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TOTALFLOW®

6400 Flow Computer

User's Manual

TOTALFLOW
MEASUREMENT & CONTROL SYSTEMS

ABB

Copyright Notice

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Introduction

About the Manual

Audience & Purpose

This manual is written to provide an experienced flow meter technician with the requirements necessary to install, setup and operate a Totalflow 6400 Series Flow Computer System.

Organization & Style

Each of the chapters in this manual presents labeled blocks (chunks) of information in an organized and concise manner. Readers are able to look at the headings and get a broad picture of the content without reading every word. Also, there are overviews at the beginning of each chapter that provides you with an idea of what is in the chapter, and how it fits into the overall manual.

Chapter Contents

This manual provides the following information.

Chapter	Description
1. System Description	Provides a description of the Totalflow, 6400 system components, specifications, and description of flow computer computation methods.
2. Installation	Includes unpacking and detailed procedures for setup and installation.
3. Portable Calibration & Collection Unit	Provides you with an overview of the PCCU, a description of the keyboard, and how to install and change batteries.
4. FCU Operation	Provides you with a tutorial on how to get a newly installed FCU system up and running.
5. Maintenance	Provides instructions on how to remove and replace major modules.
6. Troubleshooting	Provides a description of the FCU front panel error messages and provides a troubleshooting chart on how to correct most problems.
7. Parts Catalog	Includes drawing and parts list for all FCU major components as well as parts ordering information.
8. Drawings	Provides a place to put drawings that accompany a unit.

Getting Help

Technical Support

At Totalflow, we take pride in the on going support we provide our customers. When you purchase a product, you receive documentation which should answer your questions; however, your Totalflow technical support provides you an 800 number as an added source of information.

If your require assistance, call:

(800) 442-3097

Before You Call

Know your Totalflow's serial number. Serial numbers can be found on the escutcheon plate located on the side of each unit.

Prepare a written description of problem.

How to Describe Your Problem

Be prepared to give the customer service representative a detailed description of the problem.

Note any alarms or messages as they appear on the PCCU or front panel LCD.

Safety Practices and Precautions

Safety First

This manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the product in a safe condition.

Terms in This Manual

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

Terms as Marked on Equipment

DANGER indicates a personal injury hazard immediately accessible as one reads the markings.

CAUTION indicates a personal injury hazard not immediately accessible as one reads the markings, or a hazard to property, including the equipment itself.

Symbols in This Manual

This system indicates where applicable cautionary or other information is to be found.

Symbols Marked on Equipment

DANGER - High voltage

Protective ground (earth) terminal

ATTENTION - Refer to Manual

Safety Practices and Precautions, Continued

Grounding the Product

A grounding conductor should be connected to the grounding terminal before any other connections are made.

Correct Operating Voltage

Before switching on the power, check that the operating voltage listed on the equipment agrees with the available line voltage.

Danger Arising From Loss of Ground

Any interruption of the grounding conductor inside or outside the equipment or loose connection of the grounding conductor can result in a dangerous unit. Intentional interruption of the grounding conductor is not permitted.

Safe Equipment

If it is determined that the equipment cannot be operated safety, it should be taken out of operation and secured against unintentional usage.

Use the Proper Fuse

To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your product. Use of repaired fuses or short circuiting of the fuse switch is not permitted.

Safety Guidelines

DO NOT open the equipment to perform any adjustments, measurements, maintenance, parts replacement or repairs until all power supplies have been disconnected.

Only a properly trained technician should work on any equipment with power still applied.

When opening covers or removing parts, exercise extreme care "live parts or connections can be exposed".

Capacitors in the equipment can still be charged even after the unit has been disconnected from all power supplies.

Chapter 1.0
System Description

Overview

Introduction

This Chapter introduces you to the Totalflow® Model 6400 Series Flow Computer Units (FCU). The 6400 series are microprocessor based units designed for calculating and measuring both oil and gas flow in a pipeline or from a well. Two models of the 6400 FCU are available, a Model 6410 and a Model 6413.

The model 6413 is packaged in an enclosure that can accommodate both the FCU, and a variety of remote communications devices. The model 6410 is packaged in a smaller enclosure and is designed for installations that do not require communications to be housed in the same enclosure. For these installations communications devices can be installed in a separate model 6470 enclosure.

What it Does

An FCU maintains an hourly history of average differential pressure (Dp), average absolute pressure (AP), average flowing temperature (Tf) and maintains hourly accumulated volumes. The FCU can be programmed to calculate flow rates and volumes in accordance with either AGA 3-85 or AGA 3-92. This includes calculating supercompressibility, in accordance with either NX-19 or AGA 8-92 Gross method or AGA 8-92 Detail.

The FCU can store 50 days of hourly average data including 10 skip days. An FCU also maintains an event file that encompasses 200 FCU events, and a characteristic file of the current configuration set into the unit.

Chapter Highlights

This chapter covers the following topics:

Continued on next page

Chapter Highlights (Continued)

6400 General Specifications

Certification	Designed to meet Class 1, Division 1, Groups C & D, FM and CSA hazardous area classifications. Meets FCC Part 15, Class A Certification.
Dimensions	**Model 6410** - 8.50 in. W x 10.00 in. H x 8.85 in. D (215.90 mm x 254.00 mm x 224.79 mm) **Model 6413** - 11.12 in. W x 14.62 in. H x 10.25 in. D (282.45 mm x 371.35 mm x 260.35). Installed Depth: 6410 - 12.35 in. (311.15), 6413 - 13.75 in. (349.25).
Weight	6410 - 26.0 lbs. (12.02 kg) with 7AH Powersonic Battery 6413 - 28.0 lbs (12.70 kg).with 8AH Gates Battery
Mounting	Wall, pipe or direct
Analog Inputs	2 (1-5 VDC)
Digital Inputs	2 (State Change or Pulse to 20 kHz)
Digital Outputs	2 FETs, sink = 100 ma
Power	Battery 12 VDC
Charger	Solar or 13-26 VDC
Memory	Data stored in 128K CMOS RAM. RAM memory has lithium backup battery. Applications programs stored in 256K ROM.
Data Storage	50 days (35 days in old database, or 40 days in new database plus 10 skip days)
Comm Ports	4 Ports Available: 1 - dedicated - AMU 1 - dedicated - PCCU 1 - RS232 or RS485 or RS422 Plug-In Modules 1 - RS232
Analog Measuring Unit	Self Contained , Environmentally Protected. See page 4 for Specifications.

Analog Measuring Unit Specifications

General	18 bits of A/D Range. Differential Inputs for Totalflow Smart transducers. 5:1 turn down capability on Totalflow Smart Differential pressure transducers. 5:1 turn down capability on Totalflow Smart Static pressure transducer. E^2 Prom for holding factory calibration data. Tested for EMI/RFI susceptibility from 30 to 1000 MHz and for field strengths to 32V/m, minimum (verified by independent lab). Dedicated 100-ohm platinum RTU input Two 1 to 5 volt analog inputs Temperature Limits Compensated -20 to 140°F (-29 to 60°C) Operational -40 to 200°F (-40 to 93°C) Storage -60 to 225°F (-51 to 107°C)
Performance Specifications	Reference Conditions, zero-based spans at calibration temperature.
Accuracy	Includes the effects of linearity, hysteresis and repeatability. (Standard Accuracy) <= ±0.2% of URL (Upper Range Limit) Accuracy after turn down: <= ±100 * (0.2% of URL, +0.13% of Span) / Span for spans 1:1 to 5:1 (Optional Accuracy) <= ±0.05% of factory calibrated span (After calibration, NIST traceable, additional charge) Accuracy after turn down: <= ±100 * (0.05% of URL, +0.13% of Span) / Span for spans 1:1 to 5:1
Stability	±0.25% of URL for 6 months.
Static Pressure Effect (DP Units)	Zero Error ±0.1% of calibrated span. Span Error ±0.15% per 1000 psi (6895 kPa)
Temperature Effect (DP Units)	±0.25% Total temperature effect including zero and span errors
Temperature Effect (AP Transducers)	same as DP

Continued on next page

Analog Measuring Unit Specifications, Continued

Residual Thermal Effects	Thermal hysteresis Typically ±0.15% of URL for 200°F (93°C). Temperature cycle without recalibration Worst case ±0.3% of URL for 200°F (93°C). Temperature cycle without recalibration Thermal Repeatability Typically ±0.15 of URL for 200°F (93°C) temperature cycle without recalibration Worst case ±0.3% of URL for 200°F (93°C) temperature cycle without recalibration
Over Pressure Effects (Toggle)	±0.6% of URL for < 1000 psi (6895 kPa). ±1.0% of URL for ≥ 1000 ≤ 2000 psi (13790 kPa)
Vibration Effect	The total effect (maximum effect at any point on scale) at frequencies up to 200 Hz and amplitude up to 0.25 in. Peak to peak, or for accelerations up to 1 “g” (10 m/s^2), which is smaller, is less than 0.25% of span.
Shock	Maximum of 25G’s in any axis, 11 ms duration.
Humidity	0-95% R.H. 12 hours exposure non-condensing over compensated temperature range.

6400 Flow Computer Hardware

Introduction, See Figure 1-1

The Totalflow Model 6400 Flow Computer Units (FCU) are housed in a lightweight two-compartment aluminum case. With the exception of the size of the cases the Models 6410 and 6413 use identical components. Components of the FCUs are:

- Enclosure
- 6400 Digital Controller Board
- Analog Measuring Unit
- Battery & Comm Compartments
- Solar Panel
- Resistive Temperature Detector (RTD)

Enclosure

The enclosure consists of hinged-lid box. The lid provides a watertight, corrosion resistant seal between the outside elements and the FCU components. It is designed to meet Class I, Division I, Groups C&D and is NEMA 4X rated. A single clasp is used to secure the lid to the enclosure. Opening the lid's latch allows access to electronics, battery and Analog Measurement Unit (AMU) components.

Mounted to the bottom of the enclosure is the dual absolute pressure/differential pressure transducer that provides the primary measurement capability for the FCU. The absolute pressure sensor measures line pressure while the differential pressure sensor measures the pressure across the orifice. Output from the transducer is cabled through the bottom to the AMU.

Digital Circuit Board

The 6400 single electronics controller board is mounted on the inside of the lid. All FCU input and output connections are made on snap-in connector terminals mounted directly on the board. The PC board uses a low power 12- MHz microprocessor with 128 K RAM and 256 K ROM. Other circuitry processes the inputs from the Analog Measuring Unit and provide the interface to the LCD as well as the PCCU. Remote communications are handled by the RS232, RS485 and RS422 communication modules that plug directly into the PC board.

Analog Measure-ment Unit (AMU)

The AMU contains circuitry for processing all analog measurements. The unit is designed to provide EMI/RFI protection of the low level signals, and to protect the circuitry from other environmental effects. The AMU contains a single circuit board which contains the A to D converter and analog conditioning circuitry necessary for the transducers, and the RTD.

Because the AMU is characterized over temperature at the factory the unit is not field repairable. All repairs should be done at an authorized Totalflow depot service center or returned to the factory. The AMU is characterized over temperature so that any changes occurring in the transducers or in the electronics can be compensated. The mathematical flow computations are processed on the digital board but, the coefficients for the mathematics are stored in the AMU.

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6400 Flow Computer Hardware, Continued

Battery Compartment

The battery compartment houses the various optional battery packs that are available for the FCU; standard pack is a single lead acid 7-ampere hour battery pack. Installation of the battery requires only removing the battery plate, placing the battery in place, and connecting the battery cable to J1 on the Digital Circuit PC board. A legend for the field termination connector located on the PC board is affixed to the battery hold-down plate.

Comm Compartment

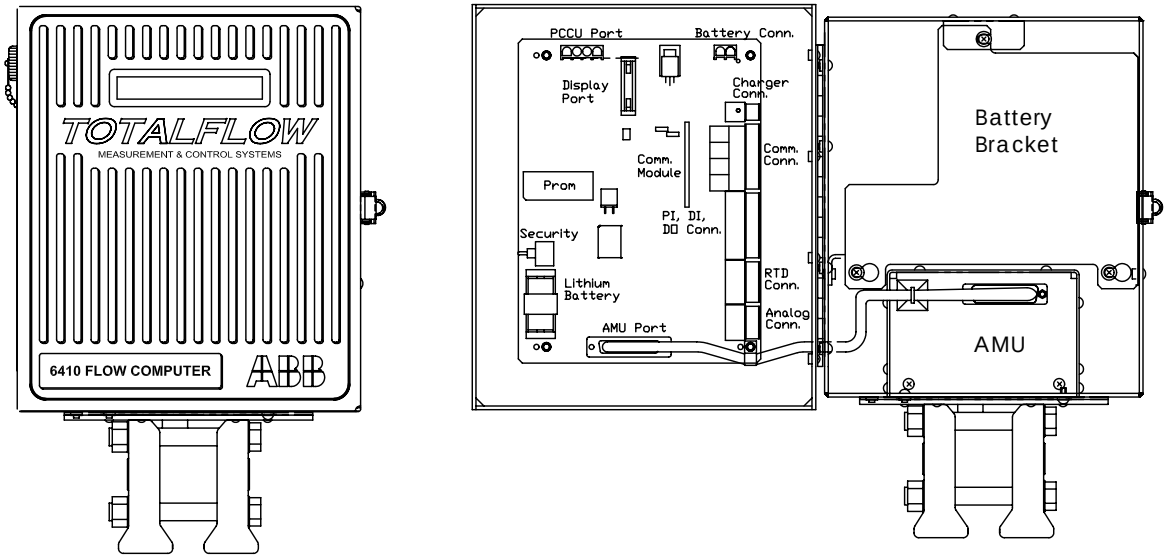
Model 6413 FCU only. Provides an enclosure to house a remote communication device; transceiver, cellular phone, etc.

Solar Panel

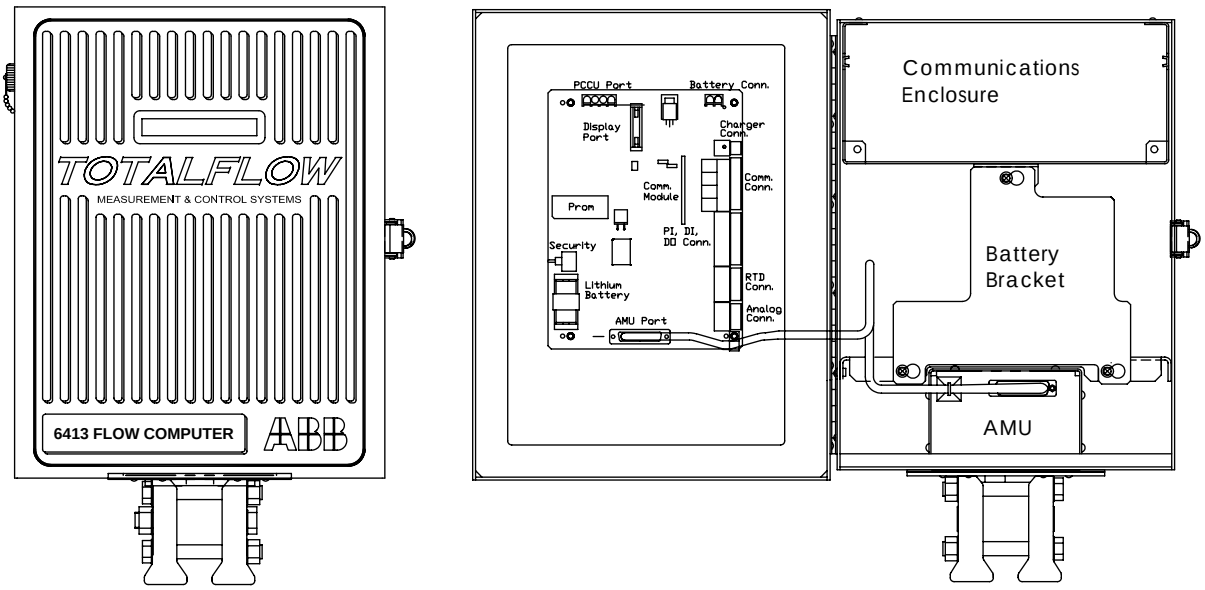
The 6400 FCU comes standard with a 5-Watt solar panel. The panel is designed to be mounted on 2-inch extension pipe on the top of the FCU or it can be mounted on top of or on the side of a meter house.

Resistive Temperature Detector (RTD)

The RTD measures real-time flow temperature of the gas. The 6400 FCU includes a 100-ohm Platinum RTD with 10-foot cable as standard equipment. Other lengths of cable are available upon request.



FCU Model 6410



FCU Model 6413

Figure 1-1. Model 6410 and 6413 Flow Computer

Functions of the FCU

Description

Primary functions of the FCU reflect a instrumental design that is practical and efficient. The FCU is simple to use and easy to learn - and it saves time usually spent in calculations and report preparation.

The FCU allows you to perform the following with minimum effort, maximum speed and greater accuracy.

Complete hourly flow and operational records including -
- Average absolute pressure
- Average differential pressure
- Average flowing temperature
- Corrected volume
- Operating status
- Alarm

Complete daily flow records including -
- Average absolute pressure
- Average differential pressure
- Average flowing temperature
- Average C' (composite correction factor; product of individual factors)
- Corrected volume

Complete daily operation statistics including -
- Percent flowing time
- Percent back flow time
- Percent out of limits (programmable) on AP and DP

FCU Capabilities

The records and statistics generated are due to the following capabilities of the FCU:

- Calculation of flow rates, volume and coefficients per AGA-3, AGA-8, and supercompressibility standards
- Calculation of flow extension $\sqrt{\frac{Dp * Ap}{Tf}}$ once per second
- Extrapolation of flow accumulation during transducer calibration
- Selection of all coefficients for hourly calculation; calculation of dynamic factors (dependent upon Dp, Ap and Tf) using hourly averages based on one second samples

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FCU Capabilities (Continued)

- Measurement of differential and absolute pressure once per second; measurement of flowing temperature once per second.
- Production of sample set of all selected AGA-3 and supercompressibility calculations allowing subsequent verification of proper factor calculation and usage
- Monitoring of the operational limits to insure detection and reporting of malfunctions or abnormal site conditions
- Acceptance and storage of system constants from the PCCU
- Storage of data records for 50 days (35 days in old database, or 40 days in new database plus 10 skip days.)
- Storage of 200 operational events (200 in new database)

Additional Features

Additional features of the Totalflow System enabling its flexibility include the following:

- Programmable differential pressure zero cutoff
- Two digital outputs
- Programmable multi-level security codes to prevent unauthorized communication and configuration of the FCU
- Two state inputs configurable as either digital inputs or high speed pulse accumulator inputs.
- Automatic drift compensation of electronic measurement circuitry
- Automatic internal calibration of the RTD, with programmable bias adjustment
- Quick, simple calibration procedures for pressure transducer with steps outlined using people oriented prompts
- Internal crystal controlled clock providing a highly stable time base for the system

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Functions of the FCU, Continued

Additional Features (Continued)

- Normal battery operation for 20 days without charging power; optional battery packs to extend operation for longer periods without power
- Three available charging sources -
  External solar panel (standard)
  External AC power
  External 24/12 VDC power
- LCD (liquid crystal display) to allow monitoring of the FCU operation (for example, displays voltage level of batteries in FCU)
- Rugged aluminum, powder coated, NEMA 4X enclosure, lockable to prevent internal access
- Optional ability to allow rapid data collection over several communication links. 3 Comm ports are available: Local, Remote and Remote 2
- Additional I/O for valve control, pressure, level monitoring, etc.

FCU Display Function

Description

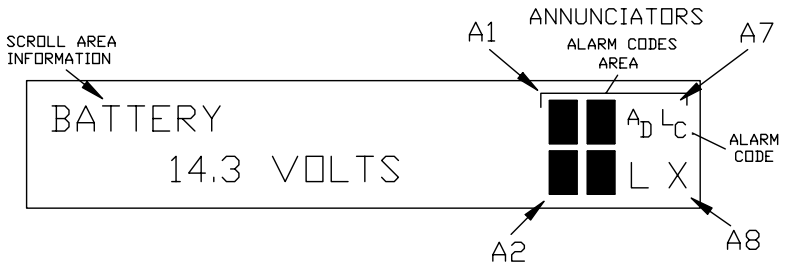
During the operation of the FCU the front panel LCD continuously scrolls through the operating parameters shown below. The duration that the parameter is displayed can vary from 1 to 255 seconds (default is 5 seconds); a setting of 0 seconds will set any function to off. See "Program Display" in Chapter 4 for more details.

Display	Description
DATE/TIME MM/DD/YY HH:MM:SS	Current Date and Time 24 hour clock
YEST DP LO NN PERCENT	Yesterday's Percent DP Low Limit Percent time below DP Low Set Point
YEST DP HI NN PERCENT	Yesterday's Percent DP High Limit Percent time below DP High Set Point
FLOWRATE NNNNNN.N SCF/HR	Current Flow Rate Programmable SCF or MCF or MMCF
ACCUM VOL NNNNNN.NN MCF	Total Accumulated Volume Programmable SCF or MCF or MMCF
BATTERY NN.N VOLTS	Battery Voltage Volts
DIFF PRESS NNN.N IN. H2O	Differential Pressure Inches H2O
PRESSURE NNN.N PSIA	Static Pressure Absolute PSIA
FLOW TEMP NN.N DEG. F	Flowing Temperature °F
YEST VOL NNNN.N MCF	Yesterday's Volume Programmable SCFM or MCF or MMCF
PERIOD VOL NNNN.N SCF	Previous Period Volume Last volume calculation period volume
CHARGER NN.N VOLTS	Charger Voltage
M_FLOWRATE NNNNNN.N SCF/HR	Minute Average Flow Rate

FCU Alarm and Status Conditions

Description

One of the primary functions of the FCU is the provision of complete hourly flow and operational records; therefore, the FCU indicates when an unusual or “alarm” condition is occurring. For how to use the display to troubleshoot, refer to Chapter 6; Troubleshooting.



Whenever an alarm is indicated the FCU records it on hourly flow records. The hour of the occurrence and the type of alarm indicated are stored in the FCU and can be retrieved when desired.

FCU Visual Alarm and Status Codes

Alarm Character Designators	Description
LL	Battery Voltage: When LL (low lithium) is displayed, battery voltage is below 2.5 Vdc. If battery voltage is above 2.5VDC, LL appears shaded.
↑/↓	Differential Pressure: If differential pressure is above high limit, ↑ arrow is displayed. If pressure is below low limit, ↓ arrow is displayed. If pressure is within limits, ↑/↓ arrow keys are shaded.
↑/↓	Absolute Static Pressure: If absolute static pressure is above high limit, ↑ arrow is displayed. If pressure is below low limit, ↓ arrow is displayed. If pressure is within limits, ↑/↓ arrow keys are shaded.

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FCU Visual Alarm and Status Codes (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A2, A4, A8 A2=Comm3 A4=Comm2 A8=Comm1	ǂ	*Listen Cycle*: ǂ flashes if this remote port is active and running Totalflow Remote Protocol. Flashes in sync with listening cycle that occurs at 1, 2 or 4 second intervals. 3 remote communications ports are available (2 for 6400) and can be each programmed as described. When FCU remote port is not active, ǂ is shaded. In early versions of 6700s with EXIO, the A8 display will toggle between ǂ and V. Not toggling could indicate a bad board or PROMs mismatched.
See above	→	*Transmitting Data*: If remote port is active and Totalflow Remote Protocol is running, → is displayed.
See above	←	*Receiving Data*: If remote port is active and Totalflow Remote Protocol is running, ←is displayed.
See above	**X**	*Remote Port Not Active*: This is the default state at cold start of the FCU for all remote communications ports. Baud rate must be toggled to activate each remote port. Also displayed when a communications card is missing or bad.
See above	**M**	*MODBUS ASCII*: Modbus ASCII protocol selected on this port. 3 remote communications ports are available for 6700s, 2 for 6400s which can be programmed with any of 5 resident remote protocols; Totalflow, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**m**	*MODBUS RTU*: Modbus RTU protocol selected on this port. Same options available as above.
See above	**1**	Read X-Frame.
See above	**2**	Process X-Request.
See above	**3**	Wait for Ack/Nak.
See above	**4**	Re-Send Packet.
See above	**5**	Direct Download.
See above	**6**	Positive Acknowledge.
See above	**7**	Nak w/packet list.
See above	**8**	Negative Acknowledge (Typically wrong Security Code).
See above	**9**	Single host write request – send data after ready.

Continued on next page

FCU Visual Alarm and Status Codes (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A3	=	*Valve Control*: Valve Control option installed. Process Value (PV) is within the user set dead band. No control action required
A3	V	*Valve Control*: Displayed when Valve Control option is on an Expanded I/O board (plug-in RTU). Other Valve Control symbols do not apply.
A3	⌈	*Valve Control*: Valve Control option installed. Valve is in full open position.
A3	⌋	*Valve Control*: Valve Control option installed. Valve is in full closed position.
A3	↑	*Valve Control*: Valve Control option installed. Valve is opening (open signal is being sent to valve actuator).
A3	↓	*Valve Control*: Valve Control option installed. Valve is closing. (close signal is being sent to valve actuator).
A3	ö	*Valve Control*: Valve Control option installed. Valve controller override conditions met (DP/AP override set point or Low Battery).
A3	L L	*Valve Control*: Valve Control option installed. Local Lock-out is initiated.
A3,A5	A D	Displayed if A to D Converter Absolute Differential Pressure, Absolute Static Pressure or temperature readings exceed maximum counts or are less than minimum counts. If A to D Converter readings are within range, AD is shaded. A3 Location for 6400, A5 location for 6700.
A4,A7	L C	*Low Charger.* Displayed if FCU battery charging voltage is (+)0.4 Vdc or is less than or equal to battery voltage. If (+)0.4 Vdc battery charging voltage is greater than battery voltage, LC is shaded.
A4,A6	L	*Local Protocol.* Displayed when PCCU part is active and running Totalflow Local Protocol. When PCCU port is not active, L is shaded. This will occur if PCCU is not connected to PCCU port.

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FCU Alarm and Status Conditions, Continued

FCU Visual Alarm and Status Codes (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A5	**H**	*Hold.* Displayed when HOLD flag is active. When not active, H is shaded. Also displayed when HOLD flag is active for the following: 1. PCCU is being calibrated or 2. A to D Converter cannot be read.
A2, A4, A8 A2=Comm3 A4=Comm2 A8=Comm1	**¥**	*Totalflow Packet Protocol.* The Totalflow Packet Protocol selected on this port. 3 remote communications ports are available for 6700s, 2 for 6400s which can currently be programmed with any of 5 resident remote protocols; Totalflow, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**S**	*Square D Protocol*: Square D protocol is running on this port. Same options available as above.
See above	**r**	*Alarm Monitoring System.* Ring indicator for the alarm cryout option.
See above	**h**	*Alarm Monitoring System.* Hang up indicator for the alarm cryout option
See above	**i**	*Alarm Monitoring System.* Modem initialization indicator for the alarm cryout option.
See above	**R**	*LevelMaster*: LevelMaster tank gauging option installed. Tank level(s) and temperature are polled (user selectable intervals) by flow computer via RS485.
A6	**C**	*Host Console.* Host Console connected and communicating.
A6	**T**	*Terminal Mode.* Terminal is connected and communicating. See Technical Bulletin #44.
A8	**L V**	*Low Voltage-Communications.* FCU battery voltage below 12 Vdc--too low to communicate. If FCU is below 11.5 Vdc, sleep mode will occur.
A8	**+9**	*Alarm Monitoring System:* Successful download of alarm page.
A8	**?**	*Alarm Monitoring System:* Received exception broadcast.

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FCU Visual Alarm and Status Codes (Continued)

A8	**i**	*Alarm Monitoring System:* Initialize modem for cryout.
See above	**+**	Single host send acknowledge with code.
See above	****	Single host send neg-acknowledge with code.
See above	**0**	Attempt to resync on multi-host data requests.

FCU Hourly Daily Record Entries

Description

Each daily record has fixed length hourly entries that contain the following information:

- average AP (absolute pressure),
- average DP (differential pressure),
- average T (temperature),
- hours calculated volume and
- up to 16 individual alarm indicators

Processing Load

Hourly calculations require approximately one (1) minute to complete. During this time period, FCU maintains the following functions:

- continue to maintain the one (1) minute calculations,
- calculate hour's AGA-3 corrected volume,
- update hourly and daily data,
- continue processing any I/O (input/output) requirements and
- continue updating LCD display.

Communications

Communications can be established with the 6400 series FCU even while in the data processing mode.

Before completion of hourly processing, gathered data does not affect any of that hour's calculations.

Note

Updating hourly data entries, begins at start of an hour and takes approximately one (1) minute to complete.

EXAMPLE: Before collecting FCU data up to and including 7:00 a.m., user should wait until approximately 7:01 a.m. This allows sufficient one (1) minute processing time to insure completion of hourly calculations and data accumulated at 7:00 a.m. has been updated.

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FCU Hourly Daily Record Entries, Continued

Making Hourly Data Entries

Hourly data entries are made once per hour, on the hour immediately following completion of hourly calculations. These calculations take approximately one (1) minute.

When the FCU voltage drops below 11VDC the unit automatically records any data collected since the last collection before entering a “Sleep” mode.

Note

When FCU voltage drops below 11VDC, *SLEEP MODE* is entered. When this occurs, a Reset Volume command forces an hourly data entry. Entry reflects information collected between last hour’s entry and time Reset Volume command was encountered.

Changing FCU Clock

Changing FCU clock could affect time when next hourly entry is made. Clock changes are handled as follows:

Clock Change Not Crossing an Hour Boundary

When next hourly data entry is made, clock is not altered.

Example: If present time is 4:15 p.m. and clock is changed to 4:05 p.m. of the same day, data entry is the same. Entry reflects averages accumulated over a 70 minute time period (15 minutes plus 55 minutes).

Forward Clock Change Crossing an Hourly Boundary

Forces an hourly data entry for part of hour that has accumulated since last hourly entry. FCU then advances to newly defined hourly boundary and begins maintaining balance of days' data in newly defined boundary.

Backward Clock Change Crossing an Hourly Boundary

To protect integrity of accounting audit trail, FCU handles this type of clock change as follows:

- Hourly entry is made for part of hour that has accumulated since making last hourly entry. This is same as for a Forward Clock Change Crossing an Hourly Boundary.

FCU advances to a new day’s data flow record and maintains balance of day’s data in new record.

Note

A backward clock change uses two (2) daily records to maintain data integrity. This assures that previously recorded data is not overwritten.

If it is necessary to make small backward time changes, less than one (1) hour, user should wait until current hour has progressed far enough to make change that does not cross an hour boundary.

Remote Sense/Digital Output

Description

The Totalflow FCU provides one remote sense input and one digital (12V dc) output as a means to control external equipment with the FCU. Details on the control of external devices are given in Section 4: FCU Operations.

Remote Sense

The Remote Sense reads an external contact. This contact must be closed to be considered “ON” and must remain “ON” for 2 consecutive seconds to be recognized by the flow computer. The input is read once every second. The “ON” condition is recorded in the hourly alarms and can trigger the action of the flow computer’s digital voltage (12 Vdc) output. “OFF” is defined as an open contact at the input for 2 consecutive seconds. The Reference Section describes the maximum voltage allowable on the remote sense input.

Voltage Output

The output is primarily used to trip a sampler on a volume setpoint.

The output can also be set by the FCU when at least one of the following conditions occur:

- Differential pressure over high limit
- Differential Pressure under low limit
- Absolute Pressure over high limit
- Absolute Pressure under low limit
- Low Charger voltage
- Remote Sense is ON
- User programmable using Gello user’s programming tools

AGA-3/NX-19 Flow Calculations

Description

Totalflow equipment allows the user to select which of the nine AGA-3 or NX-19 factors to include in the hourly calculations. All AGA-3 factors are listed and described later in this section.

One Second Calculations

Each second the FCU calculates a flow extension (defined as $\sqrt{Dp\,Ap}$) from measured variables. The extension is summed for an hour to provide an integrated extension or flow extension over time (sum total of flow extension). Also, each second the FCU conditionally stores measured variables of differential pressure (Dp), absolute pressure (Ap) and flowing temperature (Tf). This record is updated only if differential pressure is above a programmable zero cutoff value. These values are used later in hourly computations of averages for Dp, Ap and Tf. The averages include measurements made during times of flow only unless there is no flow for the entire hour.

Minutes Calculations

Each minute the FCU calculates the previous minutes integrated extension. Using this extension and the previous hour's C', the current flow rate is computed. This value is available to be shown on the FCU display.

Hourly Calculations

Each hour the FCU calculates

- Averages for Dp, Ap and Tf as stated above.
- Each selected AGA-3 factor using above-mentioned averages.
- A composite correction factor (C') from the product of the individual factors.
- An hourly volume from the product (C' x integrated extension). NOTE: The product is a true reflection of Volume only if the orifice factor (Fb) is selected for inclusion in C'.

The complete list of FCU calculations and their frequency can be found in the reference section of this manual.

The FCU maintains an hourly history of average Dp, average Ap, average Tf and hourly accumulated volume. A summary of the last hour's calculations is maintained in the CHARACTERISTIC FILE; therefore, in subsequent processing with the office computer or PCCU printout, users may examine a single set of correction factors and an integrated extension to insure that the selected factors are being calculated and used correctly.

Continued on next page

Calculation of Constants

The constants Kr, Kp, Fb and orifice (Fa) do not dynamically change with Dp, Ap or Tf; therefore, they only require being calculated once. These constants are calculated by the PCCU when necessary, transmitted to the FCU and stored for future use. This implies that any external device used for future communications to update variables must be capable of calculating these constants:

In summary, those CONSTANTS are:

1. Kr = Fc x b (to FCU for use in Reynolds number factor (Fr)).

where:

Fc = $5124 \times mu \times \sqrt{\frac{1}{G}}$

b = $\frac{E}{12835} \times d \times k$

E = $d\,[830-5000(beta) + 9000(beta^2)-4200(beta^3) + B]$

K = (see table D8 of AGA-3 Report, Second Edition, September 1985)

mu = Absolute viscosity (user definable from the PCCU)

G = Specific gravity (user definable from the PCCU)

B = $\frac{530}{\sqrt{D}}$

beta = $\frac{d}{D}$

d = Orifice diameter (user definable from the PCCU)

D = Pipe diameter (user definable from the PCCU)

2. Kp = $0.41 + 0.35 \times beta^4$ (to FCU for use in the Expansion factor Y)

3. Fb = $338.17 \times d^2 \times K$ (to FCU as F(b))

4. Orifice = 0.0000185 if the orifice plate material is stainless steel. If not, orifice = 0.0000159. This constant is passed to the FCU for use in the Orifice Thermal Expansion factor (Fa)

5. F_t and F_p (To FCU for use in F(pv) supercompressibility)

Continued on next page

Calculation of Constants (Continued)

Note When Nx-19 gravity method is valid, the PCCU will calculate Fp and Ft as shown below. Otherwise, the user will be asked to provide Fp and Ft. The gravity method is valid over the ranges of: specific gravity $\leq$ 0.75, nitrogen $\leq$ 15.0 percent and carbon dioxide $\leq$ 15.0 percent.

Important Basic Orifice Factor F(b) is calculated by the PCCU based on the flange tap formula. If pipe taps are used or some other method for calculating F(b) is used, it must be entered by hand.

Important Expansion Factor Y is calculated based on the static pressure measurement being taken at the downstream differential pressure tap.

$$Fp = \frac{156.47}{(160.8 - 7.22xG + Kp)}$$

$$Ft = \frac{226.29}{(99.15 + 211.9xG - Kt)}$$

where:

Kp	=	Mc - 0.392 x Mn	
Kt	=	Mc + 1.681 x Mn	
Mc	=	percent nitrogen	(user definable from the PCCU)
Mn	=	percent carbon dioxide	(user definable from the PCCU)
G	=	specific gravity	(user definable from the PCCU)

Note Results of FCU calculations are detailed in the PCCU printout descriptions and sample printouts in Chapter 4: FCU Operations.

AGA-3/NX-19 FCU Factor Calculations

Description

AGA-3 refers to Report No. 3 of the American Gas Association. This report is the standard that provides guidance on the measurement of natural gas flow. Not only does it provide the standards for construction and installation of orifice plates and associated fittings, it also gives instructions for computing the flow of natural gas through orifice meters.

The report includes the necessary tables providing the basic factors for expansion, Reynolds number, temperature, pressure, specific gravity and supercompressibility.

The recommendations of the AGA committee and references concerning the calculation of the flow through the orifice meter and the computations of the necessary constants for use in these calculations are briefly reviewed below.

Equation

In the measurement of natural gas, it is almost universal practice in the United States to express the flow in cubic feet per hour on base conditions of pressure and temperature. For the calculations of the quantity of gas, the committee recommends the use of this formula:

$$Qh = C'\sqrt{Dp\,Ap}$$

where:

Qh	=	Quantity rate of flow at base conditions, $\frac{cu.ft.}{hr.}$
C’	=	Orifice flow constant
Dp	=	Differential pressure in inches of water
Ap	=	Absolute static pressure in psia

Continued on next page

Orifice Flow Constant

VOLUME: The orifice flow constant C' may be defined as the rate of flow in cubic feet per hour, at base conditions, when the extension ($\sqrt{Dp\,Ap}$) equals one. It is calculated by the following equation:

C' = Fb x Fr x Y x Fpb x Ftf x Fg x Fpv x Fm x Fa x Fl

where:

Fb	=	basic orifice
Fr	=	Reynold's number
Y	=	expansion
Fpb	=	pressure base
Ftb	=	temperature base
Ftf	=	flowing temperature
Fg	=	specific gravity
Fpv	=	supercompressibility
Fm	=	manometer
Fa	=	orifice thermal expansion
Fl	=	gauge location

Note

Fm (manometer factor) and Fl (gauge location) are NOT used by the 6400 FCU.

The values of these factors can be obtained from the tables provided in the AGA-3 report. Each factor is defined and categorized in the report. Also, detailed instructions for using tables, indexes and equations are given in the report.

AGA-3 1992 Flow Calculations

Description

This section describes Totalflow's realtime implementation of the new orifice metering equations. The fundamental equation for volumetric flow rate is stated as follows.

$$Q_v = \frac{\frac{\pi}{4} N_c \, C_d \, E_v \, Y \, d^2 \sqrt{2 \, \rho_f \, \Delta P}}{\rho_b}$$

Background

AGA-3 Report No. 3 Part 4 of the new standard exists for the purpose of providing implementation procedures that, when followed, produce consistent results for most all computer systems. Additionally, Part 1 of the new standard recommends Part 4 procedures be followed.

Note

The recommended implementation procedures provided in Chapter 14.3, Part 4, allows different entities using various computer languages on different computing hardware to arrive at nearly identical results using the same standardized input data.

Additionally, since Part 4's implementation uses the equation's fundamental form it is more easily adapted to a mass flow equation and can also be handily adapted to other sets of engineering units.

For these reasons our implementation is based on Part 4 of the new standard. This means that factors, as such, are not part of this implementation. However, the equation is still solved as a collection of various terms. These terms are themselves factors of the equation, but they are not the classic collection of factors historically associated with the AGA-3 equation.

The new standard has clearly relegated the older factored form of the equation to a less prominent position by putting it in an appendix. It is clear the authors of the new standard are moving toward the more fundamental form of the equation.

Continued on next page

Integration and Time Related Issues

Equation 7 is a rate equation which must be integrated over time to produce a quantity (volume or mass). Since the orifice metering standard does not specify integration requirements, these techniques are left to each system designer. Much of this section is devoted to describing techniques for integrating the fundamental flow rate equation to produce volume.

As illustrated below, portions of the equation are computed at different times. The possible times are:

Table 1-2. Names of Calculation Time Periods

Time Period	Description
CONST (constant)	Computed once, never change
SEC (second)	Computed once per second (sample period)
VOLP (Vol Period)	Computed once per volume calculation period (user adjustable)
NEW_VOL_CONST	Computed when static values are manually changed
NEW_COMP	Computed when new gas analysis data is received

Description

To begin describing these time domain issues, the fundamental equation is rewritten such that the portion of equation 7 under the radical (e.g. $\sqrt{\ }$) is set apart as a separate entity. Part 4 of the standard refers to this portion of the equation as F_{ip}. For consistency we refer to it likewise here.

This results in equations:

$$Q_v = \frac{\frac{\pi}{4} N_c C_d E_v Y d^2 F_{ip}}{\rho_b} \qquad \textit{eq. 8}$$

where, $F_{ip} = \sqrt{2 \rho_f \Delta P}$ *eq. 9*

Continued on next page

Equation 9 contains a flowing density term $\left(\rho_f\right)$ which is computed using the following gas density equation.

$$\rho_f = \frac{P_f \; M_{r_{air}} \; G_i}{Z_f \; R \; (T_f + N_5)}$$

eq. 3 Density at Flowing conditions

Substituting equation 3's density solution into equation 9, results in the following equation for F_{ip}.

$$F_{ip} = \sqrt{2\left[\frac{P_f \; M_{r_{air}} \; G_i}{Z_f \; R \left(T_f + N_5\right)}\right]\Delta P}$$

eq. 10 Fip with gas density equation included

Equation 10 above contains a ideal gas gravity term, which is computed using the following equation.

$$G_i = G_r\left[\frac{Z_{b_{gas}}}{Z_{b_{air}}}\right]$$

eq. 5 Gi computed from Gr

Substituting equation 5's ideal gravity solution into equation 10, results in the following equation for F_{ip}.

$$F_{ip} = \sqrt{2\left[\frac{P_f \; M_{r_{air}} G_r \left[\frac{Z_{b_{gas}}}{Z_{b_{air}}}\right]}{Z_f \; R \left(T_f + N_5\right)}\right]\Delta P}$$

eq. 11 Fip with Gr used instead of Gi

Continued on next page

Equation 11 shows the form of F_{ip} used in this implementation to compute gas volumes. However, portions of F_{ip} are computed on different time periods. To illustrate those portions of F_{ip}, the following equations are provided.

$$F_{ip_{const}} = \frac{2 \quad M_{r_{air}}}{R}$$

eq. 12 Constants within Fip equation

$$F_{pv} = \sqrt{\frac{Z_{b_{gas}}}{Z_{f_{gas}}}}$$

eq. 13 Supercompressibility within Fip equation

$$Ext_{pt} = \sqrt{\frac{P_f \ \Delta P}{(T_f + N_5)}}$$

eq. 14 Extension within Fip equation

Restating the F_{ip} equation in terms of the variables solved for in equations 12, 13 and 14 results in an F_{ip} equation of the following nomenclature.

$$F_{ip} = Ext_{pt} \quad F_{pv} \sqrt{\frac{F_{ip_{const}} \ G_r}{Z_{b_{air}}}}$$

eq. 15 Fip with time dependent factors shown

With this final representation of F_{ip}, we can now construct a table showing each portion of the flowrate equation (equation 8) and their respective computation time periods. See Table 1-3, Summary of Calculations Time Periods on following page.

Continued on next page

Table 1-3. Summary of Calculation Time Periods

Variable Name	Equation Being Computed	Time Period for Computation
$Q_v, C_d, E_v, Y, \frac{\pi}{4}, and\ d^2$	See equations in Part 4 of standard or Section 4 of this document.	***VOLP***
ρ_b	$\rho_b = \frac{P_b \ M_{r_{air}} \ G_r}{Z_{b\,air} \ R \ (T_b + N_5)}$	***NEW_VOL_CONST*** *and* ***NEW_COMP***
F_{ip}	$F_{ip} = Ext_{pt} \ F_{pv} \sqrt{\frac{F_{ip_{const}} \ G_r}{Z_{b_{air}}}}$	***VOLP*** But portions are computed on different time periods as shown in following three table entries *for* $F_{ip_{const}}$, F_{pv}, *and* Ext_{pt}
$F_{ip_{const}}$	$F_{ip_{const}} = \frac{2 \ M_{r_{air}}}{R}$	***CONST*** Computed once, never changes.
F_{pv}	$F_{pv} = \sqrt{\frac{Z_{b_{gas}}}{Z_{f_{gas}}}}$	***VOLP***
Ext_{pt}	$Ext_{pt} = \sqrt{\frac{P_f \ \Delta P}{(T_f + N_5)}}$	***SEC*** The extension is computed and integrated each second until VOLP, when it is used in the volume calculation.

Continued on next page

Static Pressure and Expansion Factor

If a downstream expansion factor is used then an additional Z (compressibility) calculation must be performed. To avert the need for this additional processing, this implementation always uses the upstream static pressure; thereby allowing computation of the upstream expansion factor.

The user is allowed to specify either up or downstream for location of the static pressure sensing element. If the upstream location is specified, that pressure measurement is used without modification. However, if the downstream location is specified then the upstream pressure is computed as:

$$P_{f1} = P_{f2} + \frac{\Delta P}{N}$$

This logic and math execute each second, thereby always providing the upstream static pressure for use throughout the whole equation.

Averaging Techniques

Two types of averaging techniques are used:

Type 1 Averages
Type 2 Averages

Type 1 Averages

Type 1 averages are stored for periods in which some quantity (volume or mass) accrued. Type 2 averages are stored for periods in which zero quantity accrued. This technique provides adequate volume adjustment averages for downstream processing but also supports site operations with averages even where there is no flowrate.

Linear, time based averages constructed from one second samples taken only during times of flow are maintained for the real time measured variables of differential pressure, static pressure, and flowing temperature.

Type 2 Averages

An additional set of Linear straight time based averages constructed from one second samples are also maintained for the same variables.

Other New Implementation Features

Different Z (compressibility) calculation methods are available. These include the latest AGA-8 methods and NX-19. Additionally F_{pv} can be *turned off* if desired.

- VOLP, Volume calculation period defaults to one hour, but is user selectable. Sections offered are 1, 2, 5, 10, 30, and 60 minutes.
- Up to 23 composition variables for supporting AGA-8 detailed method are supported.
- Selectable static pressure tap location is supported.
- Selectable differential pressure tap type is supported.
- Higher static pressure transducers are supported. Up to 3500 psi is currently in use.

Algorithmic Detail of Realtime Implementation of New Equation for Gas

Overview

The following is a more detailed summary of periodic computations performed by this implementation for solving the new orifice equations (AGA-3-1992). The periods referred to in this section are those same periods summarized in Table 1-2, Names of Calculations Time Periods.

CONST PERIOD

$$F_{ip_{const}} = \frac{2 \quad M_{r_{air}}}{R}$$

Where:

$M_{r_{air}}$ = molar mass (molecular weight) of dry air

R = Universal gas constant

NEW_COMP PERIOD & NEW_VOL_ CONST PERIOD

Currently the same calculations are being performed for each of these two periods. Future optimizations could result in different calculations being performed for each of these two periods.

Perform Fpv Pre-Calculations

IF (FpvMethod = AGA-8_{gross})

Compute AGA-8 gross method precalcs (e.g. AGA-8 terms that are function of composition)
Using AGA-8 gross method Compute Zb_{gas}

ELSE IF (FpvMethod = AGA-8_{detail})

Compute AGA-8 detail method precalcs (e.g. AGA-8 terms that are function of composition)
Using AGA-8 detail method Compute Zb_{gas}

ELSE IF (FpvMethod = NX19_FIXEDFTFP)
Accept user supplied Ft and Fp values

ELSE IF (FpvMethod = NX19)

IF ((G_r < 0.75) AND (CO2 < 15%) AND (N2 < 15%))
Compute Ft and Fp using NX19 Gravity Method
ELSE
Compute Ft and Fp using Methane Gravity Method
ENDIF

Continued on next page

Algorithmic Detail of Realtime Implementation of New Equation for Gas, Continued

Perform Fpv Pre-Calculations (Continued)

ELSE IF (FpvMethod = NX19_GRAVITY)
Compute Ft and Fp using NX19 Gravity Method

ELSE IF (FpvMethod = NX19_METHANE-GRAVITY)
Compute Ft and Fp using NX19 Methane Gravity Method

ENDIF

Calculate Base Density

$$\rho_b = \frac{P_b \; M_{r_{air}} \; G_r}{Z_{b\,air} \; R \; (T_b + N_5)}$$

SEC Period

IF (Pressure Tap Downstream) Calculated Upstream Static Pressure, Pf

$$Pf_{\sec} = P_{f1} + \frac{Dp_{\sec}}{N_5}$$

ELSE

$$Pf_{\sec} = P_{f2}$$

ENDIF

$$Secs = Secs + 1$$
$$Pf_{acc} = Pf_{acc} + Pf_{\sec}$$
$$Tf_{acc} = Tf_{acc} + Tf_{\sec}$$

IF (DP > DP_ZERO_CUTOFF) (If Flow Exists)

$$Ext_{pt} = \sqrt{\frac{Pf_{\sec} \; Dp_{\sec}}{(Tf_{\sec} + N_5)}}$$

$$Ext_{acc_{flow}} = Ext_{acc_{flow}} + Ext_{pt}$$

$$Dp_{acc_{flow}} = Dp_{acc_{flow}} + Dp_{\sec}$$

$$Pf_{acc_{flow}} = Pf_{acc_{flow}} + Pf_{\sec}$$

$$Tf_{acc_{flow}} = Tf_{acc_{flow}} + Tf_{\sec}$$

$$Secs_{flow} = Secs_{flow} + 1$$

ENDIF

Continued on next page

VOLP (VOL PERIOD)

This only executes if there was flow during the VOLP.

Construct averages from one second accumulators

$$Ext_{volp} = \frac{Ext_{acc\ flow}}{Secs}$$

$$Dp_{volp} = \frac{Dp_{acc_{flow}}}{Secs_{flow}}$$

$$Pf_{volp} = \frac{Pf_{acc_{flow}}}{Secs_{flow}}$$

$$Tf_{volp} = \frac{Tf_{acc_{flow}}}{Secs_{flow}}$$

At T_f, calculate terms that depend only upon orifice geometry: d, D, b, E_V and orifice coefficient correlation terms.

Calculate corrected diameters and Beta

$$d = d_r \left[1 + \alpha_1 \left(T_f - T_r\right)\right]$$

$$D = D_r \left[1 + \alpha_2 \left(T_f - T_r\right)\right]$$

$$\beta = \frac{d}{D}$$

Calculate velocity of approach term

$$E_v = \frac{1}{\sqrt{1-\beta^4}}$$

Calculate orifice coefficient of discharge constants

Note: In the following equations A0 through A6 and S1 through S8 are references to constants that are documented in the standard.

$$L_1 = L_2 = \frac{N_4}{D}$$

$$M_2 = \frac{2L_2}{1-\beta}$$

$$T_u = \left[S_2 + S_3 e^{-8.5L_1} + S_4 e^{-6.0L_1}\right] \frac{\beta^4}{1-\beta^4}$$

Continued on next page

Calculate Orifice Coefficient of Discharge Constants (Continued)

$$T_D = S_6\left[M_2 + S_7 M_2^{1.3}\right]\beta^{1.1}$$

$$If \quad D > \left(A_4 N_4\right) \quad Then \quad T_s = 0.0$$

$$Else \quad T_s = A_3\left(1-\beta\right)\left(A_4 - \frac{D}{N_4}\right)$$ Additional Tap Term for small diam. pipe

$$C_{d_0} = A_0 + A_1\beta^2 + A_2\beta^8 + T_U + T_D + T_S$$
$$C_{d_1} = A_5\beta^{0.7}(250)^{0.7}$$
$$C_{d_2} = A_6\beta^4(250)^{0.35}$$
$$C_{d_3} = S_1\beta^4\beta^{0.8}(4.75)^{0.8}(250)^{0.35}$$
$$C_{d_4} = \left(S_5 T_U + S_8 T_D\right)\beta^{0.8}(4.75)^{0.8}$$

Calculate F_{pv} at Tf, Pf and other specified fluid conditions (using NEW_COMP precalcs).

IF (FpvMethod = OFF)
Fpv = 1.0

ELSE IF (FpvMethod = AGA-8_{gross})
Calculate Zf_{gas} using AGA-8_{gross} method then calculate F_{pv}

$$F_{pv} = \sqrt{\frac{Z_{b_{gas}}}{Z_{f_{gas}}}}$$

ELSE IF (FpvMethod = AGA-8_{detail})
Calculated Zf_{gas} using AGA-8_{detail} method then calculate Fpv

$$F_{pv} = \sqrt{\frac{Z_{b_{gas}}}{Z_{f_{gas}}}}$$

ELSE IF (FpvMethod = NX19_FIXEDFTFP OR NX19_GRAVITY OR NX19_METHANE-GRAVITY)
Calculate F_{pv} using NX19 method and previously supplied f_t and f_p

END IF

Continued on next page

Calculate the upstream expansion factor.

Compute orifice differential to flowing pressure ratio, x

$$x = \frac{Dp_{volp}}{N_3 \, Pf_{volp}}$$

Compute expansion factor pressure constant Yp

$$Y_p = \frac{0.41 + 0.35\,\beta^4}{k}$$

Compute expansion factor

$$Y = 1 - Y_p x$$

Calculate F_{ip}

$$F_{ip} = Ext_{volp} \;\; F_{pv} \sqrt{\frac{F_{ip_{const}} \; G_r}{Z_{b_{air}}}}$$

Determine the converged value of C_d

Cd_step.0 Calculate the iteration flow factor, Fi, and its component part, F_{ip} . Re-use the Fip computed earlier.
Then use these in the Cd convergence scheme.

$$F_{ic} = \frac{4000 \; N_{ic} \; D\,\mu}{E_v \; Y \; d^2}$$

Compute Cd's Iteration flow factor, F_I

$$If \;\; F_{ic} < 1000 \; F_{ip}$$

$$Then \;\; F_I = \frac{F_{ic}}{F_{ip}}$$

$$Else \;\; F_I = 1000$$

Cd_step.1 Initialize C_d to value at infinite Reynolds number

$$C_d = C_{d_0}$$

Cd_step.2 Compute X, the ratio of 4000 to the assumed Reynolds number

$$X = \frac{F_I}{C_d}$$

Continued on next page

Algorithmic Detail of Realtime Implementation of New Equation for Gas, Continued

Determine the converged value of Cd (Continued)

Cd_step.3 Compute the correlation value F_c and it's derivative D_c, of C_d at the assumed flow, X

$$If \quad (X < X_c)$$

$$F_c = C_{d_0} + \left(C_{d_1} X^{0.35} + C_{d_2} + C_{d_3} X^{0.8}\right) X^{0.35} + C_{d_4} X^{0.8}$$

$$D_c = \left(0.7C_{d_1} X^{0.35} + 0.35C_{d_2} + 1.15C_{d_3} X^{0.8}\right) X^{0.35} + 0.8C_{d_4} X^{0.8}$$

$$Else$$

$$F_c = C_{d_0} + C_{d_1} X^{0.7} + \left(C_{d_2} + C_{d_3} X^{0.8}\right)\left(A - \frac{B}{X}\right) + C_{d_4} X^{0.8}$$

$$D_c = 0.7C_{d_1} X^{0.7} + \left(C_{d_2} + C_{d_3} X^{0.8}\right) \frac{B}{X} + 0.8C_{d_3}\left(A - \frac{B}{X}\right) X^{0.8} + 0.8C_{d_4} X^{0.8}$$

Cd_step.4 Calculate the amount of change to guess for C_d

$$\delta C_d = \frac{C_d - F_c}{1 + \frac{D_c}{C_d}}$$

Cd_step.5 Update the guess for C_d

$$C_d = C_d - \delta C_d$$

Cd_step.6 Repeat steps 2,3,4 and 5 until the absolute value of δC_d is less than 0.000005.

Calculate the final value of q_m, the mass flow rate at line conditions

$$q_m = \frac{\pi}{4} N_c \, C_d \, E_v \, Y \, d^2 \, F_{ip}$$

Continued on the next page

Algorithmic Detail of Realtime Implementation of New Equation for Gas, Continued

Calculate the final value of Q_V, the volumetric flow rate at base conditions

$$Q_v = \frac{q_m}{\rho_b}$$

Calculate the final value of Vol_b, the volume at base conditions for the Volume Period

$$Vol_b = Q_v * \frac{Secs}{N_{vtime}}$$

Definitions of Flow Calculation Terms

a_1	Linear coefficient of thermal expansion of the orifice plate material.
a_2	Linear coefficient of thermal expansion of the meter tube material.
b	Beta. Ratio of orifice plate bore diameter to meter tube internal diameter (d/D) at flowing temperature, T_f.
C_d	Orifice plate coefficient of discharge.
C_{d0}	First flange-tapped orifice plate coefficient of discharge constant within iteration scheme.
C_{d1}	Second flange-tapped orifice plate coefficient of discharge constant within iteration scheme.
C_{d2}	Third flange-tapped orifice plate coefficient of discharge constant within iteration scheme.
C_{d3}	Forth flange-tapped orifice plate coefficient of discharge constant within iteration scheme.
C_{d4}	Fifth flange-tapped orifice plate coefficient of discharge constant within iteration scheme.
C_{d_f}	Orifice plate coefficient of discharge bounds flag within iteration scheme.
d	Orifice plate bore diameter calculated at flowing temperature T_t.
D	Meter tube internal diameter calculated at flowing temperature T_f.
d_r	Orifice plate bore diameter calculated at reference temperature T_r.
D_r	Meter tube internal diameter calculated at reference temperature T_r.
D_c	Orifice plate coefficient of discharge convergence function derivative.
DP	Orifice differential pressure.
e	Napierian constant, 2.71828.
E_v	Velocity of approach factor.
F_c	Orifice calculation factor for C_d (Used differently in Parts 3 and 4)
F_{sl}	Orifice Slope Factor for C_d
F_l	Iteration flow factor
F_{lc}	Iteration flow factor - independent factor.
F_{lp}	Iteration flow factor - dependent factor.
F_{mass}	Mass flow factor.
F_b	Basic orifice factor.
Fr	Reynolds number factor.
Fpb	Pressure base factor.
Ftb	Temperature base factor.
Ftf	Flowing temperature factor.
Fgr	Real gas gravity factor.

Continued on next page

Definitions of Flow Calculation Terms, Continued

Fpv	Supercompressibility factor.
F_a	Orifice thermal expansion factor.
g_c	Dimensionless conversion constant.
G_i	Ideal gas relative density (specific gravity).
G_r	Real gas relative density (specific gravity).
k	Isentropic Exponent.
m	Mass.
Mr_{air}	Molar mass (molecular weight) of dry air.
N_c	Unit conversion factor (orifice flow).
N_1	Unit conversion factor (Reynolds number).
N_3	Unit conversion factor (expansion factor).
N_4	Unit conversion factor (discharge coefficient).
N_5	Unit conversion factor (absolute temperature).
N_{vtime}	Time Interval Constant used in flowrate integration algorithm to produce quantity volume
P_b	Base pressure.
P_f	Static pressure of fluid at the pressure tap.
P_{f1}	Absolute static pressure at the orifice upstream differential pressure tap.
P_{f2}	Absolute static pressure at the orifice downstream differential pressure tap.
Pm_{air}	Measured air pressure.
Pm_{gas}	Measure gas pressure.
p	Pi, 3.14159.....
q_m	Mass flow rate at actual line conditions
q_v	Volume flow rate at actual line conditions.
Q_v	Volume flow rate per hour at base conditions.
R	Universal gas constant.
R_{eD}	Pipe Reynolds number.
r_b	Density of the fluid at base conditions, (P_b, T_b).
r_{bair}	Air density at base conditions, (P_b, T_b).
r_{bgas}	Gas density at base conditions, (P_b, T_b).
r_f	Density of the fluid at flowing conditions, (P_f, T_f).

Continued on next page

Definitions of Flow Calculation Terms, Continued

T_b	Base temperature.
Tm_{air}	Measured temperature of air.
Tm_{gas}	Measured temperature of gas.
T_f	Flowing temperature.
T_r	Reference temperature of orifice plate bore diameter and/or meter tube internal diameter.
T_d	Downstream tap correction factor.
T_s	Small meter tube correction factor.
T_u	Upstream tap correction factor.
Vol_b	Quantity Volume at base conditions
X	Reduced reciprocal Reynolds number ($4000/Re_D$).
X_c	Value of X where change in orifice plate coefficient of discharge correlation occurs.
Y	Expansion factor.
Y_p	Expansion factor pressure constant.
Z_b	Compressibility at base conditions (P_b, T_b).
Zb_{air}	Air compressibility at air base conditions (P_b, T_b).
Zb_{gas}	Gas compressibility at gas base conditions (P_b, T_b).
Z_f	Compressibility at flowing conditions (P_f, T_f).
Zm_{air}	Air compressibility at air measurement conditions, (assumed P_b, T_b).
Zm_{gas}	Gas compressibility at gas measurement conditions, (assumed P_b, T_b).

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Chapter 2.0

Installation

Overview

Introduction

This Chapter provides you with the information for installation and setup. By the time you finish this chapter you will have the FCU unpacked, installed, field wired and ready for operation. For safe and trouble free installation follow all instructions and advisories.

Installation Hint

Read through this chapter before you begin the installation to plan your installation requirements. Also before you begin, refer to the wiring diagrams contained in this manual under the tab Wiring Diagrams.

Installation procedures, presented within this Chapter, are applicable to both FCU Models 6410 and 6413. .

Sequence of Events Table

The table provides you a recommended sequence of events to be followed for the installation process. Before you begin the installation familiarize yourself with the process; detail procedures are given on the pages referenced.

Events	See Page
Unpack the equipment and inspect for damage.	2-3
Select placement of equipment on the meter run; consult AGA Report No. 3 for placement of the RTD probe.	2-4
Install the pipe saddle to the meter run in selected location. BE SURE TO LOCATE THE FCU CLOSE TO THE ORIFICE TO KEEP THE TAP LINES AS SHORT AS POSSIBLE.	2-8
If direct mounting FCU, skip the next 4 events.	2-15
Install the 40-inch pipe in the pipe saddle.	2-8
Mount the FCU on the 2-inch pipe.	2-9
Mount the manifold to the bottom of the FCU.	2-18
Connect the stainless steel tubing from the manifold to the orifice tap valves.	2-18

Continued on next page

Sequence of Events Table (Continued)

Events	See Page
Install the RTD and connect the wiring to the connector block on the digital PC board.	2-20
Mount and connect the battery to J1, the primary battery connector on the digital PC board.	2-23
Mount the solar panel, do not connect wiring until battery pack(s) are connected.	2-24
Connect the PCCU to FCU.	3-3
Set date and time; program ID and location	4-15 & 4-16
Calibrate the absolute pressure using a deadweight tester or acceptable standard.	4-73
Calibrate the differential pressure using a deadweight tester or acceptable standard.	4-81
Use the PCCU ENTRY and AGA-3 operation modes to enter all operational parameters.	4-13
Setup balance of Entry mode items.	
Setup and monitor the RTD measurement.	4-90
Perform calibration check if desired.	4-83
Place the FCU on line:	
a. Open the bypass valves and close the vent valve on the manifold.	2-18
b. Open the orifice tap valves slowly (high pressure side first), then close bypass valve.	2-18
c. Give the FCU a RESET VOLUME command with the PCCU to reset the total volume measured to zero.	4-26
d. Verify the FCU display is calculating volume correctly.	4-9
e. Collect data and printout to verify all data has been entered correctly.	4-7

Unpacking & Inspection

Unpacking

The 6400 FCU and RTD are shipped in a specially designed shipping carton which contains the unit, mounting brackets, parts list and wiring and interconnect diagrams. The Solar Panel and the Battery Pack with applicable hardware are shipped in a separate carton.

Carefully remove the items from each carton.

Initial Inspection

Inspect the shipping carton for damage. If the shipping carton is damaged, keep it until the contents have been inspected for damage.

- Inspect the unit exterior for dents, chipped paint, etc.
- Inspect the LCD window for breakage.
- Open the housing by first releasing the set screw and releasing the latch/latches.
- Visually inspect the Digital PC Board, cables, and Analog Module Unit for damage.

Damaged Components

If any components has been damaged or if there are noticeable defects, notify your Totalflow representative. Keep all shipping materials for the carrier's inspection. Totalflow will arrange for immediate repair or replacement; see 'Getting Help', page vi.

FCU Meter Run Installation

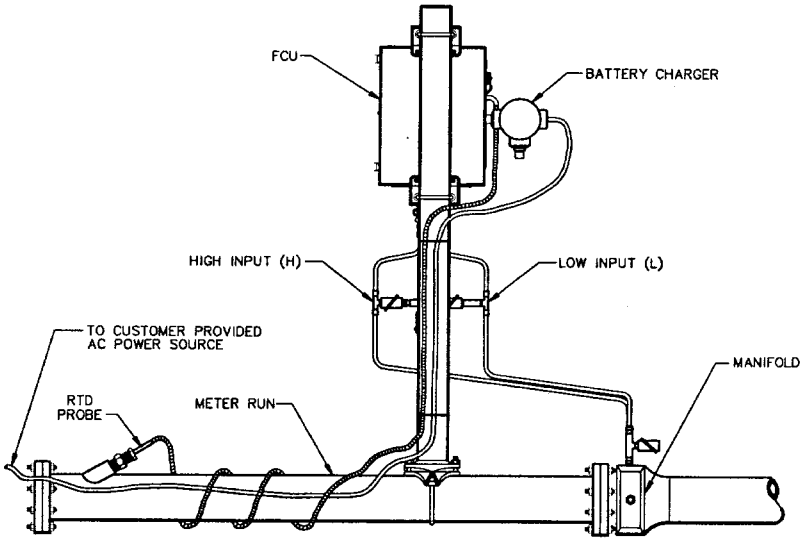
Description

The following procedures unless otherwise stated are applicable for either the FCU Model 6410 or 6413. The FCU can either be pipe, direct or wall mounted, use the procedure that fits your installation. Figure 2-1 and Figure 2-2 shows the dimensions and outline for the Model 6410 and 6413 FCUs.

Important

The FCU should be located as close to the manifold orifice as possible on the meter run. This keeps the manifold stainless steel tubing run as short as possible to the orifice tap valves.

Typical Pipe Installation



Instructions

If you want to...	THEN use...	For Procedure See Page
Install on meter run	Pipe Mounting Procedure	2-8
Install on wall	Wall Mounting Procedure	2-12
Direct Mount	Direct Mounting Procedures	2-15

Continued on next page

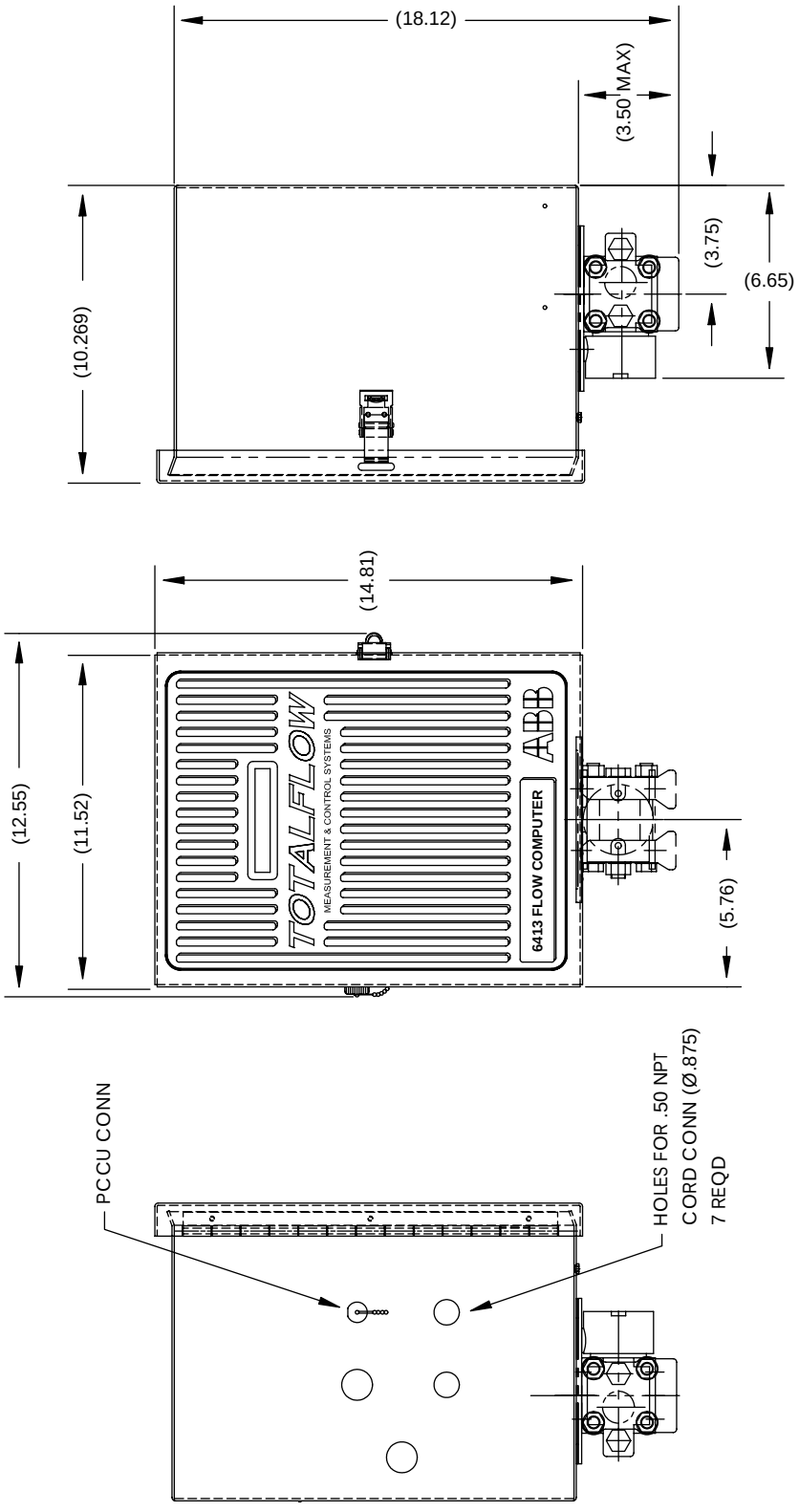


Figure 2-1. Outline Drawing, Model 6413 FCU

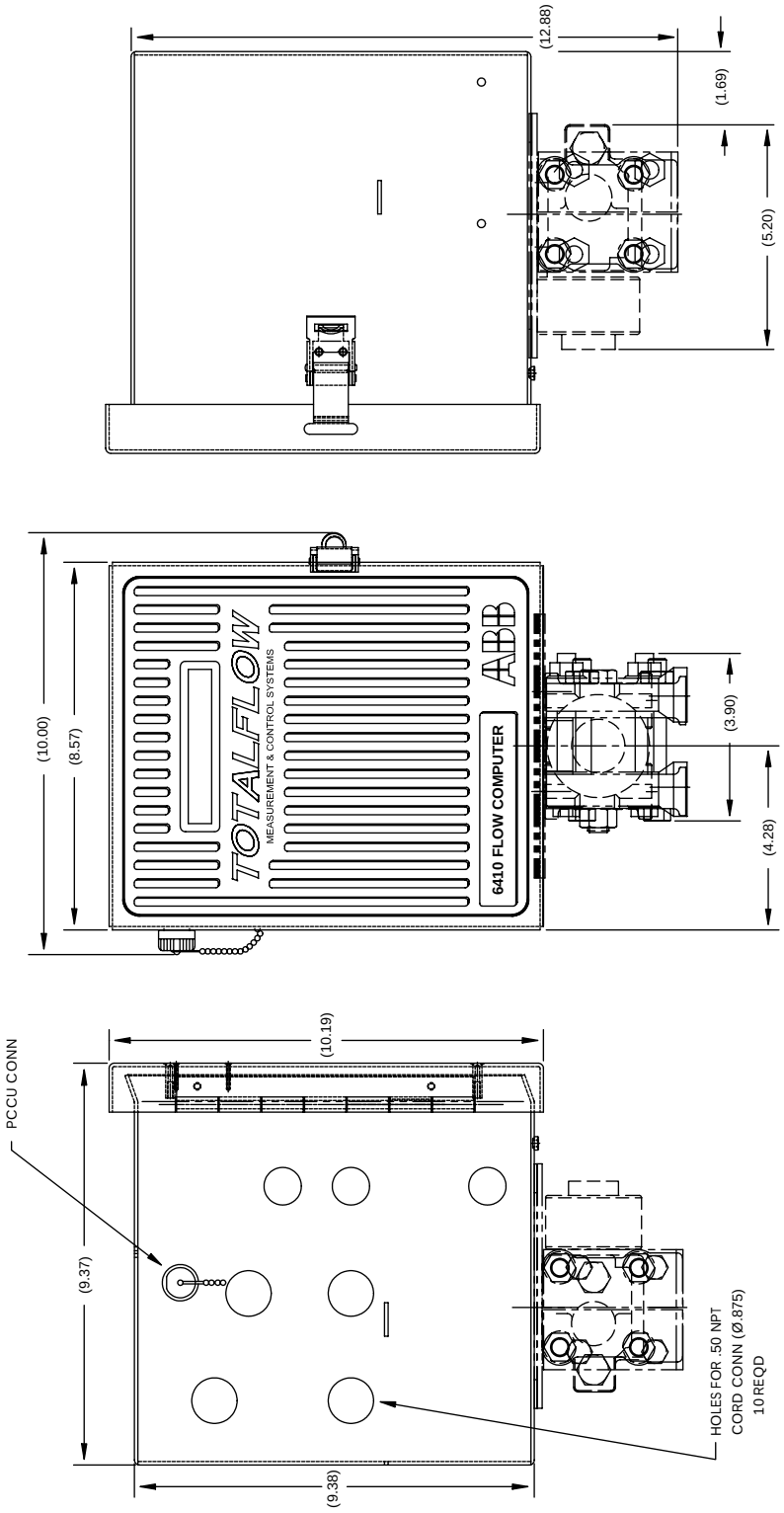
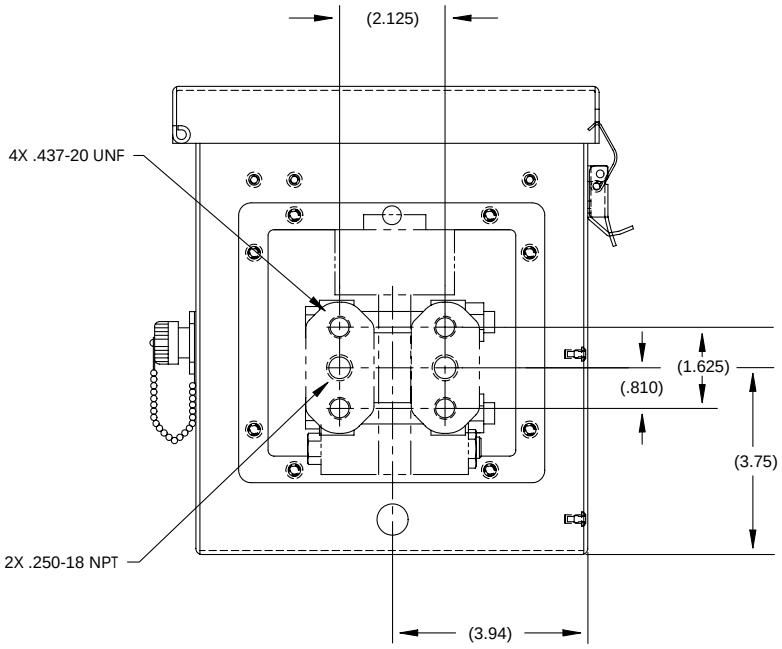
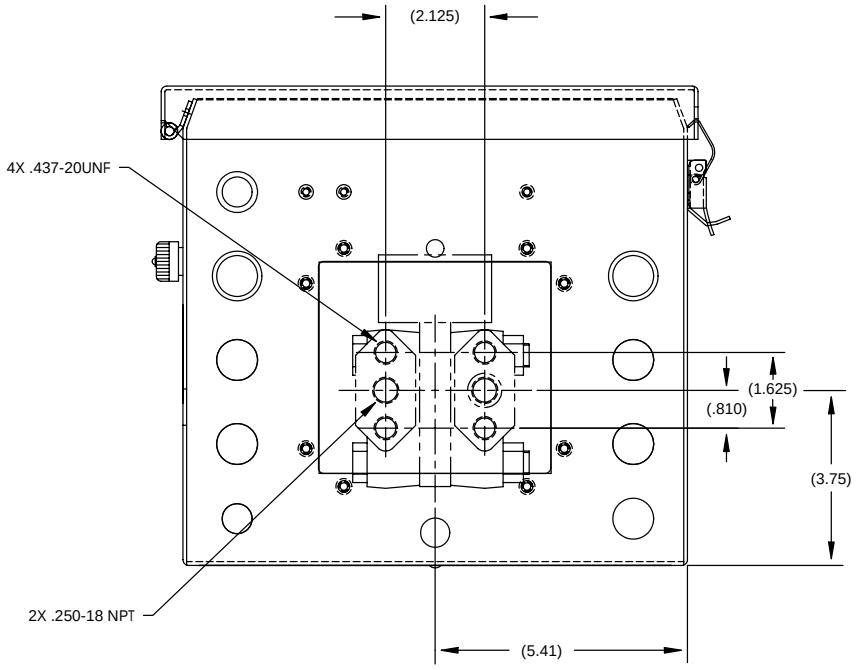


Figure 2-2. Outline Drawing, Model 6410 FCU



6410 Bottom View



6413 Bottom View

Figure 2-3. Bottom Views

Pipe Mounting Procedure

If you are installing directly to the meter run use this procedure. Before you begin, review the procedure and the materials required for installation.

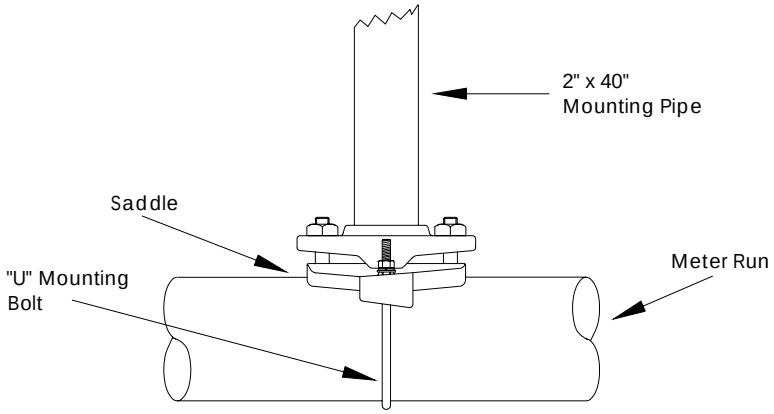
Totalflow Supplied Materials

- Two U-bolts plus fastening hardware
- FCU mounting brackets

Material Not Supplied

- One pipe Saddle
- One 40-inch, 2-inch pipe
- Standard 3 or 5 valve manifold
- Stainless steel tubing

Instructions

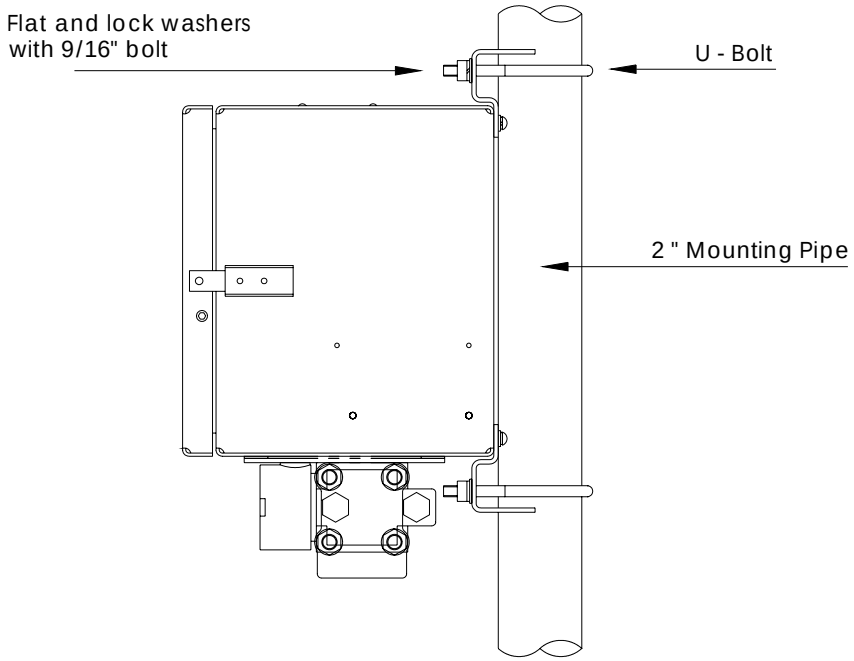
Step	Procedure
1.	Position pipe saddle on meter run. Select a location that allows easy user access and is close to manifold orifice high/low lines. Lines should be as short as possible. 
2.	Temporarily attach Saddle on meter run pipe using U-bolt and associated hardware.
3.	Screw 2” by 40” mounting pipe into Saddle. Place level against pipe and vertically align. Adjust pipe, mounted in saddle, until vertical alignment is achieved.
4.	After vertical alignment, securely tighten 2” by 40” pipe in Saddle then securely tighten Saddle mounting bolts. Be certain pipe is securely installed in Saddle.

Continued on next page

Pipe Mounting Procedures (Continued)

Note The following procedures are to be followed when installing FCU unit on 2” mounting pipe. To install FCU, it is recommended that two people make the installation. One to hold unit in position and the other to install and tighten mounting brackets.

Method of installation must be consistent with customers company policy.

Step	Procedure
5.	Position FCU unit in position on 2” mounting pipe and secure in place with two U-bolts, flat washers, lock washers and two 9/16” bolts. 

Note Position FCU unit high enough on pipe to allow slope from externally mounted manifold to tap valves, refer to Figure 2-4 or 2-5.

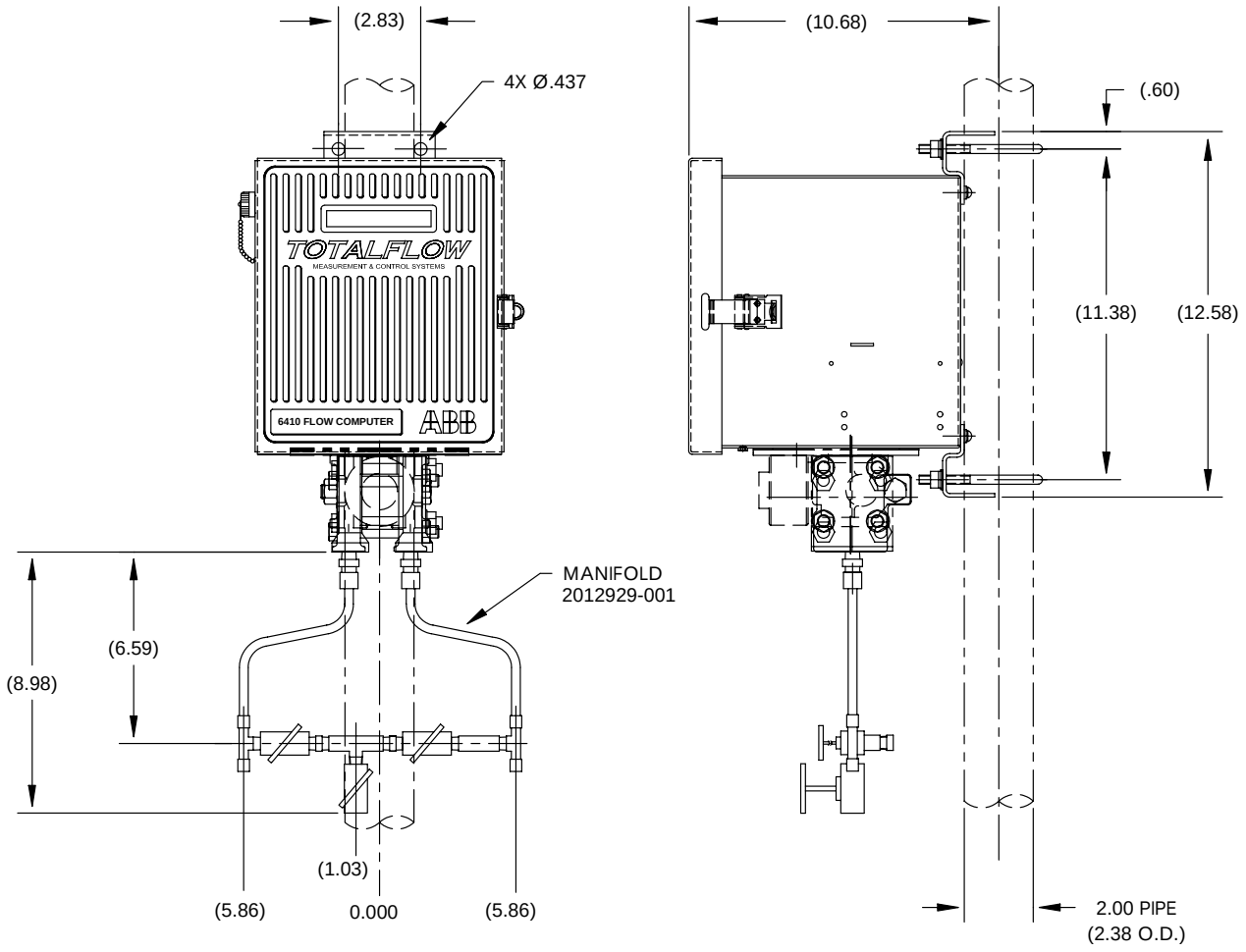


Figure 2-4. Model 6410, Pipe Mounting W/Discrete Manifold

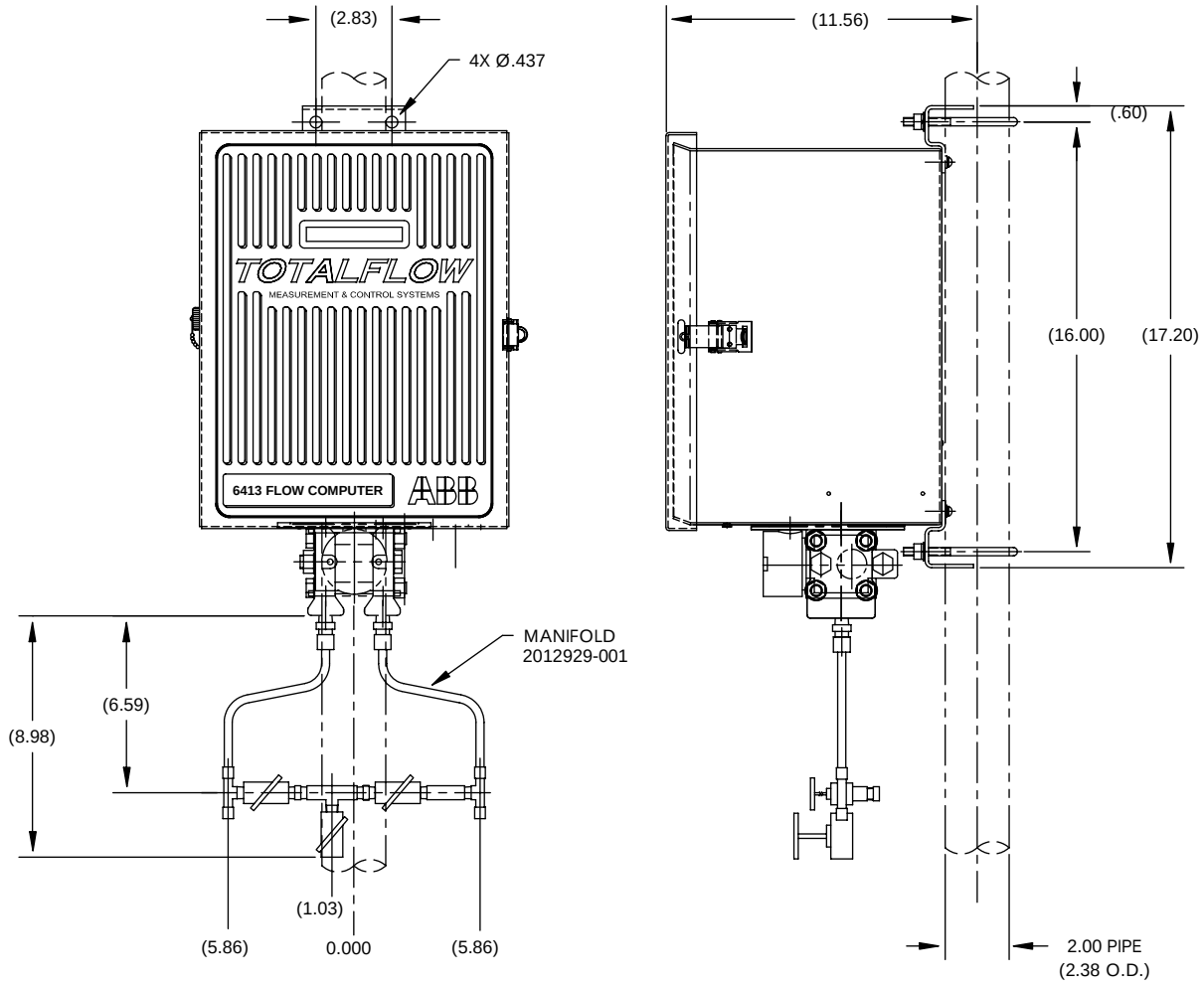


Figure 2-5. Model 6413, Pipe Mounting W/Discrete Manifold

Wall Mounting Procedure

If you are installing to a wall near the meter run or inside a meter shed use this procedure. Before you begin, review the procedure and the materials required for installation. Refer to outline drawing for mounting dimensions requirements.

Totalflow Optionally Supplied Materials

- FCU wall mounting brackets

Material Not Supplied

- Four 1/4” x 1/4” machine bolts
- Standard 3 or 5 valve manifold
- 3/8-inch stainless steel tubing
- 3/8” x 1/4” tubing fittings

Instructions

CAUTION

If FCU is to be wall mounted, the wall itself should be of sufficient strength to support the hanging weight of the unit.

There should be no obstruction(s) that would prevent the FCU door from being opened to access interior installed components or to interfere with installation of the solar panel.

Step	Procedure
1.	Referring to Figures 2-6 or 2-7 FCU Outline Drawings, drill mounting holes in wall supports.
2.	Remove 2” mounting post brackets, from back of FCU unit, and install supplied wall mounting brackets.
3.	Lift and align FCU unit wall mounting brackets with mounting holes drilled in wall.
4.	Insert 1/4” x 1/4” diameter machine bolts through FCU mounting brackets into wall. Securely tighten all bolts to secure unit to wall.

Note

Position FCU unit high enough on wall to allow slope from manifold tap valves.

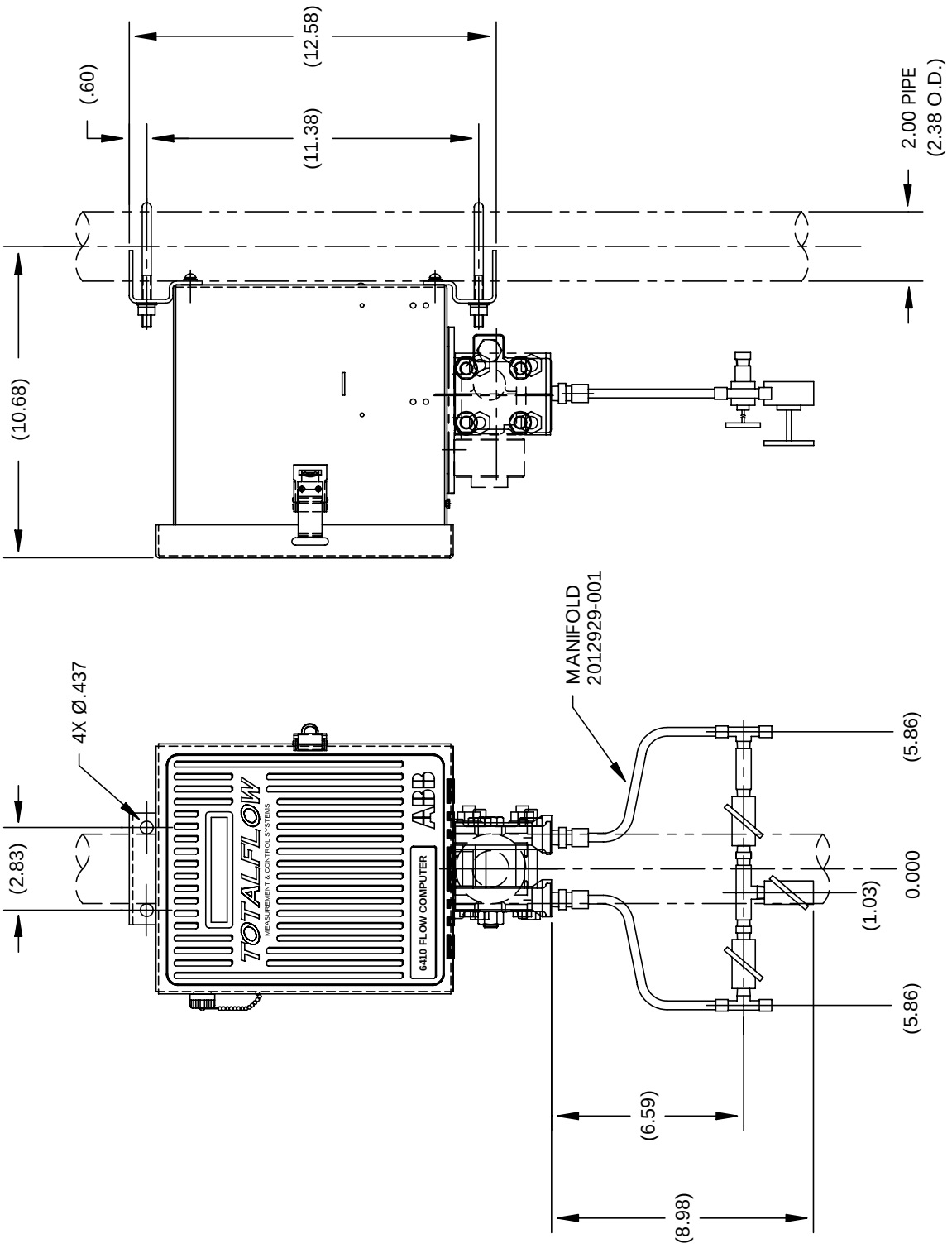


Figure 2-6. Model 6410, Wall Mounting

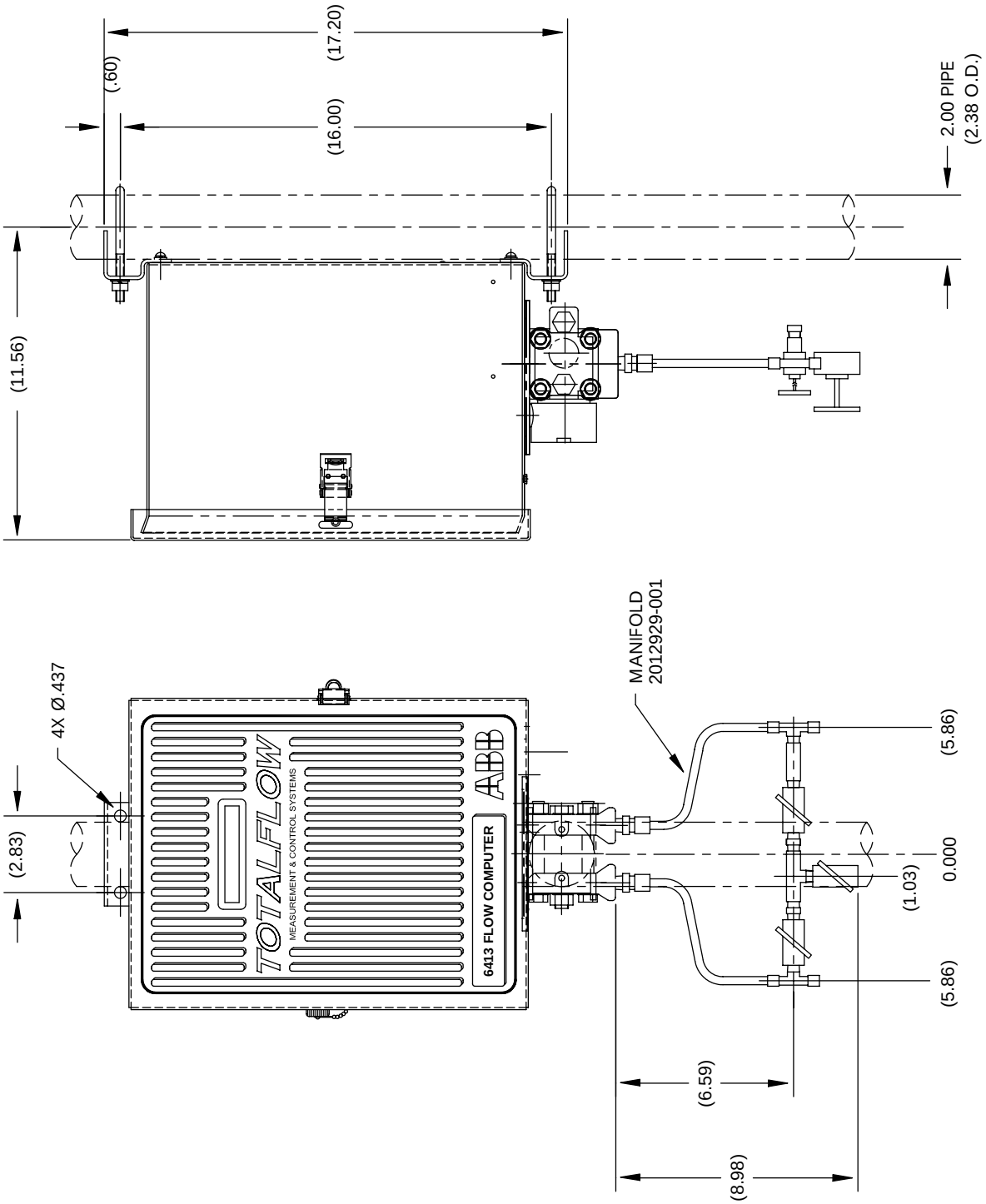


Figure 2-7. Model 6413, Wall Mounting

Direct Mounting Procedure

If you are installing the FCU directly to an instrument manifold use this procedure. Before you begin, review the procedure and the Direct Mount Outline Drawings; see Figures 2-8 or 2-9.

Important

All required hardware for mounting to the FCU to the manifold is to be supplied by the customer.

Instructions

Step	Procedure
1.	Referring to Figures 2-8 or 2-9 FCU Outline Drawings, attach the AMU to the instrument manifold. Before aligning with the manifold ensure that Teflon seal rings are in place around the two process ports.
2.	Using the four 7/16-inch bolts supplied with the manifold secure the AMU to the manifold.
3.	Refer to Figure 2-8 or 2-9 and complete installation.

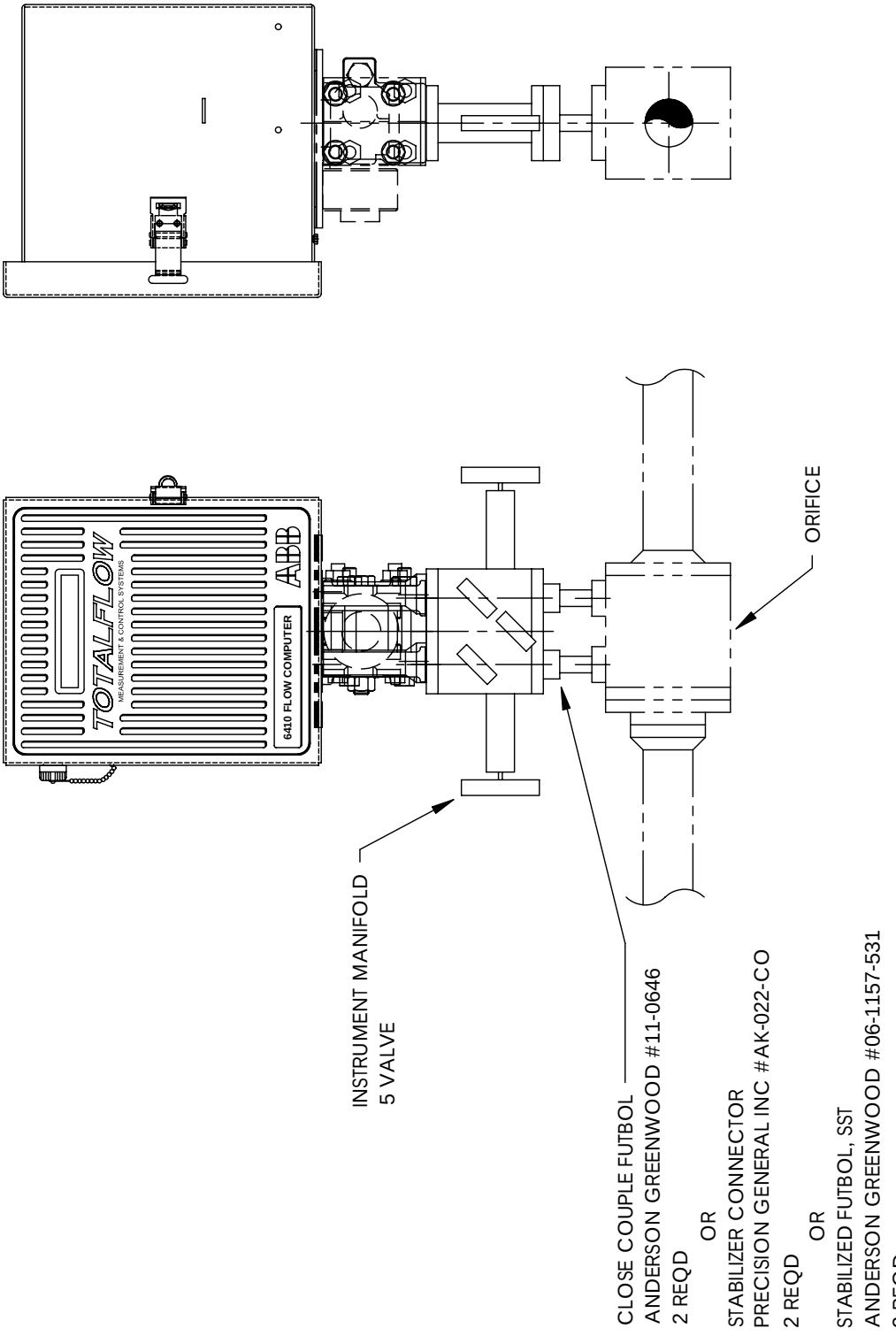


Figure 2-8. Model 6410, Direct Mount

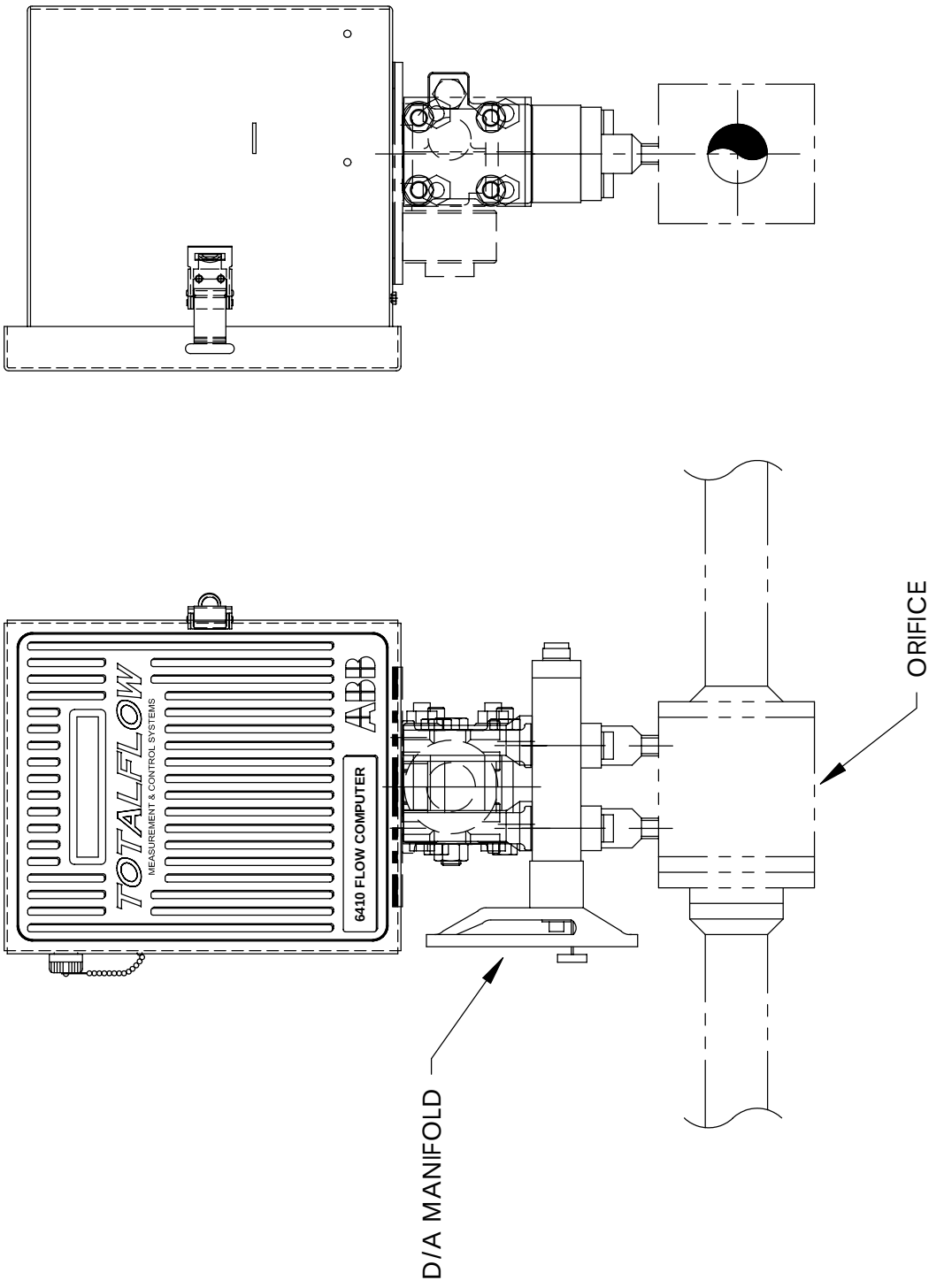
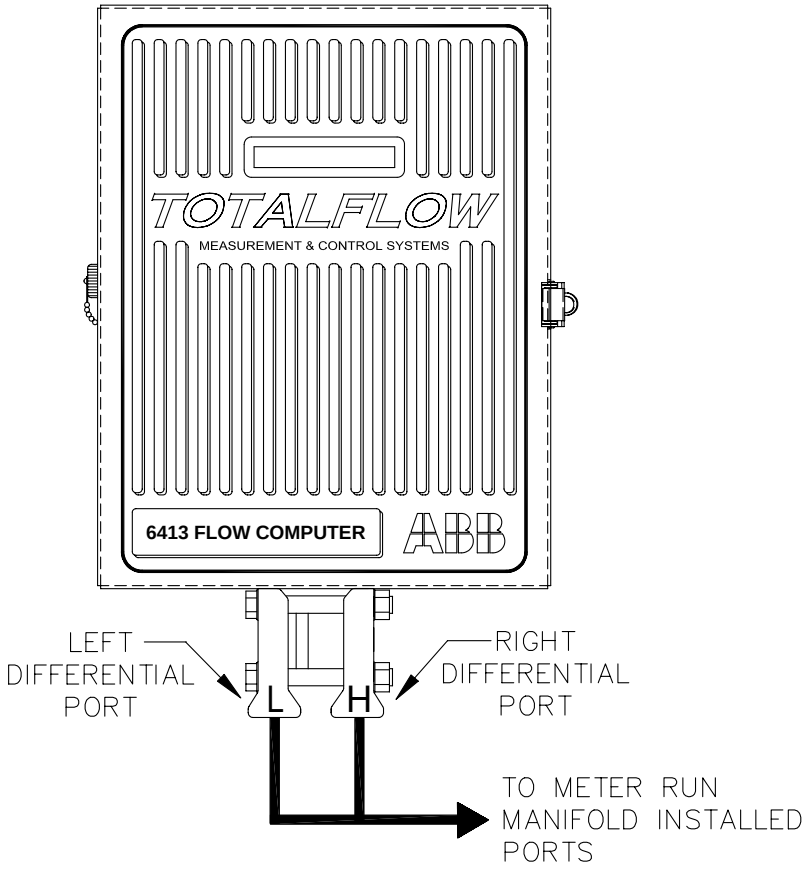


Figure 2-9. Model 6410, Direct Mount with D/A Manifold

Manifold Input Lines

Description

The following instructions will provide procedural steps to install the manifold. The run manifold high (H) and low (L) pressures terminate in FCU H and L Differential Port cells. Differential Port cells are located on bottom of FCU.



Installation

The hardware required to connect meter run installed manifold differential pressure lines to FCU Differential Ports is as follows. Installation is customers responsibility.

Customer Provided Materials

- Stainless steel tubing
- Tubing fittings

CAUTION

A backup wrench should always be used when attaching stainless steel tubing to meter run installed manifold, shutoff valves and to FCU high and low Differential Ports. This prevents fitting from turning and/or putting tension on stainless steel tubing.

Continued on next page

Manifold Input Lines, Continued

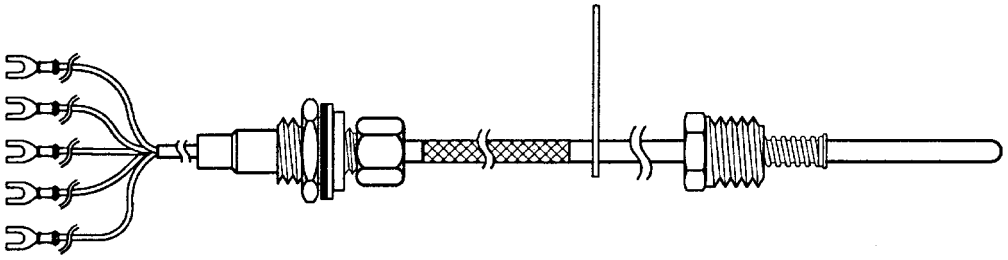
Instructions

Step	Procedure
1.	Install isolation valves on meter run (if using 5 or 3 way manifolds). If direct mounting, skip to step 4.
2.	Install manifold and tubing to meter run and FCU. (Note: Manifold to FCU fittings not supplied with FCU).
3.	Leak check all connections. Leaks in the tubing or manifold will introduce errors when calibrating transducers.
4.	Mount direct mount manifold to meter run as per manufacturers recommended procedures.
5.	Mount FCU to direct mount manifold.
6.	Leak check direct mount manifold before calibrating. Leaks in manifold will introduce errors in transducer readings.

RTD Probe Installation

Description

The RTD measures flowing gas temperature. Length of RTD supplied is 10 feet; other lengths available. Procedures, presented in this Section, enable the user to install the RTD into the meter run.



Totalflow Materials Supplied

- RTD probe with 10’ of cable. Optional lengths are 15’, 25’, 30’, 40’, and 50’.
- One (1) thermowell with 3/4” npt threads; optional threads are 1/2” and 1”.
- Nylon tie wraps.

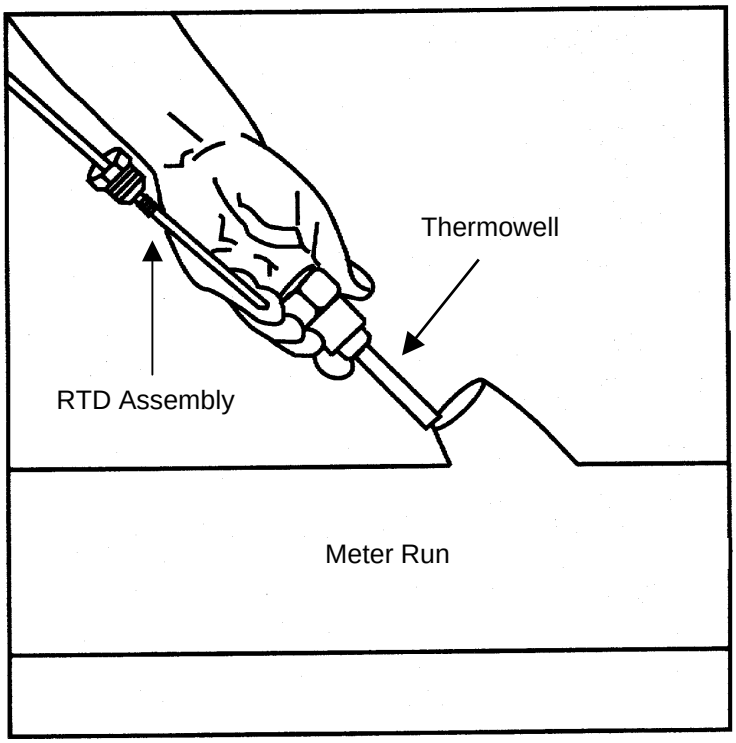
Customer Provided Materials

- Customer must specify Thermowell “U” length.
- Teflon tape

Continued on next page

RTD Probe Installation, Continued

Instructions

Step	Procedure
1.	Install thermowell into meter run. 
2.	Using snap ring pliers, adjust probe length so that it is spring loaded against bottom of thermowell.
3.	Remove nut from water tight cord connector. On FCU unit, remove hole plug unit and insert wires through the hole. Allow enough RTD cable to extend into FCU for connecting wires to RTD termination's (Termination Block J7).
4.	Secure RTD Probe cable using supplied sealing ring and nut.

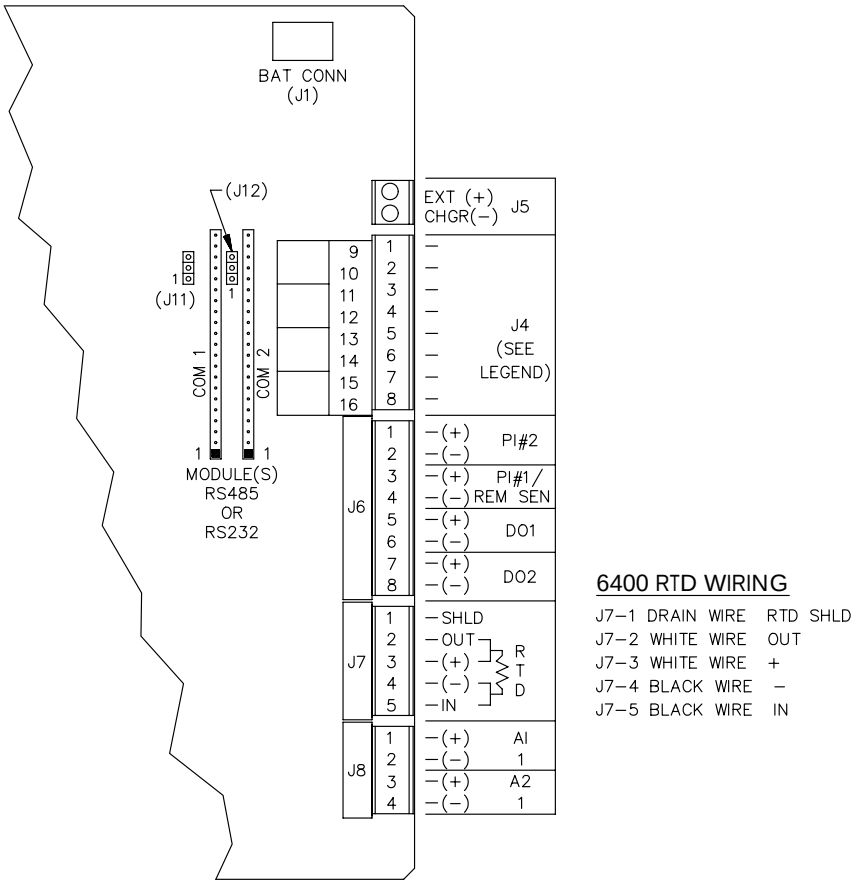
Note

To prevent moisture from entering FCU unit after installing RTD cord connector, be certain associated connector, at FCU unit, has a metal backed sealing "O" ring and metal locking nut attached.

Continued on next page

Instructions (Continued)

Note Power should be removed from FCU before performing any field wiring.

Step	Procedure
5.	Connect RTD probe to FCU RTD connector as follows. Before making connections to terminal block, remove spade lugs if attached and trim wire ends back 1/4” and remove associated terminal block from Digital Board. See overlay on battery plate. Loosen terminal block securing screws, insert wire then retighten. Reinstall terminal block with wires attached. Connect wires as follows: 
6.	Following connection of RTD thermowell, secure cable to meter run pipe with plastic tie wraps.

Battery Pack Installation

Description

A battery pack provides the FCU with it's operating power. The battery is packed and shipped separately. The battery is not installed in FCU unit when shipped. Before installation, inspect power cables, where they terminate on battery pack, and connector for breakage.

Installation

Battery pack is mounted behind the removable metal battery plate cover. The plate is adjustable for various size batteries available.

Instructions

Step	Description
1.	Remove FCU unit battery cover plate and insert battery pack into battery compartment. Insert battery pack with its long dimension facing outward. When cover plate is reinstalled, it will fit snugly against some battery packs. The screws can be loosened to accommodate larger battery.
2.	Connect battery pack connector to Digital Board BATTERY CONN J1 connector, located in upper right corner of Board.
3.	Observe LCD, the display should be on and scrolling through the startup diagnostics sequence.
4.	Remove paper tab from lithium battery bracket located on digital board.

Solar Panel Installation

Description

The Solar Panel is designed for outdoor mounting on a 2” extension pipe installed on upper end of FCU unit 40” mounting pipe. Solar panel must be mounted within 15 feet of FCU unit (other lengths available).

For wall mounted FCU unit it can be mounted on top or side of meter house.

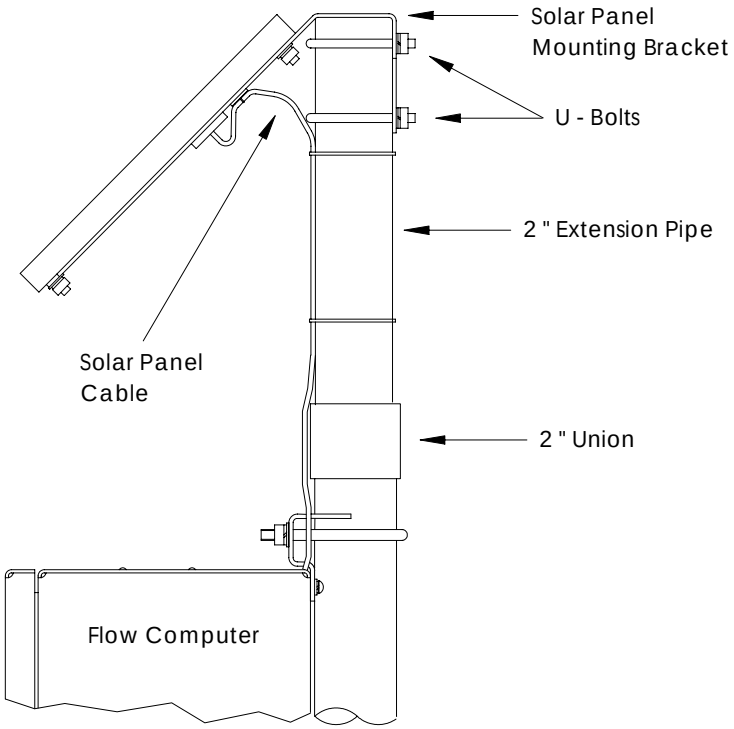
CAUTION

Do not connect solar panel power cable to the FCU unless main battery pack has been connected to J1. Refer to Section Battery Pack.

Important

If installation procedures are required for mounting Solar Panel on top or side of meter house, customer should contact Totalflow's Service Department; see page vi.

Typical Solar Panel Installation



Solar Panel Installation, Continued

Procedure

Solar panel must be mounted within 15 feet of FCU. For Solar Panel mounting, the following materials are required.

Totalflow Supplied Materials

- One Solar Panel
- Two U-Bolts and fastening hardware
- Solar panel cable

Customer Provided Materials

- Cable ties
- One 9-inch extension of 2-inch pipe or other suitable length of pipe.
- One 2-inch union or other suitable length of pipe.

Instructions

Step	Procedure
1.	Attach 2” pipe union to top end of FCU 40” mounting pipe. Securely tighten.
2.	Install 2” pipe extension into union and securely tighten.
3.	Attach Solar Panel mounting plate to top end of 2” extension pipe with U-bolts and associated mounting hardware. Do not tighten U-bolts until Solar Panel has been correctly orientated.
4.	Connect Solar Panel power cable to Solar Panel connector on back of unit. DO NOT connect other end of cable to FCU unit until instructed to do so. Check solar panel polarity using digital voltmeter to insure proper connection is made.
5.	Install Solar Panel on mounting bracket with provided hardware

Note

Exercise caution when installing Solar Panel, so as not to damage it. When mounted, Solar Panel will face up from horizon at 50° angle.

Continued on next page

Instructions (Continued)

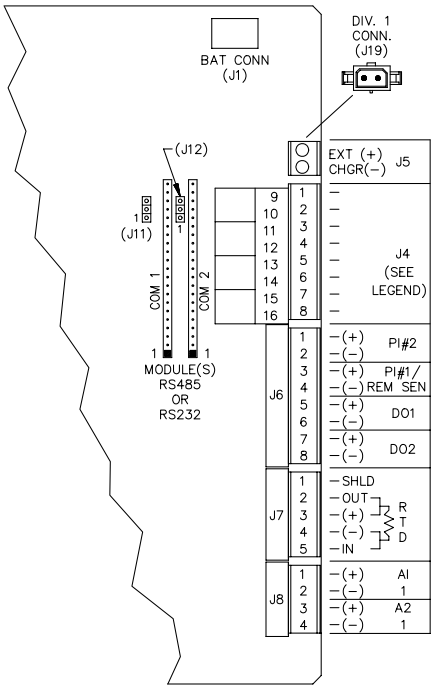
Step	Procedure
6.	Position Solar Panel so it is facing due south.

Note

Solar Panel installation is the same for northern and southern hemispheres. For northern hemispheres, Solar Panel must face south. For southern hemispheres, Solar Panel must face north.

CAUTION

Do not connect solar panel power cable to the FCU unless main battery pack has been connected to J1. Refer to Section, Battery Pack.

7.	The Solar Panel power cable is connected to FCU Digital Board EXT CHGR terminals. Refer to overlay on battery plate. Insert Solar Panel power cable through an access hole on side of case. Allow enough power cable to extend into FCU unit for cable connection to EXT CHGR +/- termination's on J5; see overlay on battery plate. NOTE: For Division 1 boards, J5 is replaced with J19. In this case, the mate to J19 is already installed on the solar panel's power cable. 

Continued on next page

Instructions (Continued)

Step	Procedure
8.	Before making connections to terminal block, trim wire ends back 1/4" and remove associated terminal block from Digital Board. Loosen terminal block securing screws, insert wire then retighten. Connect Solar Panel (+) lead to + terminal and (-) wire to - terminal. Connect cable shield to SHLD terminal. Reinstall terminal block with wires attached.
9.	Following connection of Solar Panel power cable, secure cable to 2" extension and mounting pipe cable with plastic tie-wraps provided.

AC Charging Unit Installation

Description

The AC Power Charging Unit maintains a constant voltage charge on installed battery pack.

Installation

The following hardware is required to mount the AC power charging unit to FCU.

Totalflow Materials Supplied

- AC Charging Unit
- Coupling nipple

Customer Supplied Materials

- Plastic cable ties
- AC wiring, conduit (rigid or flexible)

Warning

To prevent injury only a licensed electrician should install AC power wiring to customer supplied primary AC power source.

Instructions

Step	Procedure
1.	The AC Charging Unit is shipped separately. When unit is received, unpack and inspect all components for evidence of damage. Report damage to shipping carrier and to Totalflow's Service Department.
2.	Remove one of the plugs from the side of FCU so that AC charging unit can be mounted without obstruction; see Figure 2-10.
3.	Feed AC Charger DC power lines into FCU. Allow enough cable to extend into unit for connection to EXT CHGR +/- terminals.
4.	Connect AC Battery Pack Charger to FCU unit using supplied sealing ring and nut.

Note

To prevent moisture from entering FCU unit after installing AC Battery Pack Charger, be certain associated connector, at Charger has a metal backed sealing “O” ring and metal locking nut attached.

Continued on next page

AC Charging Unit Installation, Continued

Instructions (Continued)

Step	Procedure
5.	Before connecting Charger wiring, trim wire ends back 1/4” and remove associated EXT CHGR terminal block from Digital Board. Loosen terminal block securing screws, insert red wire into plus (+) terminal (top) and black wire in negative (-) terminal (bottom). Retighten screws and reinstall terminal block with wires attached.
6.	Plumb the conduit and associated AC wiring into the AC Charger conduit box. The AC Charger is rated at either 120 VAC 60 Hz or 240 VAC 50 Hz. Connect the 120 V hot and neutral or possibly the two hot wires for 240 V to TB1 of the AC Charger. Connect the ground wire to the green screw T1.
7.	Verify that the DC power wires are terminated properly inside the flow computer cabinet and verify that the main battery pack is plugged into J1. Apply AC power to the AC Charger.
	Monitor DC charging voltage by connecting PCCU to associated FCU connector. Set PCCU to MONITOR mode. If proper connections have been made, LCD display should indicate BATTERY CHARGER 13.0 - 13.5 VOLTS.

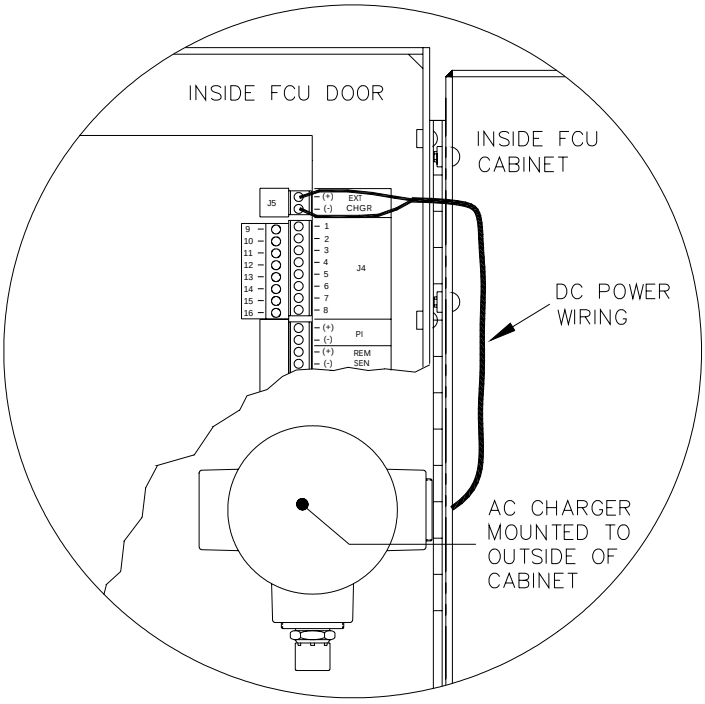


Figure 2-10. Mounting AC Charger

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Chapter 3.0

Portable Calibration & Collection Unit (FS/2)

Overview

Introduction

PCCU32 is the most recent release of Totalflow's Portable Calibration & Collection Unit (PCCU) software and is designed to be run on a Laptop computer. PCCU32 is required to setup many of the features on newer flow computers. PCCU32 users should use the online Help files for assistance. Many customers however, will still be using the FS/2 for sometime. Therefore, the information in this chapter pertains only to the FS/2.

The PCCU (FS/2) is factory programmed to communicate with the FCU. The battery powered PCCU allows you to enter gas calculation and site specific information, calibration and test parameters, answer displayed questions and make menu selections. User entries are made interactively through the PCCU keypad; see Figure 3-1.

Chapter Highlights

This chapter covers the following topics.

Figure 3-1 Totalflow Portable Calibration & Collection Unit (PCCU)

PCCU Highlights

Functions

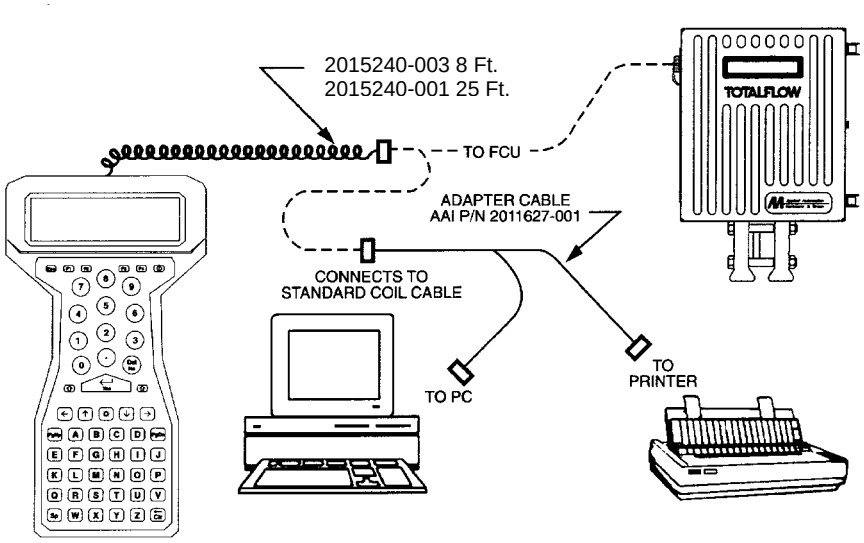
The PCCU display continuously shows user-defined site variables, and menus which present simple and easy to use options. In most cases, questions can usually be answered with a single key-stroke.

Displayed questions and menu selections are designed for easy understanding by field personnel familiar with natural gas measurement procedures and terminology.

FCU Interface

The PCCU is interconnected to the FCU unit by a coiled interface cable. One end of the interface cable is connected to the PCCU D-Type 25 Pin Connector RS-232 Serial Port and the other end is connected to FCU local port input connector.

The PCCU has the capabilities for connecting to external peripheral devices such as Totalflow Flow Computer Units, printers or PC class computers running Totalflow's CCU software. Interconnecting the PCCU to a user's computer allows retrieved data to be downloaded for viewing, analyzing and storage.



Collected Data

The PCCU allows user to graphically review natural gas flow collected data for any 24-hour or eight-day period up to 35 days. It is a primary collection device and allows the user to graphically review data either on-site or in a remotely located facility.

Collected PCCU data can be read by Totalflow central collection units for archiving, production of tabular or graphical hard copy, data analysis or transmitting to a central business computer system. Central business computer system can be a district or regional office that provides for local data collection, verification, and analysis.

PCCU Highlights, Continued

Modes of Operation

The PCCU standard modes of operation, which support FCU functions are as follows:

- Calibration
- Entry Mode
- Print Data
- Data Collection
- AGA Mode
- Download Data
- Monitor Mode
- On-Screen Data View
- Trend Data

AGA-3 Flow Equations

TOTALFLOW calculation procedures are based on the AGA-7 flow equations including AGA-8 1992 [*Gross & Detailed*] and NX-19 supercompressibility calculation procedures and are user selectable via the PCCU menu system.

Exchange of Data

Data and programs can easily be exchanged with other computers or devices using the built-in HCOM utility or IBM compatible 3.5” external disk drive options.

Continued on next page

PCCU Components & Keypad

Description

This Section describes functions of PCCU keypad keys, connectors and the functions they control. Keypad keys and interface connectors are described.

Warning

User must never open the PCCU case. There are no serviceable parts inside. Opening case will destroy seal and void PCCU warranty.

Keypad Table 3-1

The keypad layout includes all keys necessary for the versatile operation of the unit. The keyboard arrangement reflects user requirements of simple data entry and response.

Special Keys

Reference is made in the various menu's to depress the EXIT, CONTINUE, YES, or NO key to perform desired operations. The following keys are assigned these functions. There are two ways to get each function.

Method 1	Method 2	Function
Esc	E	Menu Exit to Previous Menu
"paw"+cont.	C	Continue to Next Menu
Yes	Y	YES
No	N	NO

Continued on next page

Arrow Keys

The arrow keys have two functions:

1. Selecting certain menu items. Sometimes, the PCCU will ask you to use the arrow keys to assist in selecting certain menu items. When the PCCU asks you to do this you would simply use the arrow keys directly.

2. The FS/2 screen behaves as a “window” onto a larger “virtual” screen, which provides 25 by 80 characters of information. To move the window a line or a column at a time hold down the “paw” key and press one of the arrow keys.

   When you are printing reports, you can use the arrows along with the “paw” key (“paw”+arrow keys), to move data into view of the display (should be used when the display is halted.)

   When you are in valve control, you can use the arrows (along the “paw” key) to view the controller indicator.

Parts and Function

These are the parts and functions of the PCCU keypad and components:

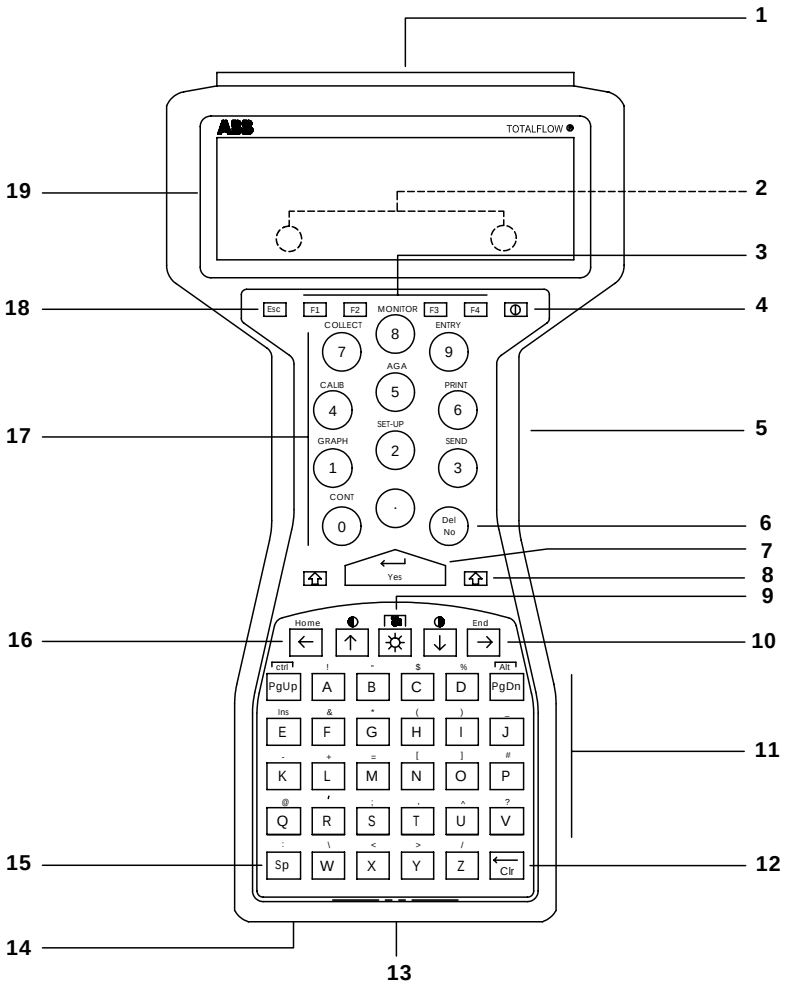


Table 3-1. PCCU Components and Keypad

Key Ident.	PCCU Key	Description
1.	25 Pin “D”-TYPE CONNECTOR	This RS-232 serial port connector provides interface facility for connecting PCCU to TOTALFLOW interface cable.
2.	COMMUNICATION and PCCU CHARGING CONTACTS	Charging contacts are located on backside of PCCU unit. They provide automatic connection to optional FS/2 Communication and Charging Rack.

Continued on next page

Table 3-1. PCCU Components and Keypad (Continued)

Key Ident.	PCCU Key	Description
3.	FUNCTION Keys (6)	Pressing a required function key activates an application function.
4.	POWER ⏻	Pressing key turns battery power ON. Pressing key a second time turns power OFF.
5.	BACKSTRAP	Connected to back of PCCU unit. Provides ease when carrying PCCU.
6.	Del/No	To erase typing or an answer, press Del. In response to a question press No**.**
7.	YES	In response to user typed data or an answer or a question.
8.	SHIFT (⇑)	To type punctuation or other symbols, hold ⇑ key down.
9.	PAW ✳	When key is depressed it provides an extra shift key. This allows access to a wide range of special functions. These functions are: CONTINUE AGA GRAPH PRINT SET-UP COLLECT SEND MONITOR CALIB ENTRY
10.	ARROW (↑ and ↓)	To use the function keys, hold down the “paw” key and press the desired function key. For example, if you want to collect you would hold “paw”+COLLECT. Arrow keys ↑ and ↓ move position of cursor. When used with SHIFT KEY ⇑ (7), arrow keys adjust LCD screen contrast.

Note

When PCCU is first turned ON, PgUp key acts as Ctrl key and PgDn key acts as Alt key.

When PCCU is first issued to a user, application normally switches these keys to functions shown by their legends. For example, PgUp and PgDn.

11.	TYPING (alpha keys)	When used with SHIFT (7) key, user can type alpha letters or symbols.

Continued on next page

PCCU Components and Keypad, Continued

Key Ident.	PCCU Key	Description
12.	Backspace/ Clr (←/Clr)	The **(←/**Clr**)** key erases user entered typing.
13.	BATTERY CAP	Removing cap provides access to PCCU power source batteries. Removal of cap allows three (3) AA batteries to be removed or new batteries installed.
14.	5-WAY FISCHER CONNECTOR (PORT 3)	This is a circular serial logic level input port. Used to connect FS/2 AC Adapter, or Husky Oracle GT external disk drive, to PCCU. Disk drive is A or B.
15.	Space (Sp)	Depressing this key enters a blank space between characters or words.
16.	SHIFT (⇑)	To type punctuation or other symbols, hold ⇑ key down.
17.	NUMERIC (0-9)	Depressing a 0-9 numeric key enters selected number. The SHIFT ⇑ (15) key has no effect on numeric keys.
18.	ESCAPE (Esc)	To exit programs or return to a previous menu.
19.	LCD Screen	Allows viewing of displayed or user entered data. Provides a window onto a full size external virtual monitor screen. LCD screen moves over virtual screen to keep cursor within user area of viewing. Arrow keys ←,↑,→ and ↓ move Window.

If Keypad Locks Up

If the PCCU locks up and does not respond to keypad entries, or cannot be turned off from PCCU keypad power key, the PCCU can be cold started. Hold down both PCCU ⇑ shift keys (located on either side of yes key) then press power key on-off until Husky reboots.

NOTE

If user continues to use PCCU with low battery power and does not replace them with new Alkaline or recharged NiCad batteries, the screen displays *Warning Batteries are Low*. The PCCU turns OFF automatically.

CAUTION

Although low power batteries can partially recover a portion of their lost power after being switched off, it is not recommended that PCCU be continually used. Continual use of PCCU with lower power NiCad batteries could totally exhaust their charged potential. This could lead to permanent damage to NiCad's.

How to Adjust LCD Contrast

For most operating lighting conditions, the LCD screen will not need adjustment. If screen must be adjusted for maximum clarity and contrast, perform the following procedures.

Procedure

Step	Procedure
1.	Position PCCU at suitable working viewing angle.
2.	Hold down PCCU ⇑ then press ↑ or ↓ arrow key.
3.	When desired clarity and contract are achieved, release keys.

How to Adjust Backlight

To improve LCD screen viewing visibility under bad lighting conditions, turn back-lighting screen ON by performing the following procedures:

Procedure

Step	Procedure
1.	From PCCU keyboard, press the paw key and the “L” key. To turn back-lighting OFF, depress key sequence a second time.

Note

When backlighting is ON, an additional battery drain occurs. Backlighting should only be used when required.

Battery Power Source and Installation

Description

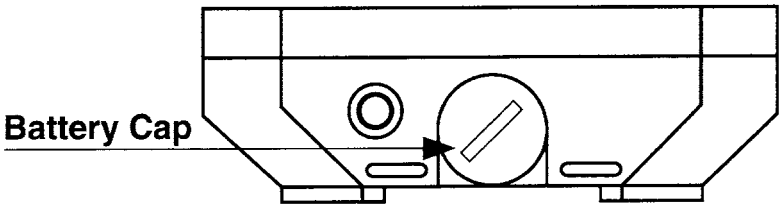
Power to operate PCCU is provided by three non-rechargeable A or AA size Alkaline or rechargeable Nickel Cadmium (NiCad) batteries.

Caution

- It is NOT recommended that Zinc Carbon batteries be used as PCCU power source. Such batteries have short operational life and may leak. This can cause internal PCCU damage which would not be visible to user. Such damage could render the PCCU inoperable.
- Do not, under any conditions, install lithium batteries in PCCU.
- Do not mix batteries of different types, sizes or state of charge.

Location of Batteries

Alkaline and NiCad batteries are located in the bottom of the PCCU. To gain access to batteries, remove the BATTERY CAP.



Battery Operating Life

Operating lifetime of non-chargeable Alkaline batteries is up to 30 hours before having to replace batteries. Chargeable lifetime of NiCad batteries is 15 hours before recharging.

Continued on next page

Recharging of *NiCad* Batteries

NiCad batteries can be recharged by an AC adapter or Husky FS/2 Communications and Charging Rack. Charging of batteries is under software control.

Data Retention

Using NiCad chargeable batteries under normal operating conditions, data is retained for at least two (2) weeks when all other PCCU power is removed.

Using *Alkaline* Batteries

Alkaline batteries can be used to power the PCCU. If such batteries are used as PCCU power source, operator must setup PCCU by performing the following procedures.

Procedures

Step	Procedure
1.	Use the HOT key power option to perform the following functions by pressing the Paw key and H key simultaneously. Refer to Husky FS/2 System Developers Guide, Part 2.
2.	Enable Advance Power Management.
3.	If fresh Alkaline batteries are used, set remaining power to 100%.
4.	Set Alkaline battery low power warning onset to 5%.
5.	Set Alkaline battery chargeable to NO.
6.	Set Alkaline battery capacity to 2250 mAh, or to value recommended by battery manufacturer.

Continued on next page

Using NiCad Batteries

The PCCU can be powered using rechargeable NiCad batteries. If such batteries are used as power source, operator must setup PCCU by performing the following procedures.

Procedures

Step	Procedure
1.	Before inserting NiCad batteries into PCCU, be certain they are fully charged.
2.	Use HOT key power option to perform the following functions. Refer to Husky FS/2 System Developers Guide, Part 2.
3.	Enable Advance Power Management.
4.	Set remaining NiCad power to 100%.
5.	Set onset of low NiCad power warning to 5%.
6.	Set NiCad battery authorization to 3.
7.	Set NiCad battery chargeable to YES.
8.	Set NiCad battery capacity to 1200 mAh or to value recommended by battery manufacturer.
9.	Press ESC and return to top menu.

Continued on next page

Installing and Removing Batteries

To install or remove Alkaline or NiCad batteries in PCCU, perform the following procedures.

Procedures

Step	Procedure
1.	Before removing Alkaline or NiCad batteries, PCCU MUST BE first turned OFF. Press function key O to turn power OFF.
2.	Using a coin, turn the battery cap counterclockwise (CCW) to undo cap.

Note

When removing battery cap, internal spring which securely holds batteries in PCCU battery compartment, may cause battery cap to spring outward.

3.	Insert three A or AA non-chargeable Alkaline or chargeable NiCad batteries into battery compartment.

Note

Insert each battery into battery compartment, with their positive (+) end first.

4.	Using finger pressure on battery cap, press it into battery compartment and turn clockwise (CW) until thread catches.
5.	Using coin, securely tighten battery cap.

Start-up After Installing Batteries

After Alkaline or NiCad batteries have been installed, turn PCCU ON by firmly pressing function key O.

Low Battery Indications and Warnings

Description

The following information is to acquaint you with the PCCU's visual and audio message used to indicate low PCCU battery status and warnings.

Important

Before you use the PCCU, the PCCU batteries should be checked to be certain NiCads are fully charged to Alkaline manufacturer's voltage rating.

If Alkaline or NiCad battery power is low, PCCU issues a user warning. Low battery voltage can cause loss of data and programs, therefore, it is recommended that PCCU be switched OFF as soon as possible to prevent this from occurring.

If Alkaline batteries are the power source, they should be replaced. If NiCad batteries are the power source, they should be recharged or replaced with precharged NiCad's. Discharged NiCad's should be recharged.

Indications and Warnings

- When PCCU is turned ON**.** Warning is repeated every five (5) seconds.
- If consecutive warnings are ignored, PCCU switches OFF automatically**.**

  Text Mode**:** For low battery power, top line on PCCU LCD screen displays *Warning Batteries are Low* in inverse video. PCCU beeps twice and original text is restored until next warning. Following power restoration, LCD screen is restored to pre-warning state.

  Graphics Mode*:* For low battery power, top line on LCD screen displays *Warning Batteries are Low* in inverse video**.** This message remains displayed on screen between battery warnings. PCCU also beeps twice.

  Warning message destructively overwrites top line on screen. Screen contents are lost.

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Chapter 4.0
FCU Operation

Overview

Introduction

This chapter describes how to get a newly installed FCU system up and running using the Portable Calibration & Collection Unit (PCCU). PCCU32, a Windows based PCCU package is the newest release for PCCU support. If using PCCU32, use the online Help files for assistance. The DOS based version such as used in the model FS/2 does not have online Help files and therefore will be discussed here.

The chapter tells you how to select each of the PCCU operating modes and gives detailed instructions on the use of each mode.

6625L PCCU Emulation Software Users

If you are using a PC to run the DOS based PCCU software refer to Totalflow 6625L Emulation Software User's Manual in lieu of this Chapter.

Before You Begin

Before you begin you should complete the task outlined in the Chapter 2.0, Installation. Reference Chapter 3.0.

Chapter Highlights

In this chapter you will learn How to:.

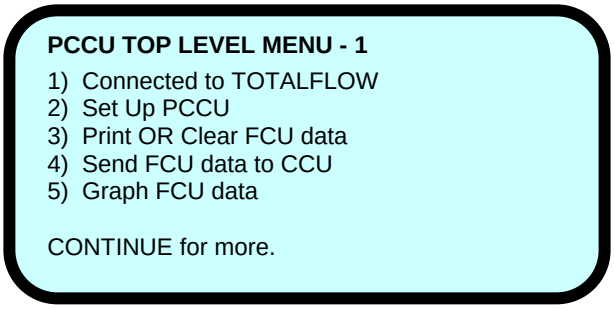
Top Operational Menu

Description

The PCCU Top Level Menu appears after you have properly connected to the FCU and the PCCU is turned on. From the Top Level menu you proceed through a series of menus and prompts related to your operational needs.

Menu Chain

When the PCCU Top Level Menu is displayed, five user selectable modes are displayed on PCCU screen.



User Aid

Each individual menu item shown above will be discussed in this chapter.

Continued on next page

Top Operational Menu, Continued

Learning Hint Use the Chart below to learn about each of the operational modes. To access second screen when a 'CONTINUE for more' prompt is displayed on any screen simply press C, or while holding down the paw key press CONT.

Important Before any function can be entered from the Top Level menu you must enter a user security code. Security codes prevents unauthorized user access to data, setup and FCU operational parameters; see page 4-20.

IF you want to learn about...	THEN enter...	And see Page
Connect to Totalflow	1	4-5
Set Up PCCU	2	4-101
Print or Clear FCU Data	3	4-111
Send FCU Data to CCU	4	4-121
Graph FCU Data	5	4-127
Set Up ID List	6	4-133

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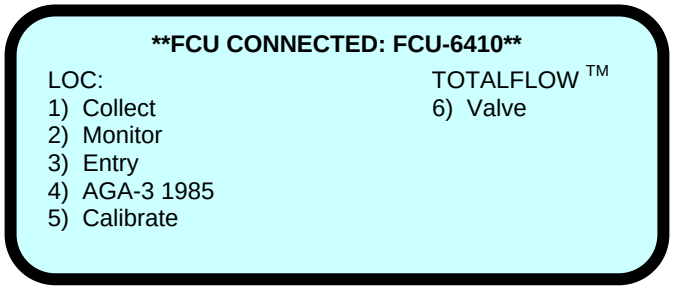
Connected to Totalflow Mode

Introduction

The Connected to Totalflow mode is accessed from the PCCU Top Level Menu by selecting item 1. This mode allows you access to the FCU data and calibration screens. After you selected item 1 from the main menu, access to the Connected to Totalflow main menu is prohibited unless you enter the correct security code from the prompt, or the security switch is set to OFF; see Programming Security Code, page 4-20.



Preview

This section is divided into 5 parts as it relates to the FCU Connected Menu.

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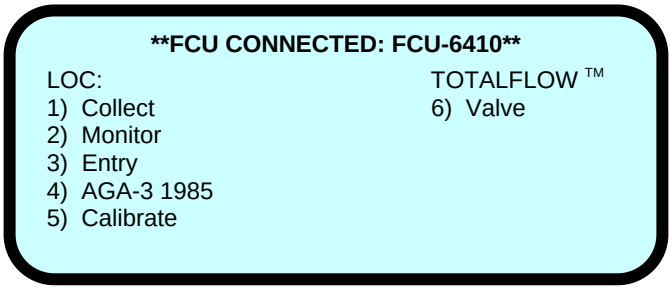
COLLECT Mode

Overview

The Collect mode enables you to collect FCU stored data, verify collected data and display and record date and time data was collected. The PCCU can collect one (1) to five (5) meter weeks of data. Collection size is defined in setup PCCU MODE; see Set Up PCCU, Collection Size page 4-105. Number of meters which can be collected depends on Model purchased.

This mode is selected from ****FCU CONNECTED: FCU-6410**** menu.

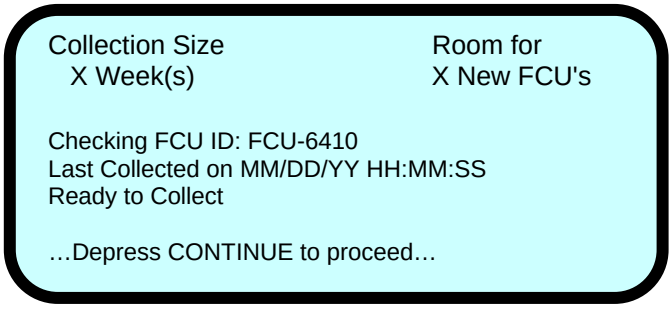


Procedure

Step	Procedure
1.	Select **1) Collect** from ****FCU CONNECTED: FCU-6410**** menu or by simultaneously pressing the paw and COLLECT keys.

Continued on next page

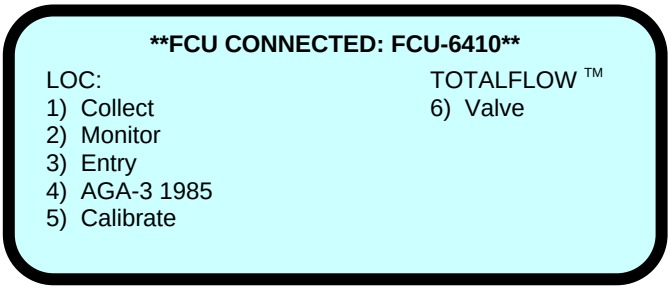
Procedure (Continued)

Step	Procedure
2.	If the PCCU has collected data from the FCU it will display the last data collected.  Last data collection time period indicated by Last Collected on MM/DD/YY HH:MM:SS field. If data is collected again, new data replaces previously collected data. Designator X in “Room For new FCU’s” field varies according to amount of PCCU memory and selected collection size.
3.	To collect new FCU data, press PCCU **CONTINUE (C)** key. A “collecting FCU data” message will appear for several seconds.

MONITOR Mode

Description

The Monitor mode enables you to display real-time operational FCU data on the PCCU display. This mode is selected from the ****FCU CONNECTED: FCU-6410**** menu.



Displayed Items

The PCCU can be programmed to display (see Program Display, page 4-30) the Items the FCU can display plus two additional items. However, only one to four of these items can be monitored at one time, and the PCCU cycles through the selected items once every 5 seconds. Numbers that exceed one million units, are displayed in scientific notation. For example, a unit of 5,070,000 would be displayed as 5.07 E06.

Display	Description
DATE/TIME MM/DD/YY HH:MM:SS	Current Date and Time 24 hour clock
YEST DP LO NN PERCENT	Yesterday's Percent DP Low Limit Percent time below DP Low Set Point
YEST DP HI NN PERCENT	Yesterday's Percent DP High Limit Percent time below DP High Set Point
FLOWRATE NNNNNN.N SCF/HR	Current Flow Rate Programmable SCF or MCF or MMCF
ACCUM VOL NNNNNN.NN MCF	Total Accumulated Volume Programmable SCF or MCF or MMCF

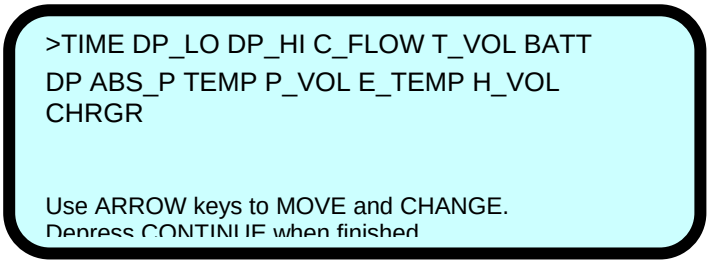
Continued on next page

Displayed Items (Continued)

Display	Function
BATTERY NN.N VOLTS	Battery Voltage Volts
DIFF PRESS NNN.N IN. H2O	Differential Pressure Inches H2O
PRESSURE NNN.N PSIA	Static Pressure Absolute PSIA
FLOW TEMP NN.N DEG. F	Flowing Temperature °F
YEST VOL NNNN.N MCF	Yesterday's Volume Programmable SCFM or MCF or MMCF
PERIOD VOL NNNN.N SCF	Previous Period Volume Last volume calculation period volume
CHARGER NN.N VOLTS	Charger Voltage
M_FLOWRATE NNNNNN.N SCF/HR	Minute Average Flow Rate

Continued on next page

Monitor Procedures

Step	Procedure
1.	Select **2) Monitor** from ****FCU CONNECTED: FCU-6410**** menu or simultaneously pressing PCCU paw and MONITOR keys 
2.	Using PCCU keyboard left ← and right → arrow keys, move to item(s) needing selection. Using up ↑ or down ↓ arrow keys, change Yes and No status of selected item.
3.	When selected item(s) are ready for display on PCCU screen, press PCCU keyboard **CONTINUE (C)** key. The items selected will be displayed.

Note

If more than four (4) items are selected, an error message is displayed on bottom of PCCU screen. You must then press PCCU keyboard **CONTINUE (C)** key. The Monitor menu is displayed to allow you to delete items.

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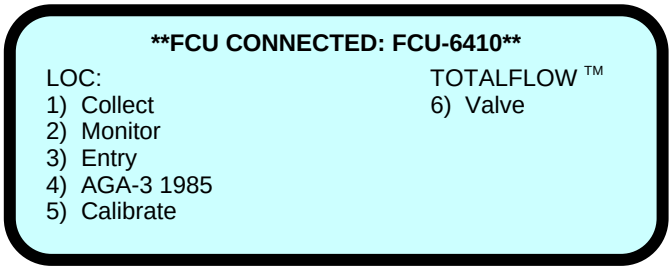
ENTRY Mode

Description

The Entry mode enables user to setup FCU operating and identification parameters. This mode is selected from ****FCU CONNECTED: FCU-6410**** menu.



Preview

Each of the following operating and identification parameters are user selectable and are available on three Entry Mode menus; MENU-1, MENU-2 and MENU-3 menu screens. Function of each parameter is discussed in this section.

Preview Topic	Menu Number	See Page
Setting FCU Calendar/Clock	1	4-15
Setting FCU Identification	1	4-16
Setting FCU Location Designator	1	4-17
Entering BTU/SCF	1	4-18
Entering Zero Cutoff	1	4-19
Setting Security Code in FCU	1	4-20
Contract Day Setup	2	4-22
Entering Operational Limits	2	4-24

Continued on next page

Preview (Continued)

Preview Topic	Menu Number	See Page
Resetting Volume Accumulator	2	4-26
Bringing FCU Up from SLEEP Mode	2	4-28
Setting FCU Display	3	4-30
Setting Site Code	3	4-33
Auxiliary Contact Setup	3	4-35
Setting Baud Rate and Listen Cycle Times	3	4-39

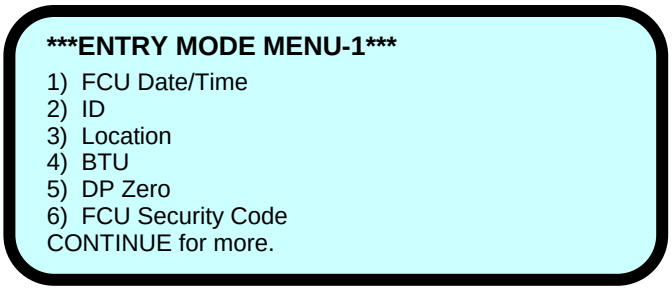
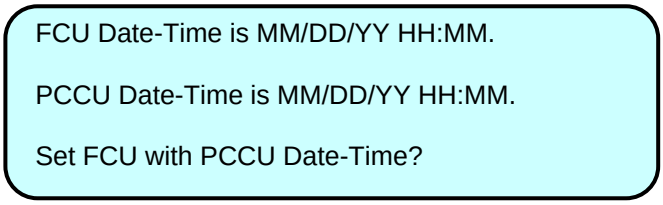
Learning Hint To move from Entry menus 1, 2 and 3 simply enter letter **(C),** or simultaneously push the paw and **CONTINUE (C)** keys. Continually holding the keys will cycle the menus.

*****ENTRY MODE MENU-1*****
1) FCU Date/Time
2) ID
3) Location
4) BTU
5) DP Zero
6) FCU Security Code
CONTINUE for more.

*****ENTRY MODE MENU-2*****
1) Contract Day
2) Set-Up TEG
3) Op Limits
4) Reset Volume
5) Wake-Up
6) Battery Type*
CONTINUE for more

*****ENTRY MODE MENU-3*****
1) Program Display
2) Set Site Code
3) Program Aux Contact
4) Remote Communications
5) Calc. Method: **[AGA-3 1985]**
6) Use Old Equation **[Fixed]**
CONTINUE for more.

Description The FCU date and time must be set with the PCCU date and time. See Set Up PCCU for setting PCCU Time.

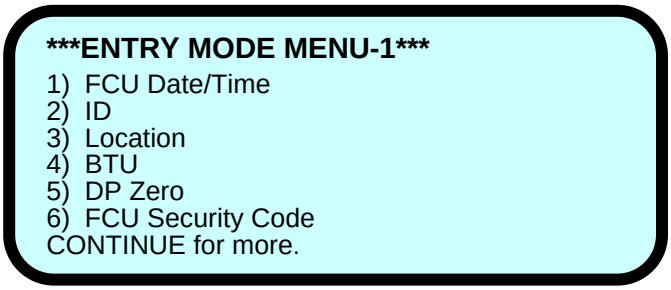
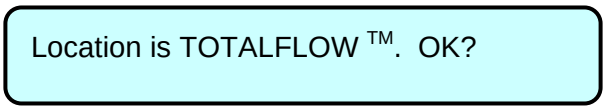
Step	Procedure
1.	To display FCU internal clock current date and time, select **1) FCU Date/Time** from *****ENTRY MODE MENU-1***** menu. 
2.	When FCU Date/Time is selected, the display will show the FCU and PCCU date and time to set FCU with PCCU, enter YES. Date and time are automatically set at top of next minute. 

Step	Procedure
1.	To display current FCU identification select **2) ID** from *****ENTRY MODE MENU-1***** menu. *****ENTRY MODE MENU-1***** 1) FCU Date/Time 2) ID 3) Location 4) BTU 5) DP Zero 6) FCU Security Code CONTINUE for more.
2.	When **2) ID** is selected, the following screen is displayed. Press No to change or enter a new ID or Y to accept. ID is XXXXXXXXXX. OK?
3.	For a new ID enter up to 10 alphanumeric characters than press Yes. PCCU repeats verification prompt allowing you to check new ID.
4.	If new ID is approved, press Yes from PCCU keypad. If not approved, enter No and enter another alphanumeric code.

Note The identifier code uniquely identifies one FCU from that of others connected in the system.

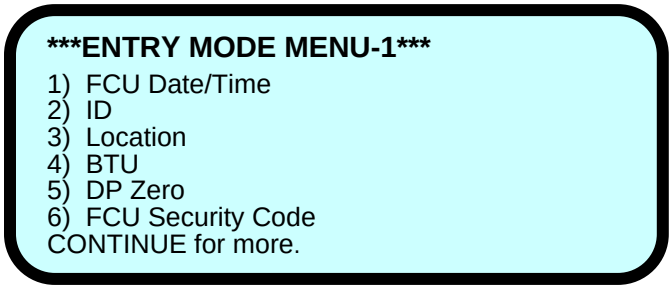
Description

An FCU can hold up to 24 alphanumeric characters to describe its location. This description is called a location description. An example would be a lease name.

Step	Procedure
1.	To display current FCU location, select **3) Location** from *****ENTRY MODE MENU-1***** menu. 
2.	When **3) Location** is selected, the following screen is displayed. Press No to change or enter a new Location or Yes to accept. 
3.	Enter new FCU location identifier and press Yes key. PCCU repeats verification prompt allowing user to check new descriptor.
4.	If new location identifier is correct, press Yes from PCCU keypad. If not, enter No and enter new identifier.

Description

The FCU gives you the option to display the BTU heat value or enter a new value. The BTU value is stored in FCU characteristics record with old and new values date/time stamped in events file.

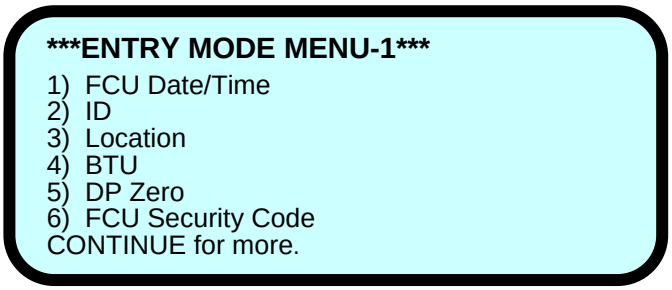
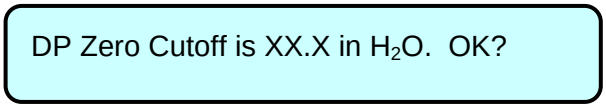
Step	Procedure
1.	To display current FCU BTU heat value, select **4) BTU** from *****ENTRY MODE MENU-1***** menu. 
2.	When **4) BTU** is selected, the following screen is displayed. Press No to change or enter a new value or Yes to accept. 
3.	Enter desired BTU heat value and press Yes from PCCU keypad.
4.	PCCU repeats BTU Heat Value Verification Prompt so user can verify newly entered heat value
5.	If newly entered heat value is correct, press Yes from PCCU keypad. If not correct, enter No and enter another BTU heat value.

Note

BTU heat value is not used in flow calculations, however its value is logged in the characteristics record.

Description

A zero cutoff value for differential pressure (inches of water) can be entered into the FCU. This cutoff defaults to zero whenever the FCU is powered up. The DP Zero Cutoff takes care of minor changes in differential pressure which may occur. It also ensures a true zero during periods of zero flow.

Step	Procedure
1.	To display DP Zero Cutoff, select **5) DP Zero Cutoff** from *****ENTRY MODE MENU-1***** menu. 
2.	When **5) DP Zero Cutoff** is selected, the following screen is displayed. Press No to change or enter a value or Yes to accept. 
3.	Enter new DP Zero Cutoff value and press Yes from PCCU keypad.
4.	PCCU repeats **DP Zero Cutoff is XX.X in $H_2$0. ok?** prompt so user can verify newly entered value.
5.	If newly entered cutoff value is correct, press Yes from PCCU keypad. If not correct, enter No and enter another cutoff value.

Description

To protect unauthorized access to the FCU operating parameter screens a user selected security code must be entered after selecting a TOP Level Menu mode. In addition, all devices that communicate with the FCU must also have a matching security code to gain access.

Code Levels

The FCU software supports two code levels of access. Both levels require a 4-digit entry. A Level 1 access code allows only reading of FCU data. The Level 2 access code allows both data reading from and data entry into the FCU.

How to Set Code

The PCCU is used to program the FCU security code. In order to program a code into the FCU the Security Switch S1 on the digital board must be OFF.

CAUTION

If the Security Switch S1 located on the digital board is in the OFF position, at any time, no security code has to be entered to access the operating parameters.

Note

During remote communications the security code must match regardless of position of security code switch (S1).

Procedure

Step	Procedure
1.	Open FCU access door and set digital board Security Switch (S1) to OFF.
2.	Connect PCCU to FCU and turn-on PCCU.
3.	From Top Level Menu select item **1) Connect to Totalflow**. The *****FCU Connected: FCU 6410***** menu will appear.

****FCU CONNECTED: FCU-6410****

LOC:
1) Collect
2) Monitor
3) Entry
4) AGA-3 1985
5) Calibrate

TOTALFLOW ™
6) Valve

Continued on next page

Programming Security Code, Continued

Procedure (Continued)

Step	Procedure
4.	Select item **3) Entry** from **Top Level Menu;** the Level 1 security screen will appear. *****ENTRY MODE MENU-1***** 1) FCU Date/Time 2) ID 3) Location 4) BTU 5) DP Zero 6) FCU Security Code CONTINUE for more.
5.	Enter **6** from Entry Mode Menu-1 to set the FCU Security Code.
6.	Enter a 4-digit security code. The PCCU will prompt you to either accept the new code by entering a Y (yes) or let you enter an N (no) to change it.
7.	If you enter a Y the next display will prompt you to enter a Level 2 code.
8.	Repeat step 6.
9.	Place Security Switch S1 to On, and secure FCU lid shut.
10.	Return PCCU to Top Level Menu by continuing to press Esc key until the menu appears. Turn PCCU off.
11.	Disconnect PCCU from FCU.

Description

You can program the FCU when to begin the hourly calculations for a contract day. When a FCU first powers up the contract day is preset to begin at midnight or (00).

Step	Procedure
1.	To display Contract Day, select **1) Contract Day** from *****ENTRY MODE MENU-2***** menu. *****ENTRY MODE MENU-2***** 1) Contract Day 2) Set-Up TEG 3) Op Limits 4) Reset Volume 5) Wake-Up 6) Battery Type* CONTINUE for more
2.	When **1) Contract Day** is selected, the following screen is displayed. Press No to change or enter a value or Yes to accept. Contract Day is 00 o'clock. Ok? NOTE: Midnight is 00 o'clock.
3.	Enter first hour (24-hour clock) of contract day then press PCCU keypad Yes key. For example, if contract day begins at 7:00 AM, enter: 07.

Note

Any value greater than 23, FCU forces value to 00 (midnight).

Continued on next page

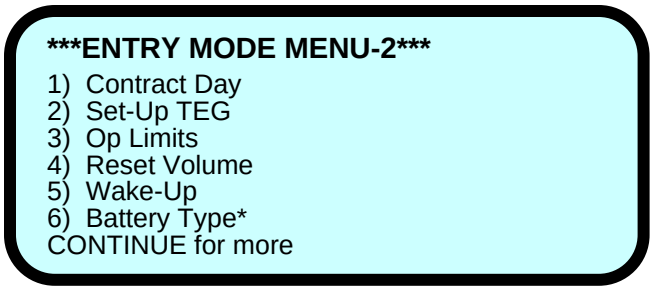
Contract Day, Continued

Step	Procedure
4.	PCCU repeats Contract Day prompts allowing user to check new contract day entry.
5.	If new contract day is approved, press Yes from PCCU keypad. If not approved, enter No and enter another contract day.

Note Following a Yes response, user is returned to *****ENTRY MODE MENU-2***** menu.

Description

You can program in the FCU the operational limits for the absolute and differential pressures. These limits are maintained in the Characteristic File.

Step	Procedure
1.	To set FCU absolute and differential pressure (AP and DP) operating limit values, select **3) Op-Limits** from *****ENTRY MODE MENU-2***** menu. 

Note

Any violation of the AP and DP operating limits will cause not only an alarm on the LCD, but an alarm will be recorded in the Historical File. The Alarm will appear in the hour that violation occurred.

Each limit is checked once per second. Even if the operational limit may be exceeded, FCU continues to measure actual AP and DP, and flow.

Also entered in the Historical File is the percent of time that each AP and DP limit was violated during the current day.

Continued on next page

Step	Procedure
2.	Select **DP Lo Limit**. The following display is shown. The displayed value is current DP low operating pressure (inches of water). DP Lo Limit is 5.0 in H_2O. Ok?
3.	From PCCU keypad, enter No. The display will request a new DP Lo Limit be entered. After entering desired DP Lo Limit, enter Yes. The *****OPERATIONAL LIMITS MENU***** menu is displayed.
	Other AP and DP limits can be changed in same manner as DP Lo Limit. AP and DP Limit default values are as follows: • **DP Lo Limit** (inches of water): Defaults to 0 • **DP Hi Limit** (inches of water): Defaults to 2047 • **AP Lo Limit** (psia): Defaults to 0 • **AP Hi Limit** (psia): Defaults to 2047

Note To return to ***ENTRY MODE MENU-2***, press **Esc**. The PCCU automatically returns to this menu after AP Hi Limit has been entered.

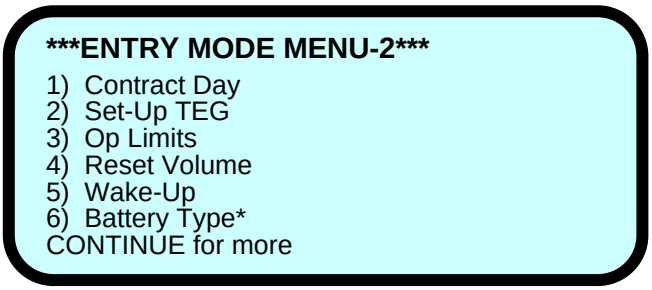
Description

When you Reset the volume accumulator the FCU will:

- Store time, date and previous accumulated partial calc periods volume into the historical record file
- Zero the remaining partial calc periods accumulations.
- Complete all computations for the present flow file daily record.
- Begin a new flow file daily record.
- Zero total volume accumulator and log the event with an accumulator value before zeroing out accumulator.

Important

Since the FCU volume calculations are made each vol calc period, any changes you make during the period would affect the volume calculations (such as changing the orifice plate size) and be introduced into the calculations. To avoid introduced errors, it is recommended that Reset Volume command be used. This command forces the FCU to perform volume calculations for the elapsed time since a previous volume calculation was made. A new partial period volume is added to the volume accumulator, which is logged as an event before it is reset to zero (0).

Step	Procedure
1.	To reset FCU volume accumulator to complete the following operational functions, select **4) Reset Volume** from *****ENTRY MODE MENU-2***** menu. 

Continued on next page

Reset Volume, Continued

Step	Procedure
2.	When **Reset Volume** is selected, the following fail safe prompt screen is displayed. Since the reset volume command sets FCU total volume to zero, this fail safe user prompt is issued to notify you against making an error. RESET VOL Selected. Are you sure? Last chance.
3.	If volume accumulator command is correct, press Yes from PCCU key-pad. The following reset volume screen is displayed. RESET VOL Selected. Are you sure? Last chance. RESET VOL Complete C to Proceed

Description

The SLEEP mode is a safety feature which maintains the flow records but discontinues flow measurement calculations. When the FCU is in the SLEEP mode the word SLEEP is displayed on the FCU. If FCU battery voltage falls below 11VDC, FCU enters SLEEP mode. The FCU can be restarted with PCCU WAKE-UP command. If battery voltage is still below 11VDC, FCU returns to SLEEP mode after approximately 2 minutes. If battery voltage is above 11VDC, FCU remains awake.

Step	Procedure
1.	To allow FCU to start measuring inputs, calc. and storing flow records, select **5**) **Wake -Up** from *****ENTRY MODE MENU-2***** menu. The FCU performs the following functions: • Store time, date and present calc periods accumulations in historical record, • Zero present calc periods accumulations and • End current daily record and start new daily record. *****ENTRY MODE MENU-2***** 1) Contract Day 2) Set-Up TEG 3) Op Limits 4) Reset Volume 5) Wake-Up 6) Battery Type* CONTINUE for more

Continued on next page

Wake-Up, Continued

Step	Procedure
2.	When Wake-Up is selected, the following screen is displayed: WAKE-UP selected. WAKE-UP Complete. Depress Continue to Proceed.
3.	Pressing PCCU keypad **C** key displays *****ENTRY MODE MENU-3***** menu and user selectable functions. To return to ****FCU CONNECTED: FCU-6610 TOTALFLOW TM** menu, press PCCU keypad **Esc**.

Description

The FCU scrolls the parameters shown below continuously on the FCU LCD. The factory set default for the display cycle time is 5 second for each parameter. The previous day's volume defaults to a display cycle time of 0 seconds. The PCCU gives you the ability to change this default to zero or any value from 5 to 255 seconds. If you specify zero for an item, the FCU will stop displaying the item. If you specify a non-zero value less than 5 seconds, the FCU sets the cycle time for that item to 5 seconds. You are also able to change the engineering units on the volume and rate entries.

FCU Displayed Items

Display	Description
DATE/TIME MM/DD/YY HH:MM:SS	Current Date and Time 24 hour clock
YEST DP LO NN PERCENT	Yesterday's Percent DP Low Limit Percent time below DP Low Set Point
YEST DP HI NN PERCENT	Yesterday's Percent DP High Limit Percent time below DP High Set Point
FLOWRATE NNNNNN.N SCF/HR	Current Flow Rate Programmable SCF or MCF or MMCF
ACCUM VOL NNNNNN.NN MCF	Total Accumulated Volume Programmable SCF or MCF or MMCF
BATTERY NN.N VOLTS	Battery Voltage Volts
DIFF PRESS NNN.N IN. H2O	Differential Pressure Inches H2O
PRESSURE NNN.N PSIA	Static Pressure Absolute PSIA
FLOW TEMP NN.N DEG. F	Flowing Temperature °F
YEST VOL NNNN.N MCF	Yesterday's Volume Programmable SCFM or MCF or MMCF
PERIOD VOL NNNN.N SCF	Previous Period Volume Last volume calculation period volume
CHARGER NN.N VOLTS	Charger Voltage
M_FLOWRATE NNNNNN.N SCF/HR	Minute Average Flow Rate

Continued on next page

Setting FCU Display Cycle Time Procedures

Step	Procedure
1.	To display Program Displayed cycle times, select **1) Program Display** from *****ENTRY MODE MENU-3***** menu**.** *****ENTRY MODE MENU-3***** 1) Program Display 2) Set Site Code 3) Program Aux Contact 4) Remote Communications 5) Calc. Method: **[AGA-3 1985]** 6) Use Old Equation **[Fixed]** CONTINUE for more.
2.	When **Program Display** is selected, the following Program FCU Display Menu is displayed: Program FCU Display Menu 1) Select Display Times 2) VOLUME Units [mcf] 3) RATE Units [mcf/day]
3.	Select **1) Select Display Times** from **Program FCU Display Menu.** The PCCU display shows following cycle time verification prompt screen for first FCU display. CURRENT DISPLAY DURATION For: TIME IS 5 SECONDS. Ok?

Continued on next page

Setting FCU Display Cycle Time Procedures (Continued)

Step	Procedure
4.	If cycle time verification is correct, press PCCU keypad Yes key. Cycle time for next display item is displayed. To change displayed item cycle time, press PCCU keypad No key. The display screen asks that a new cycle time be entered.
5.	Enter new cycle time. PCCU repeats verification prompt allowing user to check new entry.

Important

To select a displayed item, page down the list by pressing PCCU keypad Yes key to each prompt until reaching item to be changed.

When bottom of displayed item list is reached, PCCU returns to Program FCU Display Menu.

6.	Select **2) VOLUME units [mcf]** from **Program FCU Display Menu.** Volume units toggle between mcf and mmcf. To change units back to their original state, enter **VOLUME units [mcf]** again.
7.	Select **RATE units [mcf/day]** from **Program FCU Display Menu.** Rate units toggle between scf/hr, mmcf/day or mcf/day. Toggling between rate units is dependent on selected **VOLUME units [mcf].**

Note

The **RATE units** in mcf/day or mmcf/day track selected **VOLUME units**.

8.	To return to **ENTRY MODE MENU-3** menu**,** press PCCU keypad **Esc.**

Description

The FCU has a feature called a site code. The site code is a number from one to six digits which you can enter into the FCU that can represent predetermined information or notes about the site. It can include a decimal point, and the decimal point can be inserted anywhere among the digits.

The information or notes can represent any sequence of events that may have occurred at the meter site. For example, each site code number could be defined by the field people and by the office people to represent different site conditions or equipment failures. These site codes are intended to provide communication similar to writing notes on the back of circular charts.

Date and time tagged Site Codes are recorded in the FCU EVENT FILE for future reference.

Entering Site Code Procedures

Step	Procedure
1.	To display Set Site Code, select **2) Set Site Code** from *****ENTRY MODE MENU-3***** menu**.** *****ENTRY MODE MENU-3***** 1) Program Display 2) Set Site Code 3) Program Aux Contact 4) Remote Communications 5) Calc. Method: **[AGA-3 1985]** 6) Use Old Equation **[Fixed]** CONTINUE for more.

Continued on next page

Entering Site Code Procedures (Continued)

Step	Procedure
2.	Enter site code, one (1) to six (6) digits with or without decimal, then press Yes key. Set SITE CODE Selected Enter New Site Code.
3.	PCCU display's the entered site code and asks for verification.
4.	From PCCU keypad, enter Yes if correct. Site code will be sent to FCU. If not correct, enter No**.** The message **Site code NOT sent to FCU** is displayed and *****ENTRY MODE MENU-3***** menu is displayed.

Additional Site Codes

Additional site codes can be entered if needed. The FCU can store up to 100 events in the FCU EVENT FILE. The last 100 events will be printed out at the end of the CHARACTERISTIC FILE report on the PCCU printout when it is transferred from the PCCU to a printer or screen.

Three predetermined site codes are recorded in the FCU EVENT FILE whenever their associated events occur. These are -3.0000 for a collection of the FCU data with a PCCU, -2.0000 for an AP LOW CALIBRATION AND -1.0000 for a DP LOW CALIBRATION.

Description

The FCU provides one remote input sense line and one 12 VDC digital output. The 12 volt output is referred to as the Aux Contact.

Definitions

The following definitions describe the functions of each of the I/O's:

Remote Sense

Contact closure on the line causes an alarm in the Flow File Report during the hour which it occurred.

12 Volt Digital Output

Can be set to trip a sampler on a volume setpoint, or provide 12 volts to an auxiliary device based on alarm conditions.

Rating

- 12 Volts Typical
- 2 Digital Outputs (open drain FET, can sink 100 ma)
- Time on with auto-reset enabled is approximately 5 seconds.

Digital Output Volume

A volume accumulator used in conjunction with the digital output control logic. (This is not the volume accumulator seen on the FCU display or in the FCU characteristic file.) It is a separate variable that is updated each minute and is based on last calc periods C' and last minute's extension.

Digital Output Volume Set Point

Value in MCF against which the Digital Output Volume may be compared for deciding whether to activate the output or not. The digital output volume set point is entered from the PCCU. Any time the set point is entered the FCU automatically resets the Digital Output Volume accumulator to zero and resets the digital output.

The set point is entered in MCF.

Activating Digital Output

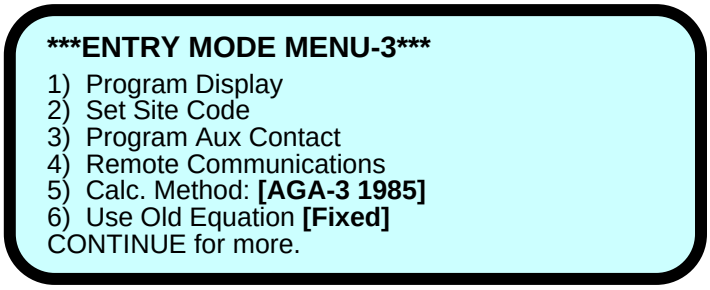
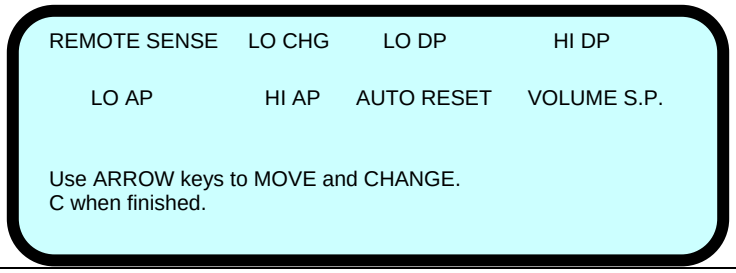
Connections for the D/O's are made on the FCU digital board; refer to overlay on battery plate for terminal location. After **Program Aux Contact** has been selected from *****Entry Mode Menu-3***** and 12 volt digital output has been setup**,** the following two methods can be used to activate 12 volt digital output auxiliary contact output.

- Operating Conditions method
- Calculated Volume method

They are each described in the following Sections.

Continued on next page

Setting Up Digital Output Procedures

Step	Procedures
1.	To display program auxiliary contact setup parameters, select **3) Program Aux Contact** from *****ENTRY MODE MENU-3***** menu. 
2.	When **Program Aux Contact** is selected, the following user prompt is displayed. 

Operating Condition Procedures

Step	Procedures
1.	Select one or more of Digital Output parameters to trigger an Aux Contact Output. Using PCCU keypad ← and → arrow keys to go to condition, and ↑ and ↓ to select the Yes and/or No condition. • REMOTE SENSE = REMOTE SENSE • LO CHG = Low Charger • LO DP = Low Differential Pressure • HI DP = High Differential Pressure • LO AP = Low Absolute Pressure • HI AP = High Absolute Pressure
2.	Entering Yes for any condition, the 12 volt output is energized if condition is encountered.
3.	After all parameter conditions have been set, press PCCU keypad **C** key. The PCCU screen will display the following user prompt. The prompt shows current state of 12 Volt Digital Output and manually changes condition. **AUTO RESET** is used with digital output conditions. When selected parameter conditions clear, **AUTO RESET** returns digital output to untripped condition. Aux Contact is NOT Tripped. Ok? OR Aux Contact is Tripped. Ok?

Continued on next page

Tripping a Sampler

When using Calculated Volume Method to trip sampler, **AUTO RESET** must be set to Yes.

Calculated Volume Method Procedures

Step	Procedure
1.	Set **VOLUME S.P.** and **AUTO RESET** to Yes.
2.	After setting step 1 conditions to Yes, press PCCU keypad **C** key. The PCCU will display the following user prompt. Volume Set Point is X.XXX MCF. Ok?
3.	If Volume Set Point is not correct, press PCCU keypad No key and enter new set point. When volume matches or exceeds Volume Set Point, output will be enabled.

Note

When set point volume is reached, output is enabled and accumulator resets to zero (0). Any residual volume above the setpoint volume is put back into accumulator (not to lose any volume).

The 12 volt digital output on the FCU digital is labeled J4, pin 3 and return is labeled DO1+. The switch is located in the DO1+ connection, which takes the SIGNAL to ground when active.

Description

The Remote Communication mode is used to set up the correct baud rate and listen cycle time when the FCU is coupled to a remote communication device such as a modem or radio.

Remote Communications Procedures

Step	Procedures
1.	To display communication parameters, select **4) Remote Communications** from *****ENTRY MODE MENU-3***** menu. *****ENTRY MODE MENU-3***** 1) Program Display 2) Set Site Code 3) Program Aux Contact 4) Remote Communications 5) Calc. Method: **[AGA-3 1985]** 6) Use Old Equation **[Fixed]** CONTINUE for more.

Continued on next page

Remote Communications Procedures (Continued)

Step	Procedures
2.	When **Remote Communications** is selected, the following user prompt screen is displayed. Baud rate and listen cycle time can be set. Remote Communications Menu 1) Comm Rate [1200] baud 2) Listen Cycle [4] sec.
3.	Enter **Comm Rate [1200] baud** and toggle between the following baud rates: • 1200 • 2400 • 4800 • 9600
4.	Enter **Listen Cycle [4] sec.** and toggle between desired listen cycle time. Listen cycle time is between 1, 2 and 4 seconds.

PCCU display options may vary depending on PCCU firmware revision and FCU firmware revision.

Note

Remote communications must be entered to activate the FCU's use of remote com. port. This will be visually by a blinking telephone pole symbol (‡) in the lower right hand corner of display.

AGA-3 Factor Mode

Overview

The FCU is programmed to calculate volumes by using either AGA-3 1985 or AGA-3 1992 methods. Using the PCCU or laptop PC you select which method to use. The FCU must also be configured to use either the Totalflow standard characteristic file for use with the AGA-3 1985 equation, or an extended characteristic file for use with both the AGA-3 1985 and 1992 equations. A software switch allows you to *chose which file to use*; see How to Select a Method.

Important

The extended 1985 characteristic files gives you more options and more flexibility than the standard 1985 file. Figure 4-2, AGA-3 Menu Tree shows the characteristics associated with the AGA-3 1985 and AGA-3 1992 equations. The AGA setup options for each of the methods are shown in Table 4-1. If extended char. is selected, the user must be using version 5.2 or later CCU software.

How to Select a Method

Use this procedure to select the AGA-3 mode and characteristic file; choices are AGA-3 1985 Fixed and AGA-3 Selectable. Fixed means the standard characteristic file is *fixed* for use with AGA-3 1985. Selectable means extended characteristics file is *selectable* for use with either AGA-3 1985 or 1992 equations.

Step	Action
1.	Connect and power-up PCCU to display Top Level Menu.
2.	From the Top Level Menu select **1) Connected to Totalflow**, to display the **FCU Connected: FCU 6410** menu. ****FCU CONNECTED: FCU-6410**** LOC: 1) Collect 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate TOTALFLOW ™ 6) Valve Note: Item 4, in the above menu, is a toggle field and will only be enabled after performing step 3 to perform the selected AGA-3 mode.

Continued on next page

How to
Select a Method (continued)

Step	Action
3.	Select item **3) Entry** and press **CONTINUE (C)** key until you reach Menu-3. Note, item 6 will read Use Old Equation Fixed. *****ENTRY MODE MENU-3***** 1) Program Display 2) Set Site Code 3) Program Aux Contact 4) Remote Communications 5) Calc. Method: **[AGA-3 1985]** 6) Use Old Equation **[Fixed]** CONTINUE for more.
4.	Select item **6) Use Old/New Equation** the message "This makes changes to the database. Are you sure ? Last Chance" will be displayed. Answer No to accept the setting or answer yes to change it to "Use Old/New Equation Selectable"

IF your are going to use...	THEN select item 6 to...
AGA-3 1985 Fixed	N/A. This is default value.
AGA-3 1985 Selectable	Use Old/New Equation Selectable
AGA-3 1992 Selectable	Use Old/ New Equation Selectable

5.	Press Esc key to return to Top Level Menu and note that item 4 now displays your setting.

Continued on next page

How to Select a Method (continued)

Step	Action
6.	Refer to the following page on how to input the data for the AGA-3 mode you selected.

IF your are going to use...	See Page
AGA-3 1985 Fixed	4-48
AGA-3 1985 Selectable	4-54
AGA-3 1992 Selectable	4-62

Continued on next page

AGA-3 Factor Mode, Table 4-1

When the FCU is powered up, no factors are selected. Either AGA-3-1985 or AGA-3 1992 can be selected for making the gas calculations. Table 4-1 shows the AGA setup options for each of the versions.

Table 4-1

			PCCU Configurable		
Parameter	**Default Value**	**Units**	**AGA-3 1985 Fixed**	**AGA-3 1985 Selectable**	**AGA-3 1992 Selectable**
Pressure Base	14.7300	PSIA	Yes	Yes	Yes
Temperature Base	60.0000	deg. F	Yes	Yes	Yes
Default fixed temp.	60.0000	deg. F	Yes	Yes	Yes
RTD installed	No		Yes	Yes	Yes
Temperature in flow calculations is	Measured		Yes	Yes	Yes
Attached to a stream?	No		Yes	Yes	Yes
Fixed anlys. on error?	No		Yes	Yes	Yes
F(pv) Calc Method		See adjacent columns ➔	No NX19 Fixed	Yes NX19 Auto	Yes AGA8 Gross Detail
Tap Type		Flange Taps	Yes	Yes	No
Tap Location		Downstream	Yes	Yes	Yes
Volume Calculation Method		AGA3 19xx	No	Yes	Yes
Volume Historical log period	3600	seconds	No	No	No
Volume calculation period	3600	seconds	No	Yes	Yes
Primary Element	Orifice		No	No	No
Fixed cd	0.6000		N/A	N/A	Yes
Z of air at base condition	0.9996		N/A	N/A	Yes
Orifice Ref. Temp	68.0000		N/A	N/A	Yes

Continued on next page

Table 4-1 (continued)

			PCCU Configurable		
Parameter	**Default Value**	**Units**	**AGA-3 1985 Fixed**	**AGA-3 1985 Selectable**	**AGA-3 1992 Selectable**
Pipe Ref. Temp	68.0000		N/A	N/A	N/A
Pipe Coef of Expansion	6.2000 E-06		N/A	N/A	Yes
Orifice Coef of Expansion	9.2500 E-06		No	No	Yes
Ratio of spec. heats	1.3000		Yes	Yes	Yes
Orifice diameter	1.0000		Yes	Yes	Yes
Orifice type	Stainless		Yes	Yes	No
Pipe diameter	2.0670		Yes	Yes	Yes
Viscosity	0.0103	Centipoise	Yes	Yes	Yes
DP zero cutoff	0.0000	inches H2O	Yes	Yes	Yes
Heating value	1000.0000	BTU/SCF	Yes	Yes	Yes
Relative base specific gravity	0.6000	(Gr)	Yes	Yes	Yes
Percent nitrogen	0.0000	mol percent	Yes	Yes	Yes
Percent carbon dioxide	0.0000	mol percent	Yes	Yes	Yes
Percent H2S	0.0000	mol percent	No	Yes	Yes
Percent water	0.0000	mol percent	No	Yes	Yes
Percent Helium	0.0000	mol percent	No	yes	Yes
Percent Helium	0.0000	mol percent	No	Yes	Yes
Percent Methane	0.0000	mol percent	No	Yes	Yes
Percent Ethane	0.0000	mol percent	No	Yes	Yes

Continued on next page

Table 4-1 (continued)

			PCCU Configurable		
Parameter	**Default Value**	**Units**	**AGA-3 1985 Fixed**	**AGA-3 1985 Selectable**	**AGA-3 1992 Selectable**
Percent Propane	0.0000	mol percent	No	Yes	Yes
Percent nButane	0.0000	mol percent	No	Yes	Yes
Percent iButane	0.0000	mol percent	No	Yes	Yes
Percent nPentane	0.0000	mol percent	No	Yes	Yes
Percent iPentane	0.0000	mol percent	No	Yes	Yes
Percent nHexane	0.0000	mol percent	No	Yes	Yes
Percent nHeptane	0.0000	mol percent	No	Yes	Yes
Percent nOctane	0.0000	mol percent	No	Yes	Yes
Percent nNonane	0.0000	mol percent	No	Yes	Yes
Percent nDecane	0.0000	mol percent	No	Yes	Yes
Percent Oxygen	0.0000	mol percent	No	Yes	Yes
Percent Carbon Monoxide	0.0000	mol percent	No	Yes	Yes
Percent Hydrogen	0.0000	mol percent	No	Yes	Yes
Percent Argon	0.0000	mol percent No	No	Yes	Yes
Ft (for Fpv method = NX19 Fixed)	1.0000		Yes	Yes	Yes
Fp (for Fpv method = NX19 Fixed)	1.0000		Yes	Yes	Yes
Fixed Fb	210.2300		Yes	Yes	N/A

Continued on next page

Table 4-1 (continued)

			PCCU Configurable		
Parameter	**Default Value**	**Units**	**AGA-3 1985 Fixed**	**AGA-3 1985 Selectable**	**AGA-3 1992 Selectable**
Fb in calculation	No		Yes	Yes	N/A
Fr in calculation	No		Yes	Yes	N/A
Y in calculation	No		Yes	Yes	Yes
Fpb in calculation	No		Yes	Yes	N/A
Ftb in calculation	No		Yes	Yes	N/A
Ftf in calculation	No		yes	Yes	N/A
Fg in calculation	No		Yes	Yes	N/A
Fpv in calculation	No		yes	Yes	Yes
Fa in calculation	No		yes	Yes	N/A
Fw in calculation	No		Yes*	Yes	Yes
Faux in calculation	No		Yes*	Yes	Yes
Use calc. cd	Yes		N/A	N/A	Yes
DP Max database value	2047.9688	inches H2O	No	No	No
AP Max database value	2047.9688	PSIA	No	No	No
*Available on Selected Configurations					

A complete description can be found in the AGA Report No. 3.

NOTE: Faux and Fw are not AGA factors.

1. Faux is a user set multiplier to compensate for liquids in the gas stream.
2. Fw is a factor which compensates for water vapor in the gas stream and its affect on volume measurements.

AGA-3 (Fixed) 1985 Method

Description

This procedure is for those users that have selected the AGA-3 (Fixed) 1985 method; reference How to Select a Method, page 4-41.

Top Menu

Select item 4 (AGA-3 1985) from the “FCU Connected..” menu to reach the AGA-3 1985 top menu This screen is used to enter AGA-3 (Fixed) 1985 factors, enter constants and send the data to the FCU.

Procedures

Step	Procedure
1.	Select item **4) AGA-3 1985** from the *****FCU CONNECTED: FCU-6410***** menu. The following message is displayed for approximately five (5) seconds. During this time, PCCU polls FCU for current AGA setup. Reading AGA Data from FCU
2.	When PCCU completes reading AGA data, the following user selectable option menu is displayed. ****AGA-3 1985 TOP MENU**** 1) Select Factors 2) Enter Constants 3) Send AGA Data to FCU

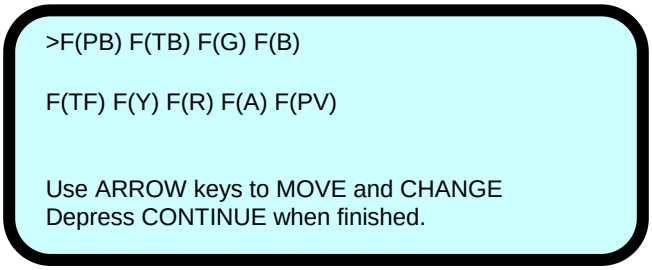
Continued on next page

Select Factors

The following procedure enables you to change or select a AGA-3 computation factor. Factors available are shown below. For a complete description of each of the factors see to AGA Report No. 3.

Fpb or F(PB)	Pressure base factor
Ftb or F(TB)	Temperature base factor
Fg or F(G)	Specific gravity factor
Fb or F(B)	Basic orifice factor
Ftf or F(TF)	Flowing temperature factor
Y or F(Y)	Expansion factor
Fr or F(R)	Reynolds number factor
Fa or F(A)	Orifice thermal expansion factor
Fpv or F(P)	Supercompressibility factor

Select Factors Procedure

Step	Procedure
1.	To change or set selected factor(s), select item **1) Select Factors** from ****AGA-3 1985 TOP MENU****. 
2.	Move to a factor using the ← and → arrow keys. To change a factor selection state, use the ↑ and ↓ keys.
3.	When finished moving to or changing factor(s), press C on PCCU keypad or ESC. The ***AGA-3 1985 TOP MENU*** is displayed. Enter **3) Send AGA Data to FCU** from the AGA-3 Top Menu. The display will acknowledge that the data has been received by the FCU.

Continued on next page

Enter Constants

The following procedure enables you to change or enter a AGA-3 computation constant. Constants available are shown below. For a complete description of each of the constants see to AGA Report No. 3.There are two screens associated with Constant menu. Pressing **CONTINUE (C)** key displays AGA-3 CONSTANTS MENU-2 screen; see Table 4-1.

Enter Constants Procedures

Step	Procedure
1.	To changed constant(s), select item **2) Enter Constants** from ****AGA-3 1985 TOP MENU****. The *****AGA-3 1985 CONSTANTS MENU-1***** menu selection screen is displayed. ****AGA-3 1985 CONSTANTS MENU-1**** 1) Orifice Diameter 2) Pipe Diameter 3) Basic Orifice Factor, F(B) 4) Composition Data 5) Pressure Base, P(B) 6) Temperature Base, T(B) CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After you enter your choice the display will return to the AGA-3 CONSTANTS MENU-1.

Continued on next page

Enter Constants Procedures (Continued)

Step	Procedure
2.	Select **1) Orifice Diameter** from the **AGA-3 CONSTANTS MENU-1.**
3.	Select **2) Pipe Diameter** from the **AGA-3 CONSTANTS MENU-1**.
4.	Select **3) Basic Orifice Factor** from the **AGA-3 CONSTANTS MENU-1**. This display shows the F(b) calculated from the selected orifice and pipe diameter. This calculation is based on flange tap connections and must be manually calculated and entered here if pipe tap connections are used.
5.	Select 4 from the AGA-3 CONSTANTS MENU-1. You will step through the following items of the Composition Data. 1. Specific Gravity 2. % Nitrogen 3. % Carbon Dioxide 4. F(p) 4. F(t) To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. Appearances of F(p) and F(t). The queries for F(p) and F(t) will appear if: GRAVITY (G) IS GREATER THAN .75 CARBON DIOXIDE (Mc) IS GREATER THAN 15% NITROGEN (Mn) IS GREATER THAN 15% If any of these conditions exist F(p) and F(t) must be hand calculated and entered through the PCCU. Otherwise, the PCCU will use the gravity method for F(pv) and will do the F(P) and F(t) calculations internally. After entering item 5 the display will return to the AGA-3 CONSTANTS MENU-1.

Continued on next page

Enter Constants (Continued)

Step	Procedure
6.	Select 5 from the AGA-3 CONSTANTS MENU-1 to enter the Pressure Base, P(B). The Pressure Base and the next Temperature Base are the base numbers for the gas volume calculations.
7.	Select 6 from the AGA-3 CONSTANTS MENU-1 to enter the Temperature Base, T(B).
8.	Push CONTINUE to display the AGA-3 CONSTANTS MENU-2. ****AGA-3 1985 CONSTANTS MENU-2**** 1) Viscosity, mu 2) Ratio of Specific Heats, CP/CV 3) Orifice Plate Material 4) Tap Type CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After item is selected the display will return to the AGA-3 CONSTANTS MENU-2.
9.	Enter 1 to enter the Viscosity.
10.	Enter 2 from the AGA-3 CONSTANT MENU-2 to enter the Ratio of Specific Heats.
11.	Enter 3 from the AGA-3 CONSTANTS MENU-2 to select the Orifice Plate Material; Stainless or Monel.

Continued on next page

Enter Constants (Continued)

Step	Procedure
12.	Enter 4 from the AGA-3 CONSTANTS MENU-2 to select the Tap Type; Flange or Pipe. After your selection a prompt will ask for AP Tap Location; chose between Upstream or Downstream.
13.	AGA-3 data must be sent to the FCU anytime AGA-3 factors or Constants are changed. Otherwise the AGA-3 calculations remain unchanged. Enter 3 Send AGA data to FCU from the AGA-2 Top Menu. The display will acknowledge that the data has been received by the FCU. The FCU will not accept data while it is making its hourly calculations. If this occurs, the display will give an FCU Busy indication. Once the calculations are completed, the sequence will complete
14.	Press Continue to return to the FCU Connected Menu.

AGA-3 (Selectable) 1985 Method

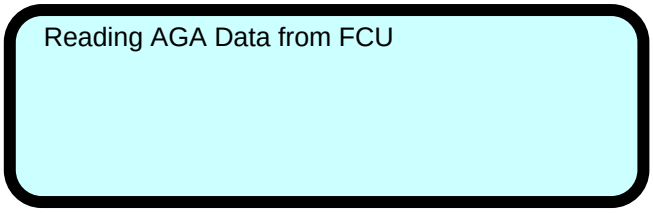
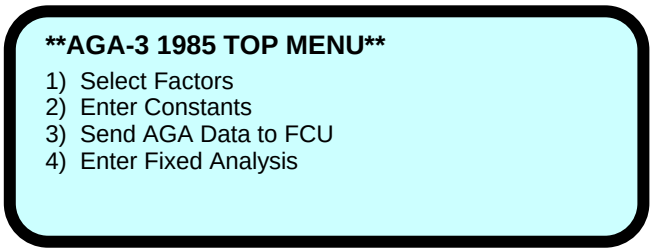
Description

This procedure is for those users who have selected the AGA-3 (Selectable) 1985 method; reference page 4-41.

Top Menu

Select item 4 (AGA-3 1985) from the “FCU Connected..” menu to reach the AGA-3 1985 top menu. This screen is used to enter AGA-3 (Fixed) 1985 factors, enter constants and send the data to the FCU.

Procedures

Step	Procedure
1.	Select **item 4) AGA-3 1985** from the *****FCU CONNECTED: FCU-6410***** menu. The following message is displayed for approximately five (5) seconds. During this time, PCCU polls FCU for current AGA setup. 
2.	When PCCU completes reading AGA data, the following user selectable option menu is displayed. 

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Select Factors

The following procedure enables you to change or select a AGA-3 computation factor. Factors available are shown below. For a complete description of each of the factors see to AGA Report No. 3.

Fpb or F(PB)	Pressure base factor
Ftb or F(TB)	Temperature base factor
Fg or F(G)	Specific gravity factor
Fb or F(B)	Basic orifice factor
Ftf or F(TF)	Flowing temperature factor
Y or F(Y)	Expansion factor
Fr or F(R)	Reynolds number factor
Fa or F(A)	Orifice thermal expansion factor
Fpv or F(P)	Supercompressibility factor

F(AUX) Non AGA Factor: a user set multiplier to compensate for liquids in the gas stream
F(W) Non AGA Factor: compensates for water vapor in the gas stream and its affect on volume measurements

Select Factors Procedure

Step	Procedure
1.	To change or set selected factor(s), select item **1) Select Factors** from ****AGA-3 1985 TOP MENU****. >F(PB) F(TB) F(G) F(B) F(TF) F(Y) F(R) F(A) F(PV) F(AUX) F(W) Use ARROW keys to MOVE and CHANGE Depress CONTINUE when finished.
2.	Move to a factor using the ← and → arrow keys. To change a factor selection state, use the ↑ and ↓ keys.
3.	When finished moving to or changing factor(s), press C on PCCU keypad or ESC. The ***AGA-3 1985 TOP MENU*** is displayed. Enter **3) Send AGA data to FCU** from the AGA-3 Top Menu. The display will acknowledge that the data has been received by the FCU.

Continued on next page

Enter Constants

The following procedure enables you to change or enter a AGA-3 computation constant. Constants available are shown below. For a complete description of each of the constants see to AGA Report No. 3. There are two screens associated with Constant menu. Pressing **CONTINUE (C)** key displays AGA-3 CONSTANTS MENU-2 screen; see AGA-3 Factor Mode, Table 4-1.

Enter Constants Procedure

Step	Procedure
1.	To changed constant(s), select item **2) Enter Constants** from ****AGA-3 1985 TOP MENU****. The *****AGA-3 1985 CONSTANTS MENU-1***** menu selection screen is displayed. ****AGA-3 1985 CONSTANTS MENU-1**** 1) Orifice Diameter 2) Pipe Diameter 3) Basic Orifice Factor, F(B) 4) Composition Data 5) Pressure Base, P(B) 6) Temperature Base, T(B) CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After you enter your choice the display will return to the AGA-3 CONSTANTS MENU-1.
2.	Select **1) Orifice Diameter** from the **AGA-3 CONSTANTS MENU-1**.
3.	Select **2) Pipe Diameter** from the **AGA-3 CONSTANTS MENU-1**.
4.	Select **3) Basic Orifice Factor** from the **AGA-3 CONSTANTS MENU-1**. This display shows the F(b) calculated from the selected orifice and pipe diameter. This calculation is based on flange tap connections and must be manually calculated and entered here if pipe tap connections are used.

Continued on next page

Enter Constants (Continued)

Step	Procedure
5.	Select 4 Composition Data from the AGA-3 CONSTANTS MENU-1. You will step through the following items of the Composition Data. 1. Specific Gravity 2. % Nitrogen 3. % Carbon Dioxide 4. Methane To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After you made all choices the display will return to the AGA-3 CONSTANTS MENU-1.
6.	Select 5 from the AGA-3 CONSTANTS MENU-1 to enter the Pressure Base, P(B). The Pressure Base and the next Temperature Base are the base numbers for the gas volume calculations.
7.	Select 6 from the AGA-3 CONSTANTS MENU-1 to enter the Temperature Base, T(B).

Continued on next page

Enter Constants (Continued)

Step	Procedure
8.	Push CONTINUE to display the AGA-3 CONSTANTS MENU-2. ****AGA-3 1985 CONSTANTS MENU-2**** 1) Viscosity, mu 2) Ratio of Specific Heats, CP/CV 3) Orifice Plate Material 4) Tap Type CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After item is selected the display will return to the AGA-3 CONSTANTS MENU-2.
9.	Enter 1 to enter the Viscosity.
10.	Enter 2 from the AGA-3 CONSTANT MENU-2 to enter the Ratio of Specific Heats.
11.	Enter 3 from the AGA-3 CONSTANTS MENU-2 to select the Orifice Plate Material; Stainless or Monel.
12.	Enter 5 from the AGA-3 CONSTANTS MENU-2 to select F(AUX). F(AUX), Full Well Stream Factor, is a user set multiplier used in the C calculation. With volume of gas measured by the orifice being affected by the liquids flowing with the gas, F(AUX) can be changed so that the volume of gas calculated by the FCU agrees with the volume of gas actually flowing through the orifice.

Continued on next page

Enter Constants (continued)

Step	Procedure
13.	Enter 4 from the AGA-3 CONSTANTS MENU-2 to select the Tap Type; Flange or Pipe. After your selection a prompt will ask for AP Tap Location; chose between Upstream or Downstream.
14.	Push CONTINUE to display the AGA-3 CONSTANTS MENU-3. ****AGA-3 1985 CONSTANTS MENU-3**** 1) Vol Calc Period [1, 2, 5, 10, 15, 30, 60] 2) Z Method [*] CONTINUE for more.
15.	Item 1 selects the Volume Calculation Period; 1, 2, 5, 10, 15, 30 or 60 minutes. To select a time, continue to press 1 until your choice is displayed.
16.	Item 2 lets you chose Z or compressibility Choices are: AGA-8 Gross — GCN=Gravity, CO2, Nitrogen *AGA-8 Detail — GCNM=Gravity, CO2,N2,Methane NX19 fixed Ft, Fp NX19 GCN or GCNM NX19 GCN NX19 GCNM To select a factor continue to press 2 until your choice is displayed. * If you are using the AGA-8 Detail option you must enter the Fixed Analysis screen; see page 4-61.

Continued on next page

Enter Constants (Continued)

Step	Procedure
17.	AGA-3 data must be sent to the FCU anytime AGA-3 factors or Constants are changed. Otherwise the AGA-3 calculations remain unchanged. Enter 3 Send AGA data to FCU from the AGA-2 Top Menu. The display will acknowledge that the data has been received by the FCU. The FCU will not accept data while it is making its hourly calculations. If this occurs, the display will give an FCU Busy indication. Once the calculations are completed, the sequence will complete
18.	Press Continue to return to the FCU Connected Menu.

Fixed Analysis

The Fixed Analysis mode is used only if you have selected the AGA-8 Detail Method for calculating FP; see page 4-59, Step (16). The AGA-8 Detailed Method calculates super compressibility based on a total analysis consisting of 21 components. Three screens are used to allow you to do the component entries for the Detailed FP method.

Fixed Analysis Procedures

Step	Procedure
1.	Select item **4) AGA-3 1985** from the *****FCU CONNECTED: FCU-6410***** menu to display the AGA-3 Top Menu.
2.	Enter 4 Fixed Analysis from the AGA-3 Top Menu. After FCU reads the Analysis data the first of three Fixed Analysis menus will be displayed. Press the Continue key to scroll through each menu. ****FIXED ANALYSIS (MOL%) MENU-1**** 1) H_2S X.XX 6) Propane X.XX 2) Water X.XX 7) n-Butane X.XX 3) Helium X.XX 8) i-Butane X.XX 4) Methane X.XX 9) n-Pentane X.XX 5) Ethane X.XX 0) I-Pentane X.XX CONTINUE for more. To enter or change a value select the number corresponding to the component. Enter the value, the press Yes.
3.	When finished moving to or changing factor(s), press C on PCCU keypad or ESC. The ***AGA-3 1985 TOP MENU*** is displayed. Enter **3) Send AGA data to FCU** from the AGA-3 Top Menu. The display will acknowledge that the data has been received by the FCU.

AGA-3 1992 Method

Description

This procedure is for those users who have selected the AGA-3 1992 method; reference How to Select a Method, page 4-41.

Top Menu

Select item 4 (AGA-3 1992) from the “FCU Connected..” menu to reach the AGA-3 1992 top menu This screen is used to enter AGA-3 1992 factors, enter constants and send the data to the FCU.

Procedures

Step	Procedure
1.	Select item **4) AGA-3 1992** from the *****FCU CONNECTED: FCU-6410***** menu. The following message is displayed for approximately five (5) seconds. During this time, PCCU polls FCU for current AGA setup. Reading AGA Data from FCU
2.	When PCCU completes reading AGA data, the following user selectable option menu is displayed. ****AGA-3 1992 TOP MENU**** 1) Select Factors 2) Enter Constants 3) Send AGA Data to FCU 4) Enter Fixed Analysis

Continued on next page

Select Factors

The following procedure enables you to change or select a AGA-3 computation factor. Factors available are shown below. For a complete description of each of the factors, see AGA Report No. 3.

F(Y)	Expansion Factor
F(PV)	Supercompressibility factor
F(W)	see below
F(AUX)	see below
CALC cd	Coefficient of discharge

F(AUX) Non AGA Factor: a user set multiplier to compensate for liquids in the gas stream
F(W) Non AGA Factor: compensates for water vapor in the gas stream and its affect on volume measurements

Select Factors Procedure

Step	Procedure
1.	To change or set selected factor(s), select item **1) Select Factors** from ****AGA-3 1992 TOP MENU****. ****AGA-3 1992 TOP MENU**** 1) Select Factors 2) Enter Constants 3) Send AGA Data to FCU 4) Enter Fixed Analysis
2.	Move to a factor using the ← and → arrow keys. To change a factor selection state, use the ↑ and ↓ keys.
3.	When finished moving to or changing factor(s), press C on PCCU keypad or ESC. The ***AGA-3 1985 TOP MENU*** is displayed. Enter **3) Send AGA data to FCU** from the AGA-3 Top Menu. The display will acknowledge that the data has been received by the FCU.

Continued on next page

Enter Constants

The following procedure enables you to change or enter a AGA-3 computation constant. Constants available are shown below. For a complete description of each of the constants see to AGA Report No. 3.There are two screens associated with Constant menu. Pressing **CONTINUE (C)** key displays AGA-3 CONSTANTS MENU-2 screen; see AGA-3 Factor Mode, Table 4-1.

Enter Constants Procedure

Step	Procedure
1.	To change constant(s), select **item 2) Enter Constants** from ****AGA-3 1992 TOP MENU****. The *****AGA-3 1992 CONSTANTS MENU-1***** menu selection screen is displayed. ****AGA-3 1992 CONSTANTS MENU-1**** 1) Orifice Diameter 2) Pipe Diameter 3) Coef. of Discharge, Cd 4) Composition Data 5) Pressure Base, P(B) 6) Temperature Base, T(B) CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After you enter your choice the display will return to the AGA-3 CONSTANTS MENU-1.
2.	Select **1) Orifice Diameter** from the AGA-3 CONSTANTS MENU-1.
3.	Select **2) Pipe Diameter** from the AGA-3 CONSTANTS MENU-1.
4.	Select **3) Coef of Discharge**, Cd from AGA-3 Constants Menu-1. Coef of Discharge (Cd) is a multiplying or correction factor to theoretical flow rate. It is derived over varying flow rates, fluid types (Reynolds number condition) and various diameter geometry's. FCU calculates Cd.

Continued on next page

Enter Constants (Continued)

Step	Procedure
5.	Select **4) Composition Data** from the AGA-3 CONSTANTS MENU-1. You will step through the following items of the Composition Data. 1. Specific Gravity 2. % Nitrogen 3. % Carbon Dioxide 4. Methane To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After you made all choices the display will return to the AGA-3 CONSTANTS MENU-1.
6.	Select 5 from the AGA-3 CONSTANTS MENU-1 to enter the Pressure Base, P(B). The Pressure Base and the next Temperature Base are the base numbers for the gas volume calculations.
7.	Select **6) Temp Base** from the AGA-3 CONSTANTS MENU-1 to enter the Temperature Base, T(B).

Continued on next page

Enter Constants (Continued)

Step	Procedure
8.	Push CONTINUE to display the AGA-3 CONSTANTS MENU-2. ****AGA-3 1992 CONSTANTS MENU-2**** 1) Vol Calc Period 60 2) Z Method [AGA8 Gross]* 3) Z of Air 4) Orif, [Stainless], Coef Exp. [9.25] 5) Pipe, [Carbon Steel], Coef Exp. [6.20] 6) F(Aux) CONTINUE for more. To change an entry press the NO key and enter the desired value. The prompt will repeat to insure you entered the correct value. Press the Yes key to advance to the next item. After item is selected the display will return to the AGA-3 CONSTANTS MENU-2.
9.	Item 1 selects the Volume Calculation Period; 1, 2, 5, 10, 15, 30 or 60 minutes. To select a time, continue to press 1 until your choice is displayed.
10.	Item 2 lets you chose Z or compressibility Choices are: AGA-8 Gross *AGA-8 Detail NX19 fixed Ft, Fp NX19 GCN or GCNM NX19 GCN NX19 GCNM To select a factor continue to press 2 until your choice is displayed. * If you are using the AGA-8 Detail option you must enter the Fixed Analysis screen; see page 4-61.

Continued on next page

Enter Constants (Continued)

Step	Procedure
11.	Select item 3 to select the compressibility or Z of Air. Default value is 0.996.
12.	Enter 4 from the AGA-3 CONSTANTS MENU-2 to select the Orifice Plate Material; Stainless or Monel or Special.
13.	Enter 5 from the AGA-3 CONSTANTS MENU-2 to select the Material; Stainless or Monel or Special.
14.	Enter 6 from the AGA-3 CONSTANTS MENU-2 to select F(AUX). F(AUX), Full Well Stream Factor, is a user set multiplier used in the C calculation. With volume of gas measured by the orifice being affected by the liquids flowing with the gas, F(AUX) can be changed so that the volume of gas calculated by the FCU agrees with the volume of gas actually flowing through the orifice.
15.	Push CONTINUE to display the AGA-3 CONSTANTS MENU-3. ****AGA-3 1992 CONSTANTS MENU-3**** 1) Viscosity, mu 2) Ratio of Specific Heats, CP/CV 3) AP Tap Loc 4) Tap Type CONTINUE for more.

Continued on next page

Enter Constants (Continued)

Step	Procedure
16.	Enter 1 to enter the Viscosity.
17.	Enter 2 from the AGA-3 CONSTANT MENU-2 to enter the Ratio of Specific Heats.
18.	Enter 4 from the AGA-3 CONSTANTS MENU-2 to select AP Tap Location; choose between Upstream or Downstream.
19.	AGA-3 data must be sent to the FCU anytime AGA-3 factors or Constants are changed. Otherwise the AGA-3 calculations remain unchanged. Enter 3 Send AGA data to FCU from the AGA-2 Top Menu. The display will acknowledge that the data has been received by the FCU. The FCU will not accept data while it is making its hourly calculations. If this occurs, the display will give an FCU Busy indication. Once the calculations are completed, the sequence will complete.
20.	Press Continue to return to the FCU Connected Menu.

Continued on next page

Fixed Analysis

The Fixed Analysis mode is used only if you have selected the AGA-8 Detail Method for calculating FP; see page 4-66, step (10). The AGA-8 Detailed Method calculates super compressibility based on a total analysis consisting of 21 components. Three screens are used to allow you to do the component entries for the Detailed FPB method.

Step	Procedure
1.	Select item **4) AGA-3 1992**) from the *****FCU CONNECTED: FCU-6410***** menu to display the AGA-3 Top Menu.
2.	Enter 4 Fixed Analysis from the AGA-3 Top Menu. After FCU reads the Analysis data the first of three Fixed Analysis menus will be displayed. Press the Continue key to scroll through each menu. ****FIXED ANALYSIS (MOL%) MENU-1**** 1) H_2S X.XX 6) Propane X.XX 2) Water X.XX 7) n-Butane X.XX 3) Helium X.XX 8) i-Butane X.XX 4) Methane X.XX 9) n-Pentane X.XX 5) Ethane X.XX 0) I-Pentane X.XX CONTINUE for more. To enter or change a value select the number corresponding to the component. Enter the value, the press Yes.
3.	When finished moving to or changing factor(s), press C on PCCU keypad or ESC. The ***AGA-3 1992 TOP MENU*** is displayed. Enter **3) Send AGA data to FCU** from the AGA-3 Top Menu. The display will acknowledge that the data has been received by the FCU.

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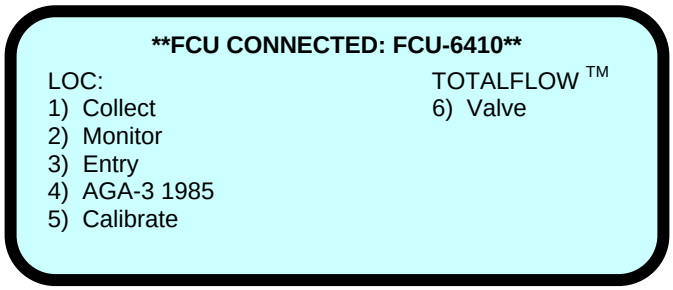
Calibration Mode

Overview

To select Calibrate Mode you must select **5) Calibrate** from **FCU Connected Menu**.



Calibrate Menu

After entering 5, the Calibrate Menu is displayed. The calibration mode enables you to calibrate, check and zero the absolute and differential pressure transducer in an FCU. In addition, this mode allows you to set the bias for the Resistance Temperature Detector (RTD). To move from Calibrate menus 1 and 2 simply enter the letter **(C)**, or simultaneously push the paw and **CONTINUE (C)** key. Continually holding the keys will cycle the menus.

Menu Choices	Menu Number	See Page
Calibrate AP	1	4-73
Calibrate DP	1	4-81
Check AP	1	4-83
Check DP	1	4-86
Set Up Temperature	1	4-90
Zero AP Transducer	2	4-96
Zero DP Transducer	2	4-98

Continued on next page

Required Test Equipment

The following test equipment is required to calibrate the FCU transducer:

- PCCU
- Deadweight tester or equivalent calibration standard
- Barometer or another means which can determine barometric pressure
- Nitrogen or compressed air source

Important

If a method other than the 'compressed nitrogen / deadweight tester' method is used to calibrate Absolute Pressure Transducer, you must ensure that the prescribed Flange Tap valves are blocked to prevent false differential pressure from being applied to DP Transducer. During the AP calibration, the FCU reads the 'actual' line pressure effects on DP transducer and compensates DP calibration accordingly after the AP calibration is completed. Also ensure that both high and low sides are pressured up during AP calibration.

Hold Mode

When calibrating a transducer or setting up a temperature, the PCCU will instruct the FCU to ignore any changes to the flow calculations for the period of time the FCU is being calibrated. This prevents real time FCU flow calculations from being affected during the present calibration. During this time the FCU continues to use values from the last calibration period. (This is called the “HOLD” mode.)

Flow calculations, temporarily in hold mode, can be removed by the following methods:

- Unplug DATA cable at FCU connector.
- Exit Calibration mode using PCCU Esc. key

Description

A three or five point pressure method is used to calibrate the FCU Absolute Pressure Transducer. These different pressures are applied to the transducer from a known traceable source with resultant pressure values entered into FCU using the PCCU.

Note When doing the following procedures wait for the FCU display to stabilize. If the FCU is not in the calibration mode the display will not necessarily match applied transducer pressures.

Before You Begin

The following information is important:

Because the FCU uses an Absolute Pressure (AP) Transducer, the initial calibration point is barometric pressure reading in psig. Measured pressure reflects changing barometric pressure.

When the Absolute Pressure Transducer is vented, it measures true barometric pressure.

To convert barometric pressure measured from inches of mercury to Barometric Pressure (psi), perform the following calculation:

- Barometric pressure, in inches of mercury x .4912 or (÷ 2.036) equals Barometric Pressure in psi.

3-Point calibrate AP Procedures

Step	Procedure
1.	Select item **1) Calibrate AP** from the *****Calibrate Menu 1***** menu. A prompt message will query you on the calibration method to be used. Enter a Yes to accept a 3 point or a No if you want to do a 5 point calibration, and go to page 179.

Continued on next page

3-Point Calibrate AP Procedures (Continued)

Step	Procedure
2.	After you selected Yes to the 3-point calibration method a prompt message will ask you to vent, to atmosphere, both sides of AP Transducer and then enter a new barometric pressure. Vent Both Sides of Transducer Enter New Barometric Pressure _____
3.	Vent, to atmosphere, both sides of AP Transducer, and enter barometric pressure. A verification prompt asks if the correct barometric pressure was entered. You entered xx.xx psia ok? ___
4.	If the entered barometric pressure is correct and the FCU display is stable enter Yes to proceed or No to change entry. After correct barometric pressure is entered, a user prompt is displayed to enter new AP range. Pressure Both Sides of Transducer Enter New AP Range ____
5.	Apply upper range source pressure to the AP transducer in psia.
6.	Calculate the actual absolute pressure by adding the applied pressure transducer gauge reading plus the barometric pressure. Because a dead weight pressure source generates gauge pressure, barometric must be added to the output value for proper calibration of the AP transducer. Absolute pressure (psia) = applied pressure (psi) + barometric pressure (psi).

Continued on next page

3-Point Calibrate AP Procedures (Continued)

Important Check FCU system for pressure leaks. No leaks should be present during the AP calibration sequence. During the AP calibration, the FCU measures the line pressure effect errors associated with the DP transducer and compensates the DP transducer for actual effects.

Step	Procedure
7.	Enter new AP range. A verification prompt asks if the correct range was entered. You entered xx.xx psia ok? ___
8.	If the entered AP range is correct and the FCU display is stable, enter Yes to proceed or No to change entry. After correct AP Range is entered, a user prompt is displayed to enter new expected AP range. Pressure Both Sides of Transducer Enter Expected AP ____
9.	Pressure up the calibration source to the AP transducer and apply the desired expected value in psia. Calculate the actual absolute pressure; see step 5. This 3rd point can be and usually is mid range value. Sometimes accuracy can be improved if 3rd point is normal operating pressure.
10.	Enter the calculated absolute pressure. A verification prompt asks if correct barometric pressure was entered. You entered xx.xx psia ok? ___

Continued on next page

Calibrating Absolute Pressure (AP), Continued

3-Point Calibrate AP Procedures (Continued)

Step	Procedure
11.	If the entered pressure is correct and the FCU display is stable, enter Yes to calibrate or No to change entry. A prompt message will indicate the start of calibration and finish with: CALIBRATION COMPLETE

Note: At this time the FCU display should be measuring the correct pressure.

12.	Depressing **CONTINUE (C)** redisplays **CALIBRATE MENU-1** menu.

5- Point Calibrate AP Procedures (Some older PCCU's may not support a 5-point calibrate)

Step	Procedure
1.	Select item **1) Calibrate AP** from the **Calibrate Menu 1***** menu. A prompt message will query you on the calibration method to be used. Enter a No to reject the 3 point calibration. The following prompt screen will appear. Enter a Yes to accept a 5 point calibration. Do 5 Point Calibration ok? ___
2.	After you selected Yes to the 5-point calibration method a prompt message will ask you to vent, to atmosphere, both sides of the AP Transducer and then enter a new barometric pressure. Vent Both Sides of Transducer Enter New Barometric Pressure _____

Continued on next page

5-Point Calibrate AP Procedures (Continued)

Step	Procedure
3.	Vent, to atmosphere, both sides of AP Transducer, and enter barometric pressure. A verification prompt asked if correct barometric pressure was entered. You entered xx.xx psia ok? ___
4.	If the entered barometric pressure is correct and the FCU display is stable, enter Yes to proceed or No to change entry. A verification prompt asked if correct value was entered. Pressure Both Sides of Transducer Enter New AP Mid Lo Range ___
5.	Pressure up the calibration source to the AP transducer and apply the desired AP Mid Lo Range value in psia.
6.	Calculate the actual absolute pressure by adding the applied pressure transducer gauge reading plus the barometric pressure. Because a dead weight pressure source generates gauge pressure, barometric must be added to the output value for proper calibration of the AP transducer. Absolute pressure (psia) = applied pressure (psi) + barometric pressure (psi).

Important

Check FCU system for pressure leaks. No leaks should be present during the AP calibration sequence. During the AP calibration, the FCU measures the line pressure effect errors associated with the DP transducer and compensates the DP transducer for actual effects.

Continued on next page

5-Point Calibrate AP Procedure (Continued)

Step	Procedure
7.	Enter the new AP Mid Lo value. A verification prompt asked if the correct value was entered. You entered xx.xx psia ok? ___
8.	If the entered AP Mid Low value is correct and the FCU display is stable enter Yes to proceed or No to change entry. After correct AP Mid Range is entered, a user prompt is displayed to enter new AP Mid Range. Pressure Both Sides of Transducer Enter New AP Mid Range ___
9.	Pressure up the calibration source to the AP transducer and apply the desired AP Mid range value in psia. Calculate the actual absolute pressure; see step 5.
10.	Enter the calculated absolute AP Mid pressure range. A verification prompt asks if the correct AP Mid Range pressure was entered. You entered xx.xx psia ok? ___

Continued on next page

5-Point Calibrate AP Procedure (Continued)

Step	Procedure
11.	If the entered AP Mid Range value is correct and the FCU display is stable, enter Yes to proceed or No to change entry. After correct value is entered, a user prompt is displayed to enter new AP Mid High range. Pressure Both Sides of Transducer Enter New AP Mid High Range ___
12.	Pressure up the calibration source to the AP transducer and apply the desired AP Mid High value in psia.
13.	Calculate the actual absolute pressure by adding the applied pressure transducer gauge reading plus the barometric pressure. Because a dead weight pressure source generates gauge pressure, barometric must be added to the output value for proper calibration of the AP transducer. Absolute pressure (psia) = applied pressure (psi) + barometric pressure (psi).
14.	Enter new AP Mid Hi range. A verification prompt asked if correct range was entered. You entered xx.xx psia ok? ___
15.	If the entered AP Mid High is correct and the FCU display is stable, enter Yes to proceed or No to change entry. After correct value is entered, a user prompt is displayed to enter new expected AP range. Pressure Both Sides of Transducer Enter New AP High Range ___

Continued on next page

5-Point Calibrate AP Procedure (Continued)

Step	Procedure
16.	Pressure up the calibration source to the AP transducer and apply the desired upper range value in psia. Calculate the actual absolute pressure; see step 5.
17.	Enter the calculated absolute pressure. A verification prompt asks if the correct barometric pressure was entered. You entered xx.xx psia ok? ___
18.	If the entered AP High Range pressure is correct and the FCU display is stable, enter Yes to proceed or No to change entry. A prompt message will be displayed that indicates the start of calibration and finish with. CALIBRATION COMPLETE
19.	Depressing **CONTINUE (C)** redisplays **CALIBRATE MENU-1** menu.

Important Line Pressure Correction to Differential Pressure (DP).

Note Any Differential Pressure (DP) measured by DP cell during Absolute Pressure calibration, is considered a false DP. A false DP is subtracted or added, if negative from total DP cell indication.

For this feature to work, low DP calibration point must be vented to atmosphere. Any Absolute Pressure calibration must be made with DP cell equalized.

Calibrate DP Procedures

Step	Procedure
1.	From the **Calibrate Menu-1**, select **2) Calibrate DP** (Differential pressure). When selected, the following user prompt is displayed. Vent Both Sides of Transducer Enter New DP Zero ___
2.	Vent, to atmosphere, both sides of the AP Transducer, and enter the DP pressure. A verification prompt asked if correct value was entered. You entered xx.xx in H2O ok? ___
3.	If the entered value is correct and the FCU display is stable, enter Yes to proceed or No to change entry. After the correct value is entered, a prompt is displayed asking you to enter a new DP range. Vent Low Side, Pressure Hi Side Enter New DP Range ___

Continued on next page

Calibrate DP Procedures, (Continued)

Step	Procedure
4.	If the entered value is correct and the FCU display is stable, enter Yes to proceed or No to change entry. After the correct value is entered, a prompt is displayed asking you to enter the next pressure point. Repeat step 3 until all points have been entered.
5.	After the last entry is made a prompt message will indicate the start of calibration and finish with: CALIBRATION COMPLETE After Absolute Pressure calibration, verify operation of line pressure by applying line pressure with DP cell equalized. Zero DP should be indicated. A reading, other than zero, indicates a possible meter run manifold leaks or non-equalized DP during calibration of Absolute Pressure.

Note: At this time the FCU display should be measuring the correct pressure.

6.	Depressing **CONTINUE (C)** redisplays **CALIBRATE MENU-1** menu..

Description

The PCCU allows you to check the FCU Absolute Pressure Calibration and log the pressure marker check points into the FCU EVENTS file.

Check AP Procedures

Step	Procedure
1.	From the **Calibrate Menu-1**, select Check AP (Absolute Pressure) by entering 3. When selected, the following user prompt is displayed. Pressure Both Sides of Transducer. Enter New Expected AP. Pressure Marker No. <1> psia.

Note

The FCU display provides continuous AP Transducer readouts; however during this procedure the FCU is placed in a temporary hold mode.

2.	Read barometric pressure and perform the following procedures: • Apply a check pressure equally to both sides of Absolute Pressure Transducer. • Add applied Absolute Pressure check pressure to the barometric pressure reading.
3.	Compare the applied pressure values to the pressure shown on FCU display when display stabilizes.

Caution

The resulting comparison pressure must not be greater than absolute pressure transducer's maximum pressure**.**

Continued on next page

Checking AP Procedures (Continued)

Step	Procedure
4.	If the Applied Pressure markers are not desired, press Esc to return to the **CALIBRATE MENU-1**.
5.	To log the pressure marker check points into the FCU, enter the applied Absolute Pressure value then press Yes. This causes the PCCU to instruct the FCU, to log the entered pressure value along with measured value into the FCU event File as a pressure marker. PCCU displays the value entered your verification.
6.	If the pressure value is correct, press Yes. If value is not correct, press No and enter correct value. If the value is correct the PCCU instructs the FCU to log the entered value along with the measured value into the FCU Event File as a pressure marker. Once logged a prompt screen asks you to enter a new expected value.
7.	If another AP pressure marker is desired, enter applied absolute pressure value and depress Yes. If no further AP pressure markers are required, depress Esc to return to **CALIBRATE MENU-1** menu.

Continued on next page

Checking AP Procedures (Continued)

Important

The PCCU displayed PRESSURE MARKER no. <1> psia informs you how many AP pressure markers have been logged during current session. This is similar to a camera frame counter.

Caution

You can enter as many AP pressure markers as you desire, however, do not log an excessive number. Typically, 3 or 5 is recommended. If 3, enter a low, mid and high value. If 5 enter a low, mid-low, mid, mid-high and high value.

Important additional events are recorded in the FCU events file. Recording to many markers causes FCU to overwrite existing older events.

Description

The PCCU allows you to check the FCU DP Calibration and log pressure marker check points into a FCU EVENTS FILE from this mode.

Checking DP Procedures

Step	Procedure
1.	From the **Calibrate Menu 1**, select **4) Check DP** (Differential pressure). When selected, the following user prompt is displayed. Vent Low Side, Pressure Hi Side. Enter New Expected DP. Pressure Marker No. <1> in. H_2O

Note

The FCU display provides continuous readouts of the Differential Pressure Transducer. During any check mode the FCU is placed in a temporary hold condition.

Continued on next page

Checking DP Procedures, (Continued)

Step	Procedure
2.	Vent the manifold. Differential pressure must read zero (0). Pressure both high and low sides of meter run installed manifold to operating pressure. Block the pressure source. Differential pressure must remain at zero (0) +/- 0.1%. The PCCU LCD screen displays user instructional prompts. Vent Low Side, Pressure Hi Side. Enter New Expected DP. Pressure Marker No. <1> in. H_2O If problems are encountered, be certain that the DP remains at zero (0). The value must be under the operating line pressure. To isolate problems, check the following: • pressure leaks in system • re-calibrate AP; 1) Calibrate AP • re-calibrate DP; 2) Calibrate DP
3.	Apply differential check pressures across DP

Note

When the FCU display stabilizes, compare applied pressure values with FCU displayed pressures.

The Pressure value **Shall Not** be greater than Differential Transducer maximum pressure rating.

Continued on next page

Checking DP Procedures (Continued)

Step	Procedure
4.	If the Differential pressure markers are not desired, press Esc to display the **CALIBRATE MENU-1**.
5.	Log Transducer differential pressure marker check points into FCU. Enter the value of applied differential pressure into PCCU then depress Yes.
6.	The PCCU instructs the FCU to log the entered differential pressure value, along with measured pressure value, into the FCU EVENT file as a pressure marker.
7.	If the entered pressure value is correct, press Yes. The following prompt screen is displayed. If pressure **is not correct**, press No and enter the correct pressure value. Vent Low Side, Pressure Hi Side. Enter New Expected DP XX. You Entered XX.XX in. H2O Ok? Sending Marker XX.X to FCU Pressure Marker No. <1> in. H_2O

Continued on next page

Checking DP Procedures, (Continued)

Important

The PCCU displayed PRESSURE MARKER no. <1> in. H2O informs you how many DP pressure markers have been logged during the current session. This is similar to a camera frame counter.

Caution

Enter as many DP pressure markers as you desire, however, do not log an excessive number. Typically, 3 or 5 is recommended. If 3, enter a low, mid and high value. If 5 enter a low, mid-low, mid, mid-high and high value.

Important additional events are recorded in the FCU events file. Recording to many markers causes the FCU to overwrite existing older events.

Step	Procedure
8.	After entering each DP pressure, depress Yes if pressure is correct. The PCCU sends the pressure marker value to the FCU. Another user prompt is displayed requesting user to send next marker if required. When sending markers is completed, depress Esc to return to CALIBRATE MENU-1.

Description

Although the RTD (Resistive Temperature Detector) temperature is accurately self-calibrating, you can match it to another reference source. This is accomplished by entering temperature bias, which shifts the RTD probe curve either positive or negative.

Setting FCU Temperature Calculation

The FCU temperature calculations can be set to the following conditions. Setting each condition is described in the following applicable Sections.

Selection of Fixed Temperature Used in Calculations. The procedures are used as a fixed temperature in calculations.

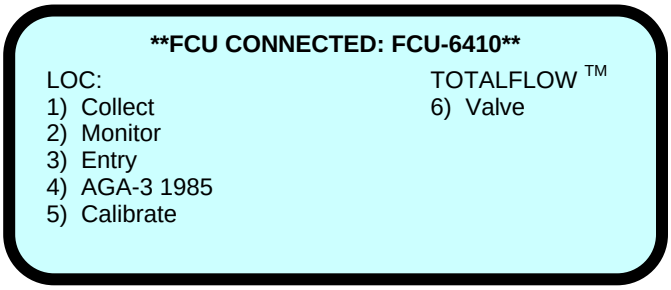
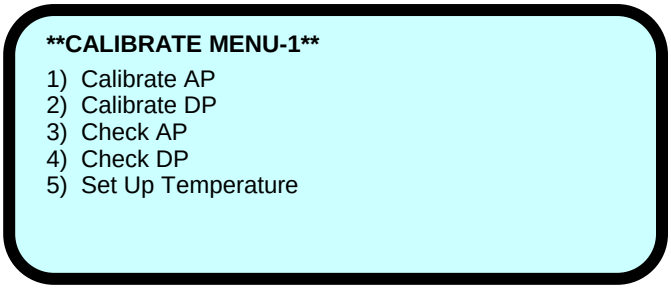
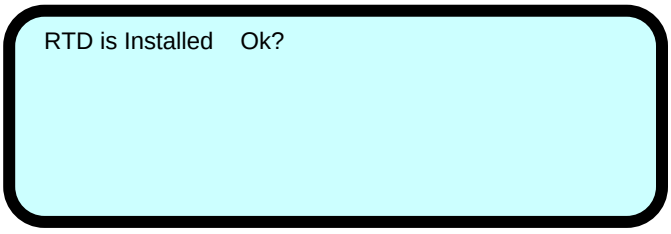
Selection of Fixed Temperature Used in Calculations While Monitoring RTD Temperature**.** The procedures measure and record RTD temperature using fixed temperature in calculations.

Selection of RTD Measurements Used in Calculations. Procedures measure and record RTD temperature.

Important

If RTD probe is used in calculations, and fails or over-ranges, temperatures default to fixed temperature.

Procedures

Step	Procedure
1.	Select **5) Calibrate** from **FCU CONNECTED** menu. 
2.	When selected, the **CALIBRATE MENU-1** is displayed. From Calibrate Menu 1, select Set Up Temperature by entering 5. 
3.	Press No until the following screen is displayed. 

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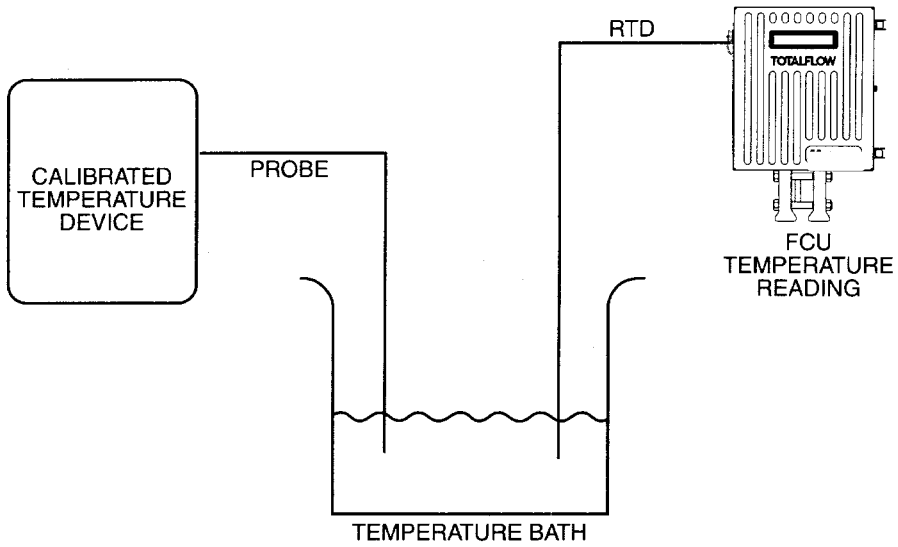
Selection of Fixed Temperature While Monitoring RTD Temperature, Continued

Procedures (Continued)

Step	Procedure
4.	Enter Yes, a verification prompt asked if the fixed value is correct. Fixed Temperature is XX.X deg. F. Ok? If displayed fixed temperature is correct, depress Yes. If not correct, press No and enter correct fixed temperature.
5.	If No was entered the PCCU screen displays the newly entered temperature. This allows your to change value. If the new temperature is correct, press Yes. The **CALIBRATE MENU-1** is displayed.

Important To accurately setup the RTD temperature the following test setup or equivalent should be used for the following procedures.



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Procedures

Step	Procedure
1.	Select **5) Calibrate** from **FCU CONNECTED: FCU 6410** menu. ****FCU CONNECTED: FCU-6410**** LOC: TOTALFLOW ™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate

Continued on next page

Procedures (Continued)

Step	Procedure
2.	When selected, the **CALIBRATE MENU-1** is displayed. From **Calibrate Menu 1**, select Set Up Temperature by entering 5. ****CALIBRATE MENU-1**** 1) Calibrate AP 2) Calibrate DP 3) Check AP 4) Check DP 5) Set Up Temperature CONTINUE for more. .
3.	Press No until the following screen is displayed. RTD is Installed. Ok?
4.	Enter Yes, the following verification prompt will be displayed. If not, press No until the RTD is used in calcs. user verification prompt is displayed. RTD is used in calcs. Ok?

Continued on next page

Selection of Fixed Temperature, Continued

Procedures (Continued)

Step	Procedure
5.	Enter Yes, the following verification prompt will be displayed. RTD bias is XX.X deg. F. Ok? If the displayed RTD bias is correct, depress Yes. If not correct, press No and enter correct bias temperature in degrees F.
6.	If No was entered the PCCU screen displays the newly entered temperature. This allows you to change value. If new temperature is correct, press Yes. The **CALIBRATE MENU-1** is displayed.

Zero Absolute Pressure (AP) Transducer Calibrate Mode Menu-2

Description

The Absolute Pressure (AP) can be zeroed without it having to be re-calibrated. If AP shifts, user can enter new barometric pressure value using PCCU. This shifts the AP Transducer curve. The re-zero function assumes that Transducer shift is linear. Transducer must first be calibrated.

Procedure

Step	Procedure
1.	From the **CALIBRATE MENU-1**, press **CONTINUE (C).** The following menu is displayed. This menu provides additional user selectable options. ****CALIBRATE MENU-2**** 1) Zero AP Transducer 2) Zero DP Transducer 3) Transducer Temperature Correction CONTINUE for more. *Selection 3 above does not apply to Model 6400 Series FCU's.
2.	Enter 1 to select Zero AP Transducer. When selected, the following user prompt is displayed. Vent Both Sides of Transducer Enter New Barometric Pressure ___ Before entering zero barometric pressure wait for FCU LCD display to stabilize. Both sides of Absolute Pressure Transducer must be equalized and vented to atmosphere.
3.	Enter a new barometric pressure reading then press Yes. User verification prompt is displayed to be certain entry is correct.

Continued on next page

Procedure (Continued)

Step	Procedure
4.	If not correct, press No and enter new barometric pressure value. After entering barometric pressure, PCCU LCD screen displays user calibrating and calibrating complete screens.
5.	Following calibration, pressing **CONTINUE (C)** redisplays **CALIBRATION MENU-2.**

Zero Differential Pressure (DP) Transducer Calibrate Mode Menu-2

Description

The Differential Pressure (DP) can be zeroed without it having to be re-calibrated. If DP shifts, user can enter a new zero (0) using PCCU. This shifts the DP Transducer curve. The re-zero function assumes that Transducer shift is linear. Transducer must first be calculated.

Procedure

Step	Procedure
1.	From **CALIBRATE MENU-1**, press **CONTINUE (C).** The following menu is displayed. This menu provides additional user selectable options. ****CALIBRATE MENU-2**** 1) Zero AP Transducer 2) Zero DP Transducer 3) Transducer Temperature Correction CONTINUE for more. *Selection 3 above does not apply to Model 6400 Series FCU's.
2.	Enter 2 to select Zero DP Transducer. When selected, the following user prompt is displayed. Vent Both Sides of Transducer Enter New DP Zero ___

Note

Before entering zero (0), wait for FCU LCD display to stabilize. Both sides of Absolute Pressure Transducer must be equalized and vented to atmosphere.

Continued on next page

Zero Differential Pressure (DP) Transducer, Continued

Procedure (Continued)

Step	Procedure
3.	Enter new DP Zero reading then press Yes. A verification prompt is displayed asking you to be certain the entry is correct. You entered xx.xx in H2O ok? ___
4.	If not correct, press No and enter new barometric pressure value. After entering DP Zero the PCCU screen displays the calibrating and calibrating complete screens.
5.	After the calibration is performed press **CONTINUE (C)** to return to the **CALIBRATION MENU-2**.

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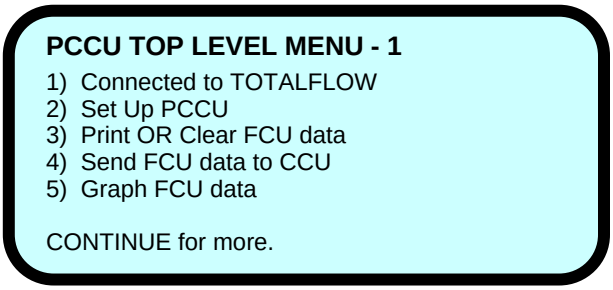
Set Up PCCU

Overview

This section provides you with instructions for setting up the PCCU.

To select PCCU setup instructions, you must select **2) Set Up PCCU** from **PCCU TOP LEVEL MENU-1**.



After entering 2**,** the SET-UP PCCU MENU is displayed presenting user selectable options.

User Selectable Options

These sections provide you with instructions for each user selectable option.

PCCU Security

Description

The security code is a four digit code and can be entered to automatically match up with LEVEL 1 or Level 2 security code set in the FCU; see Programming Security Code, page 4-20.

Procedures

Step	Procedure
1.	To enter user security code, select **PCCU Security Code** by entering **1.** The display will prompt you if the Security Code is ok.
2.	If new user security code is to be entered, press NO. The PCCU LCD screen will ask you to enter the new code.
3.	If code is correct, enter Yes. If a new user security code is to be entered, press No. The PCCU LCD screen will ask you to enter a new four (4) digit security code.

PCCU Communication Setup

Description

The PCCU Communication Setup lets you enter the baud rates for the communication link as well specifying the CCU connection.

Procedure

Step	Procedure
1.	To enter user PCCU Communication Setup functions, select PCCU Communication Setup by entering **2.** *****PCCU COMMUNICATION SETUP MENU***** 1) Print Speed [9600] 2) CCU Speed [9600] 3) CCU Connection [Cable] 4) CCU Telephone No.
2.	Select baud rate of printer. Entering 1 selects baud rate of printer connected to PCCU. Depressing PCCU keypad **1** key, toggles between 150, 300, 600, 1200, 2400, 4800 and 9600 baud rates. This matches PCCU baud rate with baud rate of receiving printer.
3.	Select CCU baud rate. Baud Rate of CCU: Entering **2** selects baud rate of CCU connected to PCCU. Depressing PCCU keypad **2** key, toggles between 150, 300, 600, 1200, 2400, 4800 and 9600 baud rates. This matches PCCU baud rate with baud rate of CCU.

Continued on next page

Procedure (Continued)

Step	Procedure
4.	Toggle modem or cable. Connection: Selects connection between PCCU and CCU. Connection can either be a cable or modem.
5.	Enter CCU Telephone Number. CCU Telephone Number**:** If a modem is selected by entering **3**, telephone number can be entered. The PCCU LCD screen displays the following menu. *****PCCU COMMUNICATION SETUP MENU***** 1) Print Speed [9600] 2) CCU Speed [9600] 3) CCU Connection [Cable] 4) CCU Telephone No. Enter CCU Telephone Number
6.	Enter telephone number of receiving CCU and press **Yes**. PCCU LCD screen shows entered CCU telephone number. Telephone number **must be** prefixed with a **T** (touch phones) or **P** (pulse or rotary phones).
7.	To return to **SET-UP PCCU MENU,** press **Esc**. Another user option can be selected.

PCCU Collection Size

Description

The data collection capacity is determined by amount of memory within PCCU. It is also determined by PCCU installed software updates, size of database and other programs.

PCCU Meter Capacities

The FS/2 PCCU (see Chapter 2.0) has the following minimum meter capacities. Refer to the following Table.

FS/2 PCCU Meter Capacities

Memory Capacity	# of Meters
1.0 M	13
1.5 M	45
2.0 M	77
3.0 M	141

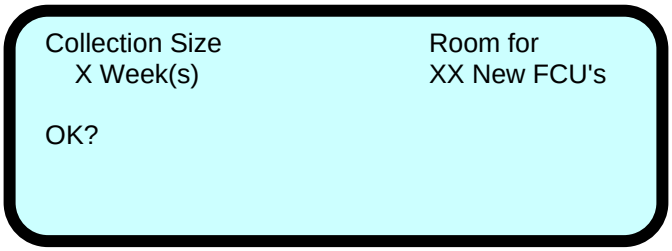
Referring to Table, the number of meters is based on collecting a maximum of five (5) weeks of data information for each meter.

To gain data storage capacity for more FCU units, collection capacity can be decreased below five (5) weeks. Valid collection capacities are one to five weeks. This is based on one week increments.

Continued on next page

PCCU Collection Size, Continued

Procedure

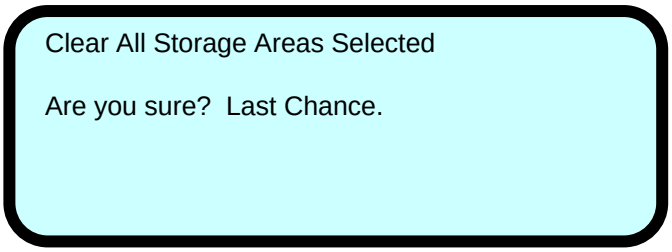
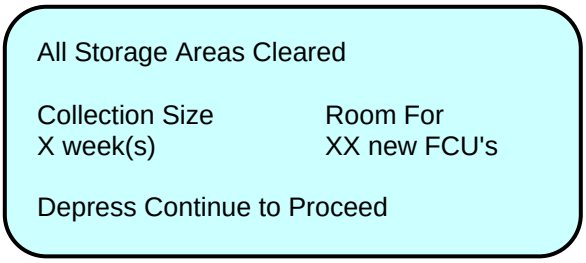
Step	Procedure
1.	To enter data Collection Size, select **3) Collection Size.** 
2.	If data collection size is satisfactory, enter Yes**.** The SET-UP PCCU MENU is redisplayed. Another user selectable option can be selected.
3.	To change data collection size, press No**.** The PCCU screen will ask you to enter new collection size.
4.	Enter new data collection size. PCCU LCD screen shows new entry. Keeping data collection size small allows additional memory storage capacity for more FCU's.
5.	Depressing either Yes or Esc, redisplays SET-UP PCCU MENU.

Clear All FCU Storage Areas

Description

All previously collected data can be cleared, from PCCU memory, using option Clear All FCU Storage Areas.

Procedure

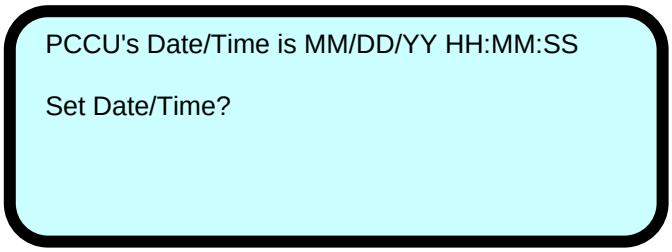
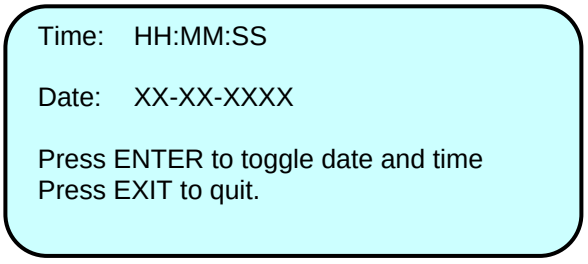
Step	Procedure
1.	To enter Clear All FCU Storage Area's option, select **4) Clear All FCU Storage Areas.** 
2.	For PCCU to clear FCU collected data, enter Yes. When cleared, the following screen is displayed. 
3.	Depressing **CONTINUE (C)** redisplays **SET-UP PCCU MENU.**

Set PCCU Calendar/Clock

Description

The following procedure sets the calendar and clock in the PCCU.

Procedure

Step	Procedure
1.	To enter Set PCCU Calendar/Clock option, select **5) Set PCCU Calendar/Clock.** The following screen is displayed. 
2.	If date and time *are not* to be set, press No**.** The SET-UP PCCU MENU is redisplayed. If date and time *are* to be set, press Yes. The following user prompt is displayed. 

Continued on next page

Procedure (Continued)

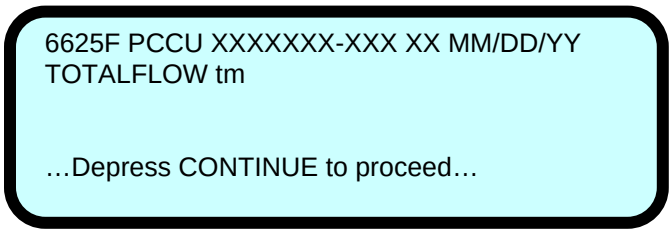
Step	Procedure
3.	Enter necessary time and date. To set time, the following user prompt is displayed. Before entering minutes, hours MUST BE entered. Before seconds are entered, hours and minutes MUST BE entered. Set time ahead a few seconds or the succeeding minute. Time: HH:MM:SS press ENTER to set the time Date: XX-XX-XXXX Press ENTER to toggle date and time Press EXIT to quit.
4.	When entered time *equals* actual time, press YES**.** Clock is now running on new time and cursor moves down to Date**:** field. Time displayed on PCCU LCD screen does not continually show actual time. Whenever **Yes** is pressed, time is updated.
5.	When cursor is flashing in Date**:** field, new date can be entered. When entire data is entered, the following user prompt is displayed. Enter entire date even if some data numbers are correct. Time: HH:MM:SS Date: XX-XX-XXXX press ENTER to set the date Press ENTER to toggle date and time Press EXIT to quit.
6.	To return to SET-UP PCCU MENU**,** press Esc**.** Another user option can be selected.

PCCU Software Rev Level

Description

The following procedure lets you see the revision of software being used.

Procedure

Step	Procedure
1.	To enter PCCU Software Rev Level option, select PCCU Software Rev Level by entering 6**.** Displayed data, on screen, indicates which software is installed in PCCU. 
2.	To return to SET-UP PCCU MENU**,** press CONTINUE**.** The SET-UP PCCU MENU is redisplayed. Another user selectable option can be selected.

Description

The Print or Clear FCU Data mode allows you to perform the following functions from the PCCU.

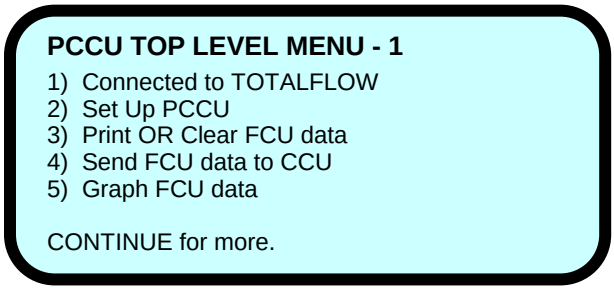
- Display PCCU held collected data on PCCU LCD screen.
- Clears PCCU memory of individual meters.
- Provide a file report printout.

Suggestion

Although reports can be printed from the handheld unit, it is recommended that if the user has Central Collection Unit software (CCU) running on a desktop, it is more convenient to print reports from there.

Menu Description

The Print or Clear FCU Data mode function is selected from the **PCCU TOP LEVEL MENU-1** by entering **3.**



Continued on next page

Print or Clear FCU Data, Continued

Procedure

Read through the following procedural steps before you begin. The Print or Clear FCU Data function is selected from the PCCU TOP LEVEL MENU-1**.**

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1.</td><td>Select 3) Print or Clear FCU Data from the PCCU TOP LEVEL MENU-1 to display ID Selection Menu.

ID SELECTION MENU*
1) Print ID list to Screen
2) Print ID list to Printer
3) Select ALL
4) Select by ID
5) Select by SEQ. No.
6) Select [FCU]</td></tr>
<tr><td>2.</td><td>If you are printing or clearing data from a FCU verify that item 6 on the ID Selection Menu is set to FCU; refer to Totalflow Analyzer Interface Unit User’s Manual 2012978-001 for information on the AIU setting.

Pressing the 6 key will toggle the field from FCU to AIU.</td></tr>
<tr><td>3.</td><td>Use the table below to determine your next step. Result: a new screen appears.

<table>
<tr><th>IF you want to ...</th><th>THEN go to...</th></tr>
<tr><td>Print ID List to Screen</td><td>Step 4</td></tr>
<tr><td>Print ID List to Printer</td><td>Step 5</td></tr>
<tr><td>Print or Clear All FCUs</td><td>Step 6</td></tr>
<tr><td>Print or Clear by FCU ID</td><td>Step 7</td></tr>
<tr><td>Print or Clear By Seq. Number</td><td>Step 8</td></tr>
<tr><td>Print or Clear AIU</td><td>Step 9</td></tr>
</table>
</td></tr>
</table>

Continued on next page

Step 4. Print ID List to Screen

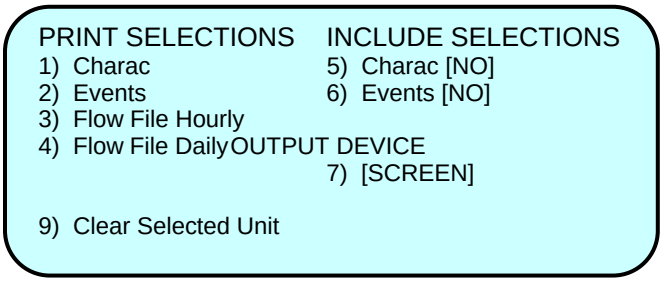
Step	Procedure
1.	To view a list of the collected FCUs by ID number, select **1) Printer ID List to Screen**. The following screen is displayed. COLLECTED DATA MM/DD/YY HH:MM:SS SEQ ID SIZE COLLECTION DATE 1 6410001 5wk MM/DD/YY HH:MM:SS 2 6410002 5wk MM/DD/YY HH:MM:SS End of Collected FCU's List. Press EXIT to quit.

Step 5. Print ID List to Printer

Step	Procedure
1.	To print a list of the FCUs by Identifier, select **2) Print ID List to Printer**. The PCCU **must be** connected to a serial printer to receive data output. The PCCU Communication Print Speed Set-Up, print speed, **must agree** with printer baud rate. Printing ID List.

Continued on next page

Step 6. Select All

Step	Procedure
1.	To select data from all of the recorded FCUs choose **3) Select All.** The following screen is displayed. If screen does not appear check to see that ID Selection Menu, item 6 is not set to AIU. 
2.	Select the options from the screen. Table below describes the options you can make.

Field	Description
1) Charac	Prints a Characteristic Report for selected FCU's
2) Events	Prints Events Report for selected FCU's
3) Flow File Hourly	Prints Flow File Report with hourly numbers
4) Flow File Daily	Prints Flow File Report with daily numbers
5) Charac [NO]	Selects Characteristic Report to be included or not included with Daily or Hourly report files

Continued on next page

Step 6. Select All (Continued)

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td></td><td>
<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>6) Events [NO]</td><td>Selects Events Report to be included or not included with Daily or Hourly report files.</td></tr>
<tr><td>7) [SCREEN]</td><td>Instructs PCCU to direct reports to connected serial printer or the PCCU display.</td></tr>
<tr><td>9) Clear Selected Unit</td><td>Displays prompt instructions</td></tr>
</table>
Results: Functions will be initiated.
</td></tr>
<tr><td>3.</td><td>To display ID SELECTION MENU, press CONTINUE (C). Pressing Esc, from PRINT SELECTIONS menu, displays ID SELECTION MENU</td></tr>
<tr><td>4.</td><td>The table below provides PCCU function keys that can control the display and printing.
<table>
<tr><th>Key</th><th>Function</th></tr>
<tr><td>+</td><td>Speeds up PCCU display</td></tr>
<tr><td>-</td><td>Slows down PCCU display</td></tr>
<tr><td>Yes (enter)</td><td>Starts and stops PCCU display</td></tr>
<tr><td>← →:</td><td>Moves data into view on PCCU display. Should be used when display is not moving</td></tr>
<tr><td>↑ ↓</td><td>Scrolls PCCU display. Should be used when display is not moving</td></tr>
</table>
Results: Functions will occur.
</td></tr>
<tr><td>5.</td><td>Press Esc key for stop print, exit, or continue selections.</td></tr>
</table>

Continued on next page

Step 7. Select FCU by ID

Step	Procedure
1.	To select collected FCU by its identifier select, **4) Select FCU by ID**. The following screen is displayed. Select SEQ NO. 1, ID XXXXXXXXXX ? Depress any of the keys listed below. YES include FCU in selections NO exclude FCU from selections EXIT cancel selections CONTINUE finished with selections
2.	Use Yes and No keys to select from which collected FCU's you want to display data. When no other FCU's are available for selection an end of ID list message will appear on the LCD.
3.	Depressing Esc displays ID SELECTION MENU**.** If *no selection* is made, pressing CONTINUE also redisplays ID SELECTION MENU**.**
4.	After making selections, depress **CONTINUE (C),** the LCD displays the following screen. The function of each option is described in Step 6, Select All (For FCU) Only selected FCU's, from previous display, are affected by your selections. PRINT SELECTIONS INCLUDE SELECTIONS 1) Charac 5) Charac [NO] 2) Events 6) Events [NO] 3) Flow File Hourly 4) Flow File Daily OUTPUT DEVICE 7) [SCREEN] 9) Clear Selected Unit

Continued on next page

Step 7. Select FCU by ID (Continued)

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>5.</td><td>The table below provides the PCCU function keys that can control the display and printing.
<table>
<tr><th>Key</th><th>Function</th></tr>
<tr><td>+</td><td>Speeds up PCCU display</td></tr>
<tr><td>-</td><td>Slows down PCCU display</td></tr>
<tr><td>Yes (enter)</td><td>Starts and stops PCCU display</td></tr>
<tr><td>← →:</td><td>Moves data into view on PCCU display. Should be used when display is not moving</td></tr>
<tr><td>↑ ↓</td><td>Scrolls PCCU display. Should be used when display is not moving</td></tr>
</table></td></tr>
<tr><td>6.</td><td>Press Esc key for stop print, exit, or continue selections.</td></tr>
</table>

Continued on next page

Step 8. Select FCU by Sequence Number

Step	Procedure
1.	To select a collected FCU by its sequence number, select **5) Select by SEQ. No.** The screen will prompt you to enter the Sequence Number. Sequence numbers are found by entering one of the two of selections. These selections are found on the ID Selection MENU. 1) Print ID list to screen or 2) Print ID list to printer
2.	Enter FCU sequence number of the data to be displayed.
3.	Enter a Yes to accept; Enter No, to change or enter another Sequence Number. After entering Yes to a newly entered number, the PCCU displays the following screen. The function of each option on this menu is described in Step 6, Select All (For FCU). Only FCU's, whose sequence number was selected, are affected. PRINT SELECTIONS INCLUDE SELECTIONS 1) Charac 5) Charac [NO] 2) Events 6) Events [NO] 3) Flow File Hourly 4) Flow File Daily OUTPUT DEVICE 7) [SCREEN] 9) Clear Selected Unit

Continued on next page

Step 8. Select FCU by Sequence Number (Continued)

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>4.</td><td>The table below provides the PCCU function keys that can control the display and printing.
<table>
<tr><th>Key</th><th>Function</th></tr>
<tr><td>+</td><td>Speeds up PCCU display</td></tr>
<tr><td>-</td><td>Slows down PCCU display</td></tr>
<tr><td>Yes (enter)</td><td>Starts and stops PCCU display</td></tr>
<tr><td>← →:</td><td>Moves data into view on PCCU display. Should be used when display is not moving</td></tr>
<tr><td>↑ ↓</td><td>Scrolls PCCU display. Should be used when display is not moving</td></tr>
</table></td></tr>
<tr><td>5.</td><td>Press Esc key for stop print, exit, or continue selections.</td></tr>
</table>

Step 9. Print or Clear Data From Analyzer Interface Unit

Step 9 is for users of the Totalflow Natural Gas Analyzer Interface Unit (AIU). For detailed information on how to use this mode refer to the Totalflow Analyzer Interface Unit User's Manual 2012978-001.

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Send FCU Data to CCU

Description

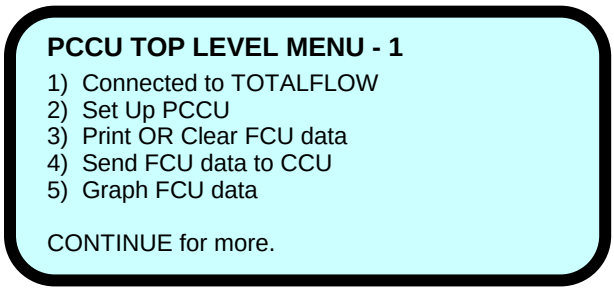
The Send FCU Data to the CCU (Central Collection Unit) lets you down load data collected by the PCCU to the Totalflow Central Collection Unit.

Related Manual

Refer to Totalflow Central Collection Unit User's Manual, 2010135-001 for detailed information on the DOS CCU. For WinCCU32, see the online Help files.

Menu Description

The Send FCU Data to CCU mode function is selected from the **PCCU TOP LEVEL MENU-1** by entering **4**.



Important

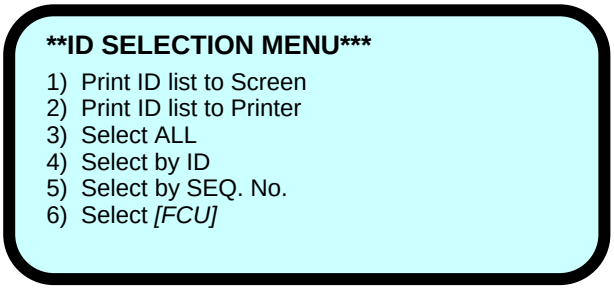
The PCCU communications baud rate MUST AGREE with CCU set baud rate. Before transferring data, cable or modem connections with CCU telephone number, must be selected.

Using modem to transfer data, the PCCU must be set to the correct modem speed. If PCCU communication setup is not properly set, error messages are displayed.

Instructions for completing PCCU to CCU data transfer, are presented in CCU User Manual, Section: Data Collection. After selection of O(D)-Data Collection and 1(L)-Local to initiate data transfer, follow instructions on PC screen.

Continued on next page

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Select 1) Send FCU Data to CCU from the PCCU TOP LEVEL MENU-1 to display ID Selection Menu.

 
</td></tr>
<tr><td>2.</td><td>Verify that item 6 on the ID Selection Menu is set to FCU; refer to Totalflow Analyzer Interface Unit User’s Manual 2012978-001 for information on the AIU setting.

Pressing the 6 key will toggle the field from AIU to FCU.</td></tr>
<tr><td>3.</td><td>Use the table below to determine how you want to specify what data to send.

<table><tr><th>IF you want to ...</th><th>THEN go to...</th></tr><tr><td>Print ID List to Screen</td><td>Step 4</td></tr><tr><td>Print ID List to Printer</td><td>Step 5</td></tr><tr><td>Send All FCUs</td><td>Step 6</td></tr><tr><td>Send Data By FCU ID Number</td><td>Step 7</td></tr><tr><td>Send Data By Seq. Number</td><td>Step 8</td></tr><tr><td>Print or Clear AIU</td><td>Step 9</td></tr></table>
Result: a new screen appears.</td></tr>
</table>

Continued on next page

Step 4. Print ID List to Screen

Step	Procedure
1.	To view a list of the collected FCUs by ID number, select **1) Print ID List to Screen**. The following screen is displayed. COLLECTED DATA MM/DD/YY HH:MM:SS SEQ ID SIZE COLLECTION DATE 1 6410001 5wk MM/DD/YY HH:MM:SS 2 6410002 5wk MM/DD/YY HH:MM:SS End of Collected FCU's List. Press EXIT to quit.

Step 5. Print ID List to Printer

Step	Procedure
1.	To print a list of the collected FCUs by Identifier, select **2) Print ID List to Printer**. The PCCU must be connected to a serial printer to receive data output. The PCCU Communication Print Baud Rate, print speed, must agree with printer baud rate. COLLECTED DATA MM/DD/YY HH:MM:SS SEQ ID SIZE COLLECTION DATE 1 6410001 5wk MM/DD/YY HH:MM:SS 2 6410002 5wk MM/DD/YY HH:MM:SS End of Collected FCU's List. Press EXIT to quit.

Continued on next page

Step 6. Select All

Step	Procedure
1.	To down load all of the collected FCUs choose **3) Select All**. The following screen is displayed. Ready to Send FCU data to CCU *****Depress CONTINUE to proceed***** Depressing CONTINUED initiates data transfer from PCCU to CCU. PCCU selects all FCU's and automatically cycles, in sequence, to each FCU ID number. Data is sent from each PCCU to the central collection unit. Depressing Esc returns user to ID Selection Menu.

Continued on next page

Step 7. Select FCU by ID

Step	Procedure
1.	To select a collected FCU by its identifier select **4) Select FCU by ID**. The following screen is displayed. Select SEQ NO. 1, ID XXXXXXXXXX ? Depress any of the keys listed below. YES include FCU in selections NO exclude FCU from selections EXIT cancel selections CONTINUE finished with selections
2.	Use Yes and No keys to select which FCU's to display data. When no other FCU's are available for selection an end of ID list message will appear on the LCD.
3.	Depressing EXIT redisplays ID SELECTION MENU. If no selection is made, pressing CONTINUE will cause the following prompt. Ready to Send FCU data to CCU *****Depress CONTINUE to proceed*****
4.	Depressing **CONTINUE (C)** initiates data transfer from PCCU to CCU.
5.	Depressing Esc returns user to ID Selection Menu.

Continued on next page

Step 8. Select FCU by Sequence Number

Step	Procedure
1.	To select collected FCU by its sequence number, select **5) Select by SEQ No.**
2.	Enter the FCU sequence number of the data to be transferred.
3.	Enter a Yes to accept; Enter No, to change or enter another Sequence Number.
4.	Depressing Esc redisplays ID SELECTION MENU. If no selection is made, pressing CONTINUE will cause the following prompt. Ready to Send FCU data to CCU *****Depress CONTINUE to proceed*****
5.	Depressing **CONTINUE (C)** initiates data transfer from PCCU to CCU.
6.	Depressing Esc returns user to ID Selection Menu.

Step 9. Select Analog Input Device

Step 9 is for users of the Totalflow Natural Gas Analyzer Interface Unit (AIU). For detailed information on how to use this mode refer to the Totalflow Analyzer Interface Unit User's Manual 2012978-001.

Graph FCU Data

Description

The Graph FCU data mode gives you the capability to display or print the collection data for each FCU the PCCU has collected from. In addition, you can graphically display, on the PCCU, the TEMP, AP, DP or VOLUME versus Time for a selected FCU. Only two of the parameters can be displayed for any 1 day (24 hr.) or 8 day time base.

Menu Description

The Graph function is selected from the **PCCU TOP LEVEL MENU-1** by entering **5**.

PCCU TOP LEVEL MENU - 1

1) Connected to TOTALFLOW
2) Set Up PCCU
3) Print OR Clear FCU data
4) Send FCU data to CCU
5) Graph FCU data

CONTINUE for more.

After entering 5**,** the ID Selection Menu is displays user selectable options. This menu is similar to the menu used for the Print mode. The first two selections are identical and will initiate a display or printout listing the collection sequence, ID number, size and collection date of each FCU the PCCU has collected from.

****ID SELECTION MENU*****

1) Print ID list to Screen
2) Print ID list to Printer
3) Select ALL
4) Select by ID
5) Select by SEQ. No.
6) Select *[FCU]*

Graph Parameters

Items 3, 4, and 5 initiates the graph mode by first letting you select which FCU you want to graph by specifying all FCUs, by its ID number or by its sequence number.

How to Graph

Procedure

Read through the following procedural steps before you graph. The Graph function mode is selected from the PCCU TOP LEVEL MENU-**1.**

Step	Action
1.	Select Graph from the PCCU TOP LEVEL MENU-1 by entering a 5.
2.	If you are graphing from a FCU verify that item 6 on the ID Selection Menu is set to FCU; refer to Totalflow Analyzer Interface Unit User's Manual 2012978-001 for information on the AIU setting. Pressing the 6 key will toggle the field from FCU to AIU
3.	Use the table below to determine your next step.

IF you want to graph ...	THEN enter...
All the recorded FCUs	3 and go to Step 6
Select particular FCU ID's	4 and go to Step 4
Select particular Sequence numbers	5 and go to Step 5

	Result: a new screen appears.

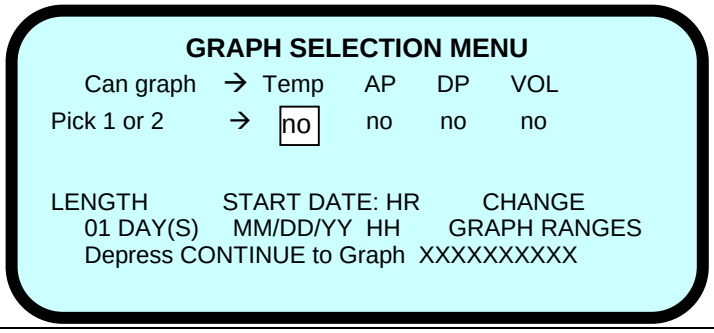
Continued on next page

Procedure (Continued)

Step	Action
4.	Selecting 4 from the ID Selection Menu and PCCU displays the following screen. Enter the ID of the FCU and use Yes and No keys to change other parameters. Select SEQ NO. 1, ID XXXXXXXXXX ? Depress any of the keys listed below. YES include FCU in selections NO exclude FCU from selections EXIT cancel selections CONTINUE finished with selections A message will tell you when no other FCUs are available for selection. Press continue after you make your selections to display the Graph Selection Menu. Go to Step 6.
5.	Enter the Sequence Number of the FCU you want to transfer data from. Depress Yes. A prompt will appear showing you what you have entered. Press No to enter another number. Press Yes to view the graph Selection Menu.

Continued on next page

Procedure (continued)

Step	Action
6.	After a few seconds after selecting ALL, by ID or by Seq. No. the Graph Selection Menu will appear. 
7.	Make appropriate changes to screen:

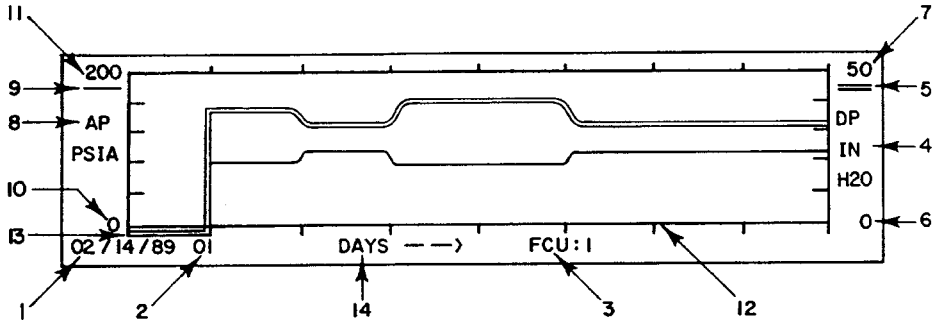
Key or Field Name	Description
Up and Down Arrow Keys	Used to change all variables fields. Remember, only two parameters can be displayed on a graph
Left an Right Arrow Keys	Move Cursor to another field
Length Selection	selects 1 or 8 days of data to be graphed
Start Date Hr	Date when graph is made The Hr is the contract hour in the FCU and cannot be changed
Change Graph Ranges	Calls up separate menu to sets up the scales of the graph to better analyze data

8.	After completing all entries press **Continue (C)** to Graph; see next page for a description of a typical graph.

How to Read a Graph

Graph

The graph shown is an example of an 8-day graph using Absolute Pressure and Differential Pressure as variables.



Description

The Table describes the key components of the graph

Item	Description
1.	The date on the graph is the start day of the 8 day graph. In this example 2/14/89 to 2/21/89.
2.	01 is the contract hour set in the flow computer unit. The start of each day begins at 01:00 or 1 o'clock A.M.
3.	FCU: Indicates the ID number of the FCU being graphed.
4.	Denotes the variable being graphed and the engineering units represented by the graph.
5.	Double line represents the variable whose scale is indicated.
6.	Denotes the minimum scale for the variable indicated on the side of the graph.
7.	Denotes the maximum scale for the variable indicated on this side of the graph.
8.	Denotes the variable being graphed and engineering units represented by the graph.

Continued on next page

Description (continued)

Item	Description
9.	Single line represents the variable whose scale is indicated.
10.	Denotes the minimum scale for the variable indicated on this side of the graph.
11.	Denotes the maximum scale for the variable indicated on this side of the graph.
12.	Denotes the start of a new day. Days start at the contract hour.
13.	Double line below the bottom of the graph means that the flow computer unit does not have data available for that time period.
14.	Denotes the unit of time measurement per increment on the graph.

Set-Up ID List

Description

The Set -Up ID List mode is for users of the Totalflow Natural Gas Analyzer Interface Unit (AIU). This mode lets you create a list of FCUs that are on the RS-485 Bus.

For detailed information on how to use this mode refer to the Totalflow Analyzer Interface Unit User's Manual 2012978-001.

Valve

Description

The Valve mode is for users who have installed the valve control option on a flow computer. If you have this option please contact Totalflow for detailed information; see page vi in the front of this manual.

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Chapter 5.0
Maintenance

Overview

Introduction

This chapter provides you with standard Maintenance information and instructions on how to remove and install components of the FCU. In addition, there are instructions you should follow when changing out an orifice plate.

Chapter Highlights

In this chapter you will learn how to:

Maintenance Support

If installation, calibration and maintenance assistance is required, user can contact the Totalflow Service Department.

(800) 442-3097

Continued on next page

How to Use This Chapter

We recommend that you develop regularly scheduled daily, weekly or monthly maintenance program. By establishing such a maintenance program FCU down-time can be at a minimum.

Record all items within this Chapter, in the maintenance practice procedures. Also include any other procedures found through experience.

Practical experience permits updating this schedule over a period of time. This results in many maintenance items being handled on a routine basis before potential problem(s) result in a failure.

Maintaining Cleanliness of FCU

Because an FCU installation is primarily exposed to external environmental conditions, it is important that it be regularly inspected for cleanliness, both externally and internally. Foreign contaminants can cause damage to interior mounted components rendering FCU inoperable.

Front Mounted LCD Display

The two lines by 24 alphanumeric character LCD display displays alarm codes on right side of display window. By observing this display, user is informed of operational problems or to flag operational limits. FCU alarm troubleshooting procedures are presented in Troubleshooting Section.

PCCU Unit Maintenance

This PCCU is maintenance free except for the recharging of NiCad batteries or replacement of the non-rechargeable Alkaline batteries.

Returning Part(s) for Repair

If a TOTALFLOW component is to be returned to Totalflow for repair, securely wrap it in protective anti-static packaging. Before returning a component, call us for a Return for Authorization Number (RA). Affix this number to the outside of return package.

Part shipments must be prepaid by customer. Any part, not covered by original SYSTEM WARRANTY, will be shipped to customer, F.O.B.

Replacing FCU Battery Pack

Description

This section presents the procedures for removal and installation of FCU battery pack. To access battery pack, open FCU door. Battery pack is located behind front mounted keeper plate.

Important

If the Totalflow Battery Charger is connected it MUST be disconnected from 6400 Digital Circuit Board terminals EXT CHGR +/- prior to removal and installation of battery pack.

When removing battery pack, DO NOT remove Lithium battery from 6400 Digital Circuit Board. This prevents any data stored in Board RAM, from being lost.

Procedures See Figures 5-1, 5-2 & 5-3

In the following procedure the common name for a component or part is followed by a number in parentheses. This number refers to the call-out numbers in Figure 5-1 & 5-2. Refer to Figure 5-3 for location of Digital Circuit Board connections.

Step	Procedure
1.	Make sure paper tab has been removed from lithium battery (3A).
2.	Either make sure “LL” battery alarm is not being displayed on FCU or measure lithium battery and make sure it is > 3.0V.
3.	Before removing battery pack, disconnect the Battery Cable from the 6400 Digital Circuit Board (3) connector J1.
4.	Remove keeper plate (13), which secures battery pack in its mounting location, by slightly loosening the three mounting screws. It is not necessary to remove screws.
5.	Remove battery pack from battery compartment.
6.	Insert new battery pack into battery compartment. Battery pack must be positioned so its longest dimension fits snugly against keeper plate when plate is installed. Reinstall keeper plate (13) and tighten three keeper plate mounting screws.

Continued on next page

Procedures (Continued)

Step	Procedure
7.	Reconnect battery pack cable to 6400 Digital Circuit Board (3) connector J1. If battery pack charging source green wiring block was disconnected, reconnect it to 6400 Digital Circuit Board EXT CHGR +/- terminals.
8.	After closing FCU door, check door mounted LCD display for normal operational readings.

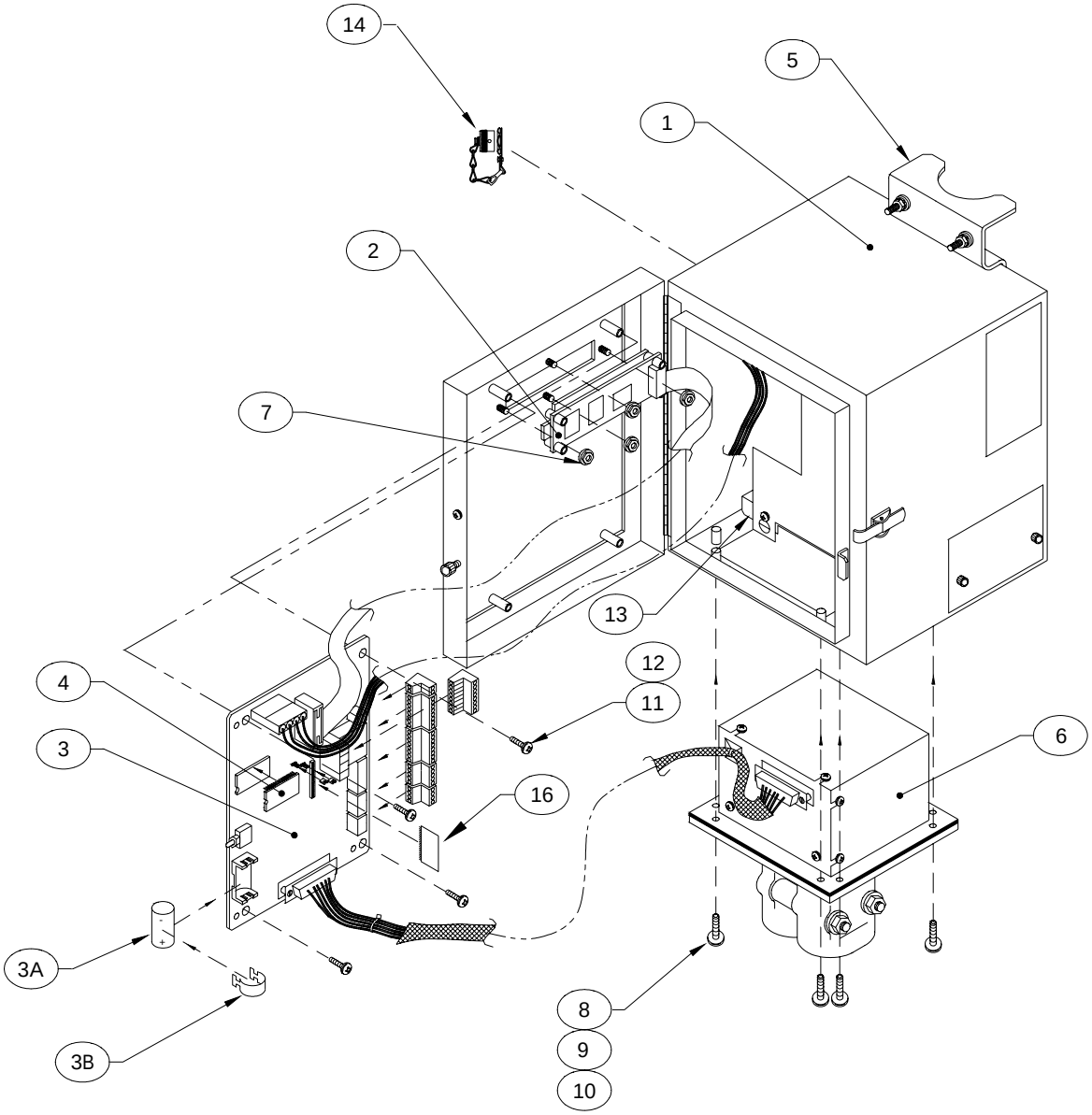


Figure 5-1 6410 FCU Component/Cable Locations

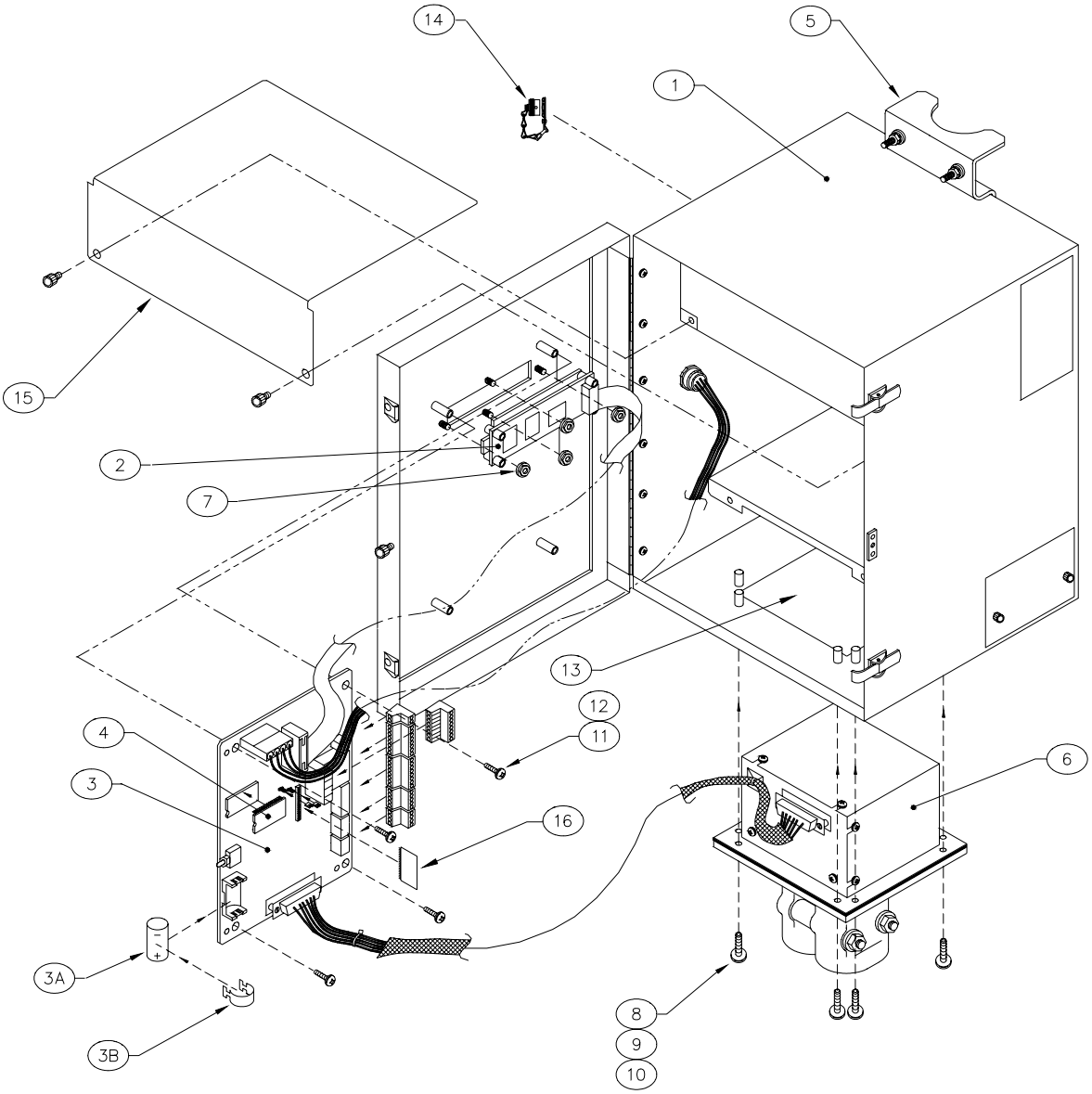


Figure 5-2 6413 FCU Component/Cable Locations

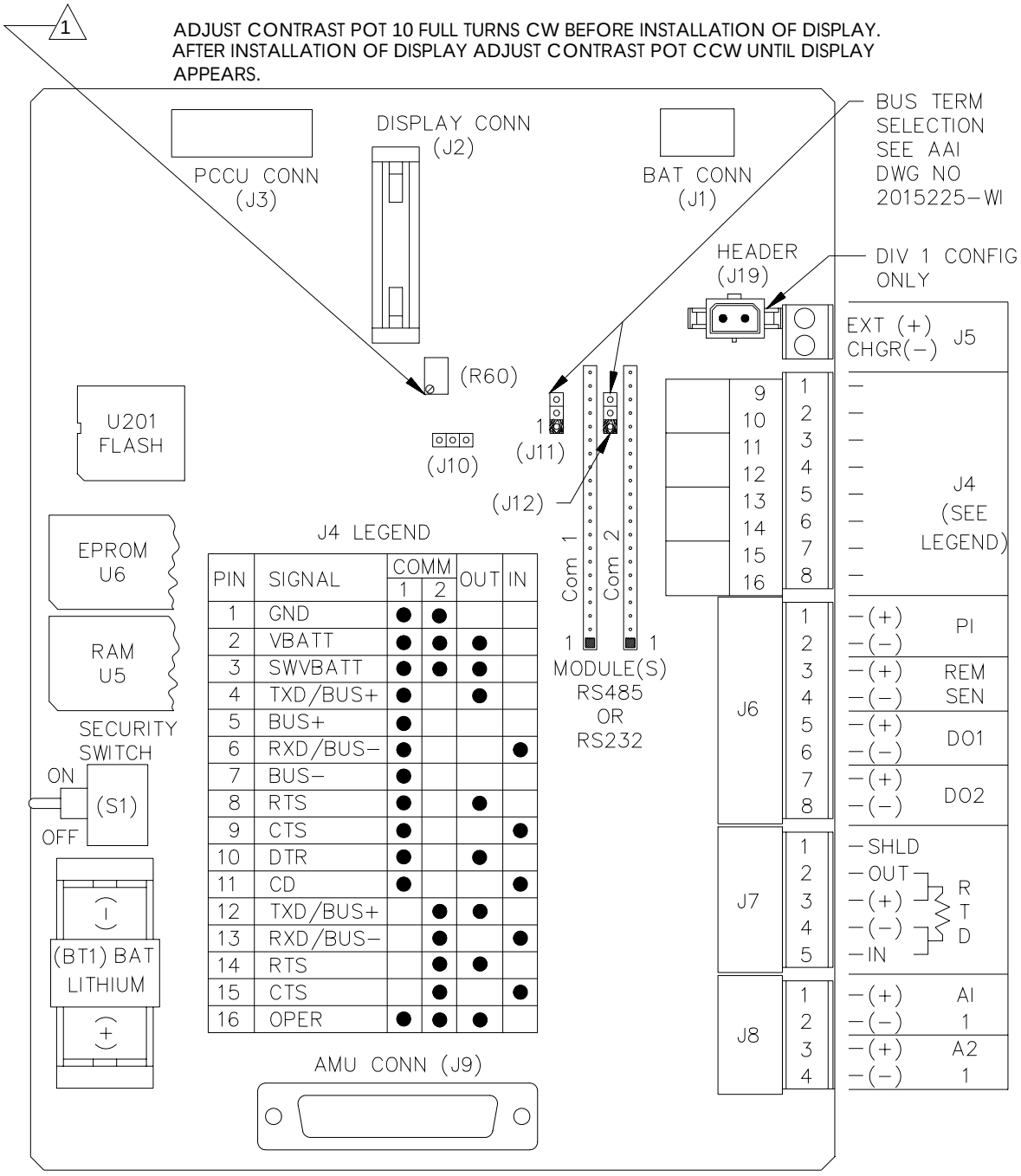


Figure 5-3 Digital Circuit Board Parts Location

Replacing 6400 Digital Circuit Board

Description

The 6400 Digital Circuit Board is mounted to the backside of FCU access door. It is mounted, to the door, on standoffs. Refer to Figure 5-1 or 5-2.

Caution

The 6400 digital circuit board is susceptible to damage by static electricity build-up or improper handling. To prevent this from occurring, user should install a grounding strap.

A grounding strap is a conductive device used to make connection between the person handling the board, and a high quality ground potential.

Before handling the board you must install ground strap on this body then connect it to ground potential. This discharges electrical static buildup from the persons body to ground. This prevents any electrical static buildup from discharging to the board.

Important

Before removal of 6400 Digital Circuit Board, be certain any RAM stored data has been downloaded to an external storage medium. Failure to do so will result in data loss when Circuit Board is removed.

Procedures See Figures 5-1, 5-2 & 5-3

In the following procedure the common name for a component or part is followed by a number in parentheses. This number refers to the call-out numbers in Figure 5-1 & 5-2. Refer to Figure 5-3 for location of Digital Circuit Board connections.

Step	Procedure
1.	Before Digital Board (3) removal, disconnect the following associated connectors in this order. • If used, disconnect external battery charging source. • Disconnect battery pack connector J1. • Slide, to the right; green terminal strips J4, J6, J8 and J19 from their associated circuit board connector. DO NOT lift connectors upward. • Tape an identifier to each connector so it will be correctly reinserted into the same Board mounting connector during reinstallation of 6400 Digital Circuit Board. • Disconnect PCCU Port connector J3. • AMU Pressure Transducer Port connector J9. • FCU LCD Display port connector J2.

Continued on next page

Replacing 6400 Digital Circuit Board, Continued

Procedure (Continued)

Step	Procedure
2.	Remove four mounting screws and lock washers securing Digital Circuit Board (3) to door mounted standoffs.

Note When removing Digital Circuit Board, grasp its outer edges. This prevents damage to circuitry and components.

3.	Replace and secure 6400 Digital Circuit on four standoffs and secure in place using four screws and lock washers. DO NOT over tighten screws. Doing so could cause damage to Board or associated circuitry.
4.	Reinstall connectors, removed in Step 1, to their associated Board mounted connectors in the following order. • AMU Connector • LCD Connector • J3 • Battery Pack • Charger Last

Replacing LCD Display Board

Overview

The LCD Display Board is mounted on the backside of hinged doors behind 6400 Digital Circuit Board. To access and remove Display Board, perform the following procedures.

Procedures See Figures 5-1, 5-2 & 5-3

In the following procedure the common name for a component or part is followed by a number in parentheses. This number refers to the call-out numbers in Figure 5-1 & 5-2. Refer to Figure 5-3 for location of Digital Circuit Board connections.

Step	Procedure
1.	To access the LCD Display Board, open the TOTALFLOW unit door. Board is located behind 6400 Digital Circuit Board.

Note

To prevent power damage to the 6400 Digital Circuit Board and Display Board, it is recommended that the battery pack connector be disconnected from Board mounted connector J1. If an external charging unit is connected to Digital Circuit Board, the applicable EXT CHGR +/- green terminal block must be disconnected.

2.	DO NOT remove Digital Board mounted Lithium battery since it provides power to RAM. This prevents loss of accumulated data. It is recommended that RAM data be downloaded before accessing and removing LCD Display Board to prevent potential loss of stored data.
3.	Disconnect LCD Display Board cable connector from Digital Circuit Board Display Port connector J2. To remove connector, extend connector hold down fingers outward. Connector will pop upward.
4.	Remove four Digital Board mounting screws and lock washers. DO NOT let screws and lock washer fall onto Board circuitry. Move Board away from door then support it so its circuitry does not come in contact with any metal surface.

Continued on next page

Replacing LCD Display Board, Continued

Procedures (Continued)

Step	Procedure
5.	Using a 3/16” nut driver, remove four Display Board hexagonal mounting standoffs. Lift Board from door mounted standoffs. If Board is being returned to Totalflow for service, it is recommended that attached ribbon cable be left connected and returned with Display Board.
6.	To reinstall Display Board, perform procedures 1 to 5 in reverse order. Once Display Board is reinstalled, apply power to FCU and verify information displayed on LCD display is correct. Adjust contrast potentiometer for optimum display.

Note When reinstall mounting hardware, DO NOT over tighten screws.

Replacing FCU Pressure Transducer

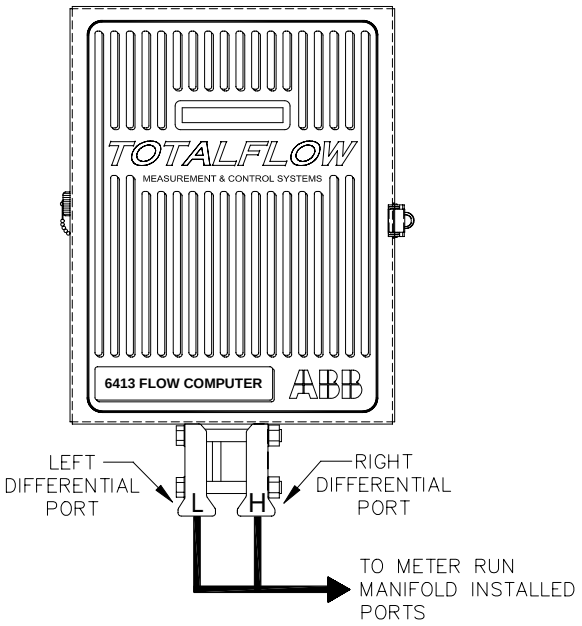
Important

Under no circumstances shall the FCU AMU pressure transducer cover be removed. Removal of this cover, and entry into interior of pressure transducer, voids transducer warranty.

If AMU pressure transducer requires servicing, the entire assembly must be removed from FCU, securely packaged for shipping and returned to Totalflow.

Procedures See Figures 5-1, 5-2 & 5-3

In the following procedure the common name for a component or part is followed by a number in parentheses. This number refers to the call-out numbers in Figure 5-1 & 5-2. Refer to Figure 5-3 for location of Digital Circuit Board connections.

Step	Procedure
1.	Using meter run installed Manifold high/low control valves, equalize pressure to AMU Transducer. 
2.	Using FCU high/low tap valves, close off both lines. These two valves connect Meter Run high/low output lines to FCU.
3.	Vent manifold to atmosphere using vent valve.
4.	Completely disconnect high/low Manifold lines from AMU Pressure Transducer.

Continued on next page

Replacing FCU Pressure Transducer, Continued

Procedures (Continued)

Step	Procedure
5.	If used, disconnect external battery charging connected to J5.
6.	Disconnect battery pack from J1.
7.	Disconnect FCU AMU Transducer cable J9 from 6400 Digital Circuit Board. Cable is secured to Digital Circuit Board with a Board mounting screw which must be removed. Do not disconnect AMU cable with power connected.
8.	Remove cable from AMU Pressure Transducer connector. Do not ship AMU Transducer to Totalflow with cable installed.
9.	Loosen FCU 2” mounting post clamps and rotate FCU a sufficient distance to allow removal of AMU Pressure Transducer. Clearance of approximately 7” is required for removal. After rotation, tighten clamps to hold FCU in place before removing Pressure Transducer.

Note When rotating FCU, be careful not to place twisting stress on attached cables.

10.	Using a Phillips screwdriver, remove eight mounting screws, washers and lock washers securing AMU Pressure Transducer to FCU cabinet. Access mounting hardware from underside of FCU.
11.	Tilt AMU Pressure Transducer slightly upwards then remove unit. A weather sealing gasket is affixed to top side of AMU Pressure Transducer mounting flange.

Note During reinstallation of AMU Pressure Transducer, weather sealing gasket must be reinstalled between the AMU Transducer and bottom of FCU.

12.	To install AMU Pressure Transducer, perform steps 1 to 8 in reverse order. When installing AMU Transducer, the eight mounting screws should be securely tightened to keep external environmental elements from entering FCU interior.

Note Before placing AMU Transducer back into operation, the FCU MUST be calibrated. Refer to Calibration Procedure; page 4-71 for detailed procedures.

How to Change Orifice Plate

Description

Use the following procedures when changing an orifice plate.

Taking Run Out of Service Procedures (Blocking Flow with meter run valve)

Step	Procedure
1.	Take meter run out of service. FCU sees zero (0) in. of H_2O across the orifice plate.
2.	From *****ENTRY MODE MENU-2***** menu, select **4) Reset Volume**, see page 4-26. This forces FCU to perform hourly calculations, based on old orifice plate diameter, for part of hour old orifice plate was installed.
3.	Replace old orifice plate.
4.	Go to the ****AGA-3 1985 CONSTANTS MENU-1**** and select**: 1) Orifice Diameter** and enter new orifice plate diameter. Be certain proper F(b) is calculated.
5.	Send new AGA-3 data to FCU. At top of next hour, FCU will do hourly calculations based on new orifice plate diameter. This is for part of hour new orifice plate was installed.

How to Change Orifice Plate, Continued

Leaving Run in Service

Step	Procedure
1.	Using PCCU, put FCU in HOLD so constant AP and DP values are used while orifice plate is being changed. To place FCU in HOLD, proceed to the following menu: From *****Calibrate MENU-1***** menu, perform Check AP and Check DP; see pages 4-83 and 4-86.
2.	Replace orifice plate.
3.	From *****ENTRY MODE MENU-2***** menu, select **4) Reset Volume**; see page 4-26. This forces FCU to perform hourly calculations, based on old orifice plate diameter, for part of hour old orifice plate was installed
4.	Once Reset Volume is completed, go to the ****AGA-3 1985 CONSTANTS MENU-1**** and select**: 1) Orifice Diameter** and enter new orifice plate diameter. Be certain proper F(b) is calculated. Send new data AGA data to FCU. At top of hour, FCU performs hourly calculations based on new orifice diameter for part of hour it was installed.

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Chapter 6.0

Troubleshooting

Overview

Overview

This chapter contains troubleshooting tables to correct most FCU alarm code condition(s). The alarm codes flag you that an operational problem exists, and are visible on the FCU's front cover display.

The Troubleshooting Tables are designed to match an alarm code with its probable cause(s) and the corrective procedure(s). Besides these tables, this section contains procedures for setup and troubleshooting an FCUs with an installed radio communication unit.

Repair Procedures

For instructions on how to remove modules refer to Chapter 5.0, Maintenance.

Chapter Highlights

This chapter covers the following topics:

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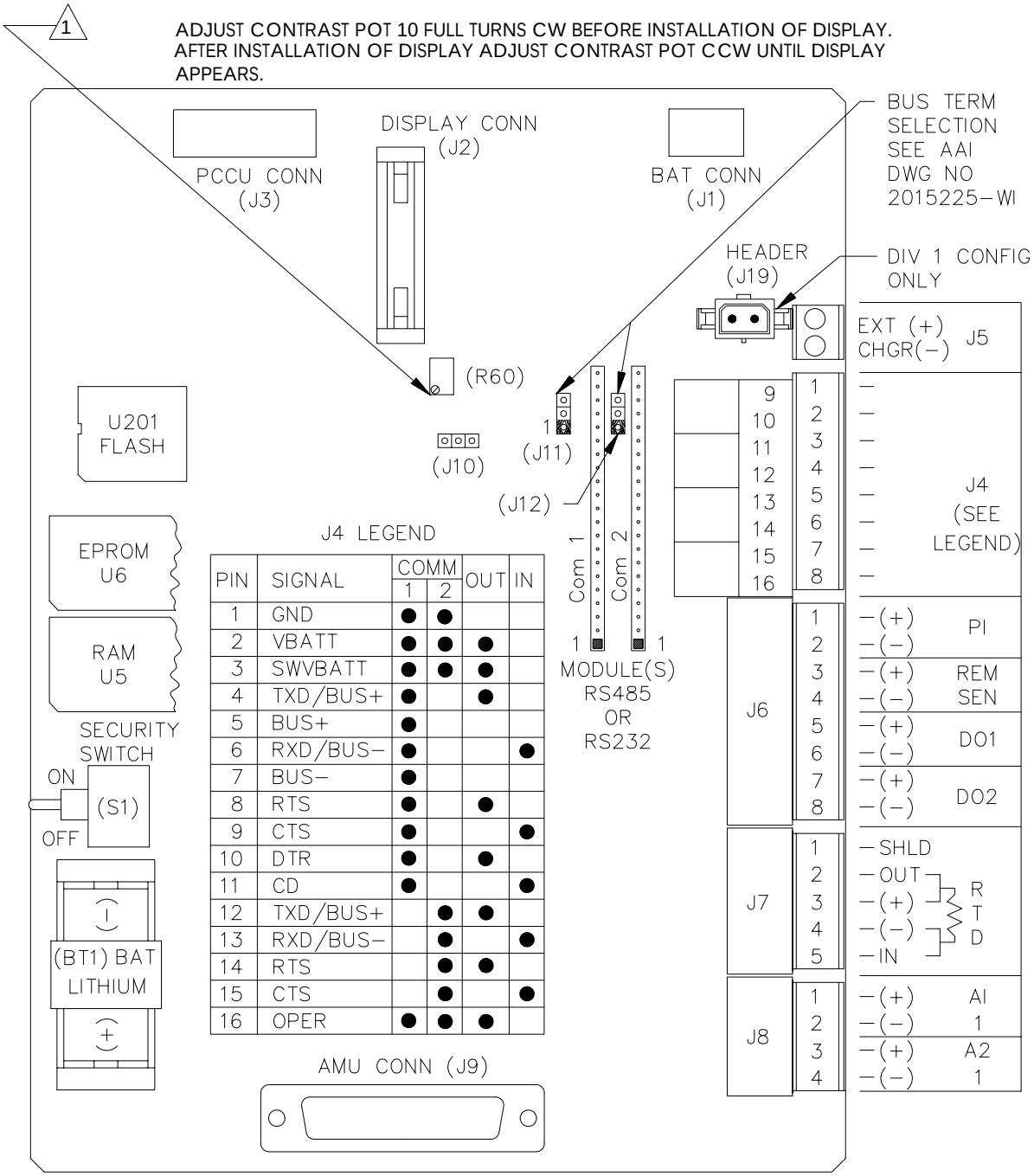

PIN	SIGNAL	COMM 1	COMM 2	OUT	IN
1	GND	●	●		
2	VBATT	●	●	●	
3	SWVBATT	●	●	●	
4	TXD/BUS+	●		●	
5	BUS+	●			
6	RXD/BUS-	●			●
7	BUS-	●			
8	RTS	●		●	
9	CTS	●			●
10	DTR	●		●	
11	CD	●			●
12	TXD/BUS+		●	●	
13	RXD/BUS-		●		●
14	RTS		●	●	
15	CTS		●		●
16	OPER	●	●	●	

Figure 6-1 Digital Circuit Board Connector/Wiring Location

FCU Reset Procedures

Description

The FCU operating system can be reset through either a cold or warm start procedure. The decision to use these procedures should only be made by an experienced technician.

Cold Start

A cold start clears all the data that is stored in RAM as well as resetting all entered variables to their factory default values. A cold start should be used for new FCU installations. This will ensure that all memory is clear and the operating program is at its default settings. Discretionary use of this procedure is advised.

Warm Start

A warm start does not clear the data stored in RAM since the lithium battery is not removed. The warm start will only reset the FCU microprocessor and not disturb any data that has been stored in RAM. A warm start should be used when taking an FCU out service to perform maintenance or troubleshooting. A warm start can be used when a power or communication interruption caused the FCU microprocessor to lock-up.

Cold Start Procedures Figure 6-1

A cold start clears all the data that is stored in RAM as well as resetting all entered variables to their factory default values. Discretionary use of this procedure is advised.

Step	Procedure
1.	If an external charging source is connected, it must be disconnected. Slide external battery pack charger EXT CHGR +/- terminal block J5 from the FCU digital circuit board green terminal block.
2.	Disconnect battery pack connector from Digital Circuit Board BAT CONN connector J1.
3.	Remove Lithium battery, BT1, from its Digital Circuit Board mount. The FCU is now out of service.

Continued on next page

Cold Start Procedures (Continued)

Step	Procedure
4.	To return to service reconnect 12 Vdc battery pack connector to Digital Circuit Board BAT CONN connector J1 and observe LCD display.
5.	If removed, reconnect external battery pack charging source to EXT CHGR connector J5.
6.	Reinstall Lithium battery BT1 in its Digital Circuit Board mount. During installation of battery, observe correct polarity. Refer to Figure 6-1.
8.	Enter all necessary parameters and calibrate FCU, Chapter 4.0, FCU Operation.

Note

When FCU has been cold started, the military clock will be reset to 00:00:00.

Warm Start Procedures

A warm start does not clear the data stored in RAM since the lithium battery is not removed. The warm start will only reset the FCU microprocessor and not disturb any data that has been stored in RAM.

Step	Procedure
1.	If an external charging source is connected, it must be disconnected. Slide external battery pack charger EXT CHGR +/- terminal block J5 from the FCU digital circuit board green terminal block.
2.	Disconnect battery pack connector from Digital Circuit Board BAT CONN connector J1. The FCU is now out of service.
3.	To place FCU in service, connect EXT CHGR +/- terminal block J5 and battery pack connector J1.

FCU Visual Alarm & Status Codes

Description

After the FCU completes recording hourly flow and operational records the LCD will show any alarm conditions that has occurred. Also, the date, hour and type of alarm conditions are stored in the FCU memory. An alarm can be a word, character, letter or symbol. The alarm character designators shown in Table 6-1 will appear on the right side of the FCU screen; see illustration below. A description of each FCU LCD alarm code, are described in Table 6-1.

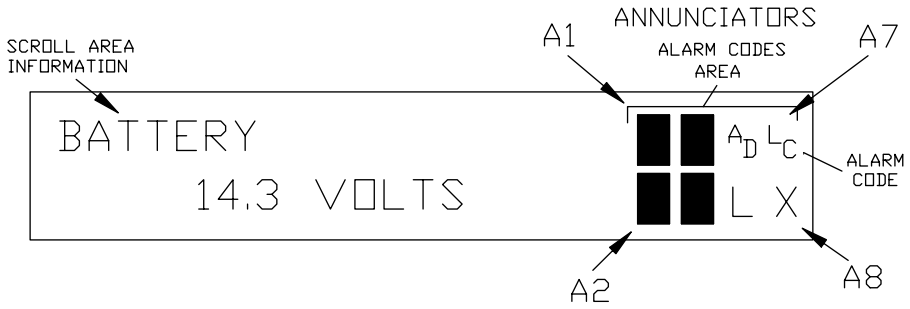

Table 6-1 Alarm and Status Codes

Annunciator Location	Alarm/ Status Codes	Description
A1	LL	Battery Voltage: When LL (low lithium) is displayed, battery voltage is below 2.5 Vdc. If battery voltage is above 2.5VDC, LL appears shaded.
A1	↑/↓	Differential Pressure: If differential pressure is above high limit, ↑ arrow is displayed. If pressure is below low limit, ↓ arrow is displayed. If pressure is within limits, ↑/↓ arrow keys are shaded.
A1	↑/↓	Absolute Static Pressure: If absolute static pressure is above high limit, ↑ arrow is displayed. If pressure is below low limit, ↓ arrow is displayed. If pressure is within limits, ↑/↓ arrow keys are shaded.

Continued on next page

Table 6-1 Alarm and Status Codes (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A2, A4, A8 A2=Comm3 A4=Comm2 A8=Comm1	ǂ	*TOTALFLOW Listen Cycle*: ǂ flashes if this remote port is active and running Totalflow Remote Protocol. Flashes in sync with listening cycle that occurs at 1, 2 or 4 second intervals. 3 remote communications ports are available (2 for 6400) and can be each programmed as described. When FCU remote port is not active, ǂ is shaded. In early versions of 6700s with EXIO, the A8 display will toggle between ǂ and V. Not toggling could indicate a bad board or PROMs mismatched.
See above	→	*Transmitting Data*: If remote port is active and Totalflow Remote Protocol is running, → is displayed.
See above	←	*Receiving Data*: If remote port is active and Totalflow Remote Protocol is running, ←is displayed.
See above	**X**	*Remote Port Not Active*: This is the default state at cold start of the FCU for all remote communications ports. Baud rate must be toggled to activate each remote port. Also displayed when a communications card is missing or bad.
See above	**M**	*MODBUS ASCII*: Modbus ASCII protocol selected on this port. 3 remote communications ports are available for 6700s, 2 for 6400s which can be programmed with any of 5 resident remote protocols; Totalflow, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**m**	*MODBUS RTU*: Modbus RTU protocol selected on this port. Same options available as above.
See above	**1**	Read X-Frame.
See above	**2**	Process X-Request.
See above	**3**	Wait for Ack/Nak.
See above	**4**	Re-Send Packet.
See above	**5**	Direct Download.
See above	**6**	Positive Acknowledge.
See above	**7**	Nak w/packet list.
See above	**8**	Negative Acknowledge (Typically wrong Security Code).
See above	**9**	Single host write request – send data after ready.

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Table 6-1 Alarm and Status Codes (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A3	=	*Valve Control*: Valve Control option installed. Process Value (PV) is within the user set dead band. No control action required
A3	V	*Valve Control*: Displayed when Valve Control option is on an Expanded I/O board (plug-in RTU). Other Valve Control symbols do not apply.
A3	⌈	*Valve Control*: Valve Control option installed. Valve is in full open position.
A3	⌋	*Valve Control*: Valve Control option installed. Valve is in full closed position.
A3	↑	*Valve Control*: Valve Control option installed. Valve is opening (open signal is being sent to valve actuator).
A3	↓	*Valve Control*: Valve Control option installed. Valve is closing. (close signal is being sent to valve actuator).
A3	ö	*Valve Control*: Valve Control option installed. Valve controller override conditions met (DP/AP override set point or Low Battery).
A3	L L	*Valve Control*: Valve Control option installed. Local Lock-out is initiated.
A3,A5	A D	Displayed if A to D Converter Absolute Differential Pressure, Absolute Static Pressure or temperature readings exceed maximum counts or are less than minimum counts. If A to D Converter readings are within range, AD is shaded. A3 Location for 6400, A5 location for 6700.
A4,A7	L C	*Low Charger.* Displayed if FCU battery charging voltage is (+)0.4 Vdc or is less than or equal to battery voltage. If (+)0.4 Vdc battery charging voltage is greater than battery voltage, LC is shaded.
A4,A6	L	*Local Protocol.* Displayed when PCCU part is active and running TOTALFLOW Local Protocol. When PCCU port is not active, L is shaded. This will occur if PCCU is not connected to PCCU port.

Continued on next page

Table 6-1 Alarm Codes and Description (Continued)

Annunciator Location	Alarm/ Status Codes	Description
A5	**H**	*Hold.* Displayed when HOLD flag is active. When not active, H is shaded. Also displayed when HOLD flag is active for the following: 1. PCCU is being calibrated or 2. A to D Converter cannot be read.
A2, A4, A8 A2=Comm3 A4=Comm2 A8=Comm1	**¥**	*Totalflow Packet Protocol.* The Totalflow Packet Protocol selected on this port. 3 remote communications ports are available for 6700s, 2 for 6400s which can currently be programmed with any of 5 resident remote protocols; Totalflow, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**S**	*Square D Protocol*: Square D protocol is running on this port. Same options available as above.
See above	**r**	*Alarm Monitoring System.* Ring indicator for the alarm cryout option.
See above	**h**	*Alarm Monitoring System.* Hang up indicator for the alarm cryout option
See above	**i**	*Alarm Monitoring System.* Modem initialization indicator for the alarm cryout option.
See above	**R**	*LevelMaster*: LevelMaster tank gauging option installed. Tank level(s) and temperature are polled (user selectable intervals) by flow computer via RS485.
A6	**C**	*Host Console.* Host Console connected and communicating.
A6	**T**	*Terminal Mode.* Terminal is connected and communicating. See Technical Bulletin #44.
A8	**L V**	*Low Voltage-Communications.* FCU battery voltage below 12 Vdc--too low to communicate. If FCU is below 11.5 Vdc, sleep mode will occur.
A8	**+9**	*Alarm Monitoring System:* Successful download of alarm page.
A8	**?**	*Alarm Monitoring System:* Received exception broadcast.

Continued on next page

Table 6-1 Alarm Codes and Description (Continued)

A8	**i**	*Alarm Monitoring System:* Initialize modem for cryout.
See above	**+**	Single host send acknowledge with code.
See above	****	Single host send neg-acknowledge with code.
See above	**0**	Attempt to resync on multi-host data requests.

FCU Troubleshooting

Overview

Alarm conditions and their probable cause, and procedure(s) for correcting the problem, are presented in Table 6-2.

Table 6-2 Troubleshooting FCU

Alarm Condition	Probable Cause	Procedure
SLEEP	Battery Voltage Below 11 VDC	1. Try to bring FCU out of SLEEP mode by giving it a WAKE-UP command using PCCU. This causes FCU to function normally for two (2) minutes. If battery pack voltage is still below 11 VDC, FCU returns to SLEEP mode. This allows enough time to check all alarm conditions. 2. Check battery pack cable. It must make a good secure electrical connection with Digital Circuit Board BAT CONN connector J1. If battery pack cable is securely connected, check battery pack voltage. If voltage is low, replace with another battery pack.
LC	Charging Source Below 0.8 Vdc Plus Battery Pack Voltage	Check battery pack charging source with PCCU. This is for either Solar or externally connected charging sources.
LC	Solar Power Charging Unit	1. Check that the solar panel is positioned to receive direct sunlight. In low lighting conditions, normally display LC. 2. Check solar panel angle and direction. In northern hemisphere, panel should face due south and due north in southern hemisphere.

Continued on next page

Table 6-2 (Continued)

Alarm Condition	Probable Cause	Procedure
LC	Solar Power Charging Unit Cont'd.	3. Check solar panel for any physical damage or obstructions to sunlight. Sunlight obstruction prevents solar panel from receiving enough sunlight to charge installed battery pack. Solar panel should be positioned so it receives the most sunlight. Do not place it in a shaded area. 4. Check solar panel wiring to be certain it is correctly connected to associated Digital Circuit Board green termination block. Refer to Figure 6-1. 5. If solar panel wiring is correct, sunlight is not obstructed and voltage does not increase above 0.8 VDC under bright sunlight, replace Solar Panel.
LC	AC Power Unit	1. Check AC charger wiring to FCU green termination block connector J5. Be certain wiring is correct. 2. Check input AC voltage to external AC charging unit. Be certain primary AC voltage is correct. 3. If input primary AC voltage level is correct, wiring to FCU Digital Circuit Board green terminal is correct and there is no DC output from the charger, replace charger fuse. 4. If fuse is not faulty or there is no charger DC output voltage after replacing fuse, replace AC charging unit.

Continued on next page

Table 6-2 (Continued)

Alarm Condition	Probable Cause	Procedure
AD	A/D Converter on Digital Electronics Board is Over or Under Range	This alarm condition can be caused by differential or absolute pressure being under or over measurement range and/or temperature is out of measurement range. 1. Check AP, DP and temperature with PCCU operating in Monitor mode. This determines which condition is causing alarm.
AD	Differential or Absolute Pressure Causing Alarm	1. From PCCU enter CALIBRATION check mode. This forces FCU to monitor differential or absolute pressure. 2. Vent meter, run installed Manifold, to atmospheric pressure. Check to see if alarm code AD disappears. If it does, it is an indication transducer is being operated out of its pressure range. 3. If AD alarm code does not disappear, replace AMU.

Important Do not remove cover from AMU transducer. Doing so voids warranty. Remove AMU as an entire assembly.

Table 6-2 (Continued)

Alarm Condition	Probable Cause	Procedure
AD	Temperature Measurement Causing Alarm	A faulty RTD Probe, or loose wiring connection(s), can cause an AD alarm code. 1. Check RTD wiring on FCU Digital Board green terminal connector J7. 2. To determine if problem is with the RTD Probe or FCU Digital Circuit Board, disconnect green RTD wiring connector from Digital Board connector J7. 3. Perform either of the following two procedures: Substituting RTD Probe with Resistor: These procedures are performed on the Digital Circuit Board. . 1. Connect a 100-ohm resistor across connector J7 RTD OUT and (+) terminals 3 and 4. 2. Connect a jumper wire from J7 terminals 2 and 3. 3. Connect a jumper wire from J7 terminals 4 and 5. 4. If FCU is setup with RTD connected to Digital Circuit Board green connector J7, FCU LCD display should read approximately 32°F. If temperature is 32°F, RTD probe is faulty and should be replaced. If temperature is not 32°F, Digital Circuit Board or AMU is faulty and should be replaced.

Continued on next page

Table 6-2 (Continued)

Alarm Condition	Probable Cause	Procedure
AD Cont'd.	Temperature Measurement Causing Alarm Cont'd.	RTD Probe Resistive Impedance Check: 1. Immerse RTD Probe in ice bath. 2. Perform a continuity check between any two similar colored wires. Measured resistance should be 1-ohm or less. 3. Perform a continuity check between any two dissimilarity colored wires. Measured resistance should be approximately 100 ohms. 4. Perform a continuity between RTD shield and any other wire. Measured resistance should be in the megohm range.
↑	Indicates that DP or AP is OVER Operational Limit Set with PCCU.	1. With PCCU operating in ENTRY mode, reset differential or absolute pressure operational limit to a higher value. or 2. Change manifold orifice plate to bring pressure measurement below operational limit.
↓	Indicates that DP or AP is UNDER Operational Limit set with PCCU.	1. With PCCU operating in ENTRY mode, reset differential or absolute pressure operational limit to a lower value. or 2. Change manifold orifice plate to bring pressure measurement above operational limit.

FCU Model 6400 Communications

Overview

These troubleshooting procedures are applicable to a FCU with an installed radio communication unit.

What is in This Section

This section contains the following Communication Troubleshooting procedures:

- Central Collection Unit (CCU)
- RS-232 Serial Communication
  - FCU Will Not Respond
  - Receiver Supply Voltage
  - Receive Data
  - Request to Send (RTS)
  - Transmit Data
  - Existing Communication Problems
- RS-485 Communications
  - FCU Will Not Respond
  - Transceiver Power Supply Switch
  - Transceiver Power Supply
  - Receive Data
  - Request to Send (RTS)

Communication Configurations

The two basic types of radio communications that can be used between the FCU and a radio receiver, are:

RS-232 Communications: Communication is accomplished using an RS-232 Module (P/N-2015192-001), connected to the FCU Digital Electronics Board, through the associated RS-232 or RS-485 connector.

RS-485 Communications: Communication is accomplished using an RS-485 Module (P/N-2015193-001), connected to the FCU Digital Electronics board, through the associated RS-232 or RS-485 connector.

Warning

Before removing or installation either of the above communication interface modules, it is important that you disconnect FCU external battery charger and main FCU installed battery pack cable connectors from Digital Circuit Board. Refer to Figure 6-1.

Continued on next page

Setting Up Communications

After installation of communication equipment and before placing the communication system into operation, the user should adhere to the following information:

- Verify RS-232 or RS485 Interface Modules, cables, associated FCU Digital Board MODULE RS-485 or RS-232 connector and radio are correctly installed.
- Check FCU identifier (ID) number. Log the ID for future reference.
- Log FCU access security code for future reference.

Helpful Hints

The following helpful hints aid the user after communication equipment has been installed and setup:

- When communication equipment is powered on, FCU displays the → after it recognizes the FCU identifier number.
- Check baud rate of FCU transmission and LISTEN time settings. The baud rate and time settings can be changed when PCCU is in ENTRY mode. Default settings are 1200 baud and listening time is 4 seconds.

Central Collection Unit (CCU)

Overview

The following CCU troubleshooting procedures will assist the user in determining the possible cause for an indicated error message. Refer to Table 6-3.

Table 6-3. Central Collection Unit (CCU)

Error Message	Possible Cause
FCU Did Not Respond to Communication Message	• CCU transmitting from wrong serial port. • In Meter ID Manager, FCU ID is incorrect. • In Meter ID Manager, communication baud rate is incorrect. • In Meter ID Manager link establishment time is incorrect. • Bad communication link. • More than one FCU has same ID. • Problem(s) with installed hardware.
CRC Error Detected in FCU Data	• Bad communication link • Installed hardware problems
FCU Error Detected in CCU Transmis-sion	• In Meter ID Manager, FCU security code is incorrect.
FCU Modem Did Not Answer	• In Meter ID Manager, FCU phone number is incorrect. • In Meter ID Manager, communication BAUD rate is incorrect. • Incorrect type of modem being used.
FCU Did Not Respond to Download Request	• CCU transmitting from incorrect serial port. • In Meter ID Manager, FCU ID is incorrect. • In Meter ID Manager, communication BAUD rate is incorrect. • In Meter ID Manager, link establishment time is incorrect. • Bad communication link. • More than one FCU has same ID. • Problem(s) with installed hardware. • Wrong security code

RS-232 Serial Communications

Overview

The following RS-232 Serial Communication troubleshooting procedures will assist the user in what may be the possible cause for indicated error message. Refer to Table 6-4.

Table 6-4 RS-232 Serial Communication

Error Message	Possible Cause
FCU Will Not Respond to Communication Message	• Verify FCU Digital Circuit Board wiring to radio transceiver is correct. • Verify battery pack voltage is greater than 11.5 Vdc. • Verify FCU identification number and access security code are correct. • Check FCU transceiver SWVBATT supply voltage. Refer to the following Measuring SWVBATT Transceiver Supply voltage for procedures.
Measuring SWVBATT Transceiver Supply Voltage	• Using a digital voltmeter, measure transceiver SWVBATT DC supply voltage between the following Digital Circuit Board J4 green connector terminals. Refer to Figure 6-1. J4-1 (GDN [BLK]) and J4-3 (SWVBATT [WHT]) Voltage should be greater than 11.5 Vdc.

Important

The transceiver measured DC voltage should pulse every four (4) seconds for a time duration of approximately 350 milliseconds (Baud rate dependent 350 max = 1200 Baud). Voltage must be at least 11.5 Vdc.

Voltage may be difficult to measure because of the short 350 millisecond time duration.

Continued on next page

Table 6-4 (Continued)

Error Message	Possible Cause
Measuring Receiving Data [RXD (+)] Voltage	• Using an oscilloscope or digital voltmeter, connect it to Digital Circuit Board J4 green connector across the following terminals. Refer to Figure 6-1. J4-1 (GND [BLK] and J4-6 (RXD+ [BRN]) When communication data is being transmitted from CCU to FCU, voltage should vary between +5 Vdc and -5 Vdc.

Note

Voltage may be difficult to see using a digital voltmeter. It can be seen using an oscilloscope.

Verify voltage by continuously polling FCU from CCU.

Measuring Request To Send (RTS) Voltage	• Using an oscilloscope or digital voltmeter, connect measuring device to Digital Circuit Board J4 green connector across the following terminals. Refer to Figure 6-1. J4-1 (GND [BLK]) and J4-8 (RTS [Red]) When FCU is sending communication data to CCU, voltage should be +5 Vdc.

Important

Voltage may be difficult to see using a digital voltmeter. It can be seen using an oscilloscope.

Verify voltage by continuously polling FCU from CCU.

Continued on next page

Table 6-4 (Continued)

Error Message	Possible Cause
Measuring Transmitting Data (TXD+) Voltage	• Using an oscilloscope or digital voltmeter, connect measuring device to Digital Circuit Board J4 green connector across the following terminals. Refer to Figure 6-1. J4-1 (GND [BLK]) and J4-4 (TXD+ [GRN]) When communication data is being transmitted from the FCU, voltage should vary between +5 Vdc and -5 Vdc.

Note

This voltage may be difficult to see using a digital voltmeter. It can be seen using an oscilloscope.

Verify voltage by continuously polling FCU from CCU.

Communication Problem(s) Still Exists	• Using two (2) hand-held transceivers, check communication path between Master and Remote sites. If available, voice activated interface can be used. • Using a wattmeter, check transceiver output power. Refer to manufacturer's documentation for measuring instructions. • Verify that transceiver is on correct frequency. Refer to manufacturer's documentation for checking frequency instructions.

RS-485 Communications

Overview

The following RS-485 Communications troubleshooting procedures will assist the user in what may be the possible cause for indicated error message. Refer to Table 6-5.

Table 6-5 RS-485 Communications

Error Message	Possible Cause
FCU Will Not Respond To Communication Message	• Verify that FCU Digital Circuit Board wiring, to optional universal Communications Interface (UCI) Board or Radio Modem Assembly, is correct. • Verify wiring from UCI Board to Radio Transceiver Assembly is correct. Verify UCI Board jumper settings are correct. • Verify wiring from Radio Modem Assembly to Radio Transceiver Assembly is correct. • Verify FCU battery pack voltage is at least 11.5 Vdc. • Verify that FCU identifier number and access security code are correct.
Measuring SWVBATT Transceiver Supply Switch Voltage	• Using a digital voltmeter, measure transceiver SWVBATT DC supply voltage between the following digital Circuit Board J4 green connector terminals. Refer to Figure 6-1. J4-1 (GND [BLK]) and J4-3 (SWVBATT [WHT]) Switched voltage should be greater than 11.5 Vdc.

Note

The transceiver SWVBATT measured DC voltage should pulse every four (4) seconds for a time duration of approximately 350 milliseconds. Voltage must be at least 11.5 Vdc. (Baud rate dependent 350 max = 1200 Baud.)

Voltage may be difficult to measure because of the short 350 millisecond time duration.

Continued on next page

Table 6-5 (Continued)

Error Message	Possible Cause
Measuring Battery Pack Voltage (V-BATT)	• Using a digital voltmeter, measure transceiver V-BATT power supply voltage between the following Digital Circuit Board J4 green connector terminals. Refer to Figure 6-1. J4-1 (GND [BLK]) and J4-2 (V-BATT) Switched voltage should be greater than 11.5 Vdc.

Important

Power to transceiver can be provided from an external power supply. This allows FCU to switch external power to transceiver. Switching is accomplished using a 12VDC switch line connected to J4-3 (WHT). Refer to Measuring SWVBATT Transceiver Supply Switch Voltage.

If this option is used, J4-2 (V-BATT) is not used.

Measuring RS-485 Line Driver voltage	• Using an oscilloscope or digital voltmeter, connect it to Digital Circuit Board J4 green connector across the following terminals. Refer to Figure 6-1. J4-4 (BUS-[RED]) and J4-6 (BUS+[BRN]) Voltage should vary between +5 Vdc and 0 Vdc when communication data is being transmitted from CCU to FCU.

Important

Voltage may be difficult to see using a digital voltmeter. It can be seen using an oscilloscope.

Verify voltage by continuously polling FCU from CCU.

Continued on next page

Table 6-5 (Continued)

Error Message	Possible Cause
Measuring Request to Send (RTS) Voltage	• Using an oscilloscope or digital voltmeter, connect it to Digital Circuit Board J4 green connector across the following terminals. Refer to Figure 6-1. J4-1 (GRD [BLK]) and J4-8 (VIO [BRN]) Voltage should be +5 Vdc when sending data to CCU. 0 V when not transmitting.

Note

Voltage may be difficult to see using a digital voltmeter. It can be seen using an oscilloscope.

Verify voltage by continuously polling FCU from CCU.

When RTS is high, transmitter must be keyed and transmitting data.

Communication Problem(s) Still Exit	Using two hand-held transceivers, check communication path between Master and Remote sites. If available, voice activated interface can be used. Using a wattmeter, check transceiver output power. Refer to wattmeter manufacturers documentation for operating instructions. Verify that transceiver is on correct frequency. Refer to transceiver manufacturer's documentation for procedures to check frequency.

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Chapter 7.0

Parts Catalog

Overview

Overview

This chapter provides the you with a list of Totalflow subassembly parts, and component location drawings. Subsequent information includes how to order and return parts as well as a list of available replacement parts.

Hint

For a more current list of spare parts, check the Totalflow web site at (www.totalflow.com), look for the heading "Totalflow Services" and "Spare Parts Catalog".

Chapter Highlights

This chapter covers the following topics

What Part(s) Can Be Ordered

All parts, listed in this Chapter, can be purchased from Totalflow. If a part is not listed, check the Totalflow web site listed on the previous page or call the number listed below. To order a part, contact the Totalflow Service Department at the address listed in Section, “How to Place an Order”.

How to Place a Part(s) Order

To order part(s), contact Totalflow at the following address and phone number:

ABB Automation Inc.
Totalflow Division
Customer Service, Order Entry
7051 Industrial Blvd.
Bartlesville, OK 74006

(800) 442-3097

To ensure an immediate response to a part(s) order, you should provide the following information to the customer service representative:

- Purchase Order number. When ordering by phone, a confirming P.O. should be verbally provided to Customer Service representative and then mailed to Totalflow.
- Address where Totalflow is to ship part(s).
- Address where Totalflow part(s) invoice is to be sent.
- Totalflow Part(s) numbers. Refer to the following Sections; and How to Determine an FCU's Option.
- Quantity of each part(s) ordered.
- Part serial number, Totalflow Model number (6410/6413), or Totalflow System project number. This is necessary for warranty related part(s) orders or application dependent part(s).
- Quantity of each part(s) ordered.
- Preferred method for shipping part(s).

Continued on next page

How to Return Part(s)

Any Totalflow part(s) can be returned to Totalflow service facility for testing and/or repair, warranty replacement or restocking.

Shipment of part(s) to Totalflow, whether for repair or replacement, must be prepaid by customer. Return part(s) shipment must have a Totalflow Return Authorization Number (RA#). To obtain an RA#, call Totalflow Customer Service Department at (800) 442-3097.

Package with part(s), must be returned to the following address. Affix RA# to outside of return package.

ABB Automation Inc.
Totalflow Division
7051 Industrial Blvd.
Bartlesville, OK 74006

Attention: Returns Department, RA#
(800) 442-3097

Spare Parts
Refer to Figures 7-1 & 7-2

Item No.	Totalflow Part Number	Description	Remarks
1	2015281-002	6410: Enclosure Assembly with LCD Display.	None
	2015250-002	6413: Enclosure Assembly with LCD Display.	
2	2012804-001	LCD Display Assembly	Part of FCU door assembly.
3	2015333-002	Digital Circuit Board Kit. GP/Div. 2.	
3A	1487010-001	Lithium 3.6 Battery	
4	XXXXXX-XXX	PROMS	Contact Customer Service or see www.totalflow.com, spare parts catalog.
5	2015224-001 2015372-A1	Mounting Kit, Orifice Pipe Mounting, P.I. Pipe Mounting or Wall Mounting.	Fittings not included.
6	2015285-(*)	AMU Orifice Assembly 0.2 percent accuracy For correct dash numbers determine DP Range in H20 and AP range; see Table 7-1.	AP on low side, DP low on left (facing front of unit)
	2015232-(*)	AMU Orifice Assemble 0.2 percent accuracy For correct dash numbers determine DP Range in H20 and AP range; see Table 7-1.	AP on high side, DP low on left (facing front of unit)
	2015317-(*)	AMU Orifice Assemble 0.05 percent accuracy For correct dash numbers determine DP Range in H20 and AP range; see Table 7-1.	AP on high side, DP low on right (facing front of unit)
	2015318-(*)	AMU Orifice Assemble 0.05 percent accuracy For correct dash numbers determine DP Range in H20 and AP range; see Table 7-1.	AP on low side, DP low on right (facing front of unit)

Spare Parts
Refer to Figures 7-1 & 7-2

Item No.	Totalflow Part Number	Description	Remarks
7	1313040-205	Threaded Spacer: Nylon, #2-56 x .312 Long. Threaded to FCU door mounted standoff. Located on under side of LCD Board.	Quantity 4
	1313040-205	Threaded Spacer: Nylon, #2-56 x .312 Long. Threaded to top of door mounted standoff to secure LCD Board in place.	Quantity 4
8	H10085	Screw, .190-32 UNF x .50 Long, SST, Pan Head.	Quantity 8
9	H11467	Washer, Flat, .190, SST, .562 OD x .203 ID x .010 Thick.	Quantity 8
10	H11656	Washer, Split, .190, SST, .47 Thick.	Quantity 8
11	H11469	Washer, #6 Flat, SST	Quantity 4
12	10732-00	Screw, 4-40 x 3/8" Pan. Phillips, SST	Quantity 4
13	2015113-003	Battery, 12VDC - 8.0 AH Cyclone (2x3)for the Model 6413	Charge Temp. Operating Range: -40°F (-40°C) to 140°F (60°C).
	2015052-001	Battery, 12VDC - 26.0 AH Genesis	Charge Temp. Operating Range: -40°F (-40°C) to 140°F (60°C).
	2015259-001	Battery, I.S.; 12VDC -8.0 Cyclone (2x3). for the Model 6410.	Charge Temp. Operating Range: -40°F (-40°C) to 140°F (60°C). Must have Division 1 Certification.
14	12150000-001	Protective Cap	

Spare Parts
Refer to Figures 7-1 & 7-2

Unit No.	Totalflow Part Number	Description	Remarks
15	2015260-002	Communication Mounting Bracket	
	XXXXXXX-XXX	Communication Kits	Contact Customer Service
16	2015193-001	Communication Module, RS485	Not Shown
	2015192-001	Communication Module, RS232.	Not Shown
17	2000073-002	PCCU Cable Assembly	
18	2015218-001	AMU Cable	

Charging Source Options

Totalflow Part Number	Description	Remarks
1488010-102	Solar Panel, 12VDC, 10W, Crystalline	Kit not assembled.
2011720-007	AC Power Supply, 115 VAC	
2012546-003	Power Supply; 24VDC Input, 12VDC Output	
2015232-002	Solar Panel Kit; 12VDC, 10 watt, Crystalline	Kit not assembled.
2011962-004	Solar Panel; 12VDC, 10 watt, Crystalline with 50' power connector.	Required for Division 1, NRTL/C.
2011962-005	Solar Panel: 12VDC, 10 watt, Crystalline with 135' power connector.	Required for Division 1, NRTL/C.
2011962-002	Solar Panel: 12VDC, 10 watt with 50' power cable.	GP, Div2
2011962-001	Solar Panel: 12VDC, 10 watt with 135' power cable.	GP, Div2
2015095-001	Solar Panel: 12VDC, 18 watt with 15' power cable.	GP, Div2

Spare Parts
Refer to Figures 7-1 & 7-2

		AP Range								
		100	**150**	**250**	**500**	**1000**	**1500**	**2000**	**2500**	**3200**
DP Range	**100**	002	027	003	004	005	009	019		041
	150	023	001	018	033	014	011	038		042
	250	024	028	006	007	008	010	039		043
	400	025	029	031	034	035	015	040		044
	800								045*	

* Available in 2015285 only (Foxboro DP)

Table 7-1. Transducer Pressure Range (suffix) Part Numbers.

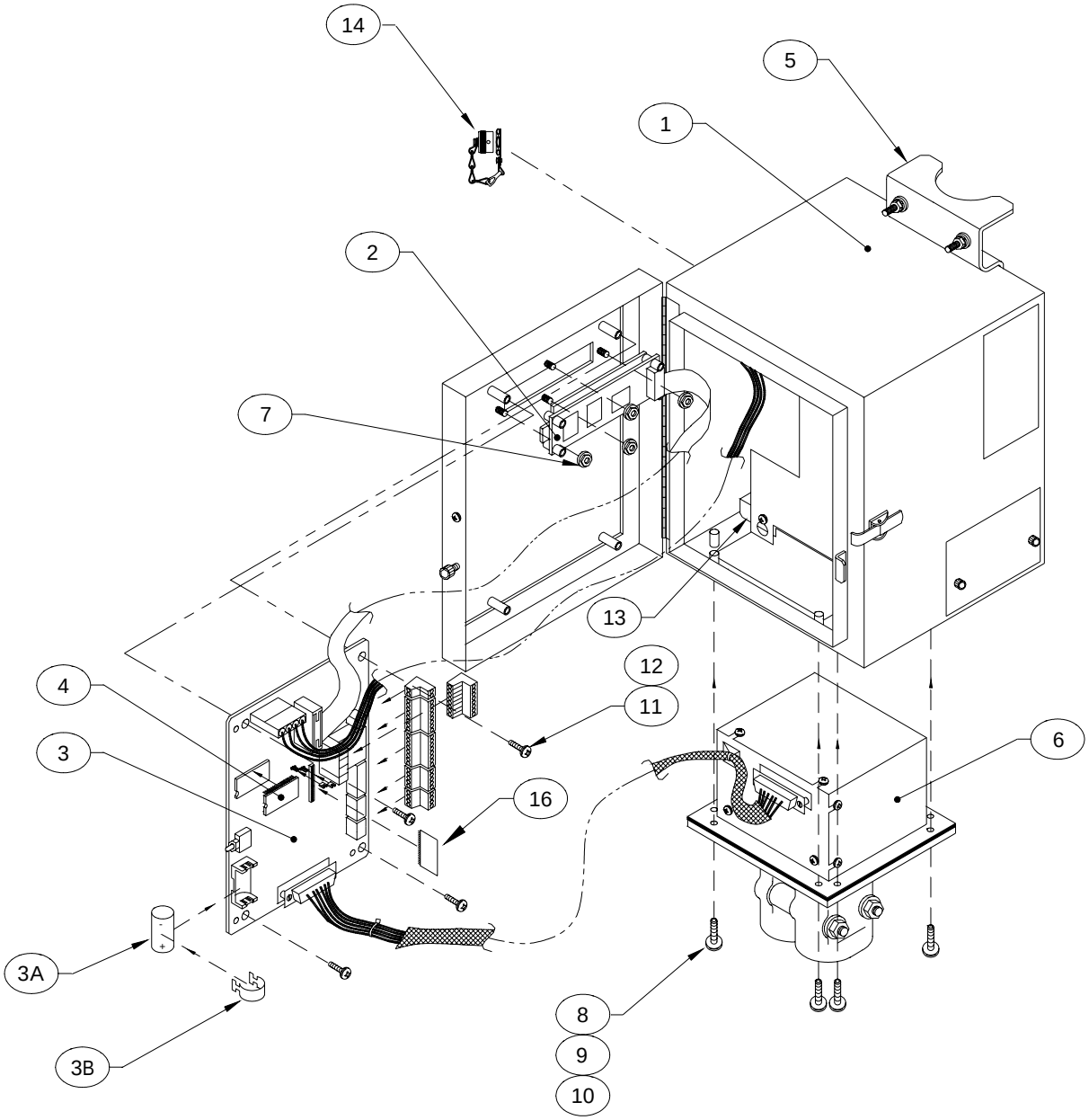

Figure 7-1 FCU Model 6410 Enclosure

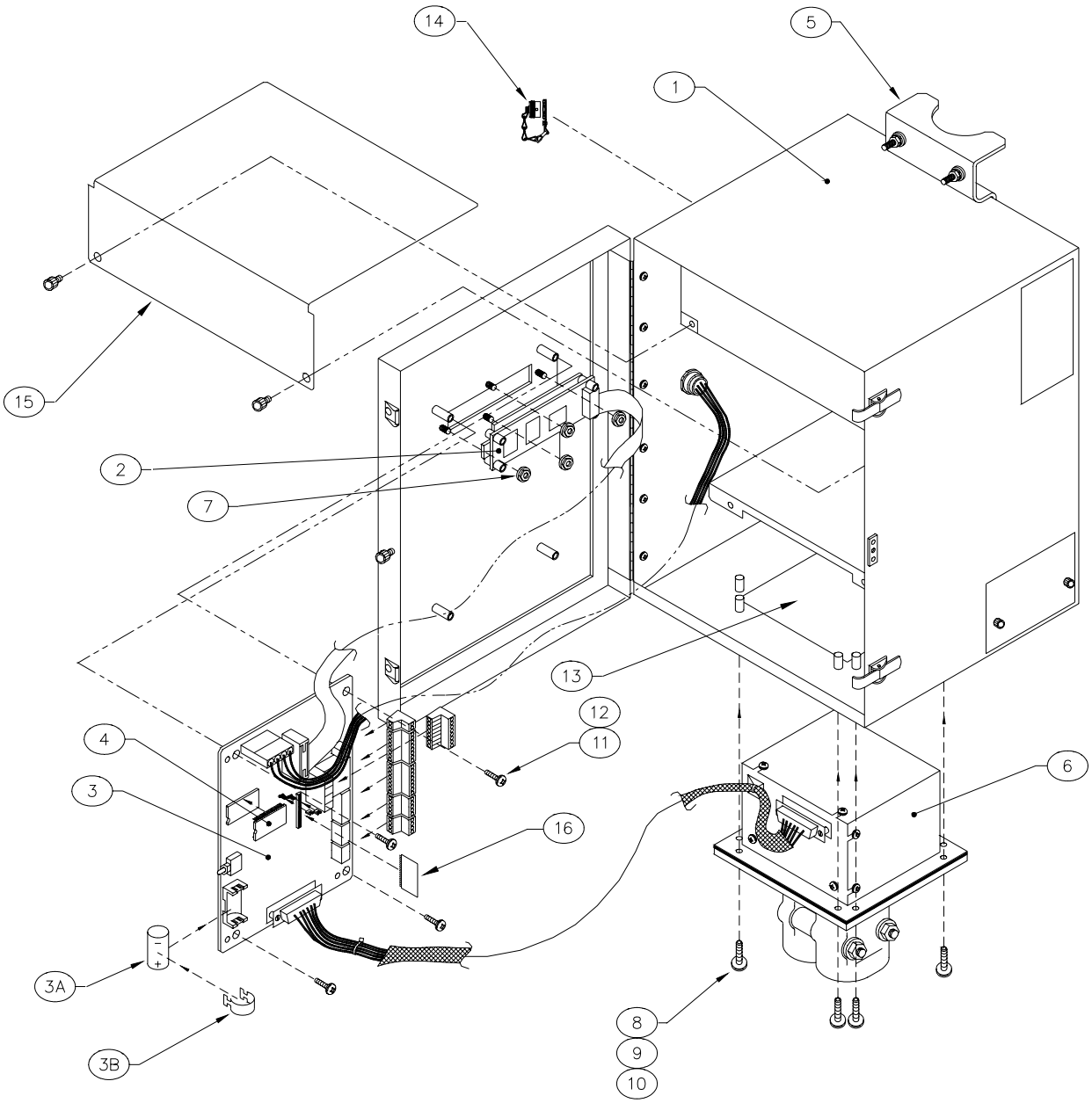

Figure 7-2 FCU Model 6413 Enclosure

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Chapter 8

Drawings Section

This section of the manual has been provided as a location for the user to place drawings that accompanies their new Totalflow units.

Totalflow recommends that a complete set of all drawings that accompany a Model 6400 Flow Computer be placed in this section. This would ensure that the user have only drawings applicable to their units and drawings that are at the latest revision level.