GE Energy Management

LTC MAP™

Maintenance Action Planner

LTC-MAP 2130 Monitor Product Manual

Part No. 70055MP
Rev. D, February 3, 2000

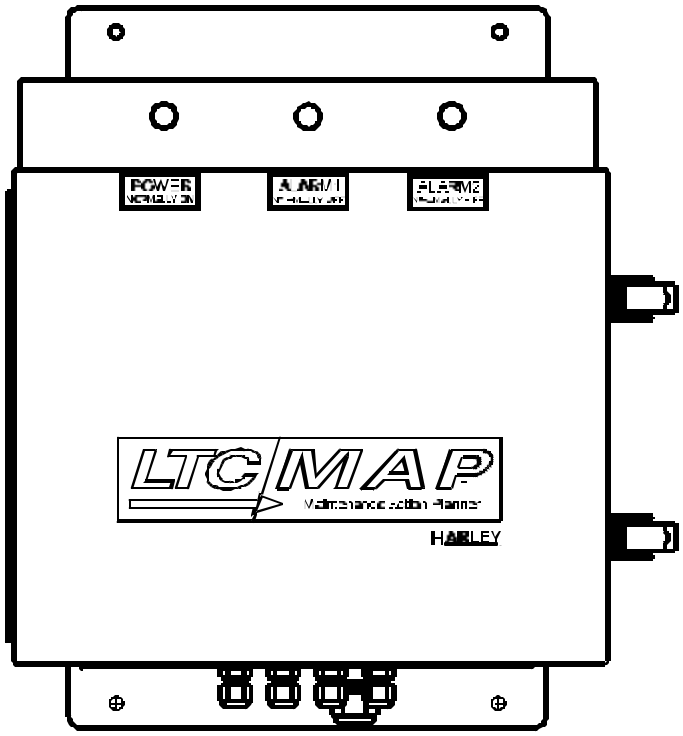
HARLEY™

GE Energy Management

LTC-MAP 2130 Monitor

Maintenance Action Planner Monitoring System

Product Manual



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Revision History

Revision	Release Date
1.0	November 14, 1997
1.1	January 26, 1998
B	July 6, 1998, July 19,1999
C	October 14, 1999
D	February 3, 2000

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Section 1: Introduction

Product Overview

The LTC-MAP 2130 Monitor (Figure 1-1) is an on-line maintenance action planner (MAP) for load tap changers (LTC). It continuously monitors performance data from various types of sensors, such as temperature and current. It stores this data in non-volatile memory for downloading to a personal computer.

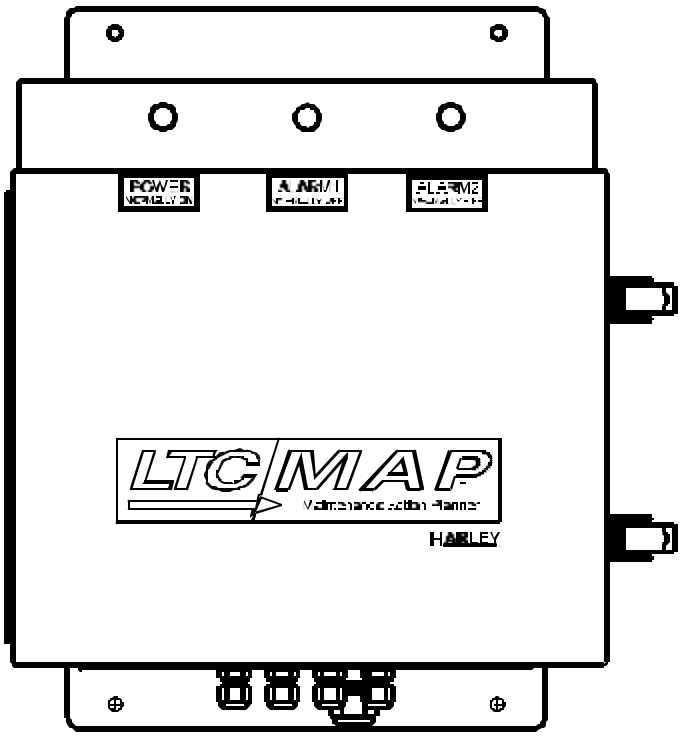


Figure 1-1: LTC-MAP 2130 Monitor

LTC-MAP 2130 Monitor is a multi-input data storage and analysis system. Each system features:

- Seventeen (17) analog input channels.
- Sixteen (16) digital input channels (via optional Control Isolator).
- One (1) serial port/modem line.
- Two annunciator relay outputs (form C contacts).

LTC-MAP 2130 uses state of the art technology to process, analyze, and store data into a configurable profile. A built-in microprocessor compares, computes, and relates stored data to set parameters. Alarms are generated when data levels exceed the set parameters.

NOTE: Parameters are set via the SAGE™ host software package. Refer to the SAGE™ Product Manual, Part No. 70057MP, for details on parameter configuration and data retrieval and analysis.

Data profiles and alarm events are stored in non-volatile random-access memory. The stored information is then downloaded to a personal computer, either directly through the serial port or via an optional modem. The SAGE™ host software package allows data retrieval and analysis.

Specifications

Input

Analog	Seventeen (17) channels. Channels 1 - 7 Input: 4 to 20 mA. Sample rate: 150 Hz. Channel 8 Input: ±10 VDC. Sample rate: 150 Hz. Channels 9-11 Configurable input: • 4 to 20 mA with a sample rate of 150 Hz, or • 5A AC (as monitored by a CT) with a sample rate of 1920 Hz. Channel 12 Configurable input: • 4 to 20 mA with a sample rate of 150 Hz, or • 50A AC (as monitored by a CT) with a sample rate of 1920 Hz. Channels 13-16 Configurable input: • 4 to 20 mA with a sample rate of 150 Hz, or • 120/240 VAC with a sample rate of 1920 Hz. Channel 17 Configurable input: • 4 to 20 mA with a sample rate of 150 Hz, or • Signal conditioned with a sample rate of 1920 Hz.
Digital	Sixteen channels via two optional control isolators (eight channels each). Input: ±120/240 VAC. Sample rate: 960z.

General

Relay Outputs	Two dry-contact relay outputs for alarm indication.
Front Panel Indicators	Three LEDs: **POWER:** When lit, indicates that the monitor is receiving power. **ALARM1:** When lit, indicates that a software configurable alarm has been activated; contact relay driven. **ALARM2:** When lit, indicates that a software configurable alarm has been activated; contact relay driven.
Display	Front panel four line liquid crystal (LCD). Resolution: 1 V, 1 A, 1 °C.
Communications	Standard: RS-232-C serial port; DB-9 connector. Optional: 14.4k bps modem, installed on the back left side of the monitor base.
Data Storage	Type: Non-volatile, solid state RAM. Capacity: Up to 128 K, based on configuration. Mode: Revolving loop. Averaging Interval: Configurable from 1 to 60 minutes.
Controls	Three front panel push buttons: **Operating Conditions:** Used to display present operating conditions. **Alarm Status & Settings**: Used to display present alarm status. **Acknowledge Alarm:** Used to deactivate alarm relays. One CPU Board mounted push button: **SETUP:** Used to initiate setup procedure for tap position calibrations.
Installation Category	III.
Maintenance	No regular maintenance is required.
Cleaning	No regular cleaning is required.
Intermittent Operation	No specific limit; however, intermittent operation is undesirable and should be corrected as soon as possible.

Electrical

Sensor Power Supply	24 VDC @ 0.65A.
Power Input Protection	Fused (F1) Type: AGC3 instant blow. Rating: 3A @ 250 V.
Power Input (Electrical Rating)	AC: Standard: 120 VAC +10/-15%AC, 50 - 60 Hz. Optional (factory set): 240 VAC +10/-15%AC, 50 - 60 Hz. DC: 125 VDC ±15%DC. **NOTE:** Monitors supplied with internal heater option must have AC power input.
Power Consumption	Less than 16VA.
Supply Voltage Fluctuation	Mains supply voltage must not exceed ±10% of nominal supply voltage.

Environmental

Operating Temperature Range	Standard: 0°C to +60 °C (+32°F to +140 °F). With Heater Option: -40°C to +60 °C (-40°F to +140 °F).
Pollution Degree	4.
Maximum Relative Humidity	80%.
Maximum Altitude	2000m.

Physical Enclosure

Material	Stainless steel, weather-proof.
Standard	NEMA Type 4.
Dimensions	12” (305 mm) x 12” (305 mm) x 6” (152 mm).
Weight	18 lbs. (8.16 kg); additional weight for accessories.

NOTE: *Specifications subject to change without notice.*

Available Options

Available options for the LTC-MAP 2130 are listed in Table 1-1. Refer to the applicable documentation for detailed information on the available options.

Table 1-1: LTC-MAP 2130 Options

Option	Part No.	Description/Function
Magnetic Mount RTD Temperature Sensor	30000MP	Attaches magnetically to the transformer; has a built-in 4-20 ma transmitter. Refer to Document No. 70063MP for more information.
RTD Transmitter	T821028	Connects to an insertion-type temperature sensor and transmits a 4-20 mA signal back to the monitor. Refer to Document No. 70064MP for more information.
Clamp-On AC Current (CT) Sensor	T821026	Clips onto a transformer lead and detects load current. Refer to Document No. 70059MP for more information.
Control Isolator	40041MP	Optically isolates the monitoring system from the transformer controls. Refer to Document No. 70062MP for more information.
Combustible Gas Sensor	10384MP	Measures hydrogen and hydrocarbon levels in the insulating oil.
Moisture Sensor	T801074	Measures moisture levels in the insulating oil. Refer to Document No. 70065MP for more information.
Eight Line Phone Multiplexer	40047MPA	Allows up to eight monitors (with installed modems) to be connected to a single phone line for data transmission. Refer to Document No. 70061MP for more information.
Fifteen Line Phone Multiplexer	40047MPB	Allows up to fifteen monitors (with installed modems) to be connected to a single phone line for data transmission. Refer to Document No. 70061MP for more information.
14.4k bps Modem	20046MP	Installed in the monitor; allows transfer of data and configuration parameters over a telephone line to an off-site PC. Refer to Document No. 70058MP for more information.
SAGE™ Host Software Package	SAGE™	Provides tools for parameter configuration, parameter calibration, data retrieval, and data analysis. Refer to Document No. 70057MP for more information.

Typical Application

A transformer utilizing an LTC-MAP 2130 monitor is illustrated in Figure 1-2. The monitor is mounted on the transformer. Analog sensors mounted on the transformer are connected to the monitor. Refer to the example typical wiring diagram in Section 3 to determine specific sensor input connections.

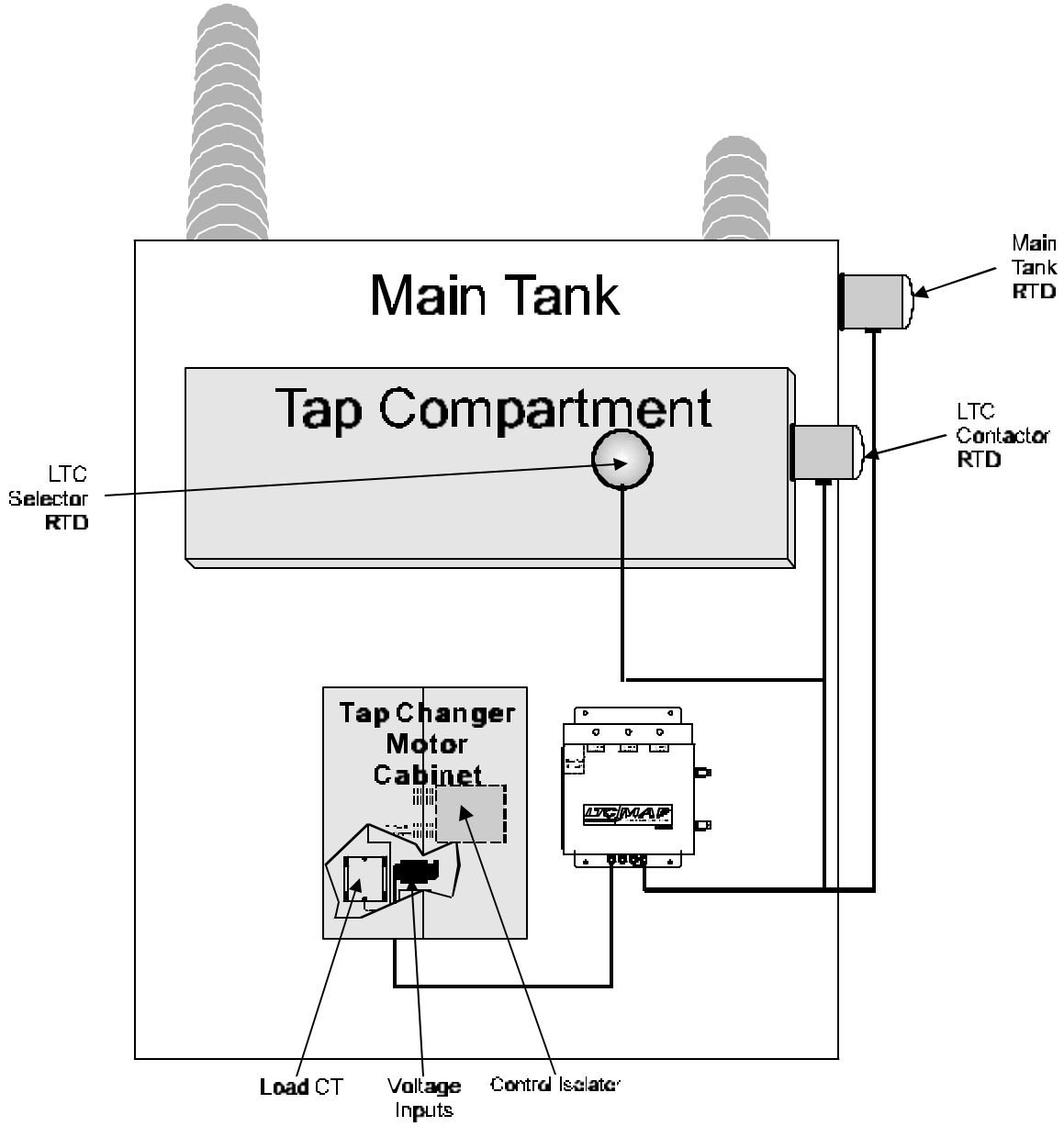


Figure 1-2: Typical LTC-MAP 2130 Application

A typical system may include several monitors, one for each transformer at the site, multiplexed together. The multiplexer is typically located at the on-site substation. (See Figure 1-3). Data from all monitors on site may then be downloaded to a remote personal computer (PC). SAGE™ host software installed on the PC allows for data retrieval and analysis.

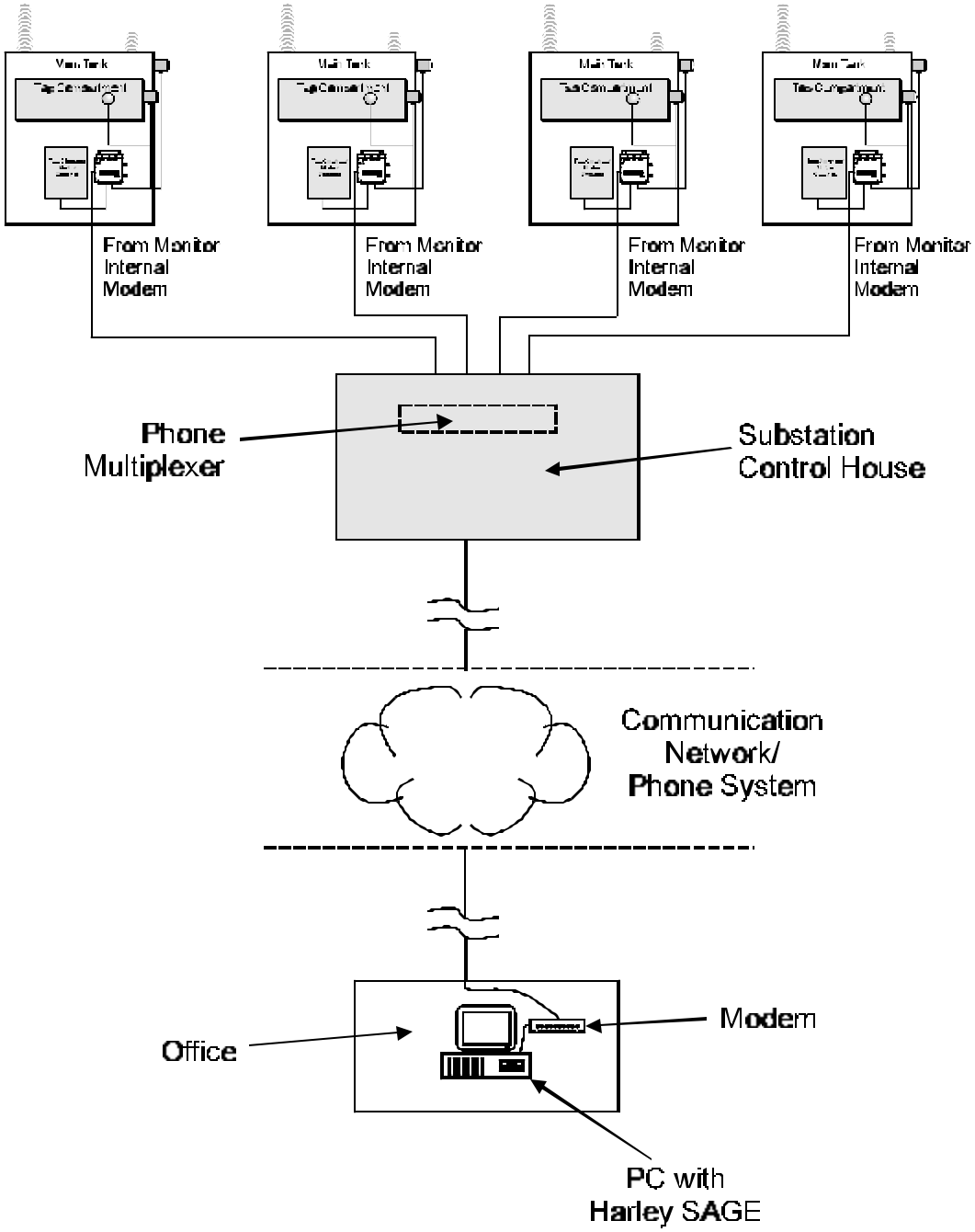


Figure 1-3: Typical System

Manual Conventions

This manual provides the information you will need to install, operate, and maintain the LTC-MAP 2130 Monitor.

Throughout this manual **CAUTIONS, WARNINGS,** and **NOTES** are provided.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNING: Indicates a potentially hazardous situation which, if not avoided, may result in death or serious injury.

NOTE: Contains supplemental information.

Section 2: Getting Started

Receiving Inspection

On receipt of the LTC-MAP 2130 Monitor:

1. Carefully inspect the packing containers and contents for physical damage.
2. Carefully unpack the monitor, checking that all items listed on the packing slip are present and in good condition.

NOTE: If damage is evident, or any items are missing, contact Support Services at (330-425-3755) for further instructions.

Customer Support/Service

For service or support for your LTC-MAP 2130 Monitor, contact:

Field Service/Customer Support Department

Reuter-Stokes, Inc.
Edison Park
8499 Darrow Rd.
Twinsburg, OH 44087
PH: 330-425-3755
FAX: 330-425-1812

GE Syprotec
179 Boulevard Brunswick
Pointe-Claire, Quebec H9R 5N2
Canada
PH: 514-694-3637
FAX: 514-694-9245

www.gepower.com

Front Cover Layout

There are three indicator lights on the front cover of the LTC-MAP 2130 Monitor (see Figure 2-1):

- The yellow **POWER** indicator illuminates whenever the monitor is receiving power.
- The red **ALARM1** indicator illuminates whenever a configured contact relay alarm is activated.
- The red **ALARM2** indicator illuminates whenever a configured contact relay alarm is activated.

The fasteners on the right side of the front cover allow access to the inside face panel of the monitor.

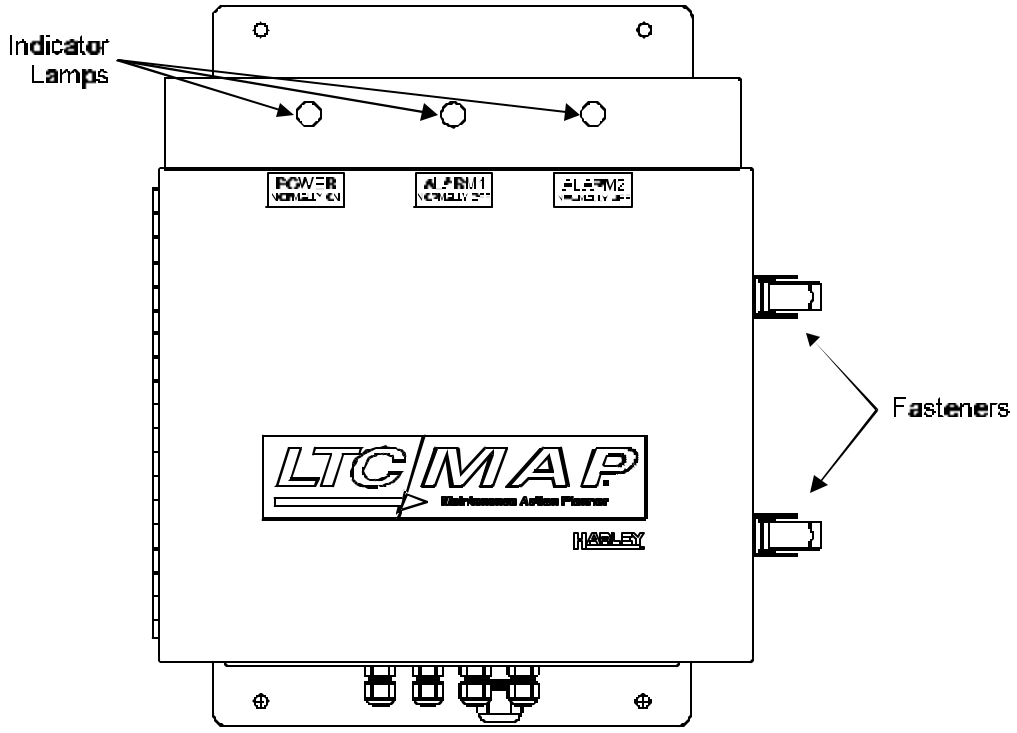


Figure 2-1: LTC-MAP 2130 Monitor (Front Cover)

Face Panel Layout

The face panel is accessed by releasing the fasteners on the right side of the front cover. The front panel features (see Figure 2-2):

- A four-line LCD display.
- **Operating Conditions** button.
- **Alarm Status & Settings** button.
- **Acknowledge Alarm** button.
- A serial port.

Present operating conditions, alarm settings, and alarm status may be viewed on the display by pressing the appropriate buttons.

The serial port allows direct connection, utilizing a null modem cable, between the LTC-MAP 2130 and a portable computer for data transfer.

NOTE: A null modem cable is available from Reuter-Stokes (Part No. 10101MP).

The two thumb screws on the right side of the face panel provide access to the CPU and I/O circuit boards.

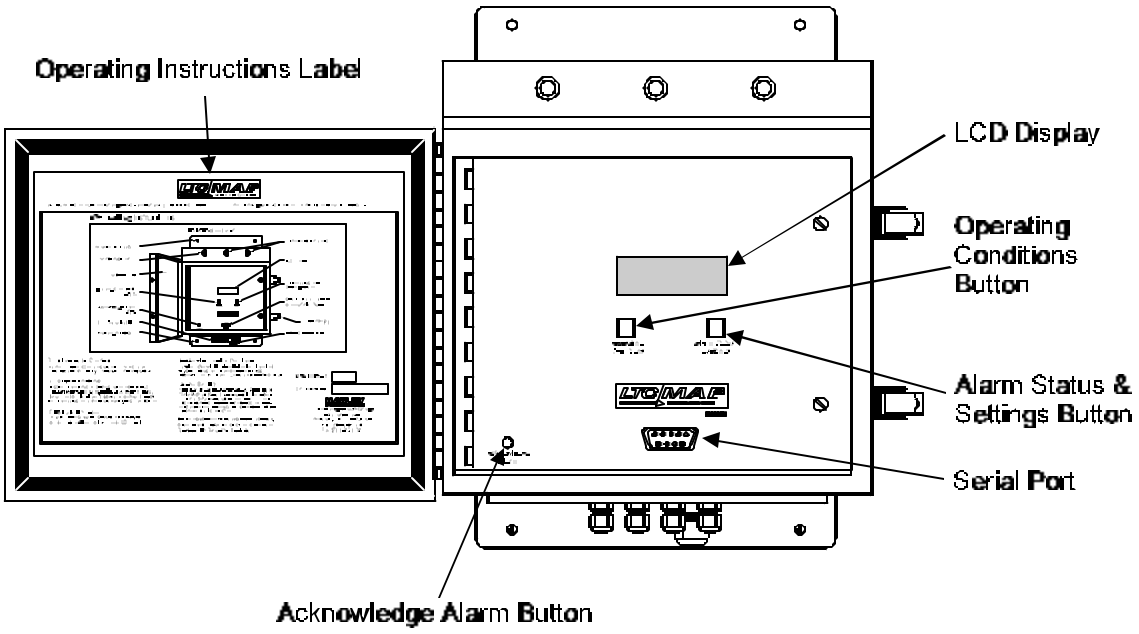


Figure 2-2: LTC-MAP 2130 Monitor (Face Panel)

Operating Conditions Button

The **Operating Conditions** button is located directly below and left aligned with the display. Pressing the **Operating Conditions** button displays the sensor value readings. Four channels are displayed simultaneously. The display includes:

- Channel number.
- Channel name.
- Present reading.
- Units.

After all sensor screens are displayed, pressing the **Operating Conditions** button again displays the tap change summary screen.

During tap position calibration, the **Operating Conditions** button is used to adjust settings.

Alarm Status & Settings Button

The **Alarm Status & Settings** button is located directly below and right aligned with the display. Pressing **Alarm Status & Settings** displays the monitor status and the date and time. If there are alarm conditions, pressing **Alarm Status & Settings** scrolls through descriptions of alarm conditions.

During tap position calibration, the **Alarm Status & Settings** button is used to adjust settings.

Acknowledge Alarm Button

The **Acknowledge Alarm** button is located in the lower left corner of the face panel. Pressing **Acknowledge Alarm resets** the alarm relay; however, the indicator remains lit for the duration of the alarm condition.

LCD Display

The LCD is a 20 character by 4 line display (Figure 2-3). It displays operating and status conditions. Screens are scrolled through using the **Operating Conditions** and **Alarm Status & Settings** buttons.

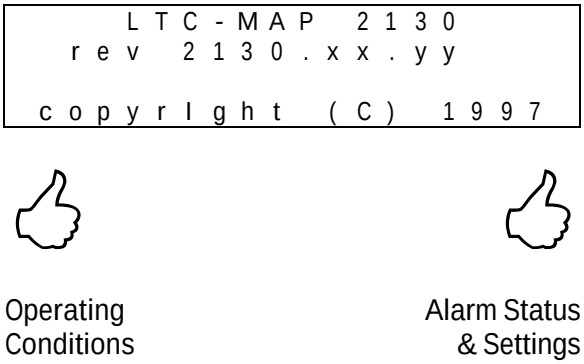


Figure 2-3: Display with Control Buttons

Serial Port

CAUTION: The serial port and the modem cannot function simultaneously. When using the serial port for communications, the internal modem (if installed) must be disconnected at JP8; otherwise the serial port will not function.

The serial port is a 9-pin male DB-9 connector. This port allows direct connection, utilizing a null modem cable, between the LTC-MAP 2130 and a portable computer for data transfer. Data transfer rate is 19.2 kbps.

The serial port does not support dumb terminal operation. In order for communications to take place:

- A null modem cable must be installed between the monitor serial port and personal computer serial port.
- SAGE™ host software must be installed on the personal computer.

NOTE: A null modem cable is available (Part No. 10101MP).

Circuit Board Location

The CPU and I/O circuit boards are accessed by loosening the two thumb screws on the right side of the face panel (see Figure 2-4).

The CPU circuit board is mounted to the back side of the face panel.

The I/O Circuit board is mounted to the inside rear panel of the Monitor cabinet. The Power Supply board is mounted on the I/O Circuit board.

A ribbon cable connects the CPU and I/O circuit boards.

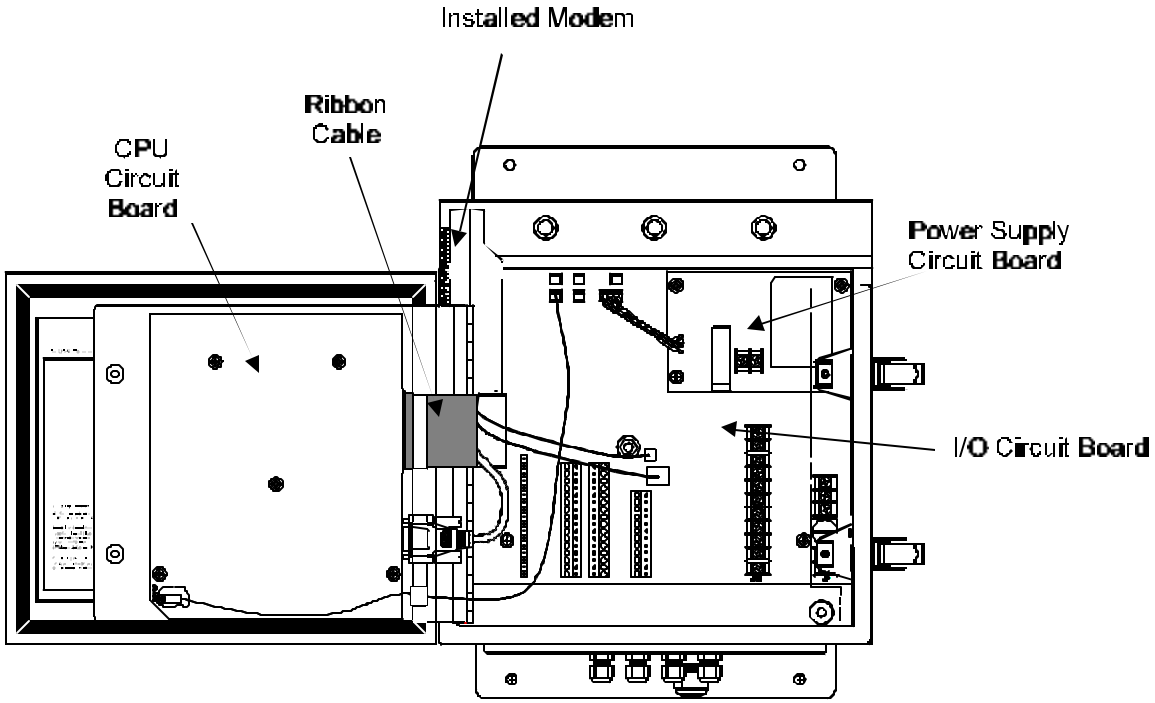


Figure 2-4: LTC-MAP 2130 (Top View with Face Panel Open)

I/O Board

The I/O Circuit board (Figure 2-5) contains sensor signal conditioning circuitry and hardware to interface to the sensors mounted on the transformer.

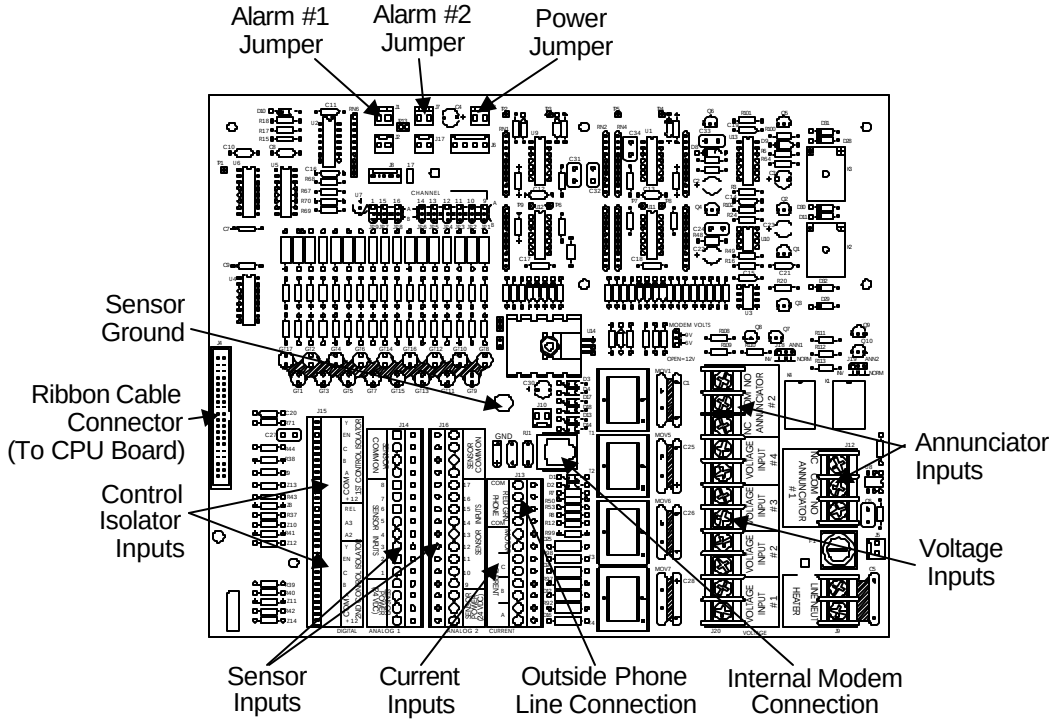


Figure 2-5: I/O Circuit Board

Power Supply Board

The Power Supply circuit board (Figure 2-6) contains the low voltage supplies, incoming power terminals, and the power fuse (F1) for the monitor. F1 is a type AGC3 fuse, rated for 3 Amp at 250 V.

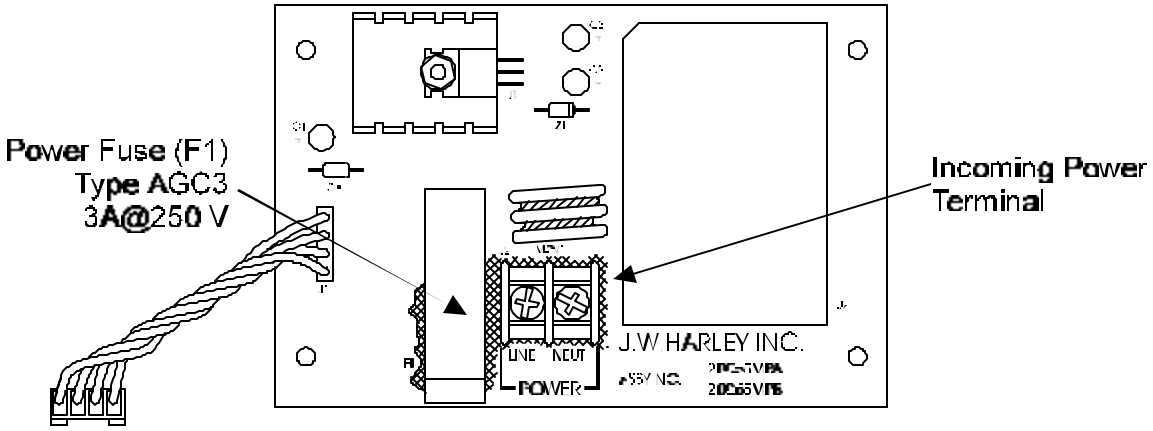


Figure 2-6: Power Supply Circuit Board

CPU Board

The CPU circuit board (Figure 2-7) contains the microprocessor (CPU), LCD Display, front panel buttons, and serial port.

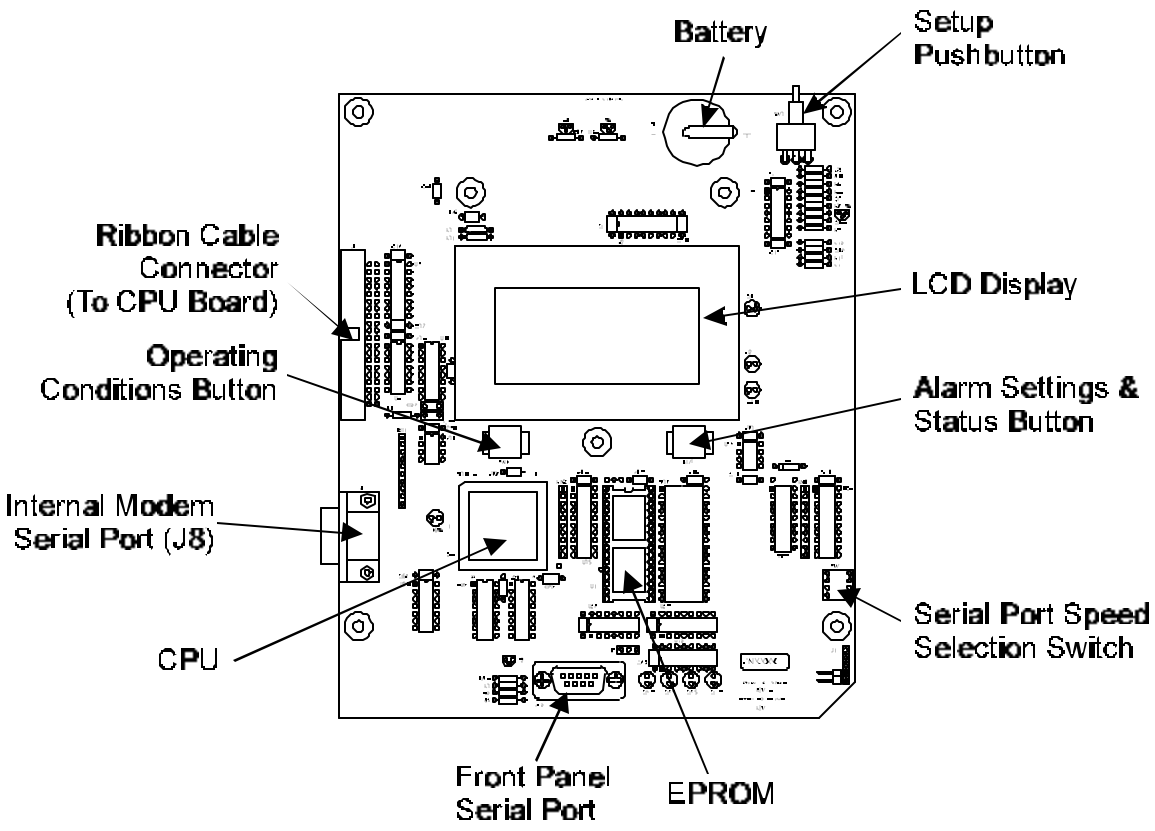


Figure 2-7: CPU Circuit Board

Communications

The SAGE™ host software installed on a personal computer allows for data retrieval and analysis. Communications with the LTC-MAP 2130 must be established in order to download data to the PC or upload configuration information to the terminal. Communication between the PC and the monitor can be established:

- Directly via the front panel serial port and a null modem cable to a personal computer running the SAGE™ host software.

NOTE: SAGE™ host software must be installed on the PC for proper communication to take place. The front panel serial port does not support dumb terminal operation.

- Over phone lines using an optional modem installed inside the monitor.
- Over phone lines via a phone multiplexer installed in the control house and connected to several LTC-MAP 2130 monitors. Refer to Document No. 70061MP for detailed information on the phone multiplexers available from Reuter-Stokes, Inc.

CAUTION: The serial port and the modem cannot function simultaneously. When using the serial port for communications, the internal modem (if installed) must be disconnected at J8; otherwise the serial port will not function.

Section 3: Installation

This Section includes procedures for installation, configuration, wiring, setting up communications, and initial start-up of the LTC-MAP 2130 Monitor.

Selecting a Location

The LTC-MAP 2130 is enclosed in a weatherproof stainless steel box that can be mounted indoors or outdoors. When selecting a mounting location for the monitor, verify that:

- The mounting surface is able to support a minimum of 25 pounds (11.3 kg).
- The mounting surface allows ample space for mounting the stainless steel box and allows for a 12-inch (305 mm) door clearance (see Figure 3-1).
- Sensors are located nearby to minimize cable length.
- Wiring and cables can access the monitor gland plate.
- The face panel display is at a readable level.
- An operating temperature of 0 ºC to +60 ºC (+32 ºF to +140 ºF) can be maintained at the monitor location.

  NOTE: With the heater option installed, an operating temperature of -40 ºC to +º60 C (-40 ºF to +140 ºF) must be maintained at the monitor location.

CAUTION: Select a mounting location that assures an operating temperature of 0 ºC to +60 ºC (+32 ºF to +140 ºF), otherwise system operation could be interrupted.

Mounting the Monitor

Secure the monitor to the selected location using four ¼-20# stainless steels bolts through the mounting holes (see Figure 3-1).

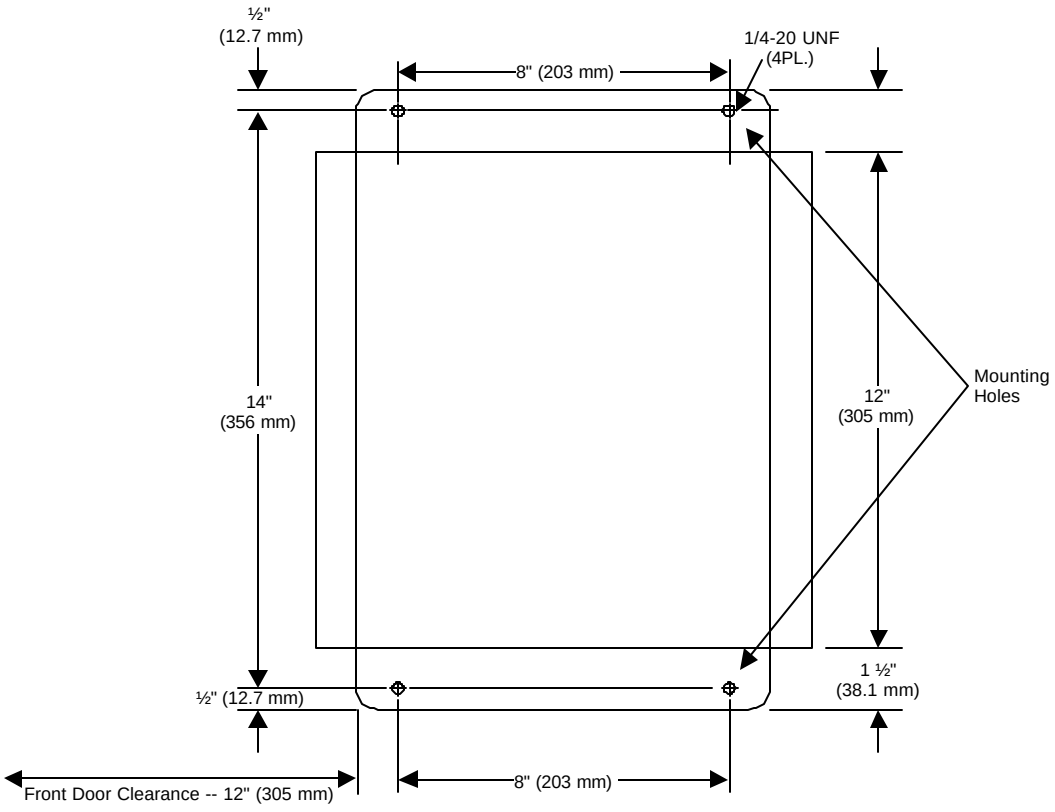


Figure 3-1: LTC-MAP 2130 Monitor Mounting Dimensions

Cable Installation

After securely mounting the LTC-MAP 2130 monitor, route the input and output cables back to the gland plate.

CAUTION: Do not apply power to the LTC-MAP 2130 until all input and output cables are connected.

The removable gland plate on the bottom of the LTC-MAP 2130 Monitor has pre-punched conduit holes (see Figure 3-2) and strain relief cable connectors. Weep holes are provided to allow drainage of excess moisture.

Additional holes can be drilled into the gland plate if required. Remove the plate by removing the two nuts and washers securing it to the monitor. The nuts are accessed from inside the monitor.

CAUTION: Do not drill additional holes into the gland plate while it is installed on the monitor. Metal chips can damage the circuit boards.

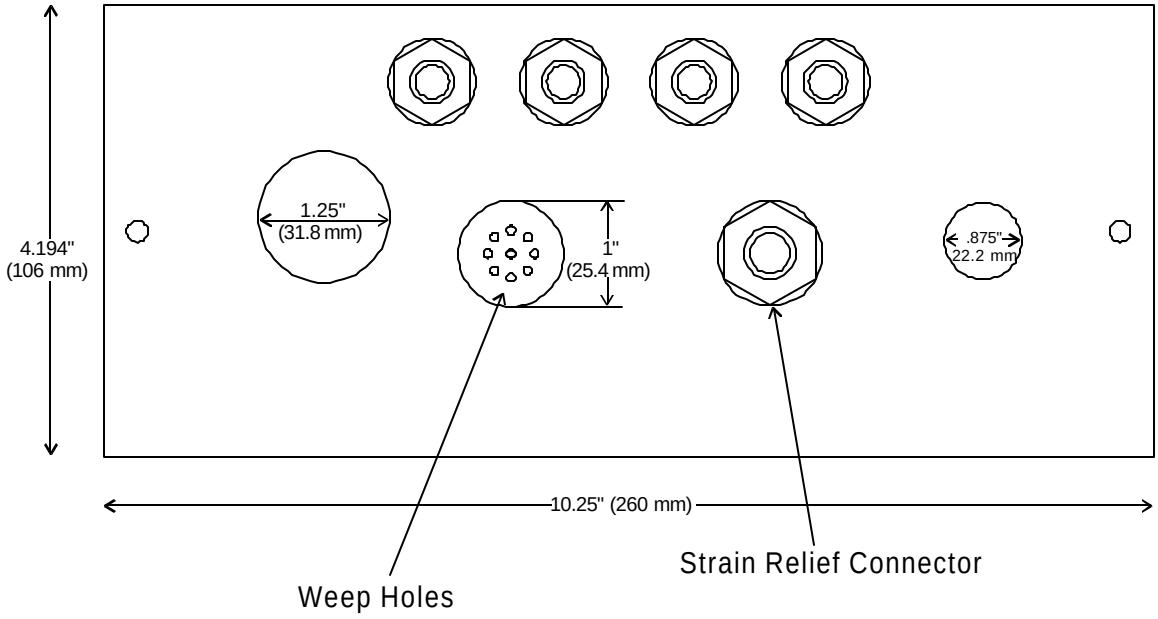


Figure 3-2: Gland Plate

I/O Board Configuration Jumpers

The I/O board configuration jumpers allow you to customize the LTC-MAP 2130 monitor to your application's specific sensor (channel type input), alarm, and modem requirements.

Channel Configuration

Channels 9 through 12 are configurable for a 4-20 mA sensor input or a 5A/50A current input (as monitored through a CT). Channels 13 through 16 are configurable for a 4-20 mA sensor input or a voltage input. Refer to Table 3-1 for specific jumper numbers and positions for each channel. Refer to Figure 3-3 for A and B jumper positions.

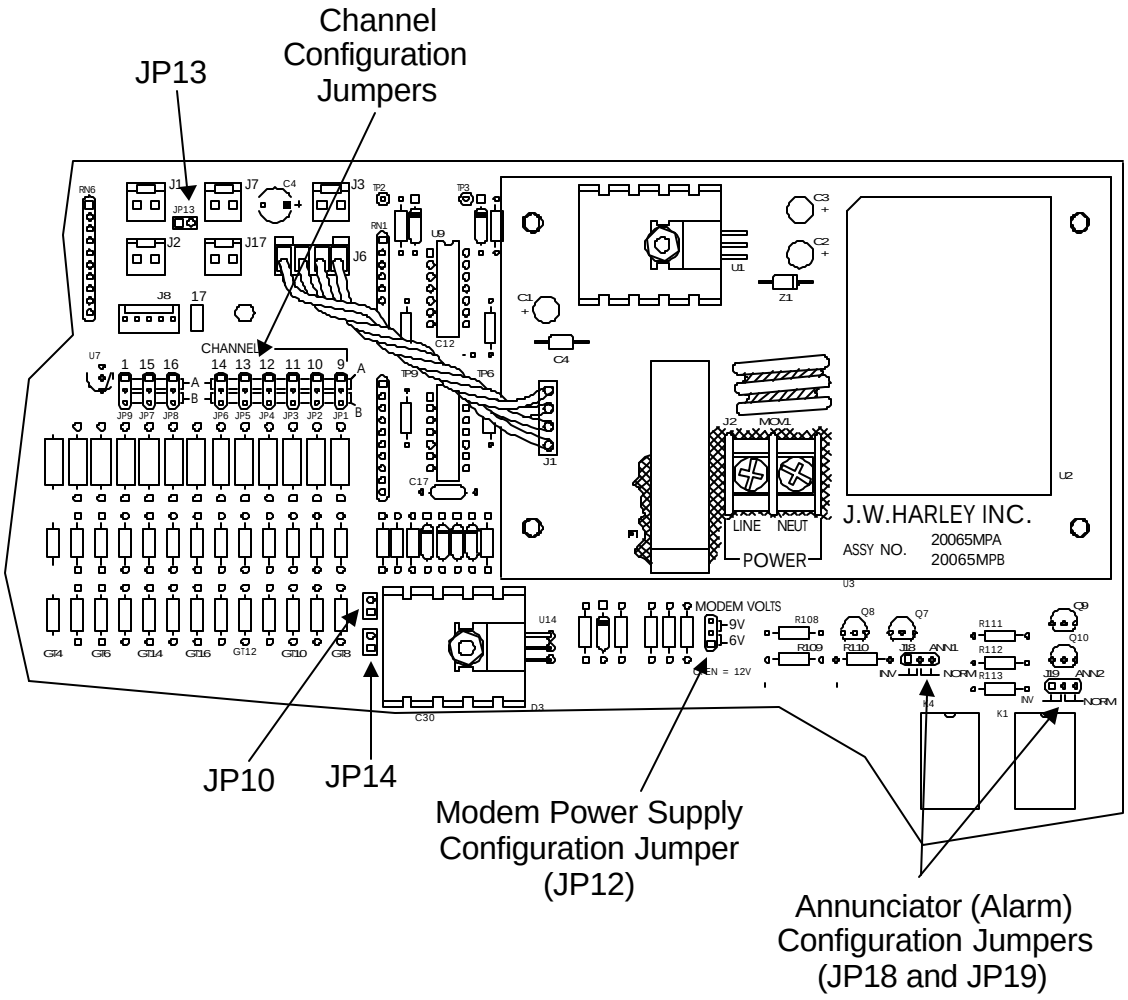


Figure 3-3: I/O Board Configuration Jumper Locations

Table 3-1: Channel Configuration Jumpers and Positions

Jumper	Position	Selected Input
JP1	A	5A (CT) Current Input A.
	B	4-20 mA Sensor Input #9.
JP2	A	5A (CT) Current Input B.
	B	4-20 mA Sensor Input #10.
JP3	A	5A (CT) Current Input C.
	B	4-20 mA Sensor Input #11.
JP4	A	50 A (CT) Motor Current.
	B	4-20 mA Sensor Input #12.
JP5	A	Voltage Input 1.
	B	4-20 mA Sensor Input #13.
JP6	A	Voltage Input 2.
	B	4-20 mA Sensor Input #14.
JP7	A	Voltage Input 3.
	B	4-20 mA Sensor Input #15.
JP8	A	Voltage Input 4.
	B	4-20 mA Sensor Input #16.
JP9	A	Temperature Inside the monitor.
	B	4-20 mA Sensor Input #1.

Modem Power Supply Configuration Jumper

Jumper JP12 sets the modem power supply. Refer to Table 3-2 for jumper positions.

NOTE: Refer to the modem specifications to determine the modem power supply requirements. Refer to Figure 3-3 for jumper location.

Table 3-2: Modem Power Supply Configuration (JP12)

JP12 Position	Selected Modem Power Supply
1-2	6 VDC
2-3	9 VDC
No Jumper	12 VDC

Alarm Configuration Jumpers

Jumpers JP18 and JP19 set the annunciator relay outputs to normal or inverted. Jumper JP13 configures the **Acknowledge Alarm** button. Refer to Table 3-3 for jumper positions. Refer to Figure 3-3 for jumper locations.

NOTE: JP13 must always be installed.

Table 3-3: Alarm Configuration

Jumper	Position	Description
JP18	INV NORM	Annunciator 1 Output Inverted. Annunciator 1 Output Normal.
JP19	INV NORM	Annunciator 2 Output Inverted. Annunciator 2 Output Normal.
JP13	Installed Removed	Configures the Alarm Acknowledge button for use. Not applicable.

Ground Jumpers

Jumpers JP10 and JP14, when installed, are set to earth ground. These jumpers must always be installed for accurate and safe operation.

WARNING: Jumpers JP10 and JP14 must always be installed for accurate and safe monitor operation.

Wiring

Overview

Prior to starting any wiring procedures:

Pull the power fuse (F1) on the Power Supply board.

- Securely ground the LTC-MAP 2130 at the ground lug.

CAUTION: Pull the power board fuses or remove F1 on the I/O board before making connections.

WARNING: The LTC-MAP 2130 Monitor must be properly grounded before placing the unit in service. An improper or missing ground can create a safety hazard.

Refer to Figure 3-4 for fuse and ground lug locations.

LTC-MAP 2130 wiring consists of:

- Wiring the sensors.
- Wiring a tap position indicator (if used).
- Wiring the AC current inputs.
- Wiring the AC voltage inputs.
- Wiring the digital inputs.
- Wiring the annunciator outputs.
- Wiring the internal heater.
- Wiring power.

Refer to Figure 3-4 for I/O Board Terminal Locations. Refer to Figure 3-5 for an example of a typical wiring diagram.

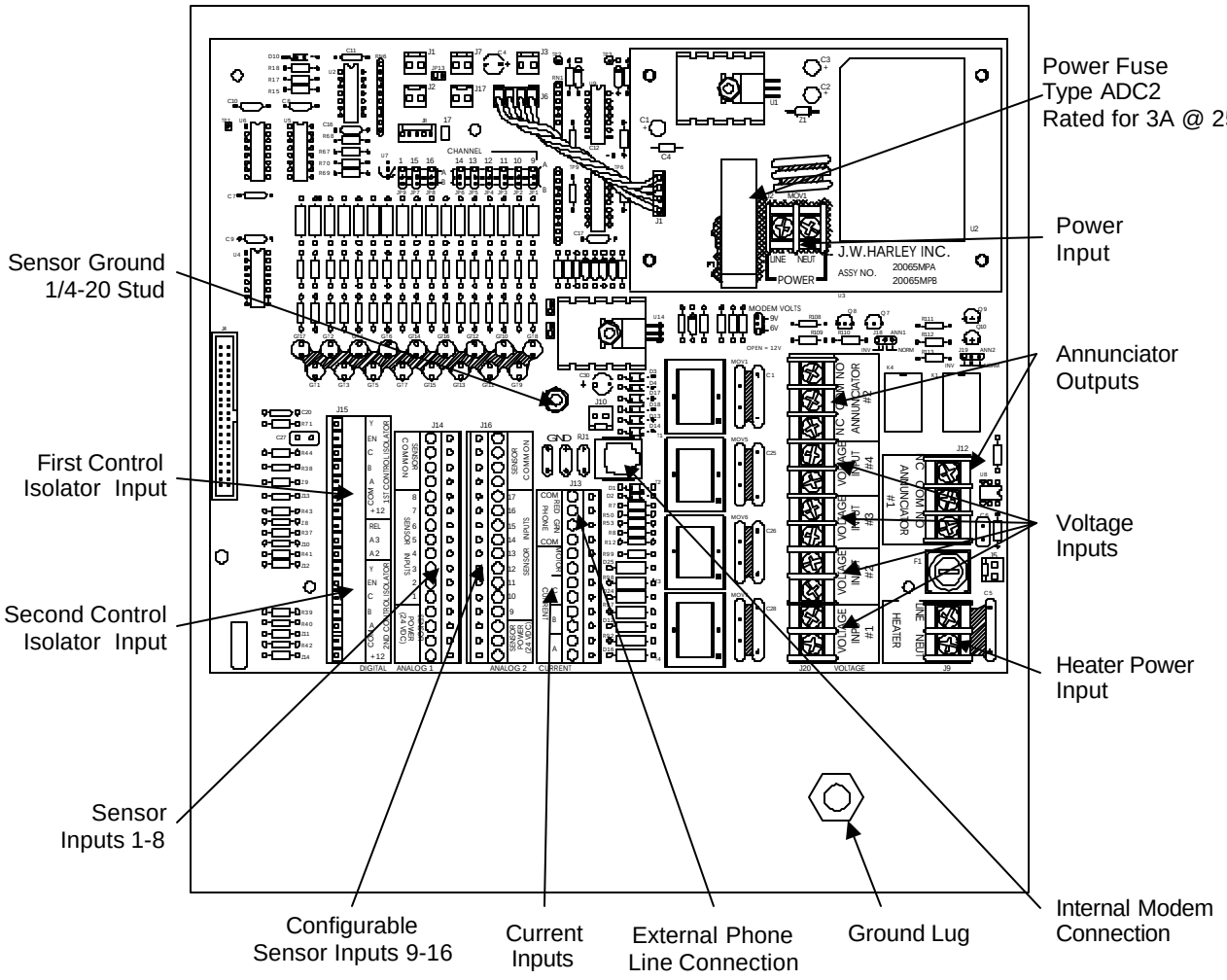


Figure 3-4: Fuse, Input Terminals, and Ground Locations

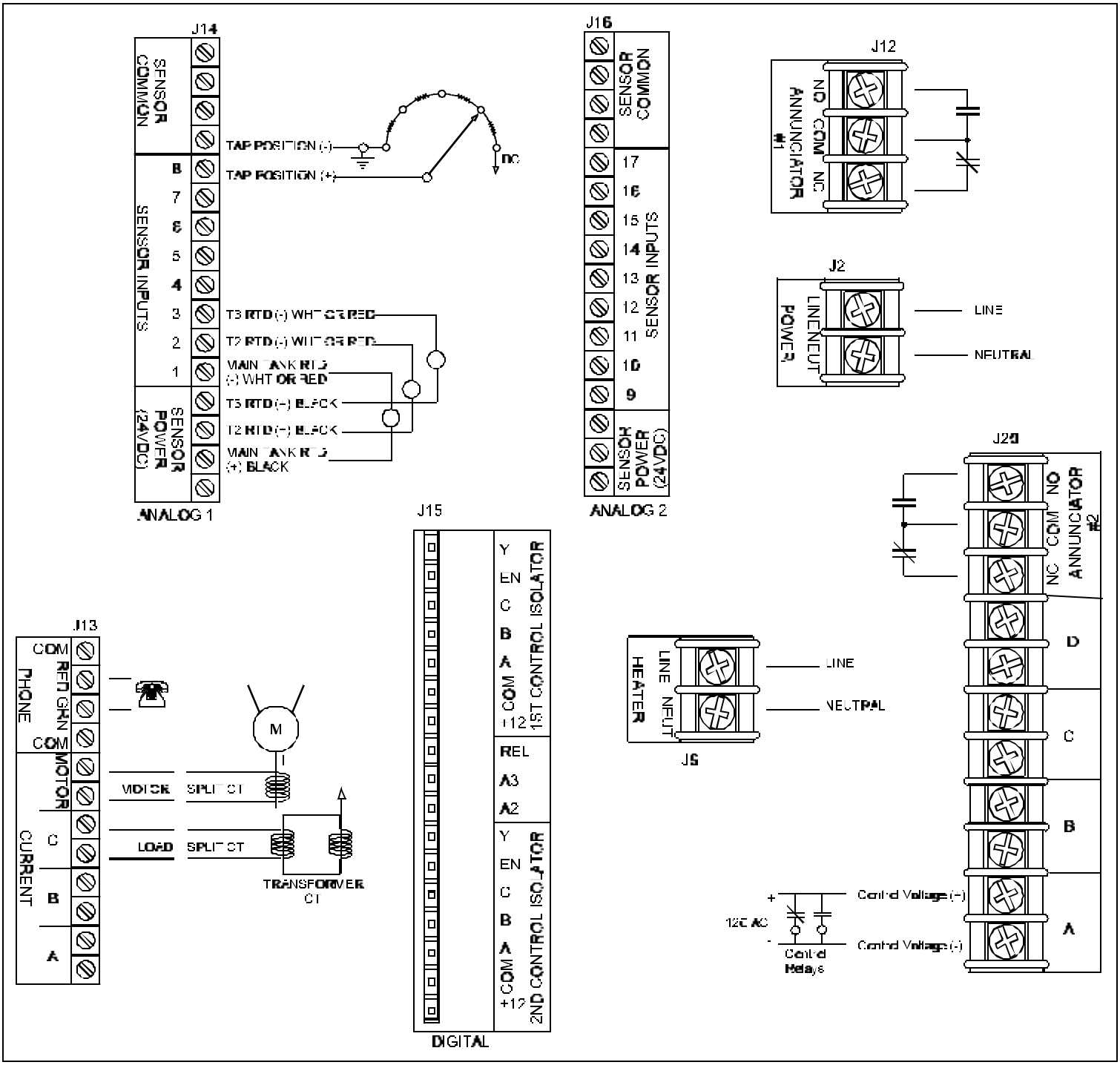


Figure 3-5: Example of a Typical Wiring Diagram for the LTC-MAP 2130

Wiring the Sensors

Refer to Table 1-1 for a list of sensors available for use with the LTC-MAP 2130 Monitor. Detailed installation information for each sensor is provided in the referenced documentation.

Some general notes to consider during sensor selection and installation:

- Thermowell RTD sensors require a signal conditioning transmitter to provide a 4-20 mA output to the monitor.
- Figure 3-4 provides Sensor and Input Connection locations on the I/O board.
- We recommend using #18 AWG shielded, twisted pair wire for sensor input connections to the I/O board, unless stated otherwise in the documentation provided with the sensor. Use of shielded twisted pair improves noise immunity; the shield should be grounded at one end only.

Wiring a Tap Position Indicator

OEM Potentiometers

The OEM potentiometer is a voltage divider containing a resistor string. Each position on the string represents a tap position. In the examples in this Section, the potentiometers have thirty three positions containing thirty two 40-ohm resistors. The actual number of positions and number and values of resistors may be different on your potentiometer.

The power supplied to the OEM potentiometer depends on the utility. The variations include:

- -5 to +5 VDC or -10 to +10 VDC.
- 0 to +5 VDC or 0 to +10 VDC.
- No voltage (connect with LTC-MAP power).

Determine the voltage across your potentiometer and follow the appropriate wiring instructions.

In general, two signals are utilized between the OEM potentiometer and the LTC-MAP. The signal is a linearly varying DC voltage ($\pm$10 V maximum).

For proper tap position recording by the LTC-MAP, the linearly varying DC voltage from the OEM potentiometer must have a uniform increment for each tap position. For example, a potentiometer used for a 33 tap device (16 lower, 16 raise, and neutral) with a 10 Volt drop across the entire bridge must show a 10V/32 = 0.3125 V change per tap step on the potentiometer wiper.

0 to +5 VDC or 0 to +10 VDC Power

Connect the OEM potentiometer to the LTC-MAP Circuit Board, as follows (refer to Figure 3-6):

1. Connect the OEM Potentiometer Wiper to Sensor Input #8.
2. Connect the OEM Potentiometer 0 VDC Common Point to Sensor Common.

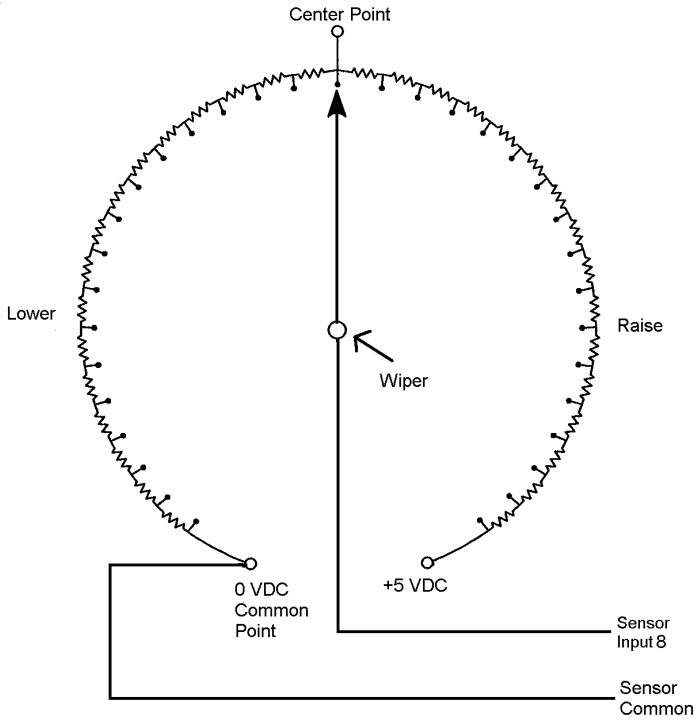


Figure 3-6: Typical OEM Potentiometer with 0 to +5 VDC Power

-5 to +5 VDC or -10 to +10 VDC Power

Connect the OEM potentiometer to the LTC-MAP Circuit Board, as follows (refer to Figure 3-7):

1. Connect the OEM Potentiometer Wiper to Sensor Input #8.
2. Connect the OEM Potentiometer Center Point to the Sensor Common.

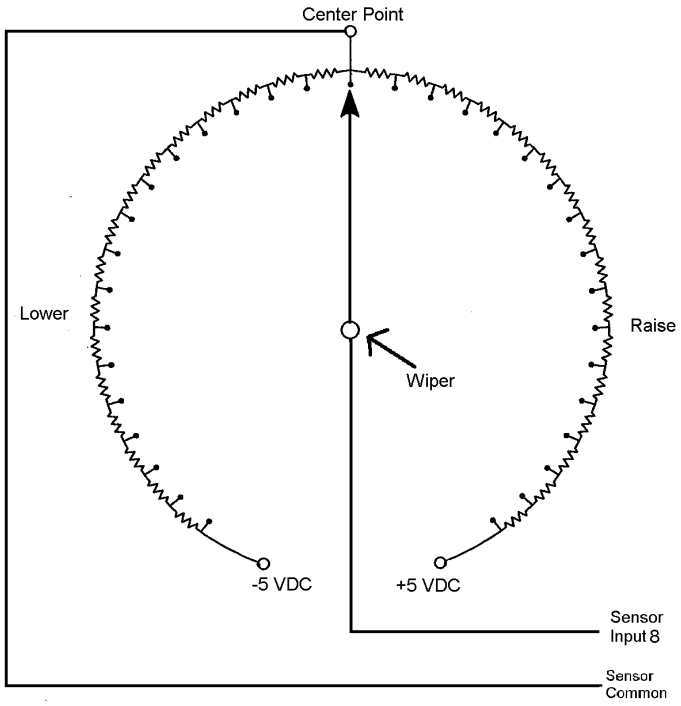


Figure 3-7: Typical OEM Potentiometer with -5 to +5 VDC Power

LTC-MAP Power

OEM potentiometers that are not powered require power from the LTC-MAP's 24 VDC Sensor Power Supply. To use the LTC-MAP supply, you must:

- Select a Voltage Drop Resistor (R_d).
- Connect the Power Supply wires to the OEM Potentiometer.
- Connect the wires at the Monitor Circuit board.

In order to use this power, you must first calculate the value of the required voltage drop resistor (R_d). The voltage drop resistor limits the current and voltage across the potentiometer (see Figure 3-8).

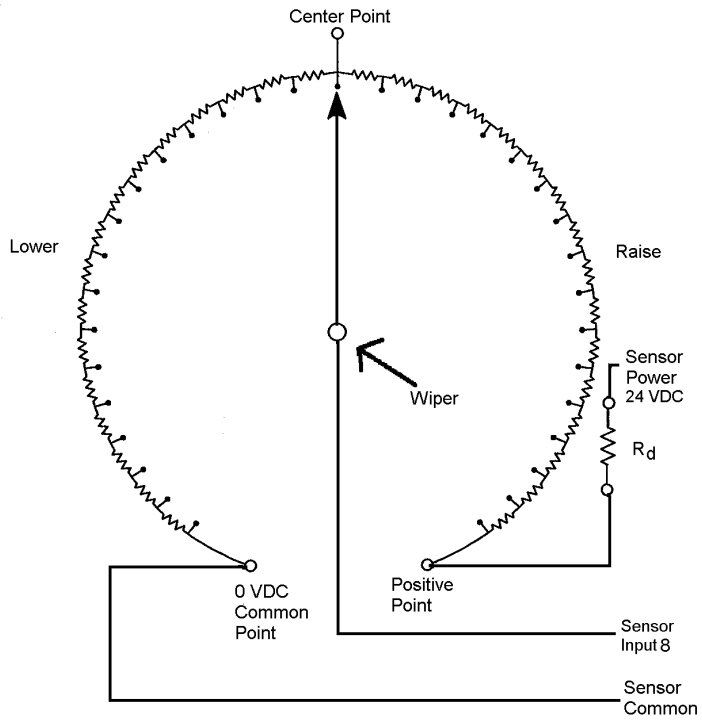


Figure 3-8: Typical OEM Potentiometer Powered by LTC-MAP

To calculate R_d:

1. Determine the value and number of resistors in the potentiometer.

   NOTE: LTC-MAP can accommodate any value or number of tap position resistors.

2. Calculate the String Resistance (Rs) where:
   Rs = (Resistor Value) x (Number of Resistors).

3. Calculate the Voltage Drop Resistor value (Rd):
   $R_d = R_s$ x 1.4.

4. Select a voltage drop resistor as follows:
   Resistance: first standard value greater than the Rd.
   Power rating: 2 watts.
   Tolerance: 5% or less

   As an example, consider a potentiometer with thirty-two 40 ohm resistors. The calculated string resistance would be:
   R_s = (40 ohms) x (32 Resistors) - 1280 ohms.
   And
   $R_d = R_s$ x 1.4 = 1280 x 1.4 = 1792 ohms.
   The next standard resistor value greater than 1792 is 1800 ohms. Therefore, the selected voltage drop resistor should be an 1800 ohm, 5%, 2 watt resistor.

Connect the wires to the OEM Potentiometer as follows:

1. Connect the designated positive point lead to the OEM Potentiometer Positive Point.
2. Connect the designated common point lead to the OEM Potentiometer Common Point.
3. Connect the designated wiper lead to the OEM Potentiometer Wiper.

Connect the wires to the circuit board as follows:

1. Connect one end of the Voltage Drop Resistor (V_d) to a sensor power supply terminal.
2. Connect the positive point lead to the other end of the Voltage Drop Resistor (V_d).
3. Connect the common point lead to the designated Sensor Common terminal.
4. Connect the wiper lead to Sensor Input #8.

NOTE: Tap Position must be calibrated to operate correctly (see Calibrate Tap Position).

CAUTION: The positive lead must be connected to Sensor Input #5 and the negative lead to Sensor Common. Failure to comply can damage the LTC-MAP.

After-Market

Use the following procedure to wire an After-Market Tap Position Indicator.

1. Verify that the signal output is one of the following:
    - - 5V to + +5 VDC
    - -10 to + 10 VDC,
    - 0 to +5 VDC, or
    - 0 to +10 VDC.
2. Connect the signal output to Sensor Input #8.
3. Connect the signal reference to a Sensor Common Terminal.

NOTE: Tap Position must be calibrated to operate correctly (see Calibrate Tap Position).

Wiring the AC Voltage Inputs

Connect voltage signals to the designated terminals (Voltage Input #1, #2, #3, #4) on the wiring and installation diagrams. Refer to Figure 3-5 for terminal location.

NOTE: The signal specification range for Voltage Inputs #1, #2, #3, and #4 are 0 to 300 Vrms. If your signal input is different, contact Support Services as noted on back cover.

Wiring the AC Current Inputs

There are two types of current inputs - powered CT and unpowered CT (e.g., Clamp On AC Current Transducer).

Connections for unpowered CT's are not polarity sensitive. Connect the CT between the A, B, or C Current terminals (refer to Figures 3-4 and 3-5).

Connections for powered (active) CT's are polarity sensitive. Refer to information on the active CT's connection points for proper polarity.

Wiring the Digital Inputs

The LTC-MAP 2130 monitor collects output data from the Control Isolator at the digital inputs. (See Figure 3-4 for Control Isolator Input terminal locations.)

NOTE: Refer to Document No. 70062MP for specific information on the Control Isolator, Part No. 40041MP.

1. Mount the Control Isolator(s) per the guidelines provided in the documentation provided with the Control Isolator.

   NOTE: The control Isolators are provided with a 10 foot cable; therefore, when selecting a mounting location, be sure it is within 10 feet of the monitor.

2. Connect the output cable of the Control Isolator to the First Control Isolator Input (digital channels 1-8) as designated on the wiring and installation diagrams.

3. If there is a second Control isolator installed, connect the output cable of the Control Isolator to the Second Control Isolator Input (digital channels 9-16) as designated on the wiring and installation diagrams.

NOTE: If only one Control Isolator is installed, it must be connected to the First Control Isolator input terminals on the I/O board.

Wiring the Annunciator Outputs

Wire the alarms by connecting the alarm activation signal to the Alarm normally opened or Alarm normally closed contacts. Refer to Figure 3-5 for Alarm Contact (Annunciator Output) locations.

NOTE: The signal specification range for the Alarm Inputs are 120 VAC @ ¼ HP, 240 VAC @ 10 A, or 150 VDC @ 10 A. If your signal is different, contact Support Services as noted on back cover.

Be sure to configure the alarm jumpers (JP18 and JP19) for either normal or inverted output as required by your application.

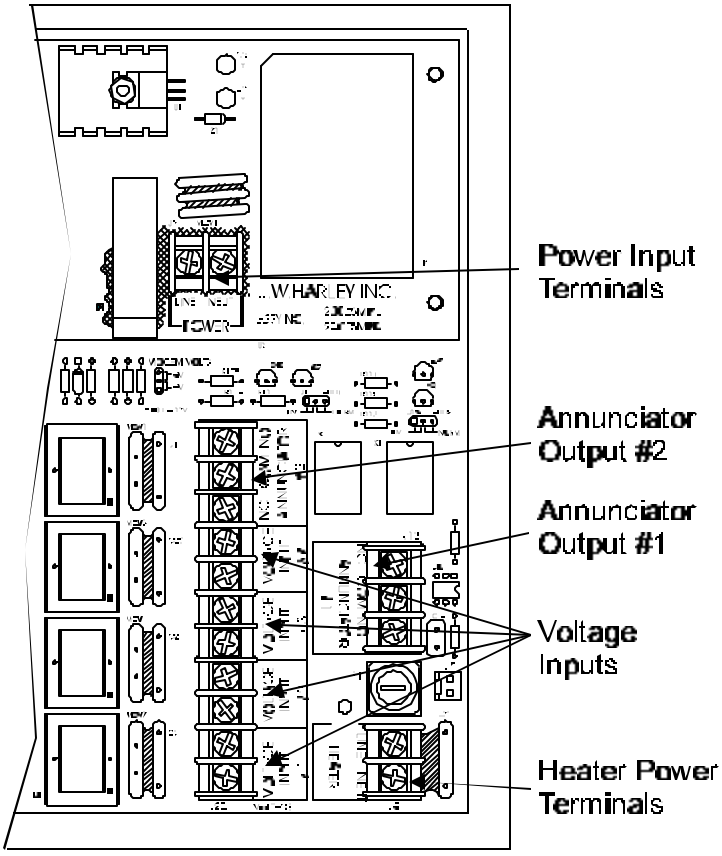


Figure 3-9: I/O Board Terminal Locations

Wiring the Internal Heater

The monitor's internal heater requires 110 VAC power input. Refer to Figure 3-9 for Heater Terminal locations.

WARNING: Do not bridge the heater power terminals to the monitor power supply terminals if DC is used to supply the monitor. The heater is AC only.

Wiring Power

The LTC-MAP 2130 is factory configured for either 120 VAC or 240 VAC operation per the customer order. Refer to Figure 3-9 for the location of the Power Input Terminals.

1. Connect the "hot" phase of the 120 or 210 power line to the LINE Power Input Terminal.
2. Connect the neutral line to the NEUT Power Input Terminal.

Establishing Communications

The SAGE™ host software installed on a personal computer allows for data retrieval and analysis. Communications with the LTC-MAP 2130 must be established in order to download data to the PC or upload configuration information to the LTC-MAP. Communication between the PC and the monitor can be established:

- Directly via the front panel serial port and a null modem cable to a personal computer running SAGE™.

NOTE: The SAGE™ host software must be installed on the PC for proper communication to take place. The front panel serial port does not support dumb terminal operation.

- Over phone lines using an optional modem installed inside the monitor.
- Over phone lines via a phone multiplexer installed in the control house and connected to several LTC-MAP 2130 monitors. Refer to Document No. 70061MP for detailed information on the phone multiplexers available from Reuter-Stokes.

CAUTION: The serial port and the modem cannot function simultaneously. When using the serial port for communications, the internal modem (if installed) must be disconnected at J8; otherwise the serial port will not function.

Serial Port Communications

To establish communications via the front panel serial port:

1. Be sure the modem, if installed, is disconnected at J8.
2. Be sure the SAGE™ host software is installed on the personal computer.
3. Connect a null modem cable between the front panel serial port and the serial port on the personal computer. See Figure 3-10 for serial port location.
4. From within the SAGE™ host software, set the serial port rate to 19200 bps.

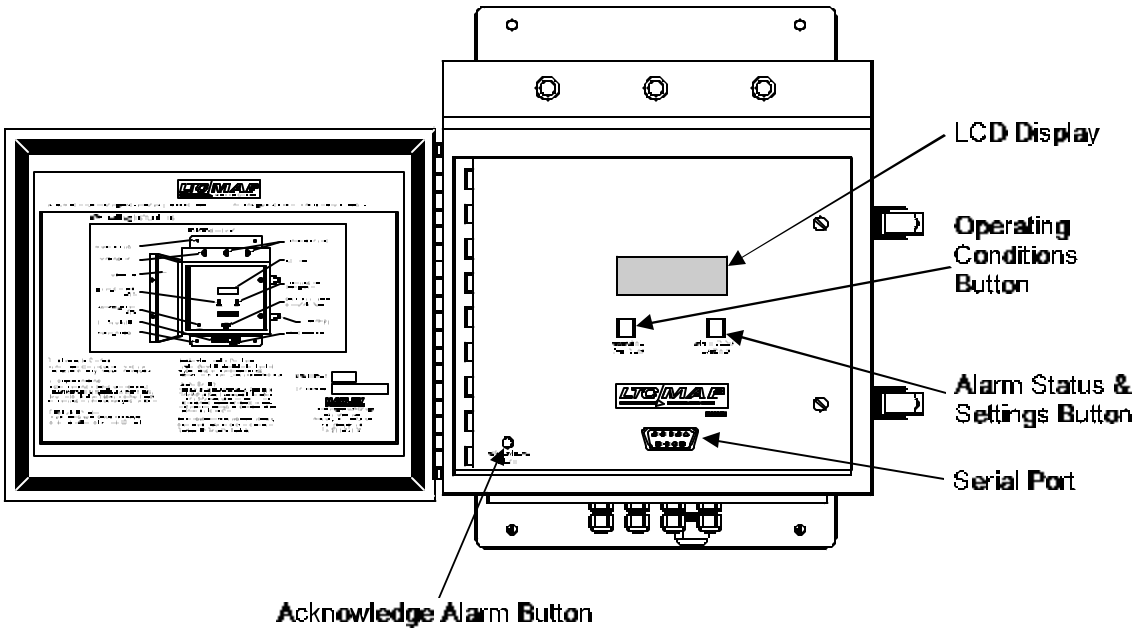


Figure 3-10: Serial Port Location

Modem Communications

To establish communications via a modem:

1. If not already installed, mount the modem inside the monitor using the supplied Velcroattachments.
2. Connect the modem per the instructions supplied with it.

   See Figure 3-11 for modem mounting location and typical connections.
3. Set JP12 on the I/O board to select the modem power supply. Refer to Modem Power Supply Configuration earlier in this section.
4. Be sure the serial port speed rate is set to 19200 bps (positions 3 and 4 on SW4 on the CPU board should be open).

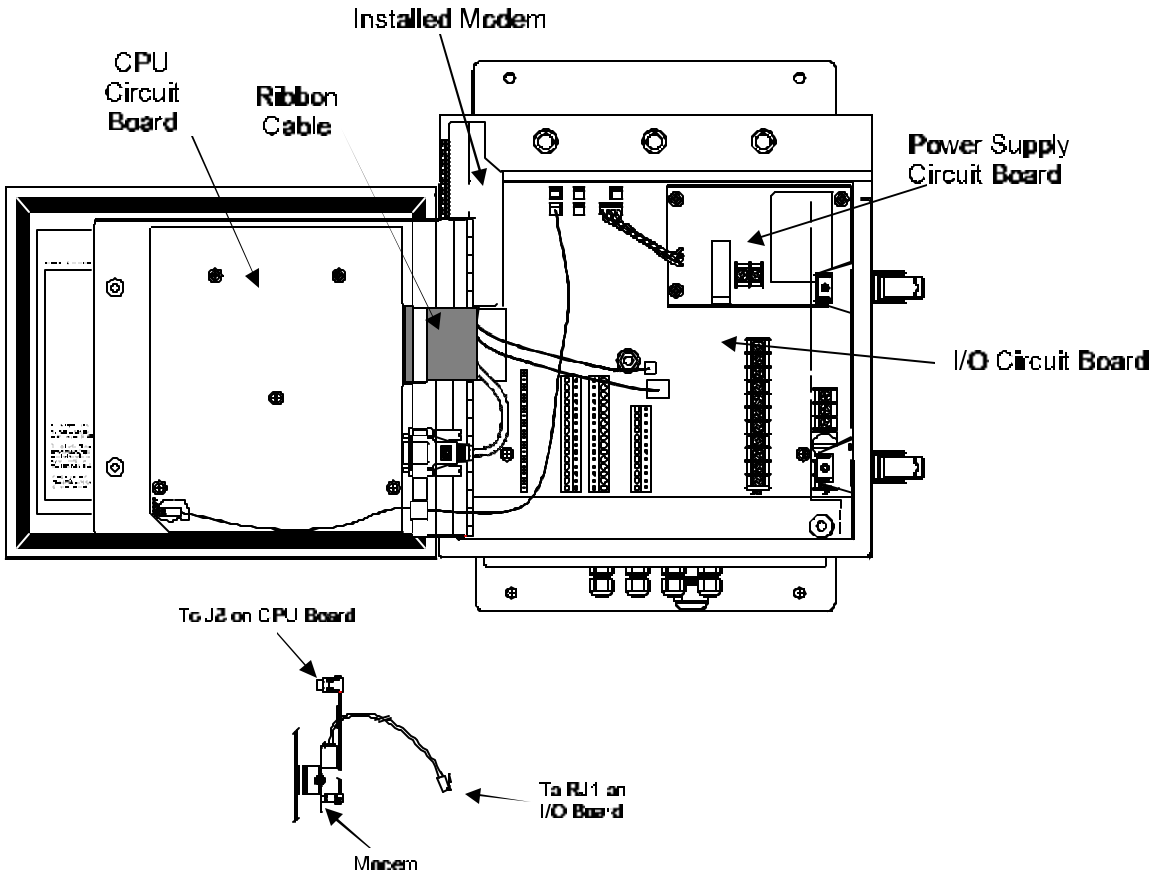


Figure 3-11: Modem Location and Connections

Initial Start Up

1. Before applying power to the system, verify that:
   - All sensors are mounted and connected properly.
   - None of the wiring or cables are shorted.
   - All connections follow the wiring and installation diagrams.
   - All monitored input signals are within specified input ranges.
   - Phone lines are properly connected to a phone multiplexer (if used).

WARNING: Check all wiring before applying power to the unit. Wiring errors can damage the device and create a safety hazard.

2. Connect the power input wires to the 120 V AC/DC Power terminal.
3. Apply power to the monitor.

   NOTE: Copyright information will be displayed for approximately ten seconds. After that, the display will go blank.

```
      LTC-MAP 2130
  rev 2130.xx.yy

copyright (C) 1997
```

4. Configure and set system parameters using the SAGE™ host software package. (Refer to the SAGE™ documentation for specific procedures.)
5. Upload the SAGE™ configuration files to the LTC-MAP, either through the RS232 Serial port or via a modem. (Refer to the SAGE™ documentation for specific procedures.)
6. Verify the current date and time.
   - Press the **Alarm Status & Settings** button two times or until the Current Time and Current Date screen is displayed:

```
   Current Time:
      12:30:22
   Current Date:
Wed     09/17/1997
```

   - If the time and date are incorrect, reset them using the procedures outlined in the SAGE™ documentation.

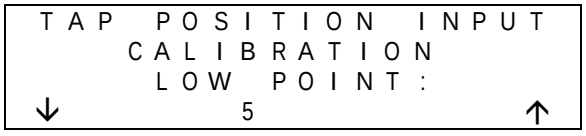
   NOTE: The date and time must be set accurately to insure that LTC-MAP 2130 properly acquires data.

Once power is applied, and configuration parameters have been uploaded to the monitor, the monitor enters normal operation and begins monitoring sensor and voltage inputs.

Refer to **Section 4 - Operation** for further operation procedures.

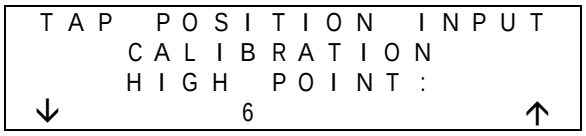
Calibrate Tap Position

1. Press the **Setup** button to display the Tap Position Input Calibration Low Point screen.



   The Setup button is located on the upper left corner of back side the CPU board.

2. Observe and record the actual tap position of the LTC at the TAP Position Indicator.
3. Adjust the value of the low tap position calibration point to the value observed in Step 2 by pressing ↓ or ↑ until the correct value is displayed
4. Press **Setup** to display the Tap Position High Point Calibration screen.



5. Manually move the tap up one position.
6. Adjust the value of the high tap position calibration point up one position from the low calibration point by pressing ↓ or ↑ until the correct value is displayed.
7. Press **Setup** to exit the Calibration and return to normal operation.

Section 4: Operation

Overview

Once power is applied, the LTC-MAP starts monitoring sensor, voltage, current, and relay timing inputs. Monitoring functions continue uninterrupted while operating conditions and alarm status & settings are viewed and during system setup procedures. Channel readings, alarm status, and current time and date as set from the SAGE™ host software package, can be viewed on the LTC-MAP Monitor display.

Refer to the SAGE™ documentation for detailed channel configuration, parameter setting procedures, and monitoring capabilities.

CAUTION: To keep the enclosure weatherproof, close and latch the door when not using the LTC-MAP. Failure to comply can result in equipment damage.

Operating Conditions Button

Operating conditions, including current analog and digital channel readings and a tap change summary, are displayed by pressing the **Operating Conditions** button.

- Pressing **Operating Conditions** during normal operation displays the first Analog Channels Screen.
- Pressing **Operating Conditions** repeatedly during normal operation continuously scrolls through the following screens:
  - Analog Channels 1 through 4 Readings.
  - Analog Channels 5 through 8 Readings.
  - Analog Channels 9 through 12 Readings.
  - Analog Channels 13 through 16 Readings.
  - Analog Channel 17 Reading.
  - Digital Channels 1 through 4 Readings.
  - Digital Channels 5 through 9 Readings.
  - Digital Channels 10 through 12 Readings.
  - Digital Channels 13 through 16 Readings.
  - Tap Change Summary.
- If **Alarm Status & Settings** is pressed while any one of the operating condition screens is displayed, the Status screen is displayed.

Analog Channel Readings Screens

The Analog Channel Readings screens display up to four channels each (see Figure 4-1). There is one line of display (20 columns) available for each channel:

- Columns 1 through 10 display the channel's description as uploaded from the SAGE™ configuration file.
- Columns 11through 16 display a numeric representation of the current value being read at the channels input.
- Columns 17 through 20 display the units of the reading.
- If a channel is not connected, no information is displayed for the channel; down arrows indicate that pressing **Operating Conditions** will display more information (e.g., other configured analog channel readings, or digital channel readings).

```
RM  TEMP          37.5degC
Top  Oil          45.3degC
↓              ↓↓        ↓
Load  Curre       689  Amp
```

Figure 4-1: Sample Analog Channel Display

Digital Channel Readings Screens

The Digital Channel Readings screens display up to four channels each (see Figure 4-2). There is one line of display (20 columns) available for each channel:

- Columns 1 through 17 display the channel's description as uploaded from the SAGE™ configuration file.
- Columns 18 through 20 display the channels status as ON or OFF.

```
CNTRL  ISO1  CH1        ON
CNTRL  ISO1  CH2        ON
CNTRL  ISO1  CH3        ON
CNTRL  ISO1  CH4       OFF
```

Figure 4-2: Sample Digital Channel Display

Tap Change Summary Screen

The Tap Change Summary screen (Figure 4-3) displays:

- Tap Changes in the last hour.
- Tap Changes so far this hour.
- Total number of tap changes since power up.

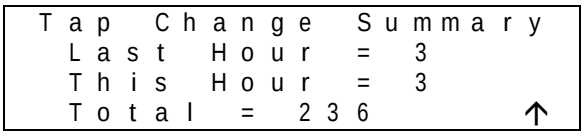


Figure 4-3. Tap Change Summary Screen

Alarm Status & Settings Button

Alarm Status & Settings screens are accessed by pressing the **Alarm Status & Settings** button:

- Pressing **Alarm Status & Settings** during normal operation displays the LTC-MAP Status screen.
- Pressing **Alarm Status & Settings** repeatedly during normal operation continuously scrolls through the Alarm and Status screens, in the following order:
  - LTC-MAP Status Screens
  - Current Date and Time Screen
- Pressing **Operating Conditions**, while an Alarm Status & Setting screen is displayed, will display the first Analog Channels readings screen.

LTC-MAP Status Screen

The LTC-MAP status screen displays current alarm status. If there are no alarm conditions, the Normal Status screen (Figure 4-4) is displayed.

If one or more alarms are present, each alarm will be displayed sequentially and on a separate screen (see Figure 4-5). There are two lines of text available to display the alarm description; also displayed is the present value of the parameter triggering the alarm.

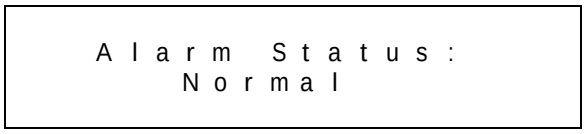


Figure 4-4: LTC-MAP Status Screen (No Alarms)

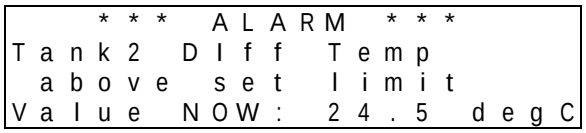


Figure 4-5: LTC-MAP Alarms Screen

Current Time and Date Screen

The Current Time and Current Date screen (Figure 4-6) displays:

- The current time as read from the system clock and displayed in 24 hour format (HH/MM/SS).
- The current date as read from the system clock and displayed as: Day MM/DD/YYYY.

NOTE: The system clock must be set to the correct date and time to ensure that the LTC-MAP properly acquires data. If the date or time are incorrect, refer to the SAGE™ documentation for procedures for setting the date and time.

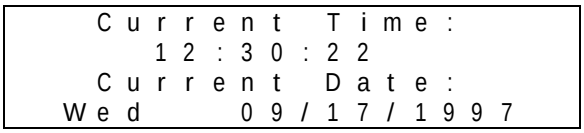


Figure 4-6: Current Time and Date Screen

Acknowledging Alarms

Alarms are acknowledged by pressing the **Acknowledge Alarm** button, located in the lower left corner of the face panel. Pressing **Acknowledge Alarm** deactivates the alarm relay on the LTC-MAP so subsequent alarms can trip the annunciator outputs.

NOTE: The LTC-MAP remains in alarm mode, and the corresponding ALARM indicators remain lit, until the alarm condition goes away.

Section 5: Troubleshooting Procedures

Refer to Table 5-1 for common troubleshooting procedures.

Table 5-1: Common Troubleshooting Procedures

Condition	Possible Cause(s)	Corrective Action
Incorrect Temperature Reading on a 4-20 mA Channel.	Defective sensor.	Swap suspect sensor with a known good sensor.
	Loose wiring connection from sensor to circuit board	Check wiring connection from the sensor to the circuit board; ensure that the wire is correctly inserted into the screw down connector block.
	Defective circuit board.	Swap suspect circuit board with a known good board.
	Ribbon cable between CPU and I/O circuit boards loose.	Temporarily move the suspect RTD sensor wire to an unused 4-20 mA channel to determine whether fault follows sensor or circuit board.
		Inspect ribbon cable connection at CPU board and at I/O board.
	Ground loop exists with another connection.	Systematically remove other connections to the circuit board until the cause of the loop is found. For example, problems may be caused having the individual wire (color) order incorrect for the cable between the control isolator and the I/O board.
Unrecorded tap change events.	Incorrect wiring.	Check wiring diagram and installation.
	Incorrect parameter settings.	Check event start and stop parameters.
		Check for a minimum motor current parameter.
Incorrect Current Readings.	Incorrect installation.	Check wiring diagram and installation.
	No current present.	Verify current with a handheld meter.
	Incorrect parameter settings.	Check CT Ratio.
		Check Calibration Parameters.
Incorrect Voltage Readings.	Incorrect wiring.	Check wiring diagram and installation.
	Incorrect parameter settings.	Check Calibration Parameters.
	Power glitch.	Cycle Power.

Table 5-1: Common Troubleshooting Procedures (Cont'd)

Condition	Possible Cause(s)	Corrective Action
Incorrect Tap Position Displayed/Recorded.	Sensor Input and Sensor Common connections reversed. Battery supply for OEM resistor string not stable or floating to ground causing a ground loop.	Disconnect inputs and test voltage on the wires with a volt meter referenced to earth ground. Disconnect inputs and test voltage on the wires with a volt meter referenced to earth ground. Cut or remove the strap for Sensor Common input to chassis ground connection on the circuit board. Use a DC voltage from the monitor, rather than a battery, to supply the OEM resistor string.
Heater ON at ambient over 60 ºF (15.5 ºC).	Faulty heater.	Disconnect heater from I/O board; contact Reuter-Stokes, Inc..
Heater not ON at ambient under 50 ºF (10 ºC).	Faulty connections.	Check heater connections.

Appendix A: User-Specific Information Forms

Use the Analog Channel Configuration form to document LTC-MAP 2130 channel settings.

Use the Tap Position Calibration form to document tap position calibration settings.

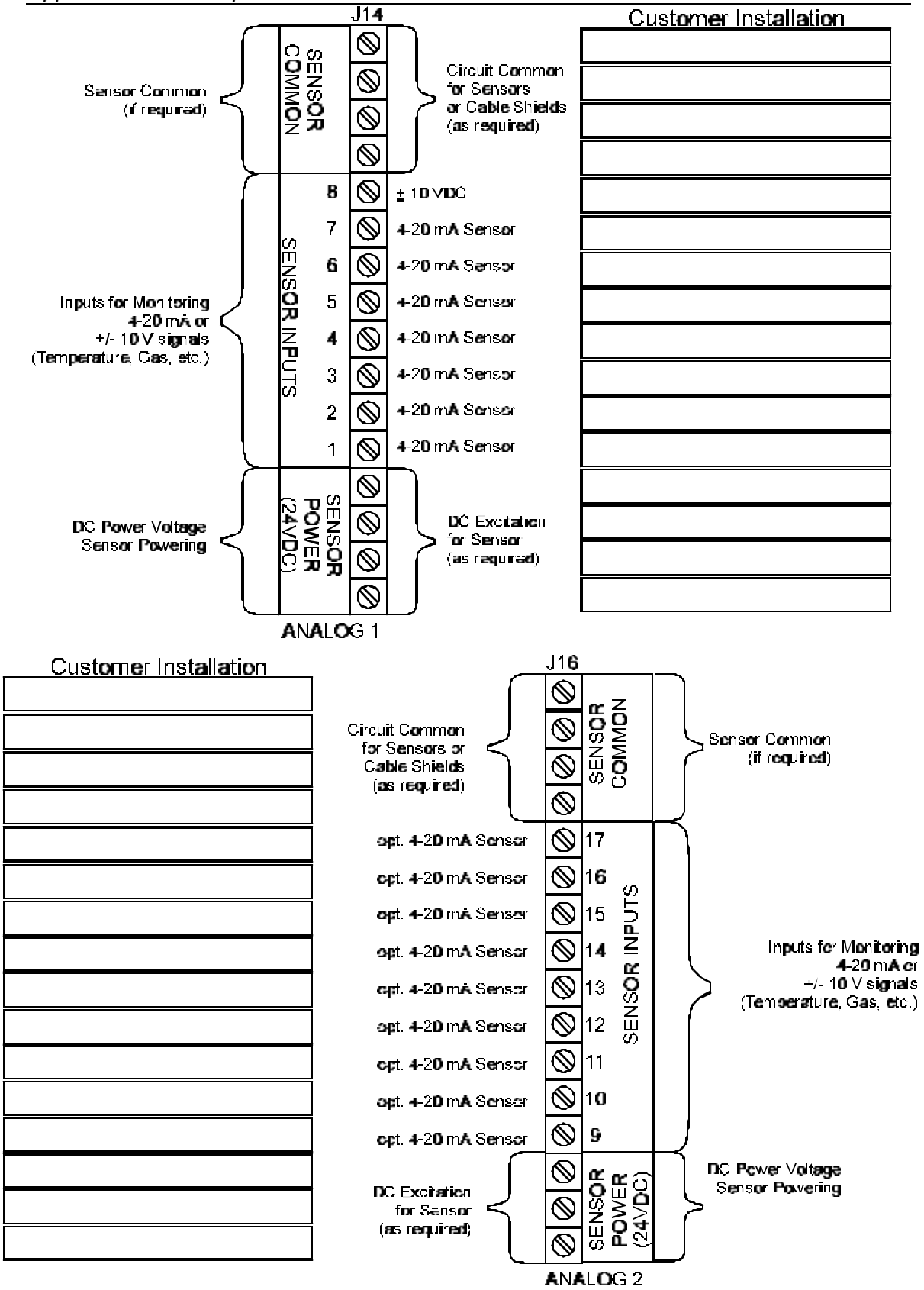
Use the wiring diagram forms to document specific system connections.

Analog Channel Configuration

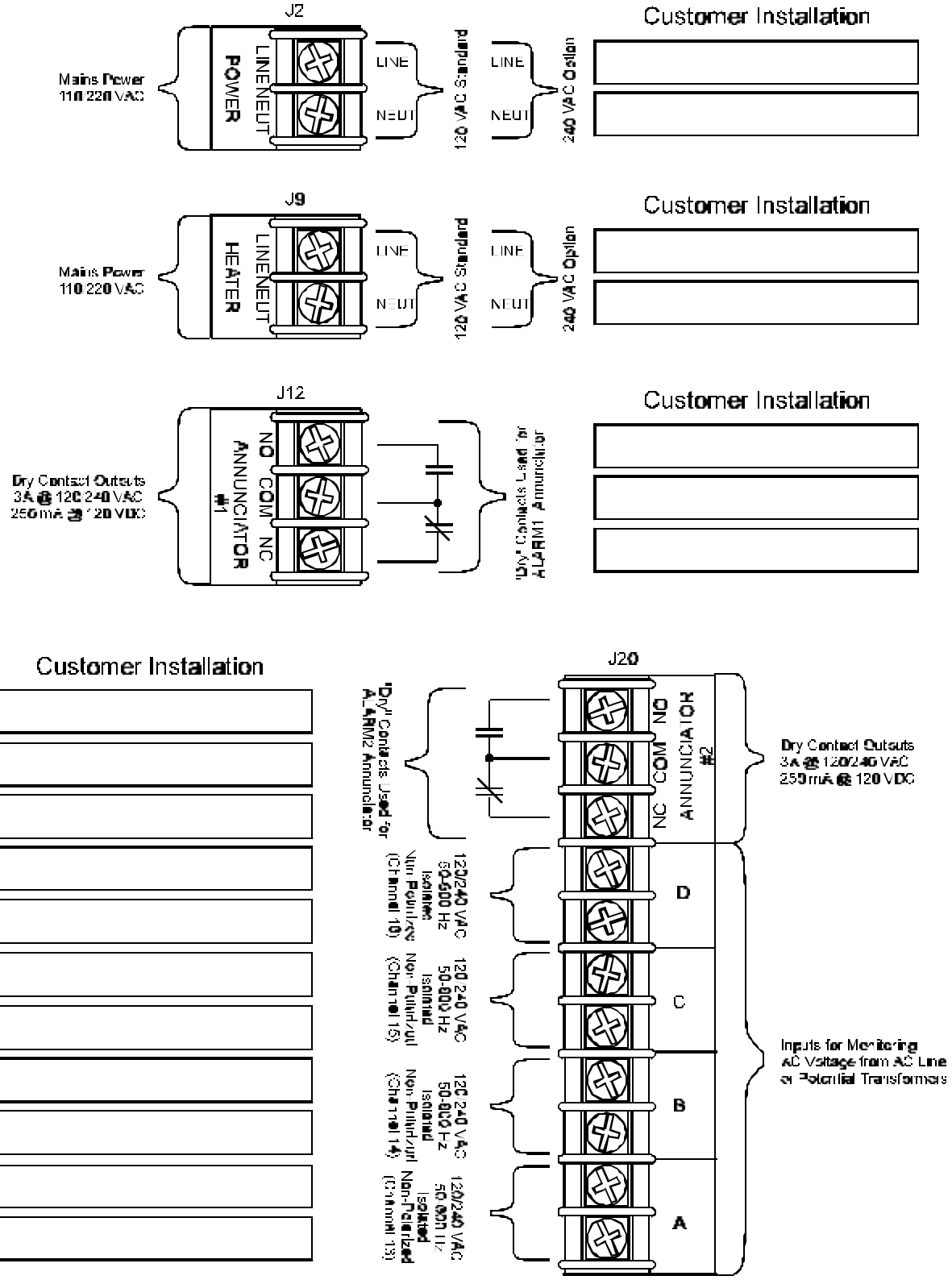
Jumper	Position A or B	Selected Input	Input Description
N/A	N/A	4-20 mA Sensor Input #1.	
N/A	N/A	4-20 mA Sensor Input #2.	
N/A	N/A	4-20 mA Sensor Input #3.	
N/A	N/A	4-20 mA Sensor Input #4.	
N/A	N/A	4-20 mA Sensor Input #5.	
N/A	N/A	4-20 mA Sensor Input #6.	
N/A	N/A	4-20 mA Sensor Input #7.	
N/A	N/A	±10 VDC Input Channel #8.	
JP1		(5A Input per CT or 4-20 mA Input #9)	
JP2		(5A Input per CT or 4-20 mA Input #10)	
JP3		(5A Input per CT or 4-20 mA Input #11)	
JP4		(50 A Current per CT or 4-20 mA Input #12)	
JP5		(Voltage Input 1 or 4-20 mA Input #13)	
JP6		(Voltage Input 2 or 4-20 mA Input #14)	
JP7		(Voltage Input 3 or 4-20 mA Input #15)	
JP8		(Voltage Input 4 or 4-20 mA Input #16)	

Tap Position Calibration

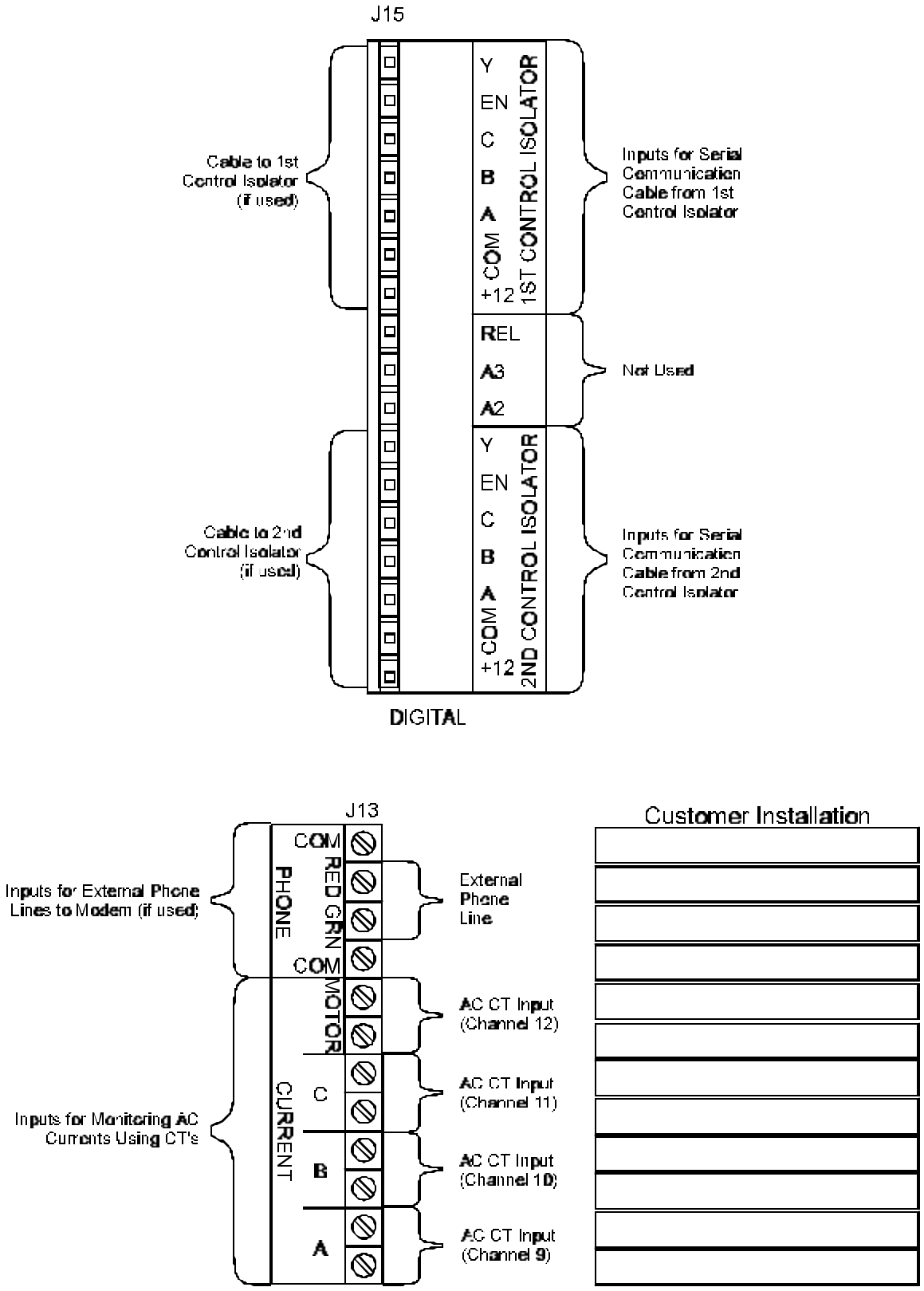
Low Point	High Point



LTC-MAP 2130 Customer Installation Information (Part 1)



LTC-MAP 2130 Customer Installation Information (Part 2)



LTC-MAP 2130 Customer Installation Information (Part 3)

Appendix B: Firmware Upgrades

Use the following procedure to replace the EPROM for firmware upgrades:

NOTE: Be sure to download to the PC the LTC-MAP 2130 monitor configuration, calibration, and parameter settings via SAGE™ host software package before replacing the EPROM.

1. Open the front cover by releasing the fasteners on the right side of the LTC-MAP 2130.
2. Loosen the thumbscrews on the face panel.
3. Swing out the panel to access the I/O and CPU circuit boards.
4. Slip the supplied static control wrist strap over your hand and connect the other end to any convenient electrical ground.
5. Remove the F1 power fuse from the power board.

CAUTION: To avoid equipment damage, you must remove F1 on the I/O board when installing the EPROM.

6. Unplug the ribbon cable and modem serial port connector from the CPU circuit board.

CAUTION: To avoid damage to the ribbon cable, pull the ribbon cable by the hard plastic connector.

7. Using a No.1 Phillips head screwdriver, remove the five screws securing the CPU circuit board to the face panel.
8. Carefully remove the CPU circuit board and turn it component side up.

9. Using a 3/16" slotted screwdriver, carefully remove the existing EPROM. Note the orientation of the EPROM notch and the location within the socket. See Figure B-1 for EPROM location.

   NOTE: Pin number 1 of the EPROM is placed into contact number 3 of the socket.

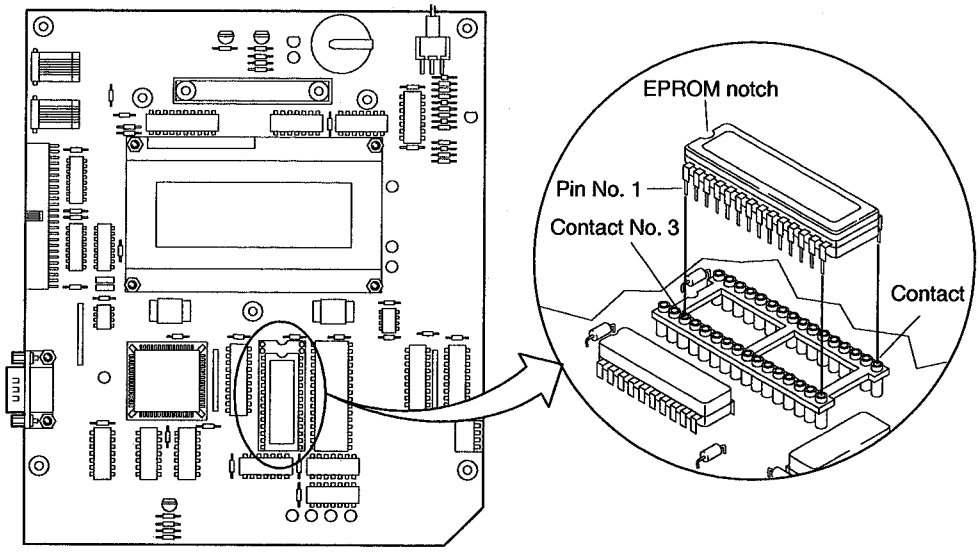


Figure B-1: EPROM Replacement

10. Remove the new EPROM from the protective packaging.

CAUTION: To avoid damage to the component, do not remove the EPROM from the protective packaging until you are ready to install it.

11. Determine the proper notch orientation and location within the socket.

12. Carefully bend the pins on the EPROM until they align with the socket contacts.

CAUTION: To avoid damage to the component, do not push the EPROM into the socket until all pins are perfectly aligned with the contacts.

13. Once all pins are aligned with the socket contacts, push down on the EPROM until it is fully seated.

14. Verify that all pins are inserted in the socket contacts.

    NOTE: Carefully inspect each pin and contact to verify that none of the pins are bent under the EPROM.

15. Carefully re-install the CPU circuit board into the face panel.

    NOTE: The **Operating Conditions** and **Alarm Status & Settings** buttons must be aligned and inserted into the face panel.

16. Re-install the hardware that secures the CPU board to the face panel.
17. Re-install the ribbon cable and modem serial port connector.
18. Remove the static control wrist strap.
19. Re-install F1 in the power circuit board.
20. Depress the **Operating Conditions** and **Alarm Status & Settings** buttons while applying power to the system.
21. Verify that the LTC-MAP displays copyright information for ten seconds before going blank.

    NOTE: If the copyright information does not appear, and you have checked the EPROM installation, contact Reuter-Stokes, Inc..
22. Place the old EPROM in the protective packaging and return it to Reuter-Stokes, Inc.

Appendix C: Glossary of Terms

A	Amperes.
Alarm	Operating condition occurring when data point value exceeds the alarm parameter set point.
Averaging Interval	Configurable time period, up to 60 minutes, when the monitor automatically takes incoming data levels and transfers them into memory.
Calibration Parameters	Calibration setpoints for voltage, current, temperature, combustible gas, and tap position.
Clear Memory	Action removes the monitored input data from the monitor non-volatile memory.
COM	Serial communication port on a personal computer.
Combustible Gas	Fault gas in the dielectric oil.
CPU	Central Processing Unit.
CT	Current transducer.
Download	Command that transfers data stored in memory from the monitor to a personal computer.
Gland Plate	Assembly with pre-punched holes, used for routing cables and conduits into the monitor.
Event	Tap change time period.
I/O	Input/Output.
LTC	Load Tap Changer installed on the transformer.
mA	Milliamperes.
Profile Data Recording Mode	Method in which data is stored and updated in the monitor memory.
Relay Parameters	Parameters for transformer control relay and cam signals.
Remote Site	Transformer location – substation.
Rms	Root mean square of a number.
RTD	Resistance temperature detector.
Settable Parameters	Alarm level parameters for sensor inputs.
Tap Position	LTC tap location.
Upload	Command that transfers alarm parameters and site description information to the monitor.
VAC	Volts alternating current.
VDC	Volts direct current.

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