spirax sarco

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-8-631-US

May 2013

EFT10 Electromagnetic Flow Transmitter

FOREWORD

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Spirax Sarco recommends that you read this manual completely before placing the equipment in service.

Although Spirax Sarco designs reliability into all equipment, there is always the possibility of a malfunction occurring. You can use this manual to help in diagnosing and repairing the malfunction, if possible.

If the malfunction persists, call or write the Spirax Sarco Customer Service Department for assistance.

Address and contact information:

Spirax Sarco
2150 Miller Drive
Longmont, CO 80501

Phone: 800-356-9362 or 303-682-7060
Fax: 303-682-7069

email: sales@emcoflow.com
website: spiraxsarco.com/us

For other countries, consult your nearest Spirax Sarco representative. Simple difficulties can often be diagnosed over the phone. If it is necessary to return the equipment to the factory for service, please read our Return Authorization Policy on the following page. This will aid in the prompt repair and return of the equipment.

Spirax Sarco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

IMPORTANT NOTICE
RETURN AUTHORIZATION POLICY

Spirax Sarco must pre-approve and assign a Return Authorization Number to any instrument you plan to return. Please identify the Return Authorization Number clearly on all shipping cartons and paperwork.

Please note that the provision of a Return Authorization Number does not automatically mean that the return is covered by our warranty.

In order to serve you better, and to protect our employees from any potentially hazardous containers, Spirax Sarco MUST RETURN UNOPENED, AT THE SENDER'S EXPENSE, ALL ITEMS THAT DO NOT HAVE A RETURN AUTHORIZATION NUMBER AND DECONTAMINATION CERTIFICATE.

To obtain a Return Authorization Number, Spirax Sarco requires a completed Decontamination Certificate, which states that equipment to be returned has been thoroughly cleaned. To receive a copy of this document, please contact Spirax Sarco and request a Decontamination Certificate.

Phone: 800-356-9362 or 303-682-7060
Fax: 303-682-7069

email: sales@emcoflow.com
website: spiraxsarco.com/us

Please note that we will be unable to issue a Return Authorization Number unless we have a completed Decontamination Certificate. This ensures everyone's safety and helps us speed up the repair and return process.

OSHA Hazard Communication Standard 29CFR 1910.1200 mandates that we take special steps to protect our employees from exposure to potentially hazardous materials. Therefore, all equipment so exposed must be accompanied by a completed Decontamination Certificate prior to issuance of an RA number by Spirax Sarco.

The employees of Spirax Sarco sincerely appreciate your cooperation in following this policy.

Address your equipment to:

Spirax Sarco
2150 Miller Drive
Longmont, CO 80501

Spirax Sarco

Product Limited Warranty Statement

Spirax Sarco warrants each UniMag magnetic flow metering system to be free from defects in material and workmanship under normal use and service for the following periods from the date of purchase:

Note: Spirax Sarco may recommend materials that come into contact with the media. However, Spirax Sarco cannot guarantee the compatibility of those materials for any specific application, and does not include compatibility in its warranty.

UniMag Sensors And Flowtubes	2 year warranty, except when temperatures and pressures exceed approved customer application data.
DemiMags	1 year warranty
Transmitters	1 year warranty

The user must provide any notice of any defect to Spirax Sarco within the warranty period, thoroughly clean the product, return intact and prepay transportation charges. The obligation of Spirax Sarco under this warranty is limited to repair or replacement at its factory. This warranty shall not apply to any product which has been repaired or altered by non Spirax Sarco employees, or which has been subject to misuse, negligence, accident, or incorrect wiring by non Spirax Sarco employees. The EFT10 transmitter contains a tamper seal on the field wiring board. If this sticker is removed or damaged the warranty will be void.

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IMPORTANT – PLEASE READ

⚠ DANGER

The installation and operation of this product may put you at risk of serious injury or even death. The electrical installation, start-up and maintenance of this device must be performed by trained personnel authorized by Spirax Sarco. The personnel must read and understand this Instruction Manual and follow its procedures. Take whatever precautions are necessary to ensure your safety before making an installation or working on one. Never work alone or unsupervised. Install and operate this product in accordance with all applicable safety and health regulations, as well as any appropriate local ordinances. Observe the national standards in your country applicable to testing the operation, repair and maintenence of electrical devices.

This product may be installed in confined spaces. Examples of confined spaces are manholes, pipelines, digesters, and storage tanks. These places can be dangerous or fatal if you are not suitably prepared. The primary hazards of confined spaces are the possibility of poisoned air and the lack of proper ventilation. Work in such places is governed by OSHA 1910.146, and may require a permit before entering. The other major hazard particular to this product is its extreme weight, which makes it dangerous to handle and creates the risk of being crushed or struck by the unit during installation.

This manual may also contain Material Safety Data Sheets (MSDS) for chemical agents supplied or recommended for use with this product. If needed, these sheets will be in the MSDS Appendix. These sheets provide information about possible hazards from the chemicals. Additional MSDS, covering various proprietary agents (name-branded or trademarked mixtures) that can also be used with this product, are available from the manufacturers of those agents.

This manual uses the following notations to set apart hazard warnings and notes:

⚠ DANGER

DANGER describes situations that will result in loss of life or serious personal injury, unless avoided. The emphasis is on clear and immediate threats to your life or safety.

⚠ WARNING

WARNING describes situations that could result in loss of life or serious personal injury unless avoided. The emphasis here is on the potential for a serious accident.

⚠ CAUTION

CAUTION describes situations that may result in moderate personal injuries, property damage, or damage to the equipment, unless avoided.

☑ *Note*

NOTES draw your attention to particular features, practices, tips, or other information useful in setting up or operating the product.

EFT10 Electromagnetic Flow Transmitter

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EFT10 Electromagnetic Flow Transmitter

Section 1 Introduction

1.1 Introduction

A UniMag electromagnetic flow meter system consists of a flow sensor and a EFT10 microprocessor based transmitter. EFT10 transmitters use a unique and innovative method of coil excitation to create a stable flow signal having a signal-to-noise ratio higher than conventional AC or pulsed DC magmeters. As a result, the system offers fast response, high accuracy (unaffected by zero drift), and unequaled insensitivity to the worst slurry generated noise.

The EFT10 can be operated, configured, and calibrated locally from the front panel's keypad and display window.

1.2 Summary of Features

The following list summarizes the major functional capabilities and options available with the EFT10:

- Bidirectional flow measurement capability.
- Two analog (4-20 mA) outputs that can be individually configured.
- Pulse output that is configurable as a scaled totalizer value or as a frequency that is proportional to the flow rate.
- Totalizer that maintains Forward, Reverse, Net, and Gross Total values in user specified volume units.
- Two Contact Inputs that can be programmed to acknowledge alarms, reset totals,or force zero flow.
- Two Relay Outputs that can be configured as high alarm, low alarm, diagnostic error, flow direction, or empty pipe. The alarm set points may be based on flow rates or totalizer values with a programmable dead band. You can also choose if alarms clear themselves or must be manually acknowledged when the alarm condition returns to normal.
- Two levels of password protection that allow you to prevent undesired modification of the configuration parameters and/or resetting of totals and alarms.
- A 4-line x 20-character backlighted LCD display with keypad.

1.3 Specifications for the EFT10

The technical specifications for the EFT10 are listed in Table 1-1.

Table 1-1 EFT10 Electromagnetic Flow Transmitter Specifications

Height	9.2 inches (235 mm)
Width	9.8 inches (248 mm)
Depth	4.4 inches (113 mm)
Weight	8.375 pounds (3.8 kg)
Material	UV resistant fiberglass with stainless steel screws
Keypad	Tactile feedback, waterproof, vandal resistant
Display	Waterproof, backlit liquid crystal, 4 lines of 20 characters each

Totalizers	Forward, reverse, net and grand total flow, resettable or non-resettable
Operating Temperature	-4 to +140°F (-20 to +60°C)
Storage Temperature	-40 to +160°F (-40 to +70°C)
Enclosure	NEMA 4X, IP65
Supply Voltage	120VAC 60Hz, 120VAC 50Hz, 230VAC 50Hz, 230VAC 60Hz
Mains Power Fuse	250V, slo-blo, 250mA Dimensions: 5 x 20mm
Coil Protection Fuse	5A fuse
Power Consumption at 120 VAC 60Hz	EFT10 Transmitter 6 Watts typical Max for Sensors 65 Watts typical
Compatible Flowtubes	Full pipe meters only. UniMag M, DT, DM, DL, Delta Kit, DeltaMass
Sensor Excitation	UniPulse (unipolar pulsed hybrid)
Magnetizing Current	Up to 5.5 A base to peak, depending on sensor size
Coil Voltage	120VAC 60Hz, 120VAC 50Hz, 230VAC 50Hz, 230VAC 60Hz
Exciter Frequency	40Hz (with 60Hz supply), 33.3Hz (with 50Hz supply)
Input Impedance	10^{12} Ohms
Media Conductivity	Conductivity >0.8 µS/cm. For deionized water, consult Spirax Sarco.
Non-full Pipe Detection	Using sensor electrodes or user supplied signal, holds analog output at 4 mA and pulse output at 0.
Low Flow Cutoff	A low flow cutoff algorithm forces the pulse output, display, and digital measurement value to zero when the measurement signal falls below user adjustable setpoint. The default is 2% of 4-20 mA flow range.
Time Constant	Minimum of 30 milliseconds
Temperature Coefficient	Less than ±0.5% of span for any temperature variation.
Contact Inputs (2)	Two user configurable inputs, rated 12 volts DC, 10 mA. These inputs require a contact closure or transistor switch between the terminals.
Communications	RS232 proprietary protocol for data log retrieval and configuration.

Analog (4 to 20 mA) Outputs	Two 4-20mA outputs from separate terminals are available for bidirectional flow. When internally powered, a loop voltage of 24 V DC is supplied with a maximum load of 800 Ohms. Theses outputs are not potential free and are isolated from ground and all other circuits. When externally powered, the maximum load is calculated by: Max. Ohms = [(Vdc x 45) - 290] For an external 24 Vdc supply, this would be [(24 x 45) - 290] = 788 Ohms. Minimum current 3.75mA, maximum 22mA
Signal Damping	0 to 300 seconds
Pulse Output	Two-wire, externally powered, configurable as a scaled output (for totalizing flow) or frequency output (for rate of flow). Rated 5 - 42 volts DC, 200 mA.
Scaled Mode (for totalizing)	Slow: 200 ms with maximum frequency of 2 Hz. Medium: 50 ms pulse width with maximum frequency of 10Hz Fast: 10 ms pulse width with maximum frequency of 40Hz
Frequency Mode (for rate indication)	Square wave output, 0 - 1,000Hz, 0 - 2,000Hz, 0 - 5,000Hz, 0 - 10,000Hz
Relay Outputs (2)	Two user configurable form C (changeover) relays, activated based on forward or reverse flow, forward or reverse total, net total, gross total, diagnostics or non-full pipe detection.
Maximum Distance Between Flow Transmitter and Flowtube	300 feet (100m) or 66C whichever is less, for conductivity > 5 µS/cm where C is conductivity in µS/cm (microsiemens/cm). For cable lengths > 100 feet (30m) or conductivities < 5 mS/cm, a preamp in the magmeter is necessary.
Data Log	User configurable log interval. Log data is retrieved using RS-232 and a serial emulation on a PC.
HART	HART 7 over 4-20mA channel 1 output using internal or external power supply.
Modbus RTU	Modbus RTU over serial RS-485.

Wiring From Flow Transmitter to Flowtube	Four cables are required; one for the reference coil (which compensates for variation in supply voltage), one for the electrodes, one for the exciter coils, and one for the pre-amp. Each cable should be 50 feet (15 m) standard, twisted shielded pair, 18 gauge (0.75 mm2) minimum, Belden 8760 or 9318, Alpha 5610/1801 or 5611/180, or equivalent.

1.4 Transmitter Identification

The transmitter can be identified by a data plate located behind the door of the enclosure. Although all EFT10 transmitters are interchangeable with all UniMag flowmeters, they are normally supplied already calibrated to a particular magnetic flowmeter.

EFT10 Electromagnetic Flow Transmitter

Section 2 Installation Procedures

2.1 The EFT10 Transmitter Dimensions

The dimensions of the EFT10 transmitter are shown in Figures 2-1 and 2-2.

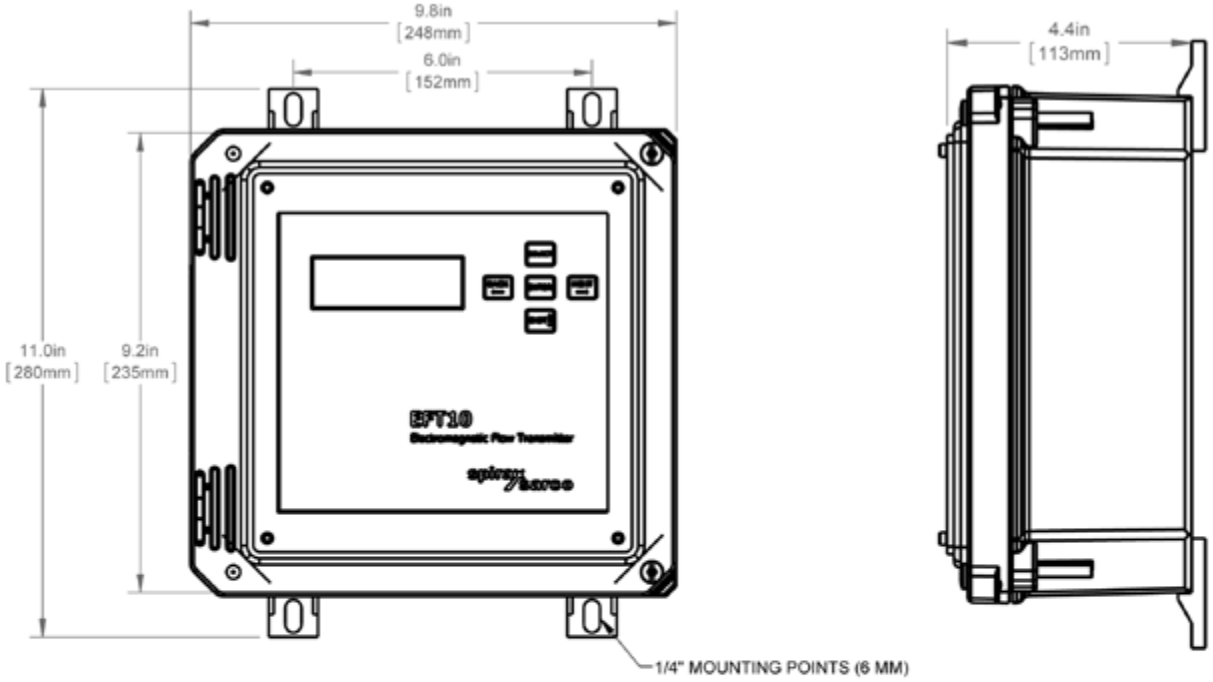


Figure 2-1: EFT10 Front Panel Dimensions

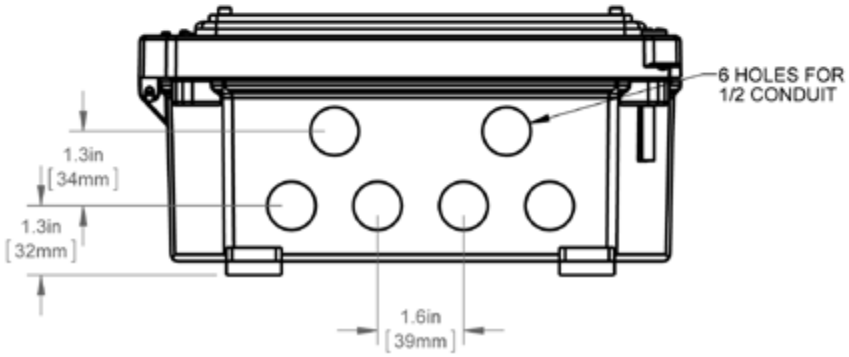


Figure 2-2: EFT10 Bottom Dimensions

2.2 Mounting the Transmitter

The EFT10 transmitter must be mounted where it will never be submerged in water. When properly installed, the EFT10 is dust tight, corrosion resistant, and protected against water jets, to NEMA 4X and IP65.

Although the EFT10 has high insensitivity to electrical noise, it is preferable to locate it and the flowtube away from high voltage, radio frequency, and similar external noise. It should not be located in direct sunlight, and proper ventilation is required to circulate the air in the immediate area around the transmitter.

Location in areas of high moisture content should be avoided to prevent excessive buildup of moisture inside the enclosure. If this is unavoidable, an appropriate heater should be used in the transmitter location.

The ambient air temperature should be within -4°F to +140°F (-20°C to +60°C) for operation. This temperature range can be -40°F to +160°F (-40°C to +70°C) for storage.

The transmitter is intended to be a wall mounted unit, and is normally supplied with mounting feet. The feet (Figure 2-3) can be used for mounting the enclosure, or holes can be made in the mounting panel to match the four tapped holes in the back of the EFT10 enclosure (Figure 2-1).

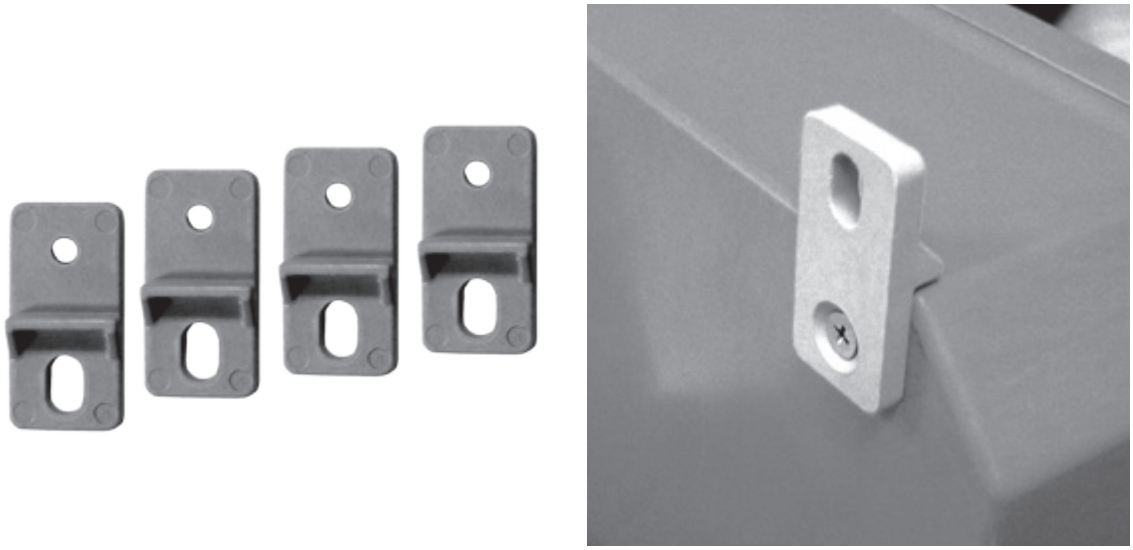


Figure 2-3: Mounting Feet and Attached Mounting Foot

If you use the mounting feet, screw through the hole of each foot into a tapped hole in the back of the enclosure using the supplied 4 x 10-32 UNF screws, and tighten. Mark the center of each slot in the mounting feet onto the mounting panel. Drill and tap 10/32" (6mm) holes in the mounting panel. Secure the enclosure to the mounting panel through the slots of the mounting feet. You can also mount the feet onto a strut that is attached to the mounting panel.

2.3 Wire Entrances and Conduit Connections

Six non-threaded conduit holes are located on the bottom of the transmitter case. The holes are sized to accommodate ½" conduit or M20 connectors (provided by the user). The wires to the meter should be run in shielded conduit. Separate runs are recommended for the input signal; output signal; flowtube coil drive wires, electrode wires, and reference wires; and AC supply.

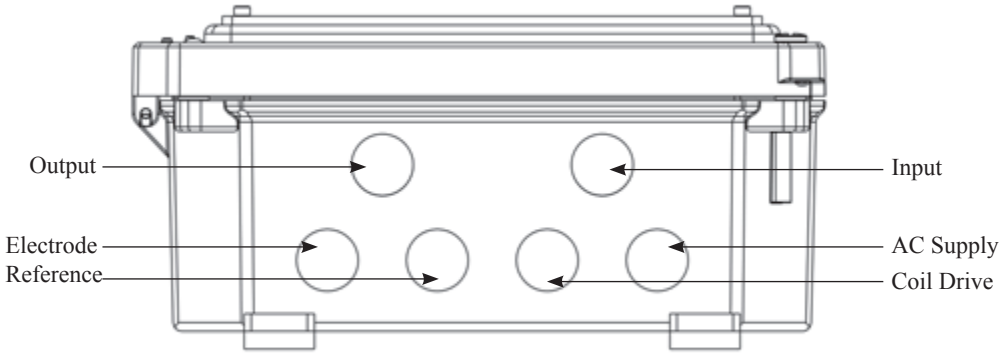
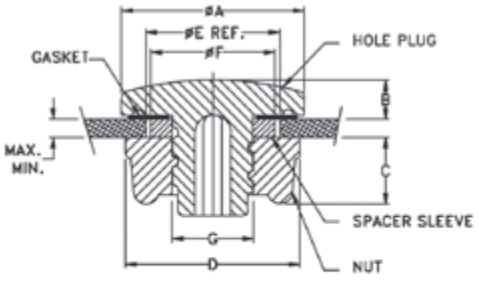


Figure 2-4: Recommended Use of Conduit Holes

⚠ WARNING

To maintain NEMA 4X (IP66) rating the conduit must be run through liquid tight fittings, see recommended fittings below. Place a small amount of silicon sealant on the threads of the liquid tight fitting prior to install and tighten with a wrench. Unused conduit openings must be plugged with NEMA 4X (IP66) rated fittings.

To plug unused conduit openings, use watertight conduit fittings such as the plug assembly shown below. The recommended fitting is from Hubbell Electrical Products, RACO, 3512-8 – Straight Liquidtight Connector ½" Insulated (UPC 050169351284), or equivalent.



øA	B	C	D ACROSS FLATS	øE REF NOM HOLE DIA RANGE	øF	øG	COMMON INDUSTRY APPLICATIONS
1.29" (30.48)	0.22" (5.59)	0.38" (9.63)	1.04" (26.39)	0.88" (22.35)	N/A	0.81" (20.57)	½" CONDUIT

Figure 2-5: Plug Assembly

Spirax Sarco offers plug assemblies that provide a watertight, strain relieved entrance for 9.5 mm to 11.1 mm (0.375" to 0.437") diameter cable.

2.4 Electrical Installation

Maximum Ratings
Stresses above those listed under Maximum Ratings may cause permanent damage to the EFT10 transmitter.

Table 2-1 Maximum Ratings

PARAMETER	CONDITIONS	MAX. RATING
[1]POWER SUPPLY VOLTAGE, L (L1) to N (L2)	120VAC Transmitter	95VAC to 132VAC
	230VAC Transmitter	195VAC to 252VAC
POWER SUPPLY CURRENT	120VAC 50Hz Transmitter	3.3A
	120VAC 60Hz Transmitter	2.9A
	230VAC 50Hz Transmitter	1.7A
	230VAC 60Hz Transmitter	1.5A
OPERATING TEMPERATURE		-20C to +60C
STORAGE TEMPERATURE		-40C to +70C
4-20mA OUTPUT SUPPLY VOLTAGE	Internal Power	+28VDC max
4-20mA EXTERNAL VOLTAGE LIMITS	External Power	+14VDC to +28VDC
RS-232 RxD INPUT VOLTAGE LIMIT	External voltage applied to RxD terminal	+/- 25VDC
RS-232 TxD OUTPUT VOLTAGE	Voltage out from TxD terminal	+/- 13.2VDC
RS-485 (MODBUS) INPUT VOLTAGE LIMITS	External voltage applied to '+' or '-' terminal	-7VDC to +12VDC
RS-485 (MODBUS) OUTPUT VOLTAGE	Voltage out	2.5VDC
RELAY OUTPUTS	Relay Contact Ratings	125VAC, 1A, 30VA
PULSE/FREQUENCY OUTPUTS MAXIMUM POWER LIMITS	Externally supplied power	42VDC, 0.20A maximum
CONTACT CLOSURE INPUTS	Contacts Open	Do not connect external power
	Contacts Closed	
DISTANCE BETWEEN EFT10 TRANSMITTER AND METER ON FLOWTUBE	Shielded cable run in shielded conduit. Pre-amp installed on flowtube.	300 feet maximum

[1] Power supply voltage is applied across the line to neutral terminals, see wiring section. Each transmitter is configured for either 120VAC or 230VAC operation. The operating frequency mode can be set to either 50Hz or 60Hz using the keypad menu and is independent of the line voltage.

Table 2-2 Recommended Operating Conditions

PARAMETER	CONDITIONS	MIN.	TYP. RATING	MAX.
4-20mA EXTERNAL VOLTAGE SUPPLY			+24VDC	
PULSE/FREQUENCY OUTPUTS			+24VDC, 0.1A	
RELAY OUTPUTS			+24VDC, 0.1A DC +24VAC, 0.1A AC 120VAC, 0.1A AC	
POWER SUPPLY VOLTAGE, L (L1) to N (L2)	120VAC Transmitter		120VAC, 50/60 Hz	
	230VAC Transmitter		230VAC, 50/60 Hz	
CONTACT INPUTS	Contact closure applied using relay or switch.		12VDC Internally Supplied. 10mA Sourced	
4-20mA Load Resistance	+24VDC Internal Supply	0 ohm	250 ohm	800 ohm
	Variable External Supply	0 ohm	250 ohm	(VDC x 45) - 290

2.4.1 Terminal Connections

⚠ DANGER

High Voltage Hazard: disconnect power before opening enclosure or servicing.

For access to the terminal board and terminals inside the transmitter, unscrew the Phillips screws at the top and bottom of the enclosure and swing the door open.

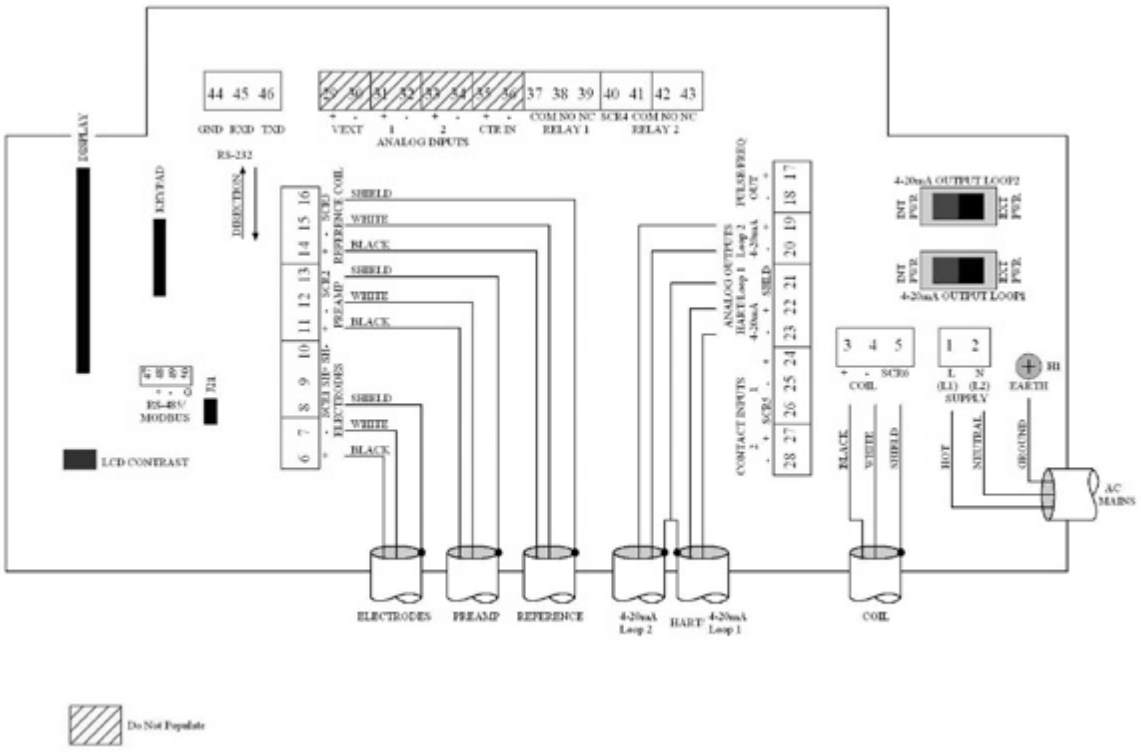


Figure 2-6: EFT10 Terminal Board

Table 2-3 – Terminal Identification

Terminal Identification	
Terminal Number	Description
EARTH	EARTH Ground - AC Mains. Connect Earth ground from the AC power supply to the EARTH termination screw (H1) on the terminal board. This will Earth ground the chassis.
1	Line – AC Mains. Connect Line/Hot from the AC power supply to this terminal, which is labeled L or (L1) on the terminal board.
2	Neutral – AC Mains. Connect Neutral from the AC power supply to this terminal, which is labeled N or (L2) on the terminal board.
3	Coil Supply (+). Connect the black wire from the exciter coils to this terminal, which is labeled '+' on the terminal board. Use only Spirax Sarco approved sensors.
4	Coil Supply (-). Connect the white wire from the exciter coils to this terminal, which is labeled '–' on the terminal board. Use only Spirax Sarco approved sensors.
5	Coil Supply Shield (SCR6). Connect the shield from the exciter coil cable to this terminal, which is labeled 'SCR6' on the terminal board. Use only Spirax Sarco approved sensors.
6	Electrode (+). Connect the black wire from the electrodes to this terminal, which is labeled '+' on the terminal board. Use only Spirax Sarco approved sensors.
7	Electrode (-). Connect the white wire from the electrodes to this terminal, which is labeled '-' on the terminal board. Use only Spirax Sarco approved sensors.
8	Electrode Shield. Connect the shield from the electrode cable to this terminal, which is labeled 'SCR1' on the terminal board. Use only Spirax Sarco approved sensors.
9	SH+. Do not connect.
10	SH-. Do not connect.
11	Pre Amp (+). Connect the black wire from the preamp to this terminal, which is labeled '+' on the terminal board. Use only Spirax Sarco approved equipment.
12	Pre Amp (-). Connect the white wire from the preamp to this terminal, which is labeled '-' on the terminal board. Use only Spirax Sarco approved equipment.
13	Pre Amp Shield. Connect the shield from the preamp cable to this terminal, which is labeled 'SCR2' on the terminal board. Use only Spirax Sarco approved equipment.
14	Reference (+). Connect the black wire from the reference coil to this terminal, which is labeled '+' on the terminal board. Use only Spirax Sarco approved sensors.
15	Reference (-). Connect the white wire from the reference coil to this terminal, which is labeled '-' on the terminal board. Use only Spirax Sarco approved sensors.

16	Reference Shield. Connect the shield from the reference cable to this terminal, which is labeled 'SCR3' on the terminal board. Use only Spirax Sarco approved sensors.
17	Pulse/Frequency Output (+). The Pulse/Frequency output forms a contact closure between the (+) and (-) terminals. An external power supply with a current limiting resistor is required. The higher voltage side of the circuit connects to the (+) terminal.
18	Pulse/Frequency Output (-). The Pulse/Frequency output forms a contact closure between the (+) and (-) terminals. An external power supply with a current limiting resistor is required. The lower voltage side of the circuit connects to the (-) terminal.
19	4-20mA Output (+), Loop 2. The 4-20mA analog outputs regulate a DC current between 4mA and 20mA. They can be configured by a user to output a linearly scaled current that represents the forward or reverse volumetric flow rate. Each loop can be selected to be powered internally or externally by sliding the switches SW2 and SW3 to indicate internal or external power. CAUTION: Damage may occur if the switch is set to internal power and an external power supply is connected to the loop. See the 4-20mA wiring section for more details.
20	4-20mA Output (-), Loop 2. See the 4-20mA wiring section for more details.
21	4-20mA Shield
22	4-20mA Output (+)/HART, Loop 1. HART interface and 4-20mA analog output, loop 1. See the HART interface section for more details. The 4-20mA analog outputs regulate a DC current between 4mA and 20mA. They can be configured by a user to output a linearly scaled current that represents the forward or reverse volumetric flow rate. Each loop can be selected to be powered internally or externally by sliding the switches SW2 and SW3 to indicate internal or external power. CAUTION: Damage may occur if the switch is set to internal power and an external power supply is connected to the loop. See the 4-20mA wiring section for more details.
23	4-20mA Output (-)/HART, Loop 1. See the HART or 4-20mA wiring section for more details.
24	Contact Input (+), Channel 1. This input will detect a contact closure (ie: relay or switch) connected across the (+) to (-) contact terminals. The contact inputs can be configured by a user to reset totalizers or clear alarms. External power must not be connected to this input.
25	Contact Input (-), Channel 1. Contact closure (-) terminal. External power must not be connected to this input.
26	SCR5. Cable shield termination for user wiring.
27	Contact Input (+), Channel 2. This input will detect a contact closure (ie: relay or switch) connected across the (+) to (-) contact terminals. The contact inputs can be configured by a user to reset totalizers or clear alarms. External power must not be connected to this input.
28	Contact Input (-), Channel 2. Contact closure (-) terminal. External power must not be connected to this input.
29	VEXT (+). Not supported. Do not connect.
30	VEXT (-). Not supported. Do not connect.

31	Analog Input (+), Ch1. Not Supported. Do not connect.
32	Analog Input (-), Ch1. Not Supported. Do not connect.
33	Analog Input (+), Ch2. Not Supported. Do not connect.
34	Analog Input (-), Ch2. Not Supported. Do not connect.
35	CTR Input (+). Not Supported. Do not connect.
36	CTR Input (-). Not Supported. Do not connect.
37	Relay COM, Channel 1. Common terminal of a Form C relay, SPDT (Single Pole Double Throw).
38	Relay NO, Channel 1. Normally open terminal of a Form C relay, SPDT (Single Pole Double Throw).
39	Relay NC, Channel 1. Normally closed terminal of a Form C relay, SPDT (Single Pole Double Throw).
40	SCR4. Cable shield termination for user wiring.
41	Relay COM, Channel 2. Common terminal of a Form C relay, SPDT (Single Pole Double Throw).
42	Relay NO, Channel 2. Normally open terminal of a Form C relay, SPDT (Single Pole Double Throw).
43	Relay NC, Channel 2. Normally closed terminal of a Form C relay, SPDT (Single Pole Double Throw).
44	RS-232 GND. This is the reference of the RS-232 interface. Connect the RS-232 ground reference to this terminal.
45	RS-232 RxD. This is the RxD serial data of a DTE device. It is an input to the EFT10. The serial baud rate is user selectable, and the data format is 8N1 with no flow control, no parity. RS-232 is used to extract the contents of the data log.
46	RS-232 TxD. This is the TxD serial data of a DTE device. It is an output from the EFT10. The serial baud rate is user selectable, and the data format is 8N1 with no flow control, no parity. RS-232 is used to extract the contents of the data log.
47	Do not connect.
48	RS-485 (+)/MODBUS. Positive side of the RS-485 differential signal. MODBUS protocol over RS-485.
49	RS-485 (-)/MODBUS. Negative side of the RS-485 differential signal. MODBUS protocol over RS-485.
50	MODBUS reference ground.

⚠ WARNING

To maintain NEMA 4X (IP66) protection, be sure to close and tighten lid securely with screws before operation.

2.4.2 Printed Circuit Boards

The printed Circuit Boards are not to be accessed by the customer. The EFT10 transmitter contains a tamper seal on the field wiring board. If this sticker is removed, or damaged the warranty will be void. Please contact Spirax Sarco for technical support at (800) 356-9362.

2.5 Connecting the Flowmeter

Install the flowmeter in accordance to the flowmeter instruction manual. Make sure the serial number of the flowmeter, shown on the tag plate on the flowmeter agrees with the serial number on the transmitter tag plate, when they have been supplied together.

⚠ WARNING

The EFT10 Transmitter must only be used with Spirax Sarco Pulsed Hybrid magnetic flowmeters having coils of the same voltage supply as the transmitter supply.

The maximum distance between the flowmeter and transmitter depends on the media conductivity for the given recommended cable. See page 3 for details.

Most water based media has a conductivity of 100 to 800 µS/cm.

2.5.1 Meter Cable Connections

The EFT10 is designed for use with Spirax Sarco approved meters that install into the pipework, such as the UniMag product line. The EFT10 must be wired to the meter's sensors via cable connections. The cables should be run inside shielded conduit.

Cable Types
Connect the meter on the flowtube to the transmitter using 2-core 18 AWG or 2-core 0.75 mm^2 multistranded, twisted, shielded cable, such as Belden #8760 or 9318; or Alpha 5610/1801 or 5611/1801.

Cable Wiring
Multiple cables are required between the EFT10 transmitter and the UniMag flowtube. One cable (marked Ref) is for the reference coil, which compensates for variation in supply voltage as well as magnetic fields in the media. A second cable (marked Elec) is for the electrodes, and a third (marked Coil) is for the exciter coils. A pre-amp, installed at the flowtube, is used in all EFT10 applications for immunity from external interference sources. This will require the use of a fourth cable to supply power from the EFT10 to the pre-amp at the flowtube.

Sensor Cable Connections			
Exciter Coils	**Electrodes**	**Reference**	**Pre-Amp**
Black to 3	Black to 6	Black to 14	Black to 11
White to 3	White to 7	White to 15	White to 12
Shield to 6	Shield to 8	Shield to 16	Shield to 13

Note: when using BLACK and RED pairs, the black wire is the positive (+) connection and the red wire is the negative (-) connection.

2.5.2 Cable Shielding

The cable shielding should not be cut more than 1 inch (25mm) from the terminals. The cable itself should be cut no longer than needed to connect to the terminals. It is recommended to use shielded cable on all circuit connections, as well as shielded, terminated conduit.

2.5.3 Multiple Sensors

Flowmeters that contain multiple sensors are connected in parallel in the flowmeter junction box.

2.5.4 Sensor Coil Resistance

When checking for correct wiring, note that the sensor coils have the following resistances.

Table 2-3 120V Sensor Coil Resistances (Ohms)

Sensor Diameter	Single or Quadruple	Pair
2"/3" (50 mm / 80 mm)	Pre-2005 version: 40 2005+ version: 70	Pre-2005 version: 20 2005+ version: 35
6" (150 mm)	10	5
8" (200 mm)	5	2.5
12" (300 mm)	8	4
DemiMag DM Series	100	--
DemiMag DL Series	--	50
Reference Coils	10k (single only)	6.6k (pair or quadruple)
For 230V coils multiply the above x 4		

2.5.5 Connect Power Supply

Check for the correct power supply and connect the power cable to the EFT10 Supply terminals 1 (L) and 2 (N) , and the case ground. Follow safety precautions. The transmitter case must be grounded in accordance with local practice.

⚠ DANGER

HAZARD of ELECTROCUTION. AC line voltage is present. Disconnect power before opening case or front panel, or before servicing.

Figure 2-7: Power Supply Connections on Connection Board

2.5.6 Junction Box Wiring

Users must connect the meter at the flowtube to the EFT10 transmitter by wiring between the junction box located at the flowtube and the EFT10 pre-amp terminal board. The diagram below illustrates the pre-amp terminal board for the EFT10 meter.

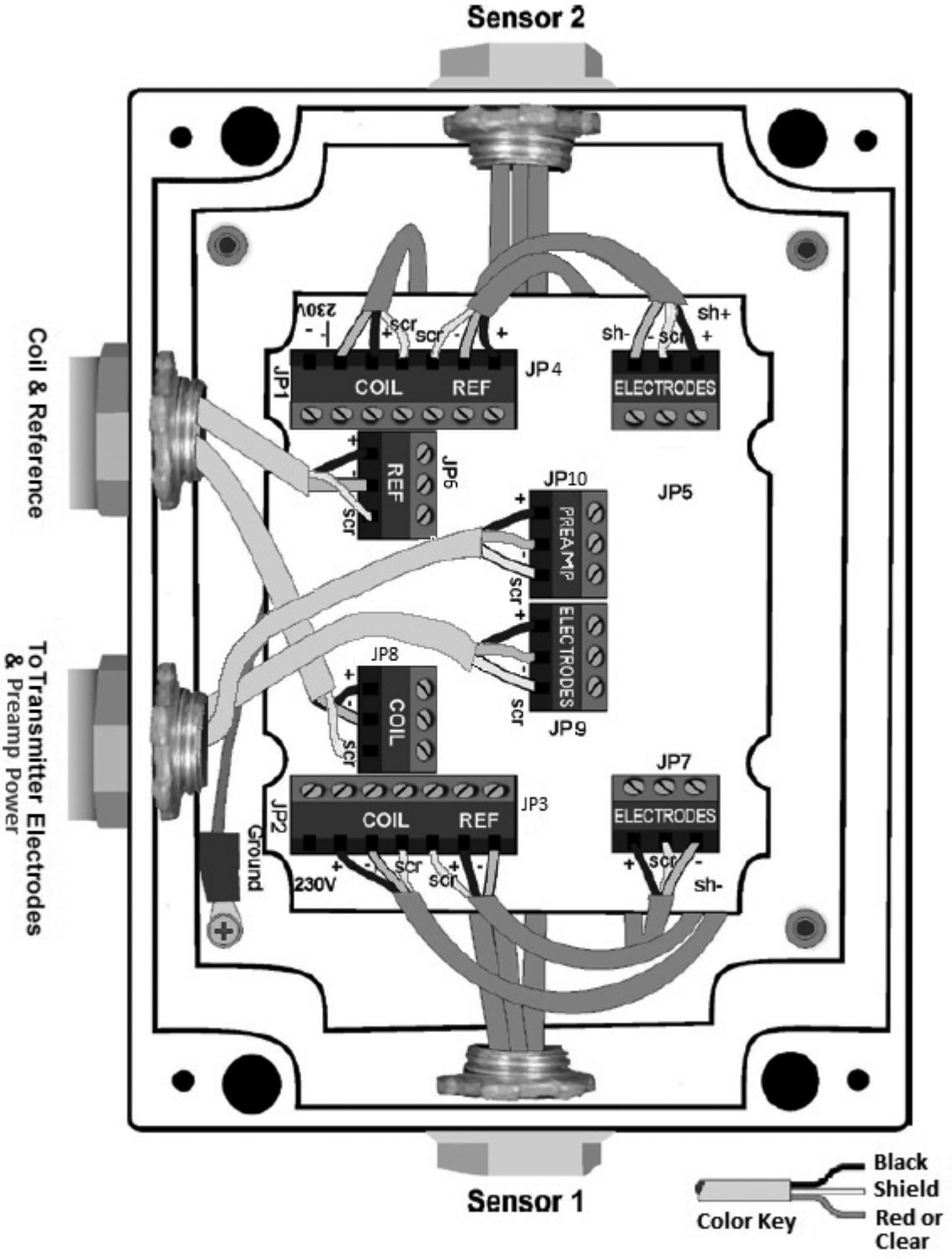


Figure 2-8: EFT10 Contact Input Diagram for the Pre-Amp Terminal Board

2.5.7 Junction Box Wiring Using an EFT10 to Replace an Existing 4411e Transmitter

If the EFT10 transmitter is used to replace an existing 4411e transmitter in the field then the flow tube wiring junction box will probably have a terminal board as shown in the diagram below:

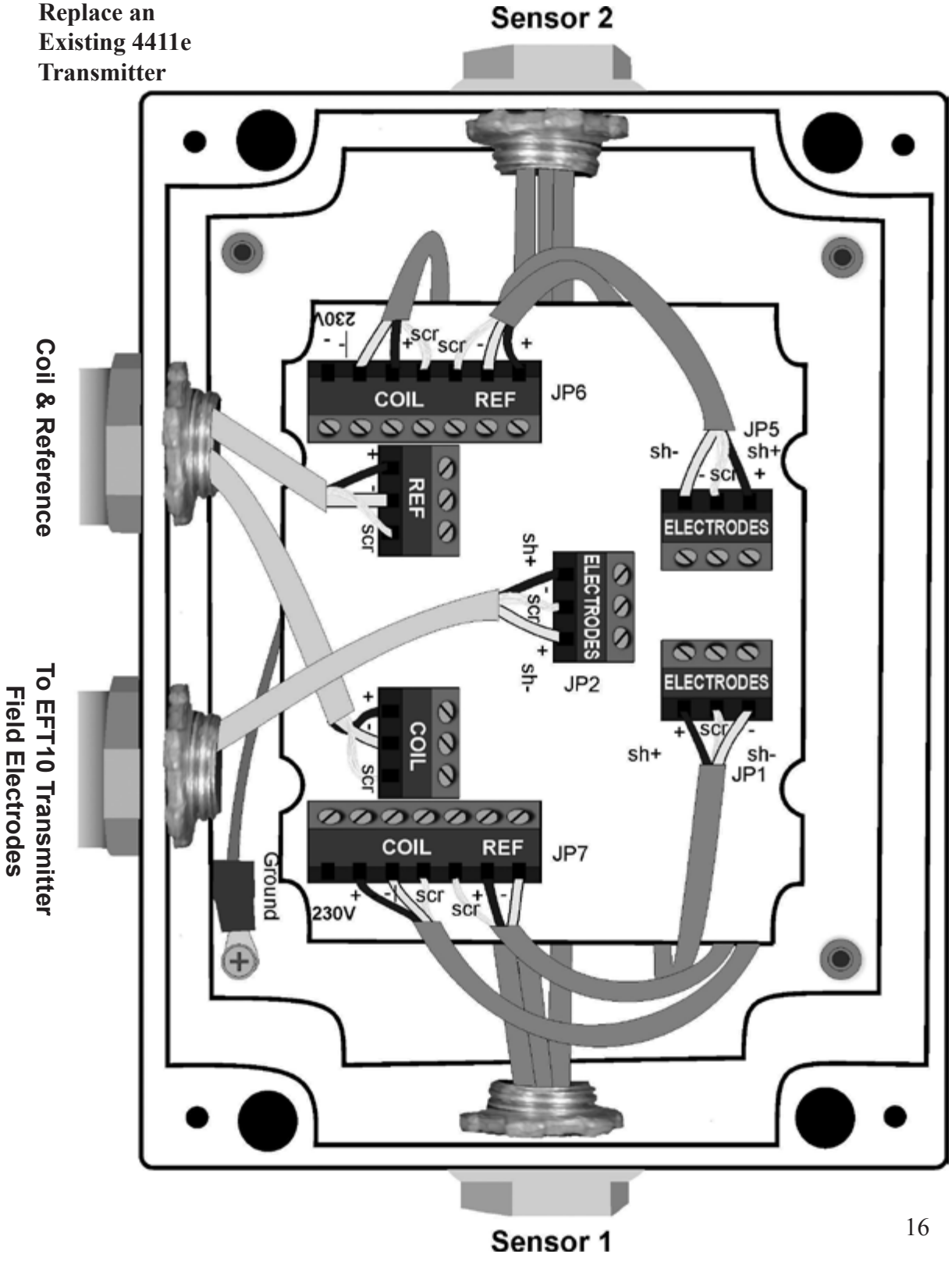


Figure 2-9: Contact Input Diagram for the Passive Terminal Board

2.6 Outputs

2.6.1 Pulse / Frequency Outputs

The EFT10 transmitter Pulse/Frequency output is powered by an external supply between 5VDC and 42VDC. The supply must have a current limiting resistor (Rlimit) to set the maximum current at no more than 0.2 amps. The minimum value for Rlimit can be calculated from the following equation:

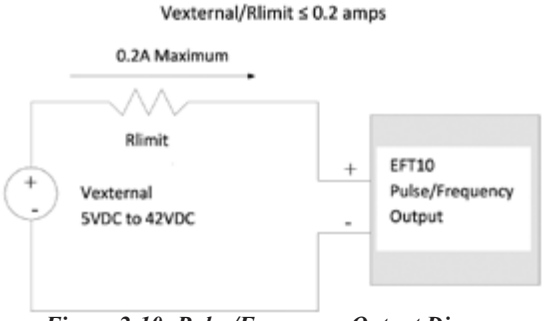


Figure 2-10: Pulse/Frequency Output Diagram

Frequency Mode
In frequency mode, the output is as a scaled frequency output in the range from 0Hz to a user selectable maximum frequency of 1kHz, 2kHz, 5kHz, or 10kHz. The frequency scales linearly over its configured range so that the frequency output is proportional to the rate indication.

Pulse Mode
In pulse mode, the output is configured as a pulsed output indicating a scaled totalizer value. The pulse width is user selectable to be 10ms, 50ms, or 200ms. The frequency of the pulse output is limited by the pulse width selected, since the pulse output cannot switch faster than the minimum pulse width. This results in maximum frequencies of 40Hz (10ms pulse), 10Hz (50ms pulse), or 2Hz (200ms pulse).

2.6.2 4-20mA Analog Outputs

The EFT10 transmitter has two independent 4-20mA analog outputs. The function of each output is user configurable to represent either forward or reverse volumetric flow rates. The 4-20mA analog outputs function to control the DC current through the loop, over a range from 4mA to 20mA. The current is scaled according to the Flow Range parameter, which is user configurable. 4mA represents zero volumetric flow in the configured direction (forward or reverse) and 20mA represents a volumetric flow rate equal to or exceeding the configured Flow Range. The current will scale linearly between 4mA and 20mA based on the volumetric flow rate.

4-20mA Cable Shielding
A dedicated cable shield connection is provided for users of 4-20mA analog outputs. This cable shield connection provides an AC termination to chassis ground. The advantage of this shield termination is that a user can terminate the cable shield at the EFT10 via AC termination and also terminate the other end of the cable shield directly to an Earth ground, without causing loop currents. The result is improved immunity to noise and interference that could otherwise affect HART communications over the 4-20mA loop.

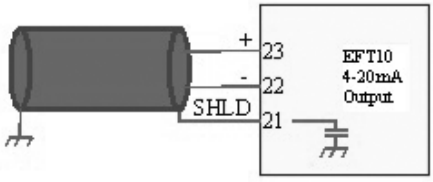


Figure 2-11: 4-20mA Cable Shielding

Power Supply Selection

Each 4-20mA loop has a slide switch to select between internal or external loop power. The switches, SW2 and SW3, are located on the terminal board. To select internal power, slide the switch toward the 'Int Pwr' label to the side of the switch. For external power, slide the switch to the 'Ext Pwr' label to the side of the switch. When internally powered, the 4-20mA will drive an external load without the need for an external power supply on the loop.

4-20mA Analog Output Wiring Diagrams

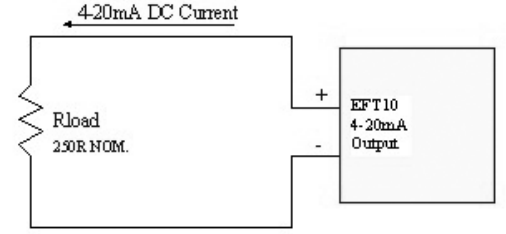


Figure 2-12: 4-20mA Internally Powered

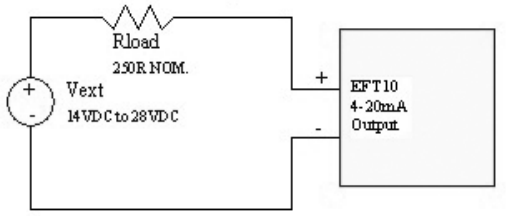


Figure 2-13: 4-20mA Externally Powered

2.6.3 HART Interface

The HART interface is supported on the 4-20mA Loop 1. Use of an external loop supply is required when using the HART interface. The EFT10 functions as a HART Transmitter, and is able to communicate with a HART host device or handheld. Connect the HART modem across the load resistor, Rload shown in Figure 3, to initiate communications with the EFT10. See the HART section for more details.

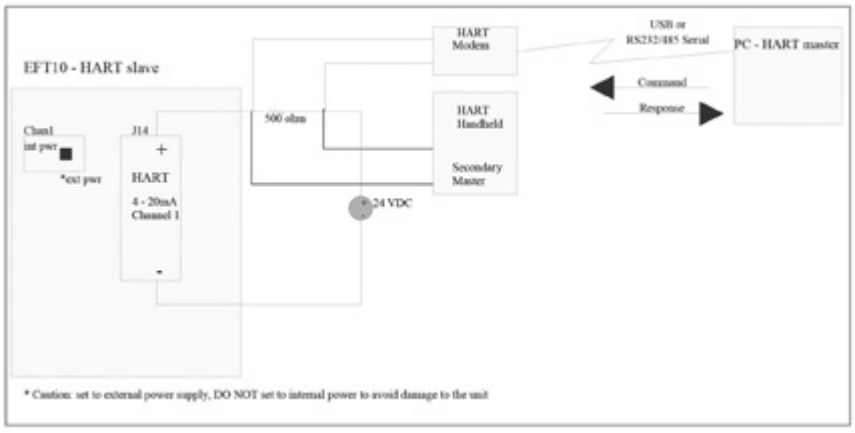


Figure 2-14: Simple HART Modern Connection

The EFT10 can also be connected with other HART devices in a multidrop configuration, as shown in Figure 9

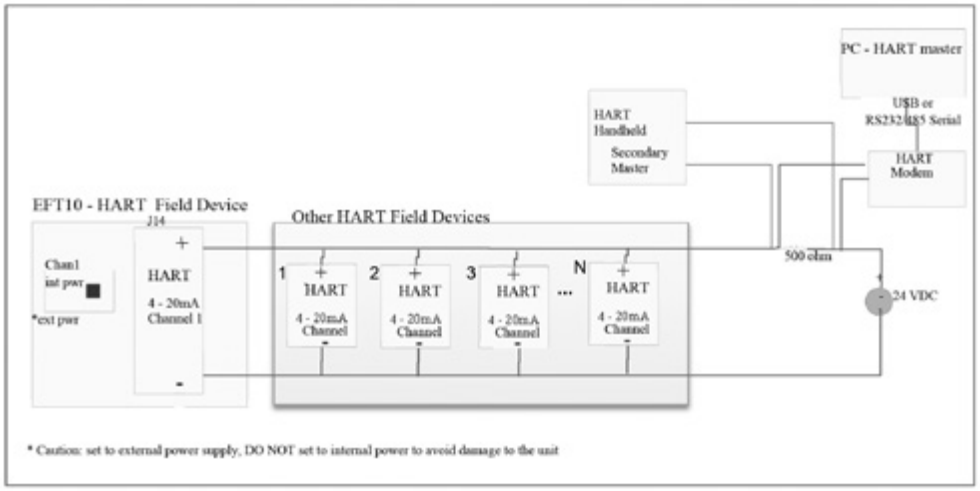


Figure 2-15: HART Multidrop Configuration

2.6.4 Relays

The EFT10 provides two, form C, relays. These relays can be configured to indicate high alarm, low alarm, flow direction, or empty pipe. The alarm set points may be based on flow rates or totalizer values with a programmable dead band. The dead band is used to provide hysteresis on the relay alarm operation. The addition of hysteresis prevents relay chatter when the alarm condition (the parameter that the alarm is compared against) is fluctuating around the alarm set-point. You can also choose if alarms clear themselves, auto-clear, or must be manually acknowledged when the alarm condition returns to normal.

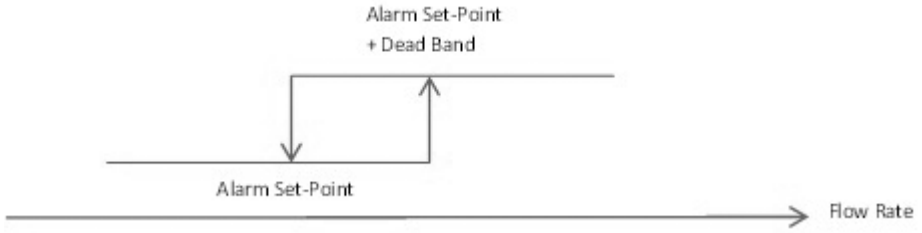


Figure 2-16: Relay alarm dead band operation while using low-point alarm

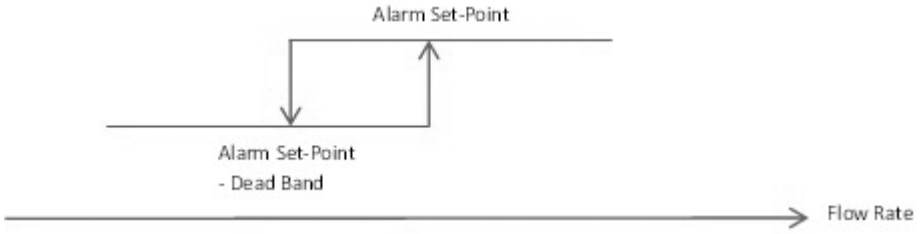


Figure 2-17: Relay alarm dead band operation while using high-point alarm

Power to the relays must be current limited to avoid damage to the relay. See Maximum Ratings for details.

2.6.5 Contact Inputs

Two user configurable inputs are provided to indicate status to the EFT10. These can be used to acknowledge alarm conditions, indicate empty pipe, reset totalizers, or zero flow. The contact inputs are pre-biased by the EFT10 and only require a user to provide a contact closure between the contact input terminals, (+) and (-).

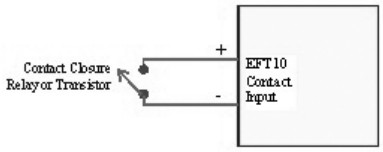


Figure 2-18: Contact Input Diagram

2.6.6 RS-485 / Modbus

The EFT10 transmitter provides a 3-wire, half-duplex, RS-485 communications channel that can be used as a Modbus RTU interface. It is possible to connect the RS-485 communications channel in a two-wire configuration by not connecting the reference between the EFT10 and peripheral equipment, but use of the reference signal as the third wire is recommended. Refer to the Modbus section for detailed information about the application and register mapping of the EFT10 Modbus interface.

The RS-485 communications channel requires 120Ω termination. If the bus is not terminated, it is possible to terminate the RS-485 bus with 120Ω by populating jumper J21 on the terminal board. When J21 is populated with a jumper, a 120Ω termination resistor is in-circuit across RS-485(+) to RS-485(-). Depopulating the jumper on J21 removes the 120Ω termination resistor from the circuit. When networking the RS-485 bus, the last device on the chain should be terminated.

Refer to the diagram below for wiring the RS-485 communications channel on the EFT10.

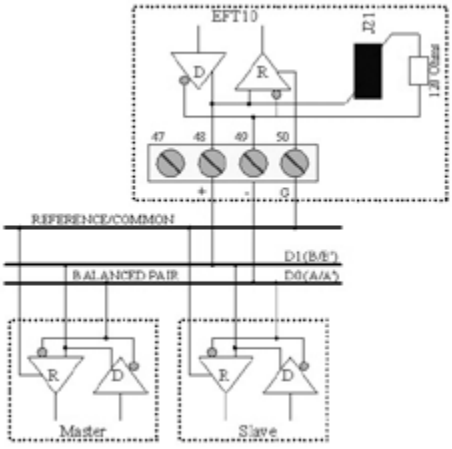


Figure 2-19: RS-485 communications

⚠ DANGER

To avoid electrical shock, installation and service should be done by qualified personnel. Incorrect handling of the 115/230 VAC power supply can kill you. For this reason, service of components subject to high voltage should be carried out only when the power has been disconnected.

Local agency requirements take precedence for supply power wiring and grounding. If no grounding wire is available, connect protective ground to plant safety ground.

EFT10 Electromagnetic Flow Transmitter

Section 3 Operation

3.1 Introduction

This section provides an overview of how to operate the EFT10 transmitter, and familiarizes you with its display and operation. Menus are explained for common functions in figured 3.4 through 3.20.

3.2 EFT10 Menu Overview

The diagram below shows the details of the EFT10's menu overview.

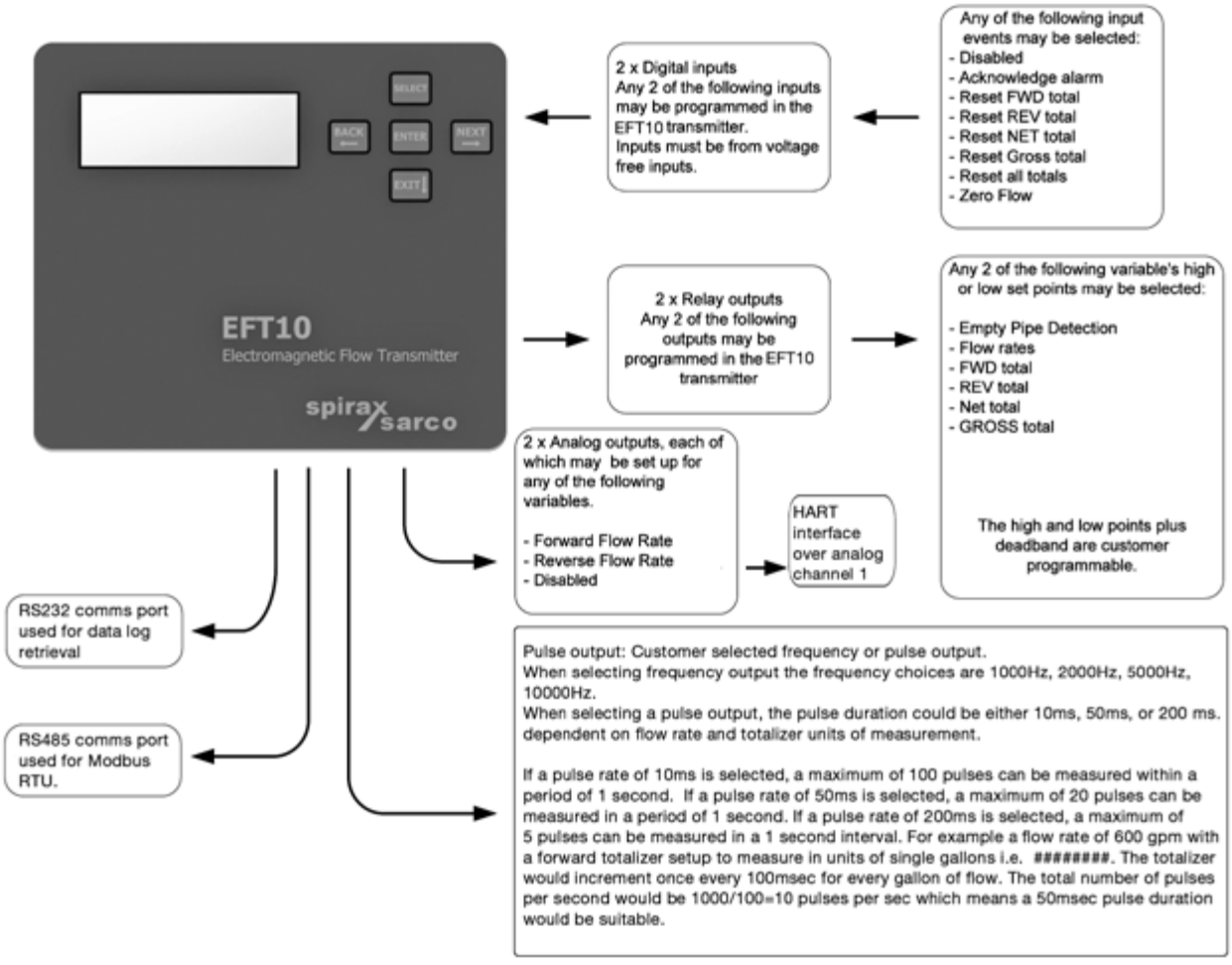


Figure 3-1: Menu Overview

3.3 Keypad and Display Panel

For local operation and configuration, all operator entries are made through a 5-button keypad and all data is presented on a 4-line x 20-character LCD display. The keypad/display is shown in Figure 3-1.

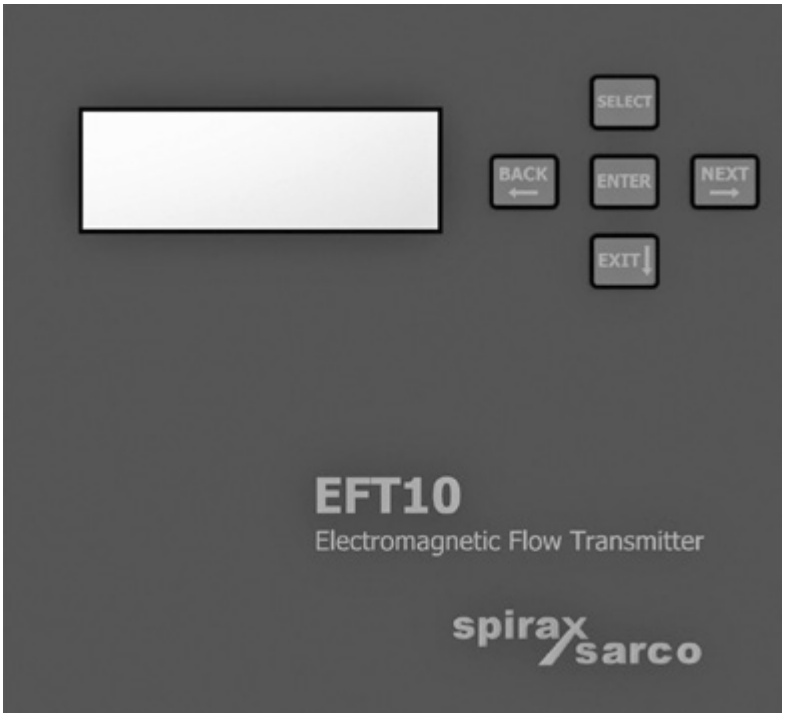


Figure 3-2: EFT10 Transmitter – Keypad and Display

The menus are navigated using the five buttons to the right of the display screen:

SELECT

Pressing SELECT brings you to the Default Display screen, which can display up to four user selectable lines of information. Subsequent key presses will step through all available display values one at a time, allowing you to see any value not presented on the default display.

NEXT

When you press the NEXT button, it takes you to the menu system. Each subsequent key press advances to the next menu item or choice within the menu system.

ENTER

Pressing ENTER opens the sub-menu for the selected menu item or allows you to change a parameter. If the parameter is available as a choice from preselected values, press NEXT to cycle through the available choices and press ENTER to save. If the parameter is an alphanumeric value, use the keypad to highlight the value and then press ENTER to choose. When finished choosing press SELECT to save the parameter value.

BACK

When you press BACK, you exit the current menu item and return to the previous level. When making an entry with the keypad, pressing BACK erases your entry.

An alphanumeric display is used to input parameter values. Use the NEXT and BACK keys to highlight the chosen numeral and the ENTER key to input the number on the screen. When finished inputting the value, press the SELECT button. The parameter will be updated and user will be placed into the Menu structure again.

3.4 Powering Up the Unit

When power is applied to the unit, you will see the following display:

```
Spirax Sarco
EFT10 Ver x.xx
FPGA. kev x.xx
www.spiraxsarco.com
```

After a delay of a few seconds, the software will begin loading and the unit will start at the 1st menu level “Display Readings”.

You can press SELECT to advance to the Default Display screen or NEXT to step through the menu choices. If no key press is detected within 30 seconds, the transmitter will automatically advance to the Default Display screen.

3.5 The Default Display

It will look similar to the following:

```
1. Flow
2. Flow %
3. Fwd Total
4. Rev Total
```

You can also access the default display when the Main Menu shows the following:

---- Main Menu ----
Display Readings
Press Enter or Next

Press SELECT or ENTER to advance to the Display Readings menu. This will show you what the current display settings are, starting with the default display. If you press SELECT, the display will cycle through all the readings, most of which aren't on the four line default display.

Use the System Setup menu to choose which variables (such as flow rates or totals) display on each of the four display lines of the Default Display.
From the Main Menu, press NEXT until you see:

---- Main Menu ----
System Setup Menu
Press Enter or Next

Press ENTER to select the System Setup Menu. Press NEXT until you see:

---- Main Menu ----
Set Default Display
Press Enter or Next

Press ENTER. You will be asked if you want to modify Line 1. If you do, press ENTER; if not, press NEXT to advance to the line you want to modify.

Once you select the line to modify, you can advance through the following choices by pressing NEXT. Note: Continue selecting NEXT until the proper option is found.

Date/Time
Flow Rate
Flow %
Forward Total
Reverse Total
Net Total
Gross Total
Active Alarm
Diagnostics
Tag Number
Location
Analog 1 Setting (disabled, forward flow rate or reverse flow rate)
Analog 2 Setting (disabled, forward flow rate or reverse flow rate)
Blank Line
Gain

Press ENTER when you see the item you want to display. When you have made your choices for the four line display, press SELECT, you return to the Display Readings.

3.6 Online and Offline Status

In one of the Main Menu selections, you have the ability to take the unit offline and return it online. Also, within some of the sub-menus, you will be asked if you want to take the unit offline before making changes.

⚠ WARNING

When the unit is offline, no measurement occurs and analog outputs are at 4 mA. If the unit is in a critical application or driving a control loop going offline could have severe consequences. Use care when taking the unit offline!

To go online or offline, press NEXT from the Main Menu until you see:

```
---- Main Menu ----
Online & Offline
Unit is ===> ONLINE
Press Enter or Next
```

Press ENTER, and you will be asked if you want to take the unit offline. Press ENTER again and the unit will be taken offline:

```
---- Main Menu ----
Online & Offline
Unit is ===> OFFLINE
Press Enter or Next
```

To return to online, press ENTER and you will be asked if you want to return the unit online. Press ENTER again, the unit will be returned to online.

3.7 Setting Date & Time

To change the date and time, press NEXT from the Main Menu until you see:

```
---- Main Menu ----
System Setup Menu

Press Enter or Next
```

Press ENTER to select the System Setup Menu. Press NEXT until you see:

```
---- System Setup ----
System Utilities

Press Enter or Next
```

Press ENTER and then press NEXT until you see the option “Set Date & Time”. Press ENTER to display the current date, and ENTER again to proceed with changing the time. You will be asked if you want to take the unit offline. Press ENTER to do so,

and then proceed through the prompts to enter the year, the numerical month, the day, hour, and minutes. Use the NEXT, BACK and EXIT keys to highlight a character on the alphanumeric display, press ENTER to select the character and show it on screen. When finished inputting the parameter value, press the SELECT key to save it and proceed to the next requested value. Mistakes can be erased by highlighting the "<" sign and pressing ENTER. The last character entered will be erased from the display.

When you have entered all the requested information, the current date and time will be displayed. Press SELECT. You will be asked if you want to return the unit online. Press ENTER to do so and return to the Main Menu.

3.8 Setup Identity

You can enter identifying information for your unit, which can then be displayed on the screen.

3.8.1 Entering Identity Information

Press NEXT from the Main Menu until you see:

```
---- Main Menu ----
System Setup Menu

Press Enter or Next
```

Press ENTER to select the System Setup Menu. Press NEXT until you see:

```
---- System Setup ----
Setup Identity

Press Enter or Next
```

Press ENTER to access the list of identity items:

Name
Tag Number
Location
Transmitter Model #
Transmitter Serial #
Flow Meter Model #
Flow Meter Serial #
FPGA Revision ID
Firmware Revision ID

Press NEXT to move through the list and ENTER to choose the item you want to change. (Note the Transmitter Serial and Model numbers as well as the last two items in the list cannot be modified by the user.) Use the NEXT, BACK, and EXIT keys to highlight a character on the alphanumeric display, press ENTER to select the character and show it on the screen. When finished inputting the parameter value, press the SELECT key to save it and use the NEXT button to proceed through the list and make other changes as needed.

When you have made all your changes, press SELECT.

3.8.2 Displaying Identity Information

To display the identity information for a unit, press NEXT from the Main Menu until you see:

```
---- Main Menu ----
Display Identity

Press Enter or Next
```

Press ENTER to select Display Identity. Then press NEXT repeatedly to scroll through the display. When you are done, press SELECT to return to the Main Menu.

3.9 Setting Up Passwords

You have the option of setting up one or two levels of passwords to restrict access to certain menus on the EFT10. By using passwords, you can choose to have either unrestricted resetting of totals and alarms but restricted configuration changes, or you can restrict all total and alarm resets as well as configuration changes.

Press NEXT from the Main Menu until you see:

```
---- Main Menu ----
System Setup Menu

Press Enter or Next
```

Press SELECT/ENTER to select the System Setup Menu. Press NEXT until you see:

```
---- System Setup ----
Setup Passwords

Press Enter or Next
```

Press ENTER and you will see “Setup Level 1 Passwd”. If you press NEXT at that point, you will advance to “Setup Level 2 Passwd”. If you press ENTER for either Level 1 or Level 2, you will be prompted to change the password. Use the NEXT, BACK, and EXIT keys to highlight a character on the alphanumeric display, press ENTER to select the character and show it on the screen. To clear and disable a password, highlight the space between the character and press ENTER.

If only a Level 1 password is set, the user needs to enter the password to do the following:
Reset Totalizers
Clear Alarms
Clear the Data log

The password is also needed to access:
Field Setup Menu
System Setup Menu
Take Unit Offline

If only the Level 2 password is set, the password needs to be used to do the following:
Clear Data Log
Access System Setup Menu or Field Setup Menu
Take Unit Offline

If both passwords are set, the user needs enter the appropriate password as follows:

Level 1: Reset Totalizer, Clear Alarms.

Level 2: Clear Data Log, Access Field Setup or System Setup, take System Offline.

3.10 Setting Flow Direction and Rate

The Setup Flow Rate Menu is used to set up forward or reverse ranges, designate flow units and display format, set up flow rate damping, and set up a minimum cut-off value (as a % of the 4-20 mA flow range).

You can set up separate ranges for forward and reverse flows, which will automatically set the scaling for the 4-20 mA outputs.

Press NEXT from the Main Menu until you see:

```
---- Main Menu ----
System Setup Menu

Press Enter or Next
```

Press ENTER to select the System Setup Menu. Press NEXT until you see:

```
---- System Setup ----
Setup Flow Rate

Press Enter or Next
```

Press ENTER to enter the Setup Flow Rate Menu. Then press NEXT to move through the menu choices. When you see an item you want to change, press ENTER and make your entries.

Entry Example

As an example, assume you wanted to set up a forward flow range of 0 to 150 GPM, and wanted the display to be formatted to two decimal places (e.g. 120.42 GPM).

From the Setup Flow Rate screen, press ENTER. When you see Forward Range displayed, press ENTER. You will be asked if you want to take the unit offline. Press ENTER. Use the keypad and alphanumerical display to enter the range (in this case, 150) and press ENTER. The new range will be displayed:

```
---- Flow Rate Setup ----
Forward Range
150.0000000
Press Enter or Next
```

Press NEXT until you see Set Flow Rate Units. Press ENTER and you will be prompted to choose your units. Press NEXT until the unit you want (in this case, Gal/min) is displayed. Then press ENTER. The new units will be displayed:

```
---- Flow Rate Setup ----
Set Flow Rate Units
Gal/min
Press Enter or Next
```

Press NEXT to advance to Display Format. Press ENTER and you will be prompted to choose your display format. Press NEXT until you see the format you want (in this case, ######.##) and then press ENTER. The new format will be displayed:

```
---- Flow Rate Setup ----
Display Format
######.##
Press Enter or Next
```

Press SELECT. You will be asked if you want to return the unit online. Press ENTER. The diagnostics will run briefly and you will be returned to the Main Menu.

3.11 Setting Up The Reference Mode

The EFT10 transmitter can be used in place of the Spirax Sarco 4411e.

The Reference Mode Menu is used to set up your Meter C Factor (analog) or Meter Factor (microprocessor).

Press NEXT from the Main Menu until you see:

```
---- Main Menu ----
System Setup Menu

Press Enter or Next
```

Press ENTER to select the System Setup Menu. Press NEXT until you see:

```
---- System Setup ----
Setup Reference Mode

Press Enter or Next
```

Press ENTER and then use NEXT to display either the Reference Coil (analog -- 4412) screen or the Reference Current (microprocessor) screen. When you see the screen you want, press ENTER. You will be asked if you want to put the unit offline. Press ENTER and enter either your Meter C Factor or your Meter Factor, as prompted.

Note that when one of the factors is ON, the other will be OFF.

The default setting for transmitters supplied with flowtubes is Reference Coil mode.

When you have made your entry, press SELECT. You will be asked if you want to return the unit online. Press ENTER. You will be returned to the Main Menu.

3.12 Setup Totalizers

EFT10 totalizer menus let you select units and formats for forward, reverse, net, and gross totals.

Press NEXT from the Main Menu until you see:

---- Main Menu ---- System Setup Menu Press Enter or Next

Press ENTER to select the System Setup Menu. Press NEXT until you see:

---- System Setup ---- Setup Totalizers Press Enter or Next

Press ENTER. Then use NEXT to move through the four submenus: Set Fwd/Rev/Net Units, Fwd/Rev/Net Disp Fmt, Set Gross Tot Units, and Set Gross Dsp Format.

When you are at the submenu you want, press ENTER and then use NEXT to scroll through the unit or format choices. Press ENTER to select the unit or format you want.

To setup Scaling, use the ########.e1 to ########.e4 formats.

To increment the totalizer for every 10 units (ml, L, Gal, etc.), select ########.e1.

To increment the totalizer for every 100 units (ml, L, Gal, etc.), select ########.e2.

To increment the totalizer for every 1,000 units (ml, L, Gal, etc.), select ########.e3.

To increment the totalizer for every 10,000 units (ml, L, Gal, etc.), select ########.e4.

3.13 Empty Pipe Detection

Empty pipe detection is set up as a relay/alarm function. If either relay is configured for Empty Pipe, the empty pipe detection circuitry will be enabled. When an empty pipe is detected, the selected relay will be energized and all flow measurements will be forced to zero.

Note: Empty pipe detection shows the sensor is no longer covered by liquid, it does not indicate the pipe is empty of liquid.

Note: Default threshold is 1.5, this value can be modified in the Empty Pipe Threshold Menu. Adjust the threshold up with high conductivity fluid, and down when fluid has lower conductivity.

Press NEXT from the Main Menu until you see:

---- Main Menu ---- System Setup Menu Press Select or Next

Press ENTER to select the System Setup Menu. Press NEXT until you see:

---- System Setup ---- Setup Relay Outputs Press Enter or Next

Press ENTER. The current setup for Relay 1 will be displayed. If you want to change Relay 1, press ENTER. If you want to proceed to Relay 2, press NEXT.

Once you have selected a relay, you will be asked if you want to go offline. Press ENTER to do so. You will then be asked to select a relay source.

Use NEXT to scroll through the possible source choices until you see Empty Pipe. Press ENTER. You will see:

Relay Outputs Setup Choose AutoClear... AutoClear Relay 1 Press Select or Next

Alarms can be set to clear themselves (autoclear) or to require manual acknowledgment (no autoclear) when the alarm condition returns to normal. If you don't want the relay to be autocleared, press NEXT to display No AutoClear Relay 1.

Press ENTER to select either AutoClear or No AutoClear. The relay will be updated and you will be returned to the Relay Output Setup menu. Press SELECT, you will be asked to return unit online. Press ENTER to return to the Main Menu.

When empty pipe detection is enabled, the EFT10 will automatically return to normal operation when the pipe returns to a full condition. The only action required may involve resetting an alarm.

☑ ***Note***

The alarm condition is separate from the automatic function of the EFT10 upon returning to a full pipe condition. It is not necessary to reset the alarm to return the EFT10 to normal operation.

3.14 Menu Structure Diagrams

This section contains diagrams that illustrate the menu structure of the transmitter and show how you can use the local display and keypad to get from one point to another within the structure. These diagrams, and the examples provided in Section 3, will help you in configuring and using your transmitter.

Entries are made using the 5-button keypad, and data is displayed on the 4-line by 20 character LCD display.

EXIT is used when highlighting a character on the alphanumeric display.

When you press the NEXT button, it takes you to the menu system. Each subsequent key press advances to the next menu item or choice within the menu system.

Pressing SELECT has three different outcomes, depending where you are in the menu system. If in the Main Menu and SELECT is pressed, it will bring you the Default Display screen, which can display up to four user selectable lines of information. Subsequent key presses will step through all available display values one a time, allowing you to see any value not presented on the default display. If pressed after a parameter change, the display will prompt the user to return unit online. If a parameter value is chosen through the alphanumeric display, pressing SELECT will save the parameter change.

ENTER

Pressing ENTER opens the sub-menu for the selected menu item or allows you to change a parameter. If the parameter is available as a choice from pre-selected values, press NEXT to cycle through the available choices and press ENTER to save. If the parameter is an alphanumeric value, use the NEXT, BACK, and EXIT keys to highlight a character on the alphanumeric display. Press ENTER to select the character and show it on the screen. When finished inputting the parameter value, press the SELECT key to save it. Then proceed to the next requested value. Mistakes can be erased by highlighting the "<" sign and pressing ENTER. The last character entered will be erased from the display.

BACK

When you press BACK, you exit the current menu item and return to the previous level.

An alphanumeric display is used to input parameter values. Use the NEXT and BACK keys to highlight the chosen numeral and the ENTER key to input the number on the screen. When finished inputting the value, press the SELECT button. The parameter will be updated and the user will be placed into the Menu structure again.

TIMEOUT on Menu Structure Diagrams
Timeout may take up to 20 seconds before the Default Measurement Display appears.

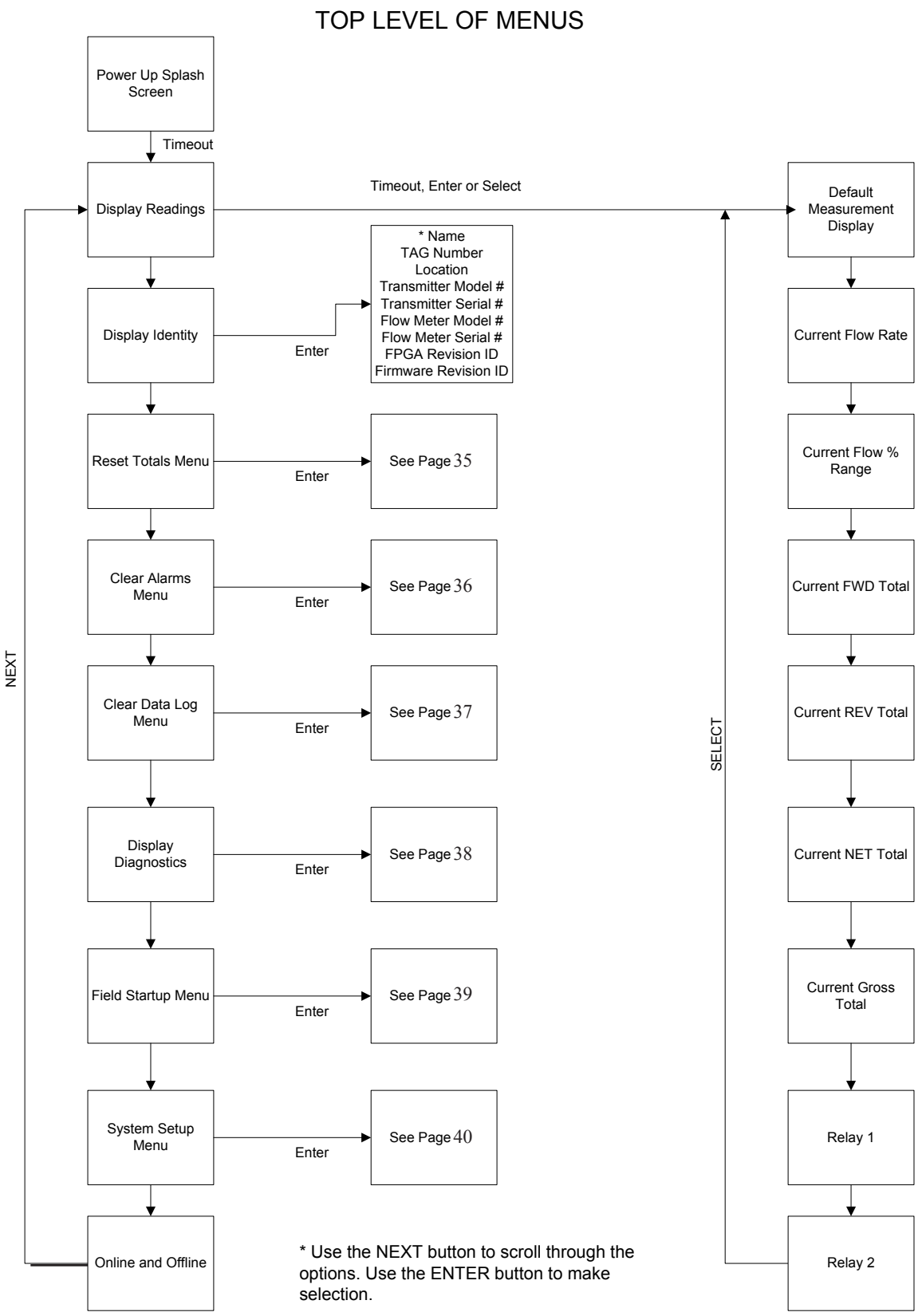
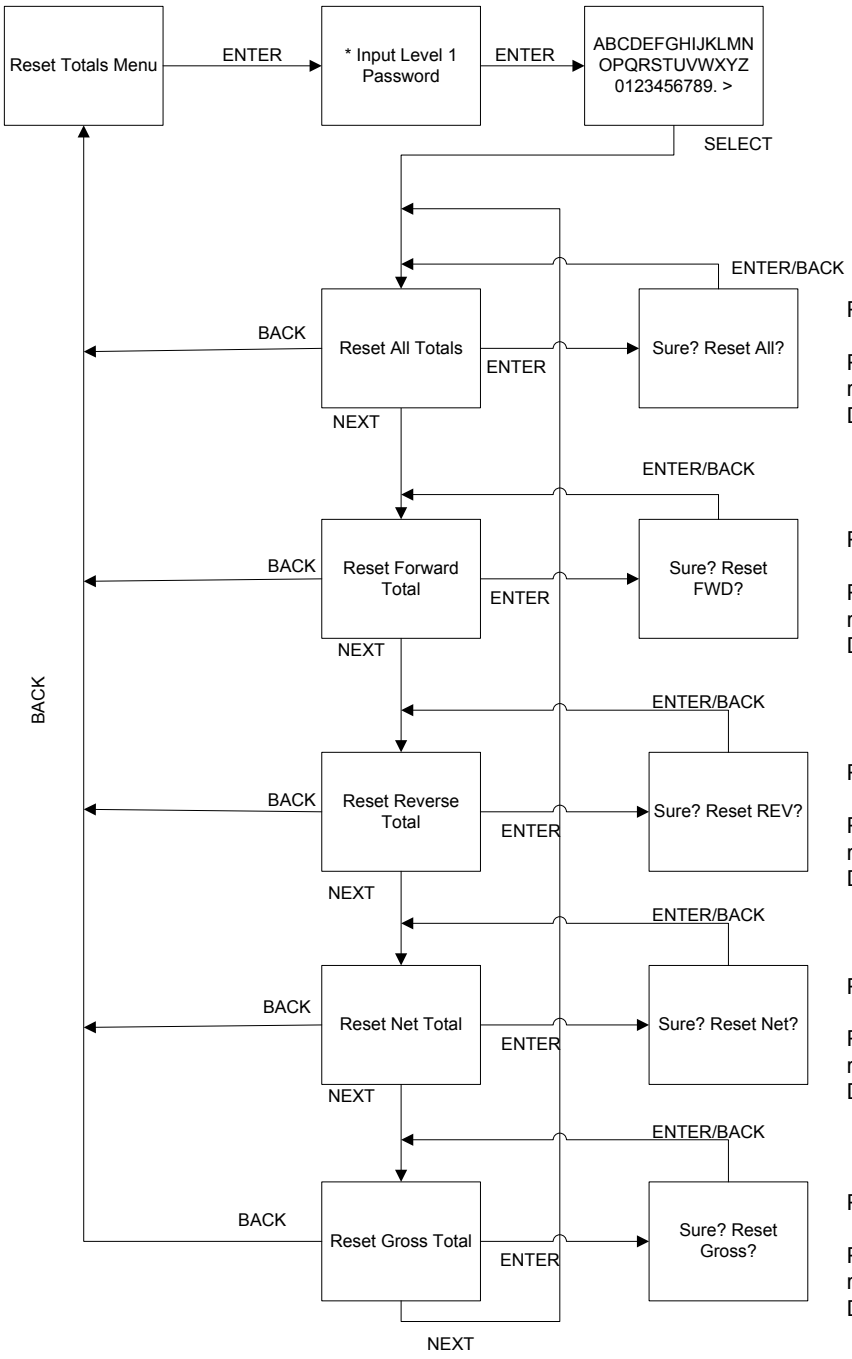


Figure 3-3: Menu Diagram -- Top Level of Menus

RESET TOTALS



Press ENTER to reset all totalizers

Press SELECT to cancel reset and return to the “Default Measurement Display”

Press ENTER to reset FWD totalizers

Press SELECT to cancel reset and return to the “Default Measurement Display”

Press ENTER to reset REV totalizers

Press SELECT to cancel reset and return to the “Default Measurement Display”

Press ENTER to reset NET totalizers

Press SELECT to cancel reset and return to the “Default Measurement Display”

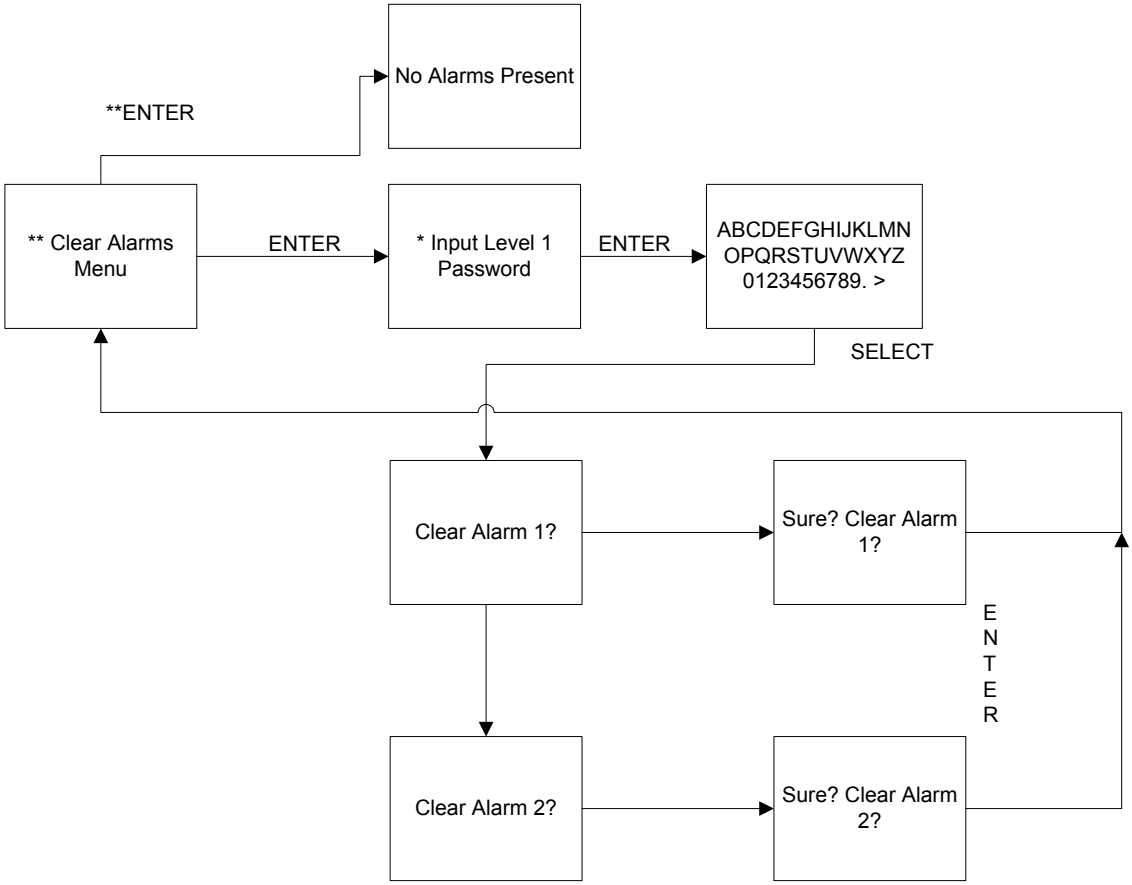
Press ENTER to reset Gross totalizers

Press SELECT to cancel reset and return to the “Default Measurement Display”

* If a Level 1 password has been setup, the user will be prompted for the Level 1 password before being admitted to the “Reset All Totals” menu.

Figure 3-4: Menu Diagram -- Reset Totals

CLEAR ALARMS

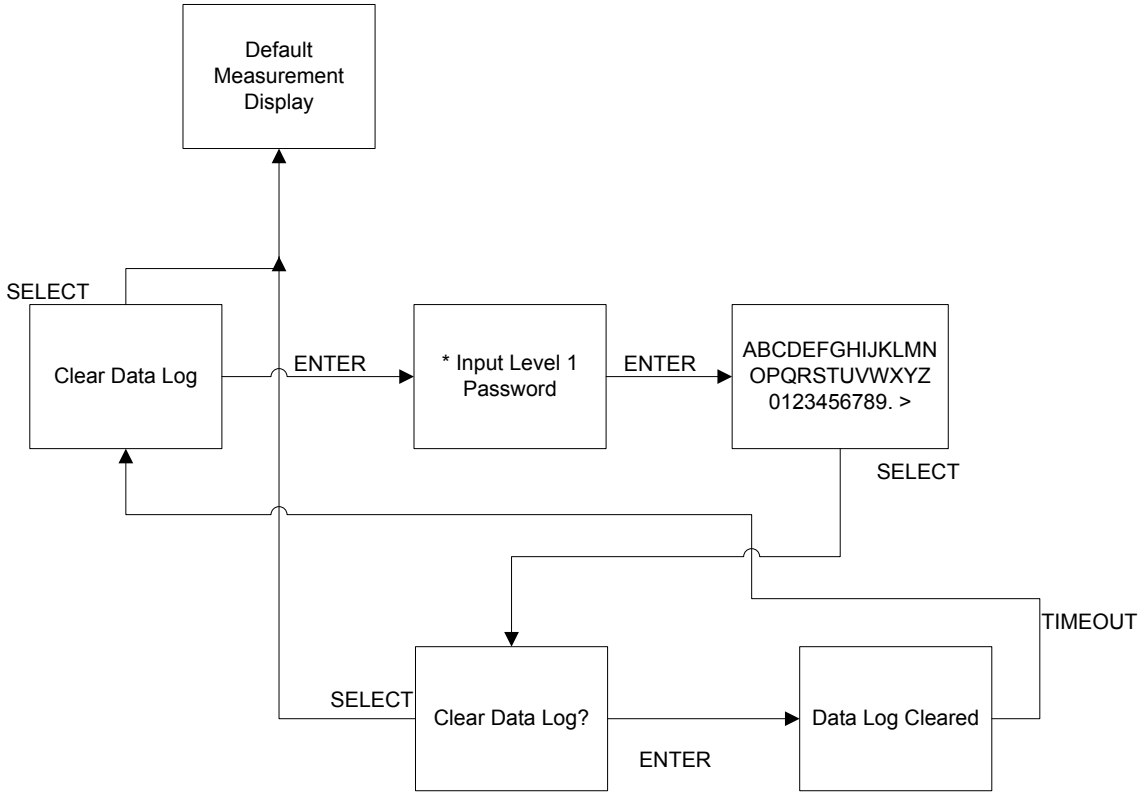


* If a password has been set, the unit will prompt the user for a level 1 password before allowing user into the “Clear Alarms Menu”.

** If there is not alarm present, pressing ENTER will take you straight into the “No Alarms Present” screen.

Figure 3-5: Menu Diagram -- Clear Alarms

CLEAR DATA LOG



* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user into the "Clear Data Log" menu.

Figure 3-6: Menu Diagram -- Clear Data Log

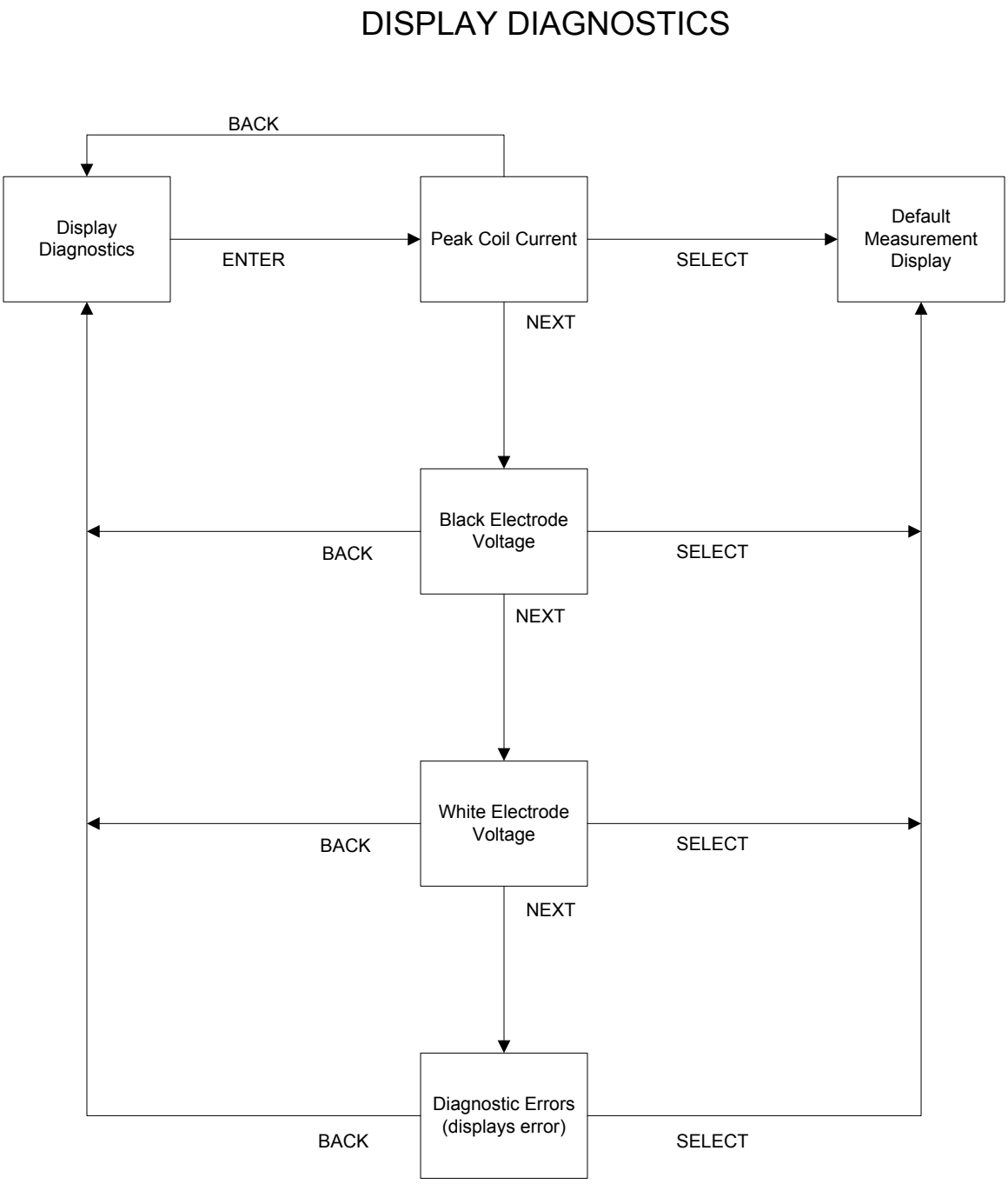
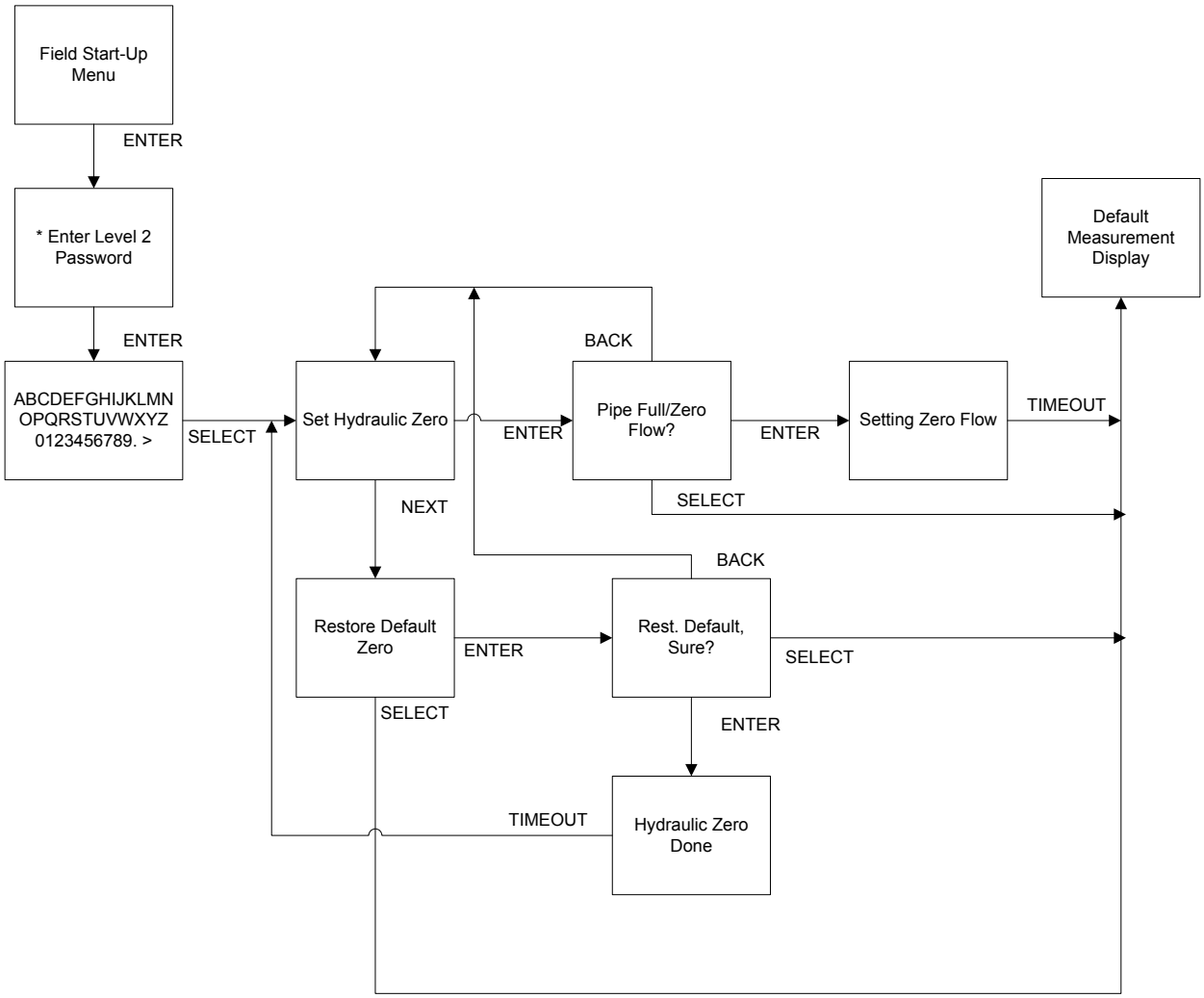


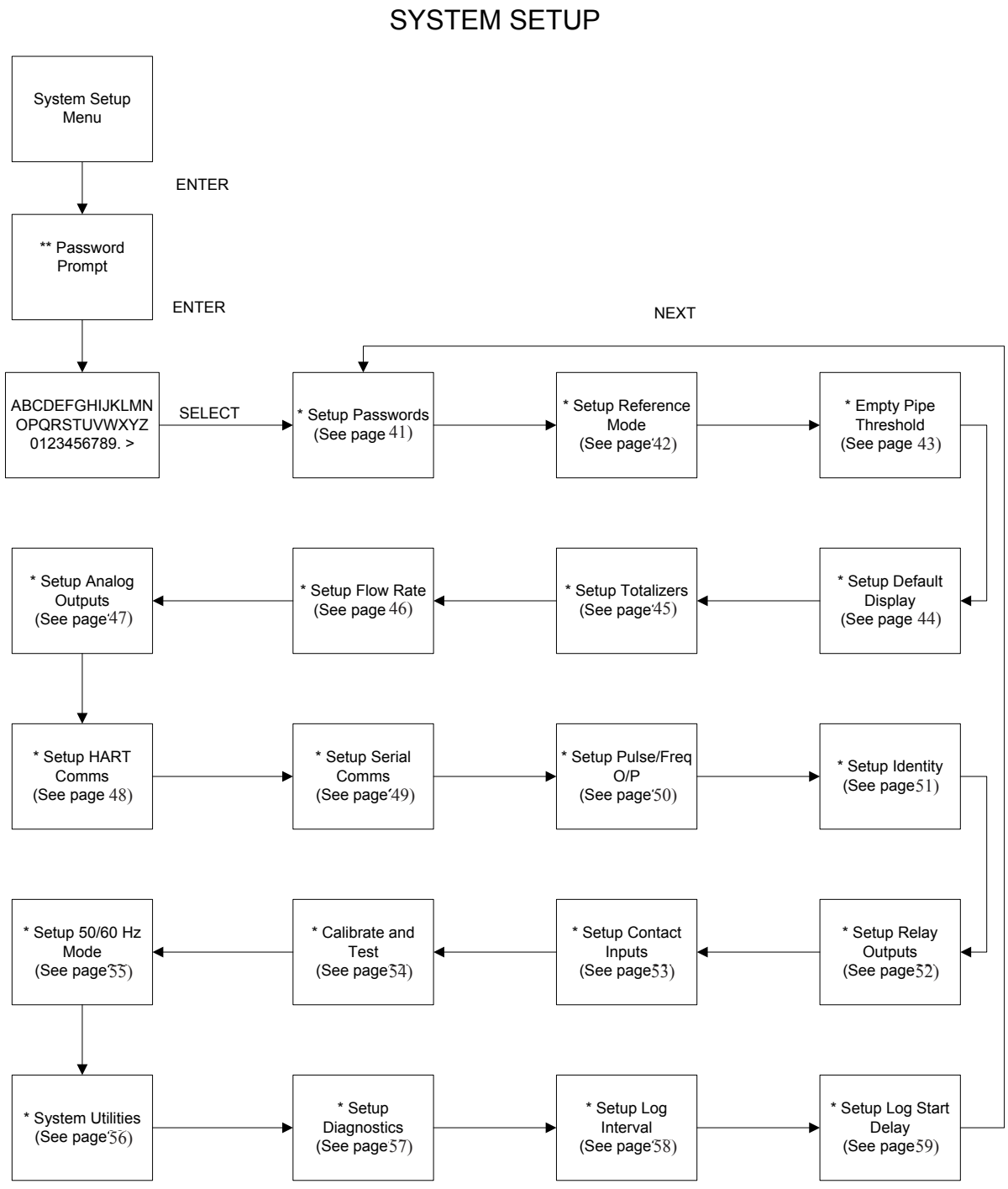
Figure 3-7: Menu Diagram -- Display Diagnostics

FIELD START-UP



* If a Level 2 Password has been set, then the user will be prompted to input the Level 2 password before being admitted into the “Set Hydraulic Zero” menu.

Figure 3-8: Menu Diagram -- Field Start-Up

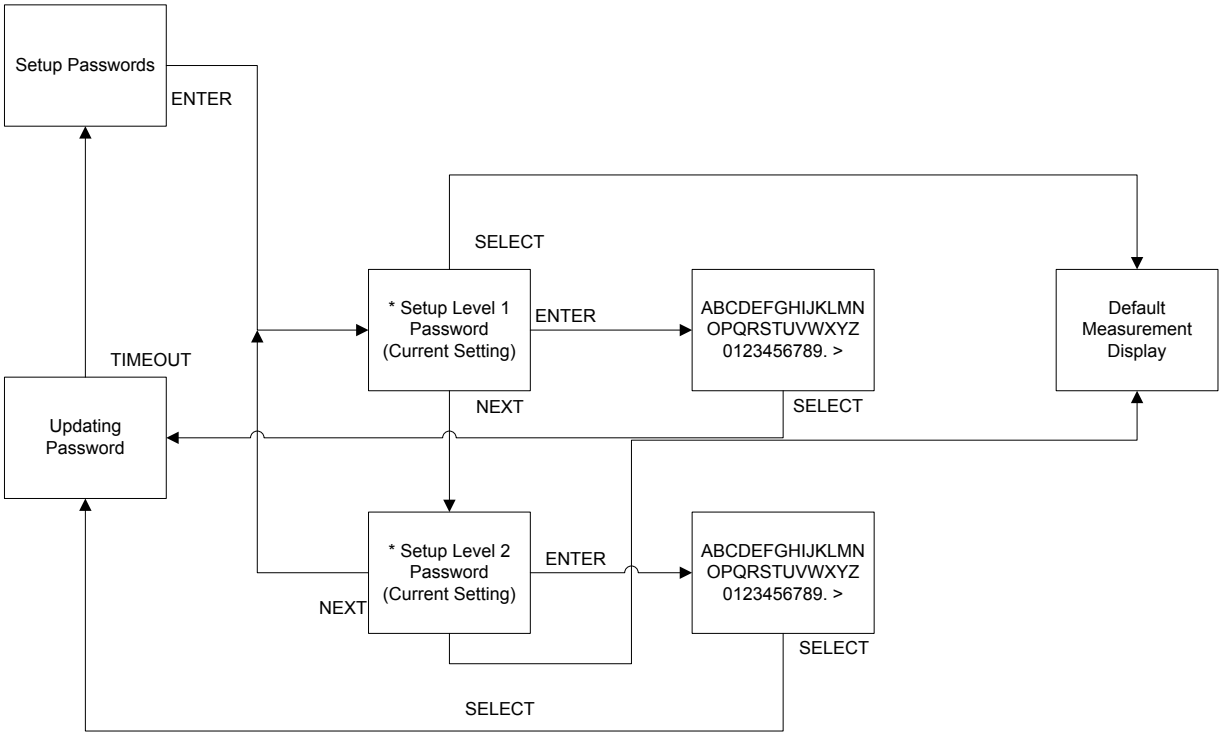


* Use the NEXT button to scroll through the submenus under the “System Setup” menu;
Use the BACK button to return to the “System Setup” menu;
Use the SELECT button to return to the “Default Measurement Display”.

** If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user into the submenus.

Figure 3-9: Menu Diagram -- System Setup

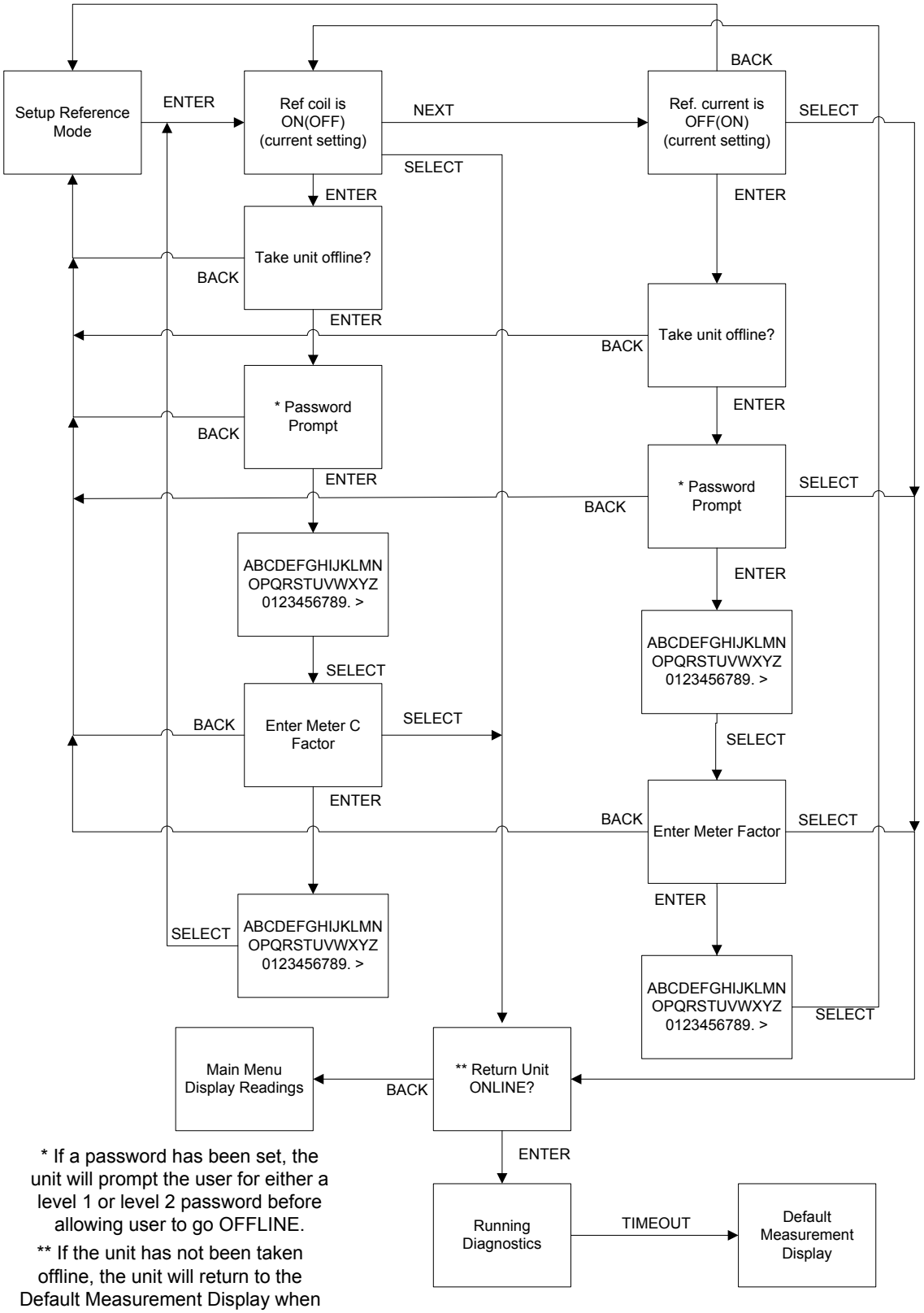
SETUP PASSWORDS



* Use the BACK button to return to the "Setup Passwords" submenu".

Figure 3-10: Menu Diagram -- Setup Passwords

SETUP REFERENCE MODE

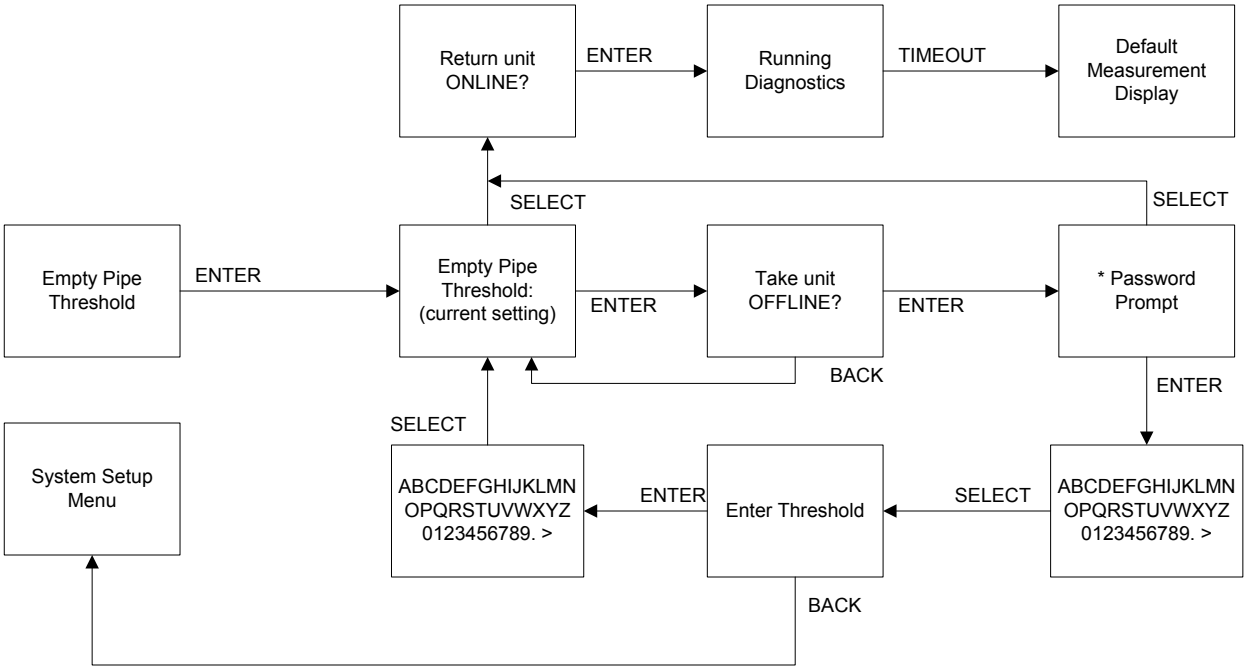


* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to go OFFLINE.

** If the unit has not been taken offline, the unit will return to the Default Measurement Display when pressing SELECT.

Figure 3-11: Menu Diagram -- Setup Reference Mode

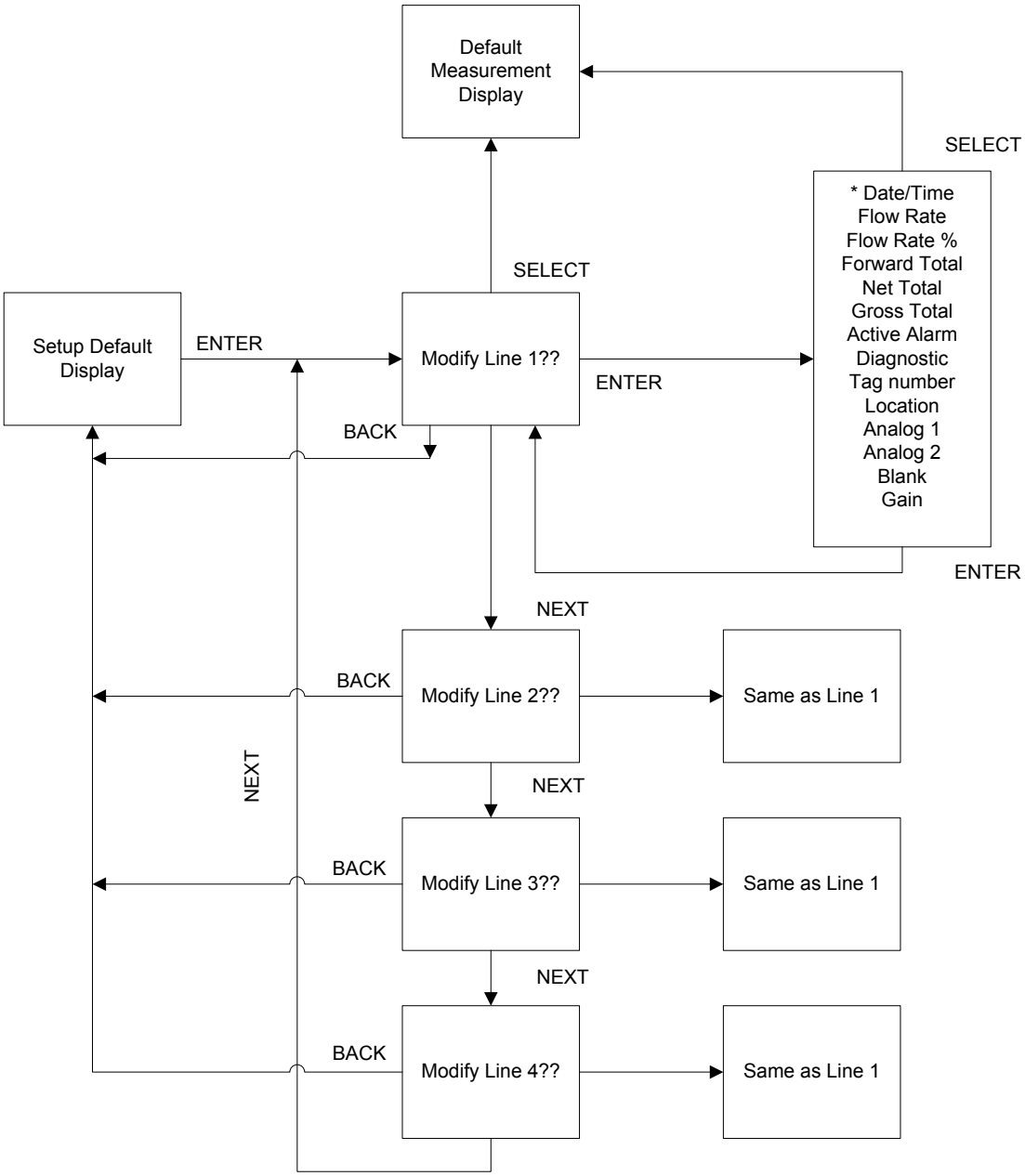
SET EMPTY PIPE THRESHOLD



* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

Figure 3-12: Menu Diagram -- Set Empty Pipe Threshold

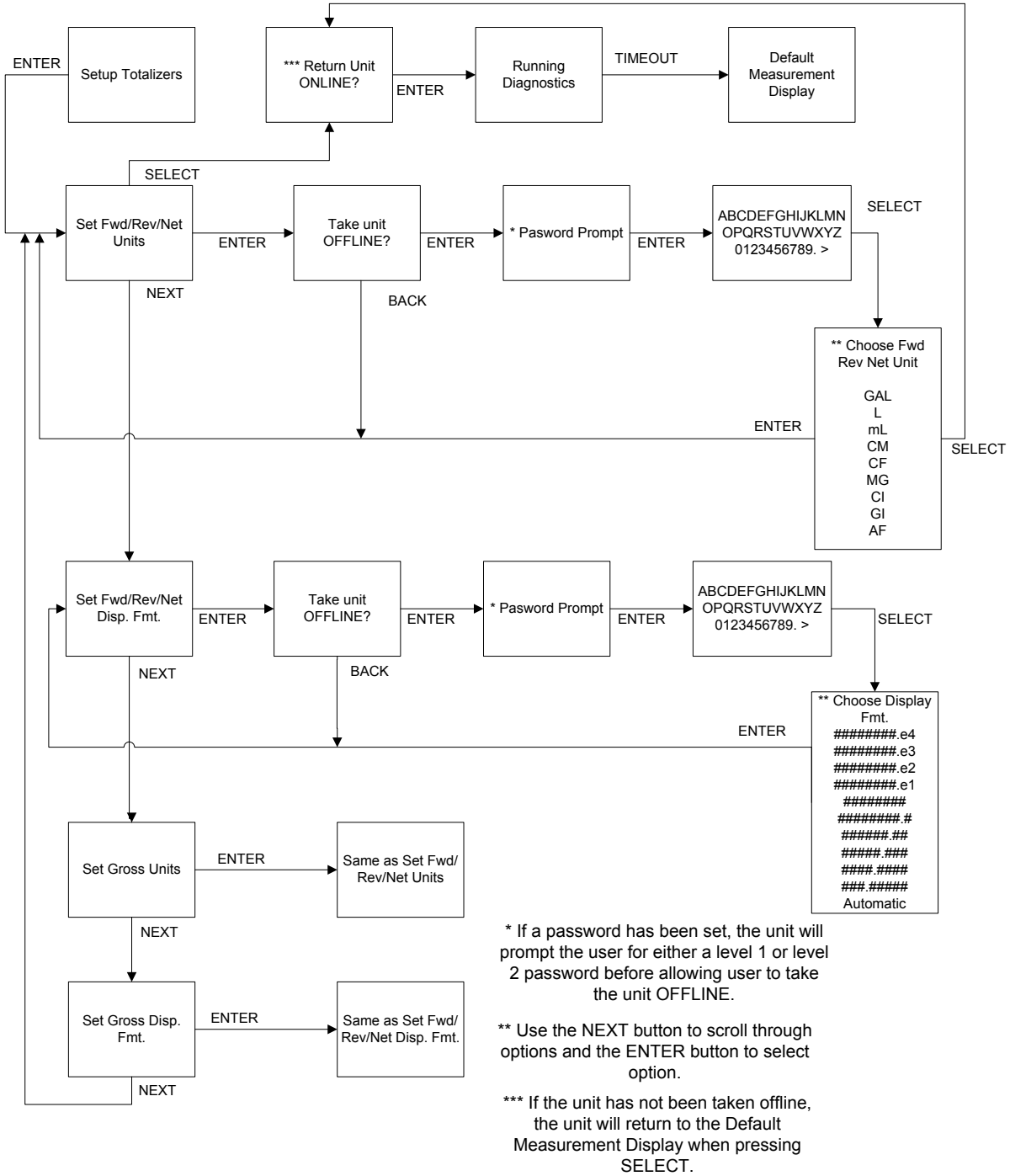
SETUP DEFAULT DISPLAY



*Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-13: Menu Diagram -- Setup Default Display

SETUP TOTALIZERS



* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the NEXT button to scroll through options and the ENTER button to select option.

*** If the unit has not been taken offline, the unit will return to the Default Measurement Display when pressing SELECT.

Figure 3-14: Menu Diagram -- Setup Totalizers

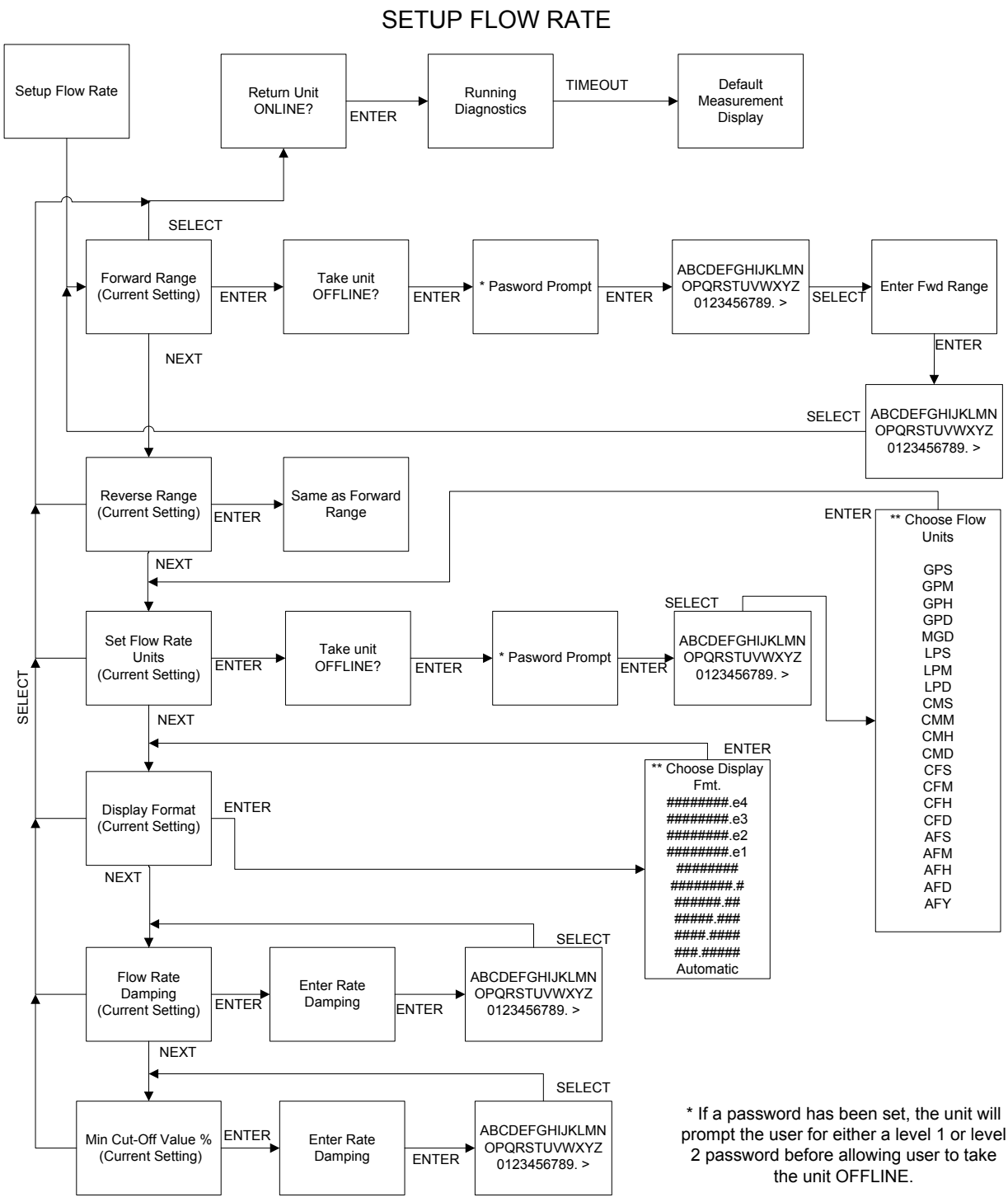
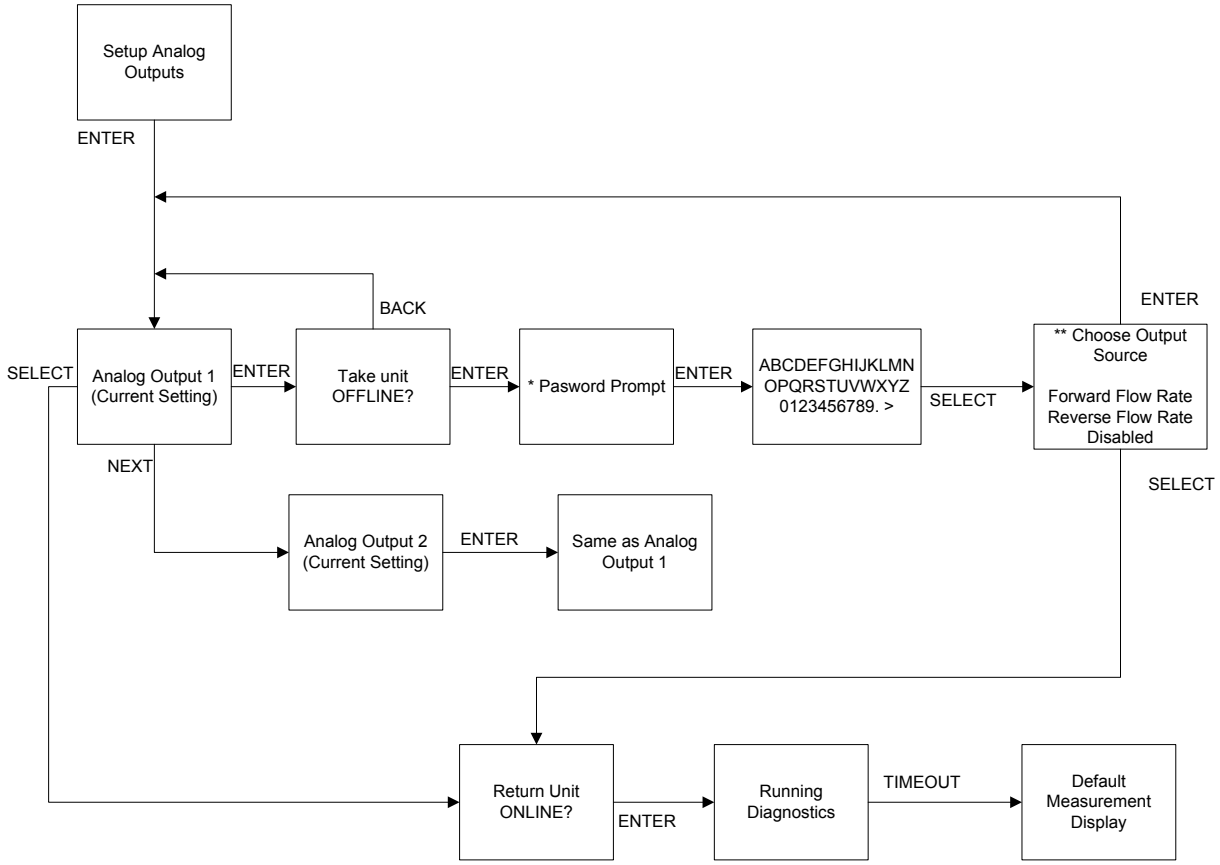


Figure 3-15: Menu Diagram -- Setup Flow Rate

SETUP ANALOG OUTPUTS

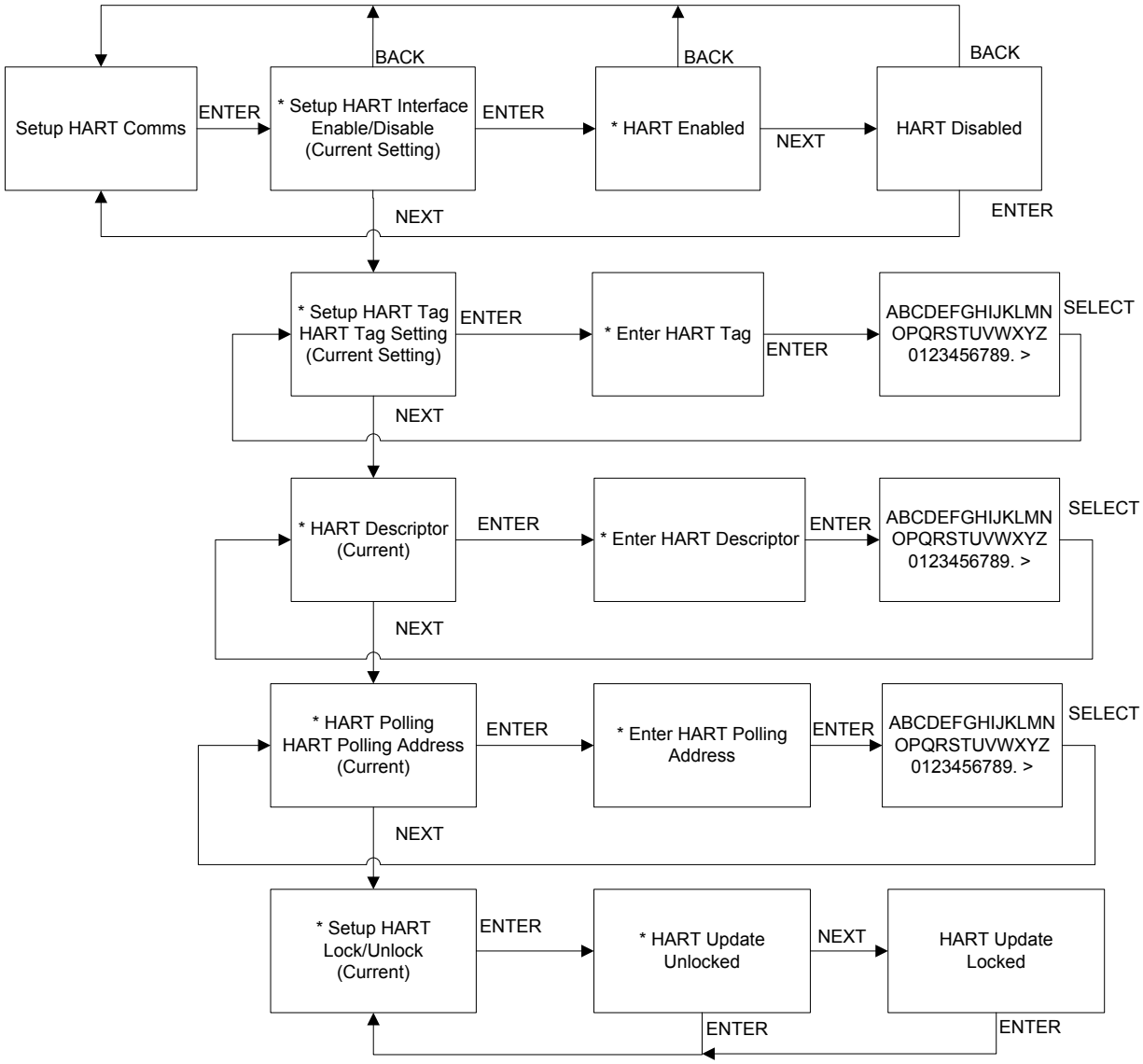


* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the NEXT button to scroll through the options. Use the ENTER button to make selection.

Figure 3-16: Menu Diagram -- Setup Analog Outputs

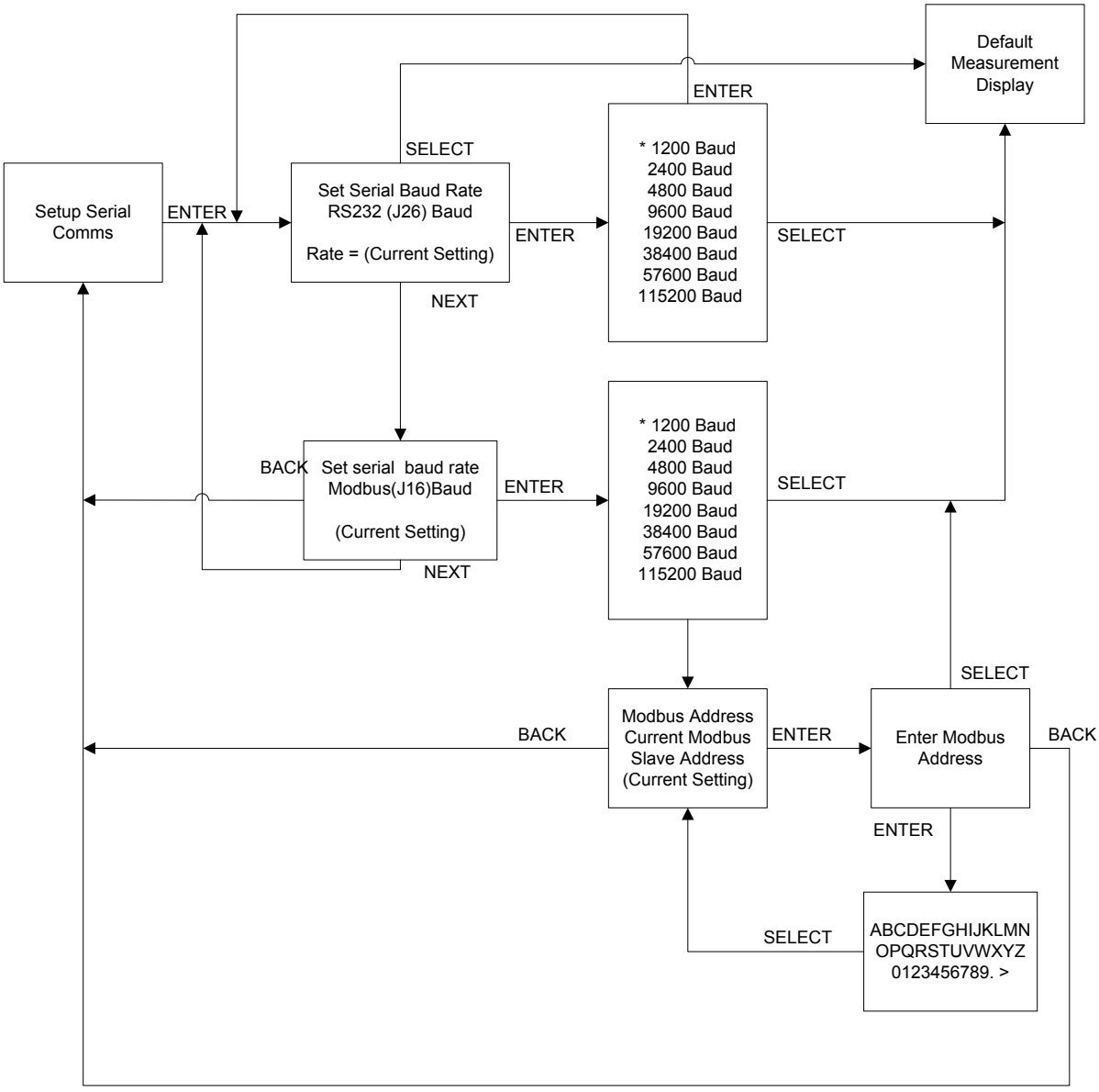
SETUP HART COMMS



*Use the SELECT button to return to the "Default Measurement Display" Use the BACK button to return to the "Setup HART Comms" menu.

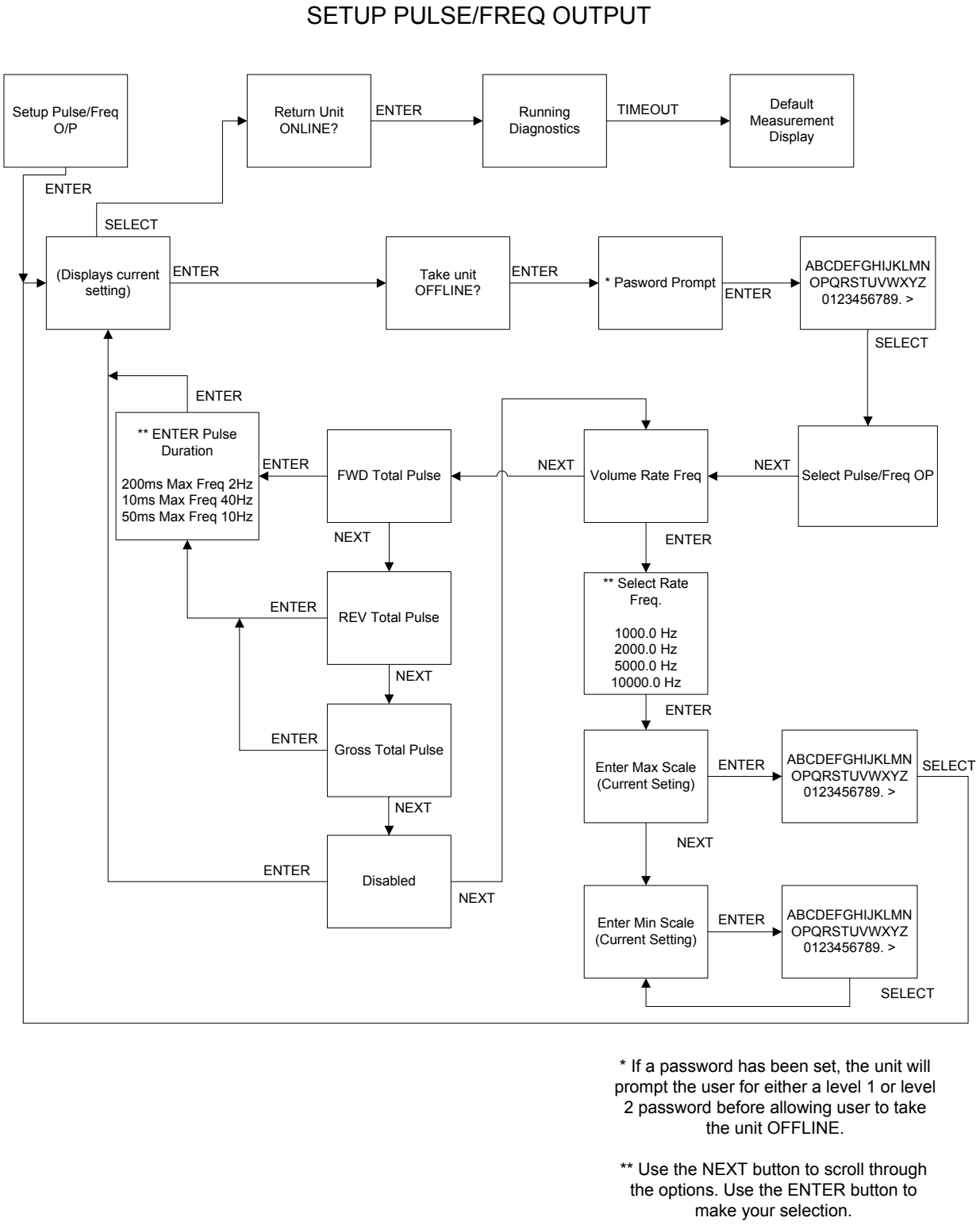
Figure 3-16: Menu Diagram -- Setup HART Comms

SETUP SERIAL COMMS



*Use the NEXT button to scroll through the options. Use the ENTER button to make selection.

Figure 3-17: Menu Diagram -- Setup Serial Comms

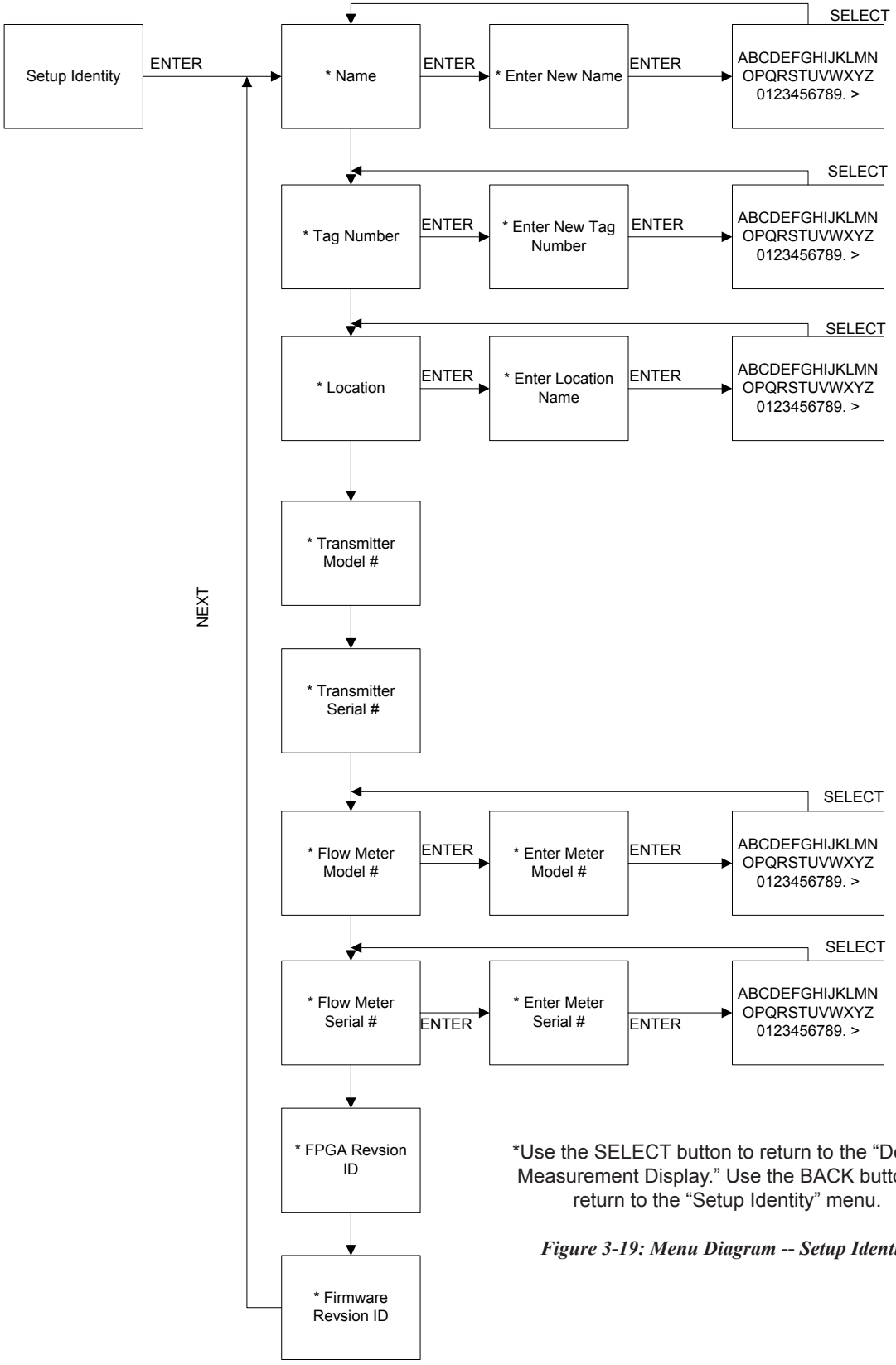


* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-18: Menu Diagram -- Setup Pulse/Frequency Output

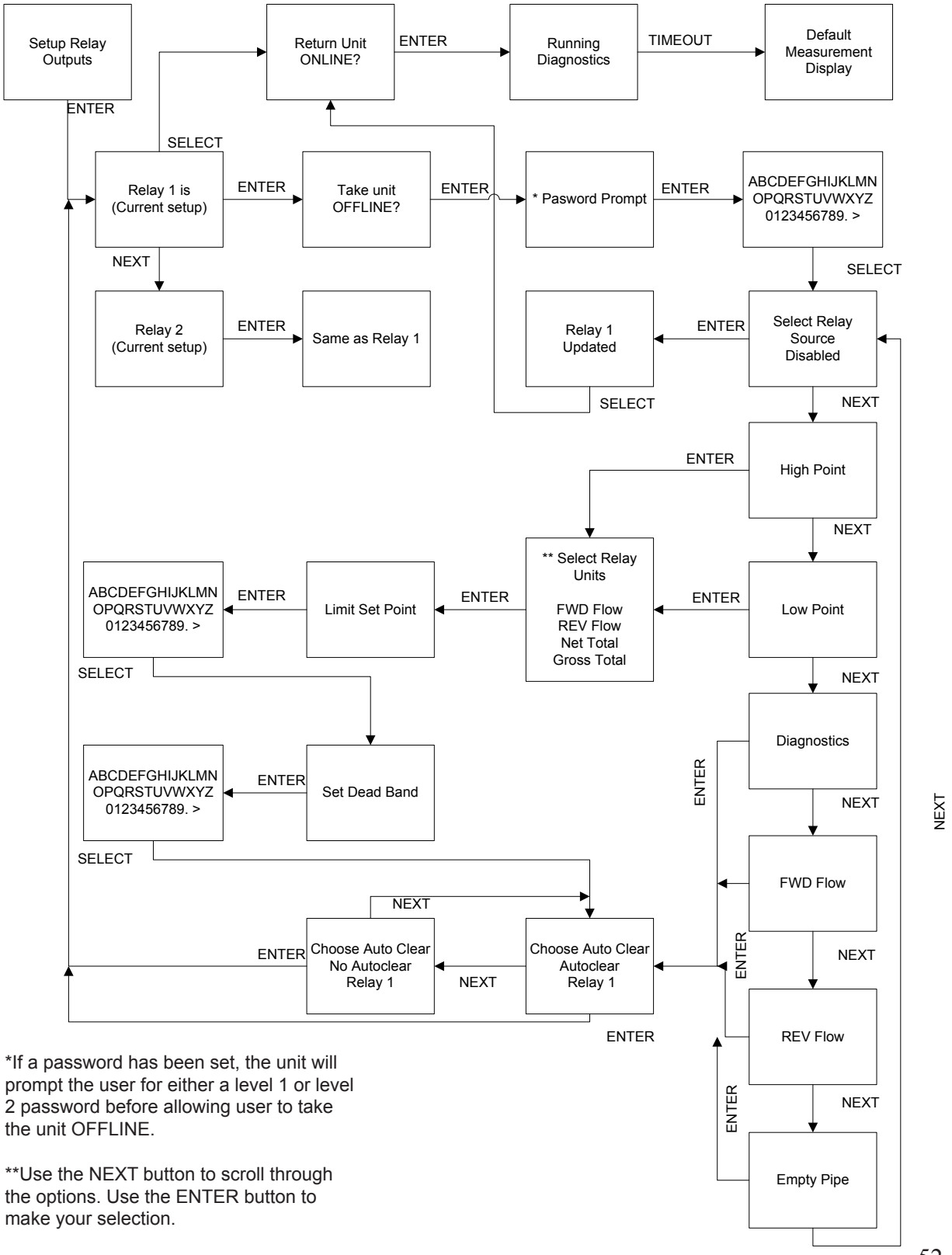
SETUP IDENTITY



*Use the SELECT button to return to the “Default Measurement Display.” Use the BACK button to return to the “Setup Identity” menu.

Figure 3-19: Menu Diagram -- Setup Identity

SETUP RELAY OUTPUTS

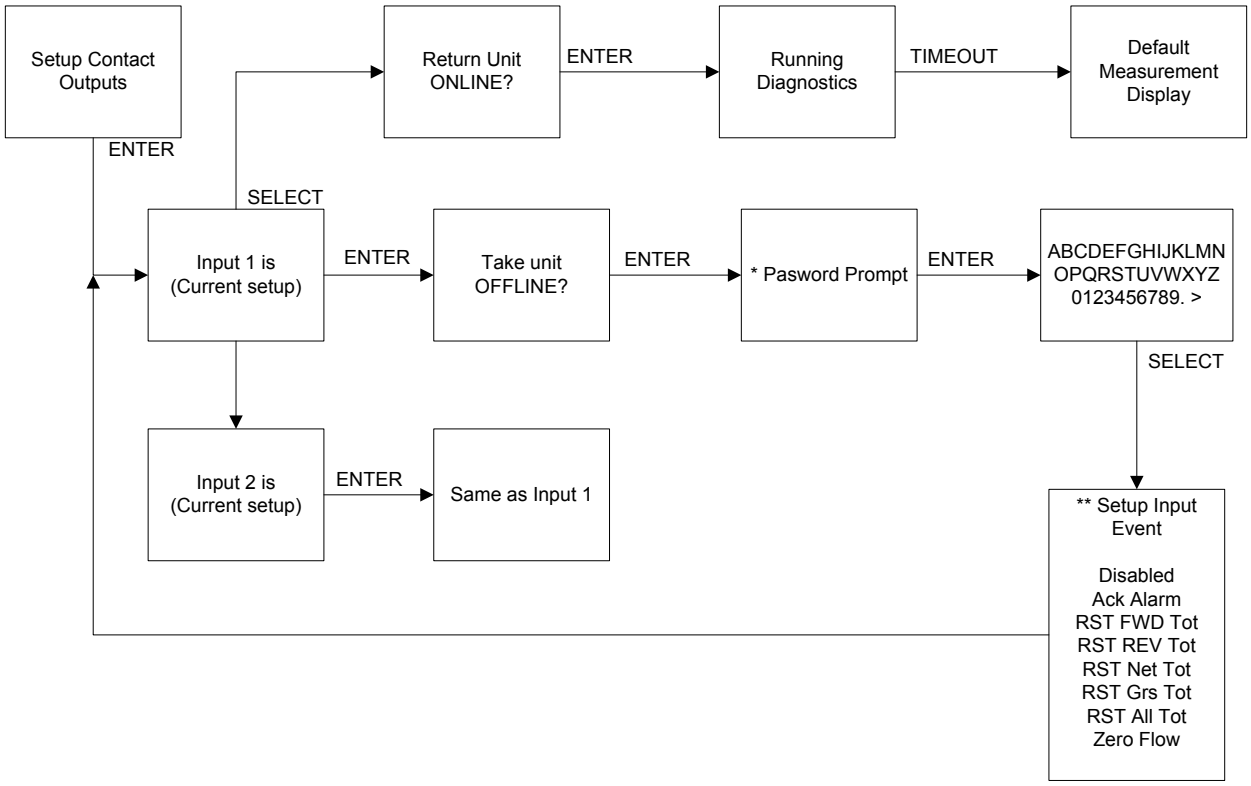


*If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

**Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-20: Menu Diagram -- Setup Relay Outputs

SETUP CONTACT INPUTS



* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-21: Menu Diagram -- Setup Contact Inputs

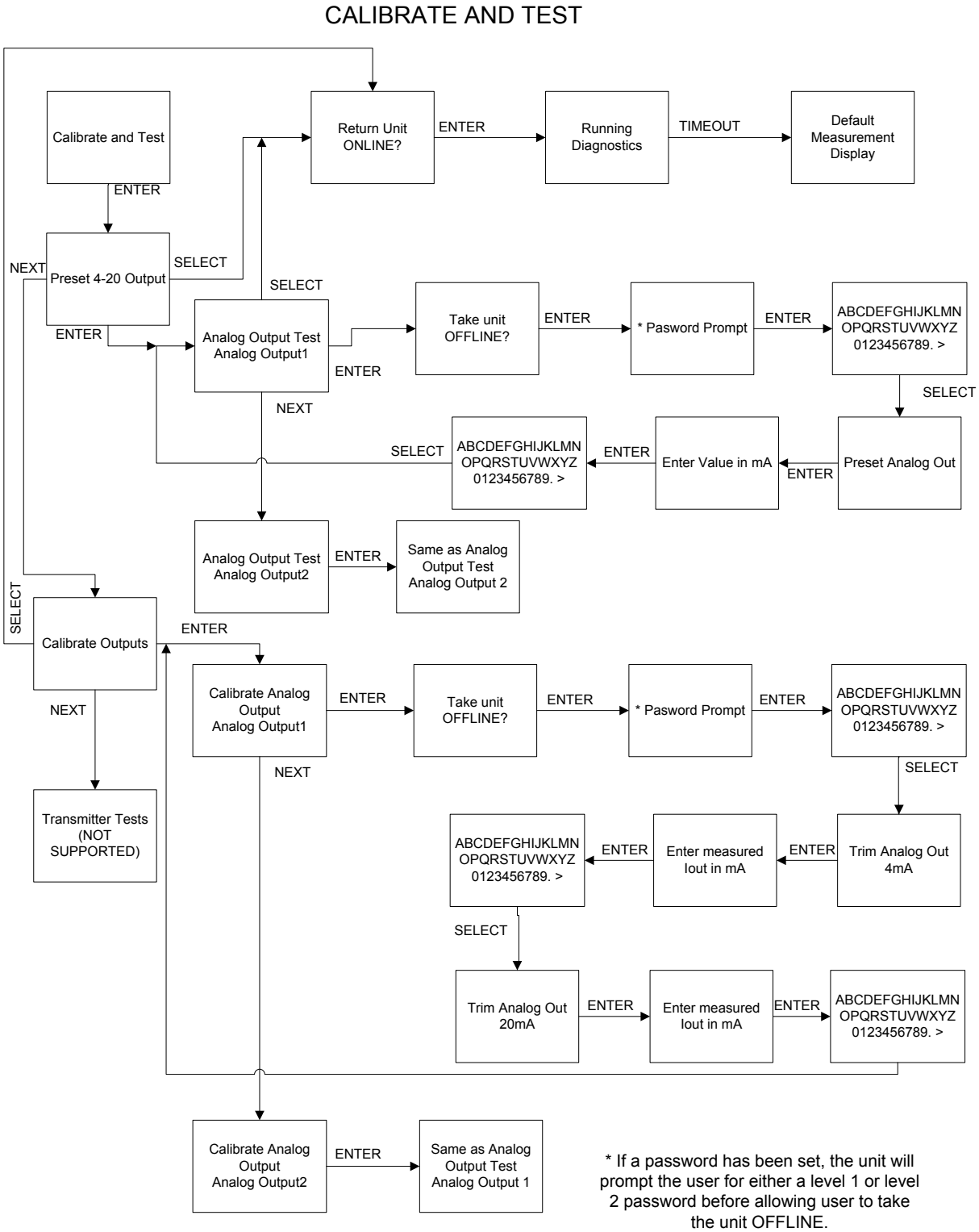


Figure 3-22: Menu Diagram -- Calibrate and Test

SETUP 50/60 HZ MODE

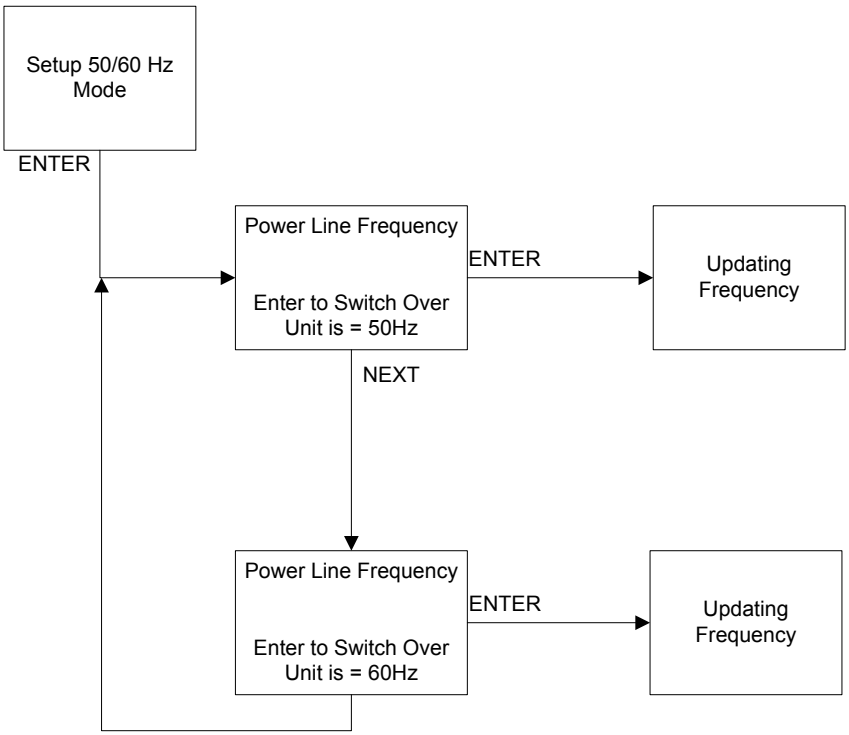
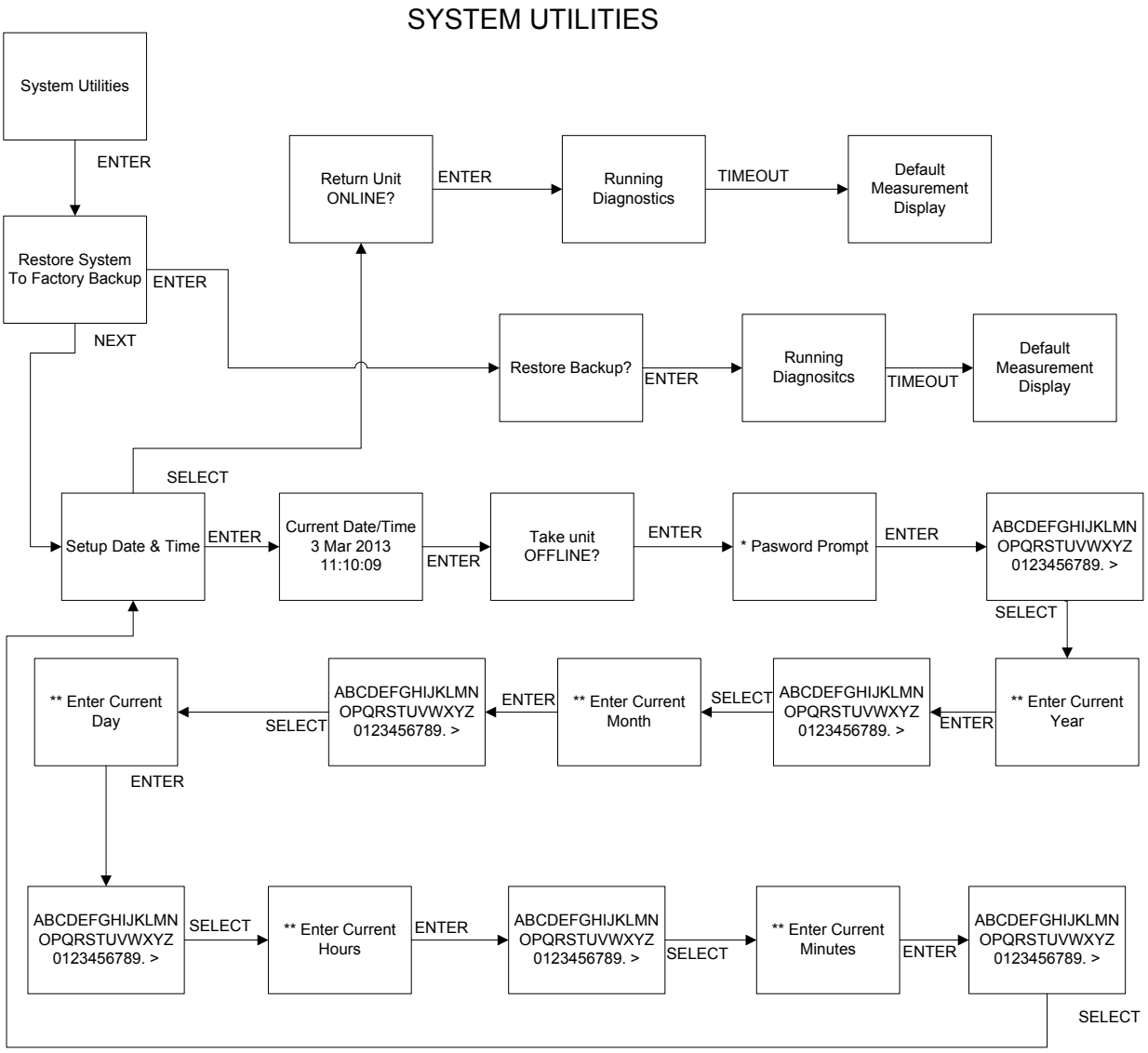


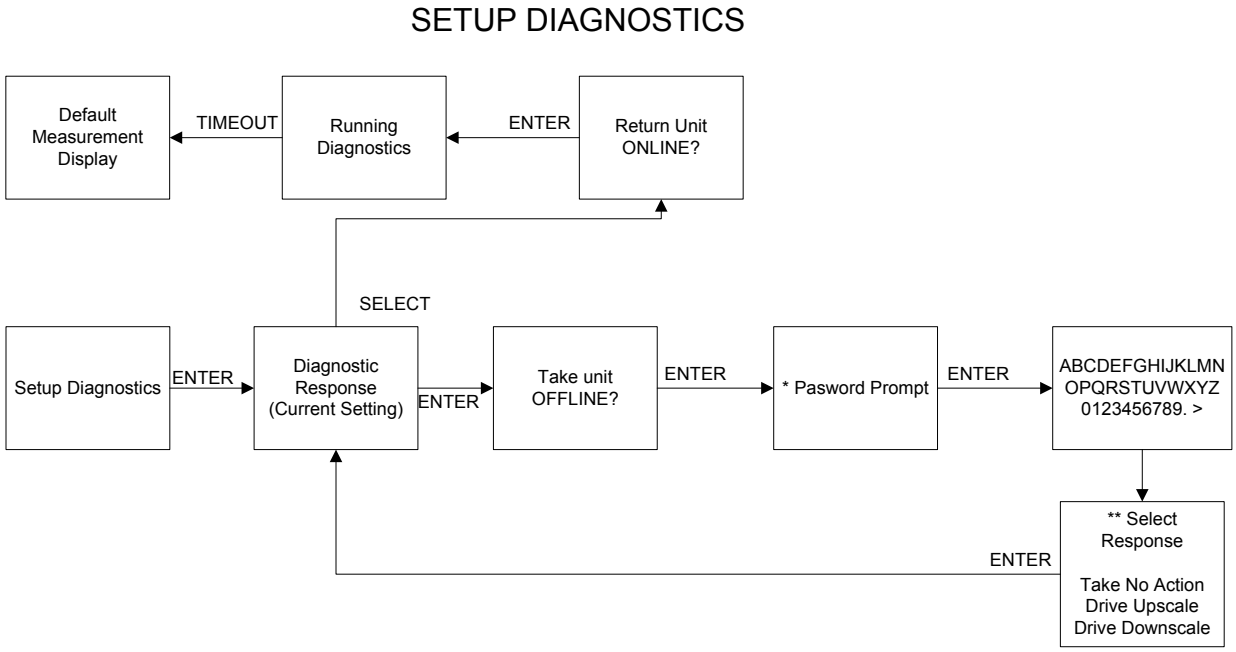
Figure 3-23: Menu Diagram -- Setup 50/60 Hz Mode



* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the SELECT button to return unit online.

Figure 3-24: Menu Diagram -- System Utilities

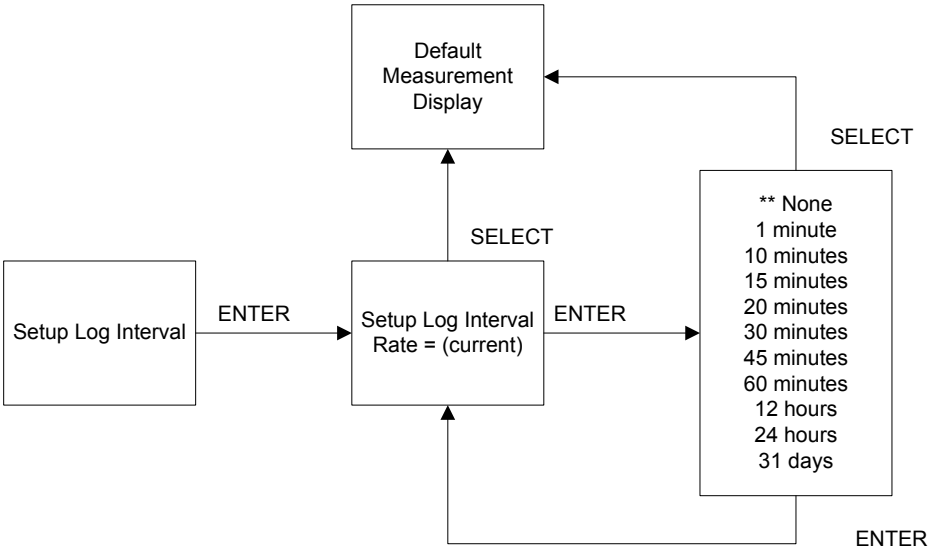


* If a password has been set, the unit will prompt the user for either a level 1 or level 2 password before allowing user to take the unit OFFLINE.

** Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-25: Menu Diagram -- Setup Diagnostics

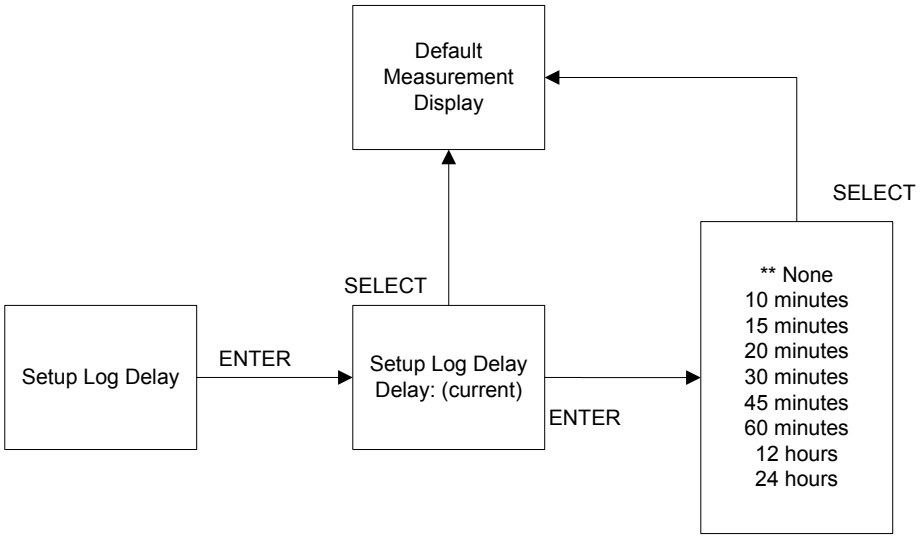
SETUP LOG INTERVAL



** Use the NEXT button to scroll through

Figure 3-26: Menu Diagram -- Setup Log Interval

SETUP LOG START DELAY



** Use the NEXT button to scroll through the options. Use the ENTER button to make your selection.

Figure 3-27: Menu Diagram -- Setup Log Start Delay

NOTES

EFT10 Electromagnetic Flow Transmitter

Section 4 Data Logger

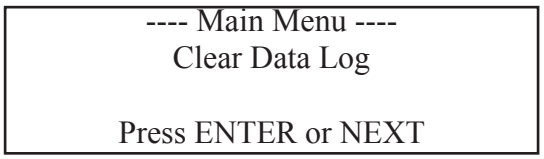
4.1 Introduction

The EFT10 contains a Data logging feature which will sample runtime variables at preset intervals and permanently save the information to memory. Each time the data logger takes a sample, the date, time, volume, forward, reverse, net, gross totalizers, fault code, and relay alarm states are stored as a single record. Up to 28,672 log records can be saved before the log wraps back over the first entry.

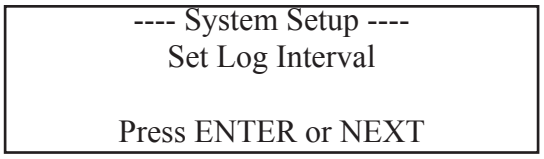
4.2 Configuration

The Data logger is configured through the front panel. From the front panel, the user can clear the data log, set the logging interval or set a start delay.

Clear Data Log
This menu allows the user to clear the log file.



Setup Log Interval
The available log intervals along with log capacity are shown in Table 1. Note: An interval must be chosen to enable data logging.



Set Log Start Delay
This menu enables the user to select a delay time to wait before the meter begins to log. The available delay times are: none, 10min, 15min, 20min, 30min, 45min, 60min, 12hr and 24hr.

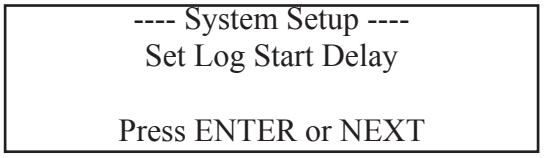


Table 4-1: Data Log Capacity

Log Interval	Days to fill log
1 min	19
10 min	199
15 min	298
20 min	398 (1.1 year)
30 min	597 (1.6 years)
45 min	896 (2.4 years)
60 min	1,194 (3.3 years)
12 hours	14,336
24 hours	28,672
31 days	888,832

4.3 Data Log Operation

When the user has finished setting the log interval, if no start delay is set, the meter will begin logging data records. Once started, the data logger will continue to save records even after a power cycle. When the data logger reaches record 28,672, it will write the next record over the first record.

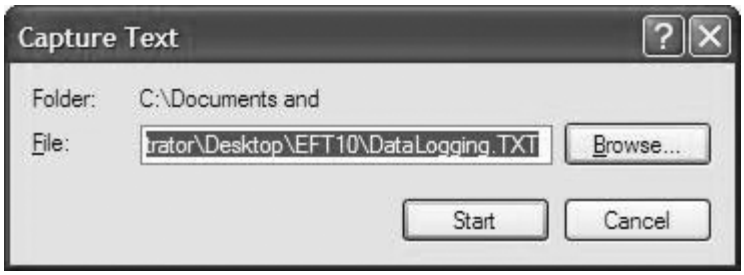
4.4 Data Log Retrieval

Although the data logger is configured through the front panel, the log data can only be viewed by sending a command from a terminal program like HyperTerminal over an RS-232 connection to port J26 on the terminal board of the EFT10.

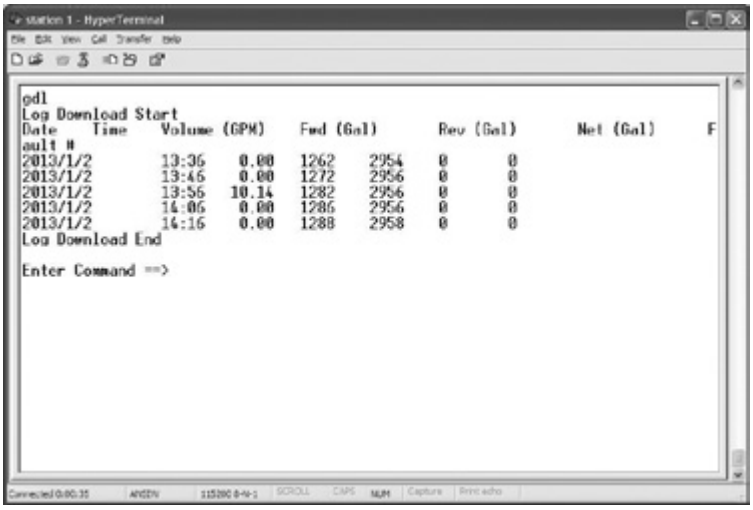
It will be necessary to open the case of the EFT10 and connect the Gnd, Tx, and Rx signals on port J26 to a PC serial port or a USB-to-RS232 converter. See the Wiring Installation chapter for details.

Set the com properties in HyperTerminal as below:

Next configure HyperTerminal to capture every command and response in a text document. Transfer → Capture → browse to location to save file:



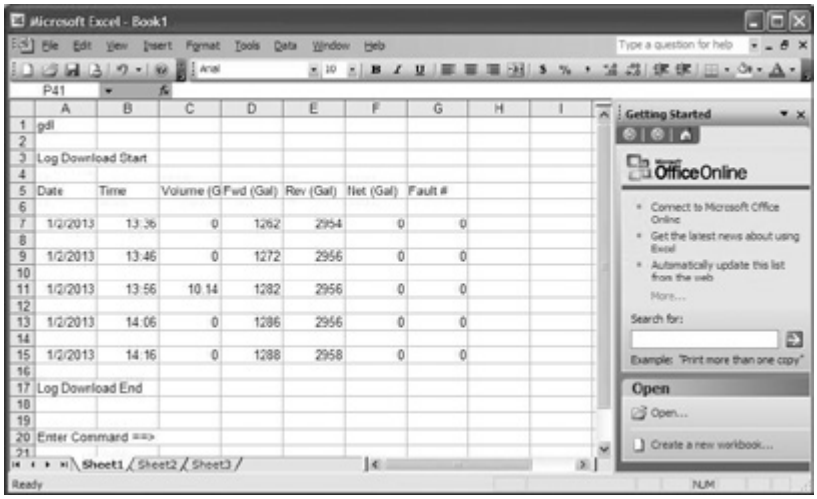
Click the start button. Now when the meter receives the command "gdl", it will send the entire data log as a text file to the serial terminal, which will save the session in the file selected above (Datalogging.txt). Below is an example of the data log record when downloaded from the meter using HyperTerminal.



4.4.1 Data Log Import into Excel

The data log header row and parameters are separated by tabs to make it easy to import the data into a spreadsheet. Once finished with data log extraction, stop data capture and close the HyperTerminal application: Transfer→Capture→Stop

Open up the captured test file (Datalogging.text), select all (CNTRL A), copy (CNTRL C) and paste into the first cell of an Excel spreadsheet (CNTRL V).



The first two columns display the date and time of the log record. The Next four columns depict flow rate and totalizer values. The final column shows the fault (if any) which was present at the time the record was created. See Table 2 for a listing and explanation of the fault codes.

4.5 Fault Code Interpretation

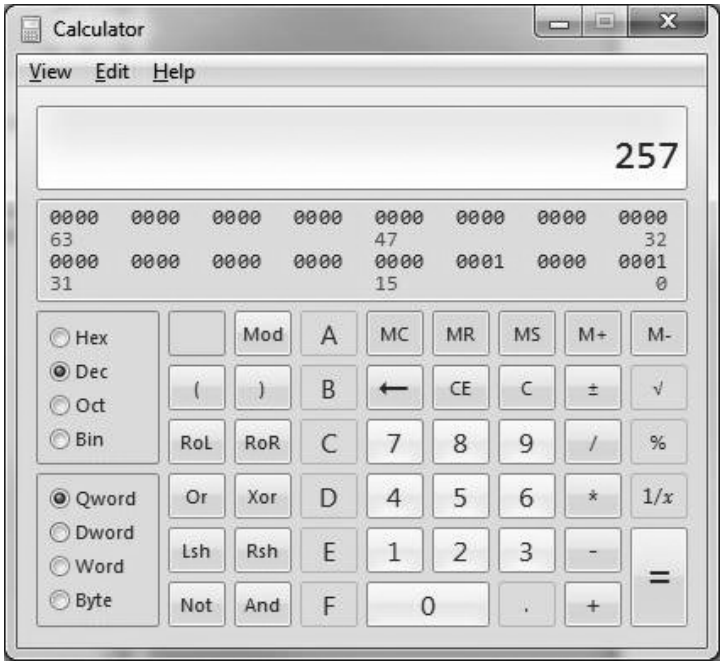
This table defines the meaning of the bits in the fault code. A fault code of 0 means the system has no faults at the time of the log.

Table 4-2: Fault Codes

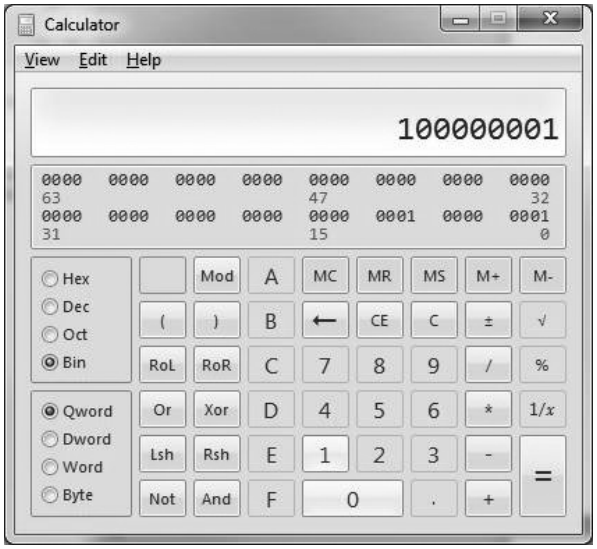
Fault Code Bit Position	Fault Code in binary	Fault Description
0	1	The meter experienced a power cycle
1	10	The backup memory device has failed
2	100	The real-time clock has failed
3	1000	The RAM memory device has failed
4	10000	The FPGA device has failed
5	100000	The Analog to Digital converter device has failed
6	1000000	The sensor main coil has failed
7	10000000	The sensor reference coil has failed
8	100000000	The meter flow rate has exceeded the maximum set point

To identify a specific system fault, it is necessary to convert the fault code from decimal to a binary value. This can be done through the Windows calculator program or web application. See example below.

First input the decimal value shown on the log record, use 257 as an example:



Select binary representation:



In the example above, two faults are shown: with a “1” in bit position 0 and a “1” in bit position 8. This would indicate a “power cycle fault” and a “meter exceeded maximum set point fault”, as shown in the fault code table.

The “power cycle fault” is unique in that it is cleared after the data logger logs a new entry to flash. So, the first record may show this fault but in the second record the fault will be cleared. All other faults must be cleared by a system reset or by changing the condition that caused the fault.

NOTES

EFT10 Electromagnetic Flow Transmitter

Section 5 Modbus

5.1 Modbus Introduction

Modbus is a serial communication protocol commonly used in industrial applications. It allows communications between many devices and is typically used to transmit data from instruments or control devices back to a main controller or data gathering system.

The Modbus implementation for the EFT10 lets users view selected meter parameters. Modbus uses a Master/Slave communication scheme. The EFT10 is always the Modbus slave. The customer must provide the Modbus master application. The EFT10 supports only Modus RS-485 (RTU) communications. Tables 1, 2 and 3 list the details of available Modbus registers.

A Modbus master application we've used for testing is available at http://www.simplymodbus.ca. The initial free version allows a limited number of uses before a restart is required.

5.2 Modbus Configuration

Configuration of the EFT10 for Modbus consists of meter configuration and wiring.

(1) Meter: Front Panel interface, select "System Setup Menu/Setup Serial Comms/ Set Serial Baud Rate/Modbus". In this menu, the user selects the Modbus RTU baud rate and slave ID number. The default baud rate is 9600 and the default slave id is 1. Refer to the section on Operation for more details.
(2) Wiring: Refer to the electrical installation instructions for wiring the RS-485 communications channel.

5.3 Modbus Operation

All registers are readable. Only the totalizer registers allow writes. Note that it is not possible to write a value to a totalizer, any value written will still result in the totalizer being set to 0.

The following operations are required to perform a read operation using Modbus:

1. Start the Modbus master program, and verify connectivity to the meter. Check the RS-485 serial parameters, unit number.
2. Select a register from the Modbus register list. Note that all data values are 32-bits. This means all register accesses require 2, 16-bit reads to get all the data. Table 1 contains a list of registers where the volume value is in fixed units of gallons per minute. Table 2 contains a list of register values converted to user selected units. Table 3 contains a list of register values where the volume value is converted to the user units.
3. Read the register from the master. Note: Reading or writing a Modbus register typically requires specifying the slave device id code, function code, register address, and the number of registers to access. Tables 1, 2, and 3 contain the EFT10 register maps. Table 4 defines the bit encoding of the fault code.
4. Float and integer values are transferred as 2, 16-bit words. The Modbus master program must ensure that the bytes are ordered correctly, and it may be necessary to re-order. The EFT10 provides 3 address ranges to allow the customer to configure their Modbus master with the least effort. Tables 1 and 3 (non-byte swapped) fit the byte order of other Spirax products. Table 2 addresses support the "standard" big endian high byte / low byte, high word / low word format.

Modbus RTU Read Example:
Read float 36.00 from holding register 41800.

Command: (from Master to EFT10)

Modbus Packet Field	**Hex value**
Slave ID	01
Function	03
Address byte Hi	A3
Address byte Lo	48
Bytes to read Hi byte	00
Bytes to read Lo byte	02
CRC Hi byte	66
CRC Lo byte	59

Response: (from EFT10 to Master)

Modbus Packet Field	**Hex value**
Slave ID	01
Function	03
Byte Count	04
Data Hi (41800)	00
Data Lo (41800)	01
Data Hi (41801)	42
Data Lo (41801)	10
CRC Hi byte	9A
CRC Lo byte	9F

Format 1: (Little-Endian)

The returned 4 bytes will be in the order: 0x00 0x00 0x42 0x10.
To get the correct IEEE-754 value of 36.0, the bytes must be ordered as:
0x42 0x10 0x00 0x00. The address mapping in Table1 and Table 3 support this.

Format 2: (Big-Endian)

All values read from the register map starting at address 41700 return the data in the order: 0x42 0x10 0x00 0x00. This sequence would not require the master to re-order the bytes. Table 2 registers support this format.

Table 5-1: Modbus Core Units Register Table (Format 1)

Parameter	Address	R/W	Type	Bytes	Description
Meter Name	4101	R	char	20	Text describing meter name
Volume	41002	R	float	4	Fluid volume, gal/min
Fwd Total	41006	R/W	float	4	Forward Totalizer, user units, write to reset
Rev Total	41008	R/W	float	4	Reverse Totalizer, user units, write to reset
Net Total	41030	R/W	float	4	Net Totalizer, user units, write to reset
Gross Total	41032	R/W	float	4	Gross Totalizer, user units, write to reset
Faults	41036	R	Int	4	Fault code, bit encoded, see Table 4
Alarm 1	41038	R	Int	4	Alarm 1 state, 0 = no alarm, 1 = alarm active
Alarm 2	41040	R	Int	4	Alarm 2 state, 0 = no alarm, 1 = alarm active

Table 5-2: Modbus User Units Register Table (Format 1)

Parameter	Address	R/W	Type	Bytes	Description
Volume	41702	R	float	4	Fluid volume, user units
Fwd Total	41704	R	float	4	Forward Totalizer, user units
Rev Total	41706	R	float	4	Reverse Totalizer, user units
Net Total	41708	R	float	4	Net Totalizer, user units
Gross Total	41710	R	float	4	Gross Totalizer, user units
Faults	41712	R	Int	4	Fault code, bit encoded, see Table 4
Alarm 1	41714	R	Int	4	Alarm 1 state, 0 = no alarm, 1 = alarm active
Alarm 2	41716	R	Int	4	Alarm 2 state, 0 = no alarm, 1 = alarm active

Table 5-3: Modbus User Units Register Table (Format 2)

Parameter	Address	R/W	Type	Bytes	Description
Volume	41802	R	float	4	Fluid volume, user units
Fwd Total	41804	R	float	4	Forward Totalizer, user units
Rev Total	41806	R	float	4	Reverse Totalizer, user units
Net Total	41808	R	float	4	Net Totalizer, user units
Gross Total	41810	R	float	4	Gross Totalizer, user units
Faults	41812	R	Int	4	Fault code, bit encoded, see Table 4
Alarm 1	41814	R	Int	4	Alarm 1 state, 0 = no alarm, 1 = alarm active
Alarm 2	41816	R	Int	4	Alarm 2 state, 0 = no alarm, 1 = alarm active

5.4 Fault Codes

This table defines the meaning of the bits in the faults register. For address 41712 and 41036, the order is in Little - Endian, which means the least significant bit is on the right side, the most significant is on the left. Address 41812 has the bits shifted by 16 positions. The faults cannot be cleared by a write to the register – it is read-only. The power cycle fault is cleared when the data logger logs an entry to flash. All other faults must be cleared by a reset or by changing the condition that caused the fault.

Table 5-4: Modbus Fault Codes

Fault Code bit position registers 41712, 41036	**Fault Code bit position, register 41812**	**Fault Description**
0	16	If 1, the meter experienced a power cycle
1	17	If 1, the backup memory device has failed
2	18	If 1, the real-time clock has failed
3	19	If 1, RAM memory device has failed
4	20	If 1, the FPGA device has failed
5	21	If 1, the Analog to Digital converter device has failed
6	22	If 1, the sensor main coil has failed
7	23	If 1, the sensor reference coil has failed
8 – 31	0 – 15, 24 - 31	Reserved for future use.

EFT10 Electromagnetic Flow Transmitter

Section 6 HART

6.1.1 Scope

The Spirax Sarco, Inc. EFT10 transmitter complies with HART Protocol Revision 7.0. This document specifies all the device-specific features and documents HART Protocol implementation details (e.g., the Engineering Unit Codes supported). The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART-capable Host Applications.

6.1.2 Purpose

This specification provides a complete description of this Field Device from a HART Communication perspective.

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands and performance requirements) used during development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

6.1.3 References

HART Smart Communications Protocol Specification. HCF_SPEC-12. Available from the HCF.

6.2 Device Identification

Manufacturer Name:	Spirax Sarco	**Model Name(s):**	EFT10
Manufacture ID Code:	202 (CA Hex)	**Device Type Code:**	51,856 (CA90 Hex)
HART Protocol Revision	7.0	**Device Revision:**	1
Number of Device Variables	4		
Physical Layers Supported	FSK		
Physical Device Category	Electromagnetic Flow Transmitter		

6.3 Product Overview

The EFT10 HART provides a 4 to 20mA flow output signal and can be monitored and configured using a HART master device or a hand-held communicator.

NOTE: Multidrop HART requires an external 4-20mA power source. HART registration is pending using an external power source.

6.4 HART Product Interface

6.4.1 Host Interface

6.4.1.1 4-20mA Current Output Loops

The EFT10 has two 4-20mA outputs for capturing flow. HART communication protocol is supported on current loop channel 1. When internally powered, a loop voltage of 24 VDC is supplied with a maximum load of 800 Ohms. These outputs are not potential free, but are isolated from ground and all other circuits.

6.5 HART Option Wiring

The wiring for HART is covered in the Electrical Installation section of the EFT10 Installation and Maintenance Instructions.

6.6 HART Communication Setup

HART communication is setup through the EFT10 front panel in the Serial Comms portion of Section 3 Operations.

6.7 HART Device Variables

Four Device Variables are implemented.

Device Variable	Meaning	Supported Units Codes*
1	Forward Flow Rate	15, 16, 17, 19, 22, 23, 24, 25, 26, 27, 28, 29,130, 131, 136, 138, 235
2	Forward Flow Totalizer	Follows Variable 1
3	Reverse Flow Totalizer	Follows Variable 1
4	Net Flow Totalizer	Follows Variable 1

*Table 2.66 Volumetric Unit Codes from HART Foundation Common Tables Specification (HCF_SPEC-183, v21.0, 12 May, 2011)

Unit Code Description Table

Unit Code	Description
15	Cubic feet per minute
16	Gallons per minute
17	Liters per minute
19	Cubic meters per hour
22	Gallons per second
23	Million gallons per day
24	Liters per second
25	Million liters per day
26	Cubic feet per second
27	Cubic feet per day
28	Cubic meters per second
29	Cubic meters per day
130	Cubic feet per hour
131	Cubic meters per minute
136	Gallons per hour
138	Liters per hour
235	Gallons per day

6.8 Dynamic Variables

Four Dynamic Variables are implemented.

Device Variable	Meaning	Supported Units Codes*
PV	Forward Flow Rate	15, 16, 17, 19, 22, 23, 24, 25, 26, 27, 28, 29,130, 131, 136, 138, 235
SV	Forward Flow Totalizer	Follows Variable 1
TV	Reverse Flow Totalizer	Follows Variable 1
QV	Net Flow Totalizer	Follows Variable 1

* See Table 2.66 Volumetric Unit Codes in HART Device Variables in Section 6.7 HART Device Variables.

6.9 Status Information

6.9.1 Device Status

Bit #	Bit Name	System Notes
0	PV Out Of Limits	
1	Non PV Out Of Limits	
2	PV Analog Output Saturated	
3	PV Analog Output Fixed	
4	More Status Available	This bit is set when a status changes within the system. It indicates more status information is available.
5	Cold Start	
6	Configuration Change	
7	Device Malfunction	

6.9.2 Extended Device Status

Bit #	Bit Name	System Notes
0	Maintenance Required	This occurs when the Diagnostic Test has a failure.
1-5	Not Used	
6	Configuration Change	
7	Device Malfunction	

6.9.3 Additional Device Status (Cmd #48)

Byte #	Bit #	Bit Name	Class	Device Status Bits Being Set
0	0	Reference Coil Not Present	Error	4, 7
	1	Low Coil Current	Error	4, 7
	2	Low Reference Value	Error	4, 7
	3-7	Not Used		
1	0	4-20mA 1	Information	4
	1	4-20mA 2	Information	4
	2-7	Not Used		
2	0-7	Not Used		
3	0	Zero Offset High	Information	4
	1-7	Not Used		
4	0-7	Not Used		
5	0	Relay 1 Active	Information	4
	1	Relay 2 Active	Information	4
	2	Contact 2 Active	Information	4
	3	Contact 2 Active	Information	4
	4-7	Not Used		
6-9	0-7	Not Used		

6.10 Common Practice Commands

6.10.1 Supported Commands

Cmd #	Command
33	Read Transmitter Value
34	Write PV Damping Value
35	Write PV Range Values
36	Set PV Upper Range Value
37	Set PV Lower Range Value
41	Self-Test Start
42	Device Reset
43	Set PV Zero
44	Write PV Units
47	Write PV Transfer Function

6.10.2 Burst Mode

Burst mode is not supported in this device.

6.10.3 Catch Device Variable

Catch Device is not support in this device.

6.11 Device-Specific Commands

There are no device specific commands supported.

6.12 Tables

6.12.1 Unit Codes

Code	Additional Units Codes
240	Volume Flow Acre-Foot per Second (af/sec)
241	Volume Flow Acre-Foot per Minute (af/min)
242	Volume Flow Acre-Foot per Hour (af/hr)
243	Volume Flow Acre-Foot per Day (af/dy)
244	Volume Flow Acre-Foot per Year (af/yr)
245	Volume Acre-Foot (af)

6.13 Performance

6.13.1 Reset

Command 42 (“Device Reset”) causes the device to reset its microprocessor. The resulting restart is identical to the normal power up sequence.

6.13.2 Self-Test

The self-test and diagnostics procedures are executed at power up, and after issuing Cmd #42, Device Reset, since the device will do a warm boot. The Cmd #41, Self-Test”, will only run diagnostic procedures.

6.13.3 Busy and Delayed-Response

The Busy respond code will occur when executing Hydraulic Zero.

6.13.4 Long Messages

The longest message that can be written to/from the EFT10 is 34 bytes with 2 status bytes, from Cmd #20 and Cmd #21.

6.13.5 Non-Volatile Memory

Nonvolatile memory is used to hold the device's configuration parameters. The Nonvolatile memory in the EFT10 is based on Magnetoresistive Random Access Memory (MRAM) technology. New data is written to this memory immediately on execution of a write command.

6.13.6 Modes

Command 40 is not implemented. To fix current only available by front panel menu option.

6.13.7 Write Protection

Write-protection is provided, selected under the front panel menu ("Home"->System Setup Menu->Setup HART Comms->Lock/Unlocked). Press "Enter" button to toggle lock/unlock options. When the setting reads "Locked", no "write" or "command" commands are accepted.

6.13.8 Damping

Damping factor affects only the PV.

ANNEX A. Capability Checklist

Manufacturer, Model and Revision	Spirax Sarco , Inc., EFT10, rev A
Device Type	Transmitter
HART Protocol Revision	7.0
Number and Type of Process Connections	1, UniMag (Electromagnetic Flow Meter System)
Number and Type of Host Connections	— 2: 4-20mA Loops • Channel 1, HART Support — 1: RS 485 Modbus — 1: RS 232 Proprietary Serial Command Prompt
Number of Device Variables	4
Number of Dynamic Variables	4
Map-able Dynamic Variables	0
Number of Device Specific Commands	2: Non-Public
Bits of Additional Device Status	10
Alternative Operating Modes	no
Burst Mode	no
Capture Device Variables	no
Write Protection	yes
Device Description Available	no

EFT10 Electromagnetic Flow Transmitter

Section 7 Troubleshooting

7.1 Quick Guide to Troubleshooting

Should measurement be outside the limts given in the Table 7-1, the installation is unsatisfactory.

7.1.1 Serial Numbers

Flow transmitter serial number must match the primary magmeter's serial number.

> ☑ ***Note***
>
> There shall be no potential difference when measured between the grounding at the flow transmitter and the grounding at the flowtube. Excessive unequal potentials are beyond the control of Spirax Sarco and additional cost of remedy is extra to that of Spirax Sarco normal supply.

The EFT10 transmitter is interchangeable with full pipe Spirax Sarco magmeters (M, DT, DP, DemiMag, DeltaKit, and DeltaMass). For each particular order, however, they are factory programmed in accordance with the appropriate flow ranges and pulse frequency outputs, and are dedicated to a specific primary magmeter. For this reason, serial numbers for the EFT10 transmitter and the primary magmeter must match.

7.1.2 Resistances

Check flowtube resistances before connecting to the transmitter.

> ⚠ DANGER
>
> **HIGH VOLTAGE EXCITER COIL. Disconnect the main power before taking measurements on the exciter coil.**

1. **Exciter Coil**: Using a multimeter, read and compare the resistances between the following:

- Black / Shield: must be greater than 10 MΩ
- White / Shield: must be greater than 10 MΩ
- White/Black: must be between 2.5 and 100Ω, dependant on size (see page 18)

Should the resistance at the transmitter cable ends be substantially less than 10 Meg Ohms, there is probably damage to the cable and/or moisture has entered into the sensor or wiring. To dry out, use a hair dryer if not in a hazardous area; otherwise let dry in the sun. If drying is unsuccessful, then the sensor(s) or cable requires replacement.

For individual sensor resistances, see Instruction Manual.

2. **Reference Coil**: Using a multimeter, read and compare the resistances between the following:

- Black / Shield: must be greater than 10 MΩ
- White / Shield: must be greater than 10 MΩ

• White / Black: typically 6.6k Ω for multiple sensors, 10k Ω for single sensors

These resistance checks are similar to the Exciter Coil checks above, but they are not as critical to the sensor function. The reference coil resistances should, however, be checked at the transmitter cable ends to make sure the reference coil is correctly wired and operational.

3. **Electrodes**: Using a multimeter, while the electrodes and pipe are dry without water in the pipe, read and compare the resistances between the following:

- Black / Shield: must be between 100k Ω and 5 MΩ, and should be approximately equal to the White / Shield resistance
- White / Shield: must be between 100k Ω and 5 MΩ, and should be approximately equal to the Black / Shield resistance
- White / Black: must be greater than 100k Ω

Electrode cable ends at the transmitter should have approximately the same resistance. If one is substantially different, this normally indicates a shorting effect of an electrode in the flowtube or in the junction box. Sensor(s) may have to be removed for visual inspection if substantial resistances occur.

4. **Shields**: Using a multimeter, read the resistance between the Exciter Coil Shield and the Electrode Shield. This reading should be less than 8 Ω.

If the shield resistances are greater than 8 Ohms, then unacceptably large and unequal potentials in the pipe work may be present. See 7.1.4 below.

7.1.3 Connecting Field Input / Outputs

Connect the following cables to allocated termination. Check the wiring in accordance with Section 2.4.1 Terminal Connections.

a) Coil Cable
b) Reference Coil Cable
c) Electrode Cable
d) Pre-Amp Cable (where applicable)

Flow Signal: connect the flow rate signal cable to analog output channel 1 or 2 as required.

Pulse / Frequency Signal: connect the pulse or frequency output signal cable to allocated termination.

7.1.4 Connecting the Power Supply

Before connecting the power supply, make sure the transmitter is properly grounded.

The EFT10 transmitter and the primary magmeter must be properly grounded. Ensure that there is no potential difference between the flow sensor ground and the flow transmitter ground. If there are rubber sealed pipe joints it may be necessary to drill and tap pipe flanges on either side of the pipe joint. Screw copper braiding or minimum 1/16” (2mm) copper grounding cable to connect adjacent piping.

Using a multimeter on mV AC, read and compare measurements across the following:

- Black / Shield: must be 1 to 6 mV AC
- White / Shield: must be 1 to 6 mV AC
- These readings should be approximately equal.

Should mV AC be substantially unequal, unacceptably large and unequal potentials in the pipe work are present (i.e. bad grounding). This fault is not a result of the use of grounding electrodes or the use of grounding rings. Such high unequal potentials are BEYOND THE CONTROL OF Spirax Sarco, but should this be the case, we recommend the following:

a) Re-check with the exciter coil shield out of the terminal to see if the problem is alleviated.
b) Check the effect on the mV AC readings in this section (4.1.4) across pipe joints. The pipe joint has an insulative seal and the pipes are often coated, giving rise to the high unequal potentials. This may require scraping a patch of the protective coating from the outside of the pipe to expose the bare metal to achieve a reliable connection. Put a temporary cable, approximately □" (3mm) diameter from the exposed patch each side of the joint and then to the ground of the UniMag. Re-check 4.1.2, step 4 (Shields) to see if the problem is alleviated. If so, drill and tap into the flanges on either side of the pipe joint and run —" (3mm) diameter grounding cable from screws into the flanged tapped holes across the pipe joint and onto the ground screw of the UniMag.
c) If (a) or (b) does not alleviate the problem, the grounding cable must also be connected to a known good ground, or to a 1½" (15mm) diameter copper rod driven a minimum of 4 feet (1200mm) into the ground.

7.1.5 Programming the EFT10 Transmitter

For detailed instructions on programming the EFT10, see Section 3 Operation.

From the **System Startup Menu**:

- Setup Reference Mode: Ensure that the reference coil or the coil current mode is selected and enter the correct calibration or meter factor.

> ☑ ***Note***
>
> The Calibration or Meter Factor is found on the flowtube identification label.

- Setup Flow Rates
- Setup Totalizers
- Setup Analog Outputs
- Setup 50/60 Hz Mode
- Setup other parameters as required

From the **Field Startup Menu**:

- Set Hydraulic Zero
- Restore Default Zero: The is the factory default setting – if experiencing problems, restore this setting and then carry out a Hydraulic Zero again.

There are three main problems resulting in a "Diagnostic Error" display and, if programmed, an alarm relay. This will cause the EFT10 to go offline and the signal to go to 4mA.

The three reasons for a Diagnostic Error are:

a) **The presence of a reference coil is undetected**. There should be approximately 500 mV AC across the reference coil. If there is substantially less, the diagnosis is usually a faulty sensor. This is diagnosed at start-up or returning to on-line ("Running Diagnostics").

⚠ DANGER

HIGH VOLTAGE EXCITER COIL. Disconnect the main power before taking measurements on the exciter coil.

b) **The presence of an exciter coil is not detected.** There should not be less than 90 VAC across the exciter coil, as measured with a multimeter. If there is less, the likely cause is a blown exciter coil fuse. This is diagnosed at start-up or returning to on-line ("Running Diagnostics").

c) **The reference coil is invalid.** This is continuously being diagnosed and will only occur if the transmitter passes the start-up checks, but develops a problem after flow is being measured.

7.1.6 Modbus and HART Troubleshooting

Subsystem	Reason	Possible Solution
MODBUS	No communications or invalid data over RS485	
	Incorrect wiring	Verify that the wiring is in accordance with the electrical installation and wiring instructions.
	Wrong Polarity	Verify that the wiring is connected to the correct polarity at each end of the RS-485 network
	Termination missing or excessive	Verify that the RS-485 bus is terminated in accordance with the electrical installation and wiring instructions
	Wrong baud rate	Verify that the host device has the same baud rate as the EFT10. Default baud rate is 9600baud.
	Wrong Data encoding	Verify that the host device has the same data encoding as the EFT10. The default encoding is 8 data bits, no parity, and 1 stop bit.
	Wrong Address	Verify that the register set is addressed correctly as defined in the MODBUS register map
	Wrong Data Type	Verify that the data type of the addressed register matches the host command

Subsystem	Reason	Possible Solution
HART	No communication over PC host or Handheld masters.	
	Wrong Load Resistor size	This resistor is for a voltage drop for the host modem circuitry. Verify the right size of register for the HART load. The valid sizes are 250Ω or 500Ω.
	Wrong Device Address in Multi-Drop Configuration	Verify the wiring is in accordance with HART and wiring instructions.
		Make sure each HART device on the HART network has a unique polling address and device ID.
	No support for Internal power source	The EFT10 was not qualified for internal power source. There is no guarantee that communication will be stable in this mode.
	No or low voltage at external power source.	Recommended +24VDC power source. Make sure there is enough power to support all HART devices that are on the HART network.
Sensor	Coil Error message displaying on front panel.	
	Poor or no flow tube resistances	Follow the solution for “Check Flow tube Resistances” section to determine which part of the coil is failing.
Front Panel Contrast	Difficult to see or no display on the front panel.	
	The characters on the screen are hard to see or no characters are displaying	Turn the adjustable resistor, R3, clockwise (to the right) to turn up the contrast.

7.1.7 EFT10 Troubleshooting Guide

Should measurements be outside the limits given in the chart below, installation is unsatisfactory.

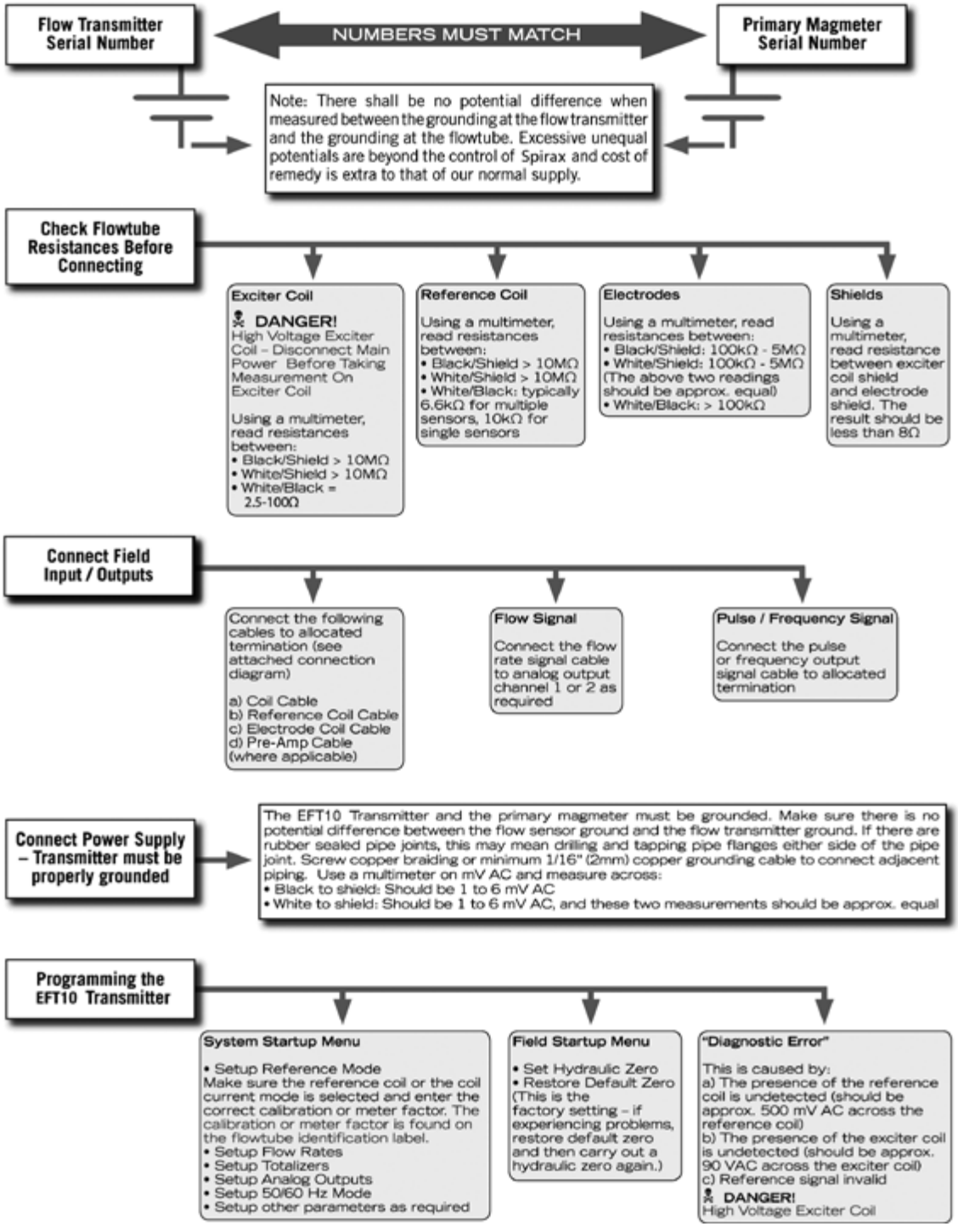


Figure 7-1: EFT10 Troubleshooting Guide

EFT10 Electromagnetic Flow Transmitter

Section 8 Revalidation of Electrical Parameters Certificate

8.1 Revalidation Program

For details on Spirax Sarco program for Revalidation of Electrical Parameters Certificate, contact Spirax Sarco.

Phone 800-356-9362 or 303-682-7060
Email support@emcoflow.com

-------- Notes --------

EFT10 Electromagnetic Flow Transmitter

Section 9 Additional Resources

9.1 Additional Resources Available

Additional information is available on the Spirax Sarco Web site www.spiraxsarco.com/us, in the Documentation section.

To search for documentation, go to www.spiraxsarco.com/us and click on **Documentation**. Type in a search term in the **Partial Title** box, or use the **Keyword** drop-down list and click **Search For Documents**.

> ☑ ***Note***
>
> Due to continuous product improvement, details may be subject to change without notice. Our Web site will always have the latest version of any document.

spirax sarco

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