify that the yellow GFR 12V power LED is lit and the trip switch is on.
2. Connect an appropriate size temporary ground fault to one of the load phase conductors and set the load center breaker. The GFR must trip immediately and trip the load center breaker (if a zero ohm or low resistance fault was connected, GM8900 will also trip).
3. Remove the temporary ground fault and reset the GFR and the load breaker.
4. If the above procedure does not result in proper operation, refer to the Maintenance Manual.

E. GM8900 Adjustment Procedure

1. Adjustment of the GM8900 consists of adjusting the frequency of the transmitter oscillator to the resonant frequency of the filters and stray cable impedance. The reactive components of the circuit impedance are tuned out and the GM8900 monitors circuit resistance.

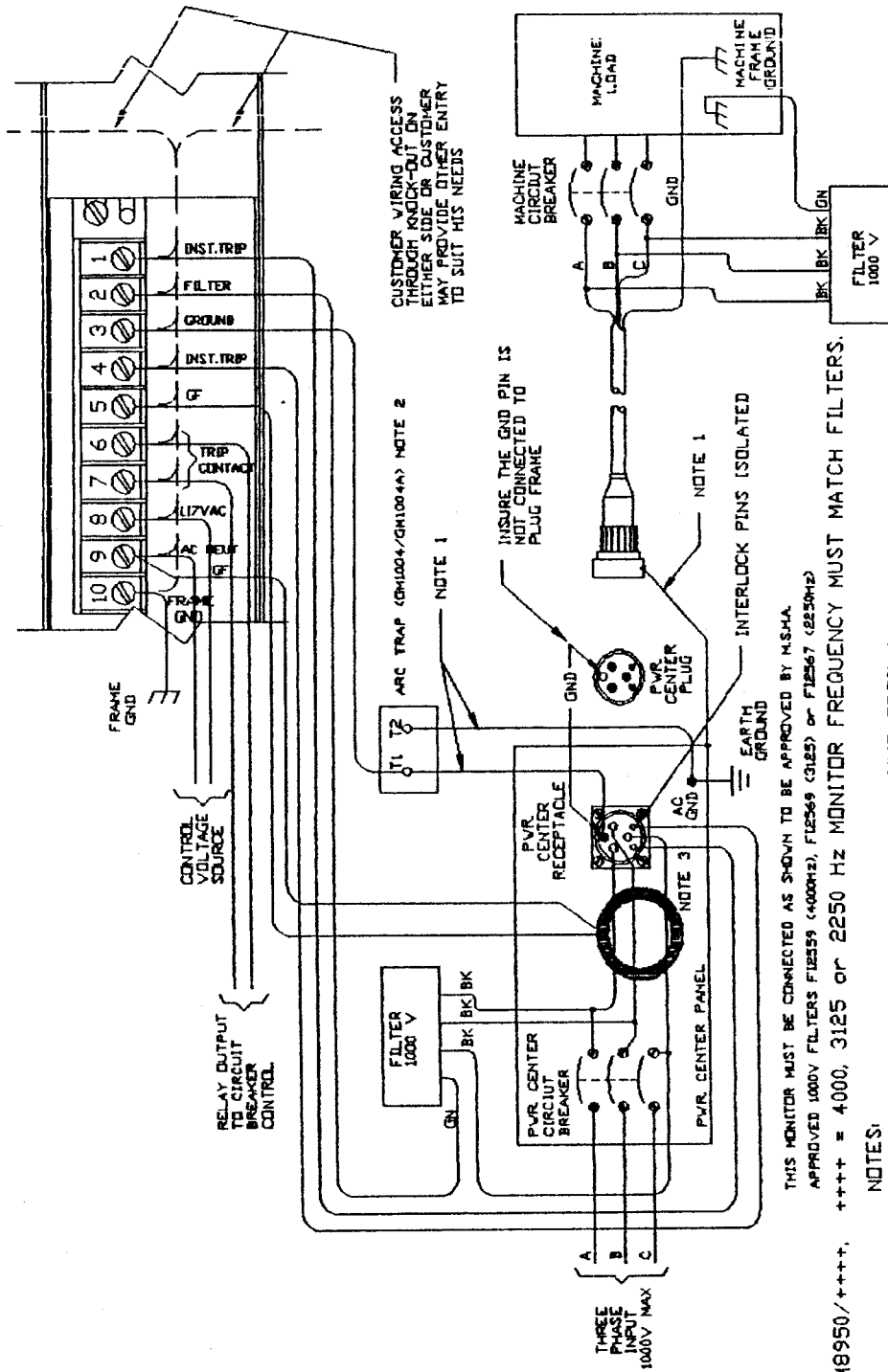
This is accomplished by placing an AC meter in TP1 and TP2 and adjusting R4 for a peak on the meter. This should occur at about 1.2V RMS with a short cable and decrease as the length of the cable monitored increases.

The trip may be checked by adding resistance into the circuit. With no cable (just two filters) the trip resistance is  $15 \pm 2$  ohms.

F. Ground Fault Relay Adjustment Procedure

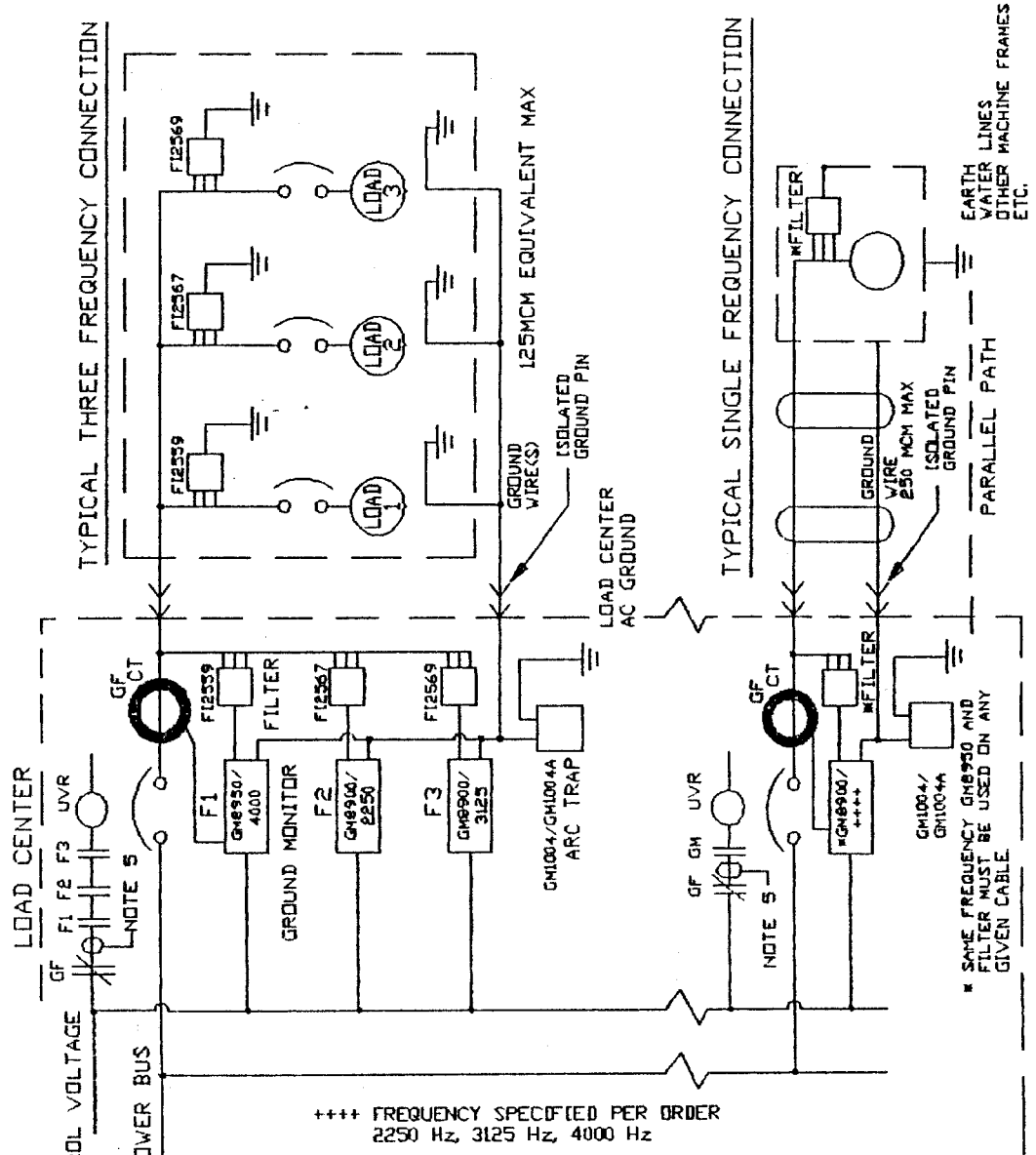
1. The only field adjustment possible on the GFR is made by selecting 5 amp trip (pin jumper on E10 and E11) or 7.5 amp trip (pin jumper on E10 and E13) on the GFR printed circuit board.

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INSTALLATION  
 COMBINED  
 GND MON/GND FAULT  
 GM8950/++++

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++++ FREQUENCY SPECIFIED PER ORDER  
 2250 Hz 3125 Hz 4000 Hz

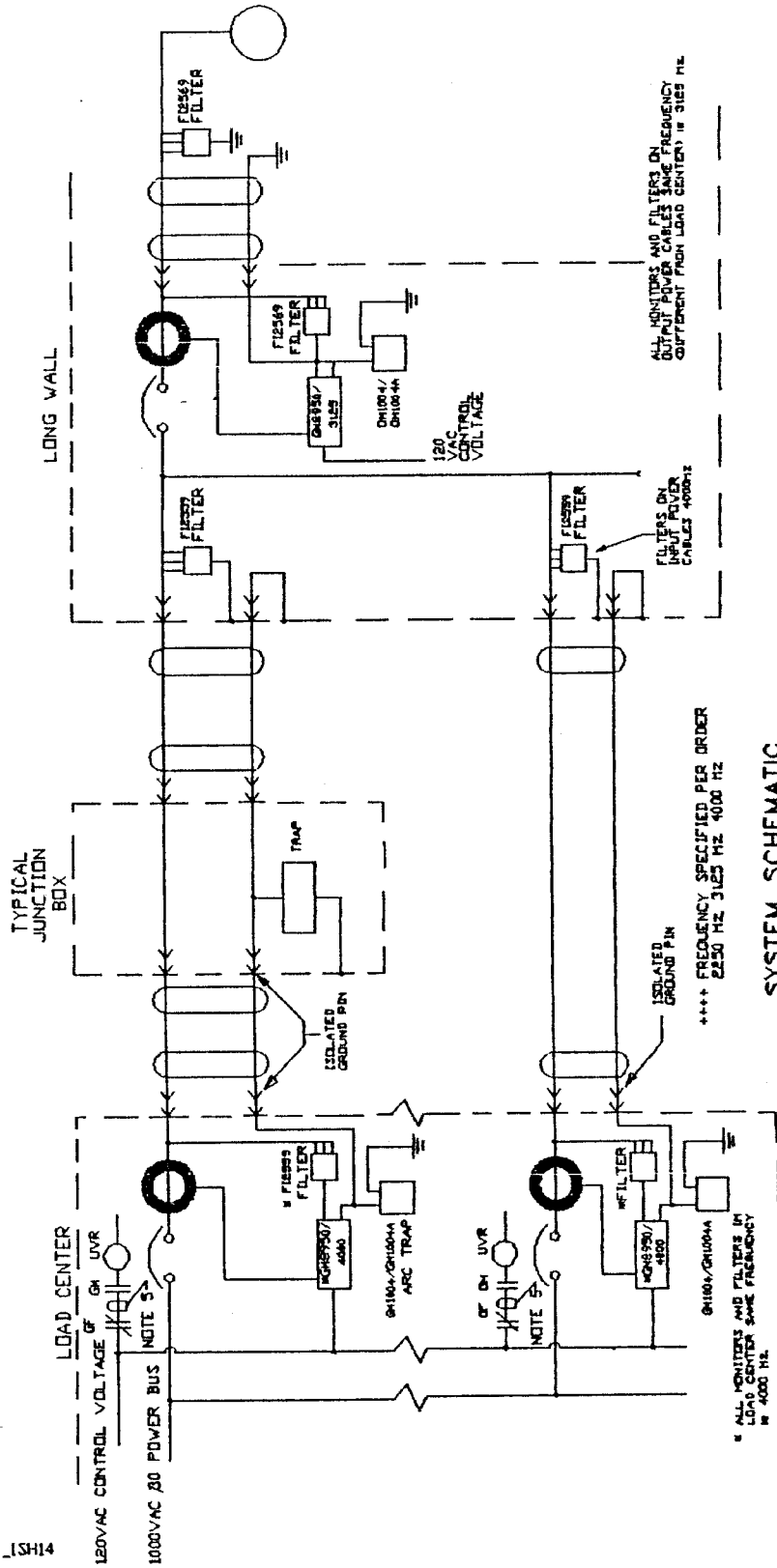
- NOTES:
1. ANY NUMBER OF SINGLE AND MULTIPLE FREQUENCY MONITOR SYSTEMS CAN BE USED ON PARALLEL POWER CIRCUITS DUE TO ARC TRAP ISOLATION. A MAXIMUM OF THREE CAN BE USED IN SERIES IN A POWER CIRCUIT DUE TO ARC TRAP SATURATION DURING A GROUND FAULT.
  2. SERIES TRIP IS DEPICTED BUT SHUNT TRIP IS AVAILABLE.
  3. GM1000, GM6000, GM8000 SYSTEMS INSTALLED IN A PILOT-WIRELESS CONFIGURATION ARE COMPATIBLE WITH THE GM8900/++++.
  4. INTERLOCK PINS ON PLUG AND RECEPTACLE AND GM INSTANTANEOUS TRIP TERMINALS NOT SHOWN.
  5. WIRED INTERNALLY IN GM8950.

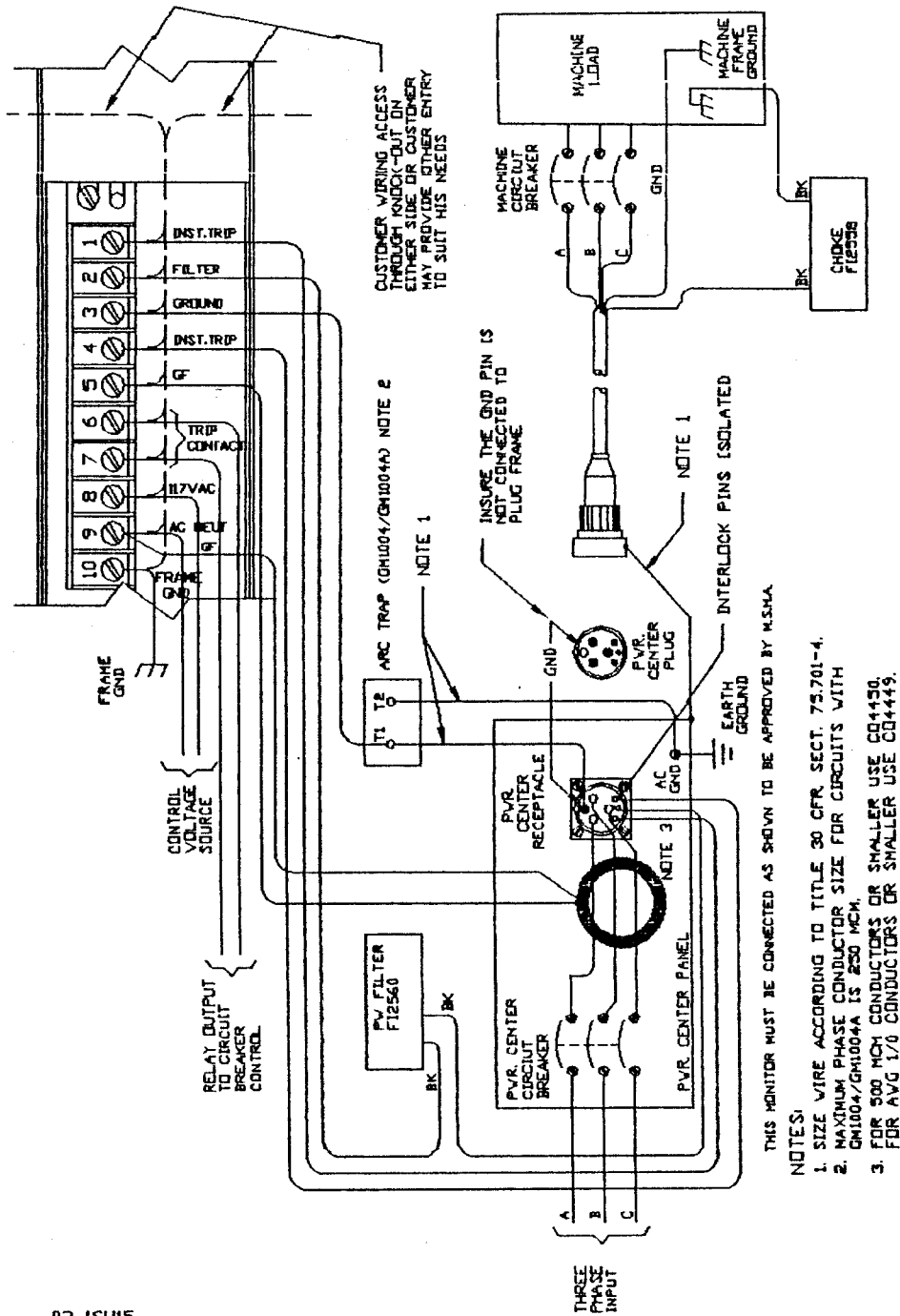
SYSTEM SCHEMATIC  
 COMBINED  
 GND MON/GND FAULT  
 GM8950/++++

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PW INSTALLATION  
 COMBINED  
 GND MON/GND FAULT  
 GM8950/4000

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