Programmable Magnetic Flowmeter User Manual

FM100 Series

APG®

Doc #9004859
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Introduction

Thank you for purchasing an FM100 programmable magnetic flowmeter from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your FM100 and this manual.

The FM100 Programmable Magnetic Flowmeter is a highly accurate, bi-directional flowmeter, with configurable 4-20 mA output. It comes with a two-line LCD display and four-button keypad for intuitive display set up and menu navigation. The hard technical rubber liner of the FM100 is compatible with most water and waste water applications.

Reading your label

Every APG FM100 comes with a two labels, one on the sensor and one on the converter. The converter label will include the APG model number (starting with FM100-) and serial number, while the sensor will have the sensor number. Please ensure that the model number on your converter label matches your order.

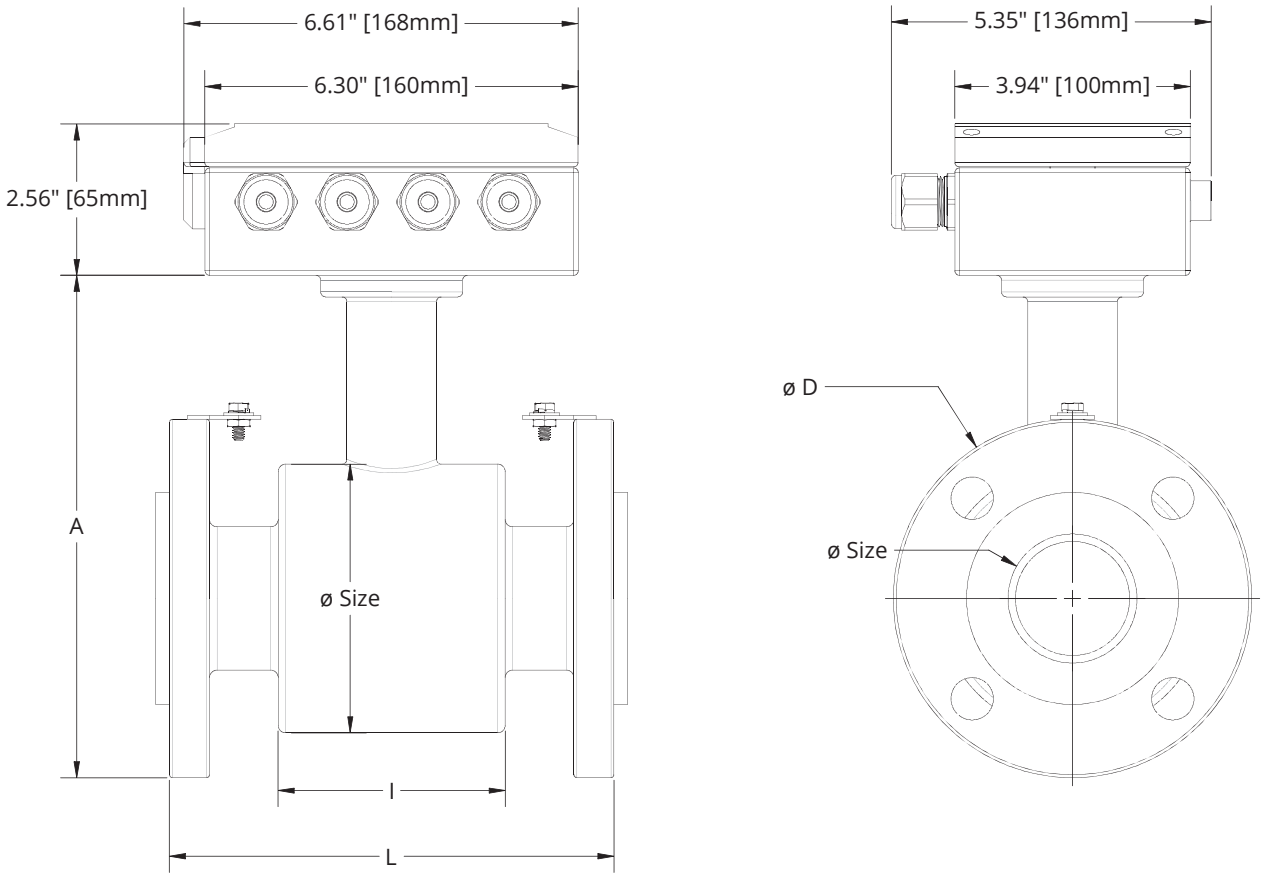
Warranty and Warranty Restrictions

This product is covered by APG's waranty to be free from defects in material and workmanship under normal use and service of the product for 24 months. For a full explanation of our Warranty, please visit https://www.apgsensors.com/about-us/terms-conditions. Contact Technical Support to recieve a Return Material Authorization before shipping your product back.

Scan the QR code below to read the full explanation of our Warranty on your tablet or smartphone.

Chapter 1: Specifications and Options

- **Dimensions**



Size	Flange	ø D*	L**	A	Weight
1" (25mm)	150lbs	4.53" (115mm)	7.87" (200mm)	7.09" (180mm)	9.7 lbs (4.4 kg)
2" (50mm)	150lbs	6.30" (160mm)	7.87" (200mm)	8.78" (223mm)	19.6 lbs (8.9 kb)
3" (80mm)	150lbs	7.68" (195mm)	7.87" (200mm)	10.2" (260mm)	28.4 lbs (12.9 kg)
4" (100mm)	150lbs	8.46" (215mm)	9.84" (250mm)	11.0" (280mm)	37.2 lbs (16.9 kg)
6" (150mm)	150lbs	11.0" (280mm)	11.8" (300mm)	13.4" (340mm)	63.6 lbs (28.9 kg)

*Flange dimensions meet ANSI B 16.5
**Standard construction length meets ISO 13359.

• Specifications

Accuracy

Accuracy	<0.5% of full scale
Resolution	16 bit resolution DAC

Environmental

Process Temperature	32 - 158 °F (0.1- 70 °C)
Enclosure Protection	IP67

Electrical

Supply Voltage	85 - 265 VAC
4-20 mA Loop Resistence	1000Ω
Minimum Fluid Conductivity	20µS/cm

Materials of Construction

Measuring Tube	Stainless Steel
Flanges, Housing	Carbon Steel, Polyurethane paint
Converter Box	Aluminum, Powder paint
Sensor Lining	Hard Technical Rubber
Electrodes	AISI 316Ti Stainless Steel

• Flow Rates per Line size

Size		Flow Rates				R25 Range (Q_3)	
Inches	mm	Q_{min}		Q_{max}		(Q_3 @ Q_3/Q_1=25)	
1″	25	0.7740 gpm	2.94 l/m	93.36 gpm	353.4 l/m	27.74 gpm	6.3 m^3/hr
2″	50	3.114 gpm	11.78 l/m	373.4 gpm	1414 l/m	110.1 gpm	25 m^3/hr
3″	80	7.968 gpm	30.16 l/m	955.8 gpm	3619 l/m	277.4 gpm	63 m^3/hr
4″	100	12.45 gpm	47.12 l/m	1494 gpm	5654 l/m	440.3 gpm	100 m^3/hr
6″	150	28.01 gpm	106.0 l/m	3360 gpm	12.72 x 10^3 l/m	1101 gpm	250 m^3/hr

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• Model Number Configurator

Model Number: FM100 - ____ - ____ - ____ - ____ - ____ - ____
A B C D E F

A. Size (Pipe Diameter)

□ **01** 1″
□ **02** 2″
□ **03** 3″
□ **04** 4″
□ **06** 6″

B. Process Connection

□ **F** 150 lb Flange

C. Liner Material

□ **1** Hard Rubber

D. Output

□ **A6** 4-20 mA

E. Input Power

□ **1** 85 - 240 VAC

F. Display

□ **LCD** LCD Display

• Wiring Diagram and Terminal Layout

The FM100 comes with an active 4-20 mA output, and requires 85 - 240 VAC input power. The 4-20 mA loop is connected to pins 12 and 13 (See Figures 1.1 and 1.2), and power is connected on the L, N, and PE terminals at the far right (Figure 1.2).

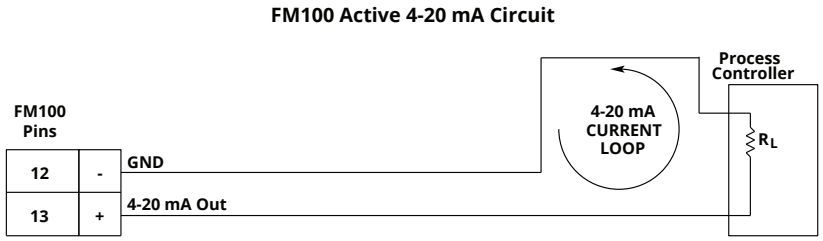

Figure 1.1 - 4-20 mA Wiring Diagram

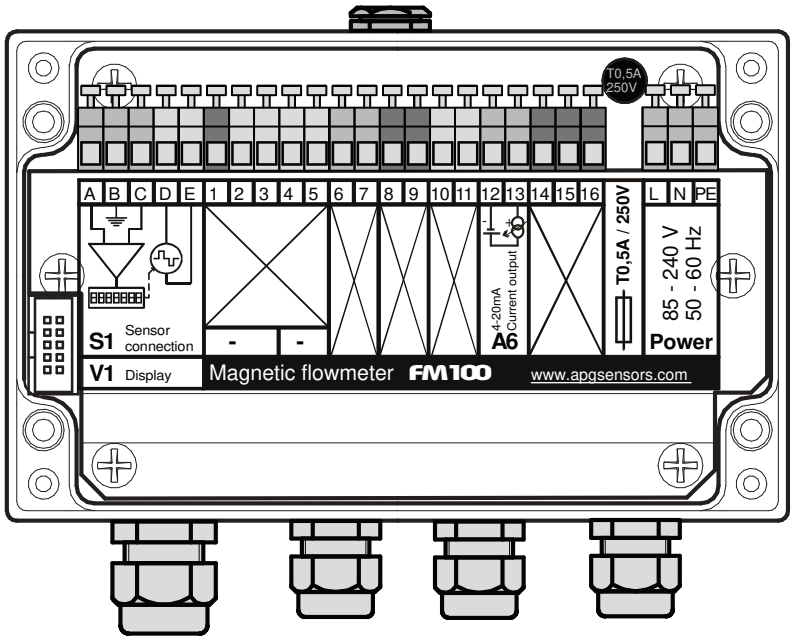

Figure 1.2 - FM100 Terminal Layout

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Chapter 2: Installation and Removal Procedures and Notes

• Tools Needed

Two sets of tools will be needed to install your FM100. One set will be necessary to physically install the FM100 in the pipe line. Physical installation of your FM100 in the pipeline should be done by a piping installer, using appropriate tools.

To electrically install your FM100, you will need:

- A small phillips head screwdriver
- A small flat head screwdriver

> NOTE: Physical installation of your FM100 in the pipeline should be done by a piping installer, using appropriate tools.

• Installation Requirements and Recommendations

To ensure proper opperation of your FM100, the following installation requirements must be met.

1. Pipe adjacent to the FM100 must match the sensor exactly (see Figure 2.1). Any transitions will create turbulence that will disupt sensor operation.
2. Pipe adjacent to the FM100 must be straight, without fittings or bends) for at least 5 times the diameter of the sensor upstream and 3 times the diameter of the sensor down stream (see Figure 2.2).

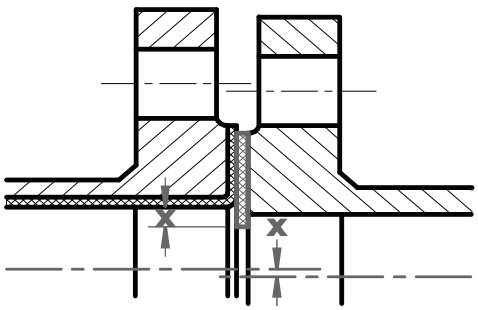

Figure 2.1

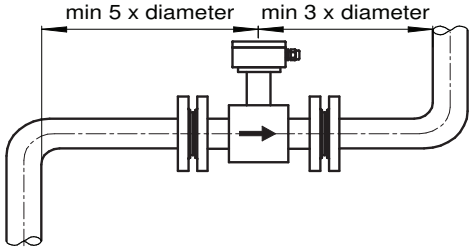

Figure 2.2

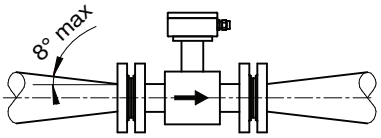

Figure 2.3

> NOTE: Straight-line lengths may include up to 8° slopes (see Figure 2.3)

3. The FM100 must be located downstream of any pumps in the pipeline (see Figure 2.4). Straight-line length of at least 25 times the diameter of the sensor is required between a pump and the FM100.
4. Stop valves must be located downstream of the sensor (see Figure 2.5), ensuring that the sensor does not run dry when the valve is closed.
5. If necessary, a bypass can be installed for sensor imstallation and removal (see Figure 2.6).

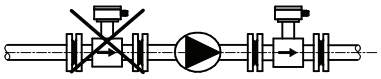

Figure 2.4

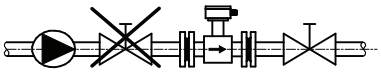

Figure 2.5

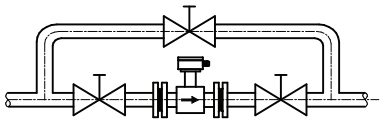

Figure 2.6

For optimal opperation of your FM100, the following installation recommendations should be followed.

1. For sensors installed near vertical sections of pipe, the FM100 can be either in the horizontal section upstream of the vertical, or on the upstream vertical (see Figure 2.7). To avoid airlock, it must not be installed on the raised section of pipe, nor on the downstream vertical.
2. Where continuous flow is to low to ensure permanent flooding of the full cross section of the sensor, a low-water trap can be used to create permanent flood in the FM100 (see Figure 2.8).
3. Pipe supports of adjacent pipe should be placed as close to the FM100 as possible to reduce the risk of vibration (see Figure 2.9).
4. For horizontal installation of the FM100, the electrodes must be within 45° of the horizontal plane (see Figure 2.10).

NOTE: For sensors installed on vertical pipe, nominal flow should be upward through the FM100 (see Figure 2.7).

IMPORTANT: Do NOT touch the electrodes inside the FM100 sensor chamber.

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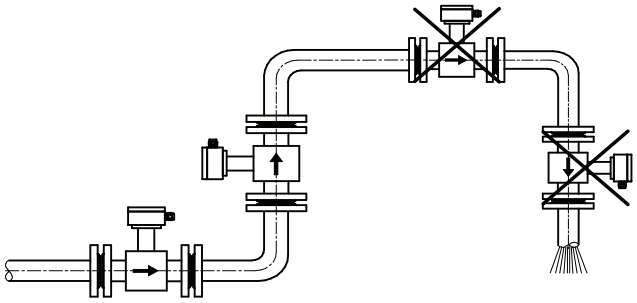

Figure 2.7

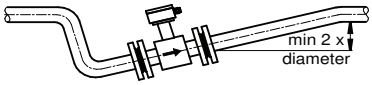

Figure 2.8

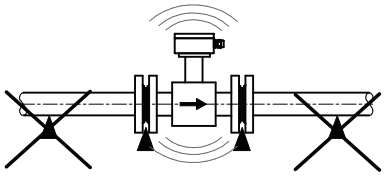

Figure 2.9

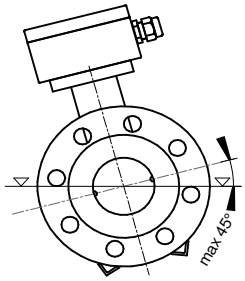

Figure 2.10

- ## Electrical Installation

  - Use the philips head screwdriver to remove the four small screws on the top of the cover, and open the cover (hinged on the left side).
  - Insert the incoming power line through the right-most cable gland. Connect the wires to the L, N, and PE terminals (see Figure 1.2). Use the small flat head screwdriver to operate the terminals if necessary.
  - Insert the 4-20 mA loop cable through another cable gland. Connect the wires to terminals 12 and 13 (see Figure 1.2). Use the small flat head screwdriver to operate the terminals if necessary.
  - Replace the cover and screws.

• Grounding Instructions

There are three grounding scenarios for the FM100:

- **For adjacent conductive pipe:**

1. Wire each flange of the FM100 to the adjacent pipe.
2. Ground both sections of the pipeline.

- **For non-conductive adjacent pipe:**

1. Use conductive grounding rings between the flanges to establish a connection from the conducting fluid to ground.
2. Wire each flange of the FM100 to a ground ring.
3. Ground both grounding rings.

- **For electrified fluid (e.g. cathodic protection against corrosion):**

1. Ensure complete electrical isolation of the FM100 from the adjacent pipe.
2. Wire the adjacent upstream pipe to the adjacent downstream pipe, bridging over the FM100.
3. Use galvanized conduit for the electical connection to the FM100 to ensure isolation.

• Removal Instructions

- Ensure that power to the sensor and current loop are both off.
- Ensure that liquid is not flowing through the sensor.
- Disconnect both cables to sensor.
- Remove the sensor and store it in a dry place, at a temperature between -40° F and 180° F.

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Chapter 3: Set Up and Operation

• User Interface

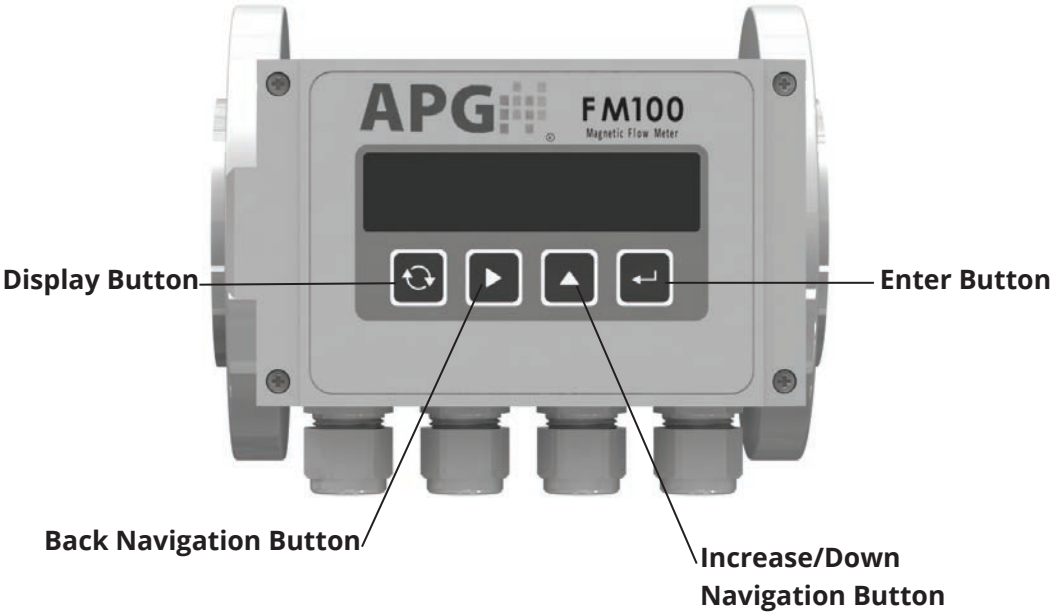

Figure 3.1

The operation of the FM100's three buttons depends on whether the FM100 is in Display Mode or you are navigating the FM100 Setup Menus.

During Display Mode

Display Button:
Cycles through sensor readings selected for display
Back Navigation Button:
Cycles between Total readings, Current or Temporary readings, and Hourly/Daily/Monthly Archives
Increase/Down Navigation Button:
Disabled in Display Mode
Enter Button:
Brings up Password prompt to enter Setup Menus

Within FM100 Setup Menus

Display Button:
Switches to Display Mode
Back Navigation Button:
Exit current menu or parameter to previous menu level, or cycles through character positions for text input
Increase/Down Navigation Button:
Cycles to next shown menu or parameter, or increases a blinking value
Enter Button:
Press to enter selected menu or parameter, or accept text input.

- **FM100 Display Mode Menu**

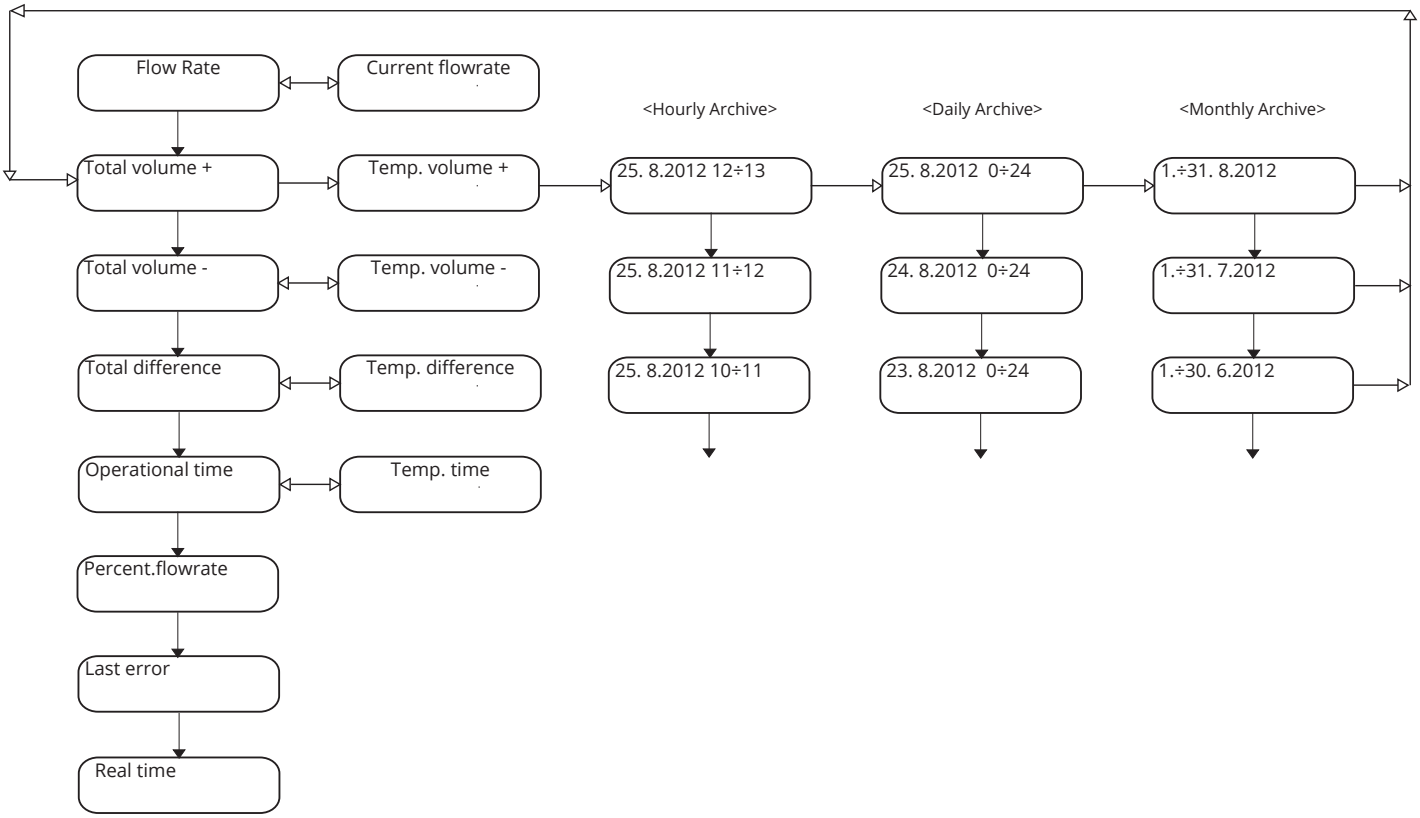

Figure 3.2

- **FM100 Setup Menus**

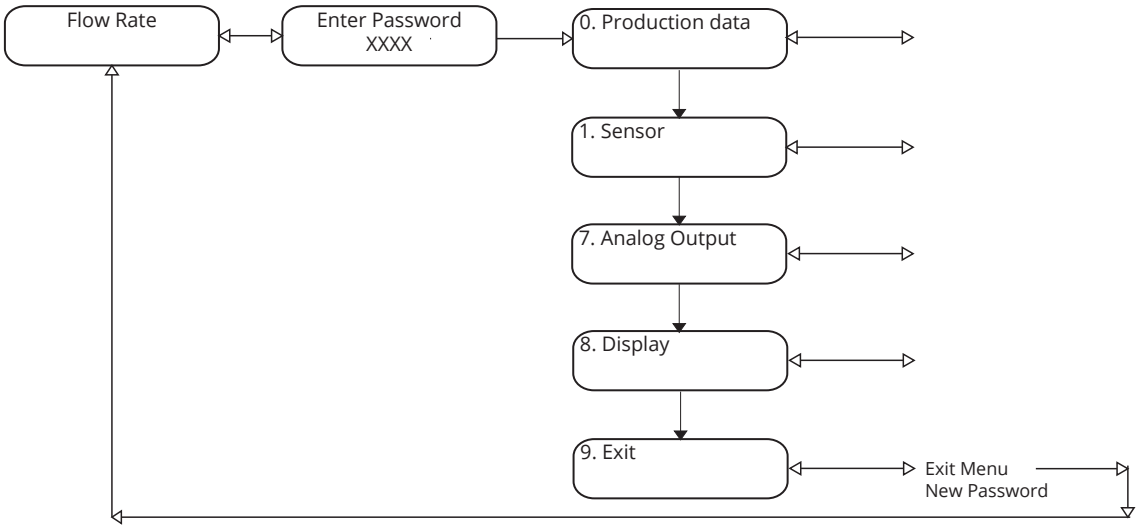

Figure 3.3

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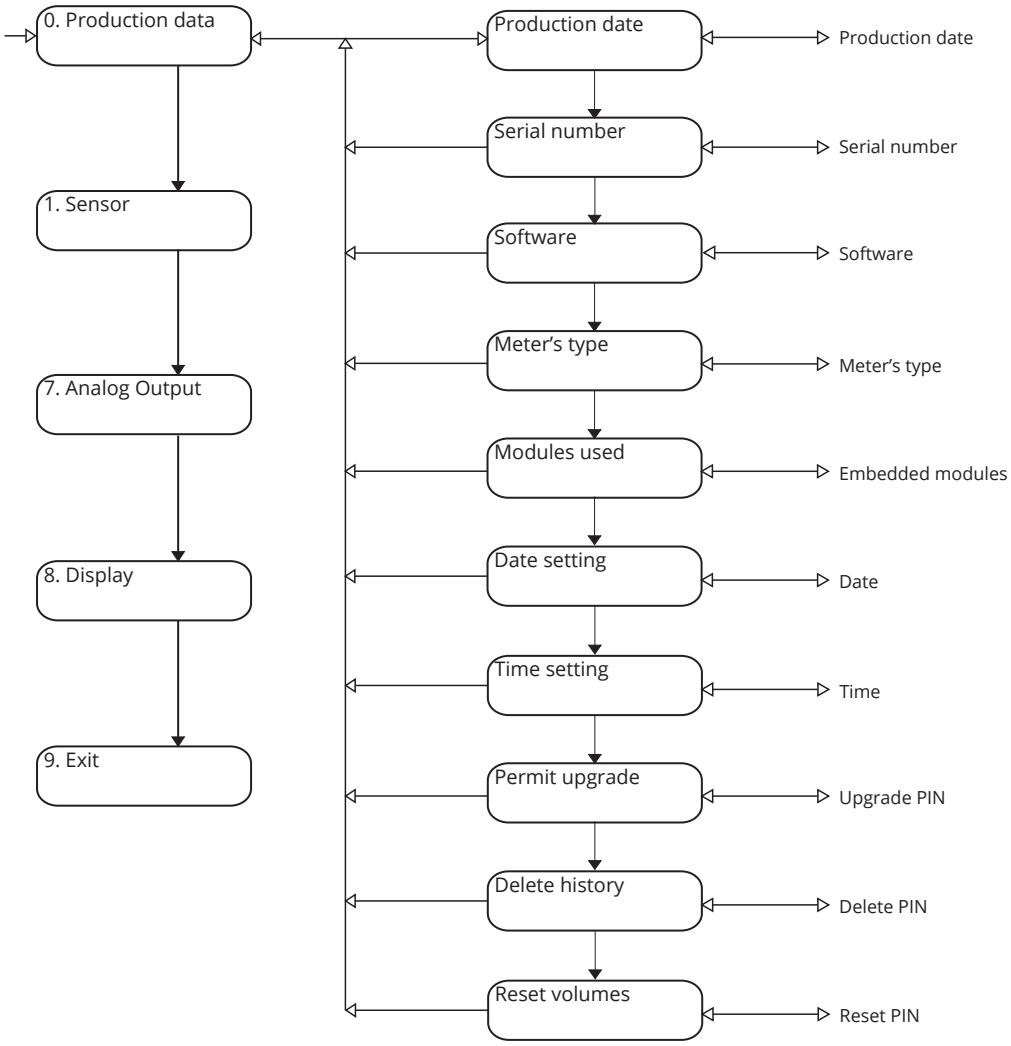
0. Production data
1. Sensor
7. Analog Output
8. Display
9. Exit
Production date
Serial number
Software
Meter's type
Modules used
Date setting
Time setting
Permit upgrade
Delete history
Reset volumes
Production date
Serial number
Software
Meter's type
Embedded modules
Date
Time
Upgrade PIN
Delete PIN
Reset PIN

Figure 3.4

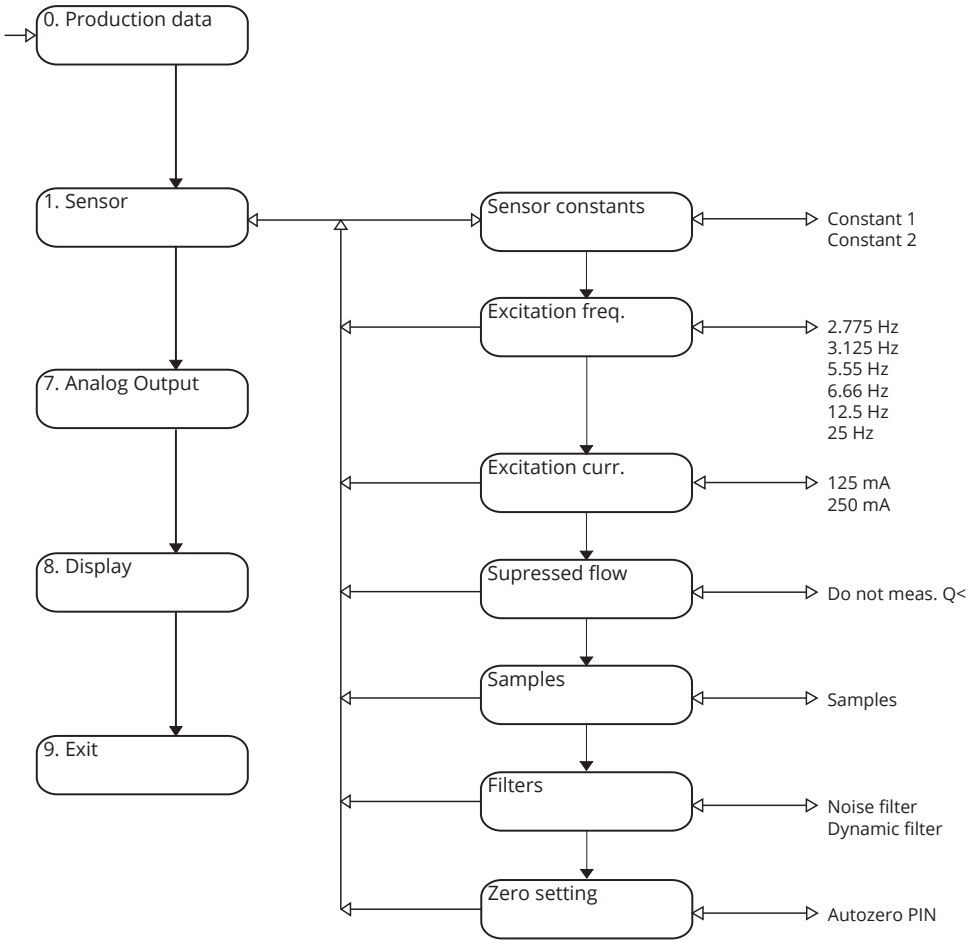

Figure 3.5

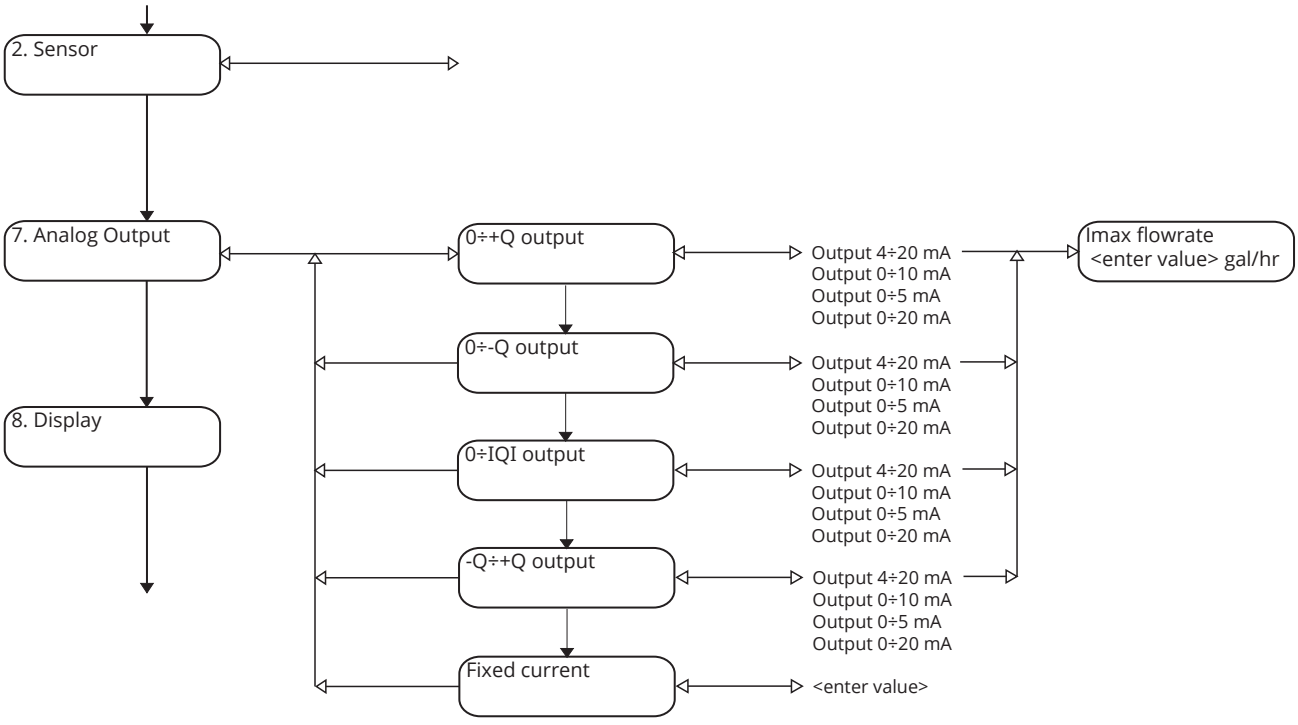

Figure 3.6

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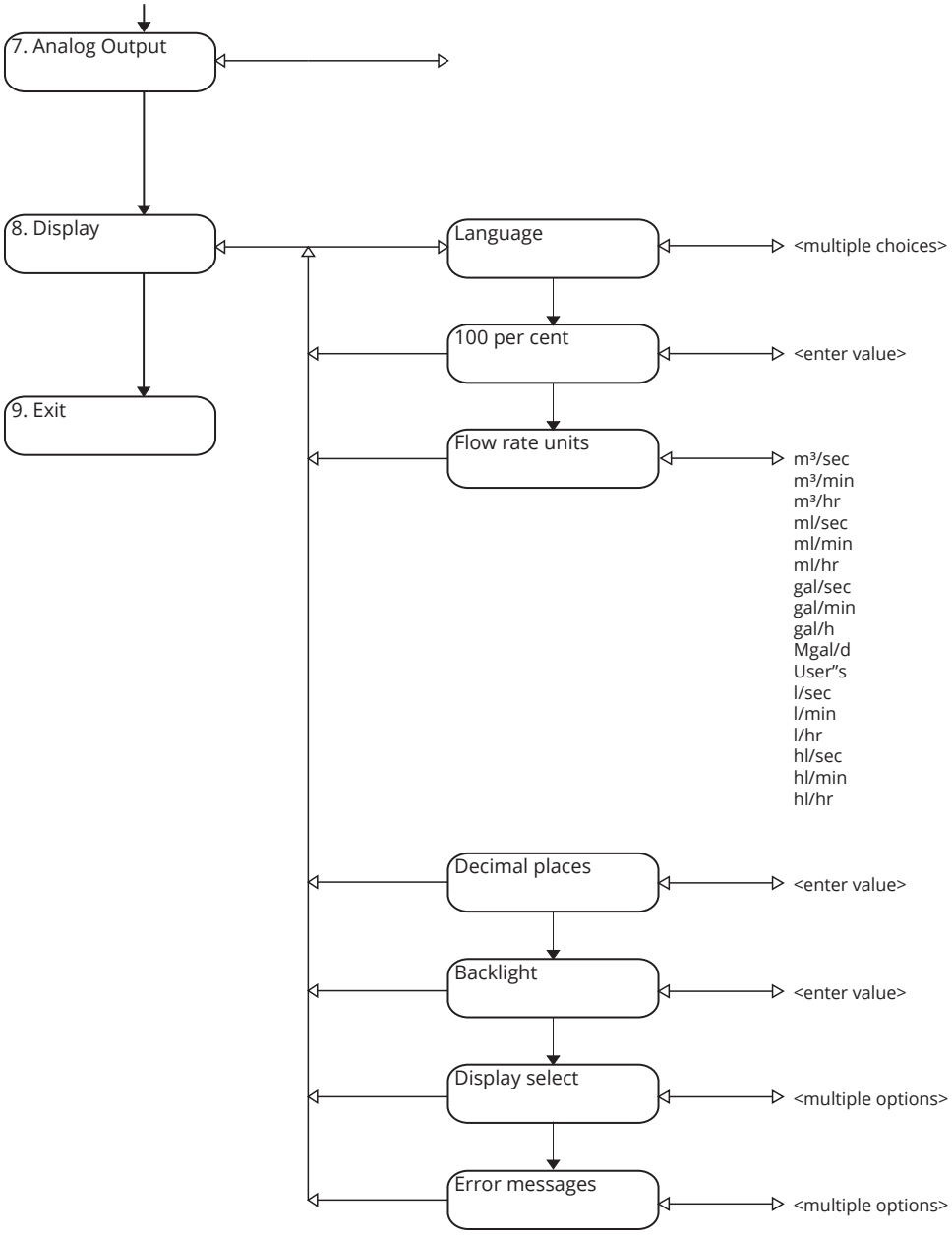
7. Analog Output
8. Display
9. Exit
Language
<multiple choices>
100 per cent
<enter value>
Flow rate units
m³/sec
m³/min
m³/hr
ml/sec
ml/min
ml/hr
gal/sec
gal/min
gal/h
Mgal/d
User"s
l/sec
l/min
l/hr
hl/sec
hl/min
hl/hr
Decimal places
<enter value>
Backlight
<enter value>
Display select
<multiple options>
Error messages
<multiple options>

Figure 3.7

- **Enter/Change Password**

The default password for the FM100 Setup Menus is 0000. Correct password entry is required to access the Setup Menus (See Figure 3.3).

To change the password:

1. Use the Increase/Down Button (See Figure 3.1) to navigate through the Setup Menus to 9. Exit (See Figure 3.3).
2. Select 9. Exit using the Enter Button.
3. Use the Increase/Down button to navigate to New Password, and select using the Enter Button.
4. Use the Increase/Down button to increase the value of a blinking character.
5. Use the Back Navigation Button to cycle through the character positions.
6. Use the Enter Button to save the displayed password.

NOTE: Write down your new password, as the correct password must be entered to access the FM100 Setup Menus. Password is NOT required to navigate the Display Mode Menus.

IMPORTANT: You MUST use the Exit Menu to save any changes in the Setup Menus. Cycling back to Display Mode using the Display Button leaves unsaved changes vulnerable to being lost in the event of power outage.

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• Display Mode Menus

DISPLAY PARAMETER	TEMPORARY/INSTANTANEOUS PARAMETER
Flowrate	*Current flowrate*

Flowrate displays an averaged value in the units selected in the Display Setup Menu (Figure 3.7). See *Samples* in the Sensor Menu below for setting the number of samples to be averaged.
Current Flowrate displays an instantaneous, unaveraged value also in the units selected in the Display Setup Menu.

DISPLAY PARAMETER	TEMPORARY/INSTANTANEOUS PARAMETER
Total volume +	*Temp. volume +*

Total volume + displays the total volume of liquid that has flowed in the direction of the arrow (Figure 3.8), from the start of measurement.
Temp. volume + displays the total volume of liquid that has flowed in the direction of the arrow during user specified time. See *Temp. time* below.

DISPLAY PARAMETER	TEMPORARY/INSTANTANEOUS PARAMETER
Total volume -	*Temp. volume -*

Total volume - displays the total volume of liquid that has flowed against the direction of the arrow (Figure 3.8), from the start of measurement.
Temp. volume - displays the total volume of liquid that has flowed against the direction of the arrow during user specified time. See *Temp. time* below.

DISPLAY PARAMETER	TEMPORARY/INSTANTANEOUS PARAMETER
Total difference	*Temp. difference*

Total difference displays the total volume difference between the positive (volume +) and negative (volume -) flows from the start of measurement.
Temp. difference displays the volume difference between the positive (volume +) and negative (volume -) flows during user specified time. See *Temp. time* below.

DISPLAY PARAMETER	TEMPORARY/INSTANTANEOUS PARAMETER
Operational time	*Temp. time*

Operational time displays the total time, in hours and minutes from the start of measurement (unit powered on). This is the time used for *Total volume* +, *Total volume* -, and *Total difference*.
Temp. time displays the time elapsed, in hours and minutes, since being set/reset by the user. *Temp. time* is reset by holding the Increase/Down Navigation Button and the Enter Button (See Figure 3.1) at the same time. This will reset *Temp. time* and all three *Temp. volume* parameters.

DISPLAY PARAMETER
Percent.flowrate

Percent.flowrate displays the current flow in a horizontal bar compared to the 100 per cent flow rate set in the Display Setup Menu (See Figure 3.8).

DISPLAY PARAMETER
Last error

Last error displays a shortened version of the last error message. A complete lest of error messages is found in the Display Setup Menu (See Figure 3.8).

DISPLAY PARAMETER
Real time

Real time displays the actual time, in 24 hours and minutes, and date (day.month.year), as set in the Production Data Setup Menu (See Figure 3.4).

• Onboard Archives

The FM100 automatically archives cumulative flow volumes for three set time intervals: Hourly, Daily, and Monthly. The Hourly archive will maintain up to 192 hours (eight days), the Daily archive up to 192 days (more than half a year), and the Monthly archive up to 12 months.

The screen for each archive is laid out similarly. The top line (See Figure 3.2) shows the time interval. For Hourly and Daily archives, the interval number is listed first, followed by the date and hour interval. For Monthly archives, the time interval is shown as the days of the month (e.g., 1.÷30. or 1.÷30.) followed by the year. The bottom line shows the volume of flow for the stated interval and any elapsed time during that interval that the FM100 was powered off.

NOTE: The Back Navigation Button moves from Daily to Hourly to Monthly archives. The Increase/Down Navigation Button moves back through the selected archive. Pushing the Increase/Down Navigation Button and the Enter Button at the same time returns to the most recent entry in the selected archive.

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• Production Data Setup Menu

MENU PARAMETER
Production date

Production date displays the date the convter box was assembled.

MENU PARAMETER
Serial number

Serial number displays the serial number of the converter box.

MENU PARAMETER
Software

Software displays the current version of software installed on the converter.

MENU PARAMETER
Meter's type

Meter's type displays type number of the flow meter.

MENU PARAMETER
Modules used

Modules used lists the modules installed in the converter box.

MENU PARAMETER
Date setting

Date setting allows the user to set the current date. The date set here is used for *Real Time* and for the three archives.

MENU PARAMETER
Time setting

Time setting allows the user to set the current time. The time set here is used for *Real Time* and for the three archives.

MENU PARAMETER
Upgrade enabled

Upgrade enabled allows the user to upload a new firmware version after entering a PIN.

MENU PARAMETER
Delete history

Delete history allows the user to clear the Hourly, Daily, and Monthly archives after entering a PIN.

MENU PARAMETER
Reset volumes

Reset volumes allows the user to reset the display volume totalizers after entering a PIN.

• Sensor Setup Menu

MENU PARAMETER	RANGE
Sensor constants	Constant 1
	Constant 2

Sensor constants allows the user to set the sensor calibration constants.

MENU PARAMETER	RANGE
Excitation freq.	2.775 Hz
	3.125 Hz
	5.55 Hz
	6.66 Hz
	12.5 Hz
	25 Hz

Excitation freq. allows the user to choose the frequency of the sensor coils.

MENU PARAMETER	RANGE
Excitation curr.	125 mA
	250 mA

Excitation curr. allows the user to choose the current of the sensor coils.

MENU PARAMETER	RANGE
Supressed flow	Do not meas. Q<

Supressed flow allows the user to set a minimum measured flow rate. Measured flow below this level will show as 0 on the display and will not count towards totalizers.

MENU PARAMETER	RANGE
Samples	1 - 256

Samples allows the user to set the number of current flow samples to be averaged for the displayed *Flowrate* (See Figure 3.2). More samples results in a more stable output, but with an increased lag between changes in the measured flow and the displayed output. Fewer samples results in a more volatile output, but less lag time between change in measured flow and change in display. Individual samples count toward totalized volumes.

MENU PARAMETER	RANGE
Filters	Noise filter Dynamic filter

Filters allows the user to activate two input signal filters. Noise filter removes lower periodical intereference and also dampen the effect of sharp changes in flow, while only causing 0.3 seconds of delay between measurement and output. Dynamic filter significanlty reduces the effect of sharp changes in flow. Because the filters opperate on the input signal, intereference blocked by the filters is not included in cumulative totalizers.

MENU PARAMETER	RANGE
Zero setting	Autozero PIN

Zero setting allows the user to reset the true Zero flowpoint after entering a PIN.

• Analog Output Setup Menu

MENU PARAMETER	RANGE	VALUE
0..+Q Output	Output 4÷20 mA Output 0÷10 mA Output 0÷5 mA Output 0÷20 mA	Imax flow rate

0..+Q Output maps the current output of the sensor across the range of postive flow detected by the sensor. The user sets the flow rate value to be associated with the max current. 4-20mA is the only Range available.

MENU PARAMETER	RANGE	VALUE
0..-Q Output	Output 4÷20 mA Output 0÷10 mA Output 0÷5 mA Output 0÷20 mA	Imax flow rate

0..-Q Output maps the current output of the sensor across the range of negative flow detected by the sensor. The user sets the flow rate value to be associated with the max current. 4-20mA is the only Range available.

MENU PARAMETER	RANGE	VALUE
0..|Q| Output	Output 4÷20 mA Output 0÷10 mA Output 0÷5 mA Output 0÷20 mA	Imax flow rate

0..|Q| Output maps the current output of the sensor across the range of absolute flow detected by the sensor. The user sets the maximum flow rate value (positive or negative) to be associated with the max current. 4-20mA is the only Range available.

MENU PARAMETER	RANGE	VALUE
-Q..+Q Output	Output 4÷20 mA Output 0÷10 mA Output 0÷5 mA Output 0÷20 mA	Imax flow rate

-Q..+Q Output maps the current output of the sensor across the full range of flow, positive and negative, detected by the sensor. The user sets the single flow rate value to be associated with the minimum current (negative flow) and maximum current (positive flow). 4-20mA is the only Range available.

MENU PARAMETER	VALUE
Fixed current	Fixed current [mA]

Fixed current allows the user to set a fixed current output.

• Display Setup Menu

MENU PARAMETER	RANGE
Language	<multiple choices>

Language sets the language of the display data and setup menus.

MENU PARAMETER	RANGE
100 per cent	100 per cent

100 per cent sets the 100% flow rate for the *percent.flowrate* bar graph in the Display Mode (See Figure 3.2).

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MENU PARAMETER	RANGE	Value 1	Value 2
Flow rate units	m^3/sec		
	m^3/min		
	m^3/hr		
	ml/sec		
	ml/min		
	ml/hr		
	gal/sec		
	gal/min		
	gal/h		
	Mgal/d		
	User's	Flow rate multipl	Unit's name
	l/sec		
	l/min		
	l/hr		
	hl/sec		
	hl/min		
	hl/hr		

Flow rate units sets the volume units used for all displays and totalizers. User's allows the user to define units as a multiple of l/s.

MENU PARAMETER	RANGE
Decimal places	0-4

Decimal places sets the number of displayed decimal places for flow and volume.

MENU PARAMETER	RANGE
Backlight	0 (always off)
	1-254 seconds
	255 (always on)

Backlight sets the number of seconds the backlight remains on after the last button press.

MENU PARAMETER	RANGE
Display select	Flowrate
	Total volume+
	Total volume-
	Total difference
	Operational time
	Percent.flowrate
	Last error
	Real time

Display select allows the user to choose the values displayed in Display Mode (See Figure 3.2).

MENU PARAMETER	RANGE
Error messages	E0
	E1
	E2
	E3
	E4
	E5
	E6
	E7
	E8
	E9
	E10
	E11
	E12
	E13

Error messages allows the user to enable or disable each error code. See Chapter 4 Error Messages for explanations of each error message.

• Exit Menu

MENU PARAMETER
Exit Menu

Exit Menu save all changes made in Setup Menus and returns the FM100 to Display Mode.

MENU PARAMETER	Value
New Password	4 alpha-numeric characters

New Password sets a new 4-character password for the Setup Menus. See Enter/Change Password.

! IMPORTANT: You MUST use the Exit Menu to save any changes in the Setup Menus. Cycling back to Display Mode using the Display Button leaves unsaved changes vulnerable to being lost in the event of power outage.

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Chapter 4: Error Messages

• Error Codes and Explanations

ERROR CODE	ERROR TITLE
E0	No Error

E0 indicates no recent error.

ERROR CODE	ERROR TITLE
E1Mx	EEPROM Checksum error

E1 indicates a checksum error (invalid input) in the module indicated (Mx). Check data in indicated module and resave. Menu module numbers are shown in Figure 3.3.

ERROR CODE	ERROR TITLE
E2	Stack overflow
E3	Frequency limit exceeded

E2 and *E3* indicate pulse frequency settings are too low for measured flow rate.

ERROR CODE	ERROR TITLE
E4	Power fail

E4 appears for a short time after a power failure.

ERROR CODE	ERROR TITLE
E5	Old software

E5 indicates that firmware in the converter is too old to work with an installed module. Firmware upgrade is required.

ERROR CODE	ERROR TITLE
E6	Can’t use this mode

E6 indicates a module has been installed in the wrong position.

ERROR CODE	ERROR TITLE
E7	Sensor loop disconnected

E7 indicates current is not flowing to the current detecting coils.

ERROR CODE	ERROR TITLE
E8	Empty pipe

E8 indicates full pipe sensor is not submersed.

ERROR CODE	ERROR TITLE
E9	Low medium conductivity

E9 indicates sensing electrodes are not sensing current in fluid.

ERROR CODE	ERROR TITLE
E10	MBus conflict

E10 indicates networking error.

ERROR CODE	ERROR TITLE
E11	Current output overrange

E11 indicates that flow rate measured is higher than max flow rate set in Analog Output Setup Menu. Increase max current setting.

ERROR CODE	ERROR TITLE
E12	Serial line fail communication error

E12 indicates a network communication error.

ERROR CODE	ERROR TITLE
E13	Sensor signal overrange

E13 indicates the signal from the sensor to the converter is beyond the converter's range. Check sensor and cables for short circuit.

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Chapter 5: Maintenance

• General Care

Your FM100 flowmeter is very low maintenance and will need little care as long as it was installed correctly (See Installation Requirements and Recommendations, pages 5-7). However, in general, you should:

- Avoid applications for which the sensor was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals, or other damaging environments.
- Ensure that the sensor chamber is fully flooded whenever the sensor is powered on.

• Trouble Shooting

Should you have problems with your FM100, here are some troubleshooting steps.

- Check the *Last Error* display (See Figure 3.2) for recent error. See Chapter 4 Error Messages for error codes and explanations.
- Check that all wiring is connected correctly and securely.
- Check that sensor is grounded correctly and completely (See Grounding Instructions, page 8).

• Repair and Returns

Should your flowmeter require service, please contact the factory via phone, email, or online chat. We will issue you a Return Material Authorization (RMA) number with instructions.

- Phone: 888-525-7300
- Email: sales@apgsensors.com
- Online chat at www.apgsensors.com

Please have your FM100's part number and serial number available. See Warranty and Warranty Restrictions for more information.

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