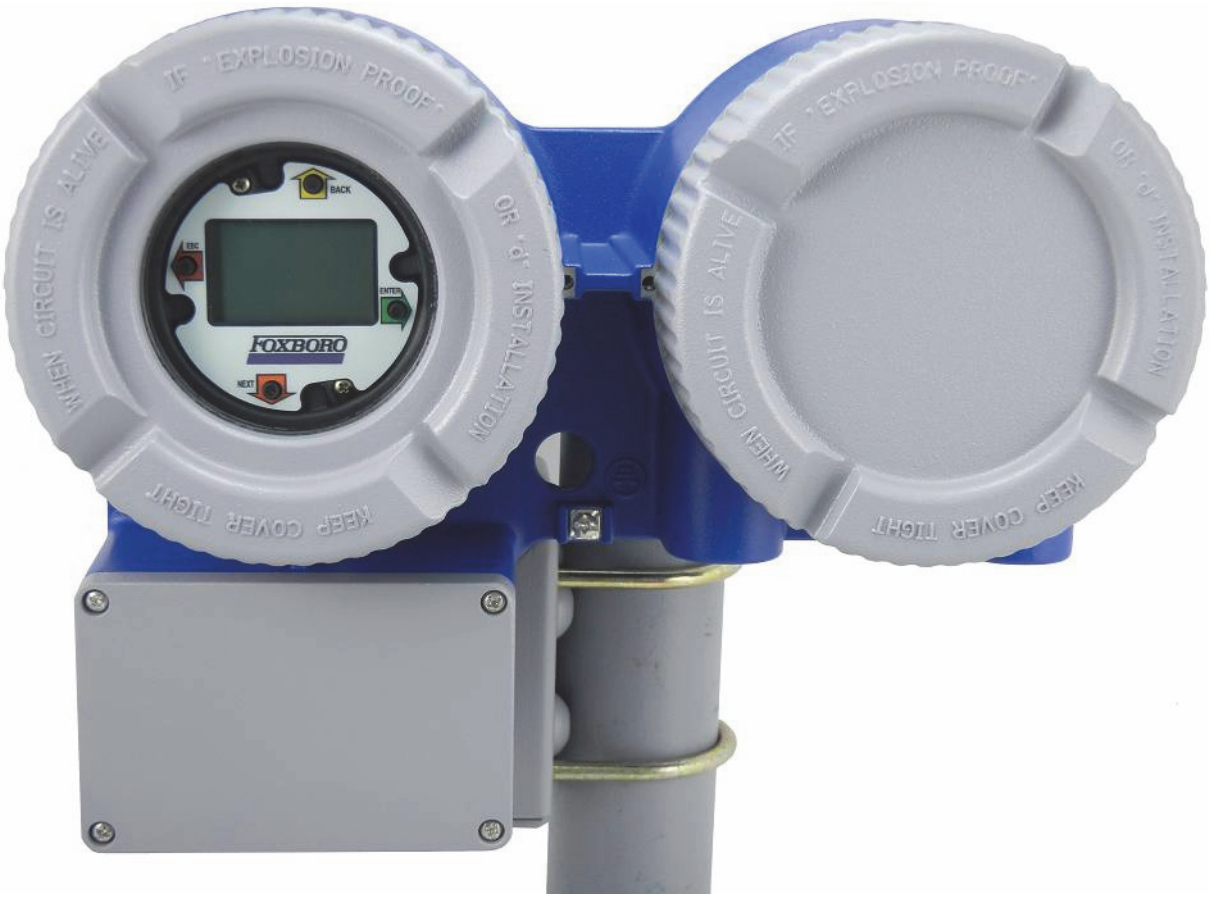
Instruction

MI 019-140
November 2019

Digital Coriolis Mass Flow Transmitter Model CFT51 with HART® or Modbus® Communication Protocol

Installation, Startup, Configuration, and Maintenance



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Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

1. Introduction

Overview

The CFT51 Digital Coriolis Mass Flow Transmitter, when used with a Foxboro® CFS flowtube, measures the mass flow rate, density, and temperature of process fluid directly. It uses digital signal processing technology in conjunction with the Coriolis principle. The transmitter provides frequency, scaled pulse, 4 to 20 mA current, alarm, and contact outputs. It also supports nonvolatile totalization of the output.

You can configure the CFT51 transmitter to use the HART or Modbus communication protocol via LCD indicator pushbuttons on the transmitter at any time.

HART communications protocol can be used in full digital communications mode to a HART host system, or as a direct analog communications interface over the 4-20 mA analog signal with a HART communicator or the configuration software.

Modbus communications protocol allows full digital communications using a Modbus communication interface.

Local communication is always available using the LCD indicator/configurator.

Reference Documents

In addition to this instruction, there is other user documentation supporting the CFT51 Transmitter, as listed in Table 1.

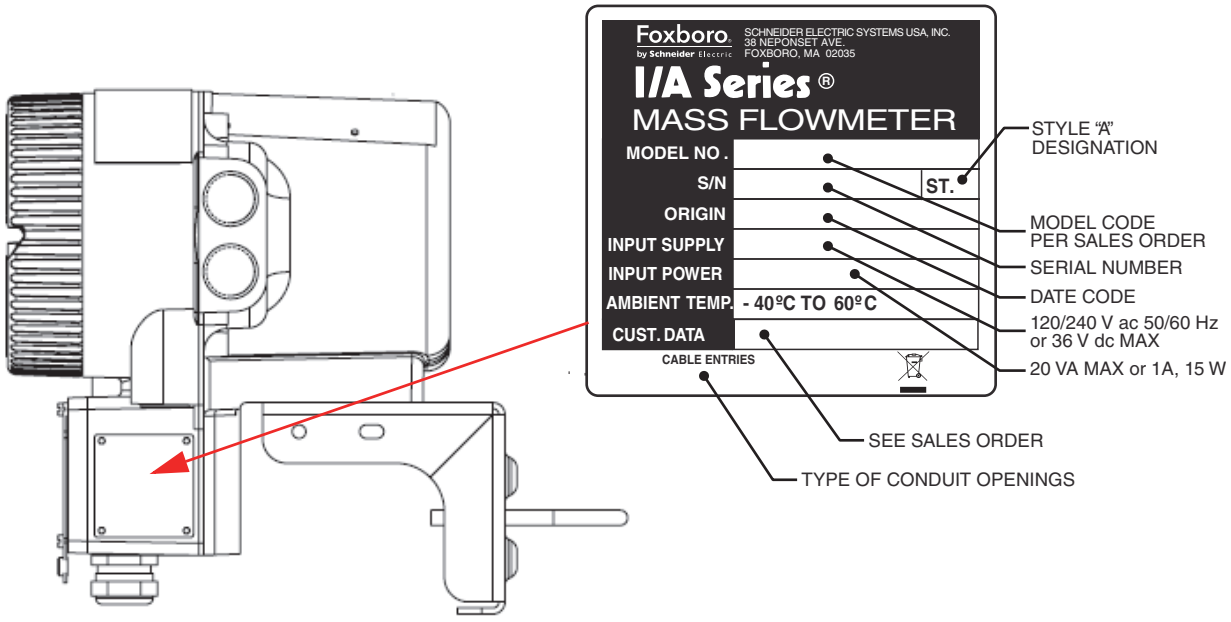
Table 1. Reference Documents

Document Number	Document Description
DP 019-182	Dimensional Print – CFS10 Style B Flowtubes (1/4 through 2 inch)
DP 019-183	Dimensional Print – CFS20 Style B Flowtubes (11/2 and 3 inch)
DP 019-366	Dimensional Print – CFS10 Style B Flowtubes (1/8 inch)
DP 019-376	Dimensional Print – CFT51 Transmitter
MI 019-120	Instruction – CFS10 and CFS20 Mass Flowtubes
MI 019-141	Instruction – CFT51 Safety Connection Diagrams (FM, CSA)
MI 019-179	Flow Products Safety Information
MI 019-276	Advanced DTM Library – Operation Using Modbus Communication Protocol
MI 020-520	Field Device Tool with Advanced DTM Library – Operation Using HART Communication Protocol
PL 008-752	Parts List – CFT51 Transmitter
PL 008-733	Parts List – CFS10 Style B Flowtubes
PL 008-735	Parts List – CFS20 Style B Flowtubes

Transmitter Identification

A data plate fastened to the side of the housing provides the model number and other information as described in Figure 1. Some of this information is also available in the configuration software of the transmitter.

Figure 1. Transmitter Identification



Standard Specifications

Table 2. Standard Specifications

Item	Specification
Ambient Temperature Normal Operating Condition Limits	 –40 and +60°C (–40 and +140°F) (a)
Relative Humidity Limits	5 and 100% (with transmitter covers installed)
Power Supply (ac)	Nominal: 120/240 Vac 50/60 Hz, 20 VA Maximum Limits: 102 to 264 Vac; 47 to 63 Hz (b)
Power Supply (dc)	10 - 36 Vdc 10 W typical; 15 W maximum 3 A startup current
Current Output Limits Supply Voltage Load Current	 24 Vdc ±10% (External Power Supply) 0 to 683 Ω (250 to 683 Ω with Current Output 1 when HART Communicator or PC-Based Configurator is used) 22 mA maximum, 3.8 mA minimum
Pulse Output Limits Supply Voltage Current	 24 Vdc ±10% (External Power Supply) 80 mA maximum
Contact Input Supply Voltage Current	 24 Vdc ±10% (External Power Supply) 15 mA minimum
Contact Output Limits Supply Voltage Current	 24 Vdc ±10% (External Power Supply) 100 mA maximum
Vibration Limits	5 m/s^2 (0.5 “g”) from 5 to 500 Hz

a. At temperatures between -40 and -20° C, the display may fade or appear to be blank; however, the device is still operational.

b. For installations that require safety certifications, the maximum input voltage is 250 Vac.

Modbus Specifications

Table 3. Modbus Specifications

Item	Possible Configurations	As Shipped Configuration
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	9600
Format	None, Odd, Even	None
Device Address	1 through 247	247
Byte Order	0123, 2301, 1032, 3210	2301

Electromagnetic Compatibility (EMC) Specifications

The CFT51 Transmitter complies with international and European Union standards listed in Table 4.

Table 4. International and European Union Standards

Parameter	IEC Standard	EN Standard
Radiated RFI Immunity	10 V per IEC 61000-4-3	10 V per EN 61000-4-3
Conducted RFI Immunity	10 V per IEC 61000-4-6	10 V per EN 61000-4-6
RFI Radiated and Conducted Emissions	CISPR Class A	EN 55011 Class A
ESD Immunity	6 kV contact discharge per IEC 61000-4-2	6 kV contact discharge per IEC 61000-4-2
Electrical Fast Transients/Burst Immunity Power	2 kV per IEC 61000-4-4	2 kV per EN 61000-4-4
Electrical Fast Transients/Burst Immunity I/Os	1 kV per IEC 61000-4-4	1 kV per EN 61000-4-4
Surge Immunity Power	2 kV per IEC 61000-4-5	2 kV per IEC 61000-4-5
Surge Immunity I/Os	1 kV per IEC 61000-4-5	1 kV per IEC 61000-4-5
Power Dips and Interruptions	IEC 61000-4-11	EN 61000-4-11

Electrical Safety Specifications

These transmitters have been designed to meet the electrical safety descriptions listed in the table below. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

Types of Protection and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX, II 2 (1) G Ex d [ia IIB Ga] IIC T6 Gb	Flameproof enclosure with Intrinsic safe sensor outputs. Temperature Class T6. Ta = -40°C to +60°C.	ADA
ATEX, II 2 (3) G Ex d [ic IIB Gc] IIC T6 Gb	Flameproof enclosure with Energy Limited or intrinsic safe zone 2 sensor outputs. Temperature Class T6. Ta = -40°C to +60°C.	ADN
ATEX, II 3 (1) G Ex nA [ia IIB Ga] IIC T4 Gc	Non-sparking enclosure with Intrinsic safe sensor Temperature Class T4. Ta = -40°C to +60°C.	ANA
ATEX, II 3 G Ex nA IIC T4 Gc	Non-sparking Temperature Class T4. Ta = -40°C to +60°C	ANN
CSA/CSAus XP Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1; AIS Class I, Division 1, Groups A, B, C, and D; Ex d IIC [ia] IIB; AEx d IIC [ia] IIB	Explosionproof and Flameproof enclosure with intrinsically safe outputs Temperature Class T6. Ta = -40°C to +60°C Temperature Class T4. Ta = -40°C to +60°C	CDA
CSA/CSAus XP Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1; ANI Class I, Division 2, Groups A, B, C, and D; Ex d [nL] IIC; AEx d [nC] IIC	Explosionproof and Flameproof enclosure with Non-Incendive outputs Temperature Class T6. Ta = -40°C to +60°C Temperature Class T4. Ta = -40°C to +60°C	CDN
CSA/CSAus NI Class I, Division 2, Groups A, B, C, and D; also intrinsically safe for AIS Class I, Division 1, Groups A, B, C, and D; AEx nA IIC [ia] IIB; Ex nA IIC [ia] IIB	Non-incendive enclosure with intrinsically safe outputs Temperature Class T4. Ta = -40°C to +60°C	CNA
CSA/CSAus NI Class I, Division 2, Groups A, B, C, and D; also nonincendive for ANI Class I, Division 2, Groups A, B, C, and D; AEx nA [nL] IIC; Ex nA [nC] IIC	Non-incendive and Non-sparking Temperature Class T4. Ta = -40°C to +60°C	CNN
FM XP Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1; AIS Class I, Division 1, Groups A, B, C, and D. AEx d IIB [ia] IIC	Explosionproof and Flameproof enclosure with intrinsically safe outputs Temperature Class T6. Ta = -40°C to +60°C Temperature Class T4. Ta = -40°C to +60°C	FDA
FM XP Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1; ANI Class I, Division 2, Groups A, B, C, and D. AEx d [nC] IIC	Explosionproof and Flameproof enclosure with Non-Incendive outputs Temperature Class T6. Ta = -40°C to +60°C Temperature Class T4. Ta = -40°C to +60°C	FDN
FM NI Class I, Division 2, Groups A, B, C, and D; AIS Class I, Division 1, Groups A, B, C, and D AEx nA IIC [ia] IIB	Non-incendive enclosure with intrinsically safe outputs Temperature Class T4. Ta = -40°C to +60°C	FNA
FM NI Class I, Division 2, Groups A, B, C, and D; ANI Class I, Division 2, Groups A, B, C, and D AEx nA IIC	Non-Incendive Temperature Class T4. Ta = -40°C to +60°C	FNN
IECEx, Ex d [ia IIB Ga] IIC T6 Gb	Flameproof enclosure with Intrinsic safe sensor outputs. Temperature Class T6 Ta = -40°C to +60°C	EDA
IECEx, Ex d [ic IIB Gc] IIC T6 Gb	Flameproof enclosure with Energy Limited or intrinsic safe zone 2 sensor outputs Temperature Class T6. Ta = -40°C to +60°C	EDN

Types of Protection and Area Classification	Application Conditions	Electrical Safety Design Code
IECEx, Ex nA [ia IIB Ga] IIC T4 Gc	Non-sparking enclosure with Intrinsic safe sensor. Temperature Class T4 Ta = -40°C to +60°C	ENA
IECEx, Ex nA IIC T4 Gc	Non-sparking Temperature Class T4. Ta = -40°C to +60°C	ENN
EAC, 1Ex d [ia IIB Ga] IIC T6 Gb	Flameproof enclosure with intrinsic safe sensor outputs. Temperature class T6. Ta = -40°C to +60°C	RDA
EAC, 1 Ex d [ic IIB Gc] IIC T6 Gb	Flameproof enclosure with energy limited or intrinsic safe zone 2 sensor outputs. Temperature class T6. Ta = -40°C to +60°C	RDN
EAC, 2Ex nA [ia IIB Ga] IIC T4 Gc	Non-sparking enclosure with intrinsic safe sensor outputs. Temperature class T4. Ta = -40°C to +60°C	RNA
EAC, 2Ex nA IIC T4 Gc	Non-sparking. Temperature class T4. Ta = -40°C to +60°C	RNN
INMETRO, Ex d [ia IIB Ga] IIC T6 Gb	Flameproof enclosure with intrinsic safe sensor outputs. Temperature class T6. Ta = -40°C to +60°C	BDA
INMETRO, Ex d [ic IIB Gc] IIC T6 Gb	Flameproof enclosure with energy limited intrinsic safe zone 2 sensor outputs. Temperature class T6. Ta = -40°C to +60°C	BDN
INMETRO, Ex nA [ia IIB Ga] IIC T4 Gc	Non-sparking enclosure with intrinsic safe sensor outputs. Temperature Class T4. Ta = -40°C to +60°C	BNA
INMETRO, Ex nA IIC T4 Gc	Non-sparking. Temperature class T4. Ta = -40°C to +60°C	BNN
KOSHA, Ex nA IIC T4	Non-sparking. Temperature class T4. Ta = -40°C to +60°C	KNN
No Certifications	Not Applicable	ZZZ

Electrical Safety Warnings

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not open while circuits are live.

Do not open when energized or when an explosive atmosphere may be present.

Substitution of components may impair intrinsic safety or Division 2 approvals.

Failure to follow these instructions can result in death or serious injury.

For Explosionproof Certifications

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Keep cover tight while circuits are live unless area is known to be nonhazardous.

To help prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

The flowtube junction boxes contain more than 10% aluminum and are considered to constitute a potential risk of ignition by impact or friction. Care must be taken to prevent impact and friction when installing or using the junction box in a Zone 0 installation.

Failure to follow these instructions can result in death or serious injury.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

The CFT51 transmitter is to be used only with a Foxboro CFS flowtube in accordance with control drawings MI 019-141 and MI 019-179.

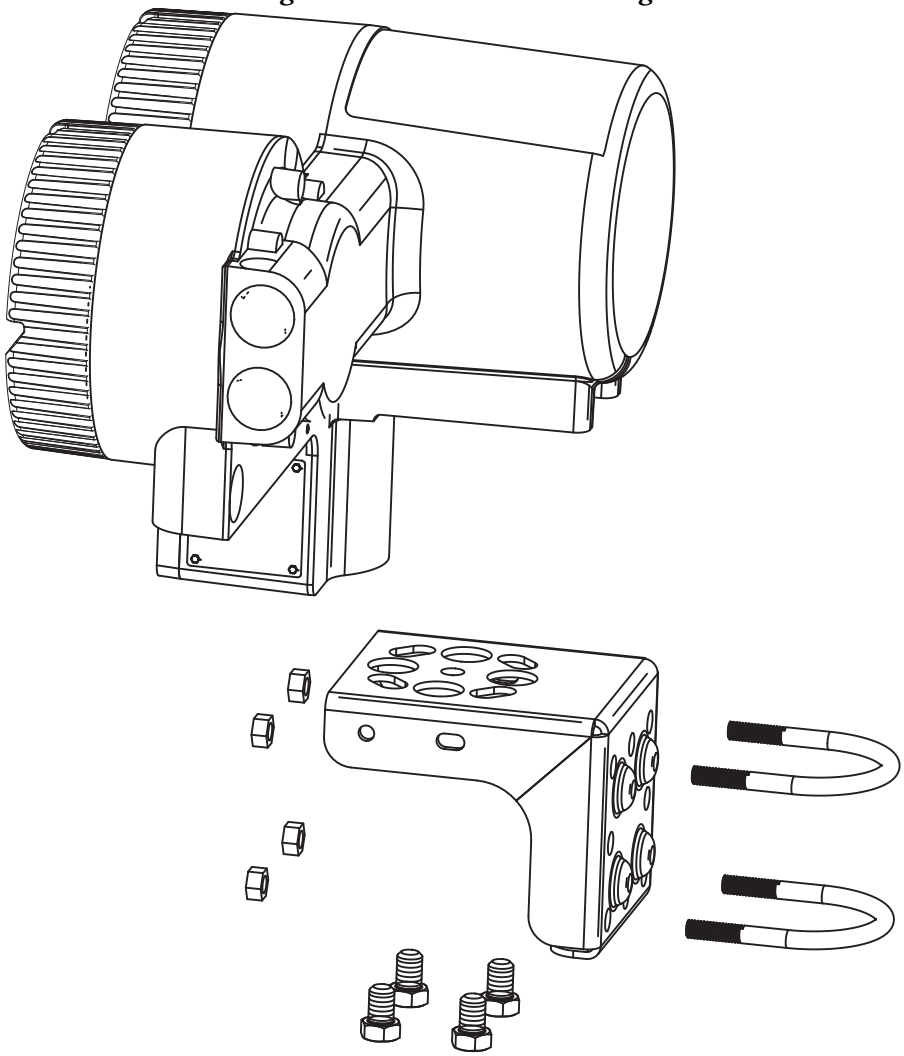
Failure to follow these instructions will result in injury or equipment damage.

2. Installation

Mounting

Four 0.437-20 UNS threaded holes are provided on the surface of the enclosure on which a carbon steel mounting bracket or optional stainless steel (SS) mounting bracket can be attached. The other surface of the bracket allows for mounting to a surface, or to a nominal DN50 (2 inch) vertical or horizontal pipe. An optional bracket is available for mounting to a DN80 (3 inch) vertical or horizontal pipe. See Figure 2.

Figure 2. Transmitter Mounting

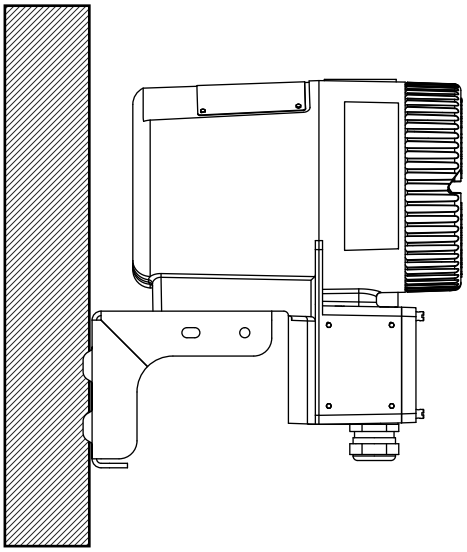


Positioning the Housing

The housing can be positioned at almost any angle in a horizontal plane by loosening the bracket bolt and turning the housing with respect to the mounting bracket. See Figure 2.

The CFT51 transmitter can be mounted to a wall as displayed in Figure 3.

Figure 3. Wall Mounting



The transmitter can be mounted horizontally or vertically to a pipe. Some of the more common mounting configurations are shown in Figures 4, 5, 6 and 7.

Figure 4. Vertical Pipe Mounting - Orientation 1

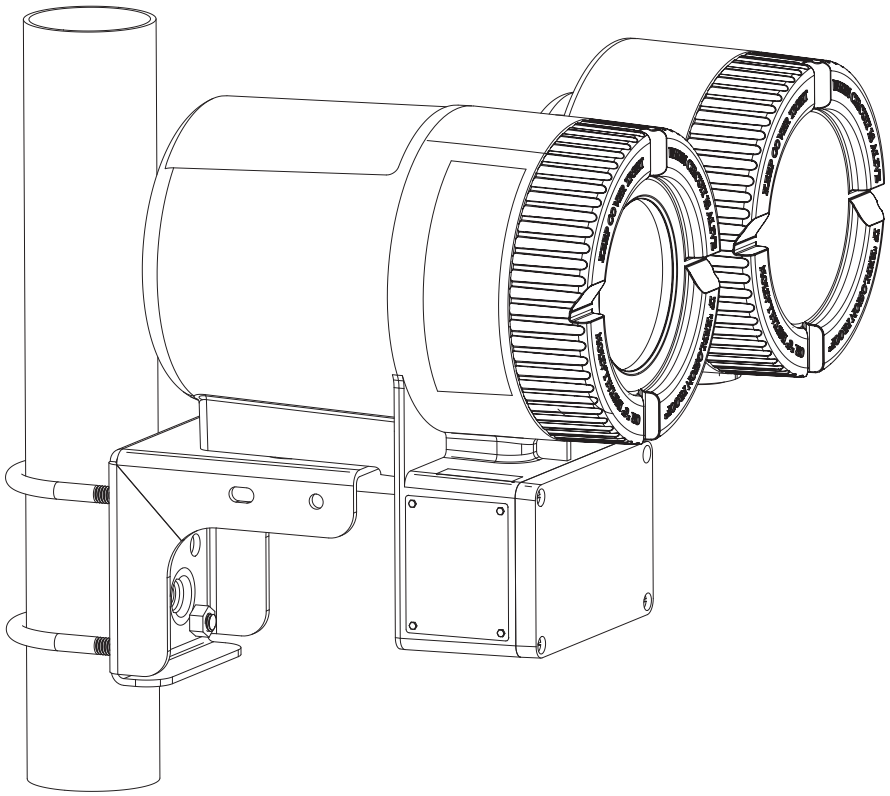


Figure 5. Vertical Pipe Mounting - Orientation 2

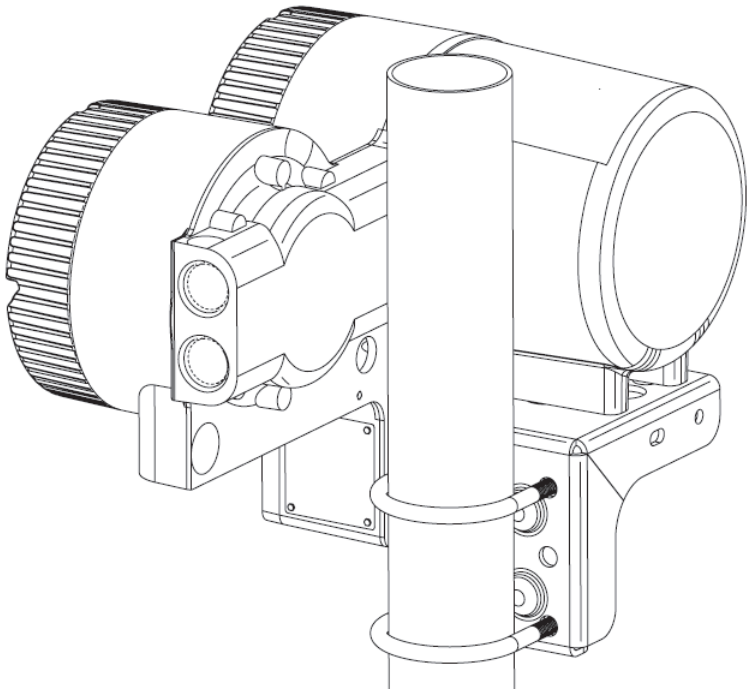


Figure 6. Vertical Pipe Mounting - Orientation 3

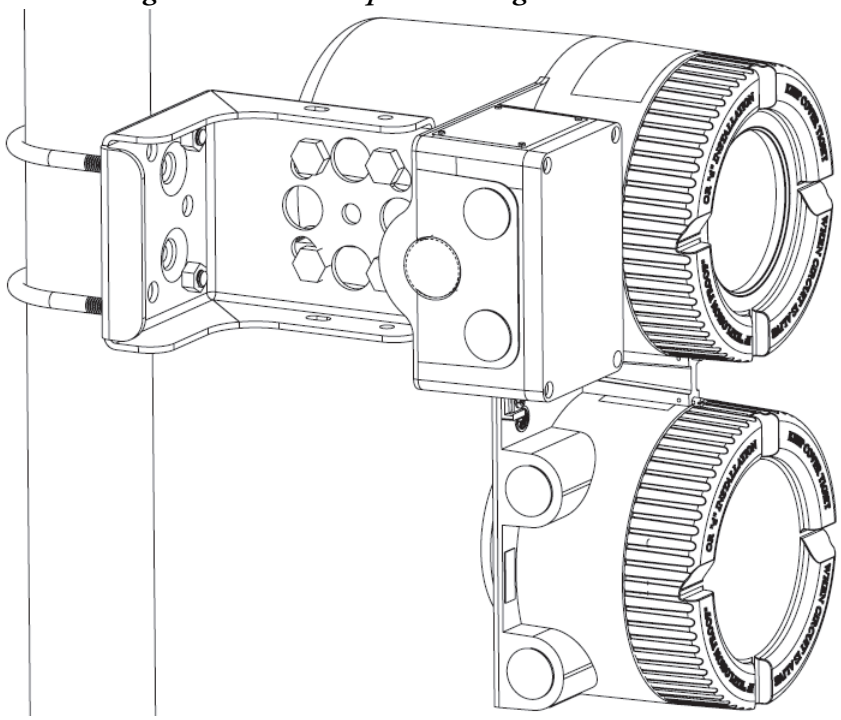
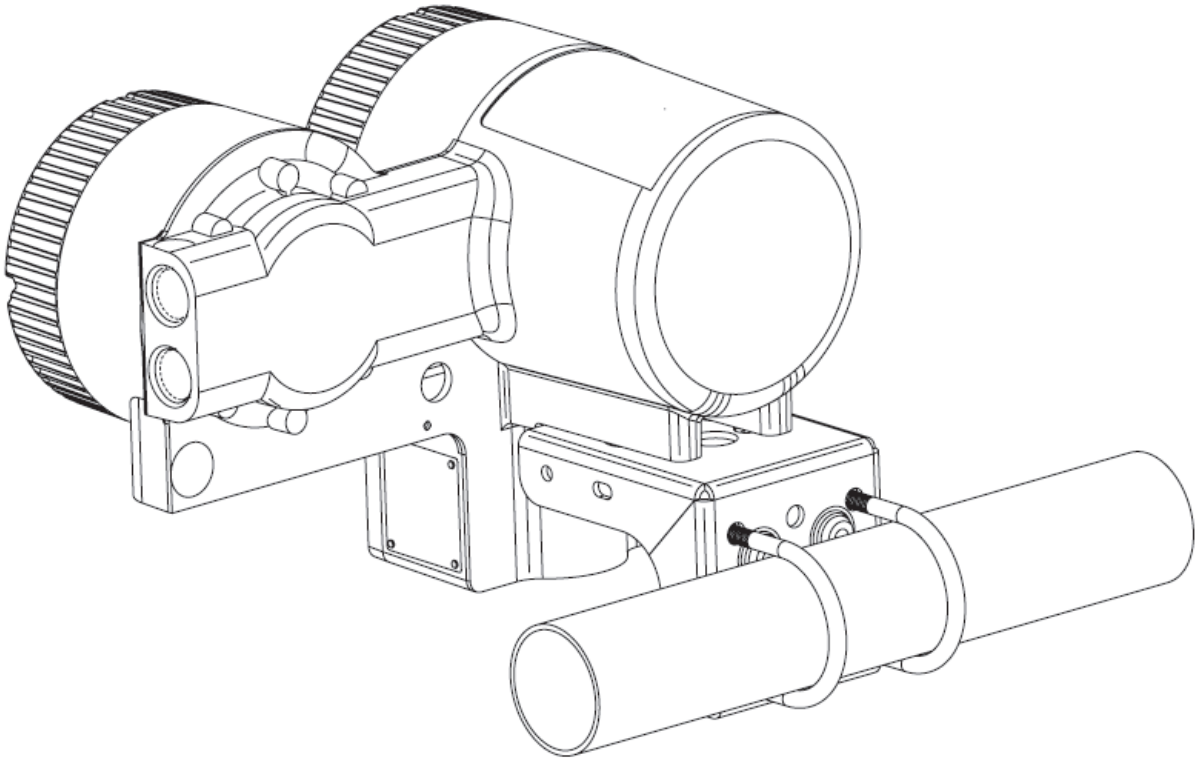


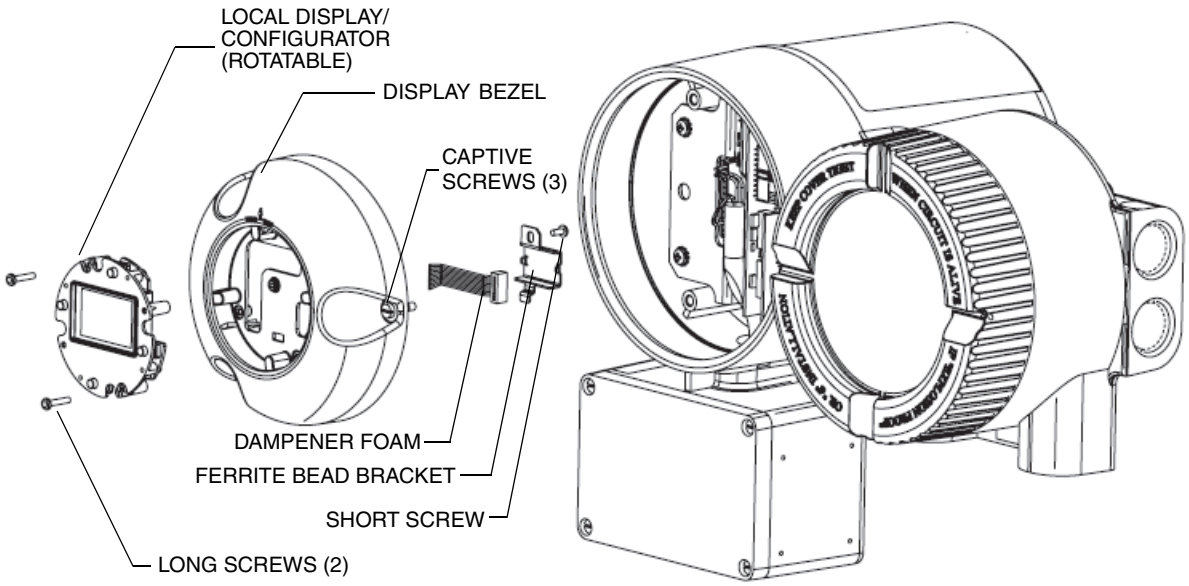
Figure 7. Horizontal Pipe Mounting



Rotating the Display

The Display/Configurator can be rotated in 90 degree increments in the display bezel. The display bezel does not rotate, and must always be mounted in the housing in the orientation shown in Figure 8.

Figure 8. Display Orientation



To rotate the display to the desired orientation:

1. Remove the display assembly by loosening the captive screws.
2. Remove the short screw that retains the ferrite bead bracket and the dampener foam to the back of the molding. Be careful to retain the screw for reassembly.
3. Remove the Local Display/Configurator from the Display Bezel by removing the long screws that retain the assembly to the front of the molding.
4. Rotate the Local Display/Configurator to the desired orientation with the display assembly molding and feed the cable of the Local Display/Configurator through the corresponding opening in the molding.
5. Attach the Local Display/Configurator to the bezel using the long screws.
6. Place the dampener foam and the bracket over the ferrite bead on the cable and attach the Local Display/Configurator to the Display Bezel using the short screw.
7. Place the reassembled display assembly in line with the required orientation as shown.
8. Attach the assembly to the housing using the captive screws.

NOTE

The display bezel is not rotatable. The bezel must always be aligned with the housing as shown in Figure 8 to retain the jumper configurations on the electronic module.

Cover Lock Versions

Various lock and seal mechanisms are available with the CFT51. One or more of these locking mechanisms may be required for specific applications.

- For all model code selections, locking pins are provided for the round electronic housing covers (Figure 9). These cover locking mechanisms are required for all agency flameproof applications.
- For the Tamperproof Sealing (-S), U.S. Weights and Measures Custody Transfer NTEP (-T), and Weights and Measures Industry Canada Approvals (-D) model code selections:
  - Locking pins are provided with an additional seal wire and crimp seal for the round electronic housing covers (Figure 10).
  - Additional locking mechanisms are provided for the transmitter junction box (Figure 17) and flowtube junction box (CFS10 and CFS20 flowtubes only, Figure 18).

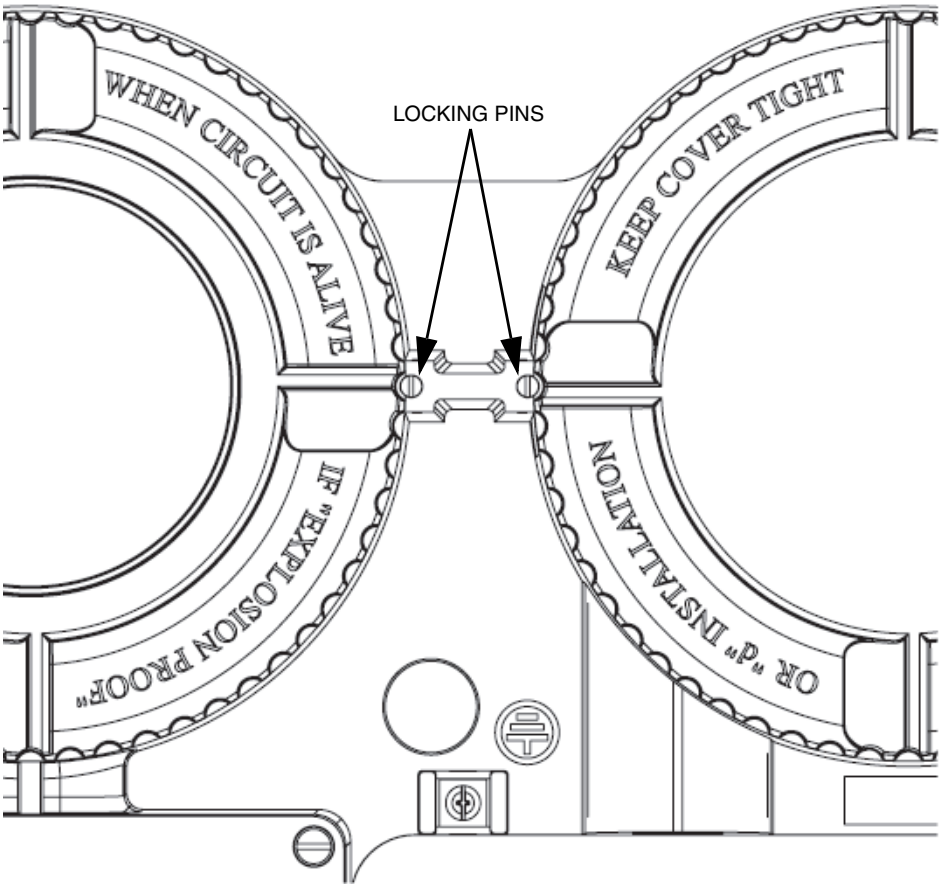
NOTE

The U.S. Weights and Measures Custody Transfer NTEP (-T) and Weights and Measures Industry Canada Approvals (-D) model code selections are applicable only when the transmitter is used with CFS10 or CFS20 flowtubes.

Locking Pins

To lock the two round transmitter housing covers, unscrew each locking pin (provided with all model code selections) until approximately 6 mm (0.25 in) engages the groove on the cover. Note that the two round transmitter housing covers must be locked for all agency (ATEX, CSA, FM, IECEx) flameproof certifications.

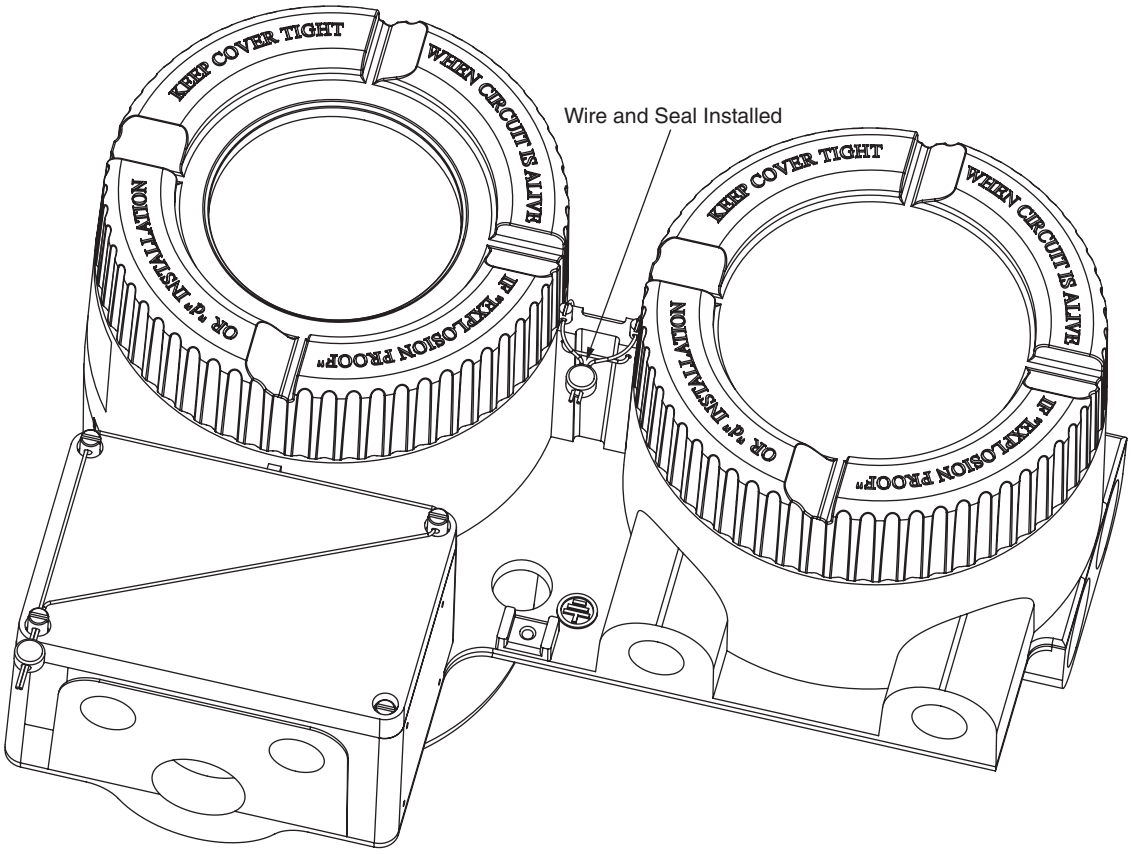
Figure 9. Cover Locking Pins for All Model Code Selections



Wire Seals

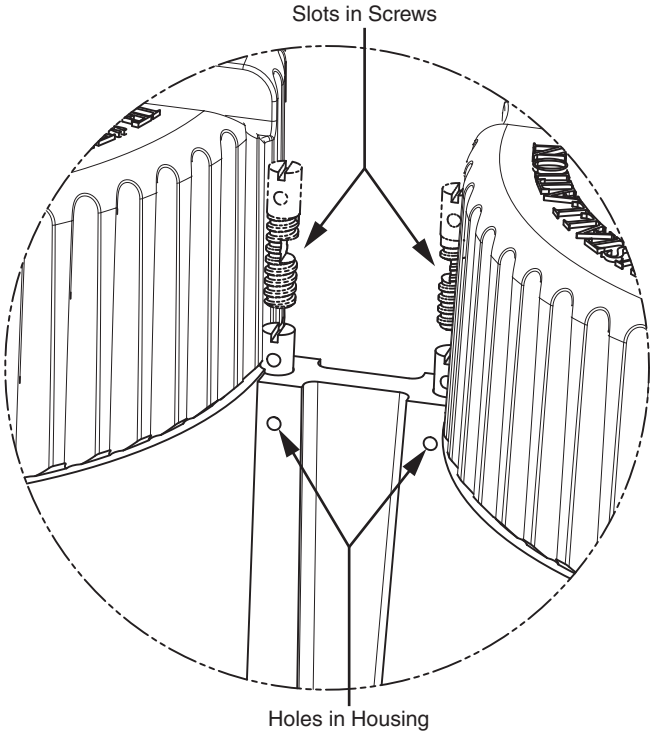
For the Tamperproof Sealing (-S), U.S. Weights and Measures Custody Transfer NTEP (-T), and Weights and Measures Industry Canada Approvals (-D) model code selections, perform the following steps to lock and seal the transmitter housing covers (Figure 10), the transmitter junction box (Figure 17), and the flowtube junction box (CFS10 and CFS20 flowtubes only, Figure 18):

Figure 10. Cover Locks for Tamperproof Sealing (-S), U.S. Weights and Measures Custody Transfer NTEP (-T), and Weights and Measures Industry Canada Approvals (-D) Model Code Selections



1. Lock and seal the round transmitter housing covers:
   a. Install the cover lock screws so that the slots in the screws align with the holes in the housing. The screws will stick out approximately ¼ inch. See Figure 11.

Figure 11. Aligning Cover Lock Screws with Housing



b. Insert one end of the seal wire through each of the two holes in the housing and corresponding slots in the locking screws, and pull both ends of the wire until it contacts the housing. See Figure 12 and Figure 13.

Figure 12. Inserting the Wire in the Holes in the Housing

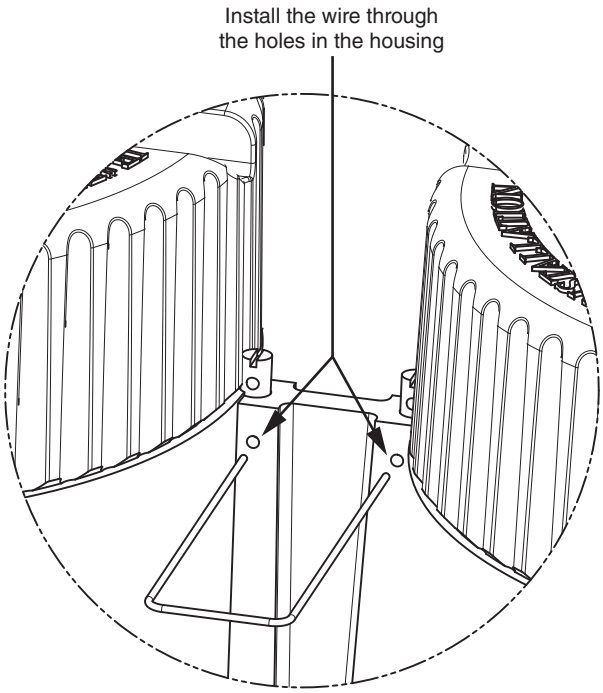
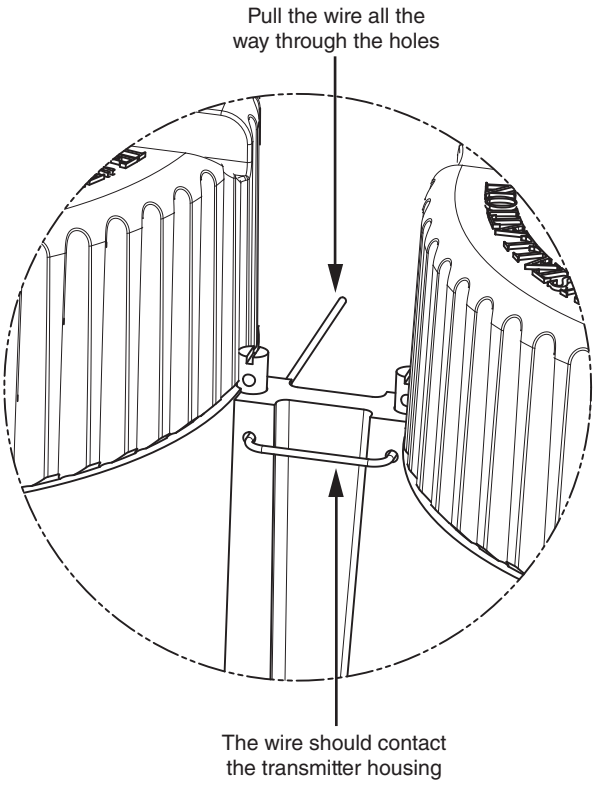
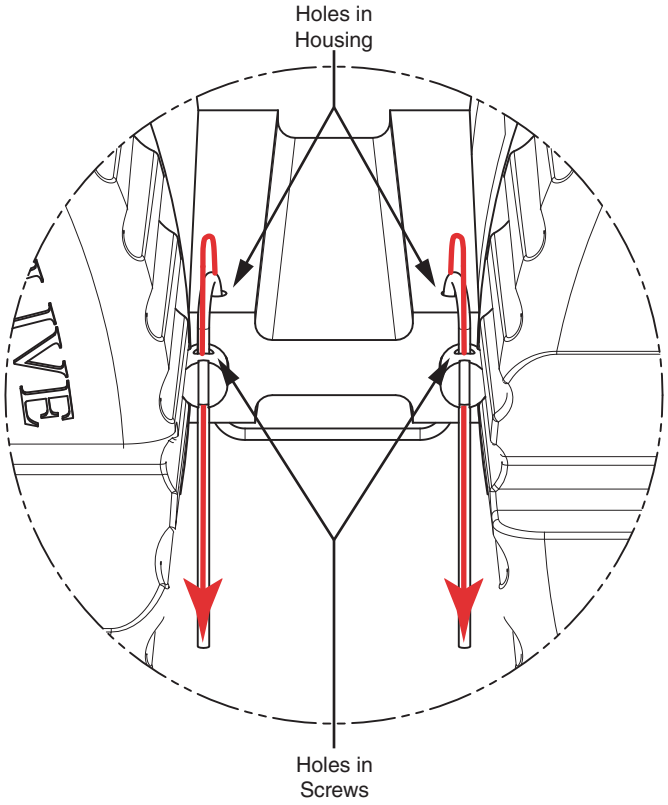


Figure 13. Pulling the Wire Through the Housing



c. Insert one end of the seal wire through each of the two holes in the locking screws and pull both ends of the wire until snug. See Figure 14.

Figure 14. Pulling the Wire Through the Housing Screws



d. Insert both ends of the seal wire through the hole in the seal. Slide the seal up on the wires until the seal is close to the housing, and crimp the seal on the wires to secure them. See Figure 15 and Figure 16.

Figure 15. Inserting Both Ends of the Wire Through the Seal

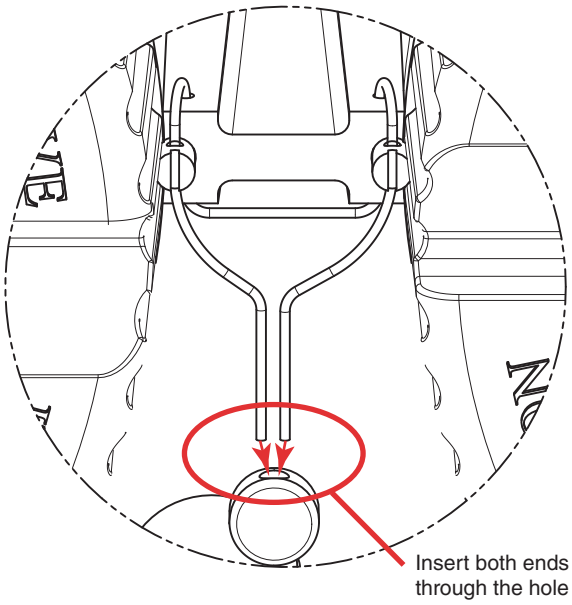
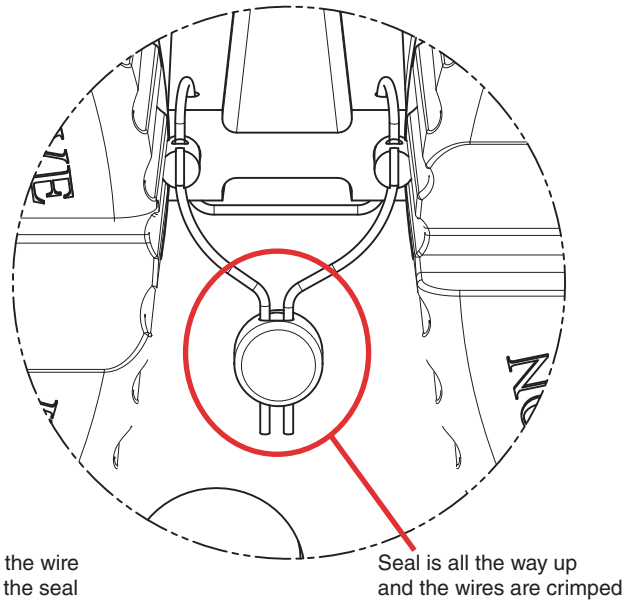
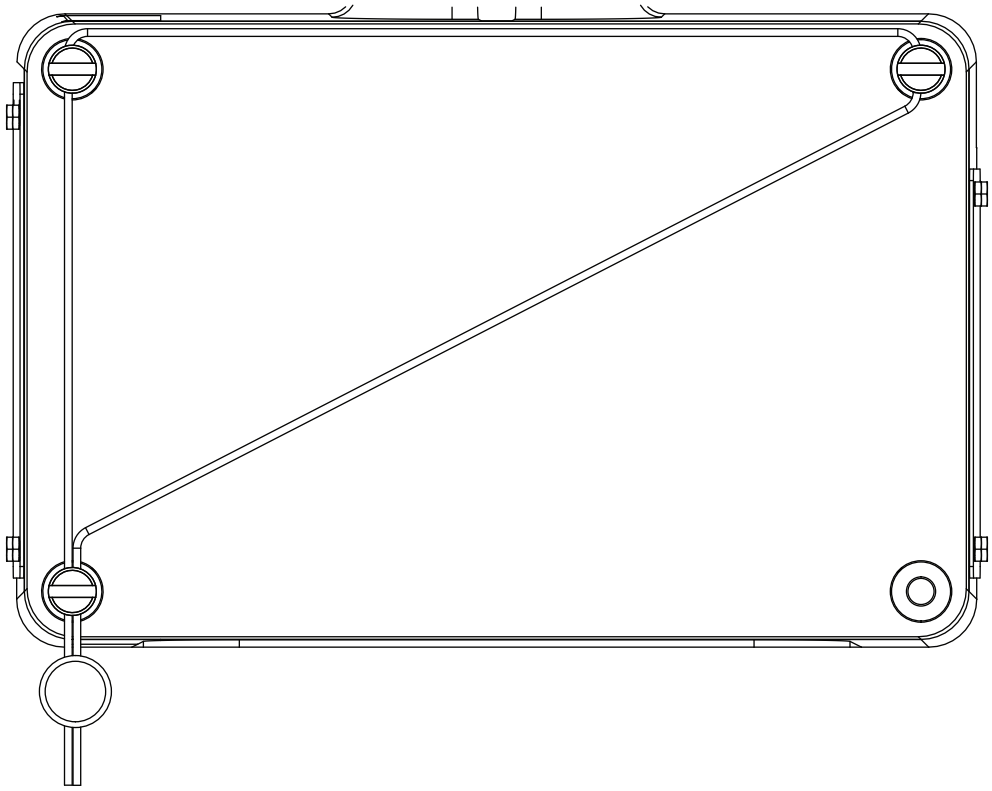


Figure 16. Positioning the Seal and Crimping the Wire



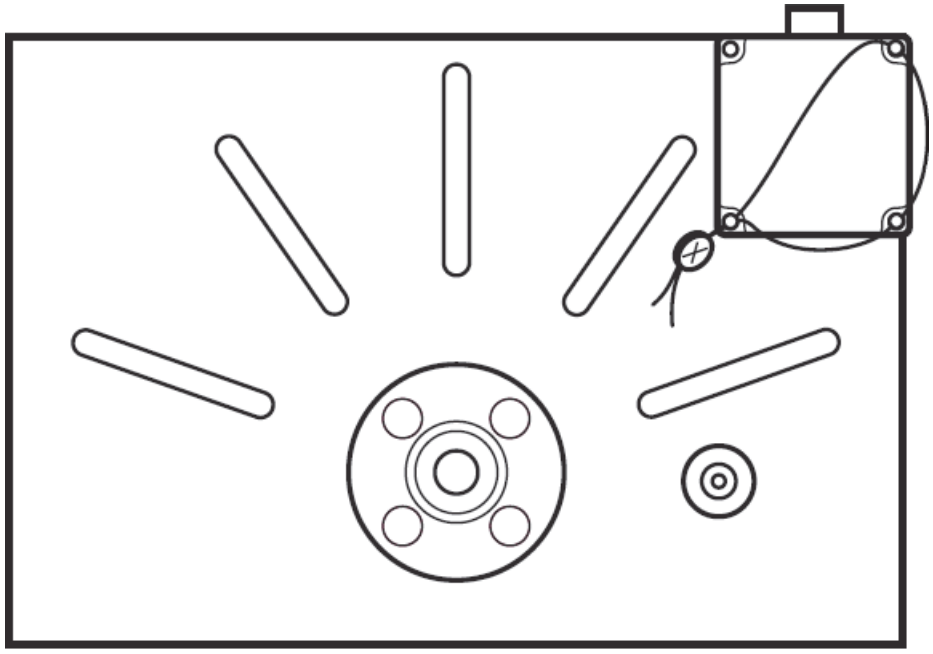
2. Lock the transmitter junction box (Figure 17):
   a. Slide one end of the seal wire through the holes in the three elongated cover screws as shown.
   b. Slide the other end of the wire through the bottom screw as shown, checking that both ends of the wire pass through the hole in the screw.
   c. Slide the seal onto both wire ends and crimp the seal as shown.

Figure 17. Transmitter Junction Block - Cover Locks



3. Lock the flowtube junction box (CFS10 and CFS20 flowtubes only; Figure 18):
   a. Slide one end of the seal wire through the holes in the three elongated cover screws as shown.
   b. Slide the other end of the wire through the bottom screw as shown, checking that both ends of the wire pass through the hole in the screw. This is important to ensure that each screw cannot be removed by independent sequential loosening of the screws.
   c. Slide the seal onto both wire ends and crimp the seal as shown.

Figure 18. Flowtube Junction Box



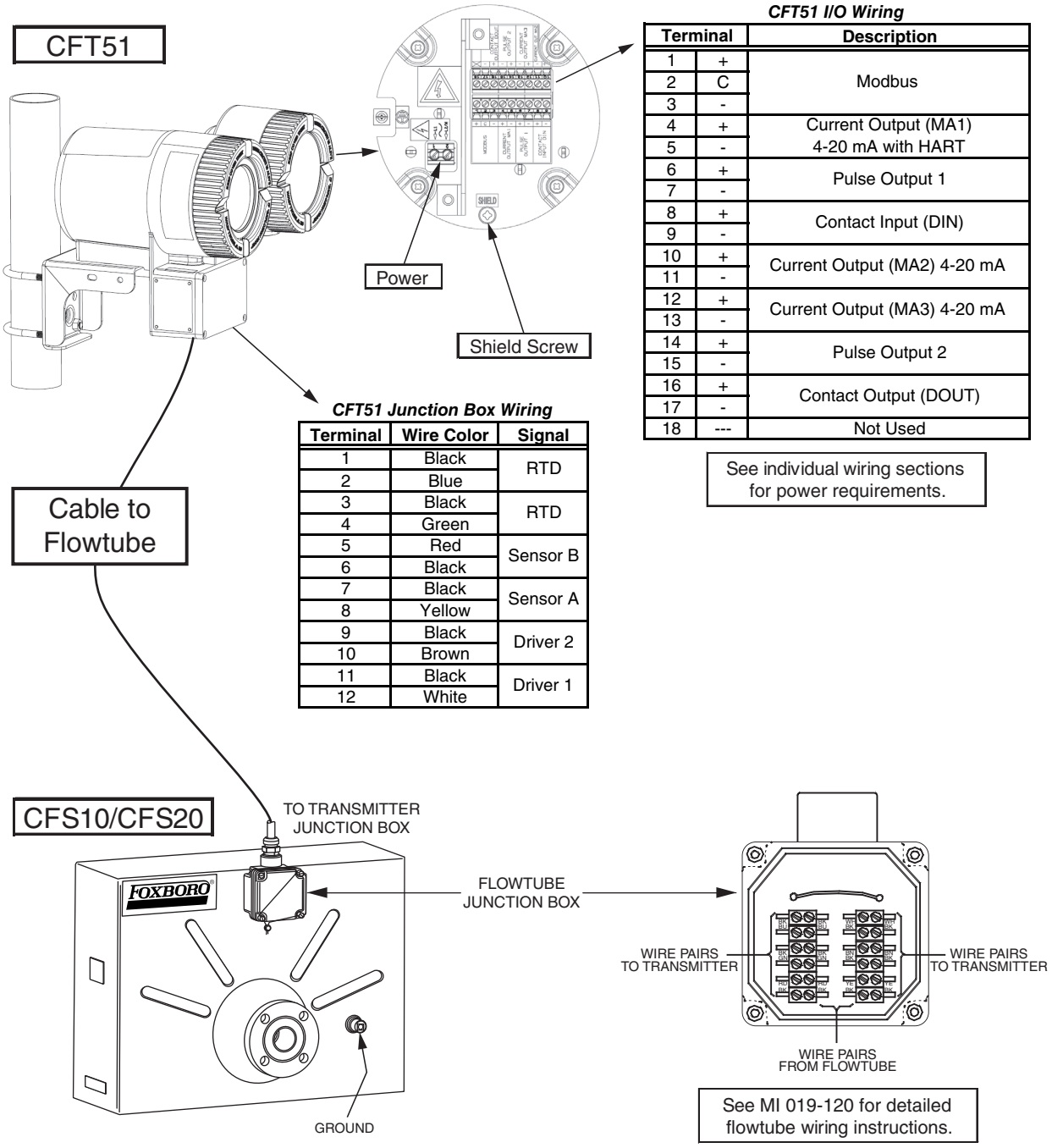
NOTE

For additional information on cover locks for flowtube models CFS10 and CFS20, refer to MI 019-120.

Wiring

The installation and wiring of your transmitter must conform to local code requirements. See Figure 19 for an overview of transmitter wiring with a CFS10 or CFS20 flowtube.

Figure 19. Overview of Transmitter Wiring with a CFS10 or CFS20 Flowtube



CFT51 I/O Wiring

Terminal		Description
1	+	Modbus
2	C	
3	-	
4	+	Current Output (MA1) 4-20 mA with HART
5	-	
6	+	Pulse Output 1
7	-	
8	+	Contact Input (DIN)
9	-	
10	+	Current Output (MA2) 4-20 mA
11	-	
12	+	Current Output (MA3) 4-20 mA
13	-	
14	+	Pulse Output 2
15	-	
16	+	Contact Output (DOUT)
17	-	
18	---	Not Used

See individual wiring sections for power requirements.

CFT51 Junction Box Wiring

Terminal	Wire Color	Signal
1	Black	RTD
2	Blue	
3	Black	RTD
4	Green	
5	Red	Sensor B
6	Black	
7	Black	Sensor A
8	Yellow	
9	Black	Driver 2
10	Brown	
11	Black	Driver 1
12	White	

Field Wiring

To access the transmitter field terminals, remove the field wiring compartment cover by turning it counterclockwise. The field wiring compartment cover is the one closest to the conduit openings. See Figure 20.

When replacing the cover, tighten it until the cover meets the housing metal-to-metal.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH.

In hazardous locations, do **not** remove cover while circuits are live.

Failure to follow these instructions can result in death or serious injury.

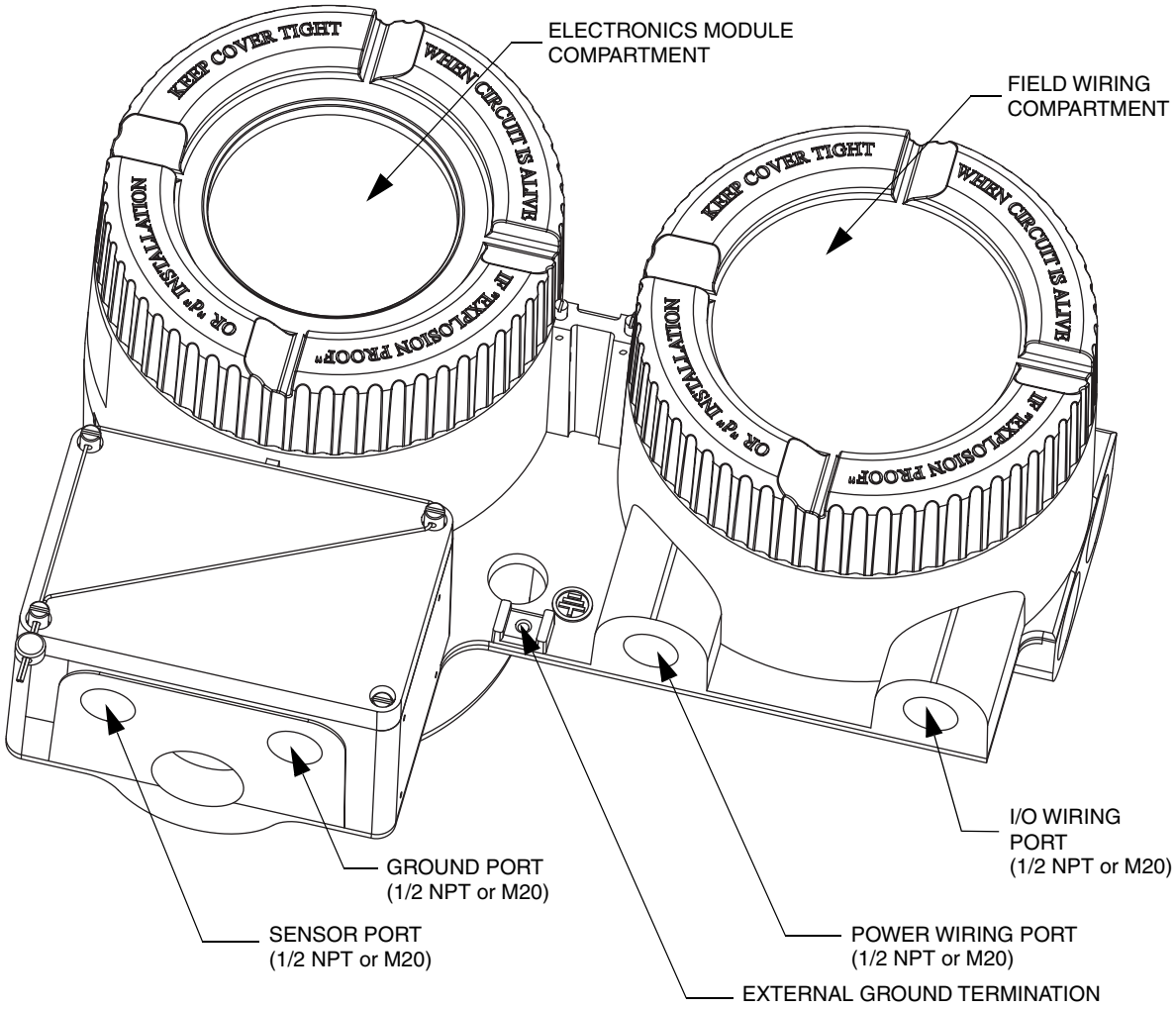
⚠ CAUTION

EQUIPMENT OPERATION HAZARD

Field wiring must be rated for 77°C or higher.

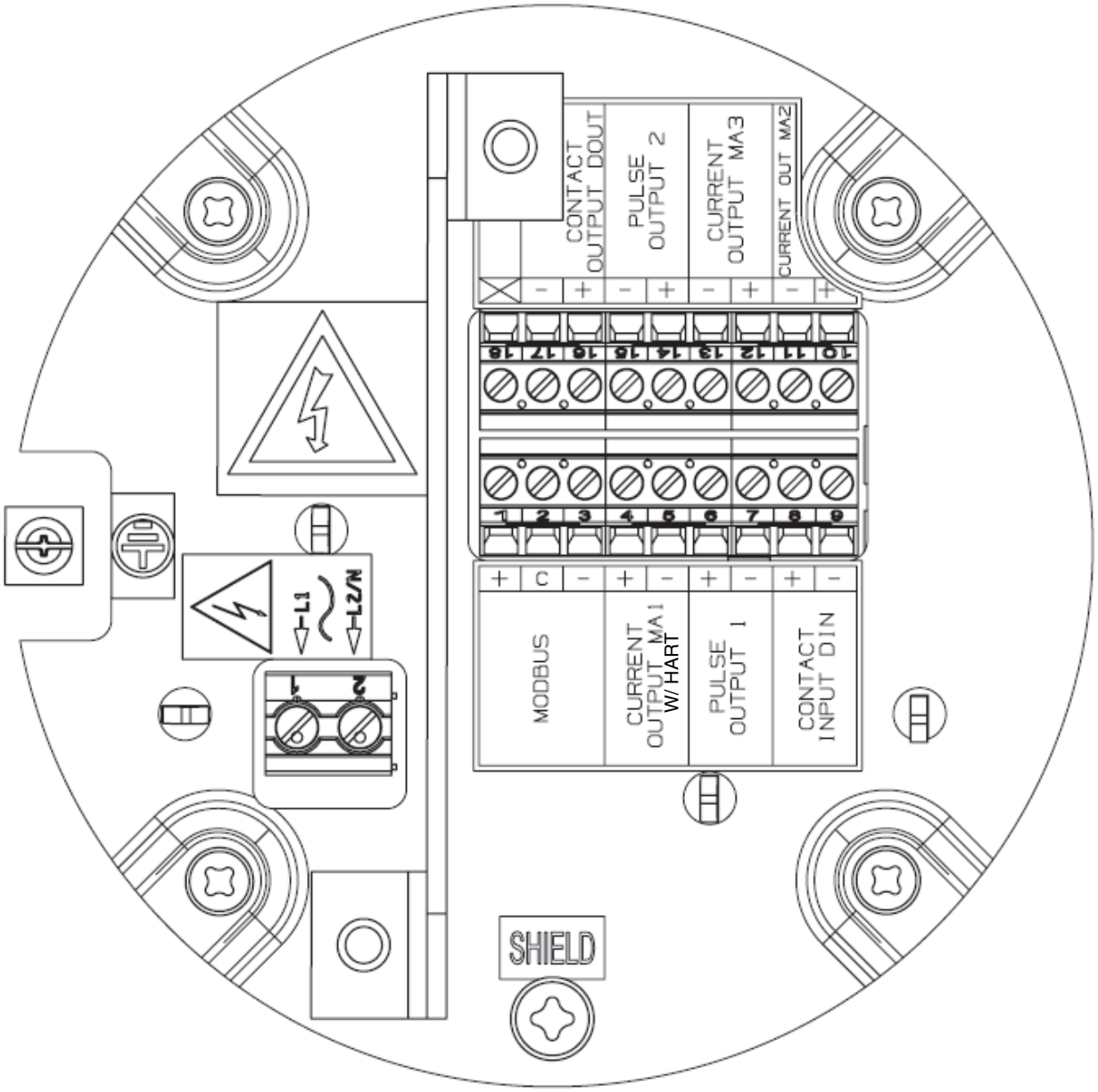
Failure to follow these instructions can result in injury or equipment damage.

Figure 20. Accessing Field Terminals



The field wiring terminal board is shown in Figure 21.

Figure 21. Field Wiring Terminal Board

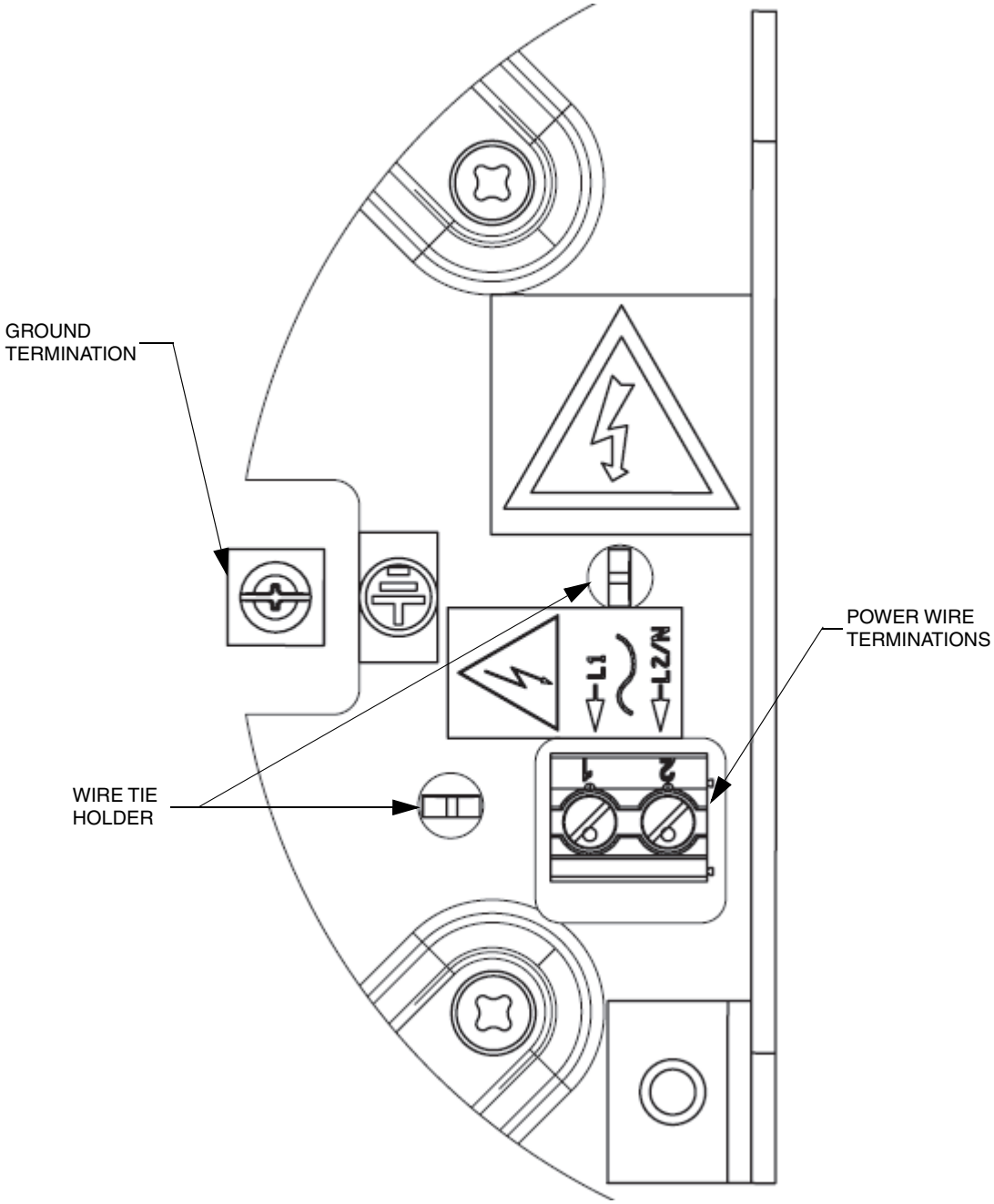


Transmitter Power Wiring

Connect the power wiring to the field wiring terminal board. Shielded wire should be used on the dc version. Connect the shield on both ends.

Figure 22 shows an illustration for the power I/O wiring.

Figure 22. Transmitter Power Wiring



Transmitter ac Power Supply

Figure 23. Transmitter ac Power Connection Terminals

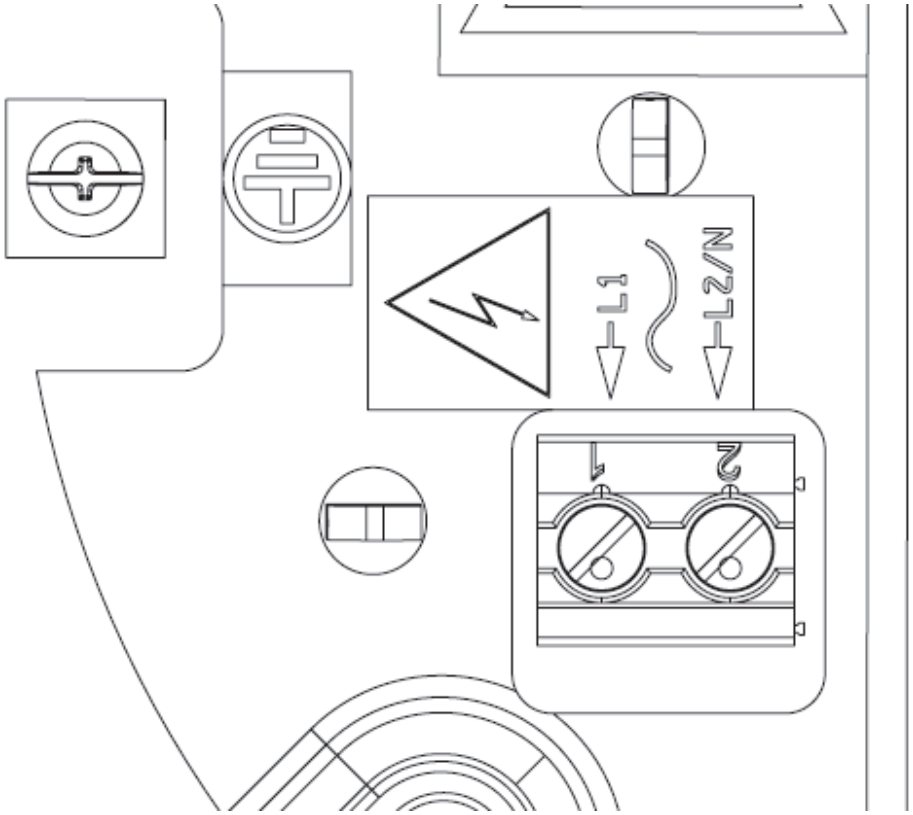


Table 5. Power (Limits): 102 to 264 Vac; 47 to 63 Hz

1	Line
2	Neutral

Transmitter dc Power Supply

Figure 24. Transmitter dc Power Connection Terminals

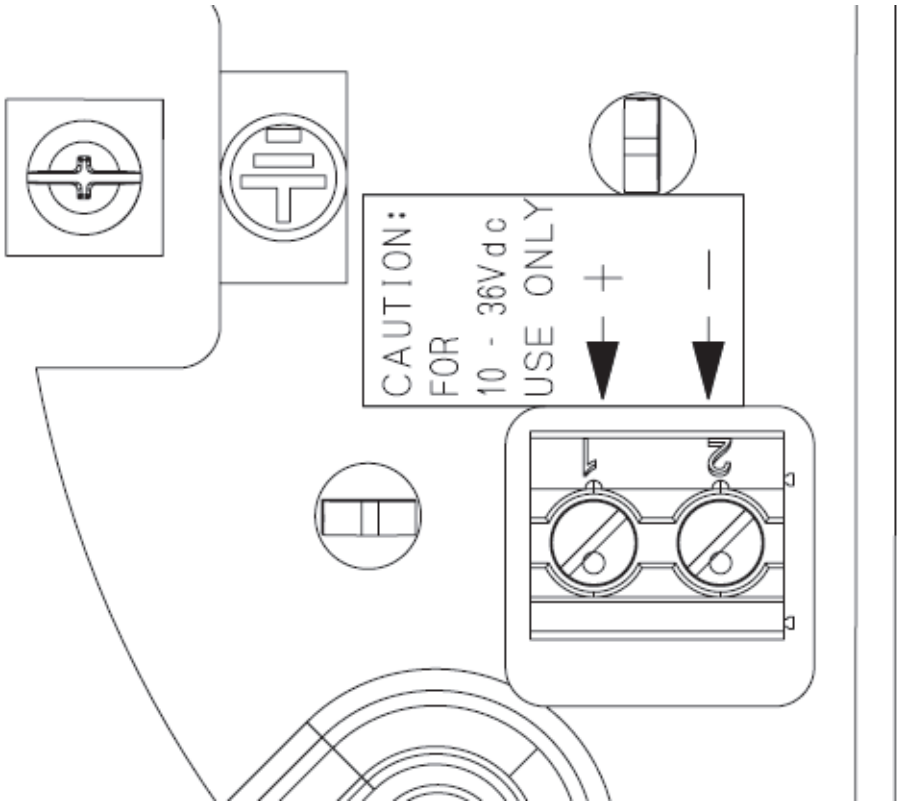


Table 6. dc Power: 10-36 Vdc

1	Positive dc connection
2	Negative dc connection

Input/Output Wiring

The CFT51 supports multiple I/O options, both isolated and non-isolated, which require external power source.

However, if only one power source is available, the + terminals of the I/Os can be connected together. In this case the I/Os are no longer isolated from each other.

In addition, for backward compatibility with existing CFT50 installations, the + terminals can all be connected together and powered by the same power source.

Table 7. I/O Wiring

Terminal		Description
1	+	Modbus
2	C	
3	-	
4	+	Current Output (MA1) 4-20 mA with HART
5	-	
6	+	Pulse Output 1
7	-	
8	+	Contact Input (DIN)
9	-	
10	+	Current Output (MA2) 4-20 mA
11	-	
12	+	Current Output (MA3) 4-20 mA
13	-	
14	+	Pulse Output 2
15	-	
16	+	Contact Output (DOUT)
17	-	
18	---	Not Used

NOTE

All outputs must be externally powered by nominal 24 Vdc.

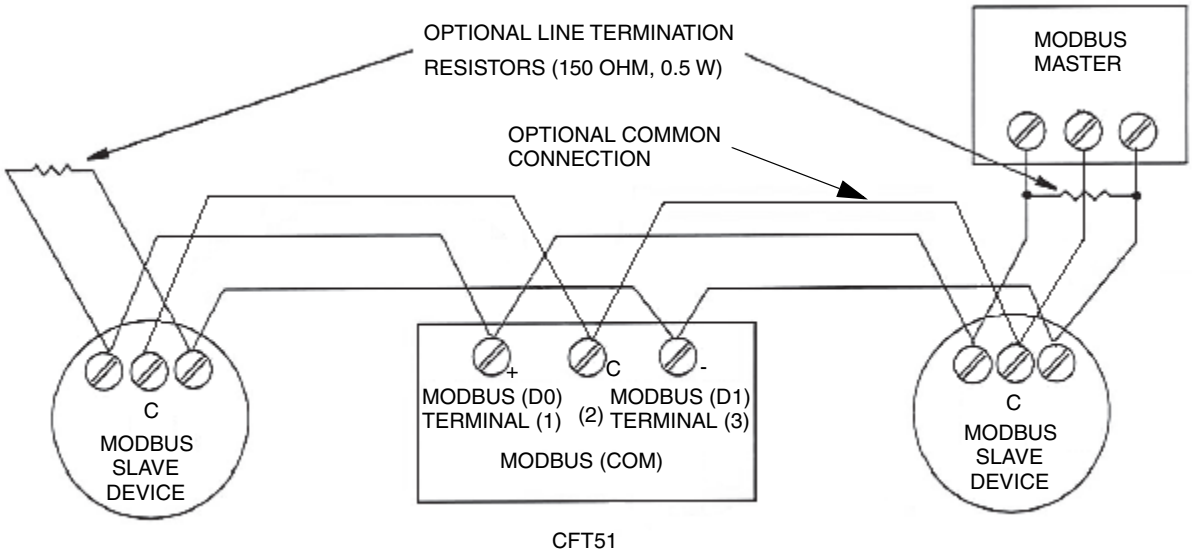
Modbus Wiring

Figure 25 shows the typical connection of the Modbus-configured CFT51 Transmitter to a Modbus master. It may be necessary to install the optional termination resistor to reduce signal reflections on long cable length interconnections. It may also be necessary to reverse the Modbus signal wires for some Modbus masters to keep the proper D0 and D1 signaling convention.

NOTE

Follow Modbus wiring guidelines and requirements as documented online at www.modbus.org.

Figure 25. Typical Modbus Wiring



The maximum length of signal wires for Modbus communications is 1000 m (3280 ft), operating at the default 9600 baud rate, running 26 AWG and 150 ohm terminator resistor. Use twisted shielded wire. Connect shield on both ends.

For systems with a common connection, use dual twisted shielded wire. One twisted pair for D0 and D1 and the other twisted pair shorted together on both ends for the common connection.

Current Output MA1 and HART Communication Interface

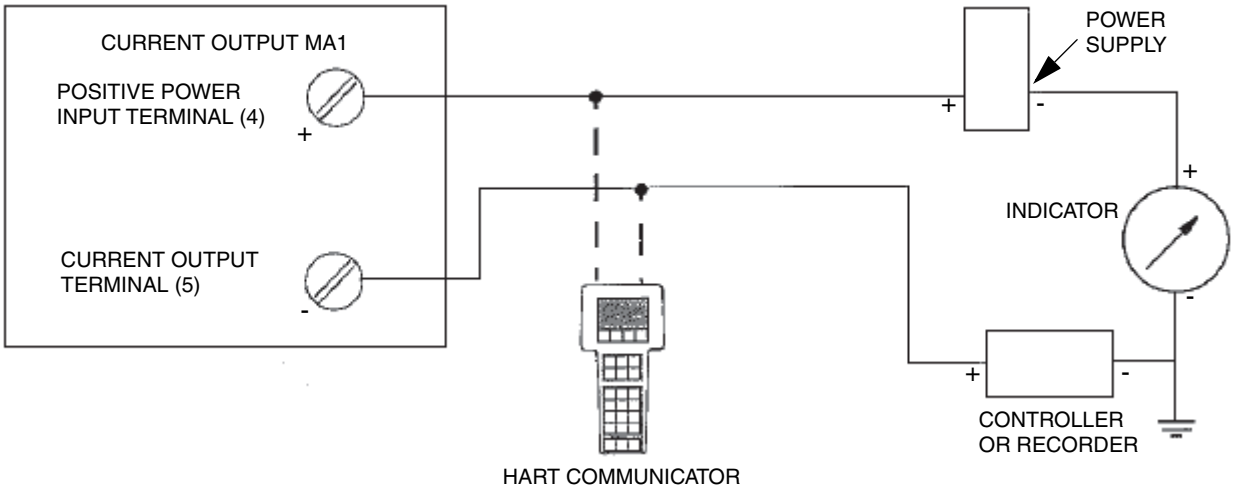
NOTE

The HART communications interface, superimposed on the 4-20 mA signal, is available only on Current Output (MA1).

The maximum length of signal wires for HART communication is 3,050 m (10,000 ft). It is 1,525 m (5,000 ft) in HART digital multidrop mode. Current Output 1 must have a minimum loop load of 250 ohms when HART communications is used.

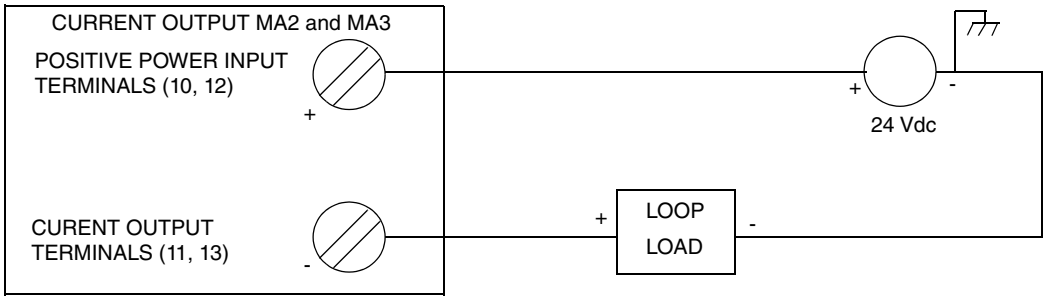
CFT51 transmitters with HART communication are factory-configured to poll address 0, allowing them to operate in the standard point-to-point manner superimposed on the 4-20 mA signal.

Figure 26. Typical HART Wiring (Current Output MA1)



Current Outputs MA2 and MA3

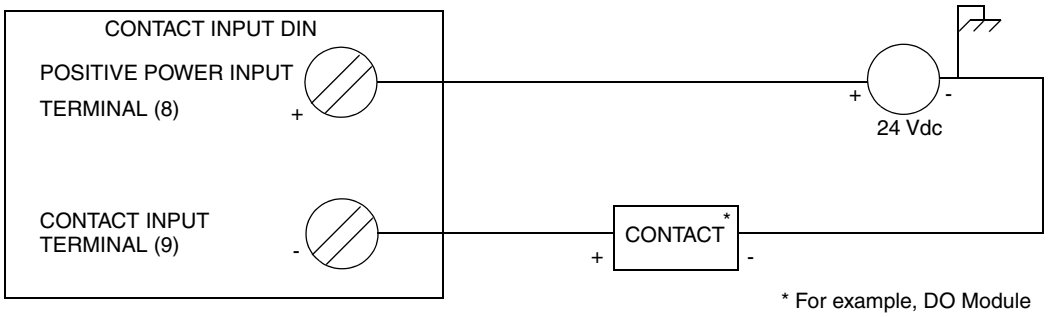
Figure 27. Current Output Wiring (MA2 and MA3)



The loop load resistor can be a value from 0 to 683 Ω.To determine your loop load resistance, add the series resistance of each component in the loop, excluding the transmitter.

Contact Input (DIN)

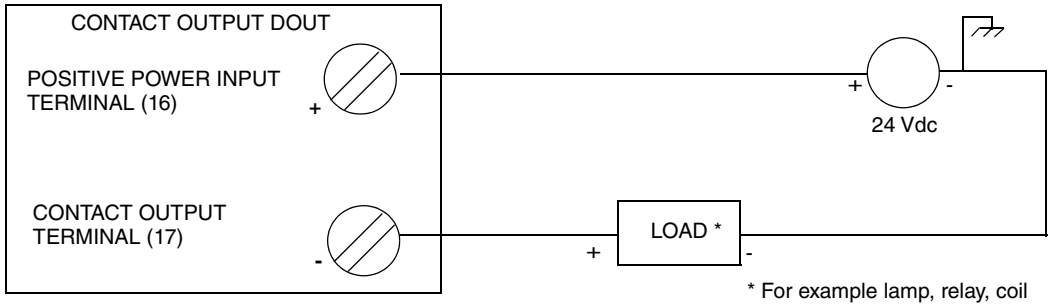
Figure 28. Contact Input Wiring (DIN)



The voltage requirement for Discrete Input (DIN) is 24 Vdc ±10%. The load requirement is limited to producing a maximum current of 100 mA.

Contact Output (DOUT)

Figure 29. Contact Output Wiring (DOUT)

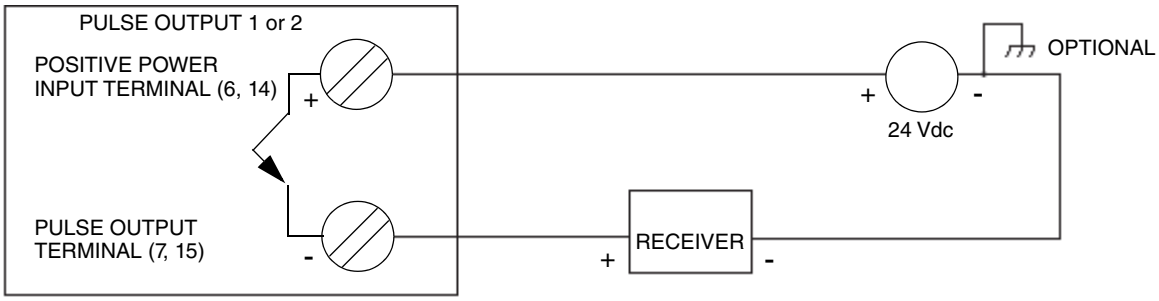


The voltage requirement for Discrete Output is 24 Vdc ±10%. The load requirement is limited to producing a maximum current of 100 mA.

Pulse Outputs 1 and 2

The pulse output (Pulse Output 1 and Pulse Output 2) signal is typically used with a receiver such as an external totalizer or control system. The pulse output is a high side switch or sourcing output. If the receiver requires a sourcing input and is internally current limited, it can be connected as shown in Figure 30.

Figure 30. Pulse Output with a Sourcing Input Receiver (with Internal Current Limiting, Pulse Output 1 or Pulse Output 2)

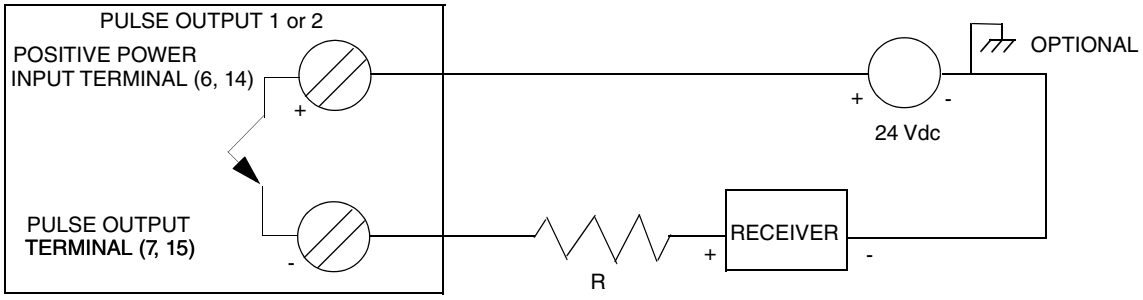


For receivers requiring a sourcing input but without internal current limiting, a resistor is required to limit the current to that specified by the receiver as shown in Figure 31. The pulse output current is limited to 80 mA maximum.

For example:

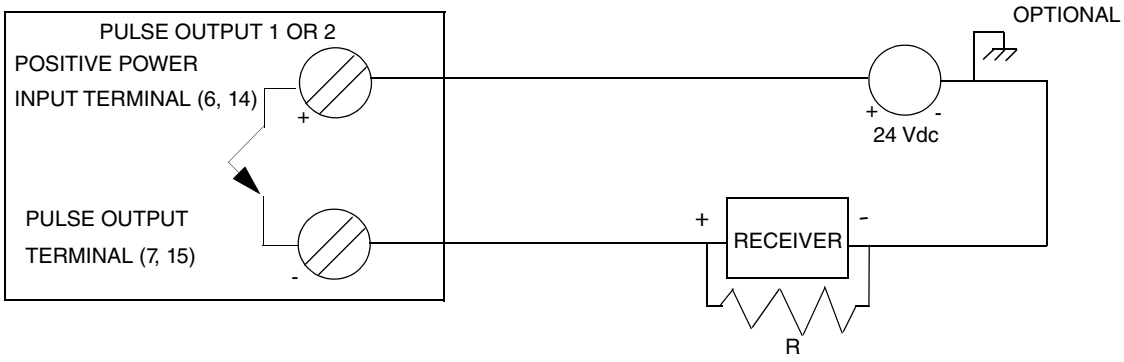
V	=	24 Vdc
I	=	80 mA
R	≥	300 Ohms

Figure 31. Pulse Output with a Sourcing Input Receiver (without Internal Current Limiting, Pulse Output 1 or Pulse Output 2)



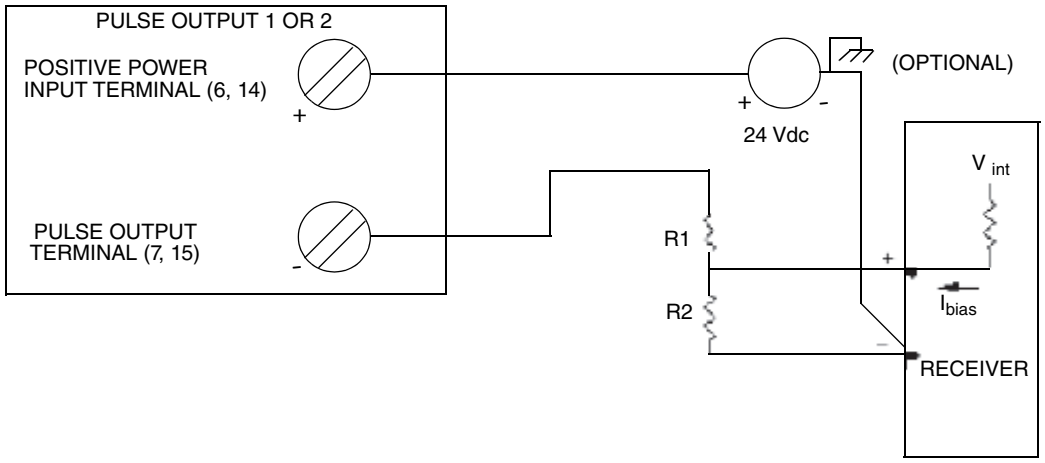
If the receiver requires a current sinking input (such as a contact closure or transistor switch), a resistor is required across the receiver terminals as shown in Figure 32. The resistor should be sized to limit the on-state current in the pulse output to 80 mA maximum.

Figure 32. Pulse Output with a Receiver Requiring a Sinking Input (Pulse Output 1 or Pulse Output 2)



Because of the internal bias currents produced by some receivers requiring sinking inputs, a resistor divider may be necessary to help ensure that the low input threshold requirement of the receiver is met. This configuration is shown in Figure 33. R1 and R2 must limit the pulse output on-state current to 80 mA maximum.

Figure 33. Pulse Output with a Sinking Input Receiver Using a Divider Network (Pulse Output 1 or Pulse Output 2)



HART Digital Multidrop Communication

"Multidrop" refers to the connection of several transmitters to a single transmission line. You can configure HART communications using the pushbuttons on the LCD indicator. Communication between the host computer and the transmitters takes place digitally.

NOTE

On selecting multidrop communication while you configure HART version 5, the first analog output of the transmitter is deactivated. First analog output deactivation is optional for HART versions 6 and higher.

With the HART digital communications protocol, up to 63 transmitters can be connected on a single twisted pair of wires or over leased telephone lines.

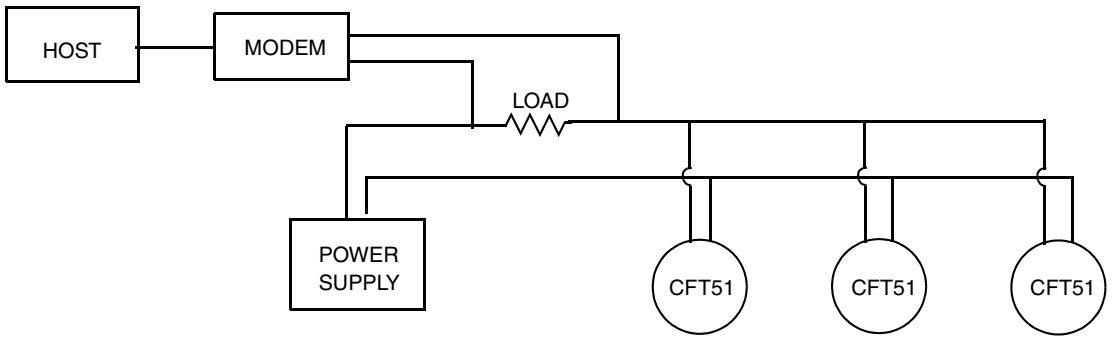
The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Communication with the transmitters can be accomplished with any HART compatible modem and a host implementing the HART protocol. Each transmitter is identified by a unique address (1-63 for HART versions 6 and higher, or 1-15 for HART version 5) and responds to the commands defined in the HART protocol.

Figure 34 shows a typical HART digital multidrop network. Do **not** use this figure as an installation diagram.

NOTE

Follow HART Communications guidelines and requirements as documented online at www.hartcomm.org.

Figure 34. Typical HART Multidrop Network



NOTE

CFT51 transmitters with HART communication are set to poll address 0 at the factory, allowing them to operate in the standard point-to-point manner superimposed on a 4 to 20 mA output signal. To activate multidrop communication, the transmitter address, when configured with HART version 6 or greater, must be changed to a number from 1 to 63. Each transmitter must be assigned a unique number on each multidrop network.

Transmitter Wiring Connections from Flowtube

Connect the wiring from the flowtube to the transmitter per Figure 35 and Table 8. Distance between the flowtube and transmitter can be up to 305 m (1000 ft) with CFS10 or CFS20 flowtubes.

Connect the "dressed" end of the factory-supplied cable to the transmitter terminals. To facilitate wire identification, ensure that the proper wire pairs remain twisted, as the black wires are not common.

Figure 35. Transmitter Junction Box

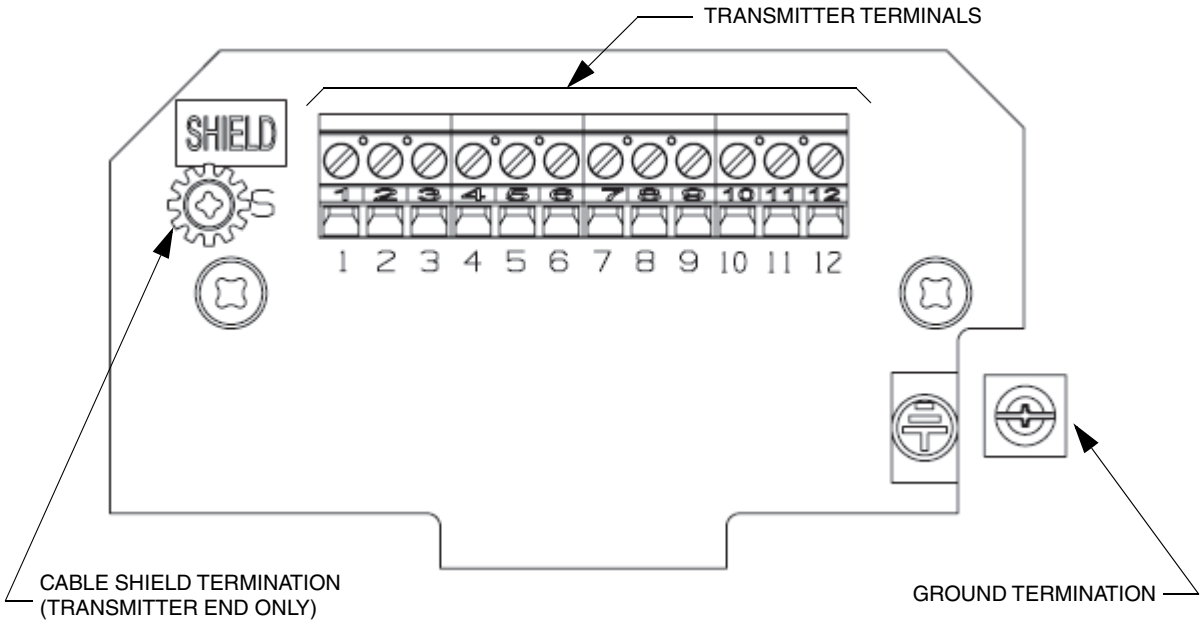


Table 8. Transmitter Junction Box Wiring

Terminal	Wire Color	Signal
1	Black	RTD
2	Blue	
3	Black	RTD
4	Green	
5	Red	Sensor B
6	Black	
7	Black	Sensor A
8	Yellow	
9	Black	Driver 2
10	Brown	
11	Black	Driver 1 (CFS10 and CFS20 only)
12	White	

Write Protect Jumper

The write protection jumper, located on the printed wiring board shown in Figure 37, allows or prevents anyone from changing the configuration of the transmitter or resetting the grand totalizers. (Batch totalizers, however, can still be changed.) This feature is usually used in custody transfer applications, or to ensure that the configuration and/or totals are not changed.

The jumper is usually placed in the "disabled" (factory default) position. Placing the jumper in the "enabled" position engages the write protection feature.

If write protection is enabled and someone tries to enter Quick Start mode, enter Setup mode, or reset the totals, the display reads `WPROT/LOCKED`.

NOTE

A change in the write protect jumper position takes effect immediately.

NOTE

When the CFT51 is configured with the U.S. Weights and Measures Custody Transfer NTEP (-T) or Weights and Measures Industry Canada Approvals (-D) model code options (available only with CFS10 and CFS20 flowtubes), the transmitter displays the message `WritProt Disabled` when the write protection jumper is disabled.

Figure 36. Write Protect Jumper Location

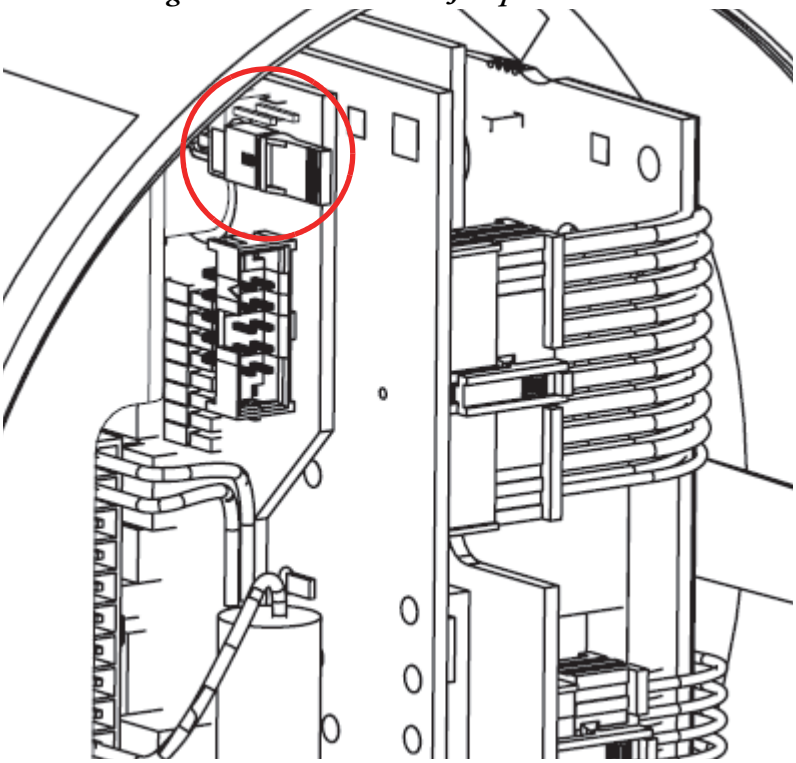
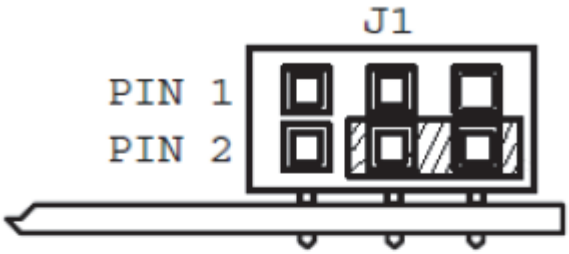
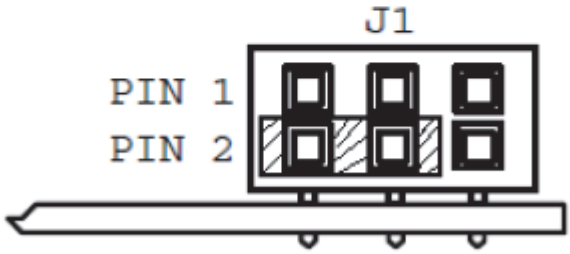


Figure 37. Write Protect Jumper Position



WRITE PROTECT DISABLED



WRITE PROTECT ENABLED

3. Quick Start

The CFT51 Transmitter can be configured with the local keypad/display, with a HART communicator, or with the Modbus protocol interface. With any of these options, two configuration menus exist, Quick Start and Setup. Most basic applications can be configured in Quick Start mode; other applications require using Setup mode.

— NOTE

If write protection is enabled, the display reads `WPROT/LOCKED` and you cannot enter Quick Start or Setup mode. To disable write protection, you must first turn the power off, move the write protect jumper to the disable position, and then turn the power back on. See "Write Protect Jumper" on page 52.

When to Use Quick Start Mode

Quick Start mode can be used for applications requiring only:

- Flow measurement in the currently selected units. (The factory default is mass flow in lb/min.)
- Positive flow direction.

Use Setup mode (described in "Setup" on page 151) for applications involving:

- Volume flow or density measurements
- Mass flow units other than the currently selected units
- Pulse or multiple Contact Outputs
- Alarm or Totalizer functions
- Reverse or bidirectional flow.

Flowtube information, including the flowtube model and calibration coefficients, must be entered in the CFT51 transmitter. The CFT51 transmitter requires three flowtube coefficients: FC2, DC2, and DC4.

— NOTE

Flow and density coefficients must be entered in real number decimal format (such as +0.003452), where previous CFT transmitters used exponential format (such as +3.54062E+02).

Steps Required

1. Obtain the flowtube constants (FC and DC coefficients) from the calibration sheet shipped with the flowtube (or from the flowtube data label).
2. Obtain the flowtube size from the model code on the flowtube data label; for example:

CFS10-##
└ FLOWTUBE SIZE

02 = 1/8" (3 mm)
03 = 1/4" (6 mm)
05 = 1/2" (15 mm)
08 = 3/4" (20 mm)
10 = 1" (25 mm)
15 = 1.5" (40 mm)
20 = 2" (50 mm)

CFS20-##
└ FLOWTUBE SIZE

15 = 1.5" (40 mm)
30 = 3.0" (80 mm)

3. Obtain the flowtube material from the model code on the flowtube data label. The material code is the letter that follows the flowtube size in the model code.

CFS10-**#
CFS20-**#
└ FLOWTUBE MATERIAL

S = 316L
H = Nickel alloy
C = 316L (Sanitary)

- S AISI Type 316L wetted material
- H Nickel alloy equivalent to Hastelloy®(1) wetted material
- C AISI Type 316L wetted material for sanitary applications

4. Mount the flowtube per MI 019-120 or MI 019-125, as applicable; mount the transmitter per “Mounting” on page 23 of this document.
5. Install wiring: power to transmitter, flowtube to transmitter, transmitter input/output wiring per “Wiring” on page 37.

Refer to “Procedure Using Keypad/Display” on page 57 or “Procedure Using the HART Communicator” on page 60 to finish the startup procedure.

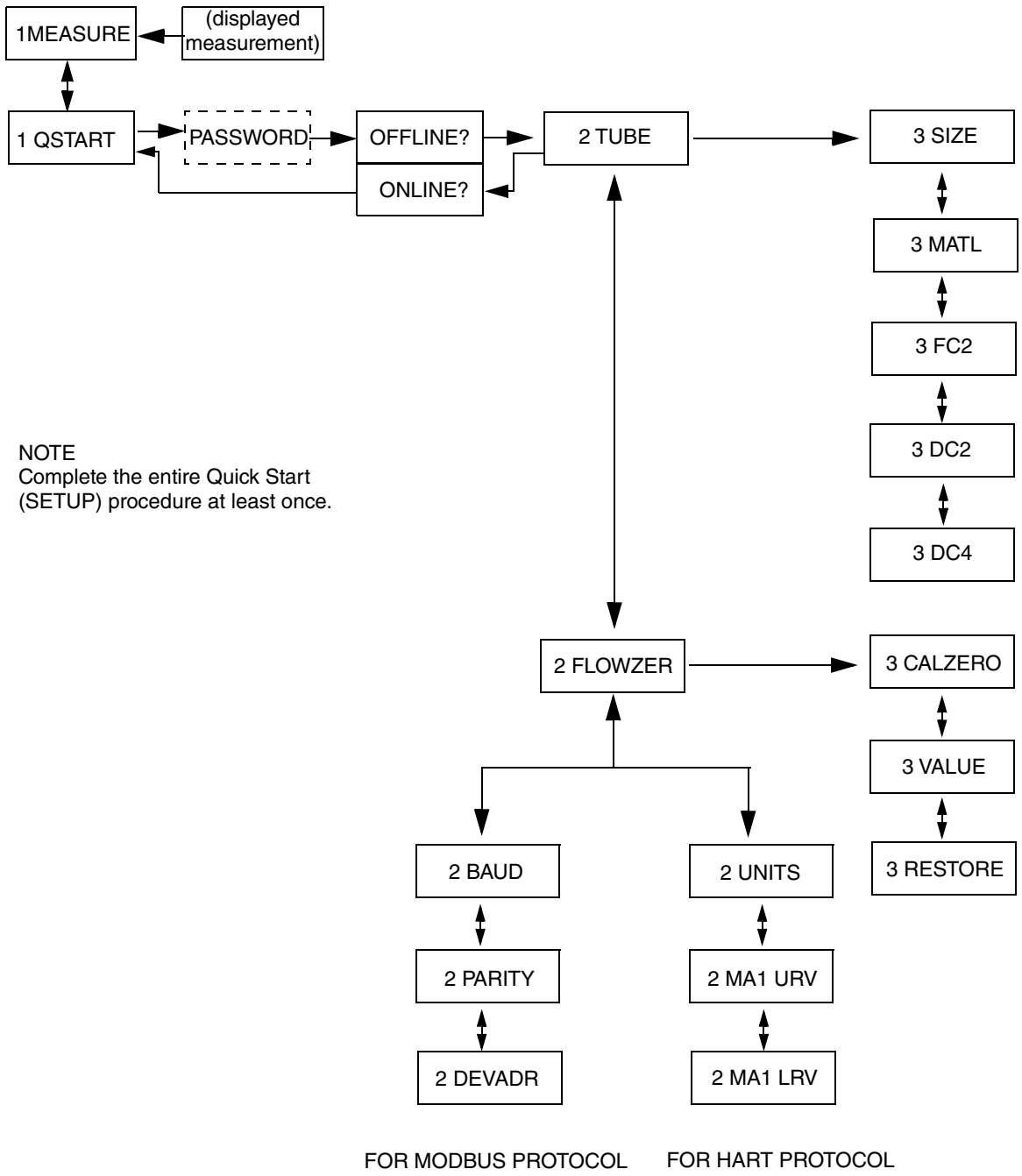
1. Hastelloy is a registered trademark of Haynes International, Inc.

Procedure Using Keypad/Display

The following section shows the Quick Start menu available on the local display and describes using the local keypad and display to execute the Quick Start procedure. Refer to “Using the Local Display” on page 61 for additional information on using the local keypad and display buttons.

The Keypad/Display Quick Start menu is shown in Figure 38.

Figure 38. Keypad/Display Quick Start Menu



Perform the following steps to execute the Quick Start procedure from the local keypad and display:

1. Press the Left arrow key until the display reads `1 MEASURE` and follow the menu using the keys as explained in Table 9 and shown in Figure 40.

Table 9. Operation of Function Keys

Key	Function
Left Arrow (ESC)	Moves left in the menu structure. Moves the cursor to the left in a data entry field. Escapes from changes in a picklist menu or data entry. (a) Answers No.
Right Arrow (ENTER)	Moves right in the menu structure. Used to access the data entry edit mode of a parameter. Moves the cursor to the right in a data entry field. Enters and saves the changed menu picklist choices or data entry. (a) Answers Yes.
Up Arrow (BACK)	Moves upward in the menu structure or a picklist menu.
Down Arrow (NEXT)	Moves downward in the menu structure or a picklist menu.

a. On data entry, repeatedly press the key until the cursor reaches the end of the display.

2. Go to `1 QSTART > 2 TUBE > 3 SIZE` and select the flowtube size code. Then go to `3 MATL` and select the flowtube material code.
3. Go to `3 FC2`, and enter flow constant FC2. Flow constants FC1 and FC3 are calculated by the transmitter.
4. Go to `3 DC2`, and enter density constant DC2. Then go to `3 DC4` and enter the density constant DC4. Density constants DC1 and DC3 are calculated by the transmitter.
5. Apply flow to your flowmeter for 5 to 10 minutes.
6. Establish zero flow by closing block valves to ensure no fluid movement. The tube must be completely filled with fluid.
7. Go to `3CALZERO`. Press the Enter key to start the zeroing process. The display reads `BUSY` until the process is finished and then reads `DONE`.

NOTE

The transmitter is zeroed at the primary zero (1). To use the secondary zero (2), you must use Setup mode.

Press the Down arrow key to display `3 VALUE`, the amount of offset that is necessary to make the transmitter read zero at zero flow conditions. You can then manually change this value if necessary (for example, if the flowmeter cannot be blocked in at no-flow condition) using the Left/Right and Up/Down arrow keys as explained in Table 9. Lastly, you can press the Down arrow key to display `3RESTORE`. Pressing the Enter key at this point changes the manually entered value back to the last `CALZERO` offset value.

8. Depending on the selected communication protocol, do the following:

   With HART Communication protocol:

   a. Go to `2 UNITS` to view the current units.

   b. Go to `2 MA URV` and enter your upper range value in the current units.

   c. Go to `2 MA LRV` and enter your lower range value in the current units.

   With Modbus protocol:

   a. Go to `2 BAUD` and enter a baud rate of 1200, 2400, 4800, 9600, 19200, or 38400.

   b. Go to `2 Parity` and enter none, even, or odd.

   c. Go to `2 DEVADR` and enter your device address from 1 to 247.

9. Go to `2 TUBE`. Press the Left arrow key to go to `ONLINE?`. Pressing the Enter key to answer Yes takes you to `1 QSTART`. Press the Up arrow key to go to `1 MEASURE` and the Left arrow key to return to Measure mode.

10. For CFS10 and CFS20 flowtubes only:

    a. Go to `CALIB` menu in `SETUP`, press the Down arrow and select the `TUBECHK` menu and press Enter.

    b. Press the Down arrow key to `DATUM`. Enter the Meter Verification Value (`MVV`) from the data plate or calibration sheet.

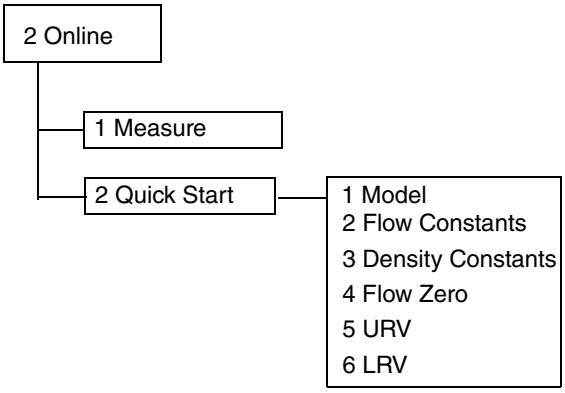
    c. Press the Up arrow key to `CHECK`. Press the Right arrow key and `RUN TEST`. After the test has completed, save as “Ratio.”

Procedure Using the HART Communicator

The following section shows the Quick Start menu available from the HART Communicator and describes using the HART Communicator to execute the Quick Start procedure.

The HART Communicator Quick Start Menu is shown in Figure 39.

Figure 39. HART Communicator Quick Start Menu



Perform the following steps to execute the Quick Start procedure from the HART Communicator:

1. Go to `2 Online`.
2. Go to `2 Quick Start.`
3. Go to `1 Model` and select your flowtube.
4. Go to `2 Flow Constants` and enter flow constant FC2. Flow constants FC1 and FC3 are calculated by the transmitter.
5. Go to `3 Density Constants` and enter density constants DC2 and DC4. Density constants DC1 and DC3 are calculated by the transmitter.
6. Apply flow to your flowmeter for five to ten minutes.
7. Create zero flow by closing block valves to ensure no fluid movement.
8. Go to `4 Flow Zero` and zero your flowmeter.
9. Go to `5 URV` and enter your upper range value.
10. Go to `6 LRV` and enter your lower range value.
11. For CFS10 and CFS20 flowtubes only:
    a. Go to `CALIB` menu in `SETUP`, press the Down arrow and select `TUBECHK` menu and press Enter.
    b. Press the Down arrow key to `DATUM`, and enter the Meter Verification Value (`MVV`) from the data plate or calibration sheet.
    c. Run the Meter Verification function and save as a "Ratio."

4. Using the Local Display

Using the Local Display

A local display, as shown in Figure 40, provides local indication of measurement, status, and identification parameters. The display also provides a means of performing quick start, configuration, calibration, and self-test. Operation is accomplished via four multi-function keys.

Figure 40. Local Display

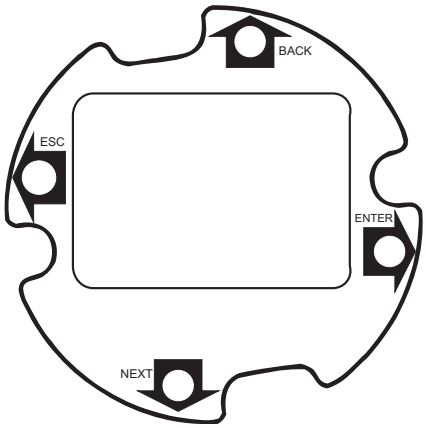


Table 10. Operation of Function Keys

Key	Function
Left Arrow (ESC)	Moves left in the menu structure. Moves the cursor to the left in a data entry field. Escapes from changes in a picklist menu or data entry. (a) Answers No.
Right Arrow (ENTER)	Moves right in the menu structure. Used to access the data entry edit mode of a parameter. Moves the cursor to the right in a data entry field. Enters and saves the changed menu picklist choices or data entry.(a) Answers Yes.
Up Arrow (BACK)	Moves upward in the menu structure or a picklist menu.
Down Arrow (NEXT)	Moves downward in the menu structure or a picklist menu.

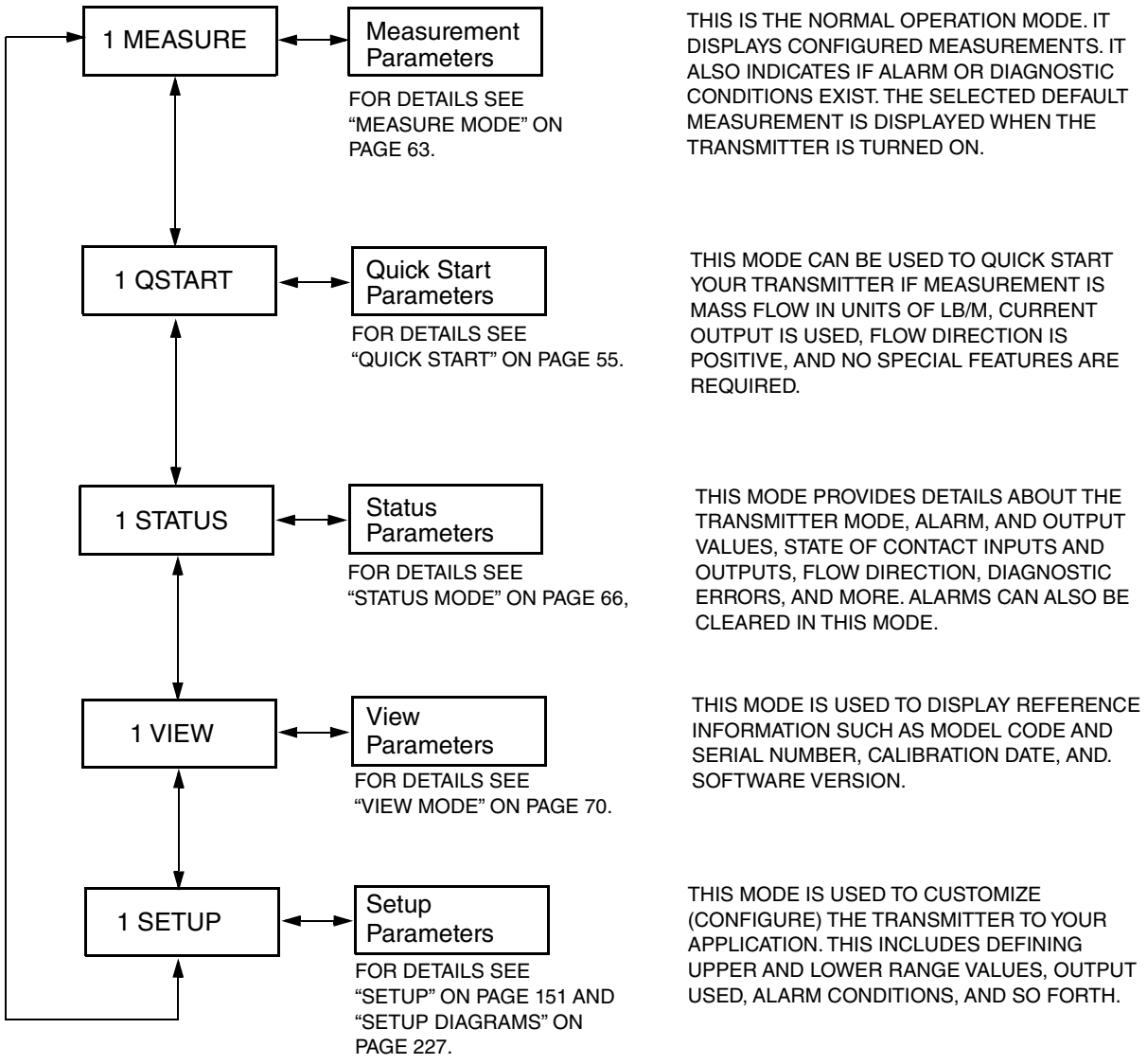
a. On data entry, repeatedly press the key until the cursor reaches the end of the display.

Top Level Menu

The Top Level menu displays five modes – Measure, Quick Start, Status, View, and Setup. You can switch from one to another in sequence by using the Up/Down arrow keys. To enter the second level menu from a particular top level display, press the Right arrow key. To return to the top level from a second level menu item, press the Left arrow key. The level of the first, second, third, and fourth level menus is indicated by the digit appearing as the first character in Line 1 of the display; "1" indicates Level 1 (Top Level), "2" indicates Level 2, "3" indicates Level 3, and so forth.

The top level menu is shown in Figure 41.

Figure 41. Top Level Modes and Their Basic Functions



NOTE

Certain parameters may be missing as you step through the menus described in this chapter, depending on the configuration of your instrument.

Measure Mode

The Measure mode, which is your main operating mode, is displayed upon startup. Depending on the transmitter configuration, it has up to 13 displays, any/all of which can be configured for viewing. See "Display" on page 175. All such displays can be configured to be scrolled with the Up/Down arrow keys or they can also be configured to cycle automatically from one to the other.

- **Mass Flow** — Shows current mass flow rate (forward or reverse) in the selected engineering units.
- **Volume Flow** — Shows current volume flow rate (forward or reverse) in the selected engineering units.
- **Density** — Shows current density in the selected engineering units.
- **Concentration** — Shows current percent concentration.

— NOTE

If the input(s) to the concentration measurement are out of range, or if the calculated output is beyond the specified limits, an error message will alternate with the current value: `INP O/R` - input (density or temperature) is out of range, or `OUT O/R` - output (calculated concentration) is out of range.

- **Temperature** — Shows current process temperature in the selected engineering units.
- **Totals 1, 2, 3, and 4** — Shows current totals in the selected engineering units.

— NOTE

If the totalizer measurement exceeds the configured format, the display will alternate the message `ROLLOVER` with the current rollover value.

- **Component A and B Measurements** — Shows current mass or volume flow rate (forward or reverse) in the selected engineering units.

The transmitter can also be configured so that the readings on the measurement display blink when an alarm and/or diagnostic condition is present. An arrow symbol also appears in the lower right corner of the display when an alarm occurs. An Up arrow indicates a high alarm; a Down arrow indicates a low alarm.

The transmitter has a feature which can produce compensated measurements in 2-phase applications for greater accuracy. The symbol 2Φ appears in the lower right corner of the display if 2-phase flow is present. This symbol does not indicate that the 2-phase feature is configured "on." To activate the 2-phase feature, refer to "2 Phase" on page 183.

Configuring Totals

Totals 1, 2, 3, 4, and Pulse Totals 1 and 2 can be turned on, off, or cleared from the Measure mode

Taking measurements online:

When using the local keypad push-button to reset Totalizers or to initiate Total Pulse, pressing the ENTER key from the Measure mode will take the measurements off-line, which means:

- 4 to 20 mA outputs are held at the last value
- Pulse output(s), if set to rate/frequency, are held at the last value, and
- Pulse output(s), if set to total, are held at zero.

This condition will continue until you exit the off-line mode and return to Measure mode. If you are idle for more than 10 minutes during the off-line mode, on-line operation automatically resumes.

— NOTE

The menu selections to turn on, off, or clear the pulse totalizers do not appear in the Measure mode unless that pulse output is configured for total mode.

Passwords can be employed to help protect the grand total(s) and batch total(s). The high level password is required to clear a grand total. If both high and low level passwords are enabled, either the high or low level password can be used to clear a batch total.

To perform this function:

1. Press the Right arrow key during any measurement display.
2. Enter the password (if passwords are employed).
3. Use the Down arrow key to select the desired total.
4. Select `off`, `on`, or `clear` and press Enter.

   Total 1, Total 2, Total 3, and Total 4 can be individually cleared by an external contact. An external contact can also be used to clear all batch totals or all grand totals.

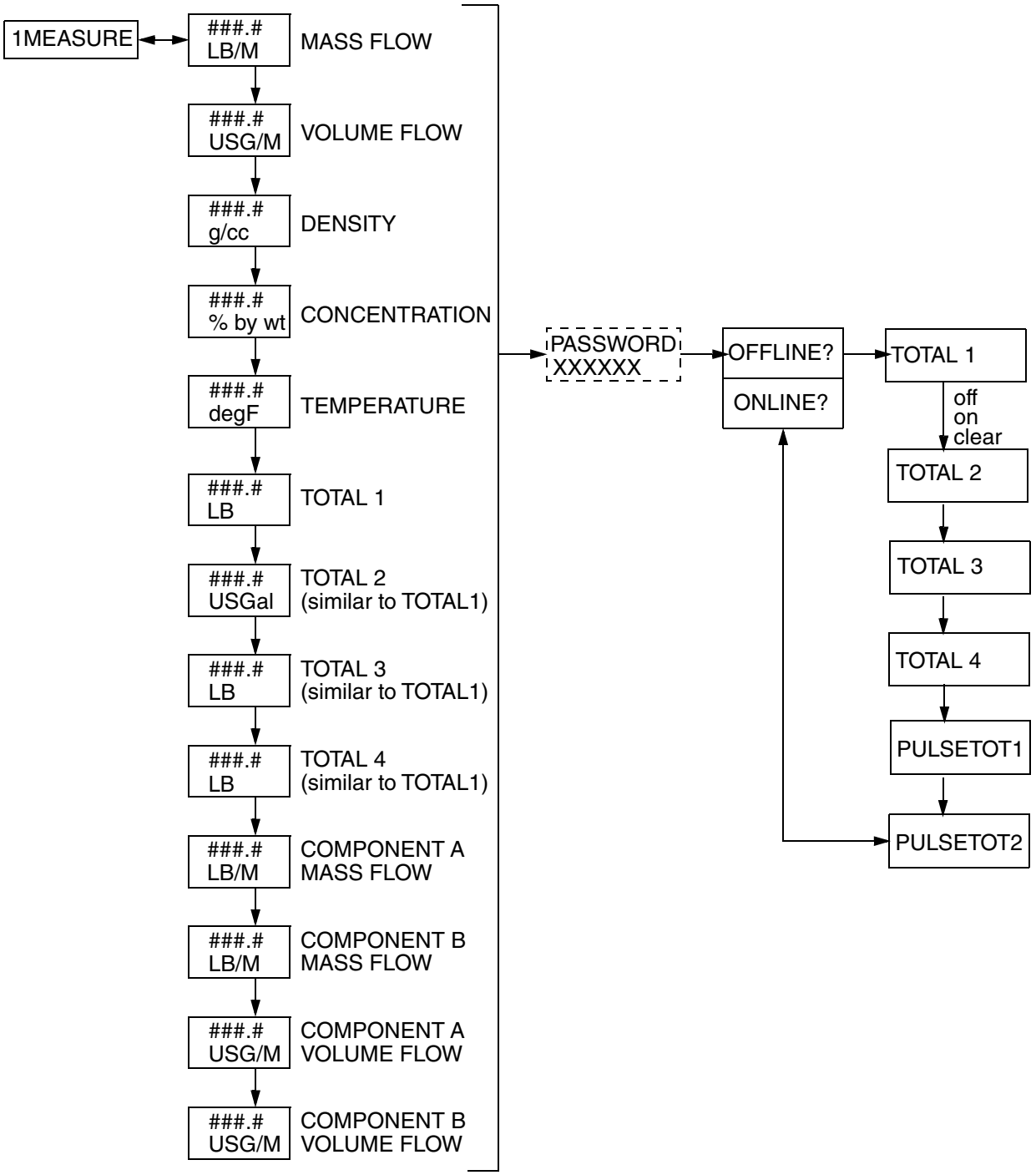
   Totals can also be cleared using the HART Communicator or Modbus protocol.

— NOTE

If write protection is enabled, the display reads `WPROT/LOCKED` and you cannot reset grand totals. Batch totals can be protected only by using the lower level password.

To disable write protection, move the write protect jumper to the “disable” position. See “Write Protect Jumper” on page 52.

Figure 42. Measure Mode Structure Diagram



Quick Start Mode

Refer to “Quick Start” on page 55.

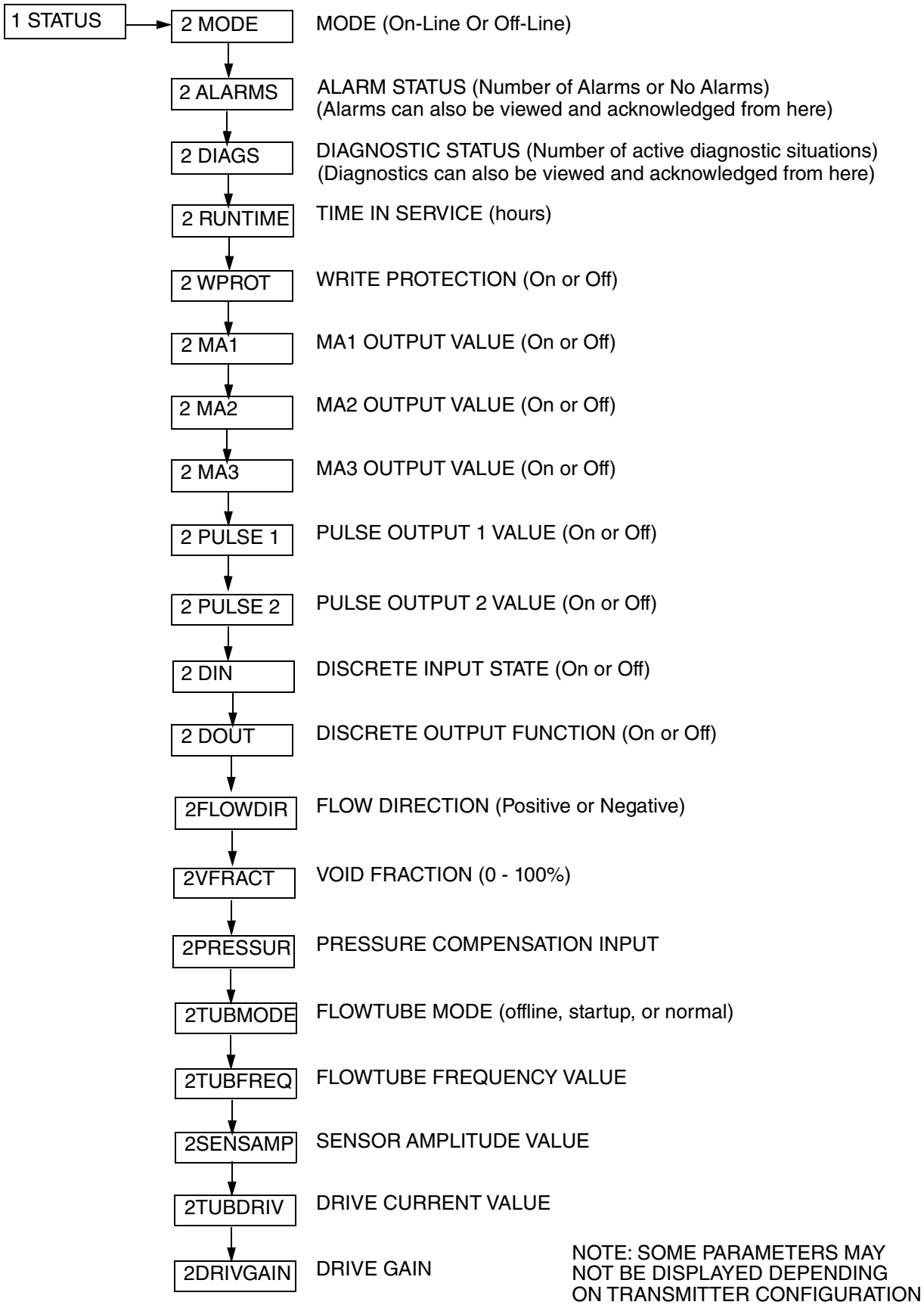
Status Mode

The Status mode enables you to view a number of system parameters and thus assess the performance of the loop. You cannot edit them in this mode. To step through the displays of the parameters, use the Up/Down arrow keys. The Status mode structure diagram is shown in Figure 43.

In Alarm status, you can determine the number of alarms and a brief description of each. You can also clear all alarms manually. In viewing the parameter `2 ALARMS`, the display reads `no alrms` or `# alarms`. If it reads `# alarms`, pressing the Right arrow key displays a brief description of the first alarm condition. Using the Down arrow key, you can step through the list to view each alarm. Press the Left arrow key to return to `# alarms`. Press the Right arrow key to obtain the message `ACK ALARMS?`. Press the Right arrow key again to acknowledge all the alarms.

In Diagnostic status, you can view the diagnostic history of the instrument. You can also acknowledge the active diagnostic manually. In viewing the parameter `2 DIAGS`, the display reads `0 active` or `1 active`. If `1 active`, press the Right arrow key to display the active diagnostic condition code. Press it again to display the time the diagnostic condition occurred. This is presented as the total number of hours the transmitter has been powered. Continue to use the Down arrow key to step through the history of up to 10 diagnostic conditions. Press the Left arrow key to return to `# active`. Press the Right arrow key to obtain the message `ACK DIAGS?`. Press the Right arrow key again to acknowledge the active diagnostic condition.

Figure 43. Status Mode Structure Diagram



Alarm Actions

Conditions That Can Be Alarmed

Alarms can be set for the high setpoint and low setpoint of mass flow, volume flow, density, concentration, temperature, and component measurements. Alarms can also be set for the high setpoint of each total measurement.

Actions of Transmitter During Alarm Conditions

Display — The display can be configured to respond or not respond to a specific alarm. The display can be configured to blink or not blink in response to an alarm condition. An arrow symbol also appears in the lower right corner of the display when an alarm occurs. An Up arrow indicates a high alarm; a Down arrow indicates a low alarm.

Milliampere Outputs — Alarms can be configured to force the milliampere output associated with the alarm to go fully upscale, fully downscale, be held at the last value, or ignore or do nothing.

Pulse Outputs — Pulse Outputs 1 and 2 have the same options as mA outputs for alarms. Alarms can be configured to force the pulse output associated with the alarm to go fully upscale, fully downscale, be held at the last value, or ignore or do nothing.

Relay Contact Outputs — Contact output relay can be configured to respond or not respond to a specific alarm.

Status Mode — Alarm conditions are defined in the status mode. Either `Alarm` or `No Alrm` is displayed.

Acknowledging Alarms — The alarm acknowledge function can be configured as Auto or Manual. In Auto, all evidence of the alarm clears when the alarm condition no longer exists. In Manual, the alarm must be acknowledged manually.

Three methods are available to acknowledge alarms when they are configured for manual acknowledgment. These methods are effective only after the condition that caused the alarm no longer exists. The methods are:

- Using the local keypad in Status mode. See “Status Mode” on page 66 for details.
- Using the HART Communicator or Modbus protocol.
- Using an external contact if the contact input was configured to acknowledge alarms and diagnostics.

NOTE

A power cycle also acknowledges the alarms.

Diagnostic Actions

Conditions That Can Be Diagnosed

- Process conditions which preclude a valid measurement
- Hardware issue (transmitter, flowtube, and wiring)
- Invalid configuration

Actions of Transmitter During Diagnostic Conditions

Display — When a diagnostic condition is present, the entire display can be configured to blink or not blink.

Outputs — If a diagnostic condition exists, the transmitter can not reliably compute flowrate. Therefore, the transmitter flowrate outputs go fully upscale, fully downscale, or are held at the last value depending on the configuration.

Status Mode — The Status mode can be helpful in identifying a diagnostic condition. The `Diag` window in Status mode gives an error code and the runtime the diagnostic condition occurred. This time is presented as the total number of hours the transmitter has been powered. A history is given for up to 10 conditions. Once the limit of 10 is reached, the oldest diagnostic is dropped and the new one added. The interpretation of this code and possible corrective actions is given “Error Codes” on page 195.

Acknowledging Diagnostics — The diagnostic acknowledge function can be configured as Auto or Manual. In Auto, all evidence of the diagnostic message clears when the diagnostic condition no longer exists. In Manual, the diagnostic message must be acknowledged manually.

Three methods are available to acknowledge diagnostics when they are configured for manual acknowledgment. These methods are effective only after the diagnostic condition no longer exists. The methods are:

- Using the local keypad in Status mode. See “Status Mode” on page 66 for details.
- Using the HART Communicator or Modbus protocol.
- Using an external contact if the contact input was configured to acknowledge alarms and diagnostics.

NOTE

A power cycle also acknowledges the diagnostic.

View Mode

The View mode enables you to view the identity parameters. You can not edit them in this mode. To step through the list of the following parameters, use the Up and Down arrow keys.

Figure 44. View Mode Structure Diagram - HART Communication Protocol

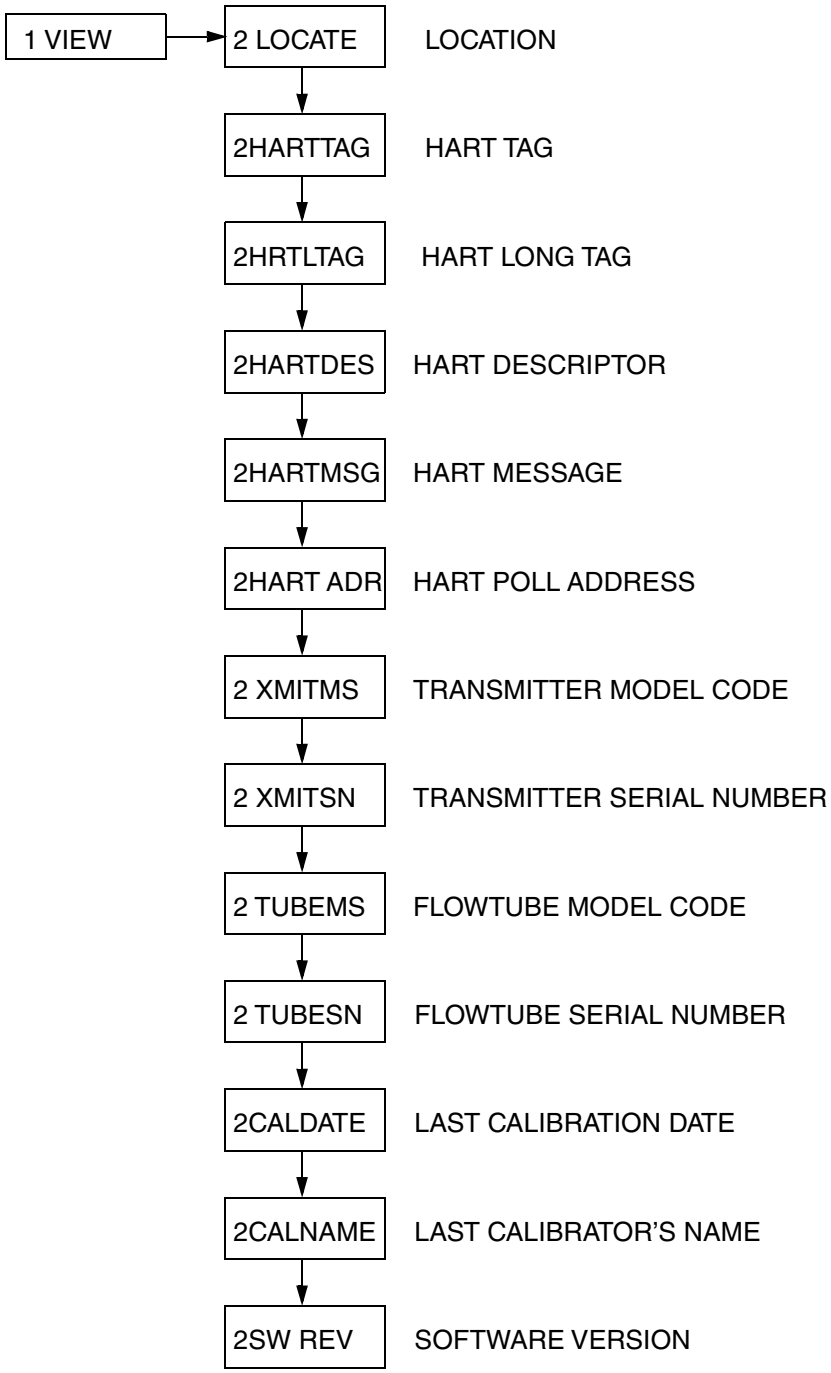
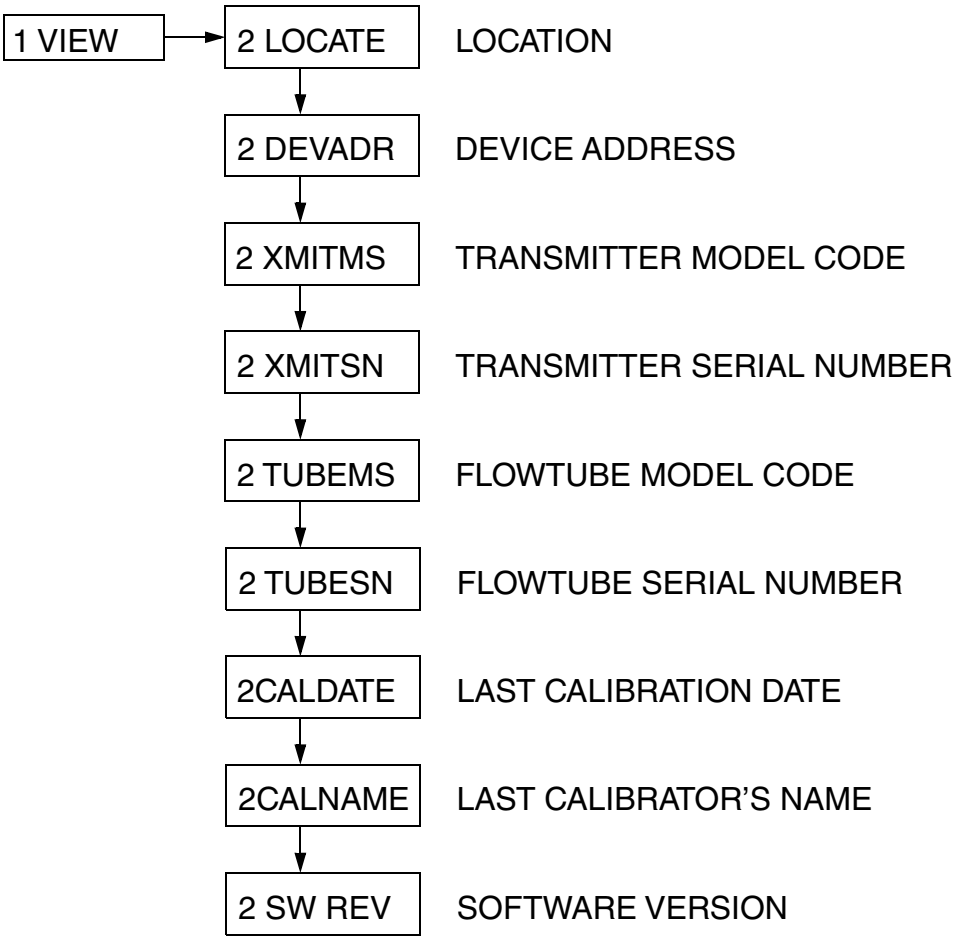


Figure 45. View Mode Structure Diagram - Modbus Protocol



Setup Mode

Refer to "Setup" on page 151.

5. Operation with HART Protocol

The CFT51 is compliant with HART versions 5, 6, and 7. Select the desired HART version in the System menu in Setup.

The Device Description (DD) with full instrument support can be downloaded from the Global Customer Support website (refer to the back page for the address).

Using the HART Communicator

A HART Communicator can only be used with Current Output 1. Current Output 1 is always available on Terminals 4 and 5.

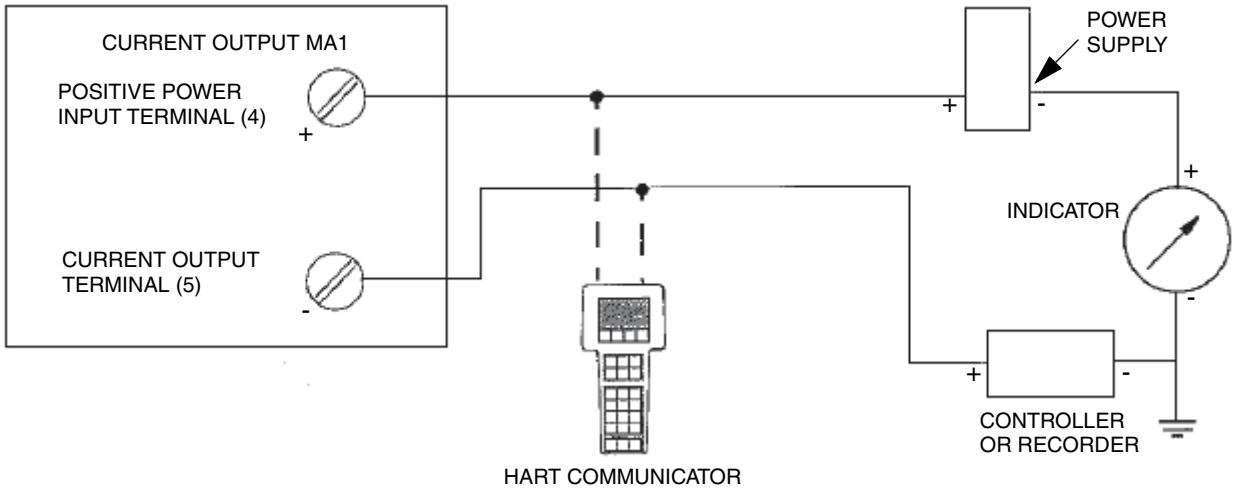
NOTE

Current Outputs 2 and 3 do not support HART communication.

Connecting the HART Communicator

Connect your HART Communicator any place in the loop between the transmitter and the power supply per Figure 46. Note that a minimum of 250 Ω must separate the power supply from the HART Communicator.

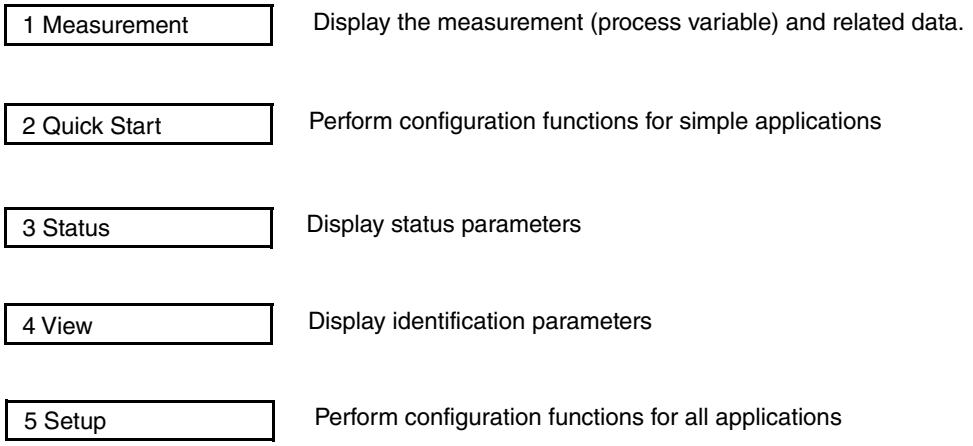
Figure 46. Connection of HART Communicator (MA1 Only)



Overview of Top Level Menus

Figure 47 shows the top level Online menu for the CFT51 Transmitter.

Figure 47. CFT51 Transmitter Top Level Online Menu



Communicator Keyboard and Display

Refer to MAN 4250 supplied with the communicator.

Offline Configuration

The offline configuration feature is not available at this time.

Online Operation

Use Online mode to:

- Monitor `Measurement` values
- Perform a `Quick Start` procedure (for some applications)
- Display `Status` of various system parameters
- `View` various identity parameters
- Perform a `Setup` procedure (for any application).

mA Calibration Procedure Using the HART Communication Protocol

The front panel menu for mA cal requires that you complete the entry of the measured values at both 4 mA and 20 mA points.

1. Enter the measured value at the 4 mA point to initiate the sequence.
2. Enter the value for 20 mA, which will calculate new offset and span calibration values and store them in the database for that particular mA output.

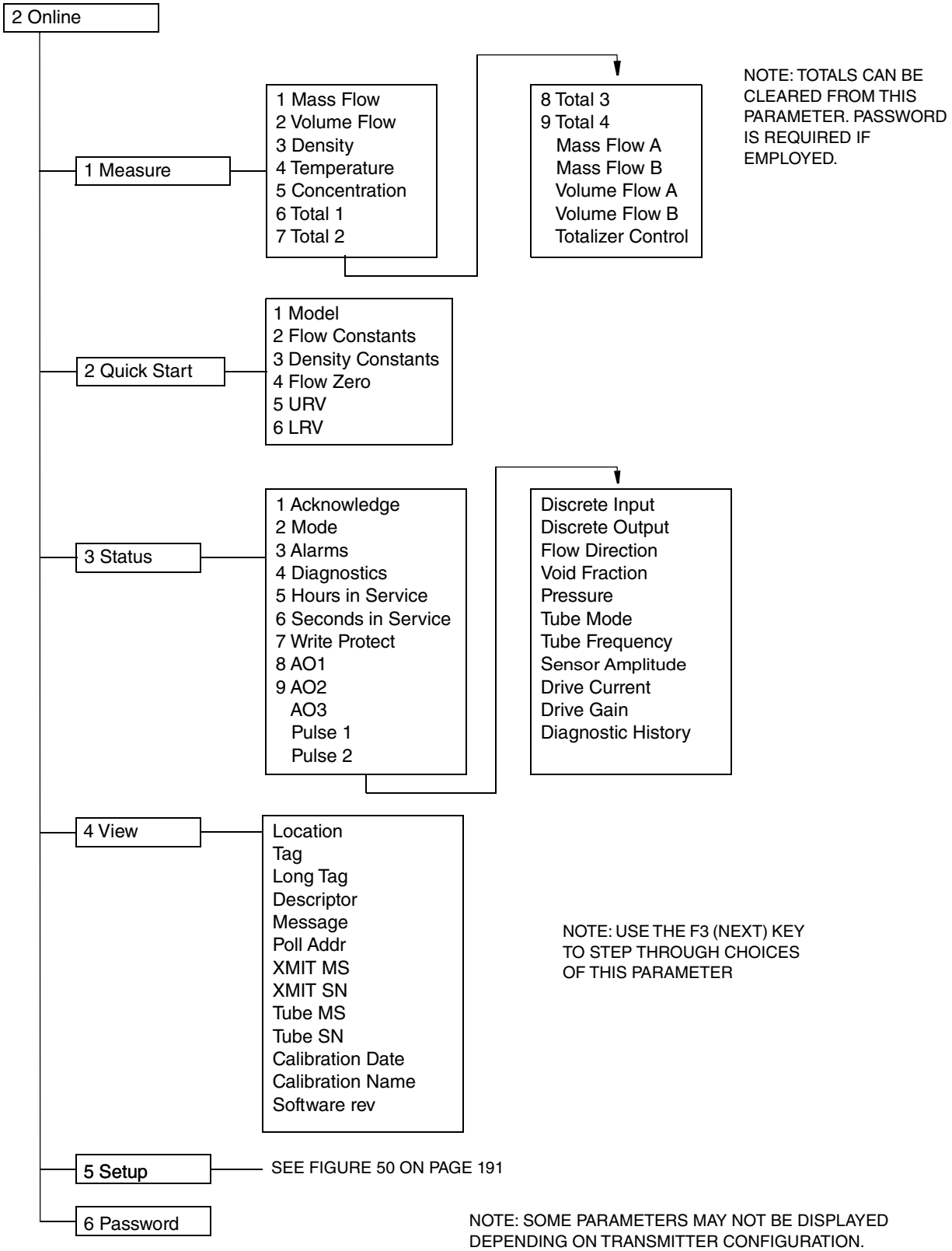
   Now you can toggle back and forth between the 4 mA and 20 mA menu choices (without making a change) and see the result of the changes.

NOTE

At either point, the default value can be cursored through and entered if the measured value is acceptable.

Online Flowchart

Figure 48. HART Online Flowchart



Explanation of Online Parameters

Parameter	Explanation
Measure Mode	
Mass Flow	Shows the value of mass flow
Volume Flow	Shows the value of volume flow
Density	Shows the value of density
Temperature	Shows the value of temperature
Concentration	Shows the value of concentration
Total 1, 2, 3, 4	Shows the value of total 1, 2, 3, 4
Mass Flow A, Mass Flow B, Volume Flow A, Volume Flow B	Shows the value of mass flow A, mass flow B, volume flow A, volume flow B
Totalizer Control	Ability to start, stop, or reset the selected total
Quick Start Mode	
Model	Used to select the flowtube size and material
Flow Constant	Used to enter the flowtube flow constants
Density Constant	Used to enter the flowtube density constants
Flow zero	Used to zero the transmitter
URV	Used to set the upper range value
LRV	Used to set the lower range value
Status Mode	
Acknowledge	Ability to acknowledge alarm and diagnostic conditions
Mode	Shows the mode as online or offline
Alarms	Shows the alarm status
Diagnostics	Shows the diagnostic status
Hours in Service	Shows the number of hours the device has been in service
Seconds in Service	Shows the number of seconds the device has been in service
Write Protect	Shows if write protection is On or Off
AO1, AO2, and AO3	Shows the analog output values
Pulse 1	Shows the pulse 1 output value
Pulse 2	Shows the pulse 2 output value
Flow Direction	Shows the flow direction (forward or reverse)
Discrete Input	Shows the contact in state
Discrete Output	Shows the contact out function
Tube Mode	Shows the flowtube mode (offline, startup, or normal)
Tube Frequency	Shows the flowtube frequency value
Sensor Amplitude	Shows the sensor amplitude value
Drive Current	Shows the drive current value
Void Fraction	Shows the void fraction in percent
Drive Gain	Shows the drive gain
Pressure	Shows the pressure
Diagnostic History	Shows the diagnostic history (not available at this time)
View Mode	
Location	Shows location of the transmitter
Tag	Shows the tag (if any)
Long Tag	Shows the long tag (if any)

Parameter	Explanation
Descriptor	Shows the HART descriptor (if any)
Message	Shows the HART message (if any)
Poll Addr	Shows the polling address
XMIT MS	Shows the transmitter model number
XMIT SN	Shows the transmitter serial number
Tube MS	Shows the flowtube model number
Tube SN	Shows the flowtube serial number
Calibration Date	Shows the date of the last calibration
Calibration Name	Shows the name of the person who performed the last calibration
Software rev	Shows the software version
Password	Used to enter the password

NOTE

See page 192 for an explanation of the Setup parameters.

6. Operation with Modbus Protocol

This section describes Modbus protocols used to communicate with the CFT51 Transmitter and the parameters that are assigned to Modbus registers.

The Modbus registers used are listed and described in two ways. First the Modbus registers are described in groups of related transmitter data, and secondly a complete sequential listing of all registers used is given.

Modbus Communication Overview

Modbus Protocols

RTU Modbus is a binary protocol that uses serial communications for data transfer. Multiple devices may be addressed on a single RS485 network. A set of Modbus commands are used to read from and write to registers containing data. Both RTU formatted commands and responses are protected by a 16 bit CRC. This protocol is supported by the CFT51.

The following protocols are not supported by the CFT51:

- Modbus ASCII
- Modbus/TCP
- Modbus/UDP
- Modbus RTU in TCP Message Format
- Modbus RTU in UDP Communication Mode

Modbus Function Codes

Modbus Commands

Modbus commands and responses are limited to a total of 256 bytes in size. The following table lists the Modbus function codes or commands supported by the CFT51 transmitter.

Code	Command	Description
01	Read Coils	Read multiple coils.
02	Read Discrete Inputs	Read multiple discrete inputs.
03	Read Holding Registers	Read the contents of multiple holding registers.
04	Read Input Registers	Read the contents of multiple input registers.
05	Write Single Coil	Set a single coil On or Off.
06	Preset Single Register	Change the contents of a single holding register.
08	Diagnostics	Perform diagnostic tests and return communication status information.
15	Write Multiple Coils	Set multiple coils On or Off.
16	Preset Multiple Registers	Change the contents of multiple holding registers.
17	Report Slave ID	Read device specific identification.

Read/Write Registers consist of two bytes of data in MSB-LSB (most significant byte-least significant byte) order. A Modbus read multiple registers command can access a contiguous block of registers (1 to 125) in one transaction. A Modbus preset multiple registers command can write a contiguous block of registers (1 to 123) in a single transaction. Note that the maximum register count is reduced by 1 when accessing floating point values.

For more information on the protocol, refer to the Modbus application protocol specification which can be downloaded from the Modbus website (http://www.modbus-ida.org/specs.php).

Diagnostic Command Options Supported

The following table lists the Modbus diagnostic function codes or commands supported by the CFT51 transmitter.

Diagnostic Option Code	Description
0	Return query data. (Heartbeat; forces slave to loopback this command as sent)
1	Restart communications interface. (Performs a complete reset of the communication interface in the slave)
4	Force listen only mode. (Slave will ignore all messages sent to it until a restart communications command is received. This can be used to take a problem device off the communications bus)
10	Clear all communication counters.
11	Return *bus message* count.
12	Return *bus communication error* count.
13	Return *bus exception error* count.
14	Return *slave message* count.
15	Return *slave no response* count.
16	Return *slave NAK* count.
17	Return *slave busy* count.
18	Return *bus character overrun* count.

Communication Counter Definitions

Bus message	Count of all Modbus messages read on the communications bus.
Bus communication error	Count of CRC errors encountered by Slave.
Bus exception error	Count of all exception responses returned by Slave.
Slave message	*C*ount of Modbus messages addressed to this Slave device.
Slave no response	Count of instances where Slave did not return a response.
Slave NAK	Count of NAK (Negative/Not Acknowledged) responses sent by the Slave.
Slave busy	Count of instances where the Slave could not perform the requested action because it was busy.
Bus character overrun	Count of bytes lost by Slave.

Modbus Communication Configurations

Baudrates

1200, 2400, 4800, 9600 (default), 19200, 34800

Parity

none (default), even, and odd

Byte Format

0 MSW_LSW

1 LSW_MSW (default)

2 RMSW_RLSW

3 RLSW_RMSW

where: MSW = Most significant word (MSB-LSB)

LSW = Least significant word (MSB-LSB)

RMSW = Most significant word with reversed bytes (LSB-MSB)

RLSW = Least significant word with reversed bytes (LSB-MSB)

Station Addressing

Device Address: 1-247.

Device Address 0 is used for broadcast commands. 247 is the default.

Data Formats

Data Type	Registers Required	Description
Integer	1	Unsigned integer in the range 0 to 65535.
Float	2	Numbers are made up of one sign bit (S), eight exponent bits (E), and twenty-three mantissa bits (M). A number consists of 4 bytes as shown below. Byte A SEEE EEEE Byte B EMMM MMMM Byte C MMMM MMMM Byte D MMMM MMMM Floating-point values are stored in two consecutive registers. Both registers must be read or written in the same Modbus command. Not doing so results in an exception response.
ASCII	1	Two ASCII characters are stored in each register.

Controlling Access to the Configuration Database

Access to the configuration database can be optionally controlled using any combination of the following methods.

Hardware Write Protect

A jumper on the CPU PWA can be set to disable all changes to the transmitter configuration attempted from both the local display and the communications interface. This feature is usually used in custody transfer applications or when you want, for another reason, to help ensure that the configuration and or totals are not changed.

This method requires partial disassembly of the CFT51 to gain access to the jumper and cannot be overridden. See “Write Protect Jumper” on page 52. The jumper is usually placed in the “disable” position (factory default position). Placing the jumper in the “enable” position engages the protection. When write protect is enabled, Modbus registers are read-only. (When write-protect is disabled, the read/write ability corresponds to the `Modbus Register Database` table.)

NOTE

A change in write protection does not take effect until power is turned off, the write protect jumper moved, and power turned on again.

Software Passwords

Controlled access to configuration changes can be made by enabling the password capability in the transmitter. Passwords, once enabled, control configuration modifications from both the local display and the communication interface.

Mechanical Protection

Additional mechanical means such as a lock out seal may be employed to control access to this transmitter.

Modbus Registers

This section of the manual describes some of the CFT51 Transmitter parameters that are assigned to Modbus registers. The registers described are divided into categories for ease of reference. See “Modbus Register Database” on page 133 for a complete listing of CFT51 transmitter Modbus registers in numerical order.

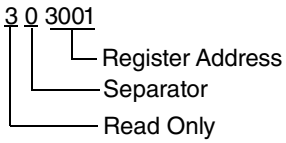
Format of listing registers in this section: #. Register Name (Register address)

NOTE

The normal practice when documenting Modbus register maps is that all register numbers are defined to be 1 based. Modbus host software that follows this convention will automatically subtract 1 from any register number before sending it in a command to a remote device. If the host software that is in use does not perform this function, then register numbers must have 1 subtracted from them before they are used.

Address

The register address is a four digit number. In the presentation in this document, the number is preceded by a 3 or a 4 and a separator (0) to indicate Read Only and Read/Write respectively. For example, 40xxxx is Read/Write and 30xxxx is Read only.



Access Information

Access Status (303581)

The Access Status register holds integer values. This register is read-only.

Access Level: *(for register 303581)*

0	Full Access	
1	Limited Access	Only totalizers can be modified, that is, passwords are in use and a low level password has been entered.
2	PWD Needed	A password is required before configuration changes can be made.
3	UI has lock	The keypad/display is in use. No changes can be made from the communication interface.
4	Remote has lock	Communication interface is in use. No changes can be made from the keypad/display.
5	DB busy	CFT51 is temporarily busy.
6	Write Protect enabled	Hardware write protect has been enabled.

Password Entry (404176-404178)

Password Entry registers (404176-404178) hold ASCII characters. Enter the six alphanumeric characters of your password in these Read/Write registers.

Dynamic Measurements

Standard Measurement

Standard measurement registers (303001-303010) hold floating-point values of the measurements. These registers are read-only and will change as updated measurements change.

1. Mass Flow (303001-303002)
   Shows current mass flow rate (forward or reverse) in the selected engineering units.
2. Volumetric Flow (303003-303004)
   Shows current volume flow rate (forward or reverse) in the selected engineering units.
3. Density (303005-303006)
   Shows current density in the selected engineering units.
4. Process temperature (303007-303008)
   Shows current process temperature in the selected engineering units.
5. Concentration (303009-303010)
   Shows current percent concentration.

Uncorrected Measurement Values

Uncorrected measurement registers (303027-303032) hold floating-point values of raw measurements. These registers are read-only and can change as updated measurements change.

1. Uncorrected Mass Flow (303027-303028)
2. Uncorrected Density (303029-303030)
3. Uncorrected Volume Flow (303031-303032)

Component Flow Rate Values

Component flow rate registers (303011-303018) hold floating-point values of the mass and volume flow for components A and B. These registers are read-only and can change as updated measurements change.

These registers show the current mass or volume flow rate (forward or reverse) in the selected engineering units.

1. Mass Flow A (303011-303012)
2. Mass Flow B (303013-303014)
3. Volume Flow A (303015-303016)
4. Volume Flow B (303017-303018)

Totalizer Value

Totalizer Value registers (303019-303026) hold floating-point values of the totalizers 1-4. These registers are read-only and can change as updated measurements change.

These registers show current totals in the selected engineering units.

1. Totalizer 1 (303019-303020)
2. Totalizer 2 (303021-303022)
3. Totalizer 3 (303023-303024)
4. Totalizer 4 (303025-303026)

NOTE

You need to reset single precision totalizers occasionally or risk a loss of resolution.

Measurement EGU Labels

EGU label registers (303992-3034030) hold ASCII characters (6 characters for each label). These registers are read-only.

1. Mass Flow Label (303992-303994)
2. Volumetric Flow Label (303995-303997)
3. Density Label (303998-304000)
4. Process Temperature Label (304001-304003)
5. Concentration Label (304004-304006)
6. Mass Flow A Label (304007-304009)
7. Mass Flow B Label (304010-304012)
8. Volume Flow A Label (304013-304015)
9. Volume Flow B Label (304016-304018)
10. Totalizer 1 Label (304019-304021)
11. Totalizer 2 Label (304022-304024)
12. Totalizer 3 Label (304025-304027)
13. Totalizer 4 Label (304028-304030)

Status Information

The status mode enables a number of system parameters to be viewed and thus the performance of the loop assessed. However, status parameters cannot be modified.

Tube Status

Most tube status registers (303033-303042) hold floating-point values. Register 303506 holds an integer.

Floating-Point

1. Drive Gain (303033-303034) Typical range is 0.3 to 2, depending on the tube mode.
2. Tube Frequency (303035-303036) (in hertz)
3. Sensor Amplitude (303037-303038) (in volts)
4. Drive Current (303039-303040) (in amperes) (ac)
5. Void Fraction (303041-303042) (in percent)

The available options for determining the tube mode are found under **Tube Mode Choices**.

Integer

6. Tube Mode (303506)

   Tube Mode Choices: *(for register 303506)*

   0 – Offline
   1 – Tube is starting up
   2 – Tube is in normal mode
   3 – Tube is in normal mode with 2-phase conditions detected

7. Tube Phase Difference (303073-303074)
8. Pressure (303079-303080)

   The pressure value used in the pressure compensation of the mass flow and density measurements.

Transmitter Status

Registers (303501-303505) hold integer values. Registers (303043-303050) hold floating-point values. mA Output values are measured in mA, and the pulse output values are in hertz. These registers are read-only.

Integers

1. Transmitter Runtime in hours (303501-303502)

The possible settings for the following transmitter status parameters are found under **Transmitter Status Choices**.

2. Write Protect (303503)
3. Din State (303504)
4. Dout State (303505)

   Transmitter Status Choices: *(for registers 303503-303505)*

   0 Off

   1 On

5. Change Counter (303511)
   Increments each time a change is made to the configuration.
6. Operating Status (303585)

   0 Normal operation

   32 A power cycle or reset has occurred; a read will clear the value

   128 Device malfunction

Floating-Point

7. mA Output 1 Value (303043-303044)
8. mA Output 2 Value (303045-303046)
9. mA Output 3 Value (303081-303082)
10. Pulse Output 1 Value (303047-303048)
11. Pulse Output 2 Value (303049-303050)

Tube Settings

Registers (303601, 303507) hold integer values, and registers (303051-303064) hold floating point values. These registers are read-only.

Integers

1. Tube Selection (303601)
2. User Calibrated Density In Use (303507)

Floating Point

3. Flow Constant FC1 (303051-303052)
4. Flow Constant FC2 (303053-303054)
5. Flow Constant FC3 (303055-303056)
6. Density Constant DC1 (303057-303058)
7. Density Constant DC2 (303059-303060)
8. Density Constant DC3 (303061-303062)
9. Density Constant DC4 (303063-303064)

Measurement Status

1. Concentration (303586)

    0 = Bad configuration

    1 = Bad input

    2 = Output hard limit exceeded

    3 = Output soft limit exceeded

    4 = Output is fixed

    5 = OK

Alarm Status

In Alarm status, you can determine the number and type of alarms for each measurement. You can also clear all alarms manually. These registers hold integer values. These registers are read-only, except acknowledge alarms, which is read/write.

1. Acknowledge Alarms (403864)

   0 = No

   1 = Yes (returns to 0 after being executed)

2. Number of Active Alarms (303512)

The possible settings for alarm status parameters are found under **Alarm Flag Options**.

3. Mass Flow Measurement Alarm (303513)
4. Volumetric Flow Measurement Alarm (303514)
5. Density measurement Alarm (303515)
6. Process Temperature Measurement Alarm (303516)
7. Concentration Measurement Alarm (303517)
8. Mass Flow A Measurement Alarm (303518)
9. Mass Flow B Measurement Alarm (303519)
10. Volume Flow A Measurement Alarm (303520)
11. Volume Flow B Measurement Alarm (303521)
12. Totalizer 1 Measurement Alarm (303522)
13. Totalizer 2 Measurement Alarm (303523)
14. Totalizer 3 Measurement Alarm (303524)
15. Totalizer 4 Measurement Alarm (303525)

Alarm Flag Options *(for registers 303513-303525)*

0 No Alarms

1 Lo Alarm

2 Hi Alarm

3 Hi and Lo Alarm

Diagnostic Status

In Diagnostic Status, you can view the diagnostic history of the transmitter. You can also acknowledge an active diagnostic manually. All these registers hold integer values.

These registers are read-only, except acknowledge diagnostics, which is read/write.

1. Acknowledge Diagnostics (403863)

   0 = No
   1 = Yes (returns to 0 after being executed)
2. Active Diagnostics (303526)
3. Diagnostic #1, Time (303527-303528)
4. Diagnostic #1, Data (303530)
5. Diagnostic #2, Time (303531-303532)
6. Diagnostic #2, Data (303534)
7. Diagnostic #3, Time (303535-303536)
8. Diagnostic #3, Data (303538)
9. Diagnostic #4, Time (303539-303540)
10. Diagnostic #4, Data (303542)
11. Diagnostic #5, Time (303543-303544)
12. Diagnostic #5, Data (303546)
13. Diagnostic #6, Time (303547-303548)
14. Diagnostic #6, Data (303550)
15. Diagnostic #7, Time (303551-303552)
16. Diagnostic #7, Data (303554)
17. Diagnostic #8, Time (303555-303556)
18. Diagnostic #8, Data (303558)
19. Diagnostic #9, Time (303559-303560)
20. Diagnostic #9, Data (303562)
21. Diagnostic #10, Time (303563-303564)
22. Diagnostic #10, Data (303566)

The meaning of the diagnostic codes are explained under **Diagnostic Code**.

23. Diagnostic #1, Code (303529)
24. Diagnostic #2, Code (303533)
25. Diagnostic #3, Code (303537)
26. Diagnostic #4, Code (303541)
27. Diagnostic #5, Code (303545)
28. Diagnostic #6, Code (303549)
29. Diagnostic #7, Code (303553)

30. Diagnostic #8, Code (303557)
31. Diagnostic #9, Code (303561)
32. Diagnostic #10, Code (303565)

Diagnostic Code *(for registers 303529, 303533, 303537, 303541, 303545, 303549, 303553, 303557, 303561, 303565)*

0	No Diagnostic
200	Problem with the first tube input sensor due to wiring or failure
201	Problem with second tube input sensor due to wiring failure
202	Problem with first drive output due to wiring or failure
203	Problem with second drive output due to wiring or failure
204	RTD resistance is out of range, there is a wiring error, or the electronics have failed
205	Flowtube cannot be controlled
208	A parameter is out of range

Status Counters

Status counter registers hold integer values. The Clear Modbus counters register is read/write, while the rest of the status counter registers are read-only.

1. Clear Modbus counters (403865)

   0 = No

   1 = Yes (returns to 0 after being executed)
2. Modbus bus messages received (303567)
3. CRC error count (303568)

   (CRC = cyclic redundancy check)
4. Command Exceptions (303569)
5. Slave Message Count (303570)
6. No response count (303571)
7. NAK count (303572)
   (NAK = Negative/Not Acknowledge)
8. Slave busy count (303573)
9. Serial Character buffer overrun (303574)
10. Timeout count (303575)
11. Illegal function request (303576)
12. Illegal data request (303577)
13. Illegal address request (303578)

Tags

The Tube MS Code, Tube Serial Number, Location, Calibration Name, and Calibration Date registers are read/write, and the Transmitter MS Code and Transmitter Serial Number registers are read-only. All these registers hold ASCII characters.

1. Xmitter MS Code (303971-303978) Model code as ordered.
2. Xmitter Serial Number (303979-303986) Number assigned when manufactured.
3. Tube MS Code (404095-404105)

   The Tube Model Code is a reference identifier of the model code of the flowtube being used with your transmitter. It does not control the operation of the transmitter. Specify up to 32 alphanumeric characters.
4. Tube Serial Number (404106-404113)

   The Tube Serial Number is a reference identifier of the serial number of the flowtube being used with your transmitter. It does not control the operation of the transmitter. Specify up to 16 alphanumeric characters.
5. Location (404114-404120)

   This parameter is available to document the location of the transmitter. This parameter performs no control function. When entering this data, specify up to 14 alphanumeric characters.
6. Calibration Name (404121-404123)

   Enter the name of the calibrator in 6 alphanumeric characters or less.
7. Calibration Date (404124-404127)

   Enter the date of the calibration in the form YYYYMMDD.

Configuration Parameters

The CFT51 Transmitter with Modbus communication can be configured from a Modbus host or with the keypad/display option. However, you cannot configure the transmitter from both simultaneously. If you are configuring the transmitter from the keypad/display, you cannot make changes through Modbus or vice-versa.

NOTE

If write protection is enabled, the configuration cannot be modified. To disable write protection, you must first turn power off, move the write protect jumper to the disable position, and then turn power back on.

Measurement Parameters

These measurement registers are read/write.

In order to configure each register, enter the number to the left of the options under **EGU Choices**. Choices are specific to a particular measurement.

The available options for determining the mass units can be selected by entering the number to the left of the options under **Mass EGU Choices**.

Integer

1. Mass Flow Unit Code (403611)
2. Mass Flow Component A Unit Code (403616)
3. Mass Flow Component B Unit Code (403617)

Mass EGU Choices: (*for registers 403611, 403616, 403617)*

1 Grams per Second (G/SEC)
2 Grams per Minute (G/MIN)
3 Grams per Hour (G/HR)
4 Grams per Day (G/D)
5 Kilograms per Second (KG/S)
6 Kilograms per Minute (KG/M)
7 Kilograms per Hour (KG/H)
8 Kilograms per Day (KG/D)
9 Pounds per Second (LB/S)
10 Pounds per Minute (LB/M)
11 Pounds per Hour (LB/H)
12 Pounds per Day (LB/D)
13 Ounces per Second (OZ/S)
14 Ounces per Minute (OZ/M)
15 Ounces per Hour (OZ/H)
16 Ounces per Day (OZ/D)
17 Short Tons (2000 pounds) per Second (ST/S)
18 Short Tons (2000 pounds) per Minute (ST/M)
19 Short Tons (2000 pounds) per Hour (ST/H)
20 Short Tons (2000 pounds) per Day (ST/D)
21 Metric Tonnes (1000 kg) per Minute (MT/M)
22 Metric Tonnes (1000 kg) per Hour (MT/H)
23 Metric Tonnes (1000 kg) per Day (MT/D)
253 Custom Units (CUSTOM)

If you select 253 (custom units), you must define your custom units in **the following** registers:

Floating-Point

4. Mass Flow Custom Slope (403131-403132)
5. Mass Flow Custom Offset (403133-403134)
6. Mass Flow A Custom Slope (403143-403144)
7. Mass Flow A Custom Offset (403145-403146)
8. Mass Flow B Custom Slope (403147-403148)
9. Mass Flow B Custom Offset (403149-403150)

ASCII

10. Mass Flow Custom Name (404128-404130)
11. Mass Flow A Custom Name (404137-404139)
12. Mass Flow B Custom Name (404140-404142)

First, enter a name for your custom units using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (slope) from kilograms per second to the custom units.

The available options for determining the volume units can be selected by entering the number to the left of the options under **Volume EGU Choices**.

Integer

13. Volume Flow Unit Code (403612)
14. Volume Flow Component A Unit Code (403618)
15. Volume Flow Component B Unit Code (403619)

Volume EGU Choices: *(for registers 403612, 403618, 343619)*

1 Liters per Second (L/S)
2 Liters per Minute (L/M)
3 Liters per Hour (L/H)
4 Liters per Day (L/D)
5 US Gallons per Second (USG/S)
6 US Gallons per Minute (USG/M)
7 US Gallons per Hour (USG/H)
8 US Gallons per Day (USG/D)
9 Imperial Gallons per Second (IMPG/S)
10 Imperial Gallons per Minute (IMPG/M)
11 Imperial Gallons per Hour (IMPG/H)
12 Imperial Gallons per Day (IMPG/D)
13 Barrels (42 gal) per Second (BBL/S)
14 Barrels (42 gal) per Minute (BBL/M)
15 Barrels (42 gal) per Hour (BBL/H)

16 Barrels (42 gal) per Day (BBL/D)

17 Cubic Meters per Second (M3/S)

18 Cubic Meters per Minute (M3/M)

19 Cubic Meters per Hour (M3/H)

20 Cubic Meters per Day (M3/D)

21 Cubic Feet per Second (FT3/S)

22 Cubic Feet per Minute (FT3/M)

23 Cubic Feet per Hour (FT3/H)

24 Cubic Feet per Day (FT3/D)

253 Custom Units (CUSTOM)

If you select 253 (custom units), you must define your custom units in the following registers:

Floating-Point

16. Volume Flow Custom Slope (403135-403136)
17. Volume Flow Custom Offset (403137-403138)
18. Volume Flow A Custom Slope (403151-403152)
19. Volume Flow A Custom Offset (403153-403154)
20. Volume Flow B Custom Slope (403155-403156)
21. Volume Flow B Custom Offset (403157-403158)

ASCII

22. Volume Flow Custom Name (404131-404133)
23. Volume Flow A Custom Name (404143-404145)
24. Volume Flow B Custom Name (404146-404148)

First, enter a name for your custom units using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (slope) from liters per second to the custom units.

The available options for determining the density units can be selected by entering the number to the left of the options under **Density EGU Choices**.

Integer

25. Density Unit Code (403613)

Density EGU Choices: (*for register 403613)*

1 Specific Gravity (SG) (water at 60°F)

3 Kilograms per Cubic Meter (KG/M3)

7 Kilograms per Liter (KG/L)

4 Pounds per Gallon (LB/G)

5 Pounds per Cubic Foot (LB/FT3)

9 Pounds per Cubic Inch (LB/IN3)

6 Grams per Milliliter (G/ML)

2 Grams per Cubic Centimeter (G/CC)

8 Grams per Liter (G/L)

10 Short Tons (2000 pounds) per Cubic Yard (ST/YD3)

253 Custom Units (CUSTOM)

If you select 253 (custom units), you must define your custom units in the following registers:

Floating-Point

26. Density Custom Slope (403139-403140)

27. Density Custom Offset (403141-403142)

ASCII

28. Density Custom Name (404134-404136)

First, enter a name for your custom units using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (slope) from kilograms per cubic meter to the custom units.

The available options for determining the process temperature units can be selected by entering the number to the left of the options under **Temperature EGU Choices**.

Integer

29. Process Temperature Unit Code (403614)

Temperature EGU Choices: *(for register 403614)*

1 Degrees C (C)
2 Degrees F (F)

The available options for determining the concentration units can be selected by entering the number to the left of the options under **Concentration EGU Choices**.

Integer

30. Concentration Unit Code (403615)

Concentration EGU Choices: *(for register 403615)*

1 Percent Solids by Weight (%WT)
2 Percent Solids by Volume (%VOL)
3 Proof (PROOF)
7 Degrees Brix (BRIX)
8 Degrees Baumé (BAUME)
10 Percent Solute (%)
253Custom (CUSTOM)

NOTE

1. If you select **Percent by Weight** or **Percent by Volume**, the component to be measured is specified as component **A** or **B**. Refer to "Component Measurements" on page 116.
2. When 2-phase compensation is turned on, only **Percent by Weight** and **Percent by Volume** units are available for concentration measurement. Conversely, if **Degrees Brix**, **Degrees Baumé**, **Percent Solute**, or **Proof** concentration units are specified, 2-phase compensation is not available.

31. Concentration Type (403728) for the BAUME unit code

    Concentration Type choices:

    0 Corn starch

32. Concentration Type (403729) for the BRIX unit code

    Concentration Type choices:

    0 Sucrose
    1 HFCS-42 (high fructose corn syrup, 42% fructose)
    2 HFCS-55 (high fructose corn syrup, 55% fructose)

33. Concentration Type (403730) for the % (Solute) unit code

    Concentration Type choices:

    0 Alcohol volume (60°F)
    1 Alcohol volume (20°C)
    2 Alcohol mass

34. Concentration Type (403731) for the PROOF unit code

    Concentration Type choices:

    0 Alcohol volume (60°F)

35. Concentration Custom Name (404179-404181)

    Enter a name, up to six alphanumeric characters, for your custom units.

36. Concentration Custom Equation (404182-404187)

    Enter the 12-character code for your custom equation.

NOTE

Contact Global Customer Support for assistance in defining custom equations.

37. Coefficient Count (403732)

    Enter the number of custom concentration coefficients.

38. Concentration Custom Coefficients (403329-403368)

Enter up to 20 coefficient values.

Coefficient 1 (403329-403330)

Coefficient 2 (403331-403332)

Coefficient 3 (403333-403334)

Coefficient 4 (403335-403336)

Coefficient 5 (403337-403338)

Coefficient 6 (403339-403340)

Coefficient 7 (403341-403342)

Coefficient 8 (403343-403344)

Coefficient 9 (403345-403346)

Coefficient 10 (403347-403348)

Coefficient 11 (403349-403350)

Coefficient 12 (403351-403352)

Coefficient 13 (403353-403354)

Coefficient 14 (403355-403356)

Coefficient 15 (403357-403358)

Coefficient 16 (403359-403360)

Coefficient 17 (403361-403362)

Coefficient 18 (403363-403364)

Coefficient 19 (403365-403366)

Coefficient 20 (403367-403368)

The available options for determining the averaging time for the dynamic measurement registers can be selected by entering the number to the left of the options under **Measurement Filter Control**.

39. Measurement Filter Control (403720)

Measurement Filter Control choices: (*for register 403720)*

0 No averaging

1 0.1 second

2 0.5 second

3 1 second (default)

4 2 seconds

5 5 seconds

Totalizers

Totals 1, 2, 3, 4, and Pulse Total can be turned on, off, or cleared. A password is required if passwords are employed. The high level password is required to clear the grand total. Either (high or low level) password can be used to clear the batch total. Totals 1, 2, 3, and 4 can also be individually cleared by an external contact. An external contact can be used to clear all batch totals or all grand totals as well.

NOTE

If Write Protection is enabled, you cannot clear any totals. To disable write protection, you must first turn power off, move the Write Protect jumper to the disable position, and then turn power back on.

These totalizer registers are read/write.

The available options for determining the mass or volume totalizer units can be selected by entering the number to the left of the options under **Mass EGU Choices and Volume EGU Choices** respectively.

Integer

1. Totalizer 1 Unit Code (403620)
2. Totalizer 2 Unit Code (403624)
3. Totalizer 3 Unit Code (403628)
4. Totalizer 4 Unit Code (403632)

Mass EGU Choices: (f*or registers 403620, 403624, 403628, 403632)*

1 Grams (G)

2 Kilograms (KG)

3 Ounces (OZ)

4 Pounds (LB)

5 Short Tons (2000 pounds) (TON)

6 Metric Tonnes (1000 kg) (MTON)

253 Custom Units (CUSTOM)

Volume EGU Choices: *(for registers 403620, 403624, 403628, 403632)*

21 US Gallons (USG)

22 Imperial Gallons (IMPG)

23 Liters (L)

24 Cubic Feet (FT3)

25 Cubic Meters (M3)

26 Barrels (BBL) (42 gal)

253 Custom Units (CUSTOM)

If you select 253 (custom units), you must define your custom units in the following registers:

Floating-Point

5. Totalizer 1 Custom Slope (403159-403160)
6. Totalizer 1 Custom Offset (403161-403162)
7. Totalizer 2 Custom Slope (403163-403164)
8. Totalizer 2 Custom Offset (403165-403166)
9. Totalizer 3 Custom Slope (403167-403168)
10. Totalizer 3 Custom Offset (403169-403170)
11. Totalizer 4 Custom Slope (403171-403172)
12. Totalizer 4 Custom Offset (403173-403174)

ASCII

13. Totalizer 1 Custom Name (404149-404151)
14. Totalizer 2 Custom Name (404152-404154)
15. Totalizer 3 Custom Name (404155-404157)
16. Totalizer 4 Custom Name (404158-404160)

    First, enter a name for your custom units using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (`slope`) from kilograms for mass and from liters for volume to the custom units. Most applications require the totalizer to begin at zero. In such cases the offset must be zero. If an offset other than zero is entered, clearing the totalizer resets it to the offset value, not zero.

The available options for determining what the totalizer is measuring can be selected by entering the number to the left of the options under **Map Choices**.

Integer

17. Totalizer 1 Map (403621)
18. Totalizer 2 Map (403625)
19. Totalizer 3 Map (403629)
20. Totalizer 4 Map (403633)

    Map Choices: *(for registers 403621, 403625, 403629, 403633)*

    0 Total Mass Flow (Component A plus Component B)

    1 Total Volume Flow (Component A plus Component B)

    14 Mass Flow of Component A

    15 Mass Flow of Component B

    16 Volume Flow of Component A

    17 Volume Flow of Component B

The available options for determining the direction of the flow can be selected by entering the number to the left of the options under **Direction Choices**.

Integer

21. Totalizer 1 Direction (403622)
22. Totalizer 2 Direction (403626)
23. Totalizer 3 Direction (403630)
24. Totalizer 4 Direction (403634)

Direction Choices: *(for registers 403622, 403626, 403630, 403634)*

0 Forward

1 Reverse

2 Bidirectional

NOTE

Bidirectional functionality of totalizers is only possible if flow direction is configured to one of the bidirectional choices.

There are two types of total. **Grand** (requires the high level password to clear the total) and **Batch** (can be cleared using either the high or low level password).

The available options for determining the type of total can be selected by entering the number to the left of the options under **Type Choices**.

Integer

25. Totalizer 1 Type (403623)
26. Totalizer 2 Type (403627)
27. Totalizer 3 Type (403631)
28. Totalizer 4 Type (403635)

Type Choices: *(for registers 403623, 403627, 403631, 403635)*

0 Grand

1 Batch

The available options for determining the use of control can be selected by entering the number to the left of the options under **Totalizer Control Choices**.

Integer

29. Totalizer 1 Control (403859)
30. Totalizer 2 Control (403860)
31. Totalizer 3 Control (403861)
32. Totalizer 4 Control (403862)

Totalizer Control Choices: *(for registers 403859, 403860, 403861, 403862)*

0 Off

1 On

2 Clear (returns to 0 or 1 after being executed)

Output Parameters

Analog Output

Analog output registers hold integer or floating-point values that are read/write.

With the Map parameters, you can map the output to mass flow, volume flow, density, process temperature, mass flow component A, mass flow component B, volume flow component A, or volume flow component B.

The available options for determining what the output is mapped to can be selected by entering the number to the left of the options under **Map Choices**.

Integer

1. Output 1 Map (403662)
2. Output 2 Map (403665)
3. Output 3 Map (403725)

Map Choices: *(for registers 403662, 403665)*

0 Mass Flow

1 Volume Flow

2 Density

3 Process Temperature

10 Concentration

14 Mass Flow Component A

15 Mass Flow Component B

16 Volume Flow Component A

17 Volume Flow Component B

Floating-Point

Set the upper range value and lower range value in the units specified in the Measure Setup parameters.

3. Output 1 URV (403255-403256)
4. Output 2 URV (403261-403262)
5 Output 3 URV (403319-403320)
6. Output 1 LRV (403257-403258)
7. Output 2 LRV (403263-403264)
8. Output 3 LRV (403321-403322)

Specify the damping time that is applied to the analog output. It can be set from 0.0 to 99.9 seconds.

9. Output 1 Damping (403259-403260)
10. Output 2 Damping (403265-403266)
11. Output 3 Damping (403323-403324)

The Alarm/Diagnostic Response parameters allow you to drive the analog output fully downscale or upscale if an alarm/diagnostic condition occurs. You can also choose to hold the output at the last reading. Analog output limits are 3.6 mA and 22.0 mA.

The available options for determining what the output is driven to can be selected by entering the number to the left of the options under **Alarm/Diagnostic Response Choices**.

Integers

12. Output 1 Alarm Response (403663)
13. Output 2 Alarm Response (403666)
14. Output 3 Alarm Response (403726)

Output Alarm: *(for registers 403663, 403666, 403726)*

0 None
1 Fail High
2 Fail Low
3 Hold Last Value

15. Output 1 Diagnostic Response (403664)
16. Output 2 Diagnostic Response (403667)
17. Output 3 Diagnostic Response (403727)

Diagnostic Response Choices: *(for registers 403664, 403667, 403727)*

1 Fail High
2 Fail Low
3 Hold Last Value

Digital I/O Configuration

The transmitter provides a relay output that can be configured to indicate certain alarm and/or diagnostic conditions. Digital I/O registers hold integer values that are read/write.

NOTE

This function applies only to the alarms of those measurements that have been configured to affect the digital output.

The available options for determining the function of the digital input can be selected by entering the number to the left of the options under **Digital Input Function Choices**.

Integer

1. Digital Input Function (403668)

Digital Input Function Choices: *(for register 403668)*

0	Off	(contact input function not enabled)
1	Calibrate Zero	(initiates a zeroing of the transmitter)

NOTE

See “Flow Zero” on page 128 for information on zeroing the transmitter.

2	Signal Lock	(drives outputs to the zero flow condition)
3	Alarm/Diag Ack	(acknowledges an alarm or diagnostic; eliminates need to do this manually)
4	Clear Total1	(resets Total1)
5	Clear Total2	(resets Total2)
6	Clear Total3	(resets Total3)
7	Clear Total4	(resets Total4)
8	Clear Batch Totals	(resets all batch totals)
9	Clear All Totals	(resets all totals)
11	Select a Zero	(selects zero [primary zero [1] = open contact; secondary zero [2] = closed contact])

The available options for determining the function of the digital output can be selected by entering the number to the left of the options under **Digital Output Choices**.

2. Digital Output Function (403669)

Digital Output Choices: *(for register 403669)*

0	Off	the relay output is not used
1	Alarm Active	the relay becomes active when any configured alarm occurs
2	Diag Active	the relay becomes active when a diagnostic condition occurs
3	Alarm/Diag Active	the relay becomes active when a diagnostic condition or any configured alarm occurs

The inactive state of the relay output is the "normal" condition of the relay (the state when the configured condition does not exist).

The available options for specifying the inactive (normal) state of the relay output can be selected by entering the number to the left of the options under **Digital Output Normal State Choices**.

3. Digital Output Normal State (403670)

Digital Output Normal State Choices: *(for register 403670)*

0 Norm Open

1 Norm Closed

Pulse Output

The fast update parameter allows you to disable averaging of the raw measurement to achieve the fastest possible dynamic response.

This parameter can be enabled or disabled by entering the number to the left of the options under **Fast Update Choices**.

Integer

1. Pulse Rate Fast Update Option (403671)

Fast Update Choices *(for register 403671)*

0 Off

1 On

When quadrature is enabled, the two pulse outputs switch from normal independent operation to one where the second pulse output maintains a 90 degree phase offset from the first pulse output.

This parameter can be enabled or disabled by entering the number to the left of the options under **Quadrature Choices**.

2. Pulse Rate Quadrature Mode (403672)

Quadrature Choices *(for register 403672)*

0 Off

1 On

You can set the type of pulse output as **rate** or **total**. These registers are read/write.

The available options for setting the type of pulse output can be selected by entering the number to the left of the options under **Pulse Output Mode Choices**.

3. Pulse 1 Output Mode (403673)
4. Pulse 2 Output Mode (403674)

Pulse Output Mode Choices *(for registers 403673, 403674)*

0 Total

1 Rate

Rate Mode

The available options for setting the scaling method can be selected by entering the number to the left of the options under **Scaling Method Choices**.

5. Pulse 1 Rate Scaling Method (403676)
6. Pulse 2 Rate Scaling Method (403687)

Scaling Method Choices: *(for registers 403676, 403687)*

0 URV

1 Units/Pulse

2 Pulses/Unit

The available options for determining what the output is mapped to can be selected by entering the number to the left of the options under **Map Choices**.

Integer

7. Pulse 1 Rate Map (403675)
8. Pulse 2 Rate Map (403686)

Map Choices: *(for registers 403675, 403686)*

If Scaling Method = URV

0 Mass Flow

1 Volume Flow

2 Density

3 Process Temperature

10 Concentration

14 Mass Flow Component A

15 Mass Flow Component B

16 Volume Flow Component A

17 Volume Flow Component B

If Scaling Method = Units/Pulse or Pulses/Unit:

0 Mass All

1 Volume All

14 Mass Flow Component A

15 Mass Flow Component B

16 Volume Flow Component A

17 Volume Flow Component B

If you select scaling method **URV**: Set the upper range value and lower range value in the units specified in the Measure Setup parameters. Then, set the frequency at the URV and LRV respectively.

NOTE

The slowest rate currently supported in Rate mode is 1.19 Hz.

If you select **Units/Pulse** or **Pulses/Unit**: Specify the units per pulse or the pulses per unit respectively. The value specified must be >0. Then, set the maximum frequency at the URV. The LRV is 0.0 and the minimum frequency is 0 Hz.

Floating-Point

9. Pulse 1 Rate Units per Pulse or Pulses per Unit (403267-403268)
10. Pulse 2 Rate Units per Pulse or Pulses per Unit (403281-403282)
11. Pulse 1 Rate URV (403269-403270)
12. Pulse 2 Rate URV(403283-403284)
13. Pulse 1 Rate LRV (403271-403272)
14. Pulse 2 Rate LRV (403285-403286)

Integer

15. Pulse 1 Rate Maximum Frequency (403677)
16. Pulse 2 Rate Maximum Frequency (403688)
17. Pulse 1 Rate Minimum Frequency (403678)
18. Pulse 2 Rate Minimum Frequency (403689)

The Pulse Rate Damping Time parameters allow you to set the damping time that is applied to the analog output. It can be set from 0.0 to 99.9 seconds.

Floating-Point

19. Pulse 1 Rate Damping (403273-403274)
20. Pulse 2 Rate Damping (403287-403288)

The Alarm/Diagnostic Response parameters allow you to drive the pulse output to zero or to the maximum frequency value if an alarm/diagnostic condition occurs. You can also choose to hold the output at the last frequency.

The available options for determining what the output is driven to can be selected by entering the number to the left of the options under **Alarm/Diagnostic Response Choices**.

Integer

21. Pulse 1 Rate Alarm Response (403679)
22. Pulse 2 Rate Alarm Response (403690)

Pulse Rate Alarm Response Choices: *(for registers 403679 and 403690)*

0 None

1 Fail High

2 Fail Low

3 Hold Last Value

23. Pulse 1 Rate Diagnostic Response (403680)
24. Pulse 2 Rate Diagnostic Response (403691)

Pulse Rate Diagnostic Response Choices: *(for registers 403680 and 403691)*

1 Fail High

2 Fail Low

3 Hold Last Value

Total Mode

The available options for determining what the totalizer is measuring can be selected by entering the number to the left of the options under **Map Choices**.

Integer

25. Pulse 1 Total Map (403681)
26. Pulse 2 Total Map (403692)

Map Choices: *(for registers 403681, 403692)*

0 Total Mass Flow (Component A and Component B)

1 Total Volume Flow (Component A and Component B)

14 Mass Flow of Component A

15 Mass Flow of Component B

16 Volume Flow of Component A

17 Volume Flow of Component B

The maximum frequency at which the pulse total output can generate pulses can be set at 10 Hz or 100 Hz. This setting also determines the on-time for the pulse total output, which is 50 milliseconds for the 10 Hz and 5 ms for the 100 Hz setting.

The available options for setting this parameter can be selected by entering the number to the left of the options under **Pulse Total Maximum Frequency Choices**.

27. Pulse 1 Total Maximum Frequency (403682)
28. Pulse 2 Total Maximum Frequency (403693)

Pulse Total Maximum Frequency Choices: *(for registers 403682, 403693)*

0 10 Hz

1 100 Hz

The available options for determining the mass total or volume total units can be selected by entering the number to the left of the options under **Mass Total EGU Choices and Volume Total EGU Choices** respectively.

29. Pulse 1 Total Units (403684)
30. Pulse 2 Total Units (403695)

Mass Total EGU Choices: *(for registers 403684, 403695)*

1 Grams (G)
2 Kilograms (KG)
3 Ounces (OZ)
4 Pounds (LB)
5 Short Tons (TON) (2000 pounds)
6 Metric Tonnes (MTON) (1000 kg)

Volume Total EGU Choices: *(for registers 403684, 403695)*

21 US Gallons (USG)
22 Imperial Gallons (IMPG)
23 Liters (L)
24 Cubic Feet (FT3)
25 Cubic Meters (M3)
26 Barrels (BBL) (42 gallon)
253 Custom Units

If you select **custom**, you must define your custom units in the Pulse Custom Registers. First, enter a name for your custom units using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (`slope`) from kilograms for mass and liters for volume to the custom units.

The available options for determining the direction of the flow can be selected by entering the number to the left of the options under **Direction Choices**.

31. Pulse 1 Total Direction (403683)
32. Pulse 2 Total Direction (403694)

Direction Choices: *(for registers 403683, 403694)*

0 Forward
1 Reverse
2 Bidir

The pulse totalizer can be enabled or disabled by entering the number to the left of the options under **Total Control Choices**.

33. Pulse 1 Total Control (403685)
34. Pulse 2 Total Control (403696)

Totalizer Control Choices *(for registers 403685, 403696)*

0 Off

1 On

Floating-Point

Pulse Custom Registers

35. Pulse 1 Total Custom Slope (403277-403278)
36. Pulse 1 Total Custom Offset (403279-403280)
37. Pulse 1 Total Units per Pulse (403275-403276)
38. Pulse 2 Total Custom Slope (403291-403292)
39. Pulse 2 Total Custom Offset (403293-403294)
40. Pulse 2 Total Units per Pulse (403289-403290)

Tube Configuration

Flowtube Configuration parameters are used to select flowtube settings. These registers are read/write.

To specify the flowtube, enter the number to the left of the corresponding model code under **Flowtube Choices** below. The model code of your flowtube is shown on the flowtube data plate.

NOTE

When the flowtube selection changes, any density calibration done for the previous flowtube selection is cleared, and two-phase compensation (if applicable) is disabled.

Integer

1. Flowtube Selection (403601)

Flowtube Choices: *(for register 403601)*

0 CFS10-02S

1 CFS10-02H

2 CFS10-03S

3 CFS10-03H

4 CFS10-03C

5 CFS10-05S

6 CFS10-05H

7 CFS10-05C

8 CFS10-08S

10 CFS10-08C

11 CFS10-10S

12 CFS10-10H

13 CFS10-10C

14 CFS10-15S

16 CFS10-15C

17 CFS10-20S

19 CFS10-20C

21 CFS20-15H

22 CFS20-30S

24 CFS20-30C

Floating Point

2. Flow Constant FC2 (403101-403102)

   Enter FC2 shown on the calibration sheet shipped with your flowtube (or on your flowtube data plate).

NOTE

Flow constants FC1 and FC3 are calculated by the transmitter.

3. Density Constant DC2 (403103-403104)

   Enter DC2 shown on the calibration sheet shipped with your flowtube (or on your flowtube data plate).

4. Density Constant DC4 (403105-403106)

   Enter DC4 shown on the calibration sheet shipped with your flowtube (or on your flowtube data plate).

NOTE

Density constants DC1 and DC3 are calculated by the transmitter.

Two-Phase Parameters

Two-Phase parameters enable you to set up a feature that produces compensated measurements in two-phase applications for greater accuracy in many cases. Two-Phase registers are read/write.

The Two-Phase Enable parameter can be set up to enable this feature for both mass flow and density or for only density.

The available options for this parameter can be selected by entering the number to the left of the options under **Two Phase Enable Choices**.

Integer

1. Two Phase Enable (403605)

   Two Phase Enable Choices: *(for register 403605)*

   0 Two Phase Comp Off

   1 Density Comp On

   2 Mass Flow and Density Comp On

— NOTE

The Two Phase Enable parameter is available for CFS10 and CFS20 flowtubes only.

The available options to specify tube orientation can be selected by entering the number to the left of the options under **Tube Orientation Choices**.

2. Tube Orientation (403606)

   Tube Orientation Choices: *(for register 403606)*

   0 Vertical

   1 Horizontal

— NOTE

The Tube Orientation parameter is available for CFS10 and CFS20 flowtubes only.

Floating-Point

3. Fluid Density (403125-403126)
4. Fluid Coefficient of Expansion (403127-403128)
5. Fluid Reference Temperature (403129-403130)

Display Parameters

Display configuration registers are used when setting the parameters of the display. These registers are read/write.

In the Display Cycle register, you can specify whether you want the display of the measurements you select to cycle automatically from one to another (On) or be able to be cycled manually (Off).

The available options for this parameter can be selected by entering the number to the left of the options under **Display Cycle Choices**.

Integer

1. Display Cycle (403697)

Display Cycle Choices: *(for register 403697)*

0 Off - Cycled manually

1 On - Cycled Automatically

In the Display Show Measurement register, you can choose to display any or all of a list of measurement options.

The available options for this parameter are shown below. You specify your choices in a different manner than you do for the other registers. Add up the decimal values for the measurements you wish to display and enter that number. For example, to display Mass Flow and Total 1, add 1 + 65536 to get 65537.

The hex values are also listed for those who need this information.

2. Display Show Measurement (403713-403714)

NOTE

If the transmitter is in Measure mode, configuration changes done using Modbus do not take effect on the transmitter display until you step out of Measure mode or cycle power.

Display Show Choices: *(for registers 403713-403714)*

Measurement	Decimal Value	Hex Value
Mass Flow	1	0x00001
Volume Flow	2	0x00002
Density	4	0x00004
Temperature	8	0x00008
Concentration	16	0x00010
Mass Flow Component A	256	0x00100
Mass Flow Component B	512	0x00200
Volume Flow Component A	1024	0x00400
Volume Flow Component B	2048	0x00800
Total 1	65536	0x10000
Total 2	131072	0x20000
Total 3	262144	0x40000
Total 4	524288	0x80000

In the Display Primary Measurement register, you can specify the measurement that you want as the default display.

The available options for this parameter can be selected by entering the number to the left of the options under **Display Primary Choices**.

3. Display Primary Measurement (403698)

NOTE

If the transmitter is in Measure mode, configuration changes done using Modbus do not take effect on the transmitter display until you step out of Measure mode or cycle power.

Display Primary Choices: *(for register 403698)*

0 Mass Flow
1 Volume Flow
2 Density
3 Process Temp
4 Concentration
8 Mass Flow Component A
9 Mass Flow Component B
10 Vol. Flow Component A
11 Vol. Flow Component B
16 Total 1
17 Total 2
18 Total 3
19 Total 4

In the Display Damping register, you can damp the displayed value to minimize flickering of the less significant digits. Specify the damping response time from 00.0 to 99.9 seconds.

Floating-Point

4. Display Damping (403295-403296)

In the Display Alarm/Diagnostic Response register, you can specify if you want the display to blink or not blink if a diagnostic condition occurs.

The available options for this parameter can be selected by entering the number to the left of the options under **Display Alarm/Diag Response Choices**.

Integer

5. Display Alarm Response (403699)
6. Display Diag Response (403700)

Display Alarm/Diag Response Choices: *(for registers 403699, 403700)*

0 Not blink
1 Blink

In the Flow Format registers, you can specify the format of the units on your display. Select a format that provides the desired precision without yielding excessive flickering of the less significant digits. The displayed value can also be damped.

The available options for this parameter can be selected by entering the number to the left of the options under **Display Flow Format Choices**.

7. Mass Flow Format (403701)
8. Volumetric Flow Format (403702)
9. Density Format (403703)
10. Concentration Format (403704)
11. Mass Flow A Format (403705)
12. Mass Flow B Format (403706)
13. Volume Flow A Format (403707)
14. Volume Flow B Format (403708)

Display Flow Format Choices: *(for registers 403701 - 403708)*

0 +XXXXXXX(display in single units)

1 +XXXXX**.**X(display in tenths of units)

2 +XXXX**.**XX(display in hundredths of units)

3 +XXX**.**XXX(display in thousandths of units)

4 +XX**.**XXXX(display in ten thousandths of units)

5 +X**.**XXXXX(display in hundred thousandths of units)

In the Totalizer Format registers, you can specify the format of the units on your display. Select a format that provides the desired precision without yielding excessive flickering of the less significant digits. The displayed value can also be damped.

The available options for this parameter can be selected by entering the number to the left of the options under **Display Totalizer Format Choices**.

15. Totalizer 1 Format (403709)
16. Totalizer 2 Format (403710)
17. Totalizer 3 Format (403711)

18. Totalizer 4 Format (403712)

Display Totalizer Format Choices: *(for registers 403709-403712)*

0	+XXXXXXX	(display in single units)
1	+XXXXX.X	(display in tenths of units)
2	+XXXX.XX	(display in hundredths of units)
3	+XXX.XXX	(display in thousandths of units)
4	+XX.XXXX	(display in ten thousandths of units)
5	+X.XXXXX	(display in hundred thousandths of units)
6	+XXXX.E5	(display in number times hundred thousand units)
7	+XXXX.E4	(display in a number times ten thousand units)
8	+XXXX.E3	(display in a number times a thousand units)
9	+XXXX.E2	(display in a number times a hundred units)
10	+XXXX.E1	(display in a number times ten units)

Component Measurements

Component Measurement registers are used when configuring a fluid component. These registers are read/write.

ASCII

1. Fluid Component A Name (404161-404163)
2. Fluid Component B Name (404164-404166)

Floating-Point

3. Fluid Component A Density (403113-403114)
4. Fluid Component A Coefficient of Expansion (403115-403116)
5. Fluid Component A Reference Temperature (403117-403118)
6. Fluid Component B Density (403119-403120)
7. Fluid Component B Coefficient of Expansion (403121-403122)
8. Fluid Component B Reference Temperature (403123-403124)

The Fluid Component can be selected by entering the number to the left of the options under **Fluid Component Choices**.

Integer

9. Fluid Component Selection (403604)

Fluid Component Choices: *(for register 403604)*

0 Component A

1 Component B

Process Limits

Process Limit registers are used for measurement control. These registers are read/write.

In the Flow Direction register you can set the flow direction. Select the Uni-Positive flow direction to get only positive readings for unidirectional flow in the same direction as the arrow on the flowtube. Select the Uni-Negative flow direction to get only positive readings for unidirectional flow opposite the direction of the arrow on the flowtube. Select the Bi-Positive flow direction for bidirectional flow to get positive readings for flow in the same direction of the arrow on the flowtube. Select Bi-Negative flow direction for bidirectional flow to get positive readings for flow opposite the direction of the arrow on the flowtube.

The available options for this register can be selected by entering the number to the left of the options under **Flow Direction Choices**.

Integer

1. Flow Direction (403602)

   Flow Direction Choices: *(for register 403602)*

   0 Bi-Positive Flow Direction

   1 Bi-Negative Flow Direction

   2 Uni-Positive Flow Direction

   3 Uni-Negative Flow Direction

The low flow cut-in function allows you to set the level above which the transmitter begins to measure flow.

The Low Flow Cut-In function can be enabled or disabled by entering the number to the left of the options under **Low Flow Cut-In Enable Choices**.

2. Low Flow Cut-In Enable (403603)

   Low Flow Cut-In Enable Choices: *(for register 403603)*

   0 Off

   1 On

The Low Flow Cut-In Limit register allows you to enter a value that provides no output under low flow conditions. The maximum low flow cut-off value is limited to 10% of the nominal capacity of the flowtube. Therefore, the size and material of the flowtube must be entered in "Model (Flowtube)" before setting the low flow cut-off value. If this is not done, the low flow cut-off is 0.0.

Floating-Point

3. Low flow cut-in limit (403109-403110)

— NOTE

The actual cutoff is at 90% of the value set. Measurement is resumed when the set value is again reached.

K-Bias is used to calibrate or match the measurement of the transmitter to that of another measuring device. If your reading was one percent low, you would set your K-Bias to 1.01.

K-Bias should only be used after all other diagnostic and troubleshooting efforts have been made to correct a discrepancy in flow measurement.

4. Kbias (403107-403108)

Density Limit is used to set the density limit of the fluid below which the mass flow measurement is zero. When the density increases above the limit, measurement resumes.

5. Density limit (403111-403112)

Alarm Parameters

The alarm limits, deadbands, on/off, and output device registers are read/write. The Alarm On/Off, Alarm Output Device, and Totalizer On/Off registers are marked in the listing below with asterisks (*). The options for each such entry are explained beginning on page 121. They are configurable by entering the number to the left of each option for each specific register.

1. Mass Flow Measurement Alarm (303513)

   Floating-Point

   1. Mass Flow High Alarm Limit (403175-403176)
   2. Mass Flow Low Alarm Limit (403177-403178)
   3. Mass Flow High Deadband (403179-403180)
   4. Mass Flow Low Deadband (403181-403182)

   Integer

   5. Mass Flow Alarm Enable/Disable (403636)*
   6. Mass Flow Alarm Output Device (403637)**

2. Volumetric Flow Measurement Alarm (303514)

   Floating-Point

   1. Volume Flow High Alarm Limit (403183-403184)
   2. Volume Flow Low Alarm Limit (403185-403186)
   3. Volume Flow High Deadband (403187-403188)
   4. Volume Flow Low Deadband (403189-403190)

   Integer

   5. Volume Flow Alarm Enable/Disable (403638)*
   6. Volume Flow Alarm Output Device (403639)**

3. Density Measurement Alarm (303515)

   Floating-Point

   1. Density High Alarm Limit (403191-403192)
   2. Density Low Alarm Limit (403193-403194)
   3. Density High Deadband (403195-403196)
   4. Density Low Deadband (403197-403198)

Integer

5. Density Alarm Enable/Disable (403640)*
6. Density Alarm Output Device (403641)**

4. Process Temperature Measurement Alarm (303516)

Floating-Point

1. Process Temperature High Alarm Limit (403199-403200)
2. Process Temperature low Alarm Limit (403201-403202)
3. Process Temperature High Deadband (403203-403204)
4. Process Temperature Low Deadband (403205-403206)

Integer

5. Process Temperature Alarm Enable/Disable (403642)*
6. Process Temperature Alarm Output Device (403643)**

5. Concentration Measurement Alarm (303517)

Floating-Point

1. Concentration High Alarm Limit (403207-403208)
2. Concentration Low Alarm Limit (403209-403210)
3. Concentration High Deadband (403211-403212)
4. Concentration Low Deadband (403213-403214)

Integer

5. Concentration Alarm Enable/Disable (403644)*
6. Concentration Alarm Output Device (403645)**

6. Mass Flow A Measurement Alarm (303518)

Floating-Point

1. Mass Flow A High Alarm Limit (403215-403216)
2. Mass Flow A Low Alarm Limit (403217-403218)
3. Mass Flow A High Deadband (403219-403220)
4. Mass Flow A Low Deadband (403221-403222)

Integer

5. Mass Flow A Alarm Enable/Disable (403646)*
6. Mass Flow A Alarm Output Device (403647)**

7. Mass Flow B Measurement Alarm (303519)

   Floating-Point

   1. Mass Flow B High Alarm Limit (403223-403224)
   2. Mass Flow B Low Alarm Limit (403225-403226)
   3. Mass Flow B High Deadband (403227-403228)
   4. Mass Flow B Low Deadband (403229-403230)

   Integer

   5. Mass Flow B Alarm Enable/Disable (403648)*
   6. Mass Flow B Alarm Output Device (403649)**

8. Volume Flow A Measurement Alarm (303520)

   Floating-Point

   1. Volume Flow A High Alarm Limit (403231-403232)
   2. Volume Flow A Low Alarm Limit (403233-403234)
   3. Volume Flow A High Deadband (403235-403236)
   4. Volume Flow A Low Deadband (403237-403238)

   Integer

   5. Volume Flow A Alarm Enable/Disable (403650)*
   6. Volume Flow A Alarm Output Device (403651)**

9. Volume Flow B Measurement Alarm (303521)

   Floating-Point

   1. Volume Flow B High Alarm Limit (403239-403240)
   2. Volume Flow B Low Alarm Limit (403241-403242)
   3. Volume Flow B High Deadband (403243-403244)
   4. Volume Flow B Low Deadband (403245-403246)

   Integer

   5. Volume Flow B Alarm Enable/Disable (403652)*
   6. Volume Flow B Alarm Output Device (403653)**

10. Totalizer 1 Measurement Alarm (303522)

    Floating-Point

    1. Totalizer 1 High Alarm Limit (403247-403248)

    Integer

    2. Totalizer 1 Alarm On/Off (403654)***
    3. Totalizer 1 Alarm Output Device (403655)**

11. Totalizer 2 Measurement Alarm (303523)

    Floating-Point

    1. Totalizer 2 High Alarm Limit (403249-403250)

    Integer

    2. Totalizer 2 Alarm On/Off (403656)***
    3. Totalizer 2 Alarm Output Device (403657)**

12. Totalizer 3 Measurement Alarm (303524)

    Floating-Point

    1. Totalizer 3 High Alarm Limit (403251-403252)

    Integer

    2. Totalizer 3 Alarm On/Off (403658)***
    3. Totalizer 3 Alarm Output Device (403659)**

13. Totalizer 4 Measurement Alarm (303525)

    Floating-Point

    1. Totalizer 4 High Alarm Limit (403253-403254)

    Integer

    2. Totalizer 4 Alarm On/Off (403660)***
    3. Totalizer 4 Alarm Output Device (403661)**

*The available options for the Alarm Enable/Disable Control registers can be selected by entering the number to the left of the options under **Alarm Enable/Disable Control Choices**.

Alarm Enable/Disable Control Choices: *(for registers 403636, 403638, 403640, 403642, 403644, 403646, 403648, 403650, 403652)*

0 Both Alarms Disabled

1 High Alarm Enabled

2 Low Alarm Enabled

3 Both Alarms Enabled

The available options for the Alarm Enable/Disable Control registers can be selected by entering the number to the left of the options under **Alarm Output Device Choices.

Alarm Output Device Choices: *(for registers 403637, 403639, 403641, 403643, 403645, 403647, 403649, 403651, 403653, 403655, 403657, 403659, 403661)*

0 No Output Device

1 Display Output

2 Digital Output

3 Display and Digital Output

***The Totalizer Alarm can be enabled or disabled by entering the number to the left of the options under **Total Alarm Off/On Choices**.

Totalizer Alarm Off/On Choices: *(for registers 403654, 403656, 403658, 403660)*

0 Off

1 On

System Parameters

System Configuration parameters allow the user to set system settings. These registers are read/write. These registers are configurable by entering the number to the left of each option for each specific register.

The alarm/diagnostic acknowledge functions can be configured as Auto or Manual. In Auto, all evidence of the alarm clears when the alarm condition no longer exists. In Manual, the alarm must be acknowledged manually.

The available options for these registers can be selected by entering the number to the left of the options under **Alarm/Diag Ack Mode Choices**.

Integer

1. Alarm Acknowledge Mode (403607)
2. Diagnostic Acknowledge Mode (403608)

Alarm/Diag Ack Mode Choices: ***(for registers 403607, 403608)***

0 Auto Ack

1 Manual Ack

ASCII

The CFT51 Transmitter employs two levels of password. Both consist of 6 alphanumeric characters. The lower level password enables the operator to clear totals in Measure mode. The higher level password enables entering the Quick Start and Setup modes as well as clearing all totals in Measure mode.

To change a password to ‘no password’, enter six spaces. Changing a high level password to ‘no password’ automatically changes the low level password to ‘no password’.

3. Old Password (404167-404169)
4. High Level Password (404170-404172)
5. Low Level Password (404173-40175)

Integer

The Password Change register shows you whether the password was changed or not.

6. Password Change Status (303580)

   Password Change Choices: *(for register 303580)*

   0 Password unchanged

   1 Password changed

The Set Configuration Default register allows you to reset the configuration to the factory default values.

The available options for the Set Configuration Defaults register can be selected by entering the number to the left of the options under **Configuration Default Choices**.

7. Set Configuration Defaults (403866)

   Configuration Default Choices: *(for register 403866)*

   0 No operation

   21930 Set configuration to factory defaults (hex value: 0x55AA)
   (returns to 0 after being executed)

Resetting the Transmitter has the same effect as a power cycle.

The available options for the Reset Transmitter register can be selected by entering the number to the left of the options under **Reset Transmitter Choices**.

8. Reset Transmitter (403867)

   Reset Transmitter Choices: *(for register 403867)*

   0 No operation

   21930 Reset transmitter (hex value: 0x55AA)
   (returns to 0 after being executed)

Modbus Communication Parameters

These registers hold integer values. They are read/write.

The Response Delay register enables a slave device to add an additional delay before sending a response to a host. The range is 0 to 255 ms increments. The default is 0 ms.

1. Response Delay (403715)

   Range: 0 to 255 ms

The Baud Rate register holds the serial port baud rate for the CFT51 transmitter. When this register changes, it updates the serial port settings.

The available options for this register can be selected by entering the number to the left of the options under **Baud Rate Choices**.

2. RS-485 Digital Communication Baud Rate (403716)

   (RS-485 = EIA/TIA 485 Standard Interface)

   Baud Rate Choices: *(for register 403716)*

   0 1200

   1 2400

   2 4800

   3 9600 (default)

   4 19200

   5 38400

The Parity register holds parity settings for the CFT51 Transmitter.

The available options for this register can be selected by entering the number to the left of the options under **Parity Choices**.

3. RS-485 Digital Communication Parity (403717)

   Parity Choices: *(for register 403717)*

   0 No Parity (default)

   1 Even Parity

   2 Odd Parity

The Device Address register holds the transmitter Modbus address. The address is used to uniquely identify the CFT51 on a Modbus network. The range of addresses that are available to a device fills the range from 1 to 247. Addresses greater than 247 are reserved and cannot be used. Address 0 may only be used by a Modbus host to send broadcast messages to all devices simultaneously.

4. Device Address (403718)

   Range: 1 to 247

The Floating Point Byte Format register enables the CFT51 to adapt to all possible byte sequences.

The available options for this register can be selected by entering the number to the left of the options under **Floating Point Format Choices**.

5. Floating Point Byte Format (403719)

   Floating Point Format Choices: *(for register 403719)*

   0 MSW_LSW

   1 LSW_MSW (default)

   2 RMSW_RLSW

   3 RLSW_RMSW

   where: MSW = Most significant word (MSB-LSB)

   LSW = Least significant word (MSB-LSB)

   RMSW = Most significant word with reversed bytes (LSB-MSB)

   RLSW = Least significant word with reversed bytes (LSB-MSB)

   Data byte order is used to determine the byte order for data types that are larger than a single 2 byte Modbus register. Byte order in a register is normally MSB-LSB (MSB transferred first) as defined by the Modbus specification. However, the specification does not define the byte order of data types that are contained in multiple registers, that is, 4 byte floats.

Calibration

mA Output Calibration

The Milliampere Calibration parameters allow the 4 to 20 mA output of the transmitter to be calibrated or matched to the calibration of the receiving device.

NOTE

The transmitter has been accurately calibrated at the factory. Recalibration of the output is normally **not** required, unless it is being adjusted to match the calibration of the receiving device.

These registers are read/write.

The mA Output Calibration Value registers allow you to enter a mA output calibration value.

Floating-Point

1. mA Output 1 Calibration Value (403297-403298)
   Enter mA output value.
2. mA Output 2 Calibration Value (403299-403300)
   Enter mA output value.
3. mA Output 3 Calibration Value (403325-403326)
   Enter mA output value.

The mA Output Calibration Function registers allow you to specify a calibration function.

The available options for these registers can be selected by entering the number to the left of the options under **mA Calibration Function Choices**.

Integer

4. mA Output 1 Calibration Function (403855)
5. mA Output 2 Calibration Function (403857)
6. mA Output 3 Calibration Function (403871)

mA Calibration Function Choices: *(for registers 403855, 403857, 403871)*

0 No Operation

1 Do Calibration offset, set mA override to 4.0

2 Do Calibration slope, set mA override to 20.0

3 Calibration complete, save changes

4 Cancel calibration

If you make changes and then decide you want to return to the factory calibration, the Restore mA Output registers allow you to do this.

This feature can be activated or not by entering the number to the left of the options under **Restore mA Output Choices**.

7. Restore mA Output 1 Factory Calibration (403856)
8. Restore mA Output 2 Factory Calibration (403858)
9 Restore mA Output 3 Factory Calibration (403872)

Restore mA Output Choices: *(for registers 403856, 403858, 403872)*

0 No

1 Yes (returns to 0 after being executed)

mA Calibration Procedure Using Modbus Protocol

The mA calibration procedure requires that you complete the entry of the measured values at both 4 mA and 20 mA points.

1. Initiate the sequence by entering option 1 (set mA output to 4 mA) to the desired analog output mA Calibration Function register.
2. Enter the measured value at the 4 mA point in the correct mA Output value register for the analog output that is being calibrated.
3. Enter option 2 (set mA output to 20 mA) to set the desired mA output to the high point.
4. Enter the measured value at the 20 mA point in the correct mA Output value register. Repeat the above steps till the 4 mA and 20 mA output values are within acceptable limits.
5. You can enter option 3 (Calibration complete, save changes) to the Calibration Function register to finish this procedure and save the new calibration values or enter option 4 (Cancel calibration) to return the analog output to its previous calibration.

Density Calibration

The CFT51 Transmitter provides an optional density calibration function that can be used to optimize the density accuracy for a specific process liquid. The factory calibration is done using water and air as the high and low calibration points respectively. The density calibration feature allows one point to be replaced with a specific process liquid calibration to provide the maximum accuracy.

If the specific gravity of the liquid (or the average of a range of liquids) is >0.2 but $\leq$0.5, you can replace the low calibration point. If it is >0.5, you can replace the high calibration point.

The User Calibrated Density shows if the calibrated density is in use.

Integer

1. User calibrated density in use (303507)
   - 0 Factory calibrated density coefficients in use
   - 1 User calibrated density is in use

In the Density Calibration Fluid register, enter whether the fluid is a high or low density fluid.

The available options for this register can be selected by entering the number to the left of the options under **Calibration Fluid Choices**.

2. Density Calibration Fluid (403845)

   Calibration Fluid Choices: *(for register 403845)*

   - 0 High
   - 1 Low

The Fluid Density Calibration Value register allows you to enter your liquid's desired density.

Floating-Point

3. Fluid Density Calibration Value (403309-403310)

NOTE

Entered density values for this register must be > 0.0. The CFT51 substitutes a default value of 0.001 in the current EGU units if a calibration density value ≤ 0.0 is written to the transmitter.

The Density Calibration Function can be activated or not by entering the number to the left of the options under **Density Calibration Function Choices**.

4. Density Calibration Function (403846)

   Density Calibration Function Choices: *(for register 403846)*

   0 Off

   1 On (returns to 0 after being executed)

The `Density Calibration Restore` register allows you to return to the last inputted values before the calibration procedure was performed.

This feature can be activated or not by entering the number to the left of the options under **Density Calibration Restore Choices**.

5. Density Calibration Restore (403847)

   Density Calibration Restore Choices: *(for register 403847)*

   0 Off

   1 On (returns to 0 after being executed)

New Density Constants, calculated from Density Calibration Fluid and Fluid Density Calibration Value, are shown in the following registers. If the `Density Calibration Restore` feature was employed, these registers read zero.

Floating-Point

6. Density Calibration Constant DC1 (303065-303066)
7. Density Calibration Constant DC2 (303067-303068)
8. Density Calibration Constant DC3 (303069-303070)
9. Density Calibration Constant DC4 (303071-303072)
10. Density Calibration Reference Pressure (403317-403318)

Flow Zero

The CFT51 gives you the ability to have two independent zeros for two separate fluids. For example, you could use one for liquid and the other for gas.

The available options for this register can be selected by entering the number to the left of the options under **Zero Selection Choices**.

Integer

1. Zero Selection (403610)

   Zero Selection Choices: (*for register 403610)*

   0 Flow Zero value 1

   1 Flow Zero value 2

The Zero Calibration register is used to initiate a zero calibration.

This feature can be activated or not by entering the number to the left of the options under **Zero Calibration Choices**

2. Zero Calibration (403848)

Zero Calibration Choices: *(for registers 403848)*

0 No function

1 Perform Zero Calibration (returns to 0 after being executed)

During and after the calibration the transmitter gives you a progress report.

The readouts for this register are shown by the number to the left of the options under **Zero Calibration Progress**.

3. Zero Progress (303579)

Zero Calibration Progress: *(for register 303579)*

0 Zero Cal Done

1 Zero Cal In Progress

2 Zero Cal Failed

Floating-Point

The Zero Value register shows you the value of the calibration. You can change this manually if you desire.

4. Zero Value (403311-403312)

The Zero Restore register allows you to change the manually entered offset value back to the last zero calibration.

This feature can be activated or not by entering the number to the left of the options under **Zero Restore Choices.**

5. Zero Restore (403849)

Zero Restore Choices: *(for registers 403849)*

0 Off

1 On (returns to 0 after being executed)

Meter Verification

NOTE

This feature is available for CFS10 and CFS20 flowtubes only.

Meter verification is used to verify calibration of the flowtube and to check for process related problems such as corrosion and sedimentation deposits. This function will take several minutes to complete and will temporarily disable tube drive and the calculation of measurements.

You can activate or deactivate the feature by entering the number to the left of the options under Meter Verify Function Choices.

Integer

1. Meter Verify function (403868)

   Meter Verify Function Choices: (*for register 403868*)

   0 Off

   1 On (returns to 0 after being executed)

This register can be polled once the function is starting to determine progress. The readouts for this register are shown by the number to the left of the options under Meter Verify Progress.

2. Verify Progress (303582)

   Meter Verify Progress (*for register 303582)*

   0 Verification done

   1 Verification Busy

   2 Verification Fail

A newly calculated ratio and run time can be saved as either the current ratio, the datum, or as both. An option not to save enables you to inspect the latest ratio without having to store it. The values for this register are shown by the number to the left of the options under Meter Verify Save Options.

3. Meter Verify Save (403869)

   Meter Verify Save (*for register 403869*)

   0 Save as current ratio

   1 Save as datum

   2 Save both datum and ratio

   3 Don't save

Once the meter verification function is done, it calculates the latest ratio of the drive and Coriolis frequencies along with the current transmitter run time (in seconds).

4. Calculated Ratio Run Time (303583-303584)

Floating Point

5. Calculated Ratio Value (303075-303076)

The initial verification time and ratio (datum) can be saved using the following registers. The datum will be used to calculate the percentage change value.

Integer

6. Datum Ratio Runtime (403721-403722)

Floating Point

7. Datum Ratio Value (403313-403314)

The last ratio is compared to the datum ratio and a percent change value is calculated.

8. Meter Verification Percent Change (303077-303078)

Pressure Compensation

Pressure compensation of the mass flow measurement and density measurement can be done on a real-time basis, if an external pressure measurement can be supplied. If the pressure does not vary or a real time pressure update is not available then a static pressure value stored in the CFT51 can be used instead in the compensation equation.

The values for this register are shown by the number to the left of the options under Pressure Compensation Enable Options.

Integer

1. Pressure Compensation Enable (403723)

   Pressure Compensation Enable Options: (*for register 403723*)

   0 Off

   1 On (Using the External Pressure Input)

   2 On (Using the Internal Static Pressure Value)

Both pressure values are in the selected EGU units. The values for this register are shown by the number to the left of the values under Pressure Unit Choices.

2. Pressure Units (403724)

   Pressure Unit Choices: (*for register 403724*)

   1 kPa

   2 bar

   3 PSI

Either pressure value contained in the following registers may be selected as the basis for the mass flow and density pressure compensation.

Floating Point

3. External Pressure Input (404589-404590)
4. Static Pressure (403315-403316)

Test Functions

The transmitter can be used as a signal source to check and/or calibrate other instruments in the control loop, such as indicators, controllers, and recorders. To do this, set the mA output, pulse output, and digital output signals to any value within the range limits of the transmitter.

These registers are read/write.

This feature can be activated or not by entering the number to the left of the options under **Test Function Choices**.

Integer

1. mA Output 1 Test Function (403850)
2. mA Output 2 Test Function (403851)
3. mA Output 3 Test Function (403871)
4. Contact Output Test Function (403852)
5. Pulse Output 1 Test Function (403853)
6. Pulse Output 2 Test Function (403854)

   Test Function Choices: *(for registers 403850, 403851, 403852, 403853, 403854)*

   0 Off

   1 On

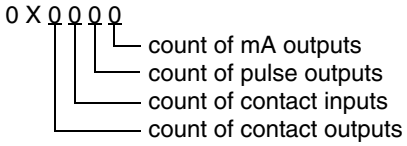
Floating-Point

7. mA Output 1 Test Value (403301-403302)
8. mA Output 2 Test Value (403303-403304)
9 mA Output 3 Test Value (403327-403328)
10. Contact Output Test Value (403609)
11. Pulse Output 1 Test Value (403305-403306)
12. Pulse Output 2 Test Value (403307-403308)

System Information

The System Information registers are all read only.

1. Register map version (303508)
   Tracks changes to the register map.
2. Transmitter Type (303509)
   Shows the transmitter type.
3. Output Configuration (303510)
   Shows the type of outputs.



4. Software Revision (303987-303991)
   Shows the software revision level.

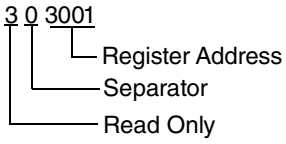
Modbus Register Database

NOTE

The normal practice when documenting Modbus register maps is that all register numbers are defined to be 1 based. Modbus host software that follows this convention will automatically subtract 1 from any register number before sending it in a command to a remote device. If the host software does not perform this function, then register numbers must have 1 subtracted from them before they are used.

Address

The register address is a four digit number. In the presentation in this document, the number is preceded by a 3 or a 4 and a separator (0) to indicate Read Only and Read/Write respectively. For example, 40xxxx is Read/Write and 30xxxx is Read Only.



Type

Float = Single precision floating point value.

ASCII = ASCII text label.

Integer = Integer of 1, 2, or 4 byte value.

Access

R.O. = Read Only. Cannot be modified by user.

R/W = Read/Write access

Update

Static = Will not change without user intervention.

Dynamic = Can change during normal operation.

Table 11. Modbus Registers

Address	Name	Access	Update	Description	Ref.
Floating Point (read only)					
303001-303002	Mass Flow	R.O.	Dynamic	Shows current mass flow rate (forward or reverse).	page 84
303003-303004	Volumetric Flow	R.O.	Dynamic	Shows current volume flow rate (forward or reverse).	page 84
303005-303006	Density	R.O.	Dynamic	Shows current density.	page 84
303007-303008	Process Temperature	R.O.	Dynamic	Shows current process temperature.	page 84
303009-303010	Concentration	R.O.	Dynamic	Shows current percent concentration.	page 84
303011-303012	Mass Flow A	R.O.	Dynamic	Shows the current mass A flow rate (forward or reverse).	page 84
303013-303014	Mass Flow B	R.O.	Dynamic	Shows the current mass B flow rate (forward or reverse) in the selected engineering units.	page 84
303015-303016	Volume Flow A	R.O.	Dynamic	Shows the current volume A flow rate (forward or reverse).	page 84
303017-303018	Volume Flow B	R.O.	Dynamic	Shows the current volume B flow rate (forward or reverse).	page 84
303019-303020	Totalizer 1	R.O.	Dynamic	Shows current Total 1.	page 85
303021-303022	Totalizer 2	R.O.	Dynamic	Shows current Total 2.	page 85
303023-303024	Totalizer 3	R.O.	Dynamic	Shows current Total 3.	page 85
303025-303026	Totalizer 4	R.O.	Dynamic	Shows current Total 4.	page 85
303027-303028	Uncorrected Mass Flow	R.O.	Dynamic	Shows raw mass flow.	page 84
303029-303030	Uncorrected Density	R.O.	Dynamic	Shows raw density.	page 84
303031-303032	Uncorrected Volume Flow	R.O.	Dynamic	Shows raw volume flow.	page 84
303033-303034	Drive Gain	R.O.	Dynamic	Shows the drive gain.	page 86
303035-303036	Tube Frequency	R.O.	Dynamic	Shows the tube frequency in hertz.	page 86
303037-303038	Sensor Amplitude	R.O.	Dynamic	Shows the sensor amplitude in volts.	page 86
303039-303040	Drive Current	R.O.	Dynamic	Shows tube drive current in amperes.	page 86
303041-303042	Void Fraction	R.O.	Dynamic	Shows the void fraction.	page 86
303043-303044	mA Output 1 Value	R.O.	Dynamic	Shows mA Output 1 value in mA.	page 87
303045-303046	mA Output 2 Value	R.O.	Dynamic	Shows mA Output 2 value in mA.	page 87

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
303047-303048	Pulse Output 1 Value	R.O.	Dynamic	Shows Pulse Output 1 value in hertz.	page 87
303049-303050	Pulse Output 2 Value	R.O.	Dynamic	Shows Pulse Output 2 value in hertz.	page 87
303051-303052	Flow Constant FC1	R.O.	Static	Shows flow constant 1.	page 88
303053-303054	Flow Constant FC2	R.O.	Static	Shows flow constant 2.	page 88
303055-303056	Flow Constant FC3	R.O.	Static	Shows flow constant 3.	page 88
303057-303058	Density Constant DC1	R.O.	Static	Shows density constant 1.	page 88
303059-303060	Density Constant DC2	R.O.	Static	Shows density constant 2.	page 88
303061-303062	Density Constant DC3	R.O.	Static	Shows density constant 3.	page 88
303063-303064	Density Constant DC4	R.O.	Static	Shows density constant 4.	page 88
303065-303066	Density Calibration Constant DC1	R.O.	Static	Shows the new calculated density constant 1.	page 128
303067-303068	Density Calibration Constant DC2	R.O.	Static	Shows the new calculated density constant 2.	page 128
303069-303070	Density Calibration Constant DC3	R.O.	Static	Shows the new calculated density constant 3.	page 128
303071-303072	Density Calibration Constant DC4	R.O.	Static	Shows the new calculated density constant 4.	page 128
303073-303074	Phase Difference	R.O.	Dynamic	Tube phase difference	page 86
303075-303076	Meter Verification Ratio	R.O.	Dynamic	Meter verification ratio	page 130
303077-303078	Meter Verification Change	R.O.	Dynamic	Meter verification percent change	page 131
303079-303080	Pressure	R.O.	Dynamic	Used to compensate the mass flow and density measurements	page 86
303081-303082	mA Output 3 value	R.O.	Dynamic	Shows the mA Output 3 value in mA	page 87
Floating Point (read/write)					
403101-403102	Flow Constant FC2	R/W	Static	Enter flow constant FC2.	page 111
403103-403104	Density Constant DC2	R/W	Static	Enter density constant DC2.	page 111
403105-403106	Density Constant DC4	R/W	Static	Enter density constant DC4.	page 111
403107-403108	Kbias	R/W	Static	Enter kbias value (if any).	page 118
403109-403110	Low Flow Cut In Limit	R/W	Static	Enter the low flow cut-in value.	page 117
403111-403112	Density Limit	R/W	Static	Enter the density limit of the fluid.	page 118
403113-403114	Fluid Component A Density	R/W	Static	Enter density of fluid A.	page 116

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403115-403116	Fluid Component A Coefficient of Expansion	R/W	Static	Enter coefficient of expansion for fluid A.	page 116
403117-403118	Fluid Component A Reference Temperature	R/W	Static	Enter reference temperature of fluid A.	page 116
403119-403120	Fluid Component B Density	R/W	Static	Enter density of fluid B.	page 116
403121-403122	Fluid Component B Coefficient of Expansion	R/W	Static	Enter coefficient of expansion for fluid B.	page 116
403123-403124	Fluid Component B Reference Temperature	R/W	Static	Enter reference temperature of fluid B.	page 116
403125-403126	Two Phase Fluid Density	R/W	Static	Enter the density of the liquid.	page 112
403127-403128	Two Phase Fluid Coefficient of Expansion	R/W	Static	Enter the temperature coefficient.	page 112
403129-403130	Two Phase Fluid Reference Temperature	R/W	Static	Enter the reference temperature.	page 112
403131-403132	Mass Flow Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 94
403133-403134	Mass Flow Custom Offset	R/W	Static	Enter custom offset.	page 94
403135-403136	Volume Flow Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 95
403137-403138	Volume Flow Custom Offset	R/W	Static	Enter custom offset.	page 95
403139-403140	Density Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 96
403141-403142	Density Custom Offset	R/W	Static	Enter custom offset.	page 96
403143-403144	Mass Flow A Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 94
403145-403146	Mass Flow A Custom Offset	R/W	Static	Enter custom offset.	page 94
403147-403148	Mass Flow B Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 94
403149-403150	Mass Flow B Custom Offset	R/W	Static	Enter custom offset.	page 94
403151-403152	Volume Flow A Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 95
403153-403154	Volume Flow A Custom Offset	R/W	Static	Enter custom offset.	page 95
403155-403156	Volume Flow B Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 95
403157-403158	Volume Flow B Custom Offset	R/W	Static	Enter custom offset.	page 95
403159-403160	Totalizer 1 Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 100
403161-403162	Totalizer 1 Custom Offset	R/W	Static	Enter custom offset.	page 100

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403163-403164	Totalizer 2 Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 100
403165-403166	Totalizer 2 Custom Offset	R/W	Static	Enter custom offset.	page 100
403167-403168	Totalizer 3 Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 100
403169-403170	Totalizer 3 Custom Offset	R/W	Static	Enter custom offset.	page 100
403171-403172	Totalizer 4 Custom Slope	R/W	Static	Enter custom slope conversion factor.	page 100
403173-403174	Totalizer 4 Custom Offset	R/W	Static	Enter custom offset.	page 100
403175-403176	Mass Flow High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 118
403177-403178	Mass Flow Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 118
403179-403180	Mass Flow High Deadband	R/W	Static	Enter high alarm deadband value.	page 118
403181-403182	Mass Flow Low Deadband	R/W	Static	Enter low alarm deadband value.	page 118
403183-403184	Volume Flow High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 118
403185-403186	Volume Flow Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 118
403187-403188	Volume Flow High Deadband	R/W	Static	Enter high alarm deadband value.	page 118
403189-403190	Volume Flow Low Deadband	R/W	Static	Enter low alarm deadband value.	page 118
403191-403192	Density High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 118
403193-403194	Density Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 118
403195-403196	Density High Deadband	R/W	Static	Enter high alarm deadband value.	page 118
403197-403198	Density Low Deadband	R/W	Static	Enter low alarm deadband value.	page 118
403199-403200	Process Temperature High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 119
403201-403202	Process Temperature Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 119
403203-403204	Process Temperature High Deadband	R/W	Static	Enter high alarm deadband value.	page 119
403205-403206	Process Temperature Low Deadband	R/W	Static	Enter low alarm deadband value.	page 119
403207-403208	Concentration High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 119
403209-403210	Concentration Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 119
403211-403212	Concentration High Deadband	R/W	Static	Enter high alarm deadband value.	page 119
403213-403214	Concentration Low Deadband	R/W	Static	Enter low alarm deadband value.	page 119

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403215-403216	Mass Flow A High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 119
403217-403218	Mass Flow A Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 119
403219-403220	Mass Flow A High Deadband	R/W	Static	Enter high alarm deadband value.	page 119
403221-403222	Mass Flow A Low Deadband	R/W	Static	Enter low alarm deadband value.	page 119
403223-403224	Mass Flow B High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 120
403225-403226	Mass Flow B Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 120
403227-403228	Mass Flow B High Deadband	R/W	Static	Enter high alarm deadband value.	page 120
403229-403230	Mass Flow B Low Deadband	R/W	Static	Enter low alarm deadband value.	page 120
403231-403232	Volume Flow A High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 120
403233-403234	Volume Flow A Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 120
403235-403236	Volume Flow A High Deadband	R/W	Static	Enter high alarm deadband value.	page 120
403237-403238	Volume Flow A Low Deadband	R/W	Static	Enter low alarm deadband value.	page 120
403239-403240	Volume Flow B High Alarm Limit	R/W	Static	Enter high alarm set point value.	page 120
403241-403242	Volume Flow B Low Alarm Limit	R/W	Static	Enter low alarm set point value.	page 120
403243-403244	Volume Flow B High Deadband	R/W	Static	Enter high alarm deadband value.	page 120
403245-403246	Volume Flow B Low Deadband	R/W	Static	Enter low alarm deadband value.	page 120
403247-403248	Totalizer 1 High Alarm Limit	R/W	Static	Enter the high alarm set point value.	page 121
403249-403250	Totalizer 2 High Alarm Limit	R/W	Static	Enter the high alarm set point value.	page 121
403251-403252	Totalizer 3 High Alarm Limit	R/W	Static	Enter the high alarm set point value.	page 121
403253-403254	Totalizer 4 High Alarm Limit	R/W	Static	Enter the high alarm set point value.	page 121
403255-403256	Output 1 URV	R/W	Static	Enter the upper range value in the units specified.	page 102
403257-403258	Output 1 LRV	R/W	Static	Enter the lower range value in the units specified.	page 102
403259-403260	Output 1 Damping	R/W	Static	Enter the damping time that is applied to the analog output.	page 103
403261-403262	Output 2 URV	R/W	Static	Enter the upper range value in the units specified.	page 102
403263-403264	Output 2 LRV	R/W	Static	Enter the lower range value in the units specified.	page 102
403265-403266	Output 2 Damping	R/W	Static	Enter the damping time that is applied to the analog output.	page 103

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403267-403268	Pulse 1 Rate Units Per Pulse	R/W	Static	Enter the units per pulse.	page 107
403269-403270	Pulse 1 URV	R/W	Static	Enter the upper range value in the units specified in the Measure Setup parameters.	page 107
403271-403272	Pulse 1 LRV	R/W	Static	Enter the lower range value in the units specified.	page 107
403273-403274	Pulse 1 Rate Damping	R/W	Static	Enter the damping time that is applied to the pulse output.	page 107
403275-403276	Pulse 1 Total Units Per Pulse	R/W	Static	Enter the units per pulse.	page 110
403277-403278	Pulse 1 Total Custom Slope	R/W	Static	Enter the custom slope conversion factor.	page 110
403279-403280	Pulse 1 Total Custom Offset	R/W	Static	Enter any custom offset.	page 110
403281-403282	Pulse 2 Rate Units Per Pulse	R/W	Static	Enter the units per pulse.	page 107
403283-403284	Pulse 2 URV	R/W	Static	Enter the upper range value in the units specified.	page 107
403285-403286	Pulse 2 LRV	R/W	Static	Enter the lower range value in the units specified.	page 107
403287-403288	Pulse 2 Rate Damping	R/W	Static	Enter the damping time that is applied to the analog output.	page 107
403289-403290	Pulse 2 Total Units Per Pulse	R/W	Static	Enter the units per pulse.	page 110
403291-403292	Pulse 2 Total Custom Slope	R/W	Static	Enter the custom slope conversion factor from kilograms (for mass units) or liters (for volume units) to the custom units.	page 110
403293-403294	Pulse 2 Total Custom Offset	R/W	Static	Enter any custom offset.	page 110
403295-403296	Display Damping	R/W	Static	Enter the damping value (00.0 (none) to 99.9 seconds).	page 114
403297-403298	mA Output 1 Calibration Value	R/W	Static	Enter mA Output 1value.	page 125
403299-403300	mA Output 2 Calibration Value	R/W	Static	Enter mA Output 2value.	page 125
403301-403302	mA Output 1 Test Value	R/W	Static	Enter the mA Output test value.	page 132
403303-403304	mA Output 2 Test Value	R/W	Static	Enter the mA Output test value.	page 132
403305-403306	Pulse Output 1 Test value	R/W	Static	Enter the Pulse Output 1 test value.	page 132
403307-403308	Pulse Output 2 Test value	R/W	Static	Enter the Pulse Output 2 test value.	page 132
403309-403310	Fluid Density Calibration Value	R/W	Static	Enter the desired density of the process liquid.	page 127
403311-403312	Zero Value	R/W	Static	Enter the amount of offset necessary to make the transmitter read zero at zero flow conditions.	page 129
403313-403314	Datum Meter Verification Ratio	R/W	Static	Meter verification datum ratio	page 131
403315-403316	Static Pressure	R/W	Static	Pressure value used in static compensation of the measurement	page 131
403317-403318	Density Calibration Reference Pressure	R/W	Static	Density calibration reference pressure	page 128

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403319-403320	mA Output 3 URV	R/W	Static	mA Output 3 URV	page 102
403321-403322	mA Output 3 LRV	R/W	Static	mA Output 3 LRV	page 102
403323-403324	mA Output 3 Damping	R/W	Static	mA Output 3 Damping	page 103
403325-403326	mA Output 3 Calibration Value	R/W	Static	mA Output 3 Calibration Value	page 125
403327-403328	mA Output 3 Test value	R/W	Static	mA Output 3 Test value	page 132
403329-403330	Concentration Custom Coef 1	R/W	Static	Concentration Custom Coefficient 1	page 98
403331-403332	Concentration Custom Coef 2	R/W	Static	Concentration Custom Coefficient 2	page 98
403333-403334	Concentration Custom Coef 3	R/W	Static	Concentration Custom Coefficient 3	page 98
403335-403336	Concentration Custom Coef 4	R/W	Static	Concentration Custom Coefficient 4	page 98
403337-403338	Concentration Custom Coef 5	R/W	Static	Concentration Custom Coefficient 5	page 98
403339-403340	Concentration Custom Coef 6	R/W	Static	Concentration Custom Coefficient 6	page 98
403341-403342	Concentration Custom Coef 7	R/W	Static	Concentration Custom Coefficient 7	page 98
403343-403344	Concentration Custom Coef 8	R/W	Static	Concentration Custom Coefficient 8	page 98
403345-403346	Concentration Custom Coef 9	R/W	Static	Concentration Custom Coefficient 9	page 98
403347-403348	Concentration Custom Coef 10	R/W	Static	Concentration Custom Coefficient 10	page 98
403349-403350	Concentration Custom Coef 11	R/W	Static	Concentration Custom Coefficient 11	page 98
403351-403352	Concentration Custom Coef 12	R/W	Static	Concentration Custom Coefficient 12	page 98
403353-403354	Concentration Custom Coef 13	R/W	Static	Concentration Custom Coefficient 13	page 98
403355-403356	Concentration Custom Coef 14	R/W	Static	Concentration Custom Coefficient 14	page 98
403357-403358	Concentration Custom Coef 15	R/W	Static	Concentration Custom Coefficient 15	page 98
403359-403360	Concentration Custom Coef 16	R/W	Static	Concentration Custom Coefficient 16	page 98
403361-403362	Concentration Custom Coef 17	R/W	Static	Concentration Custom Coefficient 17	page 98
403363-403364	Concentration Custom Coef 18	R/W	Static	Concentration Custom Coefficient 18	page 98
403365-403366	Concentration Custom Coef 19	R/W	Static	Concentration Custom Coefficient 19	page 98
403367-403368	Concentration Custom Coef 20	R/W	Static	Concentration Custom Coefficient 20	page 98

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
Integer (read only)					
303501-303502	Transmitter Runtime in hours	R.O.	Dynamic	Shows the amount of time the transmitter has been running (in hours).	page 87
303503	Write Protect	R.O.	Dynamic	Shows whether write protect is on or off.	page 87
303504	Din State	R.O.	Dynamic	Shows digital input state.	page 87
303505	Dout State	R.O.	Dynamic	Shows digital output state.	page 87
303506	Tube Mode	R.O.	Dynamic	Shows the tube mode.	page 86
303507	User Calibrated Density in Use	R.O.	Static	Shows if user calibrated density is being used or default calibration.	page 88
303508	Register Map Version	R.O.	Static	Shows the revision number of the register map.	page 133
303509	Transmitter Type	R.O.	Static	Shows the transmitter type.	page 133
303510	Output Configuration	R.O.	Static	Shows the types of outputs.	page 133
303511	Change Counter	R.O.	Dynamic	Increments each time a change is made to the configuration.	page 87
303512	Active Alarms	R.O.	Static	Shows if there are active alarms.	page 89
303513	Mass Flow Measurement Alarm	R.O.	Static	Shows mass flow alarms.	page 89
303514	Volumetric Flow Measurement Alarm	R.O.	Static	Shows volume flow alarms.	page 89
303515	Density Measurement Alarm	R.O.	Static	Shows density alarms.	page 89
303516	Process Temperature Measurement Alarm	R.O.	Static	Shows Process temperature alarms.	page 89
303517	Concentration Measurement Alarm	R.O.	Static	Shows Concentration alarms.	page 89
303518	Mass Flow A Measurement Alarm	R.O.	Static	Shows mass flow A alarms.	page 89
303519	Mass Flow B Measurement Alarm	R.O.	Static	Shows mass flow B alarms.	page 89
303520	Volume Flow A Measurement Alarm	R.O.	Static	Shows volume flow A alarms.	page 89
303521	Volume Flow B Measurement Alarm	R.O.	Static	Shows volume flow B alarms.	page 89
303522	Totalizer 1 Measurement Alarm	R.O.	Static	Shows Total 1 alarms.	page 89
303523	Totalizer 2 Measurement Alarm	R.O.	Static	Shows Total 2 alarms.	page 89
303524	Totalizer 3 Measurement Alarm	R.O.	Static	Shows Total 3 alarms.	page 89
303525	Totalizer 4 Measurement Alarm	R.O.	Static	Shows Total 4 alarms.	page 89
303526	Active Diagnostics	R.O.	Static	Shows if there is an active diagnostic.	page 90
303527-303528	Diagnostic #1, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303529	Diagnostic #1, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303530	Diagnostic #1, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303531-303532	Diagnostic #2, Time	R.O.	Static	Shows the time of the diagnostic.	page 90

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
303533	Diagnostic #2, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303534	Diagnostic #2, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303535-303536	Diagnostic #3, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303537	Diagnostic #3, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303538	Diagnostic #3, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303539-303540	Diagnostic #4, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303541	Diagnostic #4, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303542	Diagnostic #4, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303543-303544	Diagnostic #5, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303545	Diagnostic #5, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303546	Diagnostic #5, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303547-303548	Diagnostic #6, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303549	Diagnostic #6, Code	R.O.	Static	Number a correlating to the error description.	page 90
303550	Diagnostic #6, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303551-303552	Diagnostic #7, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303553	Diagnostic #7, Code	R.O.	Static	Shows a number correlating to the error description.	page 90
303554	Diagnostic #7, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303555-303556	Diagnostic #8, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303557	Diagnostic #8, Code	R.O.	Static	Shows a number correlating to the error description.	page 91
303558	Diagnostic #8, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303559-303560	Diagnostic #9, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303561	Diagnostic #9, Code	R.O.	Static	Shows a number correlating to the error description.	page 91
303562	Diagnostic #9, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303563-303564	Diagnostic #10, Time	R.O.	Static	Shows the time of the diagnostic.	page 90
303565	Diagnostic #10, Code	R.O.	Static	Shows the number correlating to the error description.	page 91
303566	Diagnostic #10, Data	R.O.	Static	Shows the data where the diagnostic occurred.	page 90
303567	Modbus Bus Messages Received	R.O.	Static	Shows if bus messages were received.	page 91
303568	CRC Error Count	R.O.	Static	Shows number of cyclic redundancy check errors.	page 91
303569	Command Exceptions	R.O.	Static	Shows number of all exception responses returned by Slave.	page 91
303570	Slave Message Count	R.O.	Static	Shows number of Modbus messages addressed to this Slave device.	page 91
303571	No Response Count	R.O.	Static	Shows number of instances where Slave did no return a response.	page 91

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
303572	NAK Count	R.O.	Static	Shows number of NAK (Negative/Not Acknowledged) responses sent by the Slave.	page 91
303573	Slave Busy Count	R.O.	Static	Shows number of instances where the Slave could not perform the requested action because it was busy.	page 91
303574	Serial Character Buffer Overrun	R.O.	Static	Shows number of bytes lost by Slave.	page 91
303575	Timeout Count	R.O.	Static	Shows number of instances when it timed out.	page 91
303576	Illegal Function Request	R.O.	Static	Shows number of illegal function requests.	page 91
303577	Illegal Data Request	R.O.	Static	Shows number of illegal data requests.	page 91
303578	Illegal Address Request	R.O.	Static	Shows number of illegal address requests.	page 91
303579	Zero Progress	R.O.	Static	Shows the progress of zeroing the transmitter.	page 129
303580	Password Change Status	R.O.	Static	Shows whether the change of password was successful.	page 123
303581	Access Status	R.O.	Static	Shows the access level.	page 83
303582	Meter Verification Status	R.O.	Static	Shows the Meter Verification status.	page 130
303583-303584	Meter Verification Runtime	R.O.	Static	Shows Meter Verification at runtime.	page 130
303585	Operating Status	R.O.	Static	Shows the operational status.	page 87
303586	Concentration Measurement Status	R.O.	Static	Shows the status of the concentration measurement.	page 88
Integer (read/write)					
403601	Tube Selection	R/W	Static	Select the flowtube model.	page 110
403602	Flow Direction	R/W	Static	Select flow direction (uni pos, uni neg, bi pos, or bi neg).	page 117
403603	Low Flow Cut In Enable	R/W	Static	Select to enable low flow cut-in (on or off).	page 117
403604	Fluid Component Selection	R/W	Static	Enter selection of Fluid Component A or B	page 116
403605	Two Phase Enable	R/W	Static	Select two phase enable/disable (off, density on, or mass flow and density on).	page 112
403606	Two Phase Tube Orientation	R/W	Static	Select tube orientation (vertical or horizontal).	page 112
403607	Alarm Acknowledge Mode	R/W	Static	Select the alarm acknowledge mode (Auto or Manual).	page 122
403608	Diagnostic Acknowledge Mode	R/W	Static	Select the diagnostic acknowledge mode (Auto or Manual).	page 122
403609	Contact Output Test Value	R/W	Static	Enter the contact output test value.	page 132
403610	Zero Selection	R/W	Static	Select which value (1 or 2) you want to re-zero.	page 128
403611	Mass Flow Unit Code	R/W	Static	Select the Mass Flow unit.	page 93
403612	Volumetric Flow Unit Code	R/W	Static	Select the volume flow unit.	page 94
403613	Density Unit Code	R/W	Static	Select the density unit.	page 95
403614	Process Temperature Unit Code	R/W	Static	Select the process temperature unit.	page 96

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403615	Concentration Unit Code	R/W	Static	Select the concentration unit.	page 96
403616	Mass Flow A Unit Code	R/W	Static	Select the mass flow A unit.	page 93
403617	Mass Flow B Unit Code	R/W		Select the mass flow B unit.	page 93
403618	Volume Flow A Unit Code	R/W	Static	Select the volume flow A unit.	page 94
403619	Volume Flow B Unit Code	R/W	Static	Select the volume flow B unit.	page 94
403620	Totalizer 1 Unit Code	R/W	Static	Select the Total 1 unit.	page 99
403621	Totalizer 1 Map	R/W	Static	Select the measurement type mapped to this totalizer.	page 100
403622	Totalizer 1 Direction	R/W	Static	Select the direction of flow that will be totalized (forward, reverse, bidirectional).	page 101
403623	Totalizer 1 Type	R/W	Static	Select the type of totalizer (grand or Batch).	page 101
403624	Totalizer 2 Unit Code	R/W	Static	Select the Total 2 unit.	page 99
403625	Totalizer 2 Map	R/W	Static	Select the measurement type mapped to this totalizer.	page 100
403626	Totalizer 2 Direction	R/W	Static	Select the direction of flow that will be totalized (forward, reverse, bidirectional).	page 101
403627	Totalizer 2 Type	R/W	Static	Select the type of totalizer (grand or batch).	page 101
403628	Totalizer 3 Unit Code	R/W	Static	Select the Total 3 unit.	page 99
403629	Totalizer 3 Map	R/W	Static	Select the measurement type mapped to this totalizer.	page 100
403630	Totalizer 3 Direction	R/W	Static	Select the direction of flow that will be totalized (forward, reverse, bidirectional).	page 101
403631	Totalizer 3 Type	R/W	Static	Select the type of totalizer (grand or batch).	page 101
403632	Totalizer 4 Unit Code	R/W	Static	Select the Total 4 unit.	page 99
403633	Totalizer 4 Map	R/W	Static	Select the measurement type mapped to this totalizer.	page 100
403634	Totalizer 4 Direction	R/W	Static	Select the direction of flow that will be totalized (forward, reverse, bidirectional).	page 101
403635	Totalizer 4 Type	R/W	Static	Select the type of totalizer (grand or batch).	page 101
403636	Mass Flow Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 118
403637	Mass Flow Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 118
403638	Volume Flow Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 118
403639	Volume Flow Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 118
403640	Density Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 119
403641	Density Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 119
403642	Process Temperature Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 119
403643	Process Temperature Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 119

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403644	Concentration Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 119
403645	Concentration Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 119
403646	Mass Flow A Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 119
403647	Mass Flow A Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 119
403648	Mass Flow B Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 120
403649	Mass Flow B Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 120
403650	Volume Flow A Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 120
403651	Volume Flow A Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 120
403652	Volume Flow B Alarm On/Off	R/W	Static	Select which alarms are enabled (none, high, low, or both).	page 120
403653	Volume Flow B Alarm Output Device	R/W	Static	Select alarm output (no output, display output, digital output, or display and digital output)	page 120
403654	Totalizer 1 Alarm On/Off	R/W	Static	Select Totalizer 1 alarm (on or off).	page 121
403655	Totalizer 1 Alarm Output Device	R/W	Static	Select the alarm output device (no output, display output, digital output, or display and digital output).	page 121
403656	Totalizer 2 Alarm On/Off	R/W	Static	Select Totalizer 2 alarm (on or off).	page 121
403657	Totalizer 2 Alarm Output Device	R/W	Static	Select the alarm output device (no output, display output, digital output, or display and digital output).	page 121
403658	Totalizer 3 Alarm On/Off	R/W	Static	Select Totalizer 3 alarm (on or off).	page 121
403659	Totalizer 3 Alarm Output Device	R/W	Static	Select the alarm output device (no output, display output, digital output, or display and digital output).	page 121
403660	Totalizer 4 Alarm On/Off	R/W	Static	Select Totalizer 4 alarm (on or off).	page 121
403661	Totalizer 4 Alarm Output Device	R/W	Static	Select the alarm output device (no output, display output, digital output, or display and digital output).	page 121
403662	Output 1 Map	R/W	Static	Select the measurement mapped to this output.	page 102
403663	Output 1 Alarm Response	R/W	Static	Select the direction the analog output is driven if an alarm condition occurs (high, low, or last value).	page 103
403664	Output 1 Diagnostic Response	R/W	Static	Select the direction the analog output is driven if a diagnostic condition is detected (high, low, or last value).	page 103
403665	Output 2 Map	R/W	Static	Select the measurement mapped to this output.	page 102
403666	Output 2 Alarm Response	R/W	Static	Select the direction the analog output is driven if an alarm condition occurs (high, low, or last value).	page 103
403667	Output 2 Diagnostic Response	R/W	Static	Select the direction the analog output is driven if a diagnostic condition is detected (high, low, or last value).	page 103
403668	Digital Input Function	R/W	Static	Select the function of the digital input.	page 104
403669	Digital Output Function	R/W	Static	Select the function of the digital output.	page 104

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403670	Digital Output Normal State	R/W	Static	Select the inactive state of the relay output (open or closed).	page 105
403671	Pulse Rate Fast Update Option	R/W	Static	Select the pulse rate fast update option (on or off).	page 105
403672	Pulse Rate Quadrature Mode	R/W	Static	Select the Pulse Rate Quadrature Mode (on or off).	page 105
403673	Pulse 1 Output Mode	R/W	Static	Select the type of pulse output (total or rate).	page 105
403674	Pulse 2 Output Mode	R/W	Static	Select the type of pulse output (total or rate).	page 105
403675	Pulse 1 Rate Map	R/W	Static	Select the measurement mapped to this output.	page 106
403676	Pulse 1 Rate Scaling Method	R/W	Static	Select the scaling method (URV, Pulse/Units, or Units/Pulse).	page 106
403677	Pulse 1 Rate Maximum Frequency	R/W	Static	Enter the maximum frequency (URV value).	page 107
403678	Pulse 1 Rate Minimum Frequency	R/W	Static	Enter the minimum frequency (LRV value).	page 107
403679	Pulse 1 Rate Alarm Response	R/W	Static	Select the direction the pulse output is driven if an alarm condition occurs (low, high, or last value).	page 107
403680	Pulse 1 Rate Diagnostic Response	R/W	Static	Select the direction the pulse output is driven if a diagnostic condition is detected (low, high, or last value).	page 108
403681	Pulse 1 Total Map	R/W	Static	Select the measurement type mapped to this output.	page 108
403682	Pulse 1 Total Maximum Frequency	R/W	Static	Select the maximum frequency (10 or 100 Hz).	page 108
403683	Pulse 1 Total Direction	R/W	Static	Select the direction (forward, reverse, or bidirectional).	page 109
403684	Pulse 1 Total Units	R/W	Static	Select the mass, volume, or custom units.	page 109
403685	Pulse 1 Total Control	R/W	Static	Select Pulse 1 Total control (on or off).	page 110
403686	Pulse 2 Rate Map	R/W	Static	Select the measurement mapped to this output.	page 106
403687	Pulse 2 Rate Scaling Method	R/W	Static	Select the scaling method (URV, Pulse/Units, or Units/Pulse).	page 106
403688	Pulse 2 Rate Maximum Frequency	R/W	Static	Enter the maximum frequency at which the pulse output can generate pulses.	page 107
403689	Pulse 2 Rate Minimum Frequency	R/W	Static	Enter the minimum frequency at which the pulse output can generate pulses.	page 107
403690	Pulse 2 Rate Alarm Response	R/W	Static	Select the direction the pulse output is driven if an alarm condition occurs (low, high, or last value).	page 107
403691	Pulse 2 Rate Diagnostic Response	R/W	Static	Select the direction the pulse output is driven if a diagnostic condition is detected (low, high, or last value).	page 108
403692	Pulse 2 Total Map	R/W	Static	Select the measurement type mapped to this output.	page 108
403693	Pulse 2 Total Maximum Frequency	R/W	Static	Select the maximum frequency (10 or 100 Hz).	page 108
403694	Pulse 2 Total Direction	R/W	Static	Select the direction (forward, reverse, or bidirectional).	page 109
403695	Pulse 2 Total Units	R/W	Static	Select the mass, volume, or custom units.	page 109
403696	Pulse 2 Total Control	R/W	Static	Select Pulse 2 Total control (on or off).	page 110
403697	Display Cycle	R/W	Static	Select to display the measurements selected to cycle automatically (ON) or be able to be cycled manually (OFF).	page 113

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403698	Display Primary Measurement	R/W	Static	Select the measurement as the default display from the ones selected in the above register.	page 114
403699	Display Alarm Response	R/W	Static	Select to have the display blink (blink) or not blink (none) if an alarm condition occurs.	page 114
403700	Display Diagnostic Response	R/W	Static	Select to have the display blink (blink) or not blink (none) if a diagnostic condition occurs.	page 114
403701	Mass Flow Format	R/W	Static	Select the desired format of the mass flow units on the display.	page 115
403702	Volumetric Flow Format	R/W	Static	Select the desired format of the volumetric flow units on the display.	page 115
403703	Density Format	R/W	Static	Select the desired format of the density units on the display.	page 115
403704	Concentration Format	R/W	Static	Select the desired format of the concentration units on the display.	page 115
403705	Mass Flow A Format	R/W	Static	Select the desired format of the Mass Flow A units on the display.	page 115
403706	Mass Flow B Format	R/W	Static	Select the desired format of the Mass Flow B units on the display.	page 115
403707	Volume Flow A Format	R/W	Static	Select the desired format of the Volume Flow A units on the display.	page 115
403708	Volume Flow B Format	R/W	Static	Select the desired format of the Volume Flow A units on the display.	page 115
403709	Totalizer 1 Format	R/W	Static	Select the desired format of the Totalizer 1 units on the display.	page 115
403710	Totalizer 2 Format	R/W	Static	Select the desired format of the Totalizer 2 units on the display.	page 115
403711	Totalizer 3 Format	R/W	Static	Select the desired format of the Totalizer 3 units on the display.	page 115
403712	Totalizer 4 Format	R/W	Static	Select the desired format of the Totalizer 4 units on the display.	page 116
403713-403714	Display Show Measurement	R/W	Static	Enter code to display any or all of the available measurements.	page 113
403715	Response Delay	R/W	Static	Enter the delay before a response is sent.	page 124
403716	RS-485 Digital Communication Baud Rate	R/W	Static	Select the serial port baud rate for the transmitter.	page 124
403717	RS-485 Digital Communication Parity	R/W	Static	Select the serial port parity setting for the transmitter.	page 124
403718	Device Address	R/W	Static	Enter the transmitter Modbus address for the serial port.	page 124
403719	Floating Point Byte Format	R/W	Static	Select the data byte order (MSW_LSW, LSW_MSW, RMSW_RLSW, or RLSW_RMSW).	page 125
403720	Measurement Filter Control	R/W	Static	Select the average time for the dynamic registers	page 98
403721-403722	Meter Verification Datum Runtime	R/W	Static	Meter Verification Datum Runtime	page 131
403723	Pressure Compensation Enable	R/W	Static	Pressure Compensation Enable options	page 131
403724	Pressure Units	R/W	Static	Pressure Units choices	page 131
403725	mA Output 3 Map	R/W	Static	Select the measurement mapped to this output.	page 102
403726	mA Output 3 Alarm Response	R/W	Static	Select the direction the analog output is driven if an alarm condition occurs	page 103

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403727	mA Output 3 Diagnostic Response	R/W	Static	Select the direction the analog output is driven if a diagnostic condition is detected	page 103
403728	Concentration Type (BAUME)	R/W	Static	Select the degrees Baumé concentration measurement type	page 97
403729	Concentration Type (BRIX)	R/W	Static	Select the degrees Brix concentration measurement type	page 97
403730	Concentration Type (%)	R/W	Static	Select the percent solute concentration measurement type	page 97
403731	Concentration Type (PROOF)	R/W	Static	Select the proof concentration measurement type	page 97
403732	Concentration Count	R/W	Static	Enter the number of custom concentration coefficients	page 97
Integer (Function)					
403845	Calibration Fluid	R/W	Static	Select the high or low density liquid.	page 127
403846	Density Calibration Function	R/W	Static	Select to perform density calibration function (on or off).	page 128
403847	Density Calibration Restore	R/W	Static	Select to revert to the last inputted values before the density calibration procedure was performed (on or off).	page 128
403848	Zero Calibration	R/W	Static	Select to perform zeroing function (on or off).	page 129
403849	Zero Restore	R/W	Static	Select to return to initial conditions (on or off).	page 129
403850	mA Output 1 Test Function	R/W	Static	Select to turn the mA Output 1 test mode (on or off).	page 132
403851	mA Output 2 Test Function	R/W	Static	Select to turn the mA Output 2 test mode (on or off).	page 132
403852	Contact Output Test Function	R/W	Static	Select to turn the contact output test mode (on or off).	page 132
403853	Pulse Output 1 Test Function	R/W	Static	Select to turn the pulse output 1 test mode (on or off).	page 132
403854	Pulse Output 2 Test Function	R/W	Static	Select to turn the pulse output 2 test mode (on or off).	page 132
403855	mA Output 1 Calibration Function	R/W	Static	Select mA Output 1 calibration functions.	page 126
403856	Restore mA Output 1 Factory Calibration	R/W	Static	Select to restore mA Output 1 factory calibration (yes or no).	page 126
403857	mA Output 2 Calibration Function	R/W	Static	Select mA Output 2 calibration function.	page 126
403858	Restore mA Output 2 Factory Calibration	R/W	Static	Select to restore mA Output 2 factory calibration (yes or no).	page 126
403859	Totalizer 1 Control	R/W	Static	Select Totalizer 1 control (on, off, or clear).	page 101
403860	Totalizer 2 Control	R/W	Static	Select Totalizer 2 control (on, off, or clear).	page 101
403861	Totalizer 3 Control	R/W	Static	Select Totalizer 3 control (on, off, or clear).	page 101
403862	Totalizer 4 Control	R/W	Static	Select Totalizer 4 control (on, off, or clear).	page 101
403863	Acknowledge Diagnostic	R/W	Static	Acknowledge the active diagnostic.	page 90
403864	Acknowledge Alarms	R/W	Static	Acknowledge the active alarm.	page 89
403865	Clear Modbus Counters	R/W	Static	Select to clear Modbus counters (yes/no).	page 91

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
403866	Set Configuration Defaults	R/W	Static	Select whether to set the configuration to factory defaults	page 123
403867	Reset Transmitter	R/W	Static	Select whether to reset the transmitter. (Similar to a power cycle)	page 123
403868	Meter Verification Function	R/W	Static	Meter Verify Function choices	page 130
403869	Meter Verify Save	R/W	Static	Meter Verify Save options	page 130
403870	mA Output 3 Test Functions	R/W	Static	mA Output Test Function choices	page 132
403871	mA Output 3 Calibration Functions	R/W	Static	Select mA Output 3 calibration functions.	page 126
403872	mA Output 3 Calibration Restore Functions	R/W	Static	Restore mA Output choices	page 126
			ASCII		
303971-303978	Transmitter MS Code	R.O.	Static	Shows the transmitter MS (model) code.	page 92
303979-303986	Transmitter Serial Number	R.O.	Static	Shows the transmitter serial number.	page 92
303987-303991	Software Revision	R.O.	Static	Shows the software revision level.	page 133
303992-303994	Mass Flow Label	R.O.	Static	Shows mass flow EGU label.	page 85
303995-303997	Volumetric Flow Label	R.O.	Static	Shows volume flow EGU label.	page 85
303998-304000	Density Label	R.O.	Static	Shows density EGU label.	page 85
304001-304003	Process Temperature Label	R.O.	Static	Shows process temperature EGU label.	page 85
304004-304006	Concentration Label	R.O.	Static	Shows concentration EGU label.	page 85
304007-304009	Mass Flow A Label	R.O.	Static	Shows mass flow A EGU label.	page 85
304010-304012	Mass Flow B Label	R.O.	Static	Shows mass flow B EGU label.	page 85
304013-304015	Volume Flow A Label	R.O.	Static	Shows volume flow A EGU label.	page 85
304016-304018	Volume Flow B Label	R.O.	Static	Shows volume flow B EGU label.	page 85
304019-304021	Totalizer 1 Label	R.O.	Static	Shows Total 1 EGU label.	page 85
304022-304024	Totalizer 2 Label	R.O.	Static	Shows Total 2 EGU label.	page 85
304025-304027	Totalizer 3 Label	R.O.	Static	Shows Total 3 EGU label.	page 85
304028-304030	Totalizer 4 Label	R.O.	Static	Shows Total 4 EGU label.	page 85
404095-404105	Tube MS Code	R/W	Static	Enter the model code of the flowtube being used with your transmitter.	page 92
404106-404113	Tube Serial Number	R/W	Static	Enter the serial number of the flowtube being used with your transmitter.	page 92

Table 11. Modbus Registers (Continued)

Address	Name	Access	Update	Description	Ref.
404114-404120	Location	R/W	Static	Enter the location of your transmitter.	page 92
404121-404123	Calibration Name	R/W	Static	Enter the name of the calibrator.	page 92
404124-404127	Calibration Date	R/W	Static	Enter the date of calibration.	page 92
404128-404130	Mass Flow Custom Name	R/W	Static	Enter custom name of the mass flow.	page 94
404131-404133	Volume Flow Custom Name	R/W	Static	Enter custom name of the volume flow.	page 95
404134-404136	Density Custom Name	R/W	Static	Enter custom name of the density.	page 96
404137-404139	Mass Flow A Custom Name	R/W	Static	Enter custom name of the mass flow A.	page 94
404140-404142	Mass Flow B Custom Name	R/W	Static	Enter custom name of the mass flow B.	page 94
404143-404145	Volume Flow A Custom Name	R/W	Static	Enter custom name of the volume flow A.	page 95
404146-404148	Volume Flow B Custom Name	R/W	Static	Enter custom name of the volume flow B.	page 95
404149-404151	Totalizer 1 Custom Name	R/W	Static	Enter custom name of Total 1.	page 100
404152-404154	Totalizer 2 Custom Name	R/W	Static	Enter custom name of Total 2.	page 100
404155-404157	Totalizer 3 Custom Name	R/W	Static	Enter custom name of Total 3.	page 100
404158-404160	Totalizer 4 Custom Name	R/W	Static	Enter custom name of Total 4.	page 100
404161-404163	Fluid Component A Name	R/W	Static	Enter name of fluid A.	page 116
404164-404166	Fluid Component B Name	R/W	Static	Enter name of fluid B.	page 116
404167-404169	Old Password	W	Static	Enter the previous password.	page 122
404170-404172	High Level Password	W	Static	Enter the high level password.	page 122
404173-404175	Low Level Password	W	Static	Enter the low level password.	page 122
404176-404178	Password Entry	R/W	Static	Enter the password.	page 83
404179-404181	Concentration Custom Name	R/W	Static	Enter the units name for the custom concentration measurement.	page 97
404182-404187	Concentration Custom Equation	R/W	Static	Enter the custom concentration equation form.	page 97
Floating Point					
404589-404590	External Pressure Input	R/W	Dynamic	Enter external pressure input.	page 131

7. Setup

The CFT51 transmitter can be configured with a HART Communicator, the Modbus protocol, or with the optional keypad/LCD display.

With the keypad/display, two configuration menus exist. Most basic applications can be configured in Quick Start mode (see "Quick Start" on page 55). For applications requiring functions not covered by the Quick Start mode, use the Setup mode that is fully described in this chapter.

When to Use Setup Modes

Use Setup mode for applications involving:

- Volume flow or density measurements
- Mass flow units other than the current units
- Pulse or Contact Output
- Alarm or Totalizer functions
- Reverse or bidirectional flow.

Quick Start mode, fully described in "When to Use Quick Start Mode" on page 55, can be used for applications requiring only:

- Flow measurement in current units (factory default is mass flow in lb/min)
- Current output
- Positive flow direction.

Steps Required

The Top Level menu displays five modes – Measure, Quick Start, Status, View, and Setup. You can switch from one to another in sequence by using the Up/Down arrow keys. To enter the second level menu from a particular top level display, press the Right arrow key. To return to the top level from a second level menu item, press the Left arrow key. The level of the first, second, third, and fourth level menus is indicated by the digit appearing as the first character in Line 1 of the display; a 1 indicates Level 1 (Top Level), a 2 indicates Level 2, and a 3 indicates Level 3, and so forth.

The Setup mode enables you to configure your measurement, output, view, test, calibration, and system parameters. Setup mode can be a passcode protected mode. So after the initial configuration, you may need a password to enter this mode. At the display PASSWORD, enter the correct password. If the entered password is incorrect, the display reads PASSWORD/LOCKED and you cannot enter Setup to make changes. You can, however, bypass this message with the Enter key for viewing only.

NOTE

If you lose your password, call Global Customer Support for assistance.

If your transmitter is being configured from a Modbus host at the time you try to enter Setup mode, the local display reads REMOTE/LOCKED. In this case, you cannot enter Setup mode to make changes. You can, however, bypass this message with the Enter key for viewing only. This is also an off-line mode. Outputs are driven fully downscale. Upon attempts to enter this mode, a message indicates that you are going off-line and asks if you want to do so. Indicate 'yes' with the Right arrow key.

The structural diagrams for Setup from the local display and keypad are in Appendix B, "Setup Diagrams" The diagram for Setup from a HART Communicator is in Figure 50.

NOTE

1. As you step through the menus described in this chapter, available parameters depend on the communication protocol selected for your transmitter and shown in the model code.
2. If you pause in Setup mode for more than 10 minutes, the system times out and you will not be able to make more changes. If this happens, go to `1 SETUP` to reset the timer.
3. If write protection is enabled, the display reads `WPROT/LOCKED` and you cannot enter Setup mode to make changes. You can, however, bypass this message with the Enter key for viewing only. To disable write protection, you must first turn power off, move the write protect jumper to the disable position, and then turn power back on. See "Write Protect Jumper" on page 52.

Configurable Parameters

Table 12. Configurable Parameters

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Measure: Mass Flow					
Units	Select from picklist	LB/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Measure: Volume Flow					
Units	Select from picklist	USG/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Measure: Density					
Units	Select from picklist	g/cc	Yes	Yes	
Format	Select from picklist	###.####	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Measure: Concentration					
Units	% by wt, % by vol, Brix, Baumé, Proof, % Solute, Custom	% by wt	Yes	Yes	
Component (for %WT, %VOL)	A or B	A	Yes	Yes	
Type (for BRIX, BAUME, PROOF, % Solute)	Select from picklist		Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Measure: Temperature					
Units	degC or degF	degF	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Total 1 (a)					
Map	mass all, mass flow A, mass flow B, vol all, volume flow A, volume flow B	mass all	Yes	Yes	
Units	Select total units	LB	Yes	Yes	
Direction	Bidir, Forward, and Reverse	Forward	Yes	Yes	
Type (Protection)	Grand or Batch	Batch	Yes	Yes	
Format	Select from picklist	xxxxxxxx	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Total 2 (a)					
Map	mass all, mass flow A, mass flow B, vol all, volume flow A, volume flow B	vol all	Yes	Yes	
Units	Select total units	USGal	Yes	Yes	
Direction	Bidir, Forward, and Reverse	Forward	Yes	Yes	
Type (Protection)	Grand or Batch	Batch	Yes	Yes	
Format	Select from picklist	xxxxxxxx	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Total 3 (a)					
Map	mass all, mass flow A, mass flow B, vol all, volume flow A, volume flow B	mass all	Yes	Yes	
Units	Select total units	LB	Yes	Yes	
Direction	Bidir, Forward, and Reverse	Forward	Yes	Yes	
Type (Protection)	Grand or Batch	Batch	Yes	Yes	
Format	Select from picklist	xxxxxxxx	Yes	No	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Total 4 (a)					
Map	mass all, mass flow A, mass flow B, vol all, volume flow A, volume flow B	mass all	Yes	Yes	
Units	Select total units	LB	Yes	Yes	
Direction	Bidir, Forward, and Reverse	Forward	Yes	Yes	
Type (Protection)	Grand or Batch	Batch	Yes	Yes	
Format	Select from picklist	xxxxxxxx	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Mass Flow Component A					
Units	Select from picklist	LB/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Mass Flow Component B					
Units	Select from picklist	LB/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Volume Flow Component A					
Units	Select from picklist	USG/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Volume Flow Component B					
Units	Select from picklist	USG/M	Yes	Yes	
Format	Select from picklist	####.###	Yes	Yes	
Alarms					
Alarm Feature	Off, Hi Alm, Lo Alm, Both	Off	Yes	Yes	
Hi Setpoint		0.0	Yes	Yes	
Hi Deadband		0.0	Yes	Yes	
Lo Setpoint		0.0	Yes	Yes	
Lo Deadband		0.0	Yes	Yes	
Alm Output	Dig Output (yes or no) Display (yes or no)	No No	Yes	Yes	
Output					
mA1					
Map	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	mflow	Yes	Yes	
URV LRV		661.387 0	Yes	Yes	
Damping	00.0 to 99.9 seconds	0.5	Yes	Yes	
Alarm Response	None, Low, High, Last	High	Yes	Yes	
Diagnostic Response	Low, High, Last	High	Yes	Yes	
mA2					
Map	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	mflow	Yes	Yes	
URV LRV		661.387 0	Yes	Yes	
Damping	00.0 to 99.9 seconds	0.5	Yes	Yes	
Alarm Response	None, Low, High, Last	High	Yes	Yes	
Diagnostic Response	Low, High, Last	High	Yes	Yes	
mA3					
Map	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	mflow	Yes	Yes	
URV LRV		661.387 0	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Damping	00.0 to 99.9 seconds	0.5	Yes	Yes	
Alarm Response	None, Low, High, Last	High	Yes	Yes	
Diagnostic Response	Low, High, Last	High	Yes	Yes	
Pulse (affects both pulse outputs)					
Fast Mode	Enable, disable	Disabled	Yes	Yes	
Quadrature Mode	Enable, disable	Disabled	Yes	Yes	
Pulse 1					
Pulse 1 Output Mode	Rate, Total	Rate	Yes	Yes	
Pulse 1 Rate Mode:					
Map	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	Mass flow	Yes	Yes	
Scaling	URV, Units per Pulse, Pulses per Unit	URV	Yes	Yes	
URV LRV		661.387 0	Yes	Yes	
Maximum frequency Minimum frequency		10000 0	Yes	Yes	
Damping	00.0 to 99.9	0.5	Yes	Yes	
Alarm Response	High, Low, Last, None	None	Yes	Yes	
Diagnostic Response	High, Low, Last		Yes	Yes	
Pulse 1 Total Mode:					
Maximum frequency	10 to 100 Hz		Yes	Yes	
Map	mass all, mcomp A, mcomp B, vol all, vcomp A, vcomp B		Yes	Yes	
Units	Select from picklist	Lb	Yes	Yes	
Units per Pulse			Yes	Yes	
Direction	Bidir, Forward, and Reverse		Yes	Yes	
Pulse 2					
Pulse 2 Output Mode:	Rate, Total	Rate	Yes	Yes	
Pulse 2 Rate Mode:					
Map	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	Mass flow	Yes	Yes	
Scaling	URV, Units per Pulse, Pulses per Unit	URV	Yes	Yes	
URV LRV		661.387 0	Yes	Yes	
Maximum frequency Minimum frequency		10000 0	Yes	Yes	
Damping	00.0 to 99.9 seconds	0.5	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Alarm Response	High, Low, Last, None	None	Yes	Yes	
Diagnostic Response	High, Low, Last		Yes	Yes	
Pulse 2 Total Mode:					
Maximum frequency	10 to 100 Hz	100 Hz	Yes	Yes	
Map	mass all, mcomp A, mcomp B, vol all, vcomp A, vcomp B		Yes	Yes	
Units	Select from picklist	Lb	Yes	Yes	
Units per Pulse			Yes	Yes	
Direction	Bidir, Forward, and Reverse		Yes	Yes	
Contact Output					
Function	Off, Any Alarm, Diag, Alarm/Diag	Off	Yes	Yes	
Operation	Normally Open or Closed	Closed	Yes	Yes	
Contact Input	Off, CalZero, SelZero, SigLock, AckAlrm, ClearTot1, ClearTot2, ClearTot3, ClearTot4, ClearNets, ClrTots	Off	Yes	Yes	
Display					
Show	Mass flow, Volume flow, Density, Temperature, Concentration, Total 1, Total 2, Total 3, Total 4, mass flow A, mass flow B, volume flow A, volume flow B	Mflow, Density, Temperature, Total1	Yes	Yes	
Cycle	Auto or Manual	Manual	Yes	Yes	
Primary	Show items selected	Mflow	Yes	Yes	
Damping	00.0 to 99.9 seconds	1.0	Yes	Yes	
Alarm Resp	None or Blink	Blink	Yes	Yes	
Diag Resp	None or Blink	Blink	Yes	Yes	
HART Dynamic Variables					
PV	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	See Map for analog output 1 (mA1)	Yes	Yes	
SV	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	See Map for analog output 2 (mA2)	Yes	Yes	
TV	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, or volume flow B	See Map for analog output 3 (mA3)	Yes	Yes	
QV	mass flow, volume flow, density, concentration, temperature, mass flow A, mass flow B, volume flow A, volume flow B, Total 1, Total 2, Total 3, Total 4	mflow	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
View					
Locate	14 characters	(spaces)	Yes	Yes	
Flowtube Model	22 characters	(spaces)	Yes	Yes	
Flowtube Serial Number	16 characters	(spaces)	Yes	Yes	
HART Tag	8 characters	(spaces)	Yes	Yes	
HART Descriptor	16 characters	(spaces)	Yes	Yes	
HART Message	32 characters	(spaces)	Yes	Yes	
HART Poll Address	For HART 5: 0 to 15 For HART 6 or 7: 0 to 63	00	Yes	Yes	
Test					
Set mA1 Output			Yes	Yes	
Set mA2 Output			Yes	Yes	
Set mA3 Output			Yes	Yes	
Set Pulse Output			Yes	Yes	
Set Digital Output			Yes	Yes	
Calibration					
Model					
Size	02, 03, 05, 08, 10, 15, 20	02	Yes	Yes	
Matl	CFS10-S, CFS20-S, CFS10-H, CFS20-H CFS10-C, CFS20-C,	CFS10-S	Yes	Yes	
Flow Constants					
FC1	(Calculated)		No	No	
FC2			Yes	Yes	
FC3	(Calculated)		No	No	
Density Constants					
DC1	(Calculated)		No	No	
DC2			Yes	Yes	
DC3	(Calculated)		No	No	
DC4			Yes	Yes	
DC Cal	(calculate new constants)		Yes	Yes	
KBias		1.0	Yes	Yes	
Flow Direction	uni pos, uni neg, bi pos, bi neg	bi pos	Yes	Yes	
Flow Zero					
Select Zero	1 or 2	1	Yes	Yes	
Cal Zero	(zero the transmitter)	0.0	Yes	Yes	
Low Flow Cut-Off	On or Off	Off	Yes	Yes	
Density Limit		0.0	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Fluid					
Component A					
Name		water	Yes	Yes	
Density		0.998254	Yes	Yes	
Temp Coefficient		-0.000113	Yes	Yes	
Reference Temperature		68 degF	Yes	Yes	
Component B					
Name		air	Yes	Yes	
Density		0.004101	Yes	Yes	
Temp Coefficient		-0.000008	Yes	Yes	
Reference Temperature		68 degF	Yes	Yes	
2 Phase					
Void Fraction Compensation					
MFlow	Yes (for mass flow and density) (b)	No	Yes	Yes	
Density	Yes (for density only) (b)	No	Yes	Yes	
Density		0.998254	Yes	Yes	
Temperature Coefficient		-0.000113	Yes	Yes	
Reference Temperature		68 degF	Yes	Yes	
Flowtube Mounting	Vertical or Horizontal (b)	Vertical	Yes	Yes	
Milliampere Calibration					
mA1 Cal					
4 mA			Yes	Yes	
20 mA			Yes	Yes	
Factory Calibration			Yes	Yes	
mA2 Cal					
4 mA			Yes	Yes	
20 mA			Yes	Yes	
Factory Calibration			Yes	Yes	
mA3 Cal					
4 mA			Yes	Yes	
20 mA			Yes	Yes	
Factory Calibration			Yes	Yes	
Calibration Identification					
Calibration Date	MMDDYYYY		Yes	Yes	
Calibration Name	6 characters maximum		Yes	Yes	
Tube Check (b)					
Tube Check Function			Yes	Yes	
Calculated Verification Ratio		0	Yes	Yes	
Verification Time		0	Yes	Yes	

Table 12. Configurable Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator	HART Comm.	
Datum Verification Ratio		0	Yes	Yes	
Datum Time		0	Yes	Yes	
Percent Change		0	Yes	Yes	
Pressure Compensation					
Compensation Selection	Off, Enabled using External Pressure, Enabled using Internal Pressure	Off	Yes	Yes	
Internal Pressure Value		50.0	Yes	Yes	
Pressure Units	kPa, bar, PSI	PSI	Yes	Yes	
System					
Password					
High Level Password		(6 spaces)	Yes	Yes	
Low Level Password		(6 spaces)	Yes	Yes	
Alarm Acknowledge	Auto or Manual	Auto	Yes	Yes	
Diagnostic Acknowledge	Auto or Manual	Auto	Yes	Yes	
Set Factory Configuration			Yes	Yes	
Communication Protocol	Modbus or HART	HART	Yes	No	
Hart Version (c)	HART 5, HART 6, or HART 7	HART 7	Yes	No	
Hart Response Preambles (c)	5 to 20	5	Yes	Yes	
Hart Poll Address (c)	HART version 5: 0 to 15 HART version 6 or 7: 0 to 63	0	Yes	Yes	
Hart Loop Control (c)	Enable, Disable	Enable	Yes	Yes	
Modbus Baud Rate (c)	1200, 2400, 4800, 9600, 19200, or 38400	9600	Yes	No	
Modbus Parity (c)	None, Odd, or Even	None	Yes	No	
Modbus Device Address (c)	Between 1 and 247	247	Yes	No	
Modbus Byte Format (c)	0123 = MSW_LSW 2301 = LSW_MSW (default) 1032 = RMSW_RLSW 3210 = RLSW_RMSW	2301	Yes	No	
Modbus Response Delay (c)	0 to 255	0	Yes	No	
Measurement Filter	No averaging, 0.1, 0.5, 1, 2, or 5 seconds	1 Second	Yes	Yes	

a. Default is Off (set in Measure mode).

b. Available for CFS10 and CFS20 flowtubes only.

c. Only applicable to the associated communication protocol.

Setting Measure Parameters

The structural diagram of the Measure Setup menus are located on Figure 67 and Figure 69 in Appendix B, “Setup Diagrams”.

Mass Flow

Units

In the `3 MFLOW > 4 UNITS` parameter, you can specify the mass flow units as:

G/SEC, G/MIN, G/HR, G/D, (grams per unit time)
KG/S, KG/M, KG/H KG/D, (kilograms per unit time)
LB/S, LB/M, LB/H, LB/D, (pounds per unit time)
OZ/S, OZ/M, OZ/H, OZ/D, (ounces per unit time)
ST/S, ST/M, ST/H, ST/D, (short tons (2000 pounds) per unit time)
MT/M, MT/H, MT/D (metric tonnes (1000 kg) per unit time)
or CUSTOM.

Custom

— NOTE —

Base unit conversion for Mass Flow starts with kilograms per second.

If you select `custom`, you must define your custom units in `4 CUSTOM`. First, enter a `name` for your custom units using up to eight alphanumeric characters. The characters that can be used are listed in Table 13. Then, enter any offset (`offset`) and a conversion factor (`slope`) from kilograms per second to the custom units.

Example: The slope for a custom unit of long tons per hour would be 3.5424 because 3.5424 LTon/hr = 1 kg/s.
A list of slopes for frequently used units is located in Appendix A, “Custom Slopes”.

Table 13. Alphanumeric Characters

Characters
0 through 9
A through Z
a through z
. (period)
+
-
/
(space)

Format

The format of the units on your display are determined in `4 FORMAT`. The available options for this parameter are:

- ########(display in single units)
- ######.#(display in tenths of units)
- #####.##(display in hundredths of units)
- ####.###(display in thousandths of units)
- ###.####(display in ten thousandths of units)
- ##.#####(display in hundred thousandths of units).

Select a format that provides the desired precision without yielding excessive flickering of the less significant digits. The displayed value can also be damped. See “Display” on page 175.

Alarms

The configuration of mass flow alarms is determined in `4 ALARM`. This parameter has several subparameters:

- `5 ALARM` can be configured to set the alarm feature `off`, `hi alarm`, `lo alarm`, or `both`.
- `5HISETPT` and `5LOSETPT` is used to establish the high and low alarm set point values.
- `5HIDBAND` and `5LODBAND` is used to establish the high and low alarm deadband values.
- `5ALRMOUT` is used to establish whether the alarm is to affect the digital output (`DOUT`) and/or the `DISPLAY`. You can answer `yes` or `no` to each.

Volume Flow

Units

In the `3 VFLOW` > `4 UNITS` parameter, you can specify the volume flow units as:

L/S, L/M, L/H, L/D, (liters per unit time)
USG/S, USG/M, USG/H, USG/D, (US gallons per unit time)
IMPG/S, IMPG/M, IMPG/H, IMPG/D, (imperial gallons per unit time)
BBL/S, BBL/M, BBL/H, BBL/D (42 gal barrels per unit time)
M3/S, M3/M, M3/H, M3/D (cubic meters per unit time)
FT3/S, FT3/M, FT3/H, FT3/D (cubic feet per unit time)
or CUSTOM.

Custom

— NOTE —

Base unit conversion for Volume Flow starts with liters per second.

If you select `custom`, you must define your custom units in `4 CUSTOM`. First, enter a `name` for your custom units using up to eight alphanumeric characters. The characters that can be used are listed in Table 13. Then, enter any offset (`offset`) and a conversion factor (`slope`) from liters per second to the custom units.

Example: The slope for a custom unit of ft^3/min would be 2.11888 because
2.11888 ft^3/min = 1 L/s.
A list of slopes for frequently used units is located in Appendix A, “Custom Slopes”

Format

The configuration of volume flow format is determined in `4 FORMAT`. The details of this parameter are the same as explained in “Format” on page 163.

Alarms

The configuration of volume flow alarms is determined in `4 ALARM`. The details of this parameter are the same as explained in “Alarms” on page 163.

Density

Units

In the `3 DENSITY` > `4 UNITS` parameter, you can specify the density units as:

S.G., (specific gravity referenced to water at 60 deg F)
KG/M3, KG/L, (kilograms per cubic meter or liter)
LB/G, LB/FT3, LB/IN3, (pounds per gallon, cubic foot, or cubic inch)
G/ML, G/CC, G/L, (grams per milliliter, cubic centimeter, or liter
ST/YD3, (short tons (2000 pounds) per cubic yard)
or CUSTOM.

Custom

— NOTE —

Base unit conversion for Density starts with kilograms per cm^3.

If you select `custom`, you must define your custom units in `4 CUSTOM`. First, enter a `name` for your custom units using up to eight alphanumeric characters. The characters that can be used are listed in Table 13. Then, enter any offset (`offset`) and a conversion factor (`slope`) from kilograms per cubic meter to the custom units.

Example: The slope for a custom unit of oz/gal would be 7.48915 because
7.48915 oz/gal = 1 kg/m^3.
A list of slopes for frequently used units is located in Appendix A, “Custom Slopes”.

Format

The configuration of density format is determined in `4 FORMAT`. The details of this parameter are the same as explained in “Format” on page 163.

Alarms

The configuration of density alarms is determined in 4 ALARM. The details of this parameter are the same as explained in “Alarms” on page 163.

Concentration

This measurement uses the measured density and temperature to calculate the percentage of a component in a mixture or solution. Specialized algorithms for aqueous solutions of sucrose and alcohol (ethanol) are selectable, as well as more general types of calculations that determine the percentage by mass or by volume of components defined by the customer.

For best results, perform a density calibration at operating conditions.

Table 14. Concentration Limits

	Units	Low Limit	High Limit	Units	Low Limit	High Limit
Alcohol Mass, Volume 20°C, Volume 60°F (Percent Solute)						
Temperature	°C	-22.00	42.00	°F	-7.60	107.60
Density	Kg/M^3	756.49	1019.96	Lb/Ft^3	47.22	63.67
Output	Percent	0.0	100.0	Percent	0.0	100.0
Proof						
Temperature	°C	-22.00	42.00	°F	-7.60	107.60
Density	Kg/M^3	756.49	1019.96	Lb/Ft^3	47.22	63.67
Output	Proof	0.0	200.00	Proof	0.0	200.00
Sucrose (Brix)						
Temperature	°C	-2.00	52.00	°F	28.40	125.60
Density	Kg/M^3	968.00	1442.64	Lb/Ft^3	60.43	90.06
Output	Brix	0.0	80.0	Brix	0.0	80.0
HFCS42 (Brix)						
Temperature	°C	-2.00	102.00	°F	28.40	215.60
Density	Kg/M^3	938.02	1596.51	Lb/Ft^3	58.55	99.66
Output	Brix	0.0	100.0	Brix	0.0	100.0
HFCS55 (Brix)						
Temperature	°C	-2.00	102.00	°F	28.40	215.60
Density	Kg/M^3	938.02	1596.89	Lb/Ft^3	58.55	99.69
Output	Brix	0.0	100.0	Brix	0.0	100.0
Corn Starch (Baume)						
Temperature	°C	13.55	62.00	°F	56.40	143.60
Density	Kg/M^3	964.03	1230.21	Lb/Ft^3	60.18	76.79
Output	Baume	0.0	25.0	Baume	0.0	25.0
Custom						
Temperature	°C	-222.00	222.00	°F	-367.60	431.60
Density	Kg/M^3	0.00	4080.00	Lb/Ft^3	0.00	254.70
Output	CUSTOM	0.0	100.0	CUSTOM	0.0	100.0

Setting Concentration Measurement Parameters

Steps Required

1. Specify the units of concentration.
2. Specify the type of measurement or (if applicable) the component to be measured as A or B.
3. Configure any concentration alarms.
4. Configure the format of your local display for the concentration measurement.
5. If required, define the fluid components specified in Step 2.

Procedure

1. In the `1 SETUP` > `2 MEASURE` > `3 CONCENT` > `4 UNITS` parameter, specify the concentration units as `% by wt`, `% by volume`, `BRIX`, `BAUME`, `% Solute`, `Proof`, or `Custom`.
2. Choose the desired measurement:
   - If you selected `% by wt` or `% by volume`, the component to be measured is determined in `4 COMP`. The component can be specified as A or B.
   - If you selected `% Solute` or `BRIX`, the desired measurement is chosen in `4 TYPE`.
   - If you selected `Custom`, see "Custom Concentration Measurement Parameters" on page 167.
3. Configure the display format in `4 FORMAT`. Select a format that provides the desired precision without yielding excessive flickering of the less significant digits. The displayed value can also be damped. See "Display" on page 175.
4. Configure concentration alarms in `4 ALARMS`. This parameter has several subparameters:
   - Use `5 ALARM` to set `hi alarm`, `lo alarm`, `Both`, or turn the alarm feature `off`.
   - Use `5HISETPT` and `5LOSETPT` to establish the high and low alarm set point values of the measurement.
   - Use `5DEADBND` to establish the alarm deadband value.
   - Use `5ALRMOUT` to establish whether the alarm is to affect the `DOUT` (digital output) and/or the `DISPLAY`. You can answer `yes` or `no` to each.
5. If you specified your component as A or B, you must now define the A and B components. Go to `1 SETUP` > `2 CALIB` > `3 FLUID` > `4 COMP (A and B)`.

   Each component has several subparameters:
   - In `5 NAME`, specify the name of the component in eight alphanumeric characters or fewer.
   - In `5DENSITY`, specify the density of the component in units specified in "Density" on page 164.
   - In `5TEMPCO`, specify the temperature coefficient (change in density per unit temperature; for example: lb/ft3/°F) in the density units selected in "Density" on page 164 and the temperature units selected in "Temperature" on page 169.

- In 5TEMPREF, specify the reference temperature in units specified in "Temperature" on page 169.

Custom Concentration Measurement Parameters

If you specified Custom for concentration units, then you must define the units name, define the equation form, and enter the equation coefficients.

NOTE

Contact Global Customer Support for assistance in defining custom equations. Provide the table of concentration values for density and temperature points for the application. Global Customer Support will provide the equation format string and custom coefficients.

1. In 4 NAME, select a six character ASCII name to be displayed with the custom measurement.
2. In 4 EQUATN, enter a code that defines the format of the equation that will be used to calculate the custom concentration value. Example: 513211100000. The actual code will be provided by Global Customer Support.
3. In 4 COEFFS > 5 COUNT, define the number of coefficients to be used in the equation. Up to 20 coefficients are supported. This number will be provided by Global Customer Support.
4. In 4 COEFFS > 5COEFF 1 to 5COEFF20, enter each of the coefficients for the equation. The coefficients will be provided by Global Customer Support.
5. In 4 ALARM, you can optionally configure an alarm to signal if the concentration measurement output exceeds the configured high or low limit.
   - Also set up alarms on the temperature and density measurements to signal if they are outside the appropriate input range of the configured concentration measurement. See page 163 for general information on configuring alarms.

Units

In the 3CONCENT > 4 UNITS parameter, select one of the following concentration units:

- % by wt
- % by volume
- BRIX
- BAUME
- % Solute
- Proof
- Custom

— NOTE —

When 2-phase compensation is turned on, only `% by wt` and `% by volume` units are available for concentration measurement. Conversely, if units other than `% by wt` and `% by volume` have been specified, 2-phase compensation is not available. For complete information on setting component measurement parameters, see "Setting Concentration Measurement Parameters" on page 166.

% by wt:

The percentage by weight (mass) of a component in a user-defined mixture.

% by volume

The percentage by volume of a component in a user-defined mixture.

BRIX

The percentage by mass of the chosen sugar in an aqueous solution. This measurement can be configured for sucrose and high fructose corn syrup formulations.

Type selections for Brix:

- Sucrose
- HFCS-42 (high fructose corn syrup containing 42% fructose)
- HFCS-55 (high fructose corn syrup containing 55% fructose)

BAUME

The percentage by mass of corn starch in an aqueous solution.

% Solute

The percentage by weight (mass) or volume of alcohol in an aqueous solution. Volume measurements at reference temperatures of 20°C and 60°F may be selected.

Type selections for % Solute:

- % Alcohol by weight (mass)
- % Alcohol by volume (20°C)
- % Alcohol by volume (60°F)

Proof

The percentage by volume multiplied by 2 of alcohol in an aqueous solution at a reference temperature of 60°F.

Custom

This unit choice requires the user to download a group of parameters to define a customized equation. See "Custom Concentration Measurement Parameters" on page 167.

Type

Alternate choices for each of the concentration units (if available) are found in 4 TYPE.

Format

The configuration of concentration format is determined in 4 FORMAT. The details of this parameter are the same as explained in "Format" on page 163.

Alarms

The configuration of concentration alarms is determined in 4 ALARMS. The details of this parameter are the same as explained in “Alarms” on page 163.

Temperature

In the `3 TEMP > 4 UNITS` parameter, you can specify the temperature units as `degC` or `degF`.

The configuration of temperature alarms is determined in `4 ALARMS`. The details of this parameter are the same as explained in “Alarms” on page 163.

Totals

— NOTE

The following description refers to the `TOTAL1` parameter. It also applies to the `TOTAL2`, `TOTAL3`, and `TOTAL 4` parameters.

In the `3 TOTAL1 > 4 MAP` parameter, you can specify the mode as `mass all`, `mflow A`, `mflow B`, `vol all, vflow A`, or `vflow B`.

Next, in the `4 UNITS` parameter, you can specify the totals units as follows:

- For mass: KG (kilogram), G (gram), LB (pound), OZ (ounce), STON (short ton), MTON (metric tonne), or CUSTOM.
- For volume: L (liter), USG (US gallon), IMPG (imperial gallon), BBL (42 gal barrel), M3 (cubic meter), FT3 (cubic feet), or CUSTOM.

— NOTE

Base unit for Totalizer Mass is kilograms. Base unit for Volume is liters.

If you select `custom`, you must define your custom units in `4 CUSTOM`. First, enter a `name` for your custom units using up to eight alphanumeric characters. The characters that can be used are listed in Table 13. Then, enter any offset (`offset`) and a conversion factor (`slope`) from kilograms (for mass units) or liters (for volume units) to the custom units.

Most applications require the totalizer to begin at zero. In such cases the offset must be zero. If an offset other than zero is entered, clearing the totalizer resets it to the offset value, not zero.

Custom Slope Example: The slope for a custom unit of lb (troy) is 2.67921 because 2.67921 lb (troy) = 1 kg.
A list of slopes for frequently used units is located in Appendix A, “Custom Slopes”

The direction of the flow is determined in `4DIRECTN`. The available options for this parameter are `bidir` (bidirectional), `forward`, and `reverse`.

— NOTE

Bidirectional functionality of totalizers (forward total minus reverse total) is possible only if flow direction is configured to one of the bidirectional choices. See “Flow Direction” on page 180.

The type of total is determined in `4 TYPE`. The available options for this parameter are `grand` and `batch`.

The format of the units on your display are determined in `4 FORMAT`. The available options for this parameter are:

- ±####### (display in single units)
- ±#####.# (display in tenths of units)
- ±####.## (display in hundredths of units)
- ±###.### (display in thousandths of units)
- ±##.#### (display in ten thousandths of units)
- ±#.##### (display in hundred thousandths of units)
- ±####.e5 (display in a number times a hundred thousand units)
- ±####.e4 (display in a number times ten thousand units)
- ±####.e3 (display in a number times a thousand units)
- ±####.e2 (display in a number times a hundred units)
- ±####.e1 (display in a number times ten units).

If the totalizer measurement exceeds the configured format, the display (in Measure mode) alternates the message `ROLLOVER` with the current rollover value.

The configuration of total alarms is determined in `4 ALARM`. The details of this parameter are similar to the alarms explained in “Alarms” on page 163 except that there is no low setpoint and no deadband parameters.

Component A and B Mass Measurements

The setup for Mass Flow A and Mass Flow B is similar to that of “Mass Flow” on page 162.

— NOTE

The properties of each component must also be defined. See “Fluid” on page 182.

Component A and B Volume Measurements

The setup for Volume Flow A and Volume Flow B is similar to that of “Volume Flow” on page 163.

— NOTE

The properties of each component must also be defined. See “Fluid” on page 182.

Setting Output Parameters

The structural diagram of the Output menus are located on Figure 70 and Figure 71 in Appendix B, “Setup Diagrams”.

Milliampere Output

— NOTE

The following description refers to the MA1 parameter. It also applies to the MA2 and MA3 parameters.

In the `3 MA1 > 4 MAP` parameter, you can map the output to `mflow` (mass flow), `vflow` (volume flow), `density`, `temp` (temperature), `concent` (concentration), `mflow A`, `mflow B`, `vflow A`, or `vflow B`.

— NOTE

The measurement that is mapped to an analog output is inherited by the HART dynamic variable that is associated with it.

In `4 URV` and `4 LRV`, set the upper range value and lower range value in the units specified in the Measure Setup parameters.

In `4DAMPING` specify the damping time that is applied to the analog output. It is the time required to go from zero to 90% of a change. It can be set from 0.0 to 99.9 seconds.

The `4ALRMRSP` parameter allows you to drive the analog output fully downscale or upscale if an alarm condition occurs. You can also choose to hold the output at the last reading. Analog output limits are 3.6 mA and 21.0 mA. Configure this parameter as `low`, `high`, `last`, or `none`.

The `4DIAGRSP` parameter allows you to drive the analog output fully downscale or upscale if an diagnostic condition is detected. You can also choose to hold the output at the last reading. Analog output limits are 3.6 mA and 21.0 mA. Configure this parameter as `low`, `high`, or `last`.

Pulse Output

In the `3 PULSE > 4 PULSE` parameter, you can set the type of pulse output as `rate` or `total`.

NOTE

The following description refers to the Pulse 1 and Pulse 2 parameters.

Rate

If you select `rate`, there are two modes of operation, which are controlled by the scaling choice. The frequency of the pulse output in URV scaling mode changes linearly with the mapped rate measurement, similar to the way an analog output works. The maximum frequency is 10,000 Hz.

The pulse output in units/pulse scaling mode outputs a pulse for each unit increase, similar to the way pulse `total` mode works. The advantage of units/pulse scaling mode over the standard `total` mode is the higher maximum frequency of 10,000 Hz.

In `4 SCALING`, select `URV`, `U/PULSE`, or `PULSE/U`.

- If you selected `URV`:
  - Menu choices are `MAP`, `URV`, `LRV`, `MINFRQ`, `MAXFRQ`, `DAMPING`, `ALARMRSP`, and `DIAG RSP`.
  - The map selections are `mflow` (mass flow), `vflow` (volume flow), `density`, `temp` (temperature), `concent` (concentration), `mflow A`, `mflow B`, `vflow A`, or `vflow B`.
  - In `4 URV` and `4 LRV`, set the upper range value and lower range value in the units specified in the Measure Setup parameters. Then in `4 MAXFRQ` and `4 MINFRQ`, set the frequency at the URV and LRV respectively.
- If you selected `U/PULSE` or `PULSE/U`:
  - Menu choices are `MAP`, `U/PULSE` or `PULSE/U`, `MAXFRQ`, `DAMPING`, `ALARMRSP`, and `DIAG RSP`.
  - The map selections are `mass all`, `vol all`, `mflow A`, `mflow B`, `vflow A`, or `vflow B`.
  - Specify the units per pulse or the pulses per unit respectively. Then in `4 MAXFRQ`, set the frequency at the URV. (With `U/PULSE` and `PULSE/U`, the LRV is always 0.0, and the minimum frequency is always 0 Hz.)

The `4 MAP` parameter allows you to map the output based on the selected scaling method.

The `4 FAST` parameter allows you to disable averaging of the raw measurement to achieve the fastest possible dynamic response. You can turn this feature `on` or `off`.

In `4QUADTUR`, set the quadrature mode on or off. When quadrature is enabled, the two pulse outputs switch from normal independent operation to one where the second pulse output maintains a 90 degree phase offset from the first pulse output. It is mostly used in custody transfer applications.

Flow direction is indicated by a change in the phase relationship of the second pulse output from +90° for positive flow to -90° for negative flow. Quadrature is available only when rate mode is selected for the first pulse output. Once quadrature is enabled, configuration options for the second pulse output are no longer available.

— NOTE

The minimum frequency generated is 1.19 hz.

In 4DAMPING, specify the damping time that is applied to the analog output. It is the time required to go from zero to 90% of a change. It can be set from 0.0 to 99.9 seconds.

The 4ALRMRSP parameter allows you to drive the pulse output to zero Hz (low) or to 10% over the maximum frequency value (high) if an alarm condition occurs. You can also choose to hold the pulse output at the last frequency. Configure this parameter as low, high, or last, or none.

The 4DIAGRSP parameter allows you to drive the pulse output to zero Hz (low) or to 10% over the maximum frequency value (high) if an diagnostic condition is detected. You can also choose to hold the pulse output at the last frequency. Configure this parameter as low, high, or last.

Total

— NOTE

When Total is selected, you can turn the pulse totalizer on or off or clear the pulse total in 1 MEASURE.

In 4 MAXFRQ, indicate the maximum frequency at which the pulse total output can generate pulses. The choices are 10 Hz or 100 Hz. This setting also determines the on-time for the pulse total output, which is 50 milliseconds for the 10 Hz and 5 ms for the 100 Hz setting.

In 4 MAP, indicate the mode as mass all, mcomp A, mcomp B, vol all, vcomp A, or vcomp B.

In 4 UNITS, select the units from the menu presented.

— NOTE

Base unit for Totalizer Mass is kilograms. Base unit for Volume is liters.

If you select custom, you must define your custom units in 4 CUSTOM. Enter a conversion factor (slope) from kilograms (for mass units) or liters (for volume units) to the custom units.

In 4U/PULSE, specify the units per pulse.

In 4DIRECTN, indicate the direction of flow as forward, reverse, or bidir (bidirectional).

Forward: Pulses are output for flow in the forward direction. The transmitter does not consider flow in the opposite direction.

Reverse: Pulses are output for flow in reverse direction. The transmitter does not consider flow in the opposite direction.

Bidir: Pulses are output for flow in the forward direction. The transmitter internally accumulates flow in the reverse direction. When forward flow is re-established, the accumulated reverse flow is “worked off” before pulses are output again.

Contact Output (DOUT)

The transmitter provides a relay output that can be configured to indicate certain alarm and/or diagnostic conditions.

— NOTE

This function applies only to the alarms of those measurements that have been configured to affect the discrete output.

To use this feature, configure its function and operation parameters in `3 DOUT`.

In `4 FUNCT`, specify one of the following:

- `off` (the relay output is not used)
- `alarm` (the relay becomes active when any configured alarm occurs)
- `diag` (the relay becomes active when any diagnostic condition occurs)
- `alm+diag` (the relay becomes active when any diagnostic condition or any configured alarm occurs).

In `4 OPERAT`, specify the inactive state of the relay output. This is the "normal" condition of the relay (the state when the configured condition does not exist). Specify either `NormOpen` or `NormClosed`.

Contact Input (DIN)

The Contact Input parameter specifies the function of the discrete contact input.

In `3 DIN`, specify one of the following:

- `off` (contact input function not enabled)
- `cal zero` (initiates a zeroing of the transmitter)
- `sel zero` (selects zero):
  primary zero [1] = open contact; secondary zero [2] = closed contact)
- `siglock` (drives the outputs to the zero flow condition)
- `al/d ack` (acknowledges an alarm or diagnostic; eliminates the need to do this manually)
- `clr tot1` (resets Total1)
- `clr tot2` (resets Total2)
- `clr tot3` (resets Total 3)
- `clr tot4` (resets Total 4)
- `clr batch` (resets all batch totals)
- `clr tots` (resets all totals).

Display

The Display parameters allow you to set all variable features of your display.

In `3 DISPLAY > 4 SHOW`, you can choose to display any or all of the following: `MFLOW`, `VFLOW`, `DENSITY`, `CONCENT`, `TEMP`, `TOTAL1`, `TOTAL2`, `TOTAL3, TOTAL4, MFLOW A, MFLOW B, VFLOW A, VFLOW B`. Specify each as `yes` or `no`.

In `4 CYCLE`, specify whether you want the display of the measurements selected above to cycle automatically from one to another (`auto`) or be able to be cycled manually (`manual`) with the Up and Down arrow keys.

In `4PRIMARY`, specify the display from the measurements selected above that you want as the default display.

In `4DAMPING`, you can damp the displayed value to minimize flickering of the less significant digits Specify the damping response time from 00.0 to 99.9 seconds. 00.0 is no damping.

In `4ALRMRSP`, specify if you want the display to blink if an alarm condition occurs. The selections are `none` and `blink`.

In `4DIAGRSP`, specify if you want the display to blink if a diagnostic condition occurs. The selections are `none` and `blink`.

Setting HART-Specific Output Parameters

The following parameter appears only for transmitters currently using the HART protocol.

HART Variable Assignment

Four measurement variables can be monitored in the CFT51 using the HART dynamic variables. The fourth dynamic variable can be mapped to any measurement or totalizer. The first, second, and third variables cannot be independently mapped, but inherit the measurement selection mapped to each of the analog outputs. The first dynamic variable is associated with the first analog output, the second variable is associated with the second analog output, and the third variable is associated with the third analog output.

The mapped measurements for the dynamic variables can be viewed in `3 HARTDYN`. To modify the mapped measurements for the first three variables, you must go to the Analog Output menu to modify the map choice. The map for the fourth dynamic variable can be modified using this menu to any of the following measurements: mass flow, volume flow, density, concentration, temperature, component A mass flow, component B mass flow, component A volume flow, component B volume flow, total 1, total 2, total 3, or total 4.

Setting View Parameters

The structural diagram of the View menus are located on Figure 72 in Appendix A.

Location

This parameter is available to document the location of the transmitter. This parameter performs no control function. In `3 LOCATE`, specify up to 14 alphanumeric characters.

Tube Model Code

The Tube Model Code is a reference identifier of the model code of the flowtube being used with your transmitter. It does not control the operation of the transmitter. Specify up to 32 alphanumeric characters.

Tube Serial Number

The Tube Serial Number is a reference identifier of the serial number of the flowtube being used with your transmitter. It does not control the operation of the transmitter. In `3 TUBESN`, specify up to 16 alphanumeric characters.

Setting HART-Specific Output Parameters

The following parameter appears only for transmitters currently using the HART protocol.

HART Tag

This parameter is used to identify the unit. In `3HARTTAG`, specify up to 8 alphanumeric characters.

HART Long Tag

HART Long Tag is found in the menu `3HRTLTAG`. This parameter is used to identify the unit. It allows you to specify up to 32 alphanumeric characters.

HART Descriptor

This parameter is available for any desired purpose as a secondary description of the unit. This parameter performs no control function. In `3HARTDES`, specify up to 16 alphanumeric characters.

HART Message

This parameter is available for any desired purpose as a secondary description of the unit. This parameter performs no control function. In `3HARTMSG`, specify up to 32 alphanumeric characters.

Setting Test Parameters

The structural diagram of the Test menus are located on Figure 72 in Appendix B, “Setup Diagrams”

The transmitter can be used as a signal source to check and/or calibrate other instruments in the control loop, such as indicators, controllers, and recorders. To do this, set the mA output (`3SET MA1, 3SET MA2`, or `3SET MA3`), pulse output (`3PULSE1` or `3PULSE2`), and digital output (`3SETDOUT`) signals to any value within the range limits of the transmitter.

— NOTE —

If the pulse output is configured for `Total`, a maximum of 250 pulses can be sent.

Setting Calibration Parameters

Structural diagrams of the Calibration menus are located in Figure 73 in Appendix B, “Setup Diagrams”.

Model (Flowtube)

In `3 TUBE > 4 SIZE`, select the flowtube size code. The flowtube size code is part of the model code on the flowtube data label.

CFS10-## — FLOWTUBE SIZE CODE
02 = 1/8" (3 mm), 03 = 1/4" (6 mm), 05 = 1/2" (15 mm), 08 = 3/4" (20 mm), 10 = 1" (25 mm), 15 = 1.5" (40 mm), 20 = 2" (50 mm)

CFS20-## — FLOWTUBE SIZE CODE
15 = 1.5" (40 mm), 30 = 3.0" (80 mm)

In `4 MATL`, select the flowtube material code. The flowtube material code is part of the model code on the flowtube data label.

CFS10-**# / CFS20-**# — FLOWTUBE MATERIAL
S = 316L, H = Nickel alloy, C = 316L (Sanitary)

- S AISI Type 316L wetted material
- H Nickel alloy (equivalent to Hastelloy®) wetted material
- C AISI Type 316L wetted material for Sanitary applications

From the size and material, the transmitter makes a number of calculations including the nominal capacity of the flowtube.

NOTICE

POTENTIAL SETUP ISSUES

It is necessary to enter the correct tube model and flowtube material, because these attributes drive the internal calculations for coefficients. Failure to enter the correct information will cause setup issues. Changes made contrary to the model code of the flowtube entered will affect the quality and accuracy of the measurement.

Failure to follow these instructions can result in setup issues.

NOTE

When the flowtube selection changes, any density calibration done for the previous flowtube selection is cleared, and two-phase compensation (if applicable) is disabled.

Flow Constants

In `4 FC2`, enter the flow constant 2 shown on the calibration sheet shipped with your flowtube (or your flowtube data plate). Flow constants FC1 and FC3 are calculated by the transmitter.

Density Constants

Standard Entry of Density Constants

In `4 DC2`, enter the density constant 2 shown on the calibration sheet shipped with your flowtube (or your flowtube data plate). In a similar fashion, enter the value for `4 DC4`. Density constants DC1 and DC3 are calculated by the transmitter.

K-Bias

K-Bias should only be used after all other diagnostic and troubleshooting efforts have been made to correct a discrepancy in flow measurement.

K-Bias is used to match the measurement of the transmitter to that of another measuring device. For example, if your reading is 1% low, set the K-Bias to 1.01. The bias value affects both mass and volume flow.

In `3 KBIAS > 4 VALUE`, enter your K-Bias value.

Density Calibration

Function

The CFT51 Transmitter provides an optional density calibration function that can be used to optimize the density accuracy for a specific process liquid. The factory calibration is done using water and air as the high and low calibration points respectively. The density calibration feature allows one point to be replaced with a specific process liquid calibration to provide the maximum accuracy.

If the specific gravity of the liquid (or the average of a range of liquids) is > 0.2 but ≤ 0.5, you can replace the low calibration point. If it is > 0.5, you can replace the high calibration point.

Procedure

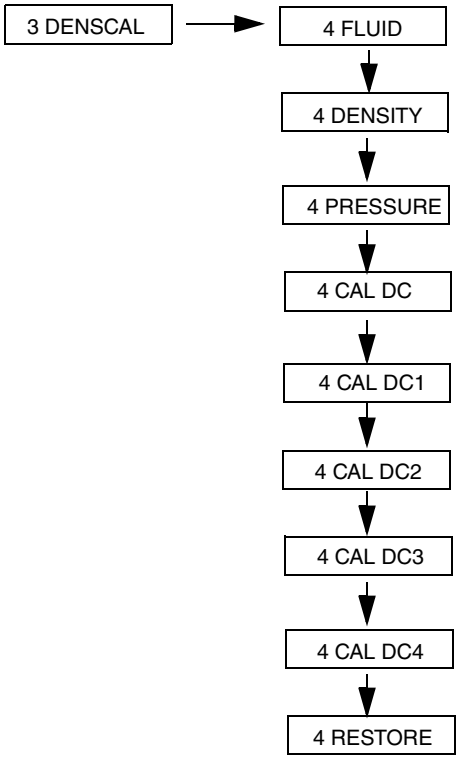
First flow the process liquid to be used in the calibration through the flowtube until the flowtube is full of liquid (no vapor or gas voids) at a reasonably constant temperature.

In `3DENSCAL`, select whether the calibration is for the high or low density liquid and enter its desired density. From this and the temperature measurement, new values for DC1, DC2, DC3, and DC4 are calculated.

Referring to Figure 49, use the subsections of `3 DENSCAL` to do the following:

- In `4 FLUID`, select high or low for the calibration point to be replaced.
- In `4DENSITY`, enter the desired known density of the process liquid.
- In `4PRESSURE`, enter the reference pressure of the last performed density calibration, so that density compensation (if enabled) is done accurately.
- Use `4 CAL DC` to calculate the new density flow constants.
- In `4 CALDC1` through `4 CALDC4`, you can view the new values.
- In `4RESTORE`, you can revert to the last inputted values before the density calibration procedure was performed.

Figure 49. Density Constants Flowchart



Flow Direction

In 3FLOWDIR, set the flow direction. Select uni pos to get only positive readings for unidirectional flow in the same direction as the arrow on the flowtube; Select uni neg to get only positive readings for unidirectional flow opposite the direction of the arrow on the flowtube; Select bi pos for bidirectional flow to get positive readings for flow in the same direction as the arrow on the flowtube; Select bi neg for bidirectional flow to get positive readings for flow opposite the direction of the arrow on the flowtube.

Zeroing the Transmitter

NOTE

Observe the density reading to see that it remains constant before and after blocking in the meter prior to zeroing. Do not attempt to zero the meter if the density is changing/dropping significantly.

To perform a zero flow calibration, the flowtube must be full and the flow rate must be zero.

The CFT51 gives you the ability to have two independent zeros for two separate conditions. For example, you could use one for liquid and the other for gas. In 3FLOWZER > 4SELZERO, select (1) or (2).

Then, using 4CALZERO, re-zero the selected zero. Pressing the Down key will display Zero Offset adjustment that is necessary to make the transmitter read zero at zero flow conditions.

Manual User Flow Zero

The zero offset value can be manually changed if necessary. For example, if the flowmeter cannot be blocked at no-flow condition.

Preferred method:

Set the **Zero Offset** value to +0.00000. Go to the Measure mode and record the measured (displayed) value including the polarity (+ or -). Go back to the zero offset value and replace it with the recorded value from the display including the polarity.

Example:

Zero Offset = +0.00000, Measured mass flow = +3.5 lb/s

New Zero Offset = +3.5

Alternate method:

Read and record the measured (displayed) mass flow value in the Measure mode. Go to Zero Offset and replace current value by adding the displayed mass flow value to the zero offset.

Example:

Measured mass flow = + 5.1 lb/s, Current Zero Offset = -1.3

New Zero Offset = +5.1 – 1.3 = +3.8

NOTE

Values given in the examples given above are for illustrative purposes only.

Meter Verification Function

NOTE

This feature is available for CFS10 and CFS20 flowtubes only.

The CFT51 transmitter offers a meter verification feature which can be used to assess the meter's performance over time.

Two modes of flowtube vibration, the Drive mode and Coriolis mode, are excited one after the other. The ratio of the resonant drive frequencies is measured and used to generate a Meter Verification Value (MVV). Over time, these ratios can be used to determine if a flowtube is experiencing excessive wear (erosion) or if it is picking up deposits internally due to sedimentation (coating).

1. The factory determined `MVV` should be entered into the CFT51 transmitter before startup.
2. Go to `CALIB` menu in `SETUP`, press the down arrow and select `TUBECHK` menu and press Enter.
3. Press the Down arrow key to `DATUM` and enter the `MVV` from the data plate or factory calibration sheet.

   Once the meter has been installed in the process piping, the meter should be either completely full of the process fluid or be run empty and dry to help ensure a stable single-phase medium. This is not a requirement for the meter operation, it is only required that the process be relatively stable during the whole verification procedure.
4. Press the Up arrow key and go to Run the `CHECK` function, to determine an in-situ `MVV`.

   This process will take approximately 5-7 minutes.
5. Once the process is complete, save the result as `RATIO`.

Changes in the MVV are an indication of changes in the flowtube. If the `MVV` change is greater than 1%, please contact Global Customer Support.

NOTE

If the meter verification function fails to complete properly, the message "Check Failed" will be displayed on the front panel. Before repeating the meter verification procedure, check that the tube is connected and operating correctly and that the flow process is stable and single-phase.

Low Flow Cut-Off

The low flow cut-off parameter allows you to set the level above which the transmitter begins to measure flow.

In `3LOWFLOW > 4 CUTOFF`, select `on` or `off`.

In `4 VALUE`, enter a low-flow cut-off value (in the selected mass flow units) that provides zero-flow measurement at low-flow conditions. The maximum low-flow cut-off value is limited to 10% of the nominal capacity of the flowtube. Therefore, the size and material of the flowtube must be entered in "Model (Flowtube)" on page 177 before setting the low-flow cut-off value. If this is not done, the low-flow cut-off is 0.0.

— NOTE

As flow increases from zero, cut-in occurs at exactly the low-flow cut-off value. As flow decreases, there is 90% hysteresis, and measurement will cut off 10% below the low-flow cut-off value.

Density Limit

In `3DENS LIM > 4DENSITY` you can set the density limit of the fluid below which the mass flow measurement reads zero. When the density increases above the limit, measurement resumes. Enter a density limit value in the selected density units.

Fluid

Fluid parameters for `COMP A` or `COMP B` are required only if `% by wt` or `% by volume` units of concentration have been set in `1 SETUP > 2 MEASURE > 3CONCENT > 4 UNITS`. See "Concentration" on page 165.

— NOTE

For complete information on setting concentration measurement parameters, see "Setting Concentration Measurement Parameters" on page 166.

In `3 FLUID > 4COMP A` and `3 FLUID > 4COMP B` you can establish the definition of component A and B.

In `5 NAME`, specify the name of the component in 8 alphanumeric characters or less.

In `5DENSITY`, specify the density of the component in units specified in "Density" on page 164.

In `5TEMPCO`, specify the temperature coefficient (change in density per unit temperature; for example: lb/ft3/°F) in the density units selected in"Density" on page 164 and the temperature units selected in "Temperature" on page 169.

In `5TEMPREF`, specify the reference temperature in units specified in "Temperature" on page 169.

2 Phase

Coriolis flowmeters require compensation for many types of two-phase (gas/liquid) flows. The CFT51 Transmitter has built in compensation that provides greater accuracy for such flows. Contact Global Customer Support for guidance in using the built in compensation.

NOTE

1. During two-phase (gas/liquid) flow, density is the aggregate of the gas and liquid content.
2. When two-phase compensation is turned on, only `% by wt` or `% by volume` units are available for concentration measurement. Conversely, if other concentration units are specified, two-phase compensation is not available.
3. In some two-phase conditions, the mass flow and density signals can go to a negative value and/or exceed the URL or normal URVs of a given meter. The Pulse Rate and mA outputs set to URL have limits and the readings will hit the stops and not process the signal the same as the digital and Modbus causing different readings. To offset this, you should apply damping/averaging to balance measurement quality against loss of information.

In `3 2PHASE` you can activate a feature that produces compensated measurements in two-phase applications for greater accuracy in many cases.

NOTE

The `3 2PHASE` parameter is available for CFS10 and CFS20 flowtubes only.

Under `4 VFCOMP` (void fraction compensation), you can enable this feature for both mass flow and density or for only density. To enable this feature for both mass flow and density, specify `5 MFLOW` as `on`; the next parameter, `5DENSITY` is automatically set to `on`. To enable this feature for only density, specify `5 MFLOW` as `off` and `5DENSITY` as `on`.

NOTE

The `4 VFCOMP` parameter is available for CFS10 and CFS20 flowtubes only.

Under `4DENSITY`, enter the density of the liquid.

Under `4 TEMPCO`, enter the temperature coefficient.

Under `4REFTEMP`, enter the reference temperature.

Under `4 MOUNT`, specify the flowtube mounting as `VERT` (vertical) or `HORIZ` (horizontal). Vertical mounting of the flowtube is recommended when using the 2 Phase feature.

NOTE

The `4 MOUNT` parameter is available for CFS10 and CFS20 flowtubes only.

Pressure Compensation

The stiffening of the flowtube, due to pressure variations, will generate small shifts in the mass flow and density measurements. See Table 15 for pressure effect on different flowtubes. This will lead to incorrect measurement values at a specific pressure. To offset the effect due to pressure variation, CFT51 transmitter offers pressure compensation for density and mass flow measurement.

CFT51 transmitters supports both static and dynamic pressure compensation.

Static compensation requires that the user enter a pressure value which will be stored in internal non-volatile memory and then applied during measurement calculations.

Dynamic compensation requires that an external communication host provide real-time updates of internal pressure.

The default is to use a static pressure value for compensation unless an external live measurement is available.

Only gauge pressure units are supported for static configured values and dynamic pressure inputs. Basic units are psi (gauge), bar (g), and kPa (g).

To set up the transmitter:

1. Go to `SETUP`, press the Down arrow key to `PRSCOMP`.
2. Choose Off, On:INT P, or On:EXT P

   On:INT P - pressure compensation enabled using internal static pressure

   On:EXT P - pressure compensation enabled using external updated pressure
3. If the internal static pressure On:INT P is used, enter the value in `PRESSURE`, and select the pressure units under `UNITS`.

   If you are using dynamic pressure On:EXT P, the external pressure measurement always has priority.

NOTE

When you modify the pressure compensation configuration or reset the CFT51 transmitter, the transmitter will use the static value until an external host updates the dynamic pressure value.

Table 15. Pressure Effects on Flowtubes

Flowtube	% Density Effect (α)		% Mass Flow Effect (β)	
	per psi	per kPa	per psi	per kPa
CFS10-02S	+8.91035E-05	+1.29234E-05	+4.45518E-05	+6.46168E-06
CFS10-02H	+1.34036E-04	+1.94402E-05	+6.70179E-05	+9.72012E-06
CFS10-03S	-1.89522E-04	-2.74878E-05	-9.47610E-05	-1.37439E-05
CFS10-03H	+9.28806E-05	+1.34712E-05	+4.64403E-05	+6.73559E-06
CFS10-03C	-1.89522E-04	-2.74878E-05	-9.47610E-05	-1.37439E-05
CFS10-05S	-2.46292E-04	-3.57217E-05	-1.23146E-04	-1.78608E-05
CFS10-05H	-4.31781E-04	-6.26245E-05	-2.15890E-04	-3.13122E-05
CFS10-05C	-2.46292E-04	-3.57217E-05	-1.23146E-04	-1.78608E-05
CFS10-08S	-2.58976E-03	-3.75612E-04	-1.29488E-03	-1.87806E-04
CFS10-08C	-2.58976E-03	-3.75612E-04	-1.29488E-03	-1.87806E-04
CFS10-10S	-2.17331E-03	-3.15212E-04	-1.08666E-03	-1.57606E-04
CFS10-10H	-1.72144E-03	-2.49673E-04	-8.60718E-04	-1.24837E-04
CFS10-10C	-2.17331E-03	-3.15212E-04	-1.08666E-03	-1.57606E-04
CFS10-15S	-1.72978E-03	-2.50884E-04	-8.64891E-04	-1.25442E-04
CFS10-15C	-1.72978E-03	-2.50884E-04	-8.64891E-04	-1.25442E-04
CFS20-15H	-1.59191E-03	-2.30887E-04	-7.95955E-04	-1.15443E-04
CFS10-20S	-1.58344E-03	-2.29658E-04	-7.91718E-04	-1.14829E-04
CFS10-20C	-1.58344E-03	-2.29658E-04	-7.91718E-04	-1.14829E-04
CFS20-30S	-1.73256E-03	-2.51286E-04	-8.66279E-04	-1.25643E-04
CFS20-30C	-1.73256E-03	-2.51286E-04	-8.66279E-04	-1.25643E-04

Correction for pressure effect on density or mass flow is implemented by:

Corrected density = *Raw density* / *[1 + ((α/100) * delta pressure)]*
Corrected mass flow = *Raw mass flow* / *[1 + ((β/100) * delta pressure)]*

Where:

Delta pressure = *Process pressure* - *datum pressure* (50 psi or 345 kPa)
a = % Density Error from Table 15
b = Mass flow Error from Table 15

Milliampere Calibration

The milliampere calibration parameters allow the 4 to 20 mA output of the transmitter to be calibrated or matched to the calibration of the receiving device.

— NOTE

The transmitter has been accurately calibrated at the factory. Recalibration of the output is normally **not** required, unless it is being adjusted to match the calibration of the receiving device.

In `3 MACALS > 4 MA1CAL > 5CAL 4 mA`, enter the mA output at the low end. Then, in `5CAL20mA`, enter the mA output at the high end. If you make changes and then decide you want to return to the factory calibration, go to `5FAC CAL.` You are asked `Factory Config?` You can then reply yes or no by pressing the Enter or ESC key respectively.

In a similar fashion, enter the values for `4 MA2CAL`, and `4 MA3CAL`.

Calibration Identification

In `3 CAL ID > 4CALDATE`, enter the date of the calibration in the form MMDDYYYY.

Then, in `4CALNAME`, enter the name of the calibrator in 6 alphanumeric characters or less.

Setting System Parameters

The structural diagram of the System menus are located on Figure 75 in Appendix B, “Setup Diagrams”.

Password

Your CFT51 Transmitter employs two levels of password. Both consist of six alphanumeric characters. The passwords are established and changed in `3PASSWRD`.

The lower level password enables the operator to clear the batch totals in Measure mode. The higher level password enables entering the QuickStart and Setup modes as well as clearing all totals in Measure mode.

To change a password, do the following:

1. In `3PASSWRD > 4 HI PWD > 5 OLD PWD`, enter the old (high level) password.

— NOTE

For initial entry of password, press Enter six times.

2. Press the Enter key to display `5 NEW PWD.`
3. Enter the new (high level) password and press Enter. The display reads `HIGH PWD CHANGED`.

— NOTE

To change a password to ‘no password’, enter six spaces. Changing a high level password to ‘no password’ automatically changes the low level password to ‘no password’.

4. Press Enter again to go back to `3PASSWRD.`

5. Go to `4 HI PWD` and then to `4 LO PWD > 5 NEW PWD`.
6. Enter the new (low level) password and press Enter. The display reads `LOW PWD CHANGED`.

Alarm Acknowledge

In `3ALRMACK`, the alarm acknowledge function can be configured as `auto` or `manual`. In `auto`, all evidence of the alarm clears when the alarm condition no longer exists. In `manual`, the alarm must be acknowledged manually.

Diagnostic Acknowledge

In `3DIAGACK`, the diagnostic acknowledge function can be configured as `auto` or `manual`. In `auto`, all evidence of the diagnostic message clears when the diagnostic condition no longer exists. In `manual`, the diagnostic message must be acknowledged manually.

Set Factory Configuration

If your transmitter database becomes corrupted, this function enables you to rewrite all calibration (except the `CALZERO` value) and configuration values with factory default values (shown in Table 12). Therefore, it should **not** be used if your transmitter is functioning properly. The factory default is accessed in `3SET DEF`. You are asked `Factory Config?` You can then reply yes or no by pressing the `Enter` or `ESC` key respectively.

Set Communication Protocol

In `3 COMMS`, the communication protocol function enables you to choose between Modbus and HART protocols. The transmitter is pre-configured at the factory for the desired protocol. Setting Factory configuration will cause the protocol to be set to HART.

HART-Specific System Parameters

The following parameters appear only for transmitters with the HART protocol selected.

Hart Version

This parameter allows you to select HART version 5, 6, or 7. HART 7 is the factory default.

Hart Response Preambles

This parameter indicates the number of preamble characters that the transmitter sends at the start of each HART response message. Depending on the characteristics of the communication link, changing this parameter could disrupt communications. For this reason, this parameter is not configurable with the HART Communicator. You can set the number of preamble characters in `3 PREAMB`.

Hart Poll Address

This parameter is used to specify the polling address of the unit, which is used in identifying the unit to a HART master device such as the HART Communicator. In `3HARTADR`, you can set the address to any value from 0 to 63. However, this parameter should always be set to 0 unless the unit is being operated in a multi-drop environment (more than one HART device present on the same current loop).

NOTE

For HART version 5 only, the poll address value is 0 to 15. If this parameter is set to any nonzero value (specifying multi-drop operation), the analog output of the device is constantly locked at 4.0 mA. Thus, the analog output no longer reflects process conditions or responds to diagnostics or alarms.

Hart Loop Control

This parameter enables a user to control the operation of the first mA output in the transmitter. The choices are to allow the first mA output to actively track the mapped process variable or to remain at a fixed value of 4 mA. The default is for the loop current to be active. This feature is not available when HART 5 is selected.

Modbus-Specific System Parameters

The CFT51 Transmitter with Modbus communications enables you to define the Modbus interface to meet your needs.

The following parameters appear only for transmitters with the Modbus protocol selected. Reconfiguring these parameters can be set through the scroll menus in the display configurator as follows:

Modbus Baud Rate

In `3 Baud`, set the baud rate to 1200, 2400, 4800, 9600, 19200, or 38400.

Modbus Parity

In `3 Parity`, set the parity to none, odd, or even.

Modbus Device Address

In `3 Devadr`, set the device address between 1 and 247.

Modbus Byte Format

In `3 Bytfmt`, set the byte format as follows:

0123 = MSW_LSW

2301 = LSW_MSW (default)

1032 = RMSW_RLSW

3210 = RLSW_RMSW

Modbus Response Delay

where:

MSW = Most significant word (MSB-LSB)

LSW = Least significant word (MSB-LSB)

RMSW = Most significant word with reversed bytes (LSB-MSB)

RLSW = Least significant word with reversed bytes (LSB-MSB)

Modbus Configuration

Modbus communication comes predefined from the factory with the following:

Baud Rate: 9600

Format: 8 Bits, No Parity

Device Address: 1

Byte Format: 2301

Setting Alarm Parameters

Setting alarm parameters must be done in both `1 Setup` > `2 Measure` and `1 Setup` > `2 Output`.

1. In `1 Setup` > `2 Measure`, under each type of measurement affected, configure
   - Whether alarm is hi alarm, lo alarm, or both
   - The high and low setpoint and deadband values
   - Whether the alarm is to affect the digital output (see note below)
   - Whether the alarm is to affect the display.
2. In `Setup` > `2 Output` > `3 MA1` (and/or `3 MA2`, `3 MA3`, `3 PULSE`)
   - Link the output (`4 MAP`) to the mass flow, volume flow, density, concentration, temperature, or component measurement.

NOTE

The alarm must have been configured to affect the digital output in `1 Setup` > `2 Measure` above.

   - Set the output response in case of an alarm condition (`4ALRMRSP`) to the highest output, lowest output or the output of the last reading.

Using the HART Communicator

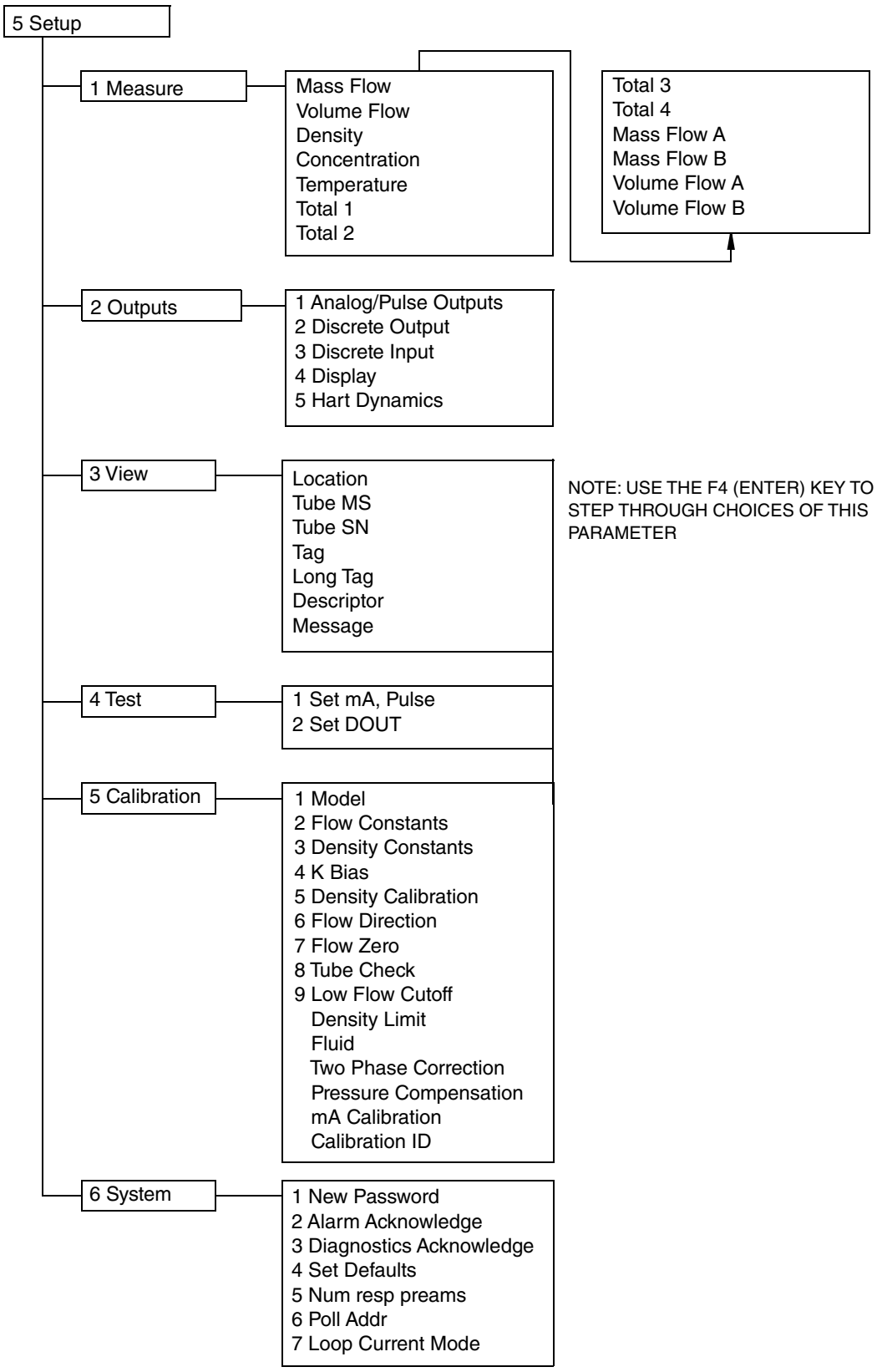
The Setup mode enables you to configure your measurement, output, identifier, test, calibration, and system parameters. Setup mode can be a passcode protected mode. So after the initial configuration, you may need a password to enter this mode. This is also an off-line mode. Outputs are driven fully downscale. Upon attempts to enter this mode, you are signaled that you are going off-line and asked if you want to do so. Indicate 'yes' with the Enter key.

NOTE

If you lose your passcode, call Global Customer Support for assistance.

The Setup Flowchart is shown in Figure 50.

Figure 50. Setup Flowchart



Explanation of Setup Parameters

Parameter	Explanation
Setup > Measure	
Mass Flow	Used to configure the mass flow parameters
Volume Flow	Used to configure the volume flow parameters
Density	Used to configure the density parameters
Concentration	Used to configure the concentration parameters (including naming Component A and B)
Temperature	Used to configure the temperature parameters
Total 1, Total 2, Total 3, Total 4	Used to configure the total 1, total 2, total 3, and total 4 parameters
Mass Flow A, Mass Flow B, Volume Flow A, Volume Flow B	Used to configure the Mass Flow A, Mass Flow B, Volume Flow A, and Volume Flow B parameters
Setup > Outputs	
Analog/Pulse Outputs	Used to configure the analog and pulse output parameters
Discrete Output	Used to configure the parameters of the contact output
Discrete Input	Used to configure the function of the contact input
Display	Used to configure the transmitter display parameters
Hart Dynamics	Used to configure the HART Dynamics parameter
Setup > View (Identifiers)	
Location	Used to specify the location
Tube MS	Used to specify the tube model number
Tube SN	Used to specify the tube serial number
Tag	Used to specify the tag identifier (up to 8 alphanumeric characters)
Long Tag	Used to specify the long tag identifier (up to 32 alphanumeric characters)
Descriptor	Used to specify the HART descriptor
Message	Used to specify the HART message
Setup > Test	
Set mA, Pulse	Used to set transmitter output to calibrate other instruments in the control loop
Set DOUT	Used to set transmitter output to calibrate other instruments in the control loop
Setup > Calibration	
Model	Used to select the flowtube size and material
Flow Constants	Used to enter the flowtube flow constants
Density Constants	Used to enter the flowtube density constants
K Bias	Used to set the K-Bias
Density Calibration	Used to optimize the density accuracy for a specific process liquid
Flow Direction	Used to specify positive or negative readings in relation to the direction of flow through the flowtube
Flow Zero	Used to select the primary or secondary zero and zero the transmitter
Tube Check	Used to assess flowtube performance over time
Low Flow Cutoff	Used to set the low flow cut-off
Density Limit	Used to set the density limit below which mass flow measurement is zero
Fluid	Used to establish the definition of components A and B
Two Phase Compensation	Used to produce flow compensation in 2-phase applications for greater accuracy in many cases
Pressure Compensation	Used to offset the effect of pressure variations, which can cause small shifts in mass flow and density measurements
mA Calibration	Used to trim the mA output of the transmitter to match the calibration of a receiving device if necessary

Parameter	Explanation
Calibration ID	Used to enter the date of the last calibration and the calibrator's name
Setup > System	
New Password	Used to initially enter or change passwords
Alarm Acknowledge	Used to establish automatic or manual alarm acknowledgment
Diagnostics Acknowledge	Used to establish automatic or manual diagnostics acknowledgment
Set Defaults	Used to rewrite all calibration and configuration values with factory default values
Num resp preams	Used to set the number of preamble characters that the transmitter sends at the start of each HART response message
Poll Address	Used to specify the polling address
Loop Current Mode	Used to enable or disable the loop current signaling state of the device

NOTE

If a reading is displayed in Setup with too many digits, the message `exceeds precision` is displayed. If this happens, enter blanks for the blinking digit and any digit to its right. For example, if the number 0.0944387 is displayed with the `exceeds precision` message and the 8 is blinking, enter blanks for the 8 and 7.

8. Troubleshooting

Error Codes

When a diagnostic condition exists, an error code is displayed in Status mode. Table 16 gives an explanation of these codes. For more information on Status mode, see “Status Mode” on page 66.

Table 16. Error Codes

Log Error Code (a)	Displayed Diagnostic Message	Description
200	No Signal	Problem with first tube input sensor due to wiring or sensor issue.
201	No Signal	Problem with second tube input sensor due to wiring or sensor issue.
202	No Signal	Problem with first drive output due to wiring or drive issue.
203	No Signal	Problem with second drive output due to wiring or drive issue.
204	RTD Hi/Lo	RTD resistance/temperature measurement is out of range, there is a wiring issue, or an electronics issue.
205	Gain Exceeded	Flowtube cannot be controlled.
P#	Change Setup	A parameter is out of range. See Table 17.
	POWER RESET or BUSY	See Table 21.

a. Always inspect the remote cable terminations to make sure wire insulation is not pinched under the terminals.

Table 17. Parameter Number Error Codes

Error Code	Description
P128	Incorrect K-Bias
P360	Invalid MSCODE model code

Also, if the display reads 9999999, the format needs correcting.

Fault Location

The fault conditions referenced in Tables 18 through 21 may be present with or without any diagnostic error message on the local display, HART Communicator, or PC-Based Configurator.

Table 18. No/Incorrect Flow Measurement

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
No flow or incorrect mass flow measurement when flowing	Incorrect configuration data entered	Flow Constant FC2 and flowtube size and material	Make sure that FC2 is the same as that found on flowtube data plate with special attention to sign and value. If FC2 is correct, enter correct flowtube MODEL data.	"Flow Constants" on page 177
		K-Bias (KBIAS)	Nominal K-Bias is 1.0.	"K-Bias" on page 178
		Fluid Density in regards to fluid density limit (DENS LIM)	Enter a lower density limit.	"Density Limit" on page 182
		Flow in regards to Low Flow Cut-Off level (LOWFLOW)	Increase flow or lower low flow cut-off level.	"Low Flow Cut-Off" on page 182
	Incorrect temperature measurement	▸ Transmitter junction box terminals 1-4 ▸ Flowtube terminal box wiring	▸ Correct wiring problems ▸ Make sure the correct color wire is connected to each terminal ▸ Make sure wire insulation is not pinched under the terminals	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120
	Flowtube drivers or sensors not working properly	TUBFREQ, SENSAMP, and DRIVE 1 in Status mode	TUBFREQ = 50-110 Hz, SENSAMP ≠ 0, DRIVE 1 < 85 mA.	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120
	Existing flowtube calibrated for a CFT10 or CFT15 transmitter	Flow measurement off by <1%	Perform in situ calibration and adjust K-Bias.	"K-Bias" on page 178
	Improper flowtube mounting	Flowtube mounting or support not per recommendations	Correct mounting issues.	MI 019-120
	2-phase (gas/liquid) present	Is 2Φ symbol displayed?	Configure 2-phase flow	"2 Phase" on page 183
Volume flow incorrect but mass flow correct	Incorrect density measurement	See "Incorrect density measurement" on page 197		
Volume flow incorrect but density correct	Incorrect mass flow measurement	See "No flow or incorrect mass flow measurement when flowing" on page 196		

Table 18. No/Incorrect Flow Measurement (Continued)

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Negative flow measurement with positive flow	Incorrect configuration	Flow direction (FLOWDIR)	Change FLOWDIR configuration.	"Flow Direction" on page 180
	Flowtube mounting	Arrow on flowtube points in correct direction	Install flowtube so arrow points in direction of positive flow.	MI 019-120
	Driver wiring incorrect	▸ Transmitter junction box terminals 9-12 ▸ Flowtube terminal box wiring	▸ Correct wiring problems ▸ Make sure the correct color wire is connected to each terminal ▸ Make sure wire insulation is not pinched under the terminals	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120
Incorrect density measurement	Incorrect configuration	Density Constants (DC2, and DC4) and flowtube size and material	Make sure that DC2 and DC4 are the same as those found on flowtube data plate with special attention to sign and value. If DC2 and DC4 are correct, enter correct flowtube MODEL data.	"Density Constants" on page 177
	Incorrect temperature measurement	▸ Transmitter junction box terminals 1-4 ▸ Flowtube terminal box wiring	▸ Correct wiring problems ▸ Make sure the correct color wire is connected to each terminal ▸ Make sure wire insulation is not pinched under the terminals	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120
	Flowtube drivers or sensors not working properly	TUBFREQ, SENSAMP, and DRIVE 1 in Status mode	TUBFREQ = 50-110 Hz, SENSAMP ≠ 0, DRIVE 1 < 85 mA.	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120
	2-phase (gas/liquid) present	Is 2Φ symbol displayed?	Configure 2-phase flow.	"2 Phase" on page 183
Flow measurement not zero at zero flow	Incorrect configuration	Transmitter not zeroed at zero flow condition	Zero the transmitter.	"Quick Start" on page 55
	Improper flowtube mounting	Flowtube mounting or support not per recommendations	Correct mounting issues.	MI 019-120
	Flowtube partially full at zero flow	Fluid Density in regards to fluid density limit (DENS LIM)	Configure density limit between displayed value and expected flowing density.	"Density Limit" on page 182
	Wrong zero selected	Is SELZERO primary (1) or secondary (2)	Select proper zero and rezero.	"Zeroing the Transmitter" on page 180
Flowtube making a noise	Sensor wiring broken, disconnected, or connected incorrectly	▸ Transmitter junction box terminals 5-8 ▸ Flowtube terminal box wiring	▸ Correct wiring problems. ▸ Make sure the correct color wire is connected to each terminal. ▸ Make sure wire insulation is not pinched under the terminals.	▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120

Table 18. No/Incorrect Flow Measurement (Continued)

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Display reads "No Signal," "RTD Hi/Lo," or "Gain Exceeded"	Incorrect wiring between the transmitter and flowtube, or temperature measurement (RTD resistance) is out of range	Error code displayed in Status mode	▸ Correct wiring problems. ▸ Check process temperature/RTD resistance.	▸ "Error Codes" on page 195; ▸ "Transmitter Wiring Connections from Flowtube" on page 51 ▸ MI 019-120

Table 19. Milliampere and Frequency Output Problems

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Output not responding to measurement	Output wiring incorrect	Is dc power connected?	Provide external dc power at Terminal 5.	
		Does wiring match output signal code?	Correct wiring issue.	
	Improper configuration	Measurement mapping to output	Correct output configuration.	"Setting Output Parameters" on page 171
	An alarm or diagnostic condition exists	▸ Current output stays at 3.6 or 21 mA? ▸ Pulse output stays at low, high, or last value? ▸ Contact output is active?	Correct alarm or diagnostic condition. Acknowledge condition (if configured for manual acknowledge).	"Status Mode" on page 66

Table 20. HART Communication Problems

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Communication problems when using a HART communicator or PC-based configurator	Not enough load in loop	Loop load	Increase loop load to 250 ohms minimum.	"Current Outputs MA2 and MA3" on page 46

Table 21. Display Problems

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Display reads all 9s	Incorrect configuration	Measured value exceeds configured format	Increase format to provide sufficient digits to the left of the decimal point to encompass the measurement range.	“Setting Measure Parameters” on page 162
Display blinking	Alarm or diagnostic condition	Status menu for alarm or diagnostic information	Correct alarm or diagnostic condition. Acknowledge condition (if configured for manual acknowledge).	“Status Mode” on page 66
Power Reset or Busy messages appear on the display.	▸ CPU controller is not talking to the display ▸ Issue with the electronics module	▸ Check the display connections to the electronics module. ▸ Check the electronics module and the display connections to the electronics module.	Correct any wiring or connection problems, replace the electronics module, or send the CFT51 transmitter for repair.	Chapter 9, “Maintenance” .

Setup Issues

Table 22. Setup Issues

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Set up issues	Incorrect entry of tube model and material	Flowtube model and flowtube material	It is necessary to enter the correct tube model and flowtube material, because these attributes drive the internal calculations for coefficients. Failure to enter the correct information will cause setup issues. Changes made contrary to the model code of the flowtube entered will affect the quality and accuracy of the measurement.	“Setting Calibration Parameters” on page 176

Measurement Issues

Table 23. Concentration Measurement Problems

Symptom	Possible Cause	Items to Check	Possible Solution	Reference
Display reads “INP O/R” or “OUT O/R”	▸ Temperature or density inputs are out of range ▸ Output (calculated concentration) is out of range	Verify that the temperature and/or density inputs are in range for the chosen type of concentration measurement.		Table 14 on page 165
	▸ Improper custom configuration	Check the equation form and coefficients that were configured for custom concentration.		“Custom Concentration Measurement Parameters” on page 167

9. Maintenance

This chapter provides instructions to remove and replace the transmitter's electronics module. The following kits are available for electronics module replacement.

Table 24. Replacement Kits for CFT51 Electronics Module

Kit Number	Power Input	Protocol	Certification Type	Kit Contents
K0168AR	ac (a)	Modbus	General	ac Power Electronics Module (K0152NM) Instruction document (SI 0-00614) Label
K0168AQ			NTEP/GOST (b)	
K0168AP			Weights and Measures Industry Canada Approvals (b)	
K0168AN		HART	General	
K0168AM			NTEP/GOST (b)	
K0168AL			Weights and Measures Industry Canada Approvals (b)	
K0168AK	dc	Modbus	General	dc Power Electronics Module (K0152NR) Instruction document (SI 0-00614) Label
K0168AJ			NTEP/GOST (b)	
K0168AH			Weights and Measures Industry Canada Approvals (b)	
K0168AG		HART	General	
K0168AF			NTEP/GOST (b)	
K0168AE			Weights and Measures Industry Canada Approvals (b)	

a. Available for CFT51 only.
b. Available for CFS10 and CFS20 flowtubes only.

Preparing for Installation

Reference Documents

Refer to the following documents for additional information:

MI 019-120	Mass Flowtubes Models CFS10 and CFS20 Installation, Startup, Troubleshooting and Maintenance

Required Tools

Make sure you have the following materials on hand:

- 5-inch long #2 Phillips-head screwdriver
- Static protection materials, such as a wrist static strap with wire to ground.

Installation Requirements

1. Be sure that the module you are replacing is the correct power input: ac or dc.

NOTICE
POTENTIAL EQUIPMENT DAMAGE Installing the wrong electronics module will result in severe damage to the transmitter. **Failure to follow these instructions can result in severe equipment damage.**

2. Check that the replacement kit number for the electronics module matches the electrical certification and version on the original transmitter data plate. Refer to Table 24 to be sure you are installing the appropriate kit.
3. If possible, save all configuration data and tube coefficients for programming into the new module.

Installation Considerations

Please observe the following safety considerations when removing and replacing the electronics module.

⚠ DANGER
HAZARD OF EXPLOSION **Do not** disconnect equipment when a flammable or combustible atmosphere is present unless power has been switched off. To prevent possible explosions and injury to personnel, ensure that wiring meets applicable safety codes. For nonintrinsically safe installations, to prevent a potential explosion in a Division 1 or Zone 1 hazardous area, de-energize transmitters before you remove threaded housing covers. **Failure to follow these instructions will result in death or serious injury.**

⚠ WARNING

HAZARD OF ELECTRICAL SHOCK OR EXPLOSION

Before replacing parts, turn the power off.

To help prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

This product contains components that have critical safety characteristics. **Do not** substitute components. Replace components only with identical factory-supplied components. Component substitution may impair the electrical safety of this equipment and its suitability for use in hazardous locations.

Failure to follow these instructions can result in death or serious injury.

NOTICE

RISK OF ELECTROSTATIC DISCHARGE

Components in your transmitter, including the replacement electronics module, are ESD sensitive and thus are susceptible to damage resulting from electrostatic discharge.

The replacement electronic module is shipped in a protective antistatic plastic bag. **Do not remove it from this bag until it is ready to be installed**. This minimizes the possibility of damage due to accidental electrostatic discharge.

Be sure that you are grounded via a conductive wrist strap or by standing on an ESD mat when performing maintenance in the electronics compartment or the remote junction box, and if the housing is removed.

Failure to follow these instructions can result in equipment damage.

Replacing the Electronics Module

1. Before replacing the electronics module, use the CFT51 Configurator to upload the configuration to a file on a computer for downloading after the replacement module is installed.
2. Take the unit offline.
3. Disconnect power from the unit.
4. Use proper static electricity protection such as a static strap or conductive shoes according to local standards.
5. Unscrew and remove the front windowed cover.

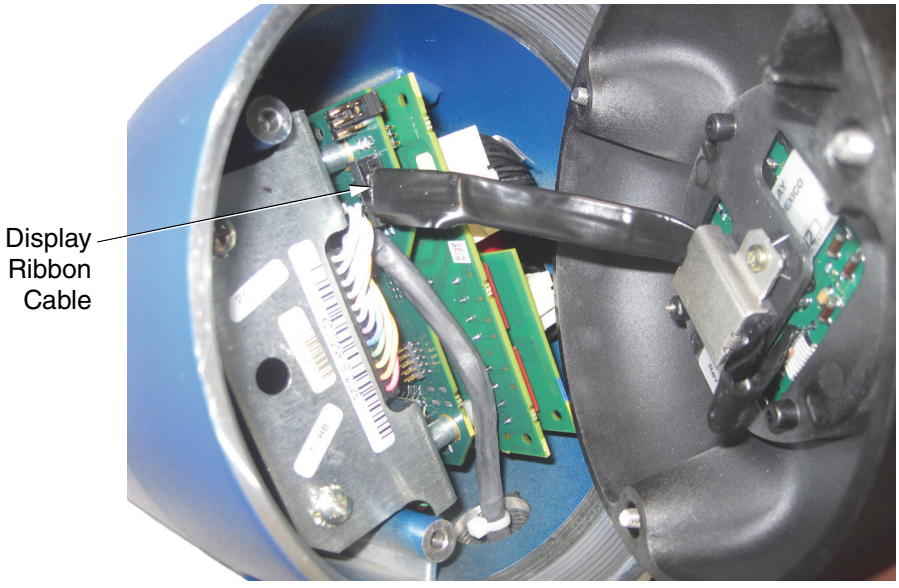
Figure 51. Removing the Front Windowed Cover

6. Remove the display bezel assembly by loosening the three screws all the way. The screws are captive and will not fall out.

Figure 52. Loosening the Display Bezel Screws

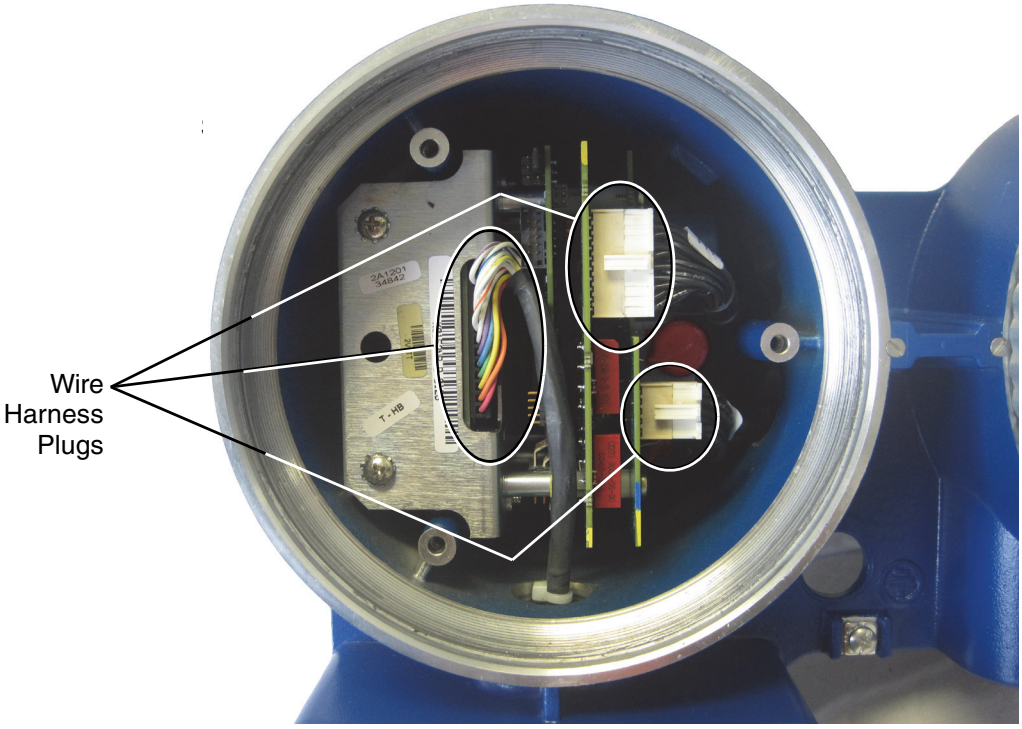
7. Once you have loosened the screws, remove the display bezel assembly and disconnect the display ribbon cable from the electronics board.

Figure 53. Disconnecting the Display Ribbon Cable



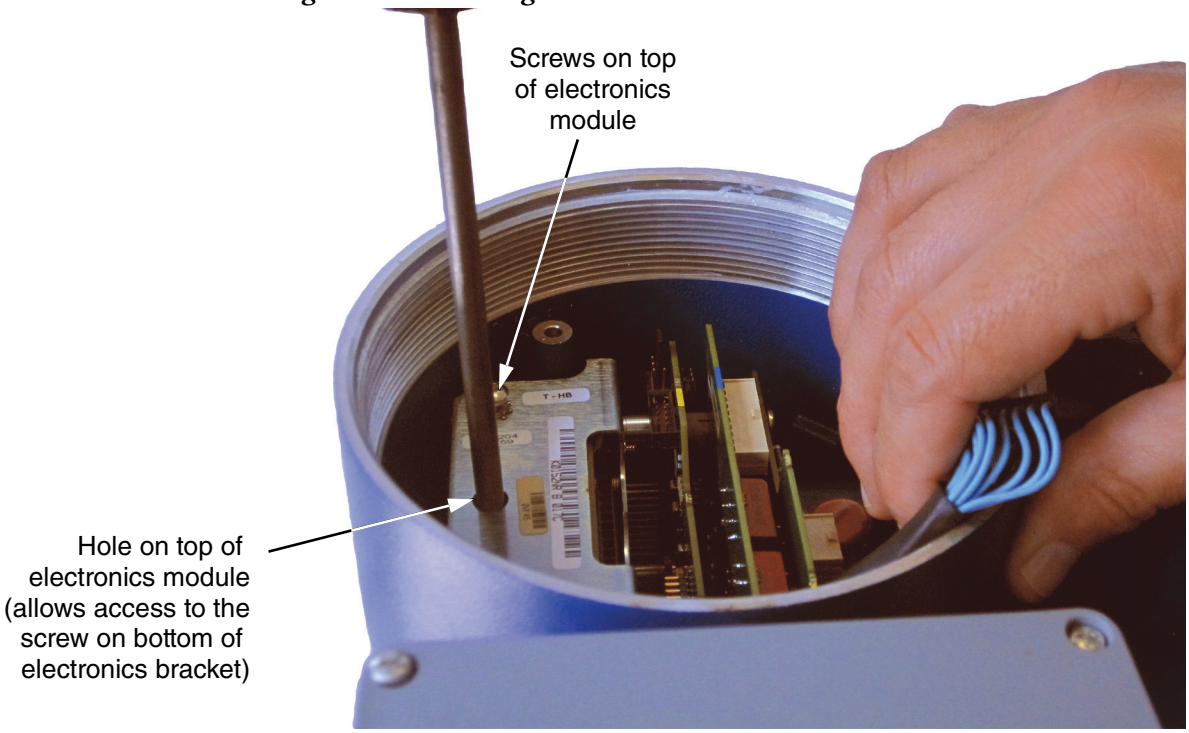
8. Disconnect all three wire harness plugs from the electronics module.

Figure 54. Disconnecting the Wire Harness Plugs



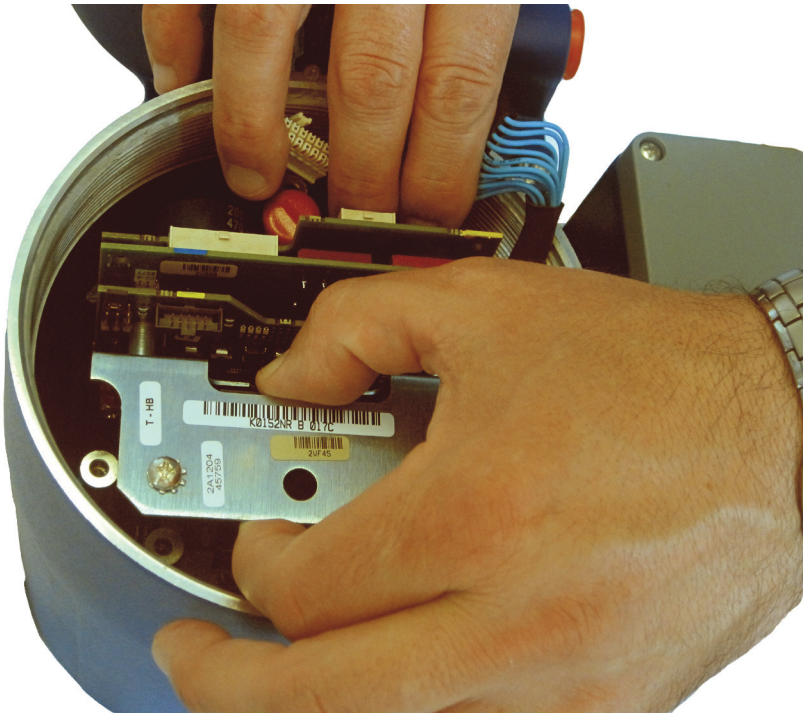
9. Access the screw that is down deep on the bottom of the electronics module by placing the long screwdriver through the hole on the front metal bracket, as shown below. Unscrew the captive screw on the bottom of the electronics module.

Figure 55. Loosening the Electronics Module Screws



10. Loosen the two screws on the top of the electronics module all the way. These screws are also captive.
11. Move the cables aside and pull out the electronics module by grasping the metal bracket as shown below.

Figure 56. Removing the Electronics Module



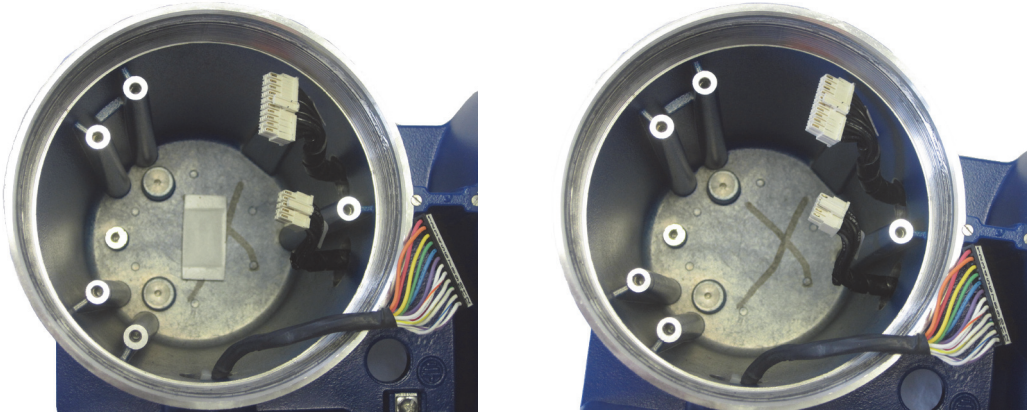
NOTE

The electronics module might be stuck to the case by the adhesive heat sink pad. This might cause some resistance to pulling the electronics module out of the case. This is only a light adhesive and can easily be overcome by pulling a little harder.

NOTICE
RISK OF ELECTROSTATIC DISCHARGE To help prevent equipment damage from electrostatic discharge, wear an ESD wrist strap when removing or installing the electronics module. **Failure to follow these instructions can result in equipment damage.**

12. Determine if the adhesive heat sink pad is stuck to the housing or stuck to the electronics module:

Figure 57. Determining the Location of the Adhesive Sink Pad



Transmitter with Sink Pad (remove pad before installing the new electronics module)

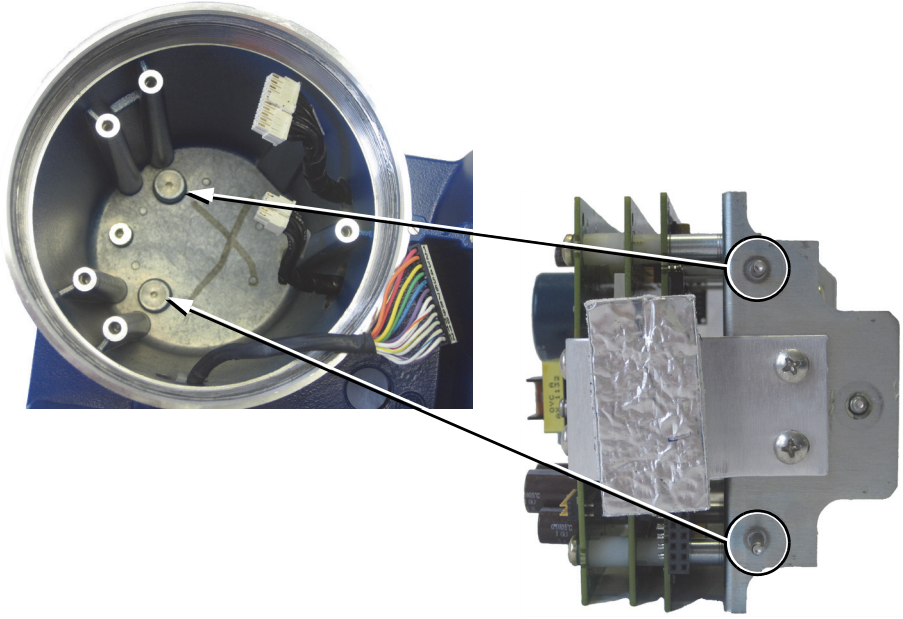
Transmitter without Sink Pad

a. If the heat sink pad is stuck in the housing and you are installing a new electronics module, remove the pad from the housing and discard it. There is a heat sink pad on the new electronics module. Continue to Step 13.

b. If the heat sink pad is not stuck in the housing, continue to Step 13.

13. Insert the new electronics module into the transmitter housing while holding the cables aside. Align the pins on the electronics module with the holes at the bottom of the case.

Figure 58. Lining Up the Electronic Module Pegs with the Holes in the Case



14. Line up all three screws on the electronics module, and tighten them to 11 in·lb.

15. Reconnect the three wire plug connectors shown in Figure 54.
16. Reconnect the display ribbon cable shown in Figure 53.
17. Position the display, making sure that the top of the display bezel is positioned at the top of the transmitter housing, and tighten the three screws shown in Figure 52.
18. Put the windowed cover back on. Tighten the cover until the cover lays flat against the metal housing.

The electronics module has now been replaced, and the transmitter is ready to be placed back into service.

Returning the Transmitter to Service

After replacing the electronics module, apply power to the device and configure it to your application. You will also need to program the flowtube information into the transmitter. The information is stamped on the flowtube data label. Flow rate measurement will not be correct if the information is not programmed into the transmitter properly. Perform the procedures in Chapter 3, “Quick Start” to make sure the flowtube information is programmed into the transmitter correctly.

10. Model Code

These tables list all of the options for the CFT51.

MODEL CODE

Description	Model
Digital Coriolis Mass Flow Transmitter	CFT51
Communication Interface (a)	
HART Communication Protocol	-T
Modbus Communication Protocol	-M
Mass Flowtube Sensor	
Models CFS10 and CFS20 Mass Flowtubes	B
Transmitter Mounting	
Remote Mounted Transmitter	1
Language	
English	E
Supply Voltage	
120/240 V ac, 50/60 Hz, Externally Powered I/O	A
10 to 36 V dc, Externally Powered I/O	B
Display	
None	A
Integral LCD Indicator with Keypad	B
Output and Power Cable Entrance	
1/2 NPT Connection (Two places)	A
M20 Connection (Two places)	B
Interconnecting Cable Insulation Material	
No Cable	N
IPVC Insulated Cable; Temperature Range from -20 to +80°C (-4 to +176°F)	P
FEP Insulated Cable; Temperature Range from -40 to +85°C (-40 to +185°F)	F
Interconnecting Cable Length	
No Cable	N
20 foot cable/6 meter cable	G
50 foot cable/15 meter cable	P
100 foot cable/31 meter cable	H
200 foot cable/61 meter cable	J
500 foot cable/152 meter cable	K
750 foot cable/229 meter cable	L
1000 foot cable/305 meter cable	M
Electrical Safety (Also see "Electrical Safety Specifications in PSS 1-2B7C)	
ATEX flameproof with intrinsically safe flowtube connections	ADA
ATEX flameproof with energy limited flowtube connections	ADN
ATEX nonsparking with intrinsically safe flowtube connections	ANA
ATEX nonsparking with energy limited flowtube connections	ANN
CSA/CSAus explosionproof with intrinsically safe flowtube connections	CDA
CSA/CSAus explosionproof with nonincendive flowtube connections	CDN
CSA/CSAus nonincendive and energy limited with intrinsically safe flowtube connections	CNA
CSA/CSAus nonincendive with nonincendive flowtube connections	CNN
FM explosionproof with intrinsically safe flowtube connections	FDA
FM explosionproof with nonincendive flowtube connections	FDN
FM nonincendive with intrinsically safe flowtube connections	FNA
FM nonincendive with nonincendive safe flowtube connections	FNN
IECEx flameproof with intrinsically safe flowtube connections	EDA
IECEx flameproof with energy limited flowtube connections	EDN
IECEx nonsparking with intrinsically safe flowtube connections	ENA

MODEL CODE (Continued)

Description	Model
IECEx nonsparking with energy limited flowtube connections	ENN
EAC flameproof with intrinsically safe flowtube connections	RDA
EAC flameproof with energy limited flowtube connections	RDN
EAC nonsparking with intrinsically safe flowtube connections	RNA
EAC nonsparking with energy limited flowtube connections	RNN
INMETRO flameproof with intrinsically safe flowtube connections	BDA
INMETRO flameproof with energy limited flowtube connections	BDN
INMETRO nonsparking with intrinsically safe flowtube connections	BNA
INMETRO nonsparking with energy limited flowtube connections	BNN
KOSHA nonsparking with energy limited flowtube connections	KNN
No Certifications	ZZZ
Tamperproof Sealing, Custody Transfer, and Weights and Measures Industry Canada Options	
Tamperproof Sealing for Housing and Terminal Block Covers	-S
Weights and Measures Custody Transfer (NTEP) (b)	-T
Weights and Measures Industry Canada Approvals (c)	-D
Paint Options	
Epoxy Paint (d)	-E
Mounting Bracket Material and Pipe Size	
Stainless Steel	-F
Carbon Steel, 3-inch pipe	-G
Stainless Steel, 3-inch pipe	-H

a. Factory default setting. Transmitters with display and keypad may be changed in the field.

b. When used with the Models CFS10 and CFS20 Style B Flowtubes, the flowtubes must also have Option -T (NTEP). Also Option -T is only available with LCD indicator and Keypad Code B.

c. When used with the Models CFS10 and CFS20 Style B Flowtubes, the flowtubes must also have Option -D (Weights and Measures Industry Canada Approvals).

d. Epoxy paint finish option applies to the enclosure body; the enclosure covers use an epoxy paint finish as standard.

11. Dimensions

For dimensional information specific to your sales order, contact your sales representative to order a Certified Dimensional Print (CDP).

All dimensions in diagrams are shown in millimeters over inches.

Digital Coriolis Mass Flow Transmitter Models CFT51

Figure 59. CFT51 (Frontal View)

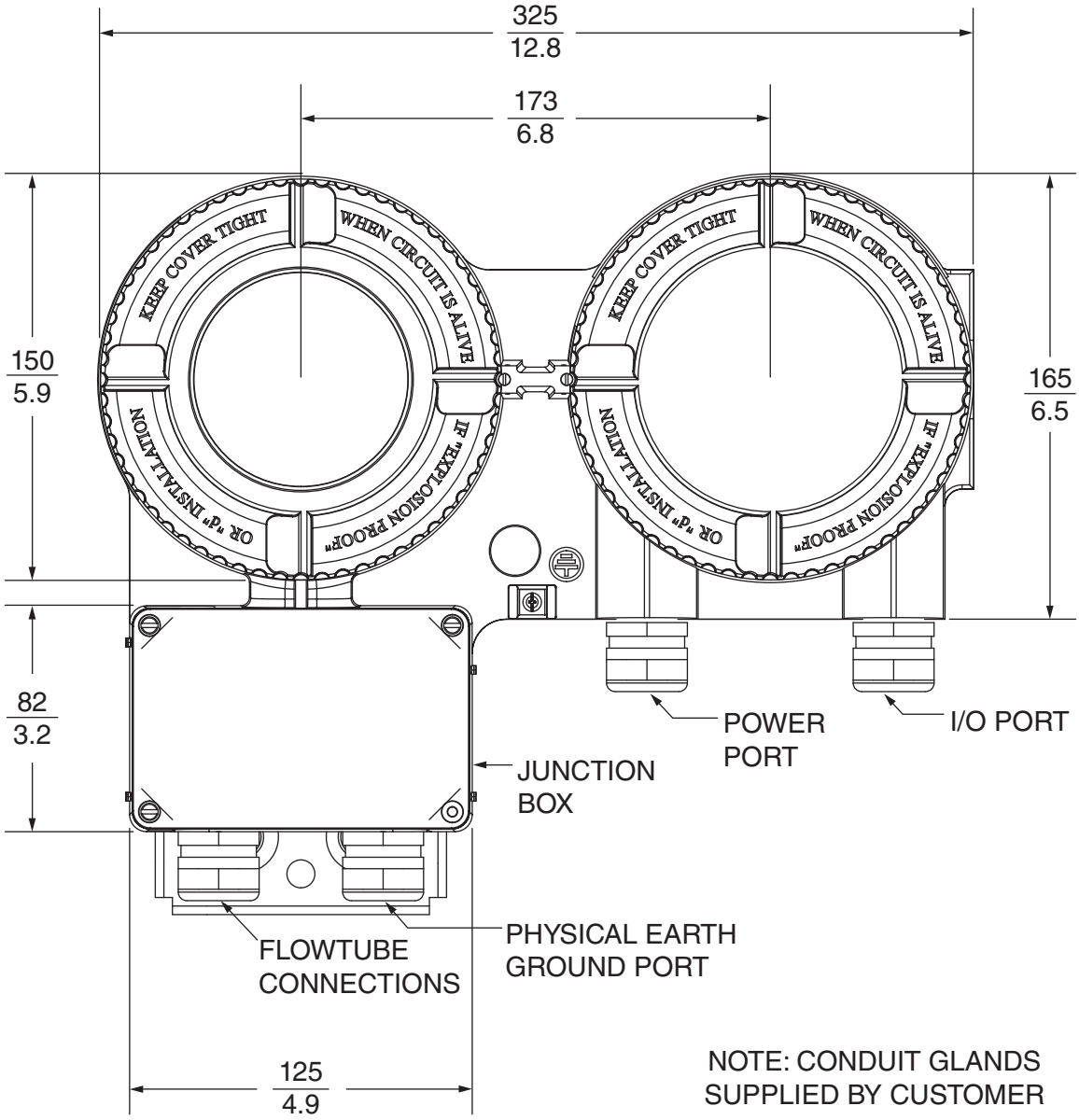


Figure 60. CFT51 (Side View)

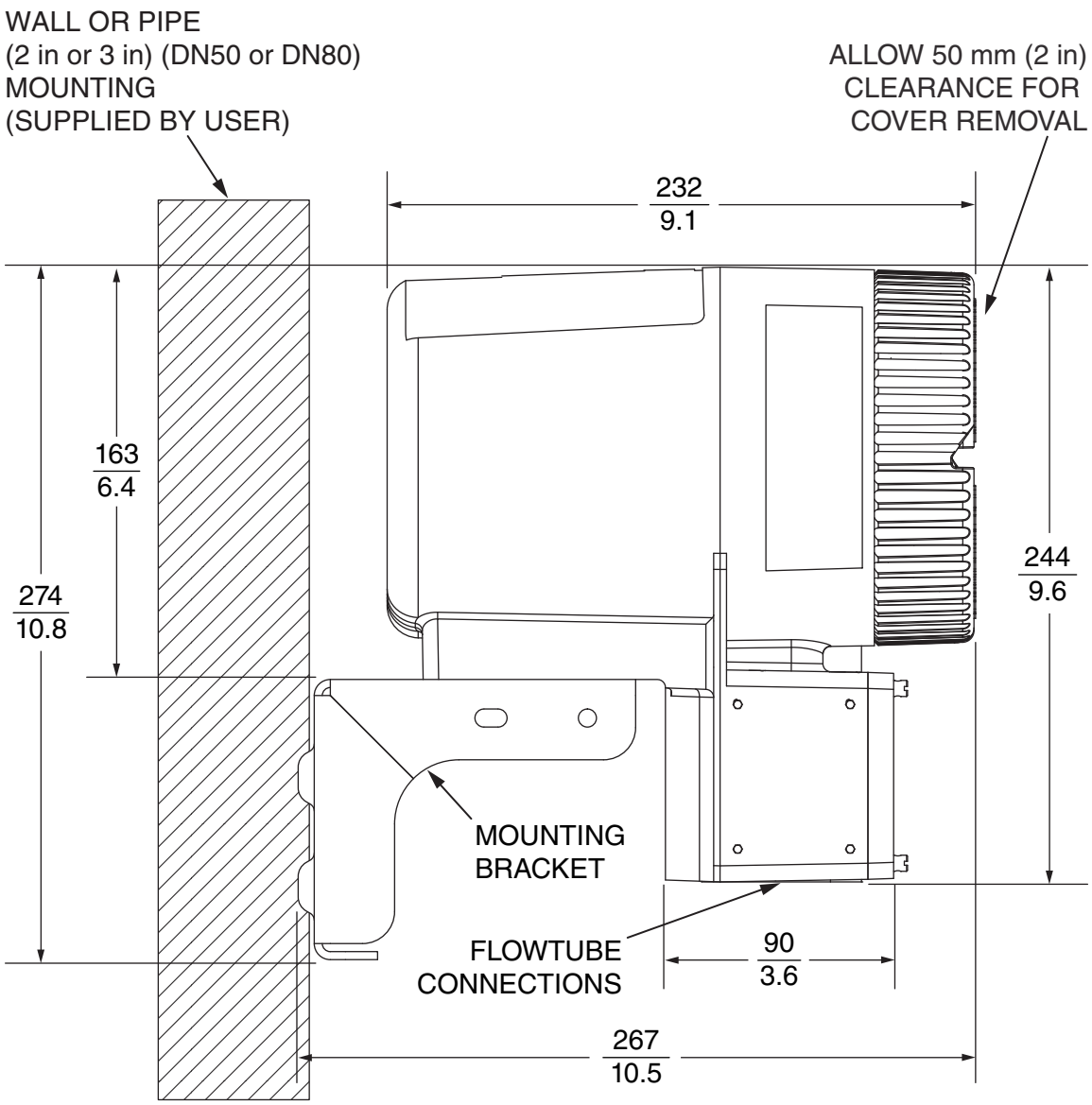


Figure 61. CFT51 (Bottom View)

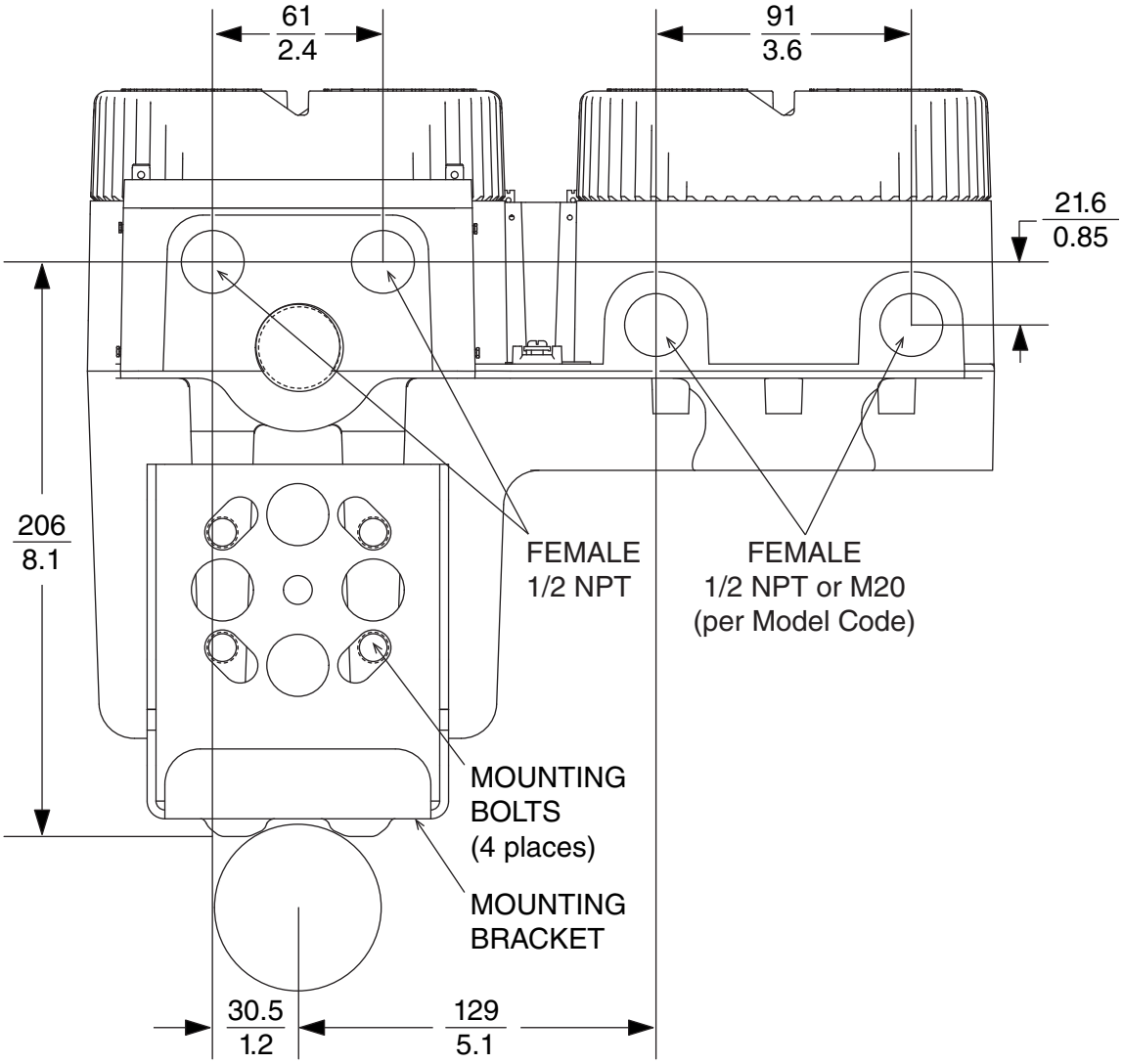
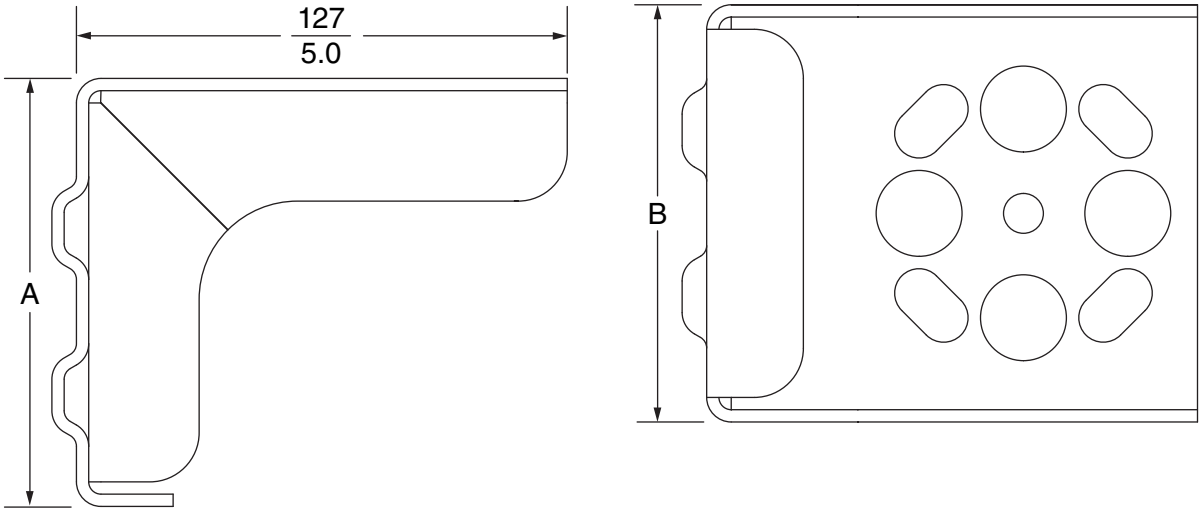


Figure 62. Mounting Bracket (Side View and Bottom View)



Bracket Size	Dimension A (Height)	Dimension B (Width)
2 inches	110 mm	108 mm
	4.4 inches	4.3 inches
3 inches	135 mm	132 mm
	5.3 inches	5.2 inches

12. Parts List

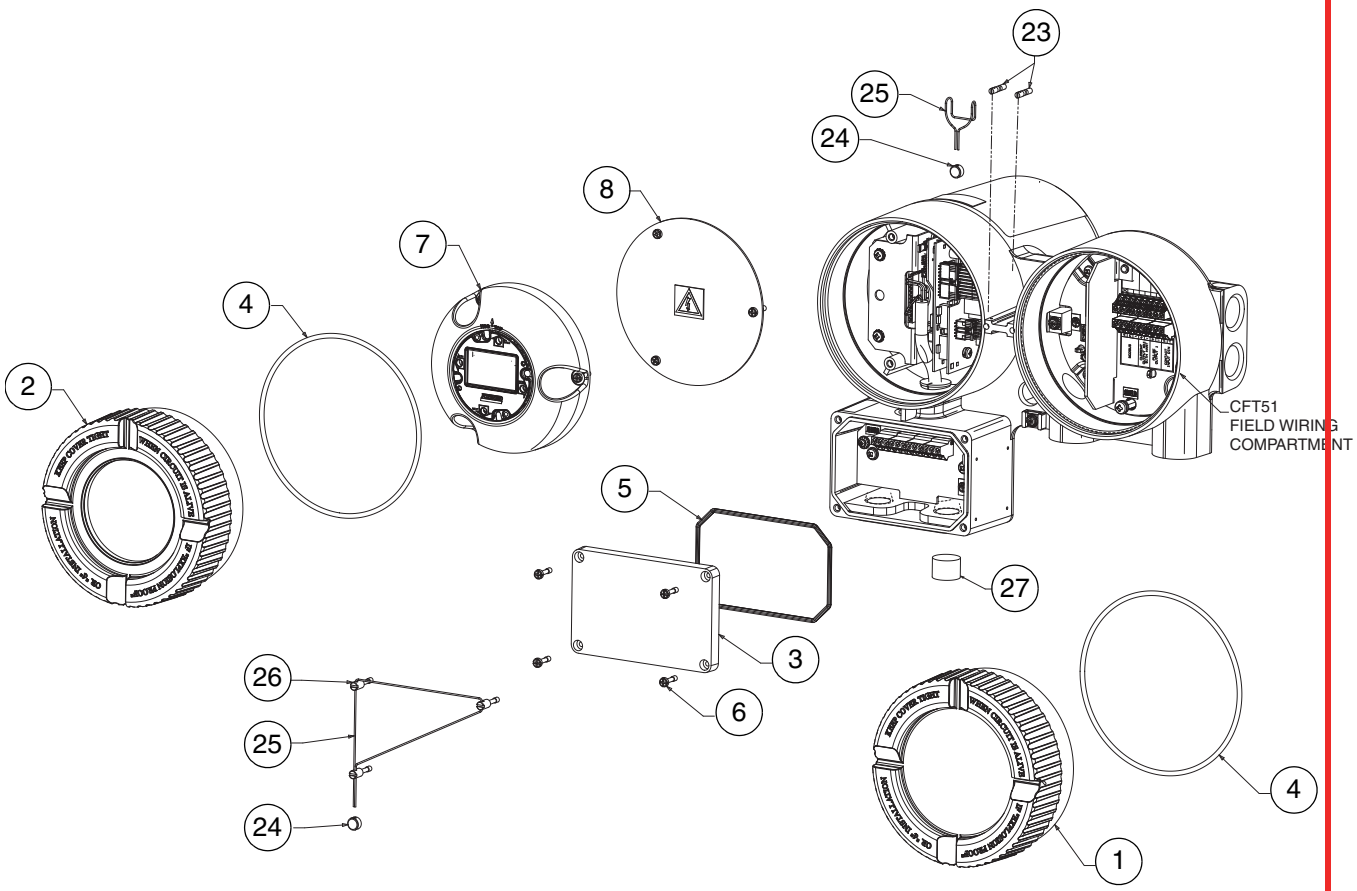
Parts

Give Instrument Model Number and Style when ordering.

See Recommended Spare Parts Summary section for quantities.

To order replacement sensors or parts, call Global Customer Support at 1-866-746-6477.

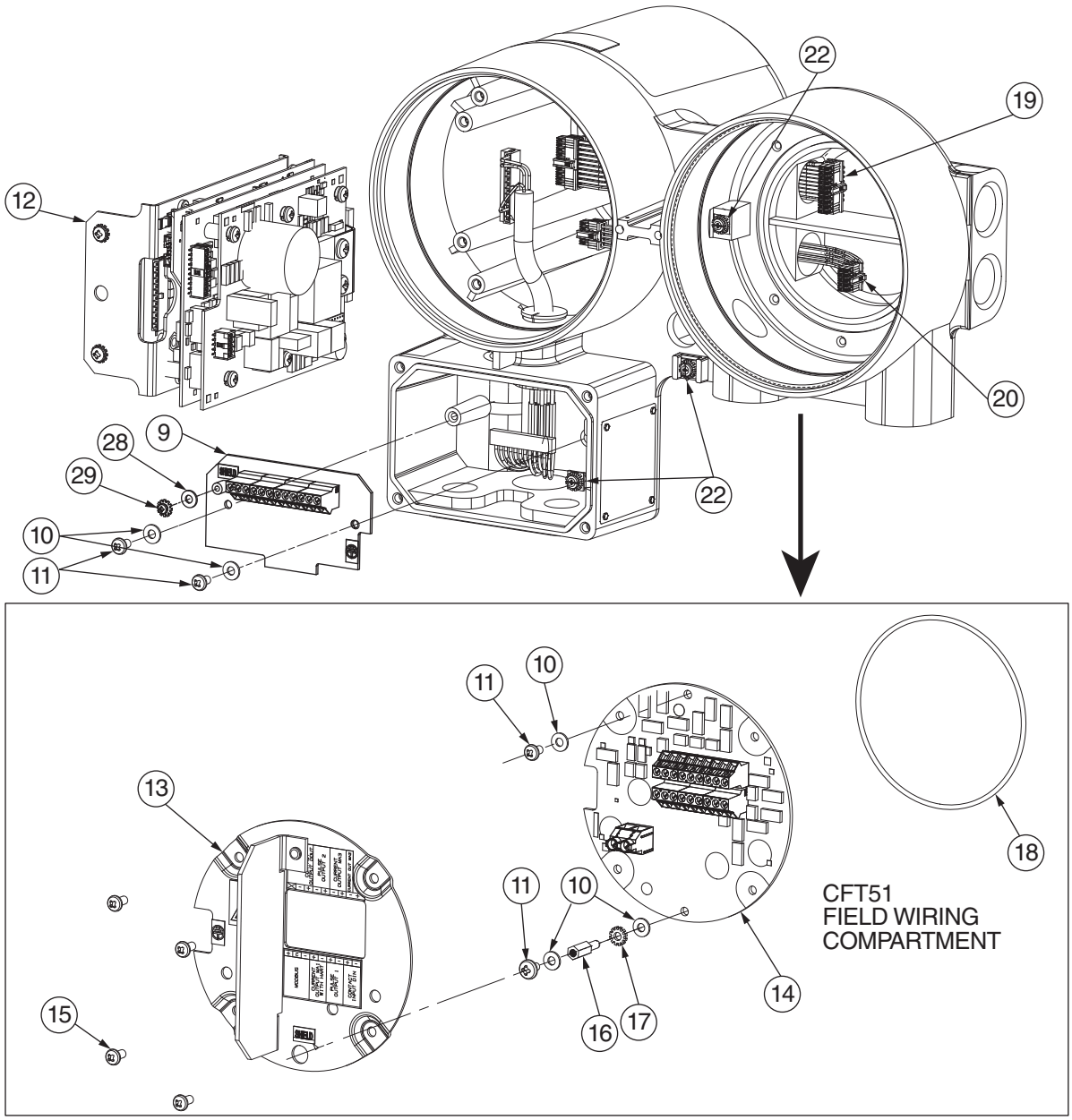
Figure 63. Parts for Housing, Display, and Cover Locks



NOTE

1. The NTEP label is part of Option -T (CFT51 only) and is attached to the instrument at the factory. The instrument cannot have a label attached and be upgraded to Option -T in the field. However, users who selected Option -T with the original sales order can still order replacement lockout screws, sealing wire, and lead seals (Items 24, 25, and 26) separately as required.
2. The Weights and Measures Industry Canada approved label is part of Option -D (CFT51 only) and is attached to the instrument at the factory. The instrument cannot have a label attached and be upgraded to Option -D in the field. However, users who selected Option -D with the original sales order can still order replacement lockout screws, sealing wire, and lead seals (Items 24, 25, and 26) separately as required.
3. The lockout screws, sealing wire, and lead seals (Items 24, 25, and 26) are offered as a convenience for those users who did not order Option -S with the original sales order, but now wish to add this option in the field. Refer to “Cover Lock Versions” on page 28 for instructions on using Option -S to lock the transmitter covers.

Figure 64. Parts Breakdown for Electronics



21 — Not Shown: Cable, Transmitter to Flowtube. See Table 65 for part numbers.

Figure 65. Parts Breakdown for Mounting Kit

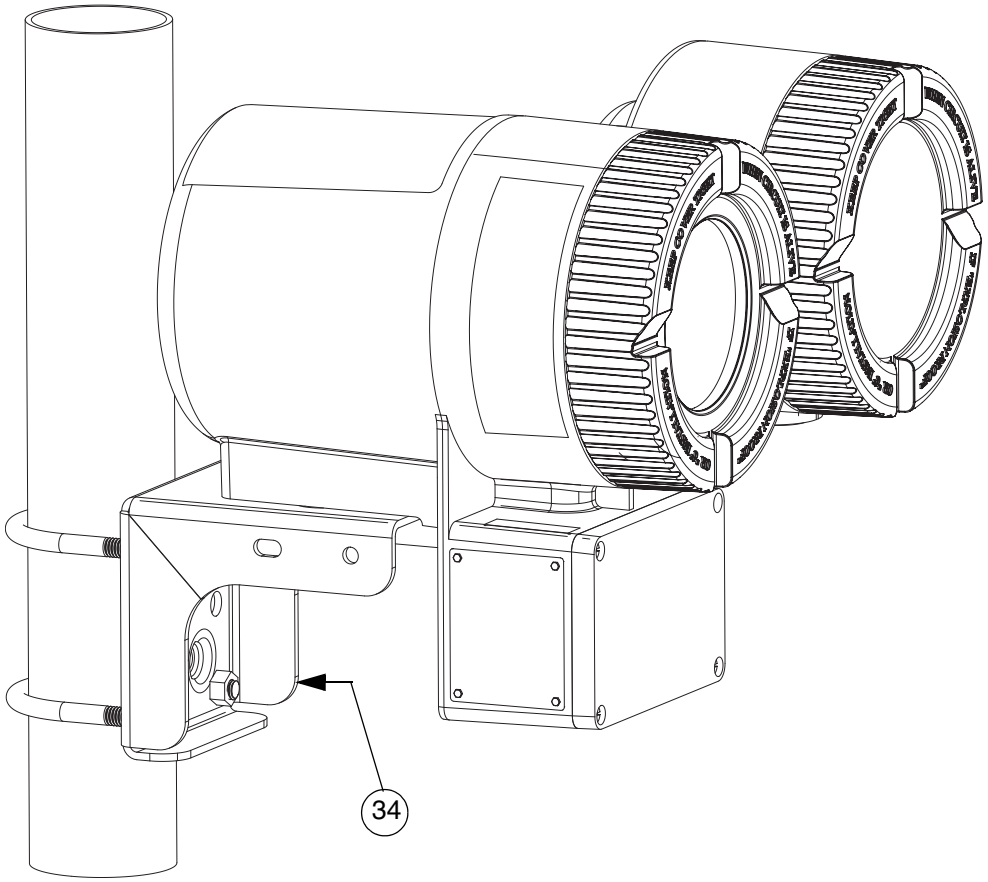


Table 25. Parts List for Figure 63, Figure 64, and Figure 65

Item	Part No.	Qty.	Part Name	Shown in
1	K0152VP	1	Cover, Blank Mach	Figure 63
2	K0152VL	1	Cover, Window Assembly	Figure 63
3	K0152NN	1	Rectangular Cover	Figure 63
4	X0144NF	2	O-ring, Cover, Round	Figure 63
5	X0201PA	1	O-ring, Cover, Rectangular	Figure 63
6	X0173YZ	4	Screw, Captive, Cover	Figure 63
7	K0152RX	1	Display Assembly	Figure 63
8	K0153AX	1	Shield, Electronics Module (only for units without LCD Display)	Figure 63
9	K0163FE	1	Sensor Termination Board PWA Kit	Figure 64
	X0169CR	--	Screw, .132-32, Sems	
	0017206	--	Washer, Flat, #6	
10	X0173YA	--	Washer, Flat #8	Figure 64
		5	for CFT51	
11	X0174EQ	--	Screw, .164-32, Sems	Figure 64
		4	for CFT51	
12	See Table 26	1	Electronics Module Assembly Kit	Figure 64
13	Below	1	Customer Connection Kits (CFT51 only)	Figure 64
	K0163FC	--	Customer Connection Kit, ac	
	K0163FD	--	Customer Connection Kit, dc	

Table 25. Parts List for Figure 63, Figure 64, and Figure 65 (Continued)

Item	Part No.	Qty.	Part Name	Shown in
14	D0177CF	1	Power, I/O Termination Board, PWA (CFT51 only)	Figure 64
15	X0174EP	4	Screw, .164-32 (CFT51 only)	Figure 64
16	X0201MZ	1	Standoff, #8, 3/4" (CFT51 only)	Figure 64
17	X0143SB	1	Washer, Star Washer #8	Figure 64
18	X0144MZ	1	O-ring, Power I/O Board	Figure 64
19	P0178NU	1	Cable, I/O	Figure 64
20	P0178NT	1	Cable, Power	Figure 64
21	See Table 27	1	Cable, Transmitter to Flowtube	Not Shown
22	D0162VJ	3	Ground Screw Assembly	Figure 64
23	D0162WM	2	Screw, Cover Lock	Figure 63
24	S001806	2	Lead Seal	Figure 63
25	S001807	1	Wire, SS, 0.06" x 40"	Figure 63
26	K0153CQ	3	Screw, Special, Lockout (for Options -S, -T, and -D) (a)	Figure 63
27	B0139CA	1	Conduit Plug	Figure 63
28	0017206	1	Washer, Flat, #6	Figure 64
29	X0169CR	1	Screw, .132-32, Sems	Figure 64
34	Below	1	Mounting Kit	Figure 65
	K0152TN	--	Carbon Steel Mounting Kit for 2-inch Pipe (Standard)	
	K0156NU	--	Stainless Steel Mounting Kit for 2-inch Pipe (Optional)	
	K0156NP	--	Carbon Steel Mounting Kit for 3-inch Pipe (Optional)	
	K0156NN	--	Stainless Steel Mounting Kit for 3-inch Pipe (Optional)	
N/A	CIB 3598	1	Printed Instruction Book - CFT51	Not Shown

a. Options -T and -D are available for CFT51 only.

Table 26. Electronics Module Assembly Kit

Kit Number	Power Input	Protocol	Certification Type	Kit Contents
K0168AR	ac	Modbus	General (a)	▸ ac Power Electronics Module (K0152NM) ▸ Instruction Document (SI 0-00614) ▸ Label
K0168AQ			NTEP (a) (b)	
K0168AP			Weights and Measures Industry Canada Approvals (a) (b)	
K0168AN		HART	General (a)	
K0168AM			NTEP (a) (b)	
K0168AL			Weights and Measures Industry Canada Approvals (a) (b)	
K0168AK	dc	Modbus	General	▸ dc Power Electronics Module (K0152NR) ▸ Instruction Document (SI 0-00614) ▸ Label
K0168AJ			NTEP (a) (b)	
K0168AH			Weights and Measures Industry Canada Approvals (a) (b)	
K0168AG		HART	General (a)	
K0168AF			NTEP (a) (b)	
K0168AE			Weights and Measures Industry Canada Approvals (a) (b)	

a. Available for CFT51 only.
b. Available for CFS10 and CFS20 flowtubes only.

Table 27. Additional Cable to Flowtube

The transmitter is shipped with one cable as specified in the Model Code. Use these part numbers to order additional cables.

Voltage rating is 30V ac. One end of the cable is dressed and ready for connection to the transmitter.

Cable Length	Cable for CFS10 and CFS20 Flowtubes (a)	
	PVC Insulation (b)	FEP Insulation (c)
20 feet	G0117CV	G0117QL
50 feet	G0117PY	G0117QM
100 feet	G0117PZ	G0117QN
200 feet	G0117QA	G0117QP
500 feet	G0117QB	G0117QQ
750 feet	G0117QC	G0117QR
1000 feet	G0117QD	G0117QS
6 meters	G0117CV	G0117QL
15 meters	G0117QE	G0117QU
30 meters	G0117QF	G0117QV
60 meters	G0117QG	G0117QW
150 meters	G0117QH	G0117QX
225 meters	G0117QJ	G0117QY
300 meters	G0117QK	G0117QZ

a. Six twisted pairs of insulated, 22 AWG stranded, tinned, copper wire. Each pair has an aluminum-polyester shield with drain wire.
b. Twisted pairs are insulated with PVC. Cable has a chrome-PVC outer jacket with ambient temperature limits of -20 and +80°C (-4 and +176°F).
c. Twisted pairs are insulated with FEP. Cable has an FEP outer jacket with ambient temperature limits of -40 and +85°C (-40 and +185°F).

Recommended Spare Parts

Figure No.	Item No.	Part Number	Part Name	Number of Parts Recommended for		
				1 Inst.	5 Inst.	20 Inst.
63	4	X0144NF	O-ring, Cover, Round	2	4	4
63	5	X0201PA	O-ring, Cover, Rectangular	1	2	2
63	7	K0152RX	Display Assembly	1	1	2
63	24	S001806	Seal, Lead (Options -S, -T, and -D only)	6	12	24
63	25	S001807	Sealing Wire, ss; 0.06 in O.D., 40 in long (Options -S, -T, and -D only)	As required	As required	As required
64	12	See Table 26	Electronics Module Assembly Kit	1	1	4
63	31	K0157AH	Battery Kit	1	1	4

Appendix A. Custom Slopes

This appendix contains the custom slopes for frequently used units.

Mass Flow

Table 28. Mass Flow Custom Slope

Unit	Conversion	Slope
LTon/hr (a)	3.5424 LTon/hr = 1 kg/s	3.5424
Tonne/hr (b)	3.6 Tonne/hr = 1 kg/s	3.6

a. Long Ton/hour
b. Metric Ton/hour

Volume Flow

Table 29. Volume Flow Custom Slope

Unit	Conversion	Slope
ft^3/min	2.11888 ft^3/min = 1 L/s	2.11888
m^3/min	0.06 m^3/min = 1 L/s	0.06000
bbl/min (a)	0.37739 bbl/min = 1 L/s	0.37739

a. 42 gallon barrel

Density

Table 30. Density Custom Slope

Unit	Conversion	Slope
oz/gal	0.13352 oz/gal = 1 g/L	0.13352

Totals

Table 31. Totals Custom Slope

Unit	Conversion	Slope
lb (troy)	2.67921 lb (troy) = 1 kg	2.67921
bbl (a)	6.2898×10^{-3} bbl = 1L	0.00629

a. 42 gallon barrel

Appendix B. Setup Diagrams

This section contains structure diagrams that illustrate the Setup menu structure of the CFT51 Transmitter with HART and Modbus communication protocols and shows how you can use the local display and keypad to get from one point to another in the structure. These diagrams can be invaluable tools in configuring your transmitter.

NOTE

Certain parameters may be missing as you step through the menus depending on the configuration of your instrument.

Setup Menu Structure Using HART Communication Protocol

Figure 66. Level 2 Setup Menu Structure (HART)

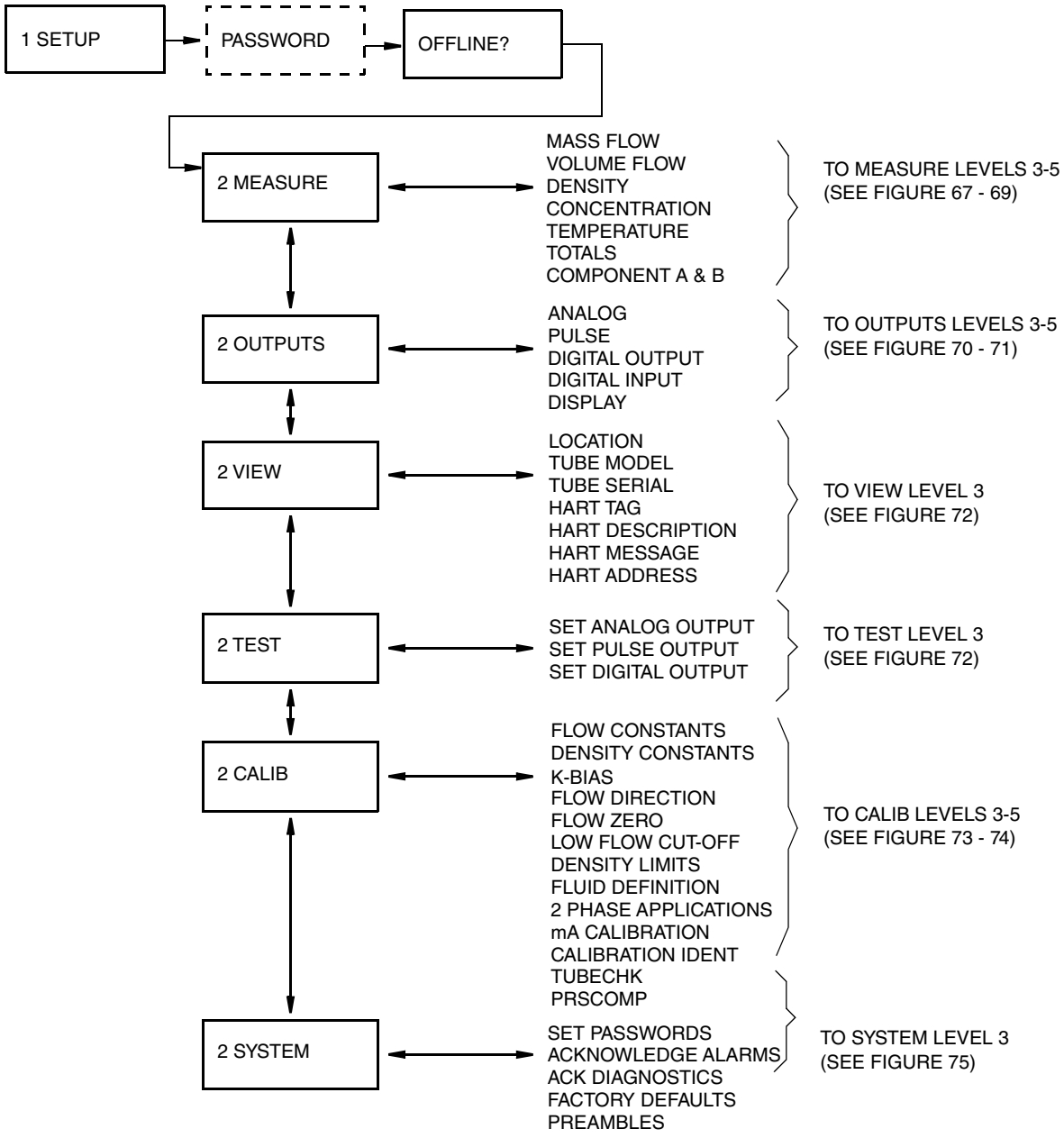


Figure 67. Level 3 Setup Measure Structure (HART)

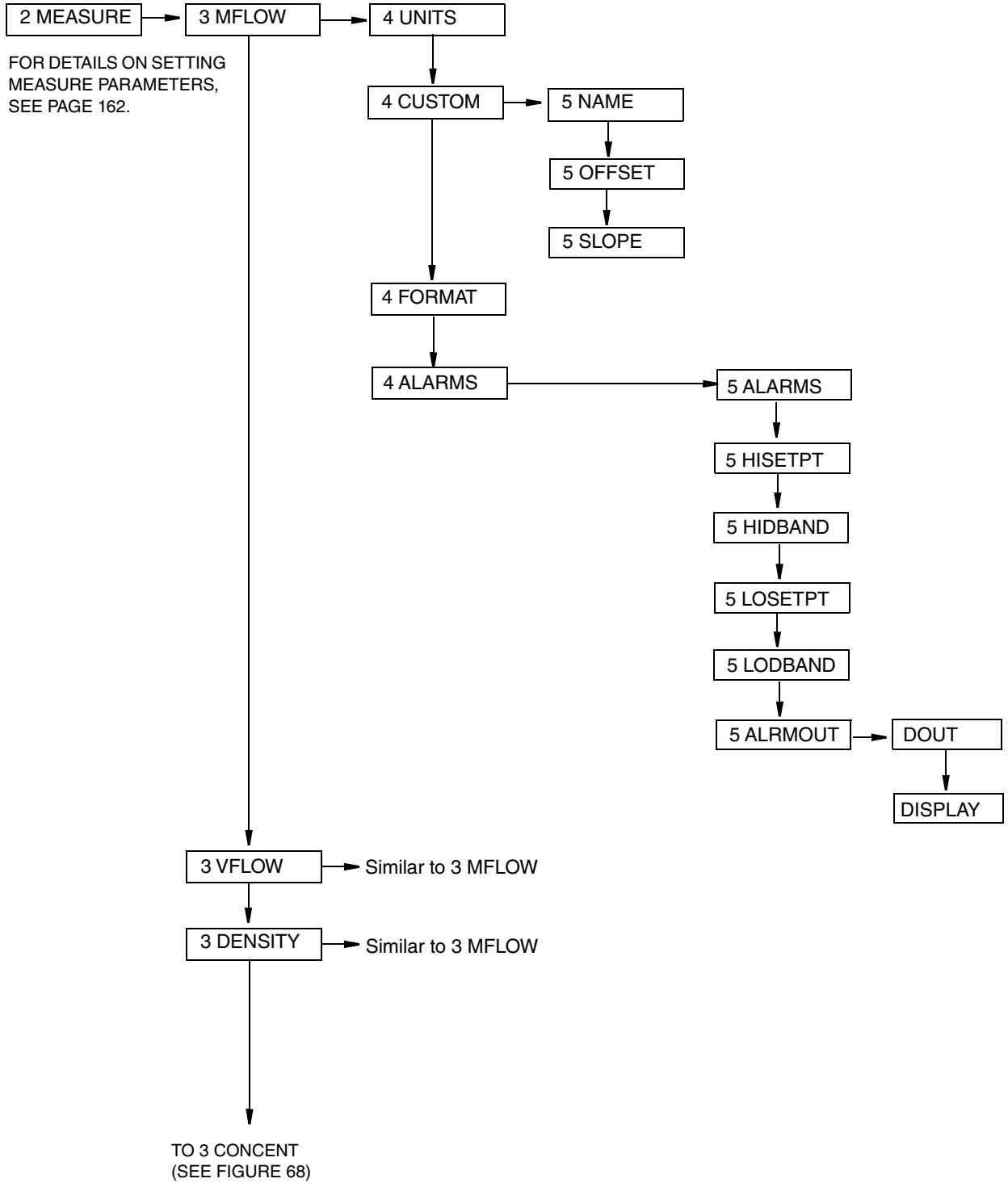


Figure 68. Level 3 Setup Measure Structure (HART) (Continued)

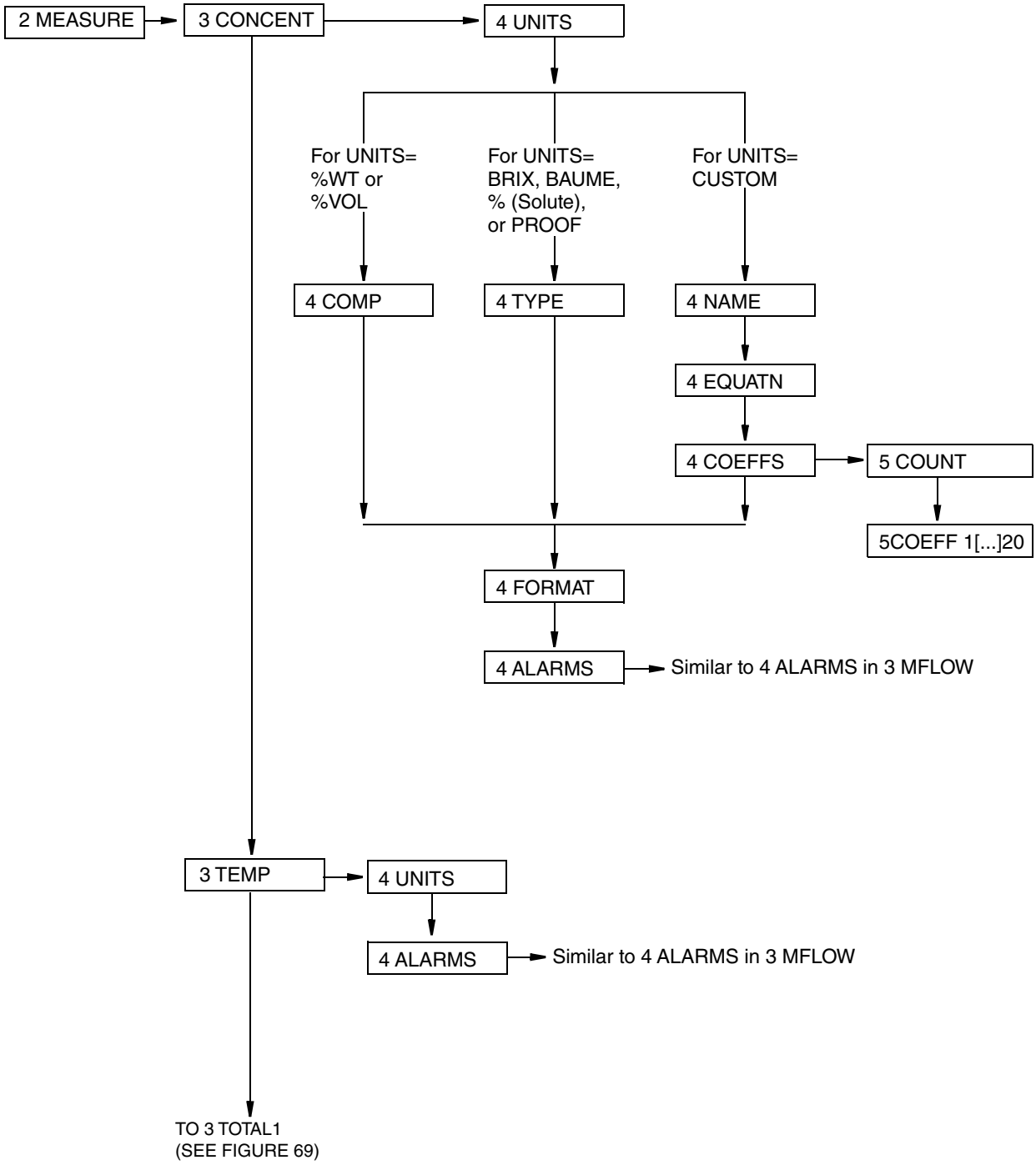


Figure 69. Level 3 Setup Measure Structure (HART) (Continued)

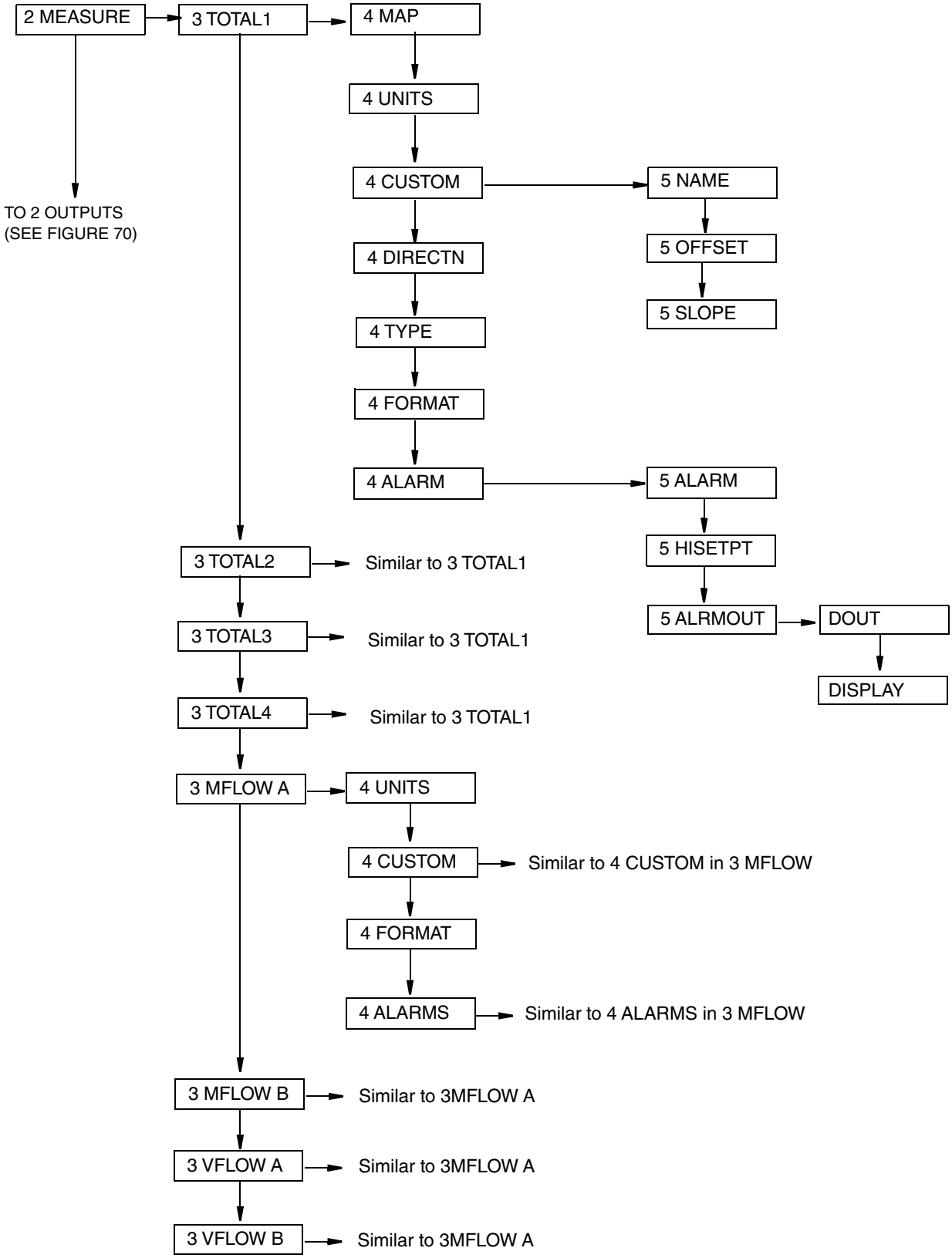


Figure 70. Level 3 Setup Output Structure (HART)

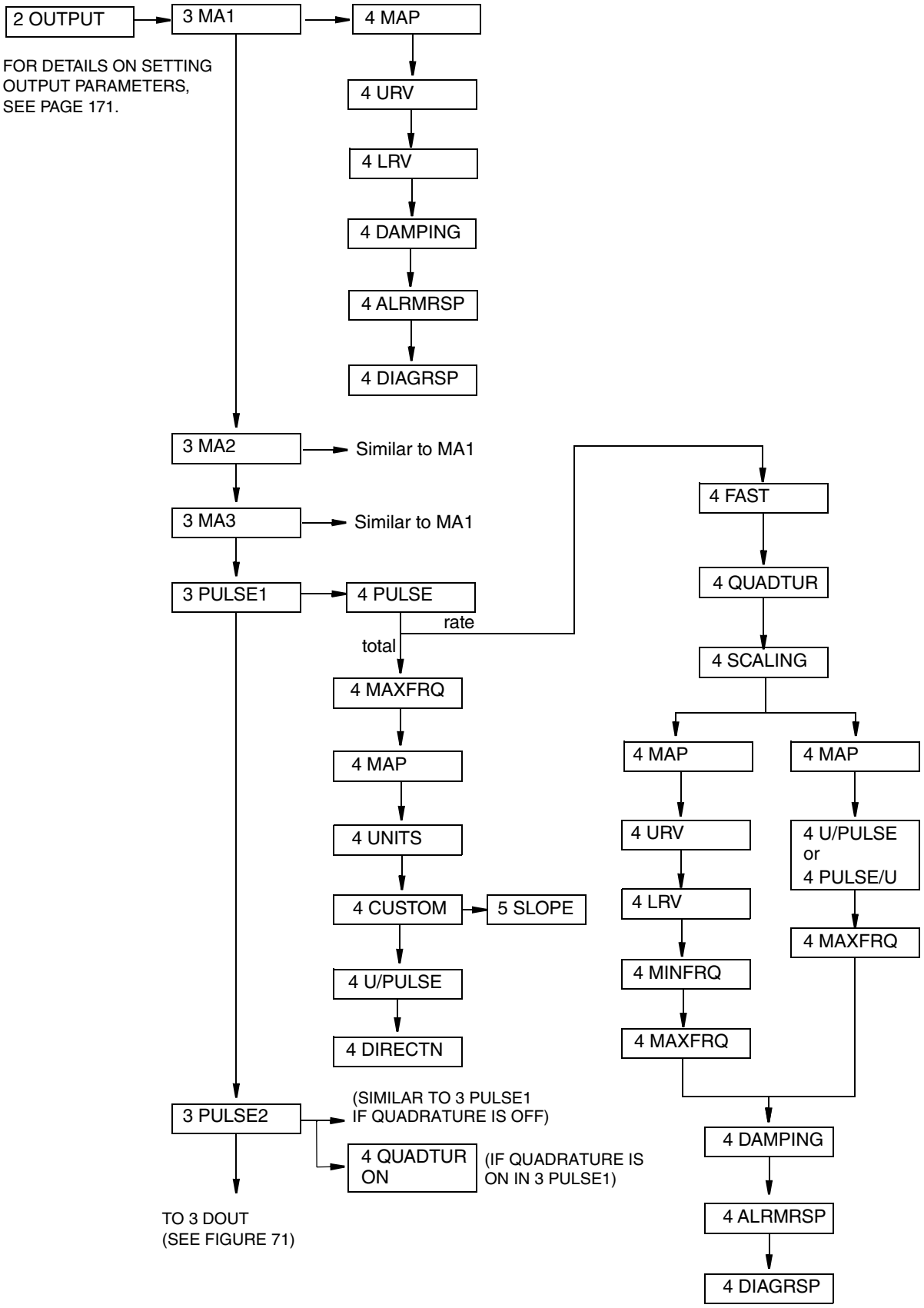


Figure 71. Level 3 Setup Output Structure (HART) (Continued)

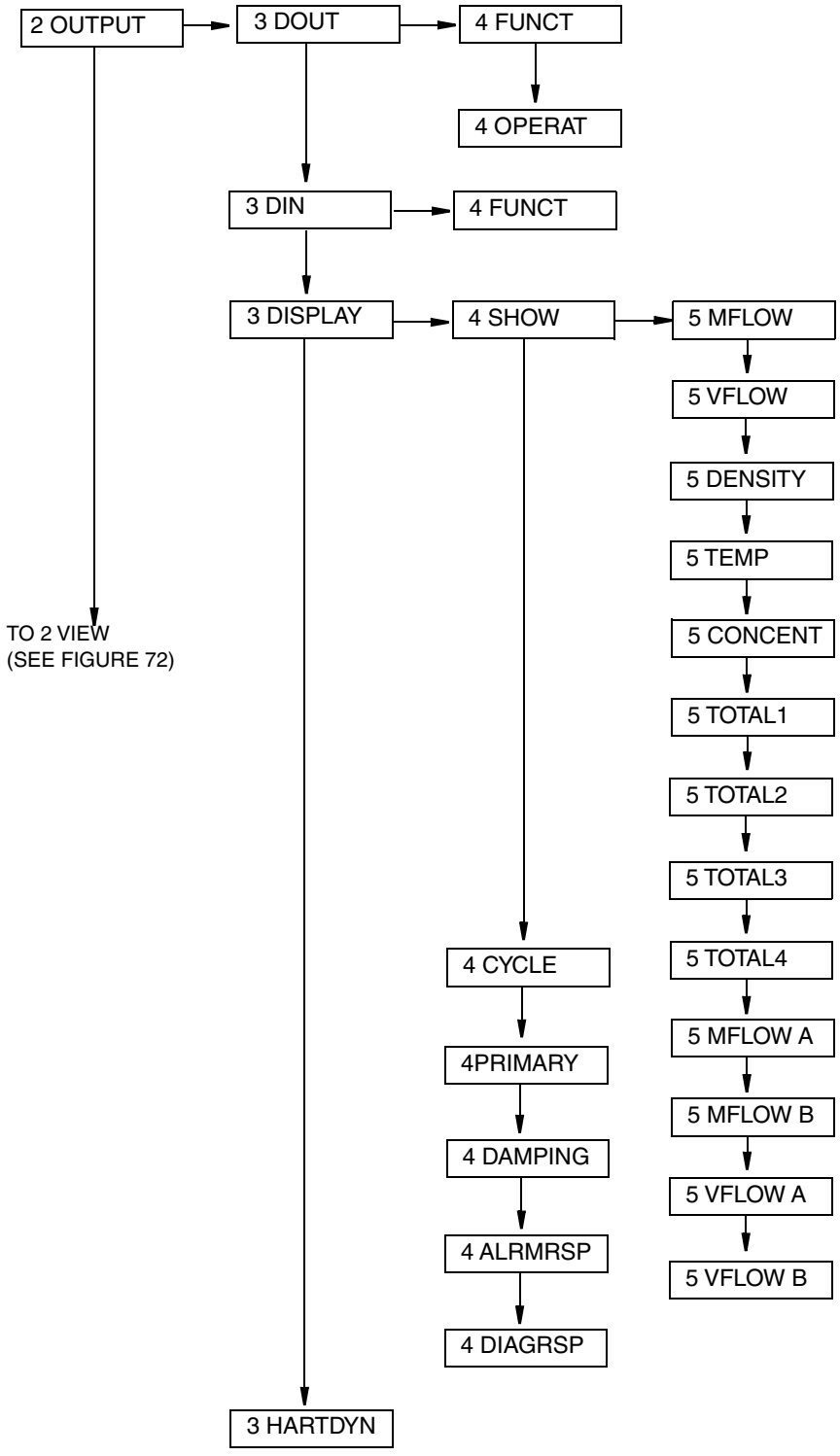


Figure 72. Level 3 View and Test Structure (HART)

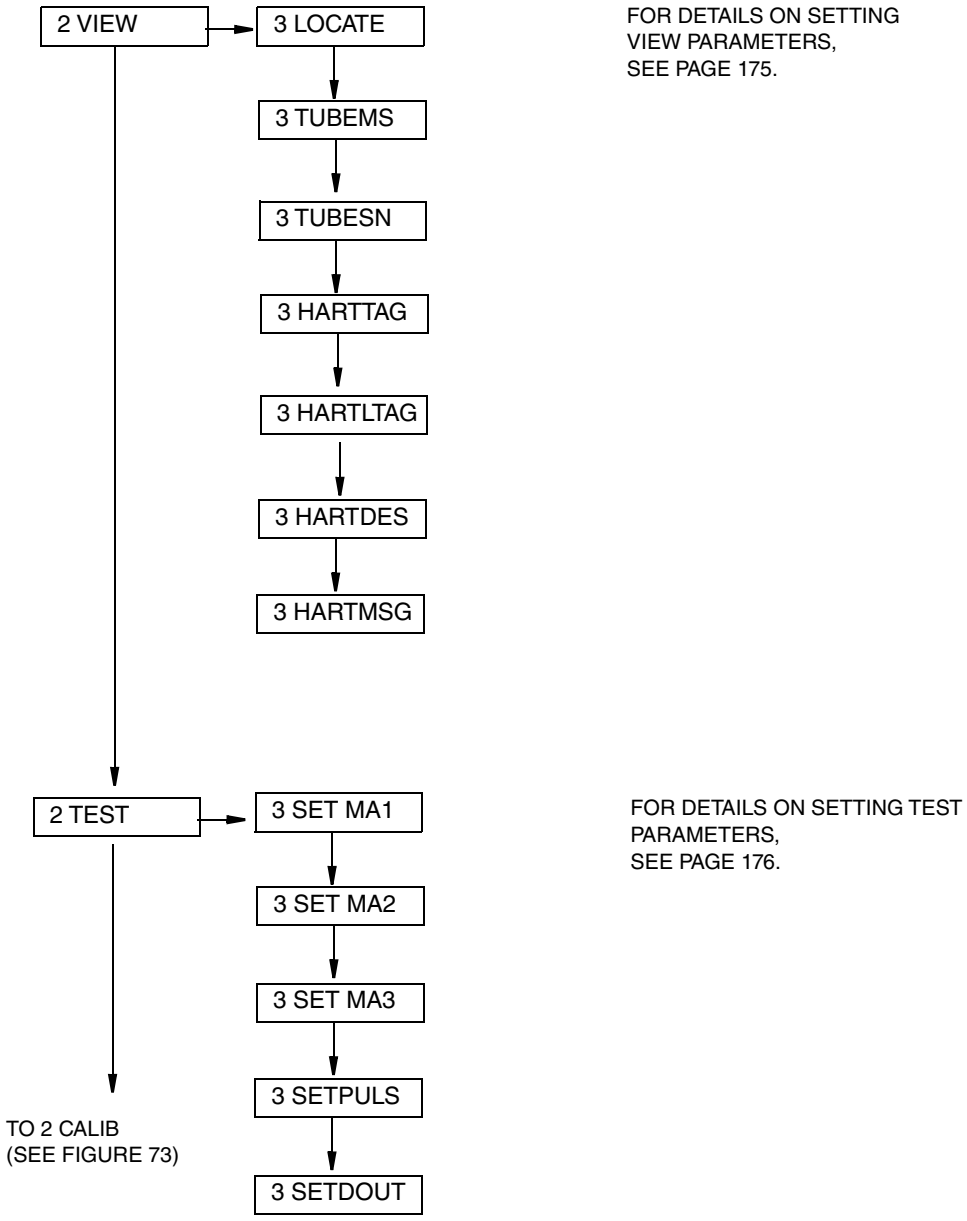


Figure 73. Level 3 Calibration Structure (HART)

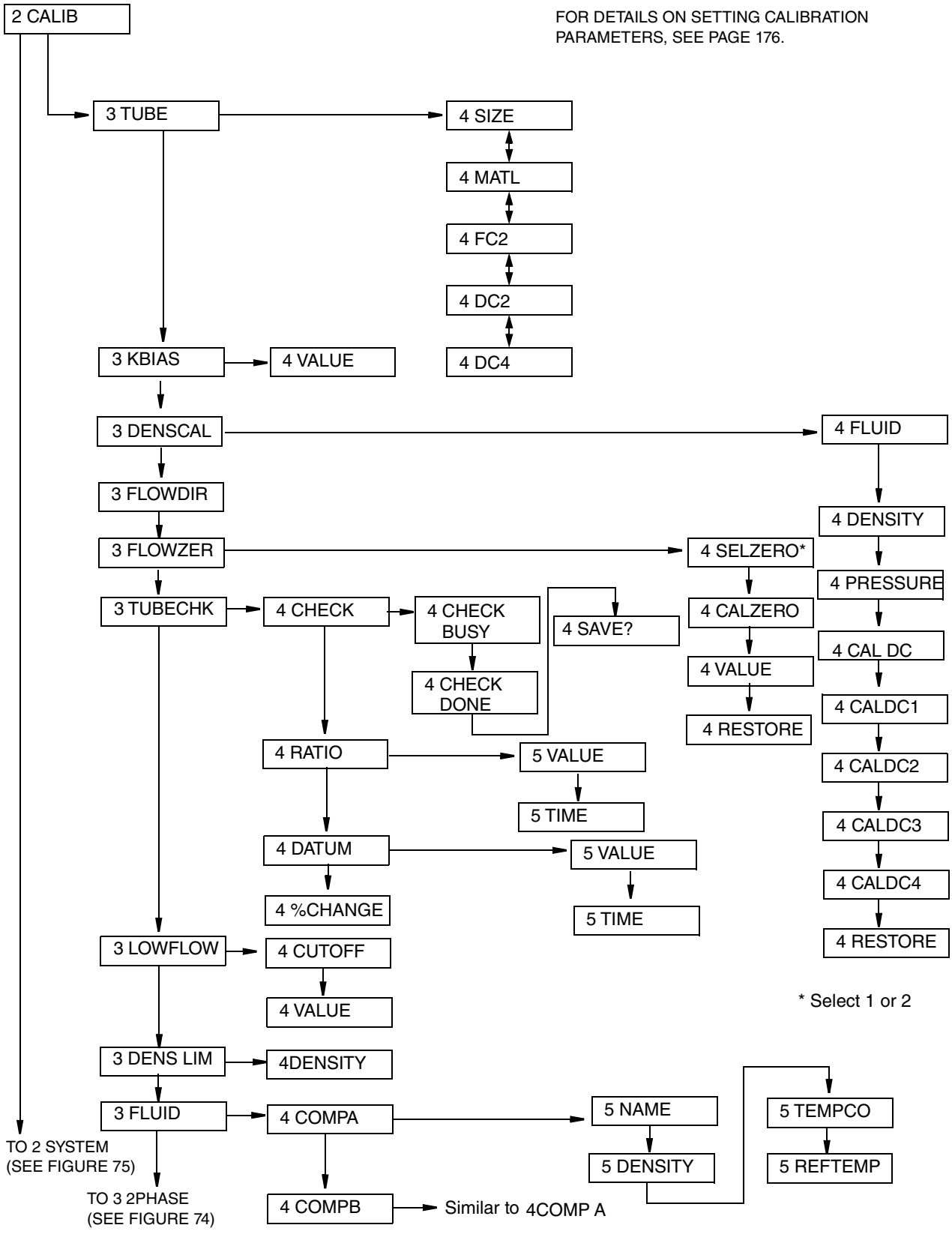


Figure 74. Level 3 Calibration Structure (HART) (Continued)

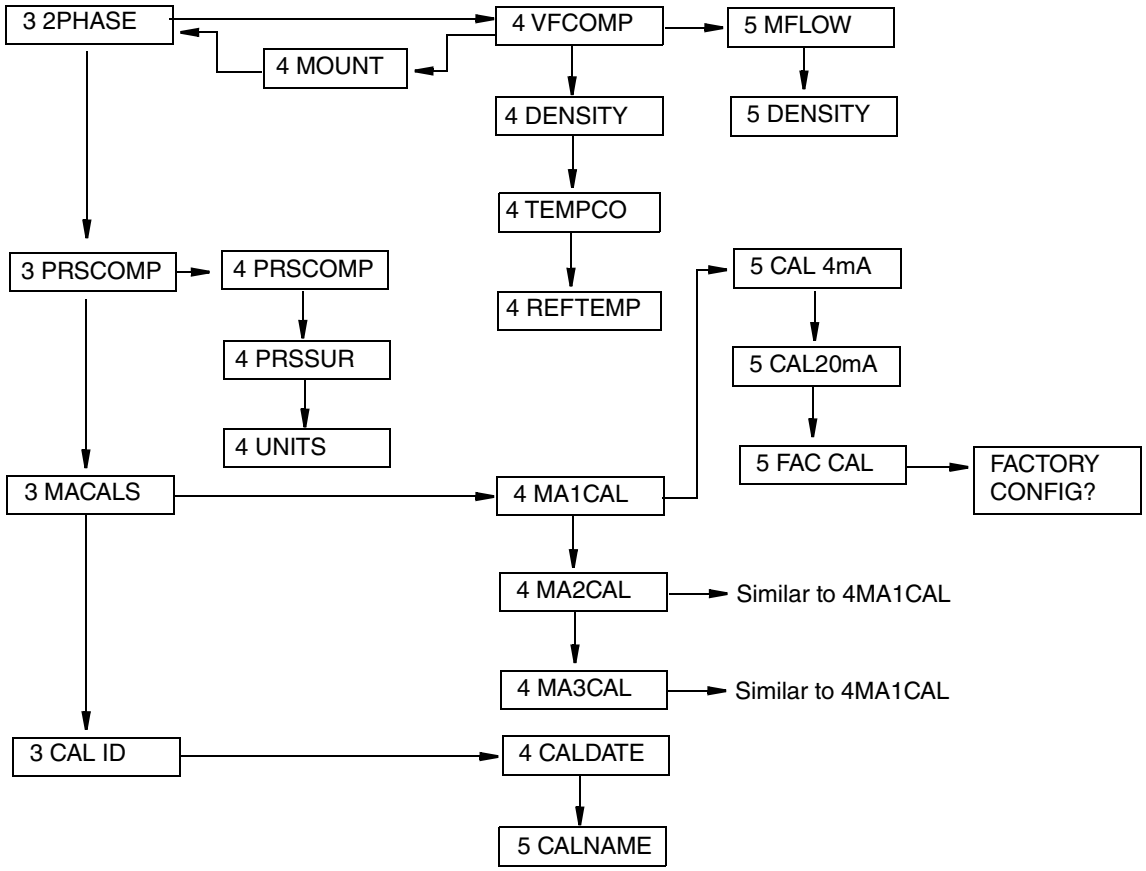
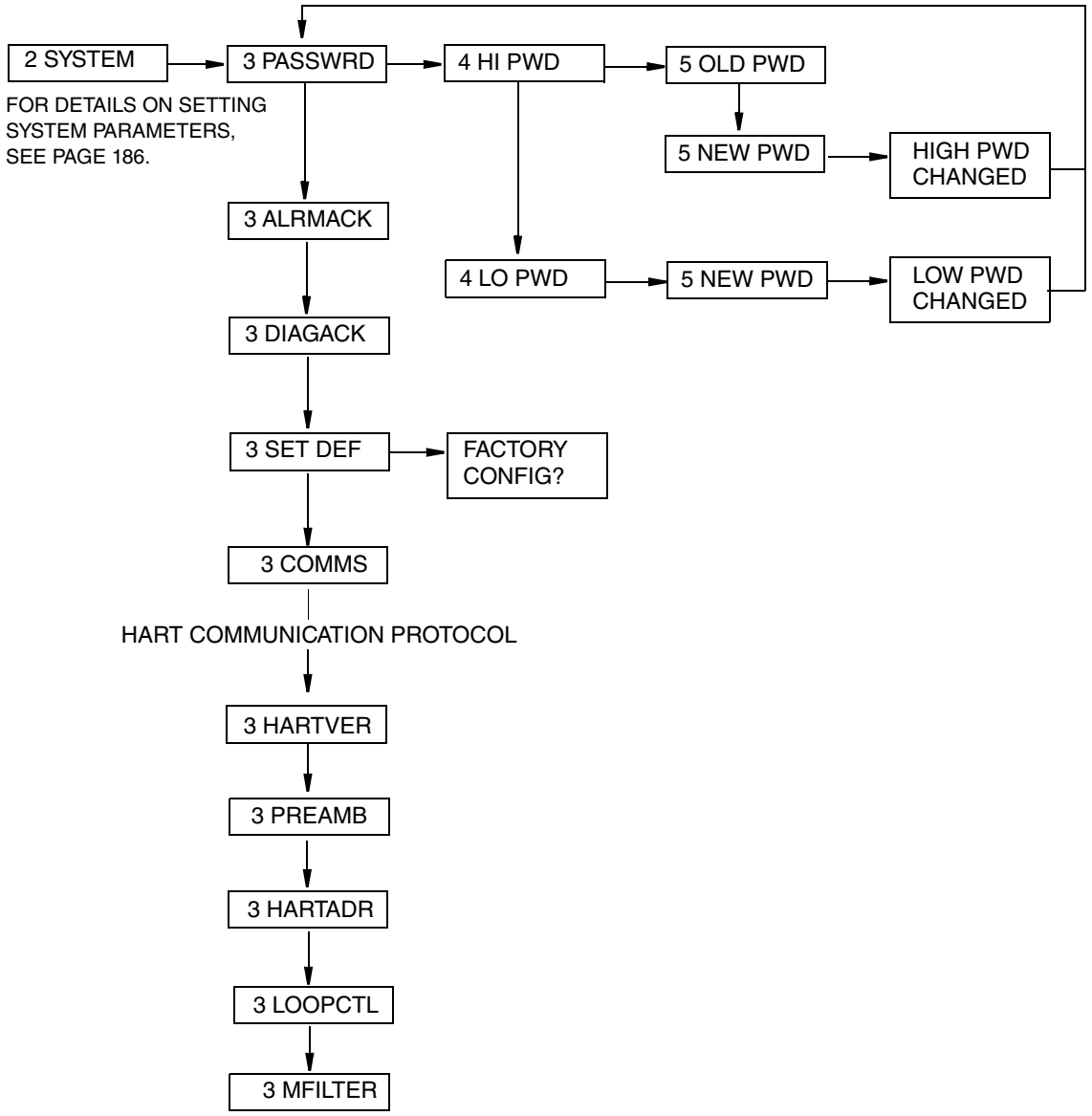


Figure 75. Level 3 System Structure (HART)



Setup Menu Structure Using Modbus Communication Protocol

Figure 76. Level 2 Setup Menu Structure (Modbus)

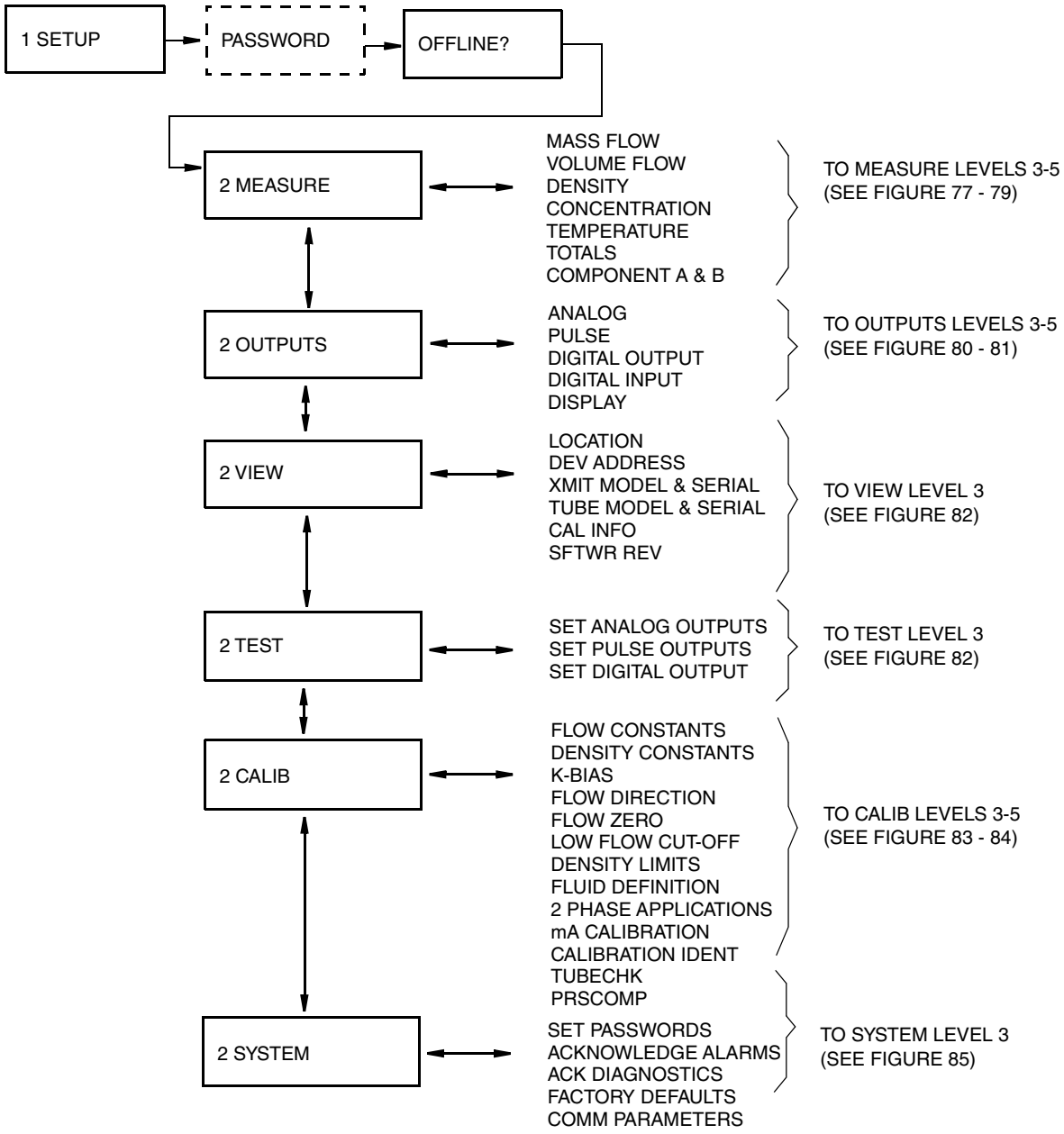


Figure 77. Level 3 Setup Measure Structure (Modbus)

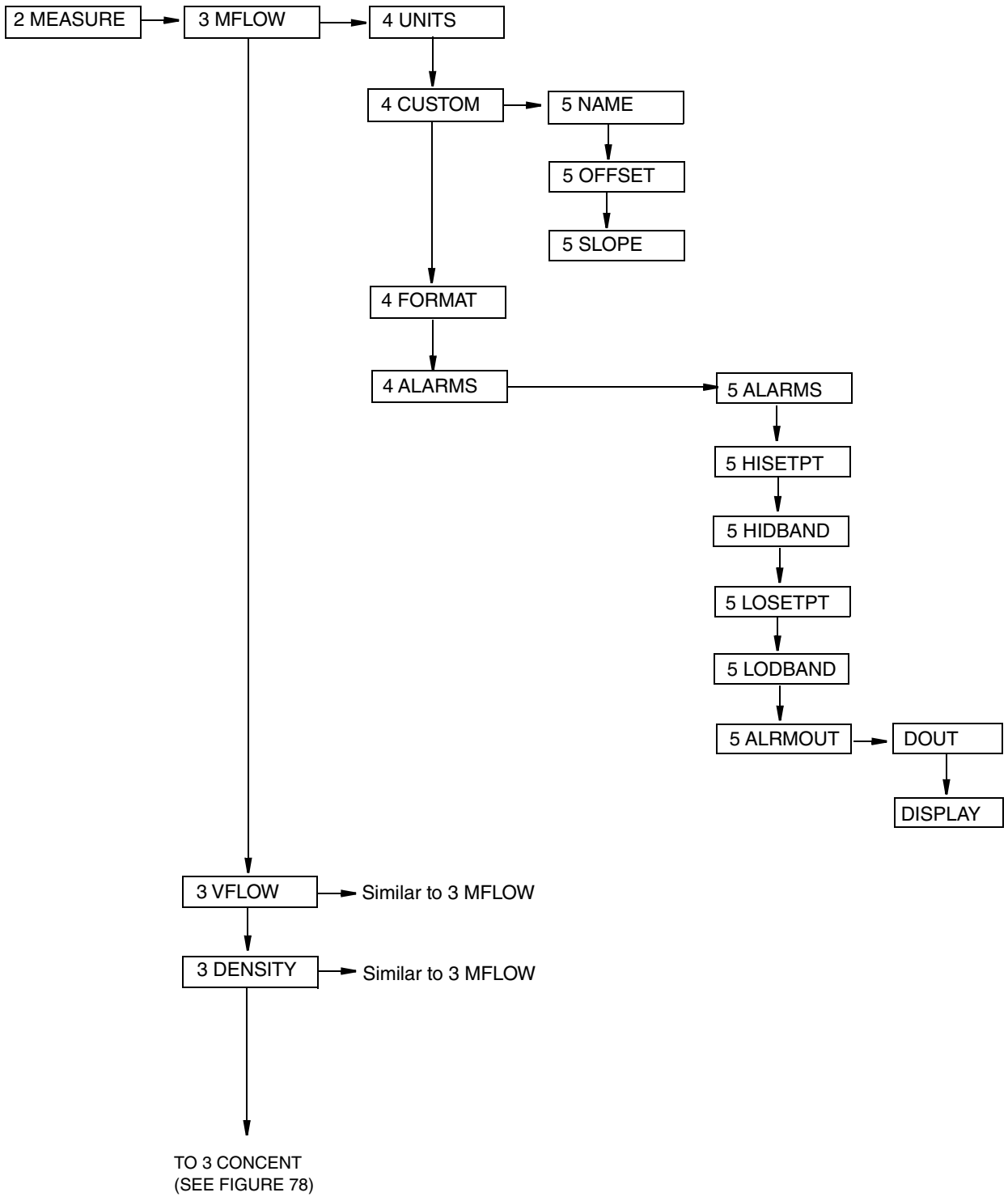


Figure 78. Level 3 Setup Measure Structure (Modbus) (Continued)

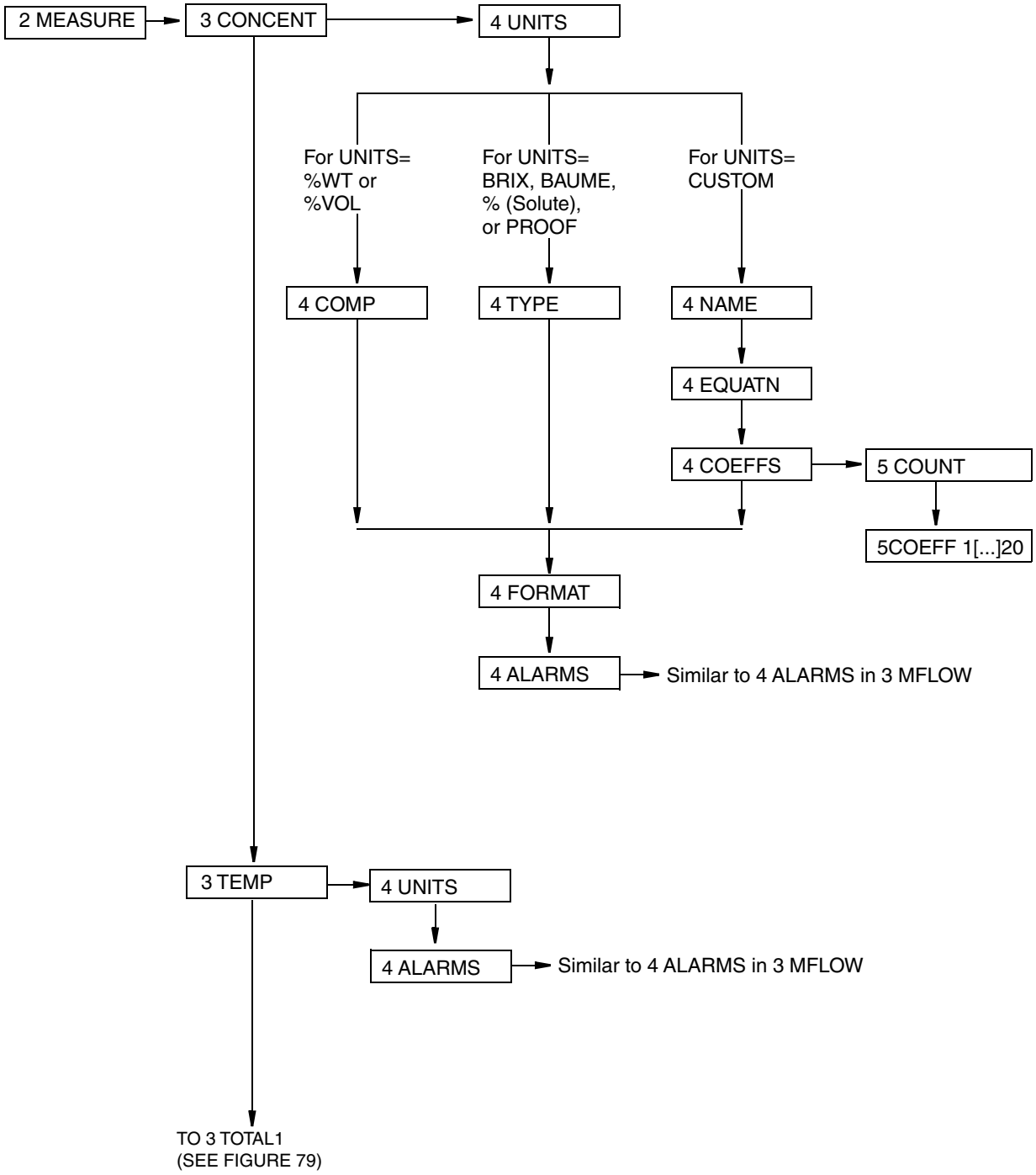


Figure 79. Level 3 Setup Measure Structure (Modbus) (Continued)

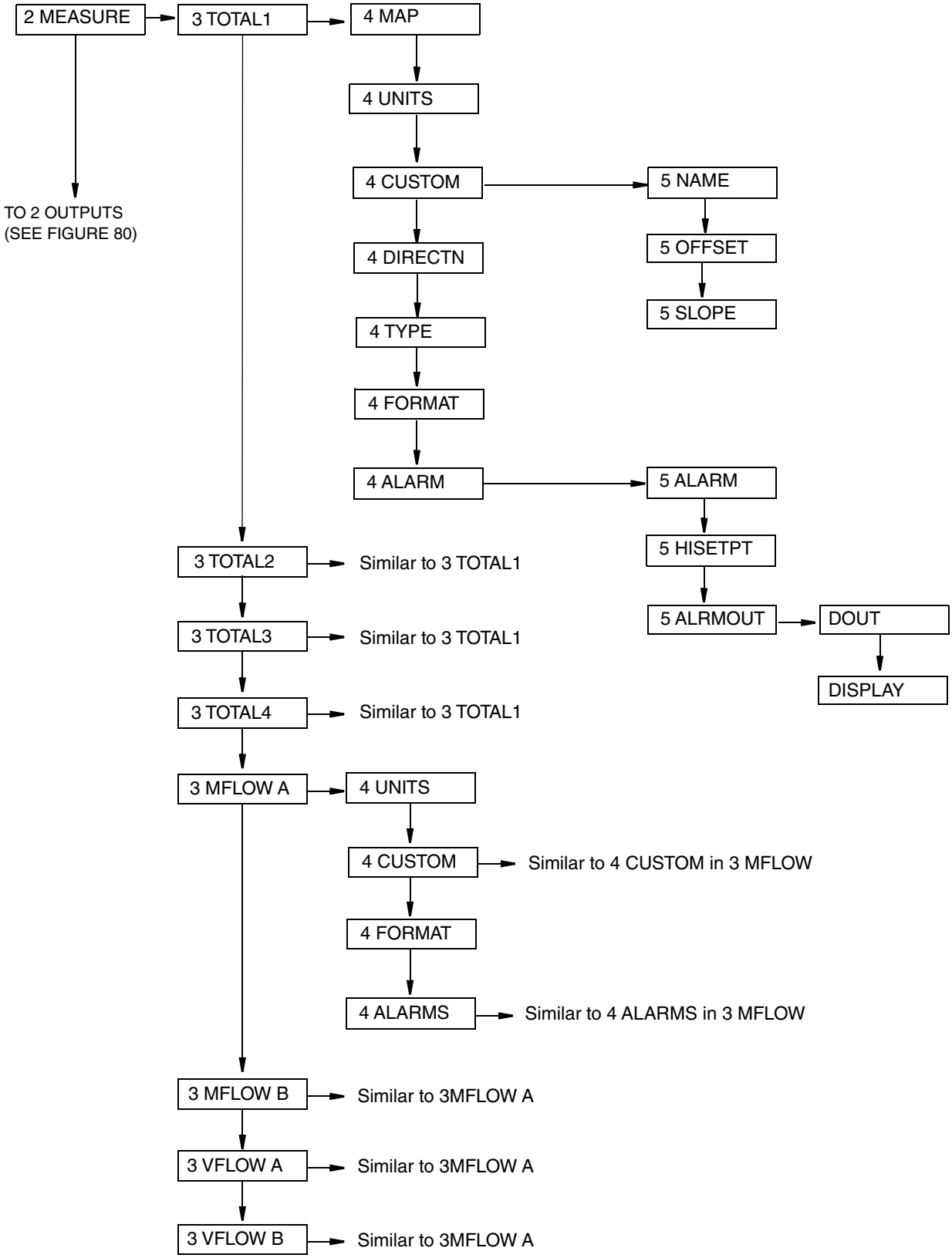


Figure 80. Level 3 Setup Output Structure (Modbus)

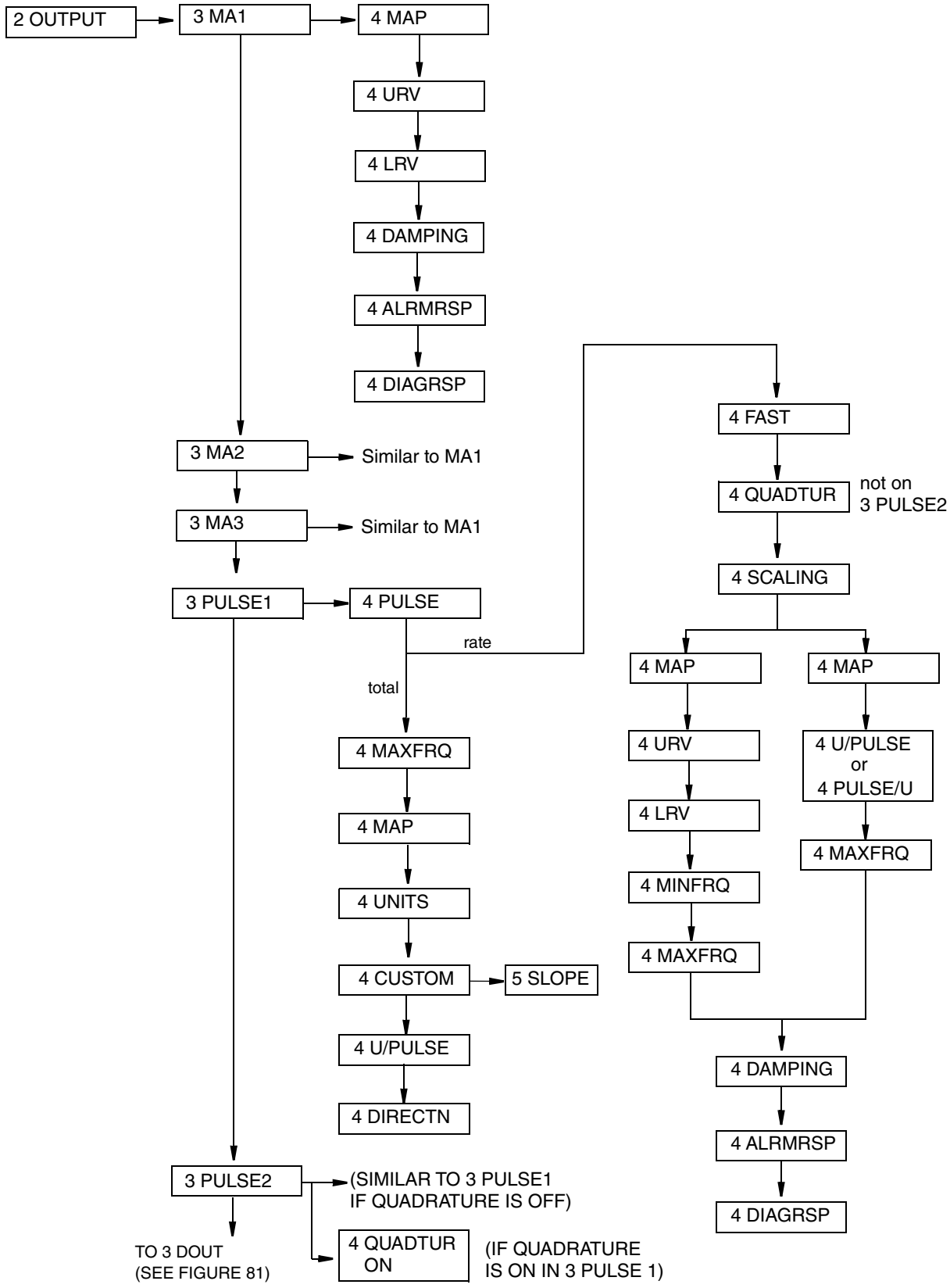


Figure 81. Level 3 Setup Output Structure (Modbus) (Continued)

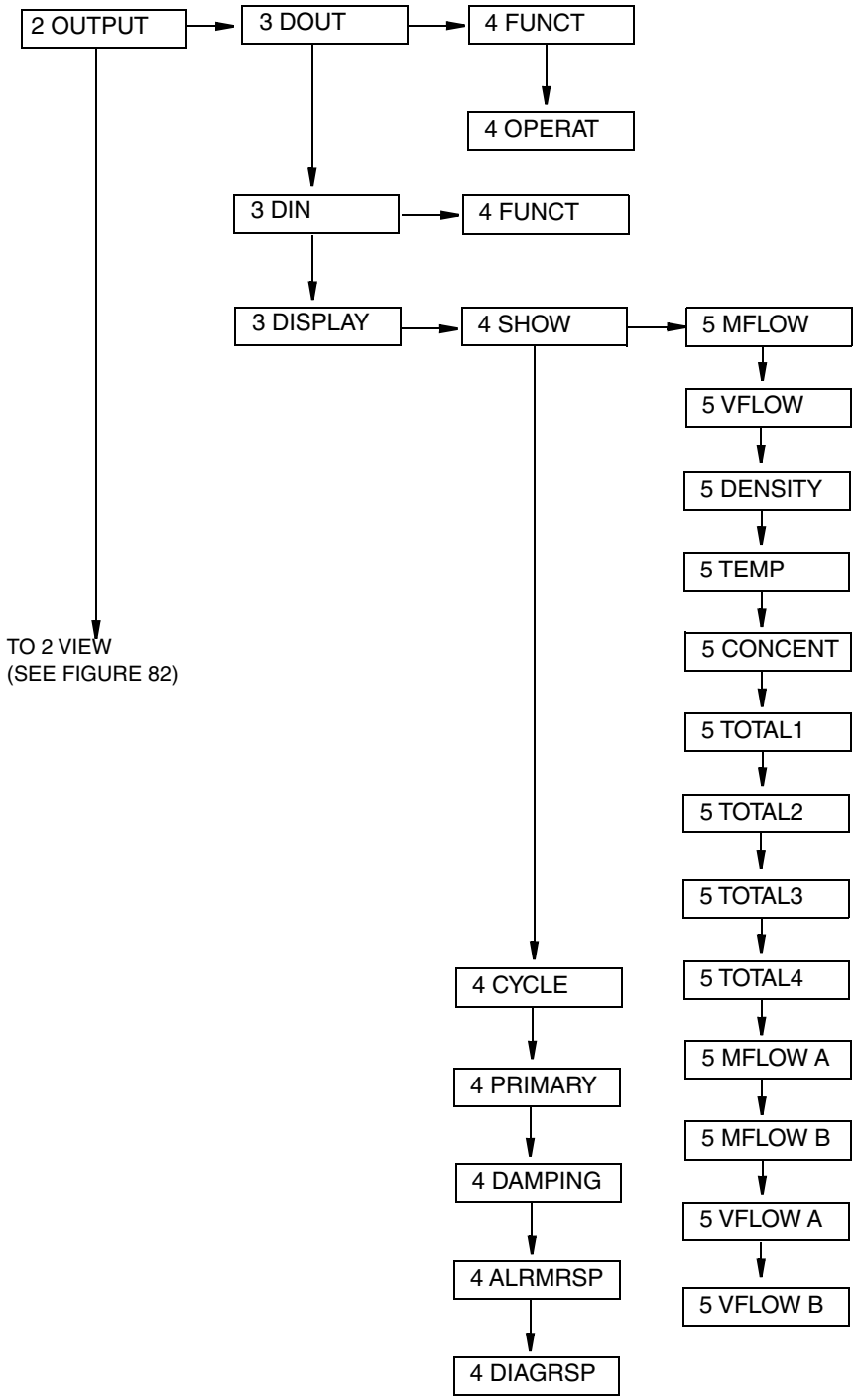


Figure 82. Level 3 View and Test Structure (Modbus)

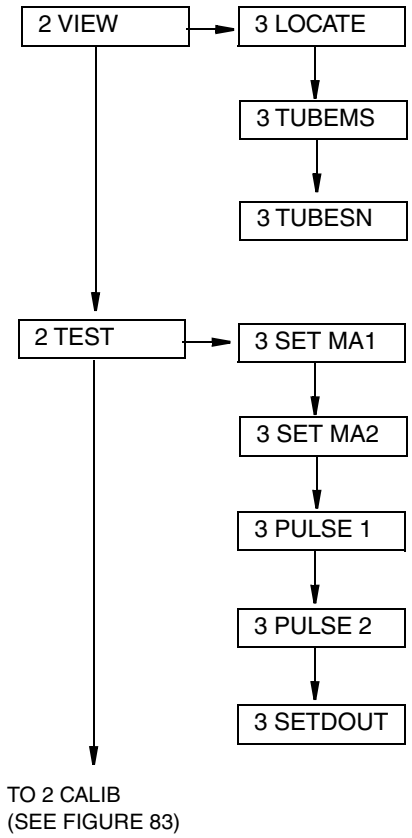


Figure 83. Level 3 Calibration Structure (Modbus)

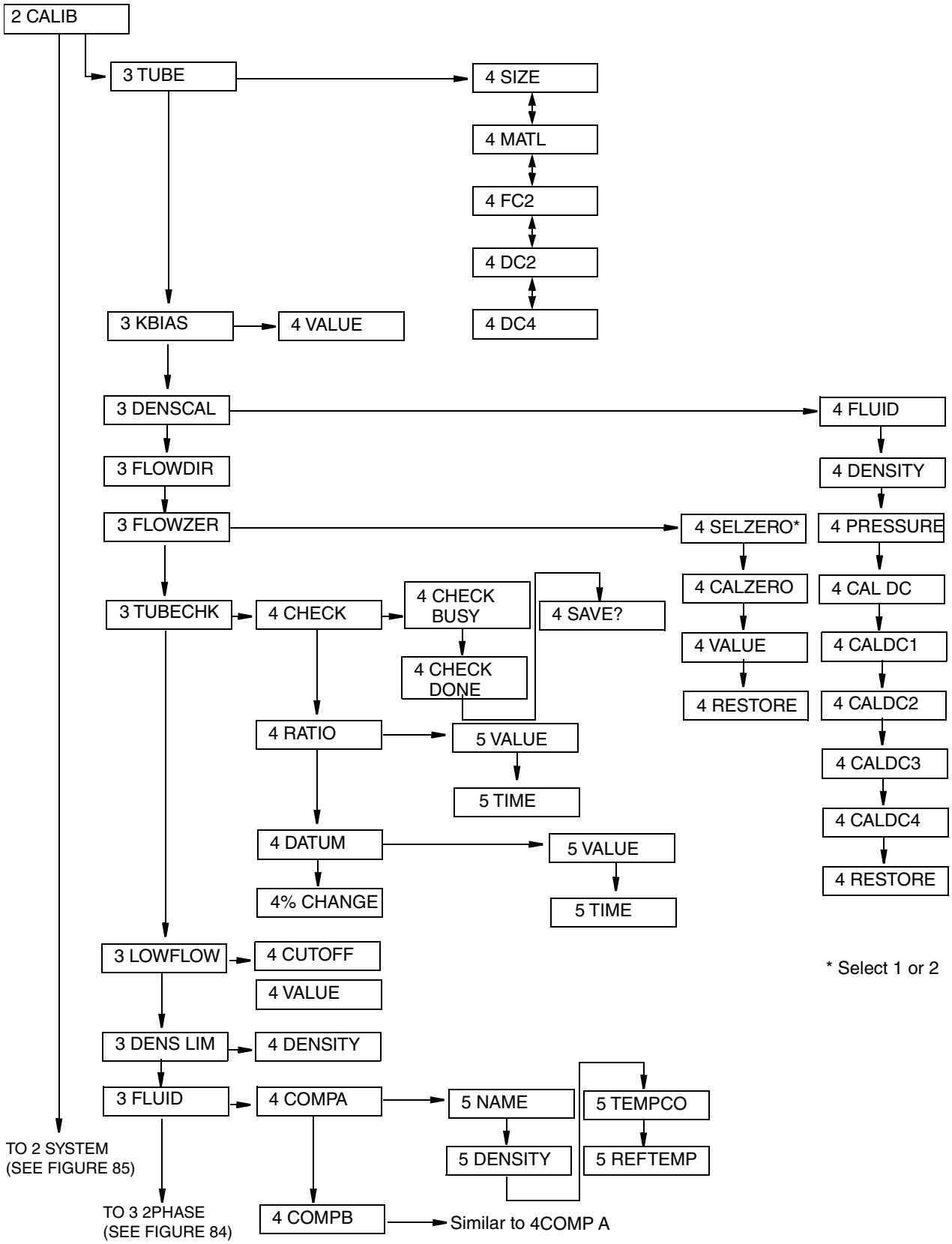


Figure 84. Level 3 Calibration Structure (Modbus) (Continued)

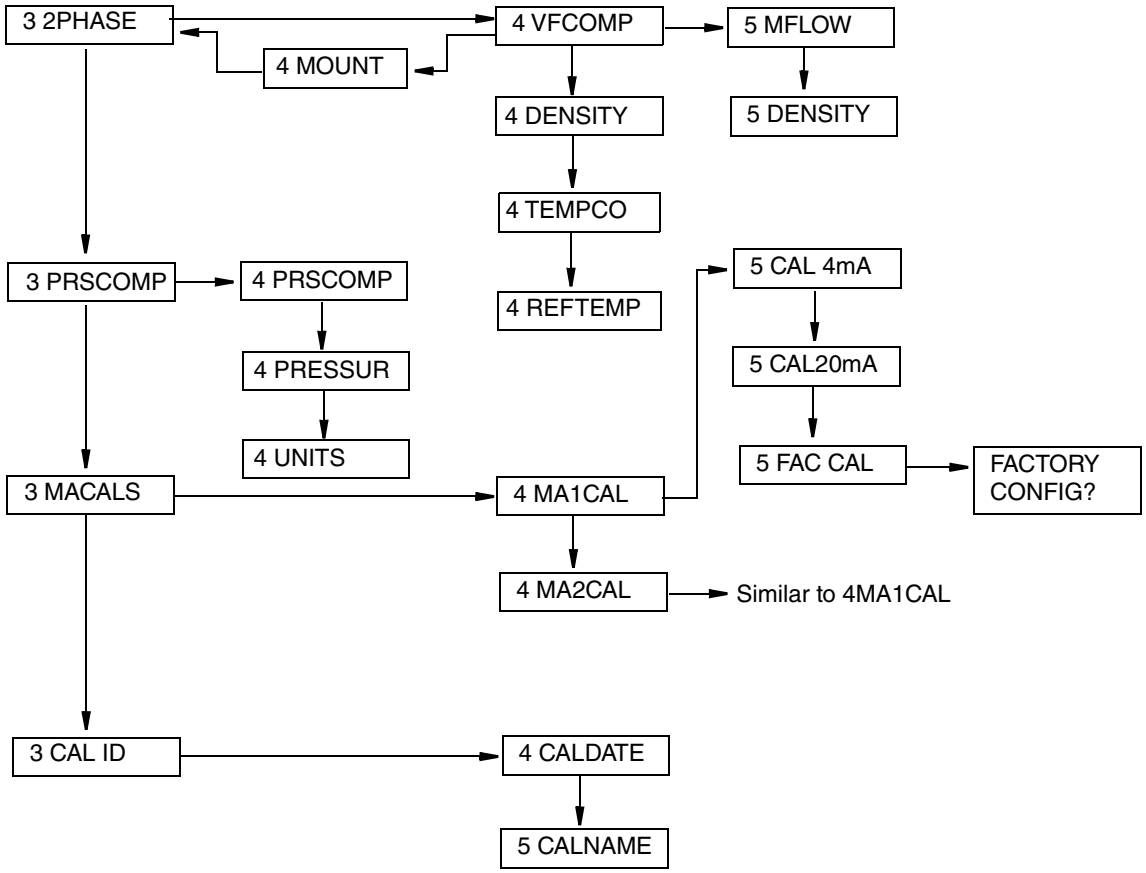
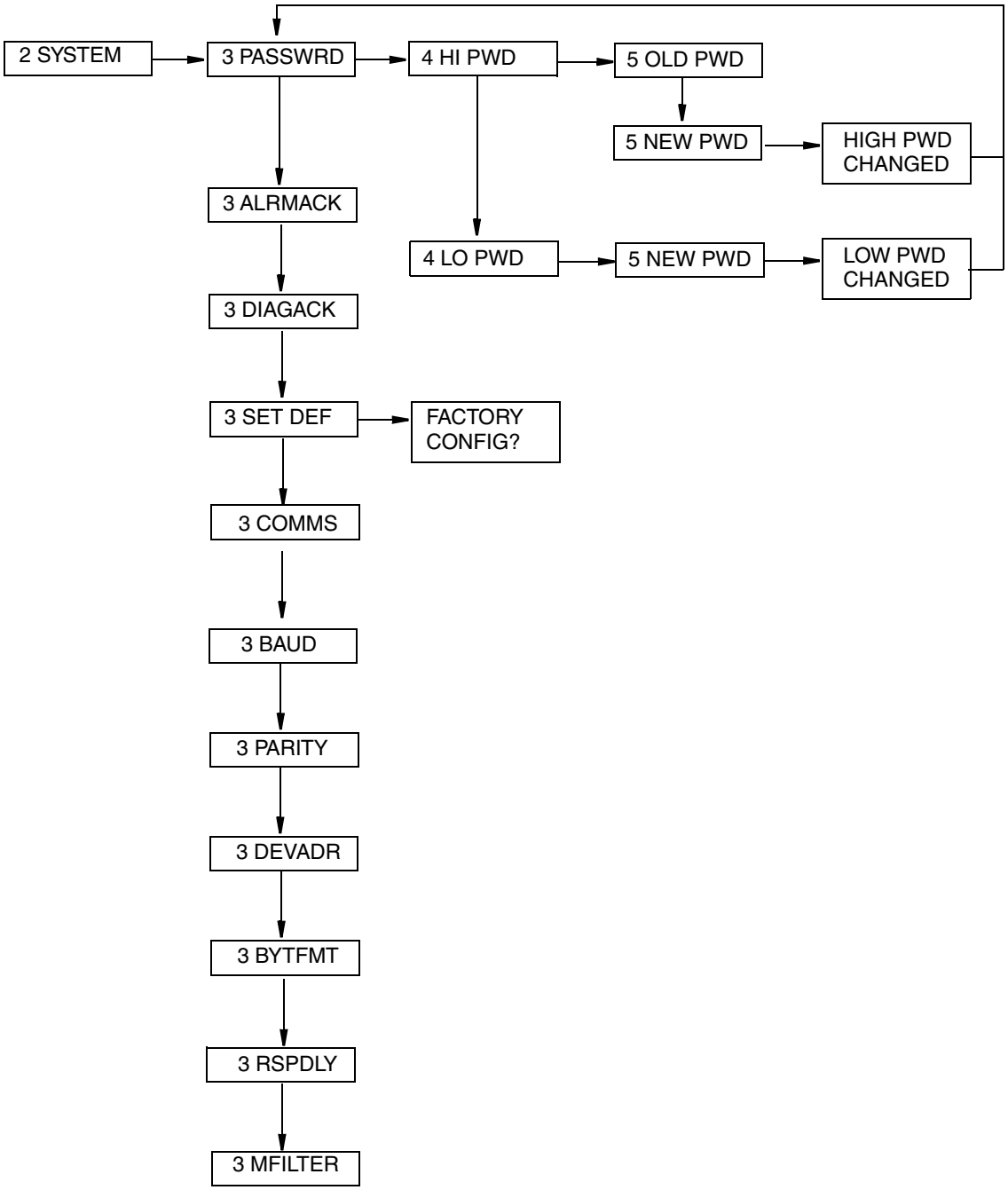


Figure 85. Level 3 System Structure (Modbus)



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