2017283-002 (AC)

TOTALFLOW®

6713 Flow Computer

User's Manual

TOTALFLOW
MEASUREMENT & CONTROL SYSTEMS

ABB

Copyright Notice

Table of Contents

Continued on next page

Continued on next page

Table of Contents, Continued

Continued on next page

Table of Contents, Continued

Introduction

About the Manual

Audience & Purpose

This manual is written to provide an experienced flow meter technician with the information necessary to install, setup and operate a Totalflow 6700 Flow Computer System.

Although this manual is primarily specific to the Model 6713, when you see the "6700" reference, with the exception of transducers and AMUs, it can also apply to the Model 6714. For more information regarding the 6714 flow computer see the "Operations & Maintenance for Pulse Input Flow Computers" manual, Part No. 2017282.

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. Knowing Your System	Provides a description of the Totalflow, 6700 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 (FS/2), 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. Plug-in RTU	Provides a description of the optional Plug-in RTU board.
8. Analog Output Expansion Options	Provides information on the different analog output options.
9. Valve Control	Provides information on the two different valve control features and how valve control works.
10. Drawings	Provides a place to put drawings that accompany a new 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 the 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

Grounding the Product

If a grounding conductor is required, it 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 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

System Description

Overview

Introduction

This Chapter introduces you to the Totalflow® Model 6700 Series Flow Computer Units (FCU). The 6700 series are microprocessor based units designed for calculating and measuring gas flow in a pipeline or from a well. Two models of the 6700 FCU are available, a Model 6713 (gas orifice) and a Model 6714 (pulse input). Although this manual is primarily specific to the Model 6713, when you see the "6700" reference, with the exception of transducers and AMUs, it will typically apply to the Model 6714 as well. For more information regarding the 6714 flow computer see the "Operations & Maintenance for Pulse Input Flow Computers" manual, Part No. 2017282.

The model 6713 is packaged in an enclosure that can accommodate both the FCU, and a variety of remote communications devices. When using the 6700 series in hazardous area installations, refer to drawing numbers 2015267-CD (Div 1) and 2015246-CD (Div 2) for information on the approved installation and wiring required.

What it Does

Model 6713 - An FCU maintains an log period history of average differential pressure (Dp), average absolute pressure (AP), average flowing temperature (Tf), Extension, Flowtime, Energy, and maintains log period accumulated volumes. The FCU can be programmed to calculate flow rates and volumes in accordance with either AGA 3-85, AGA 3-92 or ISO5167. This includes calculating supercompressibility, in accordance with either NX-19 or AGA 8 methods. AGA 8 includes the newer Gross and Detail methods.

The FCU has the capacity for 1260 log period records (50 days hourly numbers plus 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:

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Chapter Highlights (Continued)

6700 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 (see drawing #2015338)	Model 6713 - 15.10 in. W x 21.5 in. H x 13.69 in. D (383.54mm x 546.10 mm x 347.73 mm) Installed Depth: 6713 - 16.00 in. (406.40 mm)
Weight	6713 - 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
Digital Outputs *	2 FETs, sink = 100 ma
Pulse Counters *	2, (measurement range = 1 pulse per day up to 20 Khz)
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. RAM and ROM expandable to 512K.
Data Storage	Capacity for 1260 log period records (50 days hourly numbers plus 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.
Comm Ports	5 Ports Available: 1 - dedicated - AMU 1 - dedicated - PCCU 3 - RS232 or RS485 Plug-In Modules, (one used as LocalBus in Multi-tube application)
Analog Measuring Unit (AMU)	Self contained, environmentally protected unit for measuring differential pressure, static pressure, flowing temperature, and 2 additional analog inputs. See page 1-4 for AMU Specifications.
Optional Additional I/O	VCI Term Panel: 4 Digital Inputs, 4 Digital Outputs Plug-in RTU: 7 Analog Inputs, 1-4 Analog Outputs, 8 Digital Inputs, 8 Digital Outputs, 2 Pulse Inputs Single AO Card: 1 Analog Output Quad AO Card: 4 Analog Outputs

Note: Only one of the Plug-in RTU, Single AO or Quad AO expansion cards can be used at a time.

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 RTD input (measurement range = (-)96°F to (+)624°F (-69°C to +329°C) 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, hysterisis 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

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Analog Measuring Unit Specifications, Continued

Residual Thermal Effects	Thermal Hysterisis 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.

6700 Flow Computer Hardware

Introduction, See Figure 1-1

The Totalflow Model 6700 Flow Computer Units (FCU) are housed in a light-weight two-compartment aluminum case. Components of the FCU are:

- Enclosure
- 6700 Digital Controller Board
- Analog Measuring Unit
- Battery & Comm Compartments
- Solar Panel
- Resistive Temperature Detector (RTD)

Additional items used for expansion:

- Valve Control Term Board
- Single and Quad Analog Output Board
- Plug-in RTU (Expanded I/O) and Term Board
- LocalBus for Multi-tube Measurement (future)

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. Dual clasps are used to secure the lid to the enclosure. Opening the lid's latch allows access to electronics, battery, options, and Analog Measurement Unit (AMU) components.

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

Digital Circuit Board

The 6700 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 18 - MHz microprocessor with 128K RAM and 256K EPROM (both expandable to 512K). A socket for installation of FLASH memory is available and can be expanded later or at time of ordering to include FLASH memory. Other circuitry processes the inputs from the Analog Measuring Unit and provides 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.

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Analog Measurement 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 with the A to D converter and other analog conditioning circuitry necessary for the transducers, RTD, and external analog measurement channels.

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 for in real time. All factory characterization data is stored in E^2 PROM in the AMU.

Battery Compartment

The battery compartment houses the various optional battery packs that are available for the FCU; standard pack is a single lead acid 8-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 silk screened to the electronics board shield/cover plate.

Comm Compartment

Model 6700 FCU. Provides an enclosure to house a remote communication device; transceiver, cellular phone, modem, etc.

Solar Panel

The 6700 FCU comes standard with a 10-Watt solar panel. The panel is designed to be mounted on 2-inch extension pipe, or it can be mounted on top of or on the side of a meter house. Larger panels are available upon request.

Resistive Temperature Detector (RTD)

The RTD measures real-time flowing temperature of the measured gas stream. The 6700 FCU includes a 100-ohm Platinum RTD with 10-foot cable as standard equipment. Other lengths of cable are available upon request.

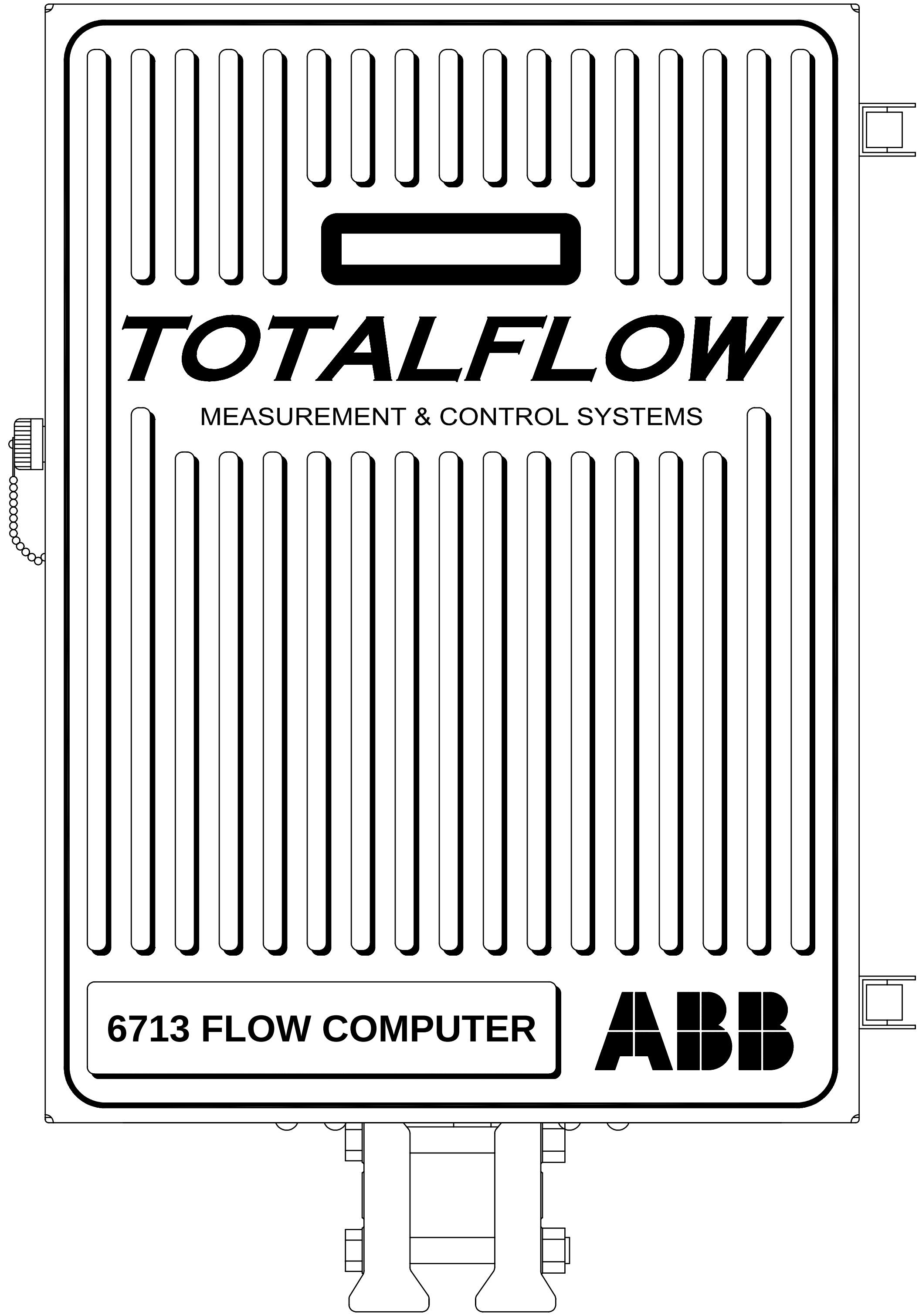

Figure 1-1. Model 6713 Flow Computer Unit

Functions of the FCU

Description

Primary functions of the FCU reflect an instrumental design that is practical and efficient. The FCU is simple to use and easy to use.

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

Complete log period flow and operational records including -
- Average absolute pressure
- Average differential pressure
- Average flowing temperature
- Corrected volume
- Extension
- Flowtime
- Energy
- Operating status
- Alarms (up to 24 discrete)

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

Complete daily operation statistics including -
- Percent flowing time
- Percent back flow time
- Percent out of limits (programmable) on AP and DP
- Maximum Differential Pressure
- Maximum Absolute Pressure
- Maximum Flowing Temperature
- Alarms (up to 24 discrete)

Adjustable Vol Calc and Log Periods
- Volume Calculation Periods – 1, 2, 5, 10, 20, 30 & 60 minutes
- Log Periods – 1, 2, 5, 10, 20, 30 & 60 minutes

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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, and AGA-8 standards
- Calculation of flow extension $\sqrt{\frac{Dp \times Ap}{Tf}}$ (92 eq.), $\sqrt{Dp \times Ap}$ (85 eq.) once per second
- Extrapolation of flow accumulation during transducer calibration
- Selection of all coefficients for log period calculation; calculation of dynamic factors (dependent upon Dp, Ap and Tf) using log period averages based on one second samples
- 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 capacity for 1260 log period records (50 days hourly numbers plus 10 skip days).
- Storage of a characteristic file of the current configuration settings in the FCU.
- Storage of up to 200 operational events (100 in old database).

Additional Features

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

- Programmable differential pressure zero cutoff
- Two digital inputs and 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
- Normal battery operation for 20 days without charging source; optional battery packs to extend operation for longer periods are available
- 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. 4 Comm ports are available: Local, Comm 1, Comm 2 and Comm 3
- Additional I/O for valve control, pressure & level monitoring, advanced control, etc.

Continued on next page

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, page 4-30 on for details on how to program the FCU.

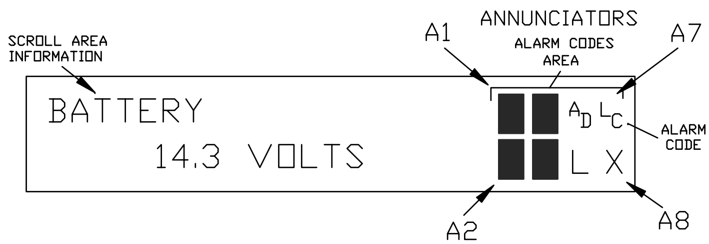
In addition to default displays, any item that is in the FCU database can be added to the display list using the PCCU32.

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 Conditions/Annunciators

Description

One of the primary functions of the FCU is the provision of complete log period 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 log period flow records. The time and date of the occurrence and the type of alarm indicated are stored in the FCU and can be retrieved when desired.

FCU Alarms/Annunciator Description

Annunciator Location	Alarm Character Designators	Description
A1	$^{\mathrm{L}}\mathrm{L}$	*Low Lithium Battery Alarm*: When $^{\mathrm{L}}\mathrm{L}$ (low lithium) is displayed, lithium battery voltage is below 2.5 Vdc. If battery voltage is above 2.5VDC, $^{\mathrm{L}}\mathrm{L}$ appears shaded. A good lithium battery will measure approximately 3.6 Vdc.
A1	↑/↓	*DP High and Low Operational Limit Violation*: 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. Visible only when DP is on display.
A1	↑/↓	*AP Hi and Lo Operational Limit Violation*: 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. Visible only when AP is on display.

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Annunciator Location	Alarm Character Designators	Description
A2, A4, A8 A2 = Comm3 A4 = Comm2 A8 = Comm1	**Ŧ**	*TOTALFLOW Listen Cycle*: Listening symbol. 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. Three remote communications ports are available and can be programmed as described individually. When FCU remote port is not active, Ŧ is shaded.
See above	→	*Transmitting Data*: If remote port is active and Totalflow Remote Protocol is running, → arrow is displayed.
See above	←	*Receiving Data*: If remote port is active and Totalflow Remote Protocol is running, < arrow is displayed.
See above	**X**	*Remote Port Not Active*: Displayed when remote port is not active. This is the default state upon cold start of the FCU for all remote communications ports. Baud rate must be toggled to activate each remote port.
A2, A4, A8 A2 = Comm3 A4 = Comm2 A8 = Comm1	**M**	*MODBUS ASCII*: Modbus ASCII protocol selected on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**m**	*MODBUS RTU*: Modbus RTU protocol selected on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
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

Annunciator Location	Alarm Character Designators	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 at full open position.
A3	⊣	*Valve Control*: Valve Control option installed. Valve is at 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 override set point, AP override set point, or Low Battery).
A3	$^{\mathrm{L}}{}_{\mathrm{L}}$	*Valve Control*: Valve Control option installed. Local Lock-out is initiated.
A5	**AD**	*Analog to Digital Converter Limit Violation*: Displayed if A to D Converter error occurs. Differential Pressure, Absolute Static Pressure or Flowing Temperature readings exceed maximum counts or are less than minimum counts. If A to D Converter readings are within range, AD is shaded.
A7	$^{\mathrm{L}}{}_{\mathrm{C}}$	*Low Charging Voltage Alarm*: Displayed if installed FCU battery charging voltage is within 0.4 Vdc of actual battery voltage. If charging voltage is 0.4 Vdc greater than battery voltage, $^{\mathrm{L}}{}_{\mathrm{C}}$ is shaded.
A6	**L**	*Local PCCU Connected*: Displayed when PCCU port is active and running TOTALFLOW Local Protocol. When PCCU port is not active, L is shaded. For example, this would occur if PCCU was not connected to PCCU port.

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FCU Alarms/Annunciators Description, Continued

Annunciator Location	Alarm Character Designators	Description
A5	**H**	*FCU in Hold Mode*: Displayed when HOLD flag is active. When not active, H is shaded. Also displayed when HOLD flag is active for the following conditions: • FCU is in the Calibrate mode (PCCU connected) • A to D Converter cannot be read.
See above	**¥**	*Totalflow Packet Protocol.* Totalflow Packet Protocol is selected on this port.
See above	**S**	*Square D Protocol*: Square D protocol is running on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
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 Mode:* Displayed when Host Console connected and communicating.
A6	**T**	*Terminal Mode:* Displayed when Terminal is connected and communicating. See Technical Bulletin # 44.
A8	**LV**	*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.
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	**O**	Attempt to resync on multi-host data requests.

FCU Log Period Record Entries

Making Log Period Data Entries

Log period data entries are made once per hour, on the hour immediately following completion of log period calculations.

When the FCU voltage drops below 11VDC the unit automatically records any data collected since the last calculation before entering a “Sleep” mode and turning power to remote device to off.

Note

When FCU voltage drops below 11VDC, *SLEEP MODE* is entered. When this occurs, a Reset Volume command forces an log period 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 log period entry is made. Clock changes are handled as follows:

Clock Change Not Crossing an Hour Boundary

When next log period data entry is made, the FCU 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 digital inputs (one designated as remote sense input for backward compatibility) and two digital (12V dc) outputs as a means to control external equipment with the FCU. Details on the control of external devices are given in Section 4: FCU Operations. Additional information on selecting other commands can be found in Technical Bulletin #44 located in the Reference section of this manual

Remote Sense

The Remote Sense reads an external contact. This contact must be closed to be considered “ON” and must remain “ON” for 1 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
- Flowing Temperature over high limit
- Flowing Temperature under low limit
- Flow Rate over high limit
- Flow Rate under low limit
- Accumulated volume set point
- Low Charger voltage
- Remote Sense is ON

AGA-3 1985 Flow Calculations

Description

Totalflow equipment allows the user to select which of the nine AGA-3 or NX-19 factors to include in the log period 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 $\sqrt{\dfrac{Dp \times Ap}{Tf}}$ *92 eq.*, or $\sqrt{Dp \times Ap}$ *85 eq.*) from measured variables. The extension is summed for the vol calc period 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 log period computations of averages for Dp, Ap and Tf. The averages are computed only during times of flow, unless there is no flow for the entire vol calc period.

Each second the FCU calculates the previous seconds integrated extension. Using this extension and the previous vol cal period C' (Integral Multiplier), the current flow rate is computed. This value is available to be shown on the FCU display.

Log period Calculations

Each Vol Calc Period 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' or Integral Multiplier) from the product of the individual factors.
- A volume from the product (C' or Integral Multiplier) x integrated extension). NOTE: The product is a true reflection of Volume only if the orifice factor (Fb) is selected for inclusion in C' or Integral Multiplier.

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

The FCU maintains an audit history of average Dp, average Ap, average Tf, Extension, Flowtime, Energy, and Log Period 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

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 1985 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 (Integral Multiplier)
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' or Integral Multiplier 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 6700 FCU. These factors can be combined by the user and entered into the FCU as Faux.

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.

$$Q_v = \frac{\frac{\pi}{4} N_c \, C_d \, E_v \, Y \, d^2 \sqrt{2 \, \rho_f \, \Delta P}}{\rho_b} \qquad \textbf{\textit{eq. 7}}$$

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.

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

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.

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

In older Totalflow devices Type 1 and 2 averages were always based on linear values. In newer Totalflow devices (series 6400 and 6700 FCUs) either linear or square root averages can be specified.

Type 1 Averages

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

Averages constructed from all one second samples (regardless of flow) 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. Selections 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 6-1. Please note that the following equations are based on using linear averages, if square root averages are selected, then square roots are performed before the one second summations take place.

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_ CONSTS 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

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

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

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

$$\begin{aligned} &If \;\; F_{ic} < 1000 \; F_{ip} \\ &\quad Then \;\; F_I = \frac{F_{ic}}{F_{ip}} \\ &\quad Else \;\; F_I = 1000 \end{aligned}$$

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

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

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

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

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

$$Else$$

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

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

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

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

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

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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_I	Iteration flow factor
F_{Ic}	Iteration flow factor - independent factor.
F_{Ip}	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

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

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).

Chapter 2

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 Model 6713.

Installation Sequence

The following table provides you a recommended sequence of steps to be followed for the installation process. Before you begin the installation familiarize yourself with the process; detailed 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
Outline Drawing.	2-5
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.	2-7
If direct mounting FCU, skip the next 4 events.	2-12
Install the 40-inch pipe in the pipe saddle.	2-7
Mount the FCU on the 2-inch pipe.	2-8
Mount the manifold to the bottom of the FCU.	2-15
Connect the stainless steel tubing from the manifold to the orifice tap valves.	2-16

Continued on next page

Overview, Continued

Sequence of Events Table (Continued)

Events	See Page
Install the RTD and connect the wiring to the connector block on the digital PC board.	2-17
Mount and connect the battery to J1, the primary battery connector on the digital PC board.	2-20
Mount the solar panel, do not connect wiring until battery pack(s) are connected.	2-21
Connect the PCCU to FCU.	3-3
Set date and time; program ID and location	4-15 4-108
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.	4-41
Setup balance of Entry mode items.	4-13
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.	2-15
b. Open the orifice tap valves slowly (high pressure side first), then close bypass valve.	2-15
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.	1-12
e. Collect data and printout to verify all data has been entered correctly.	4-7

Unpacking & Inspection

Unpacking

The 6700 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 viii.

FCU Meter Run Installation

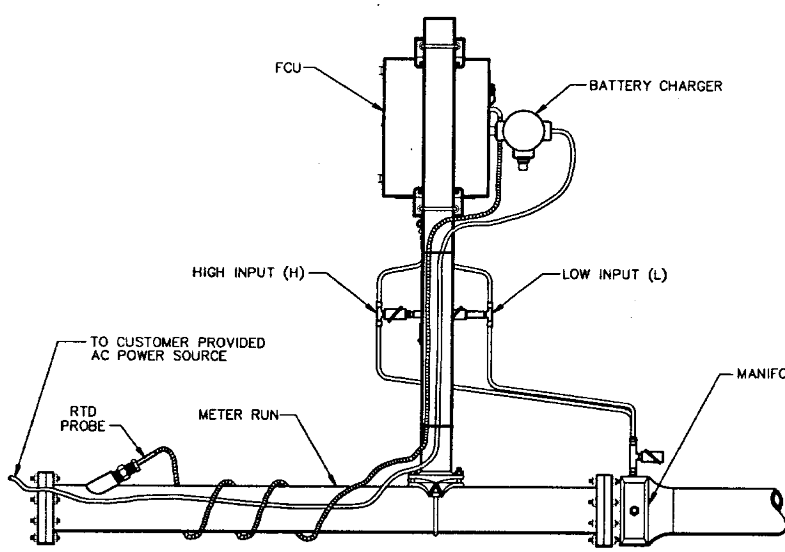
Description

The following procedures unless otherwise stated are applicable for the FCU Model 6713. The FCU can either be pipe, direct or wall mounted, use the procedure that fits your installation. Figure 2-1 shows the dimensions and outline for the Model 6713 FCU.

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	2-7
Install on wall	Wall Mounting Procedure	2-10
Direct Mount	Direct Mounting Procedures	2-12

Continued on next page

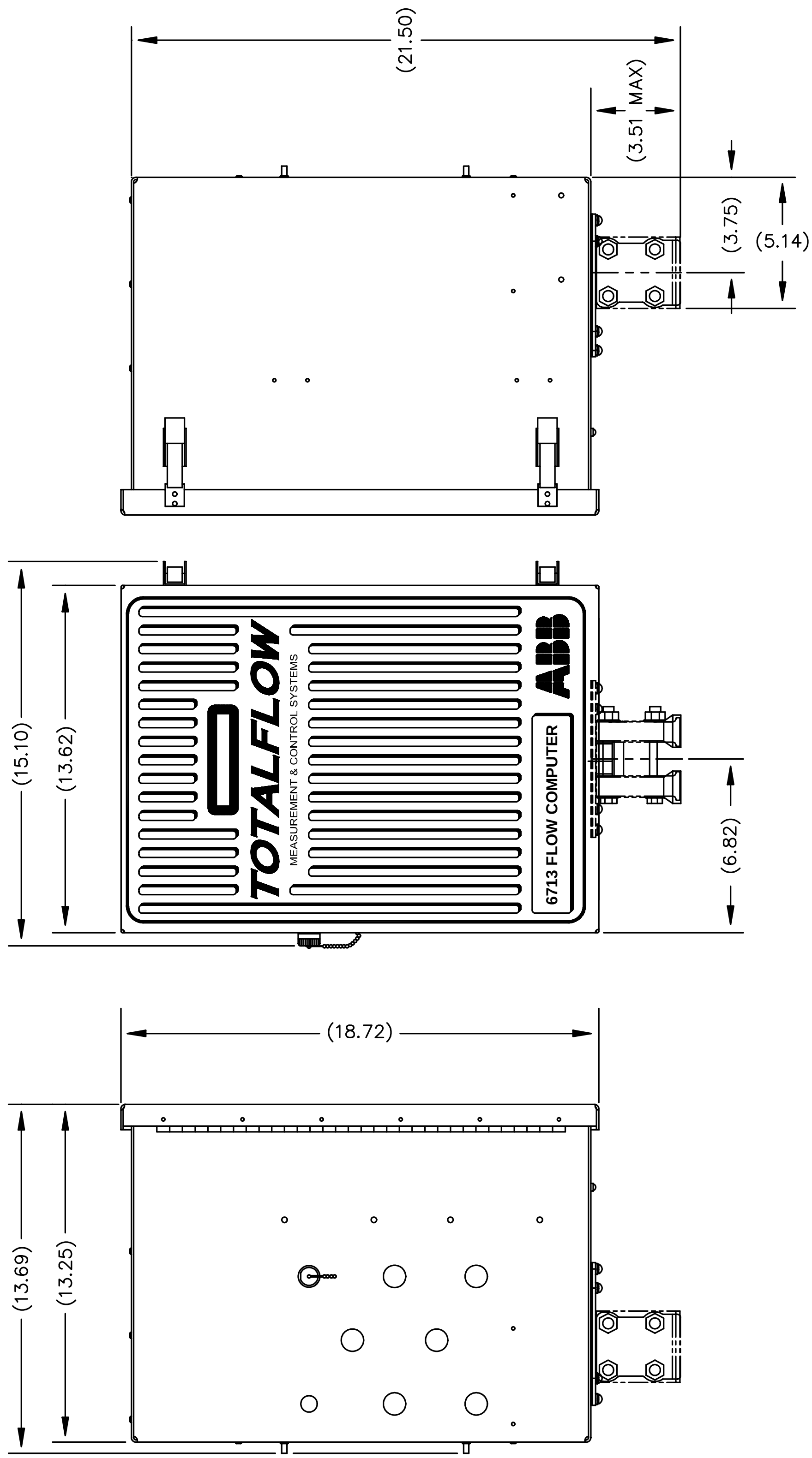


Figure 2-2. Outline Drawing, Side and Front Views, Model 6700 FCU

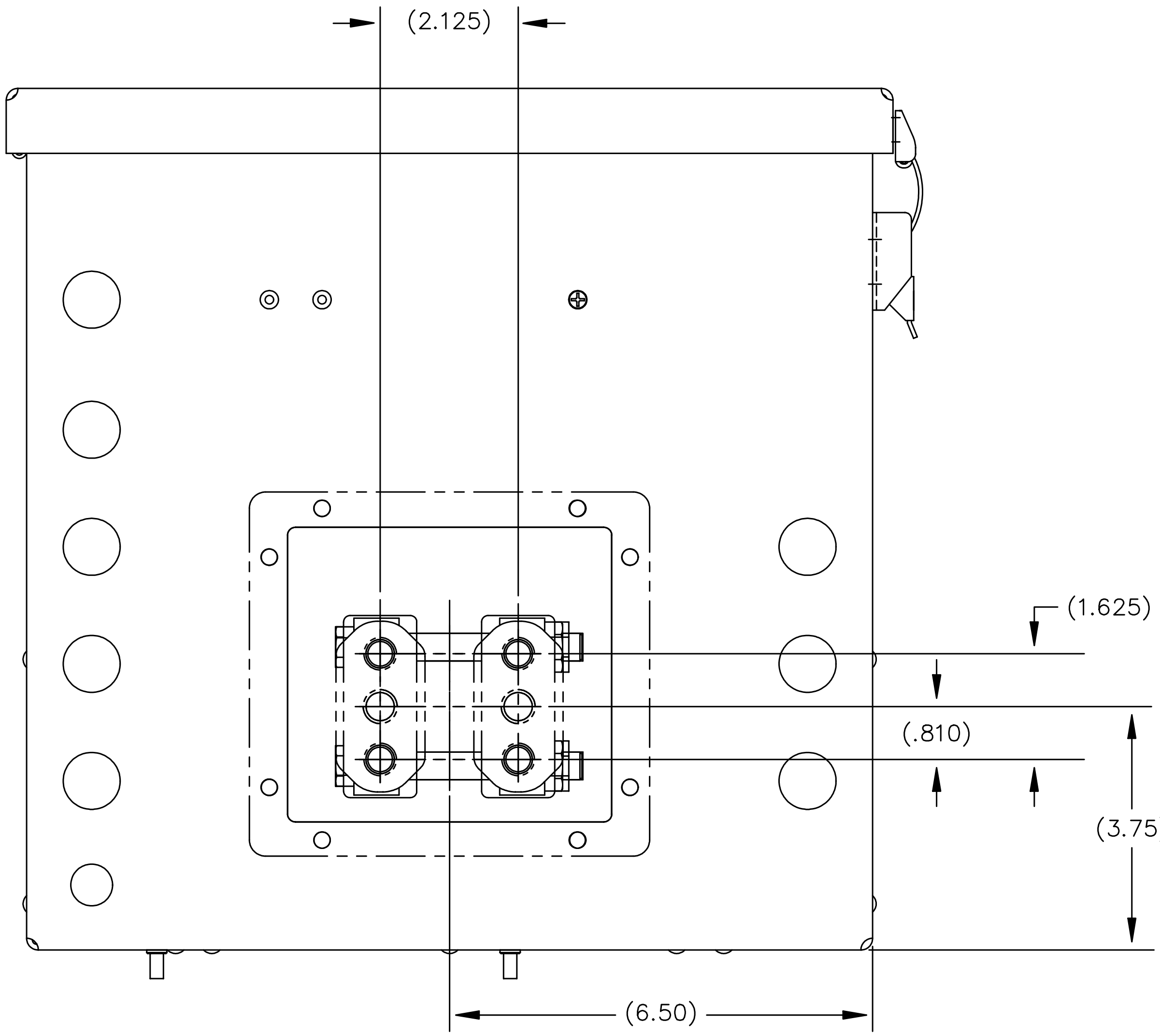


Figure 2-3. Outline Drawing, Bottom View, Model 6700 FCU

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.

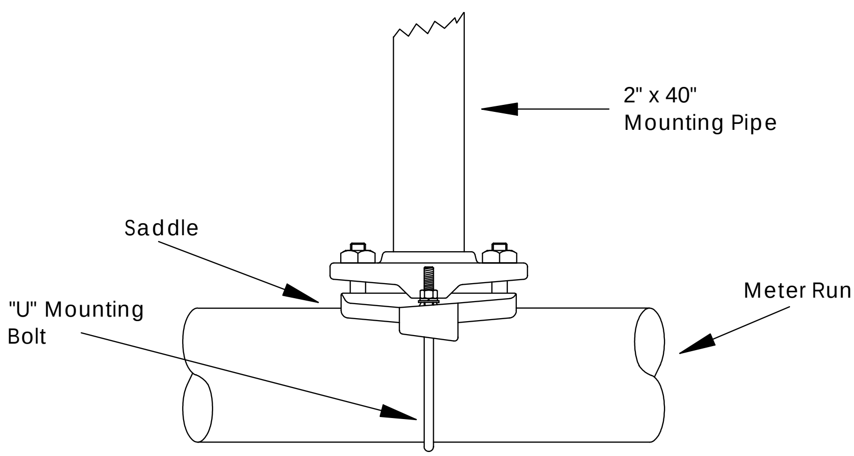
Totalflow Supplied Materials

- 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.  **Figure 2.4**
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.

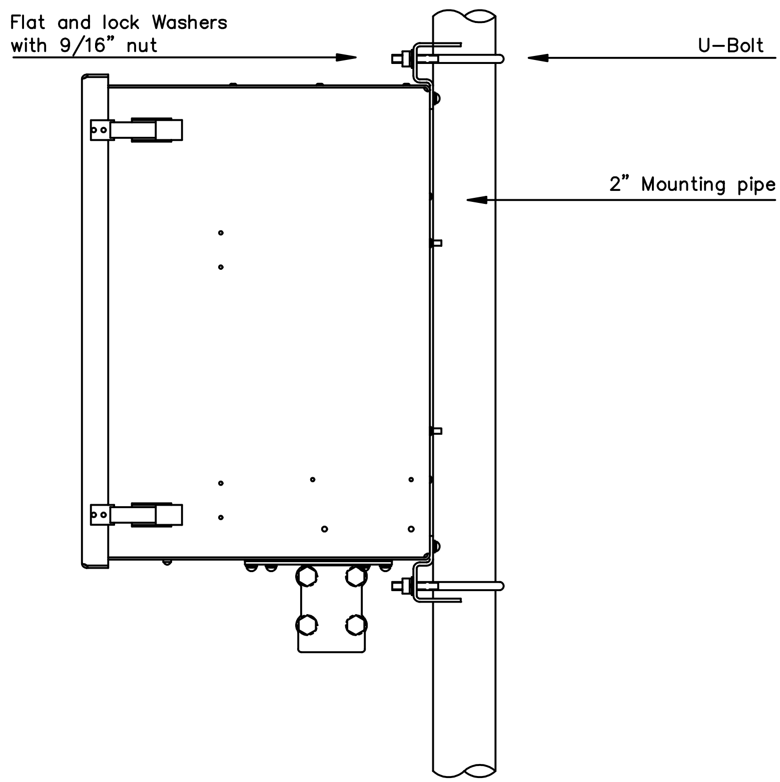
Continued on next page

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, lockwashers and two 9/16” bolts.  **Figure 2.5**

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.

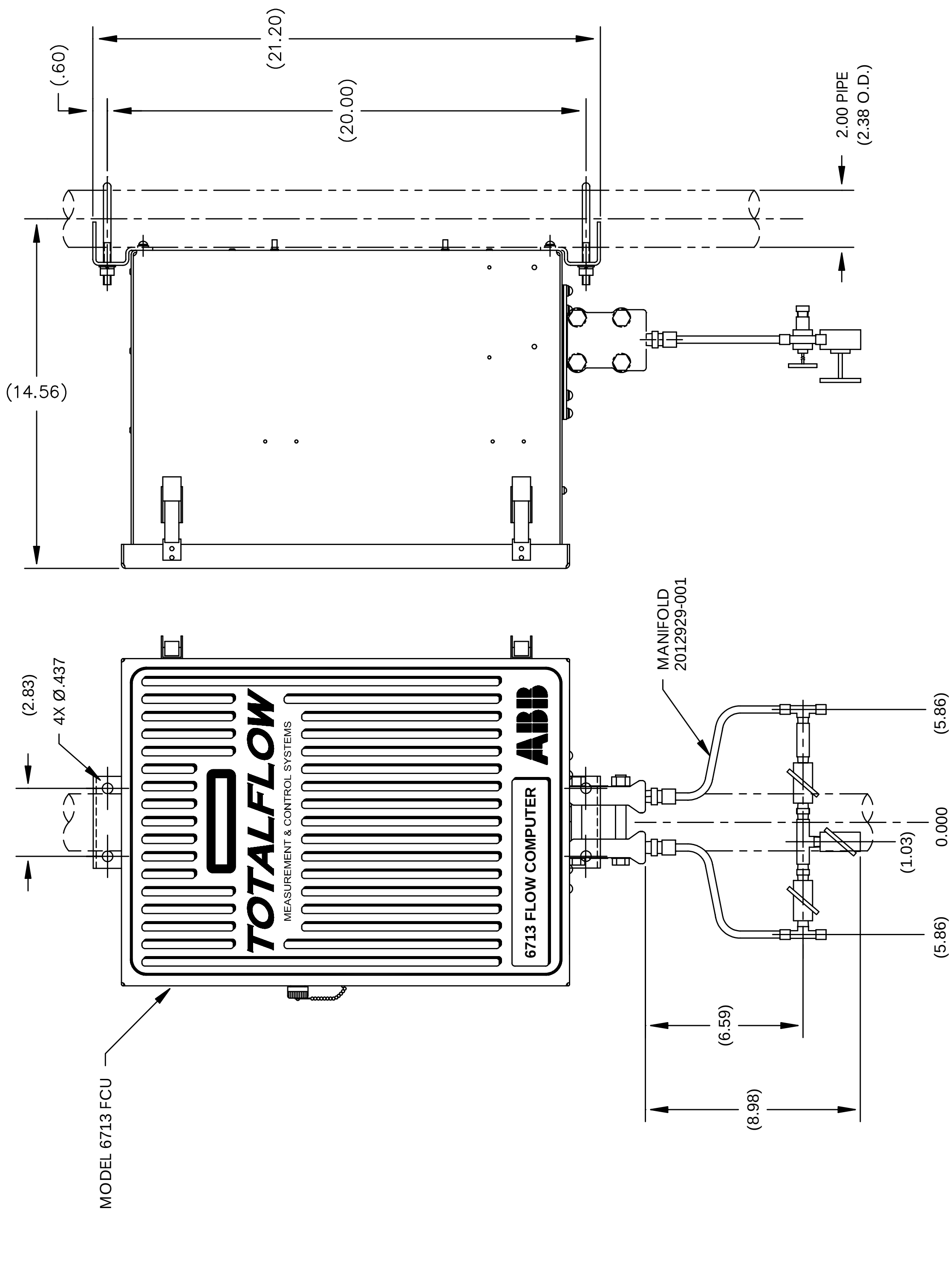


Figure 2.6 Model 6713, Pipe Mounting W/Discrete Manifold

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.

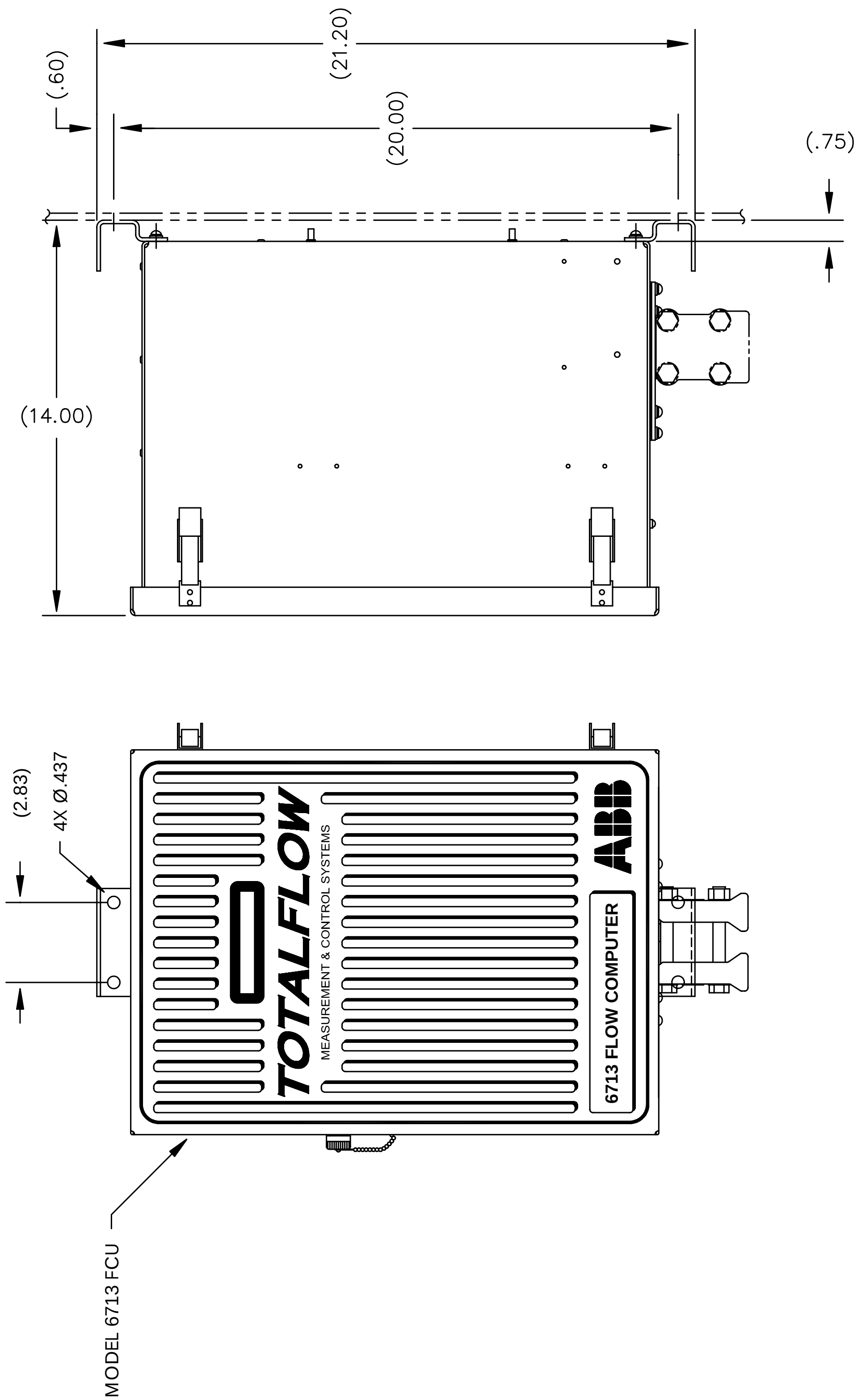


Figure 2.7 Model 6713, Wall Mounting

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.

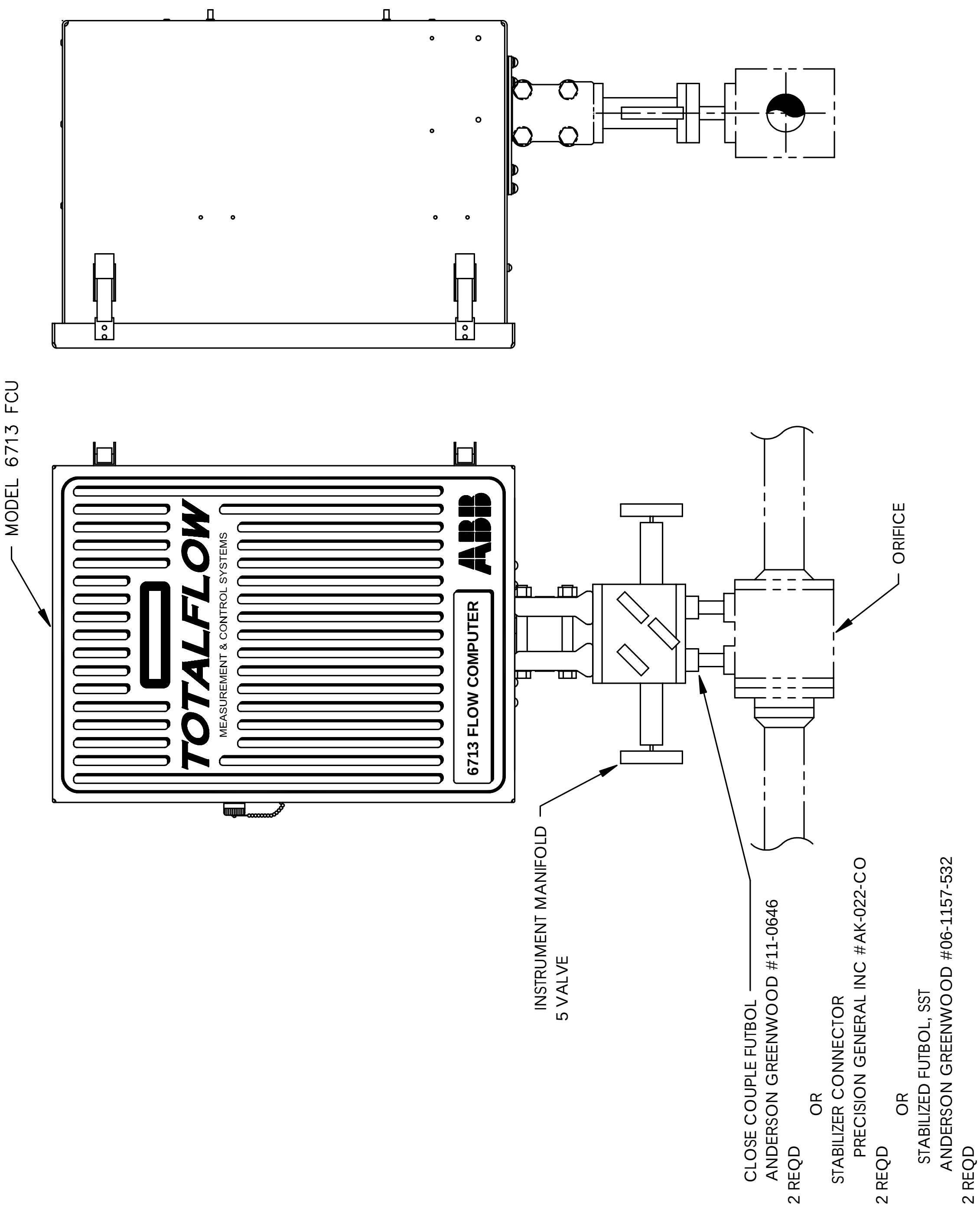


Figure 2-8. Model 6713, Direct Mount

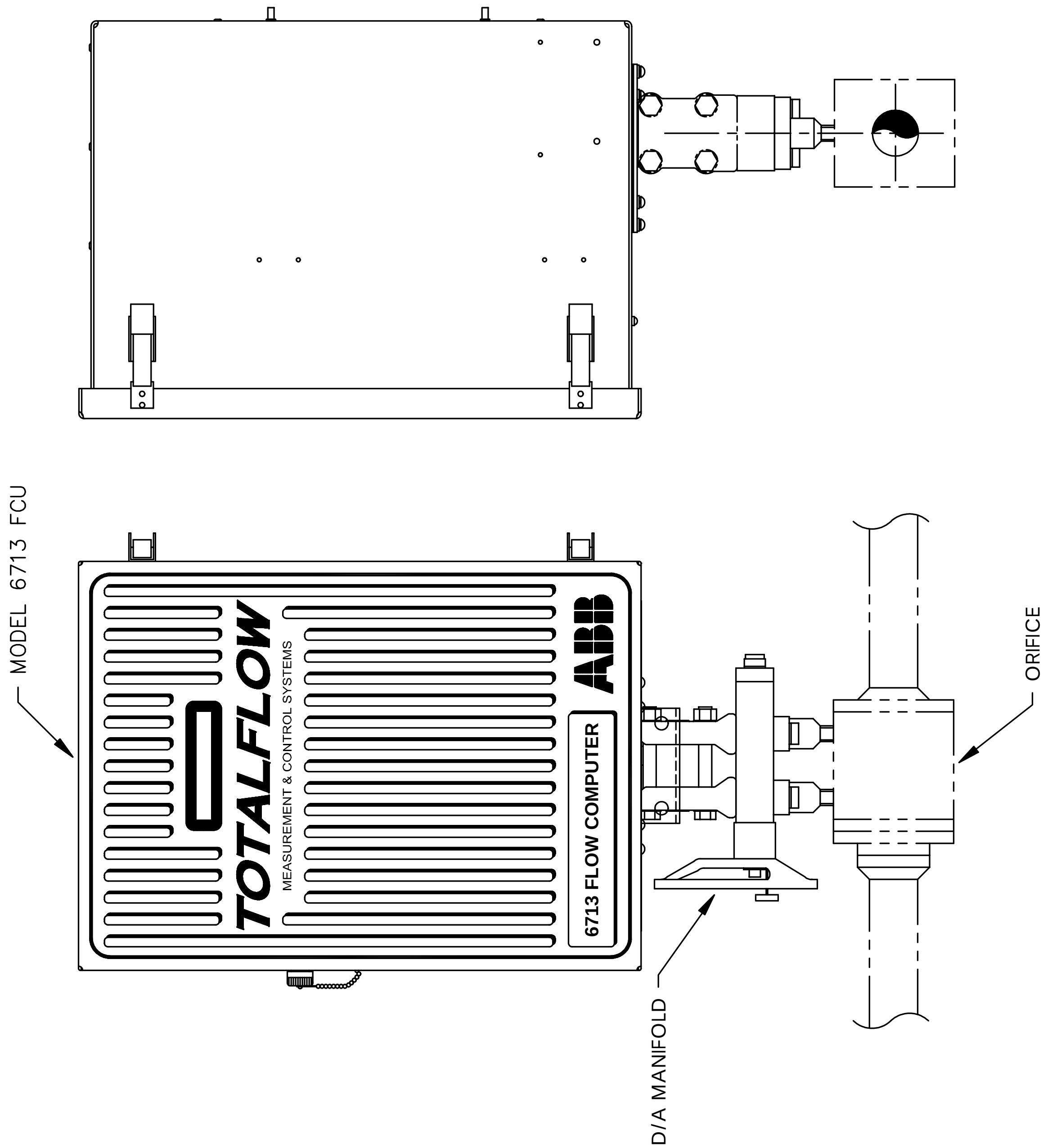
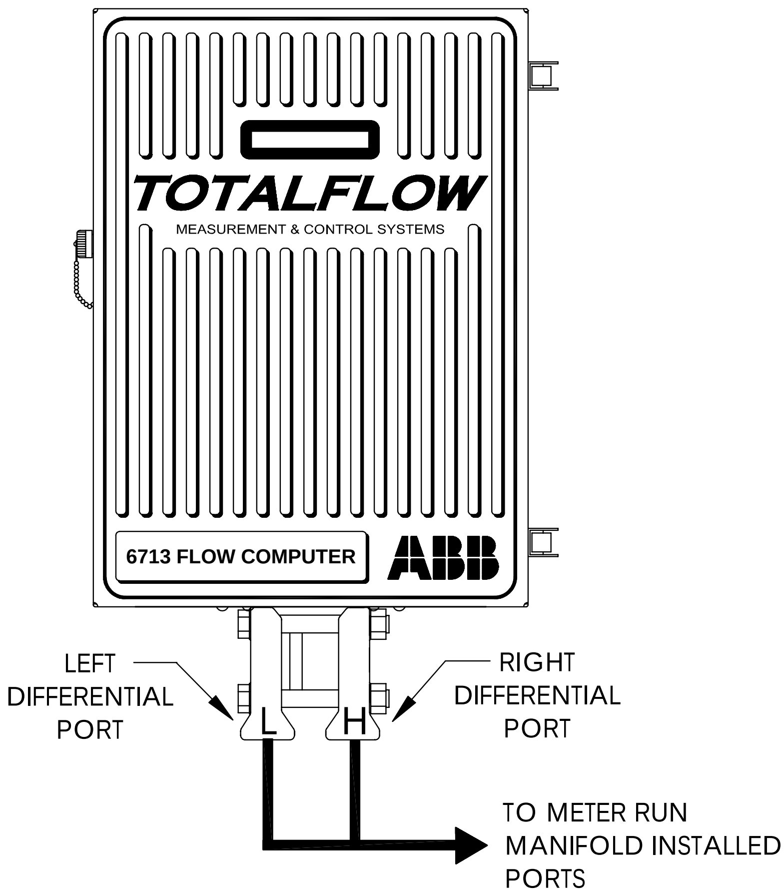


Figure 2-9. Model 6713, Direct Mount with D/A Manifold

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
  Direct Mount Manifold

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

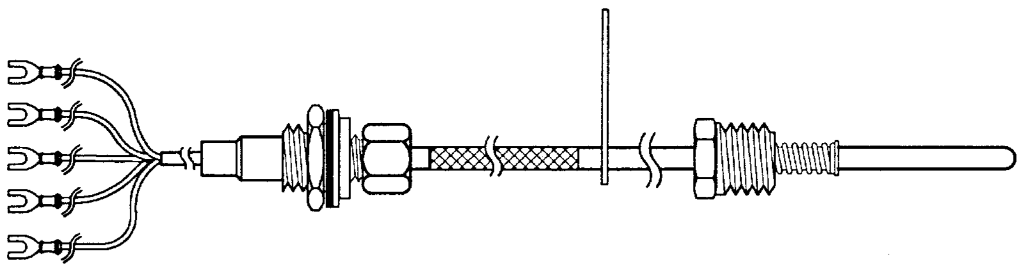
Instructions

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 are available. Procedures, presented in this Section, enable the user to install the RTD into the meter run.



Totalflow Materials Supplied

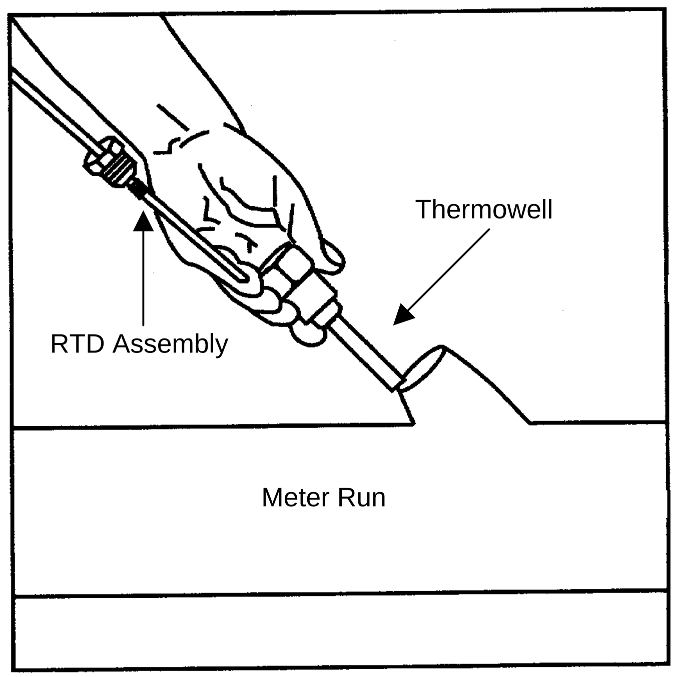
- RTD probe with 10’ of cable. Optional lengths are 15’, 25’, 30’, 40’, and 50’.
- One (1) thermowell with 3/4” npt threads; optional threads are 1/2” and 1”.
- Nylon tie wraps.

Customer Provided Materials

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

Continued on next page

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 J10).
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.

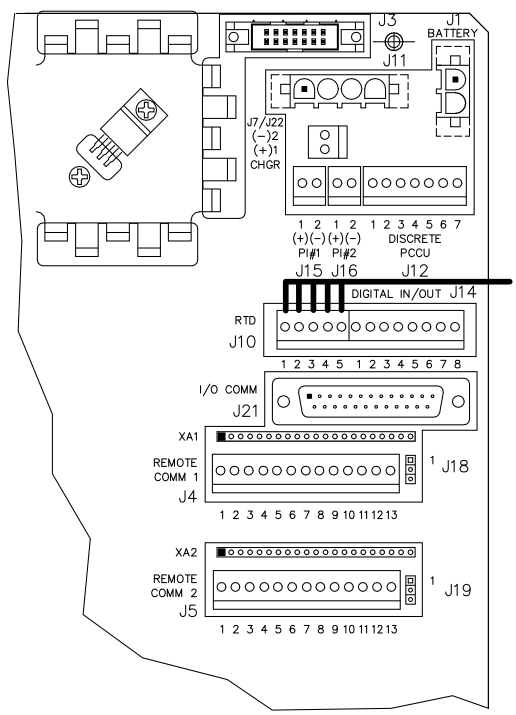
Continued on next page

Instructions (Continued)

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

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>5.</td><td>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 silk screened terminal designators on electronics board shield plate corresponding to terminal block J10 pins 1 - 5.

Loosen terminal block securing screws, insert wire then retighten. Reinstall terminal block with wires attached. Connect wires as follows:



RTD WIRING

J10-1 DRAIN WIRE RTD SHLD
J10-2 WHITE WIRE OUT
J10-3 WHITE WIRE +
J10-4 BLACK WIRE -
J10-5 BLACK WIRE IN</td></tr>
<tr><td>6.</td><td>Following connection of RTD thermowell, secure cable to meter run pipe with plastic tie wraps.</td></tr>
</table>

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.	Remove paper tab from lithium battery bracket located on digital board
3.	Connect battery pack connector to Digital Board BATTERY CONN J1 connector, located in upper right corner of Board.
4.	Observe LCD, the display should be on and scrolling through the startup diagnostics sequence.

Solar Panel Installation

Description

The Solar Panel is designed for outdoor mounting on a 2” extension pipe installed on upper end of the FCU 40” mounting pipe.

For wall mounted FCUs it can be mounted on the top or side of the meter house.

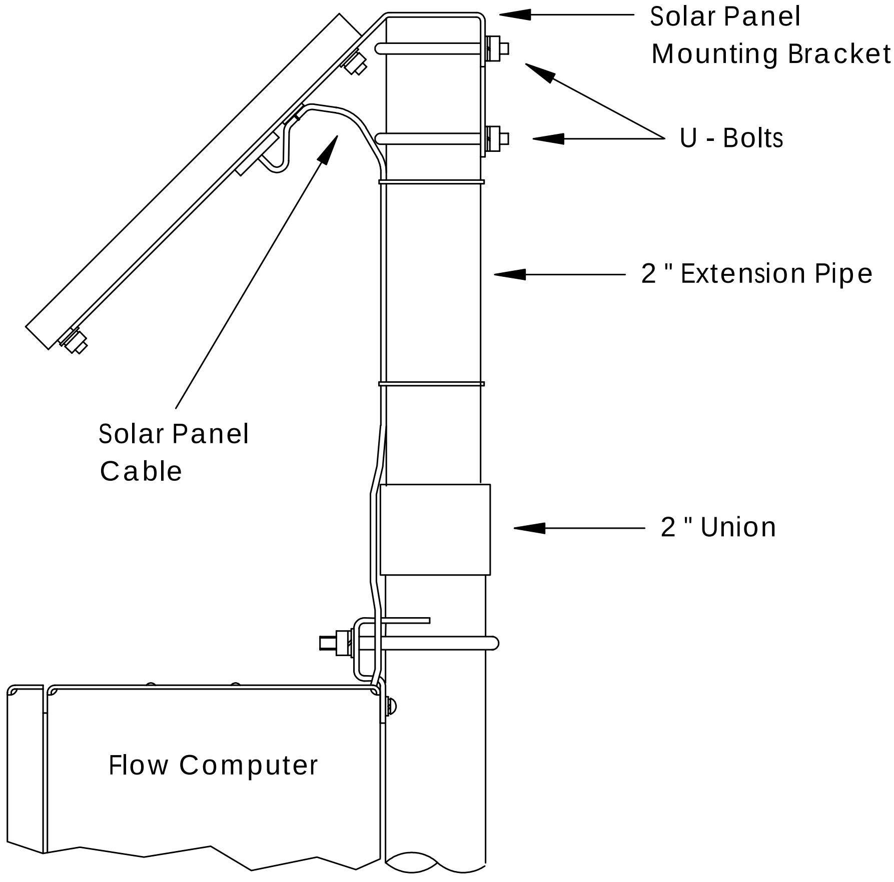
CAUTION

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 Service Department, Totalflow; see page viii.

Typical Solar Panel Installation



Procedure

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 (adapters are provided for Canadian customers for different angle orientation).

Continued on next page

Instructions (Continued)

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

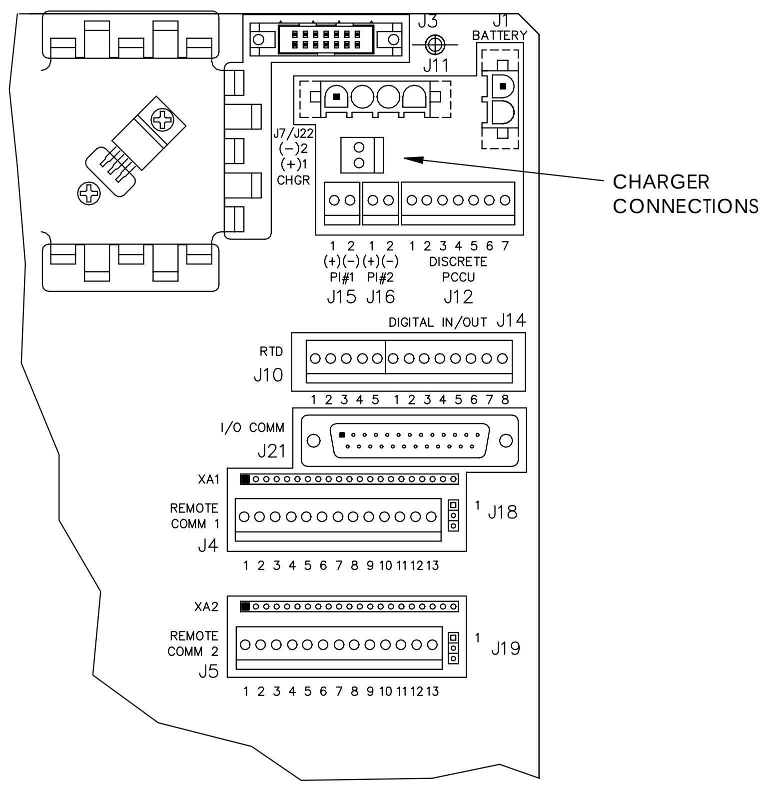
Note

Solar Panel installation is the same for northern and southern hemispheres. However, 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 silk screen on electronics board shield plate for proper terminal designations. 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 J7.



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 (J7-1), and (-) wire to - terminal (J7-2). Reinstall terminal block with wires attached.
9.	Following connection of Solar Panel power cable, secure cable to 2” extension and mounting pipe with plastic tie-wraps provided.

AC Charging Unit Installation

Description

The AC Power Charging Unit maintains a constant voltage charge on the 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.
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 the AC Charger, be certain associated connector, at Charger has a metal backed sealing “O” ring and metal locking nut attached.

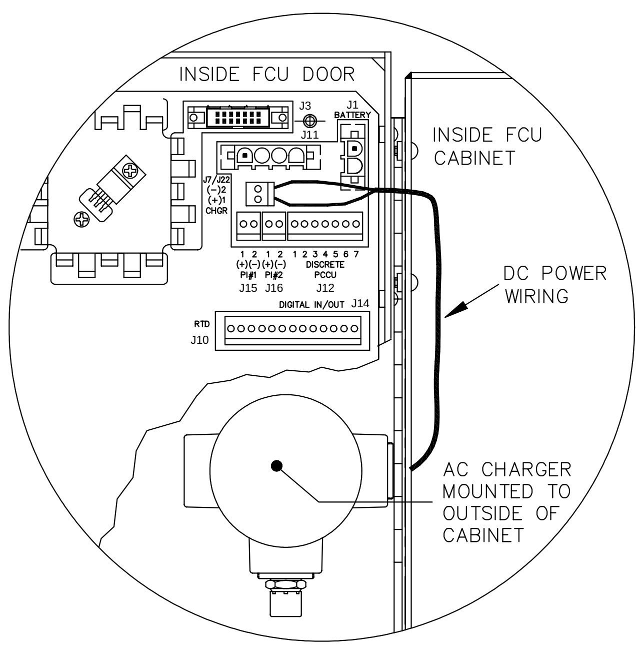
Continued on next page

Instructions (Continued)

Step	Procedure
5.	**Div 2 Installation -** Before connecting Charger wiring, trim wire ends back 1/4” and remove J7 terminal block from Digital Board. Loosen terminal block securing screws, insert red wire into plus (+) terminal 1 (bottom) and black wire in negative (-) terminal 2 (top). Retighten screws and reinstall terminal block with wires attached. 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.
5A.	**Div 1 Installation -** Plug the connector on the end of the DC wiring into J22. Route the attached AC wiring through the conduit into the user's junction box and teminate the wiring.
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.
8.	Monitor DC charging voltage by connecting PCCU to associated FCU connector. Set PCCU to MONITOR mode and select CHARGER to verify the charging voltage exits.

Figure 2-10

Mounting AC Charger



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

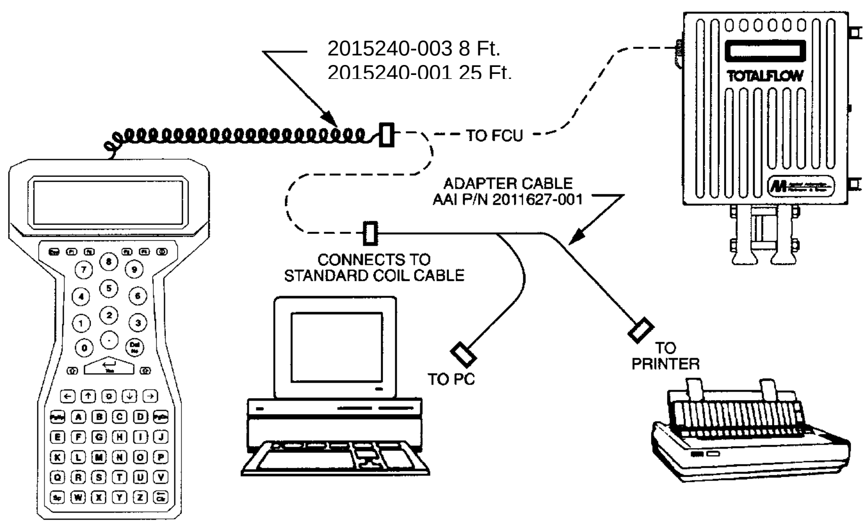
The PCCU display continuously shows user-defined site variables, and menus which present simple and easy to use options. In most cases, questions can usually be answered with a single key-stroke.

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.

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:

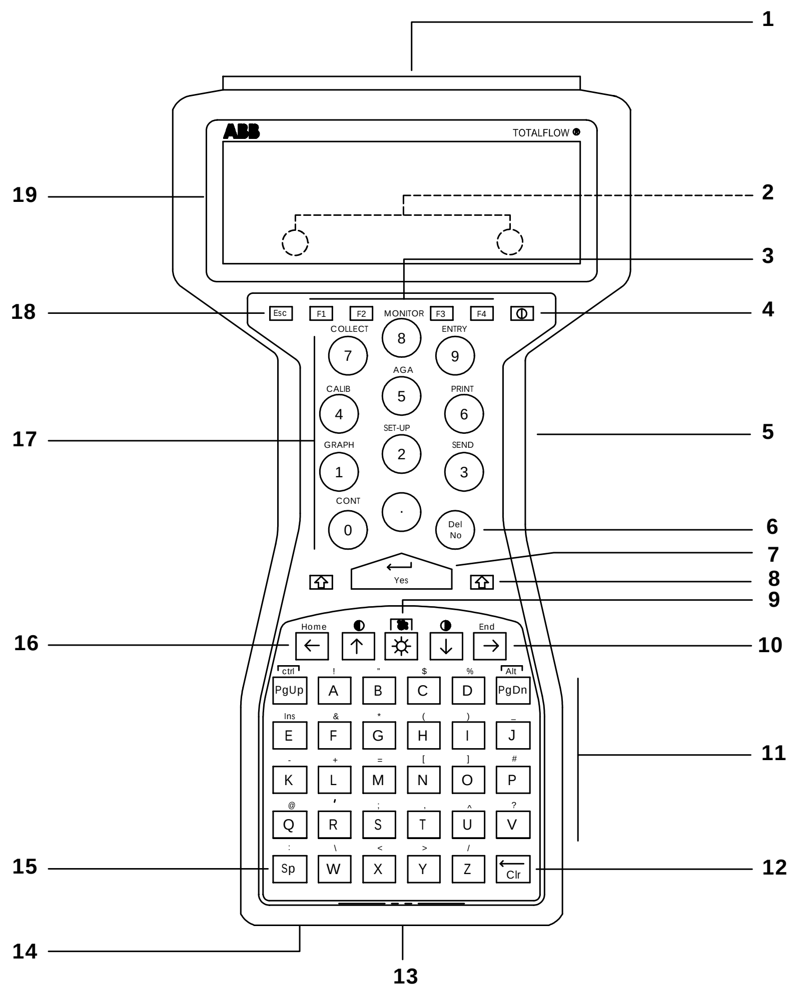


Table 3-1. PCCU Components and Keypad

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.

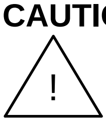
If Keypad Locks Up

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 backlighting 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.

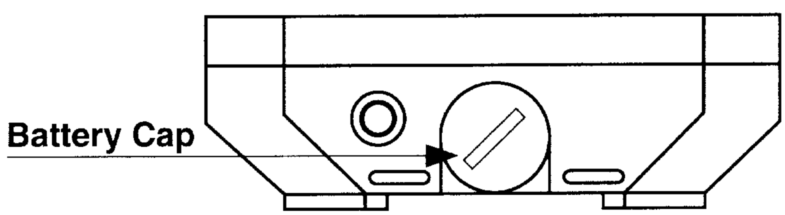
Caution

!

- 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.
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

Battery Power Source and Installation, Continued

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
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.

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.

User Aid

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

Continued on next page

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.

****FCU CONNECTED: FCU-6713****

LOC: TOTALFLOW ™
1) Collect
2) Monitor
3) Entry
4) AGA-3 1985
5) Calibrate
6) Valve

Preview

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

	Topic	See Page
1	Collect Data from the FCU	4-7
2	Monitor Operational Data	4-9
3	Enter or Change Operational Limits	4-13
4	Select or Enter AGA-3 Data	4-41
5	Calibrate Pressure Transducer or Set-Up Temperature Measurement	4-71
6	Valve Control - Not accessible unless valve control option is installed on Flow Computer. Contact Totalflow for information on valve control.	N/A

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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-6713**** menu.

****FCU CONNECTED: FCU-6713****

LOC:	TOTALFLOW ™
1) Collect	6) Valve
2) Monitor	
3) Entry	
4) AGA-3 1985	
5) Calibrate	

Procedure

Step	Procedure
1.	Select **1) Collect** from ****FCU CONNECTED: FCU-6713**** menu or by simultaneously pressing the paw and COLLECT keys.

Continued on next page

COLLECT Mode, Continued

Procedure (Continued)

Step	**Procedure**
2.	If the PCCU has collected data from the FCU it will display the last data collected. Collection Size Room for X Week(s) X New FCU's Checking FCU ID: FCU-6713 Last Collected on MM/DD/YY HH:MM:SS Ready to Collect …Depress CONTINUE to proceed… 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-6713**** menu.

****FCU CONNECTED: FCU-6713****

LOC: TOTALFLOW ™

1) Collect
2) Monitor
3) Entry
4) AGA-3 1985
5) Calibrate
6) Valve

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-6713**** menu or simultaneously pressing PCCU paw and MONITOR keys >TIME DP_LO DP_HI C_FLOW T_VOL BATT DP ABS_P TEMP P_VOL E_TEMP H_VOL CHRGR Use ARROW keys to MOVE and CHANGE. Depress CONTINUE when finished
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-6713**** menu.

****FCU CONNECTED: FCU-6713****

LOC:	TOTALFLOW ™
1) Collect	6) Valve
2) Monitor	
3) Entry	
4) AGA-3 1985	
5) Calibrate	

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.

FCU Date/Time

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. *****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 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. FCU Date-Time is MM/DD/YY HH:MM. PCCU Date-Time is MM/DD/YY HH:MM. Set FCU with PCCU Date-Time?

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. *****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 **3) Location** is selected, the following screen is displayed. Press No to change or enter a new Location or Yes to accept. Location is TOTALFLOW ™. OK?
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.

BTU

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. *****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 **4) BTU** is selected, the following screen is displayed. Press No to change or enter a new value or Yes to accept. Heat Value is XX.X BTU. OK?
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.

DP Zero Cutoff

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. *****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 **5) DP Zero Cutoff** is selected, the following screen is displayed. Press No to change or enter a value or Yes to accept. DP Zero Cutoff is XX.X in H_2O. OK?
3.	Enter new DP Zero Cutoff value and press Yes from PCCU keypad.
4.	PCCU repeats **DP Zero Cutoff is XX.X in H_20. 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.

Programming FCU Security Code

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 6713***** menu will appear. ****FCU CONNECTED: FCU-6713**** LOC: TOTALFLOW ™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate

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

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. *****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

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

Op-Limits, Continued

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.

Reset Volume

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. *****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

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

Wake-Up

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

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.**

Set Site Code

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

Program Aux Contact, Continued

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. *****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 Aux Contact** is selected, the following user prompt is displayed. REMOTE SENSE LO CHG LO DP HI DP LO AP HI AP AUTO RESET VOLUME S.P. Use ARROW keys to MOVE and CHANGE. C when finished.

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. The DOS handheld PCCU will only configure the the first communication's port which is the one typically used for remote communications. The Model 6700 flow computer has three communication's ports. The other two ports can either be setup with PCCU32 which is a Windows based PCCU package or using a terminal emulator with some local commands. These commands can be found in Technical Bulletin #44.

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 6713** menu. ****FCU CONNECTED: FCU-6713**** LOC: TOTALFLOW ™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate 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

Step	Action
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

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-6713***** 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****. >F(PB) F(TB) F(G) F(B) F(TF) F(Y) F(R) F(A) F(PV) 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

AGA-3 (Fixed) 1985 Method, Continued

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)

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>6.</td><td>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.</td></tr>
<tr><td>7.</td><td>Select 6 from the AGA-3 CONSTANTS MENU-1 to enter the Temperature Base, T(B).</td></tr>
<tr><td>8.</td><td>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.</td></tr>
<tr><td>9.</td><td>Enter 1 to enter the Viscosity.</td></tr>
<tr><td>10.</td><td>Enter 2 from the AGA-3 CONSTANT MENU-2 to enter the Ratio of Specific Heats.</td></tr>
<tr><td>11.</td><td>Enter 3 from the AGA-3 CONSTANTS MENU-2 to select the Orifice Plate Material; Stainless or Monel.</td></tr>
</table>

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-6713***** 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 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 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

AGA-3 (Selectable) 1985 Method, Continued

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, 20, 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 *AGA-8 Detail NX19 fixed Ft, Fp NX19 GCN or GCNM — Automatically selects based on .75 gravity and/or 15% N_2 or CO_2 NX19 GCN — GCN=Gravity, CO_2, Nitrogen NX19 GCNM — GCNM=Gravity, CO_2,N_2,Methane 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

AGA-3 (Selectable) 1985 Method, Continued

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

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Select item 4) AGA-3 1985 from the ***FCU CONNECTED: FCU-6713*** menu to display the AGA-3 Top Menu.</td></tr>
<tr><td>2.</td><td>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.</td></tr>
<tr><td>3.</td><td>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.</td></tr>
</table>

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-6713***** 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

AGA-3 1992 Method, Continued

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-6713***** 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**.

****FCU CONNECTED: FCU-6713****

LOC:	TOTALFLOW ™
1) Collect	6) Valve
2) Monitor	
3) Entry	
4) AGA-3 1985	
5) Calibrate	

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 4-83.

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 <u>stable</u> 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

Calibrating Absolute Pressure (AP), Continued

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

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 Note

Line Pressure Correction to Differential Pressure (DP).

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 Differential Pressure (DP), Continued

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.

Checking Differential Pressure (DP) Calibration Calibrate Mode Menu-1

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 Differential Pressure Calibration, Continued

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 Differential Pressure Calibration, Continued

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.

Selection of Fixed Temperature While Monitoring RTD Temperature

Calibrate Mode Menu-1

Procedures

Step	Procedure
1.	Select **5) Calibrate** from **FCU CONNECTED** menu. ****FCU CONNECTED: FCU-6713**** LOC: TOTALFLOW ™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate
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
3.	Press No until the following screen is displayed. RTD is Installed Ok?

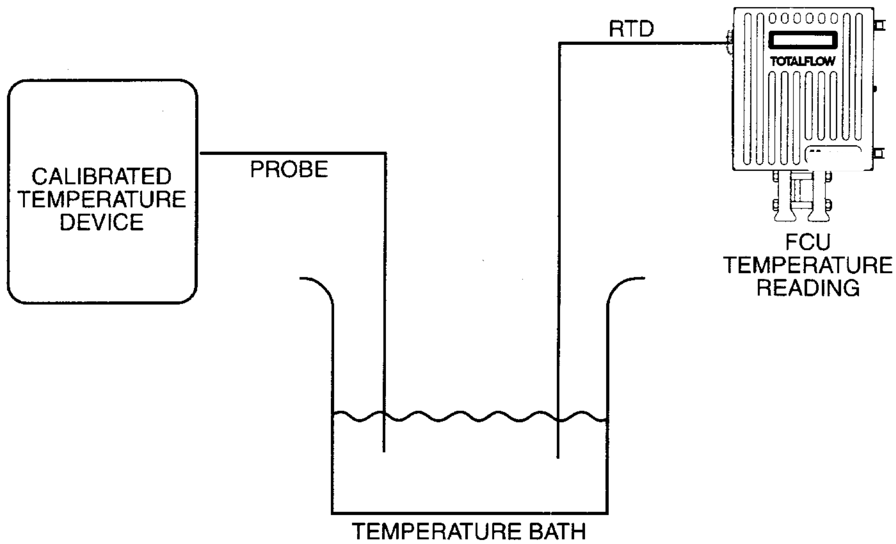
Continued on next page

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.



.

Procedures

Step	Procedure
1.	Select **5) Calibrate** from **FCU CONNECTED: FCU 6713** menu. ****FCU CONNECTED: FCU-6713**** LOC: TOTALFLOW ™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate

Continued on next page

Selection of Fixed Temperature, Continued

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

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

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**.

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 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

Procedure

Step	Procedure
1.	To enter data Collection Size, select **3) Collection Size.** Collection Size Room for X Week(s) XX New FCU's OK?
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.** Clear All Storage Areas Selected Are you sure? Last Chance.
2.	For PCCU to clear FCU collected data, enter Yes. When cleared, the following screen is displayed. All Storage Areas Cleared Collection Size Room For X week(s) XX new FCU's Depress Continue to Proceed
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. PCCU's Date/Time is MM/DD/YY HH:MM:SS Set Date/Time?
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. Time: HH:MM:SS Date: XX-XX-XXXX Press ENTER to toggle date and time Press EXIT to quit.

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. 6625F PCCU XXXXXXX-XXX XX MM/DD/YY TOTALFLOW tm …Depress CONTINUE to proceed…
2.	To return to SET-UP PCCU MENU**,** press CONTINUE**.** The SET-UP PCCU MENU is redisplayed. Another user selectable option can be selected.

Print or Clear FCU Data

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.**

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.

Continued on next page

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**.**

Step	Action
1.	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]*
2.	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.
3.	Use the table below to determine your next step. Result: a new screen appears.

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

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 6713001 5wk MM/DD/YY HH:MM:SS 2 6713002 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

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>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.

<pre>
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
</pre>
</td></tr>
<tr><td>2.</td><td>Select the options from the screen. Table below describes the options you can make.

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>1) Charac</td><td>Prints a Characteristic Report for selected FCU’s</td></tr>
<tr><td>2) Events</td><td>Prints Events Report for selected FCU’s</td></tr>
<tr><td>3) Flow File Hourly</td><td>Prints Flow File Report with hourly numbers</td></tr>
<tr><td>4) Flow File Daily

5) Charac [NO]</td><td>Prints Flow File Report with daily numbers

Selects Characteristic Report to be included or not included with Daily or Hourly report files</td></tr>
</table>
</td></tr>
</table>

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**.

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.

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.

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>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 6713001 5wk MM/DD/YY HH:MM:SS 2 6713002 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 6713001 5wk MM/DD/YY HH:MM:SS 2 6713002 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

Send FCU Data to CCU, Continued

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.

```
                 GRAPH SELECTION MENU
   Can graph    → Temp    AP    DP    VOL
Pick 1 or 2     → no      no    no    no

LENGTH          START DATE: HR        CHANGE
   01 DAY(S)     MM/DD/YY  HH      GRAPH RANGES
   Depress CONTINUE to Graph  XXXXXXXXXX
```

Step	Action
7.	Make appropriate changes to screen:

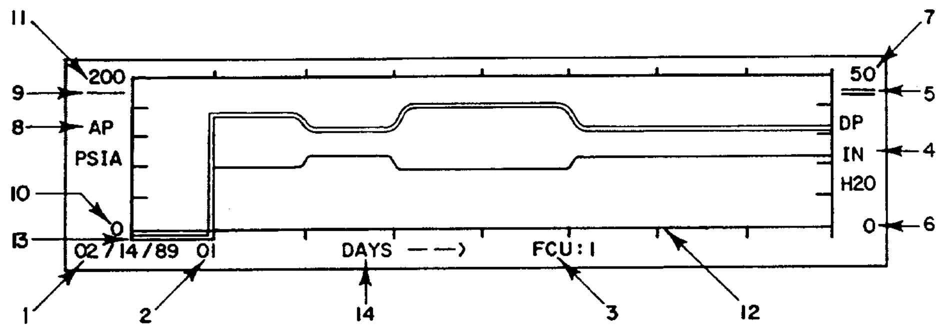
Key or Field Name	Description
Up and Down Arrow Keys	Used to change all variables fields. Remember, only two parameters can be displayed on a graph
Left an Right Arrow Keys	Move Cursor to another field
Length Selection	selects 1 or 8 days of data to be graphed
Start Date Hr	Date when graph is made The 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

Step	Action
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 viii in the front of this manual.

Chapter 5
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 or the user needs to order spare parts, contact ABB Automation Inc., Totalflow Service Department.

Inside or Outside Oklahoma 1-(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 reduced.

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 the FCU inoperable.

Front Mounted LCD Display

The two lines by 24 alphanumeric character LCD, displays alarm codes on the right side of the display window. By observing this display, you are informed of operational information or alarm conditions that may be present. FCU alarm troubleshooting procedures are presented in the Troubleshooting Section.

PCCU Unit Maintenance

The 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 Authorization Number (RA). Affix this number to the outside of your 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 the FCU battery pack. To access the 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 6700 Digital Circuit Board terminals EXT CHGR +/- prior to removal and installation of battery pack.

When removing battery pack, DO NOT remove Lithium battery from 6700 Digital Circuit Board. This prevents any data stored in RAM, from being lost.

Procedures See Figures 5-1 & 5-2

In the following procedures 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. Refer to Figure 5-2 for location of Digital Circuit Board connections.

Step	Procedure
1.	Make sure paper tab has been removed from the lithium battery.
2.	Disconnect the solar panel by removing connector at J7.
3.	Either make sure “LL” battery alarm is not being displayed on FCU or measure lithium battery and make sure it is > 3.0V.
4.	Before removing battery pack, disconnect the Battery Cable from the 6700 Digital Circuit Board (CB181) connector J1.
5.	Remove keeper plate, which secures battery pack in its mounting location, by slightly loosening the three mounting screws. It is not necessary to remove screws. Plate is keyholed.
6.	Remove battery pack from battery compartment.
7.	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 and tighten three keeper plate mounting screws.

Continued on next page

Replace FCU Battery Pack, Continued

Procedures (Continued)

Step	Procedure
8.	Reconnect battery pack cable to 6700 Digital Circuit Board connector J1. If battery pack charging source green wiring block was disconnected, reconnect it to 6700 Digital Circuit Board EXT CHGR +/- terminals marked J7.
9.	After closing FCU door, check door mounted LCD display for normal operational readings.

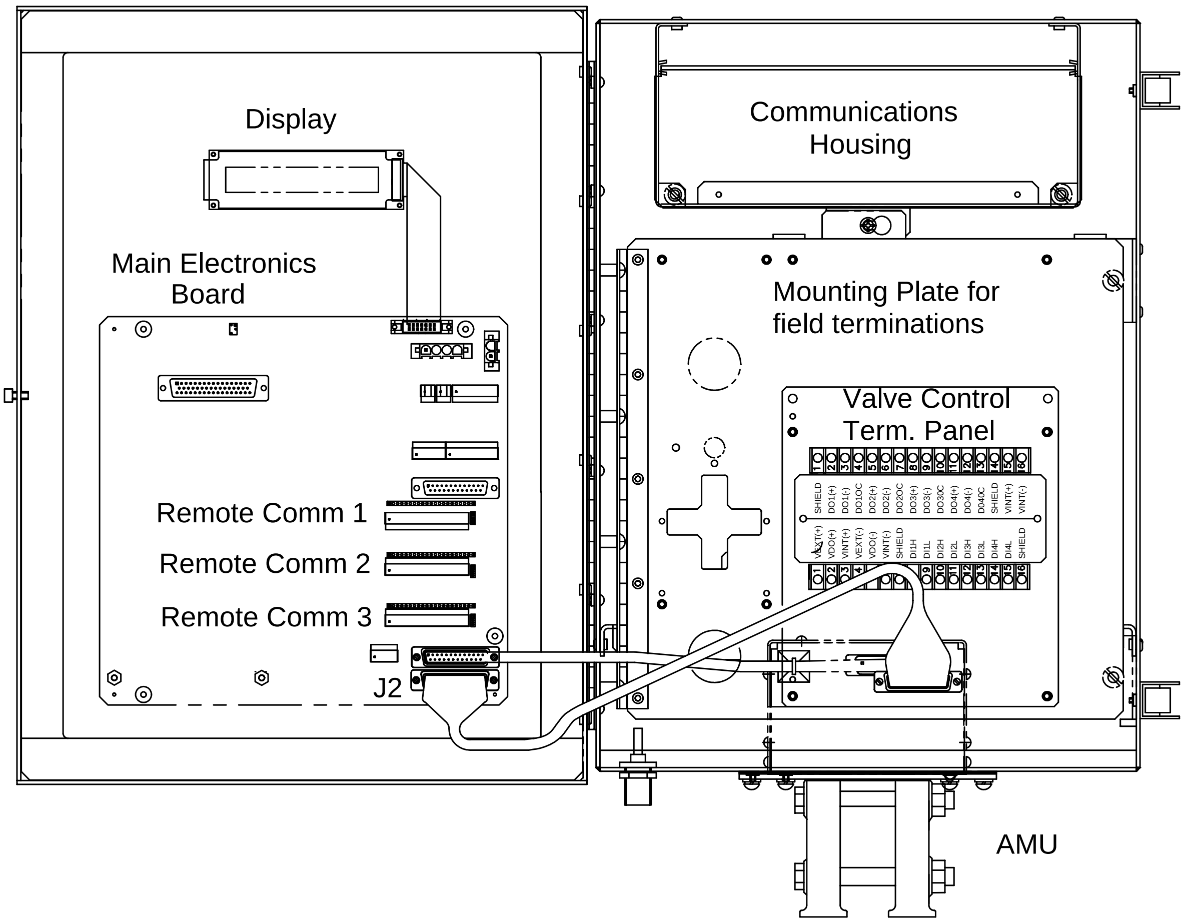


Figure 5-1a

Model 6713 FCU with on-board valve control installed

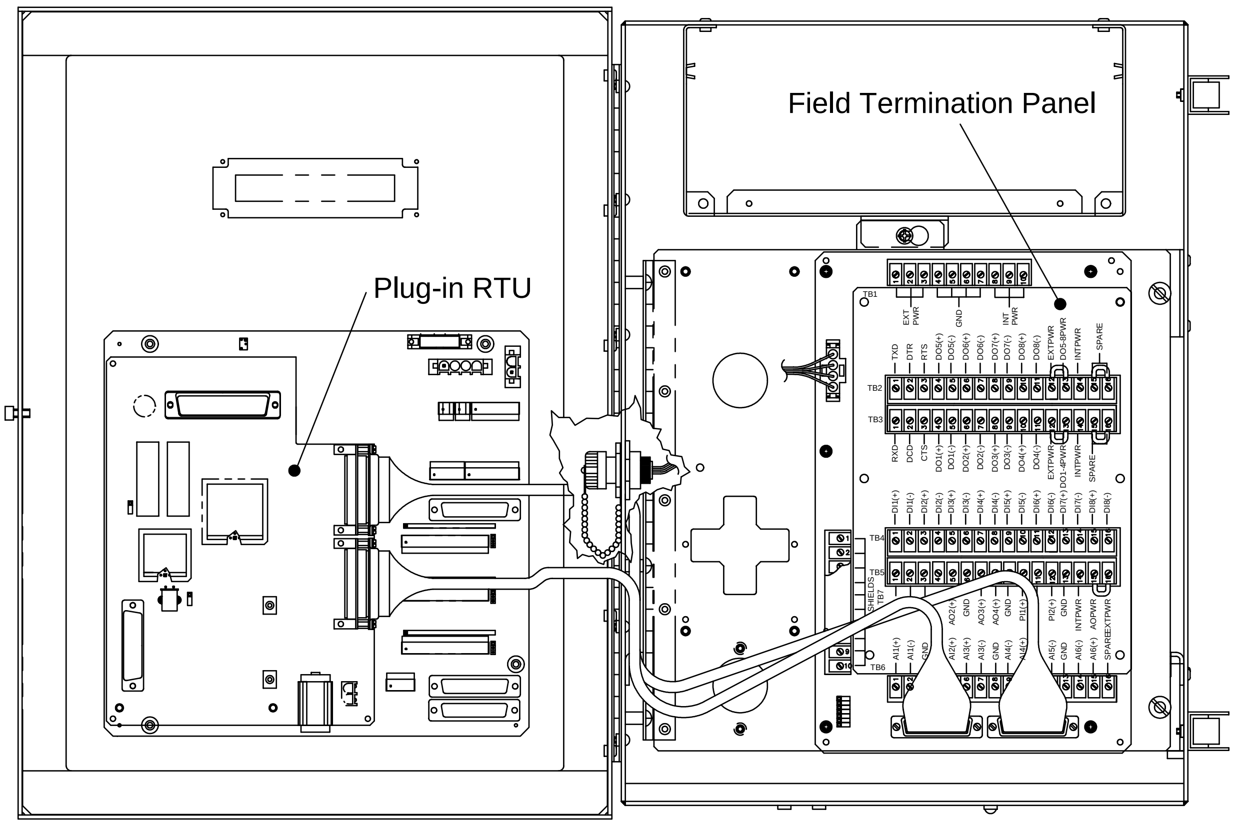


Figure 5-1b

Model 6713 FCU with Plug-in RTU installed

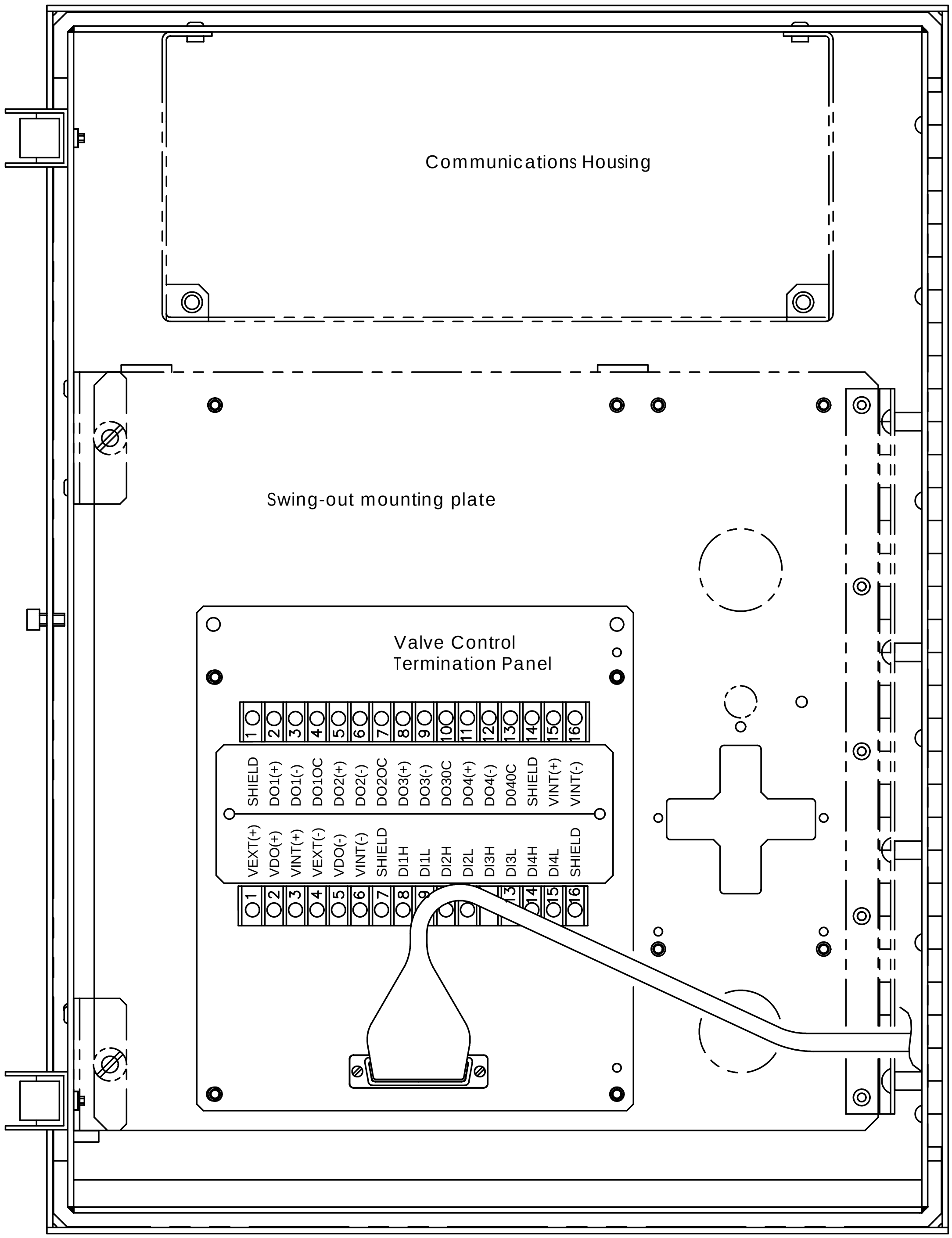


Figure 5-1c

Rear view of field termination mounting plate with valve control term board installed

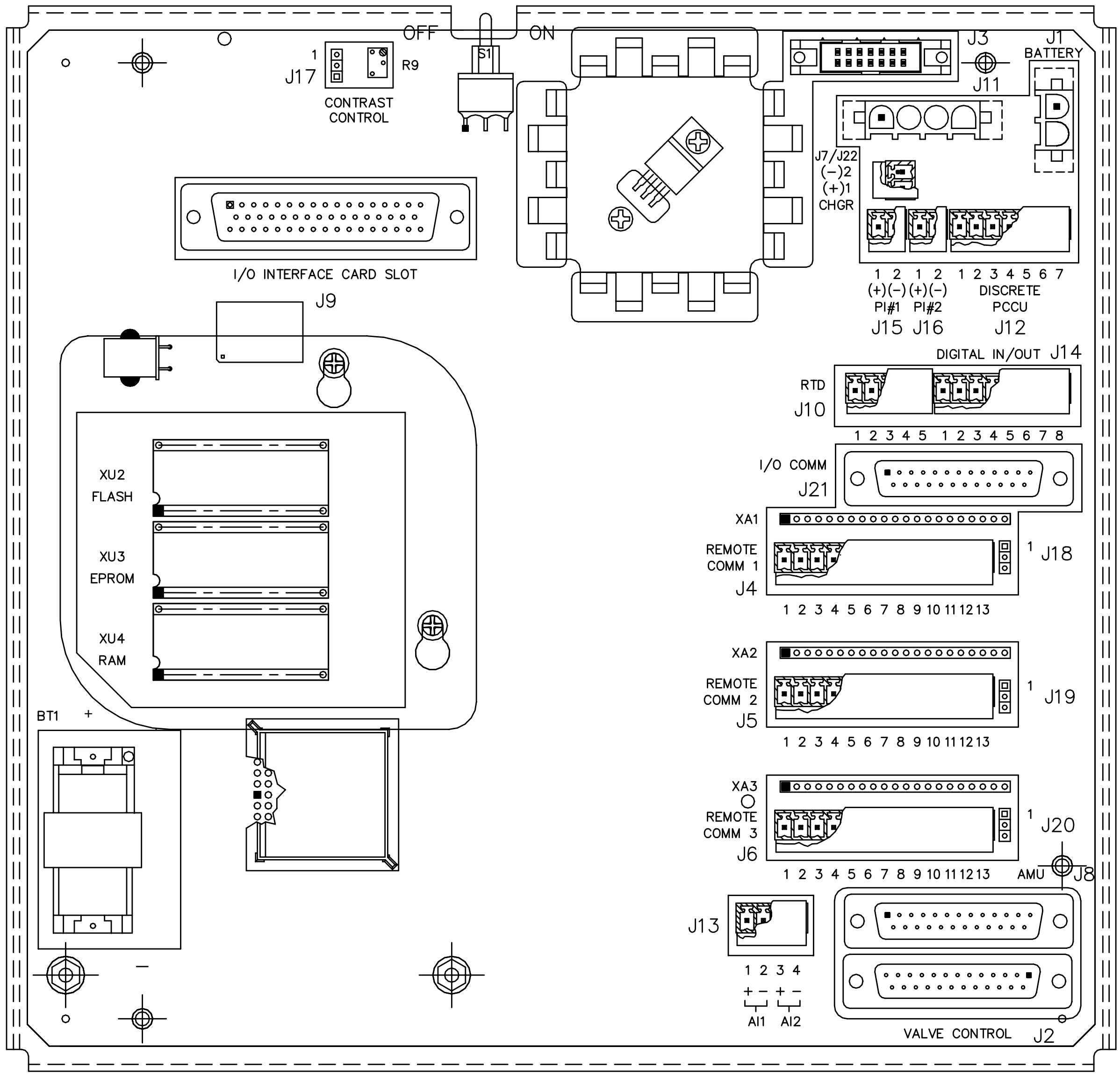


Figure 5-2

6700 Digital Circuit Board Parts Location w/ shield cover

Replacing 6700 Digital Circuit Board

Description

The 6700 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.

Caution

The 6700 digital circuit board is susceptible to damage by static electricity or improper handling. To prevent this from occurring, user should install a personal 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 a conductive part of your body, preferably your wrist, then connect it to the ground connection located on the bottom left corner of the FCU. 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 6700 Digital Circuit Board, be certain any RAM stored data has been downloaded to an external storage medium. Failure to do so could result in data loss when Circuit Board is removed.

Procedures See Figures 5-1 & 5-2

When performing these procedures, please refer to Figure 5-1 through Figure 5-2 for locations of Digital Circuit Board connections.

Step	Procedure
1.	Before Main Digital Circuit Board removal, disconnect the following associated connectors in this order. • If used, disconnect external battery charging source connector J7. • Disconnect battery pack connector J1. • Carefully lift upward, all green terminal strips with wires from their associated circuit board connector. • Tape an identifier to each connector so it will be correctly reinserted into the same Board mounting connector during reinstallation of 6700 Digital Circuit Board. • Disconnect PCCU Port connector J11. • Disconnect AMU Pressure Transducer Communications Port connector J8. • Disconnect FCU LCD Display port connector J3. • Remove protective shield/cover plate by removing 4 hex standoffs and lifting plate free

Continued on next page

Procedure (Continued)

Step	Procedure
2.	Remove four mounting screws and lock washers securing Digital Circuit Board 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 6700 Digital Circuit on four standoffs and secure in place using four hex nuts. DO NOT over tighten hex nuts. Doing so could cause damage to the digital circuit board or associated circuitry.
4.	Reinstall the protective shield/cover plate with the four hex nuts and secure in place using four hex nuts.
5.	Reinstall connectors, removed in Step 1, to their associated Board mounted connections in the following order. • J8 AMU Connector • J3 LCD Connector • J11 PCCU • J1 Battery Pack • J7 Charger • Any additional connections that were previously disconnected

Replacing LCD Display Board

Overview

The LCD Display Board is mounted on the backside of the front enclosure hinged door above the 6700 Digital Circuit Board. To access and remove the Display Board, perform the following procedures.

Procedures See Figures 5-1 & 5-2

When performing these procedures, please refer to Figure 5-1 through Figure 5-2 for locations of Digital Circuit Board connections.

Step	Procedure
1.	To access the LCD Display Board, open the TOTALFLOW unit door. The LCD board is located above the 6700 Digital Circuit Board.

Note

To prevent power damage to the 6700 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 J7 - EXT CHGR +/- green terminal block must be disconnected next.

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 the Digital Circuit Board Display Port connector J3. To remove connector, extend connector hold down fingers outward. Connector will pop upward.
4.	Using a 3/16” nut driver, remove the four plastic Display Board hexagonal mounting standoffs. Lift the LCD Board from the door mounted standoffs. If LCD Board is being returned to Totalflow for service, it is recommended that attached ribbon cable be left connected and returned with Display Board.
5	To reinstall Display Board, perform procedures 1 to 4 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 reinstalling mounting hardware, DO NOT over tighten screws.

Replacing FCU Pressure Transducer

Important

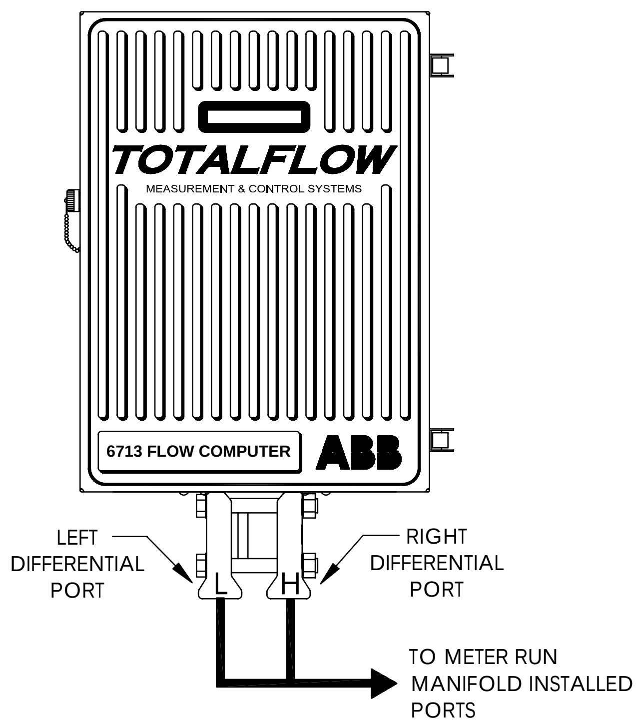
Under no circumstances shall the FCU AMU pressure transducer cover be removed. Removal of this cover, and entry into interior of pressure transducer, voids transducer warranty.

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

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. Refer to Figure 5-2 for location of Digital Circuit Board connections.

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Using meter run installed Manifold high/low control valves, isolate the transducer from the flowing gas



</td></tr>
<tr><td>2.</td><td>Using the same meter run installed Manifold valves, equalize pressure to the AMU Transducer.</td></tr>
<tr><td>3.</td><td>Vent manifold to atmosphere using vent valve.</td></tr>
<tr><td>4.</td><td>Completely disconnect high/low Manifold lines from AMU Pressure Transducer.</td></tr>
</table>

Continued on next page

Replacing FCU Pressure Transducer, Continued

Procedures (Continued)

Step	Procedure
5.	If used, disconnect external battery charging connected to J7.
6.	Disconnect battery pack from J1.
7.	Disconnect FCU AMU Transducer cable at J8 from the 6700 Digital Circuit Board. Cable is secured to Digital Circuit Board with screws 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 11 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 Meter Run out of Service (Blocking Flow with meter run valve)

Step	Procedure
1.	Place FCU into the hold mode by entering into the Calibrate Mode.
1.	Take meter run out of service. FCU reads zero (0.00) in. of H_2O across the orifice plate.
2.	Replace old orifice plate.
3.	Select “Reset Volume” to force volume calculation on old orifice value.
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.
5.	Send new orifice plate data to FCU by selecting the “Send AGA Data to FCU” menu selection from the ****AGA-3 1985 CONSTANTS MENU-1****. At top of vol_calc_period, FCU performs vol_calc_period calculations based on new orifice diameter for part of vol_calc_period it was installed.

Leaving Meter 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.
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 vol_calc_period 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. Send new data AGA data to FCU. At top of vol_calc_period, FCU performs vol_calc_period calculations based on new orifice diameter for part of vol_calc_period it was installed.

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Chapter 6

Troubleshooting

Overview

Overview

This chapter contains troubleshooting tables to correct most FCU alarm code condition(s). The annunciators and 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 FCU 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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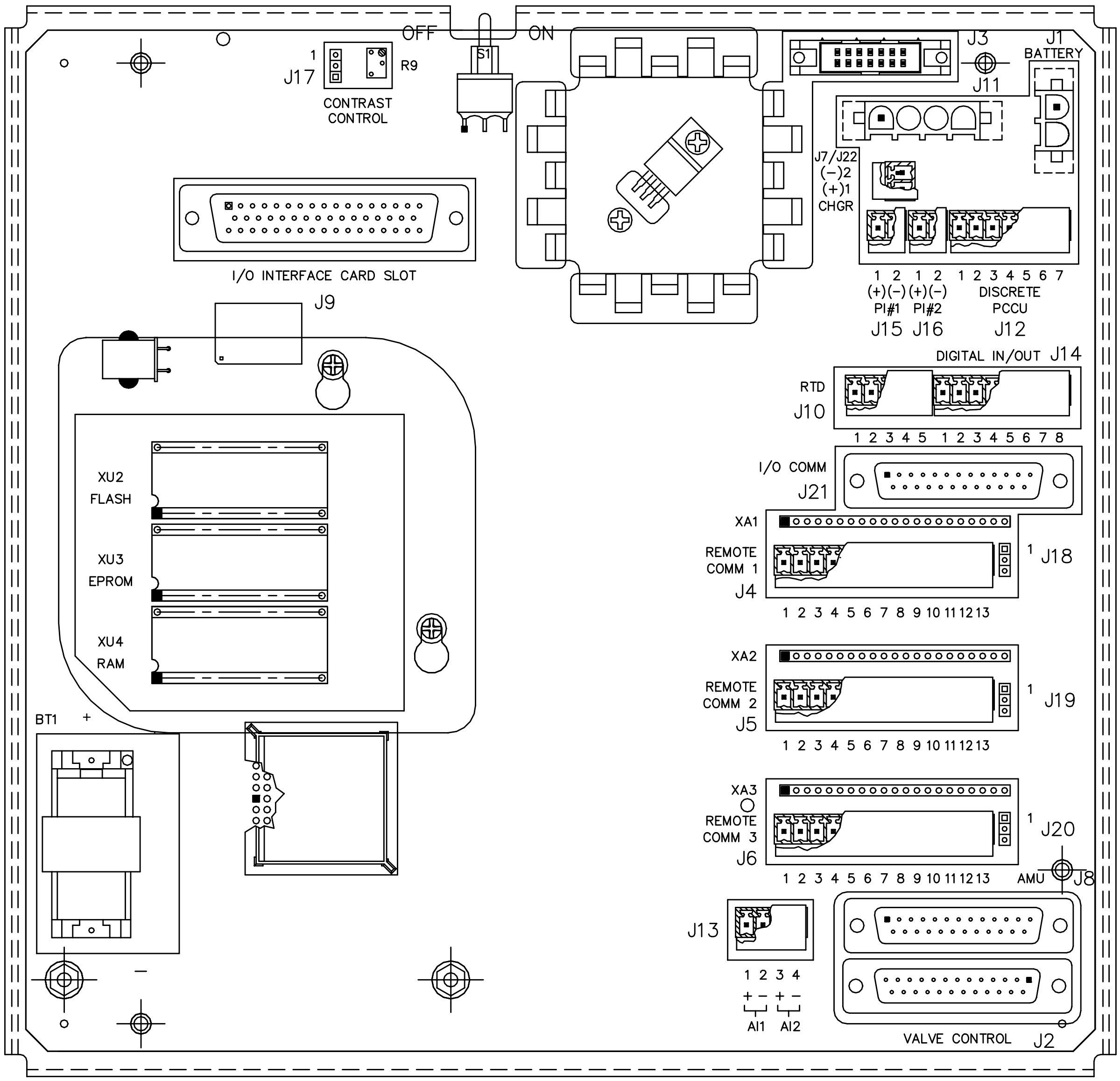

Figure 6-1. Digital Circuit Board Connector and Wiring Locations

	REMOTE COMM 1				REMOTE COMM 2		REMOTE COMM 3	
	MODULE		**CARD**		**MODULE**		**MODULE**	
	RS232	***RS485***	***RS232***	***RS485***	***RS232***	***RS485***	***RS232***	***RS485***
1	VBATT	VBATT	VBATT	VBATT	VBATT	VBATT	VBATT	VBATT
2	GND	GND	GND	GND	GND	GND	GND	GND
3	SW/VBATT	SW/VBATT	SW/VBATT	SW/VBATT	SW/VBATT	SW/VBATT	SW/VBATT	SW/VBATT
4	TXD	BUS(+)	TXD	TRM(-)	TXD	BUS(+)	TXD	BUS(+)
5		BUS(+)		OPER		BUS(+)		BUS(+)
6	RXD	BUS(-)	RXD	BUS(-)	RXD	BUS(-)	RXD	BUS(-)
7		BUS(-)		TRM(+)		BUS(-)		BUS(-)
8	RTS	RRTS	RTS	BUS(+)	RTS	RRTS	RTS	RRTS
9	CTS		CTS	AO(+)	CTS		CTS	
10	DTR		DTR	RRTS	DTR		DTR	
11	DCD		DCD	AO(-)	DCD		DCD	
12	OPER	OPER	OPER	OPER	OPER	OPER	OPER	OPER
13	GND				GND		GND	

Remote communications port functional descriptions

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.

If replacing a main electronics board, all parameters stored in RAM can be downloaded and saved to a configuration file using either a terminal emulator or our TFCONFIG program and then uploaded to the new board in the same manner. See reference section, Technical Bulletin # 44 for more information.

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 of 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 J7 from the FCU digital circuit board green terminal block.
2.	Disconnect battery pack connector from Digital Circuit Board BATTERY connector J1.
3.	Remove Lithium battery, BT1, from its Digital Circuit Board mount. The FCU is now out of service.

Continued on next page

FCU Reset Procedures, Continued

Cold Start Procedures (Continued)

Step	Procedure
4.	To return to service reconnect 12 Vdc battery pack connector to Digital Circuit Board BATTTERY connector J1 and observe LCD display.
5.	If removed, reconnect external battery pack charging source to EXT CHGR connector J7.
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 operational parameters and calibrate FCU using procedures in Chapter 4.0, FCU Operation.

Note

When FCU has been cold started, the system 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. Remove external battery pack charger EXT CHGR +/- terminal block J7 from the FCU digital circuit board green terminal block.
2.	Disconnect battery pack connector from Digital Circuit Board BATTTERY connector J1. The FCU is now out of service.
3.	To place FCU in service, connect EXT CHGR +/- terminal block J7 and battery pack connector J1.

FCU LCD Visual Alarm 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.

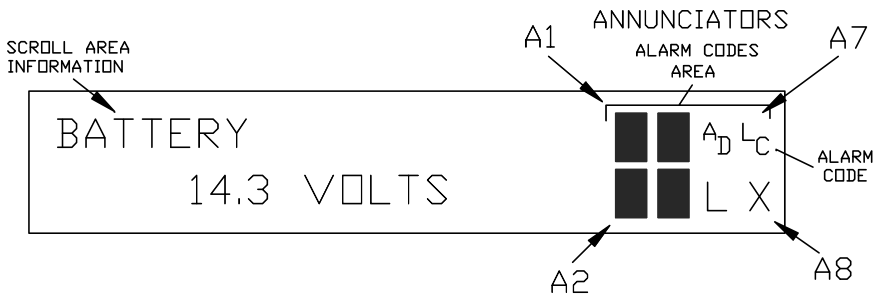

Table 6-1 Location Alarm Codes and Description

Annunciator Location	Alarm Character Designators	Description
A1	$^{L}{}_{L}$	*Low Lithium Battery Alarm*: When $^{L}{}_{L}$ (low lithium) is displayed, lithium battery voltage is below 2.5 Vdc. If battery voltage is above 2.5VDC, $^{L}{}_{L}$ appears shaded. A good lithium battery will measure approximately 3.6 Vdc.
A1	↑/↓	*DP High and Low Operational Limit Violation*: 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. Visible only when DP is on display.
A1	↑/↓	*AP Hi and Lo Operational Limit Violation*: 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. Visible only when AP is on display.

Continued on next page

FCU LCD Visual Alarm Codes, Continued

Table 6-1 Alarm Codes and Description (Continued)

Annunciator Location	Alarm Character Designators	Description
A2, A4, A8 A2 = Comm3 A4 = Comm2 A8 = Comm1	ǂ	*TOTALFLOW Listen Cycle*: Listening symbol. 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. Three remote communications ports are available and can be programmed as described individually. When FCU remote port is not active, ‡ is shaded.
See above	→	*Transmitting Data*: If remote port is active and Totalflow Remote Protocol is running, → arrow is displayed.
See above	←	*Receiving Data*: If remote port is active and Totalflow Remote Protocol is running, < arrow is displayed.
See above	**X**	*Remote Port Not Active*: Displayed when remote port is not active. This is the default state upon cold start of the FCU for all remote communications ports. Baud rate must be toggled to activate each remote port.
See above	**M**	*MODBUS ASCII*: Modbus ASCII protocol selected on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**m**	*MODBUS RTU*: Modbus RTU protocol selected on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**¥**	*Totalflow Packet Protocol.* Totalflow Packet Protocol is selected on this port.

Continued on next page

Table 6-1 Alarm Codes and Description (Continued)

See above	**S**	*Square D Protocol*: Square D protocol is running on this port. Three remote communications ports are available and can currently be programmed with any of four resident remote protocols; Totalflow Old, Totalflow Packet, Modbus ASCII, Modbus RTU, or Square D.
See above	**r**	*Alarm Monitoring System.* Ring indicator for the alarm cry-out 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**	*LevalMaster*: LevalMaster tank gauging option installed. Tank level(s) and temperature are polled (user selectable intervals) by flow computer via RS485.
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 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	⊢	*Valve Control*: Valve Control option installed. Valve is at full open position.
A3	⊣	*Valve Control*: Valve Control option installed. Valve is at full closed position.
A3	**ö**	*Valve Control*: Valve Control option installed. Valve controller override conditions met (DP override set point, AP override set point, or Low Battery).

Continued on next page

FCU LCD Visual Alarm Codes, Continued

Table 6-1 Alarm Codes and Description (Continued)

Annunciator Location	Alarm Character Designators	Description
A3	**$^{L}{}_{L}$**	*Valve Control*: Valve Control option installed. Local Lock-out is initiated.
A5	**AD**	*Analog to Digital Converter Limit Violation*: Displayed if A to D Converter error occurs. Differential Pressure, Absolute Static Pressure or Flowing Temperature readings exceed maximum counts or are less than minimum counts. If A to D Converter readings are within range, AD is shaded.
A7	**$^{L}{}_{C}$**	*Low Charging Voltage Alarm*: Displayed if installed FCU battery charging voltage is within 0.4 Vdc of actual battery voltage. If charging voltage is 0.4 Vdc greater than battery voltage, $^{L}{}_{C}$ is shaded.
A6	**L**	*Local PCCU Connected*: Displayed when PCCU port is active and running TOTALFLOW Local Protocol. When PCCU port is not active, L is shaded. For example, this would occur if PCCU was not connected to PCCU port.
A5	**H**	*FCU in Hold Mode*: Displayed when HOLD flag is active. When not active, H is shaded. Also displayed when HOLD flag is active for the following conditions: • FCU is in the Calibrate mode (PCCU connected) • A to D Converter cannot be read.
A6	**C**	*Host Console Mode:* Displayed when Host Console connected and communicating.
A6	**T**	*Terminal Mode:* Displayed when 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.

Table 6-1 Alarm Codes and Description (Continued)

A8	**+9**	*Alarm Monitoring System:* Successful download of alarm page.
A8	**?**	*Alarm Monitoring System:* Received exception broadcast.
A8	**i**	*Alarm Monitoring System:* Initialize modem for cryout.

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

Annunciator Location	Alarm Condition	Probable Cause	Procedure
Display Area	**SLEEP**	Battery Voltage Below 11 VDC	1. Try to bring FCU out of SLEEP mode by giving it a WAKE-UP command using the 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 BATTTERY connector J1. If battery pack cable is securely connected, check battery pack voltage. If voltage is low, replace with another battery pack.
A7	**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.
A7	**LC**	Solar Power Charging Unit	1. Check that the solar panel is positioned to receive direct sunlight. In low lighting conditions, normally displays 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)

Annunciator Location	Alarm Condition	Probable Cause	Procedure
A7	^{L}C	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 6-2. 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.
A7	^{L}C	AC Power Unit	1. Check AC charger wiring to FCU green termination block connector J7. 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)

Annunciator Location	Alarm Condition	Probable Cause	Procedure
A5	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.
A5	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 the warranty. Remove AMU as an entire assembly.

Table 6-2 (Continued)

Annunciator Location	Alarm Condition	Probable Cause	Procedure
A5	**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 J10. 2. To determine if problem is with the RTD Probe or FCU Digital Circuit Board, disconnect green RTD wiring connector from Digital Board connector J10. 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 J10 RTD OUT and (+) terminals 3 and 4. 2. Connect a jumper wire from J10 terminals 2 and 3. 3. Connect a jumper wire from J01 terminals 4 and 5. 4. If FCU is setup with RTD connected to Digital Circuit Board green connector J10, 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
A5	**$^{A}{}_{D}$ Con'td.**	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 dis-similarity colored wires. Measured resistance should be approximately 100 ohms. 4. Perform a continuity check between RTD shield and any other wire. Measured resistance should be in the megaohm range.
A1	↑	Indicates that DP or AP is OVER Opera-tional 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.
A1	↓	Indicates that DP or AP is UNDER Opera-tional 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 6700 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:

Communication Configurations

The three basic types of communications that can be used between the FCU and a remote communications device, 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 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-485 connector.

RS-422 Communications: Communication is accomplished using an RS-422 Module (P/N-2015194-001), connected to the FCU Digital Electronics Board, through the associated RS-422 connector.

Warning

Before removing or installation any of the above communication interface modules, it is important that you disconnect FCU external battery charger and main FCU 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, RS485 or RS422 Interface Modules, cables, associated FCU Digital Board MODULE RS-485 or RS-232 connector and remote communications equipment 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 identification number being transmitted from the host application (CCU).
- 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 listen cycle is 4 seconds.
- Make sure that communications port is enabled (turned on).

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 is responding with errors in data
FCS 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. • Problem with modem at FCU or Host PC. • 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 messages. 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, J5 or J6 green connector terminals. Refer to Figure 6-1. J4-2, J5-2 or J6-2 (GDN [BLK]) and J4-3. J5-3 or J6-3 (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. A multi-meter with a peak hold feature is recommended for proper testing.

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, J5 or J6 green connector across the following terminals. Refer to Figure 6-1. J4-2, J5-2 or J6-2 (GND [BLK] and J4-6, J5-6 or J6-6 (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, J5 or J6 green connector across the following terminals. Refer to Figure 6-1. J4-2, J5-2 or J6-2(GND [BLK]) and J4-8, J5-8 or J6-8(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, J5 or J6 green connector across the following terminals. Refer to Figure 6-1. J4-2, J5-2 or J6-2 (GND [BLK]) and J4-4, J5-4 or J6-4 (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 Request	• Verify that FCU Digital Circuit Board wiring, to optional universal Communications Interface (UCI) Board, RS485/RS232 Converter Barrier or Radio Modem Assembly, is correct or • Verify wiring from UCI Board to Radio Transceiver Assembly is correct. Verify UCI Board jumper settings are correct or • Verify wiring from , RS485/RS232 Converter Barrier to Radio Transceiver Assembly is correct or • 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 identification 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. J4-2, J5-2 or J6-2(GND [BLK]) and J4-3, J5-3 or J6-3(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. Use of a digital multi-meter with a peak hold function is recommended.

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. J4-2, J5-2 or J6-2(GND [BLK]) and J4-1, J5-1 or J6-1(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, J5-3 or J6-3(WHT). Refer to Measuring SWVBATT Transceiver Supply Switch Voltage.

If this option is used, J4-1 (V-BATT) is not used.

Measuring RS-485 Line Driver voltage	• Disconnect all communications wires from other units by removing green communications termination connectors, to isolate the unit being tested. • Using an oscilloscope or digital voltmeter, connect it to Digital Circuit Board J4, J5 or J6 green connector across the following terminals. Refer to Figure 6-1. J4-6, J5-6 or J6-6 (BUS-[RED]) and J4-4, J5-4 or J6-4 (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 (RRTS) Voltage	• Using an oscilloscope or digital voltmeter, connect it to Digital Circuit Board J4, J5 or J6 green connector across the following terminals. Refer to Figure 6-1. J4-2, J5-2 or J6-2 (GRD [BLK]) and J4-8, J5-8 or J6-8 (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 RRTS is high, transmitter should 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.

Chapter 7

Plug-in RTU (Expanded I/O) Operation

Overview

Overview

This chapter provides you with an explanation of the operation of the Plug-in RTU (PIRTU or Expanded I/O) system.

The PIRTU feature is a method to provide inputs and outputs at a meter site for control or monitoring purposes. Please consult with Project Engineering for custom applications programming.

The PIRTU feature allows the model 6700 I/O to be expanded to the following additional I/O points:

- 7 analog inputs
- 4 analog outputs
- 8 digital inputs
- 8 digital outputs
- 2 high speed pulse accumulators (20 khz)

Chapter Highlights

This chapter covers the following topics

Introduction

What is a Plug-in RTU

The PIRTU is a system that expands the I/O capabilities of the model 6700 FCU. This system is made up of a main electronics board (PIRTU), two 25 pin interconnect cables and a I/O field termination board.

The PIRTU is inserted into the 50 pin expansion connector of the 6700 main electronics system board and is powered by the 6700 battery system.

Because the PIRTU is connected to the host 6700 FCU, items being measured such as; Differential Pressure, Static Pressure, Temperature, and Flow Rate can be used by the PIRTU for control feedback purposes.

What is a Stand-Alone RTU

The SARTU is a system similar to the PIRTU with identical I/O capabilities with the exception that it does not plug into the model 6700 FCU. This system is made up of a main electronics board (SARTU), two 25 pin interconnect cables and a I/O field termination board. The SARTU requires it’s own power supply and charging source.

The SARTU can of course be multi-dropped using the RS485/RS422 communications capabilities.

See the “6790 RTU Manual” Pt# 2017285 for more information on this system.

Equipment Layout

Component Locations

The following system components layout drawing shows all the major functional parts and there locations when mounted in a model 6713 FCU system.

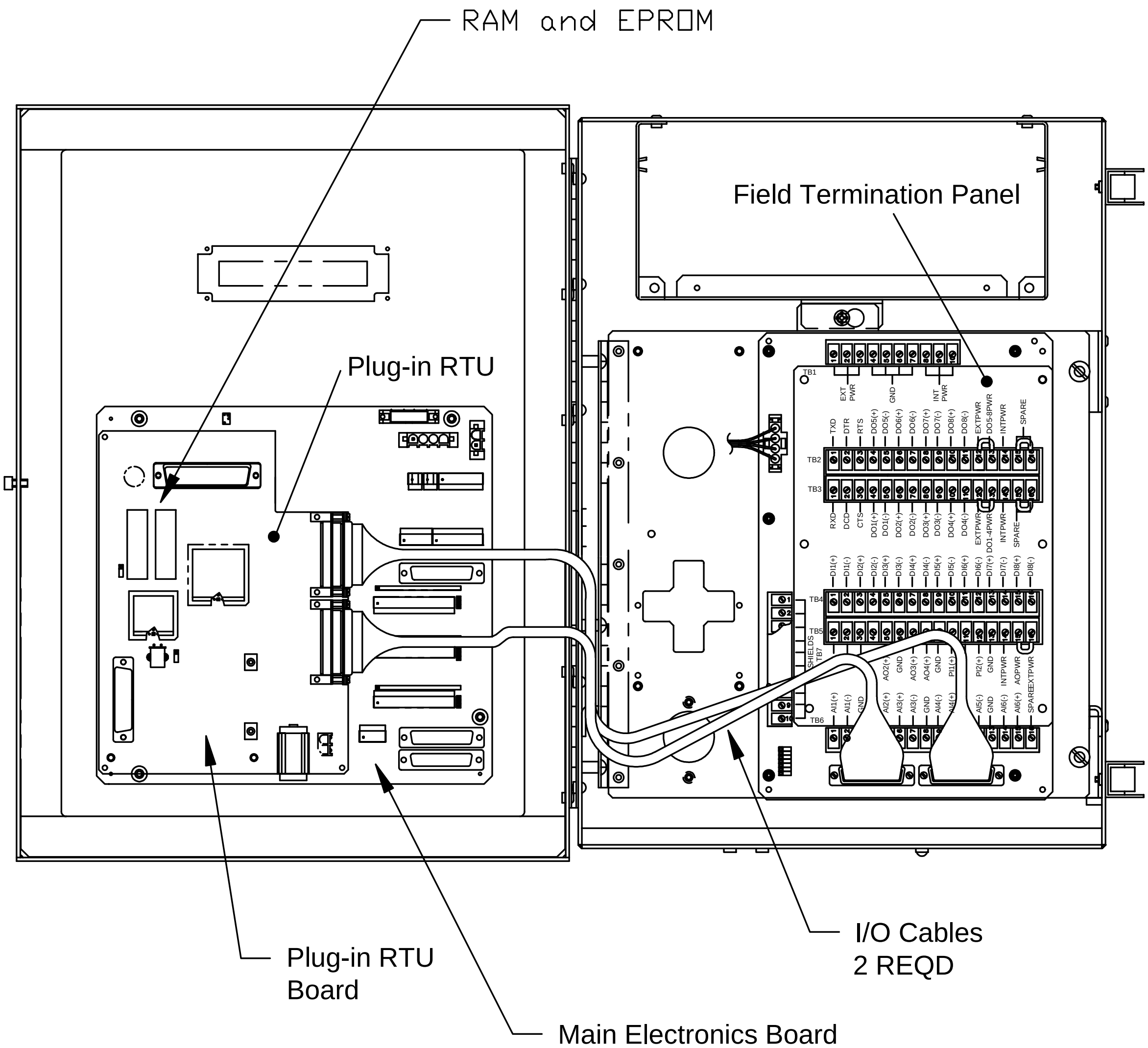

Figure 8-1. Plug-in RTU system layout drawing.

Section Highlights

This section covers the following topics.

PCCU

This section deals with setup and calibration of the RTU using the DOS version of the Portable Calibration and Collection Unit (PCCU). If the user has PCCU32 and needs further assistance, use the online help files.

How to Connect PCCU to the PIRTU

Refer to the Model 6625 Portable Calibration and Collection Unit section of the FCU Installation, Operation and Maintenance Manual for full details about the use of the 6625 PCCU including use with Flow Computer functions.

The PCCU is used with the PIRTU feature to name the available channels with names that apply to the measurement being taken. An example is "Tank Level" for one of the Analog Input channels being used to monitor the fluid level in a storage tank. Engineering Units can also be assigned. In the above example, the units can be named "Feet", "Inches", or "Barrels".

The PCCU is also used to calibrate the Analog Input, Analog Output and Pulse Input signals. The ID and Location of the device are entered in the Entry Mode, as are the Security Code and Date and Time for the data base to be built on. Currently only 6 of the measurement channels can be collected by the host CCU software at a time. Up to 16 items can be stored in the trend data base. The PCCU is used to select which channels "trend".

While connected to the I/O device, the PCCU can be used to Monitor the inputs and outputs being measured by the PIRTU.

Connect PCCU to PIRTU

Follow the steps outlined below to connect the PCCU to the PIRTU for purposes of programming, calibrating and general set-up requirements.

Step	Procedure
1.	Connect the PCCU to the military connector on the left side of the model 6713 FCU.

Continued on next page

Top Level Menu - Continued

Step	Procedure
2.	Depress the ON/OFF key on the PCCU to turn the unit ON. The PCCU displays the same information that existed before it was turned off. If the Top Level Menu screen is not displayed, depress the Menu Exit key until the following screen is displayed: 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
3.	Respond to the initial prompt from the PCCU as follows:
4.	Enter 1 if the PCCU is connected to any Totalflow field device. The initial communication between the device and the PCCU indicates to the PCCU the type of device attached. The PCCU then initiates the proper configuration displays. For any of the other items displayed on the PCCU TOP LEVEL MENU, please refer to the MODEL 6625 PCCU User's Manual. After entering 1, Connected to Totalflow, on the PCCU Top level Menu, the PCCU checks the security code assigned to the I/O. Dual level codes are used by the I/O, and are activated by the Security Switch located on the electronics board. Level 1 code permits reading of the data at the I/O, but no entry or change is allowed. Level 2 code permits reading and changing of the data. The I/O must be entered using the Level 2 code for calibration purposes. If the code of the I/O agrees with the code set in the PCCU or if the Security Switch is off, the following is displayed: Please Wait. Reading EXP I/O Data. If the code set in the PCCU does not agree with the I/O code, the message: "Invalid Security Code--Access Denied - Enter new Security Code" is displayed.

Continued on next page

Step	Procedure
5.	The PCCU will read the I/O channel tags and assigned engineering units. It takes about 20 seconds to do this. The next screen displayed is: ** EXP I/O CONNECTED: 12345 ** LOC: TOTALFLOW™ 1) Monitor 2) Entry 3) Calibration 4) PCCU EXP I/O Software Rev Level Depress the corresponding number key to select the desired operational mode. • *Monitor Mode:* This mode enables the display of up to six operating conditions of the measured I/O points at a time. • *Entry Mode:* This mode enables the entry of setup information the PIRTU needs for proper operation. • *Calibration Mode:* This mode enables the calibration of Analog Inputs, Analog Outputs, and Pulse Inputs.

Monitor Mode Operation

This mode enables the display of operational I/O data on the PCCU. The Entry Mode setup functions of assigning channel tags and selecting trend channels is usually performed before monitoring any data. Up to six items can be displayed at any one time. Any combination of items may be displayed.

Monitor Mode

Follow the steps outlined below to enter into the MONITOR Mode of operation.

Step	Procedure
1.	Upon selecting monitor, a screen will appear showing the types of information available for monitoring. ** MONITOR MODE MENU ** 1) Analog Inputs 2) Analog Outputs 3) Pulse Inputs 4) Digital Inputs 5) Digital Outputs 6) Begin Monitor
2.	Up to six total items can be selected to monitor. For example, select: 1) Analog Inputs A list of the analog inputs that may be selected for monitoring will appear. >Tank Lvl 1 Tank Lvl 2 Pressure 1 Pressure 2 Comp Tmp 1 Dischg P1 Dischg P2 Use ARROW keys to MOVE and CHANGE Depress CONTINUE when finished

Continued on next page

Monitor Mode - Continued

Step	Procedure
3.	Each analog input channel is identified by a unique "channel tag" (name). The "channel tags" are entered or changed in the ENTRY MODE. In this example, the channels have been named as: **<u>Channel</u>** **<u>Channel Tag</u>** Analog Input 1 Tank Lvl 1 Analog Input 2 Tank Lvl 2 Analog Input 3 Pressure 1 Analog Input 4 Pressure 2 Analog Input 5 Comp Tmp 1 Analog Input 6 Dischg P1 Analog Input 7 Dischg P2
4.	Move the cursor to the items that need to be selected using the LEFT/RIGHT arrow keys. Select the item with either the YES/NO keys or the UP/DOWN arrow keys. When selected, the items will be displayed on a black background.
5.	When finished selecting items to be monitored, press CONTINUE. The Monitor Mode Menu appears: ** MONITOR MODE MENU ** 1) Analog Inputs 2) Analog Outputs 3) Pulse Inputs 4) Digital Inputs 5) Digital Outputs 6) Begin Monitor
6.	Select other items to monitor from the remaining inputs and outputs. Remember, up to six total items can be selected for each viewing.

Continued on next page

Monitor Mode - Continued

Step	Procedure
7.	Once the items to monitor have been selected, enter 6) Begin Monitor. The following is displayed: Pressure 1 xxxxx.x PSIG Dischg P1 xxxxx.x PSIG Turbine 1 xxxxx.x SCF Valve 1 xxx.x % OPEN Depress EXIT when finished In this example, two Analog Inputs (Pressure 1, Dischg P1), one Pulse Input (Turbine 1), and an Analog Output (Valve 1) were selected for monitor. If more than six items are selected, an error message is displayed on the bottom of the screen. Depress CONTINUE and make the necessary changes so that only six items are selected.

Entry Mode

Entry Mode Operation

This mode enables the entry of operational set-up using the PCCU. The Entry Mode setup functions of assigning channel tags and selecting trend channels is usually performed before monitoring any data.

Below is a list of tasks that can be performed in the ENTRY mode:

- Set the Expanded I/O Date/Time
- Set the Expanded I/O Identification
- Set the Expanded I/O Location Description
- Set EXP I/O Security Code
- Select Channels to Be Trended
- Assign Channel Tags and Engineering Units
- Set the Digital Outputs

Entry Mode

Follow the steps outlined below to enter into the Entry Mode of operation.

Step	Procedure
1.	Select the ENTRY MODE and the following menu is displayed: ** ENTRY MODE MENU ** 1) EXP I/O Date / Time 2) ID 3) Location 4) EXP I/O Security Code 5) Trend Channel 6) Channel Tags 7) Set Digital Outputs Items 1 thru 4 are similar to the Entry Mode items of an FCU.

Entry Mode - Continued

Step	Procedure
2.	Select 1, EXP I/O Date/Time, and the following screen is displayed: EXP I/O Date/Time is MM.DD.YY HH:MM.SS PCCU Date/Time is MM.DD.YY HH:MM.SS Set EXP I/O with PCCU date/Time? The display shows the clock of the I/O and the PCCU. The option is to set the I/O clock with the PCCU clock. The PCCU clock is set in the PCCU Setup routine. Refer to the PCCU section of the Installation, Operation and Maintenance Manual for instructions on setting the PCCU time. Answer Yes by pressing the YES key on the PCCU to set the I/O time with the PCCU time. Answer No to not change the I/O time. If Yes is selected the display will show the PCCU time and indicate that the change will occur at the top of the next minute. The clock of the I/O is separate from the clock of the Flow Computer. The 2 clocks should be set to agree with each other.

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Step	Procedure
3.	Select 2, ID, to enter the ID of the I/O. In the FCU - I/O configuration, the I/O operation and data base are separate from the operation and data base of the FCU. Each must have unique IDs. When 2 is selected, the following appears: `ID is 12345 . OK?` The display shows the current ID of the I/O and asks if the ID is correct. Answer Yes by pressing the YES key to leave the ID as indicated. Press the NO key to change the ID. Up to 10 characters, either alpha, numeric or a combination of the two can be used in the ID. Spaces and hyphens are allowed.
4.	Press 3, Location, to enter a location description of the I/O. The current location entered will be displayed on the screen and again the option is Yes or No, leave as indicated or enter in a new description. Up to 24 characters can be used in the location description.

5.	Press 4, EXP I/O Security Code, to enter the 2 security codes. With security codes entered in the system, access to the data and access to control functions is limited to those individuals who know the codes. Level 1 code permits reading the data, level 2 code permits reading the data and the making of changes to the setup. The Security Code Switch, located on the main electronics board, must be off to enter new security code numbers.
	
	When selected, the following appears:
	
	`EXP I/O SECURITY CODE`
	`Enter new LEVEL 1 code: ________`
	
	The code must be a 4 digit number. The default code is 0000. After entering the Level 1 code, the display asks for the Level 2 code. It also must be a 4 digit number. The default code for Level 2 is also 0000. The numbers that were entered for the security codes are not available for viewing. The downloading of information remotely to the EIO - RTU requires that the Level 2 code for the device be entered at the Meter ID Manager.

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Step	Procedure
Step 6 continued	After entering the numbers, place the Security Code Switch in the ON position. NOTE: In the configuration where the I/O is used with an FCU (plug in RTU), the Security Code Switch on the FCU electronics board serves as the security switch for the I/O also. The switch is ON when it is in the Down position. In the stand alone RTU configuration, the Security Switch is located on the electronics board. The switch is ON when it is in the Up position. Remote communications with the PIRTU using the Central Collection Unit software requires a security code entry in the Meter ID Manager. The security code number entered in the Meter ID Manager must agree with the code entered at the remote device regardless of the Security Code Switch position.

Setting Channel Tags

Set Channel Tags Mode

This mode enables the entry of I/O channel tag names and engineering units using the PCCU.

The naming of the channels is usually the first step in setting up the PIRTU I/O. Each of the I/O channels can be identified with its own unique name or tag. Each tag can be up to 10 characters long. In addition, engineering units can be assigned to the Analog Inputs, Analog Outputs, and Pulse Inputs.

Setting Channel Tags

Follow the steps outlined below to channel tags and engineering units.

Step	Procedure
1.	Select 6, Channel Tags, and the following is displayed: ** CHANNEL TAGS MENU ** 1) Analog Inputs 2) Analog Outputs 3) Pulse Inputs 4) Digital Inputs 5) Digital Outputs To name an input or output channel and to assign engineering units to the channel, select the channel type from the display.
2.	Select 1) Analog Inputs and the following is displayed: *** Analog Input Tags *** 1) Channel Tag [1] 2) Tag Tank Lvl 1 3) Units BARRELS

Continued on next page

Setting Channel Tags - Continued

Step	Procedure
3.	The channel number is selected by pressing 1. Each time 1 is pressed the channel number indication [ ] changes. At the same time, the Tag and Units for the channel selected are displayed. To change the Tag or Units, enter 2,or 3. For example, to change the tag and unit selection on Analog Input channel 3, press 1 until [3] is indicated. The following is displayed: *** Analog Input Tags *** 1) Channel Tag [3] 2) Tag Pressure 1 3) Units PSIG
4.	Change the Tag and Units by pressing either 2 or 3 and entering up to 10 characters for either one. To enter alpha characters, first press the Shift Lock key on the PCCU keyboard. Press Shift Lock again after entering alpha characters.
5.	Press Menu Exit to return to the Channel Tags Menu to select the Analog Output, Pulse Input, Digital Input or Output channels. The process for assigning names and units is the same as the above example except that no engineering units can be assigned to the Digital Inputs or Outputs.

Trend Channels

Trend Channels

The PIRTU feature has the capability of storing information such as digital input and output status, analog input and outputs, and pulse accumulations, etc., up to sixteen (16) channels of information in a trend database. Six channels can then be collected and displayed by the host application (CCU) per collection. The information shows the "trend" of the channel and is referred to as “Trend Information” or “Trend Channel Data”. The PCCU is used to select which analog or pulse input channels of the PIRTU to collect.

Setting Trend Channels

Follow the steps outlined below to select trend channel assignments.

Step	Procedure
1.	Select option 5) Trend Channel on the Entry Mode Menu: ** ENTRY MODE MENU ** 1) EXP I/O Date / Time 2) ID 3) Location 4) EXP I/O Security Code 5) Trend Channel 6) Channel Tags 7) Set Digital Outputs
2.	The Trend Channel assignment screen will be displayed: Select Trend Channel 1) Trend Channel 1 trend off 2) Trend Channel 2 trend off 3) Trend Channel 3 trend off 4) Trend Channel 4 trend off 5) Trend Channel 5 trend off 6) Trend Channel 6 trend off Each of the 6 Trend Channels can be assigned to 1 of the analog or pulse input channels or not used. If not being used, the Trend Channel will indicate "trend off". When initially setup, all Trend Channels will be turned off.

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<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td></td><td>Perform the following steps to assign analog or pulse input channels to be trended.

Select Trend Channel

1) Trend Channel 1 trend off
2) Trend Channel 2 trend off
3) Trend Channel 3 trend off
4) Trend Channel 4 trend off
5) Trend Channel 5 trend off
6) Trend Channel 6 trend off</td></tr>
<tr><td>3.</td><td>Enter the number of the Trend Channel to set up from the above display. For example, to set up Trend Channel 2, enter 2.</td></tr>
<tr><td>4.</td><td>A selections menu appears showing all analog and pulse input channels with the name or tag that has been assigned to the channel. The channels appear in order from left to right: Analog Input (7), Pulse Input (2), Analog Output (4), Absolute Pressure, Differential Pressure and Flow Rate. Additionally Absolute Pressure, Differential Pressure, and Flow Rate are active and are derived directly from the model 6713 FCU that the PIRTU is plugged into.

Select ONE item to assign to the Trend Channel.

>Tank Lvl 1 Tank Lvl 2 Pressure 1
Pressure 2 Comp Tmp 1 Dischg P1
Dischg P2 Turbine 1 Turbine 2
Valve 1 Valve 2 Valve 3
Valve 4 ABS.PRES DIFF.PRES
FLOWRATE Trend Off
Use ARROW keys to MOVE and CHANGE
Depress CONTINUE when finished

To select the item to trend, move the cursor to the item using the LEFT/RIGHT arrow keys. Select the item with either the YES/NO keys or the UP/DOWN arrow keys. When selected, the item will "light up" or appear on a black background. To remove a selection, position the cursor on the Trend Off selection and select it.</td></tr>
</table>

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Step	Procedure
5.	As an example, select Pressure 1 (Analog Input 3) using the arrow keys. Tank Lvl 1 Tank Lvl 2 >Pressure 1 Pressure 2 Comp Tmp 1 Dischg P1 Dischg P2 Turbine 1 Turbine 2 Valve 1 Valve 2 Valve 3 Valve 4 ABS.PRES DIFF.PRES FLOWRATE Trend Off Use ARROW keys to MOVE and CHANGE Depress CONTINUE when finished
6.	Then press CONTINUE. The following display appears: Change Trend Channel 2 from: Trend OFF To: Pressure 1 Old data will be lost ok?
7.	Respond YES if this is correct. The prompt "Old data will be lost" means that anything that was previously trended on this channel will be lost. The data base for this channel will be cleared to start over with new information. Since this Trend Channel was previously off, the prompt does not apply. No information would previously be stored. However, if changing from 1 analog or pulse channel to another, the previously stored data would be lost. Answer NO to cancel the change and save the existing data. NOTE: Of the 16 data channels available for trending, only 6 can be collected at one time. The CCU can poll the I/O and report the condition of all channels at the time the poll request was made, but this information is not being stored in the data base at the I/O device unless the channel has been selected for trending.

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Setting Digital Outputs

Digital Outputs

The PIRTU feature has the capability of initiating digital outputs directly from the PCCU or CCU. The PCCU is used to select which Digital Output channel of the PIRTU to change.

Setting Digital Outputs

Follow the steps outlined below to select Digital Output channel status changes.

Step	Procedure
1.	To set/reset the digital outputs, enter 7 on the Entry Mode Menu. ** ENTRY MODE MENU ** 1) EXP I/O Date / Time 2) ID 3) Location 4) EXP I/O Security Code 5) Trend Channel 6) Channel Tags 7) Set Digital Outputs The following screen is then displayed: **>Dig. Out 1 Dig. Out 2 Dig. Out 3** **Dig. Out 4 Dig. Out 5 Dig. Out 6** **Dig. Out 7 Dig. Out 8** Use ARROW keys to MOVE and CHANGE Depress CONTINUE when finished
2.	Set/reset refers to voltage level at the digital output connection. Set is the active state with the battery voltage present at output. Reset is the inactive state with 0 volts at the output. The digital outputs are set or active if they are shown on the display with the black background or appear as "lit up". Move to the outputs that need to be set/reset with the LEFT/RIGHT arrow keys. Set/reset the output with either the YES/NO keys or the UP/DOWN arrow keys.

Continued on next page

Setting Digital Outputs - Continued

Step	Procedure
3.	When all the digital outputs have been set/reset as needed, press CONTINUE. The PCCU will then command the I/O to set/reset the Digital Outputs. **Setting Digital Outputs**
4.	Once the communication between the PCCU and the I/O is complete, the display returns, showing the current state of the digital outputs: **>Dig. Out 1 Dig. Out 2 Dig. Out 3** **Dig. Out 4 Dig. Out 5 Dig. Out 6** **Dig. Out 7 Dig. Out 8** Use ARROW keys to MOVE and CHANGE Depress CONTINUE when finished At this point changes can be made which would require pressing Continue again, or if the settings are correct, press MENU EXIT.

Calibration Mode

Calibration Mode

The calibration mode enables the calibration of the Analog Inputs, Analog Outputs, and Pulse Inputs of the PIRTU. Before entering the Calibrate Mode, set up the Channel Tags and Units with the necessary names and engineering units. See the section on the ENTRY MODE for the correct procedures.

Calibration Procedures

Follow the steps outlined below to calibrate the Analog Input, Analog Output and Pulse Input channels.

Step	Procedure
1.	After selecting 3 or Calibration from the Connected Menu, the PCCU commands the I/O to ignore new readings from its measurement inputs. Instead the I/O uses readings just before receiving the command from the PCCU. This prevents the I/O data base from being affected by value changes during calibration. There are two ways to remove this temporary hold: 1. Unplug the DATA cable at the EXP I/O connector. 2. Exit the calibration mode with the MENU EXIT key. Select 3 or Calibrate and the following appears: ** CALIBRATE MENU ** 1) Calibrate AIs 2) Calibrate AOs 3) Calibrate PIs

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Calibration Mode - Calibrating Analog Inputs

Calibrating Analog Inputs

The Analog Input measurement is often referred to as the measurement of the variation in a 4 to 20 milliamp signal provided by an external transducer. Normally the low value represents the lowest unit to be measured and the high value represents the highest value to be measured. The I/O of the Totalflow devices senses and measures voltage. Certain low power transducers provide the necessary 1 to 5 volt variation. Transducers providing a 4 to 20 milliamp signal must have a 250 ohm resistor jumpered across the input connection at the termination board. These resistors are provided on the termination board.

Step	Procedure
1.	To calibrate AIs, enter 1 on the Calibrate Menu and the following appears: ** CALIBRATE AI MENU ** 1) Tank Lvl 1 5) Comp Tmp 1 2) Tanl Lvl 2 6) Dischg P1 3) Pressure 1 6) Dischg P2 4) Pressure 2 In this example display, the channels are identified by the tags or names entered in the Entry Mode. Select the Analog Input to calibrate. In this example, assume Dischg P1 (Analog Input 6) was selected. Enter 6 and the display for the calibration of Analog Input 6 is shown: Dischg P1 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] 6) Number of cal points [3] 7)Begin calibration at [LO] point

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Calibrating Analog Inputs Menu Items

The items of the Analog Input Calibration Menu are:

1. Calibrate Selects the calibration procedure. The prompts for calibration will be shown on the bottom two lines of the display.

2. Lo Limit Entering 2 permits the entry of the LO Limit in the engineering units selected. The I/O Control routine calculates percent of time that the value was below the entered low limit.

3. Hi Limit Entering 3 permits the entry of the High Limit in the engineering units selected. The I/O Control routine calculates percent of time that the value was above the entered high limit.

4. Test Value Entering 4 permits the entry of a test value to use in verifying the operation of the Analog Input. The value entered should be in the engineering units selected. This value is used by the I/O when a channel is Inactive.

5. Channel Active/Inactive Entering 5 toggles between setting the channel Active or Inactive. When set to Active the channel is reading the live measurement. A channel set to Inactive is reading the Test Value.

6. Number of Cal. Points [3/2]. Entering 6 toggles between setting the number of calibration points to 2 or 3.

7. Begin Calibration at [LO/HI] point. Entering 7 toggles between beginning the calibration procedure at the LO point or HI point.

LO, MID, HI   are the low, mid, and high calibration points entered during calibration. These values are shown in milliamps.

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Calibration Mode - Calibrating Analog Inputs - Continued

Step	Procedure
2.	Before beginning, select either 2 or 3 point calibration and the calibration direction. These selections are items 6 and 7 from the calibrate display. Instructing the PCCU to begin calibration at the low point means that the calibration direction will be LO, MID, HI. By instructing the PCCU to begin calibration at the HI point the direction is reversed. If the two point calibration is selected, the direction is HI, LO or LO, HI. Dischg P1 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Zero Analog Input Enter New AI Zero Enter 6 to select the number of calibration points. Entering 6 will toggle between 2 or 3 points.
3.	Enter 7 to select whether to begin calibration at the LO point or the HI point. The Calibrate routine is not entered until 1) Calibrate is selected.

Calibration Mode - Calibrating Analog Inputs - Continued

Analog Input Calibration Steps

Step	Procedure
1.	Enter 1) Calibrate from the menu. Set the device providing the input to the I/O to reading of zero. Follow the calibration prompts shown on the last two lines of the display: Dischg P1 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Zero Analog Input Enter New AI Zero
1a.	Enter 0 and press ENTER. The verification prompt appears: Dischg P1 0.0 PSIG <--Display is updated here 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Zero Analog Input You Entered 0.0 PSIG ok?
1b.	When the verification prompt is on the screen, the measurement is being updated. When the measurement settles, answer YES to proceed or NO and re-enter the correct value.

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Calibration Mode - Calibrating Analog Inputs - Continued

Step	Procedure
2.	Set the output of the device providing the input to the expected operating point. Dischg P1 0.0 PSIG 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Set Analog Input Operating Point Enter New Operating Point
2a.	Enter the value and press ENTER: Dischg P1 50.0 PSIG <--Display is updated here 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Set Analog Input Operating Point You Entered 50.0 PSIG ok?
2b.	Here again, when the verification prompt is on the screen, the measurement is being updated. When the measurement settles, answer YES.

Continued on next page

Calibration Mode - Calibrating Analog Inputs - Continued

Step	Procedure
3.	Set the output of the device providing the input to the maximum operating value or range. Dischg P1 50.0 PSIG 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Set Up Analog Input to Full Scale Enter new AI Range
3a	Enter the range and press ENTER. Dischg P1 100.0 PSIG <--Display is updated here 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Set Up Analog Input to Full Scale You entered 100.0 PSIG ok?
3b	When the measurement settles, answer YES. The following is shown: Dischg P1 100.0 PSIG <--Display is updated here 1) Calibrate 2) Lo Limit xxxxx.x LO xxxxx.x 3) Hi Limit xxxxx.x HI xxxxx.x 4) Test Val xxxxx.x HI xxxxx.x 5) Channel [Active] Calibration is complete .... Depress CONTINUE to Proceed .... The display continues to update until Continue or Exit is selected. Since the display continues to update, verification of the calibration is possible at this point.

Calibration Mode - Calibrating Analog Outputs

Calibrating Analog Outputs

The Analog Output function of the PIRTU is capable of supplying up to four (4) outputs. These outputs can be individually addressed from internal 6713 measured points such as Differential Pressure, Static Pressure, Flowing Temperature and Flow Rate. Additionally, these outputs can be controlled using our graphically enhanced ladder logic (GELLO).

To program and set-up the Analog Outputs use the following procedures:

Step	Procedure
1.	To calibrate an Analog Output, enter 2 on the Calibrate Menu: ** CALIBRATE MENU ** 1) Calibrate AIs 2) Calibrate AOs 3) Calibrate PIs A display such as the example below is shown: ** CALIBRATE AO MENU ** 1) Valve 1 2) Valve 2 3) Valve 3 4) Valve 4

Continued on next page

Step	Procedure
2.	In this example the AOs have been tagged or named Valve 1 thru 4. Up to four analog outputs are displayed. Only 1 AO is provided on the basic I/O device. An expanded AO board is necessary to provide AO 2 through 4. Choose the Analog Output to calibrate. For this example Valve 1 (AO 1) is chosen. Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO

Calibrating Analog Outputs Menu Items

The items of the menu are:

- *Calibrate* - Selects the calibration procedure. The prompts for calibration will be shown on the bottom two lines of the display.
- *Lo Limit* - Entering 2 permits the entry of the LO Limit in Percent. The I/O Control routine calculates the percent of time that the value was below the entered low limit.
- *Hi Limit* - Entering 3 permits the entry of the High Limit in Percent. The I/O Control routine calculates the percent of time that the value was above the entered high limit.
- *Test Value* - Entering 4 the entry of a test value in Percent. The test value is used by the I/O when a channel is Inactive.
- *Channel Active/Inactive* - Entering 5 toggles between setting the channel Active or Inactive. When set to Active the channel is outputting the set value. A channel set to Inactive is outputting the Test Value.
- *Check AO* - Entering 6 permits the setting of the AO for test or operational purposes.
- *LO, HI* - are the low and high calibration points entered during calibration. These are in mA (milliamps).

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Step	Procedure
3.	Enter 1) Calibrate and the calibration prompts will appear on the last two lines of the display. Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO Now setting AO to 0% (should be 4.0 mA) Enter new measured mA value
3a.	The PCCU instructs the I/O to set the Analog Output to 0%. Check the analog output value on the termination panel with a meter. When it settles, it should read close to 4.0 mA (milliamps). Enter the value measured in milliamps (mA). For example, if the meter indicated 3.9, enter 3.9. A verification prompt then appears: Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO Now setting AO to 0% (should be 4.0 mA) You entered 3.9 mA ok? If satisfied, answer YES. If a change is necessary answer NO and enter the correct value.
3b.	The PCCU then instructs the I/O to set the Analog Output to 100%. Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO Now setting AO to 100% (should be 20.0 mA) Enter new measured mA value

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Calibration Mode - Calibrating Analog Outputs - Continued

Step	Procedure
3c.	Check the analog output value on the termination panel with a meter. When it settles, it should read close to 20.0 mA (milliamps). Enter the value measured in milliamps (mA). For example, if the meter read 19.9, enter 19.9. A verification prompt will appear: Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO Now setting AO to 100% (should be 20.0 mA) You entered 19.9 mA ok?
4.	If satisfied answer Yes. Valve 1 1) Calibrate 2) Lo Limit xx.x LO xx.x 3) Hi Limit xx.x HI xx.x 4) Test Val xx.x 5) Channel [Active] 6) Check AO Calibration Complete .... Depress CONTINUE to proceed ....

Checking and Setting Analog Outputs

Checking and Setting Analog Outputs

After calibration has been completed on the PIRTU Analog Outputs it is recommended to check or verify that the calibration is valid. You can also manually set the analog outputs to a user determined value.

To check and manually set the Analog Outputs use the following procedures:

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Enter 6) Check AO and the last two lines on the display prompts for the percent value to enter:

Valve 1
1) Calibrate
2) Lo Limit xx.x LO xx.x
3) Hi Limit xx.x HI xx.x
4) Test Val xx.x
5) Channel [Active] 6) Check AO
Enter % of Full Scale to set AO
Enter new % of Full Scale</td></tr>
<tr><td>2.</td><td>Enter a percent of full scale of the Analog Output. 0 to 100% is the scale of the AO, 100% being full scale. 0% represents 4 milliamps, 100% represents 20 milliamps. Half scale or 50% would represent 12 milliamps:

Valve 1
1) Calibrate
2) Lo Limit xx.x LO xx.x
3) Hi Limit xx.x HI xx.x
4) Test Val xx.x
5) Channel [Active] 6) Check AO
Enter % of Full Scale to set AO
You entered 50% ok?

Once the verification prompt is answered with YES the PCCU will instruct the I/O to set the AO with the value. The analog output (4-20 ma signal) will appear at the output terminals and can be read with a meter. In this example, 12 mA on should be indicated by the ampmeter.</td></tr>
<tr><td>3.</td><td>Check the Analog Output for any scale percentage setting by following steps 1 through 3. When finished, press MENU EXIT.</td></tr>
</table>

NOTE: The analog output is a fixed value, a percentage of the calibrated range, and set by the "Check AO" routine.

Calibration of Pulse Inputs

Calibrating Pulse Inputs

Two additional high speed pulse inputs are provided on the PIRTU.

To calibrate the pulse inputs use the following procedures:

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>To calibrate a Pulse Input, enter 3 on the Calibrate Menu:

** CALIBRATE MENU **
1) Calibrate AIs
2) Calibrate AOs
3) Calibrate PIs</td></tr>
<tr><td>2.</td><td>The display for the two Pulse Input channels will appear:

** CALIBRATE PI MENU **
1) Turbine 1
2) Turbine 2

In this example Turbine 1 (Pulse Input 1) is chosen:

Turbine 1
1) K Factor xxxxx.x
2) Lo Limit xxxxx.x
3) Hi Limit xxxxx.x
4) Test Val xxxxx.x
5) Channel [Active]</td></tr>
</table>

Continued on next page

The calibration for the Pulse Input channels consists of entering the K-factor. The PIRTU will read pulses at the channel inputs and multiply them by the factor entered.

Two types of pulse information are available with the PIRTU; Pulse Frequency and Pulse Accumulation. The selection is controlled by firmware version. Insure that the firmware version ordered will support the pulse information desired.

Calibrating Pulse Inputs Menu Items

The items of the Pulse Input Calibration Menu are:

- *K-Factor* - Enter 1 to enter the pulse multiplier or K-factor.
- *Lo Limit* - Entering 2 permits the setting of the LO Limit. Units for the Pulse Inputs are usually in pulses. The I/O Control routine calculates the percent of time the pulses were below the set value.
- *Hi Limit* - Entering 3 permits the setting of the High Limit pulse value. The I/O Control routine calculates the percent of time the pulses were above the set value.
- *Test Value* - Entering 4 permits the entry of a test value to use in checking the Pulse Input operation. The test value is used by the I/O when a channel is Inactive.
- *Channel Active/Inactive* - Entering 5 toggles between setting the channel Active or Inactive. An Active channel is reading the live pulse inputs. An Inactive channel is reading the Test Value.

After all entries have been made to the PIRTU with the PCCU, the PCCU can be used to monitor the operation of the device. When the operation has been verified, disconnect the PCCU. In the FCU - PIRTU configuration, the PCCU must be removed before remote communications can take place.

When connected to a radio or modem, the PIRTU's operation can be monitored or controlled remotely using the Central Collection Unit (CCU) software package. Please reference the latest revision of the Central Collection Unit (CCU) software manual for more information on this topic.

PIRTU Appendix - A

PIRTU I/O Description

4   Analog outputs: 4 to 20 ma (1 standard, 3 optional)

7   Analog inputs: 1 to 5 v (EXP I/O-non-differential) (RTU -differential)

2   Pulse inputs: 0 - 5v to 0 - 12v input range

1   Absolute Pressure (1 minute average) from FCU (I/O - FCU configuration)

1   Differential Pressure (1 minute average) from FCU (I/O - FCU configuration)

1   Flow Rate (1 minute average) from FCU (I/O - FCU configuration)

8   Digital outputs (dc switched)

8   Digital inputs (dry contact)

Specifications

Analog Output

- 4 - 20 ma output
- 12 bit resolution
- +/- 5.127 microamps accuracy
- 250 ohm minimum load

Analog Input

- 0 - 5v (4-20 ma w/250 ohm resistor)
- 13 bit resolution
- +/- 640.87 microvolts (+/-2.57 microamps) accuracy
- Non-differential inputs (common ground)

Pulse Input - Active Input

- 0 - 20000 Hz frequency input
- 0 - 5 volt minimum pulse voltage input
- 0 - 12 volt maximum pulse voltage input

Pulse Input - Contact Closure Input

- 0 - 100 Hz frequency input

Digital Output

When active or set, DC voltage is supplied across DO+ and DO-.

The DC voltage available on the outputs is determined from the power source and the total combined current available (sum of all active outputs)

- Internally powered: Battery voltage @ 2 amps
- Externally powered: External power supply @ 4 amps

Digital Input

- Input sensed by dry contact input (0 ohms) between DI+ and DI-
- Input status read once per second
- Not operational with non-dry contact input (active input)

Monitoring and Data base Information

The current value for all PIRTU I/O points is available using the Monitor Mode of the PCCU.

Minute, Hourly, or Daily resolution of inputs and outputs is available with the CCU I/O Control program.

Up to 16 channels are recorded, with only 6 of the AO, AI, and PI channels that can be collected at a time.

- Minute resolution - 60 one minute averages
- Hourly resolution - 72 one hour averages
- Daily resolution - 35 daily averages

Pulse Input can be either pulse frequency (Hz) or pulse accumulation (total pulses) for resolution selected. Pulse frequency or accumulation is controlled by firmware version.

The data base will contain the average value in the engineering units defined at calibration, the percent of time the value was above the set high limit, and the percent of time the value was below the set low limit. The Digital I/O data base contains the percent of time the channel was ON during the resolution period.

Polling the I/O using the Remote Communication routine normally returns the value present at the input or output at the time of the poll. Exceptions are the AP, DP, and Flow Rate being supplied by an FCU. These values will be the last minute's average value. The Pulse Input value read by a poll will be the frequency of the pulse input, regardless of firmware version installed.

Power Considerations

The FCU - I/O configuration and RTU are designed for 1 watt continuous operation from internal batteries in the following configuration:

- 10 watt solar charging source
- 1 - 26 amphour battery
- 6713 FCU w/AMU (smart transducer) and RTD probe (FCU - I/O configuration only)
- Communications interface and approved radio

Expanded termination board with the following I/O:

- 7 Analog Inputs active
- 1 Analog Output active
- 8 Digital Inputs active
- Digital Outputs inactive

To prevent excessive power drain of the internal batteries, it is recommended to use an external power supply whenever the Digital Outputs and more than 1 Analog Output are used.

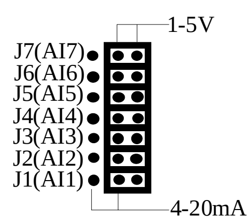
Two types of termination boards are available for the I/O:

- Part No. 2011697-001   Must be installed in 6670 Communications Enclosure

- Part No. 2012511-001   Normally installed in 6713 or RTU enclosure

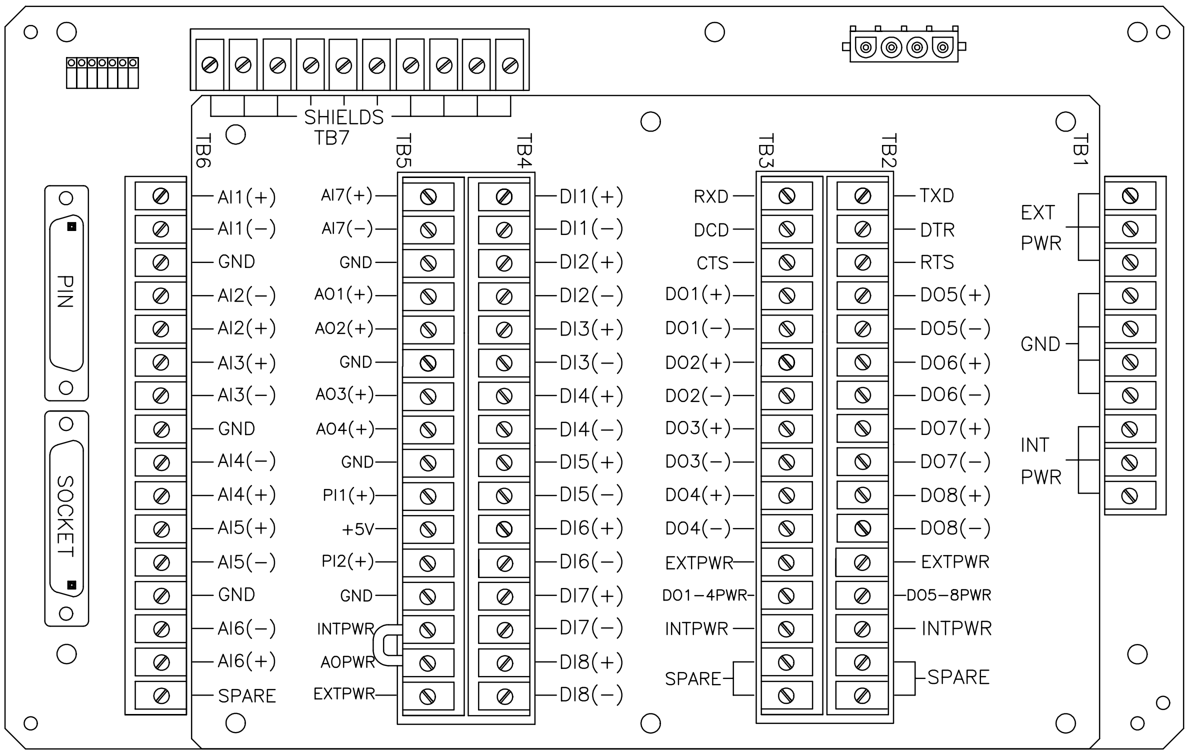
NOTE: 250 ohm load resistors are provided for all Analog Inputs and are mounted on termination board part no. 2011697-001. The load resistors should be connected across the Analog Input connections for any input that is a 4 to 20 milliamp signal.

Termination board part no. 2012511-001 has the 250 ohm load resistors soldered on the board. The connection of the resistors across the Analog Input is controlled with jumper blocks located on the termination board next to TB7, the terminal block marked "SHIELDS". Jumper the blocks as indicated for 1 to 5 volt inputs or 4 to 20 milliamp inputs. Any unused channels should have the jumper in the 4 to 20 milliamp input position.



Jumper blocks on termination board 2012511-001 (or latest revision)

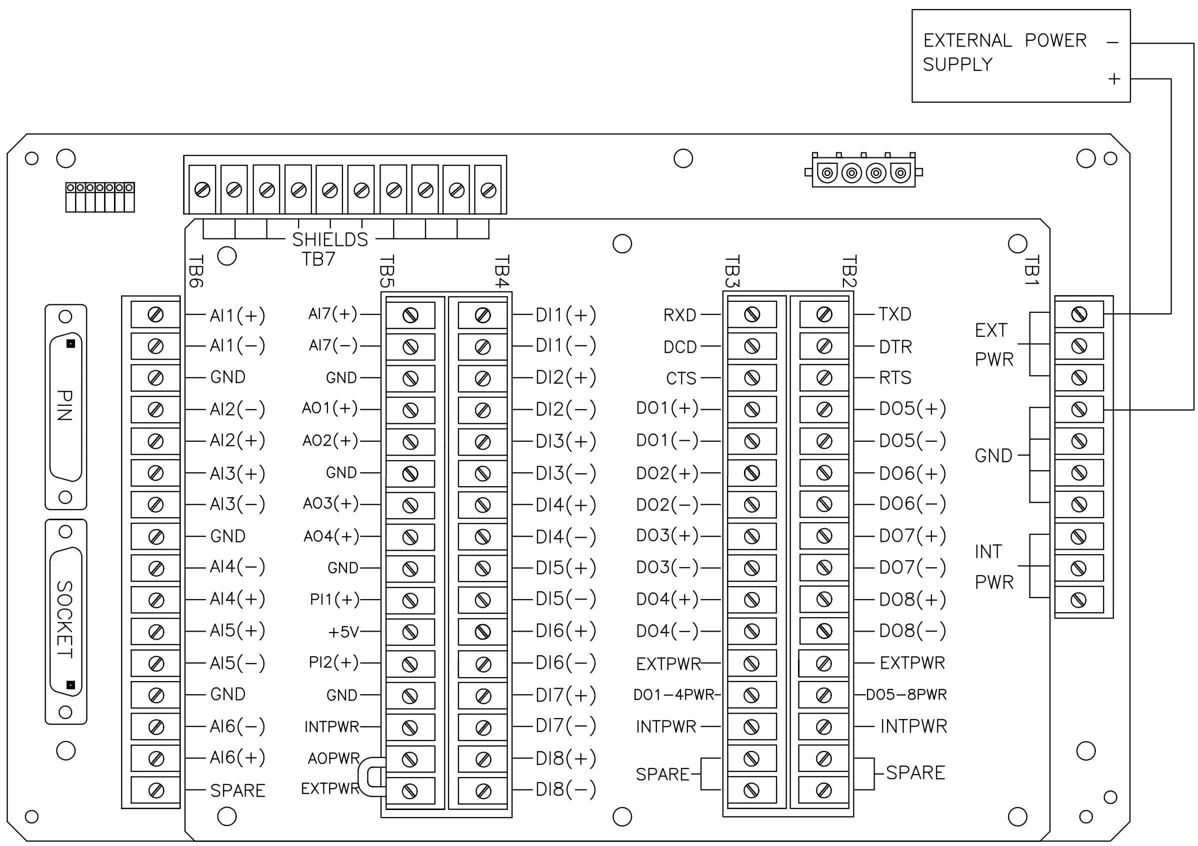
Connections to power Analog Outputs with Internal Power



Termination Board Part No. 2012511-001

Int Pwr is the Internal Power connection on the Termination Board. Jumper Int Pwr to AO Pwr as shown to power the AO with Internal Power.

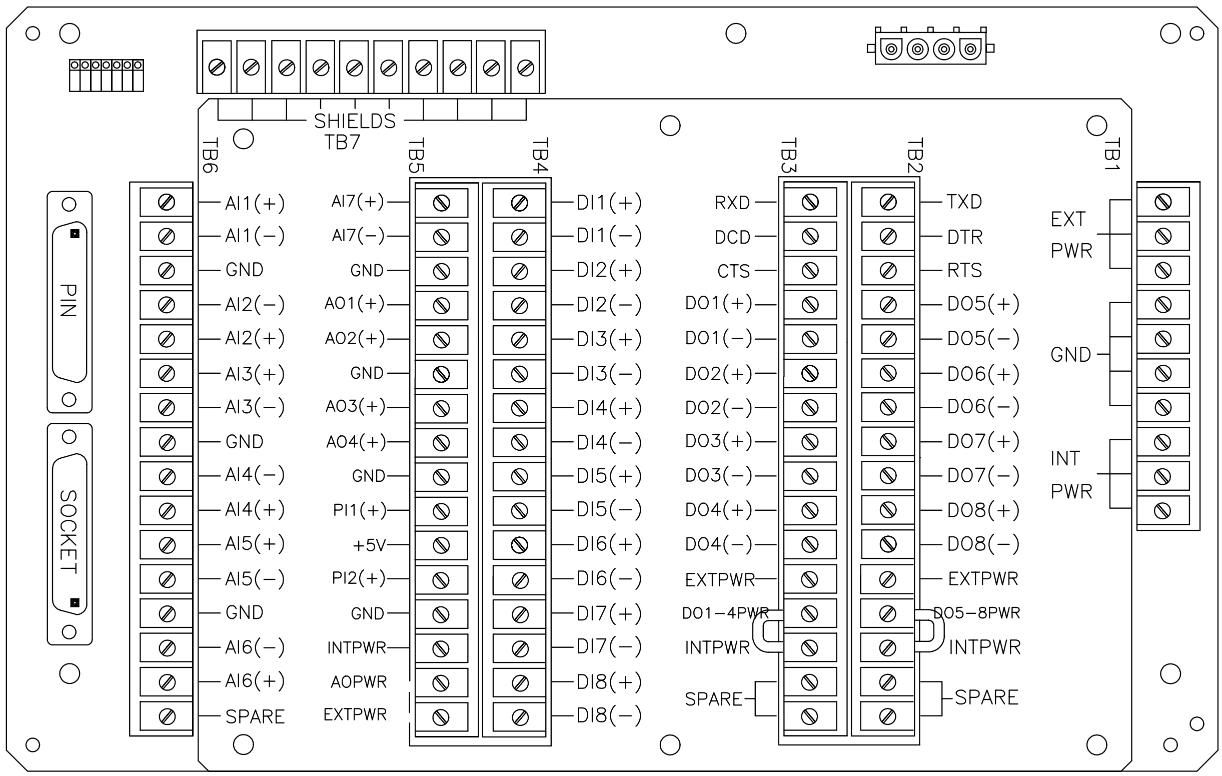
Connections to power Analog Outputs with External Power



Termination Board Part No. 2012511-001

The External Power Source is attached to Ext Pwr and Gnd at TB1 and GND as shown. Jumper Ext Pwr to AO Pwr at TB5.

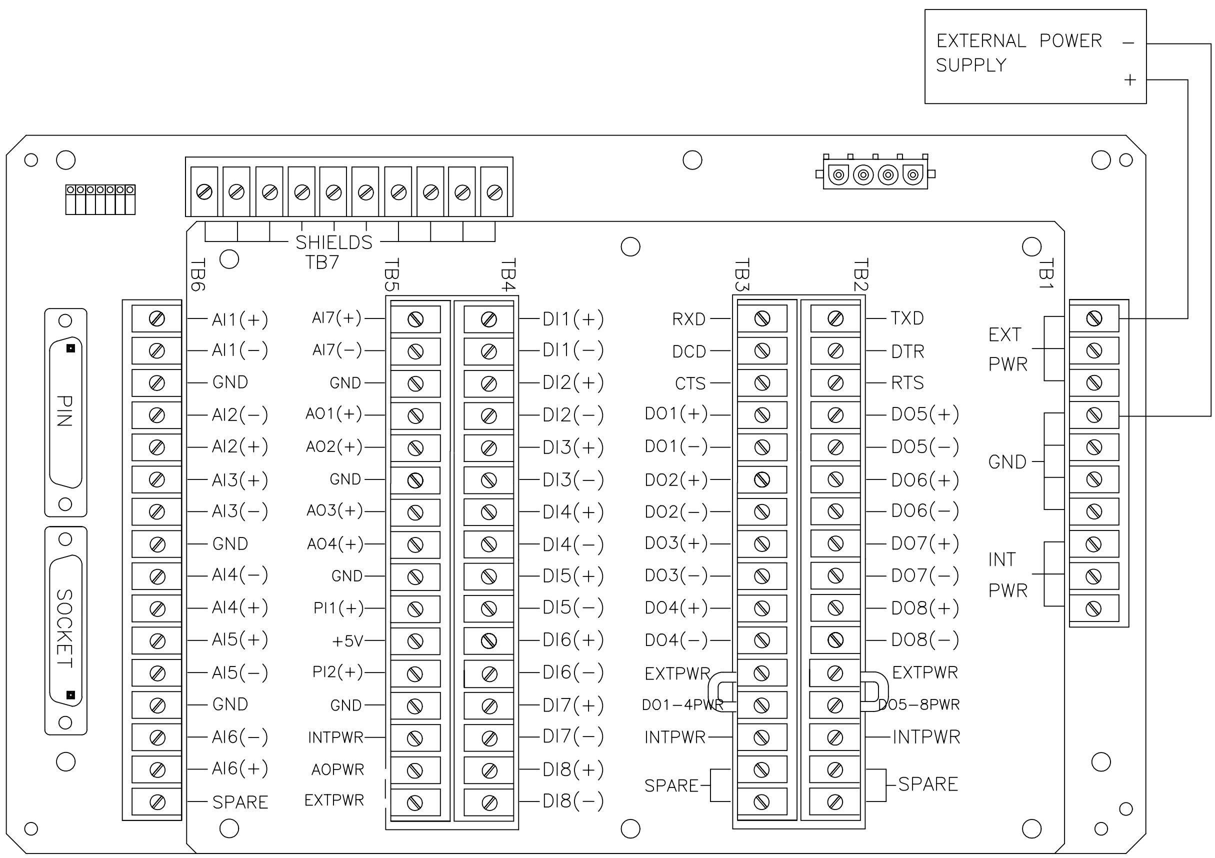
Connections to power Digital Outputs with Internal Power



Termination Board Part No. 2012511-001

Int Pwr is the internal power connection at TB2 and TB3. Jumper Int Pwr to DO5-8 Pwr on TB2 and Int Pwr to DO1-4 Pwr on TB3 to power all 8 DOs with internal battery power. Each group of DOs can be powered either with internal power or with external power.

Connections to power Digital Outputs with External Power



Termination Board Part No. 2012511-001

The External Power Source is attached to Ext Pwr and Gnd at TB1. DO5-8 is jumpered to Ext Pwr on TB2 and DO1-4 is jumpered to Ext Pwr to power all 8 DOs with External Power. Each group of DOs can either be powered internally or with external power.

Chapter 8
Analog Output Expansion Options

Overview

Overview

This Chapter provides you with information on the Analog Output expansion options.

When using the 6700 series in hazardous area installations, refer to drawing numbers 2015267-CD (Div 1) and 2015246-CD (Div 2) for information on the approved installation and wiring required.

What it Does

The Analog Output (AO) option is available for TOTALFLOW model 6713 (Orifice) and 6714 (Pulse Input) Flow Computer Units with the RS-485/Single AO, RS-485/Quad AO and RS232/Quad AO Communication Interface boards. Also required is the correct FCU and PCCU firmware which support the AO options.

The AO feature provides the user with a proportional output (4-20 mA or 1-5 Vdc) at the termination board which tracks one (single AO option) or all (quad AO option) of the following measured variables:

- Flow Rate
- Absolute (Static) Pressure
- Differential Pressure
- Temperature

In addition, the AO can be set to "manual" to provide a fixed output (user selectable).

The Single Analog Output option is powered by the Flow Computer battery. Due to the power required by this option, a minimum 26 amp-hour battery and a 10 watt solar panel are recommended.

The Analog Output is updated once per second.

The PCCU is used to select the measured variable and calibrate the AO to represent the variable selected. The PCCU is also used to set or change the range of the AO if tracking a variable, and to manually set the output if the "Manual AO" option is selected. Once the AO is calibrated, the variable selected for output can be changed without having to re-calibrate. The calibration or set-up of the AO is not possible via the remote communication option. Only the PCCU can calibrate and set-up the AO.

The connections for the AO signal are on the termination board of the 6713 FCU (See recommended procedures in *Field Wiring* section).

Chapter Highlights

This chapter covers the following topics:

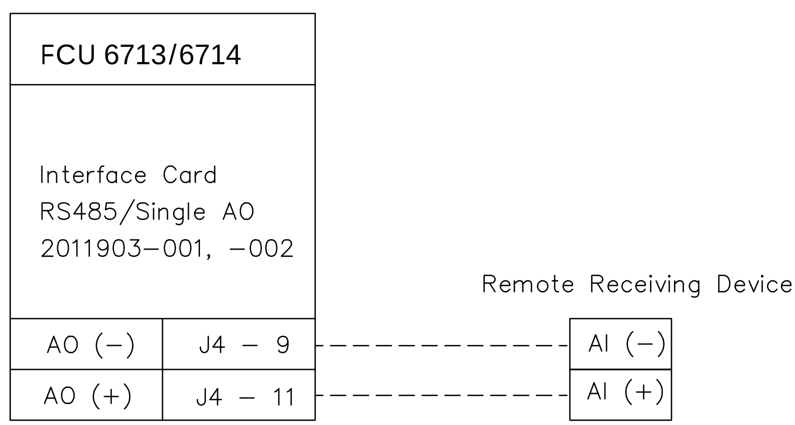
Field Wiring

How to connect Field Wiring

This section details procedures for connecting field wiring to the Analog Output expansion options.

Note:

Do not connect and or disconnect field wiring and or the Analog Output expansion board with FCU power connected. Main battery and solar power must be disconnected before servicing FCU.

Step	Procedure
1.	Disconnect solar panel wiring from FCU main electronics board.
2.	Disconnect main battery wiring from main FCU electronics board.
3.	Disconnect field analog output device power.
3.	For the ***Single Analog Output*** expansion card part number 2011903-001 or -002, connect field wiring to terminals as shown below. Connect cable shield wire at only one end of cable. 

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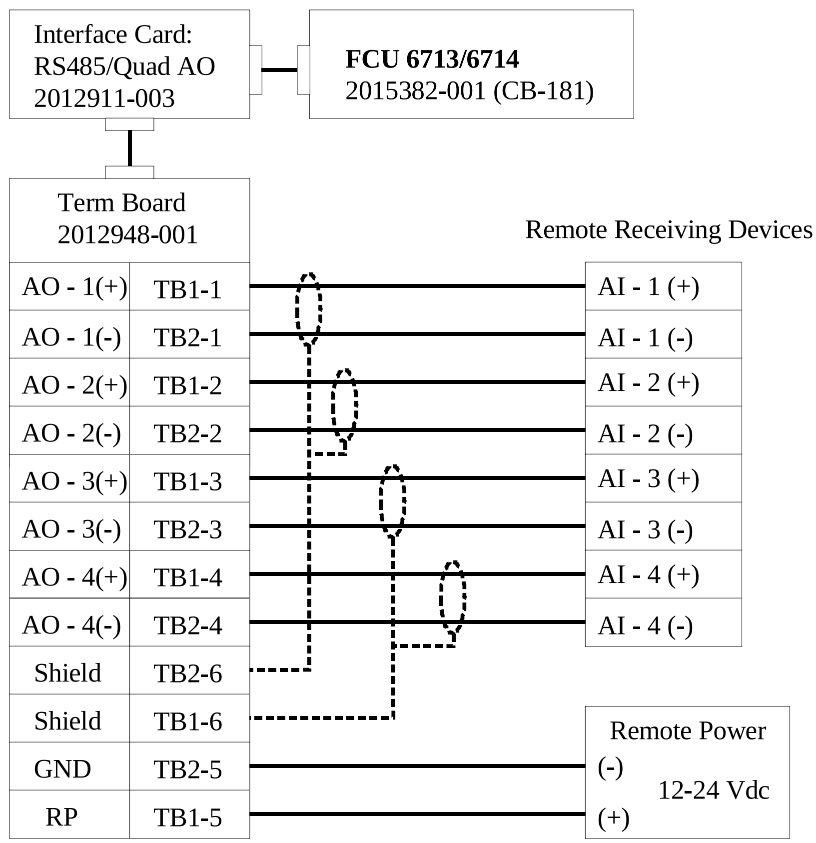
Field Wiring - Continued

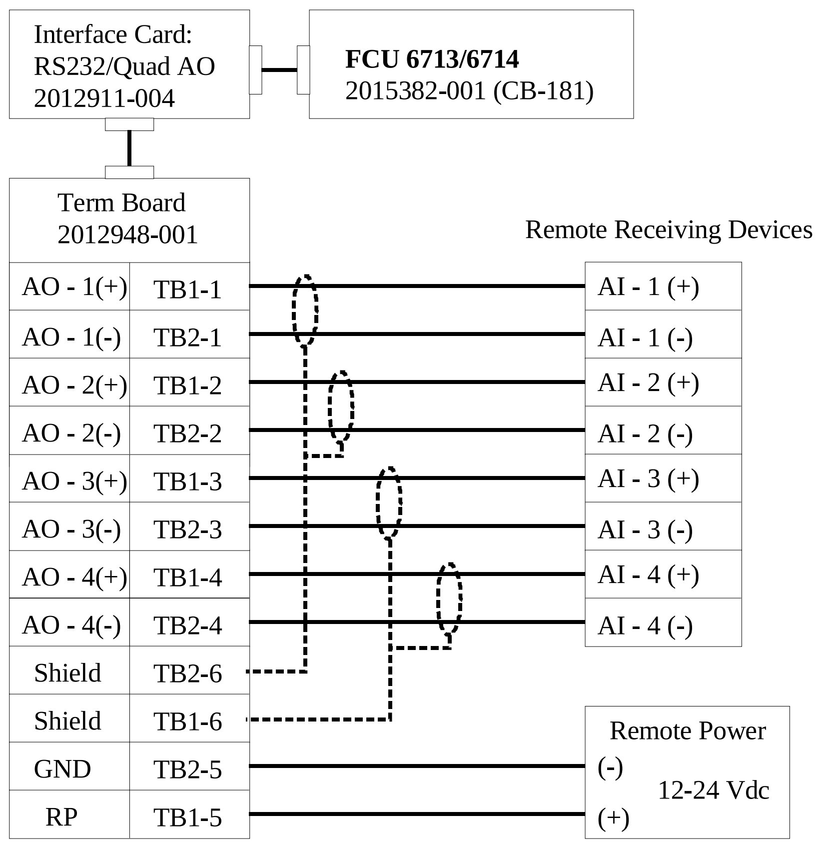
Step	Procedure
3.	For the ***RS485 Quad Analog Output*** expansion card part 2012911-003, connect field wiring to terminals as shown below. Connect cable shield wire at only one end of cable.



NOTE: When using the Quad Analog Output option, AO power must be supplied externally as shown. Four analog loops require at least 80 mA of current supply capability.

Continued on next page

Step	Procedure
3.	For the ***RS232 Quad Analog Output*** expansion card part 2012911-004, connect field wiring to terminals as shown below. Connect cable shield wire at only one end of cable.



NOTE: When using the Quad Analog Output option, AO power must be supplied externally as shown. Four analog loops require at least 80 mA of current supply capability.

Step by Step Operation

Set-up Operation

Note: The following setup and calibration procedures are described using DOS versions of PCCU. If using PCCU32 which is a Windows based program, and requiring assistance, use the on line help.

Step	Procedure
1.	To set up the Analog Output connect the PCCU to the FCU and select **"1" Connected to TOTALFLOW** from the PCCU Top Level Menu. NOTE: The proper firmware must be installed in the FCU and PCCU and the RS-485/AO board must be installed for the following displays to appear on the PCCU. If any of the 3 requirements are missing the FCU and PCCU will appear as standard units. ** 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
2.	Enter 5 to select the calibration mode from the FCU CONNECTED menu: ** FCU CONNECTED: FCU-6713 ** LOC: TOTALFLOW™ 1) Collect 6) Valve 2) Monitor 3) Entry 4) AGA-3 1985 5) Calibrate

Continued on next page

Step	Procedure
3.	To set up the Analog Output enter “6”. ** CALIBRATE MENU - 1 ** 1) Calibrate AP 2) Calibrate DP 3) Check AP 4) Check DP 5) Set Up Temperature 6) Set Up Ananlog Output CONTINUE for more And you should see the following display: Reading Calibration Data.
3.1	When using the Quad Analog Output options, the following screen will be displayed with an additional menu item # 7 “*Select AO*”. Selecting this menu item repeatedly selects which AO to program. ** CALIBRATE MENU - 1 ** 1) Calibrate AP 2) Calibrate DP 3) Check AP 4) Check DP 5) Set Up Temperature 6) Set Up Ananlog Output **7) Select AO: [AO1]** CONTINUE for more

Continued on next page

Step	Procedure
4.	The following Analog Output Setup Menu should now be displayed. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x scf/hr LO xx.xxx 4) Hi Val xxxxx.x scf/hr HI xx.xxx 5) Proportional to flow 6) Rate Units scf/hr CONTINUE for more

AO Setup Menu Definitions

- *Calibrate* - Selects the AO Calibration procedure. The prompts for calibration are shown on the bottom two lines of the display.
- *Check AO* - Entering "2" allows you to check calibration of the Analog Output.
- *Lo Val* - Entering "3" allows you to set the LO Range value in the units of the variable you are tracking.
- *Hi Val* - Entering "4" allows you to set the HI Range value in the units of the variable you are tracking.
- *Proportional to Flow/AP/DP/Temp or AO Manual* - Entering "5", over and over, causes the PCCU to select which Process Variable to track. The choices are Flow, AP, DP, Temperature, or AO Manual.
- *Rate Units* scf/hr - Section "6" lets the PCCU set the rate units that flow is measured in. Entering 6, over and over again selects scf/hr, mcf/day, or mmcf/day.
- *LO, HI* - are the low and high calibration points entered during calibration. Values are in whatever units have been selected to track.
- *Select AO* - Entering 7, over and over, causes the PCCU to select which analog output to use. This is how you select which of the four AO's to calibrate, or check. You can set up ranges and also attach which process variable you are interested in tracking to the selected analog output.

Selecting The Process Variable

Selecting the process variable

The analog output can be set up to track any one of the Process Variables that the FCU measures. It can track:

- Flow Rate
- Flowing Temperature
- Differential Pressure
- Absolute Pressure

  or

- Manual Output Operation.

Step	Procedure
1.	When you first enter the Analog Output Set-up Menu, a process variable is not selected. You will see: 1) Calibrate 2) Check AO 3) Lo Val LO xx.xxx 4) Hi Val HI xx.xxx 5) AO Manual 6) Rate Units scf/hr CONTINUE for more

Continued on next page

Selecting The Process Variable - Continued

Step	Procedure
2.	To select the Process Variable, Enter "5" over and over you will see the following screens with item 5 different for each screen: 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x **scf/hr** LO xx.xxx 4) Hi Val xxxxx.x **scf/hr** HI xx.xxx 5) Proportional to **Flow** 6) Rate Units scf/hr CONTINUE for more 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x **in. H2O** LO xx.xxx 4) Hi Val xxxxx.x **in. H2O** HI xx.xxx 5) **Proportional to DP** 6) Rate Units scf/hr CONTINUE for more 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x **PSIA** LO xx.xxx 4) Hi Val xxxxx.x **PSIA** HI xx.xxx 5) **Proportional to AP** 6) Rate Units scf/hr CONTINUE for more 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x **deg. F** LO xx.xxx 4) Hi Val xxxxx.x **deg. F** HI xx.xxx 5) **Proportional to deg. F** 6) Rate Units scf/hr CONTINUE for more

NOTE: Each time a new process variable is selected, the HI Val and LO Val that "belong" to that variable are displayed as well. Leave item 5 set to the variable that you want the AO to track.

Entering AO Ranges

Entering AO Ranges

The 4 to 20 mA analog output signal represents a percentage between 0 and 100% of the entered Lo and Hi Values of the variable selected. To assign value to this percentage, you must enter the AO Ranges. (Lo and Hi Val) the FCU stores separate ranges (Hi Val and Lo Val) for each of the four process variables (Flow, DP, AP, and Temp).

Step	Procedure
1.	Depress "3" then enter the value in the units displayed that you want a 4 mA output to represent. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x mcf/D LO xx.xxx 4) Hi Val xxxxx.x mcf/D HI xx.xxx 5) Proportional to flow 6) Rate Units **mcf/D** CONTINUE for more
2.	Depress "4" then enter the value in the units displayed that you want 20 mA output to represent.

Setting Flow Rate Ranges

Setting Flow Rate Units

If flow rate is selected as the Process Variable, the ranges (Lo Val and Hi Val) for flow rate can be made to read in various flow rate units. These are: scf/hr, mcf/day, or mmcf/day. These are the same selections that are used for flow rates in Setting FCU Display. When changing these selections the FCU display flow rate units for current flow also changes. This selection is here as a convenience so you can enter the range in units that you commonly use.

Step	Procedure
1.	To select the desired flow rate units, Enter "6" over and over you will see the following screens: 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x scf/hr LO xx.xxx 4) Hi Val xxxxx.x scf/hr HI xx.xxx 5) Proportional to deg. F 6) Rate Units **scf/hr** CONTINUE for more 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x mcf/D LO xx.xxx 4) Hi Val xxxxx.x mcf/D HI xx.xxx 5) Proportional to flow 6) Rate Units **mcf/D** CONTINUE for more 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x mmcf/D LO xx.xxx 4) Hi Val xxxxx.x mmcf/D HI xx.xxx 5) Proportional to flow 6) Rate Units **mmcf/D** CONTINUE for more

Continued on next page

Setting Flow Rate Ranges - Continued

Step	Procedure
2.	Once the rate units have been selected, enter the flow rate range)LO Val and HI Val). Changing the rate units after entering the range will change the range values displayed to agree with the rate selected.

NOTE: The Rate Units selection is here as a convenience and it does change the FCU Display settings for flow rate units. Therefore, if changed, it is necessary to set the units back to what you want the FCU display to read.

Calibrating Analog Outputs

AO Calibration Procedures

The following procedures should be used to calibrate the Analog Output functions.

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Enter "1" Calibrate and you will see the calibration prompts on the last two lines.

1) Calibrate
2) Check AO
3) Lo Val xxxxx.x scf/hr LO xx.xxx
4) Hi Val xxxxx.x scf/hr HI xx.xxx
5) Proportional to flow
6) Rate Units scf/hr
Now seting AO to 0% (should be 4.0 mA)
Enter new measured mA value</td></tr>
<tr><td>2.</td><td>The PCCU instructs the FCU to set the Analog Output to 0%. Check the analog output value on the termination panel with a meter (insure that the meter used is set to milliamps before making connection to AO terminals). When it settles, it should read close to 4.0 mA (milliamps). Enter the value you measure in milliamps (mA). For example, if you read 3.9 enter 3.9. You will now get a verification prompt.

1) Calibrate
2) Check AO
3) Lo Val xxxxx.x scf/hr LO xx.xxx
4) Hi Val xxxxx.x scf/hr HI xx.xxx
5) Proportional to flow
6) Rate Units scf/hr
Now seting AO to 0% (should be 4.0 mA)
You entered 3.9 mA OK?

This sets the mA value entered to equal the Lo Val entered. If you are satisfied, answer YES.</td></tr>
</table>

Continued on next page

Calibrating Analog Outputs - Continued

Step	Procedure
3.	The PCCU then instructs the FCU to set the Analog Output to 100%. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x scf/hr LO xx.xxx 4) Hi Val xxxxx.x scf/hr HI xx.xxx 5) Proportional to flow 6) Rate Units scf/hr Now seting AO to 100% (should be 20.0 mA) Enter new measured mA value Check the analog output value on the termination panel with a meter. When it settles, it should read close to 20.0 mA (milliamps). Enter the value you measure in milliamps (mA). For example, if you read 19.9, enter 19.9. You will now get a verification prompt. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x scf/hr LO xx.xxx 4) Hi Val xxxxx.x scf/hr HI xx.xxx 5) Proportional to flow 6) Rate Units scf/hr Now seting AO to 100% (should be 20.0 mA) You entered 19.9 mA OK?

Continued on next page

Step	Procedure
4.	This sets the mA value entered to equal the Hi Val entered. If you are satisfied, answer YES. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x scf/hr LO 3.900 4) Hi Val xxxxx.x scf/hr HI 19.900 5) Proportional to flow 6) Rate Units scf/hr

NOTE: 1 Unless instructed by "1" Calibrate or "2" Check AO the output will not change while the PCCU is in Calibrate option. After exiting the AO set-up Menu when a calibrate was requested, the selected variable changed, or a range value changed, 1 minute is necessary to insure that the AO output has reached its correct value.

NOTE: 2 Always exit to the FCU Connected Menu before selecting the Monitor option on the PCCU. Use of the Monitor Key from the Calibrate routine maintains the Calibration "hold" of the FCU which will not allow the AO output to change.

NOTE: 3 The FCU display of Flow Rate is calculated from the previous hour's C' number and the previous one second extension and extrapolated for an hour or day depending on the flow rate units selected. The AO output represents the flow rate calculated the same as the display. This value is filtered and provided at the output. For this reason, under varying flow conditions, the displayed flow rate will not agree with the AO value.

CAUTION If Calibrate AO is selected and the user exits calibration mode the previous calibration factors will be lost. Once in calibration mode the process must be completed.

Analog Output Manual Operation

Manual AO Operation

If AO Manual is selected instead of a process variable no Hi or Lo Values can be assigned. The output range is automatically set to 4 and 20 milliamps. The output is calibrated the same way as if a variable was selected. The output is then "set" with the "Check AO" option.

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>Depress "2" Check AO and the last line on the display prompts you to enter the new % of full scale to set the AO.

1) Calibrate
2) Check AO
3) Lo Val xxxxx.x mmcf/D LO xx.xxx
4) Hi Val xxxxx.x mmcf/D HI xx.xxx
5) Proportional to flow
6) Rate Units mmcf/D
Enter new % full scale to set AO</td></tr>
<tr><td>2.</td><td>Enter the % amount desired, 0% to 100%, with 0% being 4 mA and 100% being 20 mA.

Let's say 50% is entered. This means that you desire the output to be 50% of the 16 mA range or 8 mA. This added to the 4 mA 0% value gives a 12 mA output.

After entering the desired percentage, the display shows the amount entered and asks if it is "ok?". Answer "yes" to continue or "no" to enter a new value. The AO output will automatically reflect the percentage chosen and will maintain this value after the calibrate routine is exited.

1) Calibrate
2) Check AO
3) Lo Val xxxxx.x mmcf/D LO xx.xxx
4) Hi Val xxxxx.x mmcf/D HI xx.xxx
5) Proportional to flow
6) Rate Units mmcf/D
Enter new % full scale to set AO
You entered 50% OK?</td></tr>
</table>

Checking Analog Output Calibration

Checking AO Operation

Using the Monitor Mode of the PCCU or the FCU display to view the selected variable, compute the % of range the variable represents. For example say the AO was calibrated with 100 mcf/day as the Lo Value and 1100 mcf/day as the Hi Value. If the display shows the flow rate as 600 mcf/day this would represent 50% of the selected range. The AO therefore should be 50% of its range or 12 mA. Measure the AO at the termination board to confirm.

Another method to verify the AO calibration follows:

Step	Procedure
1.	Enter "2" Check AO and you will see the Check AO prompts on the last two lines. 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x mmcf/D LO xx.xxx 4) Hi Val xxxxx.x mmcf/D HI xx.xxx 5) Proportional to flow 6) Rate Units mmcf/D Enter new % full scale to set AO
2.	You are instructed to enter a percent of full scale to set the Analog Output. You enter the desired percent value. Let's say you entered 50: 1) Calibrate 2) Check AO 3) Lo Val xxxxx.x mmcf/D LO xx.xxx 4) Hi Val xxxxx.x mmcf/D HI xx.xxx 5) Proportional to flow 6) Rate Units mmcf/D Enter new % full scale to set AO You entered 50% OK?
3.	Once you answer the verification prompt, the PCCU will instruct the FCU to set the AO and you can read the analog output (4-20 mA signal) with a meter. In this case, you should read 12 mA on your meter.

Continued on next page

Step	Procedure
4.	You can check the Analog Output at different percentages by following steps 1 through 3 and entering different % values. When finished press MENU EXIT 3 times to return to the FCU CONNECTED MENU. The AO will then begin to track the variable selected.

NOTE: 1 If flow rate is selected as the process variable and an orifice plate size change is entered at the FCU, the resulting change in flow will be reflected by the AO output. Insure that the new flow rate falls within the range (Lo Val and Hi Val) set for the variable.

NOTE: 2 If the Flow Computer battery voltage falls below 11 volts the Flow Computer goes into the -SLEEP- mode to conserve power. During SLEEP mode the AO output falls to 0 mA and stays there until a Wake-up Command is issued by the PCCU. At Wake-Up, if the FCU battery power is above 11 volts, the AO will resume tracking the selected variable.

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Chapter 9
Valve Control

Overview

Introduction

This chapter provides you with information about Totalflow's Valve Control feature. The Model 6700 flow computer has two separate ways of supporting Valve Control.

The first method is referred to as "On-board Valve Control". It is referred to this way because the Model 6700 main electronics board supports valve control with any added I/O boards. All that is required is a small valve control terminations board to handle the I/O terminations.

The second method uses a plug-in RTU board which runs the valve control algorithms and supports the I/O required. The primary difference between the two methods is the additional I/O points provided by the RTU board. The RTU also has eight digital inputs, eight digital outputs, six analog inputs, two pulse inputs and support for up to four analog ouputs. This I/O can free up the I/O points that are on the main electronics board to be used for other purposes.

See pages 5-5 and 5-6 for typical configurations of on-board and plug-in RTU valve control.

Chapter Highlights

This chapter covers the following topics:

General

Valve Control is an application specific Input / Output option feature available with the Model 6700 Totalflow Flow Computer Unit (FCU). The feature provides automatic feedback control of Differential Pressure (DP), Absolute Pressure (AP), and Flow Rate for the purpose of positioning a flow valve to maintain a desired value of DP, AP, or Flow Rate.

Note

For Valve Control on Pulse Input Flow Computers, any reference to Differential Pressure (DP) can be replaced by Actual Cubic Feet (ACF).

A Controller is a device that regulates or controls its output based on inputs received. With the Totalflow Valve Control System, the Controller on the Model 6700 Flow Computer is part of the main digital board or is located on the Plug-In RTU interface board. The output of the Controller is a time period. Voltage is applied to the valve actuator for the amount of time computed. This output results in valve movement. The inputs to the Controller are the DP and AP values measured by the Flow Computer Unit and the Flow Rate which is computed by the FCU using the measured DP and AP values. One of these inputs is selectable as the Process Variable or parameter to be controlled by the action of the valve. The output voltage duration and resulting valve movement are such that the Process Variable is maintained at a pre-determined user defined value.

In addition to automatic feedback control of Flow Rate, Absolute Pressure or Differential Pressure, the following features are provided with the Totalflow Valve Control System:

- Manual control of valve
- No external power requirements. Appropriate valves and communication options can be powered with battery packs. Solar charging, AC or 24 VDC power charging is required and is a part of the standard Valve Control Package. Power requirements for additional features and options must be evaluated for specific application.
- All control features can be accessed either locally with a Portable Calibration and Collection Unit or remotely using the Totalflow Central Collection Unit software and communication option.

The maintaining of the valve in a position to keep the selected input Process Variable constant is the job of the Controller. Parameter values and limits for the Controller to use in determining its output must be entered. These values and limits can be entered using the menu entry display screens of the Portable Calibration and Collection Unit (PCCU) or Central Collection Unit (CCU).

Terms and Definitions

Terms and Definitions

The following is a list of terms and definitions necessary for understanding and setting up the controller operation.

PROCESS VARIABLE (PV): The parameter being controlled. Three process variables are supported:

Absolute Pressure in PSIA (AP)
Differential Pressure in IN. H2O (DP)
Flow Rate in MCF/DAY (Flow Rate)

Each process variable has its own unique controller with its own tuning parameters.

MODE: Specifies whether a controller is turned off or on for automatic control operation. There are three modes of operation:

OFF	Controller is turned off, no control action results.
AUTO	Controller is turned on, automatic feedback control action is in progress.
SHUT IN	Controller is in auto, but will also check for DP override SHUT IN conditions. (Conditions defined later)
TMR	Controller is in auto, but will open and close the control valve based on the intervals set by the OPEN and CLOSE time specified in the utilities menu number three.
NOM	Controller is in auto, but will nominate the flow based on a volume set point, start date/time and stop date/time. The nominations controller must be on before the nomination screen can be displayed. (Nominations is only available on Plug-In RTU)

SET POINT (SP) : The set value at which the process variable is to be maintained by the controller. SET POINT has the same engineering units as the process variable.

HIGH LIMIT (HiLm) : The process variable's upper limit for control. The highest value at which the process variable can be controlled. HIGH LIMIT has the same engineering units as the process variable. (See SPAN)

Continued on next page

Note Suggestions for picking proper HIGH and LOW LIMITS are covered later.

Terms and Definitions, Continued

LOW LIMIT (LoLm) : The process variable's lower limit for control. The lowest value at which the process variable can be controlled. LOW LIMIT has the same engineering units as the process variable. (See SPAN)

DEAD BAND (DB) : Specifies a range around the SET POINT within which the controller will take no action. DEAD BAND has the same engineering units as the process variable.

Example If the SET POINT is 50 and the DEAD BAND is 5, the controller will take no action when the PROCESS VARIABLE is between 45 and 55. A proper DEAD BAND is important for maintaining the integrity of the system's battery capacity.

GAIN : The maximum allowable CONTROLLER OUTPUT for any one control action. A good rule of thumb is to use 1/2 the control valve's travel time from a full open to a full closed state. GAIN has engineering units of milliseconds.

CONTROLLER OUTPUT (CO) : The output of the control algorithm or equation. The output is a time period for either opening or closing the valve. The system voltage will be applied to the valve actuator for the time period calculated by the controller. CONTROLLER OUTPUT has engineering units of milliseconds. (.001 second = 1 millisecond)

ERROR: The difference between the PROCESS VARIABLE and the SET POINT.

SPAN: HIGH LIMIT value minus LOW LIMIT value. The process variable's range of control. SPAN has the same engineering units as the process variable.

DIRECTION : Specifies whether the valve needs to be closed or opened to achieve the desired SET POINT. The control algorithm shown below is for control valves located on the downstream side of the Flow Computer Unit.

Continued on next page

Terms and Definitions, Continued

AP Bias

The term used to describe the pressure drop between the well head and the metering point. The well head pressure can then be determined for use by the AP controller. The WELL HEAD PRESSURE = AP at METER + AP_BIAS.

When the AP controller is being viewed on the PCCU or CCU, both the PROCESS VARIABLE (well head pressure) and the AP at METER (APM) are displayed.

Note: If using upstream control valve, an external pressure can be installed upstream of control valve for the process variable. (Wellhead Pressure)

The Weymouth formula is used to determine the AP_BIAS.

$$AP\_BIAS = \left[L \times \left[Qs / 871 \times d^{2.667}\right]^2 + P_2^{\,2}\right]^{\frac{1}{2}} - P_2$$

which was derived from:

$$\mathrm{Qs} = 871 \times \mathrm{d}^{2.667} \times \left[P_1^{\,2} - P_2^{\,2} / L\right]^{\frac{1}{2}}$$

where:

Qs	=	rate of gas flow, cu ft/24 hr.	(calculated by FCU)
d	=	internal diameter of pipe, in.	
P_1	=	initial pressure, psia.	(pressure at wellhead)
P_2	=	terminal pressure, psia.	(pressure measured by FCU)
L	=	length of line in miles.	

Override Conditions

DP Override

There are times during operation when system pressure transitions may cause the DP to go through radical changes that may push the DP reading outside the transducer's range. With the controller in operation, the calculated CONTROLLER OUTPUT PERIOD and DIRECTION are compared to a period calculated based on the Differential Pressure value and desired operating range. The controller decides which output period to use for the purpose of keeping the DP within a range that can be measured. If the controller output is overridden by the DP calculated output, the operation is called DP OVERRIDE. It can occur for either high DP or low DP conditions and is indicated on the PCCU or CCU display.

AP Override

AP override allows the controller to monitor and override on pressure while controlling on Flow rate or Differential pressure. The override condition is checked if AP high or low override is enabled in the utility menu. If the control valve is unable to maintain the pressure set point the valve will fail closed. (See AP override section for details)

The calculation and use of the DP and AP OVERRIDE output period are explained below.

Note

The computation of the OVERRIDE output by the controller **requires** that the DP and AP operating limits be entered on the DP and AP control screens of the PCCU or CCU. This is necessary even though the process variable selected is AP or Flow Rate.

Override Periods

The following explanation is for valves located downstream from the FCU.

If the current DP reading is between its HIGH and LOW LIMITS, override periods are determined for each of the limits of the DP by substituting the limits for the SET POINT and other input parameters from DP controller screen in the algorithm. The resulting values are compared against the CONTROLLER OUTPUT PERIOD from the control algorithm for the Process Variable. If an override period is less than the control algorithm CONTROLLER OUTPUT PERIOD, the override period is used and the controller indicates an override condition. If DIRECTION = CLOSING, then the LOW LIMIT period is used. If DIRECTION = OPENING, then the HI LIMIT period is used.

Continued on next page

Override Periods, Continued

If the current DP reading is less than the LOW LIMIT,
an override period is calculated for the DP LOW LIMIT by substituting the LOW LIMIT for the SET POINT and other input parameters from DP controller screen in the algorithm. If DIRECTION = CLOSING, the valve is OPENED for the override period. If DIRECTION = OPENING, the override period is compared to the control algorithm CONTROLLER OUTPUT PERIOD and the larger of the two is used. In either case a LOW LIMIT override condition occurs and a LOW DP OVERRIDE status is set.

If the current DP reading is greater than the HIGH LIMIT,
an override period is calculated for the DP HI LIMIT by substituting the HIGH LIMIT for the SET POINT and other input parameters from DP controller screen in the algorithm. If DIRECTION = OPENING, the valve is CLOSED for the override period. If DIRECTION = CLOSING, the override period is compared to the control algorithm CONTROLLER OUTPUT PERIOD and the larger of the two is used. In either case a HI LIMIT override condition occurs and a HIGH DP OVERRIDE status is set.

Note

If the DEAD BAND of the DP LIMIT includes the current DP value, the Controller output is set equal to zero.

If AP ENABLE HI is selected and the current AP reading is greater than the AP OVERRIDE,
an override period is calculated by substituting the AP OVERRIDE for the SET POINT and other input parameters from AP controller screen in the algorithm. If DIRECTION = OPENING, the valve is CLOSED for the override period. If DIRECTION = CLOSING, the override period is compared to the control algorithm controller output period and the larger of the two is used. In either case, an AP OVERRIDE condition exists and an AP OVERRIDE status is set.

Continued on next page

Override Periods, Continued

If AP ENABLE LO is selected and the current AP reading is less than the AP OVERRIDE,
an override period is calculated by substituting the AP OVERRIDE for the SET POINT and other input parameters from AP controller screen in the algorithm. If DIRECTION = OPENING, the valve is CLOSED for the override period. If DIRECTION = CLOSING, the override period is compared to the control algorithm controller output period and the larger of the two is used. In either case, an AP OVERRIDE condition exists and an AP OVERRIDE status is set.

Note

If the DEAD BAND of the AP OVERRIDE includes the current AP value, the Controller output is set equal to zero.

Flow Computer Interface

All pertinent control data is kept in the FCU's memory. This allows the data to be backed up with the FCU's board mounted lithium battery. When controller data is modified by the user (e.g. GAIN, LIMITS, etc.) the data is stored in the FCU's memory. The FCU measures the variables and stores them in it's memory. All the data is available to the controller whenever required. The controller transfers data to the FCU's memory whenever it finishes a control action. The updated status information in the FCU's memory is made available to both the PCCU and the CCU.

The controller's algorithm and data conversion programs take approximately ten seconds to execute. Therefore, assuming no valve movement is required, the controller requests data from the FCU and executes the control algorithm once every ten seconds. In the event a valve movement is required, the controller waits for the valve movement to finish before requesting new data from the FCU. The minimum controller output period is set to 80 milliseconds. The maximum output period possible would be the time necessary to ramp the valve full open or closed from the opposite condition.

Control Algorithm

The system has three controllers, only one of which can be active at any given time. The control equation is best described as a "Single Speed Floating Algorithm". This algorithm provides integral action based on :

- The process variable's difference from set point (ERROR)
- The process variable's range of control (SPAN)
- The total possible valve travel time (GAIN)

The Control algorithm is as follows:

ERROR = PROCESS VARIABLE - SET POINT

If ERROR is greater than the DEAD BAND then:
CONTROLLER OUTPUT = (ERROR / SPAN) * GAIN

If ERROR is less than or equal to the DEAD BAND then:
CONTROLLER OUTPUT = 0

DIRECTION of valve movement

AP MODE If AP is less than the AP SET POINT, close valve.
FLOW MODE If FLOW is less than the FLOW SET POINT, open valve.

DP MODE If DP is less than the DP SET POINT, open valve.

The output and direction computed above are for control valve location downstream from the metering point.

See definition of DIRECTION.

Selecting Control Parameters

Setting of the control parameters varies with each well site control point. Careful analysis of the control point characteristics is required before entry of the necessary parameters. General guidelines are given below.

AP Controller Settings

The AP HIGH LIMIT should be set to the maximum AP pressure the well achieves after an extended SHUT IN period. This value is used to restart the controller if DP LO SI = Reactivate on AP HI. The AP LOW LIMIT should be set to the minimum well head pressure the well achieves after an extended full open period. These values are used when calculating an output if AP OVERRIDE is Enabled, and must be entered even if the active controller is using either DP or Flowrate as the process variable.

When using automatic AP control after an extended shut in period, the set point should initially be set to a value close to the HIGH LIMIT and gradually dropped (i.e. several hour intervals) until the desired operating point is achieved. This allows the well head pressure to drop slow enough to keep the DP reading from going off scale and to keep from toggling the DP transducer. This procedure should be followed **before** using the FLOW controller.

DP Controller Settings

The DP HIGH LIMIT should be set to the maximum controllable DP. This would be slightly less than the range of the DP transducer. The DP LOW LIMIT should be set to a value just above zero DP. These values are used for the DP override checks and must be entered even if using AP or Flow Rate as the Process Variable.

DP controllability improves as the DP SET POINT moves higher on the DP control range scale. This is due to a square root relationship which makes small valve movements create large DP changes on the low end of the DP control range. For this reason, when using the DP controller after an extended shut in period, it is advisable that a small gain value be used (i.e. less than 1/8 the valve total travel time), until the system has stabilized.

Flow Controller Settings

The Flow Rate HIGH LIMIT should be set to the maximum controllable Flow Rate (i.e. after AP pressure is down from shut in levels). The Flow Rate LOW LIMIT should be set to the minimum controllable flow.

Dead Band Selection

The selection of the DEAD BAND setting is a compromise between the desired control and the amount of valve movement. A process variable exhibiting little change can be assigned a small DEAD BAND and will operate with little valve movement. A selected process variable that changes frequently may need a large DEAD BAND to prevent continuous valve movement.

Note

When activating any automatic mode, insure that the step time in the PCCU utilities menu is set to a value between 1000 - 1500 msec. This value is used when initially opening the valve from a full closed position.

Low DP Override

Auto Mode

If the set DP LOW LIMIT is **greater than 0** and the measured DP remains below the LOW LIMIT, the override condition exists and the override period used will open the valve in an attempt to increase the DP. If the DP remains below its LOW LIMIT, even with the valve full open, the valve will remain open waiting for flow conditions to change.

Auto, Shut In or Timer Mode

If the set DP LOW LIMIT is **greater than 0** and the measured DP remains below the LOW LIMIT, the override condition exists and the override period used will open the valve in an attempt to increase the DP. If the DP remains below its LOW LIMIT with the valve full open, the controller will wait until the DP LOW TIME has expired then ramp the valve closed.

Auto or Auto Shut In Mode

If the set DP LOW LIMIT is **exactly 0**, the DP low limit override condition will be ignored. This allows the controller to operate with either the DP high override or the CONTROLLER OUTPUT PERIOD computed for the Process Variable selected.

High AP Override

Auto, Shut In or Timer Mode

Set AP OVERRIDE to "Enable Hi".

Downstream valve location:
The external pressure transmitter must be installed downstream of the control valve. Connect the external transmitter to the analog input on the plug-in RTU. Select AI [1-7] on the valve control utility menu. If Select AI = NONE, AP OVERRIDE will be ignored. When AP exceeds the AP OV value set in utility menu, the controller will close the valve in an attempt to decrease the AP. If the valve travels to full closed, the active controller is set to FAIL and SHUT IN if Auto Shut In Mode is selected. When the AP falls below the APRSTRT value, the selected process variable's output will be used and the controller is restarted.

Upstream valve location:
FCU's AP pressure (downstream of control valve) is used for AP OVERRIDE. No external pressure transmitter is required. When AP exceeds the AP OV value set in utility menu, the controller will close the valve in an attempt to decrease the AP. If the valve travels to full closed, the active controller is set to FAIL and SHUT IN if Auto Shut In Mode is selected. When the AP falls below the APRSTRT value, the selected process variable's output will be used and the controller is restarted.

Low AP Override

Auto, Shut In or Timer Mode

Set AP OVERRIDE to "Enable Lo".

Downstream valve location:
The external pressure transmitter must be installed downstream of the control valve. Connect the external transmitter to the analog input on the plug-in RTU. Select AI [1-7] on the valve control utility menu. If Select AI = NONE, AP OVERRIDE will be ignored. When AP falls below the AP OV value set in utility menu, the controller will close the valve in an attempt to increase the AP. If the valve travels to full closed, the active controller is set to FAIL and SHUT IN if Auto Shut In Mode is selected. When the AP exceeds the APRSTRT value, the selected process variable's output will be used and the controller is restarted.

Upstream valve location:
FCU's AP pressure (downstream of control valve) is used for AP OVERRIDE. No external pressure transmitter is required. When AP falls below the AP OV value set in utility menu, the controller will close the valve in an attempt to increase the AP. If the valve travels to full closed, the active controller is set to FAIL and SHUT IN if Auto Shut In Mode is selected. When the AP exceeds the APRSTRT value, the selected process variable's output will be used and the controller is restarted.

Auto Shut In Operation

The purpose of the AUTO SHUT IN Mode is to shut in the well by closing the valve if the DP measurement cannot be kept high enough to provide accurate measurement and control. If the control mode selected is AUTO/SHUT IN, the SHUT IN check is activated.

The SHUT IN Mode checks for continuous minutes of the condition where the valve is FULL OPEN and DP is below its LOW LIMIT. If this condition persists for the specified time (DP LOW TIME), the valve is ramped closed. The FAIL CLOSED status, the LOW DP OVERRIDE (LDPO) status, the SHUT IN (SHUT) status, and the FULL CLOSED (FCL) status are all set.

Once the SHUT IN status is set, automatic control is terminated until the RESTART CONTROLLER command is received by the controller. This command can be sent manually using the PCCU. The controller can also be instructed to restart automatically by one of the following:

1. At the end of a specified time period (shut-in time)
2. In response to an external contact closure signal (DI4 on VCI termination board and DI8 on plug-in RTU). External event mode = RESTART CONTROLLER.
3. When the AP reaches its operational HI LIMIT (DP LOW Shut-in = Reactivate on AP HIGH)

Low Battery Fail Closed Condition

If the battery voltage is less than the specified LOW BATTERY VOLTAGE, the valve is ramped closed. The FAIL CLOSED status and the LOW BATTERY status are both indicated and only a manual RESTART CONTROLLER command from the PCCU will restart the controller.

Timer Mode

This mode will allow the controller to open and close the valve based on the open and close time specified in the utility menu. During open time the active controller will adjust the valve. All other controller modes and overrides can be selected and active during the open time. When open time remaining elapses the valve will close for the close time period. No other controller or overrides can manipulate valve during close time.

Utility Commands and Parameter Definitions

Note

The following Utility Commands and Parameter definitions are necessary for understanding and setting up the controller for operation:

Commands & Parameters

BATTERY VOLTAGE LOW LIMIT (LO BATT) : A low voltage threshold used by the controller's logic to detect a LOW BATTERY condition. The default value is 11.5 Vdc.

DP LOW TIME : A duration, in minutes, used by the controller logic to determine if a DP SHUT IN condition exists. If the DP is below its set LOW LIMIT for the specified time, the DP SHUT IN condition exists and the valve is ramped closed. The controller checks for this condition when in the AUTO / SHUT IN mode. The default value is 0 minutes. The range is 65535 minutes.

STEP TIME : A period, in milliseconds, used when a STEP OPEN or STEP CLOSED command is processed. This period is also used when a valve is initially opened from a full closed position. The default is 0. The range is 65535 milliseconds.

PIPE ID : The internal diameter, in inches, of the pipe run between the well head and the metering point.

PIPE LENGTH : The distance, in feet, between the wellhead and the metering point.

STEP OPEN / CLOSED : These commands will move the control valve in the desired direction for the specified STEP TIME period. Only one VALVE STEP is made for each STEP COMMAND.

RAMP OPEN / CLOSED : These commands will move the control valve continuously in the desired direction until the control valve trips the respective open or closed limit switch.

VALVE LOCATION : The UP STREAM or DOWN STREAM location of the valve with respect to the flow computer.

EXTERNAL EVENT MODE : The selection of an externally applied signal to cause the valve to FAIL CLOSED or to RESTART if in a FAIL CLOSED SHUT IN condition. DI4 on VCI termination board and DI8 on plug-in RTU termination board.

DP LOW SHUT IN MODE : The selection of the method to generate a restart command if the controller is in a FAIL CLOSED SHUT IN condition. Selection of NORMAL allows a timer to be used to restart the controller. Selection of REACTIVATE ON AP HI allows the restart command to occur when the AP reaches its Hi Limit, timer or external event.

SHUT IN TIME : The timer setting used with the DP LOW SHUT IN mode. Can be set from 0-255 minutes or hours selectable using the timer units, minutes or hours.

Continued on next page

Commands & Parameters, Continued

TIME REMAINING (TR) : Once the timer is activated by a DP LOW SHUT IN condition, the display will show the time remaining on the timer before the restart command is issued.

RESTART CONTROLLER : When a SHUT IN condition exists, no further automatic control action takes place. The RESTART CONTROLLER command is used to restart the controller that was active at the time the SHUT IN condition occurred. The command can be issued manually with the PCCU or automatically using one of the conditions discussed above. A manual restart is necessary for control after a LOW BATTERY FAIL CLOSED condition has occurred or after a External Event FAIL CLOSED condition has occurred.

AP OVERRIDE : AP override has three modes, Off, Enable High or Enable Low. The pressure override mode allows the AP controller to take over either the Differential pressure or Flow rate controller. If set to Enable High the AP controller will override when the pressure exceeds the AP OV (Override) value. If set to Enable Low the AP controller will override when the pressure drops below the AP OV (Override) value.

Note

If valve location is downstream an external transmitter must be installed downstream of control valve to override. If valve location is upstream the Flow Computers pressure is used to override.

Select AI [] : An external analog input can be used as a pressure input to the controller. This transmitter if upstream of valve will be used to as AP process variable to control or restart controller after shut-in due to low DP. If transmitter located downstream of valve it will be used as AP override process variable.

Timer Units : Programs shut-in units to either minutes or hours. Used to determine the amount of time to leave the controller off after shut-in due to low DP.

AP OV and APRstrt : Setup parameters for pressure override. AP OV value determines when AP controller will override. APRstrt value determines what pressure to restart previous controller after shut-in. AP restart will only be used by the controller when 1) SI (Shut-in) is set in controller and 2) AP override value has been reached and valve has been closed by AP controller.

On LoBatt : Determines the valve action after low battery value is reached. Close will force the valve closed and Freeze will hold the valve in last position.

OPEN and CLOSE Time : Setup parameters for the timer function. These parameters are observed by the controller when the TMR (Timer) controller mode is activated. The valve will open and close as determined by the associated times. During the open time the active controller will be determining valve position. During the close time the valve will be closed until either the close timer has elapsed or the controller is turned off.

Status Conditions

Description

Eight status conditions are maintained by the controller. These status conditions are displayed by the PCCU and the CCU and show the current state of the control system. The items highlighted on the screen indicate that the condition is active or true. If true the meaning is:

VALVE FULL OPEN (FOP) The valve's full open switch is tripped.

VALVE FULL CLOSED (FCL) The valve's full closed switch is tripped.

HIGH DP OVERRIDE (HDPO) DP has exceeded the specified high limit during AP or FLOW control. Valve control is maintained at the high DP limit until the condition clears after which normal control is resumed.
or if AP OVERRIDE = ENABLE HI or ENABLE LO

AP OVERRIDE (APO) AP has exceeded or fallen below AP Override Value. AP OVERRIDE annunciator is displayed instead of HIGH DP OVERRIDE.

LOW DP OVERRIDE (LDPO) DP has dropped below the specified low limit during AP or FLOW control. Valve control is maintained at the DP LOW LIMIT until the condition clears after which normal control is resumed. If SHUT IN is enabled and the LOW LIMIT violation persists with the valve FULL OPEN for the DP LO TIME the valve is ramped closed and valve control ceases until a restart command occurs.

or if AP OVERRIDE = ENABLE HI or ENABLE LO

DP OVERRIDE (DPO) DP has exceeded DP LOW or HIGH LIMIT. DP OVERRIDE annunciator is displayed instead of LOW DP OVERRIDE.

FAIL CLOSED (FAIL) The FCU battery voltage has dropped below the specified low limit, a LOW DP OVERRIDE SHUT IN condition has occurred, an External FAIL CLOSED Event has occurred, or an internal VCI error has occurred. The valve is ramped closed and valve control ceases until a restart command occurs.

LOW BATTERY (LBAT) The FCU battery voltage has dropped below the specified BATTERY VOLTAGE LOW LIMIT.

LOCAL-LOCKOUT (LCLL) The cable between the control valve and the termination box is disconnected. If the valve used does not support the local lockout feature, the jumpers at the termination board are not installed. Local-Lockout indication is not available with actuators providing a torque switch output.

SHUT IN (SHUT) The controller has ramped the valve closed because a SHUT IN condition has occurred. SHUT IN indicates that the valve was closed because of operation in the AUTO SHUT IN mode and the DP could not be maintained above its Low Limit.

Setting Up Valve Control with the PCCU

Introduction

After determining the type of control operation to apply to the valve, the necessary parameters and limits must be defined and entered. The Portable Calibration and Control Unit is used to enter the parameter values and to select the operating conditions. This section pertains to the DOS version of PCCU. Those users using PCCU32 and requiring assistance should use the online help files.

Procedure

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1.</td><td>With the PCCU connected to the Flow Computer Unit, select 1) Connected to Totalflow from the Top Level Menu

*** PCCU TOP LEVEL MENU ***
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.

The following screen will be displayed:

** FCU CONNECTED: 376385
LOC: Johnson Crossing

1) Collect 6) Valve
2) Monitor
3) Entry
4) AGA-7
5) Calibrate</td></tr>
<tr><td>2.</td><td>Select 6) Valve to enter the valve control setup screen and the following message will be displayed:

Please wait.
Reading Controller Data.</td></tr>
</table>

Setting Up Valve Control with the PCCU, Continued

Note After initially applying power to the FCU, wait until it has gone through it's startup cycle before attaching the PCCU.

Step	Procedure
3.	Once the controller data is read by the PCCU, the following menu will be displayed:

1) AP-PSIA MODE		→	OFF TMR AUTO SI	FOP	FOP
2) SP	75.0		PV 73.8	FCL	FCL
3) HiLm	120.0		P	HDPO	APO
4) LoLm	25.0			LDPO	DPO
5) DB	10.0		S	FAIL	FAIL
6) GAIN	3000	ms	0% CO 300 ms 100%	LBAT	LBAT
7) UTIL				LCLL	LCLL
APM 71.6				SHUT	SHUT

A menu of this format is used for each of the AP, DP and FLOW RATE controllers. The controller status data read by the PCCU determines which of the three menus to display first. If a controller is "active" or turned on, it is automatically displayed first. If no controller is turned on, the DP controller menu is displayed first. **To access the other controller menus depress the CONTINUE (CONT.) key.** Pressing the CONTINUE key causes the PCCU display to cycle through the three controller menus.

The PCCU updates the Process Variable (PV) display information on the screen once every five seconds. The Status Information and Controller Output (CO) is updated once every 15 seconds.

Changing Menu Parameters

Six parameters are capable of being entered or selected from the Controller Menu. These are items 1 through 6 on the display. Item 7 selects a UTILITY Menu which also requires parameter entry.

Item 1 shows the selected controller and the engineering units of the selected controller. Press item 1 to choose the operational mode of the controller displayed. When 1 is pressed, OFF, AUTO, or AUTO SI is highlighted by the moving cursor. Leave the cursor on the desired operational mode to activate that mode. When a controller is made active by selecting AUTO or AUTO SI, any other controller which was active becomes inactive. Items 2 through 5 have the same engineering units as the displayed controllers engineering units.

Reminder Press CONTINUE to choose another controller. Only 1 controller can be active at a time.

Changing Menu Parameters, Continued

To change the parameters associated with the displayed controller select the parameters corresponding number. The PCCU will quit polling the FCU for display update information and the cursor will move to the selected item. Enter the necessary value for the item selected. If the wrong key is pressed or an incorrect entry made, press the Menu Exit key and the original value will be retained.

Select items 2 through 6 and enter the necessary values. Refer to the term definitions and the section on selecting the control parameters for more information on the entry requirements.

User selections for changing controller data:

2)	SP	SET POINT
3)	HiLm	HI LIMIT
4)	LoLm	LO LIMIT
5)	DB	DEAD BAND
6)	GAIN	GAIN

When the AP controller is selected, the PV value displayed is the well head pressure and APM is the pressure measured by the FCU. Well head pressure is equal to APM + AP_BIAS. AP_BIAS is calculated dynamically by the controller.

PV	Current controllers PROCESS VARIABLE
CO	Current controller's most recent OUTPUT PERIOD in milliseconds
TR	Time Remaining before the Automatic Restart of the controller takes place. This feature is selected in the Utility Menu.

The PV value is updated on the PCCU display every 5 seconds, the CO and TR values are updated every 15 seconds.

Graph

At the center of the display screen is a graph of the current controllers PROCESS VARIABLE (P), SET POINT (S), and DEAD BAND in percent of SPAN. The graph shows the relationship of PROCESS VARIABLE to the SET POINT and the DEAD BAND around the SET POINT. The left limit of the display is 0% of SPAN and the right limit is 100% of SPAN. The graphic display is updated every 5 seconds by the PCCU.

Continued on next page

Status Flags

The right edge of the display shows the controller STATUS FLAGS. Any indication that is highlighted is active or true. The STATUS FLAGS are updated by PCCU every 15 seconds. Refer to the definitions for more information on the STATUS FLAGS.

	FOP	Valve Full Open
	FCL	Valve Full Closed
	HDPO	High DP override condition exists
or	APO	High or Low AP override condition exists
	LDPO	Low DP override condition exists
or	DPO	High or Low DP override condition exists
	FAIL	Fail Closed condition exists
	LBAT	Low Battery voltage condition exists
*	LCLL	Local Lock-Out condition exists
	SHUT	Shut In condition exists

* Local Lock-out indication not available with all actuators

Utility Menu

Select item 7, UTIL to access the Utility Menu. The following will be displayed:

							or
	STEP		MISC			FOP	FOP
1)	Open	5)	LO BATT	11.5	Vdc	FCL	FCL
2)	Close	6)	DP LO TIME	1	min	HDPO	APO
		7)	STEP TIME	500	ms	LDPO	DPO
	RAMP	8)	PIPE ID	4.5	in	FAIL	FAIL
3)	Open	9)	PIPE LEN	345	ft	LBAT	LBAT
4)	Close	0)	Restart Controller			LCLL	LCLL
			Cont for More	TR 0 Min		SHUT	SHUT

Three screens make up the Utility Menu. Press Continue from the above screen to view the second screen.

Note

The capabilities of the Utility Menu second screen became available with firmware revisions released June 1993. The screen will be different if the unit does not have this firmware installed. PCCU firmware revisions released the same date are required to access the capabilities. Additional changes in the Plug-In RTU and PCCU firmware has added a third utility menu. These options were released in October 1994.

Continued on next page

Utility Menu, Continued

The Utility Menu requires entry of various operating parameters for the Valve Control System to work properly.

Items 1, 2, 3, and 4 are selections for manual operation of the valve. STEP refers to incremental movement of the valve. The increment of movement is defined in item 7, STEP TIME and is a time duration in milliseconds. Each time 1 or 2 is selected a prompt appears at the bottom of the display asking if a STEP is desired. Answer Yes or No to the prompt. Only 1 STEP or increment is performed each time 1 or 2 is selected. No movement of the valve will take place if the valve is against the limit switch of the direction selected.

RAMP refers to the movement of the valve to its full open or closed position. The time duration of the ramp is whatever is necessary to move the valve to the selected position, 3 to Open, 4 to Close. Movement stops when the limit switch is activated.

Important **The selection of STEP or RAMP turns any active controller OFF.**

Item 5, LO BATT, is selected to enter the battery voltage value where control will cease. If the system battery supply voltage drops to the entered value control ceases and a Low Battery (LBAT) FAIL CLOSED condition is indicated. The purpose of the condition is to reserve battery power for FCU operation. **A manual restart is required to remove the LBAT FAIL CLOSED condition.**

Item 6, DP LO TIME, is selected to enter the time, in minutes, that the Low DP Override condition will be allowed to exist with the valve full open before the Low DP Override condition forces the valve closed. DP LO TIME is active only when operating in the AUTO SHUT IN mode with DP Low Limit greater than 0. For example, if operating in AP AUTO SHUT IN mode and the flow quits, the Low DP Override output period will force the valve open in an attempt to increase DP.(Down stream valve location) The opening to the full open position will be in steps. Once full open, the controller will count the time that the Low DP Override condition exists. At the end of the time period, the valve will ramp closed.

Important **The setting of the DP Low Limit to 0 will allow the controller to operate on the AP controller output period which will force the valve closed when flow stops. SHUT IN will not occur if the DP Low Limit is set to 0.**

Items 8 and 9 are selected to enter the Pipe Inside Diameter and Length between the well head and the metering point or Flow Computer Unit. The controller computes the AP BIAS, or difference between the AP measured at the Flow Computer and the well head. The bias value is added to the AP measured by the FCU to determine the AP Process Variable value. The computed well head AP value is the control value. Both AP values are shown on the AP control display. If an external transmitter is installed (upstream valve control), the AP process variable is equal to the external transmitter pressure.

Utility Menu, Continued

Item 0 is used to restart the controller from a FAIL CLOSED condition. When selected, a prompt will appear at the bottom of the screen asking if a Restart is desired. Answer Yes or No. Item 0 is the Manual Restart operation necessary if a LOW BATTERY FAIL CLOSED or an External Event FAIL CLOSED condition occurs.

To exit the Utility Menu depress the MENU EXIT key. The PCCU will return to the Controller Menu that was active before the Utility Menu was requested. To view the continuation of the Utility Menu, press the Continue (CONT) key. The second of three menu screens is displayed:

				or
1)	VALVE LOC →	DN STREAM	FOP	FOP
2)	EXT EVT MODE:	FAIL CLOSE	FCL	FCL
3)	DP LO SI:	NORMAL	HDPO	APO
4)	SI TIME:	0 min TR 0 Min	LDPO	DPO
5)	AP OVERRIDE	ENABLE HI	FAIL	FAIL
6)	SELECT AI [1]	7) Timer Units Min	LBAT	LBAT
			LCLL	LCLL
	Continue for More		SHUT	SHUT

Item 1 of the second display of the Utility Menu is used to enter the Valve Location with respect to the Flow Computer. The two selections are **DOWN (DN) STREAM and UP STREAM**. Select 1 and a prompt will appear at the bottom of the display asking if the parameter is to be changed. Answer Yes to change the item to the other possible setting or answer No to leave it as indicated on the screen.

The Valve Location selection is very important to the proper operation of the Valve Control System.

Some conditions that require the valve to move in the open direction if the valve is Down Stream require the valve to move in the opposite direction if the valve is Up Stream.

Items 2, 3, 4, 5 ,6 and 7 enhance the operation of the Valve Control System.

Item 2 allows an External Event (Digital Input) to either cause a FAIL CLOSED condition or restart the controller after a SHUT IN condition has occurred. (RESTART CONTROLLER). The External Event must be a contact closure signal applied to the Digital Input (DI4) contacts of the valve control termination board or the Digital Input (DI8) contacts of the plug-in RTU termination board.

Only 1 set of contacts is available for the External Event on each type of termination board. Therefore, no External Restart is possible if the External Event created the FAIL CLOSED condition.

Utility Menu, Continued

Important **A Manual Restart is required to restart the controller if the External Event caused the FAIL CLOSED condition.**

If RESTART CONTROLLER is selected as the External Event Mode, the required contact closure signal will restart the controller from a FAIL CLOSED SHUT IN condition. A Low Battery (LBAT) FAIL CLOSED or FREEZE VALVE condition requires a Manual restart of the controller.

Item 3 of the menu, DP LO SI (DP LOW SHUT IN), can be set to either NORMAL or REACT. ON AP HI. If NORMAL is selected, the controller can be restarted from a FAIL CLOSED SHUT IN condition by a Timer. **FAIL CLOSED SHUT IN conditions are created by operating in the AUTO SHUT IN mode when the DP drops below its Low Limit.** The amount of time between the FAIL CLOSED SHUT IN condition and the restart command is set by selecting item 4, SI TIME (SHUT IN TIME). The timer can be set from 1 to 255 minutes or hours, depending on setting of Item 7 (TIMER UNITS). An entry of 0 minutes in item 4 cancels the timer and no Restart occurs. A read only TR (Time Remaining) will be displayed next to SI TIME to indicate the remaining time before the controller restarts.

If REACT. ON AP HI is selected for item 3, the controller can be restarted from a FAIL CLOSED SHUT IN condition by the pressure increasing to its High Limit (Hi Lim) value as set on the AP controller display, timer (if shut-in time is greater than 0) or external event (if external event is = restart controller). **FAIL CLOSED SHUT IN conditions are created by operating in the AUTO SHUT IN mode when the DP drops below its Low Limit**. When either the AP reaches the value set as its Hi Limit, the timer elapses or the external event trips, the restart command will automatically occur.

Important **In upstream valve control, an external pressure transmitter must be installed upstream of the control valve for the Reactivate on AP High Limit to work.**

If item 4, SI TIME (SHUT IN TIME) is set to 0, the timer function to restart the controller is disabled.

If item 4 is set to some value greater than 0, the restart command will occur when the set time elapses or when the AP has reached its Hi Limit, whichever occurs first.

Continued on next page

Utility Menu, Continued

Item 5: AP OVERRIDE

Upstream valve location:
When enabled the controller uses the FCU's absolute pressure (APM) to override the active controller. AP OVERRIDE will attempt to close the control valve to control system pressure.

Downstream valve location:
An external transmitter must be installed downstream of the control valve to use AP OVERRIDE. In Item 6, Select AI [1-7].

When AP OVERRIDE is enabled, the controller uses the external transmitter's pressure to override the active controller. AP OVERRIDE will attempt to close the control valve to control system pressure.

Important

AP OVERRIDE using downstream valve location will not work without an external transmitter installed.

Item 6: SELECT AI

Allows an external pressure transmitter to be connected to an analog input on the plug-in RTU's termination board. Any analog input can be selected (1-7) or (none) if no external transmitter is being used.

With upstream valve control, the input is used as the process variable on the AP controller and to restart the controller on AP HIGH LIMIT.

While making entries at the Utility Menu, if an incorrect item is inadvertently selected or a wrong parameter entered, depress the Menu Exit key. The original value will be retained.

Item 7: TIMER UNITS

Units can be toggled between minutes and hours. Shut-in time can be programmed from 0 (disable timer) to 255 minutes or hours.

Important

Any change in item 1, 2, or 3 causes a restart of the controller.

Note

While viewing the Utility Menu the PCCU updates the STATUS information every fifteen seconds. The display is refreshed to reflect any new status from the controller.

Utility Menu, Continued

Press the CONTINUE (CONT) key while in the second Utility menu and the last Utility screen will appear.

				or
1)	AP OV	95.0	FOP	FOP
2)	AP Rstrt	20.0	FCL	FCL
3)	On LoBatt	[CLOSE]	HDPO	APO
4)	Open TIME	000:00	LDPO	DPO
5)	Close TIME	000:00	FAIL	FAIL
			LBAT	LBAT
			LCLL	LCLL
	Continue for More		SHUT	SHUT

Item 1: AP OV
AP override set point. If AP Override = Enable Hi, when the pressure downstream of control valve exceeds this value the valve will close attempting to reduce the system pressure. If AP Override = Enable Lo, when the pressure downstream of control valve falls below this value the valve will close attempting to increase the system pressure.

Item 2: APRSTRT
AP restart value. Restarts controller after shut-in caused by AP override. If AP Override = Enable Hi, when downstream pressure drops below APRSTRT the controller will restart based on the active controller before the override condition occurred. If AP Override = Enable Lo, when downstream pressure exceeds APRSTRT the controller will restart based on the active controller before the override condition occurred.

With downstream valve control, the external analog input is used as the AP OVERRIDE variable. The AI value is compared to the AP OV LIMIT to determine if AP OVERRIDE has occurred.

Item 3: OPEN TIME
The active controller must have TMR (Timer mode) enabled before open time and close time periods are valid. If enabled the Open Time will set the active controllers on time programmed in hours and minutes (000:00). At the end of this period the controller will close valve for the Close Time period. During the open time all other modes can be activated including Shut-in, Nominations and AP override.

Continued on next page

Setting Up Valve Control with the PCCU, Continued

Utility Menu, Continued

Item 4: CLOSE TIME
The active controller must have TMR (Timer mode) enabled before close time and open time periods are valid. If enabled the Close Time will set the active controllers off time programmed in hours and minutes (000:00). At the end of this period the controller will open the valve for the Open Time period. During the close time all other modes will be deactivated.

Turning Control On

After all entries are made, manually step the valve to the position where the desired parameter is near the control Set Point. If a large step time was used to manually open the valve, enter a smaller step time before turning the controller on. The entered step time value is the period used by the controller initially opening the valve from a full closed position. Select the desired control mode and the valve should position itself to maintain the Process Variable at the selected Set Point.

As flow conditions change and the controlled parameter goes outside the boundaries of the Dead Band, the controller output will move the valve in steps as determined by the algorithm to bring the parameter back to within the Dead Band. Often times only one movement of the valve will accomplish this. Other times, as determined by the changing parameters, many small steps of the valve may be necessary.

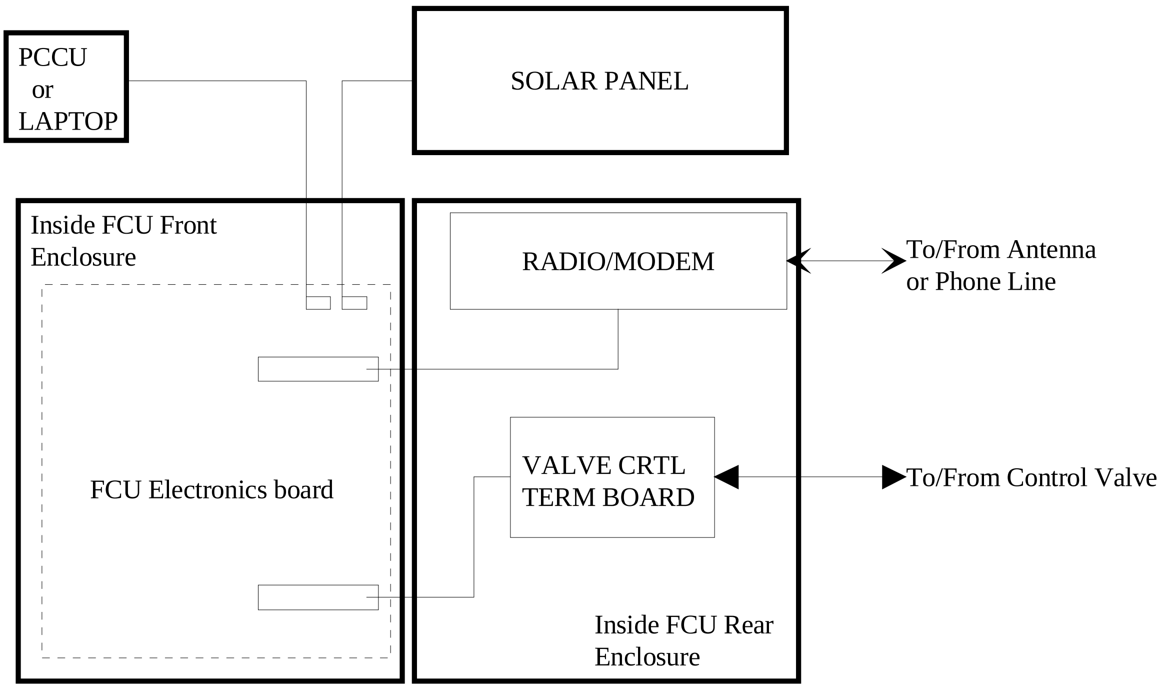
Control Valve Actuator Compatibility Specification

The actuator motor must be a nominal 12Vdc bi-directional motor with a maximum inrush current of 800 milli-amps and a nominal holding current of 200 milli-amps.
The actuator must provide two dry contact switches. One switch for indicating valve FULL OPEN the other for FULL CLOSED.
Valve/Actuator manufacturers known to provide compatible configurations are:

- Jamesbury
- Keystone
- Ledeen (Local Lock-out indication not available)
- Foxboro Jordon
- Valvcon
- Worchester

System Configuration

Block Diagram Of Valve Control Field Equipment



The valve option uses 2 Digital Outputs and 4 Digital Inputs

Digital Outputs	**Digital Inputs**
2 used for actuator motor power	2 used to detect limit switches
	1 used to detect Local Lockout/Torque
	1 used to detect External Event

Valve option is also available with the Plug-in RTU (PIRTU).

Valve Control Setup Checklist

Set-up Parameters	DP Auto	DP Auto/ Tmr	DP Auto/Tmr /SI	DP Auto/SI	AP Auto	AP Auto/ Tmr	AP Auto/Tmr /SI	AP Auto /SI
DP Low Limit	✔	✔	✔(3)	✔(3)	✔(4)	✔(4)	✔(4)	✔(4)
DP High Limit	✔	✔	✔	✔	✔(4)	✔(4)	✔(4)	✔(4)
DP Setpoint	✔	✔	✔	✔	✔(4)	✔(4)	✔(4)	✔(4)
DP Deadband	✔	✔	✔	✔	✔(4)	✔(4)	✔(4)	✔(4)
DP Gain	✔	✔	✔	✔	✔(4)	✔(4)	✔(4)	✔(4)
AP Low Limit	O(2)	O(2)	✔(2)	✔(2)	✔	✔	✔	✔
AP High Limit	O(2)	O(2)	✔(1)(2)	✔(1)(2)	✔	✔	✔(1)	✔(1)
AP Setpoint	O(2)	O(2)	✔(2)	✔(2)	✔	✔	✔	✔
AP Deadband	O(2)	O(2)	✔(2)	✔(2)	✔	✔	✔	✔
AP Gain	O(2)	O(2)	✔(2)	✔(2)	✔	✔	✔	✔
Flow Rate Low Limit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flow Rate High Limit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flow Rate Setpoint	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flow Rate Deadband	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flow Rate Gain	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Low Battery	✔	✔	✔	✔	✔	✔	✔	✔
DP Low Time	N/A	N/A	✔(3)	✔(3)	N/A	N/A	✔(3)	✔(3)
DP Shut-In Time	N/A	N/A	✔(3)	✔(3)	N/A	N/A	✔(3)	✔(3)
DP Low Shut-In Mode	N/A	N/A	✔(1)(3)	✔(1)(3)	N/A	N/A	✔(1)(3)	✔(1)(3)
AI	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)
Low Bat. Valve Action	✔	✔	✔	✔	✔	✔	✔	✔
Step Time	✔	✔	✔	✔	✔	✔	✔	✔
Valve Location	✔(6)	✔(6)	✔(6)	✔(6)	✔(6)	✔(6)	✔(6)	✔(6)
Timer Units	N/A	N/A	✔	✔	N/A	N/A	✔	✔
External Event Mode	O	O	O	O	O	O	O	O
Battery Low Limit	✔	✔	✔	✔	✔	✔	✔	✔
Pipe ID	O	O	O	O	O	O	O	O
Pipe Length	O	O	O	O	O	O	O	O
AP Override Limit	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)
AP Restart	N/A	N/A	O(2)	O(2)	N/A	N/A	O(2)	O(2)
Timer Open Time	N/A	✔	✔	N/A	N/A	✔	✔	N/A
Timer Close Time	N/A	✔	✔	N/A	N/A	✔	✔	N/A
AP Override Mode	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)
On Low Battery	✔	✔	✔	✔	✔	✔	✔	✔
Nom. Start Time	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nom. Stop Time	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nom. Term. Mode	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nom. Target Volume	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note See checklist notes on page 9-31.

Continued on next page

Valve Control Setup Checklist, Continued

Set-up Parameters	Flow Rate Auto	Flow Rate Auto/ Tmr	Flow Rate Auto/ Tmr/ SI	Flow Rate Auto/ Nom/ Tmr	Flow Rate Auto/ Nom/ SI/Tmr	Flow Rate Auto/ Nom	Flow Rate Auto/ Nom/ SI	Flow Rate Auto/ SI
DP Low Limit	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)
DP High Limit	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)
DP Setpoint	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)
DP Deadband	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)
DP Gain	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)	✔(4)
AP Low Limit	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)
AP High Limit	✔(2)	✔(2)(1)	✔(2)(1)	✔(2)	✔(2)(1)	✔(2)	✔(2)(1)	✔(2)(1)
AP Setpoint	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)
AP Deadband	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)
AP Gain	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)	✔(2)
Flow Rate Low Limit	✔	✔	✔	✔	✔	✔	✔	✔
Flow Rate High Limit	✔	✔	✔	✔	✔	✔	✔	✔
Flow Rate Setpoint	✔	✔	✔	✔	✔	✔	✔	✔
Flow Rate Deadband	✔	✔	✔	✔	✔	✔	✔	✔
Flow Rate Gain	✔	✔	✔	✔	✔	✔	✔	✔
Low Battery	✔	✔	✔	✔	✔	✔	✔	✔
DP Low Time	N/A	✔N/A	✔(3)	N/A	✔(3)	N/A	✔(3)	✔(3)
DP Shut-In Time	N/A	✔N/A	✔(3)	N/A	✔(3)	N/A	✔(3)	✔(3)
DP Low Shut-In Mode	N/A	✔N/A	✔(1)(3)	N/A	✔(1)(3)	N/A	✔(1)(3)	✔(1)(3)
AI	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)
Low Bat. Valve Action	✔	✔	✔	✔	✔	✔	✔	✔
Step Time	✔	✔	✔	✔	✔	✔	✔	✔
Valve Location	✔	✔	✔	✔	✔	✔	✔	✔
Timer Units	N/A	N/A	✔	N/A	✔	N/A	✔	✔
External Event Mode	O	O	O	O	O	O	O	O
Battery Low Limit	✔	✔	✔	✔	✔	✔	✔	✔
Pipe ID	O	O	O	O	O	O	O	O
Pipe Length	O	O	O	O	O	O	O	O
AP Override Limit	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)
AP Restart	N/A	N/A	O(2)	N/A	O(2)	N/A	O(2)	O(2)
Timer Open Time	N/A	✔	✔	✔	✔	N/A	N/A	N/A
Timer Close Time	N/A	✔	✔	✔	✔	N/A	N/A	N/A
AP Override Mode	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)	O(2)(6)
On Low Battery	✔	✔	✔	✔	✔	✔	✔	✔
Nom. Start Time	N/A	N/A	N/A	✔	✔	✔	✔	N/A
Nom. Stop Time	N/A	N/A	N/A	✔	✔	✔	✔	N/A
Nom. Term. Mode	N/A	N/A	N/A	✔	✔	✔	✔	N/A
Nom. Target Volume	N/A	N/A	N/A	✔	✔	✔	✔	N/A

Note See checklist notes on following page.

Valve Control Setup Checklist, Continued

Checklist Notes

(N/A)- Not Applicable

(✔) - Required settings

(1) - Required to reactivate controller on pressure (AP high) when "DP LO SI" = "React. on AP HI".

(2) - Required for calculating AP override limits and/or to shut-in valve

(3) - Used to activate and control on Low DP shut-in (DP Low Limit must be > 0 to activate) Select "Normal" or "React. on AP HI" mode settings to intermit on Low DP and restart on timer

(4) - Required for calculating DP override limits

(5) - Optional pressure input.

If Valve selection = Upstream - External pressure used to control and restart controller after shut-in caused by low DP.

If Valve selection = Downstream - External pressure transmitter located downstream of control valve used to override.

(6) - Pressure override settings:

If valve location = Downstream an external transmitter must be connected and will be used to override.

If valve location = Upstream the Flow Computer's pressure is used as the process variable.

(O) - Optional Parameters