FieldMaster™

Power/Energy Meter

User Manual

COHERENT®

FieldMaster™ Power/Energy Meter

User Manual

Part Number 0302-167-00 EA

Table of Contents

FieldMaster™

General

Figure 1. FieldMaster™ Power/Energy Meter

FieldMaster™ is a rugged, compact, microprocessor driven power and energy meter that interfaces with the full line of Coherent power and energy detector heads. FieldMaster is a unique combination of an analog meter for laser tuning with a precise digital display of power or energy on the LCD backplane.

FieldMaster can be used with all lasers commonly manufactured today – CW and pulsed, from UV to IR, with rated power form nanowatts to kilowatts – simply by plugging the appropriate sensor head into the console.

General (cont'd)

FieldMaster features include:

- **Analog Meter Movement** - gives fast, smooth feedback for easy tuning of lasers.
- **Digital Backplane** - The FieldMaster's unique LCD Backplane provides precise digital readout of power or energy and indicators for warning or error conditions.
- **CW Power Measurement** - FieldMaster is compatible with the full range of Coherent's *SmartDetector Heads*, providing power measurement capability form 1 nW to 5 kW.
- **Pulsed Energy Measurement** - FieldMaster provides single pulse or pulse train energy measurement from 0.5 mJ to 10 J (1 μsecond pulse).
- **Broad Wavelength Range** - FieldMaster detectors cover the spectrum from 0.19 to 10.6 μmeters.
- **Smart Detector Technology** - FieldMaster detectors employ Coherent's *Smart Detector Technology*. Each detector head has an EEPROM which stores the characteristics and calibration data for the detector. This information is read by the FieldMaster console at start-up, eliminating the need to make manual changes to the console when changing detector heads.
- **Beam Alignment Display** - Thermal disk CW sensor heads provide a quadrant display of beam position on the sensor. By centering the beam on the detector, maximum accuracy can be achieved.
- **Ease of Use** - FieldMaster controls consist of one clearly labelled rotary switch and three push buttons for wavelength and offset entry. All adjustments for different detector heads are handled automatically using *Smart Detector Technology*.
- **Updatable microprocessor architecture** - The software controlling the FieldMaster system can be easily updated to include the latest developments and enhancements to the instrument.
- **Portability** - The compact, lightweight console and internal battery pack create a system that is easily transported from lab to lab, or around the world.

General (cont'd)

- **Reliability** - The FieldMaster, with its integral cover, is designed to withstand the rigors of travel and regular field use. Coherent's rugged detector head design has been the industry standard for more than 30 years.
- **Accuracy** - The combination of Smart Detector Technology, microprocessor wavelength correction, and accurate beam positioning information create a highly accurate laser measurement system.

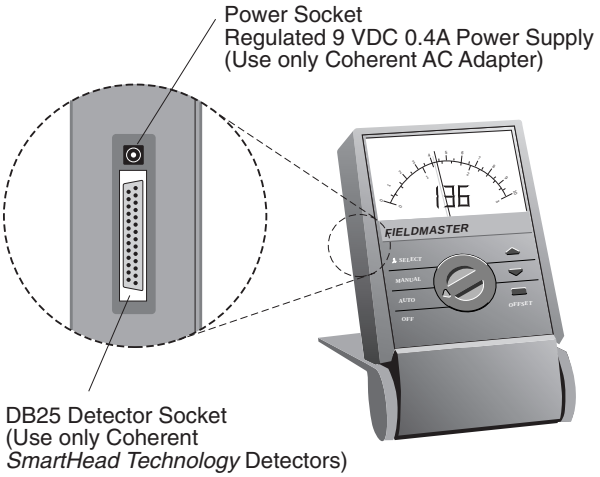


Figure 2. Initial Setup

FieldMaster console is shipped in foam inserts. When ordered together with Detector Heads, they are normally shipped in the same carton as the FieldMaster console. In addition to the console and detector head, the carton contains the AC adaptor with cord and the user manual. The optional Soft Case (if ordered) and all additional detector heads are shipped in separate cartons. Batteries are installed in the FieldMaster prior to shipment.

Visually check cartons and contents for damage before unpacking. Advise Coherent of any damage immediately and a Returned Material Authorization will be issued for the instrument (see page 29 for service).

Remove all items from carton. If desired, plug the AC Adaptor into 110 VAC (in Europe, 220 VAC) outlet and the 9V Input socket on the left side of the FieldMaster (see Figure 2). Plug the detector head into the DB25 socket on the left side of the console. The unit is now ready to use.

Controls & Connections

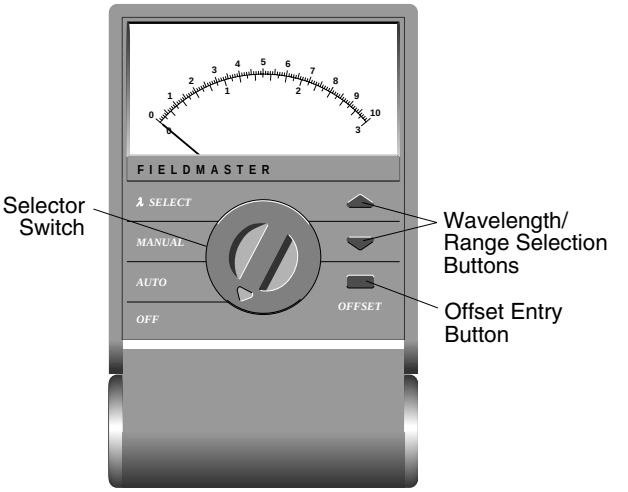


Figure 3. Front Panel Controls

Front Panel

The front panel of the FieldMaster has a rotary SELECTOR SWITCH and three push button controls.

The SELECTOR SWITCH has four positions. In the bottom position, unit is turned off. The next position up, labelled AUTO, turns the unit on in the auto ranging mode. In the next position, labeled MANUAL, the unit is on the manual ranging mode. The top position, labelled λ SELECT, is the wavelength selection mode.

Controls & Connections (cont'd)

To the right of the SELECTOR SWITCH are three pushbutton controls. The top two (shaped like arrows are WAVELENGTH/RANGE SELECTION BUTTONS. These are used to change the wavelength up and down in the wavelength selection mode or to change the power or energy range up and down in the manual ranging mode.

The bottom button (rectangular shaped) is the OFFSET ENTRY BUTTON. It is used to enter current power or energy reading as an offset amount and zero the meter reading when in AUTO or MAN mode. In λ Select mode, the OFFSET ENTRY BUTTON adjusts the liquid crystal display contrast. FieldMaster is shipped with the contrast at the middle of the range. To change contrast, push the OFFSET ENTRY BUTTON. Each time the OFFSET ENTRY BUTTON is pushed, contrast is increased 4%. After maximum contrast is achieved, the next push of the button will return the contrast to minimum. The LCD screen can effectively be turned off by adjusting contrast to minimum.

Controls & Connections (cont'd)

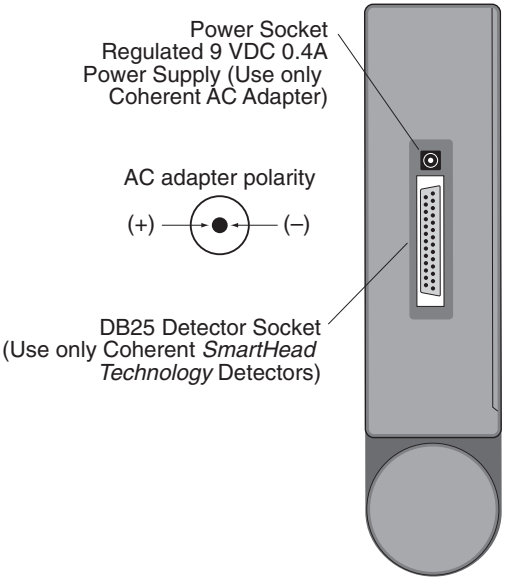


Figure 4. Side Panel Connectors

Side Panel

The side panel of the FieldMaster console has a power socket and a female DB25 type connector (see Figure 4).

The power socket is for the regulated 9VDC 0.4A power supply provided with the FieldMaster. **Use only Coherent power supply.**

The female DB25 connector is for the detector. The FieldMaster is designed to use only Coherent's Smart Head Technology Detectors. Do not plug other types of detectors into the FieldMaster console.

Startup

Replace batteries with standard 9V transistor radio batteries (Duracell MN1604 or ID1604 or equivalent). FieldMaster is fully functional with only one battery connected. Use 2 batteries for maximum working life battery change.

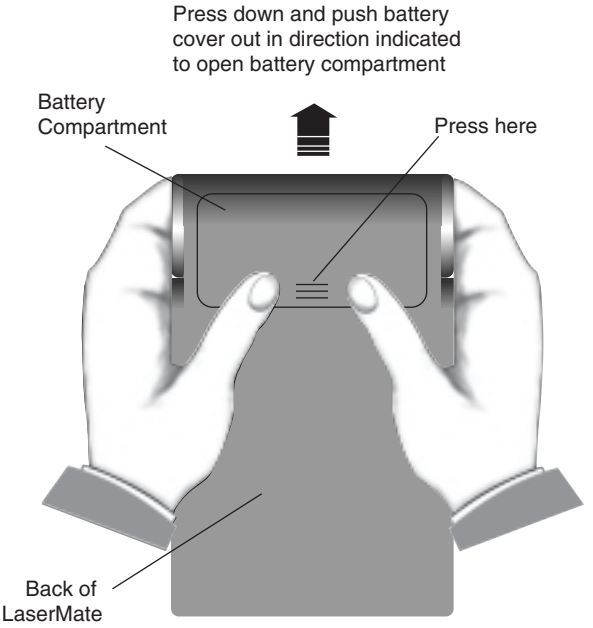


Figure 5. Battery Installation

Battery Installation

To start the FieldMaster either batteries must be installed (see Figure 5) or the AC adapter must be plugged into the socket on the left side of the console (see Figure 4).

Startup (cont'd)

Figure 6. Initial Turn On

Turn On

Turn the SELECTOR switch to AUTO. All screen features will be displayed for approximately 7 seconds while the unit is performing the following self tests (see Figure 6):

Internal test of processor, memory and software. If the FieldMaster fails the self test, an error message will be displayed. In case of failure, no further tests will be made and the system will not operate. Note the failure code that is displayed. TURN OFF POWER AND CONTACT COHERENT OR YOUR LOCAL REPRESENTATIVE (See Service and Warranty section page 29).

Startup (cont'd)

Check for detector head. A query will be sent to the EEPROM in the Detector Head. If no head is plugged in, the message "**DETECTOR ERROR**" will be displayed. A Detector Head must be plugged in.

When the self tests are completed and the parameters for the detector have been loaded, the current power or energy reading and the Beam Position Indicator (Thermal Disc sensors) or the Pulse Received Indicator (pulsed detectors will be displayed.

Contrast Adjustment

FieldMaster is shipped with the LCD contrast at the middle of the range. To change contrast, turn the SELECTOR SWITCH to the λ SELECT position (see Figure 7). Push the OFFSET ENTRY BUTTON is pushed, contrast is increased 4%. After maximum contrast is achieved, the next push of the button will return the contrast to minimum. The LCD screen can effectively be turned off by adjusting contrast to minimum.

Cleaning the Lens

To reduce the effect of static electricity on the analog meter movement, please clean the lens with the enclosed anti-static cloth only.

Wavelength Selection

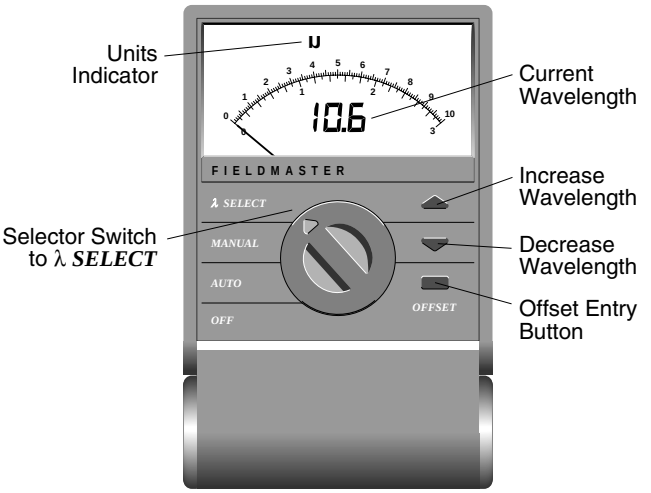


Figure 7. Wavelength Selection

Turn selector switch to l SELECT (see Figure 7). The digital display will show the selected wavelength in **n** (nanometers) or µ (micrometers). To change the selected wavelength, use the WAVELENGTH/RANGE SELECTION buttons to the right of the selector switch. To move to a longer wavelength, press the top button (the arrow pointing up). To move to a shorter wavelength, press the bottom button (the arrow pointing down). Pressing and releasing the button will cause the range to change one increment (see below). Holding the button down will cause the wavelength to change continually at an increasing rate. New wavelength will be stored in memory and retained when power is turned off.

The size of the incremental change in the wavelength depends on the current wavelength. From 190 to 1000 nm the incremental change is 10 nm. Above 1 µm incremental change is 0.1 µm.

Wavelength maximum and minimum are determined by the detector. These parameters are read from the EEPROM in the detector at startup. The wavelength display will not go below the minimum or above the maximum for the detector head in use.

Manual Range Selection

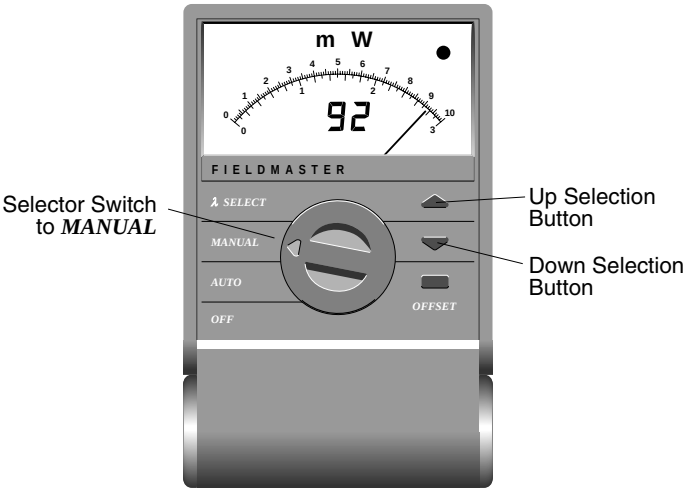


Figure 8. Manual Range Selection

Turn On

Turn the Selector Switch to MANUAL. The FieldMaster will be in the lowest range for the detector when it is first turned on if the detector head is CW. It will be in the highest range for the detector when first turned on if the detector head is pulsed.

Note: When using a pulse detector, the FieldMaster will display an erroneous reading when it is switched from manual to autorange mode and vice versa until the next pulse occurs. This is due to the "switch-bounce" when the mode selector switch in changed. When the system is initially switched on, several pulses will be required before an energy level is displayed in order to set the appropriate amplifier gain range.

Manual Range Selection (cont'd)

Range Selection

To select a new range, press the UP or DOWN SELECTION BUTTON. The first time the button is pushed, the current range will be displayed. This display will be maintained for 2 seconds. If the SELECTION BUTTON is pressed again during the 2 second interval the range is being displayed, the range will be changed to the next higher (if UP) or lower (if DOWN) range. After 2 seconds, the range display is replaced by the display of the current power/energy reading. If the FieldMaster is indicating an over range condition, pressing the UP SELECTION BUTTON will immediately change the range to the next higher range. Range can be increased to the limit of the detector head currently in use.

Manual Range Selection (cont'd)

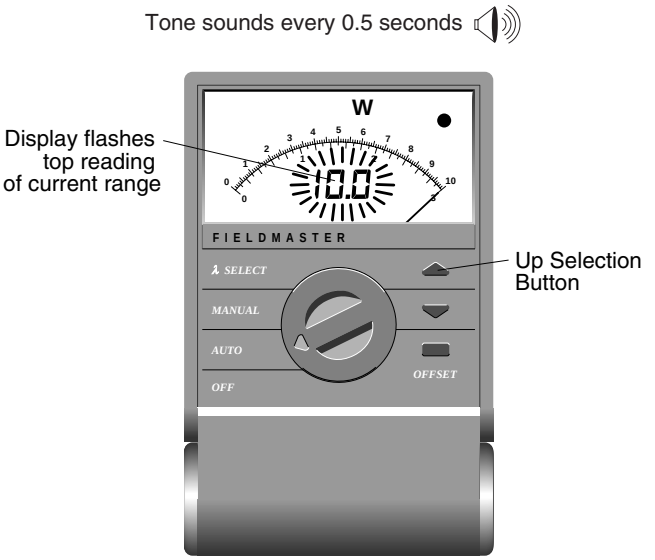


Figure 9. Over Range Indication

Over Range

During operation in the Manual Range Mode, if the power exceeds the selected range, a warning tone will sound every 0.5 seconds and the display will flash the top power reading of the selected range. To change the range upward, press the UP SELECTION BUTTON once.

When changing to a lower range, if the current power level is above the maximum of the range selected, the warning tone will begin sounding and the display will flash the top value of the selected range.

Manual Range Selection (cont'd)

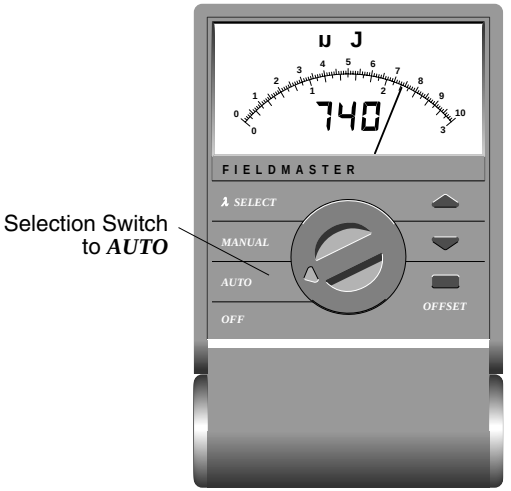


Figure 10. Auto Range Selection

Turn the selector switch to AUTO (see Figure 10). In pulse mode, the system will require several pulses before an energy level is displayed in order to set the appropriate amplifier gain range. The digital display will display the proper power and units for any power/energy within the minimum and maximum of the head plugged in. The display range for the analog display will automatically switch up to the next range when the current reading reaches 95% of the current range. The display range will switch down when the current power/energy reading reaches 95% of the next lower range.

Note: When using a pulse detector, the FieldMaster will display an erroneous reading when it is switched form manual to autorange mode and vice versa until the next pulse occurs. This is due to the "switch-bounce" when the mode selector switch is changed. When the system is initially switched on, several pulses will be required before an energy level is displayed in order to set the appropriate amplifier gain range.

Offset Entry

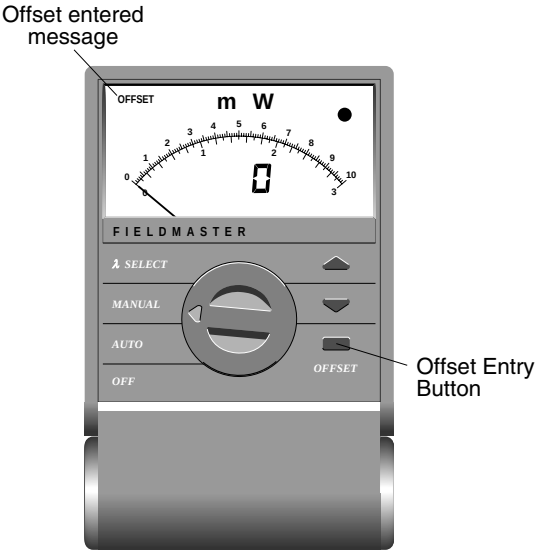


Figure 11. Offset Entry

Pressing the OFFSET button (the lowest button to the right of the Selector Switch) enters the current power/energy reading as an offset value and zeros the digital and analog power displays. (This can also be used to cancel ambient light levels for low power applications.) When an offset has been entered, the word OFFSET is shown in the upper left corner of the display (see Figure 11). If an offset has already been entered, pressing OFFSET cancels the old offset and adds the new offset value to the digital and analog displays. In order to achieve specified accuracy for the head being used, ambient light must be cancelled using OFFSET.

The OFFSET function operates only with CW detectors. When a pulsed detector is plugged in, the OFFSET button is not functional.

Beam Position Display

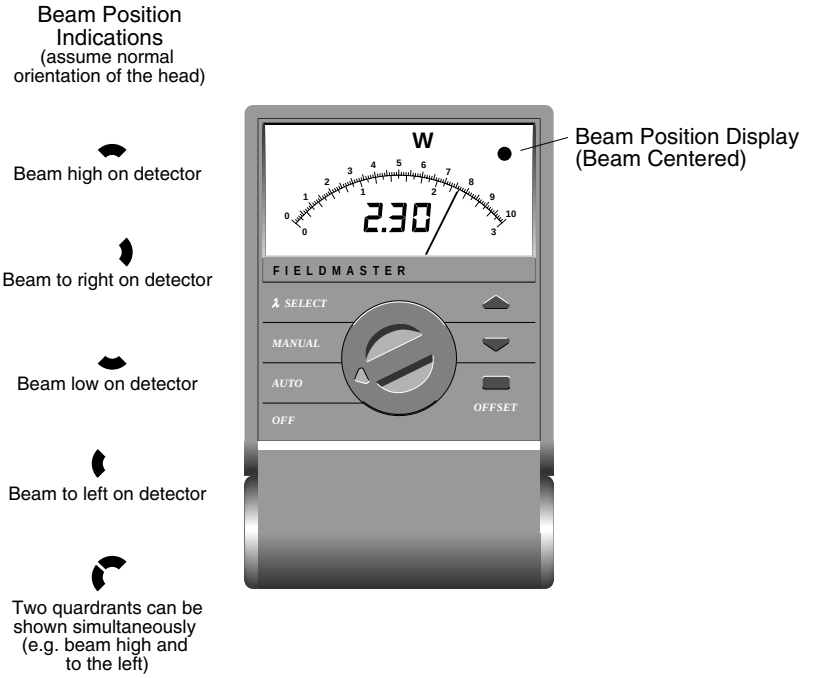


Figure 12. Beam Position Display

In order to achieve the greatest accuracy with Thermal Disk CW Power Sensors, the beam must be centered on the sensor disk. To assist in centering, beam position on the detector is indicated in the upper right of the FieldMaster display (see Figure 12). Note that this display is not active with pyroelectric (LM- #), silicon sensor (LM-2) detectors, or LM-1 thermal sensor.

Move the detector head until the beam position display indicates the beam is striking the center of the detector.

Back Light

The FieldMaster features a read back light. This feature is automatically activated when the AC Adapter is used, and is inactive when batteries are used. There is no on/off or level control for the backlight.

Warnings & Alarms

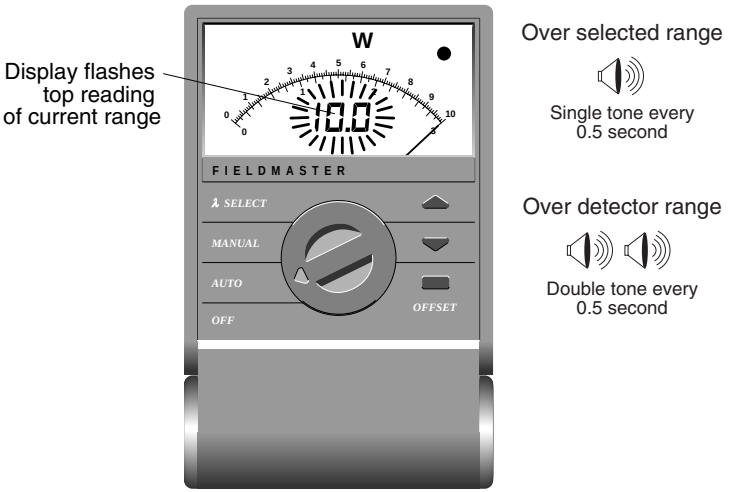


Figure 13. Over Range Indication

Over Range

During operation in the Manual Range Mode, if the power goes above the top of the selected range, a warning tone will sound every 0.5 seconds and the display will flash the top power reading of the selected range (see Figure 13). To change the range upward, press the UP SELECTION BUTTON once. If the power is over the maximum for the detector, the audible alarm will be a double tone every 0.5 seconds.

When changing to a lower range, if the current power level is above the maximum of the range that is selected, the warning tone will begin sounding and the display will flash the top value of the selected range.

Warnings & Alarms (cont'd)

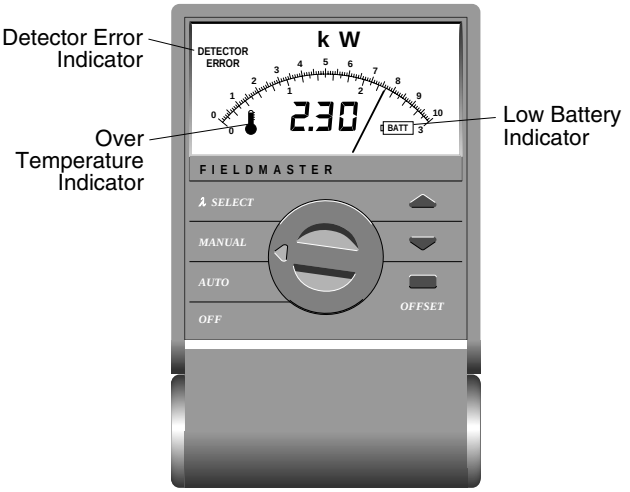


Figure 14. Warning Indicators

Over Temperature

If the detector temperature is above its specified maximum, the over temperature indicator will appear on the display (see Figure 14).

Low Battery

If the battery is below 5% of its specified life, the low battery indicator will appear in the lower right of the display (see Figure 14). Approximately 1 hour battery life remains.

Detector Error

If the FieldMaster console is turned on with no detector or a defective detector plugged in, or if the head is unplugged, the message DETECTOR ERROR will appear in the upper left of the display (see Figure 14).

Warnings & Alarms (cont'd)

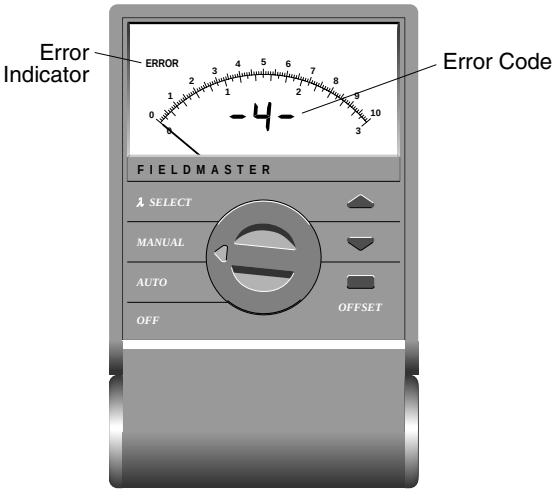


Figure 15. Error Messages

Error Messages

In the event of head or console failure, the following diagnostic error codes may be displayed (see Figure 15).

Error Code	Reason
0	ROM (checksum)
1	RAM (memory error)
2	INTERNAL BUS
3	DAC RANGE (unable to correct amp offset)
4	LOW BATTERY (below 5.6 volts)
5	ANALOG EEPROM (checksum)
6	DETECTOR EEPROM (checksum)
7	UNKNOWN DETECTOR (unable to decode EEPROM)
8	NON-SUPPORTED DETECTOR
9	DETECTOR INCOMPATIBILITY

CW Detector Heads

Coherent offers two types of CW sensor heads. The LM-2 series employs a semiconductor or quantum sensor element; all other CW detectors use Coherent's patented Thermal Disk Sensor.

LM-2 Head, Silicon or Germanium Sensor

Quantum sensors offer fast response time and very high photosensitivity. The major disadvantage of the quantum sensor is non-linearity with wavelength. In the FieldMaster, this has been overcome by the ability to enter the wavelength at which the measurement is being taken. The spectral correction factor is stored in the EEPROM in the detector, and the correction for wavelength is made automatically and a true reading is displayed.

The accuracy of a quantum cell is not dependent on the beam being centered on the cell. Therefore, there is no beam location display for the LM-2 Detector Head.

The quantum cell is extremely sensitive to wavelength. It is not unusual at the ends of the useful wavelength region for the sensitivity to have dropped by a factor of ten. **It is extremely important to have the right wavelength correction set for an accurate power reading.**

Note: an external preamplifier was required for the LM-2 series detectors with a LabMaster console. **Preamp is <u>not required</u> for the FieldMaster and <u>should not be used</u>.**

LM-3, LM-10, LM-20, LM-45, LM-100, LM-100E, LM-100XL, LM-150FS, LM-200, LM-200XL, LM-200XLE, LM-1000, LM-2500, LM-5000:

Thermal Disk Sensors

Coherent Thermal Disk sensors are rugged, proven laser measurement devices with flat spectral response from 0.25 to 10.6 μm. At the heart of the Thermal Disk Sensor is an array of vacuum deposited thermocouples. Each thermocouple produces a voltage proportional to temperature. When the thermocouples are at the same temperature, the sum of the voltages produced is zero. When the thermal disk is heated by laser energy, all of the thermocouples are not at the same temperature. Heat absorbed from the laser is transferred radially from the center of the disk to the disk edge,

CW Detector Heads (cont'd)

thus creating a temperature gradient. Due to this temperature gradient, the sum of the voltages produced by the thermocouples is proportional to the amount of laser energy striking the disk. The higher the laser energy, the higher the net voltage output.

The radially symmetrical thermocouple array is theoretically insensitive to beam position (assuming the beam is totally within the array). As a practical matter, minor differences in the deposited thermocouples lead to variations in reading as the beam position is moved around the sensor disk. The sensor head is calibrated for a Gaussian mode laser beam incident on the center of the thermal disk. The accuracy of the sensor head is therefore dependent on the beam type, size, and on the beam being centered on the disk. The Beam Position Display on the FieldMaster enables the user to center the beam precisely on the sensor to achieve maximum accuracy from the sensor head.

If water cooling is required, the detector should not be placed in the beam without specified cooling water flow.

Laser Damage

All sensors will be damaged if the specified maximum power density is exceeded. Check the maximum power density for your detector head. Expand the beam if necessary.

Pulse Detector Heads

LM-P5, LM-P10, LM-P10i, LM-P5LP, LM-P10LP Pyroelectric Detectors

Coherent pulse energy detectors feature a crystalline pyroelectric material with proven advantages over other ceramic materials:

Better surface quality, providing better spatial uniformity.

Lower temperature coefficient, providing greater accuracy and stability.

Lower piezoelectric coefficient, eliminating microphonic noise.

Lower capacitance, allowing higher rep rates.

Pyroelectric Detector Operation

All pyroelectric detectors act as pulse integrators. The pulse integration occurs in the black absorbing coating as a result of its thermal capacitance. This assumes that the pulse is much shorter than the thermal time constant of the coating. In either case, the pulse detector produces a voltage whose peak value is directly proportional to the radiant energy.

Laser Damage

All sensors will be damaged if the specified maximum energy density is exceeded. Check the maximum energy density for your detector head. Expand the beam if necessary.

Specifications

Sensor Types Supported:	Thermopile, power measurement. Photodiode, power measurement. Pyroelectric, pulse energy measurement. See sensor data for details.
Ranging:	Automatic or manual, user selectable. Useful ranges for any supported detector head are limited by head specifications only.
Offset:	All ranges except top range can be offset by one full range.
Wavelength Correction:	Readings can be frequency corrected over the range 190 nm to 10.6 µm Correction frequency is stored in permanent memory.
Display:	Three digit liquid crystal display (LCD) and conventional moving coil meter. Contrast can be adjusted via push buttons. Contrast setting is stored in permanent memory. Backlit with AC Adaptor connected. Backlight color is red. Backlighting disabled when operating on battery power.
Power Requirements:	• AC operation 65-125 VAC 50/60 Hz 10 VA maximum 1.5 VA typical Adapter 0214-047-00 130-250 VAC 50/60 Hz 7.5 VA maximum 1.5 VA typical Adapter 0217-048-00 • DC Operation Uses 2 standard 9 V transistor radio batteries. Unit is fully functional with only one battery connected. Use 2 batteries for maximum working life before battery change. Low battery condition is indicated at 5% of battery life remaining. Working life of batteries: 8 hours with 2 Duracell MN1604 or ID1604 4 hours with 1 Duracell MN1604 or ID1604
Size:	7.6" long x 4.6" wide x 1.8" thick, when closed. (19.3 cm x 11.7 cm x 4.6 cm)
Weight (with batteries):	26 ounces (737 gms), with batteries
Console Accuracy:	2%. Net accuracy with any head is *head accuracy + instrument accuracy*
Response Time:	A function of sensor response speed. See sensor data.
Safety Features:	Sensor over-temperature and sensor over-range alarmed visually and audibly.
Operating Temperature Range:	5°C to 40°C

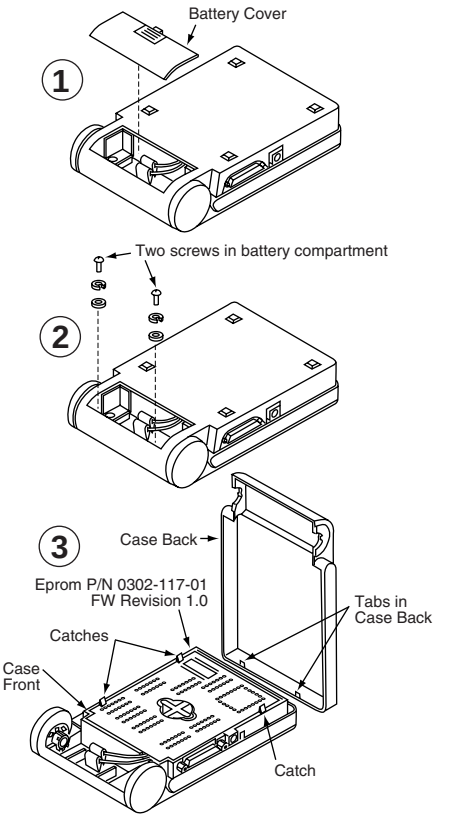
Determining Firmware Version

Turn the FieldMaster on with no head connected. The message DETECTOR ERROR will appear in the upper left of the display. The numerals in the center of the display will show any error conditions as -#-. If no errors exist, either three dashes, "---", will be displayed for firmware versions older than Revisions 1.2, or, for versions 1.2 and later, the version number will be shown (e.g. 1.20). Newer detector heads (e.g. the LM-2IR) may require current firmware to operate. For firmware updates, contact Service (see page 29).

Firmware Installation

Exercise ESD protective measures when working on the FieldMaster. The unit will not require re-calibration after this change, provided the existing calibration is current. When installation is completed, return old EPROM to Coherent Auburn Division.

1. Place the FieldMaster face down, remove battery cover and disconnect batteries. (Drawing 1).
2. Remove two screws in the battery compartment. (Drawing 2).
3. Carefully separate case halves by pressing in on case front at the location of the catches (Drawing 3), to release them. Leave case front in position, face down, to protect delicate analog meter.



Trouble Shooting

Problem	Probable Cause	Solution
FieldMaster display does not turn on	Dead battery, AC Adapter not plugged in	Plug in AC adapter or replace batteries with Duracell MN1604 or ID1604 9 V batteries or equivalent (unit will operate on one 9 V battery, use 2 batteries for maximum service life)
	Defective selector switch	Call service
DETECTOR ERROR message on display when unit is turned on	No detector plugged in	Plug in detector
	EEPROM is detector is defective or cable is broken	Call service
Display is flashing and tone is sounding every 0.5 seconds	In Manual Range mode, the current power/energy is higher than the current range	Press UP Range Selection Button to increase range
Display is flashing and double tone is sounding every 0.5 seconds	Current energy/power is higher than the detector is rated for	Turn energy/power down, attenuate beam, or remove detector from beam
BATT symbol is displayed on lower right of screen	Batteries are low (low battery condition is indicated at 5% of useful battery life	Plug in AC adapter or replace batteries with Duracell MN1604 or ID1604 9 V batteries or equivalent (unit will operate on one 9 V battery, use 2 batteries for maximum service life)
Over Temperature symbol is displayed on lower left of screen	Detector head is over specified maximum temperature	Turn energy/power down, attenuate beam, or remove detector from beam
	Insufficient cooling water (water cooled heads only)	Check cooling water temperature, flow. Check hoses for kinks.

Trouble Shooting (cont'd)

Problem	Probable Cause	Solution
FieldMaster display error code:		
-0-	ROM (checksum)	Call service
-1-	RAM (memory error)	Call service
-2-		
-3-	DAC Range (unable to correct amp offset)	Call service
-4-	Battery below 5.6 volts	Plug in AC Adapter or replace batteries with Duracell MN1604 or ID1604 9 V batteries or equivalent (unit will operate on one 9 V battery, use 2 batteries for maximum service life)
-5-	ANALOG EEPROM (checksum)	Call service
-6-	DETECTOR EEPROM (checksum)	Call service
-7-	UNKNOWN DETECTOR unable to decode EEPROM	Call service
-8-	NON-SUPPORTED DETECTOR	Use compatible detector
-9-	DETECTOR INCOMPATIBILITY	Call service
Backlight not on	AC Adapter not plugged in	Backlight only works when operating on AC Power. Plug in AC Adapter

Warranty

The seller warrants to the original Buyer each item manufactured by it to be free from defects in material and workmanship for a period of time and under such conditions as specified in the Seller's warranty for the individual product, or for twelve (12) months from delivery if a warranty for the individual product is not specified. Major sub-systems manufactured by other firms but integrated into the Seller's systems are covered by the original Manufacturer's warranty. The Seller's liability under valid warranty claims is limited to repair or replacement at the Seller's plant or the Buyer's location, all at the option of the Seller.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED AND SHALL BE THE BUYER'S SOLE REMEDY AND THE SELLER'S SOLE LIABILITY ON CONTRACT OR WARRANTY OR OTHERWISE FOR THE PRODUCT. THE SELLER'S DISCLAIMS ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR PURPOSE.

All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, must be received within the applicable warranty period by the Seller, and shall be subject to the terms and conditions stated herein. Such claims should include the product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any products are returned for repair and/or adjustment, authorization for the Seller for the return and instructions as to how and where these Products should be shipped must be obtained. Any product returned to the Seller for examination and/or warranty repair shall be sent prepaid via the means of transportation indicated as acceptable by the Seller. The Seller reserves the right to reject any warranty claim on any item that has been shipped by non-acceptable means of transportation. When any product is returned for examination and inspection, or for any other reason, the Buyer and its shipping agency shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect of non-conformity in the Product. In all cases, the Seller has sole responsibility for determining the cause and nature of failure, and the Seller's determination with regard thereto shall be final.

If it found the Seller's Product has been returned without cause and is still serviceable, the Buyer will be notified and the Product returned at the Buyer's expense, in addition, a charge for testing and examination may, in the Seller's sole discretion, be made on products returned.

Sales & Service Information

Thirty years of innovation

Coherent has been the world leader in the manufacture of lasers, and the instruments to measure them, for over thirty years. Coherent offers complete solutions for laser characterization, process control, and system design.

You may contact your local representative or Coherent for further information regarding these items. Call and ask for one of our customer care specialists. Purchase orders may be placed by phone, fax or mail.

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