

**MAGNE-SONICS
SERIES 200
SINGLE POINT
DETECTION LEVEL SYSTEM**

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PART ONE - INTRODUCTION

SECTION 1- GENERAL INFORMATION

1.1 Description

The Series 200 RF electronic, single-point level detection system can be used in conductive and non-conductive liquids, granular materials, foams, pastes and slurries.

The Series 200 system consists of an electronic switch module housed in an explosion proof cast aluminum enclosure which is integrally mounted onto a level sensing probe. The level probe is constructed of PFA Teflon and 316 stainless steel for use in a wide variety of corrosive and non-corrosive materials.

The Series 200 system contains special shield driver circuitry to ignore the effect of conductive material buildup on the level probe surface. A relay time delay feature prevents chattering in turbulent material. The relay can be field-configured for a low or high level fail-safe operating mode.

1.2 Product Identification

The Serial # of your instrument is located on the electronic chassis next to the power input terminals. Use it as a handy reference when re-ordering. Write the serial # in the space provided below the matrix for convenient identification when technical assistance is required.

Serial # _____

SECTION 2 - SPECIFICATIONS

2.1 Operational

Measurement.....	RF Impedance
Setpoint Range.....	0 to 100pF
Temperature Range.....	-40° to 71°C(-40°to160°F) electronics; probe rated to 232°C(450°F)
Protection.....	RFI, EMI, and designed to pass IEC- 801-2 static discharge test
Spark Protection.....	100 amps
Power Requirements.....	100-137.5 VAC,50/60 Hz; 195-275 VAC, 50/60 Hz available; 24 VDC available, 6VA nominal
Relay Function:	
Output (one relay).....	DPDT, two Form C contacts, 5A resistive @ 115/230 VAC and 30 VDC
Time Delay.....	Adjustable 0 to 30 seconds, field selectable delay on pull-in, drop-out or both ways
Fail-Safe.....	High or low level, field selectable

2.2 Performance

Sensitivity.....	0.1 pF or better
Stability.....	0.01 pF per 24 hrs., non-cumulative
Temperature Drift.....	0.01 pF per °F
Repeatability.....	0.1 pF
Response time.....	100 milliseconds minimum

2.3 Mechanical

Enclosure.....	Cast aluminum w/urethane finish - NEMA 4,7 and 9 (weatherproof, hosedown, dust and vapor explosionproof)
Sensor Wetted Materials.....	316 stainless steel and PFA Teflon construction, rated to 1000 psig
Mounting Configuration.....	Integrally Mounted probe with 3/4 inch male NPT fitting for direct mounting to vessel
Net Weight.....	4.5 lbs. (2.0 kg) approx.

PART TWO - INSTALLATION

SECTION 1 - UNPACKING

After unpacking, carefully unscrew the cover from the base casting and inspect the electronic chassis for shipping damage. If there is any evidence of damage, notify your carrier immediately. Save the small plastic screwdriver and banana plug for later use.

SECTION 2 - MECHANICAL REQUIREMENTS

2.1 Location

Mounting positions for the Series 200 system should be carefully considered. The probe may be installed vertically, horizontally or angled, but should not be located where the inflow of material could contact it as this could cause false or sporadic relay actuation. Side mounted level probes are typically mounted at a downward angle to allow the measured material to drain or fall from the electrode surface. Vertically mounted level probes must be clear of agitators and other obstructions within the vessel. Figure 2-1 illustrates typical mounting locations.

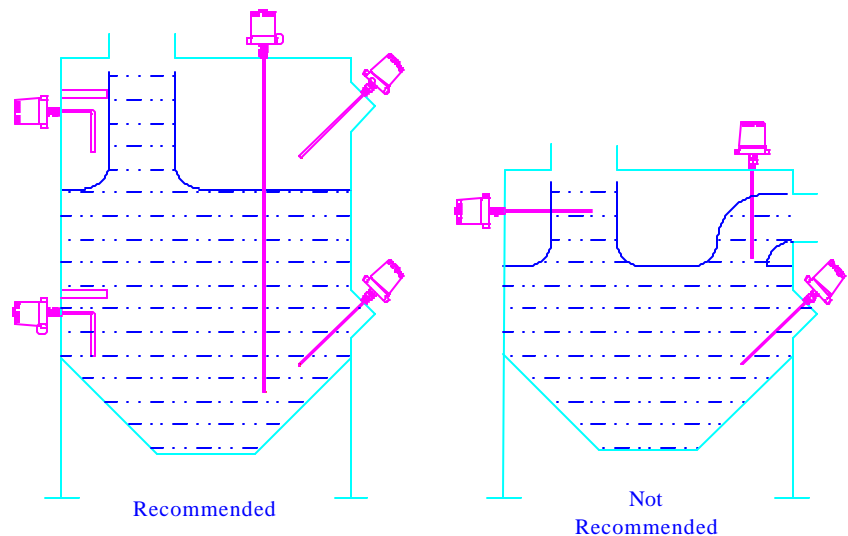


FIGURE 2-1 Typical Mounting Locations

In all cases, avoid mounting locations that would position the level probe in areas where material can build up unevenly. Typically, buildup is caused by material (granulars, powders or

dry solids) filling into the vessel unevenly. If the level probe is contacted by uneven material buildup, the Series 200 will switch at this false point which is not the intended actual level trip point. For vertically mounted probes, the effect of uneven material buildup may be minimized by moving the probe further towards the center of the vessel. For horizontally mounted probes, the end of the "driven shield" element must extend beyond uneven material by at least 1 inch. Figure 2-2 illustrates the mounting arrangements.

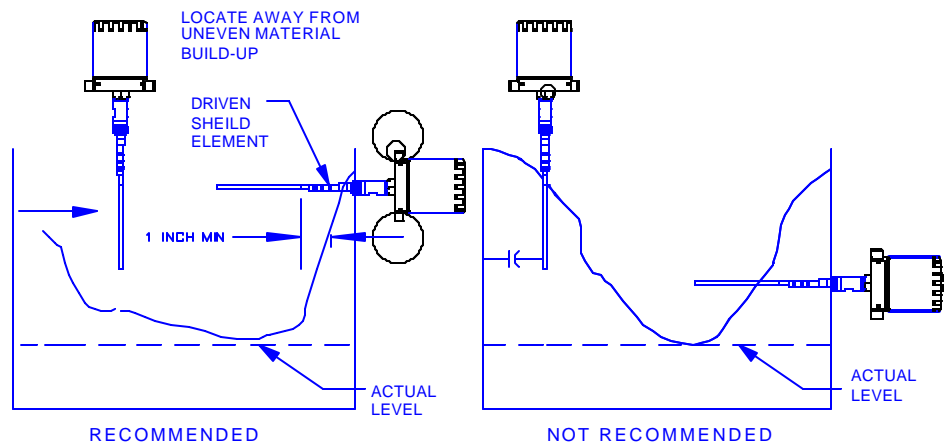


FIGURE 2-2 Probe Location Do's and Don'ts for Applications with Uneven Material Buildup

For applications involving a vessel with non-conductive walls, a ground reference plate or grounded reference electrode is required. However, if the measured material is conductive and effectively grounded is some other way, this is not necessary.

2.2 Mounting

Before installing the Series 200, it is recommended to perform the simple bench test described in Part Three, Section 2 to familiarize yourself with the instrument.

The base of the Series 200 explosion proof enclosure is threaded onto the level probe gland. If necessary, the probe may be removed to aid mounting in tight or confining areas. To do so, grip the large hex nut on the enclosure bottom with a wrench and, using another wrench on the flatted portion of the probe gland, turn the probe counterclockwise (left).

The Series 200 probe has a 3/4 inch NPT thread for mounting to the vessel. Since this bare threaded connection provides a convenient, effective ground for conductive vessels, Teflontape

is not recommended on the threads unless leaking occurs. If tape is used, grounding of conductive vessels must be verified.

NOTE: For non-conductive vessels (fiberglass, etc.) an alternative grounding method must be used.

If the probe was removed from the Series 200 enclosure to mount the probe to the vessel, carefully screw the enclosure onto the back of the level probe gland. The banana plug and spring clip make the necessary electrical connection to the electronic chassis. Screw until tight, but without excessive force to avoid stripping the aluminum threads.

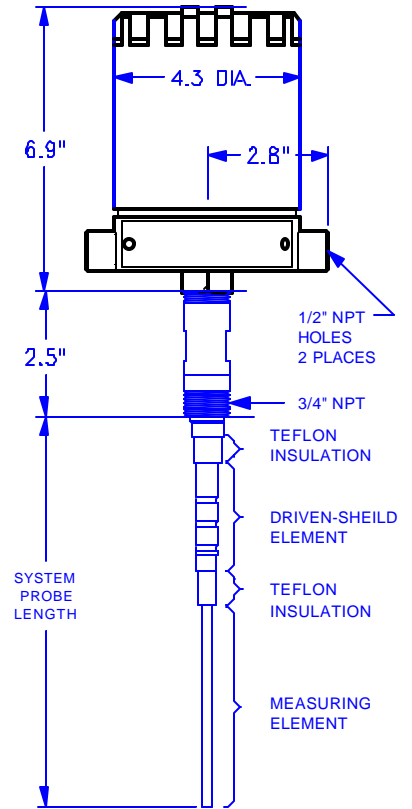


FIGURE 2-3
Mounting Details

SECTION 3 - ELECTRICAL CONNECTIONS

3.1 Relay Outputs

Two sets of relay outputs are provided (Figure 2-4). **They are not powered.**

NOTE: Terminal designations are shown with relay in the de-energized state. This is important and will have an effect on control wiring depending on the fail-safe mode of operation selected (Part Three, Section 1.2).

Always check control wiring to insure that line power will not be shorted by the switching action of the relay contacts.

CAUTION: Do not exceed the relay's contact rating of 5A 115/230 VAC. Use an adequate wire size rated for the load.

3.2 Line Power

Power requirements may be 115 VAC, 230 VAC, or 24 VDC. Insure which voltage is correct for the unit being installed.

AC Powered Series 200's Connect AC line power to N(neutral), HOT and ground symbol terminals (Figure 2-4) which are fuse protected. Wire size of #12 AWG is recommended for primary power and control circuit wiring.

Use wiring practices which conform to local codes (National Electrical Code Handbook in the U.S.A). Use only the standard three-wire connection for AC wiring. The ground terminal grounds the instrument which is mandatory for safe operation.

WARNING:

FOR HAZARDOUS AREA APPLICATIONS, APPROVED WIRING SEAL FITTINGS MUST BE USED IN THE CONDUIT OPENINGS TO PRESERVE THE EXPLOSION PROOF RATING. UNUSED CONDUIT OPENINGS MUST BE SEALED USING A SOLID PIPE PLUG.

DC-Powered Series 200's Connect 24 VDC to the appropriate terminals on TB2, matching polarity as indicated (Figure 2-5)

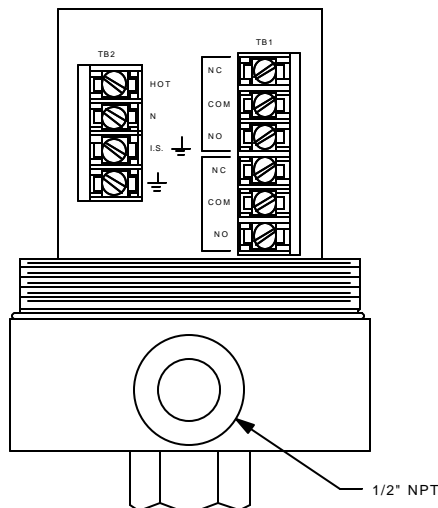


FIGURE 2-4 Hook-up Details For Relay Outputs And AC Line Power

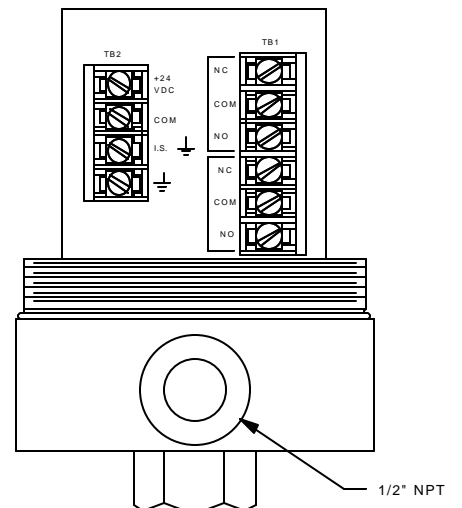


FIGURE 2-5 Hook-up Details For Relay Outputs And DC Line Power

PART THREE - OPERATION

SECTION 1 - OPERATING CONTROLS

All operating controls are clearly marked and accessed by unscrewing the top cover from the enclosure. Use the small plastic screwdriver provided to make control adjustments. Do not force any adjustment past its stops to avoid a breakage.

1.1 Level Setpoint

1. SET POINT control (Figure 3-1)

Sets the level point at which the relay transfers. The range of adjustment is 100 pF in 20 turns.

2. HIGH LEVEL indicator (red LED, Figure 3-1)

Indicates that the relay is in the energized state.

1.2 Fail-Safe Relay Operation

3. FAIL-SAFE switch (Figure 3-1)

HIGH position - Selects relay to be energized when the level is below a horizontally or angle-mounted level probe or is below the setpoint on a vertically-mounted level probe. The relay de-energizes when the level rises above the level probe or setpoint.

NOTE: In the event of power failure or most component failures, the relay would naturally be in the de-energized state. The system, therefore, fails safely. For additional safety, the control contacts of the relay should be wired to a separate power source.

LOW position - Selects relay to be energized when the level rises above a horizontally or angle-mounted level probe or rises above the setpoint on a vertically-mounted level probe.

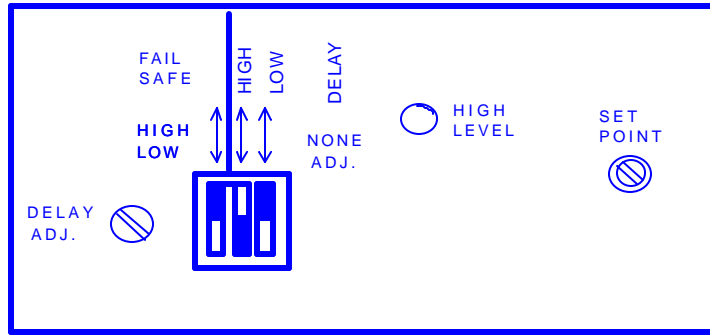


FIGURE 3-1 Control Panel Layout

1.3 Time Delay

4. **HI** and **LO DELAY** switches (Figure 3-1)

These Switches, in conjunction with the **DELAY ADJ** control (item 5), may be used to provide relay time delay to prevent contact chattering or sporadic operation in turbulent materials.

NONE position - Selects relay to operate without time delay.

ADJ. position - Selects relay to operate with a time delay. With **HI DELAY** switch in this position, relay action will occur a preset time after level rises above the level probe or setpoint. With **LO DELAY** switch in this position, relay action will occur a preset time after level falls below the level probe or setpoint. With both switches set to **ADJ.** position, delay will occur both on rising and falling level. The delay time (0-30 seconds), preset with the **DELAY ADJ.** control, is the same for both delay modes.

NOTE: Underlined actions indicate low level fail-safe mode of operation. Opposite relay operation occurs when a high level fail safe mode is selected with **FAIL-SAFE** switch (item 3).

5. **DELAY ADJ.** control (Figure 3-1)

Adjusts relay delay time from 0 to 30 seconds when **HI DELAY** and/or **LO DELAY** switch is in **ADJ.** position.

1.4 Miscellaneous

6. **FUSE** (1/4 amp, located on circuit board)

In-line, circuit board-mounted type fuse is properly rated for the instrument. It should be replaced only with a fuse of the same type and rating. See Part Five, Section 1.1 for

fuse replacement details.

NOTE: The fuse does not protect the relay output control wiring. These circuits and the primary power should be connected through adequately rated circuit breakers.

SECTION 2 - INSTRUMENT START UP (BENCH TEST)

It is recommended to become familiar with the Series 200 before actual installation. Performing these simple steps will accomplish this purpose and, at the same time, test the instrument.

WARNING: IN HAZARDOUS AREA LOCATIONS, IT IS NECESSARY TO OBTAIN PLANT SAFETY DEPARTMENT APPROVAL BEFORE OPENING THE ENCLOSURE CASTING WHILE CIRCUITS ARE POWERED.

2.1 Initial Setup

1. Clamp the larger, upper portion of the level probe gland into a vise if possible. Otherwise, lay the probe on a wooden bench and use some blocks to hold it in a steady position.
2. Place the following controls and switches to these settings:

<u>Control</u>	<u>Setting</u>
SET POINT control	Fully counterclockwise
FAIL-SAFE switch	LOW
HI DELAY switch	NONE
LO DELAY switch	NONE
DELAY ADJ. control	Fully counterclockwise

3. Connect power to appropriately marked terminals. It is not necessary to connect a load to the relay terminals for this test. The **HIGH LEVEL** indicator should be off. If this indicator remains on, it may be necessary to reposition the probe away from any nearby objects on the table.
4. Turn **SET POINT** control clockwise (right) until relay transfers and **HIGH LEVEL** indicator turns on.

5. Turn **SET POINT** control slowly counterclockwise (left) until **HIGH LEVEL** indicator just turns off.
6. Bring your hand to the level probe surface. This simulates l approaching the probe. The **HIGH LEVEL** indicator should turn on.

NOTE: The relay may transfer before actually touching the probe surface. Move your hand back and forth and observe the relay.

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2.2 Adding Relay Time Delay

To add time delay to the relay action:

1. Set **HI DELAY** switch to **ADJ.** position and turn **DELAY ADJ.** control a few degrees clockwise. Repeat step 6 in Section 2.1. Notice that relay action does not occur until some time elapses after bringing your hand to the probe.
2. Return **HI DELAY** switch to **NONE** and set **LO DELAY** switch to **ADJ.** Repeat step 6 in Section 2.1. Notice that relay action does not occur until some time elapses after removing your hand from the probe.
3. Set both **HI** and **LO DELAY** switches to **ADJ.** position and repeat step 6 in Section 2.1. Notice that delay action occurs in both directions.
4. Increase delay time by turning **DELAY ADJ.** control clockwise. The maximum delay is approximately 30 seconds.
5. Reset **HI** and **LO DELAY** switches to **NONE** and return **DELAY ADJ.** control to a fully counterclockwise setting.

2.3 Testing Fail Safe Operation

Set **FAIL-SAFE** switch to **HIGH** position. Notice that the relay logic has reversed: off at high level and on at low level. Return **FAIL-SAFE** switch to **LOW** position.

SECTION 3 - CALIBRATION

3.1 For Non-Conductive Material Applications

With material level below installed level probe:

1. Disconnect relay outputs to prevent actuation of final control elements.
2. Place the following controls and switches to these settings:

<u>Control</u>	<u>Setting</u>
SET POINT control	Fully counterclockwise
FAIL-SAFE switch	LOW*
HI DELAY switch	NONE
LO DELAY switch	NONE
DELAY ADJ. control	Fully counterclockwise

*The calibration steps below apply to low level fail-safe setup. If high level fail-safe operation is desired, the underlined actions are opposite.

3. Apply power to the instrument. The **HIGH LEVEL** indicator should be off. Manually bring the level to the desired control point.
4. Turn **SET POINT** control slowly clockwise (right) until **HIGH LEVEL** indicator just lights. This is the level setpoint. Slowly turn control counterclockwise (left) until the **HIGH LEVEL** indicator just turns off and leave it at this setting.
5. Add time delay to relay action if desired. Set **HI DELAY**, **LO DELAY** or both switches to **ADJ.** position and turn **DELAY ADJ.** control clockwise to increase the delay.
6. Reconnect control device(s) to relay outputs and replace cover on Series 200.

3.2 For Conductive Material

It is not necessary to perform a level setpoint adjustment with the **SET POINT** control when a conductive material is being

Applications

detected. However, the level probe must be properly positioned with respect to the desired level control point.

Horizontally-Mounted Level Probes

A horizontally-mounted level probe must be installed at a height that corresponds to the desired level control point.

Downward Angle-Mounted and Vertically-Mounted Level Probes

The tip of a downward angle-mounted or vertically-mounted level probe must correspond with the desired level control point. If the Series 200 is already installed and the probe tip extends below this point, simply cut off an appropriate length of the measuring element (Figure 2-3) so that the new tip matches the control point. Do not cut insulation material.

CAUTION:

At least 1 inch of measuring element length must remain intact after probe length is cut. If cutting results in less than 1 inch measuring element length, do not cut.

If the sensor measuring element is mistakenly cut too short while attempting to adjust the trip level, the element may be lengthened rather than purchasing a new sensor. This may be accomplished by attaching (using welding or hardware) a metal extension rod onto the end of the bare measuring element. The diameter of the extension rod does not have to be the same diameter as the measuring element.

Conductive Coating Considerations

The Series 200's is not insulated at the lower measuring section and it contains an electronically-driven section. Since the driven section is automatically maintained at the same potential as the measuring section, it tends to block current flow to ground through any conductive coating which may build up on the probe surface. Without this special feature, a conductive coating could provide a short circuit path to ground and force the Series 200 to indicate high level at all time.

Consider the effects of uneven material buildup. See Part Two, Section 2 and Figure 2-2 for details.

If the probe is installed in a pipe extension or nozzle, the insulated portion of the shield element must extend at least 1 inch past the end of the extension or nozzle.

1. It is recommended to manually cycle the level several times

to allow any buildup on the probe to occur before calibration.

2. With material level below the installed level probe, refer to Section 3.1 and perform steps 1 through 5.

PART FOUR - PRINCIPLE OF OPERATION

See Figure 4-1 for a simplified schematic diagram pertaining to these descriptions:

1. The power supply section (not shown) converts line power to appropriate voltages for circuit operation. Also, this section contains special circuitry to allow the bare element of the level probe to be considered intrinsically safe.
2. The level probe oscillator section produces a pulse frequency proportional to the input capacitance. The setpoint oscillator section also produces a pulse frequency, but in proportion to the gain established with the **SET POINT** control.
3. The bridge section adds the level probe and setpoint oscillator inputs and toggles a comparator based on their equality.
4. The output of the comparator is sent to the time delay stage. This stage is selectable integrator (delay high, delay low, or both) which ramps up or down to a trip level when the output of the preceding section goes "high." The ramp time is established by the **DELAY ADJ** control which regulates the integration rate (delay time).
5. The fail-safe section establishes the relay logic for switching. The **FAIL-SAFE** switch selects the relay control signal to be sent directly to the relay or through an inverter stage and then to the relay.

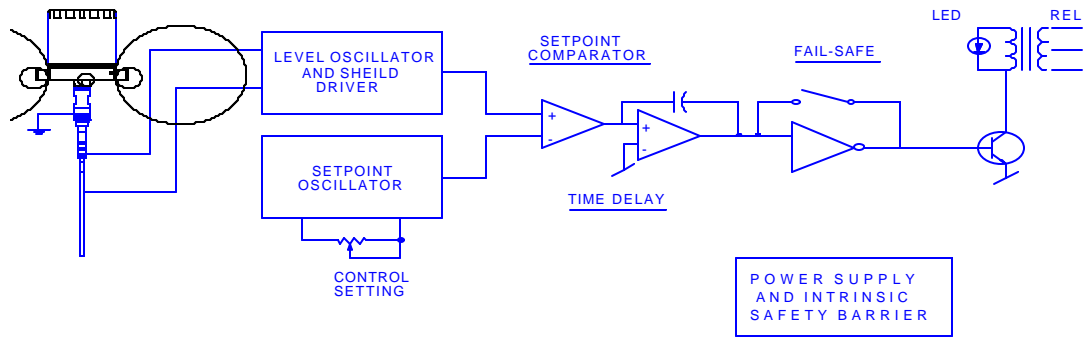


FIGURE 4-1 Instrument Operations Schematic Diagram

PART FIVE - SERVICE & MAINTENANCE

SECTION 1 - GENERAL

The electronic board assembly is held into the enclosure with two screws in the bottom of the assembly. These are accessible from the sides of the assembly.

Replacement of circuit board components should be performed by a qualified technician. Otherwise, return the entire chassis assembly to the factory after obtaining a return authorization. If possible, include a brief description of the trouble symptoms.

In some applications it may be necessary to clean the probe periodically.

1.1 Replacing the Fuse(s)

The Series 200 contains several fuses, two of which are not designed to be replaceable (F01 and F02). These two fuses provide intrinsically safe power to the RF board and should only be replaced by factory personnel. The remaining fuses (number dependant upon power supply option chosen) are line protection fuses which may be replaced.

1. Disconnect line power. Remove electronics module from enclosure base by loosening two screws located in base of module.
2. Once module has been removed, unfasten eight Phillips head screws to disassemble module. Once removed, separate the power supply board (board with terminal strips) from the RF board.

3. Unsolder open fuse (F03 or F04) from backside of power supply board (board with terminal strips) from the RF
 4. Re-assemble module in reverse order and replace into enclosure base.
- 1.2 Replacing the Relay**
1. Disconnect line power. Remove electronics module from enclosure base by loosening two screws located in base of module.
 2. Once module has been removed, unfasten eight Phillips head screws to disassemble module. Once removed, separate the power supply board (board with terminal strips) from the RF board.
 3. Unsolder relay (K01) from backside of power supply board (same side as terminal strips). Replace relay with equivalent relay.
 4. Re-assemble module in reverse order and replace enclosure base.

SECTION 2 - TROUBLESHOOTING

2.1 System Checkout

If the Series 200 is not thought to be operating properly, perform the following simple checks to verify operation:

1. Perform the "bench test" described in Part Three, Section 2 to fully test the instrument.
2. Recalibrate the Series 200 using the procedure in Part Three, Section 3.

If these checks are accomplished, the Series 200 is probably okay but the level probe may be defective. Perform the following checks to find common problems with the level probe:

Check that the banana plug on the back of the level probe is installed and not damaged. This requires

removing the probe from the Series 200 enclosure. Check that the level probe is not shorted to the mounting gland (resistance should be greater than 1 megohm).

NOTE: Do not use Teflon tape or any other pipe sealant on the 3/4-inch NPT threaded lower portion of the mounting gland. This connection must provide a good ground. If tape is used, an alternative grounding method must be used.

2.2 Common Problems The following table lists symptoms and their typical causes to aid correcting common problems:

Table A-TROUBLESHOOTING COMMON PROBLEMS		
Symptom	Typical Cause	Solution
Relay always latched regardless of setpoint position (instrument in LOW FAIL-SAFE).	Probe may be shorted or contacting grounded surface within vessel	Move probe away from shorting surface or perform bench test described in Part Three.
	Conductive material may be bridging between measurement element surface and ground reference, bypassing the driven shield element.	Reposition sensor to avoid the bridge effect from the sensor.
	Conductive measured material level is at probe height.	Lower material level. It is not necessary to calibrate instrument in conductive material applications. Setpoint pot will have no effect.
	Time delay set too high causing relay to appear latched continuously.	Disable time delay during calibration
Relay will not latch when attempting calibration (instrument in LOW FAIL SAFE).	Line fuses blown.	Perform bench test in Section3 to check instrument operation. If faulty fusing is verified, replace as described in Part Five, Section 1.1
	No instrument power.	Check supply to instrument.
	Time delay set too high, causing relay to appear non-functional.	Disable time delay during calibration.
Can establish set-point, but instrument does not respond to level change in vessel.	Banana Plug missing from probe.	Remove probe to install banana plug and reattach probe.
	Probe not firmly attached.	Verify firm probe connection into enclosure base.
	Time delay set too high , causing relay to appear non-fuctional.	Disable time delay during calibration.
	Material level was not actually contacting probe while calibration took place.	Recalibrate with material contacting probe.

Material which was used for calibration is not the material being measured.	Unless the materials are both conductive, they can not be interchanged after calibration. Recalibrate instrument with measured material in vessel.
Poor ground reference established in vessel.	Consult MAGNE-SONIC Application Note L2 for proper grounding techniques.
Probe too short, not adequately contacting measured material.	Reposition sensor or extend measurement element if cut too short. (see Part Three, Section 3.2).

PART SIX - SPARE PARTS & ACCESSORIES

	Description	Part Number
Miscellaneous Parts	Fuse, 1/4 amp. (p.c. board mount type)	E-1065-00
	Relay, 5A contacts, 12 VDC Coil	E-1066-00
Electronic Chassis	115 VAC Operation	E-6402-00
Level Probes	Driven Shield Sensing Element 36 inches long - w/banana plug connector	E-6403-00
	Spare Banana Plug Connector	E-1081-00