*FM5004*

# Field Monitor

**User Manual**



**ETS·LINDGREN™**

**HOLADAY EMF MEASUREMENT**

Trademarks used in this document: The *ETS-Lindgren* logo is a trademark of ETS-Lindgren L.P.

**Revision Record | FM5004 MANUAL | Part #H-600069, Rev. B**

| Revision | Description | Date |
|----------|-------------|------|
|  | Initial Release | January, 1994 |
| A | Updates / edits | April, 2005 |
| B | Rebrand | April, 2009 |

# Table of Contents

This page intentionally left blank.

**Notes, Cautions, and Warnings**

| | |
|---|---|
| ➜ | **Note:** Denotes helpful information intended to provide tips for better use of the product. |
| **CAUTION** | **Caution**: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures. |
| **WARNING** | **Warning**: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures. |

➜ See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

## General Safety Considerations

| Safety Symbol | Definition |
|---|---|
| **WARNING** | **Warning:** No operator serviceable parts exist inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers. |
| CAUTION: RISK OF ELECTRICAL SHOCK DO NOT OPEN WHEN CONNECTED TO POWER | **Caution:** Uninsulated voltage within the unit may have sufficient magnitude to cause electric shock. Therefore, it is dangerous to make any kind of contact with any parts inside this unit. |
| **CAUTION** | **Caution:** This instrument is shipped with a three-wire power cable, in accordance with international safety standards. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. |

➜ See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

## 1.0  Introduction

The **ETS-Lindgren FM5004 Field Monitor** is a broadband electric and magnetic field monitor designed for use in radio frequency interference and electromagnetic compatibility (RFI/EMC) test system applications.



The FM5004 is compatible with the following ETS-Lindgren **E** (electric) field or **H** (magnetic) battery-operated field probes.
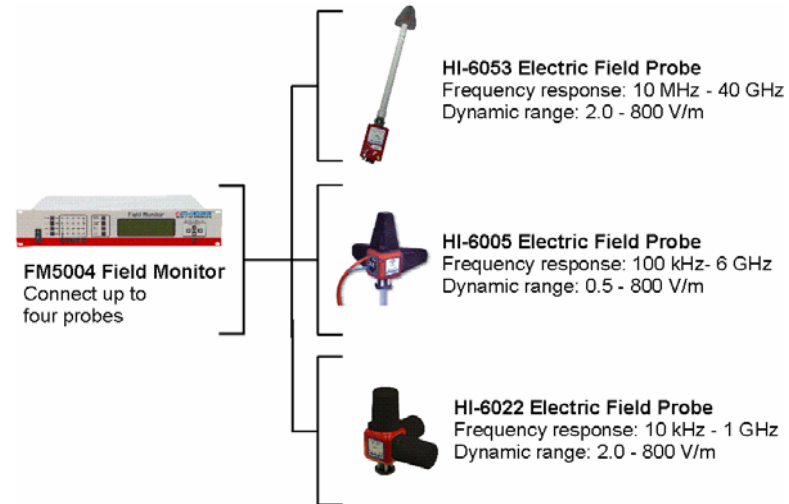


The FM5004 accepts inputs from up to any four probes, and analyzes and displays information on a user configurable LCD display.

The FM5004 provides two digital interfaces (IEEE-488 and RS-232), a switch selectable 0–5 VDC analog output, and audible user selected field strength, temperature, and low probe battery alarms. It has a probe dependent frequency response of 10 kHz–40 GHz and a sensitivity of 0.5 V/m–3000 V/m, 15.0 mA/m–30 A/m (probe dependent).

## Theory of Operation

For information about a specific probe, see the probe manual.

### SYSTEM THEORY

A complete FM5004 system consists of one to four field measurement probes coupled to the FM5004 through fiber optic cables, and optional external devices.

The FM5004 contains fiber optic I/O cards to communicate with the probes, a main processor board, an LCD to display data and system status, a keypad for operator control, and an audible alarm to indicate field strengths above or below a user-defined value. RS-232 and IEEE-488 ports are provided for remote system operation and data collection, and an analog output port is provided for leveling purposes.

The probes and I/O cards use microprocessors to provide intelligent control and operation of the system. Each has a self-contained power supply: a universal input 110–230 VAC supply for the FM5004, and rechargeable battery packs for the probes.

When a field strength reading is requested by the FM5004, the I/O card for that probe sends the appropriate command to the probe through the fiber optic cable. The probe measures the signal level for each enabled axis, a vector addition is performed on these readings, and then the result is transmitted to the I/O card through the fiber optic cables. The I/O card formats the data from the probe and routes it to the main FM5004 processor for interpretation, display, and transmission to a remote recorder (if desired).

## SYSTEM BLOCK DIAGRAM
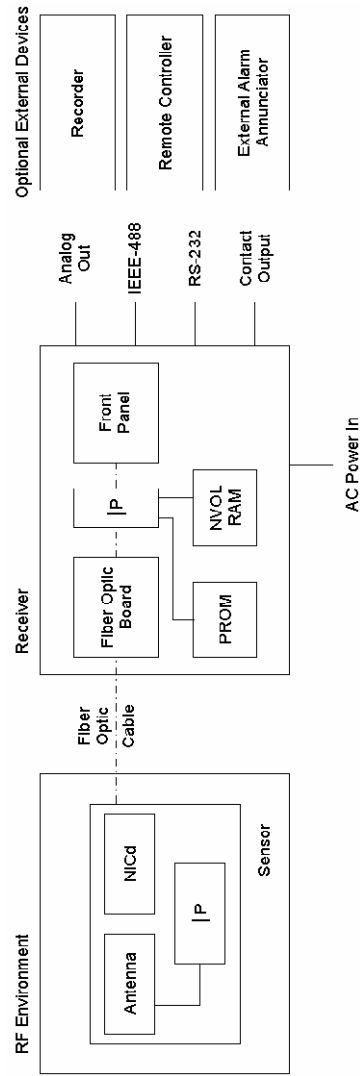
Following are other commands performed by the probes; depending on the specific probe, additional commands may be available.

- Zero

- Switch range

- Enable/disable axis

- Send temperature/battery voltage

When a probe receives a command from the I/O card it performs the requested function and sends a response back to the FM5004.

## RECEIVER THEORY

The FM5004 issues commands to the I/O cards, then the I/O card issues control signals to the probe processor. It also receives the data from the probe, formats it, and relays it to the FM5004 main processor.

The sampling rate, range settings, autorange enable/disable, display format, and other setup parameters are stored in Electrically Erasable Programmable Read-Only Memory (EEPROM). The setups are automatically restored each time the FM5004 is powered on. Flash EEPROM memory is used to store the main program. Random Access Memory (RAM) is used to temporarily store measurements and settings.

Inputs to the FM5004 come from the keypad switches on the front panel or from a remote control device connected through the IEEE-488 or RS-232 ports.

Information from the probes is communicated through the front panel LEDs and display. Optional receiver outputs include:

- Output to a remote receiver through the IEEE-488 or RS-232 ports

- Analog output (with 12-bit resolution) to recorders or leveling circuitry

- Programmable alarm values for driving a relay that controls a remote alarm

The FM5004 power supply operates from a 115–230 VAC power source. The supply provides outputs of +5 VDC, -12 VDC, and +12 VDC.

## RECEIVER BLOCK DIAGRAM
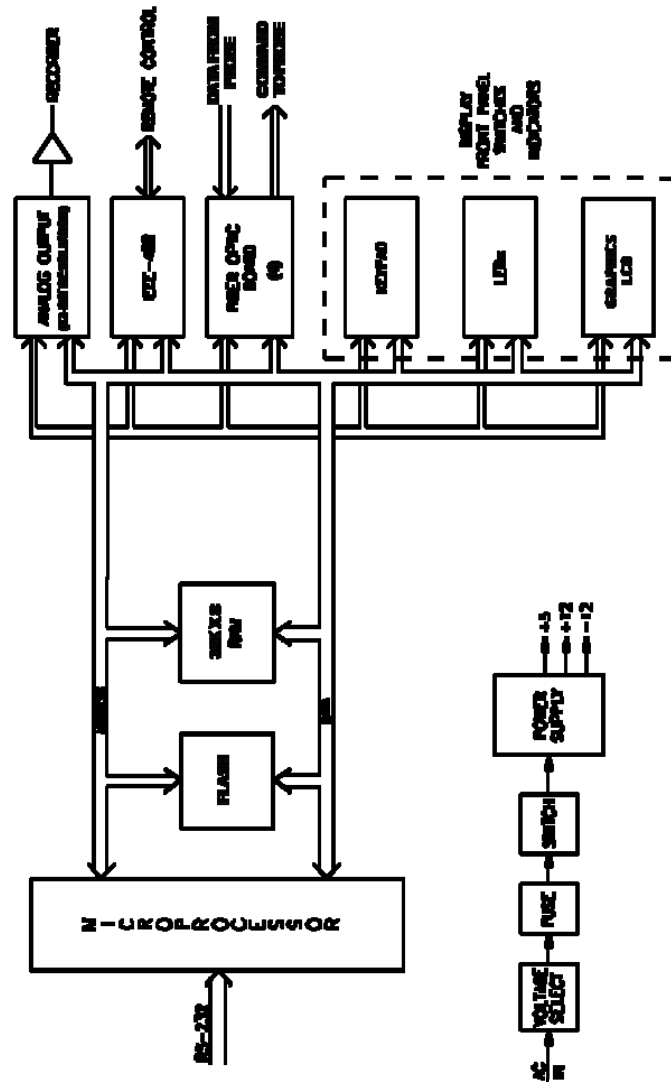
**ZEROING**

➡️ Not all probes have a zero function. For information on zeroing a probe, see the probe manual.

When a probe receives a zero command from the FM5004, the probe must be in a zero field. The processor directs the multiplexer to perform a normal read cycle on all axis signals; this procedure is executed for all 24 settings (four ranges, three axes per range, two antennas per axis). When the processor receives these readings, it stores them in a special register, and then these values are subtracted from all subsequent measurements. Therefore, a probe that is zeroed when it is not in a zero field environment will give erroneous readings.

## ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Warranty information

- Safety, regulatory, and other product marking information

- Steps to receive your shipment

- Steps to return a component for service

- ETS-Lindgren calibration service

- ETS-Lindgren contact information

Archived 10/19/10

## 2.0 Maintenance

**CAUTION** **Before performing any maintenance, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.**

WARRANTY **Maintenance of the FM5004 is limited to external components such as cables or connectors.**

**Warranty may be void if the housing is opened.**

**If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.**

### Maintenance Recommendations

**WEEKLY**

- Check battery status using front panel switch or remote command.

**MONTHLY**

- Clean contaminants from the front panel with a damp cloth. Always unplug the unit before cleaning.

- Disconnect fiber optic cables and verify they are clean. See *Maintenance of Fiber Optics* on page 18 for cleaning guidelines.

- Inspect cables for kinks, breaks, cracks, and loose connectors.

### Annual Calibration

See the *Product Information Bulletin* included with your shipment for information on ETS-Lindgren calibration services.

### Maintenance of Fiber Optics

Fiber optic connectors and cables can be damaged from airborne particles, humidity and moisture, oils from the human body, and debris from the connectors they plug into. Always handle connectors and cables with care, using the following guidelines.

**Before performing any maintenance, disconnect the fiber optic cables from the unit and turn off power.**

**When disconnecting fiber optic cables, apply the included dust caps to the ends to maintain their integrity.**

**Before connecting fiber optic cables, clean the connector tips and in-line connectors.**

**Before attaching in-line connectors, clean them with moisture-free compressed air.**

**Failure to perform these tasks may result in damage to the fiber optic connectors or cables.**

### Service Procedures

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

## 3.0   Before You Begin

**CAUTION**   **Before connecting any components or placing into operation, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.**

Perform all steps in this section before powering on the FM5004 Field Monitor or installing it in a test environment.

### Verify FM5004 Operation

1. Make sure the probes are fully charged. See the probe manual for charging information.

2. Remove the protective covers from the fiber optic cable. Inspect the tips of the cable to verify they are free from dirt and other contaminants.

   Save all protective caps and covers for re-use.
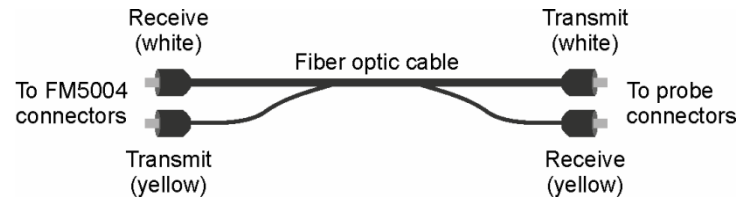


3. Attach the fiber optic cable to the transmit and receive connectors on the back of the FM5004, matching yellow to transmit and white to receive.

4. Attach the other end of the fiber optic cable to the probe connectors, matching white to transmit and yellow to receive.

5. Plug the power cord into the power connector on the back of the FM5004.

6. Plug the other end of the power cord into an electrical outlet.

Set each probe to ARM
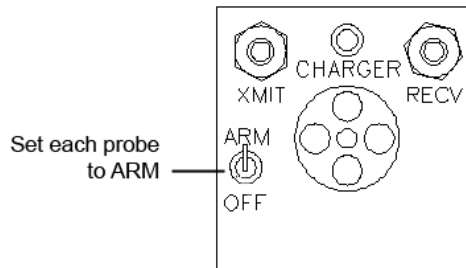
7. Set the ARM/OFF switch on all probes to ARM.

8. Power on the FM5004. A tone will sound, and it will perform a self-test. If an error occurs, see *Troubleshooting and Error Handling* on page 105.

## Verify Optional Connections

If optional connections are part of your system configuration, perform a bench test prior to installing the FM5004.

### REMOTE OPERATION

1. Connect the RS-232 or IEEE-488 cable to the appropriate connector.

   - **If RS-232 remote control is used—**See *Baud Rate* on page 72 for information on setting the device baud rate.

   - **If IEEE-488 remote control is used—**Set the DEVICE ADDRESS to the appropriate bus address for your installation. See *IEEE-488 Requirements* on page 57 for more information.

2. Send an identification query (*IDN?<LF>) from the remote controller; verify that the FM5004 returns the proper response. See *Identification Query* on page 99 for more information.

### ANALOG OUTPUT

1. Connect the appropriate cable to the Analog Out connector on the back of the FM5004.

2. Enable the analog output system and verify proper operation. See *ANALOG OUT SETUP* on page 42 for information on setting up the analog output system.

This page intentionally left blank.

## 4.0   Quick Start

| CAUTION | **Before placing into operation, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.** |

→ Before operating the FM5004, complete the steps in *Before You Begin* on page 25.

Following are the basic steps to configure and operate the FM5004 Field Monitor. To save time and improve accuracy during configuration, before you start the following steps identify the modes and configurations you want for each channel

→ See *Front Panel Controls and Indicators* on page 25 for complete information on using the switches, buttons, and other controls located on the front of the FM5004.

1. Set the ARM/OFF switch on all probes to ARM.

2. Press on the FM5004.

3. Verify no error codes appear on the FM5004 display and that there are no fault indications. If an error code appears or a fault is indicated, see *Troubleshooting and Error Handling* on page 105.

4. Select the channel to which a probe is connected by pressing the channel select switch for that channel, and then press **Disp**.

   Select the desired axes and whether the data is for display or for analog output.

5. If more than one probe is attached, repeat step 4 for each channel.

The configuration is saved in non-volatile memory. It will remain stored unless altered, regardless of whether the FM5004 is powered on.

This page intentionally left blank.

## 5.0 Front Panel Controls and Indicators

| CAUTION | Before connecting any components or placing into operation, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment. |
|---------|-----------------------------------------------|

The front panel of the FM5004 Field Monitor is divided into five sections: Power switch, Input Selection Matrix, System Status, Display, and Menu Select.
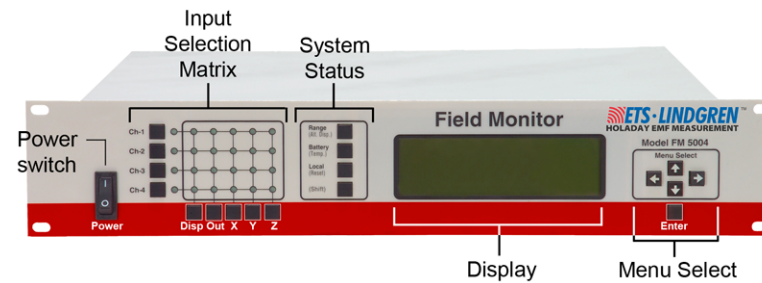


### Power Switch

When power is turned on to the FM5004, it initiates a self-test.

The power switch controls power only to the FM5004, and does not affect power to the probes.
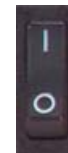
## Input Selection Matrix

The Input Selection Matrix includes Channel Select Switches, Base Mode Switches, and Channel Mode Indicators.
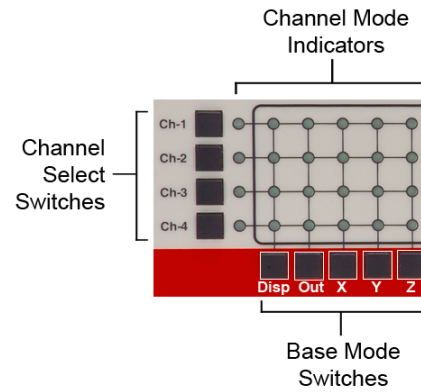


### BASE MODE SWITCHES

The Base Mode Switches include **Disp**, **Out**, **X**, **Y**, and **Z**.

These switches are used to define the FM5004 base operating mode for the selected channel.



The base mode switches select a probe axis (or axes) for display and/or analog output. The input data for the assigned channel may be displayed on the Channel Mode Indicators and/or may be routed to analog output. The base mode selections for a given channel remain active until readjusted.

| Switch | Description |
| --- | --- |
| **Disp** | When this LED is illuminated for a selected channel, that channel is *display selected*, meaning that the readings from this probe will be routed to the display. The FM5004 displays the channel input as a numeric value. To set display mode parameters, use Menu Select. See *Menu Select* on page 32 for more information. |
| **Out** | When this LED is illuminated for a selected channel, that channel is *analog output selected*; meaning that the readings from this probe will be routed to the analog output system. See *ANALOG OUT SETUP* on page 42. |
| **X, Y, Z** | This activates a particular axis on selected channel(s) for display or analog output. Any combination of axes may be chosen; isotropic response requires selecting all three axes. When multiple axes are selected, individual axes are combined vectorially. |

➔ Some probes do not allow an individual axis to be disabled.

### CHANNEL SELECT SWITCHES

The Channel Select Switches include **Ch-1**, **Ch-2**, **Ch-3**, and **Ch-4**.

These switches are used to select the input channel.



These switches determine the channel for which the base mode settings apply. A different base mode may be set up for each channel.

When a channel select switch is pressed, the FM5004 establishes communication with the probe. During this process the base mode (**Disp** or **Out**) LED for that channel will flash. When the connection is established, the LED lights continuously. If the FM5004 fails to make connection with the probe, the LED will go dark.

### CHANNEL MODE INDICATORS

These 24 LEDs form a matrix that signify the current channel and base mode selections. Following are examples that illustrate the correspondence between the LEDs and the base mode selections.
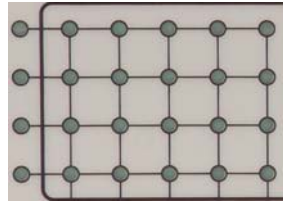


**Example 1–Single Probe Configuration**

1.  Press channel select switch **Ch-1** to select the probe attached to channel 1.

2.  Press base mode switches **X** ,**Y**, and **Z** to provide isotropic response.

3.  Press **Disp** to display the numeric value of the vectorially-combined axis values.

4.  All LEDs in the top row of the matrix are illuminated, except for the second from the left.

    All other LEDs are dark.

**Example 2–Dual Probe Configuration**

1.  Press channel select switch **Ch-1** to select the probe attached to channel 1.

2.  Press **Ch-2** to select the probe attached to channel 2.

3.  Press base mode switches **X** and **Y** to gather the data from only those two axes.

4.  Press **Out** to provide the vectorially-combined value of X and Y reading as an analog output.

5. For channel 1, all LEDs in the top row are illuminated, except for the second from the left.

For channel 2, the middle three LEDs in the second row from the top are illuminated.

All other LEDs are dark.

## System Status

The System Status selections provide one-button access to all selected probes for range and battery as well as enabling local control.

These buttons use **Shift** for additional functionality: alternate display, temperature, and reset.
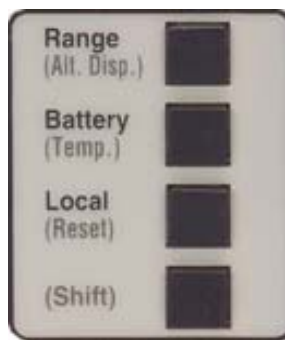
To perform a function on a selected probe, press the channel select switch for the probe. The function will be performed only on the selected probe with the blinking LED. When no channels are selected, the function will be performed for all display or analog output selected channels.

### RANGE (ALT DISP)

#### RANGE

→ Some probes do not respond to the range button due to the presence of an internal auto range function.

Press **Range** to determine the sensitivity of the probe. With each press of the button all selected probes will increment one range.

If the measured signal exceeds the full-scale value for the selected range, an over-range message will display. If the selected measured signal is too low, then an under-range indication will display.

| Range | Description |
| --- | --- |
| **Auto** | Sets the selected channels to autorange. |
| **1 to 4** | Sets the selected channels to the desired range. See the probe manual for a description of the units of measure and range levels. |
| **5** | Some probes may use five or more ranges; this is supported by the FM5004. |

### (ALT DISP)

To change to the alternate display mode, press **Shift**. Set up alternate display by selecting ALT DISPLAY FORMAT in the Main Menu. The FM5004 supports two display formats. See *Display Format* on page 36 for more information.

## BATTERY (TEMP)

### BATTERY

Press **Battery** to display a percentage that represents where in the discharge curve the battery voltage is for each selected probe. This number is derived by taking the actual voltage of the battery pack, subtracting it from the minimum voltage level for the battery (3.18 Volts for a three-cell battery pack), and dividing the result by the full range of the battery (maximum charge voltage minus fully discharged voltage; 4.10–3.18 Volts for a three-cell battery pack).

→ Due to the non-linear discharge curve of nickel-cadmium (NiCd) batteries, the percentage displayed does not reflect the actual operation time left for a probe. It is recommended that for each probe, the approximate battery life left for a given battery voltage percent be noted. In addition, as a battery ages, the overall voltage decreases.

→ When the battery level drops below approximately 13% (3.3 Volts for a three-cell battery pack), a low battery warning will display. When this occurs, the battery should be charged as soon as possible.

When the battery voltage drops to the fully discharged level, a battery fail indication will display. When this occurs, measurement accuracy will be compromised by further operation.

### (TEMP)

Press **Shift** and then **Battery/(Temp)** to display all selected probe temperatures in Fahrenheit and in Celsius.

## LOCAL (RESET)

### LOCAL

Press **Local** to transfer control of the FM5004 to a remote device. The remote device can be an RS-232 serial device or an IEEE-488 device. When the FM5004 is in remote operation, **REM** appears in the upper left corner of the display. Press **Local** again to return the FM5004 to local operation.

### (RESET)

Press and hold **Shift** and then press **Reset** to redraw the display and re-establish communication with the probes. This is useful if the display malfunctions or communication with a probe is lost. It will also reset the running minimum, maximum, and average readings if they are active.

Press **Reset** while pressing **Shift** to cause a hard reset. This is equivalent to cycling the power on the FM5004.

## (SHIFT)

When **Shift** is pressed, the functions in parentheses become active. When active, **Shift** displays. Press **Shift** again to turn it off.

## Display

The display is 240x64 with an adjustable LED back light. The display is used to indicate probe and status information as well as to display the menu windows for system setup.

## Menu Select

The FM5004 menus appear on the display, and five keys control the movement through the menu system and changing the settings.



The setup parameters are saved in non-volatile memory (EEPROM) and are loaded each time the FM5004 is powered on.
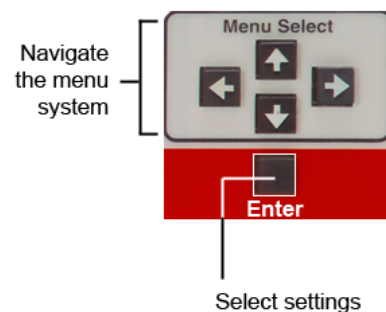
### USING THE MENU KEYS

Five keys control menu navigation and data entry:

- **Navigate the menu system—**The four arrow keys are used to enter the menu system, move between selections in the menus, open submenus, change settings, and exit the menu system.

  The UP ARROW and DOWN ARROW are used to increment and decrement a number when in a numeric entry menu.

- **Select settings—Enter** is used to select settings from a list and to save numeric entries.

### NAVIGATING THE MENU SYSTEM

 For a complete description of the menu system, Main Menu, and submenus, see *Menu System* on page 35.

- To display the Main Menu, press any arrow key. A cursor appears to the left of the first item in the Main Menu.

- The UP ARROW and DOWN ARROW move the cursor through the menu items.

- When the bottom of a column is reached, press the DOWN ARROW to go to the top of the next column or to the top of the same column if the menu contains only one column of selections. The UP ARROW works in reverse.

- With the cursor next to a submenu icon, press the RIGHT ARROW to open that submenu.

- Press the LEFT ARROW to back up to the previous menu.

### CHANGING SETTINGS

1. Press the arrow keys to move the cursor through the menu items. When the menu that contains the item to be changed is reached, place the cursor to the left of that item.

    $\sqrt{\phantom{x}}$    If the item icon is a checkmark, press **Enter** to toggle the function on or off.

    A solid checkmark indicates that the function is selected, and a hollow checkmark indicates it is not selected. If several checkmarks appear, only one of the options may be enabled at one time.

    ↑ ↓    If the item icon is a set of arrow keys, the numeric entry screen will appear. The name of the selected item will display at the top of the menu and the current value for that item will display in large type.

    Press the arrow keys to increment or decrement the number.

2. To save the value, press **Enter**. This will return the display to the previous menu.

    If you press the LEFT ARROW before **Enter**, the value will return to the last value saved and the previous menu will display.

### EXITING THE MENU SYSTEM

Press the LEFT ARROW until the menu system closes.

This page intentionally left blank.

## 6.0   Menu System

➡️ For information on navigating the menu system, see *Menu Select* on page 32.

The menus are organized into a tree format. For example, the Main Menu contains a list of submenus that will call another submenu, and that menu may call additional submenus.

Other menu types include:

- **Numeric entry—**Calls up a data entry screen.

- **Item selection—**Allows you to select a setting from a list of options.

- **Advanced setup—**Allows you to perform diagnostics and upgrade software.

### MAIN MENU

```
              MAIN MENU

 □ DISPLAY SETUP      □ ZERO PROBES

 □ ANALOG SETUP       □ SYSTEM STATUS

 □ REMOTE SETUP       ↑ ↓  SAMPLES/SEC

 □ ALARM SETUP        √  KEY CLICK

 □ SETUP SAVE/REC       ALARM SILENCE
```

**DISPLAY SETUP**

DISPLAY SETUP
- □ DISPLAY FMT          ↕ LCD CONTRAST
- □ ALT DISP FMT         ↕ LCD BRIGHT
- □ DISP UPDATE RATE

DISPLAY FORMAT
√ 4-PROBE
□ 2-LINE

—3 AXIS—
√ PROBE-1
√ PROBE-2
√ PROBE-3
√ PROBE-4

2-LINE
—LINE 1—
√ MIN OF PROBE
√ MAX OF PROBE
√ AVERAGE OF PROBE
√ ANALOG OUT

—LINE 2—
√ MIN OF PROBE
√ MAX OF PROBE
√ AVERAGE OF PROBE
√ ANALOG OUT

ALT DISPLAY FORMAT
√ 4-PROBE
□ 2-LINE

—3 AXIS—
√ PROBE-1
√ PROBE-2
√ PROBE-3
√ PROBE-4

2-LINE
—LINE 1—
√ MIN OF PROBE
√ MAX OF PROBE
√ AVERAGE OF PROBE
√ ANALOG OUT

—LINE 2—
√ MIN OF PROBE
√ MAX OF PROBE
√ AVERAGE OF PROBE
√ ANALOG OUT

DISPLAY UPDATE RATE
√ 1 UPDATE / SECOND
√ 2 UPDATES / SECOND
√ 5 UPDATES / SECOND
√ 10 UPDATES / SECOND

## DISPLAY SETUP

Sets the format of the data on the display, display brightness, and display contrast.

□ DISPLAY FMT       ↑ ↓ LCD CONTRAST

□ ALT DISP FMT      ↑ ↓ LCD BRIGHT

□ DISP UPDATE RATE

**DISPLAY FORMAT / ALT DISPLAY FORMAT**

Contains items associated with the presentation of data on the display when in normal and alternate display mode.

### DISPLAY FORMAT

√ 4-PROBE        –3 AXIS–

□ 2-LINE         √ PROBE-1

                 √ PROBE-2

                 √ PROBE-3

                 √ PROBE-4

### ALT DISPLAY FORMAT

√ 4-PROBE        –3 AXIS–

□ 2-LINE         √ PROBE-1

                 √ PROBE-2

                 √ PROBE-3

                 √ PROBE-4

→ For each saved setup, two display configurations are saved. This allows you to quickly switch between two commonly used formats.

To toggle between normal and alternate display format, on the front panel press **Shift** and then **Range (Alt Disp)**.

### 4-PROBE

When selected, the display is divided into four sections, one for each channel. The reading from each probe is displayed in these sections. If the display is disabled for a given channel, that section of the display will be empty.

### 2-LINE

Allows you to view two readings on the display at one time.

```
                          2-LINE

    –LINE 1–                      –LINE 2–

    √ MIN OF PROBE                √ MIN OF PROBE

    √ MAX OF PROBE                √ MAX OF PROBE

    √ AVERAGE OF PROBE   √ AVERAGE OF PROBE

    √ ANALOG OUT                  √ ANALOG OUT
```

→ Only one selection at a time may be made from the Line 1 column and Line 2 column.

The display is divided into two sections, line 1 on top, and line 2 on bottom. The minimum, maximum, or average of the display-enabled probes appear on each line, and the reading is sent to the analog output system; see *Analog Out Setup* on page 42 for information on setting up the analog output system. Different channels may be selected for routing to the analog output and display systems, displaying readings from different probes on each line.

For example, you may display the maximum reading from channel 1 and channel 2 on line 1, and the maximum of the readings from channel 3 and channel 4 on line 2. Selecting channel 1 and channel 2 for the display system and channel 3 and channel 4 for the analog output system will achieve this set up.

→ Unless indicated, calculations for the following readings are based on the number of previous samples, which is determined from the display update rate. See *Display Update Rate* on page 41 for information on setting the display update rate.

| **LINE 1** | |
| --- | --- |
| • **MIN OF PROBE** | The minimum of the current reading and the previous samples for the display-selected probes will display on line 1. |
| • **MAX OF PROBE** | The maximum of the current reading and the previous samples for the display-selected probes will display on line 1. |
| • **AVERAGE OF PROBE** | The average of the current reading and the previous samples for the display-selected probes will display on line 1. |
| • **ANALOG OUT** | • The readings sent to the analog output system will display on line 1. The number will be an average of the current reading and previous readings.<br><br>• The number of previous readings is determined from the filter size setting in the Analog Out Setup menu.<br><br>• For example, if filter size is set to 10, the number displayed is an average of the current reading plus the nine previous readings. This number will be updated at the display update rate. |

| **LINE 2** | |
| --- | --- |
| • **MIN OF PROBE** | The minimum of the current reading of all probes attached and the previous samples for the display-selected probes will display on line 2. |

| LINE 2 | |
|---|---|
| • **MAX OF PROBE** | The maximum of the current reading of all probes attached and the previous samples for the display-selected probes will display on line 2. |
| • **AVERAGE OF PROBE** | The average of the current reading and the previous samples for the display-selected probes will display on line 2. |
| • **ANALOG OUT** | • The readings sent to the analog output system will display on line 2. The number displayed will be an average of the current reading and previous readings.<br><br>• The number of previous readings is determined from the filter size setting in the Analog Out Setup menu.<br><br>• For example, if filter size is set to 10, the number displayed is an average of the current reading plus the nine previous readings. |

### 3-AXIS

The readings for all enabled axes and the combined reading (square root of the sum of squares) is displayed for the selected probe. Only one probe at a time may be selected for 3-axis display. If an axis is disabled, only readings for the enabled axes are displayed, and the combined reading includes only the enabled axes.

**DISPLAY UPDATE RATE**

Sets the display update rates, which is the number of times per second that the display will update with new readings.

```
DISPLAY UPDATE RATE

√  1 UPDATE / SECOND

√  2 UPDATES / SECOND

√  5 UPDATES / SECOND

√  10 UPDATES / SECOND
```
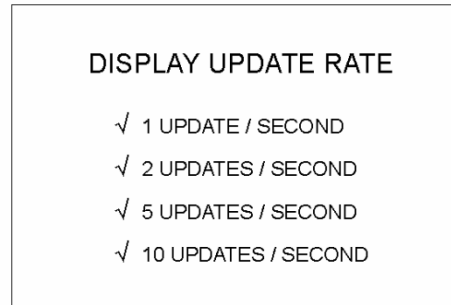
If the samples per second setting in the Main Menu is greater than the display update rate, then all samples taken after the last display update will be included in the new update. The displayed reading will be an average of the previous samples.

In 2-line display mode, with minimum or maximum of probe selected, the displayed reading will be the minimum or maximum of the previous samples. If the display update rate is set greater than samples per second, the display will update only when new samples are taken.

**LCD CONTRAST**

Adjusts the display contrast. This can make the display more readable under different lighting conditions and viewing angles.

➔ Improper adjustment of the contrast may make the display unreadable. If the display is blank, the contrast may be set too low. If the display is completely dark, the contrast may be set too high.

**LCD BRIGHTNESS**

Adjusts the brightness of the display. This can make the display more readable under different lighting conditions and viewing angles.

**ANALOG OUT SETUP**

## ANALOG OUT SETUP

- □ FULL SCALE RANGE
- □ MIN/MAX/AVG
- ↑↓ FILTER SIZE
- √ LOG SCALE OUTPUT

## MIN/MAX/AVG

- √ MIN
- √ MAX
- √ AVERAGE

## FULL SCALE RANGE

- √ RANGE 1
- √ RANGE 2
- √ RANGE 3
- √ RANGE 4

Contains the items associated with the analog output functions of the FM5004.

```
┌─────────────────────────────────┐
│       ANALOG OUT SETUP          │
│                                 │
│      ☐ FULL SCALE RANGE         │
│                                 │
│      ☐ MIN/MAX/AVG              │
│                                 │
│      ↑ ↓  FILTER SIZE           │
│                                 │
│      √ LOG SCALE OUTPUT         │
│                                 │
└─────────────────────────────────┘
```

To select a probe for the analog output system, press the channel select switch for the desired probe, and then press **Out**. The **Out** LED for that channel will illuminate. More than one channel may be selected at one time.

## FULL SCALE RANGE

This only applies to operation in auto-range mode.

When operating in a fixed range, the analog output full scale range will be the upper limit of the highest range of analog output selected probes.

```
┌─────────────────────────────────┐
│       FULL SCALE RANGE          │
│                                 │
│         √ RANGE 1               │
│                                 │
│         √ RANGE 2               │
│                                 │
│         √ RANGE 3               │
│                                 │
│         √ RANGE 4               │
│                                 │
└─────────────────────────────────┘
```

Contains the allowable full scale range settings for the analog output system. The field level that corresponds to a full scale output of five volts is the upper limit of the range selected. A zero field will create an analog output of zero volts.

➡️ If the output reading is larger than the upper range, the output voltage will be five volts and an analog output over range condition will display on the front panel.

**MIN/MAX/AVG**

Contains the allowable functions to be used on the analog output data.

```
                    MIN/MAX/AVG

                    √ MIN
                    √ MAX
                    √ AVERAGE
```
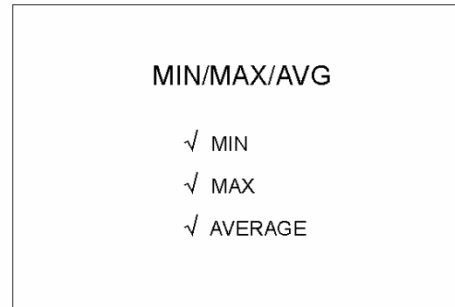
- **Minimum:**  The minimum sample in the sample window is sent to the analog output system.

- **Maximum:**  The maximum sample in the sample window is sent to the analog output system.

- **Average:**  The average of all samples in the sample window is calculated and sent to the analog output system.

For more information, see the next section, *Filter Size*.

**FILTER SIZE**

Calls up the numeric entry screen to select the number of samples to use for each analog output update. The saved sample represents a sliding window and serves as a smoothing function for the analog output signal. The analog output level is updated every sample according to the samples per second setting in the Main Menu.

- If the filter size is greater than one, the sample window contains the current sample plus the most recent samples.

- If the filter size is set to one, only the current sample is used by the analog output system.

The minimum/maximum/average setting affects how the data is processed. See *Min/Max/Avg* on page 44.

**LOG SCALE OUTPUT**

Selects either linear or log scale for the analog output voltage.

- When selected, the output will track a logarithmic curve with a zero field level being zero volts out and a full scale field level being five volts out.

- When deselected, the endpoints will be the same but the analog voltage out to field level ratio will be linear.

**REMOTE OPER SETUP**

Contains items associated with setting up the FM5004 for remote operation.

```
        REMOTE OPER SETUP

    –RS-232–

    √ 1200 BAUD      √ 19200 BAUD

    √ 2400 BAUD

    √ 4800 BAUD      –GPIB–

    √ 9600 BAUD       ↑ ↓  GPIB ADDRESS
```

- **RS-232:**    Settings for the communications rate between the FM5004 and the remote controller.

- **GPIB:**    Calls the numeric entry screen to select the GPIB address (0 to 31) for the FM5004.

# ALARM SETUP

**ALARM SETUP**
☐ 4-PROBE / 3-AXIS ALARM SETUP
☐ LINE 1 ALARM SETUP
☐ LINE 2 ALARM SETUP
☐ TEMP ALARM SETUP
☐ SYSTEM ALARM   √ BATTERY ENABLE

**SYSTEM ALARM**
√ MOMENTARY PROBE FAIL
√ HARD PROBE FAIL
√ BATTERY ENABLE

**LINE 2 ALARM**
√ UPPER ENABLE   √ LATCHED
↑↓ UPPER VALUE
√ LOWER ENABLE
↑↓ LOWER VALUE

**ALARM SETUP**
☐ 4-PROBE / 3-AXIS ALARM SETUP
☐ LINE 1 ALARM SETUP
☐ LINE 2 ALARM SETUP
☐ TEMP ALARM SETUP
☐ SYSTEM ALARM   √ BATTERY ENABLE

**LINE 1 ALARM**
√ UPPER ENABLE   √ LATCHED
↑↓ UPPER VALUE
√ LOWER ENABLE
↑↓ LOWER VALUE

**TEMP ALARM SETUP**
√ UPPER ENABLE   √ LATCHED
↑↓ UPPER VALUE
√ LOWER ENABLE
↑↓ LOWER VALUE

```
                    ALARM SETUP

                 ☐ 4-PROBE / 3-AXIS ALARM SETUP

                 ☐ LINE 1 ALARM SETUP

                 ☐ LINE 2 ALARM SETUP

                 ☐ TEMP ALARM SETUP

                 ☐ SYSTEM ALARM     √  BATTERY ENABLE
```

Contains the items associated with setting up the alarms for the FM5004.

## 4-PROBE / 3-AXIS ALARM SETUP

Contains the items associated with the following functions:

- Enabling the upper and lower alarms.

- Setting the levels that will cause an alarm.

- The pulse type of the alarm.

```
                    ALARM SETUP

         √  UPPER ENABLE          √  LATCHED

         ↑ ↓ UPPER VALUE

         √  LOWER ENABLE

         ↑ ↓ LOWER VALUE
```

- **Upper Enable:**    The alarm will activate when the measured field is greater than the upper alarm value.

- **Upper Value:**    Calls the numeric entry screen to enter the upper measured field value above which the alarm will activate.

- **Lower Enable:**    The alarm will activate when the measured field falls below the lower alarm value.

- **Lower Value:**          Calls the numeric entry screen to enter the lower measured field value below which the alarm will activate.

- **Latched:**          The alarm will sound continuously when an enabled upper or lower value is crossed, even if the measured field returns to within the normal field level.

  To temporarily disable the alarm, select Alarm Silence from the Main Menu or power the FM5004 on and off.

## LINE 1 ALARM / LINE 2 ALARM

Contains the items associated with setting up the alarm for use while in 2-line display mode. There are separate alarm setup menus for each line in 2-line display mode.

➡️  Using the alarms while in 2-line display mode allows the use of two different upper and lower alarm values for different probes.

```
         LINE 1 ALARM

√ UPPER ENABLE        √ LATCHED
↑ ↓ UPPER VALUE
√ LOWER ENABLE
↑ ↓ LOWER VALUE
```

```
         LINE 2 ALARM

√ UPPER ENABLE        √ LATCHED
↑ ↓ UPPER VALUE
√ LOWER ENABLE
↑ ↓ LOWER VALUE
```

- **Upper Enable:**          The alarm will activate when the measured field is greater than the upper alarm value.

- **Upper Value:**          Calls the numeric entry screen to enter the upper measured field value above which the alarm will activate.

- **Lower Enable:**  The alarm will activate when the measured field falls below the lower alarm value.

- **Lower Value:**  Calls the numeric entry screen to enter the lower measured field value below which the alarm will activate.

- **Latched:**  The alarm will sound continuously when an enabled upper or lower value is crossed, even if the measured field returns to within the normal field level.

  To temporarily disable the alarm, select Alarm Silence from the Main Menu or power the FM5004 on and off.

## TEMP ALARM SETUP

Contains the items associated with setting up the alarm for an out of range temperature condition.

```
TEMP ALARM SETUP

√ UPPER ENABLE          √ LATCHED
↑↓ UPPER VALUE
√ LOWER ENABLE
↑↓ LOWER VALUE
```
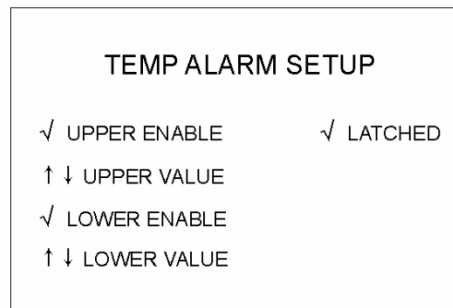
The temperature alarm will become inactive when the sample rate is set above 10 samples per second. However, taking a temperature measurement from either the front panel or by a remote temperature measurement command will cause an alarm if the alarm is enabled and the measurement causes an alarm condition.

- **Upper Enable:** The alarm will activate when temperature of any active probe rises above the upper alarm value.

- **Upper Value:** Calls the numeric entry screen to enter the upper temperature level above which the alarm will activate.

- **Lower Enable:** The alarm will activate when a probe temperature falls below the lower alarm value.

- **Lower Value:** Calls the numeric entry screen to enter the lower temperature level below which the alarm will activate.

- **Latched:** The alarm will sound continuously when an enabled upper or lower temperature level is crossed, even if the measured temperature returns to within the normal field level.

  To temporarily disable the alarm, select Alarm Silence from the Main Menu or power the FM5004 on and off.

**SYSTEM ALARM**

Contains the items associated with setting up the alarm for probe failures or system errors.

```
            SYSTEM ALARM

    √  MOMENTARY PROBE FAIL
    √  HARD PROBE FAIL
    √  BATTERY ENABLE
```
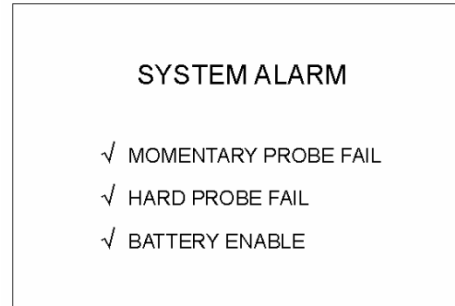
- **Momentary Probe Fail:**   The alarm will activate when a momentary error occurs in a probe or if an error occurs during communication with a probe.

- **Hard Probe Fail:**   The alarm will activate when an error condition occurs repeatably.

- **Battery Enable:**   The alarm will activate when the voltage on an active probe falls below the level at which normal probe operation is guaranteed.

  The battery alarm will become inactive when the sample rate is set above 10 samples per second. However, taking a battery measurement from either the front panel or by a remote battery measurement command will cause an alarm if the alarm is enabled and the measurement causes an alarm condition.

**SETUP SAVE/RECALL**

Contains the items associated with saving and recalling up to four different setup configurations.

Each setup may contain a separate primary display and an alternate display.

```
┌─────────────────────────────────────┐
│         SETUP RECALL/SAVE           │
│                                     │
│   √ RECALL 1          √ SAVE 1      │
│   √ RECALL 2          √ SAVE 2      │
│   √ RECALL 3          √ SAVE 3      │
│   √ RECALL 4          √ SAVE 4      │
│   √ RECALL DEFAULT      EXECUTE     │
│                                     │
└─────────────────────────────────────┘
```

To switch between primary and alternate displays, on the front panel press and release **Shift** and then press and release **Alt Disp**.

When the FM5004 is powered up it will be configured as it was before it was previously powered down; any changes made to a setup will not be saved permanently until it is saved in this menu.

The recall default setting will configure the FM5004 as it was shipped from the factory.

### ZERO PROBES

Contains the items associated with zeroing the probes connected to the FM5004.

To zero a probe, it must be enabled for either display or analog output functions.

```
ZERO PROBES

√ ALL PROBES

√ PROBE – 1

√ PROBE – 2

√ PROBE – 3

√ PROBE – 4
```
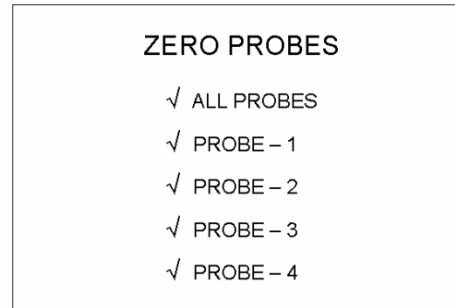
The actual zero function will not occur until the menu system is exited. **ZERO** will display after a zero operation is performed.

### MAINTENANCE

Contains the items associated with updating the FM5004 software and checking the system voltage levels.

```
MAINTENANCE

☐ LAST ERRORS

☐ SYSTEM STATUS

↑↓ SAMPLES/SEC

√ KEY CLICK

☐ ALARM SILENCE
```
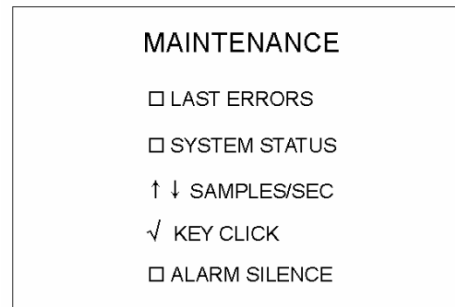
### LAST ERRORS

Displays detailed descriptions of any errors that occurred since the last system reset or power up. Each error includes a time stamp, in seconds, identifying when it occurred since the last system reset or power up. Press the UP ARROW and DOWN ARROW to scroll through the errors.

## SYSTEM STATUS

Displays the following information:

- Software Revision
- Software Date
- +5V Buss Voltage
- +12V Buss Voltage
- -12V Buss Voltage

The acceptable values for the buss voltages are +/-10% of nominal. If the measured voltages are outside of this range, contact ETS-Lindgren.

## SAMPLES/SEC

Calls the numeric entry screen to select the field measurement sample rate in samples per second. The minimum sample rate is one sample per second. The maximum sample rate is determined by the FM5004 and is based on the speed of the connected probes. The maximum rate is limited to the slowest probe that is communicating with the FM5004.

➡ When the FM5004 is in 3-axis mode, the actual sample rate for a complete measurement of the probe field is 1/6 of the selected sample rate.

## KEY CLICK

If selected, the FM5004 alarm will emit a short pulse each time a key is pressed.

## ALARM SILENCE

To silence the alarm temporarily when in latched mode, position the arrow to the left of this item and press **Enter**. However, if the parameter that caused the alarm to occur is still outside of the alarm limits, the alarm will still latch on when the menu system is exited.

To silence the alarm permanently, the alarm must be disabled in the alarm setup section or the probe must be disconnected or turned off.

This page intentionally left blank.

## 7.0   Remote Operation

The FM5004 Field Monitor may be operated remotely by connecting the IEEE-488 parallel port or the RS-232 serial port to a remote device, such as an IEEE-488 bus or a personal computer.

The IEEE-488 port is IEEE-488.2 compatible.

### Command Set Format

See *Remote Commands* on page 60 for a detailed description of remote commands.

Each command code is composed of two or three alpha characters and an optional numeric parameter; commands can be entered in upper or lower case.

If a command is sent without the optional numeric parameter, the instrument assumes the command is a status request. When the command is a status request, the instrument returns a string consisting of the command followed by the current setup for that command.

All commands are terminated by a line feed <LF>. To include several commands in a single command string, separate each command by a semicolon (delimiter). Do not include spaces between a command and the associated numeric parameter. Data returned from the instrument will be terminated with a <CR><LF>.

### IEEE-488

**IEEE-488 REQUIREMENTS**

For IEEE-488 operation, the device address is set using the menu system. At the factory the device address is set to **4**. If your IEEE-488 device uses address 4, reset the switch to a vacant address.

→ Specific IEEE-488 bus commands depend on the software package you use. To send commands, be sure that the receiver address is set properly and that the controller also has correctly identified the receiver as a listening device.

## IEEE-488 (GPIB) COMMUNICATIONS

For General Purpose Interface Bus (GPIB) communications, the End or Identify (EOI) control line may also be used for command termination. When sending commands to the receiver through the GPIB, terminate the command with a <LF>, an EOI, or both. No characters are permitted after the <LF> or EOI; the system interprets characters following <LF> or EOI as the start of another command.

When an error condition is present at the receiver, the Service Request (SRQ) signal is asserted. The operator can then perform a serial poll operation. The receiver error code (in binary) is contained in the lower bits of the serial poll status byte. If the receiver is addressed as a listener and the GPIB remote line is asserted, the receiver will switch to remote mode.

## RS-232

### RS-232 COMMUNICATIONS

During initialization, the receiver will test for a properly connected RS-232 interface. For the receiver to recognize an RS-232 device, the Data Carrier Detect (DCD) line must be asserted. This line is sampled continuously to determine if the RS-232 connection is broken; therefore, it must remain asserted for the RS-232 interface to function.

The Clear To Send (CTS) line is also used to gate information from the receiver; this line must be asserted for information to be transferred from the receiver. The CTS line can be used as a handshake line to inform the receiver when it is permissible to send information (there is a five second timeout error built into the receiver, resulting in an error if the timeout occurs). If the CTS line is de-asserted in the middle of a transmission, a character in the process of being transmitted will be completed, and then transmission will halt until the CTS line is re-asserted.

The receiver asserts two lines: Data Terminal Ready (DTR) and Request To Send (RTS). These lines are asserted continuously and do not perform a handshake function; they can simply be connected to the CTS and DCD lines at the connector. This will allow the receiver to transmit with a minimum of wires and with no handshaking. See *RS-232 Pin Detail* on page 59 for pinout information.

Once the RS-232 interface is established, commands are processed in a manner similar to the IEEE interface. The command structure is identical, except there is no EOI line; therefore, all commands must be terminated by a <LF>.

When a valid command is received, it is processed and the result is immediately transmitted back over the RS-232 interface. The CTS line can be used to control the flow of information from the receiver, as described on page 58. The output format is identical to that of the IEEE format except there is no EOI line.

### RS-232 SETTINGS

| | |
|---|---|
| **Word Length:** | 8 bits |
| **Stop Bits:** | 1 |
| **Baud Rate:** | 1200–19200 (menu selectable) |
| **Parity:** | None |

### RS-232 PIN DETAIL

- **Connector:** DB-9S

- **Mating connector:** DB-9PS
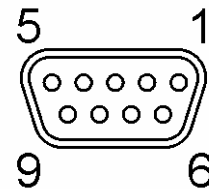
| Pin | Signal | Data Direction | Description |
|-----|--------|----------------|-------------|
| 1 | DCD | Input to FM5004 | Device Carrier Detect |
| 2 | RD | Input to FM5004 | Receive Data |
| 3 | TD | Output from FM5004 | Transmit Data |
| 4 | DTR | Output from FM5004 | Data Terminal Ready |
| 5 | GND | NA | Ground |
| 6 | NC | NA | No Connection |
| 7 | RTS | Output from FM5004 | Ready to Send |
| 8 | CTS | Input to FM5004 | Clear to Send |
| 9 | NC | NA | No Connection |

➡️ A null modem cable or adapter is required to interface the FM5004 to a standard serial port on a personal computer.

## Remote Commands

➡️ For system level commands required for IEEE-488.2 compliance, see page 96.

The following conventions are used in the remote commands and returned data syntax:

- *x*—A lowercase **x** represents a numeric value, which may be a voltage value or a numeral associated with a functional selection.

- *n*—A lowercase **n** represents a channel number (1 through 4) associated with a system probe.

- *m*—A lowercase **m** represents a mode selection.

When a numeric input is sent to the FM5004, the base of the numbers can be decimal, binary, octal, or hexadecimal. For data sent back from the FM5004, the base is always base 10. For example, all of the following are equivalent:

- AUPV,1,100

- AUPV,1,#h64

- AUPV,1,#b1100100

- AUPV,1,#q144

- AUPV,1,1e2

### ALARM LATCH

| | |
|---|---|
| **Description:** | Sets or clears the FM5004 alarm latches. <br><br> There is a separate alarm latch for each of the three alarms: line 1 alarm, line 2 alarm, and 4-probe/3-axis alarm |
| **Syntax:** | ALAT,m,x |
| **Parameters:** | Alarm mode (m): <br><br> • 0 = 4-probe/3-axis alarm latch <br><br> • 1 = line 1 alarm latch <br><br> • 2 = line 2 alarm latch <br><br> Numeric value (x): <br><br> • 0 = latch disabled (clear) <br><br> • 1 = latch enabled (set) |
| **Example:** | • To set the line 1 alarm latch: <br> ALAT,1,1<LF> <br><br> • To verify the latch status: <br> ALAT,1?<LF> <br><br> • If the latch is set, the FM5004 will return: <br> ALAT,1,1<CR><LF> |

**ALARM SILENCE**

| | |
|---|---|
| **Description:** | Temporarily silences the FM5004 alarm when it is latched. |
| | The alarm will silence temporarily, and will become active again if the reading that caused the alarm to occur does not return to the normal range before the next measurement. |
| **Syntax:** | ALSR |
| **Parameters:** | None |
| **Example:** | If the alarm is latched on, to silence it:<br>ALSR<LF> |

**ALTERNATE DISPLAY FORMAT**

| | |
|---|---|
| **Description:** | Sets the alternate display format for the FM5004 display.<br><br>When a command is sent to enable a display format, the previous format will become disabled. If all modes are turned off, the alternate display will become inactive (blank).<br><br>In the case of the 4-probe display mode, only the **m** and **x** parameters are required.<br><br>When setting the alternate display to 2-line mode, a separate command is required to define each line. |
| **Syntax:** | ADFM,m,n,x |
| **Parameters:** | Display format (m):<br><br>• 1 = 2-line, line 1 display<br><br>• 2 = 2-line, line 2 display<br><br>• 3 = 3-axis display<br><br>• 4 = 4-probe display (**n** parameter not used)<br><br>Display mode (n):<br><br>• 1 = probe 1 (3-axis format) or minimum of probes (2-line format)<br><br>• 2 = probe 2 (3-axis format) or maximum of probes (2-line format)<br><br>• 3 = probe 3 (3-axis format) or average of probes (2-line format)<br><br>• 4 = probe 4 (3-axis format) or analog output (2-line format)<br><br>Numeric value (x):<br><br>• 0 = mode disabled<br><br>• 1 = mode enabled |

### ALTERNATE DISPLAY FORMAT

| Example: | <ul><li>To set the alternate display mode to 2-line format, line 1 to average of display enabled probes, and line 2 to the analog output reading:<br>ADFM,1,3,1<LF>, ADFM,2,4,1<LF></li><li>To verify that the line 1 display is set to average of display selected probes:<br>ADFM,1,3?<LF><br><br>If it is enabled, the FM5004 will return:<br>ADFM,1,3,1<CR><LF></li><li>To set the alternate display mode to 4-probe display format:<br>ADFM,4,1<LF></li></ul> |
| --- | --- |

### ALARM LOWER ENABLE

| | |
|---|---|
| **Description:** | Enables the line 1, line 2, 4-probe/3-axis, battery, or temperature lower limit alarms. Each of these alarms must be enabled and disabled separately.<br><br>In the case of the low battery alarm, the level is not adjustable. See the *Battery* on page 30 for a description of the low battery alarm operation. See *Alarm Lower Value* on page 67 to set the alarm lower values. |
| **Syntax:** | ALOE,m,x |
| **Parameters:** | Alarm Type (m):<br><br>• 0 = low temperature alarm enable<br><br>• 1 = line 1 lower alarm enable<br><br>• 2 = line 2 lower alarm enable<br><br>• 4 = 4-probe/3-axis lower alarm enable<br><br>• 5 = low battery alarm enable<br><br>Numeric value (x):<br><br>• 0 = lower alarm disabled<br><br>• 1 = lower alarm enabled |
| **Example:** | • To enable the line 1 lower alarm:<br>ALOE,1,1<LF><br><br>• To verify the line 1 lower alarm status:<br>ALOE,1?<LF><br><br>The FM5004 will return:<br>ALOE,1,1<CR><LF> |

**ALARM LOWER VALUE**

| | |
|---|---|
| **Description:** | Sets the lower levels for the line 1, line 2, 4-probe/3-axis, and high temperature alarms. Each of the alarm levels must be set using individual commands. <br><br> For an alarm to operate, that alarm must be enabled. The data entered can contain up to five numbers and a decimal point. <br><br> See the description for each alarm type for the permissible range. See *Alarm Lower Enable* on page 66 to enable an alarm. |
| **Syntax:** | ALOV,m,xxxxxx |
| **Parameters:** | Alarm Type (m): <br><br> • 0 = low temperature alarm, range: 32°F–211°F <br><br> • 1 = line 1 alarm, range: 0—max of probe <br><br> • 2 = line 2 alarm, range: 0—max of probe <br><br> • 4 = 4-probe/3-axis alarm, range: 0—max of lowest range probe <br><br> Alarm level (xxxxxx) <br><br> • xxxxxx = alarm value: 0–1999.9 |
| **Example:** | • To set the line 1 lower alarm value to 150.5: ALOV,1,150.5<LF> <br><br> • To verify the line 1 lower alarm value: ALOV,1?<LF> <br><br> The FM5004 will return: ALOV,1,150.5<CR><LF> |

### ALARM UPPER ENABLE

| | |
|---|---|
| **Description:** | Enables the line 1, line 2, 4-probe/3-axis, battery, or temperature upper limit alarms. Each of these alarms must be enabled and disabled separately.<br><br>See *Alarm Upper Value* on page 69 to set the alarm upper values. |
| **Syntax:** | AUPE,m,x |
| **Parameters:** | Alarm Type (m):<br><br>• 0 = high temperature alarm enable<br><br>• 1 = line 1 upper alarm enable<br><br>• 2 = line 2 upper alarm enable<br><br>• 4 = 4-probe/3-axis upper alarm enable<br><br>Numeric value (x):<br><br>• 0 = upper alarm disabled<br><br>• 1 = upper alarm enabled |
| **Example:** | • To enable the line 1 upper alarm:<br>AUPE,1,1<LF ><br><br>• To verify the line 1 upper alarm status:<br>AUPE,1?<LF ><br><br>The FM5004 will return:<br>AUPE,1,1<CR><LF > |

## ALARM UPPER VALUE

| | |
|---|---|
| **Description:** | Sets the upper levels for the line 1, line 2, 4-probe/3-axis, and high temperature alarms. Each of the alarm levels must be set using individual commands. |
| | For an alarm to operate, that alarm must be enabled. The data entered can contain up to five numbers and a decimal point. |
| | See the description for each alarm type for the permissible range. See *Alarm Upper Enable* on page 68 to enable an alarm. |
| **Syntax:** | AUPV,m,xxxxxx |
| **Parameters:** | Alarm Type (m): |
| | • 0 = high temperature alarm, range: 32°F–211°F |
| | • 1 = line 1 alarm, range: 0—max of probe |
| | • 2 = line 2 alarm, range: 0—max of probe |
| | • 4 = 4-probe/3-axis alarm, range: 0—max of lowest range probe |
| | Alarm level (xxxxxx) |
| | • xxxxxx = alarm value: 0–1999.9 |
| **Example:** | • To set the line 1 upper alarm value to 150.5: AUPV,1,150.5<LF > |
| | • To verify the line 1 upper alarm value: AUPV,1?<LF > |
| | The FM5004 will return: AUPV,1,150.5<CR><LF > |

**ANALOG OUTPUT MODE**

| | |
|---|---|
| **Description:** | Sets the analog output mode to output the minimum, maximum, or average of the analog output selected probes. <br><br> Selecting an analog output mode will disable the previously selected mode. |
| **Syntax:** | ANAO,m |
| **Parameters:** | Mode (m): <br><br> • 1 = minimum of analog output selected probes <br><br> • 2 = maximum of analog output selected probes <br><br> • 3 = average of analog output selected probes |
| **Example:** | • To set the analog output to average mode: <br> ANAO,3<LF> <br><br> • To verify the analog output mode is average of probes: <br> ANAO?<LF> <br><br> The FM5004 will return: <br> ANAO,3<CR><LF> |

**ANALOG OUTPUT RANGE**

| | |
|---|---|
| **Description:** | Sets the analog output full scale range to correspond to the maximum of range 1 through range 4 of the analog output selected probes.<br><br>All analog output selected probes must use the same units of measurement and have the same ranges. |
| **Syntax:** | ANAR,x |
| **Parameters:** | Range value (x):<br><br>• 1 = range 1 upper limit corresponds to full scale analog output voltage<br><br>• 2 = range 2 upper limit corresponds to full scale analog output voltage<br><br>• 3 = range 3 upper limit corresponds to full scale analog output voltage<br><br>• 4 = range 4 upper limit corresponds to full scale analog output voltage |
| **Example:** | • To set the analog output full scale voltage to correspond to range 2 of the analog output selected probes:<br>ANAR,2<LF><br><br>• To verify the analog output full scale voltage corresponds to range 2 of the analog output selected probes:<br>ANAR?<LF><br><br>The FM5004 will return:<br>ANAR,2<CR><LF> |

## BAUD RATE

| | |
|---|---|
| **Description:** | Sets the baud rate used for remote communication between the FM5004 and a controller. |
| **Syntax:** | BAUD,xxxxx |
| **Parameters:** | Baud rate (xxxxx):<br><br>• 1200 = 1200 Baud<br><br>• 2400 = 2400 Baud<br><br>• 4800 = 4800 Baud<br><br>• 9600 = 9600 Baud<br><br>• 19200 = 19200 Baud |
| **Example:** | • To set the baud rate to 9600:<br>BAUD,9600<LF><br><br>• To verify the baud rate is set at 9600:<br>BAUD?<LF><br><br>The FM5004 will return:<br>BAUD,9600<CR><LF> |

**BUSS VOLTAGE**

| | |
|---|---|
| **Description:** | Measures and returns the FM5004 buss voltages. |
| **Syntax:** | BUSV? |
| **Parameters:** | None |
| **Example:** | To check the buss voltages:<br>BUSV?<br><br>The FM 5004 will measure the buss voltages and return:<br><br>+12 - +12.00<CR><LF><br><br>+5V - +5.00<CR><LF><br><br>-12 - -12.00<CR><LF> |

### CHANGE RANGE

| | |
|---|---|
| **Description:** | Change the range of a probe. |
| **Syntax:** | CHRA,c,r |
| **Parameters:** | Channel (c):<br><br>• 1–4<br><br>Range (r):<br><br>• 1–4 (or highest range) or A (autorange) |
| **Example:** | • If command is entered with no parameters, all probe ranges will be returned.<br><br>• If no probe is on that channel, range = 0<br><br>• If command is entered with one parameter, the current range of that probe on that channel is returned CHRA?<LF>. The FM5004 will return:<br><br>    CHRA,1,A1<CR><LF><br>    Probe on channel 1 is in autorange on range 1<br><br>    CHRA,2,1<CR><LF><br>    Probe on channel 2 is on range 1<br><br>    CHRA,3,0<CR><LF><br>    Probe on channel 3 is not on or not ready<br><br>    CHRA,4,A3<CR><LF><br>    Probe on channel 4 is in autorange on range 3<br><br>• To verify the range of the probe on channel 1: CHRA,1?<LF><br><br>  The FM5004 will return:<br>  CHRA,1,A1<CR><LF><br><br>• If command is entered with two parameters the probe on that channel will be set to that range.<br><br>    CHRA,1,2<LF><br>    Set probe on channel 1 to range 2<br><br>    CHRA,2,A<LF><br>    Set probe on channel 2 to autorange |

## DISPLAY FORMAT

| | |
|---|---|
| **Description:** | Sets the format for the FM5004 display. |
| | When a command is sent to enable a display format, the previous format will become disabled. If all modes are turned off, the display will become inactive (blank). |
| | In the case of the 4-probe display mode, only the **m** and **x** parameters are required. |
| | When setting the display to 2-line mode, a separate command is required to define each line. |
| **Syntax:** | DSFM,m,n,x |
| **Parameters:** | Display format (m): |
| | • 1 = 2-line, line 1 display |
| | • 2 = 2-line, line 2 display |
| | • 3 = 3-axis display |
| | • 4 = 4-probe display (**n** parameter not used) |
| | Display mode (n): |
| | • 1 = probe 1 (3-axis format) or minimum of probes (2-line format) |
| | • 2 = probe 2 (3-axis format) or maximum of probes (2-line format) |
| | • 3 = probe 3 (3-axis format) or average of probes (2-line format) |
| | • 4 = probe 4 (3-axis format) or analog output (2-line format) |
| | Numeric value (x): |
| | • 0 = mode disabled |
| | • 1 = mode enabled |

### DISPLAY FORMAT

| | |
|---|---|
| **Example:** | • To set the display mode to 2-line format, line 1 to average of display enabled probes, and line 2 to analog output reading:<br><br>DSFM,1,3,1<LF><br><br>DSFM,2,4,1<LF><br><br>• To verify the line 1 display is set to average of display selected probes:<br>DSFM,1,3?<LF><br><br>If it is enabled, the FM5004 will return:<br>DSFM,1,3,1<CR><LF><br><br>• To set the display mode to 4-probe display format:<br>DSFM,4,1<LF> |

### DISPLAY UPDATE RATE

| | |
|---|---|
| **Description:** | Sets the rate at which the display is updated with new readings. |
| **Syntax:** | DUPR,x |
| **Parameters:** | Display Update Rate (x):<br><br>• 1 = one update/second<br><br>• 2 = two updates/second<br><br>• 5 = five updates/second<br><br>• 10 = 10 updates/second |
| **Example:** | • To set the display update rate to five times per second:<br>DUPR,5<LF><br><br>• To verify that the display update rate is set to five times per second:<br>DUPR?<LF><br><br>The FM5004 will return:<br>DUPR,5<CR><LF> |

### ERROR REGISTER QUERY

| | |
|---|---|
| **Description:** | Returns a previous error that is contained in the error register. |
| **Syntax:** | ERRQ |
| **Parameters:** | None |
| **Example:** | To see the most recent error message:<br>ERRQ?<LF><br><br>The FM5004 will return:<br>ERRQ,128<CR><LF> |

**FILTER SIZE**

| | |
|---|---|
| **Description:** | Sets the size of the filtering to be used on the analog output readings. The number entered corresponds to how many previous readings are used to calculate the analog output voltage.<br><br>This command is useful for slowing the response of the analog output voltage to sudden changes in the fields. |
| **Syntax:** | FTSZ,xx |
| **Parameters:** | Filter Size (xx):<br><br>• Range 0 to 20.<br>   A zero will disable the filtering function. |
| **Example:** | • To set the filter size to 10 samples plus the current sample:<br>   FTSZ,10<LF><br><br>• To check the current filter size:<br>   FTSZ?<LF><br><br>   The FM5004 will return:<br>   FTSZ,10<CR><LF> |

**GPIB ADDRESS**

| Description: | Sets the GPIB address used by the FM5004. |
|---|---|
| Syntax: | GPIB,xx |
| Parameters: | GPIB Address (xx):<br><br>• Range 1 to 31 |
| Example: | • To set the GPIB address to 4:<br>GPIB,4<LF><br><br>The FM5004 will return:<br>GPIB,4<CR><LF> |

**KEY CLICK**

| Description: | Enables or disables the audible key click. |
|---|---|
| Syntax: | CLCK,x |
| Parameters: | Key click enable (x):<br><br>• 0 = key click disabled<br><br>• 1 = key click enabled |
| Example: | To turn on the key click:<br>CLCK,1<LF><br><br>The FM5004 will return:<br>CLCK,1<CR><LF> |

### LAST ERRORS

| Description: | Returns the code and a description of the last errors that have occurred. |
|---|---|
| Syntax: | LERR? |
| Parameters: | Error message (string):<br><br>• Up to 10 lines.<br>The message contains the error code followed by a description of the error. |
| Example: | To see the last error:<br>LERR?<LF><br><br>The FM5004 will return:<br>00:06:53 C1=H Probe Fail–probe did not recover<CR><LF><br><br>If no errors are logged the FM5004 will return:<br><CR><LF>'No errors logged.'<CR><LF> |

### LCD BRIGHTNESS

| Description: | Sets the LCD backlight level to a specific brightness. |
|---|---|
| Syntax: | LCDB,xx |
| Parameters: | Brightness level (xx):<br><br>• Range 0 to 15.<br>A zero turns off the LCD backlight and a 15 sets maximum brightness. |
| Example: | To set the brightness to 8:<br>LCDB,8<LF><br><br>The FM5004 will return:<br>LCDB,8<CR><LF> |

**LCD CONTRAST**

| | |
|---|---|
| **Description:** | Sets the LCD contrast level. |
| **Syntax:** | LCDC,xx |
| **Parameters:** | Contrast level (xx):<br><br>• Range 0 to 63.<br>A zero sets minimum contrast and a 63 sets maximum contrast. |
| **Example:** | To set the contrast to 8:<br>LCDC,8<LF><br><br>The FM5004 will return:<br>LCDC,8<CR><LF> |

**LED SETUP**

| | |
|---|---|
| **Description:** | Configures the FM5004 LED array. This command is used to select probes for display or analog output functions and to enable and disable probe axes.<br><br>Separate commands must be sent to update LEDs for each channel. |
| **Syntax:** | CLED,m,xxxxx |
| **Parameters:** | Channel number (m):<br><br>• 0 = all channels set the same<br><br>• 1 = channel 1<br><br>• 2 = channel 2<br><br>• 3 = channel 3<br><br>• 4 = channel 4<br><br>LED configuration (xxxxx):<br><br>• This is a five-bit binary number.<br><br>A one corresponds to an LED illuminating, and a zero corresponds to an LED going dark.<br><br>The order of the bits is: display, out, x, y, z. |
| **Example:** | To enable channel 1 for display output with all three axes enabled:<br>CLED,1,10111<LF><br>The LEDs will change accordingly and the FM5004 will return:<br>CLED,1,10111<CR><LF> |

## LOCAL MODE

| | |
|---|---|
| **Description:** | Returns the FM5004 to local mode when it is in remote mode. Local mode allows the operator to use the front panel buttons. |
| **Syntax:** | LOCL,x |
| **Parameters:** | Local mode enable (x):<br><br>• 0 = disabled; stays in remote mode<br><br>• 1 = local mode enabled |
| **Example:** | To return the FM5004 to local mode:<br>LOCL,1<LF><br>The front panel buttons will become operational and the FM5004 will return:<br>LOCL,1<CR><LF> |

## LOG SCALE

| | |
|---|---|
| **Description:** | Enables either a logarithmic or linear scale for the analog output voltage. |
| **Syntax:** | LOGS,x |
| **Parameters:** | Log scale enable (x):<br><br>• 0 = log scale disabled (linear scale enabled)<br><br>• 1 = log scale enabled |
| **Example:** | To set the analog output voltage to log scale:<br>LOGS,1<LF><br>The scale will change to logarithmic scale and the FM5004 will return:<br>LOGS,1<CR><LF> |

**READ DISPLAY**

| | |
|---|---|
| **Description:** | Writes the current screen contents to a remote port. |
| **Syntax:** | RDIS, x |
| **Parameters:** | (x):<br><br>• 0 = both lines of display (if in 2-line mode only) or all readings (if in 3-axis or 4-line display mode)<br><br>• 1 = first line of display (if in 2-line mode only)<br><br>• 2 = second line of display (if in 2-line mode only)<br><br>If zero is selected, four readings will be returned. In 2-line mode data corresponding to the third and fourth readings will be blank lines <CR><LF>. |
| **Output Format:** | 15-character data format:<br>xx.xxuuuuuuOrc <CR><LF> |

### READ BATTERY VOLTAGES

| | |
|---|---|
| **Description:** | Returns the current battery percents of probes in use. |
| **Syntax:** | RBAT? |
| **Parameters:** | None |
| **Example:** | To check the current battery percents of probes in use: RBAT?<LF><br><br>The FM5004 will return:<br><br>    RB1 = 62%<CR><LF><br>    RB2 = 77%<CR><LF><br>    RB3 = --<CR><LF><br>    RB4 = --<CR><LF><br><br>The response indicates that channel 3 and channel 4 are not on or not ready. |

**READ TEMPERATURES**

| | |
|---|---|
| **Description:** | Returns the current temperature readings from probes in use. |
| **Syntax:** | RTMP? |
| **Parameters:** | None |
| **Example:** | To check the current temperatures of probes in use:<br>RTMP?<LF><br>The FM5004 will return:<br>  T1 = 77 F    25 C<CR><LF><br>  T2 = 78 F    25 C<CR><LF><br>  T3 = --<CR><LF><br>  T4 = --<CR><LF><br>The response indicates that channel 3 and channel 4 are not on or not ready. |

**REMOTE MODE**

| | |
|---|---|
| **Description:** | Places the FM5004 into remote mode. Remote mode disables the front panel buttons. |
| **Syntax:** | REMT,x |
| **Parameters:** | Remote mode enable (x):<br><br>• 0 = disabled; returns to local mode<br><br>• 1 = remote mode enabled |
| **Example:** | To place the FM5004 into remote mode:<br>REMT,1<LF><br><br>The front panel buttons will become non-operational, and the FM5004 will return:<br>REMT,1>CR><LF> |

## SAMPLE RATE

| | |
|---|---|
| **Description:** | Sets the number of times per second that enabled probes are sampled by the FM5004.<br><br>The lowest sample rate is one sample per second. The upper sample rate allowed is limited by the speed of the probes. |
| **Syntax:** | SMPR,xx |
| **Parameters:** | Sample Rate (xx):<br><br>• 1–xx = maximum sample rate is limited by the speed of the probes |
| **Example:** | To set the sample rate to 10 samples per second:<br>SMPR,10<LF><br><br>The FM5004 will return:<br>SMPR,10<CR><LF> |

## SETUP RECALL

| | |
|---|---|
| **Description:** | Recalls a saved FM5004 setup. |
| **Syntax:** | RECL,x |
| **Parameters:** | Setup number (x):<br><br>• 0 = recall default setup (factory settings)<br><br>• 1 = recall setup #1<br><br>• 2 = recall setup #2<br><br>• 3 = recall setup #3<br><br>• 4 = recall setup #4 |
| **Example:** | To recall the default setup: RECL,0<LF><br><br>The setup will change to the factory setup configuration and the FM5004 will return:<br>RECL,0<CR><LF> |

**SETUP SAVE**

| | |
|---|---|
| **Description:** | Saves the FM5004 current configuration into EEPROM for later recall. |
| **Syntax:** | SAVE,x |
| **Parameters:** | Setup number (x):<br><br>• 1 = saves to setup #1<br><br>• 2 = saves to setup #2<br><br>• 3 = saves to setup #3<br><br>• 4 = saves to setup #4 |
| **Example:** | To save the current configuration to setup #1:<br>SAVE,1<LF><br>The setup will be saved to EEPROM and the FM5004 will return:<br>SAVE,1<CR><LF> |

Archived 10/19/10

**SYSTEM ALARM, HARD PROBE FAILURE**

| | |
|---|---|
| **Description:** | Enables or disables the alarm in the event of a hard probe failure, such as a continuous loss of communication.<br><br>The alarm will sound after several attempts to restore proper function. |
| **Syntax:** | SALH,x |
| **Parameters:** | Alarm status (x):<br><br>• 0 = alarm off<br><br>• 1 = alarm on |
| **Example:** | To enable the hard probe failure alarm:<br>SALH,1<LF><br><br>The FM5004 will return:<br>SALH,1<CR><LF> |

**SYSTEM ALARM, MOMENTARY PROBE FAILURE**

| | |
|---|---|
| **Description:** | Enables or disables the alarm for momentary probe failure.<br><br>The alarm will sound if a probe does not respond for a short time but then recovers proper operation. |
| **Syntax:** | SALM,x |
| **Parameters:** | Alarm status (x):<br><br>• 0 = alarm off<br><br>• 1 = alarm on |
| **Example:** | To enable the momentary probe failure alarm:<br>SALM,1<LF><br><br>The FM5004 will return:<br>SALM,1<CR><LF> |

**SOFTWARE DATE**

| | |
|---|---|
| **Description:** | Returns the revision date for the FM5004 software. |
| **Syntax:** | DATE |
| **Parameters:** | None |
| **Example:** | To check the date of the FM5004 software:<br>DATE?<LF><br><br>The FM5004 will return:<br>DATE,JAN 1 2000<CR><LF> |

### SOFTWARE REVISION

| | |
|---|---|
| **Description:** | Returns the revision number/level of the FM5004 software. |
| **Syntax:** | SREV |
| **Parameters:** | None |
| **Example:** | To check the revision of the FM5004 software: SREV?<LF> The FM5004 will return: SREV,2.0<CR><LF> |

### VERBOSE MODE

| | |
|---|---|
| **Description:** | Sets the FM5004 to respond to remote commands in verbose mode or to respond to inquiries only. |
| **Syntax:** | VERB,x |
| **Parameters:** | (x):<br>• 0 = verbose mode disabled<br>• 1 = verbose mode on |
| **Example:** | • To place the FM5004 into verbose mode: VERB,1<LF><br>The FM5004 will return:<br>VERB,1<CR><LF><br>• To disable verbose mode: VERB,0<LF><br>The FM5004 will not respond; verbose mode off. |

**ZERO PROBES**

| | |
|---|---|
| **Description:** | Zeros probes connected to the FM5004.<br><br>The FM5004 will respond after the zero function has been performed. |
| **Syntax:** | ZERO,x |
| **Parameters:** | Probe number (x):<br><br>• 0 = zero all probes<br><br>• 1 = zero probe 1<br><br>• 2 = zero probe 2<br><br>• 3 = zero probe 3<br><br>• 4 = zero probe 4 |
| **Example:** | To zero the probe on channel 1: ZERO,1<LF><br><br>When the zero function is complete, the FM5004 will return:<br>ZERO<CR><LF> |

## System Level Commands for IEEE-488.2 Compliance

Following are the system level commands that are required to comply with the IEEE-488.2 specifications.

### CLEAR STATUS

| | |
|---|---|
| **Description:** | Clears the IEEE-488.2 status register. |
| **Syntax:** | *CLS |
| **Parameters:** | None |
| **Example:** | To clear the IEEE-488.2 status register: *CLS |

### DEFINE DEVICE TRIGGER

| | |
|---|---|
| **Description:** | Enters a command into the define device trigger buffer. The command will be executed when a trigger command is sent. <br><br> The maximum string length for the DDT command is 80 characters. Separate the commands with A;@. |
| **Syntax:** | • *DDT <br><br> –or– <br><br> • *DDT? |
| **Parameters:** | Any IEEE-488 command in the FM5004 command set may be sent. |
| **Example:** | • To load the device trigger buffer with a zero all probes command: <br> *DDT;ZERO,0 <br><br> • To verify which command is in the device trigger buffer: <br> *DDT? <br><br> The FM5004 will return: <br> *DDT ZERO,0<CR><LF> <br><br> If trigger is not set up the F5004 will return: <br> 'DDT No Device Trigger String'<CR><LF> |

## EVENT STATUS ENABLE

| | |
|---|---|
| **Description:** | Sets or returns the event status enable bits. |
| **Syntax:** | • *ESE xxx<br><br>–or–<br><br>• *ESE? |
| **Parameters:** | Event status enable bits (xxx):<br><br>• Range = 0–255<br><br>Refers to the binary word that corresponds to the event status enable bits. |
| **Example:** | • To set the event status enable bits to 10011111 (159 base 10): *ESE 159<br><br>• To check the status of the error register enable bits: *ESE?<br><br>The FM5004 will return: *ESE 159<CR><LF> |

## ERROR STATUS REGISTER QUERY

| | |
|---|---|
| **Description:** | Returns the error status register bits. |
| **Syntax:** | *ESR? |
| **Parameters:** | None |
| **Example:** | To check the status of the error status register bits: *ESR?<br>The FM5004 will return a number in the range of 0 to 255 that corresponds to the binary representation of the error status register bits, such as:<br>*ESR 255<CR><LF> |

**IDENTIFICATION QUERY**

| | |
|---|---|
| **Description:** | Returns the FM 5004 identification string that includes model number and system software revision. |
| **Syntax:** | *IDN? |
| **Parameters:** | None |
| **Example:** | To command a system identification: *IDN?<br><br>The FM5004 will return:<br>*IDN FM5004 Rev. 1.0<CR><LF> |

**OPERATION COMPLETE**

| | |
|---|---|
| **Description:** | Sets or returns the operation complete enable bit in the standard event register. |
| **Syntax:** | • *OPC x<br><br>–or–<br><br>• *OPC? |
| **Parameters:** | Operation complete enable bit (x):<br><br>• 0 = disable operation complete function<br><br>• 1 = enable operation complete function |
| **Example:** | • To enable the operation complete function:<br>*OPC,1<br><br>• To check if the current operation is complete:<br>*OPC?<br><br>If the current operation is complete, the FM5004 will return:<br>*OPC,1<CR><LF><br><br>If the current operation is not complete, the FM5004 will return:<br>*OPC,0<CR><LF> |

**RESET**

| Description: | Causes the FM5004 to perform a system reset. |
|---|---|
| Syntax: | *RST |
| Parameters: | None |
| Example: | To cause a system reset on the FM5004: *RST |
| | The reset will occur without any response; wait six seconds before sending another command to the FM5004. |
| | The operation complete enable bit will be set after the reset. |

**SELF-TEST**

| Description: | Causes the FM5004 to perform a self-test. |
|---|---|
| Syntax: | *TST? |
| Parameters: | None |
| Example: | To perform a self-test of the FM5004: *TST? |
| | If the test passes, a **1** will be returned, if it fails, a **0** will be returned:<br>*TST 1<CR><LF> |

### SERVICE REQUEST ENABLE

| | |
|---|---|
| **Description:** | Sets or returns the service request enable bit. |
| **Syntax:** | • *SRE x<br><br>–or–<br><br>• *SRE? |
| **Parameters:** | Service request enable bit (x):<br><br>• 0 = service request bit disabled<br><br>• 1 = service request bit enabled |
| **Example:** | • To enable the service request bit: *SRE 1<br><br>• To verify that the service request bit is enabled: *SRE?<br><br>If it is enabled, the FM5004 will return:<br>*SRE 1<CR><LF>. |

**STATUS BYTE QUERY**

| | |
|---|---|
| **Description:** | Returns the contents of the status byte. |
| **Syntax:** | *STB? |
| **Parameters:** | None |
| **Example:** | To check the contents of the status byte:<br>*STB?<br><br>The FM5004 will return the contents of the status byte. The returned value is the integer value of the binary status register.<br><br>For example, if the status register contains binary byte 10100001 (161 base 10), the following status would be returned:<br>*STB 161<CR><LF> |

### TRIGGER

| | |
|---|---|
| **Description:** | Causes the command contained in the define device trigger buffer to be executed. |
| | The trigger command (TRG) is useful when used along with a define device trigger (DDT) command to continuously execute a set of commands. Entering a TRG as the last command of the DDT string will cause the DDT command to be repeated continuously until a different command is sent to break the loop. |
| | The TRG command must be the last command of the DDT string, otherwise the input buffer will overflow, causing an error. |
| **Syntax:** | *TRG |
| **Parameters:** | None |
| **Example:** | To cause the command in the define device trigger buffer to be executed:<br>*TRG |
| | The response from the FM5004 will be exactly the same as if the command contained in the define device trigger buffer were executed directly. |

## 8.0  Troubleshooting and Error Handling

### Troubleshooting

| Problem | Possible Cause / Corrective Action |
|---|---|
| Fault indicator flashes an error code (intermittent communication error) | Bad cable/connector<br><br>• Check for dirt or contaminants; clean if needed<br><br>• Replace cable<br><br>• Decrease sample rate |
| Probe fails to communicate with field monitor | Bad cable/connector/fiber optic cable reversed<br><br>• Check for dirt or contaminants; clean if needed<br><br>• Replace cable<br><br>Dead battery<br><br>• Charge battery |
| Field monitor fails to power up | Power cord unplugged/bad<br><br>• Connect cord properly<br><br>• Replace cord<br><br>Blown fuse<br><br>• Replace power fuse |

## Error Handling

Errors that occur during operation of the FM5004 appear in the fault window on the top line of the display. If a specific channel caused the error, the error code will contain the channel number.

Only the most recent error will appear in the window. The last five errors and a more detailed description of the error may be found in the Last Errors submenu; see *Last Errors* on page 54 for more information. While remotely controlling the FM5004, the last nine errors can be sent over the IEEE-488 or RS-232 port using the LERR command.

In the fault window on the display, an error will appear with the channel number that caused the error first followed by the error code; for example, **C4=O** indicates a channel 4 over-range error occurred.

Probe-generated errors appear with an **E** in front of an error number in the fault window; for example, **C2=E6** indicates that the probe sent an **E6** error to the FM5004. See the probe manual for a description of probe errors.

### ERROR CODE A: ALARM L1 UP LINE 1 UPPER ALARM

A field measurement caused the line 1 upper alarm to occur.

### ERROR CODE B: ALARM L1 LINE 1 LOWER ALARM

A field measurement caused the line 1 lower alarm to occur.

### ERROR CODE C: ALARM L2 UP—LINE 2 UPPER ALARM

A field measurement caused the line 2 upper alarm to occur.

### ERROR CODE D: ALARM L2 LO—LINE 2 LOWER ALARM

A field measurement caused the line 2 lower alarm to occur.

### ERROR CODE E: PROBE ERR PROBE RETURNED ERROR

Originates from a probe connected to the FM5004.

### ERROR CODE F: BATT FAIL AT FAIL LEVEL

A probe battery fell below the level at which proper probe operation is not guaranteed. Recharge the probe battery.

### ERROR CODE G: DOUBLE FLT–RECEIVE–PROBE RESET

A probe did not respond for two consecutive communication cycles. The FM5004 will attempt to reset the probe and re-establish communication.

### ERROR CODE H: PROBE FAIL–PROBE DID NOT RECOVER

A probe ceased to respond to and cannot be reset by the FM5004. Verify the probe is turned on and the battery is charged. Also, verify that the fiber optic cables are connected properly.

### ERROR CODE L: TEMP LOWER–TEMP UNDER LOWER LIMITS

A probe temperature measurement fell below the lower limit set for the probe temperature alarm.

### ERROR CODE N: NON SUPPORT–PROBE NOT SUPPORTED

A probe connected to the FM5004 measures field strength in improper units.

### ERROR CODE O: OVER RANGE ERROR

A field strength measurement was above the upper limit for the current range on the probe being used. When in autorange mode, this error will occur if the measurement is above the allowable field strength for the highest range of the probe.

### ERROR CODE P: PROCESS ERR NO TIME TO PROCESS DATA

The FM5004 did not have time to process the data from a field strength measurement before another measurement must be taken.

### ERROR CODE Q: SAMPLE/S–1 PROCESS ERR–RATE TOO HIGH

A probe is connected that does not support the current sample rate of the FM5004. The sample rate can only be set to the rate at which the slowest probe will operate.

### ERROR CODE R: RECEIVE ERR DATA NOT REC FROM PROBE

The FM5004 sent a command to a probe and no response was received for one sample cycle.

### ERROR CODE S: SEND ERROR PROBE NOT READY TO SEND

The FM5004 was ready to send a command to a probe but the complete response was not received from the previous command.

### ERROR CODE U: TEMP UPPER TEMP OVER UPPER LIMITS

A temperature measurement caused an upper temperature alarm to occur.

### ERROR CODE W: BATT WARN AT WARNING LEVEL

The battery voltage of a probe fell below the warning level. This indicates that the probe will operate for only a short time before the battery fails. Charge the probe battery as soon as possible.

### ERROR CODE Y: ALARM UPPER 4/3 DISPLAY ALARM

A field measurement caused the 4-probe or 3-axis upper alarm to occur.

### ERROR CODE Z: ALARM LOWER 4/3 DISPLAY ALARM

A field measurement caused the 4-probe or 3-axis lower alarm to occur.

## Appendix A:  Warranty

→ See the *Product Information Bulletin* included with your shipment for the complete ETS-Lindgren warranty for your FM5004.

### DURATION OF WARRANTIES FOR FM5004

All product warranties, except the warranty of title, and all remedies for warranty failures are limited to three years.

| Product Warranted | Duration of Warranty Period |
|---|---|
| FM5004 Field Monitor | 3 Years |

This page intentionally left blank.

## Appendix B:  Summary List of Commands

### IEEE-488.2 Commands

**CLS** – Clear Status

**DDT** – Device Trigger

**ESE** – Event Status Enable

**ESR** – Event Status Register

**IDN** – Identification Query

**OPC** – Operation Complete Query

**RST** – Reset

**SRE** – Service Request Enable

**STB** – Read Status Byte

**TRG** – Trigger command

**TST** – Self-Test Query

**WAI** – Wait to Continue

**No Parameter Commands**

**ALSR** – Alarm Silence

**BUSV** – Buss Voltage

**DATE** – Software Date

**ERRQ** – Error Register Query

**HELP** – This Command

**RBAT** – Read Battery Voltages

**RDMD** – Read Display Mode

**REMT** – Remote

**RTMP** – Read Temperatures from Probes

**SREV** – Software Revision

**One Parameter Commands**

**ANAO** – Analog Out

**ANAR** – Analog Range

**BAUD** – Baud Rate Entry

**CLCK** – Key Click

**DUPR** – Display Update Rate

**FTSZ** – Filter Size

**GPIB** – GPIB Address

**LCDB** – LDC Brightness

**LCDC** – LCD Contrast

**LERR** – Last Errors

**LOCL** – Local

**LOGS** – Log Scale

**RDIS** – Read Display

**RECL** – Recall

**SALH** – System Alarm Hard Probe Fail

**SALM** – System Alarm Momentary Fail

**SALS** – System Alarm System Fail

**SAVE** – Save Setup

**SMPR** – Samples/Second

**VERB** – Verbose Mode

**ZERO** – Zero Probes

## Two Parameter Commands

**ALAT** – Alarm Latch

**ALOE** – Alarm Lower Enable

**ALOV** – Alarm Lower Value

**AUPE** – Alarm Upper Enable

**AUPV** – Alarm Upper Value

**CLED** – Channel LEDs

**CHRA** – Change Probe Range

## Three Parameter Commands

**ADFM** – Alternate Display Format

**DSFM** – Display Format

## Appendix C:  EC Declaration of Conformity

**ETS·LINDGREN™**
An **ESCO** Technologies Company

CE 99

### Declaration of Conformity

We, ETS-Lindgren, L.P., 1301 Arrow Point Drive, Cedar Park, TX, 78613, USA, declare under sole responsibility that the:

**Model/Part Number:**  FM5004

**Model/Part Name:**  Field Monitor

**Date of Declaration:**  12 February, 1999

to which this declaration relates, meets the requirements and is in conformity with the relevant EC Directives listed below using the relevant section(s) of the following EC harmonized standards and other normative documents;

**Applicable Directive(s):**

Low Voltage Directive (LVD), 73/23/EEC and its amending directives

Electomagnetic Compatibility Directive (EMC), 89/336/EEC and its amending directives

**Applicable harmonized standard(s) and/or normative document(s):**

CISPR 11:1990 Industrial, Scientific and Medical (ISM) Radio-Frequency equipment- Electromagnetic disturbance characteristics- Limits and methods of measurement

CISPR 22:1993 Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement.

EN 50081-1:1992 Electromagnetic compatibility - Generic emission standard Part 1: Residential, commercial and light industry

EN 55011:1991- Group 1 Class B, Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment

EN 55022:1994 Limits and methods of measurement of radio disturbance characteristics of information technology equipment

EN 61010-1:1993 Safety requirements for electrical equipment for measurement, control, and laboratory use

FCC Part 15: Radio Frequency Devices, Subpart B - Unintentional Radiators

IEC 801-2:1991 Electromagnetic compatibility for industrial - Process measurement and control equipment, Part 2: Electrostatic discharge requirements

IEC 801-3:1984  Electromagnetic compatibility for industrial - Process measurement and control equipment - Part 3: Radiated electromagnetic field requirements

IEC 801-4:1988 Electromagnetic compatibility for industrial - Process measurement and control equipment, Part 4: Electrical fast transient/burst requirements

**Authorized Signatories:**

ETS-Lindgren L.P.
Bryan Sayler, General Manager

ETS-Lindgren L.P.
James C. Psencik, Vice President of Engineering

The authorizing signatures on this Declaration of Conformity document authorizes ETS-Lindgren, L.P. to affix the CE mark to the indicated product.  CE marks placed on these products will be distinct and visible.  Other marks or inscriptions liable to be mistaken with the CE mark will not be affixed to these products.

ETS-Lindgren, L.P. has ensured that technical documentation shall remain available on premises for inspection and validation purposes for a period ending at least 10 years after the last product has been manufactured.