2104349-001– rev. AB

XSeries^{G4} 6200/6201EX Flow Computer
User's Manual

XFC^{G4}EX

TOTALFLOW
MEASUREMENT & CONTROL SYSTEMS

ABB
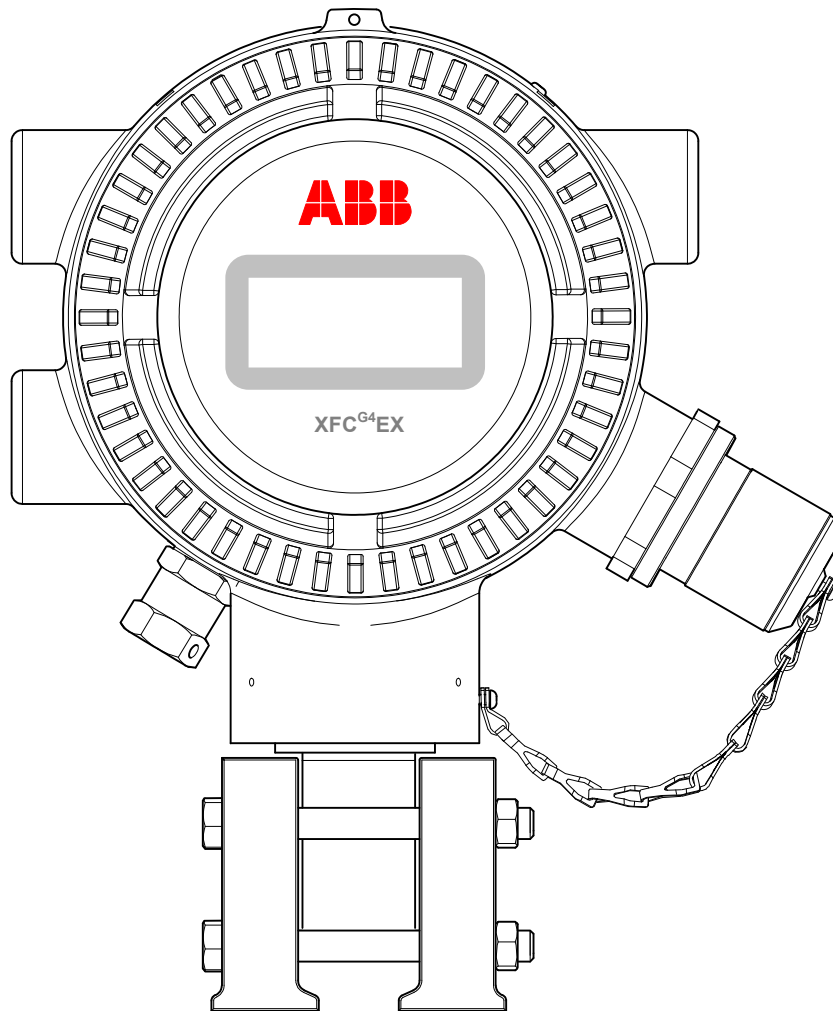
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INTRODUCTION

This manual is designed to provide an experienced flow meter technician with the requirements necessary to install, set up and operate a Totalflow XFC^{G4} 6200/6201EX.

Organization & Style

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

Chapter Descriptions

Chapter	Name	Description
1	System Description	Provides a description of the G4 EX system components and specifications.
2	Installation	Includes unpacking and detailed procedures for set up and installation.
3	G4 EX Startup	Provides the user with a tutorial on how to get a newly installed G4 EX system up and running.
4	G4 EX Maintenance	Provides instructions on how to remove and replace major modules.
5	Troubleshooting	Provides a description of the G4 EX front panel error messages and provides a troubleshooting chart on how to correct most problems.
Apdx. A	I/O Daughter Card	Instructions for the installation of the I/O daughter card.
Apdx. B	4-20 Milliamp Transmitters	Provides in-depth information regarding the powering of 4-20mA transmitter.
Apdx. C	G4 EX Modbus Register Maps	Provides a listing of all valid Modbus registers.

Getting Help

Totalflow takes pride in the ongoing support provided to customers. When purchasing a product, users receive documentation which should answer their questions; however, Totalflow Technical Support provides an 800 number as an added source of information.

If requiring assistance, call:

USA: (800) 442-3097   International: 001-918-338-4888

Before Calling

- Know the Totalflow model and serial number. Serial numbers can be found on a plate located on each unit.

- Be prepared to give the customer service representative a detailed description of the problem.
- Note any alarms or messages as they appear.
- Prepare a written description of the problem.
- Know the software version, board and optional part numbers.

Key Symbols

The following symbols are used frequently in the manual. These are intended to catch the eye and draw attention to important information.

FYI — Intended to draw attention to useful information or to clarify a statement made earlier.

TIP — Intended to draw attention to a fact that may be useful or helpful in understanding a concept.

CAUTION — Intended to draw attention to a statement that might keep the user from making a mistake, keep the user from destroying equipment or parts or keep the user from creating a situation that could cause personal injury if caution is not used. Please refer to the Safety Practices and Precautions section for additional information.

WARNING — Intended to draw attention to a statement regarding the likelihood of personal injury or fatality that could result from improper access or techniques used while working in hazardous locations. Please refer to the Safety Practices and Precautions section for additional information.

Safety Practices and Precautions

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. Installation, maintenance and repairs should only be performed by a trained and qualified technician. Please refer to the certification drawings shipped with this unit for specific guidelines. Extra copies of the certification drawings, referenced on the unit's name tag, can be obtained, free of charge, by contacting Totalflow Technical Support at the number listed in the Getting Help section.

To ensure safe installation and operation of the equipment, the instructions that are presented in this manual should be read carefully prior to their execution. As it is impossible to cover every installation scenario that exists for a given device, the instructions do not contain all possible details and do not take into account every conceivable scenario. What is presented represents the most common scenarios that a user will find in the field. If the information here does not cover the user's specific site scenario, call Totalflow Technical Support for further help in implementing the installation.

Additionally, it should be pointed out that the following instructions are neither part of nor provided for changing a previous existing agreement, promise or legal relationship. The obligations adhered to by ABB Totalflow result from the respective sales contract which also comprises the complete and solely valid warranty clauses. These contractual warranty clauses will not be limited or extended by the content of this manual.

Safety Guidelines

- DO NOT open the equipment to perform any adjustments, measurements, maintenance, parts replacement or repairs until all external power supplies have been disconnected.
- For assembly, electrical connection, installation and maintenance of the device, only a qualified and authorized specialist should attempt these tasks. A specialist would be one who is experienced in either assembly, electrical connection, installation or maintenance of a given device and holds the necessary qualifications for the task.
- When opening covers or removing parts, exercise extreme caution. Live parts or connections can be exposed.
- Installation and maintenance must be performed by person(s) qualified for the type and area of installation, according to national and local codes.
- Capacitors in the equipment can still be charged even after the unit has been disconnected from all power supplies.

Safety First

Various statements in this manual, identified as conditions or practices that could result in equipment damage, personal injury or loss of life, will be highlighted using the following icons:

CAUTION Exercise caution while performing this task. Carelessness could result in damage to the equipment, other property and personal injury.

WARNING STOP. Do not proceed without first verifying that a hazardous condition does not exist. This task may not be undertaken until proper protection has been implemented or the hazardous condition has been removed. Personal injury or fatality could result. Examples of these warnings include:

- Removal of enclosure cover(s) in a hazardous location must follow guidelines stipulated in the certification drawings shipped with this unit.
- If the unit is installed or to be installed in a hazardous location, the technician must follow the guidelines stipulated in the certification drawings shipped with this unit.
- Access to the unit via PCCU cable in a hazardous location must follow guidelines stipulated in the certification drawings shipped with this unit.
- Connecting or disconnecting equipment in a hazardous location for installation or maintenance of electric components must follow guidelines stipulated in the certification drawings shipped with this unit.

WARNING 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 to include the equipment itself.

Equipment Markings

 Protective ground (earth) terminal.

Grounding the Product

If a grounding conductor is required, it should be connected to the grounding terminal before any other connections are made.

Operating Voltage

Before switching on the power, check that the operating voltage listed on the equipment agrees with the power being connected to the equipment.

Danger From Loss of Ground

A grounding conductor may or may not be required, depending on the hazardous classification. If required, 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.

Fuse Replacement

Fuses used on G4 EX model electronic boards are surface mount, and field repair should not be attempted. Most fuses automatically reset themselves, but if a known problem exists, the board should be sent in for repair or replacement.

1.0 SYSTEM DESCRIPTION

1.1 Overview

The XFC^{G4} 6200/6201EX (G4 EX) is a next generation solution for the pre-existing generation 3 XFC6200/6201EX. The G4 EX now incorporates the same 32-bit technology currently used by the G4 XSeries products. By using 32-bit technology, Windows® CE OS and memory capabilities, the G4 EX is a versatile product offering for production automation and DIV 1 custody measurement projects.

Along with this new functionality, the hardware capabilities will also be expanded to meet the demands of targeted market applications in production automation and natural gas distribution. These hardware features will be utilized to enhance the system integration capabilities with existing Totalflow products as well as existing third-party control SCADA systems.

Additionally, the use of Bluetooth technology for local MMI connectivity is poised to enhance the product for multi-tube and Class 1, DIV 1 application where this type of user interface is an advantage.

The G4 EX offers an explosion-proof product for differential (orifice) or linear (pulse) metering and automation systems. The G4 EX is an accurate and reliable gas flow computer with the capability to measure and monitor gas flow in compliance with AGA, API and ISO standards.

The G4 EX is a low power, microprocessor-based unit designed to meet a wide range of measurement, control, monitor and alarming applications for remote gas systems located in DIV 1 hazardous areas.

See Table 1—1 for the XFC family genealogy. This highlights the main differences between the various devices.

WARNING The XFC G4 6200/6201EX (G4 EX) is approved for installation in Classified/Potential Hazardous Locations where an explosive atmosphere may be present. Follow precautions and requirements for installation, maintenance and service of equipment according to Local and National Electrical Codes and the "Warnings" contained in this manual.

Table 1—1 XFC Family Genealogy

XFC Model	DIV Class	Multi Tube	Orifice Meter	Pulse Meter	Battery Charger	Max. Battery Capacity	Communication Equipment	Max. TFIO Modules
6200EX	1		●		External	External	External	12-Point I/O Optional Expansion Card
6201EX	1			●	External	External	External	12-point I/O Optional Expansion Card
6410	2	●	●		On Board	26AH	External	N/A
6411	2	●		●	On Board	26AH	External	N/A

XFC Model	DIV Class	Multi Tube	Orifice Meter	Pulse Meter	Battery Charger	Max. Battery Capacity	Communication Equipment	Max. TFIO Modules
6413	2	●	●		On Board	26AH	Internal	3
6414	2	●		●	On Board	26AH	Internal	3
6713	2	●	●		On Board	42AH	Internal	6
6714	2	●		●	On Board	42AH	Internal	6

1.1.1   Capabilities

The G4 EX is packaged in a small, explosion-proof cast aluminum enclosure which accommodates the processor board, termination board and display. The power supply, charging source and radio communication applications must be housed in separate accommodations. See Figure 1–1.

For the G4 EX, the integral multivariable transducer (EXIMV) is a separate unit with no internal electronics and is attached to the bottom of the enclosure via a threaded neck. This contains the wiring for the connection to the electronics that are located in the enclosure.

The G4 EX defaults to the retention of daily and log period records for 40 days and the retention of 200 events. These defaults can be extended, limited only by the file storage spaces on the device.

The G4 EX may be used in conjunction with a laptop that is running PCCU32 software. PCCU32 is required for initial setup and setup of the advanced features.

The G4 EX maintains a history of alarms as well as average differential pressure (DP), average static pressure (SP), average flowing temperature (Tf), accumulated volume, energy and an average extension.

The G4 EX can be programmed to calculate flow rates and volumes in accordance with either AGA-3, AGA-7 or ISO-5167.

Supercompressibility calculations can be performed in accordance with either NX-19, AGA-8 or ISO 12213-2.
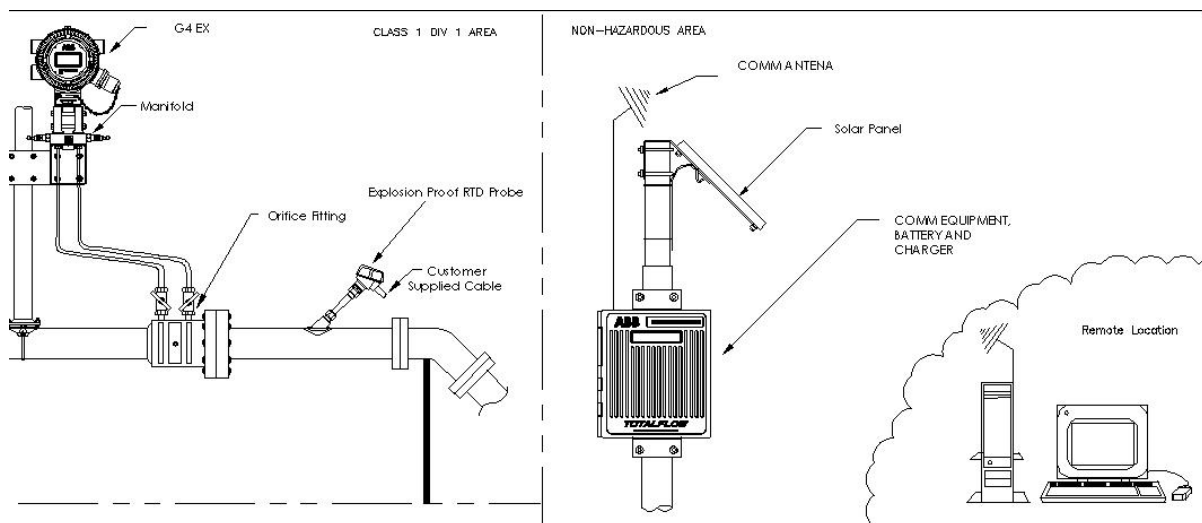
Figure 1–1 Typical G4 EX Installation

1.1.2 Functionality

Functions of the G4 EX reflect a design that is practical, straightforward and efficient. It is simple to use and easy to learn. This functionality allows for saving time that is usually allotted for calculations and report preparation. This flow computer allows the user to perform the following with a minimum of effort, maximum speed and greater accuracy.

Complete log period flow and operational records that are reported hourly (default), including:

- Average static pressure
- Average differential pressure
- Average flowing temperature
- Integral
- Corrected volume total
- Corrected energy total
- Operating status and alarms
- Flow time

Complete daily flow records, including:

- Average static pressure
- Average differential pressure
- Average flowing temperature
- Average extension
- Corrected volume total
- Corrected energy total
- Operating status and alarms

Complete daily operation statistics, including:

- Percent flowing time
- Percent back flow time
- Percent out of limits (programmable) on SP, DP, Tf and flow rate
- Minimum and maximum values for SP, DP, Tf and flow rate

1.1.3 Flow Computer Calculations

The records and statistics generated are based on the following calculation methods of the G4 EX:

- Calculation of flow rates and volumes in accordance with AGA 3–85, AGA 3–92, AGA-7 or ISO-5167.
- Calculation of flow rates and volumes in accordance with AGA-8 92 Gross or Detail or NX-19 Supercompressibility Standards.
- Calculation of flow extension for the AGA3-92 equation is $\sqrt{\dfrac{Dp*Sp}{Tf+459.67}}$, once per second.
- The flow extension reported for the log period is:

$$\sqrt{\frac{Dp*Sp}{Tf+459.67}} / 3600 * flow\ time\ in\ \sec onds$$

- Calculation of the flow extension for the AGA3-85 equation is $\sqrt{Dp * Sp}$, once per second.
- Extrapolation of flow accumulation during transducer calibration or calibration checks.
- Selection of all coefficients for calculation; the calculation of dynamic factors (dependent upon DP, SP and Tf) using averages is based on one second samples.
- Sample set of most recent calculations allowing subsequent verification.
- Monitoring of the operational limits, minimums and maximums to ensure detection and reporting of malfunctions or abnormal site conditions.
- Acceptance and storage of system constants from the PCCU32 or remote communications protocols.
- Storage of data records and operational events is determined by user (based on available memory).

1.1.3.1   Additional Features

Additional features of the Totalflow system's flexibility include the following:
- Programmable differential pressure zero cutoff.
- Programmable bi-level security codes to prevent unauthorized access to and configuration of the G4 EX or user-configurable Role Based Security Access (RBAC).
- Internal 100 Ohm platinum RTD resistance curve fit with user-programmable single point offset or 3/5-point user-calibration of the RTD input.
- Quick, simple calibration procedures for transducer.
- Real-time clock providing a highly stable time base for the system.
- Proper battery and solar sizing is determined by geographic location of the unit and total power consumption of the system. Totalflow project engineers can select the appropriate battery and solar requirements for the user's specific application. Larger capacity batteries are available to increase autonomy, if required.
- Three available power sources:
  - External solar panel (standard)
  - External AC or AC to DC power
  - External 24/12 VDC power
- Liquid crystal display (LCD) programmable to allow monitoring of the G4 EX operations and can display any variable that has a register (for example, displays current static pressure).
- Three serial communication ports are available on the G4 EX: 1 dedicated RS-232 Local and 2 user-programmable RS-232/RS-485 Remote Communication ports.
- USB and 10Base T Ethernet port.
- USB or RS-232 serial may be ordered as local, externally accessible Local Communication Interface port.

1.1.4   Log Period Records

Each record has entries that contain the following information (and more):
- Average static pressure
- Average differential pressure

- Average flow temperature
- Calculated volume

1.1.4.1   Log Period Data Entries

Log period data entries are made every 60 minutes, by default. The user may change this period to any one of the seven (7) choices (1, 2, 5, 10, 20, 30, 60). Choosing a log period of less than 60 minutes will result in additional records being logged. As a result, this requires more storage space to hold a full day's data. The log period must never be less than the volume calculation period.

1.1.4.2   Volume Calculation Period Entries

Volume calculation period entries are made every second, by default. The user may change this period up to 60 minutes. API 21.1 strongly suggests a volume calculation period (QCP) of once per second.

The volume calculation period should never be greater than the log period and should be evenly divisible into the log period.

Volume calculations are completed, following the top of the current period (i.e., top of the hour, top of the minute, each second).

1.1.5   Display Function

During operation, the front panel LCD continuously scrolls through the operating parameters. Table 1—2 shows the typical displayed parameters; however, many parameters with a register address can be displayed. The duration that the parameter is displayed can vary from 1 to 255 seconds (default is five seconds); a setting of zero seconds will set any item to Off. See the Program Display section and the PCCU32 help files for additional information.

Table 1—2 Typical G4 EX Display Options

Display	Description
DATE/TIME MM/DD/YY HH:MM:SS	Current date and time, 24 hour clock
YEST DP LOW NN PERCENT	Yesterday's % time below DP Low Set Point
YEST DP HIGH NN PERCENT	Yesterday's % time below DP High Set Point
FLOW RATE NNNNNN.N SCF/HR	Current flow rate, programmable SCF, MCF or MMCF
TOTAL ACCUM VOL NNNNNN.NN MCF	Total accumulated volume., programmable SCF, MCF or MMCF
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 SCF, MCF or MMCF
PERIOD VOL NNNN.N SCF	Last volume calculation period volume
BATTERY VOLTAGE NN.N VOLTS	Battery voltage as supplied by external unit
M_FLOWRATE NNNNNN.N SCF/HR	Minute average flow rate
STATION ID	ID of unit
ORIFICE DIAMETER N.NNNN INCHES	Size of orifice plate

1.1.6   Display Annunciators

Since a primary function of the G4 EX is to provide complete volume and operational records, it is important to indicate unusual or alarm conditions as they occur. This is supported on the LCD in the Annunciator display area shown in Figure 1–2.

In the G4 EX computer, the status and alarm indicators are user programmable. Table 1—3 identifies the default annunciator locations. Please consult the PCCU32 help files for additional instructions on programming the annunciators.

Whenever an alarm is indicated, the G4 EX records it in the appropriate log period flow record. These are automatically retrieved when data is collected. Visual alarms and status codes are described in

Table 1—4.
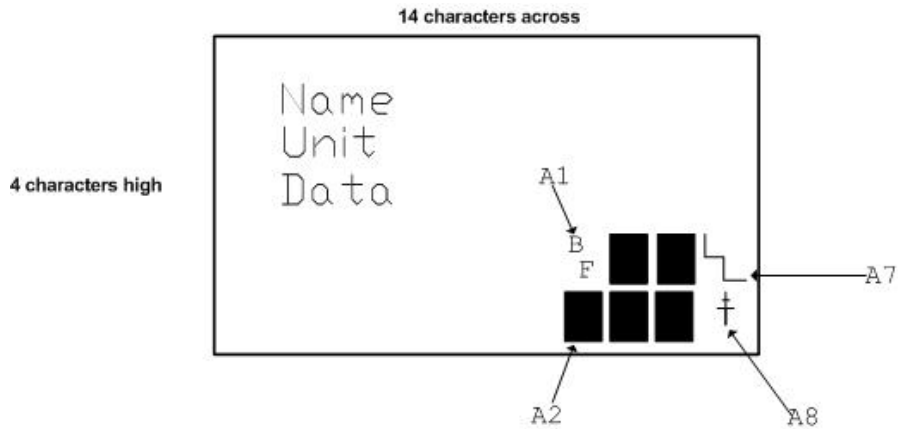
Figure 1–2 Liquid Crystal Display (LCD) and Indicators

Table 1—3 Default Annunciator Locations

Annunciator	Application
A1	Measurement Tube 1
A2	CIM 0
A3	Valve Control
A4	COM2
A5	Plunger
A6	Local-COM0
A7	System
A8	TF Remote – COM1

Table 1—4 G4 EX Status and Alarm Description

Indicator	Description
System	
^L_L	Low Lithium Battery Alarm: When ^{L}L (low lithium) is displayed, lithium battery voltage is not sufficient to maintain SRAM data. A new lithium battery measures approximately 3.6 VDC.
Display Application	
1	A number represents the Display Group number currently being displayed.
↑	The displayed item's value is above the Data High Limit value specified on the display Item Setup screen.
↓	The displayed item's value is below the Data Low Limit value specified on the display Item Setup screen.
Communications	
→	Transmitting Data: Sending a response.
←	Receiving Data: Processing request.
!	Negative Acknowledgement (Nak) w/packet list.
+	Positive Acknowledge (Ack) of receipt of request.
朮	Waiting for Positive Acknowledgement: Waiting for response after transmission.
?	Exception Alarm Processing.
¥	ID Recognized: Recognized and receiving request.
‡	Listen Cycle: 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. May not be visible if baud rate is faster than 2400. Annunciator will remain on if listen cycle is set to zero.
M	MODBUS ASCII: MODBUS ASCII protocol selected for the port assigned to this annunciator.
m	MODBUS RTU: MODBUS RTU protocol is selected for the port assigned to this annunciator.
L	Local Protocol: Displayed when PCCU32 port is active and running Totalflow Local Protocol.
n	Network (Ethernet).
u	USB.
Measurement Application	
B$_F$	Back Flow Condition: Visible only when DP variable displayed.
Z	Zero Flow Condition: Visible only when Flow Rate displayed.
H	Hold: Displayed when PCCU32 has entered Calibration mode on a Measurement Application.
A	Alarm Condition: Need to view alarm. The user may need to compare application limits to current values to determine where the alarm condition is present.
A$_D$	A to D Failure: Displayed if A to D Converter's differential pressure, absolute static pressure or temperature readings exceed maximum counts or are less than minimum counts.

1.2   G4 EX Computer Hardware

The G4 EX computers are housed in an explosion-proof enclosure. The components that comprise this are as follows:

- G4 EX Enclosure (3R/IP53 with breather drain installed; 4X/IP66 without breather installed)
- G4 EX Main Processor Board
- G4 EX Termination Board
- Lithium Battery
- Engine Card
- G4 EX Liquid Crystal Display (LCD) Assembly
- PCCU Connector
    - Internal Connector
    - Explosion Proof External Connector – USB/Miltary (optional)
- Explosion Proof Integral Multivariable Transducer with Raw Sensor Board Interface
- Resistive Temperature Detector
    - Standard RTD (DIV 2)
    - Explosion Proof RTD (DIV 1)

1.2.1   G4 EX Enclosure

The custom-designed, explosion-proof enclosure consists of a cylinder shaped, cast aluminum housing, powder coated, with front and rear end caps for access to internal components (see Figure 1–3 through Figure 1–5). This enclosure may be direct mounted, pipe mounted on the meter run using a pipe saddle or mounted on a stand alone pipe.

The enclosure features three (3) exterior hubs for wiring:

- Communication and power
- Resistive temperature detector (RTD)
- Input/output wires

The end caps have precision engineered threading and are susceptible to damage if treated roughly. End caps are water tight, corrosion resistant and NEMA 4X rated. Unauthorized removal of the end caps are protected with a 1/16" countersunk hex head set screw on each end cap.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

CAUTION Do not attempt to loosen the end cap before loosening the set screw. Doing so may damage threads on the unit.

1.2.1.1   Dimensions

Unit	Width		Height	Depth
	w/o External PCCU	w/ External PCCU		
US	7.87"	9.50"	11.25"	8.34"

	Width			
Metric	199.90 mm	241.30 mm	285.75 mm	211.84 mm

1.2.1.2   Installation and Weight

Unit	Weight	W/ EX PCCU Connector	Pipe Mounted Depth	Direct Mounted Depth
US	15.65 lbs.	16.35 lbs.	9.69"	8.34"
Metric	5.84 kg	6.10 kg	246.13 mm	211.84 mm
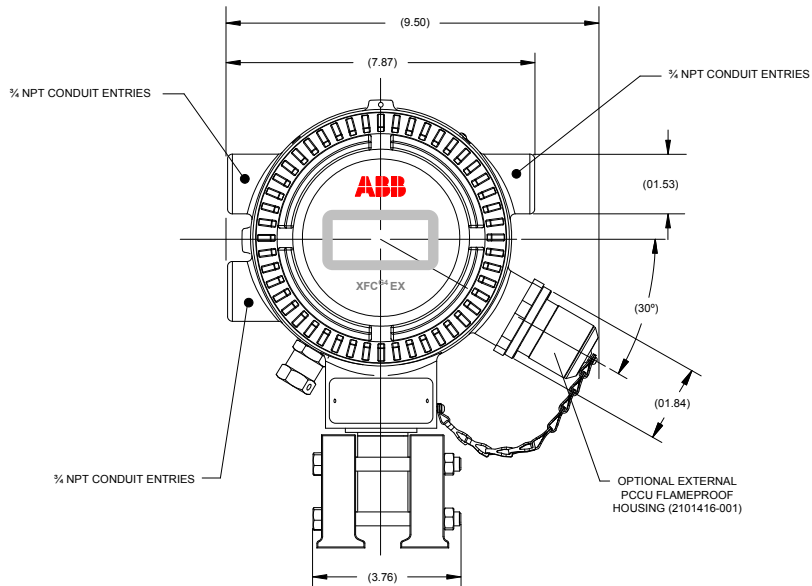
Figure 1–3 G4 EX Enclosure
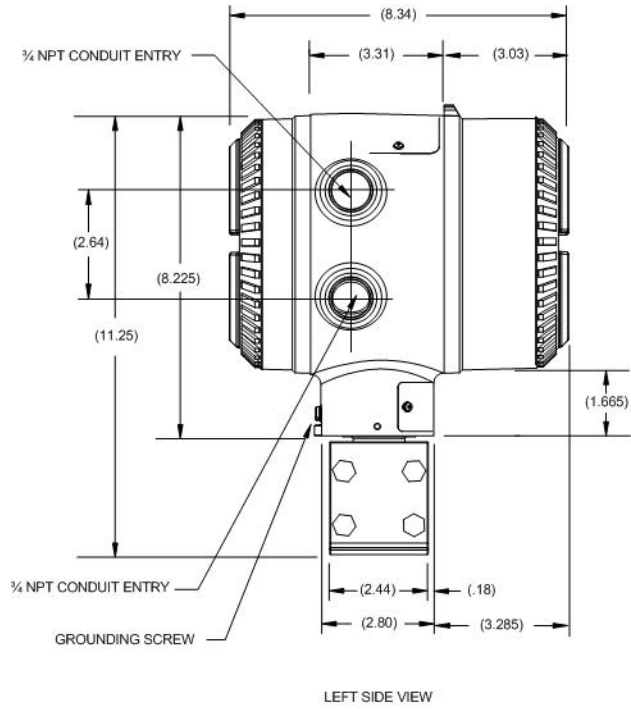
Figure 1–4 G4 EX Enclosure Left Side
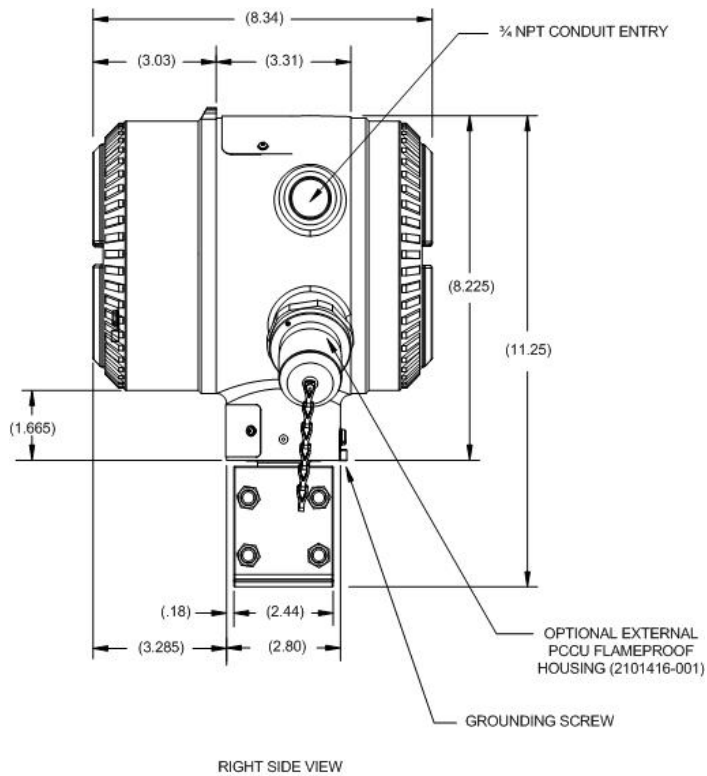
Figure 1–5 G4 EX Enclosure Right Side

1.2.2 G4 EX Main Processor Board

The G4 EX main processor board is mounted inside the front end cap, directly behind the display assembly (see Figure 1–6).

User applicable connections on this board consist of the following:

- uSD Card (J3)
- Contrast Display Potentiometer (R1)
- LCD Display Connector (J2)
- Lithium Battery Connector (J5)
- Engine Card Connector (XA1)
- Sensor Interface Connector (J6)
- Termination Board Connector (J1)

FYI The G4 EX transducer assembly utilizes a small electronic board that contains the factory characterization data. This allows the main electronics on the sensor assembly to be individually field replaceable in the event of failures.

CAUTION Installation and/or maintenance of electric components must follow guidelines stipulated in the certification drawings shipped with this unit and adhere to local codes.
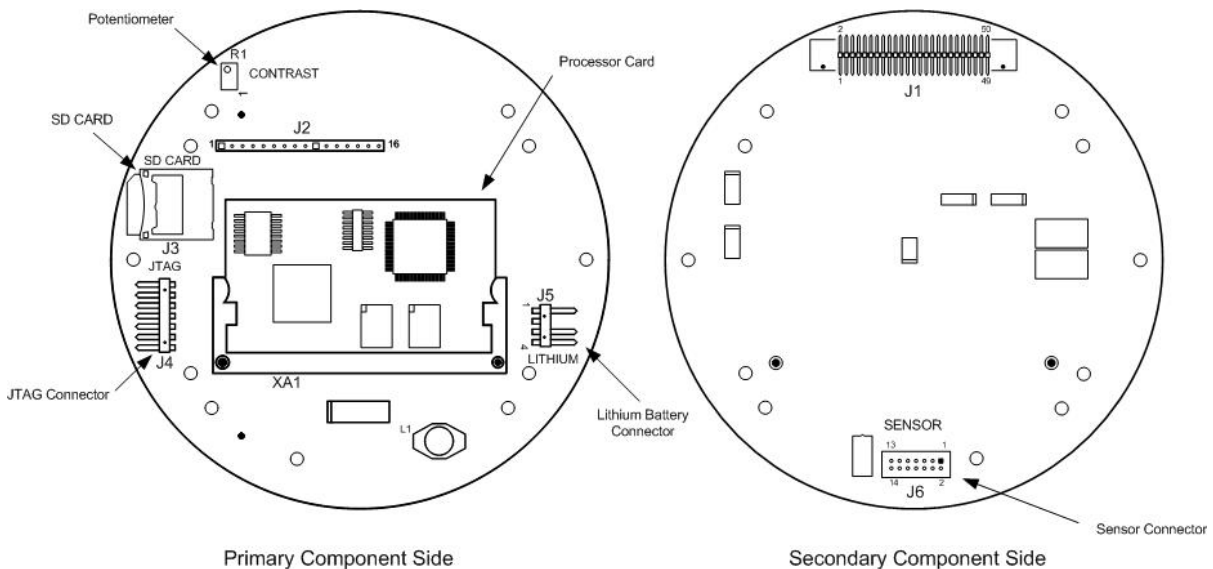
Figure 1–6 G4 EX Main Processor Board

1.2.2.1 Engine Card

An engine card plugs into the G4 EX board. All processor and memory components reside on this engine card. The engine card uses a low power processor running at 203 MHz with 16MB PSRAM for program execution and data storage, 32MB Flash for application storage and 256 bytes of serial E^2PROM. A lithium backup battery is located on the main G4 EX board. Application programs and configuration files are stored in non-volatile Flash.

1.2.2.2 G4 EX Main Processor Board Specifications

The G4 EX Main Processor board is designed as a general purpose motherboard for the 6200/6201EX devices.

Table 1—5 G4 EX Main Processor Board Specifications

Component	Description
Power	9 to 30 VDC
External Power	SWVBAT: 1 fused with 2.5 amp PTC VBAT: 1 fused with 2.5 amp PTC
Charger	No Charger
Memory	• Application (Totalflow.exe) runs out of 16M SRAM. RAM memory has lithium backup battery. • Application and configuration files permanently stored in 32M Flash. • Registry (MAC address, etc.) is stored in 256 byte E^{2}PROMSD Card • SD Card optional (512M/1G)
Comm. Ports	• 6 Ports Available • Dedicated PCCU/MMI (RS-232 or USB) • 2 Onboard User Programmable RS-232/RS-422/RS-485 Ports • USB (Client) NOTE: A special cable is required, and the user must check with Totalflow for a list of drivers to support Client peripherals. • Ethernet Bluetooth – Standard on the Main Electronics Board
Analog Inputs	1 (0-10 VDC)
Digital Inputs	1 (State Change or Pulse to 20 kHz) operating at a 50% duty cycle with (Selectable De-bounce enabled 100 Hz)
Digital Outputs	1 FETs, sink = 2.5 Amp Max.Open Drain PTC, with 1500 W Transient protection
I/O Module Interface	Optional plug-in I/O daughter card with 12 I/O (3 AI, 1 AO, 4 DI and 4 DO)
LCD Interface	Dedicated interface for Liquid Crystal Display (LCD)
Security Switch	On/Off Bi-level on-board Security (See Chapter 3 for details)
I/O Scan Rate	1 time per second
Time Base Stability	± 7.5 ppm (parts per million)
Pulse Input Bandwidth	Up to 20 KHz (Linear flow meter only)

1.2.3 G4 EX Termination Board

The G4 EX Termination board can be accessed by removing the rear end cap (see Figure 1–7). All user connections should be routed through the cable entry hubs and should adhere to local codes.

Located on the Termination board, the user will find connectors for two (2) communication ports: RS-232, RS-422 or RS-485 (software selectable). The user should also note that there is a dedicated port for RS-232 local communications. This is a plug type port and will connect to an internal PCCU connector or an Explosion Proof External PCCU connector.

For more information on the Explosion Proof PCCU connector, see the corresponding section. Additionally, for the internal PCCU connector, see the section under Optional Equipment in this chapter.

COM 1 Port	Remote communication wiring for Port 1 is handled using the J19 connector and the SW1 communication switch.
Com 2 Port	Remote communication wiring for Port 2 is handled using the J20 connector and the SW2 communication switch.

WARNING The XFC G4 6200/6201EX (G4 EX) is approved for installation in Classified/Potential Hazardous Locations where an explosive atmosphere may be present. Follow precautions and requirements for installation of equipment according to the certification drawing indicated on the device's nametag and National and Local Electrical Codes.
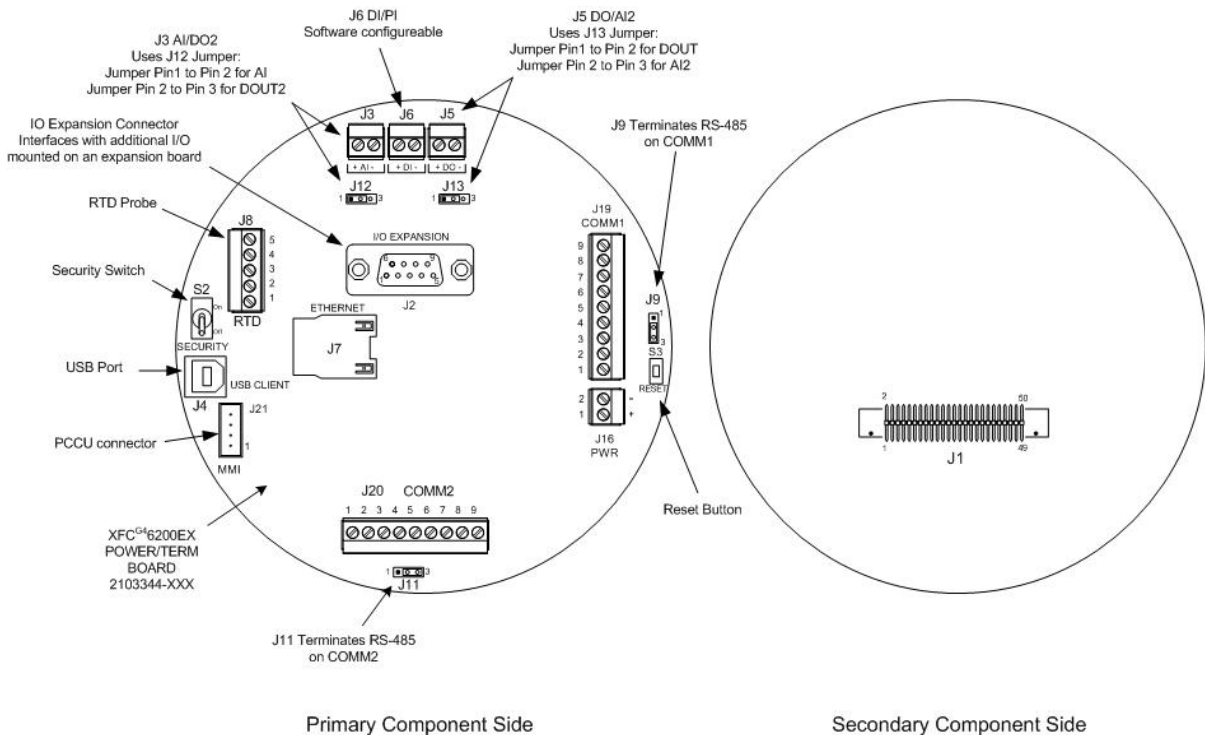
Figure 1–7 G4 EX Termination Board

1.2.3.1   On-Board I/O

The G4 EX Termination board provides similar base I/O as earlier XSeries models but with a reduced number due to enclosure restrictions. This includes:

- 1 User AI
- 1 User DO
- 1 User DI
- Interface for I/O daughter card: 3 AI, 1 AO, 4 DI (NAMUR rated) and 4 DO

1.2.3.2   Digital Input

The G4 EX provides one digital/pulse input as a means to monitor external equipment.

CAUTION — When connecting or disconnecting any wires to the G4 EX boards, the user should remove all power sources and insure that they are grounded properly.

The digital input reads an external contact. This is primarily used as a status input to read external equipment. The contact must be closed to be considered "ON". The "ON" condition is recorded in the log period alarms and can trigger the action of the G4 EX's digital voltage output. OFF is defined as an open contact. Selectable de-bounce can be enabled or disabled within PCCU32. See the PCCU32 help files for additional information.

DI Electrical Specifications

- Open Circuit Voltage: 5 VDC (Internally pulled up to 5 VDC Nom.).
- Short Circuit Leakage Current: -395 uA typical.
- Input Capacitance: 0.1 ufd typical.
- Maximum Allowable Voltage Range on Input: -0.5 VDC to 15 VDC.
- Maximum Frequency Input: 100 Hz @ 50% duty cycle with de-bounce enabled. 20 kHz @ 50% duty cycle with de-bounce disabled.

Input Specifications

- Dry Contact (form A), Open Collector or Active Voltage.
- Minimum contact resistance to activate input 1000Ω.
- Voltage threshold to deactivate the input: 3.1V (referenced to GND terminal).
- Voltage threshold to activate the input: 0.5V (referenced to GND terminal).
- Conductor pairs must be shielded to prevent spurious signals.

Typical DI Point Schematic

Figure 1–8 Typical DI Point Schematic

DI Connection Examples
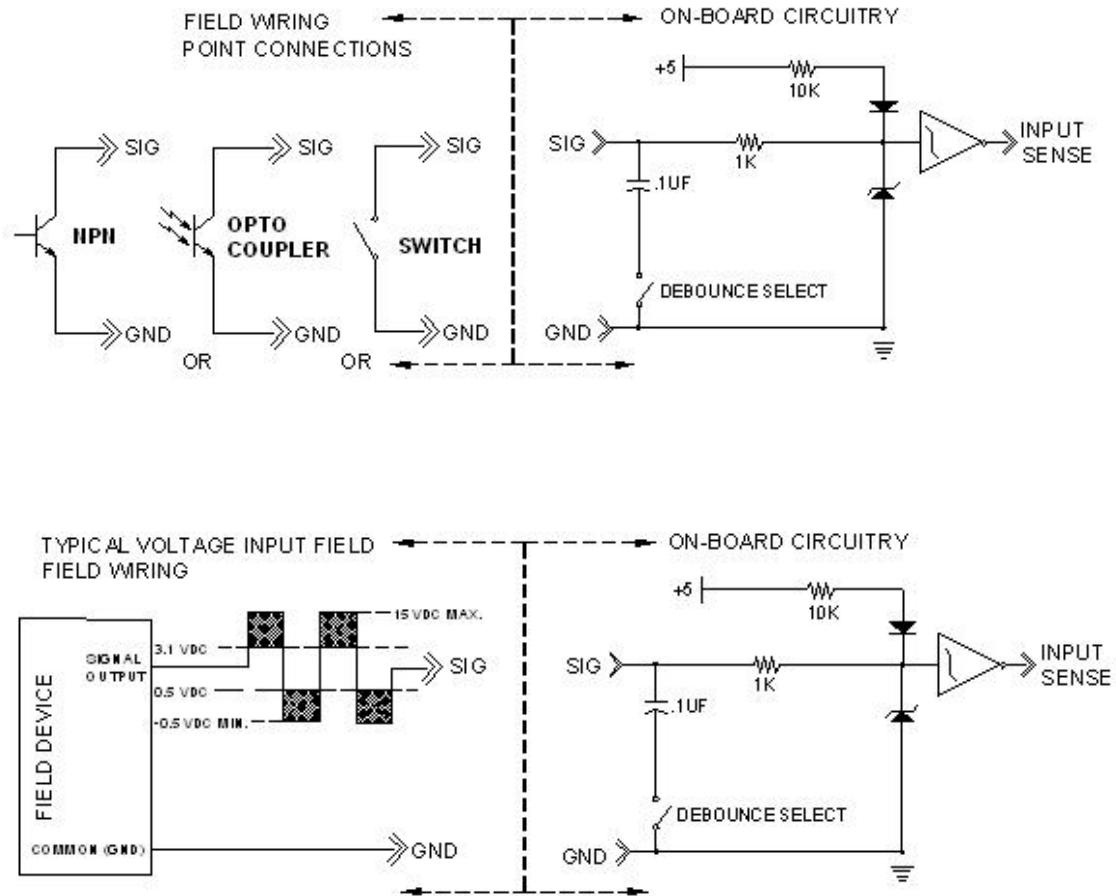
Figure 1–9 DI Connection Example

1.2.3.3 Digital Output

The G4 EX provides one digital output (12 VDC or 24 VDC max.) as a means to control external equipment.

CAUTION When connecting or disconnecting any wires to the G4 EX boards, the user should remove all power sources and ensure that they are grounded properly.

The digital output can be used in conjunction with a measurement tube (AGA-3, AGA-7 or liquid measurement) and triggered on the following measurement parameters or conditions:

- Differential pressure over high limit
- Volume set point
- Differential pressure under low limit
- Flow temperature low
- Static pressure over high limit

- Flow temperature high
- Static pressure under low limit
- Flow rate low
- Low charger voltage
- Flow rate high
- Remote sense is on
- Trip on digital input
- Custom programmable by Totalflow or user programmable with IEC 1131 programming language

DO Electrical Specifications

- Open circuit voltage: 0 VDC
- Short circuit leakage current: 0 uA typical
- Output capacitance: 1000 pF typical
- Maximum allowable voltage range on output: 0.5 VDC to 29.4 VDC

Output Specifications

- Open drain FET type
- "ON" resistance (Including PTC fuse resistance): 0.1Ω Typical
- Maximum pulse current: 3A for 5 seconds
- Maximum continuous sink current: 1.2A at 60°C or .75 at 85°C

Typical DO Point Schematics
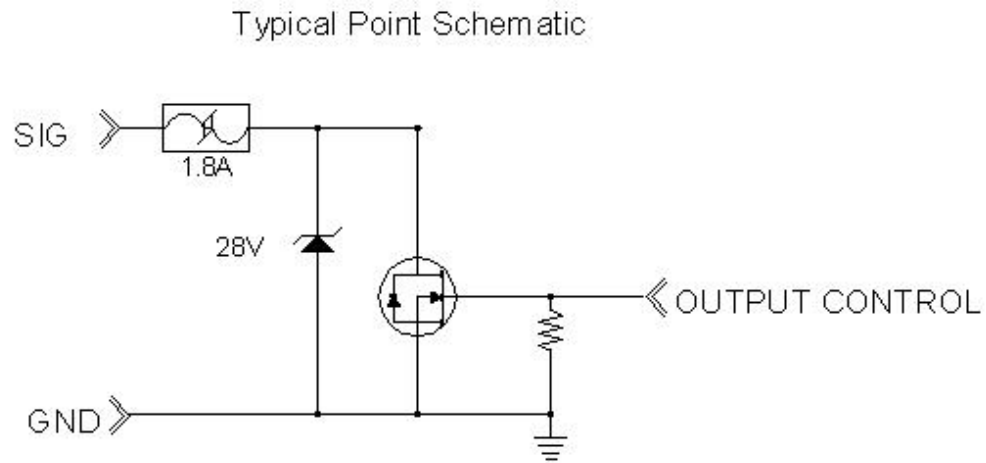
Figure 1–10 Typical DO Point Schematics

DO Connection Example
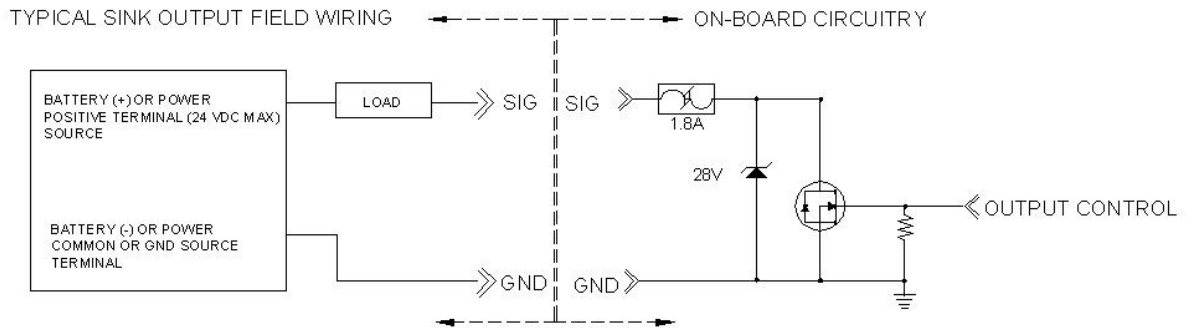
Figure 1–11 DO Connection Example

1.2.3.4   Analog Input

The G4 EX provides one analog input as a means of receiving data, represented by continuously varying voltage/current.

- Open circuit voltage: 0 VDC
- Short circuit leakage current: 0 uA typical
- Input impedance: 103.5KΩ typical (0 to 10V)
- Measurable input voltage range: 0 to 10.34 VDC
- Maximum voltage on input: 30 VDC

Typical AI Point Schematic
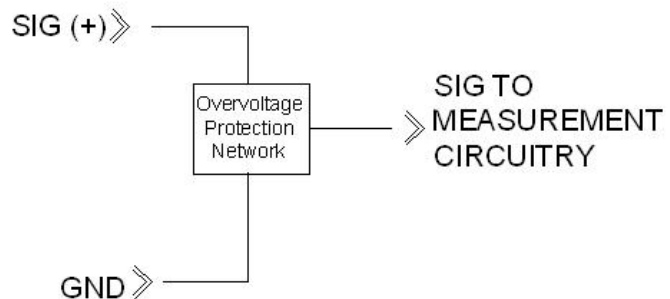
Figure 1–12 Typical AI Point Schematic

AI Example Connections
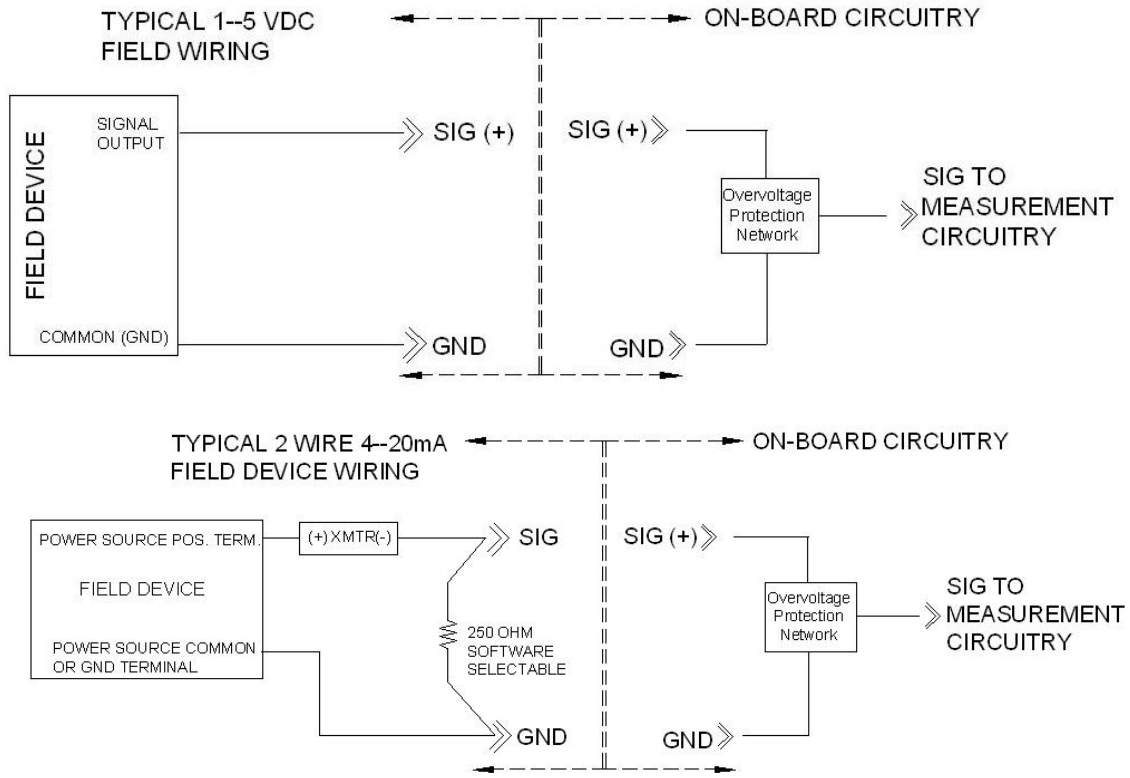
Figure 1–13 AI Example Connections

1.2.4   Explosion Proof Multivariable Transducer (EXIMV)

The EXIMV is an explosion proof version of the factory calibrated "Smart" Integral Multivariable Transducer. The EXIMV is characterized over temperature so that any changes occurring in the EXIMV or in the electronics can be compensated.

Providing the primary measurement capability for the G4 EX (see Figure 1–14), the circuitry and characterization information are stored in the raw sensor board. EXIMV specifications are discussed in Table 1—6.

The unit is designed to provide EMI/RFI protection of the low level signals and to protect the circuitry from other environmental effects.
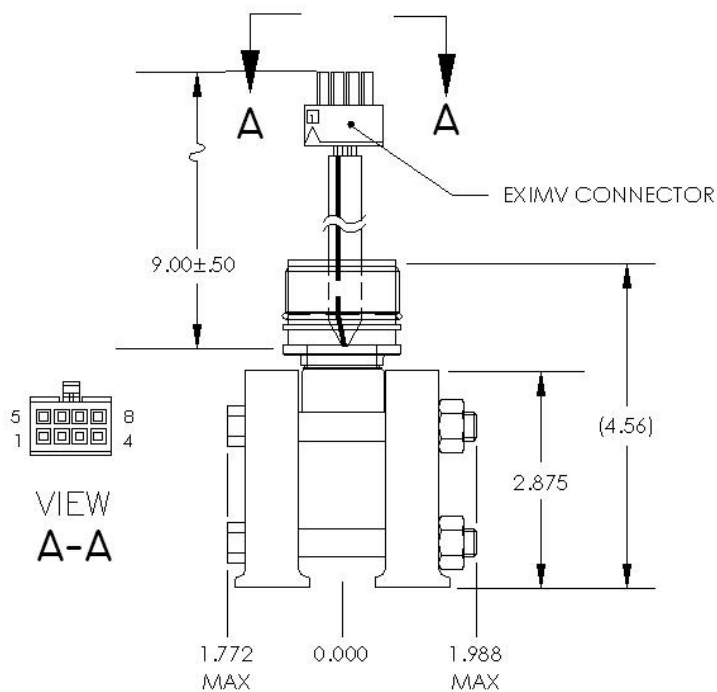
Figure 1–14 Explosion Proof Multivariable Transducer (EXIMV)

Table 1—6 Explosion Proof EXIMV Specifications

Temperature Limits	Compensated: -20°F to 140°F (-29°C to 60°C) Operational: -40°F to 140°F (-40°C to 60°C) Storage: -40°F to 185°F (-40°C to 85°C)
Resolution	24 Bit A/D conversion (0.000012% FS) (0.0012% FS effective signal resolution)
Mounting Spec.	Change from perpendicular (front to back around X-axis) <0.5% URL
Static Pressure	
Accuracy	Linearity, Hysteresis and repeatability combined: ± 0.075% of user-calibrated spans from 20% to 100% of URL
Ambient Temperature Effect Within the Operational Temperature Limit	± 0.075% of URL +0.06% of Reading
Stability	± 0.1% of URL (for 12 months)
Differential Pressure	
Accuracy	Linearity, Hysteresis and repeatability combined: ± 0.075% of user-calibrated spans from 20% to 100% of URL.
Ambient Temperature Effect Within the Operational Temperature Limit	± 0.075% of URL + 0.06% of Reading

Stability	± 0.1% of URL (for 12 months)
SP Effect	DP Zero per 1500 psi: ± 0.03% of URL (3200 psi maximum) DP Span per 1500 psi: ± 0.1% of Reading (3200 psi maximum)
Temperature	
Operating Range	-80°F to 750°F (-62°C to 339°C)
Accuracy	± 0.35°F (± 0.2°C)over Operating Range (as shipped from factory) ± 0.2°F (± 0.12°C) repeatability over Operating Range (after single point field calibration)

1.2.5   Display Assembly

The G4 EX display assembly (see Figure 1–15) has a dedicated interface to the Main Processor board from the 4x16 Liquid Crystal Display (LCD) via a 14-pin connector.

The display utilizes four lines by 16 characters. The user can then customize the annunciators based on their own specific needs. The alarm codes and annunciators communicate a basic message(s) to the user and indicate a need for further attention. These codes are location dependent and may mean different things, based upon which character space the code appears in. These are also user configurable.
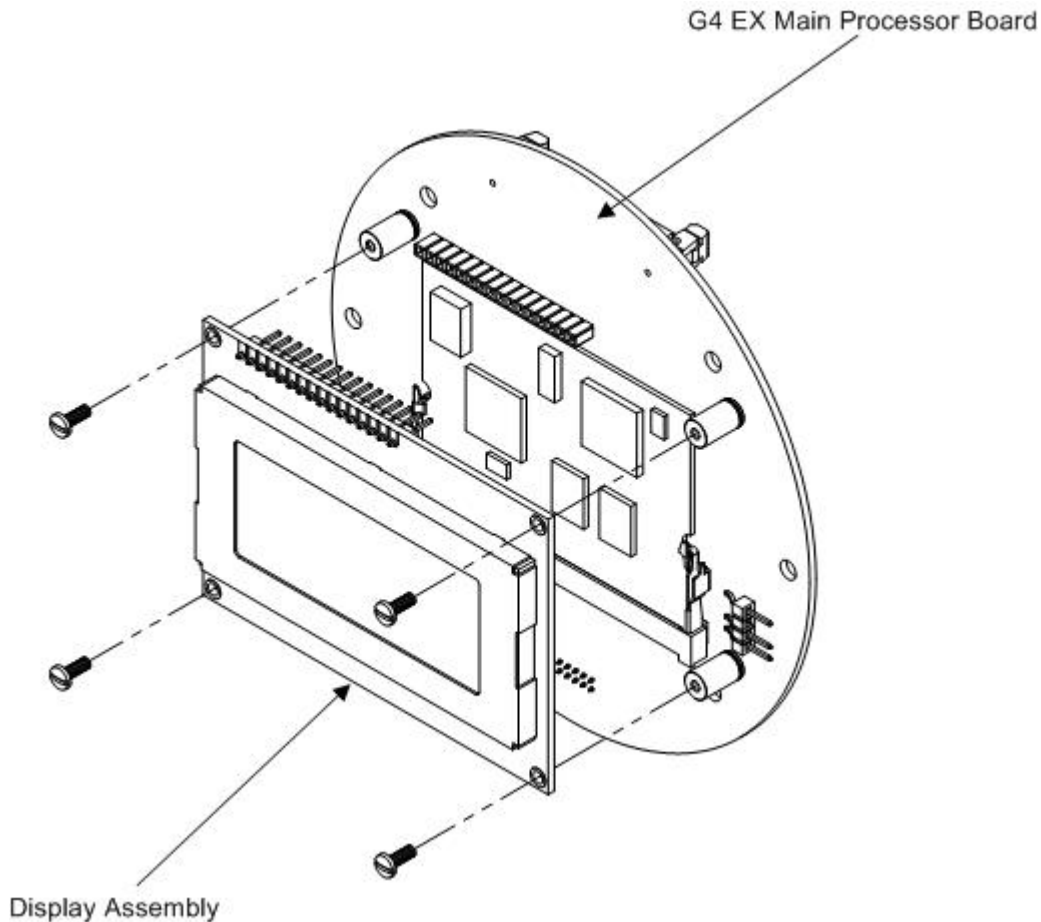
Figure 1–15 Liquid Crystal Display (LCD) Assembly

1.2.6 Resistive Temperature Detector (RTD)

Totalflow offers a choice of two RTD options. The 100 OHM Platinum RTD measures real-time flowing temperature of the gas.

1.2.6.1 Standard RTD

The standard RTD is not DIV 1 approved; therefore, this RTD may only be installed and used in general purpose areas.

1.2.6.2 Explosion Proof RTD

The Explosion Proof RTD is available for use in DIV 1 areas (see Figure 1–16). Two probe lengths are available: 10" and 16". See Table 1—7 for standard probes, based on Thermowell "U" lengths and Table 1—8 for standard Thermowells that are based on thread diameter.
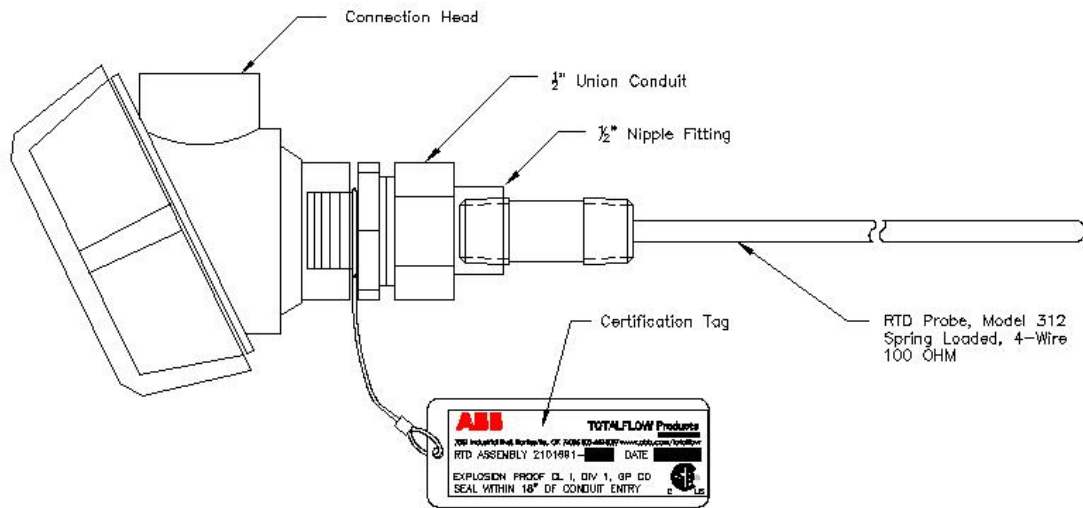
Figure 1–16 Explosion Proof Resistive Temperature Detector

Table 1—7 Standard RTD Probes

"U" Length	Part Number		"U" Length	Part Number
2.00"	2101691–020		6.00"	2101691–060
2.50"	2101691–025		7.00"	2101691–070
3.00"	2101691–030		8.00"	2101691–080
4.00"	2101691–040		9.00"	2101691–090
5.00"	2101691–050		10.00"	2101691–095

Table 1—8 Standard Thermowells

Thread Diameter	"U" Length	Base Part Number
½"	2" through 10"	1622305
1"	2" through 10"	1622302

Thread Diameter	"U" Length	Base Part Number
3/4"	2" through 10"	1622300

1.2.7   6270 Optional Equipment Unit (OEU)

The G4 EX unit is designed to be located in DIV 1 Hazardous areas; therefore, many features and requirements of the unit are housed in a separate enclosure that is located in DIV 2 or General Purpose areas.

Space is provided inside the enclosure to house a variety of remote communication devices: transceiver, cellular phone, battery, changing source and additional I/O (see Figure 1–17).

The battery compartment shelf houses various optional battery packs that are available for the OEU, from eight (8) ampere hours up to 26 ampere hours. Installation of the battery is discussed later in the manual.

WARNING The 6270 OEU system with battery and solar panel is rated for Class I, Division 2 locations only or can be installed in non-hazardous locations.
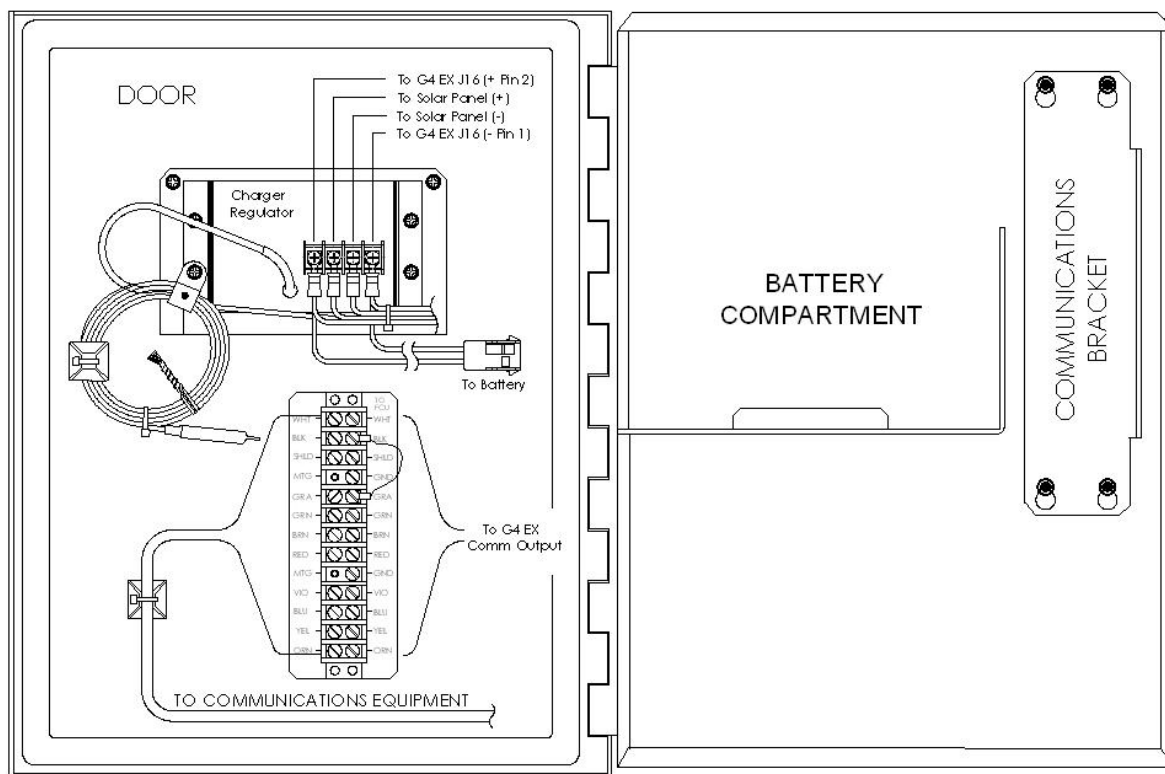
Figure 1–17 Optional Communication Enclosure

1.2.8   Solar Panel

A solar panel can be configured in the system to provide a charging source for the battery. DIV 1 installations would require that the solar panel and battery pack be

installed in a General Purpose or DIV 2 area. Typically, the solar panel would be connected through a charger regulator that is located in the 6270 OEU.

Depending upon power/charging requirements, the unit may be configured for a 5-watt, 10-watt, 20-watt or 30-watt solar panel. The panel is designed to be mounted on a 2-inch extension pipe.
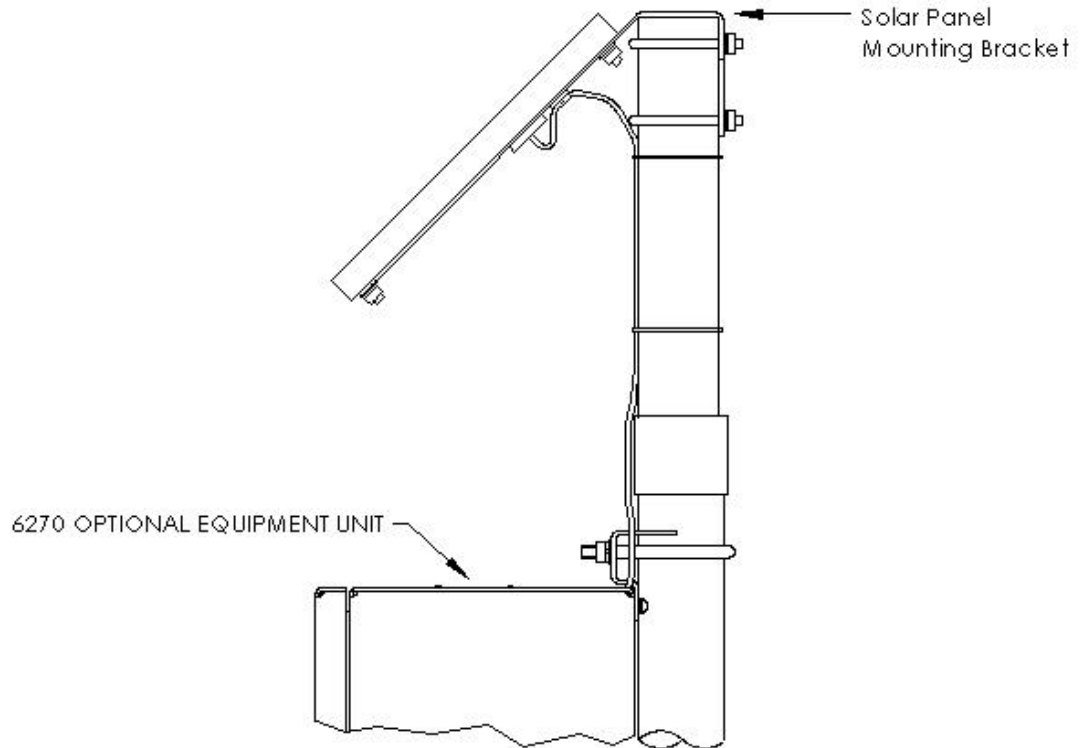
Figure 1–18 Solar Panel – Typical Installation

1.2.9   Lithium Battery

The following information displays the technical information regarding the lithium battery housed within the G4 EX.

CAUTION When the G4 EX is in storage, it is recommended that the lithium battery be disabled (unplugged from J5 connector) to prevent power drainage. Not doing so can cause the battery to lose power within six months.

Technical Data	
Nominal Capacity @ 2 mA, to 2V	2.1 Ah
Rated Voltage	3.6 V
Wires	AWG 24
Enclosure	UL 94V2
Mounting	Hook and Loop Fastner
Operating Temperature Range	-55°C to +85°C/-67°F to +185°F

1.3 G4 EX Application Licensing

The G4 (fourth generation) EX offers the user unrivaled power and flexibility. The G4 EX units can support far more applications than the G3 (third generation) devices. Various applications require that Totalflow pay a royalty to third party vendors. As such, Totalflow has developed a credit system for handling application loads beyond what would be required for a typical G3 meter run. Application credits are required to enable many of the applications.

From the factory, the G4 EX has four general credits installed. Several system configurations are possible with these four general credits:

- AGA-3 with Plunger Lift and Trending (uses 3 general credits)
- Two AGA-3 (or AGA-7) tubes with Trending (uses 3 general credits)
- AGA-3 with Pad Control and Plunger Lift (uses 3 general credits)

Applications are divided into categories: Standard, General, IEC and CO2. Other application categories may be created in the future.

Standard applications typically support general applications as well as the basic operation of the G4 EX unit. Standard applications do not require any credits to be instantiated.

Standard applications include:

- System Application
- Communications
- I/O Subsystem
- Therms Master
- Therms Slave
- Analysis Trend System
- LevelMaster
- Pulse Accumulator
- NGC Client
- PID Controller
- Operations
- XMV Interface
- Holding Registers
- Units Conversion
- Host Interface
- Displays

General applications typically provide some type of measurement, control, logging and/or archival function. General applications include:

- AGA-3 Measurement
- AGA-7 Measurement
- V-Cone Measurement
- Coriolis Gas
- Alarm System
- Shutdown
- Plunger
- PAD Controller
- Pump Interface
- Oil Custody Transfer Measurement

IEC applications are generally custom applications provided by Totalflow at the customer's request. This might include special control and/or measurement algorithms required by the customer. Multiple IEC applications can be instantiated with a single IEC credit.

CO2 (NIST) applications each require a CO2 (NIST) credit.

1.3.1   Credit Key (USB)

The G4 EX comes with four general credits installed in the unit. If the system configuration requires more application credits, they can be purchased from Totalflow's Order Entry (1-800-442-3097).

Credits (Standard, General, IEC and CO2) are maintained on the credit key. Credits can be purchased and kept on the USB credit key. The credit key is a secure USB Flash drive (i.e., thumb drive). It cannot be written to or read by any program other than PCCU32 7.0 or later. Credits can be added to the credit key via a phone call to Technical Support or through email. Again, these credits are used to run the various applications available in the G4 product line.

Credits can be transferred between the laptop and the G4 EX. If a G4 EX has extra credits (more than required to be fully licensed), the extra credits can be downloaded to the credit key to be used on other G4 units.

FYI If the G4 controller is running an unlicensed application, that fact is reflected in any reports generated from that unlicensed meter. The meter will also log the fact that it is unlicensed in the Event Log at the top of each contract day. Unlicensed applications cause the meter to connect more slowly.

1.4   Laptop Computer Running PCCU32

PCCU32 software running in a laptop Windows environment offers the user the most capabilities for programming the G4 EX. The Windows environment features user friendly help files and easy to follow menus.

If configured with the USB option, the laptop computer connects via the cable directly to the connector on the side of the G4 EX. Once this physical connection has been made, the user may begin communicating through the software.

WARNING Remove power from device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and National and Local Electrical Codes.

FYI Connecting to the G4 EX meters with PCCU32 requires version 7.05.5 or later.

Making a local connection to the meter may be accomplished one of three ways. Traditionally, local connections have been made using the RS-232 PCCU cable with the round military connector on one end and a serial port connector on the other. The second method involves the local connection being made using a USB cable. The third method utilizes the standard onboard Bluetooth wireless connection. These methods are discussed below.

1.5 Local G4 EX Connectors

1.5.1 RS-232 Serial PCCU Cable (Round Military Cable)

WARNING Remove power from device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and National and Local Electrical Codes.

The local connection (serial military connector) requires an RS-232 serial port on the host computer (generally a laptop). A PCCU cable is required to connect the host computer to the meter's round military connector (see Figure 1–19). Connecting the PCCU cable to the meter will cause the annunciator in the LCD to display an upper case letter "L" for local connect.

FYI The G4 EX meter must be ordered to include serial communication capability. A change over kit may be purchased to adapt the G4 to USB capability.

Military Connector

9-Pin RS-232

Figure 1–19 RS-232 Local Communication Cable

1.5.2 PCCU32 USB Connection

The local USB connection requires use of a USB cable connected to the host computer (generally a laptop). A USB PCCU cable is required to connect the host computer to the meter's client connector (see Figure 1–20). Connecting the PCCU cable to the meter causes an annunciator in the LCD to display an upper case letter "L" for local connect.

FYI The G4 EX meter must be ordered to include USB communication capability. A change over kit may be purchased to adapt the G4 to serial capability.

Client

Host
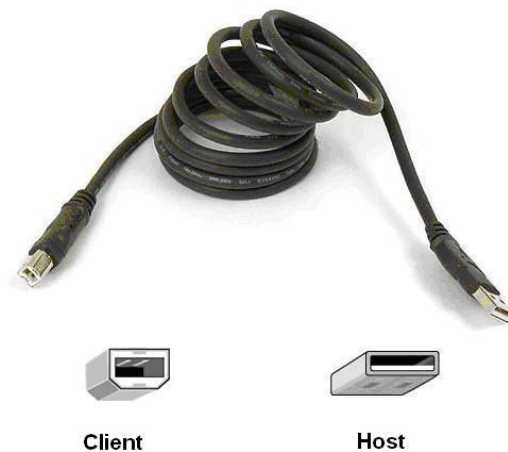
Figure 1–20 USB Local Communication Cable

1.5.3   Bluetooth Connectivity

With the latest iteration of the G4 EX device, the user now has the option of performing a local connecting using Bluetooth functionality. This option can be accessed through PCCU32.

1.5.4   Network Connectivity (Dynamic IP with Router)

When the user elects to operate the G4 EX in a network environment, using an Ethernet is a practical solution. PCCU32 communication with the meter over an Ethernet connection (TCP/IP) requires the use of a hub, switch or router along with the appropriate cabling (see Figure 1–22). Ethernet (local) communication in a remote area may also be utilized.

FYI   The Ethernet option is only available by removing the end cap on the G4 EX device.

Figure 1–21 Ethernet Communication Cable
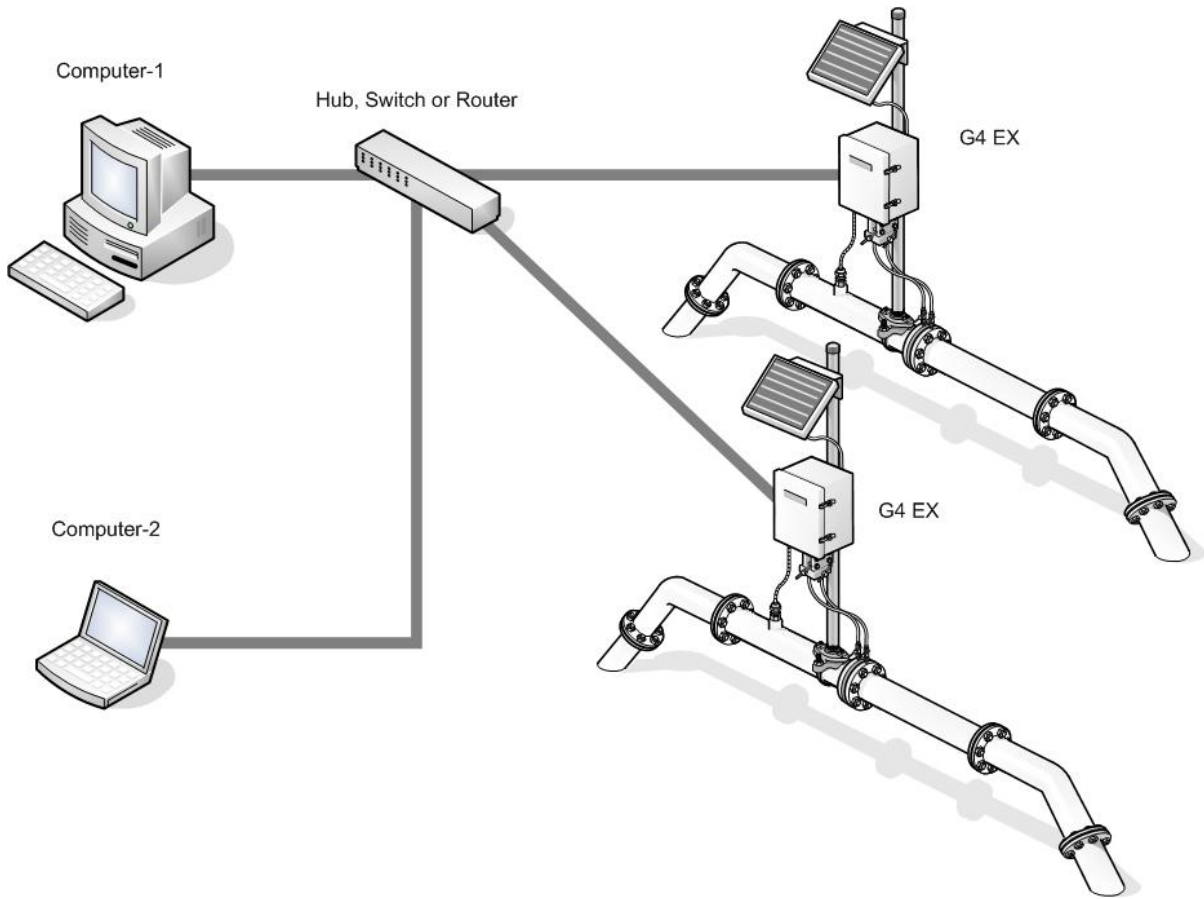
Figure 1–22 Ethernet Connectivity Diagram

2.0   INSTALLATION

This chapter provides the user with the information for installation and setup of the G4 EX. By the time the user has finished the chapter, they will have the G4 EX unpacked, installed, field wired and ready for operation. For safe and trouble free installation, follow all instructions and advisories.

FYI   Read through this chapter before beginning the installation. This will give the user the ability to plan their specific installation. Additionally, before beginning, refer to the wiring diagrams delivered with the G4 EX. The user can store these drawing under the Drawing tab in the back of the manual.

2.1   Unpacking and Inspection

2.1.1   Unpacking

The G4 EX 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.

2.1.2   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's exterior for dents, chipped paint, etc.
- Inspect the LCD window for breakage.
- Visually inspect the electronic boards, cables and EXIMV for damage.

2.1.3   Damaged Components

If any components have been damaged or if there are noticeable defects, notify the Totalflow representative. Keep all shipping materials for the carrier's inspection. Totalflow will arrange for immediate repair or replacement. See the Getting Help section at the beginning of the manual.

2.2   2" Pole Mount Installation

The following information presented in this document will detail the steps for mounting the G4 EX to a 2" mounting pipe using the mounting kit assembly provided with the device. The G4 EX has three mounting types that can be performed, based on the transducer that the user has received. It must be noted that the transducer should be mounted above the meter run to allow adequate slope between the manifold and the orifice fittings.

The installation instructions that follow can be used for either a side pole mount or a stand-alone pipe mount configuration.

Before beginning these steps, review the procedures and the materials required for installation.

2.2.1 Type A

2.2.1.1 Materials Supplied

- G4 EX mounting kit assembly and associated hardware

2.2.1.2 Materials Not Supplied

- One 2" x 40" pipe
- Standard 3 or 5 valve manifold
- Stainless steel tubing

2.2.1.3 Step-by-Step Instructions

FYI

To install the G4 EX, it is recommended that two people perform the installation. One to hold the unit in position and the other to install and tighten the mounting brackets.

The method of installation must be consistent with the user's company policy.

1) Attach the pole mount bracket to the top of the 2" pipe with the U-bolts. Use the provided hex nuts, flat washers and spring lock washers to tighten the pole mount bracket to the 2" pipe.

FYI

Position the mounting bracket high enough on the pipe to allow slope from the externally mounted manifold to the tap valves.

2) Position the provided back clamp on the pole mount bracket, and align the mounting holes between the two pieces.

3) Upon alignment, take the G4 EX and its attached transducer and set it within the recessed groove on the back clamp.

4) Once the G4 EX and its transducer have been properly positioned, attach the device to the brackets using the provided U-bolt. Use the hex nuts, flat washers and spring lock washers to tighten the device to the mounting brackets (see Figure 2–1).

Back Clamp

Pole Mount Bracket

Figure 2–1 Type A Installation Configuration

2.2.2 Type B

FYI

The Type B installation configuration comes from the factory with the transducer already enclosed in two attached mounting brackets.

2.2.2.1 Materials Supplied

- G4 EX mounting kit assembly and associated hardware

2.2.2.2 Materials Not Supplied

- One 2" x 40" pipe
- Standard 3 or 5 valve manifold
- Stainless steel tubing

2.2.2.3 Step-by-Step Instructions

FYI

To install the G4 EX, it is recommended that two people perform the installation. One to hold the unit in position and the other to install and tighten the mounting brackets.

The method of installation must be consistent with the user's company policy.

1) Attach the pole mount bracket to the top of the 2" pipe with the U-bolts. Use the provided hex nuts, flat washers and spring lock washers to tighten the pole mount bracket to the 2" pipe.

FYI 〔💡〕 Position the mounting bracket high enough on the pipe to allow slope from the externally mounted manifold to the tap valves.

2) Remove the lower two hex screws, hex nuts, flat washers and spring lock washers from the transducer's attached mounting brackets.

3) With the associated hardware removed, align the transducer's bottom mounting holes with those on the pole mount bracket.

4) Upon alignment, replace the hex screws, hex nuts, flat washers and spring lock washers through their respective mounting holes on the mounting brackets and into the pole mount bracket. Upon completion, tighten (see Figure 2–2).
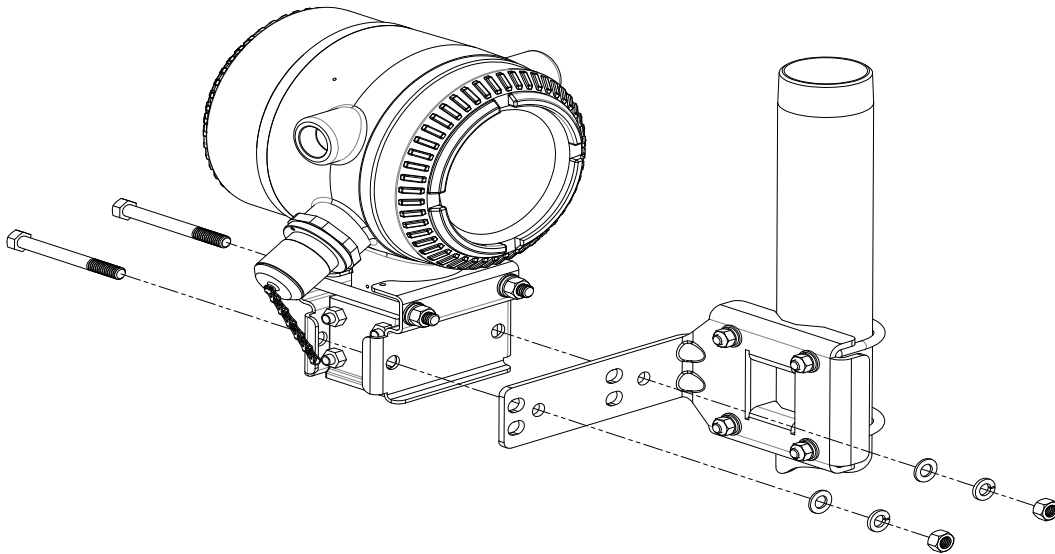
Figure 2–2 Type B Installation Configuration

FYI 〔💡〕 It should be noted that if this is the type of installation configuration that the user has received from the factory, there may be additional parts within the provided mounting kit assembly that are not used.

2.2.3   Type C

2.2.3.1   Materials Supplied

- G4 EX mounting kit assembly and associated hardware

2.2.3.2   Materials Not Supplied

- One 2" x 40" pipe
- Standard 3 or 5 valve manifold
- Stainless steel tubing

2.2.3.3 Step-by-Step Instructions

FYI

To install the G4 EX, it is recommended that two people perform the installation. One to hold the unit in position and the other to install and tighten the mounting brackets.

The method of installation must be consistent with the user's company policy.

1) Attach the pole mount bracket to the top of the 2" pipe with the U-bolts. Use the provided hex nuts, flat washers and spring lock washers to tighten the pole mount bracket to the 2" pipe.

FYI

Position the mounting bracket high enough on the pipe to allow slope from the externally mounted manifold to the tap valves.

2) Position the provided back clamp on the pole mount bracket, and align the mounting holes between the two pieces.

3) Upon alignment, take the G4 EX and its attached transducer and set it within the recessed groove on the back clamp.

4) Once the G4 EX and its transducer have been properly positioned, attach the device to the brackets using the provided U-bolt. Use the hex nuts, flat washers and spring lock washers to tighten the device to the mounting brackets (see Figure 2–3).

Back Clamp

Pole Mount Bracket

Figure 2–3 Type C Installation Configuration

2.2.4 Manifold Input Lines

The following instructions provide the procedural steps to install the manifold. The meter run manifold high (+) and low (-) pressures terminate in the transducer's

---

(EXIMV) + and – Differential Port cells. The Differential Port holes are located on the bottom of the EXIMV (see Figure 2–4).

2.2.4.1   Materials Not Supplied

- Stainless steel tubing
- Tubing fittings

CAUTION 🌪 A backup wrench should always be used when working with stainless steel tubing and valves. This prevents the fitting from turning and/or putting tension on stainless steel tubing.
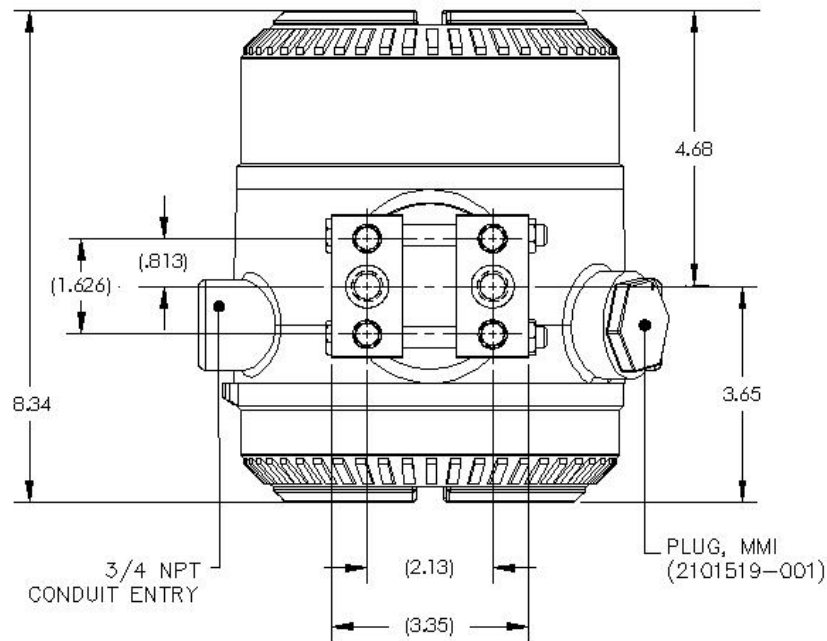
Figure 2–4 G4 EX EXIMV Ports

2.2.4.2   Step-by-Step Instructions

1) Install the isolation valves on the meter run.

2) Install the tubing between the meter run and the XFC. It should be noted that the fittings are not supplied with the unit.

3) Leak check all connections.

TIP ➤ 🎯 Leaks in the tubing or manifold will introduce errors when calibrating the transducer (EXIMV).

2.2.5   Standard RTD Probe Installation

The standard RTD measures flowing gas temperature and should only be used if the G4 EX is located in a General Purpose area, following local codes. The procedures that are presented in this section will enable the user to install the RTD into the meter run.

2.2.5.1 Optionally Supplied Materials

- RTD probe with 10' of cable; optional lengths are 15', 25', 30' 40' and 50'
- One (1) thermowell with ¾" npt threads; optional threads are ½" and 1"
- Nylon tie wraps

2.2.5.2 Materials Not Supplied

- Customer must specify thermowell "U" length
- Teflon tape

2.2.5.3 Step-by-Step Instructions

1) Install the thermowell into the meter run (see Figure 2–5).

CAUTION The power should be removed from the G4 EX before performing any field wiring.

2) Using snap ring pliers, adjust the probe length so that it is spring loaded against the bottom of the thermowell.

3) Screw the probe connector into the thermowell.
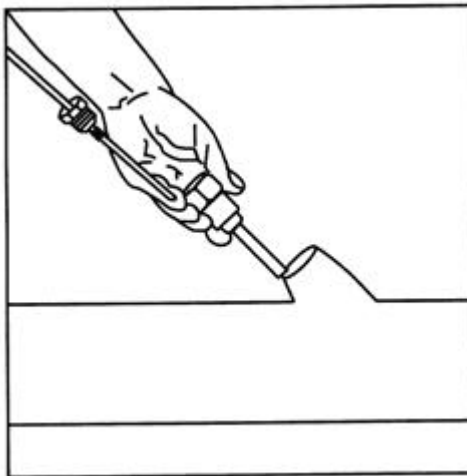
Figure 2–5 Thermowell Installation into the Meter Run

4) At the G4 EX, remove the plug from the Explosion Proof RTD hub, and screw the adapter bushing into the hub.

5) Remove the nut from the water tight cord connector. Leave the nylon sealing ring in place.

6) Insert the wires through the cord connector, and continue through the adaptor bushing into the enclosure (see Figure 2–6).

7) Screw the cord connector into the adaptor bushing, and tighten.

8) Inside of the G4 EX enclosure, begin by disconnecting the connector plug from the RTD connection, J8, to begin field wiring.
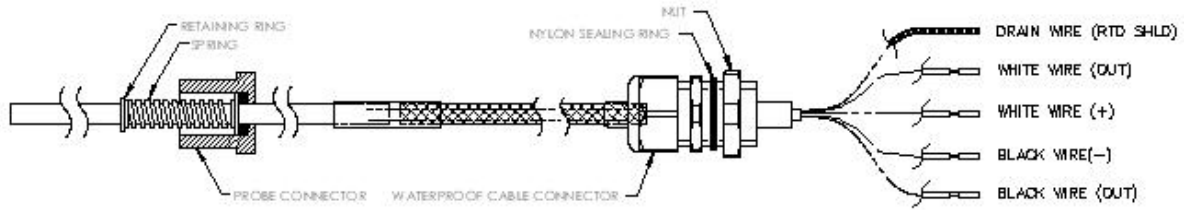
Figure 2–6 RTD Probe Wiring

9) Using the supplied wiring instructions, make the field connections to the connector plug, and re-insert into the J8 board connector.

10) Following the connection of the RTD thermowell, secure the cable to the meter run pipe with plastic tie wraps. Do not wrap cable around the meter run pipe.

2.2.6 Explosion Proof RTD Probe Assembly

If the G4 EX is installed in a DIV 1 area, the Explosion Proof RTD must be used (see Figure 2–7). The following procedures assume that the Explosion Proof RTD kit was purchased as an option. For additional information, refer to the Wiring Interconnect and Application Instructions that were supplied with the kit.
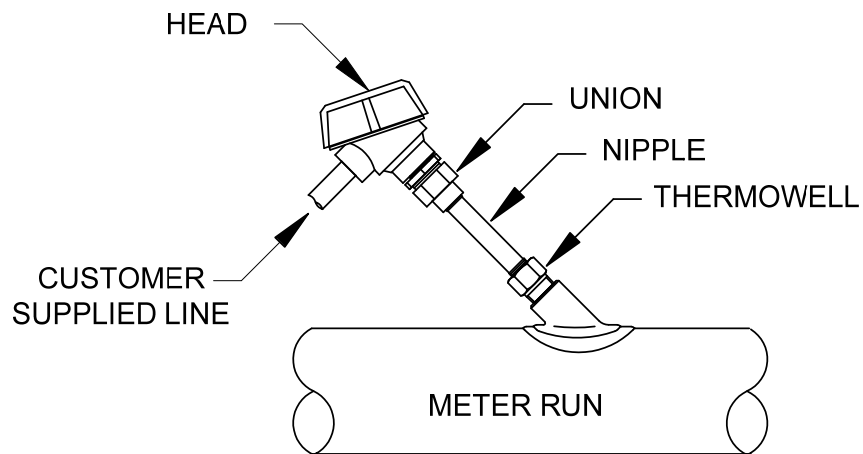
Figure 2–7 Explosion Proof RTD Overview

2.2.6.1 Materials Supplied

- RTD probe (see Table 1—7 in Chapter 1 for available parts)
- Optional thermowell (see Table 1—8 in Chapter 1 for available parts)
- Explosion proof connection head
- Conduit union
- Nipple fitting
- Certification tag
- Wiring instructions

2.2.6.2   Materials Not Supplied

- Teflon tape
- Wiring cable/conduit from Explosion Proof RTD to flow computer (see local codes for material specifications)

TIP The following instructions assume that the thermowell has previously been installed. The end of the thermowell should penetrate the center 1/3 of the meter run.

2.2.6.3   Step-by-Step Instructions

1) Unpack the parts, and verify that all the supplied materials are present. If parts are missing, contact Totalflow Customer Service at 800-442-3097 or +1918-338-4880.

2) Screw the nipple fitting into the thermowell, and tighten (see Figure 2–8).

3) Separate the top and bottom of the union. Screw the union bottom onto the nipple fitting. Be aware that the union nut is on the union bottom. Tighten.
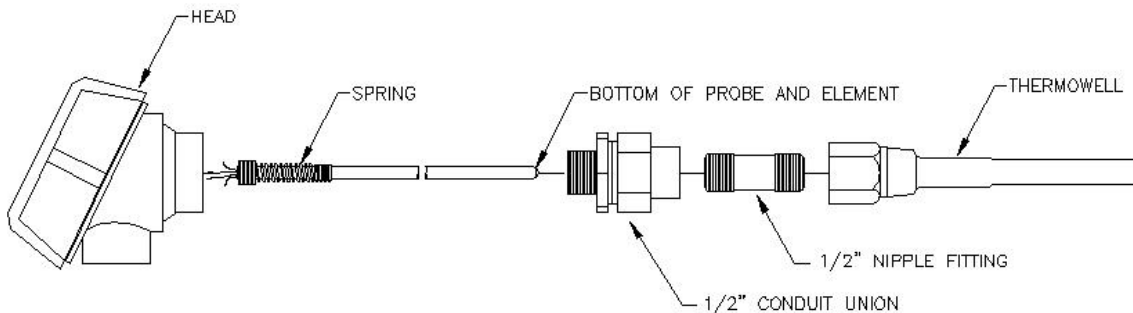
Figure 2–8 Explosion Proof RTD Disassembled

4) Screw the union top into the bottom of the connection head, and tighten.

5) Unscrew, and remove the cap from the Explosion Proof Connection Head.

6) Insert the RTD probe through the opening in the head. Holding the probe from underneath, screw the spring clockwise down into the center of the wiring block. Stop when the top edge of the spring is flush with the top of the wiring block.

7) Insert probe and head assembly through the bottom half of the union that was previously installed into the thermowell. As the union halves meet, the user should encounter some resistance. As the probe contacts the bottom of the thermowell, the user should see the top of the probe rise (3/4" max.).

TIP If the probe assembly is too long or too short, the user may need to change nipple lengths.

8) Lift the union nut up to the union top. Screw together.

9) Align the RTD head to the correct position for the conduit and wiring. Tighten the union nut.

10) Using the supplied Wiring Interconnect drawings, wire the RTD probe at the wiring block (see Figure 2–9).

---

11) Following local codes, run the RTD wiring to the G4 EX unit.
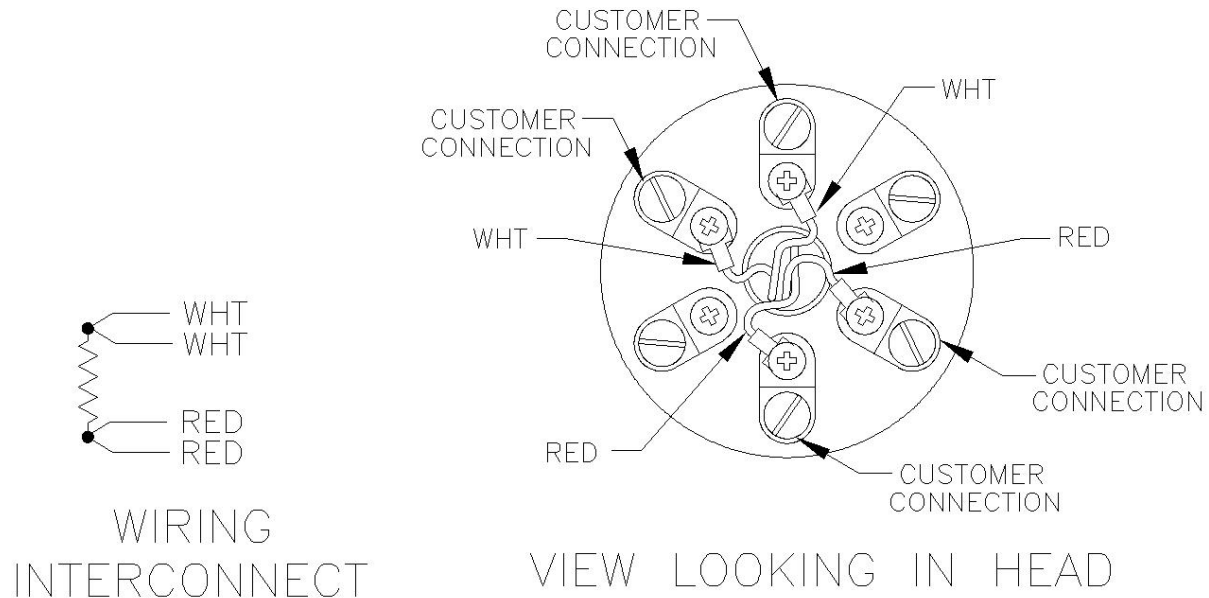
Figure 2–9 RTD Probe Wiring

12) Inside of the G4 EX enclosure, disconnect power from the Termination board. Remove the connection from J16.

13) Remove the connector plug from the RTD connection, J8, to begin field wiring.

14) Using the supplied wiring instructions, make the field connections to the connector plug. Re-insert into the J8 board connector.

15) Restore power to the unit.

2.2.7   6270 Optional Equipment Unit (OEU) Installation

If the 6270 OEU enclosure is used, it may be configured to include other options, including but not limited to, a battery pack to provide power to the G4 EX, communication equipment and solar panel charger.

Following local codes for installation, this unit would normally be located in a DIV 2 or General Purpose area. The unit may be mounted on a 2" pipe or mounted on flat surface such as a wall.

The battery and solar panel are packed and shipped separately from the 6270 OEU. Before installation, inspect all power cables where they terminate and connectors for damage.

Before beginning, review the procedure and the materials required for installation.

WARNING The 6270 OEU system with battery and solar panel is rated for Class I, Division 2 locations only or can be installed in non-hazardous locations.

2.2.7.1   Pipe Mount

Enclosure mounting brackets and fastening hardware are supplied with the unit. The customer must provide a 2" pipe of suitable length (see Figure 2–10).

If a charging source, such as a solar panel, is desired, this procedure may be configured to mount the solar panel on the upper portion of the pipe.
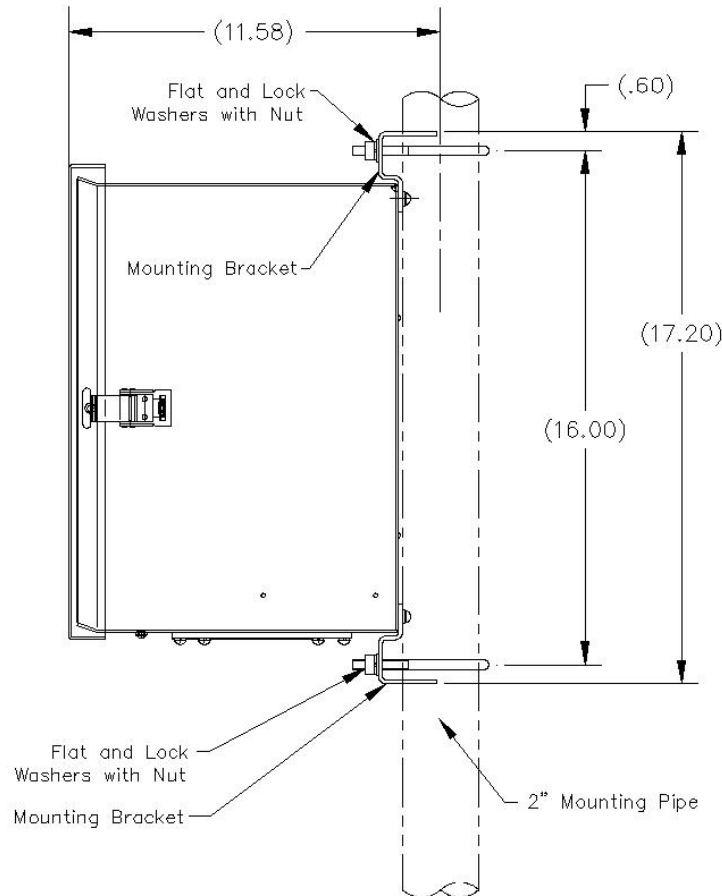
Figure 2–10 6270 OEU Pipe Mounting Installation

Step-by-Step Instructions

TIP   Instructions assume that the user has completed the installation of the 2" pipe.

1) Using the instructions supplied with the mounting kit, attach the bracket to the back of the enclosure unit.

2) Position the unit on the 2" mounting pipe, and secure in place with two U-bolts, flat washers, lock washers and two bolts (see Figure 2–10).

2.2.7.2   Wall Mount

Before beginning, review the procedures and the materials required for installation. A typical installation should look similar to Figure 2–11.

The enclosure mounting brackets and fastening hardware are supplied with the unit.
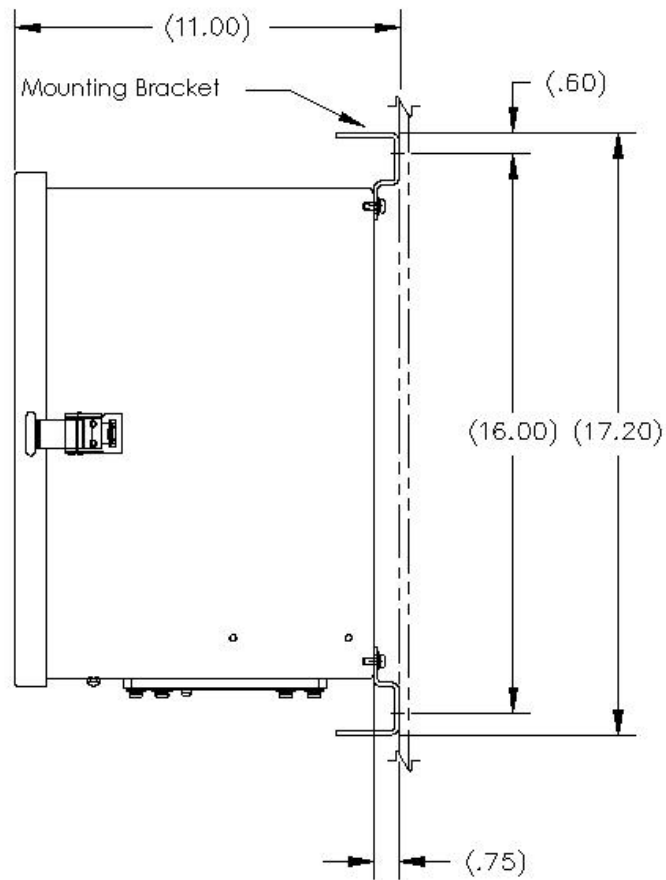
Figure 2–11 6270 OEU Wall Mount Installation

Step-by-Step Instructions

1) Using the instructions supplied with the mounting kit, attach the bracket to the back of the enclosure unit.

2) Prepare the wall surface for mounting, and mount the enclosure to the wall.

2.2.8   Battery Pack Installation

If the 6270 OEU is used (see Figure 2–12) and is configured to include a battery pack, use the following procedures.

The battery is packed and shipped separately from the 6270 OEU. Before installation, inspect the power cables that are located inside the 6270 OEU where they terminate on the battery pack and the connector for breakage.

Before beginning, review the procedures and the materials required for installation.

FYI 💡 To extend the life of the battery pack, fully charge the battery prior to installation. Systems using solar panels may not fully charge the battery. Charging the battery fast will remove the oxide buildup and will improve the life of the battery.

CAUTION 🌀 Do not over charge the battery pack.
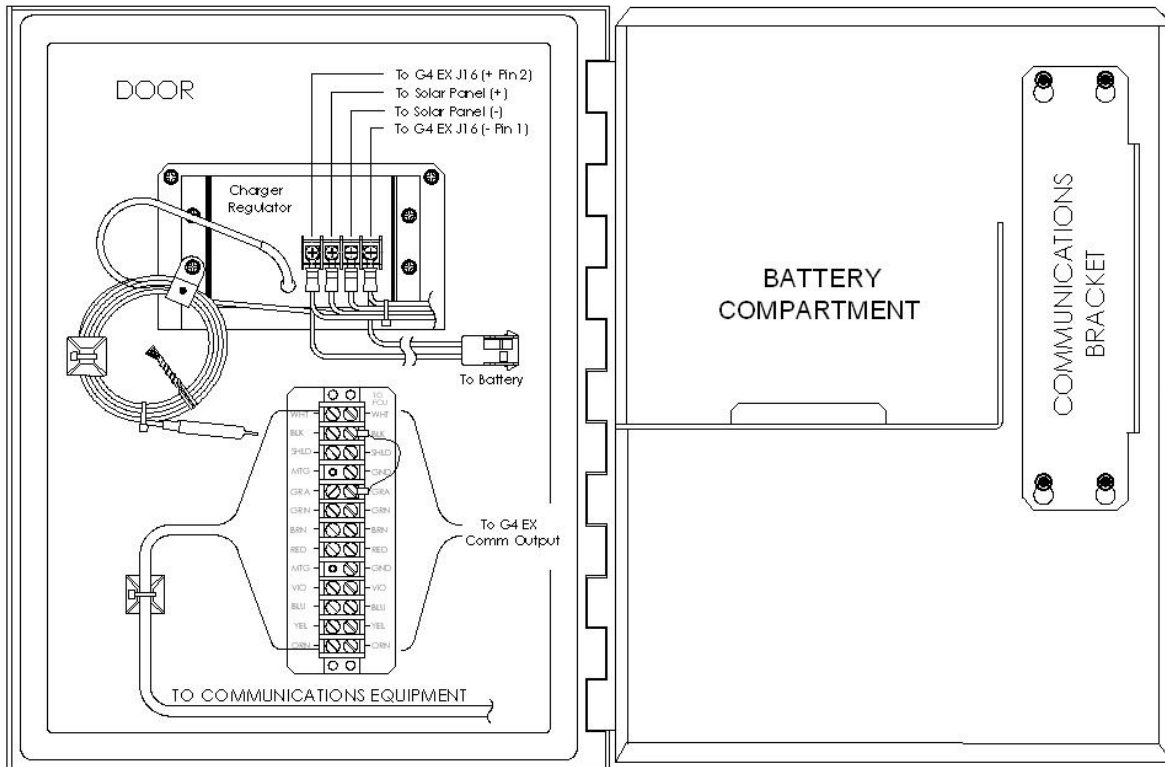
Figure 2–12 6270 OEU Enclosure

2.2.8.1   Step-by-Step Instructions

1) Insert the battery pack into the battery compartment (see Figure 2–12) with the long dimension of the battery facing outward.

2) Connect the battery pack connector to the battery connector mate that is wired to the charger regulator.

3) If the G4 EX unit is already wired to the 6270 enclosure, the LCD screen should display a warm start.

2.2.9   Lithium Battery Installation

The following are steps for installing and verifying the connection on the lithium battery. The lithium battery is disabled when shipped from the factory. The user will need to connect the battery before continuing.

2.2.9.1 Step-by-Step Instructions

1) To connect the battery, remove the front cover of the G4 EX. Look for the battery connector behind and to the lower right side of the display (see Figure 2–13).

2) On the G4 EX board, the lithium (+) red is on top (pin 1) and the (-) black (pin 4) is on the bottom. It should be noted that this is a confined space. As such, place the ground lead of a voltmeter on bare metal, such as the plate behind the display, and place the positive lead on the bottom solder pad. Do not place lead against ground.
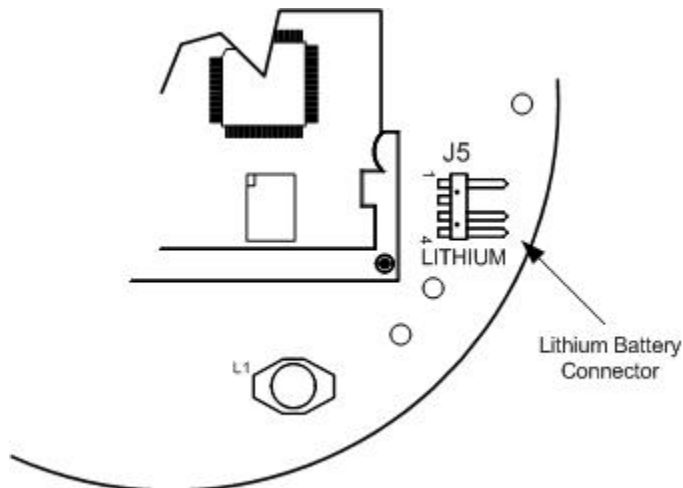
Figure 2–13 Lithium Battery

2.2.10 Solar Panel Installation

The solar panel is designed for outdoor mounting on a 2" extension pipe installed on the upper end of the 6270 OEU 40" mounting pipe (see Figure 2–14). The solar panel must be mounted within 12 feet of the 6270 enclosure (other lengths available). For wall mounted enclosures, it can be mounted on the top or the side of the meter house.

CAUTION Do not connect the solar panel power cable to the charger regulator that is located in the 6270 enclosure, unless the main battery pack has been connected. Refer to the Battery Pack Installation section.

Exercise caution when installing the solar panel so as not to damage it.

FYI For solar panel installations where the panel is mounted on the top or to the side of a meter house, please insure that the panel receives full sun all day. When mounted, the solar panel will face up from the horizon at a 50° angle and face in a southern direction.

WARNING The 6270 OEU system with battery and solar panel is rated for Class I, Division 2 locations only or can be installed in non-hazardous locations.

2.2.10.1 Materials Supplied

- One solar panel
- Two U-bolts and fastening hardware
- Solar panel cable (if not already attached)
- Solar panel mounting bracket (if not already attached to the solar panel)
- Pipe mounting kit

2.2.10.2 Materials Not Supplied

- Cable ties
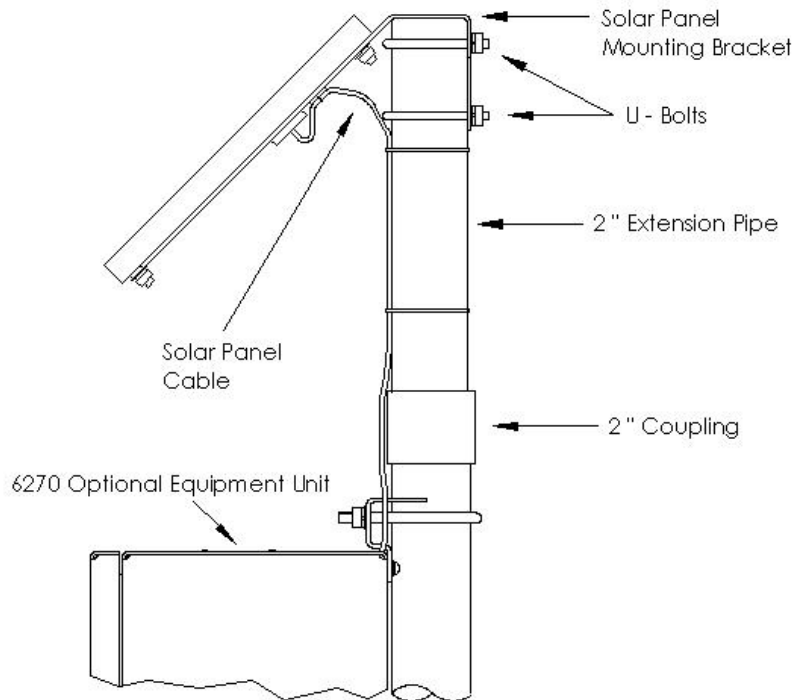
Figure 2–14 Solar Panel Installation

2.2.10.3 Step-by-Step Instructions

1) Attach the 2" pipe coupling to the top end of the 6270 OEU mounting pipe. Securely tighten.

2) Install the 2" pipe extension into the coupling. Securely tighten.

3) Check the solar panel using the Digital MultiMeter to verify polarity and output voltage. Voltage varies depending on the amount of sun, angle to the sun, etc.

4) Install the solar panel on the mounting bracket, if required, with the provided hardware. Install the solar panel cable, if required.

5) Attach the solar panel mounting plate to the top end of the 2" extension pipe with U-bolts and associated mounting hardware. Do not tighten the U-bolts until the solar panel has been correctly oriented.

6) For northern hemispheres, position the solar panel facing south; for southern hemispheres, position the solar panel facing north. For optimum charging, the solar panel should not be in shadows for any portion of the day. The panel should be kept clean for maximum charging.

FYI   The sun's orientation in the sky varies from summer to winter. Keep this in mind when installing the solar panel to make sure there are no obstructions during the entire year.

7) Do not connect the other end of the cable to the 6270 OEU until the main battery pack has been connected and the user has been instructed to do so.

8) Remove the hole plug from the OEU, and install the cord connector.

9) Remove the nut, sealing ring and grommet from the cord connector. Slide the nut, sealing ring and grommet over the end of the cable, and insert the cable through the body of the cord connector. Leave enough of the cable on the outside of the unit to allow the cable to dip below the level of the access hole. This provides a path for moisture to run away from the unit to the lowest point of the cable.

10) On the inside of the enclosure, allow enough cable to comfortably extend to the input terminals on the charger regulator (see Figure 2–14).

11) Slide the nut, sealing ring and grommet to the cord connector on the side of the unit, and tighten.

12) Before making connections to the charger regulator, trim the wire ends back ¼".

13) Verify that the main battery pack is connected.

14) Loosen the securing screws on the charger regulator, insert the wire and then retighten. Connect the solar panel (+) lead to the + terminal and the (-) wire to the – terminal.

15) Following the connection of the solar panel power cable, secure the cable to the 2" extension and mounting pipe cable with the provided plastic tie-wraps.

2.2.11   AC Charging Unit Installation

The AC power charging unit maintains a constant voltage charge on the installed battery pack. See Figure 2–15.

2.2.11.1   Materials Supplied

- AC charging unit
- Pipe nipple

2.2.11.2   Materials Not Supplied

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

FYI		To maintain system certification, all wiring must comply with NEC 501 code and applicable ABB certification drawings.
CAUTION		To prevent injury, only a licensed electrician should install AC power wiring to the user supplied primary AC power source.

2.2.11.3 Step-by-Step Instructions

1) The AC charging unit is shipped separately. When the unit is received, unpack, and inspect all components for evidence of damage. Report damage to the shipping carrier and to Totalflow's Service Department.

2) Remove one of the plugs from the side of the 6270 OEU so that the AC charging unit can be mounted without obstruction. See Figure 2–15.

3) Remove the outside of the lock nut from the nipple. Leave the sealing ring and inside lock nut.
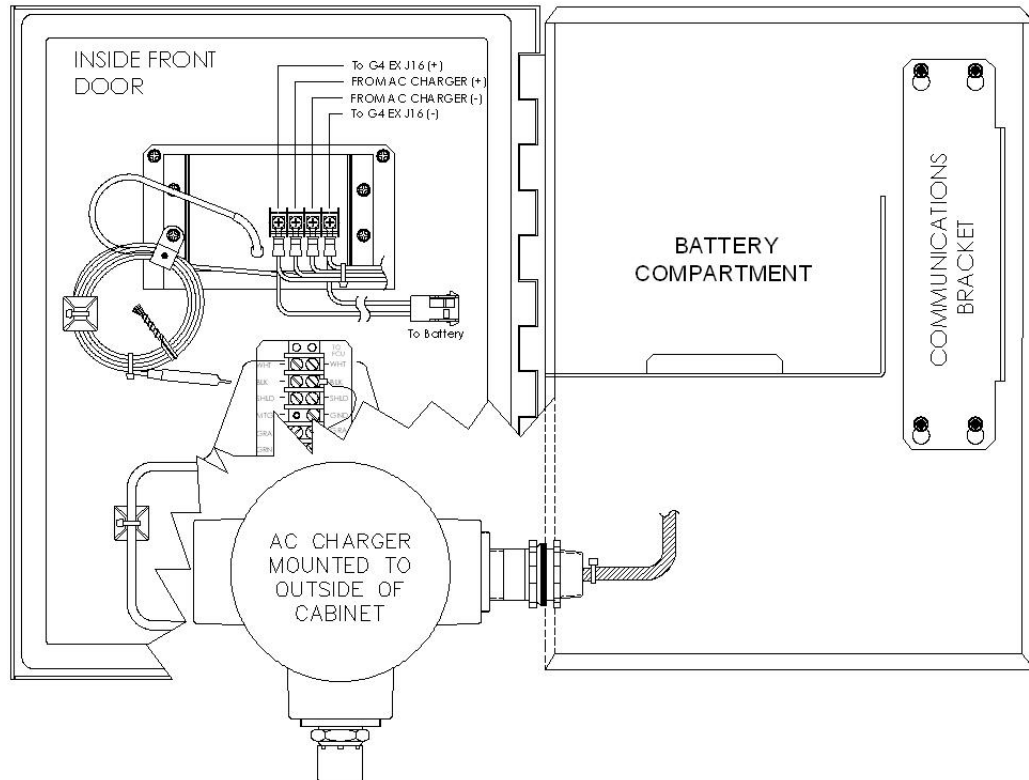
Figure 2–15 AC Charger Installed
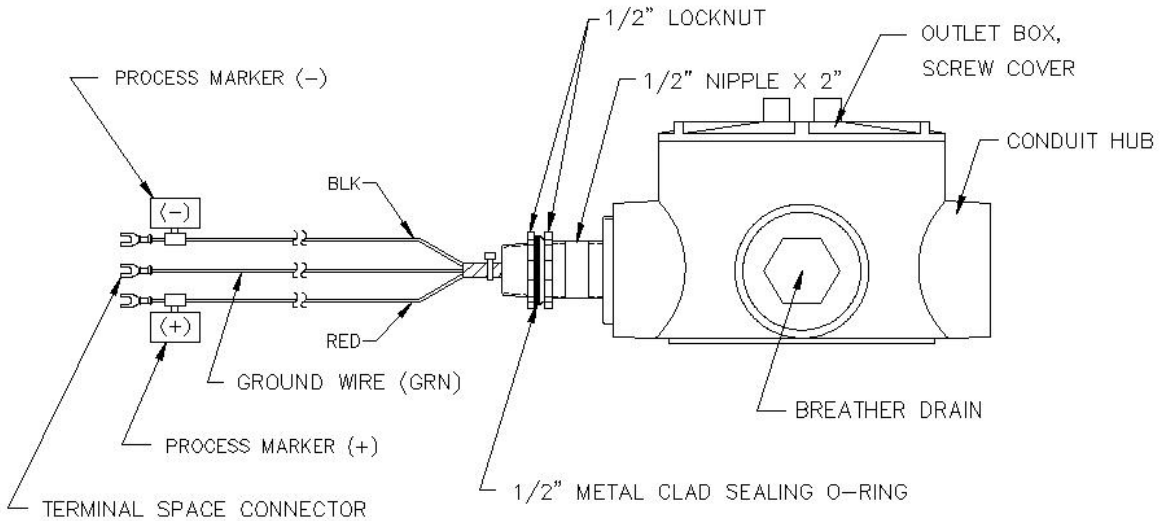
Figure 2–16 AC Charger Outlet Box Installation

4) Feed the AC charger's DC power lines into the enclosure (see Figure 2–16).

5) Insert the nipple through the side of the enclosure, and install the removed lock nut.

6) To prevent moisture from entering the enclosure after installing the AC battery pack charger, be certain the "O" ring side of the metal backed sealing "O" ring is against the enclosure.

7) Loosen the terminal screws, and insert the red wire into the plus (+) array terminal and the black wire in the negative (-) array terminal (see Figure 2–17). Retighten the screws.

8) Connect the green wire to one of the grounding screws that are located on the bottom of the enclosure.

9) Pipe 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 the two hot wires for 240 V to the terminals of the AC charger. Connect the ground wire to the green screw.

10) Verify that the DC power wires are terminated properly inside the 6270 OEU cabinet and that the main battery pack plug is already connected. Apply AC power to the AC charger.
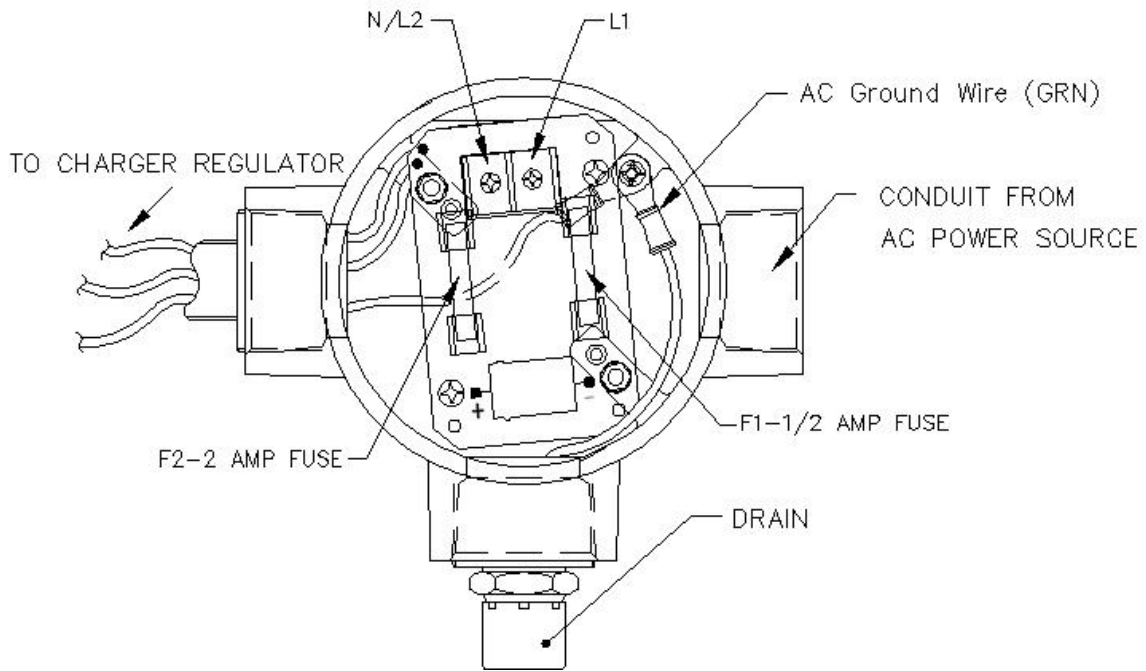
Figure 2–17 AC Charger Inside the Conduit Enclosure

2.2.12   Uninterrupted Power Supply (UPS) to the G4 EX

The G4 EX can be powered directly from any UPS that is supplying 9-30 VDC. See Figure 2–18 for instructions on how to wire the G4 EX Termination board to a UPS.
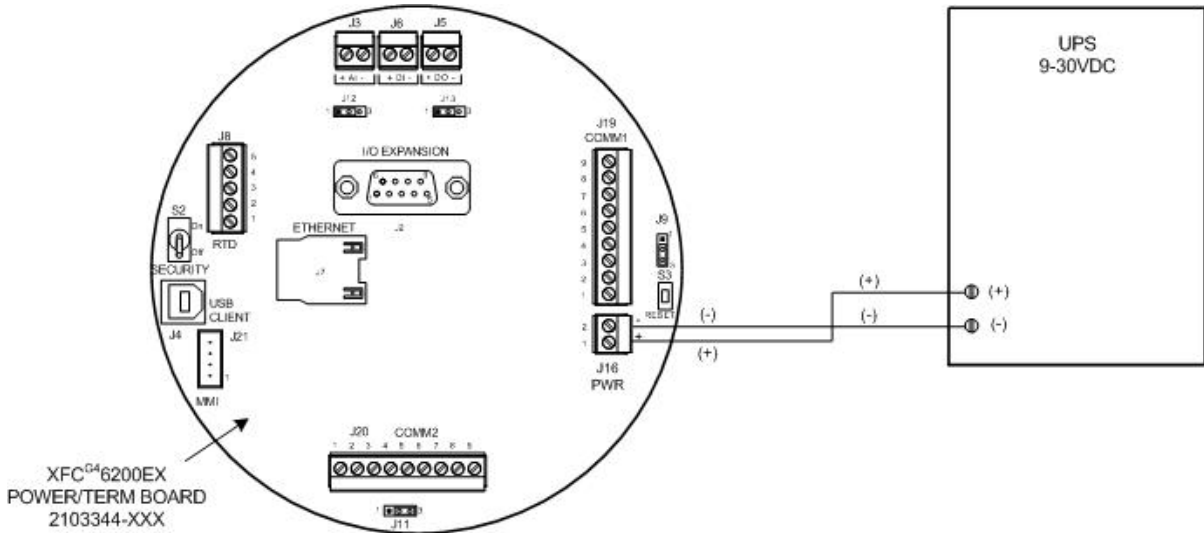
Figure 2–18 G4 EX to UPS

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3.0 G4 EX START-UP

3.1 Overview

The following chapter describes the steps required to get a newly installed G4 EX system up and running. Specific information required to complete each step (depending on equipment choice) is discussed more thoroughly in the PCCU32 help files.

FYI All references in older materials to absolute pressure (AP) have been converted to static pressure (SP). This reflects the difference of including barometric pressure during calibration.

3.2 PCCU32 Installation and Setup

Totalflow PCCU32 7.05.5 (or later) software is required to communicate with the G4 EX. Previous versions of PCCU32 are not compatible.

PCCU32 software running in a laptop Windows® environment offers the user the most capabilities for programming. The Windows environment features user friendly help files and easy to follow menus. Easy to follow menus and icons step the user through many required choices.

3.2.1 Step-by-Step Instructions

1) Insert the PCCU32 disk into the PC drive. The Install Program should automatically load (assuming the Auto Insert Notification has not been turned off).

   If the Install Program does not automatically load, click on Start and then Run.

   - Type the CD/DVD drive letter plus 'setup. For example: E:setup.
   - Click the OK button.

2) The Install Program will load followed by a Welcome message. Click the Next button.

3) A screen will display that asks for user information. Complete entering in the relevant information, and enter the serial number in the appropriate space (the user needs to ensure that they enter both the numbers and dashes for the serial number). Click the Next button.

4) Change the destination directory, if desired. Click the Next button.

5) Change the program folder, if desired. Click the Next button.

6) The installation process will load all the required software. If the install program asks the user to restart the computer, the user will need to do so before running the PCCU32 software.

7) If there is no message that asks for a restart of the computer, the installation is complete. Click the Finish button.

3.3 Establishing Local Communication

As discussed previously, local communication can be established in different ways: RS-232 MMI cable, Bluetooth or USB cable. The unit can be configured for one or the other or all. TCP/IP is available but is designed for use over a network setup.

With each selection, the user will see options that pertain only to that connection method.

3.3.1 Connecting to a Local Port via a RS-232 Cable

If the unit is configured to include the local RS-232 Communication port, the connection is made using the RS-232 cable. This connects the laptop computer to the local port on the meter.

3.3.1.1 Step-by-Step Instructions

1) Connect the MMI cable to the designated port on the PC (default is COM 0) and to the local port located on the unit.

2) The user needs to open PCCU32. Upon selection, PCCU32 will open.

3) With the MMI cable connected, click the Connect icon on the PCCU32 main toolbar. The Local Connect screen will display.

TIP If the invalid security code screen displays, enter four zeroes (0000) for the new code, and click the OK button. The G4 EX should have defaulted to 0000 on start-up.

If the meter has been given a security code, the user needs to ensure they have entered that code in PCCU32's System Setup screen (see Figure 3–1). However, if the meter has been cold started, the security code will be reset to factory default, and historical data will be lost.
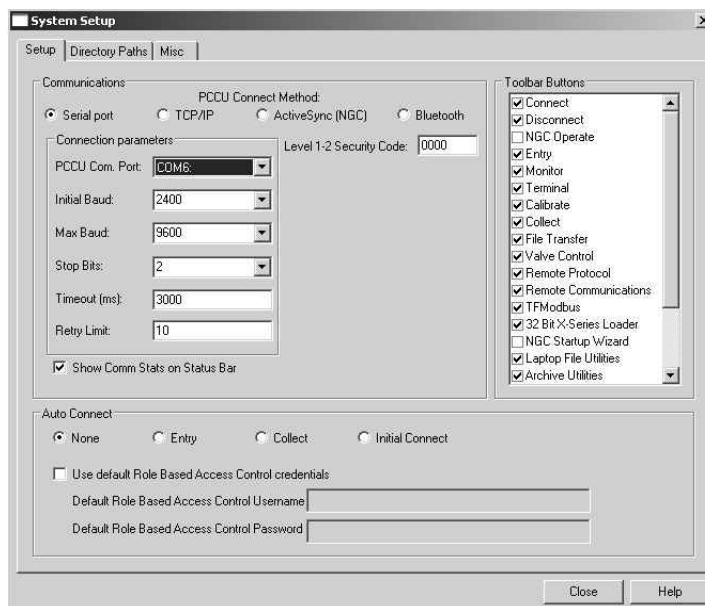
Figure 3–1 System Setup Screen

4) The Local Connect screen displays six buttons. From the button selections, click Entry Setup to move to the Station Setup screen. Links within the PCCU32 tree-view will move the user to screens for setup and daily operations.

3.3.2 Connecting To Local USB Port

If the user's unit is configured to include the local USB communication port, the connection is made using the USB cable. This connects the laptop computer to the Local port on the meter.

Before the user is able to communicate to the G4 EX using a USB cable, they must install the Totalflow USB driver: Totalflow.inf.

3.3.2.1 Step-by-Step Instructions

1) If the G4 EX and laptop are powered up when the connection is made, the user will receive the Found New Hardware Wizard screen (see Figure 3–2). When this screen displays, the user needs to select the No, not this time radio button. Click Next.

Figure 3–2 Windows Found New Hardware Wizard

2) To install Totalflow.inf, select the Install from a list or specific location (i.e., the PCCU32 folder) radio button (see Figure 3–3). Click Next.

3) Select the Include this location in the search checkbox. Browse to the PCCU32 folder. In Figure 3–4, the folder was named PCCU605 to draw attention to the necessity to run PCCU32 version 7.05.5 or later with the G4 EX. After browsing to the folder that contains the Totalflow.inf, click the Next button.

Figure 3–3 Specific Location Selection Window
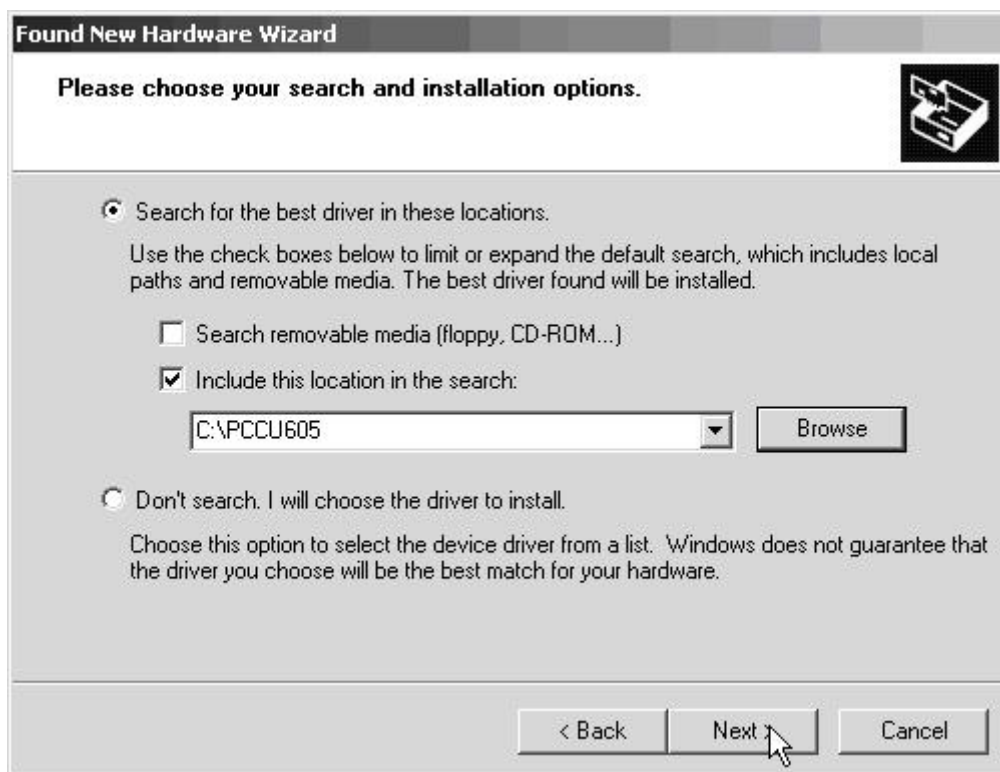
Figure 3–4 Specify Location for USB Driver (Totalflow.inf)

4) At this point, the user may receive a Microsoft message that warns that the Totalflow USB driver has not passed Windows Logo testing. If the user wishes to use their laptop's USB port, they will need to click on Continue Anyway, and proceed on with the installation.

5) The installation procedure begins loading the Totalflow.inf. This should only take a few seconds. This will complete the Found New Hardware Wizard. Click the Finish button. The Totalflow USB driver is now installed.

FYI If the user sees the Found New Hardware Wizard on subsequent connects to the meter, click the Cancel button.

6) The user will need to open PCCU32.

7) With the USB cable connected, click on the Connect icon within the PCCU32 main toolbar. The Local Connect screen displays six buttons. From the button selections, click Entry Setup to move to the Station Setup screen. Links within the PCCU32 tree-view will move the user to screens for setup and daily operations.

3.3.3   Setup of the G4 EX for Bluetooth Connectivity

The following instructions will show the user how to set up the G4 EX for Bluetooth connectivity.

3.3.3.1   Step-by-Step Instructions

1) Plug the Bluetooth adapter into the computer. Ensure that all the relevant drivers are installed, and the device is working properly.

2) Open PCCU32. From the PCCU32 main toolbar, select the System Setup icon. This will take the user to the System Setup dialog box.

3) The user will need to click the Bluetooth radio button to establish that this is the method by which they are connecting.

4) Once this has been accomplished, the screen will populate with the relevant fields that pertain to the Bluetooth connection method. If the Bluetooth adapter is supported by the G4 EX, the Search for Bluetooth Devices button is activated along with a drop-down list of Bluetooth devices that have previously been selected (see Figure 3–5).

5) The user may select a previous Bluetooth device in the drop-down list or search for a device (see Figure 3–6). If the user searches for a Bluetooth device, the list will contain previously paired devices and not just the devices in range.

6) The user may select the preferred Totalflow Bluetooth device, or if that one was not found after the search, the user can initiate another search. Upon selection, the device will be populated in the drop-down list in the System Setup dialog box.

7) The user must provide the Bluetooth pairing code to automate the connection. This is typically a 4-digit authentication code set in the device and is defaulted to 0000.
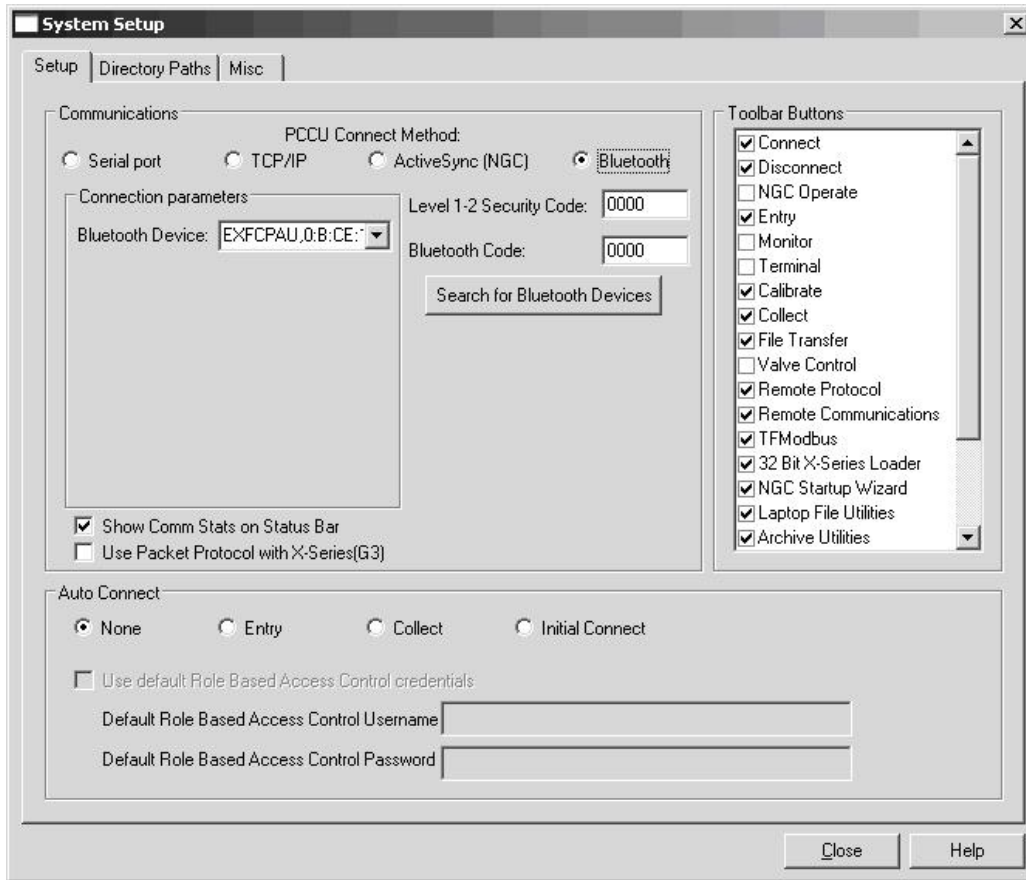
Figure 3–5 System Setup - Bluetooth
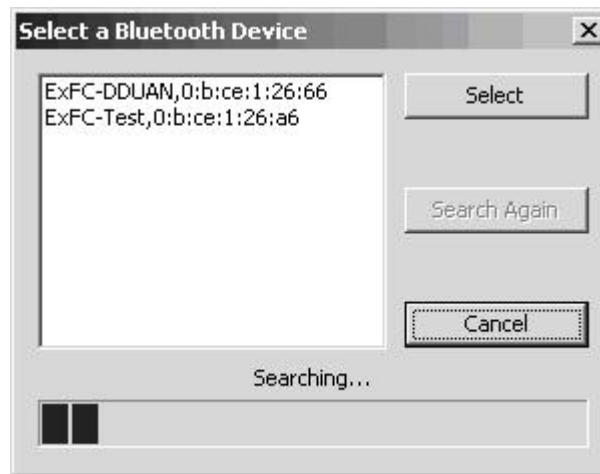
Figure 3–6 Select a Bluetooth Device Dialog Box

8) The user can close out of the System Setup dialog box, and press the Connect button. PCCU32 will attempt to pair with the selected Bluetooth supported Totalflow device and establish communication with it.

9) It should be noted that if the Bluetooth adapter plugged into the computer is one that is not supported, the user will receive a different screen in the System Setup dialog box (see Figure 3–7). At this point, the user must use

their Windows software that came with the Bluetooth adapter, and set up a pair/connection to the preferred Totalflow Bluetooth-enabled device.
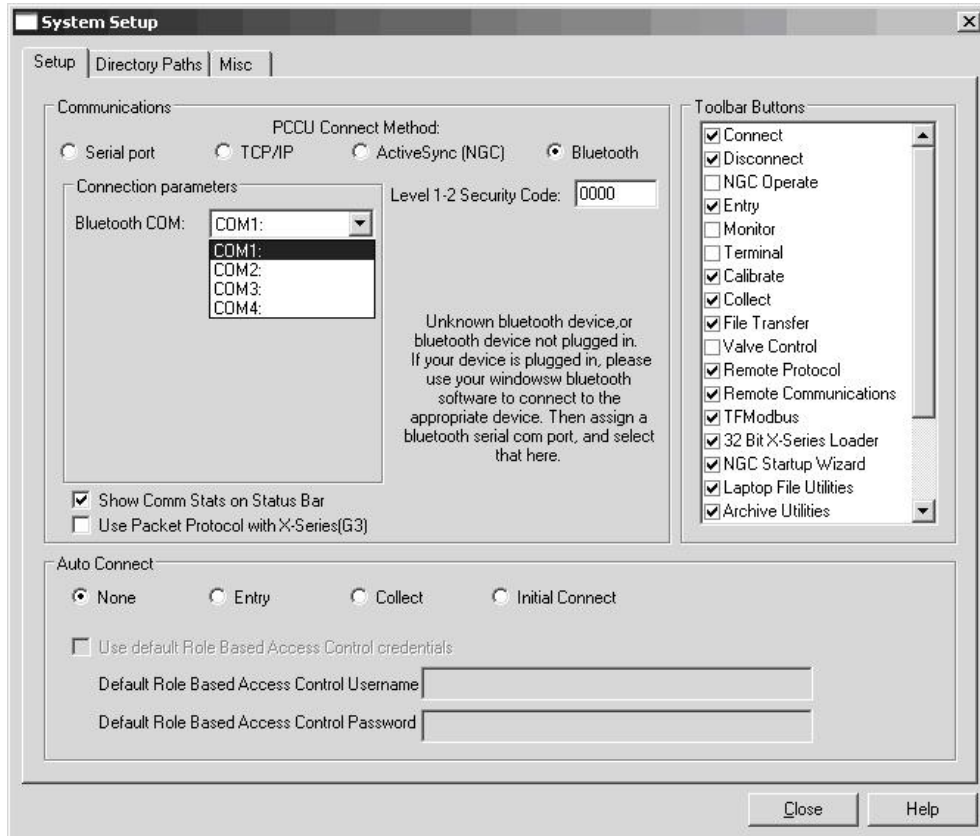
Figure 3–7 System Setup Dialog Box - Bluetooth

10) Once the pair/connection has been made, the user will need to assign a communication port to it. After this is accomplished, the user can set the com port in the drop-down list provided on the System Setup dialog box.

11) The user will then need to close the System Setup screen, and connect to PCCU32 to communicate with the device.

3.3.4 Setup of the G4 EX for Ethernet Connectivity

To set up the G4 EX for an Ethernet connection, the user must first connect locally using either the RS-232 or USB cable. Using the local connection allows the user to setup the device for Ethernet connectivity.

Currently, there are a variety of methods for completing this task. The following will cover two such methods.

3.3.4.1 Method One

1) Connect locally using either the RS-232 instructions or the USB instructions covered in the previous section(s).

2) In PCCU32 Entry mode, select Communications from the tree-view. Upon selection, click on the Network tab (see Figure 3–8).
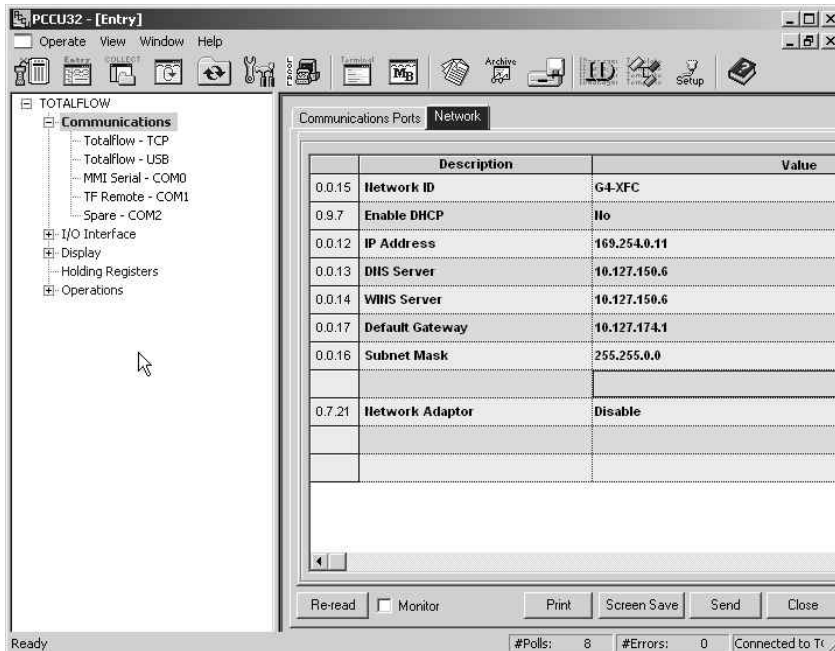
Figure 3–8 Network Tab

3) The user will need to enter a Network ID, and set the Enable DHCP parameter field value to Yes. The other fields within the tab will auto-populate. Click the Send button.

4) Next, the user will need to locate the Totalflow – TCP selection under Communications in the PCCU32 tree-view (see Figure 3–9). Once selected, the user is taken to the Setup tab. In this tab, the user needs to set the Protocol parameter value to Totalflow/TCP. When done, click the Send button.
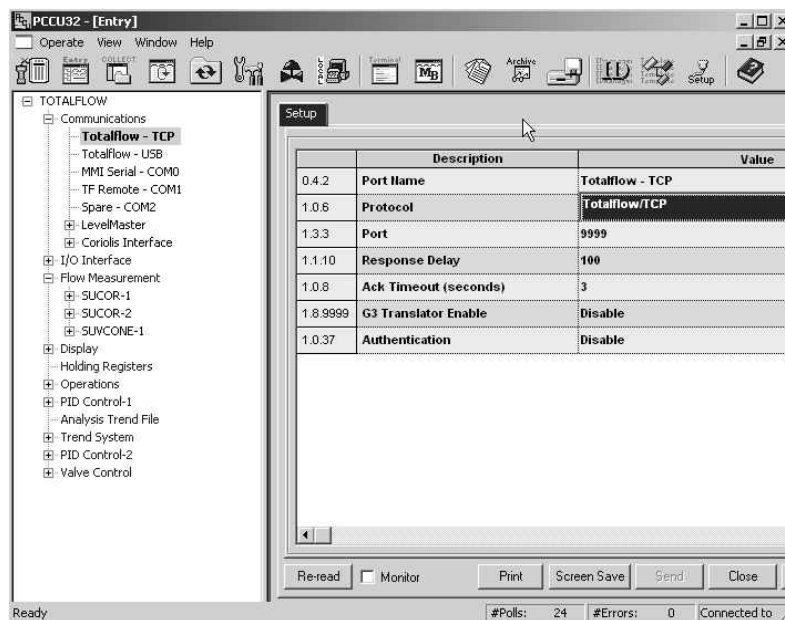
Figure 3–9 Communication Setup

5) While still in PCCU32, the user needs to click the Operate selection on the main PCCU32 toolbar. From the drop-down menu, select Setup. From the fly-out menu, select System Setup.

6) Within the System Setup dialog box (see Figure 3–10), click the TCP/IP radio button. Next, enter the network ID or IP address for the meter in the corresponding parameter field. The network ID is the same ID that the user entered earlier within the meter setup.

7) Upon finishing, click the Close button.
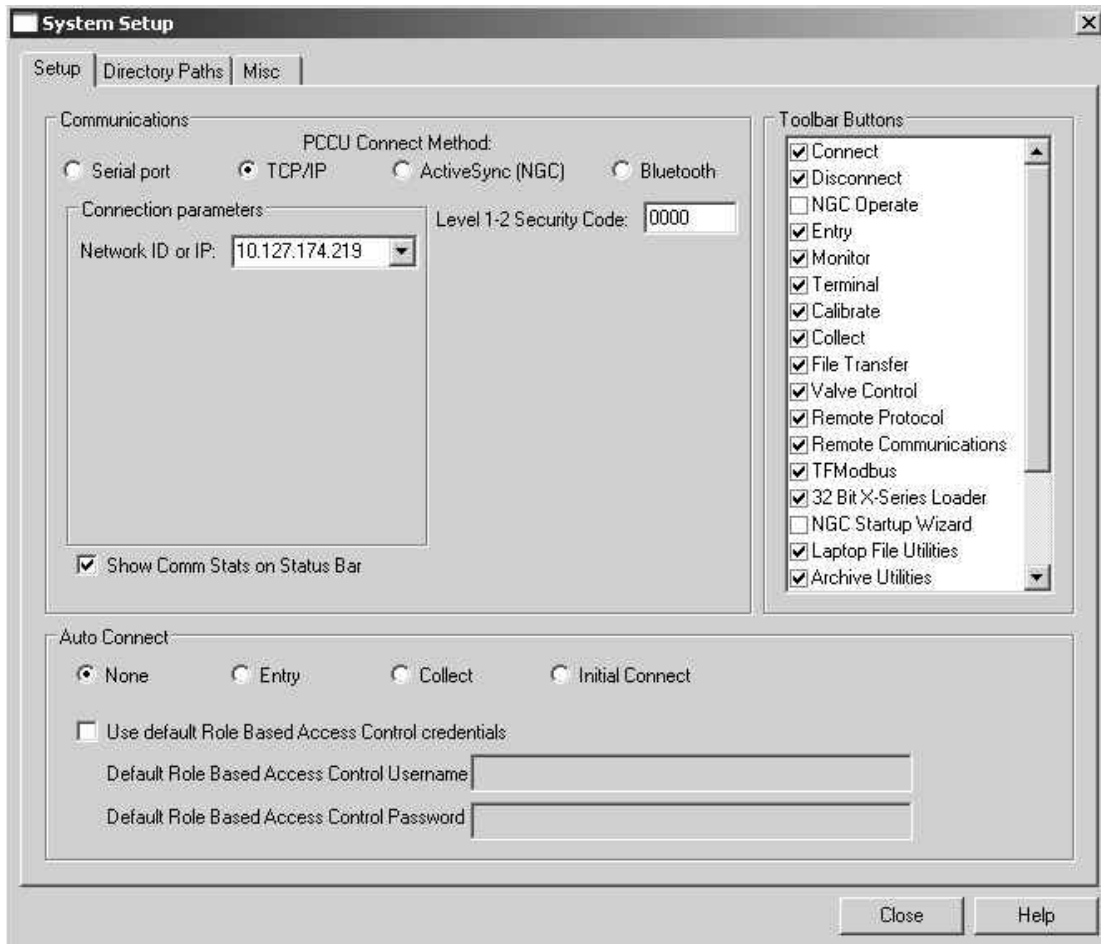
Figure 3–10 System Setup Window

8) Exit PCCU32 and the local connection.

9) With the Ethernet cabling installed, connecting to the meter is no different than when using the PCCU cable or military connector. Click on the Connect to Totalflow icon in the PCCU32 toolbar. To connect and move directly to Entry mode, click on Entry instead of the Connect icon.

TIP ⇒ ◎ If the user has several meters on their network, they may find it helpful to create a desktop shortcut for each meter. For instructions on how to accomplish this task, follow steps 10 – 12; otherwise, the user may continue on to the next section.

---

10) Create a desktop shortcut, and assign a name to it. For the sake of the example, the following will use the meter's ID for the shortcut name.

11) The user will now need to point to the version of PCCU32 that they want to use (the user may have multiple versions of PCCU32 on their laptop). It should be noted that it must be PCCU32 version 7.05.5 or later.

12) The user will then need to identify the network protocol to be used (TCP) and the network ID (see Figure 3–11).

For example:

- Point to the folder with PCCU32 in it.
- Point to PCCU32.exe.
- Point to the protocol (TCP).
- Point to the specific network address (XFC-148).
- String the enter address together: C:\PCCU605\pccu32.exe TCP:XFC-148.
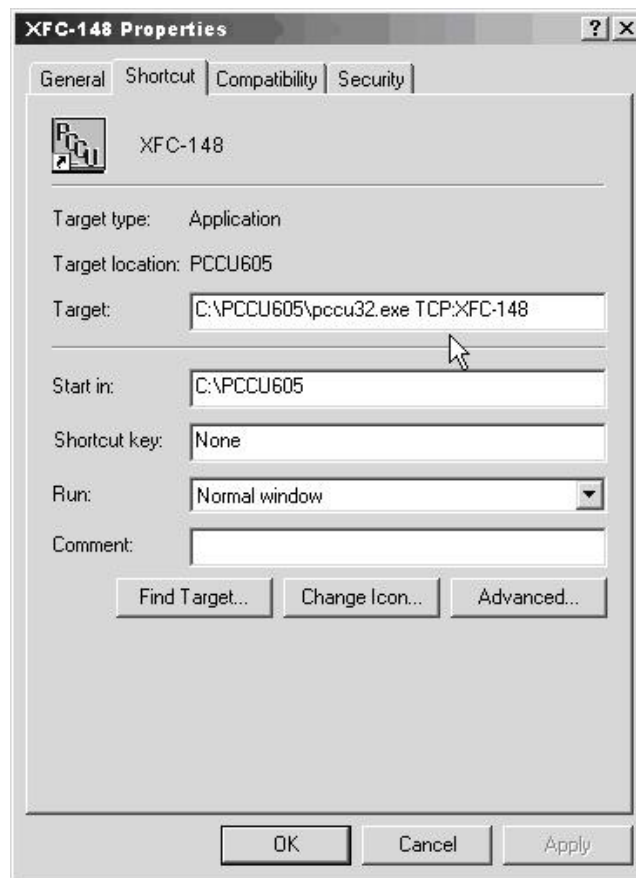
Figure 3–11 Windows Desktop Shortcut Dialog Box

3.3.4.2   Method 2

1) Connect locally using either the RS-232 instructions or the USB instructions covered in the previous section(s).

2) In PCCU32 Entry mode, select Communications from the tree-view (see Figure 3–12). Upon selection, click on the Network tab.

3) In the Network tab, set the Enable DHCP parameter field value to No. Click the Send button. The remaining parameter fields within the Network tab will auto-populate.
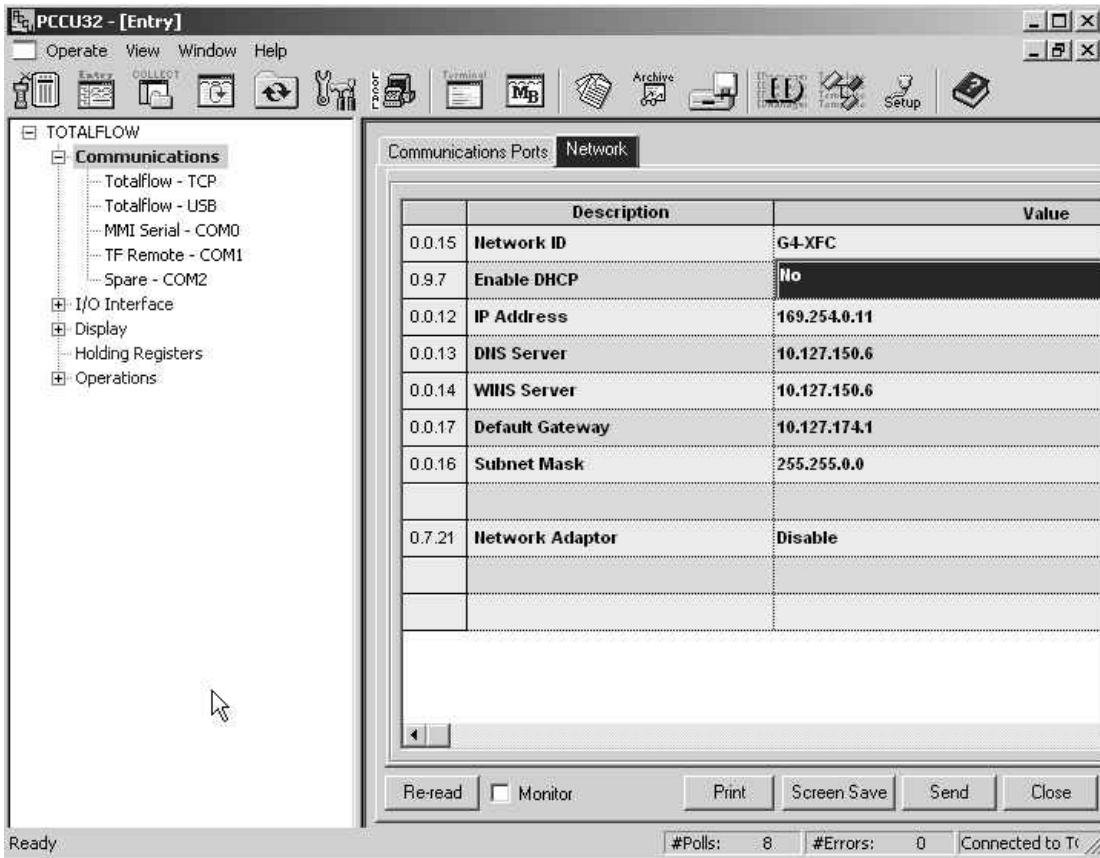
Figure 3–12 Network Tab

4) Move to the IP Address parameter field, and type in the IP address that is reserved for the device. Click the Send button.

5) Close PCCU32.

6) Open the door to the unit, and locate the Reset button on the board. When located, press the Reset button. This will set the IP address on the board.

7) The user will need to reopen PCCU32, but do not connect.

8) From the PCCU32 toolbar, click the Setup icon. This will take the user to the System Setup dialog box (see Figure 3–13).

9) Within the System Setup dialog box, the user needs to select the TCP/IP radio button.

10) Move to the Network ID or IP parameter field, and type in the IP address that was established in step 4.

11) Click the Close button.

12) Reconnect to PCCU32, and move back into Entry mode. This establishes the Ethernet connection.
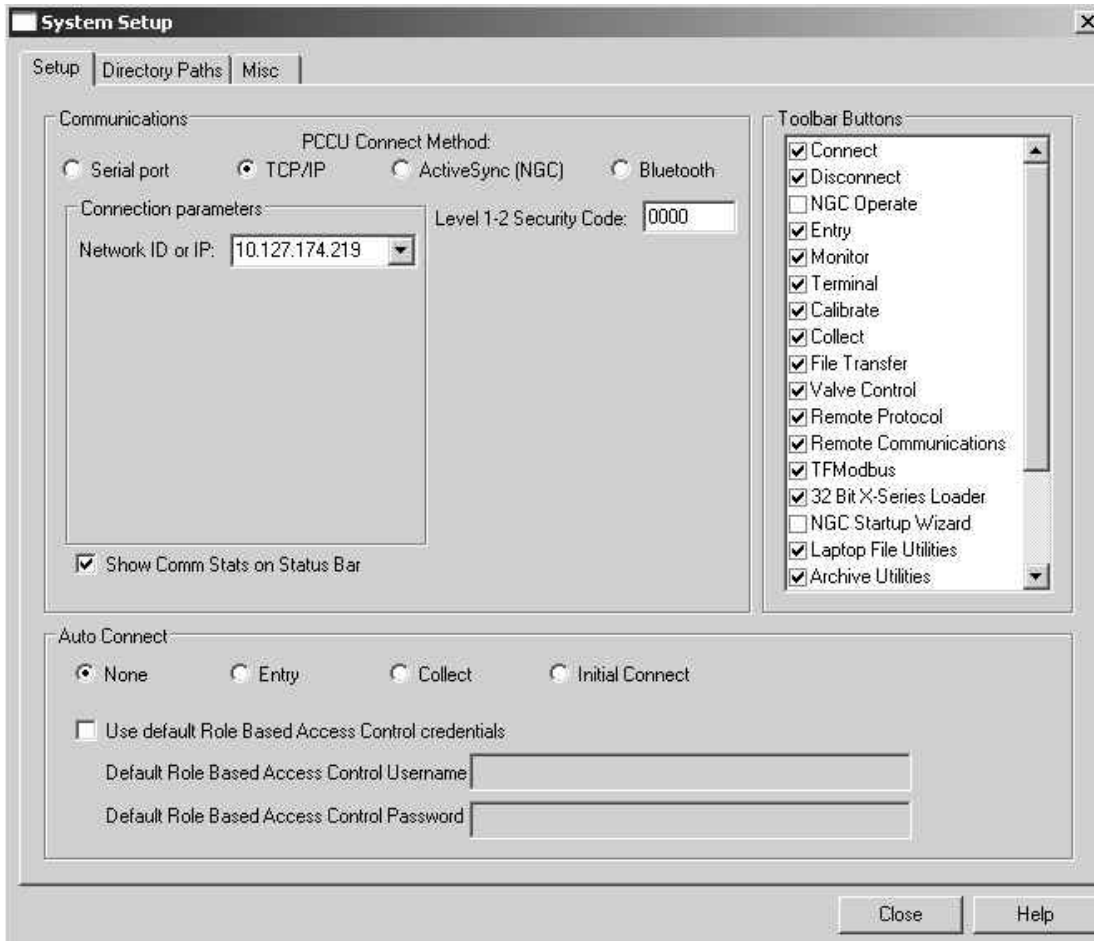
Figure 3–13 System Setup

3.4   Setting Up the G4 EX

Once the user has physically connected to the G4 EX, they must then instruct the software of the programming device to connect to. At this time, the software will actually read the device default values that are programmed at the factory. These preset values are based on the type of product that the user has ordered and programmed for the most widely used configuration.

Depending on the programming device that is being used, the following are minimum required entries. Specific information required to complete each step is discussed in the PCCU32 help files.

3.4.1   Date/Time

The G4 EX date and time should be set before other tube parameters are entered. This insures that events are properly dated and time tagged. Attention should be given that the date and time are set correctly and should agree with the collection equipment. PCCU32 or WinCCU can be used to update the date and time of the device.

Description	Format	Note
Date	MM/DD/YY	Must enter 2 digits each
Time	HH:MM:SS	24-hour clock

3.4.2   Station ID

The station identifier code should uniquely identify one G4 EX from that of any others.

Description	Format	Note
Station ID	XXXXXXXXXX	10-digit alphanumeric

3.4.3   Location

The location field can hold up to 24 alphanumeric characters to describe its location. An example would be the lease name, county name or road number.

Description	Format	Note
Station ID	XXXXXXXXXXXXXXXXXXXXXXXX	24-digit alphanumeric

FYI There are additional fields stored in WinCCU for uniquely identifying the meter, including fields for entering the lease holder, producer, operator and buyer. These fields reside on the host computer in the ID Manager not in the G4 EX.

3.4.4   Security System

Currently, there are three types of security that are possible:

- Device enforced legacy level 1-2 security
- WinCCU enforced legacy security
- Device and PCCU32 enforced Role Based Access RBAC security

The following sections will cover these security options.

3.4.4.1   Bi-Level Security

Data and configuration security in the G4 EX is spread across three elements: the flow meter, PCCU32 and WinCCU32.

The G4 EX has a security switch (S2) on the Termination board. Password security is bi-level: read only (security code level 1) or read/write (security code level 2). To establish meter security, the user must have the security switch in the OFF position, and locally connect with PCCU32. Enter a four digit number level 1 and level 2 security code, and click Send.

Meter Security

To establish a meter security, the user must have the security switch in the OFF position, and locally connect with PCCU32.

1) Enter a four digit number for level 1 and level 2 security codes (see Figure 3–14), and click Send.
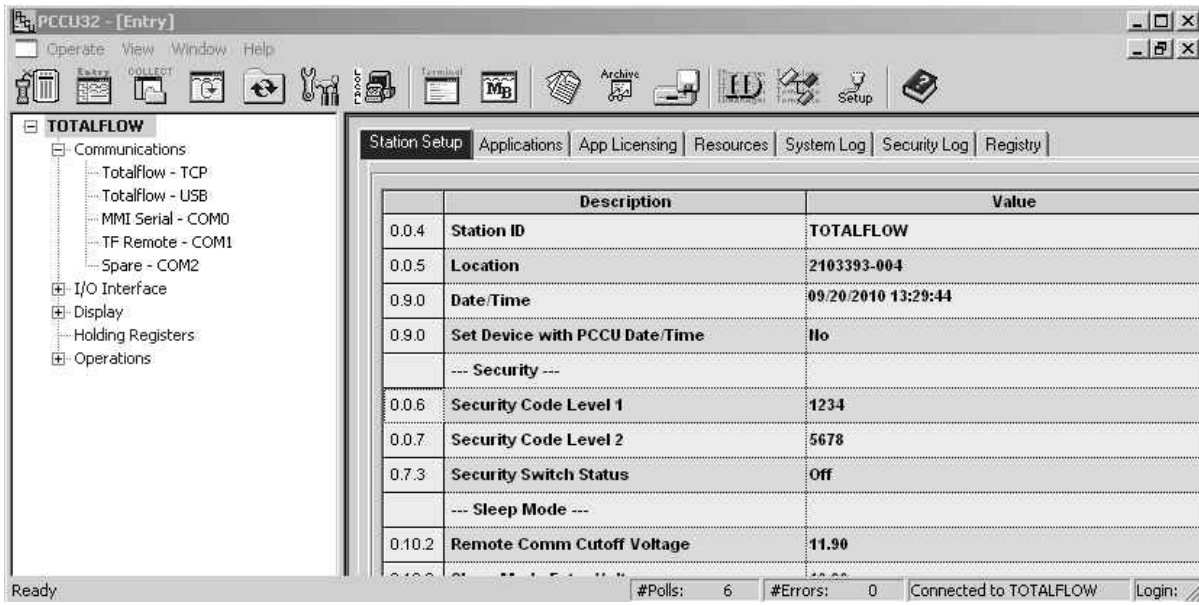
Figure 3–14 Station Setup Tab

Turning the Security Switch (S2) ON will activate the security codes. The level 1 code (in the above screenshot, 1234) will allow data and configuration values to be read but not altered. The level 2 code (in the above screenshot, 5678) will allow full access to read and write.

These security codes must be entered into PCCU32 and WinCCU32 to provide the appropriate access to the meters. However, WinCCU32 will always need the proper security code, regardless of the position of the security switch (S2). Turning the security switch Off does not allow unprotected access for a WinCCU32 operator.

FYI — Modbus access to the meters is not protected by the security codes.

PCCU32 Security

PCCU32 will require the appropriate security code to be entered. To enter the security code, the user will need to move to System Setup in PCCU32. In the provided example (see Figure 3–15), the operator has been provided with read only access to the meter.

The security code level of 1234 (per Figure 3-15) provides read only access to the meter. If 5678 was entered, the user would have full read/write access to the meter.

FYI — If the security level is breached, the meter will give no indication. Any data that the user attempted to change will simply remain unchanged.
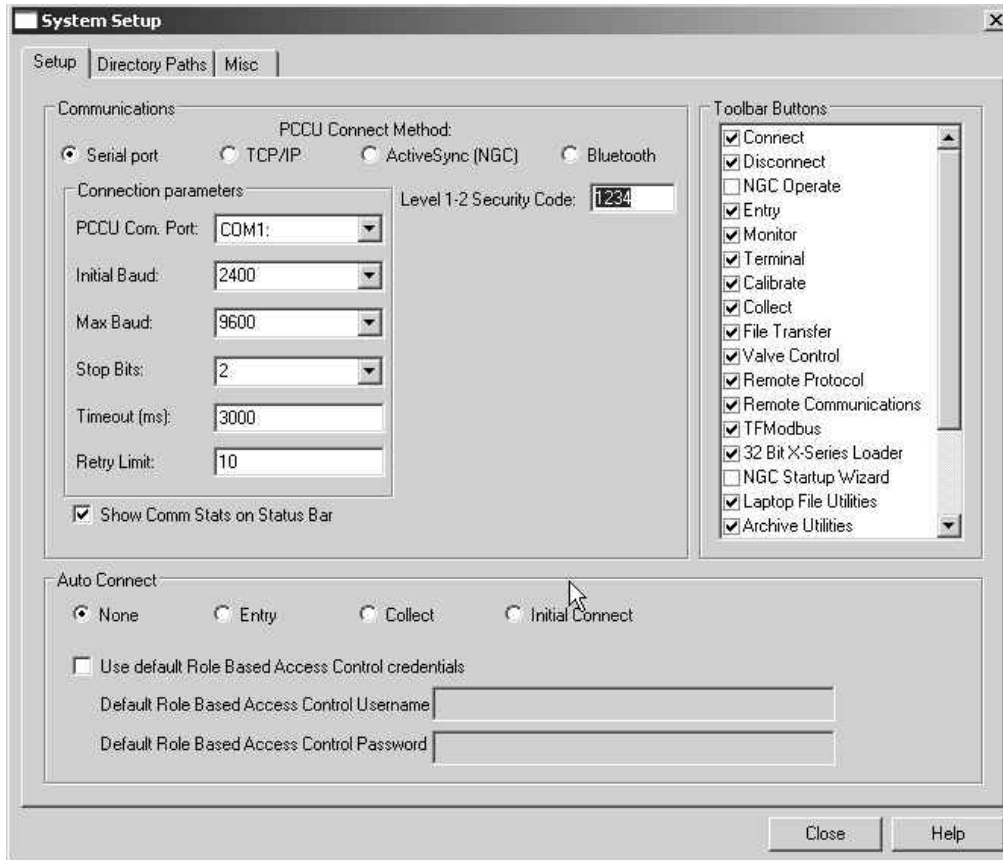
Figure 3–15 Security Setup Dialog Box

WinCCU32 Security

WinCCU32 also requires the appropriate security codes (see Figure 3–16).
Highlight the appropriate meter, and click Edit ID.
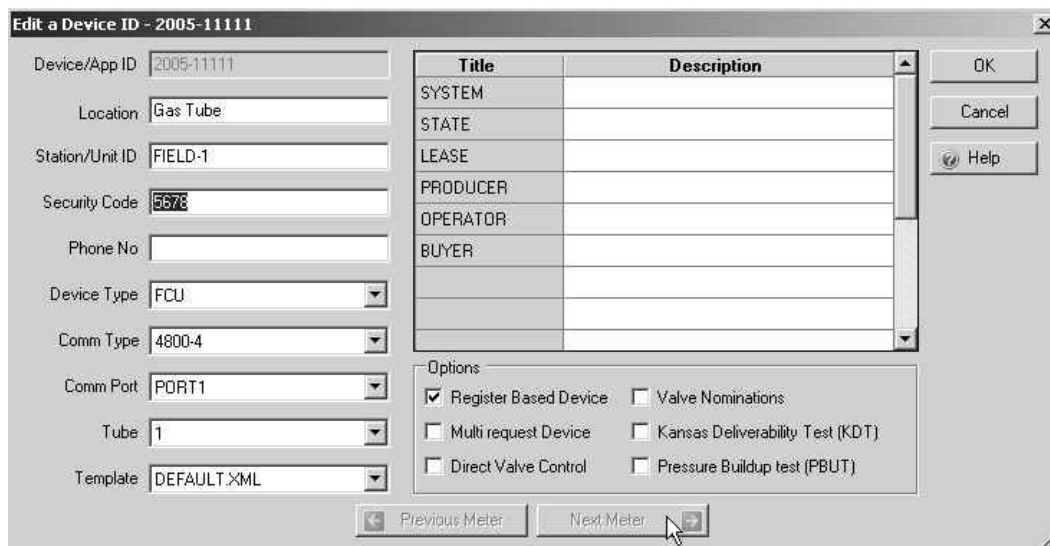
Figure 3–16 WinCCU32 Edit a Device ID Dialog Box

The security code level 2 of 5678 (per Figure 3–16) has been entered. This gives the WinCCU32 user full read/write access to the meter.

FYI   Modbus access to the meters is not protected by the security codes.

CAUTION   If the Security Switch (S2) on the Termination board is in the Off position, no security code has to be entered to access the operating parameters, even if there is one programmed into the device.

3.4.4.2   Role Based Access Control (RBAC)

Role Based Access Control (RBAC) is a feature in PCCU32 that is designed to allow an administrator to designate roles and control access levels to various applications and processes in G4 devices.

Beginning with a set of default roles, it is possible to duplicate, rename and delete these items to create a working list of access roles that are relevant to the user's company hierarchy. From this role list, it is then possible to create user accounts with various assigned roles. The user is also given the ability to take the newly created configuration and save it in the form of a security file to their PC. The security file can then be sent to a G4 device, where it is then implemented.

FYI   RBAC is enforced by both the device and the PCCU32 interface for G4 devices. Enforcement on devices is on a port-by-port basis. When RBAC is enforced, type 1 and 2 security is superseded.

Security File Configuration

RBAC configurations can be defined and saved in a security file. This mainly includes Role Definition, User Configuration and Port Configuration.

The following instructions provide information for creating and editing a security file.

1) After PCCU32 has been opened, move to the Security option under the Operate menu option from the PCCU32 toolbar. Select Role Based Access Control and then Role Administration from the fly-out menu (see Figure 3–17).
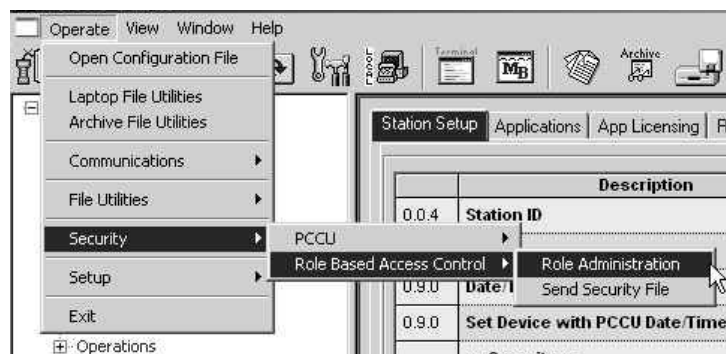
Figure 3–17 Role Administration Menu Path

2) Once the Role Administration has been selected, the Security Editor dialog box displays (see Figure 3–18).
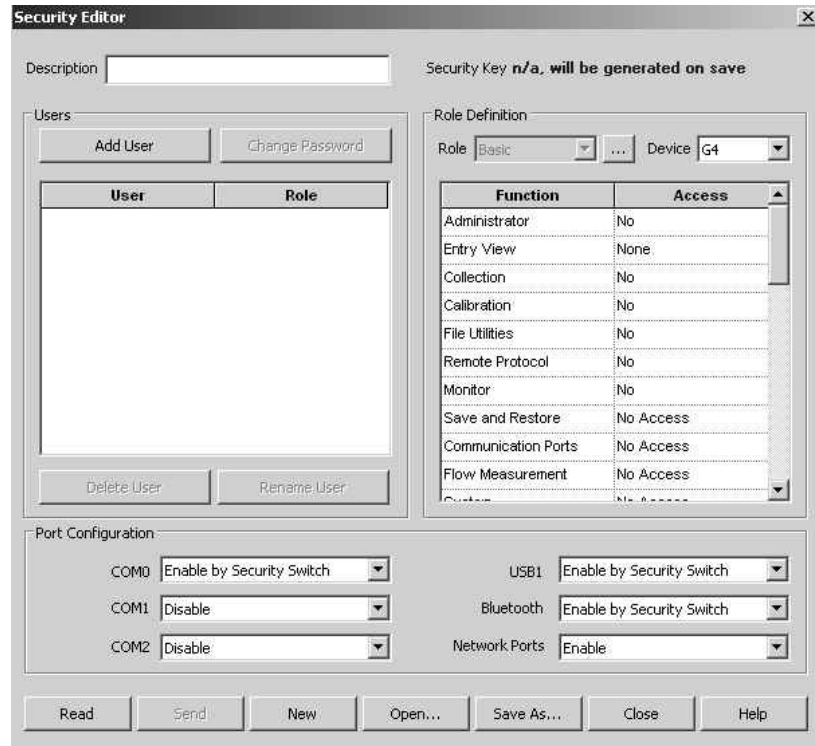
Figure 3–18 Security Editor Dialog Box

RBAC security files are supported by G4 and NGC devices. The user is given the ability to select the device type that the security file is specifically intended for.

For each role, it is possible to set the access level for each function that is listed. The Entry View function sets the highest selectable level and has the options of None, Basic, Advanced or Expert. Other functions have either a Yes | No option or a No Access | Read Only | Read/Write option. If an existing role definition does not provide the proper capabilities, a new one can be created by clicking the Browse button next to the Role drop-down list. This brings up the Roles dialog box (see Figure 3–19).
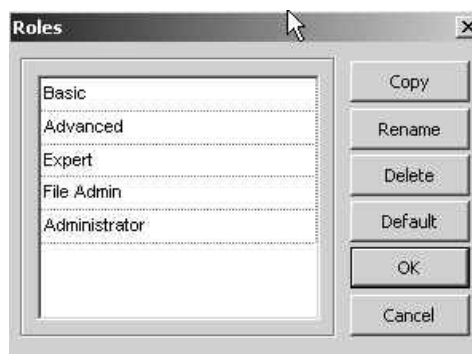
Figure 3–19 Roles Dialog Box

Role Definition

Default roles are automatically installed with PCCU32. These default roles are as follows:

- Administrator
- Expert
- Advanced
- Basic
- File Admin

The Administrator role has the highest level access rights to all functions. Expert, Advanced and Basic roles have decreasing levels of access rights.

The File Admin role has access rights of the Basic role plus minimum rights required for sending/reading RBAC security files to and from G4 devices.

Role Creation

The following instructions will walk the user through the steps for creating a new role.

1) Select the row that has the corresponding access level that the user wants. Upon location, click the Copy button.

2) A dialog box displays and asks for the name of the new role. Assign a name to the role. The new role is then available in the Roles dialog box.

3) Modify the access levels to complete the modification of the created role:

- To change the name of an existing role, select the cell, and click the Rename button.
- To delete an existing role, click the Delete button.
- The Default button resets the Role list to the factory defaults.

User Configuration

When adding a new user, the default role is the one that is currently displayed in the Role drop-down list at the time the Add User button is clicked. The following dialog box displays to set the user name and password (see Figure 3–20).
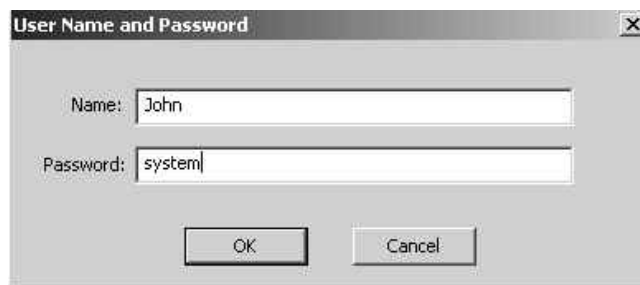
Figure 3–20 User Name and Password Dialog Box

A security key is generated and displayed after the configuration is saved to a security file. The Security Key file is displayed with "n/a will be generated on save", before a configuration is saved or after any modifications are made to a saved configuration. The security key is logged in the Security Log every time the security file is sent to a device or the device warm boots. Additionally, it can be

used to verify the security file on the device is the one created by the security administrator.

The PC file name of the security file is saved in the security file and displayed in the Security Editor dialog title bar, when the file is read from a device. It will also be used as a default file name, suggested for saving.

The Open button opens a security file from the PC for editing (see Figure 3–18). The New button clears all users and starts editing a new security configuration with default roles and no users.

RBAC security files are saved with a unique extension (.rba), by default. There is also a default directory that hosts these files. The directory is configurable by selecting the menu item Operate > Setup > System Setup (Figure 3–21).
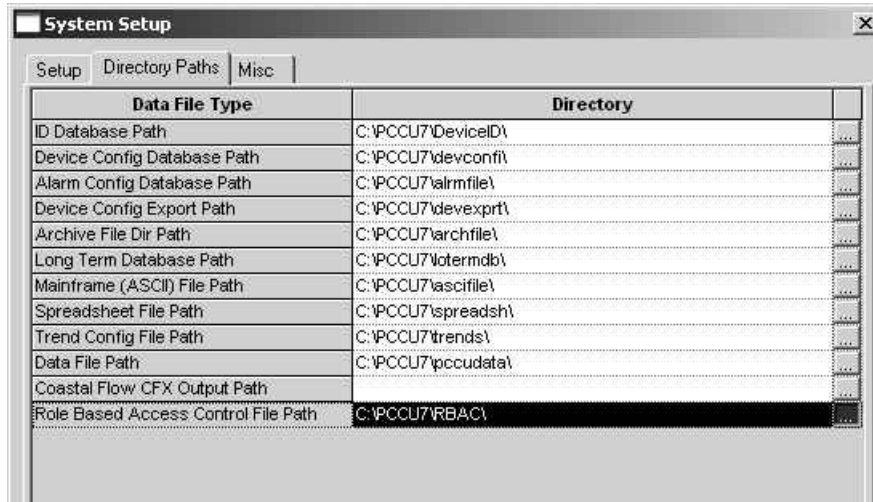
Figure 3–21 System Setup Dialog Box

When connected to a Totalflow G4 device, the Read button is enabled for all users. Additionally, the Send button is enabled only for users with Administrator rights. The Read button reads a security file from the device for editing. The Send button is used to send and apply the security configuration to a device.

Another way to send a security file is to select the menu item (Operate > Security > Role Based Access Control > Send Security File). This menu item is only enabled for users with Administrator rights. Clicking the menu item displays the Send Role Based Access Control File dialog box (Figure 3–22).

In the dialog box, the user can click the Browse button to select the required file. Upon selection, the user can click the Send button to send the security file.
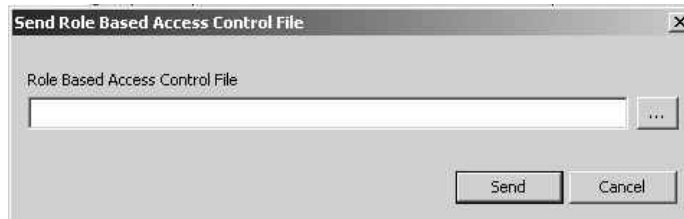
Figure 3–22 Send Role Based Access Control File Dialog Box

Port Configuration

Entry mode is available in the Advanced and Expert view modes and can be used to configure RBAC for ports that are not specified in the security file or can be used to override what is specified in the security file. Under each port which has a protocol specified is a parameter field called Authentication. This parameter can be set to Disabled, Enabled or Enable by Security Switch (See Figure 3–23).

- Disabled – Does not perform any RBAC functions on the port.
- Enabled – If the administrator name and/or password are lost or forgotten, it will be necessary to use TfLoader to delete TfCold and TfData, and then cold start the device to gain access. This will reset the device to the default factory configuration.
- Enable by Security Switch – If the administrator name and/or password are lost or forgotten, RBAC may be disabled using the legacy security switch. By setting the switch to the Off position, a user may log in and reconfigure the security access. This will not result in the loss of any data.
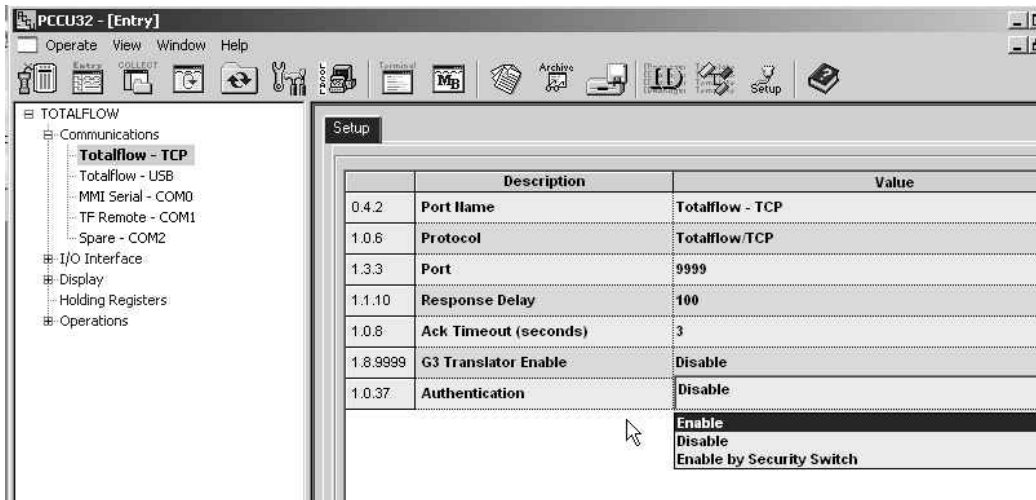
Figure 3–23 Totalflow-TCP Setup Tab

User Login

When the user tries to connect to an RBAC enabled port on a G4 device, they are first asked to login (see Figure 3–24).

The user can elect to save the user name/password as default credentials to be used for subsequent logins. To change or disable the default RBAC credentials, select the menu item, Operate > Setup > System Setup (see Figure 3–25).

After a security file is sent to a Totalflow G4 device, the user is disconnected from the device and asked to re-login under the following circumstances:

- RBAC security was not enabled on the connected port before the security file is downloaded.
- The user is not defined in the new security file.
- The user has different access rights in the new security file.

Figure 3–24 Login Dialog Box
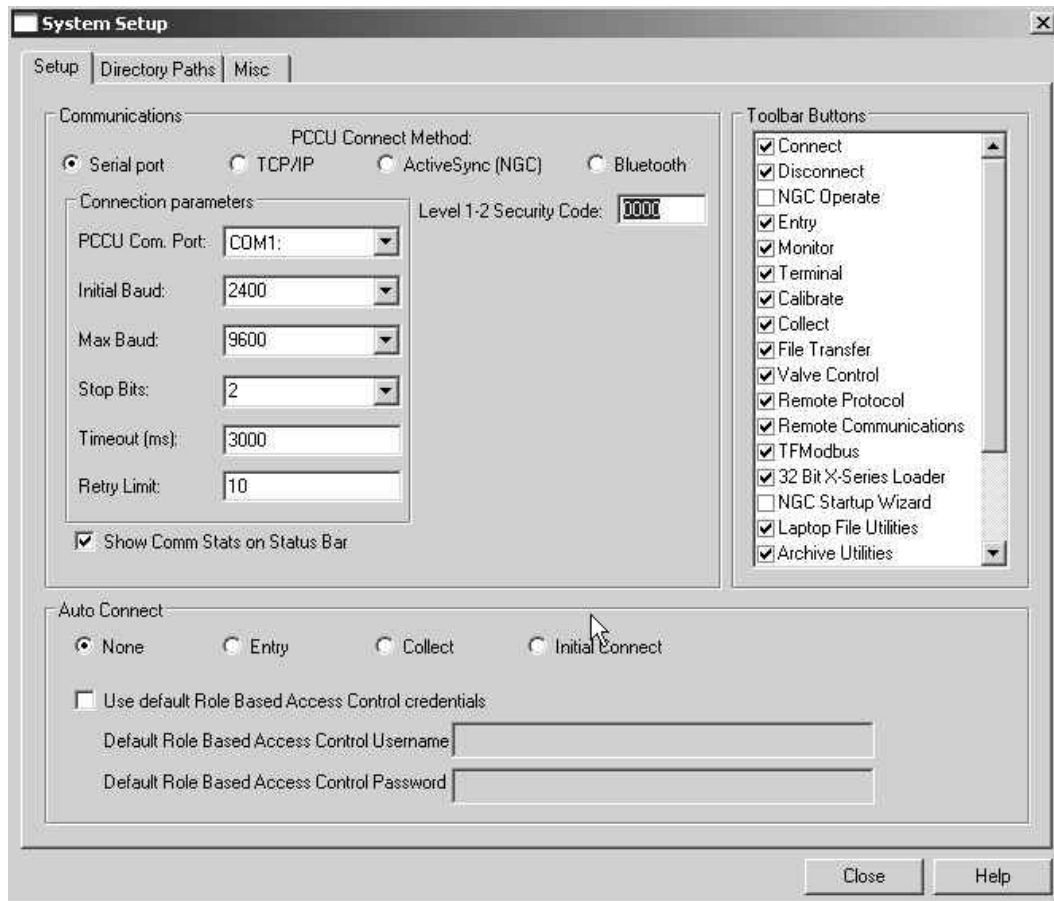
Figure 3–25 System Setup Dialog Box

Security Log

To track access to Totalflow G4 devices, a security log is kept that indicates the date and time when a user logs in, the user name, the port where the access was made and the actions taken before logout. Log entries are also generated when a security file is downloaded and/or processed. Additionally, the results of applying the configurations will also be logged every time a new security file is downloaded. This tab is available in Advanced and Expert view modes (see Figure 3–26).
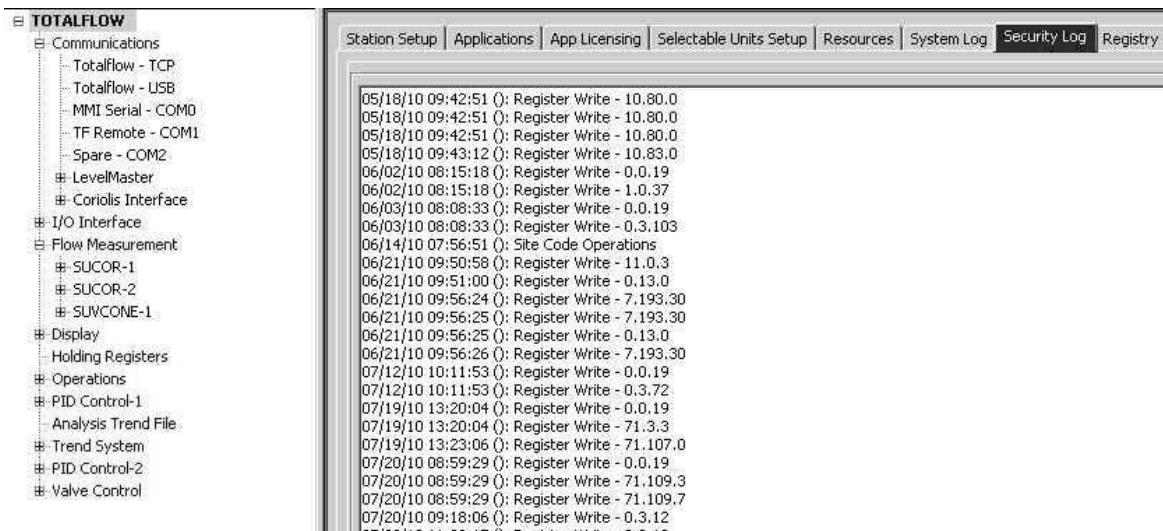
Figure 3–26 Security Log Tab

Remote Communications

While it is currently possible to enable RBAC on a remote port, this will block any access to the port since no host software currently supports RBAC.

Access Rights for Common Functions

Restricted Applications

Applications not accessible to the currently connected user are not seen in the left-hand tree-view within PCCU32. Functions that are restricted to the user are disabled. When an application with Read Only functionality is accessed, the Send button is also grayed out.

Calibration

In order for the user to perform a calibration, in addition to Calibration access rights, a user must also have read/write access to the following applications:
- System
- Flow measurement
- I/O subsystem
- Display application

For calibrating wireless I/Os, the user must have Read/Write access to the Wireless I/O application and the Communication Ports application.

For calibrating the XMV, the user must also have Read/Write access to the XMV Interface application and the Communication Ports application.

Collection

In order to perform a collection, in addition to Collection access rights, a user must also have Read access to the System application.

For collecting tube data, the user must have Read access to the Flow Measurement application.

For collecting trend data, the user must have Read access to the Trend application.

For collecting analysis trend data, the user must have Read access to the Analysis Trend application.

For collecting analyzer stream data, the user must have Read access to the Analyzer Stream application and the Analyzer Operation application.

3.5 Application Licensing Credit Key

3.5.1 Credit Key Driver Installation

3.5.1.1 Step-by-Step Instructions

1) Plug the USB credit key into an available USB port.

2) The Windows operating system will recognize the credit key as new hardware and attempt to install the appropriate driver with the Found New Hardware Wizard.

3) Click the Next button.

4) It may be necessary to point the wizard to the PCCU32 directory in the Files Needed screen. Select Browse, and locate the driver (usbkey.sys) in the PCCU32 directory.

5) Upon location, click the OK button.

6) The software driver installation will begin. When it is completed, click the Finish button.

FYI — If the user inserts the credit key in a different USB port on the computer, it will need to be installed for that new USB port. In other words, the credit key must be installed on each available port, if the user does not intend to use the same USB port each time they use the credit key.

3.5.2 Access/View the Credit Key with PCCU32 7.0 (or later)

To access and view the credit key, the user must use PCCU32 7.0 (or later). The credit key is a secure device and only accessible through PCCU32.

3.5.2.1 Step-by-Step Instructions

1) Install the credit key in an available USB port.

2) Open PCCU32, but do not connect to the unit.

3) Go to the Credit Key License Utility (Operate > File Utilities > Credit Key License Utility).

FYI — To move to the Credit Key License Utility, the user cannot be connected to the G4 EX. The user must have PCCU32 running and the initial Totalflow PCCU32 screen displayed.

4) When the Credit Key Status and Update Utility screen displays, click Load to view available credits on the USB key (see Figure 3–27).
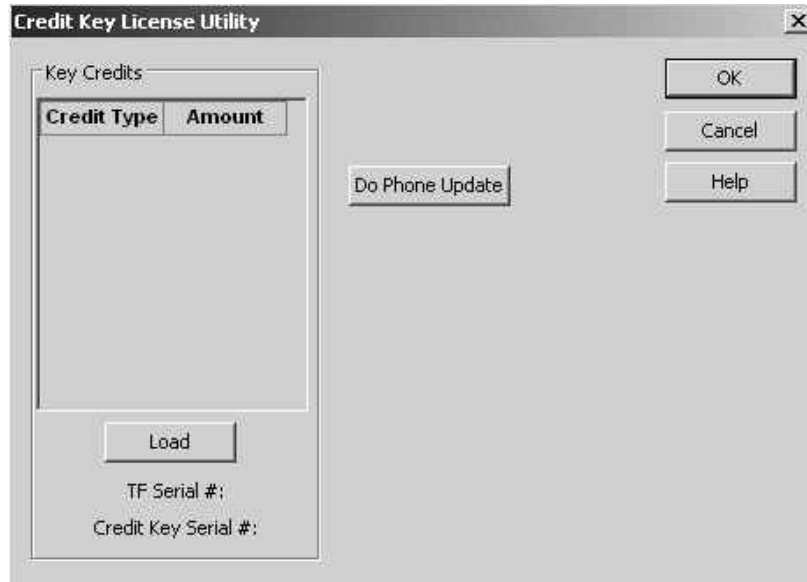
Figure 3–27 Credit Key License Utility

5) The number of credits will display.

TIP This is the same dialog box that the user would use to add more credits to the credit key.
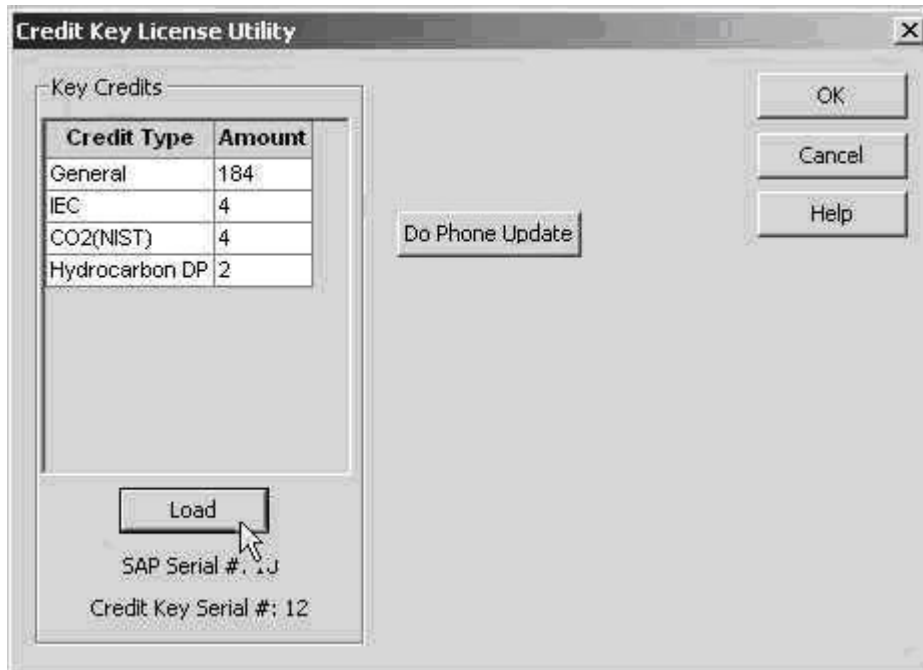
Figure 3–28 Credit Key License Utility – Status

3.5.3 Adding Credits to the Credit Key by Telephone

The user may have ordered the credit key from Totalflow with a specified number of the various credits; however, the user may need to add more or different credits in the future.

1) Open PCCU32 version 7.0 or later, but do not connect to the unit.

2) Go to the Credit Key License Utility (Operate > File Utilities > Credit Key License Utility).

3) Insert the credit key into an available USB port.

4) Select Do Phone Update (see Figure 3–28).

5) The user is then asked to call Totalflow Order Entry. Insure that the credit key is plugged in.

6) Upon connection with a Totalflow Order Entry representative, click the OK button.

7) The representative will ask the user to read the five (5) encrypted codes that appear directly beneath the Do Phone Update button. Read them from top to bottom (see Figure 3–29).
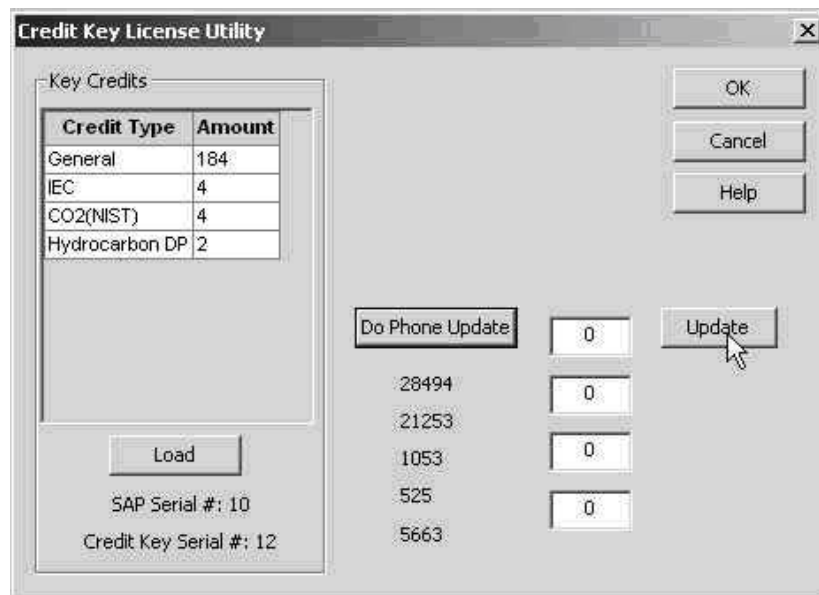
Figure 3–29 Application Credit Key Entry Screen

8) The representative will give the user four codes to enter in the provided fields.

9) After the codes have been entered (from top to bottom), click the Update button (see Figure 3–30).

10) After the button has been clicked, three more codes are displayed directly beneath the Do Phone Update button. The Totalflow representative will ask the user to read the codes to verify that the credits have been properly written to the credit key.

11) When completed, click the Update button.
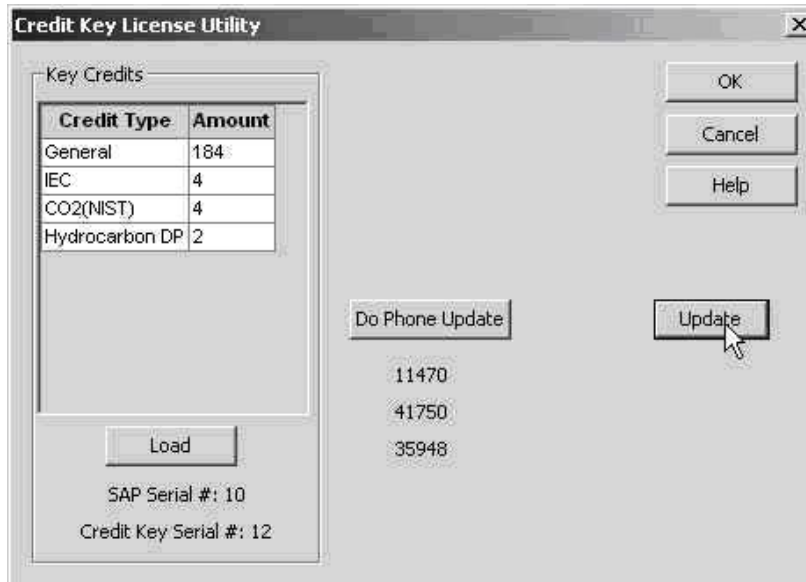
Figure 3–30 Application Credit Verification Codes

3.5.4 Transferring Credits to the G4 EX from the Credit Key

Credits can be transferred to the G4 EX. The user selects the type of credits and the amount of those credits to be transferred.

TIP — If the G4 EX has a surplus of credits, these credits can be transferred to the credit key to be used on the other meters. This is discussed in a later section.

To transfer application credits to the G4 EX, the user will need to connect to the G4 EX with PCCU32 7.0 or later.

1) Open PCCU32. Once open, move to the top of the tree-view, and click on the App Licensing tab (see Figure 3–31).

2) Install the credit key in an available USB port.

3) Click the Load button to view the available credits.

TIP — This screen enables the user to see the licensing status of the G4 EX as well as the available credits on the credit key. The left pane shows the type and amount of the available credits on the credit key. The upper right pane is for information purposes only. It shows the various available applications and the type/amount of credits necessary to run the application. The standard credits (and four general credits) are free with the purchase of the G4 EX. The lower right pane displays the licensing status of the G4 EX. It shows what credits are in the machine, what credits are being used and any surplus or deficit of credits. A surplus of credits is highlighted in green. A deficit of credits is highlighted in red.

Figure 3–31 App Licensing Tab

4) Select the Transfer to Device radio button.

5) From the Type drop-down menu, select the type of credit from the available options.

6) Next, select the number of credits to transfer.

7) Upon completion, click the Transfer button.

3.5.5 Transferring Credits to the Credit Key from the G4 EX

As has been mentioned before, excess credits (credits beyond those that are required to be fully licensed) can be taken from the G4 EX and returned to the credit key to be used on other G4 devices.

Credits can be transferred from the G4 EX. The user selects the type of credit and the amount of those credits to be transferred.

TIP If the G4 EX has a surplus of credits, these credits can be transferred to the credit key to be used on other meters.

If the G4 EX requires additional credits, these credits can be transferred from the credit key. See the previous section for the steps on how to accomplish this.

To transfer application credits to the G4 EX, the user needs to connect to the G4 EX unit with PCCU32 7.0 or later.

1) Open PCCU32. Once open, move to the top of the tree-view, and click on the App Licensing tab.

2) Install the credit key in an available USB port.

3) Click the Load button to view the available credits.

TIP ⟹ ◎ This screen enables the user to see the licensing status of the G4 EX as well as the available credits on the credit key. The left pane shows the type and amount of the available credits on the credit key. The upper right pane is for information purposes only. It shows the various available applications and the type/amount of credits necessary to run the application. The standard credits (and four general credits) are free with the purchase of the G4 EX. The lower right pane displays the licensing status of the G4 EX. It shows what credits are in the machine, what credits are being used and any surplus or deficit of credits. A surplus of credits is highlighted in green. A deficit of credits is highlighted in red.

4) Select the Transfer to Credit Key button (see Figure 3–32).

5) In the Type drop-down field, select the credit type from the available selections.

6) In the Amount field, set the number of credits to transfer.

7) Upon completion, click the Transfer button.

8) The transferred credits will display to the left of the screen.
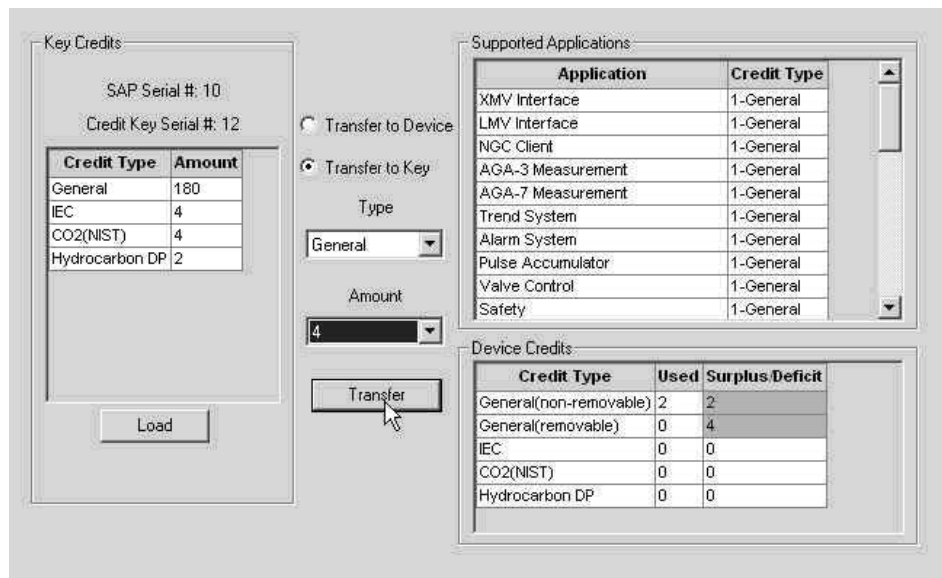
Figure 3–32 Transfer to Credit Key

3.6   G4 EX Configuration

3.6.1   Contact Hour

The user can program the G4 EX to begin the contact day based on their contract or company standards. When the G4 EX first powers up, the contract is preset to begin at midnight.

FYI 💡 Midnight is 00 o'clock. If any value entered is greater than 23, the user will receive an error message, and the G4 EX forces the value to 00 (midnight).

3.6.2 Log Period

The Log Period is the specified length of time between writing the calculated accumulated volume to record. The user may record volumes as often as every minute and as seldom as every hour. The default is 60 minutes. The G4 EX can normally store 960 log periods (40 days x 24 logs). A five minute log period will consume available memory in eight days.

Description	Options
Log Period	1,2,5,10,20,30,60 (Minutes)

3.6.3 Volume Calculation Period

Volume Calculation Period is the specified length of time between volume calculations. The Volume Calculation Period must be equally divisible into the Log Period. The default is 1 second.

Description	Options
Volume Calculation Period	1 sec, 2 sec, 5 sec, 10 sec, 20 sec, 30 sec
	1 min, 2 min, 5 min, 10 min, 20 min, 30 min and 60 min.
	It is recommended to leave at the default of 1 second.

3.6.4 Calculated Method

When the G4 EX is initially powered up, the calculation method must be set. The user has the option of setting the calculation method to AGA-3 1985, AGA-3 1992, AGA-7 or ISO-5167. Once the calculation type has been determined, the user may toggle specific factors on or off depending upon their availability (see Table 3—1).

TIP Calculation types, and many of the factors involved with setting up the calculations, are usually dictated by the user's sales contract or company policy.

Table 3—1 Configurable Calculation Factors

Calculation Parameter	AGA-3 1985	AGA-3 1992	AGA-7	ISO-5167
Fpb (Pressure Base Factor)	Yes	N/A	N/A	N/A
Ftb (Temperature Base Factor)	Yes	N/A	N/A	N/A
Fg (Specific Gravity Factor)	Yes	N/A	N/A	N/A
Fb (Orifice Factor)	Yes	N/A	N/A	N/A
Ftf (Flowing Temperature Factor)	Yes	N/A	N/A	N/A
Y (Expansion Factor)	Yes	Yes	N/A	Yes
Fr (Reynolds Number)	Yes	N/A	N/A	N/A
Fa (Orifice Thermal Expansion Factor)	Yes	N/A	N/A	N/A

Calculation Parameter	AGA-3 1985	AGA-3 1992	AGA-7	ISO-5167
Fpv (Supercompressibility Factor)[1]	Yes	Yes	Yes[2]	Yes[3]
Fw (Water Vapor Factor)[4]	Yes	Yes	Yes	Yes
Faux (Full Well Stream Factor)[5]	Yes	Yes	Yes	Yes
Cd (Coefficient of Discharge)	N/A	Yes	N/A	Yes
Fp (Fpv method = NX19 Fixed)	Yes	Yes	Yes	Yes
Ft (for Fpv method = NX19 Fixed)	Yes	Yes	Yes	Yes
Coefficient of Discharge Calc	N/A	Yes	N/A	Yes[6]
Fpc (Pressure Correction Factor)	N/A	N/A	Yes	N/A
Ftc (Temperature Correction Factor)	N/A	N/A	Yes	N/A
Fs (Fpv[2] Compressibility Factor)	N/A	N/A	Yes	N/A

3.6.5   Super Compressibility Calculation (Fpv)

When the G4 EX is powered up, the calculation method needs to be set. The user has the option of changing the formula method to any one of several other choices (see Table 3—2). Once the calculation has been determined, the user may toggle specific parameters on or off depending upon whether they would like to use fixed or live analysis data.

TIP Many decisions involved with setting up the Fpv are dictated by the user's sales contract or company policy.

Table 3—2 Fpv Analysis Data

Analysis Data	Default Value	Units	NX19 Fixed Ft/Fp	AGA-8 1992 Detail	All Others[7]
Fp (for Fpv method NX19 Fixed)	1.000		Yes	No	No
Ft (for Fpv method NX19 Fixed)	1.000		Yes	No	No
Heating Value[8]	1000.0000	BTU/SCF	Yes	Yes	Yes
Argon	0.0000	mol %	No	Yes	No
Carbon dioxide CO2	0.0000	mol %	Yes	Yes	Yes

---

[1] NX19 GCN, NX19 GCNM, AGA-8 1992 Gross and AGA-8 1992 Detail

[2] See Fs for AGA-7 Fpv^2

[3] Only AGA-3 1992 Gross and Detail

[4] Not an AGA factor. Fw is a factor which compensates for water vapor in the gas stream and its effect on volume measurement.

[5] Not an AGA factor. Faux is a user set multiplier to compensate for liquids in the gas stream. Defaults to 1.

[6] Discharge Coefficient Type-only AGA-3 1992 and ISO-5167-1

[7] NX19 GCN, NX19 GCNM, AGA-8 1992 Gross

[8] Enter the Heating Value in Btu per SCF. Not used in volume calculations. Only used for calculating MMBTU for reports.

Analysis Data	Default Value	Units	NX19 Fixed Ft/Fp	AGA-8 1992 Detail	All Others[7]
Carbon monoxide	0.0000	mol %	No	Yes	No
Ethane	0.0000	mol %	No	Yes	No
H2S	0.0000	mol %	No	Yes	No
Helium	0.0000	mol %	No	Yes	No
Hydrogen	0.0000	mol %	No	Yes	No
iButane	0.0000	mol %	No	Yes	No
iPentane	0.0000	mol %	No	Yes	No
Methane	100.000	mol %	No	Yes	Yes
nButane	0.0000	mol %	No	Yes	No
nDecane	0.0000	mol %	No	Yes	No
nHeptane	0.0000	mol %	No	Yes	No
nHexane	0.0000	mol %	No	Yes	No
nitrogen N2	0.0000	mol %	Yes	Yes	Yes
nNonane	0.0000	mol %	No	Yes	No
nOctane	0.0000	mol %	No	Yes	No
nPentane	0.0000	mol %	No	Yes	No
Oxygen	0.0000	mol %	No	Yes	No
Propane	0.0000	mol %	No	Yes	No
Water H2O	0.0000	mol %	No	Yes	No
Specific Gravity	0.6000	N/A	Yes	Yes	Yes

3.6.6 Constants

On a single tube gas orifice meter, there are certain constants or parameters that may need to be entered or changed from the default values. Table 3—3 displays the list of these constants.

Table 3—3 Gas Orifice Constants

Parameters	Default Value	Units	AGA-3 1985	AGA-3 1992	AGA-7	ISO-5167
			Configurable			
Auxiliary Factor (Faux)	1.0		Yes	Yes	Yes	Yes
Barometric Pressure		PSIA	Yes	Yes	Yes	Yes
DP Zero Cutoff	0.0000	In H2O	Yes	Yes	No	Yes
Meter Factor (Fb Basic Orifice Factor)	210.2300		Yes	No	No	No
Orifice Coefficient of Expansion	9.2500	In per Deg. F	No	Yes	No	Yes

Parameters	Default Value	Units	AGA-3 1985	AGA-3 1992	AGA-7	ISO-5167
Orifice Diameter	1.0000		Yes	Yes	No	Yes
Orifice Material	Stainless		Yes	No	No	No
Pipe Coefficient of Expansion	6.2000	Inches per Deg. F	No	Yes	No	Yes
Pipe Diameter	2.0670		Yes	Yes	No	Yes
Pressure Base (Contract)	14.7300	PSIA	Yes	Yes	Yes	Yes
Specific Heat Ratio	1.3000		Yes	Yes	No	Yes
Tap Location	Upstream		Yes	Yes	No	Yes
Tap Type	Flange Taps		Yes	No	No	Yes
Temperature Base (Tb)	60.0000	Degrees F	Yes	Yes	Yes	Yes
Viscosity	0.0103	Centipoises	Yes	Yes	No	Yes
Z of Air at Base Condition	0.9996		No	Yes	No	Yes
Fixed Cd	.6		No	Yes	No	Yes
Barometric Pressure	14.73	PSIA	Yes	Yes	Yes	Yes
K Factor (Vol. of Gas Per Pulse)	1.0		No	No	Yes	No

3.6.7 Alarm Limits

The user has the ability to set the G4 EX alarm limits for the parameters listed in Table 3—4. There are many purposes for setting these limits, i.e., controlling well output or sending digital signals.

Table 3—4 Alarm Limits

Parameter	Default Value	Units	AGA-3 1985	AGA-3 1992	AGA-7	ISO-5167
				Configurable		
Dp High Limit	2047.9688	In H2O	Yes	Yes	N/A	Yes
DP Low Limit	0	In H2O	Yes	Yes	N/A	Yes
Flow Rate High Limit	1,000,000	SCF/Hr	Yes	Yes	Yes	Yes
Flow Rate Low Limit	0	SCF/Hr	Yes	Yes	Yes	Yes
RTD High Limit	420	Degrees F	Yes	Yes	Yes	Yes
RTD Low Limit	0	Degrees F	Yes	Yes	Yes	Yes
SP High Limit	2047.9688	PSIA	Yes	Yes	Yes	Yes
Uncorrected Vol High Limit		ACF	N/A	Yes	Yes	Yes
Uncorrected Vol Low Limit		ACF	N/A	Yes	Yes	Yes

3.6.8 Reset Volume

When the user resets the volume accumulator, the G4 EX will:

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

TIP   Since the G4 EX volume calculations are made each vol calc period, any changes that are made during the period would effect the volume calculations (such as changing the orifice plate size) and be introduced into the calculations. To avoid introduced errors, it is recommended that the Reset Volume command be used. This command forces the G4 EX 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. This is logged as an event before it is reset to zero (0).

3.7 Start Up the G4 EX

3.7.1 Putting the G4 EX On Line

CAUTION   To avoid a calibration shift, carefully follow these instructions.

3.7.1.1 Step-by-Step Instructions

1) Open both the bypass valves, and close the vent to the atmosphere valve. This stabilizes the pressure on both sides of the cell.

2) Begin to slowly open the high side orifice tap valve from the meter run.

3) Begin to slowly open the low side valve.

4) Once both the high and low sides are completely open, close both bypass valves.

3.7.2 Setting G4 EX Temperature Calculation

The G4 EX temperature calculations can be set to the following conditions:

- RTD Installed – This uses the RTD temperature input and stores the RTD temperature unless the RTD fails. Additionally, it then uses and logs the Fixed GF value.
- Use Fixed TF – This uses and stores the fixed temperature.

3.8 G4 EX Standard Displays

3.8.1 Program Display

The single tube G4 EX comes from the factory with a set of default displays (see Table 3—5). By default, each display item remains on the display for five seconds. The user has the ability to change this default to zero (item not displayed) or any value from 1 to 255 seconds. The user is also able to change the engineering units and data format for display purposes. Further instructions on programming the display system can be found in the PCCU32 help files. All display items and item groups are user programmable and may be displayed by user defined parameters.

Table 3—5 G4 EX Displayed Items

Description	Format	Note
DATE/TIME	MM/DD/YY HH:MM:SS	24-hour clock
YEST DP LO	NN PERCENT	Yesterday's percent DP low limit percent time below DP low setpoint
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
STATIC PRESSURE	NNN.N PSIA	Static pressure static PSIA
FLOW TEMP	NN.N DEG. F	Flowing temperature °F
YEST VOL	NNNN.N MCF	Yesterday's volume programmable SCF, MCF or MMCF
PERIOD VOL	NNNN.N SCF	Previous period volume last volume calculation period volume
Orifice Diameter	N.NNNN INCHES	Diameter of installed orifice
STATION ID	XXXXXXXXXX	10 character alphanumeric identifier
DEVICE ID	XXXXXXXXXX	10 character alphanumeric application or tube identifier

4.0 G4 EX MAINTENANCE

4.1 Overview

The following chapter will provide the user with standard maintenance information and instructions on how to remove and install G4 EX components.

4.1.1 Maintenance Support

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

USA: (800) 442-3097   International: 001-918-338-4888

4.1.2 How to Use This Chapter

It is recommended that the user develop a regularly scheduled maintenance program. By establishing a maintenance program, the G4 EX downtime can be minimized.

Record all items within this chapter in the maintenance practice procedures. 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 problems result in a failure.

4.1.3 Cleanliness

Because a G4 EX 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 that can render the G4 EX inoperable.

4.1.4 Front Mounted LCD

The user is informed of operational problems and operational limit violations by observing the alarm codes on the LCD display. Troubleshooting techniques for dealing with these alarm codes is presented later in the manual.

4.1.5 Returning Parts 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 Totalflow for a Return for Authorization (RA) number. Affix this number to the outside of the return package.

Part shipments must be prepaid by the customer. Any part that is not covered by the original system warranty will be shipped to the customer, F.O.B.

4.2 Backing Up Configuration Files

Before beginning any maintenance on the G4 EX, the user should collect the data, and back up all configuration files to the laptop's hard drive or disk. This upload safeguards data and allows the user to restart the unit without the obstacles associated with reconfiguring the G4 EX should any problem arise.

Although there are Save buttons within the Entry mode screens in PCCU32 that allow the user to back up Entry model data items, a complete system backup is only accomplished by using the Save and Restore Utility or the 32-Bit Loader. When using this utility to back up files, the user should also download the files to the tfCold drive in the event of a cold start.

4.2.1 Step-by-Step Instructions

1) Collect the data from the unit.

2) While in PCCU32, click the Save and Restore Utility icon in the main window toolbar.

3) When the Save and Restore window displays, click the Save Station Files button. The Save Station Files dialog box will display.

4) When the Save Station Files dialog box displays, verify the default name and path for the files. Click the OK button. This will save the tfData drive files.

5) When finished saving the station files, a new dialog box offers the user the option to Restore the Station Files to the tfCold drive. If the user selects Yes, the station files will be downloaded to the tfCold drive.

4.3 Restoring Configuration Files

The Restore function enables the user to download configuration files to the G4 EX.

If prior to performing maintenance the Save Configuration Files was used, these files were downloaded to the laptop's hard drive or disk. The Restore function downloads these files into the G4 EX's tfCold drive. This safeguards the data and allows the user to restart the unit without the obstacle of reconfiguring the G4 EX should any problem arise.

4.3.1 Step-by-Step Instruction

1) While the user is in PCCU32, click the Save and Restore Utility icon on the window's main toolbar.

2) When the Save and Restore window displays, click the Restore Station Files button. The Restore Station Files dialog box will display.

3) When the Restore Station Files dialog box displays, verify the default name and file path. Click the OK button. This will restore the files to the tfCold drive.

4) Verify that the unit is functioning properly.

4.4 Performing a Warm Boot

A warm boot signifies that the user has cycled power off the board without disconnecting the lithium battery. This method enables the user to not lose any stored data. A warm boot can be initiated from a hardware or software standpoint. The following will take the user through the steps for both methods.

4.4.1 Hardware Warm Boot

There are two methods of warm booting the system from a hardware standpoint:

4.4.1.1 Method 1

1) The user will need to open the door to the unit. Locate the Reset button on the G4 EX Termination board.
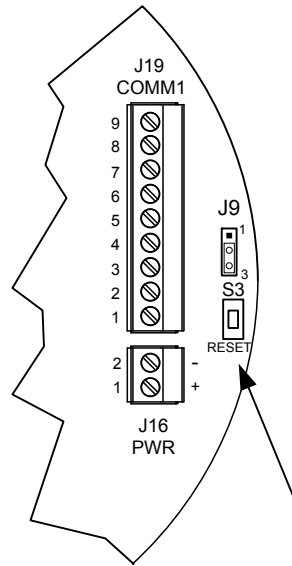
Figure 4–1 Reset Button Location

2) Upon location, press the Reset button for approximately five seconds. The unit will warm boot.

4.4.1.2 Method 2

1) Open the door to the unit. Ensure that there is voltage on the battery and that the jumper is enabled.

FYI — If either of these conditions are not met, do not attempt a warm boot. Continuing with this process without both conditions being met will result in a cold boot and all historical data will be lost.

2) Remove power to the board, and then reconnect. This will initiate a warm boot.

4.4.2 Software Warm Boot

There are three methods of warm booting the system from a software standpoint:

4.4.2.1 Method 1

1) Open PCCU32. The user needs to ensure that they are not connected initially and are at the Totalflow splash screen.

2) Click the 32-Bit Loader icon on the toolbar. This takes the user to the 32-Bit Loader screen.

3) Within the screen, the user needs to select the Reload radio button.

4) Ensure that all of the checkmarks are removed from the various software option. Once this has been accomplished, place a check in the options list beside Shutdown Flash and Start Flash.

5) Select the needed connection type from the available drop-down menu.

6) Upon completion, click the Start button.

FYI   There is a chance that the user will see a PCCU32 dialog box display that informs them that the Target Device Loader is not working. The user will need to follow the dialog box instructions to warm boot the system.

4.4.2.2   Method 2

FYI   The user must be in Expert view.

1) Move into Entry mode within PCCU32.

2) Upon completion, click on the Meter ID in the PCCU32 tree-view. By default, this will take the user to the Station Setup tab.

3) Locate the System Shutdown/then Reset parameter field. Once located, set the parameter value to Yes.

4) Click the Send button. This will initiate a warm boot.

4.4.2.3   Method 3

1) Move into Entry mode within PCCU32.

2) Once this has been completed, click the Terminal icon on the PCCU32 window toolbar. This will bring up the Terminal window.

3) Once in the Terminal window, move to the terminal prompt (->), and type in the following: BOOT=WARM. Press Enter on the keyboard to initiate the warm boot.

4.5 Performing a Cold Boot

A cold boot occurs when the user cuts power to the board, including the lithium battery backup. This causes a loss of all historical data. A cold boot can be initiated from a hardware or software standpoint. The following will take the user through both methods.

4.5.1   Hardware Cold Boot

1) Open the door to the unit. Locate the lithium battery connector.

2) Upon location, disconnect the battery.

3) Press the Reset button for approximately five seconds. The unit will cold boot.
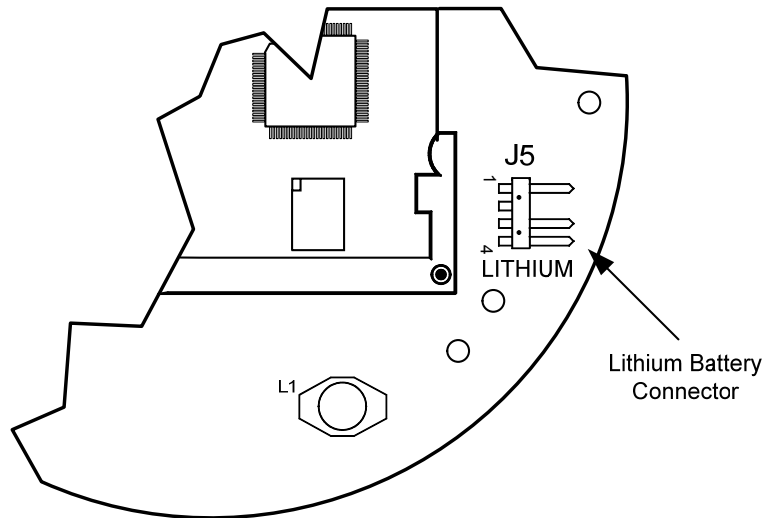
Figure 4–2 Lithium Battery Connector

4.5.2   Software Cold Boot

There are two methods for initiating a software cold boot:

4.5.2.1   Method 1

1) Open PCCU32. The user needs to insure that they are not connected initially and are at the Totalflow splash screen.

2) Click the 32-Bit Loader icon on the toolbar. This takes the user to the 32-Bit Loader screen.

3) Within the screen, the user needs to select the Reload radio button.

4) Make sure that all of the checkmarks are removed from the various software options. Once this has been accomplished, place a check in the options list beside Shutdown Flash, Delete tfData and Start Flash. A prompt will display that warns that a cold boot is occurring. Click the Yes button to initiate a cold boot.

FYI   There is a chance that the user will see a PCCU32 dialog box display that informs them that the Target Device Loader is not working. The user will need to follow the dialog box instructions to cold boot the system.

4.5.2.2   Method 2

1) Move into Entry mode within PCCU32.

2) Once this has been completed, click the Terminal icon on the PCCU32 window toolbar. This will bring up the Terminal window.

3) Once in the Terminal window, move to the terminal prompt (->), and type in the following: BOOT=COLD. Press Enter on the keyboard to initiate the warm boot.

4.6 Changing the G4 EX Clock

When any measurement applications are instantiated on the G4 EX, changing the clock could affect the time when log period entries are made. To protect the integrity of the accounting audit trails, the G4 EX handles these types of clock changes as follows:

4.6.1 Clock Change Not Crossing an Hour Boundary

When the next log period entry is made, the clock is not altered.

Example: If the present time is 4:14 pm and the clock is changed to 4:05 pm of the same day, the daily flow record is the same. Entry reflects averages accumulated over a 70 minute time period (15 minutes plus 55 minutes).

4.6.2 Forward Clock Change Crossing an Hourly Boundary

Forces a log period entry for part of the hour that has accumulated since the last hourly entry. The G4 EX then advances to the newly defined data flow record boundary and begins maintaining the balance of the day's data in a newly defined boundary.

Example: If the present time is 4:55 pm and the clock is changed to 5:05 pm of the same day, the entry reflects only a 55 minute average accumulation. A new flow record is then written. This period is also based on a 55 minute accumulation.

4.6.3 Backward Clock Change Crossing an Hourly Boundary

Hourly entry is made for part of the hour that has accumulated since making the last hourly entry. This is the same as a Forward Clock Change Crossing an Hourly Boundary. The G4 EX advances to a new day's data flow record and maintains the balance of the day's data in a new record.

Example: If the present time is 5:05 pm and the clock is changed to 4:55 pm of the same day, the log period entry reflects only a five minute average accumulation. A new flow record is then written. This log period is based on a 60 minute accumulation.

FYI

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

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

4.7 Replacing the G4 EX Battery Pack

This chapter presents the procedures for removal and installation of the G4 EX battery pack that is located within the 6270 OEU. To access the battery pack, open the door (see Figure 4–3). The battery pack is located in the upper portion of the chamber.

TIP

To extend the lift of the battery pack, fully charge the battery prior to installation. A system using solar panels may not fully charge the battery. Additionally, a fast charge,

which the solar panel cannot provide, improves the life of the battery.

To recharge a battery, a quick charge will remove buildup in the battery much more effectively than a trickle charge. A battery slowly drained by low light conditions on a solar charged system or setting in storage will be less likely to recover than a battery pack that was quickly discharged from a short. Store batteries in a cool environment for less drainage.
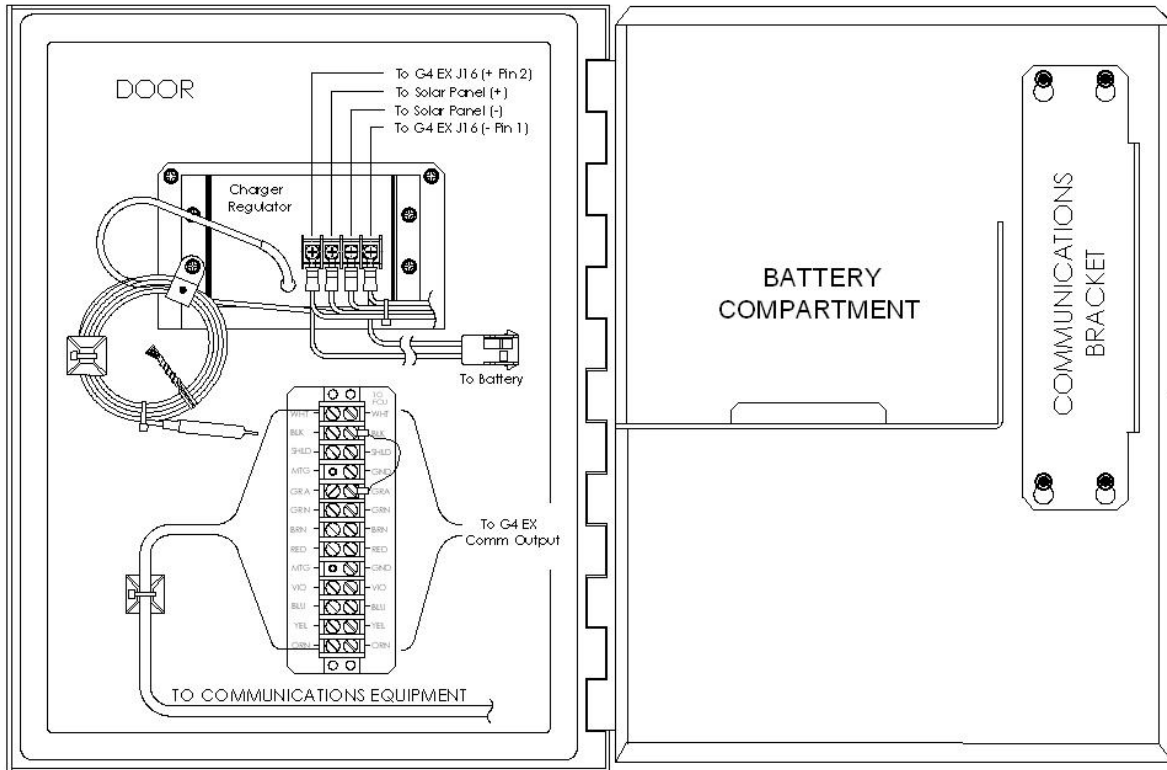
Figure 4–3 6270 OEU Configuration

4.7.1   Step-by-Step Instructions

1) Collect the data from the unit.

2) Back up the configuration files following the instructions listed previously in this chapter.

3) Verify the "LL" alarm battery alarm is not being displayed on the G4 EX's display. This prevents any data stored in RAM from being lost when power is removed.

4) Disconnect the charging source from the charger regulator.

5) Disconnect the battery pack cable connector going to the charger regulator.

6) Remove the battery pack from the battery compartment.

7) Remove the terminal lugs from the battery, and place it on the new battery. Be sure to connect the red wire to the positive (+) side and the black wire to the negative (-) side.

8) Insert the battery pack into the compartment. Insert the battery pack so that its terminals are not touching any metal inside of the unit.

9) Reconnect the battery pack cable connector to the charger regulator.

10) Reconnect the charging source to the charger regulator.

11) Monitor the LCD for normal operational reading and battery voltage.

4.8 Replacing the G4 EX Board

The G4 EX board is mounted inside of the G4 EX front end cap. To access and remove the G4 EX board, perform the following procedures.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag, national and local electrical codes.

CAUTION Installation and/or maintenance of electric components should follow guidelines stipulated in the certification drawings shipped with this unit and adhere to local codes.
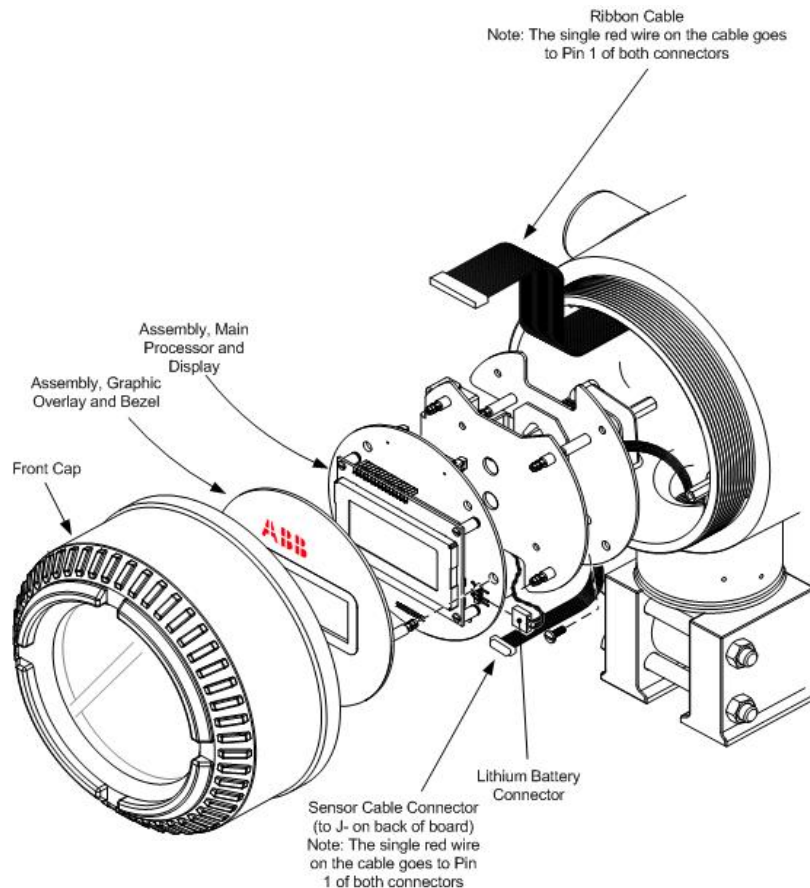
Figure 4–4 G4 EX Front End Exploded View

4.8.1   Step-by-Step Instructions

1) Collect data from the unit.

2) Back up the configuration files following the instructions listed previously in this chapter.

3) Verify that the "LL" battery alarm is not being displayed on the G4 EX LCD.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

4) Gain access to the rear Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench to perform this task. Upon completion, unscrew the end cap.

5) Disconnect the power connector (J16) from the board mounted connector (see Figure 4–5).

Figure 4–5 Termination Board

6) Gain access to the G4 EX board by loosening the countersunk hex socket locking set screw in the front end cap. Use a 1/16" hex wrench to perform this task. When completed, unscrew the end cap.

7) After the end cap has been removed, gently pull the graphic overlay plate away from the snap on standoffs.

8) Using a small slot head screw driver, remove the four screws that hold the LCD board to the G4 EX device.

9) Gently disconnect the LCD board from the G4 EX board, J2 connector (see Figure 4–6). Lift the board from the device.

Primary Component Side
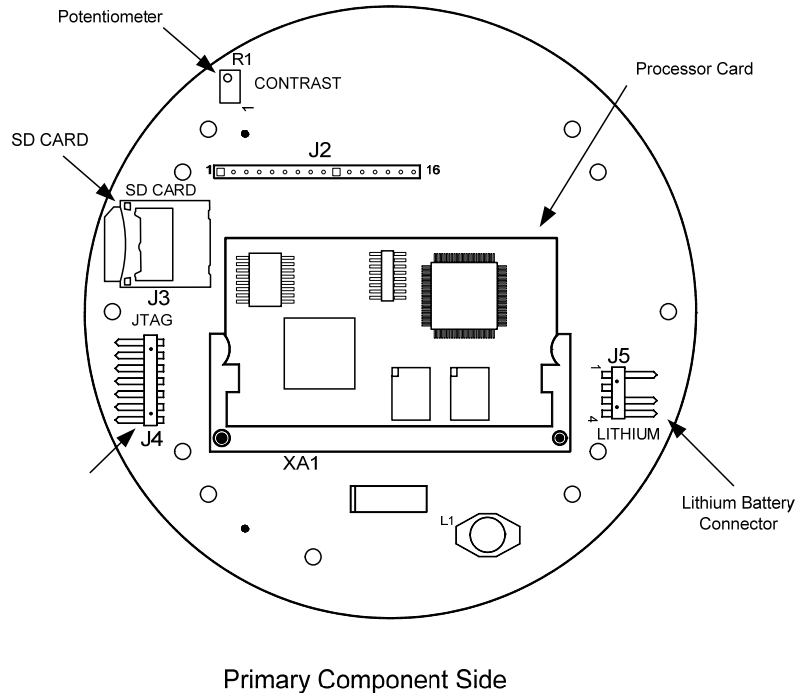
Figure 4–6 G4 EX Board

10) After the LCD board is disengaged, gently remove the lithium battery connector (J5) from the G4 EX board.

11) Upon removal of the lithium battery connector, gently snap the board out of the device. Please note that the board is still connected to the device through the cables in the back.

12) Unplug the sensor connector cable (J6) and the ribbon cable (J1) from the G4 EX board (see Figure 4–7). Remove the board from the G4 EX device.

Secondary Component Side
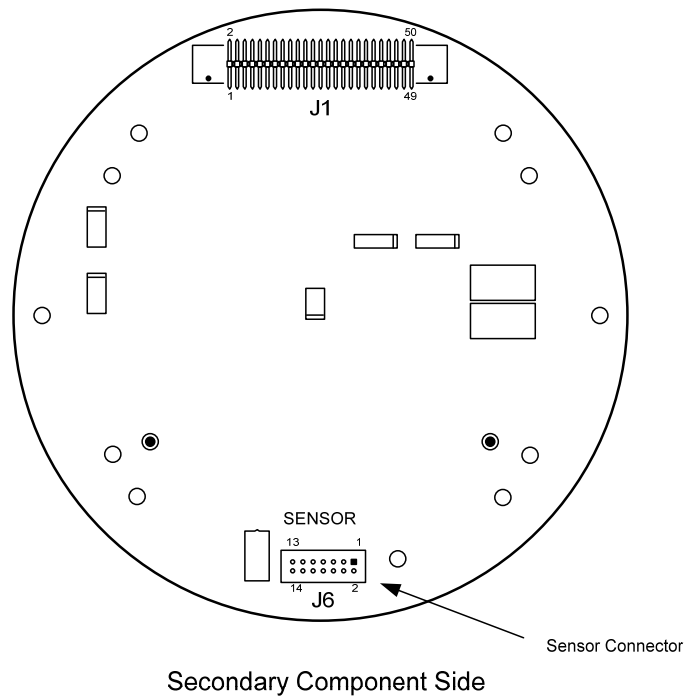
Figure 4–7 G4 EX Board Secondary Component Side.

FYI

If the user has the 2104353–503 motherboard, they will need to remove the processor card from the removed motherboard and place it into the new one. This is accomplished by pulling back the attachment brackets and gently unsnapping the processor card from its housing. Once completed, take the processor card and snap it into the replacement motherboard. Continue to step 13.

13) Take the replacement G4 EX board and attach the sensor cable and the ribbon cable to their corresponding connectors.

CAUTION

Please note that both the sensor cable and ribbon cable pin 1 wire are red. The red edge (pin 1) of the cable should plug into the outer most edge of the connector (pin 1).

14) Take the lithium battery cable and attach the cable to its corresponding connector (J5).

15) Align the mounting holes on the G4 EX board with the standoffs,. Once aligned, snap the board into place within the device.

16) Once in place, line up the LCD board mounting holes to the G4 EX board. Gently connect the LCD board into the G4 EX board via the J2 connector.

17) Take a small slot head screwdriver and attach the LCD board to the G4 EX board using the four mounting screws.

4.9   Replacing the G4 EX Termination Board

The Termination board is mounted inside of the G4 EX back end cap. To access and remove the display board, perform the following procedures.
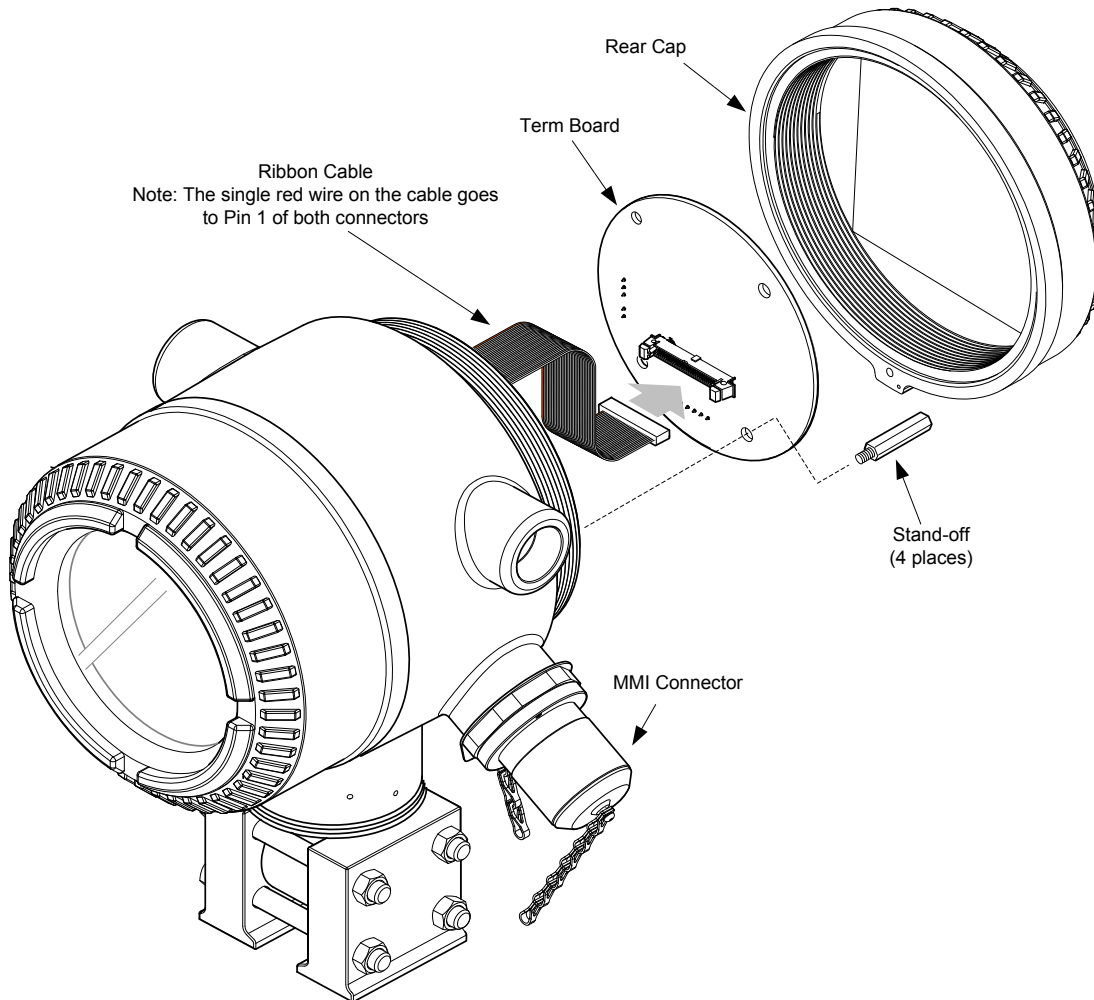
Figure 4–8 G4 EX Back End Exploded View

In the figure, the following labels appear:
- Rear Cap
- Term Board
- Ribbon Cable
  Note: The single red wire on the cable goes to Pin 1 of both connectors
- Stand-off (4 places)
- MMI Connector

4.9.1   Step-by-Step Instructions

1)   Collect data from the unit.

2)   Back up the configuration files following the instructions listed previously in this chapter.

3)   Verify that the "LL" battery alarm is not being displayed on the G4 EX LCD.

WARNING   Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

4)   Gain access to the rear Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench to perform this task. Upon completion, unscrew the end cap.

5)   Upon unscrewing the end cap, the user will see the Termination board (see Figure 4–5). Using a ¼" socket wrench, unscrew the four socket mounting screws that hold the Termination board in place.

6) Depending on the configuration that the user selected from the factory, remove either the USB cable (J4), Ethernet cable (J7) or MMI cable (J21).

7) Next, remove the Comm 1 (J19), Comm 2 (J20) and power (J16) connectors.

8) Upon completion, remove the ribbon cable from the J1 connector (Figure 4–9). This will enable the user to remove the Termination board from the G4 EX device.
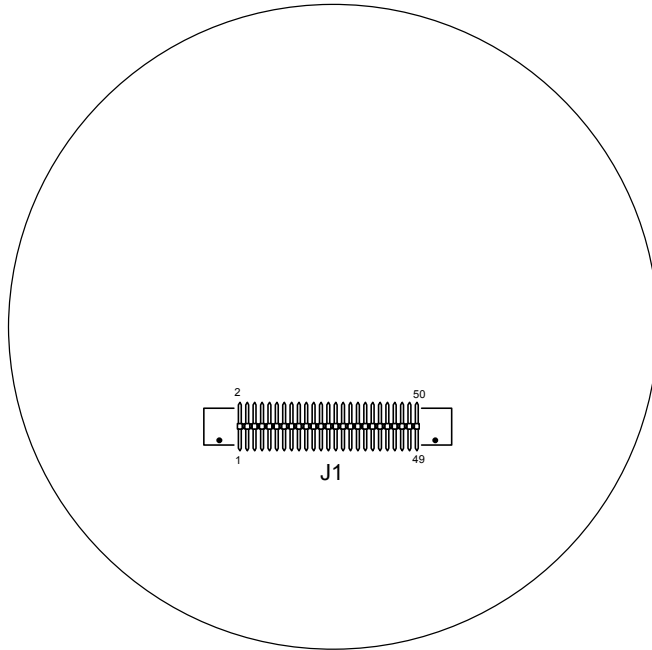
Figure 4–9 Termination Board Secondary Component Side

9) Take the replacement Termination board and attach the ribbon cable to the J1 connector.

> **CAUTION** Please note that the ribbon cable pin 1 wire is red. The red edge (pin 1) of the cable should plug into the outer most edge of the connector (pin 1).

10) Depending on the configuration that the user selected from the factory, attach either the USB cable (J4), Ethernet cable (J7) or MMI cable (J21) to their respective connection.

11) Next, attach the Comm 1 (J19), Comm 2 (J20) and power (J16) connections to their respective connectors.

12) Upon completion, take the four socket mounting screws, and attach the Termination board in the G4 EX device.

4.10 Replacing the Liquid Crystal Display (LCD) Board

The LCD board is mounted inside of the G4 EX front end cap. To access and remove the display board, perform the following procedures.

CAUTION Do not remove the lithium battery, since it provides power to the RAM. It is recommended that historical flow data be downloaded before accessing and removing the LCD board to prevent the potential loss of stored data.

4.10.1 Step-by-Step Instructions

1) Collect data from the unit.

2) Back up the configuration files following the instructions listed previously in this chapter.

3) Verify that the "LL" battery alarm is not being displayed on the G4 EX LCD.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

4) Gain access to the rear Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench to perform this task. Upon completion, unscrew the end cap.

5) Disconnect the power connector (J16) from the board mounted connector (see Figure 4–5).

6) Gain access to the LCD assembly by loosening the countersunk hex socket locking set screw in the front end cap. Use a 1/16" hex wrench to perform this task. When completed, unscrew the end cap.

7) After the end cap has been removed, gently pull the graphic overlay plate away from the snap on standoffs.

8) Using a small flat head screw driver, remove the four screws that hold the LCD board to the G4 EX device.

9) Gently disconnect the LCD board from the G4 EX board, J2 connector (see Figure 4–6). Lift the board from the device.

10) To reinstall the LCD board, repeat steps 8 through 9 in reverse order. Do not over tighten screws.

11) Once the LCD board is reinstalled, apply power to the G4 EX (step 5), and verify that the information displayed on the LCD is correct.

12) Adjust the contrast potentiometer, R1, for optimum display.

TIP To adjust the display contrast, use an extra small screwdriver to turn the potentiometer, R1, completely clockwise. After completing this, turn the screw back counter clockwise until the screen is readable.

13) Replace the graphic overlay plate that was removed earlier.

4.11 Replacing the Lithium Battery

CAUTION Do not remove power to the unit. Loss of power to the unit will initiate a cold start. All data and configuration files will be lost.

4.11.1 Step-by-Step Instructions

1) Collect data from the unit.

2) Back up the configuration files following the instructions listed previously in this chapter.

3) Gain access to the G4 EX board by loosening the countersunk hex socket locking set screw in the front end cap. Use a 1/16" hex wrench to perform this task. When completed, unscrew the end cap.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

4) After the end cap has been removed, gently pull the graphic overlay plate away from the snap on standoffs.

5) Upon completion, gently remove the lithium battery connector (J5) from the G4 EX board.

6) Once the lithium battery connector is removed, snap the board out of the device. Please note that the board is still connected to device through the cables in the back.

7) After the G4 EX board has partially been removed, unplug the sensor connector cable (J6) and the ribbon cable (J1) from the G4 EX board. This will allow the board to be completely removed from the device.

8) The user will now see a manufacturing plate. The lithium battery assembly is located on the back of this plate in a small battery enclosure. Carefully remove the plate from the snap on standoffs.

9) The lithium battery assembly is attached to the manufacturing plate by a Velcro strip. Gently remove the lithium battery from the Velcro strip.

10) Take the new lithium battery, and attach the Velcro edge of the battery to the Velcro strip in the battery enclosure on the manufacturing plate.

11) Once the lithium battery is attached to the manufacturing plate, snap the plate back into the device using the appropriate standoffs.

12) Take the G4 EX board, and attach the sensor cable and the ribbon cable to their corresponding connectors.

CAUTION Please note that both sensor cable and ribbon cable pin 1 wire is red. The red edge (pin 1) of the cable should plug into the outer most edge of the connector (pin 1).

13) Attach the lithium battery cable to its corresponding connector.

14) Align the mounting holes on the G4 EX board with the standoffs, and snap the board into place within the device.

15) Replace the display and graphic overlays that were removed earlier.

4.12 Replacing the Transducer (EXIMV)

The EXIMV is specifically designed for the G4 EX device. The transducer characterization files are stored in the G4 EX raw sensor interface board. As such, replacement/repair involves removing both the transducer and the G4 EX raw

sensor interface board from the actual G4 EX device. Contact Totalflow to return both pieces for replacement under warranty or for repair.

CAUTION 🌀 Entry into the interior of the transducer voids the transducer warranty. If the transducer requires servicing, the entire assembly must be removed from the unit, packaged securely for shipping and returned to Totalflow. Contact Totalflow Customer Service for instructions.
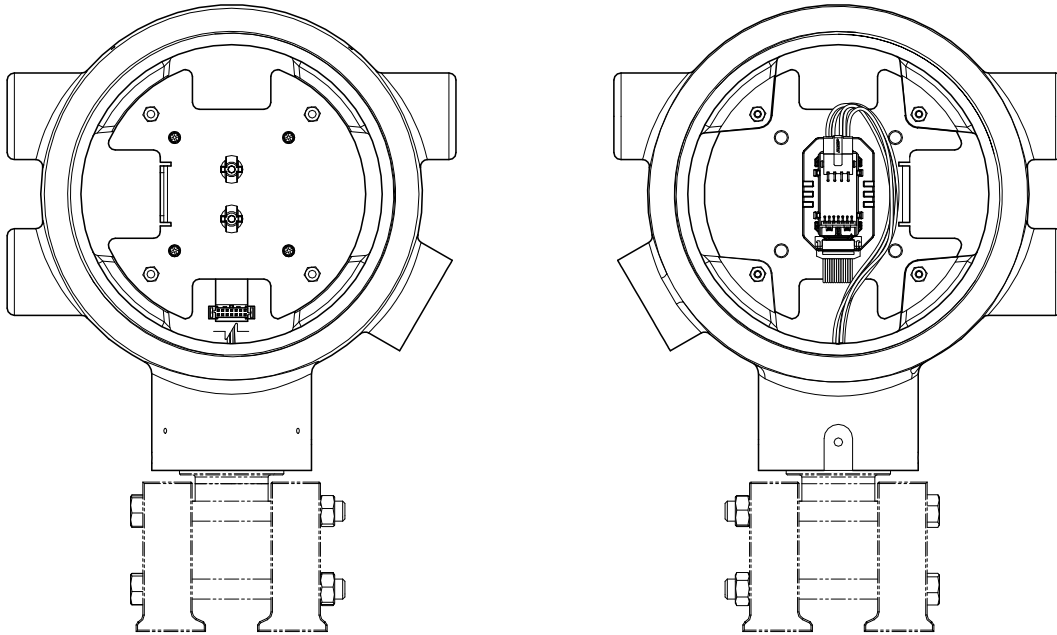
Figure 4–10 EXIMV Installation Overview

4.12.1 Step-by-Step Instructions

1) Collect data from the unit.

2) Back up the configuration files following the instructions listed previously in this chapter.

3) Once the user has finished backing up the configuration and data files, they will need to open the manifold high/low equalizer valves.

4) Using the orifice tap valves, close off both upstream and downstream. These two valves connect the meter run high/low output lines to the transducer.

5) Open the vent valve to atmosphere.

6) Completely disconnect the high/low manifold lines from the transducer.

7) If the user is able to do so at this point, remove the external power that is feeding the unit. If this can be done, skip to step 10; otherwise, continue to the next step.

LOW SIDE
EQUALIZER VALVE

HIGH SIDE
EQUALIZER VALVE

VENT TO
ATMOSPHERE

XFC^{G4}EX
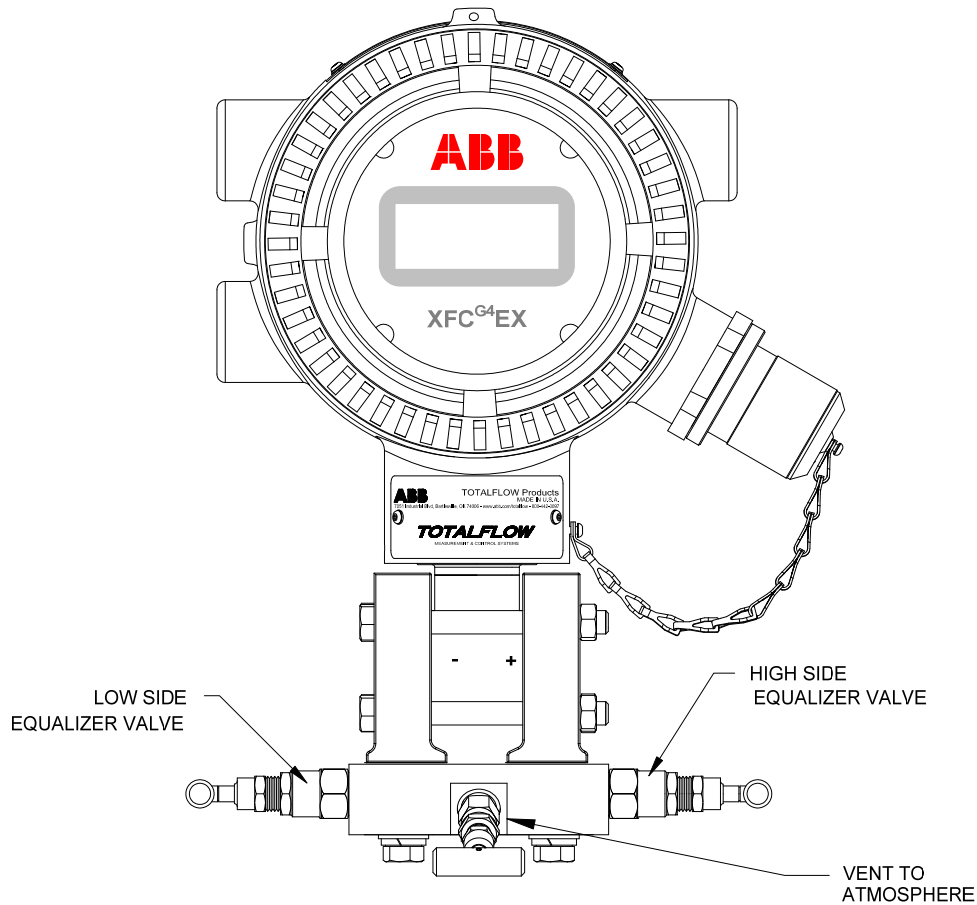
Figure 4–11 G4 EX with Block Manifold

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

8) Gain access to the rear Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench to perform this task. Upon completion, unscrew the end cap.

9) Disconnect the power connection (J16) from the Termination board mounted connector.

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

10) Gain access to the G4 EX board by loosening the countersunk hex socket locking set screw in the front end cap. Use a 1/16" hex wrench to perform this task. When completed, unscrew the end cap.

11) After the end cap has been removed, gently pull the display overlay and graphic overlay plate away from the snap on standoffs.

12) After the graphic overlay plate is off, gently remove the lithium battery connector (J5) from the G4 EX board.

13) Upon removal of the lithium battery connector, snap the board out of the device. Please note that the board is still connected to the device through the cables in the back.

14) Unplug the raw sensor connector cable (J6) and the ribbon cable (J1) from the G4 EX board.

15) Gently remove the board from the G4 EX device.

16) Loosen the 2" mounting pole U-bolts. Rotate/lower the unit a sufficient distance so that the transducer can be removed.

17) Loosen the hex socket head set screws on the neck of the unit using a 3/32" hex wrench. Continue until the transducer turns freely. Gently turn counter-clockwise until the transducer is free from the enclosure.

18) Replace the transducer and raw sensor board with a new/repaired/spare unit of the same type and pressure rating.

19) Reconnect the high/low manifold lines, and restore pressure.

20) Reassemble the unit by performing steps 10-14 in reverse order.

21) Following the instructions in section 4.3, restore the station files.

4.13 Calibration

The calibration mode allows the user to calibrate, check and zero the static and differential pressure. Additionally, this mode allows the user to set the bias for the resistance temperature detector (RTD). During the initial calibration, the parameters shown in Table 4—1 will need to be configured.

Table 4—1 Calibration Configurable Parameters

Parameter	Default Value	Units
RTD Installed	No	
RTD Bias	0.00	Degrees F
Temperature Base (Tb)	60.000	Degrees F
Used Fixed Temperature (TF)	No	

4.13.1 Required Test Equipment

The following test equipment is required to calibrate the G4 EX EXIMV:

- PCCU32 version 7.17 or later
- Deadweight tester or equivalent calibration standard
- Test gauge capable of dual range measurement (PSIG and inches)
- Barometer or another means which can determine barometric pressure
- Nitrogen or compressed air source

FYI   If a method other than compressed nitrogen/deadweight tester is used to calibrate the static pressure cell, the user must ensure that the prescribed flange type valves are blocked to prevent false differential pressure from being applied to the DP cell. Additionally, ensure that both high and low sides are pressured up during SP calibration.

4.13.2 Hold Mode

When calibrating the transducer or setting up a fixed temperature, PCCU32 will instruct the G4 EX to ignore live values for the flow calculations for the period of time that the G4 EX is being calibrated. During this time, the G4 EX uses SP, DP and temperature captured at the time that calibration mode was entered. This is referred to as the HOLD mode.

To exit HOLD mode:

1) Exit Calibration mode.

2) Unplug the PCCU cable at the G4 EX connector.

TIP Totalflow recommends performing a five point check before and after calibration. The host software (WinCCU) is capable of recalculating the volume based on the differences between the previous five point check and the current five point check.

After a secure audit trail is archived, WinCCU recalculates the flow volumes based on the previous and current markers. This allows more accurate results of the flow volume.

4.13.3 Static Pressure (SP) Calibration Checks

The G4 EX allows the user to check the static pressure calibration and log pressure marker check points. The user should perform this check prior to and directly following the calibration.

During normal operation of the G4 EX, the display provides continuous SP readouts; however, during this procedure, the G4 EX is placed in a temporary Hold mode.

A minimum of three SP markers should be set; however, the user can enter as many SP markers as they want. Recording too many markers could cause the G4 EX to overwrite existing older events. Only the last five checks are used by the WinCCU editor for calibration adjustment. Enter a low, mid-low, mid, mid-high and high value.

CAUTION The resulting comparison pressure must not be greater than the static pressure cell's maximum pressure.

4.13.3.1 Step-by-Step Instructions

1) Enter the Calibration menu's Checks screen. This will place the G4 EX on Hold. Select the preferred measurement tube from the tree-view.

2) Select SP from the Calibration drop-down menu to the left of the Pressure Marker table.

3) Select the SP type: Absolute or Gauge.

TIP Absolute will display values with the barometric pressure added in. Additionally, entered values will need the barometric pressure added. Gauge will display values in gauge pressure. Additionally, entered values will need to be in gauge pressure.

4) Click on the Enter Pressure Check Value, and select Continuous to update the current reading.

5) Verify that the vent valve is closed (see Figure 4–12).

6) Open both the high and low equalizer valves.

7) Close both the downstream and upstream tap valves.

8) Open the atmospheric vent valve.

9) Enter a pressure marker for atmospheric pressure (PSIA). Enter zero if in Gauge mode or the barometric pressure (or contract value) if in Absolute mode. Click the OK button.

10) Close the atmospheric vent valve.

11) Click on the Enter Pressure Check Value.

12) Connect Calibration Standard to the calibration test port.

13) Pressure to the next preferred verification pressure.

14) When the current reading stabilizes, enter the pressure value from the calibration source. Remember to add the barometric pressure if the pressure type is Absolute. Click the OK button.

15) Repeat steps 11 through 14 for each pressure check value.

16) When all the static pressure markers have been set, determine if calibration is required. If no calibration is required, return the manifold to service before exiting Calibration mode.

FYI For additional information regarding Static Pressure Calibration Checks, see the PCCU32 help files.
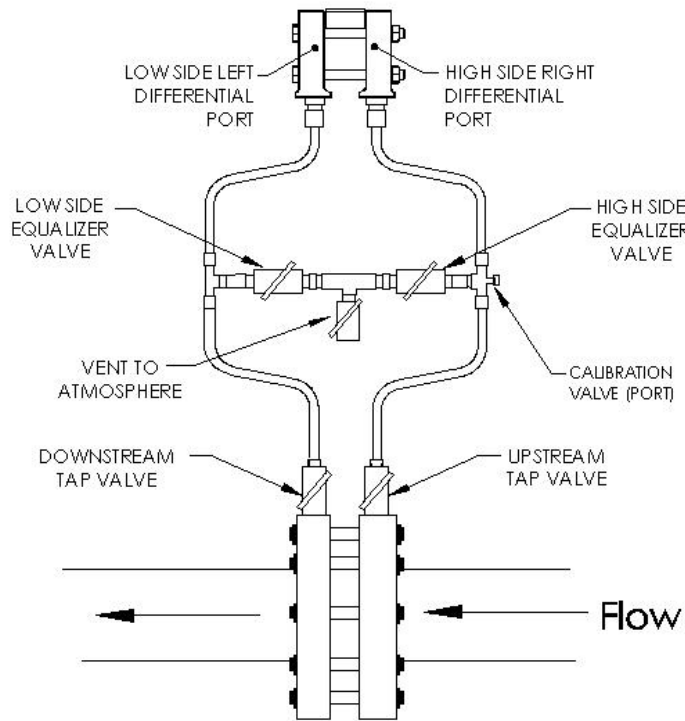
Figure 4–12 Calibration Diagram

4.13.4 Differential Pressure (DP) Calibration Checks

As discussed in section 4.13.3, it is recommended that checks of the differential pressure (DP) be performed prior to and directly following calibration.

A minimum of three differential pressure markers should be set; however, the user may enter as many DP pressure markers as they prefer. Recording too many markers may cause the G4 EX to overwrite existing older events. Only the last five checks are used by the WinCCU editor for calibration adjustment. Enter a low, mid-low, mid, mid-high and high value.

During normal operation of the G4 EX, the display provides continuous DP readouts; however, during this procedure, the G4 EX is placed in a temporary Hold mode.

4.13.4.1 Step-by-Step Instructions

1) Enter the Calibration menu's Check screen. This places the G4 EX on HOLD. Select the preferred measurement tube from the tree-view.

2) Select DP from the Calibration drop-down menu to the left of the Pressure Marker table.

3) Click on Enter Pressure Check Value, and select Continuous to update the current reading.

4) Verify that the vent valve is closed (see Figure 4–12).

5) Open both the high and low equalizer valves.

6) Close both the downstream and upstream tap valves.

7) Open the atmospheric vent valve.

8) Enter a pressure marker for differential pressure "0.0". Click the OK button.

9) Close the high side equalizer valve, and verify that the low side is vented to atmosphere.

10) Connect Calibration Standard to the calibration test port.

11) Pressure to the next preferred verification pressure.

12) When the current reading stabilizes, enter the pressure value from the calibration source. Click the OK button.

13) Repeat steps 11 through 12 for each pressure check value.

14) When all the differential pressure markers have been set, determine if calibration is required. If no calibration is required, return the manifold to service before exiting Calibration mode.

FYI For additional information regarding Differential Pressure Calibration Checks, see the PCCU32 help files.

4.13.5   Calibrating Static Pressure (SP)

A three or five point pressure method is used to calibrate the G4 EX static pressure cell. These different pressures are applied to the cell from a known, traceable source. The resultant pressure values are entered into the G4 EX using PCCU32 software.

When performing the following procedures, wait for the G4 EX display to stabilize. If the G4 EX is not in Calibration mode, the display will not necessarily match applied cell pressures.

The G4 EX uses an absolute static pressure (SP) cell. Absolute pressure measures the pressure referenced to a vacuum or sealed chamber. This is different than a gauge cell which measures the pressure referenced to the atmosphere.

FYI Since the static pressure cell is an absolute device, it always measures the true pressure relative to a vacuum or sealed chamber. As such, when vented, it measures true barometric pressure.

For other points of calibration, add the reading of PSI and barometric pressure to arrive at PSIA. Upon completion, enter this reading.

4.13.5.1   Absolute Versus Gauge

It is recommended that the initial calibration point be at vented conditions. When this is done, the barometric reading (in PSI) should be used as the initial point.

When operating in PCCU32's Absolute mode, other points of calibration are arrived at by adding the PSI reading and the barometric pressure to arrive at PSIA. Once this has happened, enter this reading.

When operating in PCCU32's Gauge mode, readings may be entered in as read, and then a barometric pressure reading is entered.

4.13.5.2   Calculating PSI

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.

Step-by-Step Instructions

1) Enter the Calibration menu's Calibration screen. This places the G4 EX in Hold. Select the preferred measurement tube from the tree-view.

2) Select SP from the Calibration drop-down box to the left of the Pressure Marker table. Select 3 or 5 Point Calibration.

3) Set the Transducer SP Pressure Range in the Calibration window. This should match the range reading from the tag or label attached to the transducer.

4) Select the SP type: Absolute or Gauge.

TIP   Absolute will display values with the barometric pressure added in. Additionally, entered values will need the barometric pressure added. Gauge will display values in gauge pressure. Additionally, entered values will need to be in gauge pressure.

5) Enter the barometric pressure in the bottom window before proceeding.

6) Verify that the vent valve is closed (see Figure 4–12).

7) Open both the high and low equalizer valves.

8) Close both the downstream and upstream tap valves.

9) Open the atmosphere vent valve.

10) Click on the Low Cal Point button. Verify the current reading is continuously updated. This should represent the lowest calibration point.

11) When the current reading stabilizes, click the OK button; otherwise, enter a different value, and then click the OK button.

12) When the previous reading was accepted, notice that the 100% Cal Point button is activated. To select, press Enter.

13) Connect calibration standard to the calibration test port.

14) Close the atmosphere vent valve.

15) Pressure to 100% of the transducer range (100% of the target value).

16) When the current reading stabilizes, accept the target value already showing in the window; otherwise, enter the pressure value from the calibration source. Click the OK button.

17) Again, notice that the next Cal Point is activated. To select, press Enter.

18) Pressure the transducer to the next target value as shown in the Calibration window.

19) When the current reading stabilizes, accept the target value already showing in the window; otherwise, enter the pressure value from the calibration source. Click the OK button.

20) Repeat steps 17 through 19 until all calibration points have been entered.

21) Upon completion of the SP calibration, new calibration markers should be set.

22) Return the manifold to service before exiting Calibration mode.

4.13.6 Calibrating Differential Pressure (DP)

A three or five point pressure method is used to calibrate the G4 EX differential pressure cell. These different pressures are applied to the cell from a known, traceable source. The resultant pressure values are then entered in the G4 EX using PCCU32 software.

During factory calibration, any differential pressure (DP) shift due to static pressure effect is corrected. This is not user configurable and will not be modified due to field or user calibration. This ensures that the readings received in the field are accurate. The user may not change the factory set shift. If readings appear incorrect, the user may need to check for leaks and then recalibrate the DP.

When calibrating, wait for the readings to stabilize before entering the new values.

4.13.6.1 Step-by-Step Instructions

1) Enter the Calibration menu's Calibration screen. This places the G4 EX in HOLD.

2) Select DP from the Calibration drop-down box to the left of the Pressure Marker table. Select 3 or 5 Point Calibration.

3) Set the Transducer DP Pressure Range in the Calibration window before proceeding. This should match the range reading from the tag or label attached to the transducer. Target values based on the selected range will display in the Calibration table.

4) Verify that the vent valve is closed (see Figure 4–12).

5) Open both the high and low equalizer valves.

6) Close both the downstream and upstream tap valves.

7) Open the atmospheric vent valve.

8) Click on the Low Cal Point button. Verify the current reading is continuously updated.

9) When the current reading stabilizes, click the OK button; otherwise, enter a different value, and click the OK button.

10) When the previous reading was accepted, notice that the 100% Cal Point button becomes activated. To select, press Enter.

11) Connect the Calibration Standard to the calibration test port.

12) Close the high side equalizer valve, and verify that the low side is vented to atmosphere.

13) Pressure to 100% of the transducer range (100% of target value).

14) When the current reading stabilizes, accept the target value already showing in the window; otherwise, enter the pressure value from the calibration source. Click the OK button.

15) Again, notice that the next Cal Point is activated. To select, press Enter.

16) Pressure the transducer to the next target value as shown in the Calibration window.

17) When the current reading stabilizes, accept the target value already showing in the window; otherwise, enter the pressure value from calibration source. Click the OK button.

18) Repeat steps 15 through 17 until all calibration ports have been entered.

19) Upon completion of the DP calibration, new calibration markers should be set.

20) Return the manifold to service before exiting Calibration mode.

FYI For additional information regarding Differential Pressure Calibration mode, see PCCU32 help files.

4.14 Onboard I/O Calibration Overview

The Calibration mode enables the calibration of the analog inputs, analog outputs and pulse inputs.

4.14.1 Hold Mode

When calibrating, PCCU32 will instruct the G4 EX to ignore live values for the period of time that the G4 EX is being calibrated. This prevents real-time G4 EX calculations from being effected during calibration. During this time, the G4 EX uses the last known value at the time Calibration mode was entered. This is referred to as a Hold mode.

To exit Hold mode:

1) Exit Calibration mode.

2) Unplug the PCCU cable at the G4 EX connector.

4.14.2 Calibrating Onboard Analog Inputs

The G4 EX comes standard with two analog inputs on the G4 EX board. As the user enters Calibration mode, the G4 EX moves into Hold mode and displays the current values.

When the user selects the Update checkbox, the Current Values section will display the current values continuously. When different analog inputs are selected, their assigned register numbers are displayed on the top of the screen.

Follow the instructions in the PCCU32 help files for specific software steps. Generally, the user will need perform the following procedures:

TIP If the user intends to use a 4-20 mA transmitter on the analog input, please refer to Appendix X. Manufacturer's specifications can often lead to confusion. In some instances, the manufacturer's specifications will claim to operate from 10 to 30 VDC. They are not always clear that

this 10-30 VDC must be applied across the 4-20 mA transmitter only (and not across the transmitter/load resistor series combination). Again, refer to the explanation in the appendix.

4.14.2.1 Calibration

1) Connect an accurate power source capable of 1-5 volts to the AI terminals that are to be calibrated.

2) In Calibration window for the AI that is being calibrated, select either 3 or 5 Point calibration for the number of preferred calibration points. 3 Point for low (50% and 100% values) and 5 Point for low (25%, 50%, 75% and 100% values).

3) In the Current Value field, place a check in the Update checkbox. This causes the AI to look for the source at the terminals instead of a test value.

4) Begin the calibration by starting with the first selection, Low Cal Point.

5) Apply one volt to the AI terminals.

6) Enter a value (typically zero) that represents the low calibration point and represents the desired engineering units. Upon completion, click the OK button.

TIP The current reading value on the pop-up entry screens will be placed in the Reading column and represent values from the previous calibration. User entered values will be displayed in the Entry column.

7) Move to the 100% Cal Point parameter field. Once there, apply five volts to the AI terminals.

8) Enter a value that represents the full range and represents the desired engineering units. Upon completion, click the OK button.

9) If 3 Point calibration was selected, move to the 50% Cal parameter field. Once there, apply three volts to the AI terminals.

10) Enter a value that represents 50% and represents the preferred engineering units.

FYI If performing a 5 Point calibration, the user will need to add additional values for both 25% and 75% calculation points.

4.14.3 Onboard Pulse and Digital Inputs

The Totalflow G4 EX comes standard with one high speed pulse input on board. This may also be used as a digital input. The following procedure will enable the user to set the digital input.

Follow the instructions in the PCCU32 help files for specific software steps.

4.14.3.1 Step-by-Step Instructions

1) The user will need to click on the Calibrate icon in the PCCU32 main toolbar. Once completed, click on the AGA-7 tube in the tree-view.

2) Click on the Setup tab.

3) If the device was ordered as a Pulse Input meter, the register addresses (Static Pressure, Pulse Input and Temperature) are listed and fixed. If, however, a new tube application was added by the user, they will need to manually enter the register addresses.

4) Next, the user will need to click on the K-Factor button. Enter a value, and click the OK button. Input pulses are multiplied by the K-Factor. To have a one-to-one pulse count, user a factor of 1.

CAUTION Please take into consideration that these inputs may have the de-bounce enabled or disabled. This feature is discussed in the PCCU32 help files and is also turned on or off within PCCU32.

4.15 Zero Transducer

During the process of setting pressure markers to determine the need for a calibration of either the static pressure (SP) or the differential pressure (DP), the user may conclude that the SP or the DP pressures are out of alignment at exactly the same amount at each pressure marker (linear shift). When this occurs, the user may either recalibrate the G4 EX or they can set the transducer to zero. The preferred method is to recalibrate the G4 EX. This maintains the G4 EX records in a manner that assures accountability and continuity when other measurement issues arise. By using the Zero Transducer command, all references to previous pressure markers are non-existent, eliminating the ability to adjust volumes based on previous markers.

CAUTION Using the Zero Transducer capability assumes that the shift is linear. This means that at different levels of pressure the transducer is off by exactly the same amount. If this is not the case, the user needs to recalibrate the transducer instead.

4.15.1 Static Pressure

The SP can be zeroed without recalibrating. If the SP shifts, the user can enter a new barometric pressure value. This shifts the SP transducer curve. After the Hold state initiates, select Zero Transducer.

4.15.2 Differential Pressure

The DP can be zeroed without recalibrating. If DP shifts, the user can enter a new zero (0). This shifts the DP curve. After the HOLD state begins, select Zero Transducer.

4.16 RTD Calibration and Bias

The Totalflow G4 EX has one onboard RTD input. The registers representing the RTD input is normally assigned to a measurement tube. The RTD tab is located in the Calibrate screen within the Onboard I/O tree-view. The user will need to click the Analog Inputs sub-menu, and move to the RTD tab (see Figure 4–13).
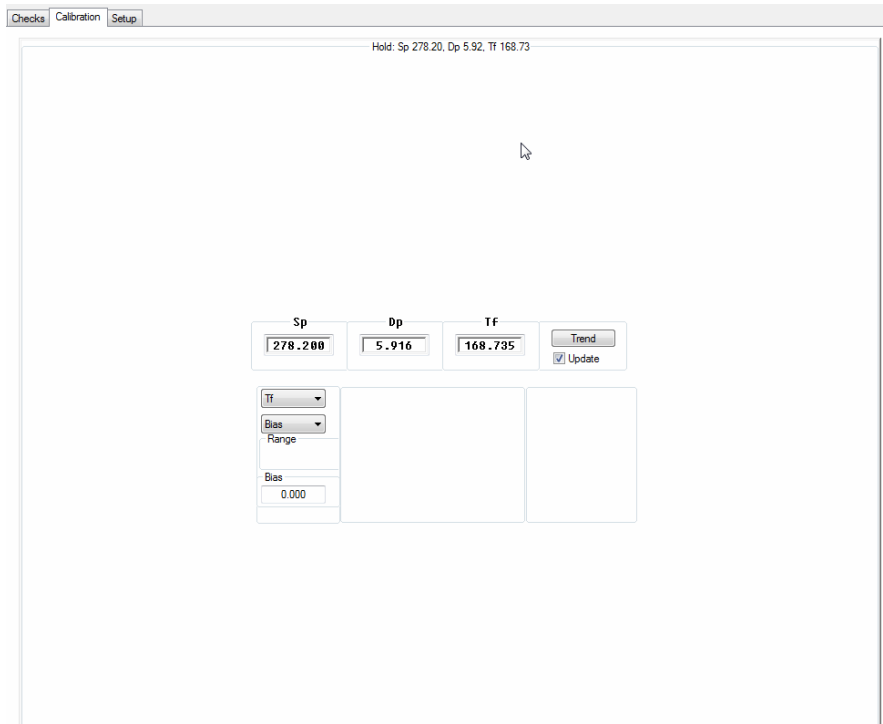
Figure 4–13 RTD Calibration Screen

The Current Value parameter will display the current value of the selected RTD by placing a check mark in the Update field.

4.16.1 Step-by-Step Instructions

1) Connect the variable resistor or RTD calibration equipment to J7 on the G4 EX board.

Terminal	J7
1	SHLD
2	Out
3	Plus (+)
4	Minus (-)
5	In

FYI If the user elects to calibrate using an 100 OHM RTD probe, refer to the PCCU32 help files to view resistance and corresponding temperature readings.

2) Select the RTD tab within the Analog Inputs tab sub-menu under Onboard I/O in the Calibration window.

3) Select whether to perform a 3 Point, 5 Point or Bias calibration. Note that if a 3 Point is selected, there will be 3 Target values and 3 Cal Point buttons. If 5 Point is selected, there will be 5 Target values and 5 Cal Point buttons.

4) Click inside the Range window, and enter a range. The range can be anything and represent any units (percent, volts, etc.) that the user prefers. Target values will be updated to reflect the new calibration range.

5) Click on the Low Cal Point button, and apply the voltage (typically 1 volt) for the low calibration point. Verify the current reading on the Enter Low Calibration Value screen is stable.

6) Enter the Target value for the Low Cal Point, and click the OK button.

7) Click on the 100% Cal Point button, apply the voltage (typically 5 volts) that represents the full range and verify the current reading is stable.

8) Enter the Target value for the 100% Cal Point, and click the OK button.

9) Click on the next highest Cal Point button, and apply a voltage representing its range. Verify the current reading is stable.

10) Enter the Target value for that Cal Point, and click the OK button.

11) Repeat Steps 9 - 10 for any remaining Cal Points. After the last point is entered, PCCU32 will automatically calibrate the AI.

4.16.2 Calibrating RTD Temperature Bias

If the user elects to use Bias as a calibration method, select Bias from the Calibration drop-down menu.

To change, click in the Bias parameter field. The RTD Bias dialog box will display. This allows the user to enter a new value. The RTD's temperature will always be biased by this value; however, the RTD Installed box on the Setup tab must be checked for the RTD temperature and bias to be used. If the bias needs to be negative, enter a minus sign (-) before the value. The current temperature value under the Tf heading will increase or decrease to reflect the effect of the bias. The bias does not effect the Fixed Temperature that is specified on the Setup tab. The user can select Sp, Dp, etc., in the drop-down Calibration window to return to the selected Calibration screen.

4.17 Changing the Orifice Plate

Use one of the following procedures when changing the orifice plate:

4.17.1 Taking Meter Run Out of Service (Simplex Fitting)

1) Take the meter run out of service.

2) Replace the physical orifice plate.

3) If the user wants to end the current log record and begin a new record with the new orifice size (as stated in API21.1), they need to first move into Entry mode within PCCU32. Next, select the preferred measurement tube, and then click on the Commands tab. Change the value for the Reset Log Period to Yes. This forces a new record to be written based on the old orifice plate size. Additionally, if the user wants to simultaneously zero the accumulated volume, they can use the Reset Volume command instead.

It is recommended to perform either the Reset Log Period or the Reset Volume command to enhance the audit trail created by the event (API 21.1 requirement).

4) In PCCU32, enter the new orifice plate diameter.

5) Return the meter to service.

4.17.2   Leaving Meter Run In Service Procedure (Senior Fitting)

1) Place the G4 EX in HOLD by entering Calibration mode. This enables constant SP, DP and Temperature values to be used, while the orifice plate is being changed.

2) Replace the orifice plate.

3) Exit Calibration mode. This releases HOLD of the SP, DP and Temperature.

4) If the user wants to end the current log record and begin a new record with the new orifice size (as stated in API 21.1), they need to first move into Entry mode within PCCU32. Next, select the preferred measurement tube, and then click on the Commands tab. Change the value for the Reset Log Period to Yes. This forces a new record to be written based on the old orifice plate size. Additionally, if the user wants to simultaneously zero the accumulated volume, they can use the Reset Volume command instead.

It is recommended to perform either the Reset Log Period or the Reset Volume command to enhance the audit trail created by the event (API 21.1 requirement.

5) In PCCU32, enter the new orifice plate diameter.

FYI   At the top of the Volume Calculation Period, the G4 EX will perform calculations based on the new orifice plate diameter for part of the period after the log was reset.

5.0 TROUBLESHOOTING

5.1 Overview

To serve as an aid in troubleshooting the G4 EX, the following chapter will provide guidelines for the various subsystems within the device.

The chapter contains a troubleshooting flowchart (see Figure 5–1). As the user follows the logic in this flowchart, they will be directed to specific test instructions that are found in this chapter or may be directed to the Power Troubleshooting section or the Communication Troubleshooting flowchart (see Figure 5–7). In addition to the flowchart, this chapter contains step-by-step procedures for troubleshooting the G4 EX with or without an installed radio communication unit.

5.1.1 Troubleshooting Support

If troubleshooting instructions do not lead to a resolution and assistance is required, the user can contact the Totalflow Service department:

USA: (800) 442–3097   International: 001-918-338-4880

5.1.2 Visual Alarm Codes

As noted in Chapter 1, the unit's LCD annunciator displays many different status indicators that are related to device operations. This section contains information on those codes that reflect errors or provide information that is useful in troubleshooting the device. Alarm codes indicate that an operational problem exists.

The user is informed of operational problems and operational limit violations by observing the alarm codes on the right side of the LCD display.

5.1.3 Sleep Mode

Totalflow units are designed to move into a low power mode, Sleep, when an insufficient supply voltage is present for a period of time. The issue that needs to be addressed is the reason for the Sleep alarm; waking up the unit will be insufficient for correcting the problem. As such, issues relating to the system's power supply should be investigated.

5.1.4 Solar Panel

When a solar panel is attached to the 6270 OEU to provide a charging source for the battery, cleanliness and positioning play an important part as do proper electrical and cabling techniques. More detailed information on power consumption can be found at www.abb.com/totalflow.

5.1.5 Communication

Troubleshooting the communications for this unit requires that both pieces of equipment be tested: the G4 EX comm ports and the communication device. This is discussed in more detail in the Communications Overview section. Other communication troubleshooting information is shared in the following categories: RS-232, RS-485, and RS-422 Communications.
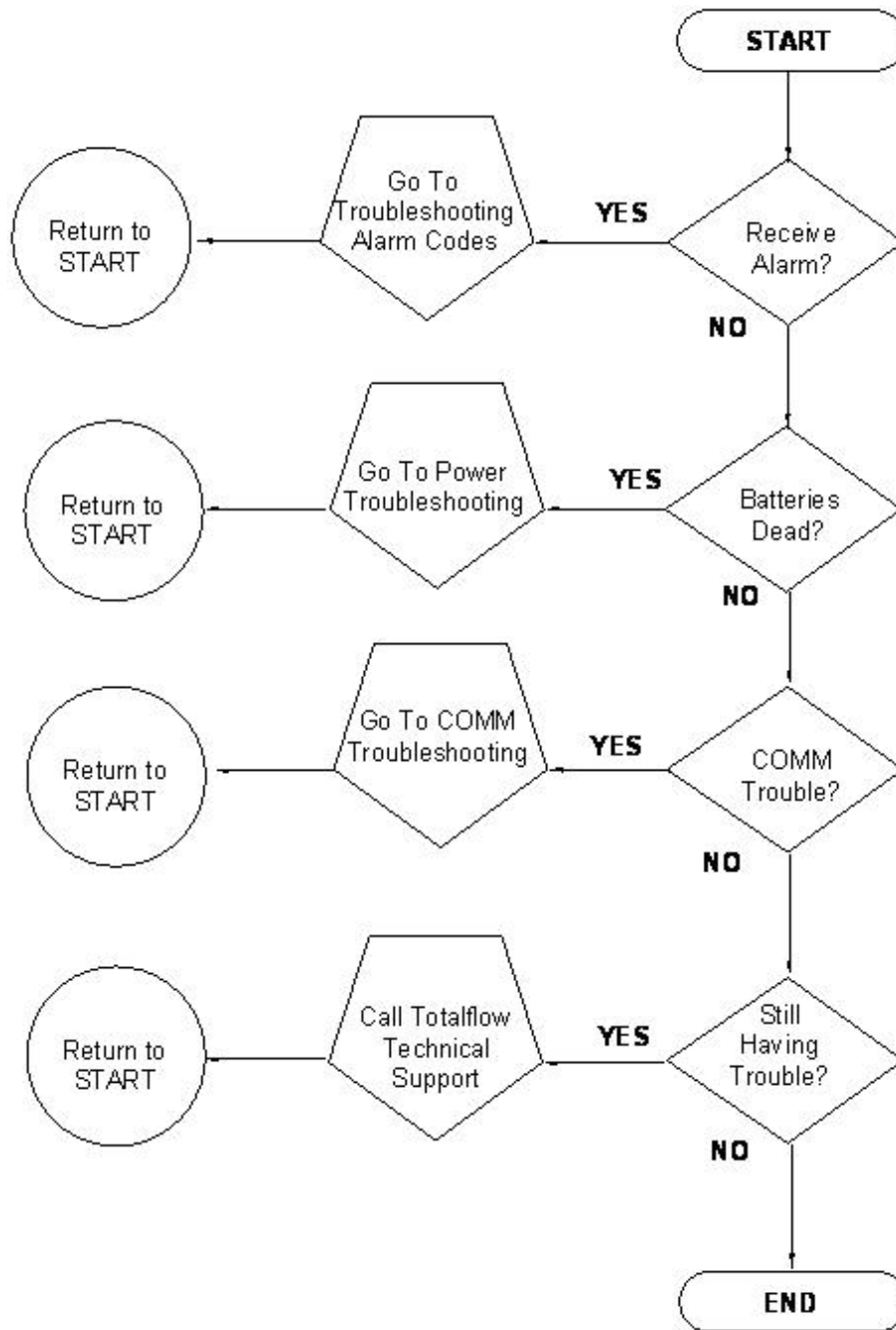
Figure 5–1 Troubleshooting Flowchart

5.2 Troubleshooting Visual Alarm Codes

When a visual indicator is present (see Figure 5–2), the following section will assist in determining the probable cause and the steps required to correct the condition.

For the purposes of troubleshooting, only those codes considered alarms or codes used to assist troubleshooting are discussed here. The entire list of status and alarm codes can be found in Chapter 1. Table 5—1 contains a description of each G4 EX alarm code. An alarm can be a word, character, letter or symbol.

An application can be assigned to an annunciator, and any alarms or status codes associated with that application will be displayed.

14 characters across

4 characters high

Name
Unit
Data
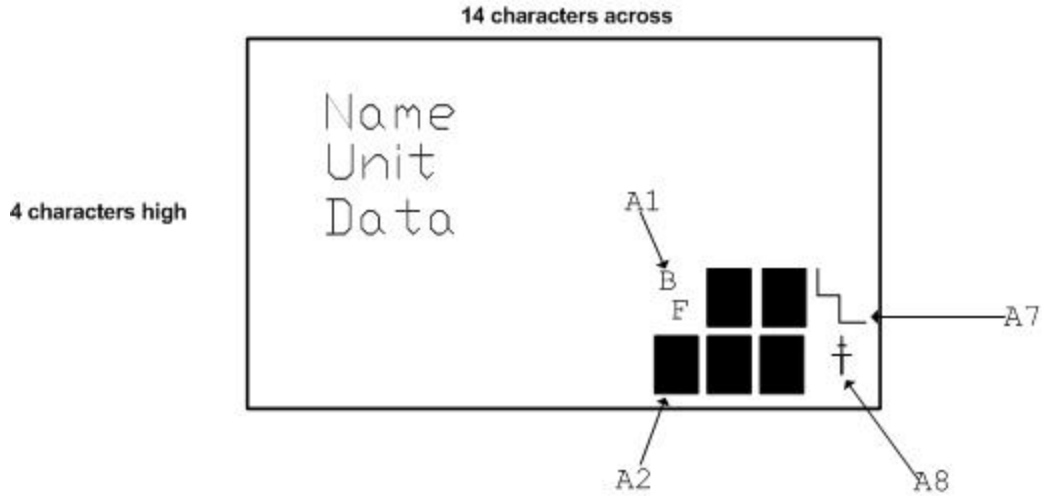
Figure 5–2 Liquid Crystal Display and Indicators

Table 5—1 Visual Alarm Codes

Indicator	Description	Alarm
I/O Subsystem		
^L_L	Low Lithium Battery Alarm: When ^L_L (low lithium) is displayed, the lithium battery voltage is below 2.5 VDC. If battery voltage is above 2.5 VDC, A1 appears shaded. A new lithium battery measures approximately 3.6 VDC.	Y
^L_C	Low Charger: This is displayed if the G4 EX battery charging voltage is less than (+)0.4 VDC higher than the battery voltage. If charging voltage is (+)0.4 VDC greater than the battery voltage, the annunciator is shaded.	Y
Measurement Application		
^A_D	A to D Failure: Displayed if the A to D Converter absolute differential pressure, absolute static pressure or temperature readings exceed maximum counts or are less than the minimum counts. If the A to D Converter readings are within range, AD is shaded.	Y
Communication Protocols		
$\rightarrow$	Transmitting Data: Sending a response.	N
$\leftarrow$	Receiving Data: Processing request.	N
!	Nak: Negative Acknowledgement w/packet list.	N
+	Ack: Positive Acknowledgement of receipt request.	N
ⵜ	Waiting for ACK: Waiting for response after transmission.	N
?	Exception Alarm Proceeding.	N
₸	ID Recognized: Recognized and receiving request.	N
‡	Listen Cycle: 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.	N

Indicator	Description	Alarm
M	MODBUS ASCII: MODBUS ASCII protocol selected for the port assigned to this annunciator.	N
m	MODBUS RTU: MODBUS RTU protocol is selected for the port assigned to this annunciator.	N
¥	ID Recognized: The ID has been recognized but is waiting for Sync.	N

5.2.1   Troubleshooting a Blank LCD Screen

When the LCD is blank, this means that the unit has entered S mode. This indicates that the battery voltage has dropped below 10.9 VDC.

5.2.1.1   Step-by-Step Instructions

1) Make a local connection with the G4 EX. This will wake the unit up so that the user can check all alarm conditions and determine the problem.

2) Check the power supply cable. It must make a good, secure electrical connection with the connector, J16 (see Figure 5–3).

3) If voltage is low, investigate power supply source.
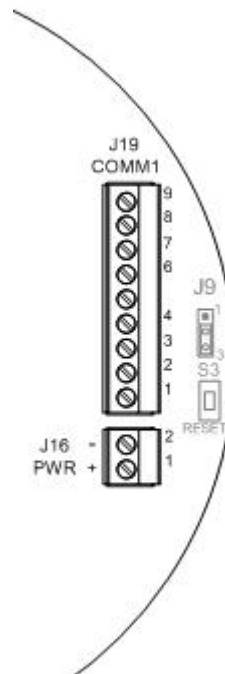
Figure 5–3 Power Supply – G4 EX Termination Board

5.2.2   Troubleshooting a Low Lithium Alarm (LL)

When the Low Lithium alarm displays, the lithium battery should be replaced immediately. Failure to replace the lithium battery could result in a loss of data following a power loss. Instructions for replacing the lithium battery can be found in Chapter 4.

5.2.3   Troubleshooting a Analog to Digital Failure Alarm (AD)

The G4 EX must have a Measurement Tube application running to receive this error. If the A to D Failure alarm is present or if the device is in Sleep mode but is still receiving minimum voltage, it may be necessary to test the data link between the main electronic board and the transducer. Use the following instructions to check the transducer.

Probable causes of receiving the A to D failure include:

- A/D Converter is over or under range (DP, SP or Tf)
- Loose wiring connections
- Faulty RTD probe

If the A to D Converter readings are within range, AD is shaded.

5.2.3.1   Step-by-Step Instructions

1) Begin by collecting data from the unit.

2) View the Event log in PCCU32 for codes (see PCCU32 help files for more information).

    - 99 A/D converter could not be read.
    - 100 A/D converter could be read again.

3) If the event code is found, follow the guidelines for returning the transducer to Totalflow for repair or replacement. If the event code is not found, continue to the next step.

4) In the PCCU32 Entry screen, monitor the readings by clicking on the I/O Subsystem in the tree-view and selecting Onboard and Analog Inputs. Check SP, DP and temperature to determine which measurement channel is causing the alarm.

    - If the alarm is caused by the SP or DP channel, equalize and vent the manifold.
        - If the alarm disappears: the SP or DP cell is not ranged properly, or the manifold may have blockage.
        - If the alarm is still present, replace the transducer.
    - If the alarm is caused by the temperature channel, move to step 9; otherwise, move to the next step.

5) Set the EXIMV back to Factory calibration. If this corrects the alarm, recalibrate the EXIMV to correct field calibration. If the alarm is not corrected, continue to the next step.

6) Perform a Warm start on the unit. Verify that the unit is not displaying a LL (Low Lithium) alarm, and then remove power from the unit. Restore power to the unit. If the A/D Failure alarm is not corrected, continue to the next step.

7) Perform the Save and Restore function. Follow the procedure in Chapter 4 for backing up configuration files. The user must ensure that they restore these files to the tfCold drive.

8) Following the reset procedures covered in this chapter, perform a Cold start on the unit. If the problem is not corrected, continue to the next step.

9) Check the RTD wiring at the EXIMV.

10) Perform the following three procedures found next in this chapter.

- RTD Continuity Test
- RTD Resistive Test
- RTD Impedance Test

11) Contact Totalflow to repair or replace the EXIMV.

5.2.4   Resistive Temperature Detector (RTD) Continuity Test

Should the readings from the RTD be suspect, follow the instructions below to test the RTD probe.

5.2.4.1   Required Equipment

- Digital MultiMeter (DMM) with alligator clip leads

5.2.4.2   Step-by-Step Instructions

1) Begin by disconnecting power and communications from the EXIMV.

2) Disconnect the RTD from the EXIMV.

3) Perform continuity test of the wires leading to the probe. Set DMM to 200 OHM or Continuity Audio.

4) Check the continuity of the first wire pair (typically red or black) by connecting one lead to each wire. The meter should read zero or close to zero.

5) If there is continuity, move to step 7. If there is no continuity, verify the wiring at the RTD head is correct.

6) If the wiring at the connection head is correct, the RTD is defective. Replace the probe; otherwise, continue to the next step.

7) Check the continuity of the second wire pair (typically white) be connecting one lead to each wire. The meter should read zero or close to zero.

8) Check the continuity of each wire (first pair either red or black, as identified in step 4) to the probe or shield. If there is continuity, the RTD is defective. Replace the probe. If there is no continuity, continue to the next step.

9) Check the continuity of each second wire pair (white, as identified in step 7) to the probe or shield. If there is continuity, the RTD is defective. Replace the probe. If there is no continuity, continue to the next step.

10) Check the continuity of each first wire pair (as identified in step 4) to each second pair wire (as identified in step 7). The meter should read approximately 100 to 140 OHMs. If this is the case, continue to the next step. If not, the RTD is defective and should be replaced.

11) If the probe is still not functioning properly, recheck the wiring using the supplied diagram. If no wiring error was found, perform the RTD Current Source Troubleshooting test.

5.2.5   RTD Current Source (Resistive) Test

If the readings from the RTD are still suspect following the RTD Probe Continuity test, follow the instructions below to test the current source on the Termination board to verify that it is receiving power.

5.2.5.1 Required Equipment

- Totalflow Diagnostics Kit
- Digital MultiMeter with alligator clip leads

5.2.5.2 Step-by-Step Instructions

1) Begin by disconnecting power and communications from the Termination board, if not already done.

2) Disconnect the RTD from the Termination board, if not already done.

3) Set the DMM to 200 mVDC.

4) Select the RTD test resistance value by selecting the resistor test connection from the FCU Diagnostic kit, or make one using a resistor appropriate for the unit.

   - Substitute the RTD probe wiring by connecting either a 100 OHM or 123 OHM resistor across connector terminals 3 and 4.
   - Connect a jumper wire between terminals 2 and 3.
   - Connect a jumper wire between terminals 4 and 5.

5) Clip the positive lead of the DMM to the upper side of the RTD test resistor.

6) Clip the negative lead of the DMM to the lower side of the RTD test resistor.

7) Supply power to the unit.

8) Once running, the measured value across the RTD test resistor should be either:

   - 100 OHM Resistor – Min of 100mv to a maximum of 125mv
   - 123 OHM Resistor – Min of 123mv to a maximum of 155mv

9) The RTD measurement temperature on the G4 EX display should read either:

   - 100 OHM Resistor – 31.0°F to 33.0°F
   - 123 OHM Resistor – 140.8°F to 142.8°F

10) If either of the measured values are outside of the range, remove power and replace the RTD.

11) Return power, and perform steps 9 and 10 again. If either of the measured values are outside of range, remove power, and replace the main Termination board.

12) Return power, and perform steps 9 and 10. If either of the measured values are outside of the range, remove power, and replace the EXIMV.

5.2.6 RTD Impedance Test

If readings from the RTD are still suspect following the RTD Probe test, follow the instructions below to test the current source on the Termination board to verify that it is receiving power.

5.2.6.1 Required Equipment

- Ice Bath
- Digitial MultiMeter

5.2.6.2 Step-by-Step Instructions

1) Immerse RTD probe in ice bath.

2) Perform a continuity check between any two similarly colored wires. Measured resistance should be 1 OHM or less.

3) Perform a continuity check between any two dissimilar colored wires. Measured resistance should be approximately 100 OHMs.

4) Perform a continuity check between shield wire and any other wires. Measured resistance should be in the Megohm range.

5) If any values are returned out of range, the RTD probe is defective. Replace the RTD.

5.3 Power Troubleshooting

5.3.1 Overview

This section focuses on determining what was has caused the G4 EX to lose power. Generally, loss of power can be attributed to only the power supply system. However, if the power supply system is used for powering a transceiver or other peripheral equipment, a problem with that equipment may drain the battery and cause the G4 EX to lose power.

The following procedures represent tests that the user can implement to deduce the problem that exists with the powering of the unit.

5.3.2 Power Supply Test

Various equipment configurations will necessitate moving to one or more additional tests from this location.

5.3.2.1 Step-by-Step Instructions

1) Check that the power supply voltage setting, the power supply current rating and the cables used for the installation meet the recommended requirements.

2) If this is a new installation and external power is being powered from the G4 EX, call Totalflow Technical Support for help in evaluating the cable and power supply installation requirements.

3) Correct and retest, as necessary.

4) Check for a poor cable connection between the G4 EX board and the lithium battery pack.

5) Verify that all field wiring screw terminals on the Termination board are tight (see Figure 5–4).
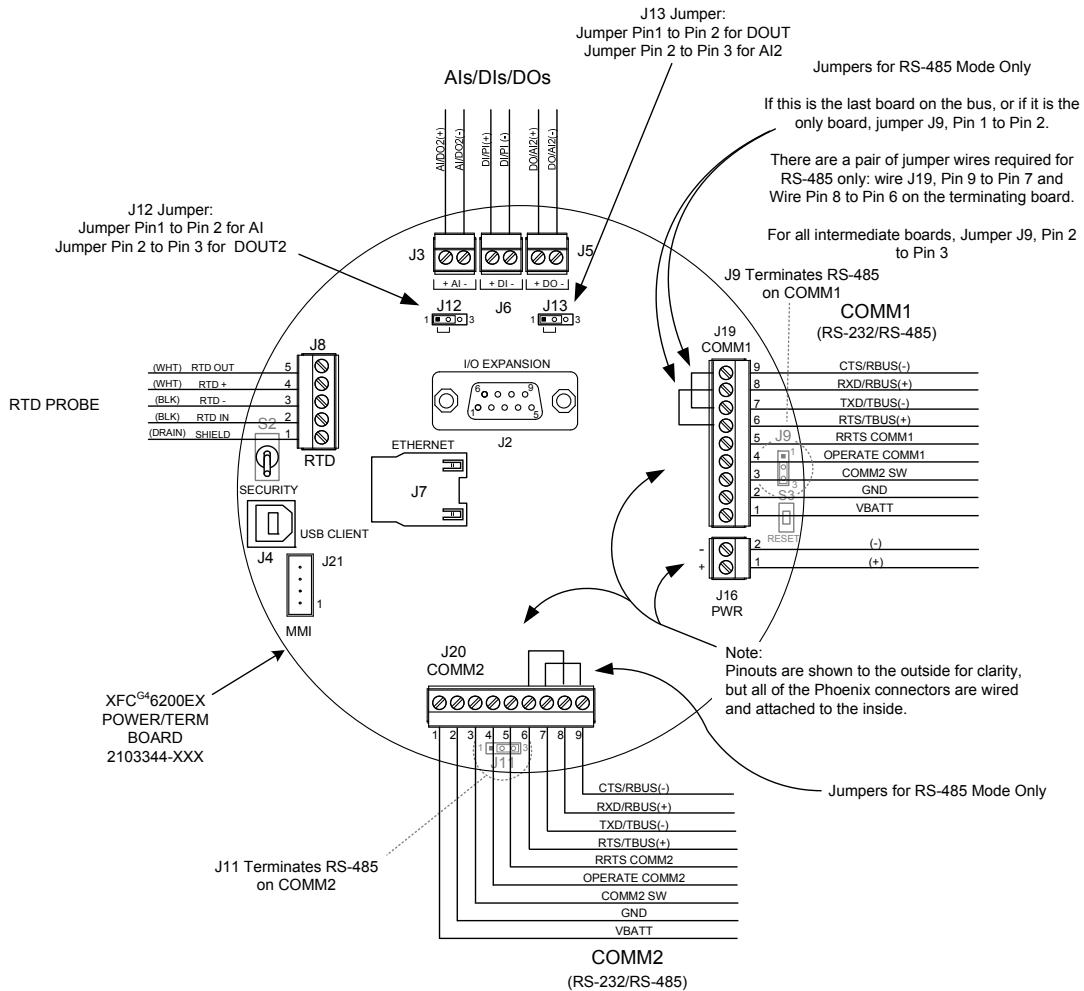
Figure 5–4 G4 EX Termination Board

6) Correct and retest, as necessary.

7) Verify that there are no other devices that may drop and excessive voltage across them in the power supply circuit to the G4 EX.

8) Correct and retest, as necessary.

9) Replace the lithium battery with a known good battery using the Replacing the Lithium Battery instructions in Chapter 4.

5.3.3 Charger Circuit Test

If the system setup includes a battery pack, solar panel or AC charging source connected to the 6270 Optional Equipment Unit (OEU) and the unit's battery is not remaining charged, the user will need to test the battery pack, AC charger and/or the solar panel.

The following instructions contain the steps required to perform the circuit testing.

5.3.3.1 Step-by-Step Instructions

1) Disconnect power from the charger regulator located in the Optional 6270 enclosure.

2) Replace the battery with a known good battery using the Battery Pack Installation procedure in Chapter 2.

3) Reconnect power to the charger regulator. If the battery pack is charged through an AC charger, move to step 5; otherwise, continue to step 4.

4) Measure the charging voltage from the solar panel at the charger regulator. Use a DMM that connects the (+) and (-) leads to the (+) and (-) solar panel wires. Loaded voltage should be greater than or equal to the specifications listed in Table 5—2. If the voltage is within range, the battery was bad.

If the loaded voltage is not above the minimum, perform the Solar Panel Troubleshooting Test found within this chapter.

5) If the unit receives charging voltage from the AC charger, perform the AC Charger Troubleshooting Test found within this chapter.

Table 5—2 Specifications for Solar Panels

Panel	Max	Volts @ P_{Max}	Open Circuit	Load Resistance	Loaded Voltage
5	4.5W	16.5V	20.5V	50 Ω 25W	13.5V
10	10W	16.8V	21V	30 Ω 25W	17.5V
20	20W	16.8V	21V	15 Ω 25W	17.8V
30	30W	16.8V	21V	10 Ω 40W	17.8V

5.3.4 Solar Panel Charging System Test

If the system setup includes a solar panel charger connected to the 6270 Optional Equipment Unit (OEU) and is not supplying the required voltage and current to the G4 EX unit, the user may need to test the solar panel.

The following instructions contain the steps required to test the solar panel.

5.3.4.1 Required Equipment

- Digital MultiMeter with 0-20 VDC range
- Required resistors for testing specific panels as listed in Table 5—2

FYI In continuous low sunlight conditions, the unit may not supply the required voltage. The solar panel should be positioned so that it receives the most sunlight. Do not place in a shaded area.

5.3.4.2 Step-by-Step Instructions

1) Measure the solar panel voltage at the charger regulator. Use a DMM connecting the (+) and (-) leads to the (+) and (-) solar panel wires. Loaded voltage should be greater than or equal to the specification listed in Table 5—2. If the solar panel is not above the minimum, replace the solar panel, and continue to step 2.

2) Check the solar panel angle and direction. In the northern hemisphere, the panel should face due south. In southern hemispheres, the panel should face due north.

3) Check the solar panel for any physical damage or obstructions to sunlight. Sunlight obstructions prevent the solar panel from receiving enough sunlight to charge the installed battery pack. Clear any debris from the cell face of the panel.

4) Check the solar panel wiring to ascertain that it is correctly connected to the associated termination pins that are located in the 6270 OEU enclosure (see Figure 5–5).

5) Disconnect the solar panel from the field device.

6) Set the DMM to 20+ VDC.

7) Determine if the open circuit voltage is greater than or equal to the specification listed in Table 5—2 by clipping the positive lead of the DMM to the first wire and clipping the negative lead of the DMM to the second wire. If the solar panel is not above the minimum, continue to the next step.

8) Using the selected resistor from Table 5—2 for the solar panel wattage, attach the selected resistor between the two solar panel wires.

9) Clip the positive lead of the DMM to the upper side of the test resistor.

10) Clip the negative lead of the DMM to the lower side of the test resistor.

11) Determine if the loaded voltage is greater than or equal to the specification listed in Table 5—2. If the solar panel is not above the minimum, replace the solar panel, and return to step 3.
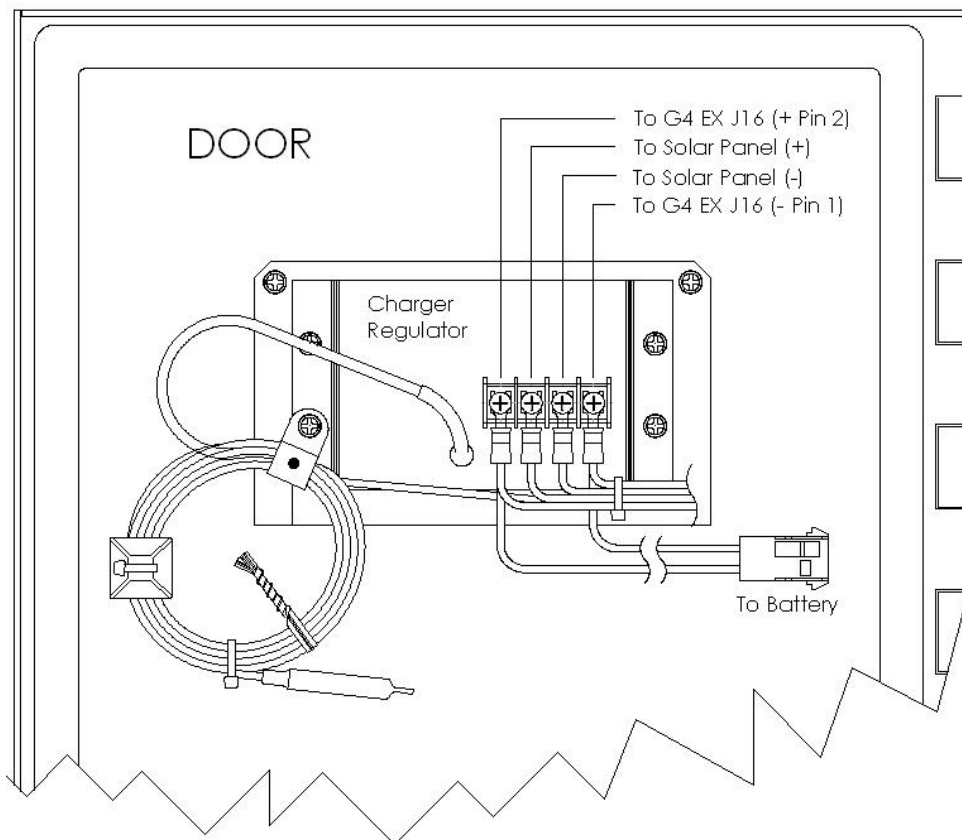
Figure 5–5 6270 OEU Charger Regulator

5.3.5 AC Charging System Unit Test

If the system setup includes an AC charger connected to the 6270 OEU Optional Equipment Unit and is not supplying the required voltage to the G4 EX unit, the user may need to test the AC charger.

The following instructions will take the user through the steps for performing this task.

5.3.5.1 Step-by-Step Instructions

1) Check the AC charger wiring to the 6270 OEU enclosure Termination board connector. Ensure that the wiring is correct.

2) Check the input AC voltage to the external AC charging unit. Ensure that the primary AC voltage is correct.

3) Correct, and retest as necessary.

4) If the input primary AC voltage level is correct, wiring to the 6270 OEU enclosure Termination board is correct, and there is no DC output from the charger; replace the charger fuse.

5) Correct, and retest as necessary.

6) If the fuse is not faulty or there is no charger DC output voltage after replacing the fuse, replace the AC charging unit.

7) Correct, and retest as necessary.

5.3.6 Auxiliary Equipment Isolation Test

This test will need to be performed if the battery pack output voltage is not remaining consistent and no errors were found during the previous Power Supply, Solar Panel Charging System or AC Charging Circuit troubleshooting tests.

5.3.6.1 Step-by-Step Instructions

1) Disconnect the solar panel charger or AC charger located in the Optional 6270 enclosure.

2) Disconnect the battery pack cable from the charger regulator. This is located in the Optional 6270 enclosure, and substitute know good battery.

3) Disconnect any auxiliary equipment that draws power from the G4 EX or battery pack.

4) Connect the current measurement troubleshooting cable (see Figure 5–6) to a known good battery, and reconnect to the charger regulator.

BLACK DMM CONNECTOR

RED DMM CONNECTOR

TO CHARGER REGULATOR

TO BATTERY CABLE
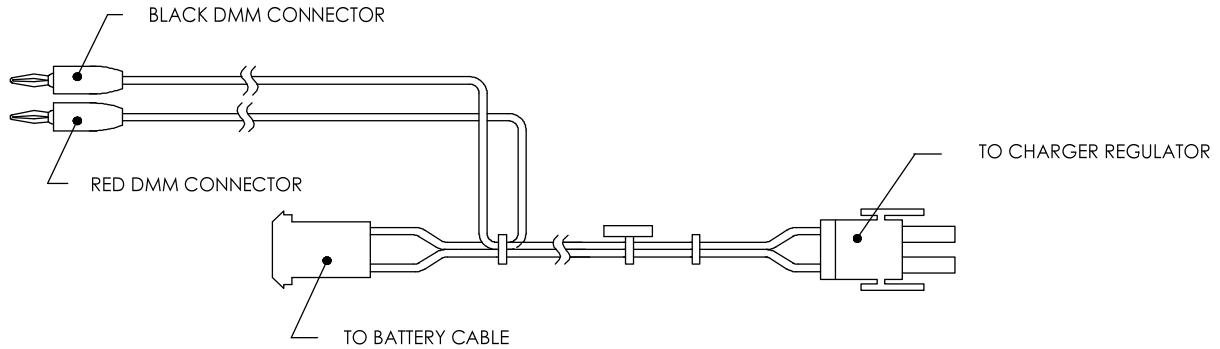
Figure 5–6 Current Measurement Troubleshooting Cable

5) Using a DMM, connect to the troubleshooting cable, and measure the average current. If it is equal to or greater than 80 mA at 12 VDC, disconnect the battery pack, and reconnect one auxiliary item. Continue to the next step.

6) If the average current is equal to or greater than the specification, no problem is found with the remote equipment. Return to the test sequence in the Power Troubleshooting section.

7) Reconnect the known good battery pack using the troubleshooting cable.

8) Using the DMM, connect the troubleshooting cable, and measure the average current during start up. If the current is higher than 33-40 mA, return to the Power Troubleshooting section above, and continue. If the current is within acceptable limits, continue to the next step.

9) When the unit reaches normal operating status, measure the average current. If the current is higher than 26-30 mA, return to the test sequence in the Power Troubleshooting section. Move past the sequential testing, and go directly to the Remote Communications troubleshooting.

5.3.7   Sleep Mode

The Sleep mode is a safety feature which maintains the RAM but discontinues data measurement calculations and control functions. When the G4 EX is in Sleep mode, the word Sleep is displayed on the LCD. If the G4 EX battery voltage falls below 11 VDC, the G4 EX enters Sleep mode.

If the battery voltage is still below 10.9 VDC when the user disconnected locally, the G4 EX returns to Sleep mode. If the battery voltage is above 11 VDC, the G4 EX remains awake.

The G4 EX has a real-time clock which maintains time and date during Sleep mode and writes an event record when entering and leaving the Sleep mode.

Upon wake-up, the G4 EX performs the following functions:

- Stores present calculation period accumulations in the historical record.
- Zeroes present calculation period accumulations.
- Ends the current daily record and starts a new daily record.

5.3.7.1   Step-by-Step Instructions

1) Connect locally to the G4 EX. This should wake up the unit for the user to determine the cause.

2) Check the lithium battery cable. Ensure that it has a good, secure electrical connection to the G4 EX board.

3) If the lithium battery cable is securely connected, check the lithium battery. If voltage is low, replace with another lithium battery.

5.3.8   Reset Procedures

The G4 EX 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.

5.3.8.1   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 or to the values last written to the tfCold drive by the Save and Restore utility. A cold start should be used for new G4 EX 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.

Refer to Chapter 4 for steps on performing both a hardware and software cold start.

5.3.8.2   Warm Start

A warm start does not clear the data stored in RAM. The warm start will only reset the G4 EX microprocessor and not disturb any data that has been stored in RAM. A warm start should be used when taking a unit out of service to perform maintenance or troubleshooting. A warm start can be used when a power or communication interruption caused the G4 EX microprocessor to lock up.

Refer to Chapter 4 for steps on performing both a hardware and software warm start.

5.4   Communications Troubleshooting

5.4.1   Overview

These troubleshooting procedures are applicable to the G4 EX with an installed radio in the optional 6270 OEU Enclosure unit. Use Figure 5–7 as an aid in troubleshooting communication problems. The three basic types of radio communication that can be used between the G4 EX and a radio receiver are:

- RS-232 Communications port programmable
- RS-485 Communications port programmable
- RS-422 Communications port programmable

The radio/modem may be powered one of two ways: always on or switched. The user's specific system set up will determine what steps are needed to power the radio/modem.

When switching power to a radio with Inhibit(Sleep) mode, the communication 1 port or switched power line will move to the radio's Inhibit(Sleep) mode input. Power out will move to the radios.

CAUTION 🌪 It is important that the user disconnect the G4 EX battery cable from the G4 EX board.

```
                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           │
                    ┌──────┴──────┐
                    │  Verify unit │
                    │ ID#, Security│
                    │  Code and    │
                    │  Protocol are│
                    │   Correct.   │
                    └──────┬──────┘
                           │
                    ┌──────┴──────┐
                    │ Verify jumper│
                    │and terminal &│
                    │ pin wiring are│
                    │   correct.   │
                    └──────┬──────┘
```

Figure 5–7 shows the Communication Troubleshooting Flow Chart with the following elements:

- START → Verify unit ID#, Security Code and Protocol are Correct. → Verify jumper and terminal & pin wiring are correct. → Does Unit Respond to Host Comm Request?
- Does Unit Respond to Host Comm Request? — YES → END
- Does Unit Respond to Host Comm Request? — NO → Transceiver Supply voltage Test → Transceiver Supply voltage within Specs?
- Transceiver Supply voltage within Specs? — NO → Investigate Transceiver Issues
- Transceiver Supply voltage within Specs? — YES → Voltage supply from unit > 11.9 VDC?
- Voltage supply from unit > 11.9 VDC? — NO → Investigate Power Supply Issues Figure 5-4
- Voltage supply from unit > 11.9 VDC? — YES → Substitute Communication Test Cable → Unit Respond to Host Comm Request?
- Unit Respond to Host Comm Request? — YES → (to END)
- Unit Respond to Host Comm Request? — NO → Is Communication RS-232?
- Is Communication RS-232? — NO → Is Communication RS-485?
- Is Communication RS-232? — YES → RS-232 Communication Test
- Is Communication RS-485? — NO → Contact Totalflow Technical Support
- Is Communication RS-485? — YES → RS-485 Communication Test
- RS-232 Communication Test / RS-485 Communication Test → Does Unit Respond?
- Does Unit Respond? — YES → (to END)
- Does Unit Respond? — NO → Transceiver Comm Check → Test Passed?
- Test Passed? — NO → (to Contact Totalflow Technical Support)
- Test Passed? — YES → (to END)

Figure 5–7 Communication Troubleshooting Flow Chart

5.4.2   Setting Up Communication

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

- Verify the field wiring terminations on the G4 EX Termination board.
- Verify the field wiring from the G4 EX unit to the Termination board inside the 6270 OEU enclosure.
- Verify the field wiring from the Termination board to the radio.
- Check the G4 EX identifier (ID). Log the ID for future reference.
- Log G4 EX access security code, baud rate, listen cycle, protocol and interface for future reference.

FYI

The following helpful hints will aid the user after the communication equipment has been installed and set up:

- When the communication equipment is powered/switched on, the G4 EX displays the → after it recognizes the G4 EX ID.
- Check the baud rate of the G4 EX transmission and Listen time settings. The baud rate and time settings can be changed when PCCU32 is in Entry mode. Default settings are 1200 baud, the listening time is 4 seconds and the communications interface is turned off.
- Minimum power required for operating remote communications is 11.9 VDC (default) or as set by the user. Should the power fall below this level, remote communications will be terminated.
- Test remote communications using the RS-232 troubleshooting cable. Use the RS-232 to RS-485 communication converter in conjunction with the RS-232 troubleshooting cable to test RS-485 remote communications.

5.4.3   Transceiver Supply Voltage Test

Using the wiring information and guidelines supplied by the transceiver's manufacturer, verify that the transceiver is receiving the manufacturer's suggested voltage. If the unit is receiving sufficient voltage, continue to the 6270 OEU Wiring Voltage Test.

FYI

If the transceiver is not receiving sufficient voltage, investigate the power supply issues. These may involve wiring irregularities at either the charger regulator, Termination board, terminal strip or at the power relay if using relay for switching power to the radio.

5.4.4   6270 OEU Supply Voltage Test

If the transceiver does not feature a Sleep mode and power is supplied through an optional relay, begin with step 1.

If the transceiver features a Sleep mode or is continuously powered, begin with step 2.

FYI	Wire color/origination inside the 6270 enclosure should comply with WI drawings. For the purposes of these instructions, wire color name and designation should coincide with the Totalflow drawings. The user may need to adapt, as appropriate, for their individual installation.

5.4.4.1   Step-by-Step Instructions

1) If the transceiver does not feature a Sleep mode and receives power through an optional relay, activate COM1SW or COM2SW, and using a Digital MultiMeter (DMM) set to Volts DC, measure the voltage at the relay between the relay coil terminals.

If the voltage reads the same as the supplied voltage (12 VDC) and the transceiver is still not receiving power, the relay may be incorrectly wired (use normally open contacts), or the relay may be bad.

If the relay is not receiving power, continue to step 2.

2) If the transceiver features a Sleep mode or is continuously powered, activate COMSW1 or COM2SW, and using a DMM set to Volts DC, measure the voltage at the next supply junction. If the next junction is located on the termination strip, verify the wiring is firmly connected; otherwise, continue to the charger relay, and measure the voltage between:

Terminal 1 (Batt +) and Terminal 4 (Batt -)

Voltage should be greater than or equal to 11.9 VDC for this unit. If the voltage is less than 11.9, return to the test sequence outlined in the Power Troubleshooting section.

5.4.5   Transceiver Check

5.4.5.1   Step-by-Step Instructions

1) If available, use a wattmeter to check the transceiver output power. Refer to the manufacturer's documentation for measuring instructions.

2) If available, use two hand-held transceivers, and verify the communication path between the master and remote sites. Voice-activated interface can be used, if available.

3) Verify that the transceiver is set to the correct frequency. Refer to the manufacturer's documentation for checking the frequency instructions.

4) If a directional antenna is used, verify the orientation to the antennae to the master site.

FYI	If a communication problem still exists and the unit has passed the transceiver check test, contact Totalflow Technical Support for additional help.

5.4.6   Termination Board Supply Voltage Test

1) Using a DMM set to Volts DC, measure the power supply voltage from the OEU enclosure to J16 on the Termination board (see Figure 5–4) between:

Pin 1 (+) and Pin 2 (-)

Voltage should be equal to or greater than the amount specified as low voltage input in PCCU32 for this unit (9 volt minimum, default is 11.9 VDC).

---

2) If the supplied voltage falls in the correct range, return to the test sequence outlined in the Power Troubleshooting section.

5.4.7 RS-232 Communication

The following test procedure is directed from Figure 5–7 and will assist the user in what may be the possible cause for an indicated error message.

With the exception of the field wiring directly on the G4 EX Termination board, all other wiring is located inside the 6270 OEU enclosure; therefore, two separate procedures are required for testing.

5.4.8 RS-232 Termination Board Test

Before performing the voltage test on the Termination board located inside the rear end cap, verify that the wiring is correct (see Table 5—3).

Table 5—3 RS-232 Field Wiring on the G4 EX Termination Board

	Description	ABRV	Description	ABRV
	J19 – COMM 1		**J20 – COMM 2**	
Pin 1	V-Battery	VBATT	V Battery	VBATT
Pin 2	Ground	GND	Ground	GND
Pin 3	Switched VBATT	COMM1SW	Switched VBATT	COMM2 SW
Pin 4	Operate Comm1	Operate Comm1	Operate Comm2	Operate Comm2
Pin 5	Mirror Request to Send	RRTS COMM1	Mirror Request to Send	RRTS COMM2
Pin 6	Request to Send	RTS	Request to Send	RTS
Pin 7	Transmit Data	TXD	Transmit Data	TXD
Pin 8	Receive Data	RXD	Receive Data	RXD
Pin 9	Clear to Send	CTS	Clear to Send	CTS

TIP When troubleshooting RS-232 mode, verify the settings of COMM 1 SW 1 and COMM 2 SW2 on the Termination board are configured properly (see Figure 5–4).

5.4.8.1 Step-by-Step Instructions

TIP Voltage on the following steps may be hard to see using a Digital MultiMeter (DMM). If available, an oscilloscope will provide a more accurate reading. To verify, the WinCCU software must be continuously polling the meter

Generally speaking, these tests performed on the Termination board will only verify incorrect or damaged wiring. If all previous testing passed and all wiring, jumpers and terminations have been verified correct, the board will need to be replaced. Contact Totalflow Customer Service. See the Getting Help section for instructions.

1) Using an oscilloscope, measure the receiving data voltage on the Termination board, J19 or J20, between:

COMM 1, J19–Pin 2 (GND) and Pin 8 (RXD) or

COMM 2, J20–Pin 2 (GND) and Pin 8 (RXD)

When the unit is transmitting to WinCCU, the voltage should vary between -5 VDC and +5 VDC. This would indicate that the unit is receiving data; continue to step 2. If the unit is not receiving data, investigate the wiring issues (see Table 5—3).

2) Using an oscilloscope, measure the request to send voltage on the Termination board J19 or J20 between:

COMM 1, J19–Pin 2 (GND) and Pin 6 (RTS) or

COMM 2, J20–Pin 2 (GND) and Pin 6 (RTS)

When the unit is communicating to WinCCU, the voltage should be +5 VDC and remain at +5 VDC until the G4 EX transmit stops. This would indicate that the unit is transmitting data; continue to step 3. If the unit is not receiving data, investigate the wiring issues (see Table 5—3).

3) Using an oscilloscope, measure the transmit data voltage on the Termination board, J19 or J20 between:

COMM 1, J19–Pin 2 (GND) and Pin 7(TXD) or

COMM 2, J20–Pin 2 (GND) and Pin 7 (TXD)

When the unit is transmitting to WinCCU, the voltage should vary between -5 VDC and +5 VDC. This would indicate that the unit is transmitting data. If the unit is still not responding, continue to the next test as directed in Figure 5–7.

5.4.9   RS-232 OEU Termination Strip Test

TIP   Generally speaking, these tests performed on the Termination strip will only verify incorrect or damaged wiring. If all previous testing passed and all wiring, jumper and terminations have been verified as correct, the Termination strip may need to be replaced but does not typically fail. Contact Totalflow Customer Service. See the Getting Help section for instructions.

FYI   Please note that NO wire colors are referenced. Individual units may vary.

Voltage on the following steps may be difficult to see using a Digital MultiMeter (DMM). If available, an oscilloscope will provide a more accurate reading. To verify, the WinCCU software must be continuously polling the meter.

5.4.9.1   Step-by-Step Instructions

1) Using a oscilloscope, if available, measure the receiving data on the G4 EX side of the OEU Termination strip (see Figure 5–8) between:

GND and RXD

When the data is being transmitted to the G4 EX unit, the voltage should vary between -5 VDC and +5 VDC.

When the unit is receiving data from WinCCU, the voltage should vary between -5 VDC and +5 VDC. This would indicate that the unit is receiving data.

2) On the OEU G4 EX side of the Termination strip (see Figure 5–8), measure the request to send voltage between terminals:

<div align="center">GND and RTS</div>

When the G4 EX is sending communication data to WinCCU, the voltage should be +5 VDC.

3) On the OEU Termination strip, measure the transmitting data voltage between terminals:

<div align="center">GND and TXD</div>

When the data is being transmitted from the G4 EX unit, the voltage should vary between -5 VDC and +5 VDC.

4) Repeat steps 1 through 3 on the transceiver side of the Termination strip.

5) If any inaccuracy exists, investigate wiring errors.
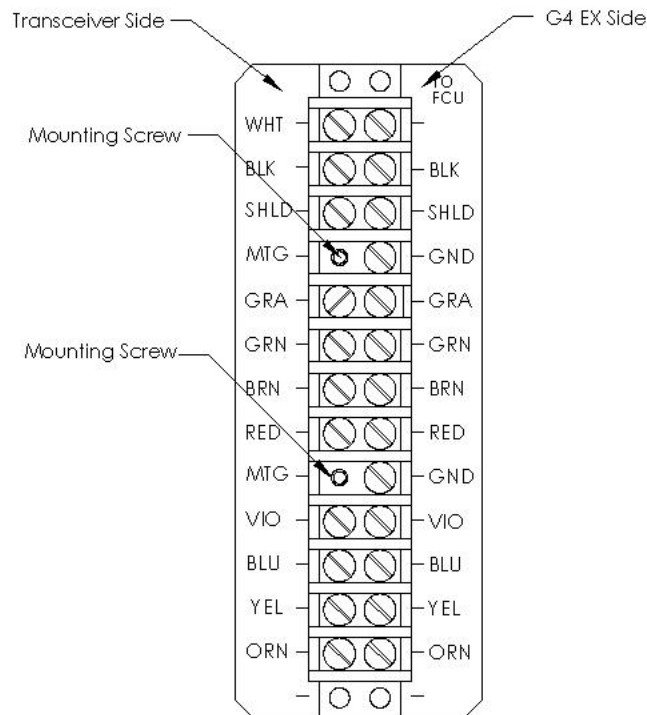
Figure 5–8 OEU Termination Strip

5.4.10 RS-485 Communication Test

The following RS-485 serial communication test procedure is directed from Figure 5–7 and will assist the user in what may be the possible cause for an indicated error message.

With the exception of the field wiring directly on the G4 EX Termination board, all other wiring is located inside the 6270 OEU enclosure. As such, there are two separate procedures required for testing.

5.4.11   RS-485 Termination Board Test

Before performing this test on the Termination board, verify that the wiring is correct.

Table 5—4 RS-485 Field Wiring on the G4 EX Termination Board

	Description	ABRV	Description	ABRV
	J19 – COMM 1		**J20 – COMM 2**	
Pin 1	V-Battery	VBATT	V Battery	VBATT
Pin 2	Ground	GND	Ground	GND
Pin 3	Switched VBATT	COMM1SW	Switched VBATT	COMM2 SW
Pin 4	Operate Comm1	Operate Comm1	Operate Comm2	Operate Comm2
Pin 5	Mirror Request to Send	RRTS COMM1	Mirror Request to Send	RRTS COMM2
Pin 6	Receive Bus (+)	TBUS(+)	Receive Bus (+)d	TBUS(+)
Pin 7	Receive Bus (-)	TBUS(-)	Receive Bus (-)	TBUS(-)
Pin 8	Receive Bus (+)	RBUS(+)	Receive Bus (+)	RBUS(+)
Pin 9	Receive Bus (-)	RBUS(-)	Receive Bus (-)	RBUS(-)

5.4.11.1   Step-by-Step Instructions

TIP When troubleshooting RS-485 mode, verify the settings on COMM 1 SW1 and COMM 2 SW2 on the Termination board are configured properly (see Figure 5–4).

FYI Voltage on the following steps may be difficult to see using a Digital MultiMeter. If available, an oscilloscope will provide a more accurate reading. To verify, the WinCCU software must continuously be polling the meter.

Generally speaking, these tests performed on the Termination board will only verify incorrect or damaged wiring. If all previous testing passed and all wiring, jumper and terminations have been verified correct, the Termination board may need to be replaced but does not typically fail. Contact Totalflow Customer Service. See the Getting Help section for instructions.

1) Using an oscilloscope, measure the line driver voltage on the Termination board, J19 and J20, between:

COMM1, J19–Pin 9 (BUS-) and Pin 8 (BUS+) or

COMM 2, J20–Pin 8 (BUS+) and Pin 9 (BUS-)

When the unit is receiving data from WinCCU, voltage should vary between +5 VDC and 0 VDC. This indicates that the unit is receiving data.

2) Using an oscilloscope, measure the remote request to send voltage on the Termination board J19. On J20, RRTS is not directed:

COMM 1, J19–Pin 2 (GND) and Pin 5 (RRTS)

When the unit is transmitting receiving data, the voltage should vary between -5 VDC and +5 VDC. This would indicate that the RRTS is working correctly.

3) If any inaccuracy exists, investigate the wiring errors or damaged wires.

FYI If a communication problem still exists and the unit has passed the required test, additional testing is required.

5.4.12 RS-485 OEU Termination Strip Test

5.4.12.1 Step-by-Step Instructions

FYI Voltage on the following steps may be difficult to see using a Digital MultiMeter. If available, an oscilloscope will provide a more accurate reading. To verify, the WinCCU software must continuously be polling the meter.

Generally speaking, these tests performed on the Termination strip will only verify incorrect or damaged wiring. If all previous testing passed and all wiring, jumper and terminations have been verified correct, the Termination strip may need to be replaced but does not typically fail. Contact Totalflow Customer Service. See the Getting Help section for instructions.

FYI When designating the wire colors in the following procedures, color/origination complies with Totalflow wiring instruction drawings. For the purposes of these instructions, the user may need to adapt for their individual installation.

1) Using an oscilloscope, if available, measure the line driver voltage on the G4 EX side of the OEU Termination strip (see Figure 5–8) between:

BUS+ and BUS-

When the unit is receiving data from WinCCU, the voltage should vary between +5 VDC and 0 VDC. This indicates that the unit is receiving data.

2) Using an oscilloscope, measure the request to send voltage on the G4 EX side of the OEU Termination strip between:

GND and RRTS

When the data in the G4 EX is sending communication data to WinCCU, the voltage should be +5 VDC for the duration of the transmission.

3) Using an oscilloscope, measure the transmitting data voltage on the G4 EX side of the OEU Termination strip between:

GND and BUS-

And

GND and Bus+

When data is being transmitted from the G4 EX unit, the voltage should vary between +2 VDC and +5 VDC.

4) Repeat steps 1 through 3 on the transceiver side of the Termination strip.

5) If any inaccuracy exists, investigate the wiring errors.

APPENDIX A   I/O DAUGHTER CARD

The following information provides an outline for the installation and application of the I/O daughter card within the G4 EX.

The I/O daughter card may already be installed in new units, if configured, or can be added as an upgrade kit to pre-existing units. The following information will address the installation for the upgrade kit.

CAUTION
Do not install the I/O daughter card until told to do so in these instructions. Installation prior to flashing the unit may cause some older models units to not boot.

A.1   Materials Supplied in the Upgrade Kit

- 1 each I/O Daughter Card
- 4 each #6 .25 OD Flat Washer
- 4 each #6 Flat Washer
- 4 each 6–32 x .625 ¼ Hex Female Spacer
- 4 each 6–32 x .75 LG, M-F Standoff
- 1 each I/O Daughter Card Generic Wiring Diagram
- 1 each CD-ROM with Specified Flash and Configuration Files

A.2   I/O Daughter Card Specifications

This card expands the capabilities of the explosion-proof flow computer by adding an additional 12 points of fixed analog and digital I/O points. Specifications for the I/O daughter card are as follows:

- Analog Points
  - 3 each 0-10V (10K ohm impedance) analog inputs
  - 1 each 0-20 mA (SINK mode) analog output
- Digital Points
  - 4 each Digital inputs/pulse inputs
  - 4 each Digital outputs (optically-isolated type 1A switches capable of switching 200 mA of 48 VDC or 40 VAC)

A.3   Installation

If the unit is currently operating, data must be collected from the unit and the configuration files saved prior to beginning this procedure.

Termination
Board

J21 PCCU
Connector

I/O Daughter
Card
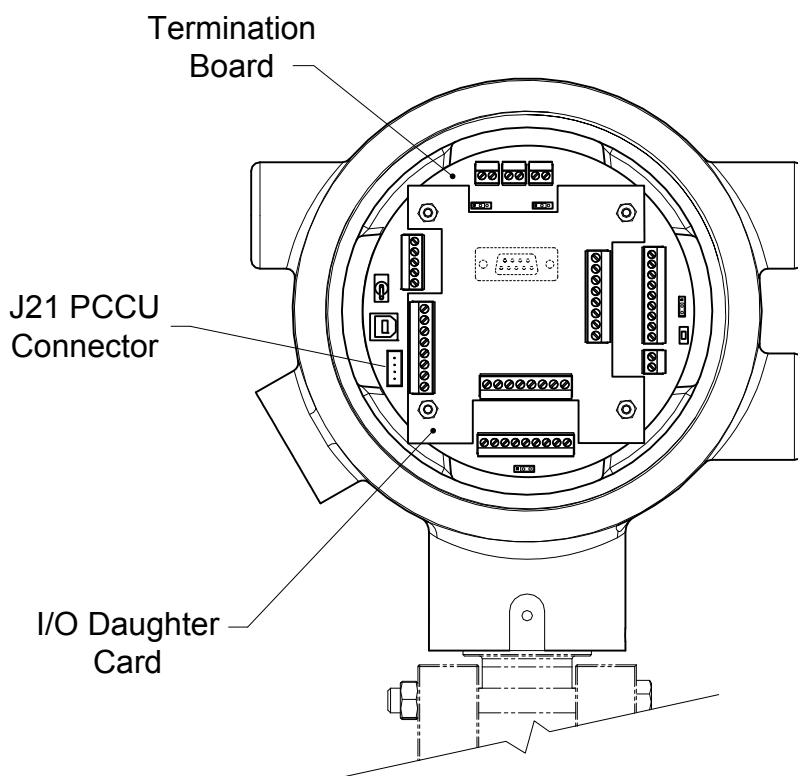
A.3.1 Upgrading the Flash

1) Open PCCU32, but do not connect.

2) Once PCCU32 has loaded, click on the 32-Bit Loader icon on the window's main toolbar. The 32-Bit Loader screen will display.
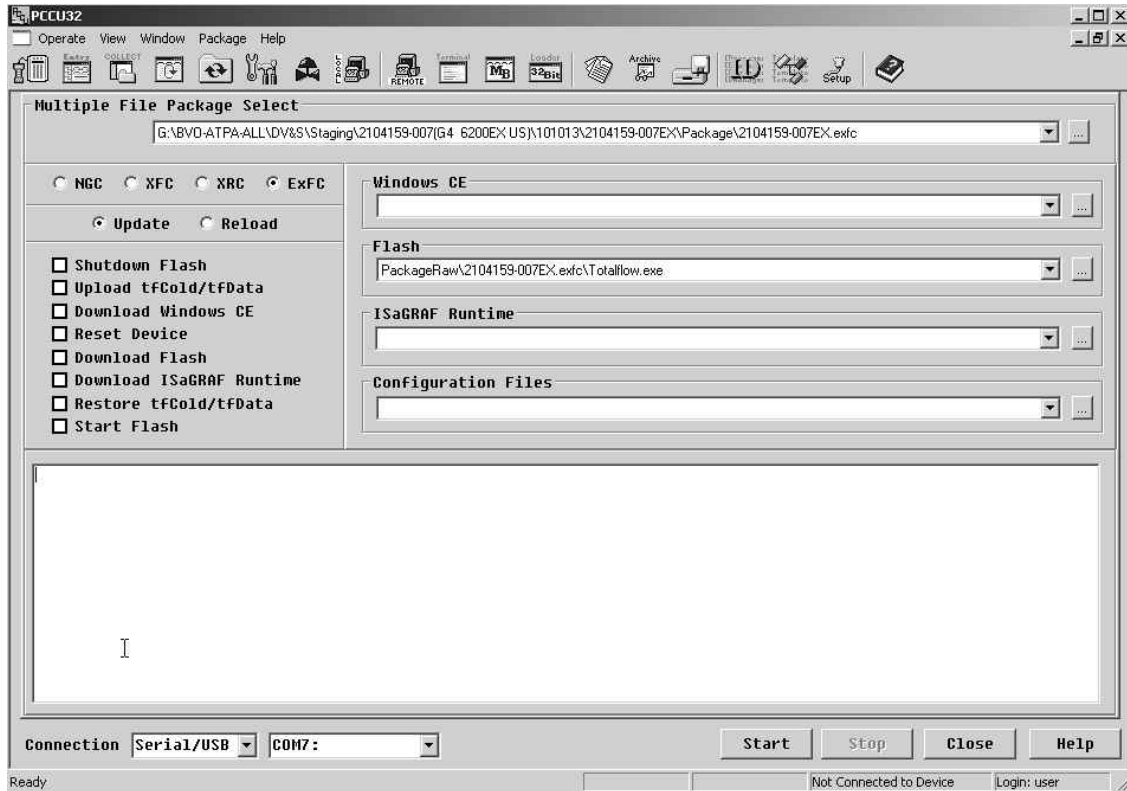
3) Select the ExFC radio button to designate that the G4 EX is the device that will receive the new Flash.

4) Next, select the Update radio button.

A.3.2 Unit Operating Status Shut Down Instructions

1) Collect data from the unit.

2) Back up all of the configuration and data files.

3) While in PCCU32, click the Save and Restore Utility icon from the main window toolbar. The Save and Restore Utility window will display.

4) Within the Save and Restore Utility, click the Save Station Files button.

5) When the Save Station Files dialog box displays, verify the default name and path for the files. Click the OK button. This will save the tfData drive files.

6) When finished saving the station files, a new dialog box will offer the option to Restore the Station Files to the tfCold drive. Select No.

7) Remove power externally from the unit.

A.3.3 Internal PCCU Connector Disassembly (If Installed)

WARNING   Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

1) Gain access to the Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench, and then unscrew the end cap.

2) Remove the four 6-32 x .625 standoffs located at the four corners of the Termination board.

3) Gently lift the Termination board out of the unit. Be careful to not disconnect the PCCU ribbon cable from the Termination board.

4) Disconnect the cable from the Termination board.

A.3.4 I/O Daughter Card Installation

WARNING Remove power from the device, or insure the area is known to be non-hazardous before removing any enclosure cover. For further information, refer to the certification drawing indicated on the device's nametag and national and local electrical codes.

1) Gain access to the Termination board by loosening the countersunk hex socket locking set screw in the rear end cap. Use a 1/16" hex wrench, and then unscrew the end cap.

2) Remove the four existing 6-32 x 625 standoffs and washers (if installed). Do not misplace as they will be needed later in this procedure.

3) Install the new standoffs (6-32 x .75") and washers supplied in the kit into the four corner mounting holes in the Termination board.

4) Center the I/O card over the Termination board (green phoenix connectors facing out). Align the four screw holes at each corner. This should allow the I/O card to interconnect with I/O Expansion connection on the Termination board. Apply gentle pressure to the I/O card in the two areas located on either side of the connector until the board is seated.

5) Using the four 6-32 x .625 standoffs removed previously, connect the I/O card to the Termination board. Do not over tighten.

6) Reapply power to the unit. Make the local connection using PCCU32 and the MMI cable. Once physically connected, open PCCU32, and move into Entry mode.

7) In the PCCU32 tree-view, select the I/O Interface application. Once expanded, click on the 6200EX I/O Card sub-menu. If the user is communicating properly, they will see the setup screens for the daughter card.
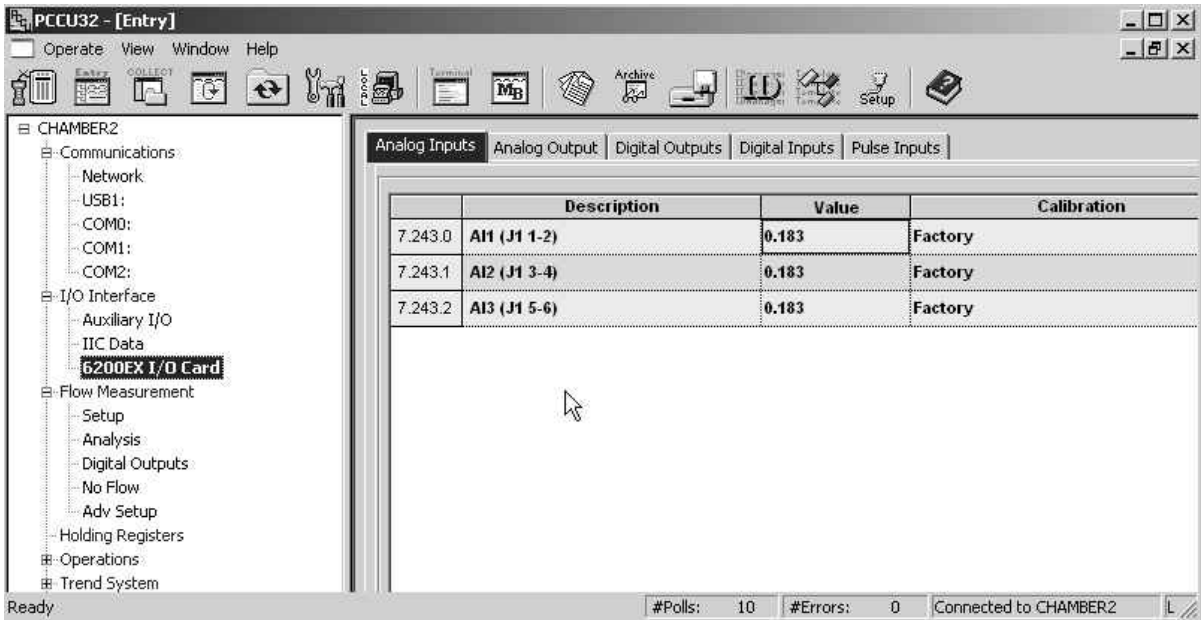
8) Disconnect, and remove power externally from the unit.

9) Perform field wiring following the diagrams in Chapter 3. If the internal PCCU connector is being reinstalled, field wiring must be done prior to installation.

DB-9 Connector to
Termination Board
(Mounted on back)

J2

J1

J3

I/O Daughter Card

DI1(+)
DI1(-)
DI2(+)
DI2(-)
DI3(+)
DI3(-)
DI4(+)
DI4(-)

AI1(+)
AI1(-)
AI2(+)
AI2(-)
AI3(+)
AI3(-)
AOut(+)
AOut(-)

DO1(+) DO1(-) DO2(+) DO2(-) DO3(+) DO3(-) DO4(+) DO4(-)
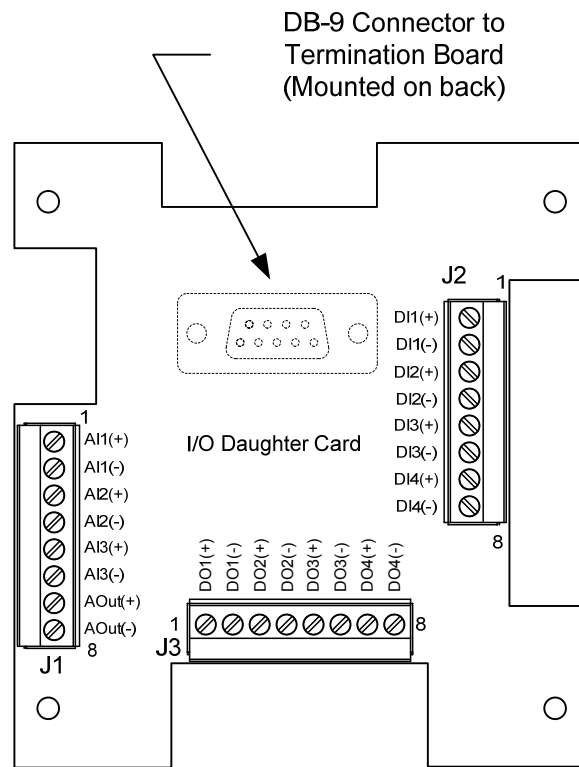
A.3.5 Internal PCCU Connector Reassembly (If Previously Installed)

1) Connect the cable from the PCCU assembly to the Termination board.

2) Reinstall the four mounting standoffs. This will secure the Termination board to the device.

A.3.6 Implementation

A.3.6.1 Generic Wiring Diagram

WARNING This drawing does not completely illustrate the installation methods required for hazardous locations. Prior to any installation in a Classified Hazardous Location, verify the installation methods by the Control Drawing referenced on the product's name tag and national and local codes.

DB-9 Connector to XFCEX Board I/O Expansion Connector (J2) (Mounted on Back)

XFCEX Board (Ref)

The DI/PI inputs will accept sensor inputs which meet the **IEC-60947-5-6** electrical characteristics.

To Third Party Digital Input Devices

To Third Party Analog Devices SEE SHEET 2

I/O Daughter Card P/N: 2102458

J1

J3

To Third Party Digital Output Devices

The Digital Outputs have a maximum "ON" resistance of 2.5Ω which can switch 48V AC/DC at up to 100mA. The outputs are isolated (AC voltage for 1 minute at 25°C, RH=60% between input and output) from each other as well as the control circuit by 1500Vrms.

A.3.6.2 Analog Points

Analog Inputs

The input range is 0-10.34 volts for the three 0-5V analog inputs (AI1, AI2 and AI3). The inputs have a low pass filter -3 dB point of 100Hz. The sourcing device must be capable of driving 10K input impedance.

As shown below, an external 250-255 OHM resistor is required (across + and – input) to convert a 0/4-20 mA signal to a 0/1-5V compatible input.
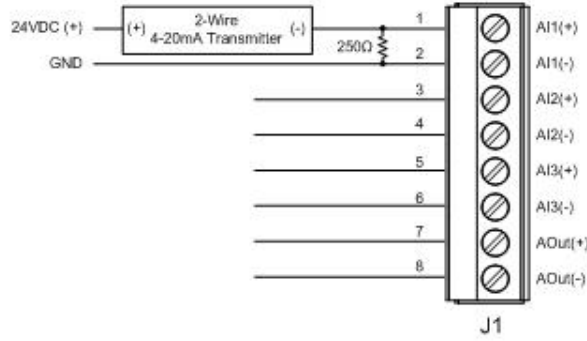
The analog inputs must be defined in PCCU32.
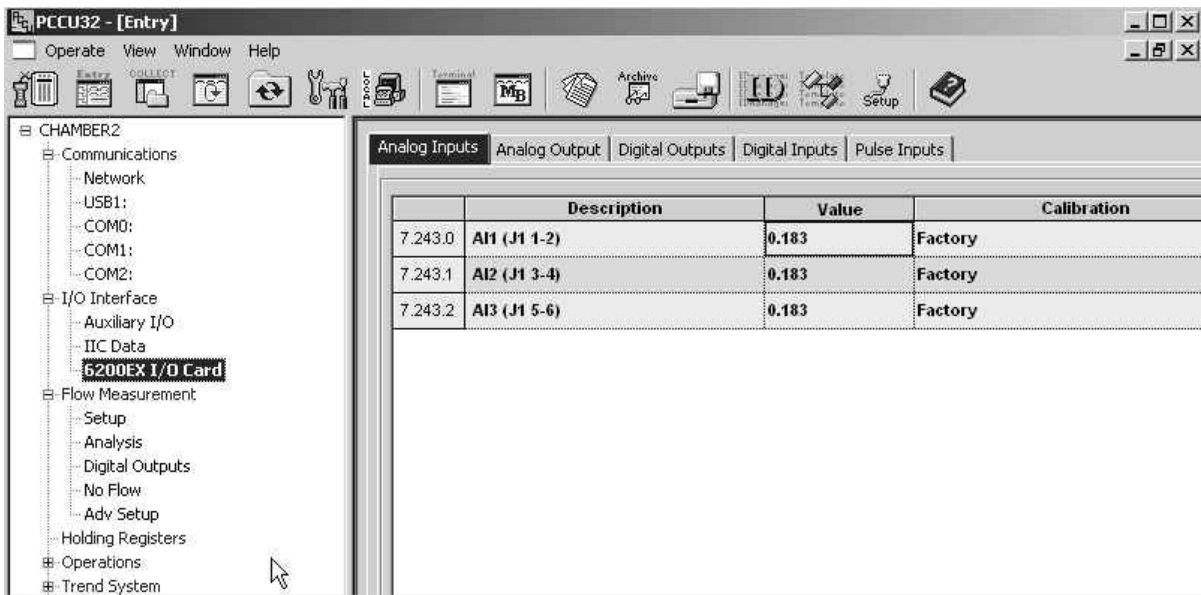
Analog Outputs

The 0-20.48 mA analog output circuit is SINK mode only and requires the use of an external power supply.
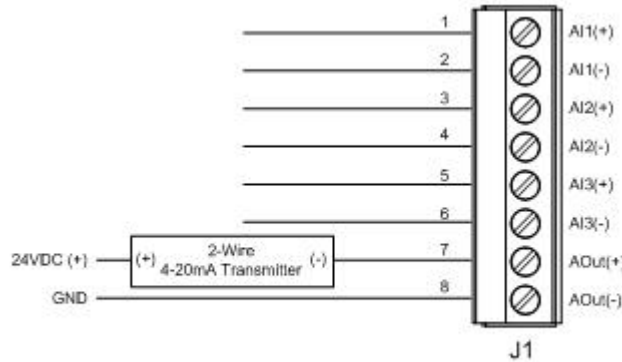
The analog inputs must be defined in PCCU32.
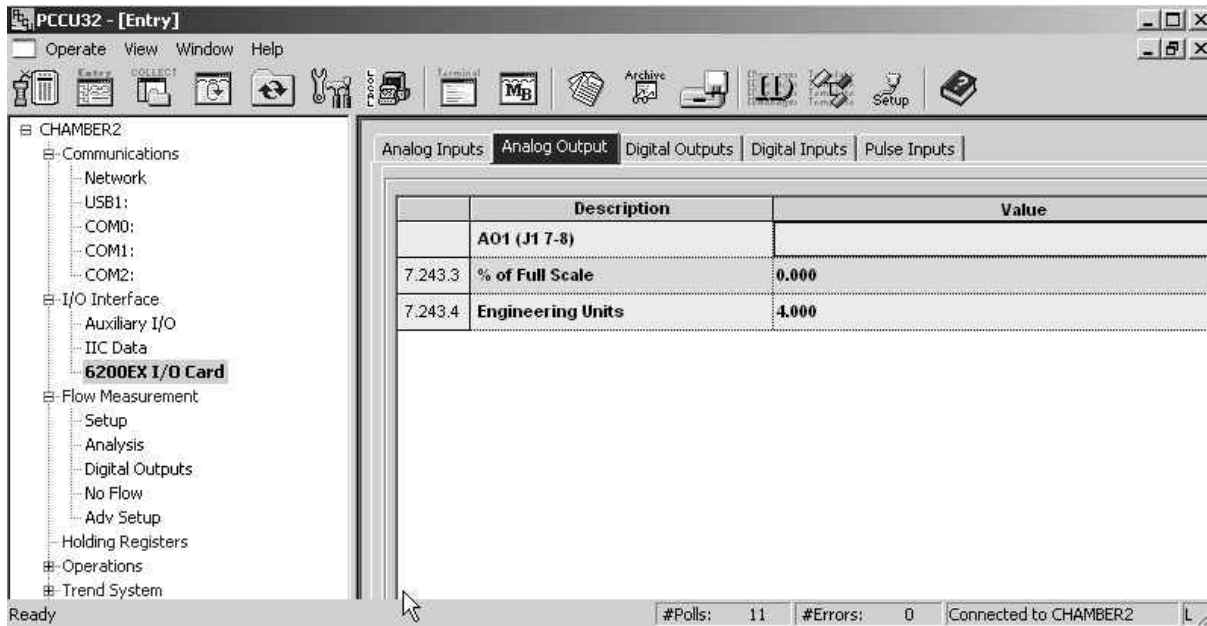
A.3.6.3 Digital/Pulse Points

The DI/PI inputs will accept NAMUR type sensor inputs which meet the IEC-60947-5-6 electrical characteristics. The digital inputs also function as event counters.

Digital Outputs

- Optically-isolated type 1A switches
- Have a maximum ON resistance of 2.5Ω which can switch 48V AC/DC at up to 200 mA at 60°C
- The outputs are isolated (AC voltage for 1 minute at 25°C, RH=60% between input and output) from each other as well as the control circuit by 1500Vrms
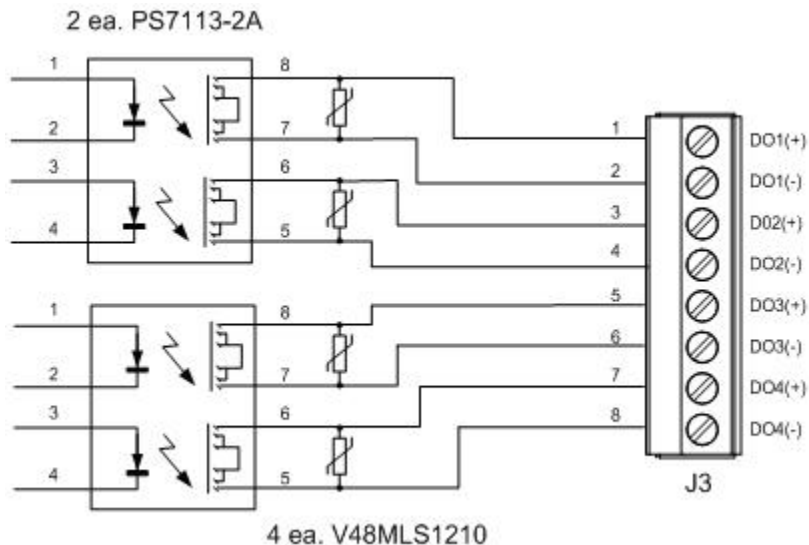
The digital inputs must be defined in PCCU32.

PCCU32 - [Entry] screen showing CHAMBER2 navigation tree on the left and Digital Outputs tab data on the right.

	Description	Value
7.240.4	DO 1 (J3 1-2)	Closed
7.240.5	DO 2 (J3 3-4)	Closed
7.240.6	DO 3 (J3 5-6)	Closed
7.240.7	DO 4 (J3 7-8)	Closed
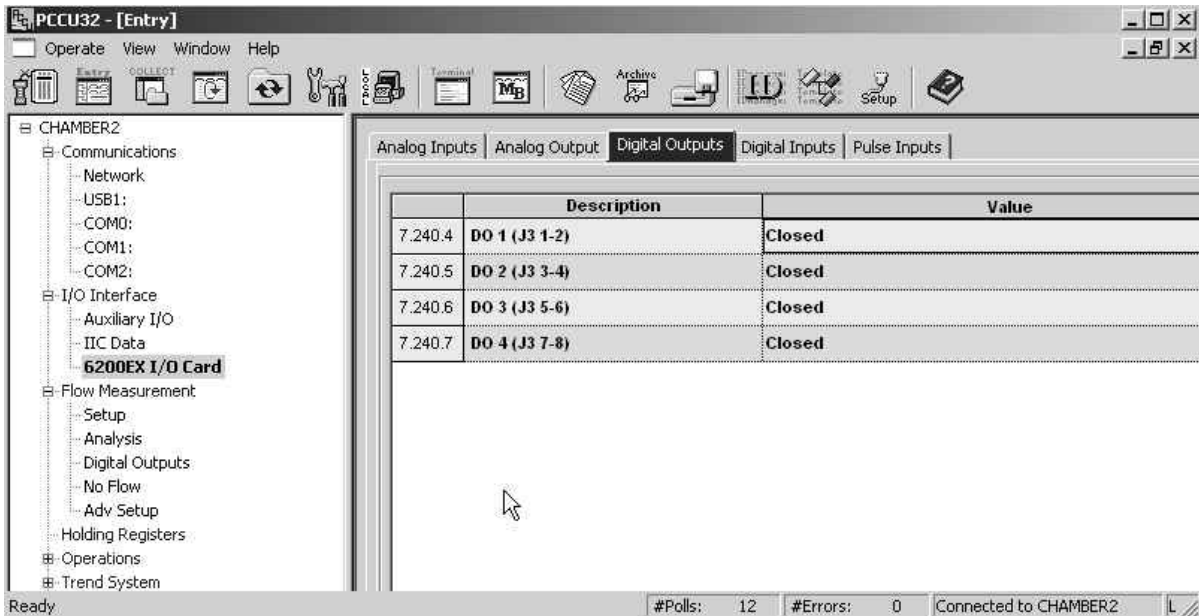
Digital or Pulse Inputs

- NAMUR: When in a low impedance, the state must draw more than 2.2 mA; when in high impedance, the state must draw less than 1.0 mA. It should be noted that in the NAMUR specification, a low impedance of less than 400 OHMS is considered a short (fault), and a high impedance of greater than 20K OHMS is an open (fault). These two conditions are not monitored.

- Open Collector (O.C.): The output transistor or FET must be capable of sinking 8.2 mA. Total impedance of the circuit must be less than 1K OHM.

- Dry Contact (i.e., reed-switch): The device must be capable of sinking 8.2 mA. The total impedance, when active, must be less than 1K OHM. Note: The pulse inputs on the 2102458-001 are designed to accept relatively high-speed(approximately 20Khz) signals. Therefore, if a reed-switch or other mechanical device subject to bouncing contacts is used, the application will require the use of a capacitor across the contact of the switching device (a value of 0.1 uF should be a good starting place).

- Active Signal: Must be capable of being connected to a 1K load which is tied to a 8.2V voltage source. When the output is driven high (above 8.8V), the load will appear at 215 OHMS connected to a 8.8V. Note: The active signal type input requires the use of an onboard DAC converter to adjust the trip threshold of the comparator input. Example: A 0-5V signal will not cause the input to transition through the NAMUR thresholds. The DAC will be set to 1.35V (to a value of 69 decimal or 0x45). This will make the apparent threshold, as seen at the input, to 2.5V.

The digital inputs and pulse inputs must be defined in PCCU32.

APPENDIX B   4–20 MILLIAMP TRANSMITTERS

B.1   Powering 4–2- Milliamp Transmitters

4-20 milliamp (mA) transmitters are essentially variable constant current sources. They need to have sufficient voltage applied to them to insure that they will be able to drive 20 mA onto a 250 OHM load. Different transmitter technologies will have different powering requirements.

Many 4-20 mA transmitters claim to be operational between 10 and 30 VDC, but this can be somewhat misleading. If it is a two-wire (line powered) transmitter and it is sourcing the maximum loop current of 20 mA, 5 VDC is dropped across the 250 OHM resistor. Dropping 5 VDC across the load resistor only leaves 5 to 20 VDC (of the aforementioned 10 to 30 VDC) to operate the transmitter. There is a good chance that 5 VDC will not be enough to properly operate the transmitter at its maximum output of 20 mA.

Example: Voltage dropped across the load resistor at the maximum loop current.

E = I x R = 20 mA x 250 OHM = 5 VDC

The figure below shows a 4-20 mA loop being powered by a 12 VDC source. This could be a solar panel with battery backup. If the battery has been discharged to 12-volts, then only 7-volts would remain to operate the transmitter. This may not be enough to fully operate the transmitter at higher loop currents.
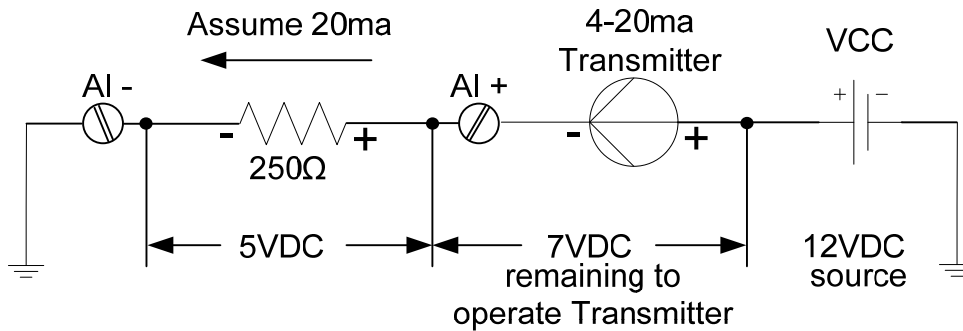
The following discussion does not pertain to 1-5 VDC transmitters.

Totalflow flow meters employ a 250 OHM resistor to convert the 4-20 mA transmitter current loop to a 1-5 VDC signal. In some meters, this conversion is made by attaching a 250 OHM resistor across the 4-20 mA input pins (see the next figure – schematic A). Some meters use a small three-pin jumper to select an onboard 250 OHM resistor (see the next figure – schematic B). Still, other meters employ an electronic switch to select the 250 OHM resistor (see the next figure – schematic C). In the figures , VCC represents the voltage source used to power the transmitter. In many instances, VCC could be tied to the meter's VBAT.

With a solar paneled system, such as many Totalflow installations, available voltage to power the 4-20 transmitter can become an issue. Batteries in a battery backed solar installation can drop to 12 VDC or less. Some transmitters may not be able to drive 20 mA into a 250 OHM load with only 12 VDC applied to them. Fully charged batteries, connected to an operational battery charger, may be sitting at about 13.5-14 VDC.

Flowmeter | External to flowmeter

To A/D Converter ← AI +

2-wire (line powered) 4-20ma transmitter

VCC

250Ω — User supplies 250Ω resistor and wires it across the AI input pins

AI -

A

Flowmeter | External to flowmeter

To A/D Converter — AI +

2-wire (line powered) 4-20ma transmitter

VCC

1   3

Onboard 250Ω resistor selected using three-pin jumper

250Ω

AI -

B

To PCCU Control   Flowmeter | External to flowmeter

To A/D Converter — AI +

3-wire 4-20ma transmitter

VCC

Onboard 250Ω resistor is selected in PCCU setup

250Ω

AI -

C

Again, the 4-20 mA transmitter that was selected by the user must be fully operational at voltages as low as VCC – 5 VDC. Again, VCC is the source voltage available at the user's site, and 5 VDC represents the voltage dropped across the meter's 250 OHM resistor at the maximum loop current (20 mA).

Totalflow can provide a 12 to 24 VDC converter. This converter can be powered from the meter's VBAT (either comm ports or J16). The converter's 24 VDC output can then be used to power the 4-20 mA transmitter loop. In other words, VCC would now be 24 VDC. Subtracting the 5-volts dropped across the 250 OHM resister would leave 19 VDC to power the transmitter.

TIP ➤⊚ Another possible solution would be to reduce the 250 OHM resistor to a small value, possibly 125 OHMs. An under-powered transmitter could more easily drive 20 mA into the lesser resister. Field calibrating the AI would negate any differences between the 250 OHM and the 125 OHM resistors. However, as the user reduces the size of the resistor, they lessen the overall resolution.

B.2 Example 1

If the 4-20 mA transmitter can drive full range (20 mA through the 250 OHM resistor), the user has essentially converted a 4-20 mA current range into a 1-5 VDC voltage range. The analog to digital (A/D) converter used in Totalflow equipment expects a 1-5 VDC signal. During field calibration, the user might have the 4 mA of loop current represent 10bbls of fluid per hour and 20 mA represent 100bbls. The conversion to voltage (using the 250 OHM resistor) would be as follows:

1 VDC = 10bbls/hour

5 VDC = 100bbls/hour

Assuming that the A/D converter is ranged between 0 and 5 VDC and the converter is resolving 15 bits, the user would expect to resolve about 150µ VDC (or .0006 mA). These numbers translate to about .003 bbl (3 thousandths of a barrel or about one half fluid ounce).

B.3 Example 2

If the 4-20 mA transmitter cannot drive full range (20 mA through the 250 OHM resistor), the user may want to reduce the value of the resistor. For this example, the following will drop it to 125 OHM (or half). A 4-20 mA current would now be converted to a 5-2.5 VDC voltage range. Again, during field calibration, the user would have the 4 mA current represent 10bbls per hour and the 20 mA signal represent 100bbls per hour. The voltage conversion (using the 125 OHM resistor) would be as follows:

.5 VDC = 10bbls/hour

2.5 VDC = 1000bbls/hour

The A/Ds full range is still 0-5 VDC; however, the user is only using about half of its range capability. Just like the resistor value, the ability to resolve barrels of fluid per hour has been cut in half. The overall accuracy remains unchanged, but the user can only resolve about 0.006bbls (6 thousandths of a barrel or about one fluid ounce).

B.4 Conclusion

If the 4-20 mA transmitter that is being used cannot drive a full 20 mA through the 250 OHM resistor, the user can reduce the resistive value. However, as the resistive value is reduced, resolution (not overall accuracy) will be reduced proportionally. If the user drops the resistive value by half (250 OHMs to 125 OHMs), the resolution will be reduced by half.

To reduce the resistive value of an onboard resistor, the user can add an external resistor across the analog input pins. This places the two resistors in parallel with one another. The parallel combination produces an equivalent resistance that is

less than either of the two resistors alone. The value of the equivalent resistance is calculated as shown in the figure below:
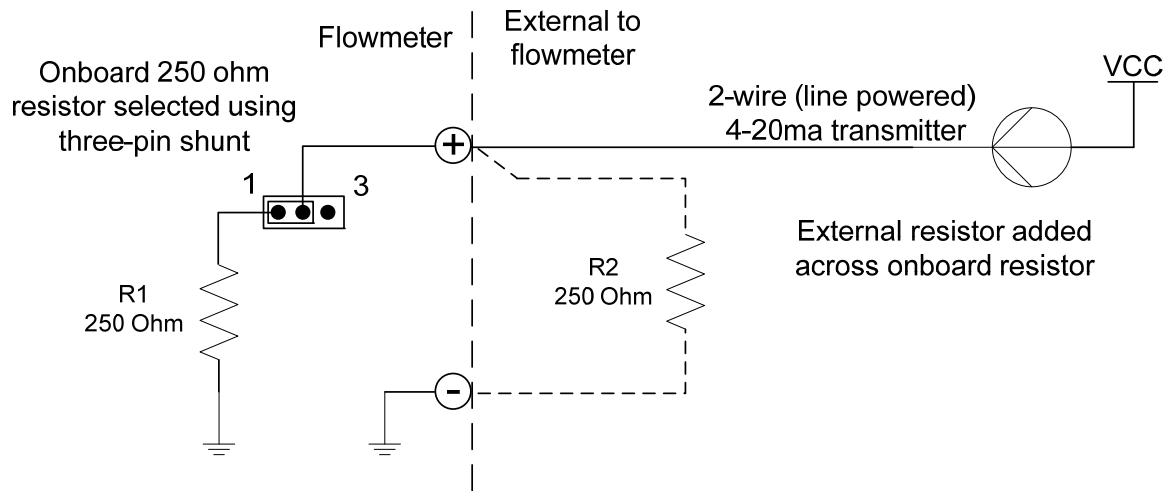
$$\text{Equivalent Resistance} = \frac{R1 \times R2}{R1 + R2} = \frac{250 \times 250}{250 + 250} = \frac{62500}{500} = 125 \text{ Ohms}$$

APPENDIX C   G4 EX MODBUS REGISTER MAPS

Totalflow G4 devices provide access to application data by numeric tags. These numeric tags consist of three values: application number, array number and register number. These three values uniquely identify any accessible application data item. These values are commonly expressed as app.array.register.

C.1   System Application Registers

The format for the register list is app#.array#.register#. The System application is always instantiated in application slot 0.

Register	Description	Type	Access	Note
0.0	Board Part Number	String	Read Only	
0.1	Prom Number	String	Read Only	
0.2	Prom Description	String	Read Only	
0.3	System Date/Time	String	Read/Write	
0.4	Device ID	String	Read/Write	
0.5	Location	String	Read/Write	
0.6	Read Level Security Code	String	Read/Write	
0.7	Write Level Security Code	String	Read/Write	
0.8	Server	String	Write Only	
0.9	Account	String	Read/Write	
0.10	Password	String	Read/Write	
0.11	Directory	String	Read/Write	
0.12	IP Address	String	Read/Write	
0.13	DNS Address	String	Read/Write	
0.14	WINS Address	String	Read/Write	
0.15	DNS Name	String	Read/Write	
0.16	Subnet Mask	String	Read/Write	
0.17	Gateway	String	Read/Write	
0.18	OS Part Revision	String	Read Only	
0.19	Log String	String	Write Only	
0.20	Blackfin Firmware #	String	Read Only	
0.21	Login User	String	Read Only	
1.0	Number of App Enumerations	Byte	Read Only	
1.1-(X)	Application Enumerations	Byte	Read Only	1
2.1-(X)	Application Descriptions	String	Read Only	
3.0	Number of Applications	Byte	Read/Write	
3.1-(X)	Application Table	Byte	Read/Write	

Register	Description	Type	Access	Note
4.1-(X)	Application Names	String	Read/Write	
5.1-(X)	Application Revisions	String	Read Only	
6.1-(X)	Application Parameters	String	Read/Write	
7.0	Low Charger	Byte	Read Only	
7.1	Very Low Battery	Byte	Read Only	
7.2	Wakeup (Obsolete)	Byte	Write Only	
7.3	Security Switch	Byte	Read Only	
7.4	System Shutdown	Byte	Read/Write	
7.5	Force Watchdog Reset	Byte	Read/Write	
7.6	Throw Exception	Byte	Read/Write	
7.7	Network Connection	Byte	Read	
7.8	MMI connection State	Byte	Read	
7.9	Watchdog Enable	Byte	Read/Write	
7.10	Lithium Status	Byte	Read	
7.11	Factory Configuration	Byte	Read	
7.12	Ethernet Enable	Byte	Read/Write	
7.13	Slow Clock Mode	Byte	Read/Write	
8.0	Last 2 byte of Prom	Int16	Read Only	
8.1	Year	Int16	Read/Write	
8.2	Month	Int16	Read/Write	
8.3	Day	Int16	Read/Write	
8.4	Hour	Int16	Read/Write	
8.5	Minute	Int16	Read/Write	
8.6	Second	Int16	Read/Write	
8.7	FLASH Checksum	Uint16	Read Only	
9.0	System Date/Time	Uint32	Read Only	
9.1	Available Task Memory	Uint32	Read Only	
9.2	Available RAM File Space	Uint32	Read Only	
9.3	Available Flash File Space	Uint32	Read Only	
9.4	Available SD Card Disk Space	Uint32	Read Only	
9.5	Boot Time	Uint32	Read/Write	
9.6	Tick Count	Uint32	Read Only	
9.7	Enable DHCP	Uint32	Read/Write	
9.8	Update DNS	Uint32	Read/Write	

Register	Description	Type	Access	Note
9.9	Number of Threads	Uint32	Read Only	
9.10	Software Date	Uint32	Read Only	
10.0	Current CPU usage (%)	Float	Read Only	
10.1	Average CPU usage (%)	Float	Read Only	
10.2	Radio Voltage	Float	Read Only	
12.0	Factory Configuration	String	Read Only	
12.1-(X)	Application Part Numbers	String	Read Only	
13.0-(X)	Test Registers			
14.0 -(X)	Thread Handle Array	UInt32	Read Only	
15.0-(X)	Thread Name Array	String	Read Only	
16.0-(X)	Thread % in User Mode	Float	Read Only	
17.0-(X)	Thread priority	UChar	Read Only	
18.0-(X)	Thread Start Time	UInt32	Read Only	
19.0-(X)	App info Data	Struct	Read Only	
20.0-(X)	App restart	UInt32	Read Only	
21.0-(X)	App Update	String	Read Only	
22.0-(X)	App Group	String	Read Only	

C.1.1 System Application Register Notes

1) Standard instantiation slot table

Application	Instantiation Slot
Spare	255
System App	0
IOS App	1
XFC Display	2
Communications App	3
AGA3 Tube App	4
AGA4 Tube App	5
Liquid tube App	6
Trend App	7
RAMS App	8
Valve Control App	9
Holding Registers App	10
Therms Master App	11
XMV App	12

Application	Instantiation Slot
IEC App	13
Therms Slave App	14
LevelMaster App	15
Pump Interface App	16
Obsolete FS2 App	17
Operations App	18
Host Interface App	19
Selectable Units Gas Orifice Tube App	20
Selectable Units Turbine Tube App	21
Instromet Ultrasonic tube App	22
V-Cone Tube App	23
TotalSonic Tube App	24
TotalSonic Interface App	25
Units Conversion App	26
Enron Aga3 Gas Orifice Tube App	27
Enron AGA7 Pulse Input Tube App	28
Test App	29
Selectable units TotalSonic App	30
Pemex Selectable Units AGA3	31
Pulse Accumulator	32
Selectable Units AGA3 Modbus App	33
Selectable Units AGA7 Modbus App	34
Pemex Selectable Units AGA7 App	35
Valve Control With KDT App	36
Oil Custody Transfer App	37
Selectable Units Liquid Tube App	38
Selectable units Wedge Gas Tube App	39
Chrom App	40
BTU App	41
GCM Interface App	42
Report App	43
NGC I/O Interface App	44
Control App	45
Chrom Post Process App	46

Application	Instantiation Slot
BTU Modbus Slave App	47
NGC LCD Display App	48
Analysis Trend File App	49
Selectable Units Liquid Orifice App	50
Nist14 Gas Equation App	51
Nist14 Liquid Equation App	52
Selectable Units VCONE App	53
ASME IAPWS-IF97 Steam Tube App	54
Coriolis Tube App	55
Plunger Lift Control App	56
Wireless Remote I/O App	57
Coriolis Interface App	58
Safety System App	59
NGC Interface TCP Server	60
NGC Interface TCP Client	61
TGP Modbus App	99
Simulated I/O	100
TFIO Interface App	101
XFC AMU Interface	102

C.2 Display Application Registers

The format for the register list is app#.array#.register#. The display application can be instantiated in any application slot.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0	Number of Files	Byte	Read/Write	1
0.1	Number of Displays	Byte	Read/Write	2
0.2	Current File	Byte	Read/Write	3
0.3	Current Display	Byte	Read/Write	3
0.4	Display Lock	Byte	Read/Write	3
0.5	Display Clear	Byte	Read/Write	4
0.6	Display Save	Byte	Read/Write	5
0.7	Restore Factory Default Display	Byte	Read/Write	6
1.0	File Name (12 Characters)	String	Read/Write	
1.1	Display Name (24 Characters)	String	Read/Write	
1.2	Display Units (14 Characters)	String	Read/Write	

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
1.3	Display Format (Width.dec)	String	Read/Write	
1.4	Group Description (24 Characters)	String	Read/Write	
2.0	Display Interval (Seconds)	Byte	Read/Write	
2.1	Name X Location (0-23)	Byte	Read/Write	
2.2	Name Y Location (0-1)	Byte	Read/Write	
2.3	Units X Location (0-23)	Byte	Read/Write	
2.4	Units Y Location (0-1)	Byte	Read/Write	
2.5	Data X Location (0-23)	Byte	Read/Write	
2.6	Data Y Location (0-1)	Byte	Read/Write	
2.7	Annunciator/Plot X Location (0-23)	Byte	Read/Write	
2.8	Annunciator/Plot Y Location (0-1)	Byte	Read/Write	
2.9	Plot Type	Byte	Read/Write	7
2.10	Plot Direction	Byte	Read/Write	8
2.12	Plot Line Width	Byte	Read/Write	
2.13	Plot Border	Byte	Read/Write	9
2.14	Display Attributes	Byte	Read/Write	10
2.15	File Attributes	Byte	Read/Write	11
3.0	Data Scale Factor	Float	Read/Write	
3.1	Data High Limit	Float	Read/Write	
3.2	Data Low Limit	Float	Read/Write	
4.0	Data Register	Register	Read/Write	
4.1	Plot Array Register	Register	Read/Write	12
4.2	Enumeration Array Register	Register	Read/Write	13
4.3	Group Scroll Control Register	Register	Read/Write	14
4.4	Display Scroll Control Register	Register	Read/Write	14
4.5	Locate/Lock Register	Register	Write Only	15
5.0	Scroll Lock Timeout	Uint32	Read/Write	16
5.1	Scroll Lock Timer	Uint32	Read/Write	16
6.0	Annunciator A1	Byte	Read/Write	17
6.1	Annunciator A2	Byte	Read/Write	17
6.2	Annunciator A3	Byte	Read/Write	17
6.3	Annunciator A4	Byte	Read/Write	17
6.4	Annunciator A5	Byte	Read/Write	17
6.5	Annunciator A6	Byte	Read/Write	17

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
6.6	Annunciator A7	Byte	Read/Write	17
6.7	Annunciator A8	Byte	Read/Write	17
7.0	Display Annunciator A1	Byte	Read/Write	
7.1	Display Annunciator A2	Byte	Read/Write	
7.2	Display Annunciator A3	Byte	Read/Write	
7.3	Display Annunciator A4	Byte	Read/Write	
7.4	Display Annunciator A5	Byte	Read/Write	
7.5	Display Annunciator A6	Byte	Read/Write	
7.6	Display Annunciator A7	Byte	Read/Write	
7.7	Display Annunciator A8	Byte	Read/Write	
8.(X)	Common Enumerations	String	Read	18

C.2.1 Display Application Register Notes

1) If the number of files being written is greater than the number of files present, spare files will be created. If the number written is less than the number present, excess files will be deleted.

2) Refers to the number of displays in the current group. If the number written is greater than the number present, spare displays will be created. If the number written is less than the number present, excess displays will be deleted.

3) X.0.2 – X.0.4 are used to navigate from group to group and display to display within a group. Setting display lock prevents the display from scrolling.

4) Display clear causes the entire display to be refreshed.

5) After making changes to the display parameters in arrays 1 through 4, display save should be written to the new parameters in the display file.

6) Setting Factory Default causes the display to be set to "Spare".

7) 0 = No Plot (Annunciators), 1 = 16x24 pixel, 2 = 8x48 pixel.

8) 0 = Left to Right, 1 = Right to Left.

9) Bit Mask: Bit 0 = Left, Bit 1 = Right, Bit 2 = Top, Bit 3 = Bottom.

10) Bit Mask: Bit 0 = Include in Scroll List, Bit 1 = Allow Keypad Entry, Bit 2 = Validate Keypad entry (Data High/Data Low).

11) Bit Mask: Bit 0 = Include in Scroll List, Bit 1 = Allow Keypad Entry.

12) Starting Register in an array to plot. Allows historical data (such as last 24 hours or last 24 days) to be plotted. The user can also plot trend data.

13) Used to show digital states such as "Open/Close" or "Running/Idle/Stopped".

14) Normally used with DIs in "Push to Read' mode. If x.4.3 is assigned, the display will scroll from group to group while the DI is pressed. If x.4.4 is assigned, the display will scroll through displays within the group while the DI is pressed.

15) Writing a register (xx.xx.xxxx) to the Locate Register will cause the display system to search all files/displays for the requested register. If it is located, the display containing the register is locked on the display. Used by the Calibrate screen to lock the point being calibrated.

16) Allows the display to timeout and resume normal scrolling activity if the operator leaves the display locked for an extended period of time.

17) Annunciator Values are determined by the App Type Enumerations. See the System App documentation for an enumeration list.

18) These are common enunciators that are used for represented values. i.e.

```
"Disabled","Enabled"        // Enabled/Disabled
"Closed","Open"             // Open/Closed
"False","True"              // True/False
"Off","On"                  // On/Off
"No","Yes"                  // Yes/No
```

C.3   Alarm System Application Registers

Format for the register list is app#.array#.register#. The Alarm System application can be instantiated in any application slot. Low order array numbers are used for the BTU application, since the BTU application is derived from a Rams application. Refer BTU Application register document.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
100.0-XX	Alarm Records	Structure	Read/Write	1A
101.0-XX	Exception Blocks	Structure	Read/Write	1B
102.0-XX	Float Registers(User settable value)	Structure	Read/Write	1C
103.0	Report Counter	Byte	Read Only	3
103.1	Current Number of Alarms	Byte	Read Only	4
103.2	Alarms Last Reported	Byte	Read Only	5
103.3	Alarm Reset	Byte	Write Only	6
103.4	Auto Clear	Byte	Read/Write	7
103.5	Cry-Out Enable	Byte	Read/Write	8
103.6	Cry-Out Frequency	Byte	Read/Write	9
103.7	Cry-Out Now	Byte	Read Only	10
103.8	Ignore DCD	Byte	Read/Write	11
103.9	Clear Cry-Out Timer	Byte	Write Only	
103.10	Clear Logged Alarms	Byte	Write Only	12
103.11	Cry-Out Timer	Byte	Read/Write	13
103.12	Log Mode	Byte	Read/Write	
103.13	Hold Frequency (In Minutes)	Byte	Read/Write	
103.14	Number of Exception Blocks	Byte	Read/Write	
103.15	Alarms Enabled	Byte	Read/Write	
103.16	Change Alarms Exception Register Apps	Byte	Read/Write	
103.17	Insert a New Exception Block	Byte	Read/Write	
103.18	Delete an Exception Block	Byte	Read/Write	
103.19	Repote Mode	Byte	Read/Write	15
103.20	Aknowledge all	Byte	Read/Write	16

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
103.21	# Number Logged Alarms Not acknowledge	Byte	Read	
103.22	CPU Load Time Trigger	Byte	Read	
103.23	Last Alarm Code	Byte	Read	
104.0	Get Alarms Report	Structure	Read Only	1
105.0	Get All Alarm Logs	Structure	Read Only	
106.X	Get Specific Alarm Log	Structure	Read Only	17
107.X	Alarm Type of Alarm at Exception Block X	Byte	Read Only	
108. X	User's Alarm Code of Alarm at Exception Block X	UInt	Read/Write	
109. X	Enable Alarm Flags of Alarm at Exception Block X	Byte	Read/Write	
110. X	Alarm Input Register of Alarm at Exception Block X	Register	Read/Write	
111. X	Alarm Threshold of Alarm at Exception Block X	Register	Read/Write	
112. X	Alarm Output Value of Alarm at Exception Block X	Register	Read/Write	
113. X	Trigger Type of Alarm at Exception Block X	Byte	Read/Write	
114. X	Trigger Reference of Alarm at Exception Block X	Register	Read/Write	
115. X	Reset Alarm Logic of Alarm at Exception Block X	Byte	Read/Write	
116. X	Filter Type of Alarm at Exception Block X	Byte	Read/Write	
117. X	Filter Threshold of Alarm at Exception Block X	Float	Read/Write	
118. X	Filter Units of Alarm at Exception Block X	Byte	Read/Write	
119. X	Log Type of Alarm at Exception Block X	Byte	Read/Write	
120.0	Current Alarm Log Record Position	UInt32	Read/Write	
120.1	Number of Alarm Logs	UInt32	Read/Write	
120.2	CPU Load Hold Off Timer	UInt32	Read	
121. X	Alarm Description of Alarm at Exception Block X	String	Read/Write	
122. X	Current State of Alarm at Exception Block X	Byte	Read Only	
123. X	Alarm Severity of Alarm at Exception Block X	Byte	Read/Write	
124.0	Faults – All RAMS	UInt	Read Only	
124.1	Warnings – All RAMS	UInt	Read Only	
124.2	Faults – This RAM App	UInt	Read Only	
124.3	Warnings– This RAM App	UInt	Read Only	

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
125. X	Threshold Type of Alarm at Exception Block X	Byte	Read/Write	
126. X	Threshold Constant of Alarm of at Exception Block X	Float	Read/Write	
127.0	Current Active Alarms	Structure	Read Only	
128.0	Current Last Logged Alarm Fault	SInt	Read Only	
128.1	Current Last Logged Alarm Warning	SInt	Read Only	
128.2	Current First Logged Alarm Fault	SInt	Read Only	
128.3	Current First Logged Alarm Warning	SInt	Read Only	
129.0	Current Last Logged Alarm Fault	String	Read Only	
129.1	Current Last Logged Alarm Warning	String	Read Only	
129.2	Current First Logged Alarm Fault	String	Read Only	
129.3	Current First Logged Alarm Warning	String	Read Only	
129.4	RAMS Port Name	String	Write/Read	
130.0	Transmit Records Only	Structure	Read Only	14
131.X	Alarm Count of currently active alarms of Severity X	Uint	Read Only	
132.X	Alarm Acknowledge	Byte	Read/Write	18
133.X	Get Alarm Acknowledge Log Record	Struct	Read Only	19
134.X	All Alarms Not Acknowledged	Record Struct	Read/Write	20
135.X	All Alarms Not Acknowledged	Record Struct	Read/Write	20
136.X	End of Array	Record Struct	Read/Write	20

C.3.1 Alarm System Application Register Notes

1) These are special structures used by the Totalflow WinCCU/PCCU32 applications. Currently, they can not be accessed via templates or ini files.

    A.   XX = MAX_ALARMS = 255

    B.   XX = num_exceptions,user selectable up to 255

    C.   XX = RAMFLTS = 16

2) Allows the user to enter floating point numbers as constants that can be used when building an Alarm page. The constants can be compared against variables in the device to generate an alarm.

3) Number cry-outs that were not acknowledged by the host.

4) Number of alarms that have not been sent and/or alarms that have been sent and not acknowledged by the host.

5) Number of alarms in the last successful cry-out. Successful meaning that the cry-out was acknowledged by the host.

6) Reset the number of alarms last reported counter.

7) Primarily used when polling for alarms or Alarm by Exception. Setting to 1 will cause the alarms to be cleared each time the device is polled for alarms.

8) Alarm cry-out is enabled by selecting the port on which alarms will be broadcast. Selections are: 0 – Disabled, 1 - COM1, 2 – COM2

9) The time in minutes between cry-outs.

10) Set to 1 when it is time to cry-out.

11) Cry-out checks the Data Carrier Detect (DCD) line to see if the communications channel is quiet before it initiates a cry-out. This keeps it from transmitting when the host is trying to communicate with the unit. Some communication equipment may not support DCD, and with nothing connected to the DCD terminal, the DCD input might float to a true state keeping cry-out from transmitting alarms. Setting this register to 1 will instruct cry-out to ignore DCD.

12) If the user corrects the situation that is generating an alarm, the user can then set this register to 1 to clear the alarm so that it will not cry-out at the next scheduled cry-out time. This command, however, causes the system to scan immediately for alarms, and if there was another existing alarm condition, it will cry-out immediately instead of waiting for the next scheduled cry-out time.

13) The amount of time left before the next scheduled cry-out as specified by the cry-out frequency.

14) Used to append Rams alarms to be transmitted to an existing remote alarm record.

15) Report Mode   Poll=1   Cry Out=0.

16) Acknowledge All Alarms any value sets this byte.

17) X= the specific alarm log to get.

18) X = the alarm number (0-255).

19) X = the alarm number (0-255). Returns 0 filled structure, if already acknowledged.

20) X = arbitrary value. Returns all un-acknowledged alarm logs.

C.4 Holding Registers

Format for the register list is app#.array#.registter#. The Holding Registers application can be instantiated in any application slot.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0	Holding Array 1 Register 1	Programmable	Read/Write	1
0.1	Holding Array 1 Register 2	Programmable	Read/Write	1
0.2	Holding Array 1 Register 3	Programmable	Read/Write	1
0.(X)	Holding Array 1 Register (X)	Programmable	Read/Write	1
1.0	Holding Array 2 Register 1	Programmable	Read/Write	1
1.1	Holding Array 2 Register 2	Programmable	Read/Write	1
1.2	Holding Array 2 Register 3	Programmable	Read/Write	1
1.(X)	Holding Array 2 Register (X)	Programmable	Read/Write	1
2.0	Holding Array 3 Register 1	Programmable	Read/Write	1
2.1	Holding Array 3 Register 2	Programmable	Read/Write	1
2.2	Holding Array 3 Register 3	Programmable	Read/Write	1
2.(X)	Holding Array 3 Register (X)	Programmable	Read/Write	1
(X).0	Holding Array (X) Register 1	Programmable	Read/Write	1
(X).1	Holding Array (X) Register 2	Programmable	Read/Write	1

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
(X).2	Holding Array (X) Register 3	Programmable	Read/Write	1
(X).(X)	Holding Array (X) Register (X)	Programmable	Read/Write	1
100.0	Holding Array 1 Register 0 Description	String	Read/Write	
100.1	Holding Array 1 Register 1 Description	String	Read/Write	
100.(X)	Holding Array 1 Register (X) Description	String	Read/Write	
101.0	Holding Array 2 Register 0 Description	String	Read/Write	
101.1	Holding Array 2 Register 1 Description	String	Read/Write	
101.(X)	Holding Array 2 Register (X) Description	String	Read/Write	
10(X).0	Holding Array (X) Register 0 Description	String	Read/Write	
10(X).1	Holding Array (X) Register 1 Description	String	Read/Write	
10(X).(X)	Holding Array (X) Register (X) Description	String	Read/Write	
251.0	Array 1 Descriptor Flag	Byte	Read Only	2
251.1	Array 2 Descriptor Flag	Byte	Read Only	2
251.2	Array 3 Descriptor Flag	Byte	Read Only	2
251.(X)	Array (X) Descriptor Flag	Byte	Read Only	2
252.0	Holding Array 1 Description	String	Read/Write	3
252.1	Holding Array 2 Description	String	Read/Write	3
252.2	Holding Array 3 Description	String	Read/Write	3
252.(X)	Holding Array (X) Description	String	Read/Write	3
253.0	Holding Array 1 Data Type	Byte	Read/Write	4
253.1	Holding Array 2 Data Type	Byte	Read/Write	4
253.2	Holding Array 3 Data Type	Byte	Read/Write	4
253.(X)	Holding Array (X) Data Type	Byte	Read/Write	4
254.0	Holding Array 1 Persistence	Byte	Read/Write	4
254.1	Holding Array 2 Persistence	Byte	Read/Write	4
254.2	Holding Array 3 Persistence	Byte	Read/Write	4
254.(X)	Holding Array (X) Persistence	Byte	Read/Write	4
255.0	Holding Array 1 Capacity	Uint16	Read/Write	5
255.1	Holding Array 2 Capacity	Uint16	Read/Write	5
255.2	Holding Array 3 Capacity	Uint16	Read/Write	5
255.(X)	Holding Array (X) Capacity	Uint16	Read/Write	5
255.255	Number of Holding Arrays	Uint16	Read/Write	6

C.4.1 Holding Register Notes

1) The number, type and size of the Holding Register arrays are user programmable.

2) Array descriptor flag indicates if the array has a descriptor contained in array 252.

3) Each Holding Register array can be assigned a 24-character name.

4) The data type of each Holding Register array is user programmable. The following data types are supported:

        0 - 32 Bit Floating Point
        1 - 16 Bit Integer
        2 - 16 Bit Unsigned Integer
        3 - 32 Bit Integer
        4 - 32 Bit Unsigned Integer
        5 - 8 Bit Byte
        6 - 24 Character String
        7 - 4 Byte Register (app.array.register)

5) Each Holding Register array can be made persistent through a warm start. If the array persistence flag is set to 1, each write operation to a register in the array causes the array data to be written to a file. This can be very slow. It will also increase processor usage considerably. If registers in an array are being updated frequently, the array should not be made persistent.

6) The number of registers in each Holding Register array is limited only by available memory.

7) Up to 250 Holding Register arrays can be allocated; however, available memory will probably be exhausted first.

C.5 Reports Application Registers

The format for the register lists is app#.array#.register#. The Reports application can be instantiated in any application slot.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0-6	BYTE Registers	BYTE		
0.0	Baud Rate	BYTE	Read/Write	
0.1	Data Bits	BYTE	Read/Write	
0.2	Parity	BYTE	Read/Write	
0.3	Stop Bits	BYTE	Read/Write	
0.4	Interface	BYTE	Read/Write	
0.5	Port Type	BYTE	Read/Write	
0.6	Trigger Byte	BYTE	Read/Write	
1.0-1	Int16 Registers	16 Bit Int		
1.0	Radio Key Delay	16 Bit Int	Read/Write	
1.1	Radio Unkey Delay	16 Bit Int	Read/Write	
2.0-0	Int32 Registers	32 Bit Int		
2.0	Timeout	32 Bit Int	Read/Write	
3.0-1	String Registers	String		
3.0	Report ID	String	Read/Write	
3.1	Report Port Name	String	Read/Write	
4.0-0	Float Registers	Float		

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
4.0	Float Accumulator	Float	Read	
5.0 – 5.31	Output Files	String	Read/Write	
6.0 – 6.31	Template Files	String	Read/Write	
7.0 – (X)	BTU Apps Trigger Registers	String	Read/Write	
8.0 – 8.31	Header Files	String	Read/Write	
9.0 – 9.31	Report Modes	Byte	Read/Write	1
10.0 – 10.31	Analysis Times	Int32	Read/Write	

C.5.1 Reports Register Notes

1)   Auto, Manual, Disabled, Triggered

C.6 Operations Application Registers

Format for the register list is app#.array#.register#. The Operations application can be instantiated in any application slot.

Register	Description	Type	Access	Note
0.0	Periodic Operations 1 Trigger Register	Register	Read/Write	1
0.1	Periodic Operations 2 Trigger Register	Register	Read/Write	1
0.2	Periodic Operations 3 Trigger Register	Register	Read/Write	1
0.(X)	Periodic Operations (X) Trigger Register	Register	Read/Write	1
1.0	Periodic Operations 1 Trigger Type	Byte	Read/Write	1
1.1	Periodic Operations 2 Trigger Type	Byte	Read/Write	1
1.2	Periodic Operations 3 Trigger Type	Byte	Read/Write	1
1.(X)	Periodic Operations (X) Trigger Type	Byte	Read/Write	1
2.0	Periodic Operations 1 Trigger Interval	Uint32	Read/Write	1
2.1	Periodic Operations 2 Trigger Interval	Uint32	Read/Write	1
2.2	Periodic Operations 3 Trigger Interval	Uint32	Read/Write	1
2.(X)	Periodic Operations (X) Trigger Interval	Uint32	Read/Write	1
3.0	Periodic Operations 1 Operation	Byte	Read/Write	2
3.1	Periodic Operations 2 Operation	Byte	Read/Write	2
3.2	Periodic Operations 3 Operation	Byte	Read/Write	2
3.(X)	Periodic Operations (X) Operation	Byte	Read/Write	2
4.0	Periodic Operations 1 Register 1	Register	Read/Write	2
4.1	Periodic Operations 2 Register 1	Register	Read/Write	2
4.2	Periodic Operations 3 Register 1	Register	Read/Write	2
4.(X)	Periodic Operations (X) Register 1	Register	Read/Write	2
5.0	Periodic Operations 1 Register 2	Register	Read/Write	2

Register	Description	Type	Access	Note
5.1	Periodic Operations 2 Register 2	Register	Read/Write	2
5.2	Periodic Operations 3 Register 2	Register	Read/Write	2
5.(X)	Periodic Operations (X) Register 2	Register	Read/Write	2
6.0	Periodic Operations 1 Output Register	Register	Read/Write	2
6.1	Periodic Operations 2 Output Register	Register	Read/Write	2
6.2	Periodic Operations 3 Output Register	Register	Read/Write	2
6.(X)	Periodic Operations (X) Output Register	Register	Read/Write	2
7.0	Math Operation 1 Result	Float	Read Only	3
7.1	Math Operation 2 Result	Float	Read Only	3
7.2	Math Operation 3 Result	Float	Read Only	3
7.(X)	Math Operation (X) Result	Float	Read Only	3
8.0	Math Operation 1 Operation	Byte	Read/Write	3
8.1	Math Operation 2 Operation	Byte	Read/Write	3
8.2	Math Operation 3 Operation	Byte	Read/Write	3
8.(X)	Math Operation (X) Operation	Byte	Read/Write	3
9.0	Math Operation 1 Register 1	Register	Read/Write	3
9.1	Math Operation 2 Register 1	Register	Read/Write	3
9.2	Math Operation 3 Register 1	Register	Read/Write	3
9.(X)	Math Operation (X) Register 1	Register	Read/Write	3
10.0	Math Operation 1 Register 2	Register	Read/Write	3
10.1	Math Operation 2 Register 2	Register	Read/Write	3
10.2	Math Operation 3 Register 2	Register	Read/Write	3
10.(X)	Math Operation (X) Register 2	Register	Read/Write	3
11.0	Bit Operation 1 Result	Uint32	Read Only	4
11.1	Bit Operation 2 Result	Uint32	Read Only	4
11.2	Bit Operation 3 Result	Uint32	Read Only	4
11.(X)	Bit Operation (X) Result	Uint32	Read Only	4
12.0	Bit Operation 1 Operation	Byte	Read/Write	4
12.1	Bit Operation 2 Operation	Byte	Read/Write	4
12.2	Bit Operation 3 Operation	Byte	Read/Write	4
12.(X)	Bit Operation (X) Operation	Byte	Read/Write	4
13.0	Bit Operation 1 Register 1	Register	Read/Write	4
13.1	Bit Operation 2 Register 1	Register	Read/Write	4
13.2	Bit Operation 3 Register 1	Register	Read/Write	4

Register	Description	Type	Access	Note
13.(X)	Bit Operation (X) Register 1	Register	Read/Write	4
14.0	Bit Operation 1 Register 2	Register	Read/Write	4
14.1	Bit Operation 2 Register 2	Register	Read/Write	4
14.2	Bit Operation 3 Register 2	Register	Read/Write	4
14.(X)	Bit Operation (X) Register 2	Register	Read/Write	4
15.0	Compare Operation 1 Result	Bool	Read Only	5
15.1	Compare Operation 2 Result	Bool	Read Only	5
15.2	Compare Operation 3 Result	Bool	Read Only	5
15.(X)	Compare Operation (X) Result	Bool	Read Only	5
16.0	Compare Operation 1 Operation	Uint16	Read/Write	5
16.1	Compare Operation 2 Operation	Uint16	Read/Write	5
16.2	Compare Operation 3 Operation	Uint16	Read/Write	5
16.(X)	Compare Operation (X) Operation	Uint16	Read/Write	5
17.0	Compare Operation 1 Register 1	Register	Read/Write	5
17.1	Compare Operation 2 Register 1	Register	Read/Write	5
17.2	Compare Operation 3 Register 1	Register	Read/Write	5
17.(X)	Compare Operation (X) Register 1	Register	Read/Write	5
18.0	Compare Operation 1 Register 2	Register	Read/Write	5
18.1	Compare Operation 2 Register 2	Register	Read/Write	5
18.2	Compare Operation 3 Register 2	Register	Read/Write	5
18.(X)	Compare Operation (X) Register 2	Register	Read/Write	5
19.0	Array Operation 1 Result	Float	Read Only	6
19.1	Array Operation 2 Result	Float	Read Only	6
19.2	Array Operation 3 Result	Float	Read Only	6
19.(X)	Array Operation (X) Result	Float	Read Only	6
20.0	Array Operation 1 Operation	Uint16	Read/Write	6
20.1	Array Operation 2 Operation	Uint16	Read/Write	6
20.2	Array Operation 3 Operation	Uint16	Read/Write	6
20.(X)	Array Operation (X) Operation	Uint16	Read/Write	6
21.0	Array Operation 1 Register	Register	Read/Write	6
21.1	Array Operation 2 Register	Register	Read/Write	6
21.2	Array Operation 3 Register	Register	Read/Write	6
21.(X)	Array Operation (X) Register	Register	Read/Write	6
22.0	Array Operation 1 Size	Uint16	Read/Write	6

Register	Description	Type	Access	Note
22.1	Array Operation 2 Size	Uint16	Read/Write	6
22.2	Array Operation 3 Size	Uint16	Read/Write	6
22.(X)	Array Operation (X) Size	Uint16	Read/Write	6
23.0	Periodic Operation 1 Descriptor	String	Read/Write	12
23.1	Periodic Operation 2 Descriptor	String	Read/Write	12
23.2	Periodic Operation 3 Descriptor	String	Read/Write	12
23.(X)	Periodic Operation (X) Descriptor	String	Read/Write	12
24.0	Math Operation 1 Descriptor	String	Read/Write	12
24.1	Math Operation 2 Descriptor	String	Read/Write	12
24.2	Math Operation 3 Descriptor	String	Read/Write	12
24.(X)	Math Operation (X) Descriptor	String	Read/Write	12
25.0	Bit Operation 1 Descriptor	String	Read/Write	12
25.1	Bit Operation 2 Descriptor	String	Read/Write	12
25.2	Bit Operation 3 Descriptor	String	Read/Write	12
25. (X)	Bit Operation (X) Descriptor	String	Read/Write	12
26.0	Compare Operation 1 Descriptor	String	Read/Write	12
26.1	Compare Operation 2 Descriptor	String	Read/Write	12
26.2	Compare Operation 3 Descriptor	String	Read/Write	12
26.(X)	Compare Operation (X) Descriptor	String	Read/Write	12
27.0	Array Operation 1 Descriptor	String	Read/Write	12
27.1	Array Operation 2 Descriptor	String	Read/Write	12
27.2	Array Operation 3 Descriptor	String	Read/Write	12
27.(X)	Array Operation (X) Descriptor	String	Read/Write	12
28.0	Select Operation 1 Descriptor	String	Read/Write	12
28.1	Select Operation 2 Descriptor	String	Read/Write	12
28.2	Select Operation 3 Descriptor	String	Read/Write	12
28.(X)	Select Operation (X) Descriptor	String	Read/Write	12
29.0	Select Operation 1 Switch	Register	Read/Write	13
29.1	Select Operation 2 Switch	Register	Read/Write	13
29.2	Select Operation 3 Switch	Register	Read/Write	13
29.(X)	Select Operation (X) Switch	Register	Read/Write	13
30.0	Select Operation 1 Input 1	Register	Read/Write	13
30.1	Select Operation 2 Input 1	Register	Read/Write	13
30.2	Select Operation 3 Input 1	Register	Read/Write	13

Register	Description	Type	Access	Note
30.(X)	Select Operation (X) Input 1	Register	Read/Write	13
31.0	Select Operation 1 Input 2	Register	Read/Write	13
31.1	Select Operation 2 Input 2	Register	Read/Write	13
31.2	Select Operation 3 Input 2	Register	Read/Write	13
31.(X)	Select Operation (X) Input 2	Register	Read/Write	13
32.0	Select Operation 1 Output	Float	Read/Write	13
32.1	Select Operation 2 Output	Float	Read/Write	13
32.2	Select Operation 3 Output	Float	Read/Write	13
32.(X)	Select Operation (X) Output	Float	Read/Write	13
33.0	Lag Operation 1 Description	String	Read/Write	12
33.1	Lag Operation 2 Description	String	Read/Write	12
33.2	Lag Operation 3 Description	String	Read/Write	12
33.(X)	Lag Operation (X) Description	String	Read/Write	12
34.0	Lag Operation 1 Interval	Uint32	Read/Write	14
34.1	Lag Operation 2 Interval	Uint32	Read/Write	14
34.2	Lag Operation 3 Interval	Uint32	Read/Write	14
34.(X)	Lag Operation (X) Interval	Uint32	Read/Write	14
35.0	Lag Operation 1 Input Register	Register	Read/Write	14
35.1	Lag Operation 2 Input Register	Register	Read/Write	14
35.2	Lag Operation 3 Input Register	Register	Read/Write	14
35.(X)	Lag Operation (X) Input Register	Register	Read/Write	14
36.0	Lag Operation 1 Output	Float	Read/Write	14
36.1	Lag Operation 2 Output	Float	Read/Write	14
36.2	Lag Operation 3 Output	Float	Read/Write	14
36.(X)	Lag Operation (X) Output	Float	Read/Write	14
37.0	Lead Operation 1 Description	String	Read/Write	12
37.1	Lead Operation 2 Description	String	Read/Write	12
37.2	Lead Operation 3 Description	String	Read/Write	12
37.(X)	Lead Operation (X) Description	String	Read/Write	12
38.0	Lead Operation 1 Interval	Uint32	Read/Write	15
38.1	Lead Operation 2 Interval	Uint32	Read/Write	15
38.2	Lead Operation 3 Interval	Uint32	Read/Write	15
38.(X)	Lead Operation (X) Interval	Uint32	Read/Write	15
39.0	Lead Operation 1 Input Register	Register	Read/Write	15

Register	Description	Type	Access	Note
39.1	Lead Operation 2 Input Register	Register	Read/Write	15
39.2	Lead Operation 3 Input Register	Register	Read/Write	15
39.(X)	Lead Operation (X) Input Register	Register	Read/Write	15
40.0	Lead Operation 1 Output	Float	Read/Write	15
40.1	Lead Operation 2 Output	Float	Read/Write	15
40.2	Lead Operation 3 Output	Float	Read/Write	15
40.(X)	Lead Operation (X) Output	Float	Read/Write	15
41.0	Queue Operation 1 Descriptor	String	Read/Write	12
41.1	Queue Operation 2 Descriptor	String	Read/Write	12
41.2	Queue Operation 3 Descriptor	String	Read/Write	12
41.(X)	Queue Operation (X) Descriptor	String	Read/Write	12
42.0	Queue Operation 1 Interval	Uint32	Read/Write	16
42.1	Queue Operation 2 Interval	Uint32	Read/Write	16
42.2	Queue Operation 3 Interval	Uint32	Read/Write	16
42.(X)	Queue Operation (X) Interval	Uint32	Read/Write	16
43.0	Queue Operation 1 Array Register	Register	Read/Write	16
43.1	Queue Operation 2 Array Register	Register	Read/Write	16
43.2	Queue Operation 3 Array Register	Register	Read/Write	16
43.(X)	Queue Operation (X) Array Register	Register	Read/Write	16
44.0	Queue Operation 1 Array Size	Uint16	Read/Write	16
44.1	Queue Operation 2 Array Size	Uint16	Read/Write	16
44.2	Queue Operation 3 Array Size	Uint16	Read/Write	16
44.(X)	Queue Operation (X) Array Size	Uint16	Read/Write	16
45.0	Queue Operation 1 Input Register	Register	Read/Write	16
45.1	Queue Operation 2 Input Register	Register	Read/Write	16
45.2	Queue Operation 3 Input Register	Register	Read/Write	16
45.(X)	Queue Operation (X) Input Register	Register	Read/Write	16
46.0	Queue Operation 1 Output	Float	Read/Write	16
46.1	Queue Operation 2 Output	Float	Read/Write	16
46.2	Queue Operation 3 Output	Float	Read/Write	16
46.(X)	Queue Operation (X) Output	Float	Read/Write	16
47.0	Ramp Operation 1 Descriptor	String	Read/Write	12
47.1	Ramp Operation 2 Descriptor	String	Read/Write	12
47.2	Ramp Operation 3 Descriptor	String	Read/Write	12

Register	Description	Type	Access	Note
47.(X)	Ramp Operation (X) Descriptor	String	Read/Write	12
48.0	Ramp Operation 1 Slope	Float	Read/Write	17
48.1	Ramp Operation 2 Slope	Float	Read/Write	17
48.2	Ramp Operation 3 Slope	Float	Read/Write	17
48.(X)	Ramp Operation (X) Slope	Float	Read/Write	17
49.0	Ramp Operation 1 Input Register	Register	Read/Write	17
49.1	Ramp Operation 2 Input Register	Register	Read/Write	17
49.2	Ramp Operation 3 Input Register	Register	Read/Write	17
49.(X)	Ramp Operation (X) Input Register	Register	Read/Write	17
50.0	Ramp Operation 1 Output	Float	Read/Write	17
50.1	Ramp Operation 2 Output	Float	Read/Write	17
50.2	Ramp Operation 3 Output	Float	Read/Write	17
50.(X)	Ramp Operation (X) Output	Float	Read/Write	17
51.0	Pulse Operation 1 Descriptor	String	Read/Write	12
51.1	Pulse Operation 2 Descriptor	String	Read/Write	12
51.2	Pulse Operation 3 Descriptor	String	Read/Write	12
51.(X)	Pulse Operation (X) Descriptor	String	Read/Write	12
52.0	Pulse Operation 1 Interval	Uint32	Read/Write	18
52.1	Pulse Operation 2 Interval	Uint32	Read/Write	18
52.2	Pulse Operation 3 Interval	Uint32	Read/Write	18
52.(X)	Pulse Operation (X) Interval	Uint32	Read/Write	18
53.0	Pulse Operation 1 Trigger Register	Register	Read/Write	18
53.1	Pulse Operation 2 Trigger Register	Register	Read/Write	18
53.2	Pulse Operation 3 Trigger Register	Register	Read/Write	18
53.(X)	Pulse Operation (X) Trigger Register	Register	Read/Write	18
54.0	Pulse Operation 1 Trigger Flags	Byte	Read Only	18
54.1	Pulse Operation 2 Trigger Flags	Byte	Read Only	18
54.2	Pulse Operation 4 Trigger Flags	Byte	Read Only	18
54.(X)	Pulse Operation (X) Trigger Flags	Byte	Read Only	18
55.0	Pulse Operation 1 Output	Float	Read/Write	18
55.1	Pulse Operation 2 Output	Float	Read/Write	18
55.2	Pulse Operation 4 Output	Float	Read/Write	18
55.(X)	Pulse Operation (X) Output	Float	Read/Write	18
56.0	Limit Operation 1 Descriptor	String	Read/Write	12

Register	Description	Type	Access	Note
56.1	Limit Operation 2 Descriptor	String	Read/Write	12
56.2	Limit Operation 3 Descriptor	String	Read/Write	12
56.(X)	Limit Operation (X) Descriptor	String	Read/Write	12
57.0	Limit Operation 1 High Limit	Float	Read/Write	19
57.1	Limit Operation 2 High Limit	Float	Read/Write	19
57.2	Limit Operation 3 High Limit	Float	Read/Write	19
57.(X)	Limit Operation (X) High Limit	Float	Read/Write	19
58.0	Limit Operation 1 Low Limit	Float	Read/Write	19
58.1	Limit Operation 2 Low Limit	Float	Read/Write	19
58.2	Limit Operation 3 Low Limit	Float	Read/Write	19
58.(X)	Limit Operation (X) Low Limit	Float	Read/Write	19
59.0	Limit Operation 1 Velocity	Float	Read/Write	19
59.1	Limit Operation 2 Velocity	Float	Read/Write	19
59.2	Limit Operation 3 Velocity	Float	Read/Write	19
59.(X)	Limit Operation (X) Velocity	Float	Read/Write	19
60.0	Limit Operation 1 Input Register	Register	Read/Write	19
60.1	Limit Operation 2 Input Register	Register	Read/Write	19
60.2	Limit Operation 3 Input Register	Register	Read/Write	19
60.(X)	Limit Operation (X) Input Register	Register	Read/Write	19
61.0	Limit Operation 1 Output	Float	Read/Write	19
61.1	Limit Operation 2 Output	Float	Read/Write	19
61.2	Limit Operation 3 Output	Float	Read/Write	19
61.(X)	Limit Operation (X) Output	Float	Read/Write	19
62.0	Scale Operation 1 Descriptor	String	Read/Write	12
62.1	Scale Operation 2 Descriptor	String	Read/Write	12
62.2	Scale Operation 3 Descriptor	String	Read/Write	12
62.(X)	Scale Operation (X) Descriptor	String	Read/Write	12
63.0	Scale Operation 1 Input High Limit	Float	Read/Write	20
63.1	Scale Operation 2 Input High Limit	Float	Read/Write	20
63.2	Scale Operation 3 Input High Limit	Float	Read/Write	20
63.(X)	Scale Operation (X) Input High Limit	Float	Read/Write	20
64.0	Scale Operation 1 Input Low Limit	Float	Read/Write	20
64.1	Scale Operation 2 Input Low Limit	Float	Read/Write	20
64.2	Scale Operation 3 Input Low Limit	Float	Read/Write	20

Register	Description	Type	Access	Note
64.(X)	Scale Operation (X) Input Low Limit	Float	Read/Write	20
65.0	Scale Operation 1 Output High Limit	Float	Read/Write	20
65.1	Scale Operation 2 Output High Limit	Float	Read/Write	20
65.2	Scale Operation 3 Output High Limit	Float	Read/Write	20
65.(X)	Scale Operation (X) Output High Limit	Float	Read/Write	20
66.0	Scale Operation 1 Output Low Limit	Float	Read/Write	20
66.1	Scale Operation 2 Output Low Limit	Float	Read/Write	20
66.2	Scale Operation 3 Output Low Limit	Float	Read/Write	20
66.(X)	Scale Operation (X) Output Low Limit	Float	Read/Write	20
67.0	Scale Operation 1 Input Register	Register	Read/Write	20
67.1	Scale Operation 2 Input Register	Register	Read/Write	20
67.2	Scale Operation 3 Input Register	Register	Read/Write	20
67.(X)	Scale Operation (X) Input Register	Register	Read/Write	20
68.0	Scale Operation 1 Output	Float	Read/Write	20
68.1	Scale Operation 2 Output	Float	Read/Write	20
68.2	Scale Operation 3 Output	Float	Read/Write	20
68.(X)	Scale Operation (X) Output	Float	Read/Write	20
69.0	PID Operation 1 Descriptor	String	Read/Write	12
69.1	PID Operation 2 Descriptor	String	Read/Write	12
69.2	PID Operation 3 Descriptor	String	Read/Write	12
69.(X)	PID Operation (X) Descriptor	String	Read/Write	12
70.0	PID Operation 1 Input Register	Register	Read/Write	21
70.1	PID Operation 2 Input Register	Register	Read/Write	21
70.2	PID Operation 3 Input Register	Register	Read/Write	21
70.(X)	PID Operation (X) Input Register	Register	Read/Write	21
71.0	PID Operation 1 Setpoint	Float	Read/Write	21
71.1	PID Operation 2 Setpoint	Float	Read/Write	21
71.2	PID Operation 3 Setpoint	Float	Read/Write	21
71.(X)	PID Operation (X) Setpoint	Float	Read/Write	21
72.0	PID Operation 1 Dead Band	Float	Read/Write	21
72.1	PID Operation 2 Dead Band	Float	Read/Write	21
72.2	PID Operation 2 Dead Band	Float	Read/Write	21
72.(X)	PID Operation (X) Dead Band	Float	Read/Write	21
73.0	PID Operation 1 Proportional Gain	Float	Read/Write	21

Register	Description	Type	Access	Note
73.1	PID Operation 2 Proportional Gain	Float	Read/Write	21
73.2	PID Operation 2 Proportional Gain	Float	Read/Write	21
73.(X)	PID Operation (X) Proportional Gain	Float	Read/Write	21
74.0	PID Operation 1 Integral Reset	Float	Read/Write	21
74.1	PID Operation 2 Integral Reset	Float	Read/Write	21
74.2	PID Operation 3 Integral Reset	Float	Read/Write	21
74.(X)	PID Operation (X) Integral Reset	Float	Read/Write	21
75.0	PID Operation 1 Derivative Rate	Float	Read/Write	21
75.1	PID Operation 2 Derivative Rate	Float	Read/Write	21
75.2	PID Operation 3 Derivative Rate	Float	Read/Write	21
75.(X)	PID Operation (X) Derivative Rate	Float	Read/Write	21
76.0	PID Operation 1 Mode	Uchar	Read/Write	21
76.1	PID Operation 2 Mode	Uchar	Read/Write	21
76.2	PID Operation 3 Mode	Uchar	Read/Write	21
76.(X)	PID Operation (X) Mode	Uchar	Read/Write	21
77.0	PID Operation 1 Action	Uchar	Read/Write	21
77.1	PID Operation 2 Action	Uchar	Read/Write	21
77.2	PID Operation 3 Action	Uchar	Read/Write	21
77.(X)	PID Operation (X) Action	Uchar	Read/Write	21
78.0	PID Operation 1 Output	Float	Read/Write	21
78.1	PID Operation 2 Output	Float	Read/Write	21
78.2	PID Operation 3 Output	Float	Read/Write	21
78.(X)	PID Operation (X) Output	Float	Read/Write	21
255.0	Number of Periodic Operations	Uint16	Read/Write	7
255.1	Number of Math Operations	Uint16	Read/Write	8
255.2	Number of Bit Operations	Uint16	Read/Write	9
255.3	Number of Compare Operations	Uint16	Read/Write	10
255.4	Number of Array Operations	Uint16	Read/Write	11
255.5	Enable Period Descriptors	Uint16	Read/Write	22
255.6	Enable Math Descriptors	Uint16	Read/Write	22
255.7	Enable Bit Descriptors	Uint16	Read/Write	22
255.8	Enable Compare Descriptors	Uint16	Read/Write	22
255.9	Enable Array Descriptors	Uint16	Read/Write	22
255.10	Number of Select Operations	Uint16	Read/Write	23

Register	Description	Type	Access	Note
255.11	Enable Select Descriptors	Uint16	Read/Write	22
255.12	Number of Lag Operations	Uint16	Read/Write	24
255.13	Enable Lag Descriptors	Uint16	Read/Write	22
255.14	Number of Lead Operations	Uint16	Read/Write	25
255.15	Enable Lead Descriptors	Uint16	Read/Write	22
255.16	Number of Queue Operations	Uint16	Read/Write	26
255.17	Enable Queue Descriptors	Uint16	Read/Write	22
255.18	Number of Ramp Operations	Uint16	Read/Write	27
255.19	Enable Ramp Descriptors	Uint16	Read/Write	22
255.20	Number of Pulse Operations	Uint16	Read/Write	28
255.21	Enable Pulse Descriptors	Uint16	Read/Write	22
255.22	Number of Limit Operations	Uint16	Read/Write	29
255.23	Enable Limit Descriptors	Uint16	Read/Write	22
255.24	Number of Scale Operations	Uint16	Read/Write	30
255.25	Enable Scale Descriptors	Uint16	Read/Write	22
255.26	Number of PID Operations	Uint16	Read/Write	31
255.27	Enable PID Descriptors	Uint16	Read/Write	22

C.6.1 Operations Application Register Notes

1) Periodic Operations can be executed at a cyclic interval (such as every five seconds), at a specific time of day (such as 8:00) or they can be triggered by another register. If the operation trigger type in array 1 is 0 (Interval), the operation is executed at the interval specified by the corresponding register in array 2. If the operation trigger type is 1 (Time), the operation is executed at the time of day specified by the corresponding register in array 2. If the operation trigger type is 2 (Triggered), the operation is executed each second if the register specified by the corresponding register in array 0 is non-zero.

2) Periodic Operations combine the capabilities of Math, Bit, Compare and Array operations. The registers in array 3 contain operation codes specifying the operation to be performed. The registers in arrays 4 and 5 contain the operands of the operations. The registers in array 6 specify where the results of the operations will be placed. The following operation codes are supported:

0 - No Operation
1 - R1 + R2 (Addition)
2 - R1 – R2 (Subtraction)
3 - R1 * R2 (Multiplication)
4 - R1 / R2 (Division)
5 - R1 ^ R2 (Power of)
6 - sqrt(R1)(Square Root)
7 - sin(R1) (Trig Sine)
8 - cos(R1) (Trig Cosine)
9 - tan(R1) (Trig Tangent)
10 - ABS(R1) (Remove sign)

11 - Log(R1) (Logarithm)
12 - 1 / R1 (Reciprocal)
13 - R1 % R2 (Modulo)
20 - R1 & R2 (Bitwise AND)
21 - R1 | R2 (Bitwise OR)
22 - R1 ^ R2 (Bitwise XOR)
23 - R1 ~ R2 (Bitwise Complement)
24 - R1 << R2 (Bitwise Shift Left)
25 - R1 >> R2 (Bitwise Shift Right)
26 - R1 = !R2 (Bitwise NOT)
30 - (R1 & R2) == 0 (True if Equal to Zero)
31 - (R1 & R2) != 0 (True if Not Equal to Zero)
32 - (R1 | R2) == 0 (True if Equal to Zero)
33 - (R1 | R2) != 0 (True if Not Equal to Zero)
34 - (R1 ^ R2) == 0 (True if Equal to Zero)
35 - (R1 ^ R2) != 0 (True if Not Equal to Zero)
40 - R1 == R2 (True if Equal)
41 - R1 != R2 (True if Not Equal)
42 - R1 > R2 (True if Greater than)
43 - R1 >= R2 (True if Greater than or equal to)
44 - R1 < R2 (True if Less than)
45 - R1 <= R2 (True if Less than or equal to)
46 - R1 == 0 (True if Equal to zero)
47 - R1 != 0 (True if Not Equal to zero)
48 - R1 > 0 (True if Greater than zero)
49 - R1 < 0 (True if Less than zero)
60 - Integer R1 + R2 (Addition)
61 - Integer R1 – R2 (Subtraction)
62 - Integer R1 * R2 (Multiplication)
63 - Integer R1 / R2 (Division)
64 - Integer abs(R1) (Remove sign)
65 - Integer R1 % R2 (Modulo)
70 - Array Addition
71 - Array Linear Average
72 - Array Square Root Average
73 - Array Minimum
74 - Array Maximum
80 - Copy Array
81 - Move Array
254 - Out = R2 = R1
255 - Out = R1

3) Math Operations are executed when the corresponding register in array 7 is read. The registers in array 8 contain operation codes specifying the math operation to be performed. The registers in arrays 9 and 10 contain the operands of the operations. The result of the math operation is returned in the corresponding register in array 7. The following math operation codes are supported:

0 - No Operation
1 - R1 + R2 (Addition)
2 - R1 – R2 (Subtraction)
3 - R1 * R2 (Multiplication)
4 - R1 / R2 (Division)
5 - R1 ^ R2 (Power of)
6 - sqrt(R1)(Square Root)
7 - sin(R1) (Trig Sine)
8 - cos(R1) (Trig Cosine)
9 - tan(R1) (Trig Tangent)
10 - ABS(R1) (Remove sign)
11 - Log(R1) (Logarithm)
12 - 1 / R1 (Reciprocal)
13 - R1 % R2 (Modulo)

4) Bit Operations are executed when the corresponding register in array 11 is read. The registers in array 12 contain operation codes specifying the bit operation to be performed. The registers in arrays 13 and 14 contain the operands of the operations. The result of the bit operation is returned in the corresponding register in array 11. The following bit operation codes are supported:

20 - R1 & R2 (Bitwise AND)
21 - R1 | R2 (Bitwise OR)
22 - R1 ^ R2 (Bitwise XOR)
23 - R1 ~ R2 (Bitwise Complement)
24 - R1 << R2 (Bitwise Shift Left)
25 - R1 >> R2 (Bitwise Shift Right)
26 - R1 = !R2 (Bitwise NOT)
30 - (R1 & R2) == 0 (True if Equal to Zero)
31 - (R1 & R2) != 0 (True if Not Equal to Zero)
32 - (R1 | R2) == 0 (True if Equal to Zero)
33 - (R1 | R2) != 0 (True if Not Equal to Zero)
34 - (R1 ^ R2) == 0 (True if Equal to Zero)
35 - (R1 ^ R2) != 0 (True if Not Equal to Zero)

5) Compare Operations are executed when the corresponding register in array 15 is read. The registers in array 16 contain operation codes specifying the compare operation to be performed. The registers in arrays 17 and 18 contain the operands of the operations. The result of the compare operation is returned in the corresponding register in array 15. The following compare operation codes are supported:

40 - R1 == R2 (True if Equal)
41 - R1 != R2 (True if Not Equal)
42 - R1 > R2 (True if Greater than)
43 - R1 >= R2 (True if Greater than or equal to)
44 - R1 < R2 (True if Less than)
45 - R1 <= R2 (True if Less than or equal to)
46 - R1 == 0 (True if Equal to zero)
47 - R1 != 0 (True if Not Equal to zero)
48 - R1 > 0 (True if Greater than zero)
49 - R1 < 0 (True if Less than zero)

6) Array Operations are executed when the corresponding register in array 19 is read. The registers in array 20 contain operation codes specifying the array operation to be performed. The registers in arrays 21 and 22 contain the operands of the array operations. The result of the operation is returned in the registers in array 19. The following operation codes are supported:

70 - Array Addition
71 - Array Linear Average
72 - Array Square Root Average
73 - Array Minimum
74 - Array Maximum
80 - Copy Array
81 - Move Array

7) Register 255.0 contains the number of Periodic Operations. It determines the size of arrays 0 through 6 and 23.

8) Register 255.1 contains the number of Math Operations. It determines the size of arrays 7 through 10 and 24.

9) Register 255.2 contains the number of Bit Operations. It determines the size of arrays 11 through 14 and 25.

10) Register 255.3 contains the number of Compare Operations. It determines the size of arrays 15 through 18 and 26.

11) Register 255.4 contains the number of Array Operations. It determines the size of arrays 19 through 22 and 27.

12) These registers only exist if 255.5 thru 9 , 11, 13, 15, 17, 19, 21, 23, 25 and 27 are set to a 1 (or Yes).

13) Select Operations are executed when the corresponding register in array 32 is read. The registers in array 29 contain the value that is used to switch the output between two input values. The registers in arrays 30 and 31 contain the inputs to the operation. The result of the select operation is returned in the corresponding register in array 32.

14) Lag Operations are executed when the corresponding register in array 36 is read. The registers in array 34 contain the value that is used as the lag interval . The register in array 35 contains the input to the operation. The result of the lag operation is returned in the corresponding register in array 36.

15) Lead Operations are executed when the corresponding register in array 40 is read. The registers in array 38 contain the value that is used as the lead interval. The register in array 39 contains the input to the operation. The result of the lead operation is returned in the corresponding register in array 40.

16) Queue Operations are executed when the corresponding register in array 46 is read. The registers in array 42 contain the value that is used as the queue interval. The register in array 45 contains the input to the operation. The register in array 43 specifies the starting register address for the array. The register in array 44 specifies the number of registers in the array. The result of the queue operation is returned in the corresponding register in array 46.

17) Ramp Operations are executed when the corresponding register in array 50 is read. The registers in array 48 contain the value that is used as the slope. The register in array 39 contains the input to the operation. The result of the ramp operation is returned in the corresponding register in array 50.

18) Pulse Operations are executed when the corresponding register in array 55 is read. The registers in array 52 contain the value that is used as the pulse interval. The register in array 53 contains the trigger input. The result of the pulse operation is returned in the corresponding register in array 55.

19) Limit Operations are executed when the corresponding register in array 61 is read. The registers in array 60 contain the input to the operation. The registers in array 57 are used as the high limit values for the input data. The registers in array 58 are used as the low limit values for the input data. The registers in array 59 specify the value in engineering units per second that the output is allowed to change in response to the input. The result of the limit operation is returned in the corresponding register in array 61.

20) Scale Operations are executed when the corresponding register in array 68 is read. The registers in array 67 contain the input to the operation. The registers in array 63 are used as the high limit values for the input data. The registers in array 64 are used as the low limit values for the input data. The registers in array 65 are used as the high limit values for the output data. The registers in array 66 are used as the low limit values for the output data. The result of the scale operation is returned in the corresponding register in array 68.

21) PID Operations are executed when the corresponding register in array 78 is read. The registers in array 70 contain the input to the operation. The registers in array 71 are used as the set points for the operation. The registers in array 72 are used as the dead band values for the set points and the inputs. The registers in array 73 are used as the proportional gain of the operation. The registers in array 74 are used as the integral reset values of the operation. The registers in array 75 are used as the derivative rate of the operation. The registers in array 76 are used for the auto (1) / manual (0) mode of the operation. The registers in array 77 are used for the action (direct =0, reverse=1) of the operation. The result of the PID operation is returned in the corresponding register in array 78.

22) The value in this register is either a 0 to disable associated descriptors or a 1 to enable the associated descriptors.

23) Register 255.10 contains the number of Select Operations. It determines the size of arrays 28 thru 32.

24) Register 255.12 contains the number of Lag Operations. It determines the size of arrays 33 thru 36.

25) Register 255.14 contains the number of Lead Operations. It determines the size of arrays 37 thru 40.

26) Register 255.16 contains the number of Queue Operations. It determines the size of arrays 41 thru 46.

27) Register 255.18 contains the number of Ramp Operations. It determines the size of arrays 47 thru 50.

28) Register 255.20 contains the number of Pulse Operations. It determines the size of arrays 51 thru 55.

29) Register 255.22 contains the number of Limit Operations. It determines the size of the arrays 56 thru 61.

30) Register 255.24 contains the number of Scale Operations. It determines the size of the arrays 62 thru 68.

31) Register 255.26 contains the number of PID Operations. It determines the size of the arrays 69 thru 78.

C.7 Communication Application Registers

Format for the register list is app#.array#.register#. The Communications application can be instantiated in any application slot.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0	Port Flags Reset/Initialize Flags	Byte	Read/Write	1
0.1	Interface Type (RS-232/485/422)	Byte	Read/Write	2
0.2	Baud Rate	Byte	Read/Write	3
0.3	Number of Data Bits	Byte	Read/Write	4
0.4	Parity	Byte	Read/Write	5
0.5	Number of Stop Bits	Byte	Read/Write	6

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.6	Protocol	Byte	Read/Write	19
0.7	Link Establishment Interval	Byte	Read/Write	8
0.8	Wait for download timeout(seconds)	Byte	Read/Write	
0.9	Scheduler Mode	Byte	Read/Write	9
0.10	Exception Retry Limit	Byte	Read/Write	
0.11	MODBUS Slave Address	Byte	Read/Write	
0.12	MODBUS Register Format	Byte	Read/Write	10
0.13	Host Retry Limit	Byte	Read/Write	
0.14	Communications Task Priority	Byte	Read/Write	1
0.15	Switched V-Batt Enable	Byte	Read/Write	
0.16	Pager On/Off	Byte	Read/Write	
0.17	Trailing Pad Characters	Byte	Read/Write	12
0.18	Modem Mode (ASCII/BINARY)	Byte	Read/Write	
0.19	Packet Trace Enable	Byte	Read/Write	13
0.20	Interface On/Off	Byte	Read/Write	
0.21	ISR Thread Priority	Byte	Read/Write	
0.22	Port Type	Byte	Read/Write	20
0.23	Port Open	Byte	Read/Write	
0.24	Keep Port Open Flag	Byte	Read/Write	
0.25	Modbus Host Scan Enabled	Byte	Read/Write	
0.40	Port Name	Byte	Read/Write	
0.50				
1.0	Power-Up Delay (Milli-Seconds)	Uint16	Read/Write	
1.1	Transmit Key Delay (Milli-Seconds)	Uint16	Read/Write	
1.2	Transmit Unkey Delay (ms)	Uint16	Read/Write	
1.3	Timeout (Milli-Seconds)	Uint16	Read/Write	
1.4	Modem Inactivity Timeout(Minutes)	Uint16	Read/Write	
1.5	Modem Connect Timeout(Seconds)	Uint16	Read/Write	
1.6	Modem Disconnect Timeout(Seconds)	Uint16	Read/Write	
1.7	MODBUS Group (Assigned)	Uint16	Read/Write	14
1.8	MODBUS Group (Current)	Uint16	Read/Write	14
1.9	TCP Port (Socket)	Uint16	Read/Write	
1.10	Response Delay (Before Raising RTS)	Uint16	Read/Write	
1.11	Record Number	Uint16	Read/Write	

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
2.0	Schedule Start Time	Uint32	Read/Write	15
2.1	Schedule Stop Time	Uint32	Read/Write	15
2.2	Schedule Cycle Interval	Uint32	Read/Write	15
2.3	Schedule Duration	Uint32	Read/Write	15
2.4	Number of Polls	Uint32	Read/Write	16
2.5	Number of Errors	Uint32	Read/Write	16
2.6	Number of Fall Behinds	Uint32	Read/Write	16
2.7	Number of Initializations	Uint32	Read/Write	16
2.8	Modbus Host Poll Loop Time	Uint32	Read/Write	
2.9	Modbus Host Poll Loop Min Time	Uint32	Read/Write	
2.10	Modbus Host Poll Loop Max Time	Uint32	Read/Write	
2.11	Number of Interrupts	Uint32	Read/Write	
2.12	Number of Received Characters	Uint32	Read/Write	
2.13	Number of Transmitted Characters	Uint32	Read/Write	
2.14	Port Status	Uint32	Read	
3.0	Modbus Directory	String	Read/Write	17
3.1	Modem Dial String	String	Read/Write	
3.2	Modem Initialization String	String	Read/Write	
3.3	Serial Comm Port Name	String	Read/Write	
3.4	TCP/IP Address	String	Read/Write	
3.5	PassThru Second Port	String	Read/Write	
4.0	Request/Response Timing DO	Register	Read/Write	19
5.0	Number of supported protocols	Byte	Read Only	19
5.1-(X)	Protocol Enumerations	Byte	Read Only	19
6.1-(X)	Protocol Descriptions	String	Read Only	19

C.7.1 Communication Application Register Notes

1) Use only as directed by Totalflow support.
2) 0 = RS-232, 1 = RS-485, 2 = RS-422, 64 = Modem.
3) 0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200.
4) Only 5, 7 or 8 Data bits supported.
5) 0 = None, 1 = Even, 2 = Odd.
6) 1 or 2 Stop Bits.
7) 0 = COM0 , 1 = COM1 , 2 = COM2, -1 = None.
8)
9) 0 = 4 seconds, 1 = 2 seconds, 2 = 1 seconds, 3 = Always On.

10) 1 = Time of Day, 2 = Time of Day/Cycle.

11) 0 = 32 Bit Totalflow, 64 = 32 Bit, 65 = 16 Bit Word Swapped, 66 = 16 Bit Modicon, 68 = 16 Bit ROS Modulo 10000.

12) Use only as directed by Totalflow support.

13) Used by many host protocols (MODBUS Host, ADP Host, ETS Host…). Appends NULL characters to transmitted packets.

14) Prints packets received/transmitted. Not supported by all protocols. To print packets on COM0: x.0.19=1; to print on COM1: x.0.19=2; to print on COM3: x.0.19=3. To disable packet dump, x.0.19=0.

15) Because of the addressing limitations of MODBUS, some SCADA systems assign devices to groups. To use this feature, configure the device's group by setting x.1.7. The SCADA host broadcast writes the current group to x.1.8. Only devices assigned to the current group respond to their slave address.

16) Communications Schedule is used to conserve power during times of inactivity.

17) Not all protocols maintain communications statistics.

18) Some protocols scan a directory for request blocks or register maps. If the user prefers to share a register map across ports, change the protocol directory to point to a common directory.

19) By assigning this register to a digital output, an oscilloscope can be used to measure protocol request/response timing. When using multiple XMV's on a common bus, this can be used to verify each device is reliably being scanned once a second (API 21.1 compliance).

20) All FLASH images do not contain all protocols. Register x.5.0 contains the number of protocols in the FLASH image. Registers x.5.1 through x.5.(x.5.0) contains the protocol type codes each protocol in the FLASH image. Registers x.6.1 through x.6.(x.5.0) contain the text descriptions for each protocol in the FLASH image.

Protocol	Enumeration	Description
No Protocol	255	No protocol used
TFLocal	0	Typical MMI/Serial connection
TFRemote	2	Remote Protocol Used by radios or secondary Serial Port on Board
Terminal	3	General Terminal mode used by serial devices
Modbus Slave ASCII	1	Modbus Slave for ASCII encoding
Modbus Slave RTU	5	Modbus Slave for RTU encoding
Modbus Host ASCII	8	Modbus Host for ASCII encoding
Modbus Host RTU	9	Modbus Host for RTU encoding
Tank Gauge	7	Protocol used for LevelMaster
Totalflow TCP	10	General Totalflow Ethernet protocol
Modbus TCP Client	11	Protocol for TCP Modbus Response client
Modbus TCP Server	12	Protocol for TCP Modbus Request Server
Totalflow BlueTooth	13	BlueTooth Protocol for the Totalflow device
PassThru	51	Enable Port signal pass through

Protocol	Enumeration	Description
Alicat	52	

21) Port Type is referenced as TCP/IP=1 or Serial=0.

C.8 Safety Controller Application Registers

C.8.1 Array Types

Ary.Reg	Type	Size	Description	Note
0.x	String	25 char	See individual register descriptions	
1.x	Unsigned byte	8 bits	See individual register descriptions	
2.x	Register Address	32 bits	See individual register descriptions	
3.x	Boolean	8 bits	See individual register descriptions	
4.x	Floating point	32 bits	See individual register descriptions	
5.x	Unsigned long	32 bits	See individual register descriptions	
6.x	Unsigned byte	8 bits	Fail Reason[x]	1,6
7.x	Unsigned byte	8 bits	Fail Reason Index[x]	1
10.0-x	Register Address	32 bits	AI Address [x]	2
11.0-x	String	25 char	AI Name[x]	2
12.0-x	Floating Point	32 bits	AI Value[x]	2
13.0-x	Floating Point	32 bits	AI High Limit[x]	2
14.0-x	Floating Point	32 bits	AI Low Limit[x]	2
15.0-x	Boolean	8 bits	AI High Alarm[x]	2
16.0-x	Boolean	8 bits	AI Low Alarm[x]	2
17.0-x	Boolean	8 bits	AI Reset Holdoff [x]	2,10
18.0-x	Unsigned Integer	16 bits	AI Time Limit[x]	2
19.0-x	Unsigned Integer	16 bits	AI Timer [x]	2
20.0-x	Register Address	32 bits	DI Address [x]	3
21.0-x	String	25 char	DI Name[x]	3
22.0-x	Boolean	8 bits	DI Value[x]	3
23.0-x	Boolean	8 bits	DI Polarity[x]	3,9
24.0-x	Boolean	8 bits	DI Alarm[x]	3
25.0-x	Boolean	8 bits	DI Reset Holdoff[x]	3,10
30.0-x	Unsigned byte	8 bits	Well[x] Application Number (Plunger)	4
31.0-x	Unsigned byte	8 bits	Well[x] State (0-6)	4,7
32.0-x	Unsigned byte	8 bits	Well[x] Status (Enable)	4,8
33.0-x	Boolean	8 bits	Well [x] Option Shutdown	4,10

Ary.Reg	Type	Size	Description	Note
34.0-x	Boolean	8 bits	Well [x] Option Schedule	4,10
35.0-x	Boolean	8 bits	Well [x] Adr State	4
36.0-x	Register Address	32 bits	Well [x] Adr Status	4, 5
37.0-x	Register Address	32 bits	Well [x] Adr Hold DO	4, 5
38.0-x	Register Address	32 bits	Well [x] Adr Fail Reason DO	4, 5
39.0-x	Register Address	32 bits	Well [x] Adr Reset DO	4, 5

C.8.2 General Registers

C.8.2.1 String Registers (x.0.x) 25 Characters

Ary.Reg	Description	Usage	Note
0.0	Program Name	R/W:	
0.1	Program Revision	Read:	
0.2	State String	Read:	

C.8.2.2 Byte Registers (x.1.x) 8-Bits

Ary.Reg	Description	Usage	Note
1.0	n/u	R/W:	
1.1	Option Safety	R/W:	8
1.2	Clear Log	R/W:	10
1.3	AI Size	R/W:	
1.4	DI Size	R/W:	
1.5	Well Size	R/W:	
1.6	Manual Timer	Read:	
1.7	Manual Limit (secs)	R/W:	
1.8	Option Well Schedule	R/W:	10
1.9	Well Open - Max	R/W	
1.10	Well Open – Current	R/W	
1.11	Well Schedule Algorithm	R/W	11
1.12	Well Next to Open (or last opened)	R/W	

C.8.2.3 Register Addresses (x.2.x) 32-Bits

Ary.Reg	Description	Usage	Note
2.0	Safety Reset Button	R/W:	
2.1	Power Monitor AI	R/W:	
2.2	Shutdown Status: DO	R/W:	
2.3	Remote Shutdown DI	R/W:	

C.8.2.4 Boolean Registers (x.3.x) 8-Bits

Ary.Reg	Description	Usage	Note
3.0	Safety State	Read:	
3.1	Reset Safety State	Read:	
3.2	Safety Reset Button	R/W:	
3.3	Cal Hold	Read:	
3.4	Power Low Alarm	Read:	
3.5	Power High Alarm	Read:	
3.6	Safety State Output	Read:	
3.7	Remote Shutdown Value	R/W:	

C.8.2.5 Floating Point Registers (x.4.x)

Ary.Reg	Description	Usage	Note
4.0	Power Value	R/W:	
4.1	Power Low Setpoint	R/W:	
4.2	Power High Setpoint	R/W:	

C.8.2.6 Ulong (x.5.x) 32-Bits

Ary.Reg	Description	Usage	Note
5.0-9	Fail Timestamp[1-10]	Read:	
5.10	Reset Timer	Read	
5.11	Reset Limit	R/W	
5.12	Reset Timestamp	Read:	
5.13	Well Open Delay - Timer	Read:	
5.14	Well Open Delay - Limit	R/W	

C.8.3 Safety Controller Register Notes

1) Array size 10 x=0-(size-1)
2) Array size varies with AI count x=0-(size-1)
3) Array size varies with DI count x=0-(size-1)
4) Array size varies with Well count x=0-(size-1)
5) Value will automatically be set by set Application number(30.x)
6) Fail Reason:

None	0
Plunger Failed to Arrive	1
Power Low	2
DI x	3
AI x LOW	4

None	0
AI x HIGH	5
REMOTE	6
DISABLE	7
RESET	8

7) Plunger State:

FAIL	0
Closing Valve	1
Valve Closed	2
Plunger Arriving	3
Blow Valve	4
Plunger Arrived	5
AfterFlow	6

8) Enable:

Disabled	0
Manual	1
Enabled	2

9) Polarity:

Low Alarm	0
High Alarm	1

10) Option:

Disabled	0
Enabled	1

11) Algorithm:

Priority	0
Round Robin	1

C.9 6200EX IOS Application Registers

Usage and notes are specific to the G4 EX IOS application. Format for the register list is array#.register#. The application number depends on where the application was instantiated.

C.9.1 IOS UINT32 Registers

Ary.Reg	Description	Usage	Note
0.10	DP Raw A/D Counts	Read Only	
0.11	SP Raw A/D Counts	Read Only	
0.12	TF Raw A/D Counts	Read Only	

Ary.Reg	Description	Usage	Note
0.13	Ambient Temperature Raw A/D Counts	Read Only	
0.14	Transducer Temperature Raw A/D Counts	Read Only	
0.20	Transducer Model Number	Read Only	
0.21	Factory Date	Read Only	
0.100	Current Pulse Count	Read/Write	
0.104	Previous Pulse Count	Read/Write	
0.108	Total Pulse Count	Read/Write	
0.120	Raw Pulse Counter	Read/Write	

C.9.2 IOS UINT16 Registers

Ary.Reg	Description	Usage	Note
1.0	DP Calibration Flag	Read/Write	
1.1	AP Calibration Flag	Read/Write	
1.3	AI 1 Calibration Flag	Read/Write	
1.4	AI 2 Calibration Flag	Read/Write	
1.10	DP Status Flag	Read/Write	
1.11	SP Status Flag	Read/Write	
1.12	TF Status Flag	Read/Write	
1.13	Ambient Temperature Status Flag	Read/Write	
1.14	Transducer Temperature Status Flag	Read/Write	
1.100	Transducer Serial #[0-1]	Read Only	
1.101	Transducer Serial #[2-3]	Read Only	
1.102	Transducer Serial #[4-5]	Read Only	

C.9.3 IOS Byte Registers

Ary.Reg	Description	Usage	Note
2.0	DI 1 Term Board	Read Only	
2.4	DO 1 Term Board	Read/Write	
2.5	DO 2 Term Board	Read/Write	
2.8	Switched Vbat 1 – Interface On	Read/Write	

Ary.Reg	Description	Usage	Note
2.9	Switched Vbat 2 – Interface On	Read/Write	
2.11	LCD Power	Read/Write	
2.12	Low Lithium	Read Only	
2.13	Security Switch	Read Only	
2.14	Local Connection – MMI Connect	Read Only	
2.15	DI 1 Debounce	Read/Write	
2.17	IOS Thread Priority	Read/Write	
2.18	IOS Scan Enable	Read/Write	
2.19	Number of IIC Ports	Read Only	
2.20	Reset IIC Stats	Read/Write	
2.21	Daughter Card Detect Flag	Read Only	
2.110	Stamp Board Factory Revision	Read Only	
2.111	Stamp Board Units of Measure	Read Only	
2.112	Stamp Board Calibration Type	Read Only	
2.113	Stamp Board Calibration Blocks	Read Only	
2.65535	Prom Write Enable	Read Only	

C.9.4 IOS Float Registers

Ary.Reg	Description	Usage	Note
3.0	RSB Differential Pressure	Read Only	
3.1	RSB Static Pressure	Read Only	
3.2	RSB RTD Temperature	Read Only	
3.3	AI 1 Term Board	Read Only	
3.4	AI 2 Term Board	Read Only	
3.5	Battery Voltage	Read Only	
3.6	Charger Voltage (Returns 0)	Read Only	
3.7	RSB Ambient Temperature	Read Only	
3.8	RSB Transducer Temperature	Read Only	
3.16	DP Calibration Zero	Read/Write	
3.17	DP Calibration Point 1	Read/Write	
3.18	DP Calibration Point 2	Read/Write	

Ary.Reg	Description	Usage	Note
3.19	DP Calibration Point 3	Read/Write	
3.20	DP Calibration Point 4	Read/Write	
3.21	DP Calibration Point 5	Read/Write	
3.22	DP Calibration Bias	Read/Write	
3.31	DP Calibration Done	Read/Write	
3.32	SP Calibration Zero	Read/Write	
3.33	SP Calibration Point 1	Read/Write	
3.34	SP Calibration Point 2	Read/Write	
3.35	SP Calibration Point 3	Read/Write	
3.36	SP Calibration Point 4	Read/Write	
3.37	SP Calibration Point 5	Read/Write	
3.38	SP Calibration Bias	Read/Write	
3.47	SP Calibration Done	Read/Write	
3.54	RTD Calibration Bias	Read/Write	
3.64	AI 1 Calibration Zero	Read/Write	
3.65	AI 1 Calibration Point 1	Read/Write	
3.66	AI 1 Calibration Point 2	Read/Write	
3.67	AI 1 Calibration Point 3	Read/Write	
3.68	AI 1 Calibration Point 4	Read/Write	
3.69	AI 1 Calibration Point 5	Read/Write	
3.70	AI 1 Calibration Bias	Read/Write	
3.79	AI 1 Calibration Done	Read/Write	
3.80	AI 2 Calibration Zero	Read/Write	
3.81	AI 2 Calibration Point 1	Read/Write	
3.82	AI 2 Calibration Point 2	Read/Write	
3.83	AI 2 Calibration Point 3	Read/Write	
3.84	AI 2 Calibration Point 4	Read/Write	

Ary.Reg	Description	Usage	Note
3.85	AI 2 Calibration Point 5	Read/Write	
3.86	AI 2 Calibration Bias	Read/Write	
3.95	AI 2 Calibration Done	Read/Write	
3.6500x	IIC Port Device 1 Usage Percent	Read/Write See Note 1:	

C.9.4.1 IOS Float Register Notes

1) IIC Device numbers are dependent upon the order in which they are created. Each device contains information that describe it.

C.9.5 IOS AI Struct and Calibration Point Registers

Ary.Reg	Description	Usage	Note
4.0	DP AI Struct	Read/Write (1)	
4.1	SP AI Struct	Read/Write	
4.2	TF AI Struct	Read/Write	
4.3	AI AI Struct	Read/Write	
4.4	AI 2 AI Struct	Read/Write	
4.5	Battery AI Struct	Read/Write	
4.6	Charger AI Struct	Read/Write	
4.7	Ambient Temperature AI Struct	Read/Write	
4.8	Transducer Temperature AI Struct	Read/Write	
4.16	DP Calibration Zero Transducer	Read/Write	
4.17	DP Calibration Point 1	Read/Write	
4.18	DP Calibration Point 2	Read/Write	
4.19	DP Calibration Point 3	Read/Write	
4.20	DP Calibration Point 4	Read/Write	
4.21	DP Calibration Point 5	Read/Write	
4.22	DP Calibration Point Bias	Read/Write	
4.31	DP Calibration Point Done	Read/Write	
4.32	AP Calibration Zero Transducer	Read/Write	

Ary.Reg	Description	Usage	Note
4.33	AP Calibration Point 1	Read/Write	
4.34	AP Calibration Point 2	Read/Write	
4.35	AP Calibration Point 3	Read/Write	
4.36	AP Calibration Point 4	Read/Write	
4.37	AP Calibration Point 5	Read/Write	
4.38	AP Calibration Point Bias	Read/Write	
4.47	AP Calibration Point Done	Read/Write	
4.54	RTD Calibration Point Bias	Read/Write	
4.64	AI 1 Calibration Zero Transducer	Read/Write	
4.65	AI 1 Calibration Point 1	Read/Write	
4.66	AI 1 Calibration Point 2	Read/Write	
4.67	AI 1 Calibration Point 3	Read/Write	
4.68	AI 1 Calibration Point 4	Read/Write	
4.69	AI 1 Calibration Point 5	Read/Write	
4.70	AI 1 Calibration Point Bias	Read/Write	
4.79	AI 1 Calibration Point Done	Read/Write	
4.80	AI 2 Calibration Point Zero	Read/Write	
4.81	AI 2 Calibration Point 1	Read/Write	
4.82	AI 2 Calibration Point 2	Read/Write	
4.83	AI 2 Calibration Point 3	Read/Write	
4.84	AI 2 Calibration Point 4	Read/Write	
4.85	AI 2 Calibration Point 5	Read/Write	
4.86	AI 2 Calibration Point Bias	Read/Write	
4.95	AI 2 Calibration Point Done	Read/Write	

C.9.5.1 IOS AI Struct and Calibration Point Register Notes

1) typedef Struct AIStruct {   //AI Register Structure
    float f;   //float value
    uint16 s;   // 16 bit status

} AISTRUCT

C.9.6   IOS Term Board Raw Counts Registers – Uint16

Ary.Reg	Description	Usage	Note
10.0	AI 2 Raw Count	Read Only	
10.1	Battery Raw Count	Read Only	
10.2	AI 1 Raw Count	Read Only	

C.9.7   Engine EEProm Registers (16 Bytes per page) – Strings

Ary.Reg	Description	Usage	Note
11.x	EEProm Page x	Read Only	

2)   X=0 – 15 (16 pages and 16 bytes per page)

C.9.8   Term Board FE Ram Registers (64 Bytes Per Page) Strings

Ary.Reg	Description	Usage	Note
12.x	FE Ram Page x	Read Only	

3)   X=0 – 7 (8 Pages and 64 bytes per page)

C.9.9   IOS II2C Descriptor Registers – Strings

Ary.Reg	Description	Usage	Note
13.x	IIC Port Descriptor	Read Only	

4)   X=II2c Port. Descriptor provides information about the port. The port is determined by the order in which it was created.

C.9.10 IOS SPI Port Data Registers

Ary.Reg	Description	Usage	Note
14.0	SPI Counter # Scans	Read Only	
14.1	SPI Channel 0 Data	Read Only	
14.2	SPI Channel 1 Data	Read Only	
14.3	SPI Channel 2 Data	Read Only	
14.4	SPI Channel 3 Data	Read Only	
14.5	SPI Channel 4 Data	Read Only	
14.6	SPI Channel 5 Data	Read Only	
14.7	SPI Channel 6 Data	Read Only	
14.8	SPI Channel 7 Data	Read Only	

5)   The register's data variable is determined by the index ID from the Factory Table ChanInfo.

C.9.11 IOS SPI Port Statistics Registers – Uint 32

Ary.Reg	Description	Usage	Note

Ary.Reg	Description	Usage	Note
15.0	SPI Start Count # Intended Scans	Read/Write	
15.1	SPI Actual Scans	Read Only	
15.2	SPI Port Transfers	Read Only	
15.3	SPI Interrupt Count	Read Only	
15.4	SPI Interrupt Timeouts	Read Only	
15.5	SPI Previous Scan Interval	Read Only	
15.6	SPI Shortest Scan Interval	Read/Write	
15.7	SPI Longest Scan Interval	Read/Write	

C.9.12 IOS String Registers

Ary.Reg	Description	Usage	Note
20.0	Transducer Serial Number	Read Only	

C.9.13 IOS Daughter CardByte Registers

Ary.Reg	Description	Usage	Note
100.0	DI 1	Read Only	
100.1	DI 2	Read Only	
100.2	DI 3	Read Only	
100.3	DI 4	Read Only	
100.4	DO 1	Read/Write	
100.5	DO 2	Read/Write	
100.6	DO 3	Read/Write	
100.7	DO 4	Read/Write	

C.9.14 IOS Daughter Card UINT16 Registers

Ary.Reg	Description	Usage	Note
101.0	AI 1 Raw Counts	Read Only	
101.1	AI 2 Raw Counts	Read Only	
101.2	AI 3 Raw Counts	Read Only	
101.3	AO 1 Raw Counts	Read/Write	
101.4	PI 1 Raw Counts	Read Only	
101.5	PI 2 Raw Counts	Read Only	
101.6	PI 3 Raw Counts	Read Only	
101.7	PI 4 Raw Counts	Read Only	

C.9.15 IOS Daughter Card UINT32 Registers

Ary.Reg	Description	Usage	Note
102.0	PI 1 Pulse Count	Read Only	
102.1	PI 2 Pulse Count	Read Only	
102.2	PI 3 Pulse Count	Read Only	
102.3	PI 4 Pulse Count	Read Only	
102.4	PI 1 Previous Pulse Count	Read Only	
102.5	PI 2 Previous Pulse Count	Read Only	
102.6	PI 3 Previous Pulse Count	Read Only	
102.7	PI 4 Previous Pulse Count	Read Only	
102.8	PI 1 Total Pulse Count	Read Only	
102.9	PI 2 Total Pulse Count	Read Only	
102.10	PI 3 Total Pulse Count	Read Only	
102.11	PI 4 Total Pulse Count	Read Only	

C.9.16 IOS Daughter Card Float Registers

Ary.Reg	Description	Usage	Note
103.0	AI 1 Input Scaled	Read Only	
103.1	AI 2 Input Scaled	Read Only	
103.2	AI 3 Input Scaled	Read Only	
103.3	AO 1 Output Scaled	Read Only	

C.9.17 IOS Daughter Card FE Ram Registers (A2) (64 Bytes Per Page)-Strings

Ary.Reg	Description	Usage	Note
104.x	FE Ram Page x	Read Only	

6) X=0 – 7 (8 pages and 64 bytes per page)

C.9.18 IOS Daughter Card FE Ram Registers (A4) (64 Bytes Per Page)-Strings

Ary.Reg	Description	Usage	Note
105.x	FE Ram Page x	Read Only	

7) X=0 – 7 (8 pages and 64 bytes per page)

C.9.19 Term Board AI/DO Usage

- DO1: Jumper J13 1 to 2
- DO2: Jumper J12 2 to 3
- AI1 Voltage Mode –
  - Jumper J12 1 to 2
  - 4-20En Off (DO2)
- AI1 4-20 mA Mode
  - Jumper J12 1 to 2

- 4-20En On (DO2)
    - AI2 Voltage Mode
        - Jumper J13 2 to 3
        - DO1 Off
    - AI2 4-20 mA Mode
        - Jumper J13 2 to 3
        - DO1 On

C.10 AGA-3 Measurement Tube Application Registers

Tube measurement applications share several common data items. The items listed under this heading are common to all tube measurement applications. Usage and notes are specific to AGA-3 tube applications. Format for the register list is .array#.register# description. The Application number depends on the order of the application's instantiation.

C.10.1 AGA-3 Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
0.0	Contract Hour	Read/Write, 0-23
0.1	Reset Volume Command	Write
0.2	Reset Log Period Command	Write
0.3	Calibration Hold Mode	Read/Write
0.4	AP/DP/TF Over Range Flags	Read Only
0.5	Tube Database Rev	Read Only
0.6	AGA-3 1985 Dynamic Select Bits	Read/Write, used only for AGA-3, 1985, other tubes or calculation methods ignore this value, See note 1)
0.7	AGA-3 1992 Static Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value, See note 2)
0.8	AGA-3 1992 Dynamic Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value, See note 3)
0.9	Volume Calc Type	Read/Write, see note 4)
0.10	Calc Units	Read Only
0.11	Report Units	Read Only
0.12	Super Compressibility Method	Read/Write, see note 5)
0.13	Use Square Root Average flag	Read/Write
0.14	Characteristic Record Type	Read/Write, see note 6)
0.15	Use Fixed H2O	Read/Write, for Fw calculation
0.16	Gravity Config flags	Read/Write, live analysis configuration, see note 7)

ARRAY.REGISTER	DESCRIPTION	USAGE
0.17	BTU Config flags	Read/Write, live analysis configuration, see note 7)
0.18	Nitrogen Config flags	Read/Write, live analysis configuration, see note 7)
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration, see note 7)
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration, see note 7)
0.21	Water Config flags	Read/Write, live analysis configuration, see note 7)
0.22	Helium Config flags	Read/Write, live analysis configuration, see note 7)
0.23	Methane Config flags	Read/Write, live analysis configuration, see note 7)
0.24	Ethane Config flags	Read/Write, live analysis configuration, see note 7)
0.25	Propane Config flags	Read/Write, live analysis configuration, see note 7)
0.26	Normal Butane Config flags	Read/Write, live analysis configuration, see note 7)
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration, see note 7)
0.28	Normal Pentane Config flags	Read/Write, live analysis configuration, see note 7)
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration, see note 7)
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration, see note 7)
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration, see note 7)
0.32	Normal Octane Config flags	Read/Write, live analysis configuration, see note 7)
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration, see note 7)
0.34	Normal Decane Config flags	Read/Write, live analysis configuration, see note 7)
0.35	Oxygen Config flags	Read/Write, live analysis configuration, see note 7)
0.36	Carbon Monoxide Config flags	Read/Write, live analysis
0.37	Hydrogen Config flags	Read/Write, live analysis configuration, see note 7)

ARRAY.REGISTER	DESCRIPTION	USAGE
0.38	Argon Config flags	Read/Write, live analysis configuration, see note 7)
0.39	Number of live components	Read/Write
0.40	Get/release calc lock	Read/Write
0.41	Tube analysis stream index	Read/Write
0.42	Flow rate / volume scale flags	Read/Write, see note 8)
0.43	Aux contact 1 re-open interval	Read/Write
0.44	Aux contact 1 current state	Read Only
0.45	Aux contact 1 manual set	Read/Write
0.46	Aux contact 2 re-open interval	Read/Write
0.47	Aux contact 2 current state	Read Only
0.48	Aux contact 2 manual set	Read/Write
0.49	Remote Sense Action	Read/Write
0.50	Remote Sense State	Read Only
0.51	Events Available	Write, Canadian Event Log
0.52	Aux Contact 1 select bits low byte	Read/Write, see note 9)
0.53	Aux Contact 2 select bits low byte	Read/Write, see note 9)
0.54	Hold tube analog inputs	Read/Write
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge
0.56	Programmable count before activating a2dfail	Read/Write
0.57	Current count of a2dfail in deadband	Read Only
0.58	Vol period complete flag	Read Only
0.59	Log period complete flag	Read Only
0.60	Day period complete flag	Read Only
0.61	Disable tube check-pointing	Read/Write 1=disable
0.62	Stop logging events from protocols for Canadian events	Read/Write 1=stop logging
0.63	Stop logging events for Canadian events	Read/Write 1=stop logging
0.64	Log gauge pressure	Read/Write 0=log absolute 1=log gage if gage transducer

ARRAY.REGISTER	DESCRIPTION	USAGE
0.65	Log Dp Check with pressure applied to Sp	Read Only
0.66	Stream source application	Read/Write
0.67	Enable/Disable Slip Second Adjustment	Read Only

C.10.1.1 Tube Byte Register Usage Notes

1) AGA-3 1985 Dynamic Factor Select Bits:

```
0x01,    1   /* Use Ftf     */
0x02,    2   /* Use Y       */
0x04,    4   /* Use Fr      */
0x08,    8   /* Use Fa      */
0x10,   16   /* Use Fpv     */
0x20,   32   /* Use Fw (water vapor factor) */
0x40,   64   /* Use pipe tap equation */
0x80,  128   /* tap cfg supported (Set by FCU ) */
```

2) AGA-3 1992 Static Factor Select Bits:

```
0x08   /* Use Live CD if set */
0x10   /* Use Fws (Faux:well stream) */
0x20   /* Static Pressure Tap is Upstream */
0x40   /* Supports switchable characteristics */
```

3) AGA-3 1992 Dynamic Factor Select Bits:

```
0x02,    2   /* Use Y       */
0x10,   16   /* Use Fpv     */
0x20,   32   /* Use Fw (water vapor factor) */
```

4) Volume Calculation Type: 0 = NONE, 1=AGA-3 1985, 2=AGA-3 1992.

5) Super-Compressibility Method: 0=NX19 with FIXED FT AND FP VALUES, 1=NX19 AUTO, 2=NX19 GRAVITY CO2 & N2, 3=NX19 CO2 & N2 & C1, 11=AGA-8 Gross, 12=AGA-8 Detail

6) Characteristics Type: This was used in "Totalflow old database" format. This does not apply to X-series, DB2 format.

7) Live Analysis Configuration flags: 0=USE FIXED ANALYSIS, 1=USE LIVE ANALYSIS FROM AIU, 2=USE LIVE ANALYSIS FROM OTHER PROTOCOL, 16=USE FIXED ANALYSIS ON ERROR. USE FIXED ANALYSIS ON ERROR may be added to selections 1 or 2.

8) Flow rate / Volume scale flags: 0=MCF for volumes, SCF/HR for flow rates; 1=MCF for volumes, MCF/DAY for flow rates; 2=MMCF for volume, MCF/HR for flow rates; 3=MMCF for volumes, MMCF/DAY for flow rates.

9) Aux Contact 1 & 2 select bits low byte: 1=trip contact on low charger; 2=trip contact on Dp low; 4=trip contact on Dp high; 8=trip contact on Ap low; 16=trip contact on Ap high; 32=trip contact on remote sense; 64=auto re-open; 128=trip contact on volume set-point. These registers can also be set from 16-bit integer registers 1.10 and 1.11.

C.10.2 Tube 16-Bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
1.0	Primary Element Mask	Read Only, indicates primary element type, see note 1)
1.1	Calc Method Mask	Read Only, indicates calculation methods supported, see note 2)
1.2	Calc Units Mask	Read Only, not used
1.3	Report Units Mask	Read Only, not used
1.4	Super Comp Method Mask	Read Only, indicates super-compressibility methods that may be selected. See note 3)
1.5	Live Analysis Update Interval	Read/Write, live analysis updates are expected in this interval, expressed in seconds
1.6	Volume Calc period	Read/Write, seconds
1.7	Daily Record Capacity	Read/Write, number of daily records, change to this value deletes existing database and starts new database
1.8	Log Record Capacity	Read/Write, number of log period records, change to this value deletes existing database and starts new database
1.9	Event Record Capacity	Read/Write, number of event records, change to this value deletes existing database and starts new database
1.10	Aux Contact 1 Select Bits	Read/Write, control bits, see note 4)
1.11	Aux Contact 2 Select Bits	Read/Write, control bits, see note 4)
1.12	Return number of events available	Write, Canadian Event Log
1.13	Therms Stream Id	Read/WriteAnalysis Stream Id
1.14	Modbus address of analyzer	Read/Write
1.15	Therms use fixed or last good	Read/Write
1.16	Daily Record Sequence Number	Read Only
1.17	Log Record Sequence Number	Read Only
1.18	Event Record Sequence Number	Read Only
1.19	DP Status Flags	Read Only, see note 5)
1.20	AP Status Flags	Read Only, see note 6)
1.21	TF Status Flags	Read Only, see note 7)

ARRAY.REGISTER	DESCRIPTION	USAGE
1.22	PI Status Flags	Read Only, see note 8)
1.23	Ext Status Flags	Read Only, see note 9)

C.10.2.1 Tube 16-Bit Integer Register Usage Notes

1) Primary Element Mask: 1=Orifice Square Root

2) Calculation Method Mask: 2=AGA-3 1985, 4=AGA-3 1992; The sum of these values (6) indicates 2 and 4 are valid choices.

3) Super-Compressibility Method Mask: 1=NX19 with FIXED FT AND FP VALUES, 2=NX19 AUTO, 4=NX19 GRAVITY CO2 & N2, 8=NX19 CO2 & N2 & C1, 2048=AGA8 Gross, 4096=AGA8 Detail. The sum of these values (6159) indicates all of the choices listed above are valid.

4) Aux Contact Select Bits: 1=trip contact on low charger; 2=trip contact on Dp low; 4=trip contact on Dp high; 8=trip contact on Ap low; 16=trip contact on Ap high; 32=trip contact on Remote Sense; 64=auto re-open; 128=trip contact on volume set-point; 256=trip contact on tf low; 512=trip contact on tf high; 1024=trip contact on flow rate low; 2048=trip contact on flow rate high; 16384=reverse contact logic.

5) Dp Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=over-range; 8=zero flow; 16=back flow.

6) Ap Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=over-range; 8=zero flow; 32768=gauge pressure device.

7) Tf Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=over-range.

8) PI Status Flags: 1=low limit exceeded; 2=high limit exceeded; 8=zero flow.

9) Ext Status Flags: 1=low limit exceeded; 2=high limit exceeded; 8=zero flow.

C.10.3 Tube 32-Bit Integer Registers

2.0	Log period	Read/Write, seconds
2.1	Julian timestamp of most recent AIU download	Read/Write, see note 1)
2.2	Julian timestamp of most recent live component update (not AIU)	Read/Write, see note 1)
2.3	Julian timestamp of prev day period	Read Only, see note 1)
2.4	Total slip seconds since boot	Read Only
2.5	Julian timestamp of last slip seconds	Read Only
2.6	Thread loop time (ms)	Read Only
2.7	Thread Min loop time (ms)	Read Only
2.8	Thread Max loop time (ms)	Read Only

C.10.3.1 Tube 32-Bit Integer Register Notes

1) Julian time is number of seconds since midnight, 1/1/1970.

C.10.4 Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
3.0	Current AP / cal checks	Read/Write, psi, see note 1)

ARRAY.REGISTER	DESCRIPTION	USAGE
3.1	AP High Limit	Read/Write, psi, see note 1)
3.2	AP Low Limit	Read/Write, psi, see note 1)
3.3	Current Temp	Deg F
3.4	Fixed Temp	Deg F
3.5	Temp High Limit	Deg F
3.6	Temp Low Limit	Deg F
3.7	Flow Rate High Limit	Read/Write, see note 2)
3.8	Flow Rate Low Limit	Read/Write, see note 2)
3.9	Null	Read Only
3.10	Null	Read Only
3.11	Fixed F(b) AGA-3 1985	Read/Write
3.12	Fixed Cd AGA-3 1992	Read/Write
3.13	Zba	Read/Write
3.14	Oriface coef of expansion	Read/Write, inches/Deg F
3.15	Pipe coef of expansion	Read/Write, inches/Deg F
3.16	Barometric Pressure	Read/Write, PSIA
3.17	F(t) for Fpv NX19	Read/Write
3.18	F(p) for Fpv NX19	Read/Write
3.19	Fixed Analysis BTU	Read/Write, BTU/SCF
3.20	Fixed Analysis Gravity	Read/Write
3.21	Fixed Analysis Nitrogen	Read/Write, mole %
3.22	Fixed Analysis Carbon Dioxide	Read/Write, mole %
3.23	Fixed Analysis Hydrogen Sulfide	Read/Write, mole %
3.24	Fixed Analysis Water	Read/Write, mole %
3.25	Fixed Analysis Helium	Read/Write, mole %
3.26	Fixed Analysis Methane	Read/Write, mole %
3.27	Fixed Analysis Ethane	Read/Write, mole %
3.28	Fixed Analysis Propane	Read/Write, mole %
3.29	Fixed Analysis Normal Butane	Read/Write, mole %
3.30	Fixed Analysis Iso-Butane	Read/Write, mole %
3.31	Fixed Analysis Normal Pentane	Read/Write, mole %
3.32	Fixed Analysis Iso-Pentane	Read/Write, mole %
3.33	Fixed Analysis Normal Hexane	Read/Write, mole %
3.34	Fixed Analysis Normal Heptane	Read/Write, mole %

ARRAY.REGISTER	DESCRIPTION	USAGE
3.35	Fixed Analysis Normal Octane	Read/Write, mole %
3.36	Fixed Analysis Normal Nonane	Read/Write, mole %
3.37	Fixed Analysis Normal Decane	Read/Write, mole %
3.38	Fixed Analysis Oxygen	Read/Write, mole %
3.39	Fixed Analysis Carbon Monoxide	Read/Write, mole %
3.40	Fixed Analysis Hydrogen	Read/Write, mole %
3.41	Fixed Analysis Argon	Read/Write, mole %
3.42	Fixed H2O Content	Read/Write, ppm
3.43	Fixed H2O Bias	Read/Write, ppm
3.44	Live Analysis Gravity Accumulator	Read/Write,
3.45	Live Analysis BTU Accumulator	Read/Write, BTU/SCF
3.46	Live Analysis Nitrogen Accumulator	Read/Write, mole %
3.47	Live Analysis Carbon Dioxide Accumulator	Read/Write, mole %
3.48	Live Analysis Hydrogen Sulfide Accumulator	Read/Write, mole %
3.49	Live Analysis Water Accumulator	Read/Write, mole %
3.50	Live Analysis Helium Accumulator	Read/Write, mole %
3.51	Live Analysis Methane Accumulator	Read/Write, mole %
3.52	Live Analysis Ethane Accumulator	Read/Write, mole %
3.53	Live Analysis Propane Accumulator	Read/Write, mole %
3.54	Live Analysis Normal Butane Accumulator	Read/Write, mole %
3.55	Live Analysis Iso-Butane Accumulator	Read/Write, mole %
3.56	Live Analysis Normal Pentane Accumulator	Read/Write, mole %
3.57	Live Analysis Iso-Pentane Accumulator	Read/Write, mole %
3.58	Live Analysis Normal Hexane Accumulator	Read/Write, mole %
3.59	Live Analysis Normal Heptane Accumulator	Read/Write, mole %
3.60	Live Analysis Normal Octane Accumulator	Read/Write, mole %
3.61	Live Analysis Normal Nonane Accumulator	Read/Write, mole %
3.62	Live Analysis Normal Decane Accumulator	Read/Write, mole %
3.63	Live Analysis Oxygen Accumulator	Read/Write, mole %

ARRAY.REGISTER	DESCRIPTION	USAGE
3.64	Live Analysis Carbon Monoxide Accumulator	Read/Write, mole %
3.65	Live Analysis Hydrogen Accumulator	Read/Write, mole %
3.66	Live Analysis Argon Accumulator	Read/Write, mole %
3.67	Log Site Code in Event Log	
3.68	Valve Control Accumulated Volume	Read/Write, MCF
3.69	Aux Contact 1 Volume Setpoint	Read/Write, MCF
3.70	Aux Contact 2 Volume Setpoint	Read/Write, MCF
3.71	current contract day accumulated energy	Read Only, MBTU
3.72	yesterdays contract day accumulated energy	Read Only, MBTU
3.73	Current Energy rate	Read Only MBTU/HR
3.74	Month Accum Volume	Read Only, MCF
3.75	Month Accum Volume, Not Reset by Reset Vol	Read Only, MCF
3.76	Month Accum Energy	Read Only, MMBTU
3.77	Month Accum Energy, Not Reset by Reset Vol	Read Only, MMBTU
3.78	Fixed AP value	Read/Write
3.79	Current SCF flow	Read Only
3.80	Previous Month Accumulated Volume	Read Only
3.81	Previous Month Accumulated Volume not affected by reset volume command	Read Only
3.82	Previous Month Energy	Read Only
3.83	Previous Month Energy not affected by reset volume command	Read Only

C.10.4.1   Tube Floating Point Register Notes

1)   Static pressure values are in PSIA or PSIG depending on gauge pressure device selection. See Tube Byte Register 0.55.

2)   Flow Rate Limits units depend on Flow rate / volume scale flags. See Tube Byte Register 0.42.

C.10.5 Tube Register Cross References

Tube register cross references are structures containing the register access values for data used by the tube but owned by another application. The following structure defines data type Register.

```
typedef struct {        // Register Struct
   byte app;                  // Application
   byte array;                // Register array
```

```
    int16 index;                    // index into array
}  Register;
```

ARRAY.REGISTER	DESCRIPTION	USAGE
4.0	AP Register	Read/Write
4.1	DP Register	Read/Write
4.2	TF Register	Read/Write
4.3	PI Register	Read/Write
4.4	RS Register	Read/Write
4.5	AC 1 Register	Read/Write
4.6	AC 1 DI Register	Read/Write
4.7	AC 2 Register	Read/Write
4.8	AC 2 DI Register	Read/Write

C.10.6 Tube String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
5.0	Tube ID	Read/Write
5.1	Tube last analyis time	Read Only
5.2	Tube Description	Read/Write

C.10.7 Tube Last Calculation Period Analysis Registers, Floating Point

ARRAY.REGISTER	DESCRIPTION	USAGE
10.0	Last Calc Nitrogen	Read Only, mole %
10.1	Last Calc Carbon Dioxide	Read Only, mole %
10.2	Last Calc Hydrogen Sulfide	Read Only, mole %
10.3	Last Calc Water	Read Only, mole %
10.4	Last Calc Helium	Read Only, mole %
10.5	Last Calc Methane	Read Only, mole %
10.6	Last Calc Ethane	Read Only, mole %
10.7	Last Calc Propane	Read Only, mole %
10.8	Last Calc Normal Butane	Read Only, mole %
10.9	Last Calc Iso-Butane	Read Only, mole %
10.10	Last Calc Normal Pentane	Read Only, mole %
10.11	Last Calc Iso-Pentane	Read Only, mole %
10.12	Last Calc Normal Hexane	Read Only, mole %

ARRAY.REGISTER	DESCRIPTION	USAGE
10.13	Last Calc Normal Heptane	Read Only, mole %
10.14	Last Calc Normal Octane	Read Only, mole %
10.15	Last Calc Normal Nonane	Read Only, mole %
10.16	Last Calc Normal Decane	Read Only, mole %
10.17	Last Calc Oxygen	Read Only, mole %
10.18	Last Calc Carbon Monoxide	Read Only, mole %
10.19	Last Calc Hydrogen	Read Only, mole %
10.20	Last Calc Argon	Read Only, mole %
10.21	Last Calc Air	Read Only, mole %
10.22	Last Calc Heavy Hydrocarbons	Read Only, mole %
10.23	Last Calc Heat Content	Read Only, BTU/SCF
10.24	Last Calc Specific Gravity	Read Only

C.10.8 Tube Archive Registers – Read Only

The following registers access historical data records or record items. For all tube archive registers, register value 0 refers to the most recent record, 1 refers to the next most recent record and 2 refers to the next oldest record. The oldest record is referred to by register number MAX RECORDS – 1. For Log Period registers, register value 0 refers to the last logged record. For Day Period, register value 0 refers to the current contract day record.

C.10.9 Tube Log Period Registers

ARRAY	DESCRIPTION	USAGE
200	Log Period Static Pressure	Floating Point, PSIA
201	Log Period Diff. Pressure	Floating Point, Inches H2O
202	Log Period Temperature	Floating Point, Deg F
204	Log Period Extension	Floating Point
205	Log Period Volume	Floating Point, MCF
206	Log Period Heating Value	Floating Point, MMBTU
207	Log Period Flow time	Unsigned Long, seconds
208	Log Period Total time	Unsigned Long, seconds
209	Log Period Alarm bits	32 bits, see note 1)
250	Log Period Record	See note 2)

C.10.9.1 Tube Log Period Usage Notes

1) Log Period Alarm Bits -

    0x00080000, 524288   - Flow rate high limit
    0x00040000, 262144   - Flow rate low limit
    0x00020000, 131072   - Temperature high limit

```
0x00010000,    65536  - Temperature low limit
0x00008000,    32768  - Static pressure high limit
0x00004000,    16384  - Static pressure low limit
0x00002000,     8192  - Dp high limit
0x00001000,     4096  - Dp low limit
0x00000800,     2048  - Zero flow
0x00000400,     1024  - Back flow
0x00000200,      512  - Remote sense (DI)
0x00000100,      256  - contact out (DO)
0x00000080,      128  - temperature channel A/D over-range
0x00000040,       64  - static pressure channel A/D over-range
0x00000020,       32  - differential pressure channel A/D over-range
0x00000010,       16  - low charger
0x00000008,        8  - low lithium battery
0x00000004,        4  - AIU / analyzer data not received
0x00000002,        2  - NX19 methane=1 / gravity=0 method
0x00000001,        1 - calculation error
```

2) Log Period Record definition –

```
    typedef struct
    {
        unsigned long date;   /* Julian Date / Time */
        unsigned int  sn;     /* Sequence Number */
        float     dp;             /* period avg DP */
        float     ap;             /* period avg AP */
        float     tf;             /* period avg TEMP */
        float     ext;        /* period EXTENSION */
        float     vol;            /* period VOLUME */
        float     btu;            /* period ENERGY */
        unsigned int  ftime;      /* period FLOWTIME */
        unsigned int  ptime;      /* period TIME */
        unsigned char aflags[3];  /* period ALARMS */
        unsigned char vcode;      /* Verification Code */
    } LOGRECORD;
```

C.10.10   Tube Daily Registers

ARRAY	DESCRIPTION	USAGE
220	Daily Static Pressure	Floating Point, PSIA
221	Daily Diff. Pressure	Floating Point, Inches H2O
222	Daily Temperature	Floating Point, Deg F
224	Daily Extension	Floating Point
225	Daily Volume	Floating Point, MCF
226	Daily Heating Value	Floating Point, MBTU
227	Daily Flow time	Unsigned Long, seconds
228	Daily Total time	Unsigned Long, seconds
229	Daily Alarm bits	32 bits, See note 1)
250	Log Period Archive Record	

ARRAY	DESCRIPTION	USAGE
251	Daily Record	See note 2)
252	Event Log	

C.10.10.1 Tube Daily Register Usage Notes

1) Daily Alarm Bits -

```
0x00080000, 524288   - Flow rate high limit
0x00040000, 262144   - Flow rate low limit
0x00020000, 131072   - Temperature high limit
0x00010000,  65536   - Temperature low limit
0x00008000,  32768   - Static pressure high limit
0x00004000,  16384   - Static pressure low limit
0x00002000,   8192   - Dp high limit
0x00001000,   4096   - Dp low limit
0x00000800,   2048   - Zero flow
0x00000400,   1024   - Back flow
0x00000200,    512   - Remote sense (DI)
0x00000100,    256   - contact out (DO)
0x00000080,    128   - temperature channel A/D over-range
0x00000040,     64   - static pressure channel A/D over-range
0x00000020,     32   - differential pressure channel A/D over-range
0x00000010,     16   - low charger
0x00000008,      8 - low lithium battery
0x00000004,      4 - AIU / analyzer data not received
0x00000002,      2 - NX19 methane=1 / gravity=0 method
0x00000001,      1 - calculation error
```

2) Daily Record definition –

```
typedef struct
{
    unsigned long date;          /* Julian Date / Time */
    unsigned int  sn;            /* Sequence Number */
    unsigned int  event;         /* Last Event Log Seq Num */
    unsigned int  firstlog;      /* First Log Period Seq Num */
    unsigned int  lastlog;       /* Last Log Period Seq Num */
    unsigned char c_hr;          /* Contract Hour */
    float         ext;           /* Daily Extension */
    float         vol;           /* Daily Volume */
    float         btu;           /* Daily Energy */
    unsigned long ftime;         /* Daily Flowtime  */
    unsigned long btime;         /* Daily Back-flowtime */
    unsigned long ptime;         /* period TIME */
    unsigned char aflags[3];     /* period ALARMS */
    float         ap;            /* Daily Avg AP */
    float         minap;         /* Daily Minimum AP */
    float         maxap;         /* Daily Maximum AP */
    float         aplpct;        /* Daily AP LO per cent */
    float         aphpct;        /* Daily AP HI per cent */
    float         dp;            /* Daily Avg DP */
    float         mindp;         /* Daily Minimum DP */
    float         maxdp;         /* Daily Maximum DP */
```

```
float     dplpct;              /* Daily DP LO per cent */
float     dphpct;              /* Daily DP HI per cent */
float     tf;                  /* Daily Avg Temp */
float     mintf;               /* Daily Minimum TF */
float     maxtf;               /* Daily Maximum TF */
float     tflpct;              /* Daily DP LO per cent */
float     tfhpct;              /* Daily DP HI per cent */
unsigned char vcode;           /* Verification Code */
```

} DAYRECORD;

C.10.11   Tube Event Registers

ARRAY	DESCRIPTION	USAGE
252	Event Log Record	See note 1)

C.10.11.1   Tube Event Register Usage Notes

1) Tube Event Log Record definition –

```
typedef struct
{
unsigned long  date;           /* Julian Date/Time  */
unsigned char  flags;          /* Event Flags      */
unsigned int   sn;             /* Sequence Number   */
unsigned int   code;           /* Event Code        */
unsigned char  oldval[4];      /* Previous Value     */
unsigned char  newval[4];      /* Current Value      */
unsigned char  vcode;          /* Verification Code */
} EVTRECORD;
```

C.10.12   AGA-3 Tube Registers

The following register tables describe registers unique to AGA-3 measurement tubes.

ARRAY.REGISTER	DESCRIPTION	USAGE
6.0	1985 Static Factor Select Bits	Read/Write, See note 1)
6.1	Misc Select Bits	Read/Write, See note 2)
6.2	Vol - Flow Rate unit selection for volume	Read/Write, See note 3)
6.3	Vol - Flow Rate unit selection for flow rate	Read/Write, See note 4)
6.4	Auto Fb Calc	Read/Write, for AGA-3 1985
6.5	Log Dp Check with pressure applied to Sp	Read/Write

C.10.12.1   AGA-3 Byte Register Usage Notes

1) AGA-3 1985 Static Factor Select Bits –

```
0x01,  1        /* Use Fpb    */
0x02,  2        /* Use Ftb    */
0x04,  4        /* Use Fg     */
```

```
        0x08,  8        /* Use Fb      */
        0x10, 16        /* Use Fws (Faux:well stream) */
        0x20, 32        /* Static Pressure Tap is Upstream */
        0x40, 64        /* Supports switchable  characteristics, this bit not writable*/
```

2) AGA-3 Misc Select Bits –

```
        0x01,  1        /* RTD Installed       */
        0x02,  2        /* Use RTD in calcs    */
        0x04,  4        /* Reserved  */
        0x08,  8        /* Check Security Code */
        0x10, 10        /* Orifice Plate type          */
        0x20, 20        /* Use Live Analyzer Data in volume calc */
        0x40, 40        /* Use Fixed Ax data on analyzer error */
        0x80, 80        /* reserved */
```

Vol - Flow Rate unit selection for volume

0 = MCF

1 = MMCF

3) Vol - Flow Rate unit selection for flow rate

0 = per hour,

> if Vol - Flow Rate unit selection for volume = 0, rate will be SCF/HOUR;

> if Vol - Flow Rate unit selection for volume = 1, rate will be MCF/HOUR.

1 = per day,

> if Vol - Flow Rate unit selection for volume = 0, rate will be MCF/DAY;

> if Vol - Flow Rate unit selection for volume = 1, rate will be MMCF/DAY.

C.10.13   AGA-3 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
7.0	Current DP / cal checks	Read/Write
7.1	DP High Limit	Read/Write
7.2	DP Low Limit	Read/Write
7.3	DP Zero CutOff	Read/Write
7.4	Current Flow Rate SCF/Hr	Read Only
7.5	Last Vol Period volume MCF	Read Only
7.6	Accumulated Volume MCF	Read Only
7.7	Today's contract day volume MCF	Read Only
7.8	Orifice diameter	Read/Write
7.9	Pipe diameter	Read/Write
7.10	Pressure base	Read/Write
7.11	Temperature base	Read/Write
7.12	Fixed F(aux)	Read/Write
7.13	Ratio of specific heats	Read/Write
7.14	Fluid viscosity	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
7.15	C-Prime	Read Only
7.16	Non-Flow weighted Accum AP	Read Only
7.17	Minute Flow Secs	Read Only
7.18	Yesterday's contract day volume SCF	Read Only
7.19	Current Flow Rate scaled per chkmcf	Read Only, See Note 1)
7.20	Last Vol Period volume scaled per chkmcf	Read Only, See Note 1)
7.21	Accumulated Volume scaled per chkmcf	Read Only, See Note 1)
7.22	Today's contract day volume scaled per chkmcf	Read Only, See Note 1)
7.23	Yesterday's contract day volume scaled per chkmcf	Read Only, See Note 1)
7.24	Flow Rate Hi limit scaled per chkmcf	Read Only, See Note 1)
7.25	Flow Rate Lo limit scaled per chkmcf	Read Only, See Note 1)
7.26	Last Calc Ap	Read Only
7.27	Last Calc Dp	Read Only
7.28	Last Calc Tf	Read Only
7.29	Last Calc Extension	Read Only
7.30	Last Calc Y Exp Factor	Read Only
7.31	Last Calc Fpv	Read Only
7.32	Last Calc Fw	Read Only
7.33	Last Calc Volumetric FlowRate (Qv) SCF/Hour	Read Only
7.34	Last Calc Hv BTU/SCF	Read Only
7.35	Last Calc Specific Gravity	Read Only
7.36	Last Calc FIP, AGA3-1992	Read Only
7.37	Last Calc Ev, AGA3-1992	Read Only
7.38	Last Calc Orifice diameter at Tf, Inches, AGA3-1992,	Read Only
7.39	Last Calc Pipe diameter at Tf, Inches, AGA3-1992	Read Only
7.40	Last Calc Base Density, lbsm/cf, AGA3-1992	Read Only
7.41	Last Calc Mass Flow Rate (qm), lbsm/hour, AGA3-1992	Read Only
7.42	Last Calc Coefficient of discharge (Cd), AGA3-1992	Read Only
7.43	Last Calc Reynolds Number Factor (Fr),	Read Only

ARRAY.REGISTER	DESCRIPTION	USAGE
	AGA3-1985	
7.44	Last Calc Pressure Base Factor (Fpb), AGA3-1985	Read Only
7.45	Last Calc Temperature Base Factor (Ftb), AGA3-1985	Read Only
7.46	Last Calc Flowing Temperature Factor (Ftf), AGA3-1985	Read Only
7.47	Last Calc Specific Gravity Factor (Fg), AGA3-1985	Read Only
7.48	Last Calc Orifice Thermal Expansion Factor (Fa), AGA3-1985	Read Only
7.49	Last Calcultate AGA3 1992 Zb	Read Only
7.50	Last Calcultate AGA3 1992 Zf	Read Only
7.51	DP/ACF Percent High for Day	Read Only
7.52	DP/ACF Percent Low for Day	Read Only

C.10.13.1   AGA-3 Float Register Usage Notes

1)   These vary based on Vol - Flow Rate unit selection. See 0.42.

C.10.14   AGA-3 String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
8.0	Rate Unit String	Note 1)
8.1	Volume Unit String starting at MCF	Note 1)
8.2	Volume Unit String starting at SCF	Note 1)

C.10.14.1   AGA-3 String Register Usage Notes

1)   These vary based on Vol - Flow Rate unit selection. See 0.42.

C.10.15   AGA-3 Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
9.0	Tube Current Alarm Bits	Read Only, See note 1)

1)   Tube Alarm Bits -

```
0x00080000, 524288   - Flow rate high limit
0x00040000, 262144   - Flow rate low limit
0x00020000, 131072   - Temperature high limit
0x00010000,  65536   - Temperature low limit
0x00008000,  32768   - Static pressure high limit
0x00004000,  16384   - Static pressure low limit
0x00002000,   8192   - Dp high limit
0x00001000,   4096   - Dp low limit
```

```
0x00000800,   2048   - Zero flow
0x00000400,   1024   - Back flow
0x00000200,    512   - Remote sense (DI)
0x00000100,    256   - contact out (DO)
0x00000080,    128   - temperature channel A/D over-range
0x00000040,     64   - static pressure channel A/D over-range
0x00000020,     32   - differential pressure channel A/D over-range
0x00000010,     16   - low charger
0x00000008,      8 - low lithium battery
0x00000004,      4 - AIU / analyzer data not received
0x00000002,      2 - NX19 methane=1 / gravity=0 method
0x00000001,      1 - calculation error
```

C.11 AGA-7 Tube Application Register

Tube measurement applications share several common data items. The items listed under this heading are common to all tube measurement applications. Usage and notes are specific to AGA-7 tube applications. Format for register list is array#.register# description. Application number depends on the order of application instantiation.

C.11.1 Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
0.0	Contract Hour	Read/Write, 0-23
0.1	Reset Volume Command	Write
0.2	Reset Log Period Command	Write
0.3	Calibration Hold Mode	Read/Write
0.4	AP/ACF/TF Over Range Flags	Read Only
0.5	Tube Database Rev	Read Only
0.6	AGA-3 1985 Dynamic Select Bits	Read/Write, used only for AGA-3, 1985, other tubes or calculation methods ignore this value
0.7	AGA-3 1992 Static Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value
0.8	AGA-3 1992 Dynamic Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value
0.9	Volume Calc Type	Read/Write
0.10	Calc Units	Read Only
0.11	Report Units	Read Only
0.12	Super Compressibility Method	Read/Write, see note 1)
0.13	Use Square Root Average flag	Read/Write
0.14	Characteristic Record Type	Read/Write, see note 2)

ARRAY.REGISTER	DESCRIPTION	USAGE
0.15	Use Fixed H2O	Read/Write, for Fw calculation
0.16	Gravity Config flags	Read/Write, live analysis configuration, see note 3)
0.17	BTU Config flags	Read/Write, live analysis configuration, see note 3)
0.18	Nitrogen Config flags	Read/Write, live analysis configuration, see note 3)
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration, see note 3)
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration, see note 3)
0.21	Water Config flags	Read/Write, live analysis configuration, see note 3)
0.22	Helium Config flags	Read/Write, live analysis configuration, see note 3)
0.23	Methane Config flags	Read/Write, live analysis configuration, see note 3)
0.24	Ethane Config flags	Read/Write, live analysis configuration, see note 3)
0.25	Propane Config flags	Read/Write, live analysis configuration, see note 3)
0.26	Normal Butane Config flags	Read/Write, live analysis configuration, see note 3)
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration, see note 3)
0.28	Normal Pentane Config flags	Read/Write, live analysis configuration, see note 3)
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration, see note 3)
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration, see note 3)
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration, see note 3)
0.32	Normal Octane Config flags	Read/Write, live analysis configuration, see note 3)
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration, see note 3)
0.34	Normal Decane Config flags	Read/Write, live analysis configuration, see note 3)
0.35	Oxygen Config flags	Read/Write, live analysis configuration, see note 3)

ARRAY.REGISTER	DESCRIPTION	USAGE
0.36	Carbon Monoxide Config flags	Read/Write, live analysis configuration, see note 3)
0.37	Hydrogen Config flags	Read/Write, live analysis configuration, see note 3)
0.38	Argon Config flags	Read/Write, live analysis configuration, see note 3)
0.39	Number of live components	Read/Write
0.40	Get/release calc lock	Read/Write
0.41	Tube analysis stream index	Read/Write
0.42	Flow rate / volume scale flags	Read/Write, see note 4)
0.43	Aux contact 1 re-open interval	Read/Write
0.44	Aux contact 1 current state	Read Only
0.45	Aux contact 1 manual set	Read/Write
0.46	Aux contact 2 re-open interval	Read/Write
0.47	Aux contact 2 current state	Read Only
0.48	Aux contact 2 manual set	Read/Write
0.49	Remote Sense Action	Read/Write
0.50	Remote Sense State	Read Only
0.51	Events Available	Write, Canadian Event Log
0.52	Aux Contact 1 select bits low byte	Read/Write, see note 5)
0.53	Aux Contact 2 select bits low byte	Read/Write, see note 5)
0.54	Hold tube analog inputs	Read/Write
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge
0.56	Programmable count before activating a2dfail	Read/Write
0.57	Current count of a2dfail in deadband	Read Only
0.58	Vol period complete flag	Read Only
0.59	Log period complete flag	Read Only
0.60	Day period complete flag	Read Only
0.61	Disable tube check-pointing	Read/Write 1=disable
0.62	Stop logging events from protocols for Canadian events	Read/Write 1=stop logging
0.63	Stop logging events for Canadian events	Read/Write 1=stop logging
0.64	Log gage pressure	Read/Write 0=log absolute 1=log

ARRAY.REGISTER	DESCRIPTION	USAGE
		gage if gage transducer
0.65	Log Dp Check with pressure applied to Sp	Read/Write 1=stop logging
0.66	Stream source application	Read/Write
0.67	Enable/Disable Slip Second Adjustment	Read Only

C.11.1.1   Tube Byte Register Usage Notes

1) Super-Compressibility Method: 0=NX19 with FIXED FT AND FP VALUES, 1=NX19 AUTO, 2=NX19 GRAVITY CO2 & N2, 3=NX19 CO2 & N2 & C1, 11=AGA-8 Gross, 12=AGA-8 Detail

2) Characteristics Type: This was used in "Totalflow old database" format. This does not apply to X-series, DB2 format.

3) Live Analysis Configuration flags: 0=USE FIXED ANALYSIS, 1=USE LIVE ANALYSIS FROM AIU, 2=USE LIVE ANALYSIS FROM OTHER PROTOCOL, 16=USE FIXED ANALYSIS ON ERROR. USE FIXED ANALYSIS ON ERROR may be added to selections 1 or 2.

4) Flow rate / Volume scale flags: bit encoded flags –

5) Bits 0-1 rates times

6) 0 = /hour, 1 = /day, 2 = N/A, 3 = N/A

7) Bits 2-4 corrected volume, rate quantity units

8) 0 = scf, 4 = dscf, 8 = cscf, 12 = mscf

9) 16 = dmscf, 20 = cmscf, 28 = mmscf

10) Bits 5-7 uncorrected volume, rate quantity units

11) 0 = acf, 32 = dacf, 64 = cacf, 96 = macf,

12) 128 = dmacf, 160 = cmacf, 224 = mmacf

13) 5) Aux Contact 1 & 2 select bits low byte: 1=trip contact on low charger; 2=trip contact on ACF low; 4=trip contact on ACF high; 8=trip contact on Ap low; 16=trip contact on Ap high; 32=trip contact on remote sense; 64=auto re-open; 128=trip contact on volume set-point. These registers can also be set from 16-bit integer registers 1.10 and 1.11.

C.11.2 Tube 16-Bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
1.0	Primary Element Mask	Read Only, indicates primary element type, see note 1)
1.1	Calc Method Mask	Read Only, indicates calculation methods supported, see note 2)
1.2	Calc Units Mask	Read Only, not used
1.3	Report Units Mask	Read Only, not used
1.4	Super Comp Method Mask	Read Only, indicates super-compressibility methods that may be selected. See note 3)
1.5	Live Analysis Update Interval	Read/Write, live analysis updates are expected in this interval, expressed in seconds

ARRAY.REGISTER	DESCRIPTION	USAGE
1.6	Volume Calc period	Read/Write, seconds
1.7	Daily Record Capacity	Read/Write, number of daily records, change to this value deletes existing database and starts new database
1.8	Log Record Capacity	Read/Write, number of log period records, change to this value deletes existing database and starts new database
1.9	Event Record Capacity	Read/Write, number of event records, change to this value deletes existing database and starts new database
1.10	Aux Contact 1 Select Bits	Read/Write, control bits, see note 4)
1.11	Aux Contact 2 Select Bits	Read/Write, control bits, see note 4)
1.12	Return number of events available	Write, Canadian Event Log
1.13	Therms Stream Id	Read/WriteAnalysis Stream Id
1.14	Modbus address of analyzer	Read/Write
1.15	Therms use fixed or last good	Read/Write
1.16	Daily Record Sequence Number	Read Only
1.17	Log Record Sequence Number	Read Only
1.18	Event Record Sequence Number	Read Only
1.19	ACF Status Flags	Read Only, see note 5)
1.20	AP Status Flags	Read Only, see note 6)
1.21	TF Status Flags	Read Only, see note 7)
1.22	PI Status Flags	Read Only, see note 8)
1.23	Ext Status Flags	Read Only, see note 9)

C.11.2.1   Tube 16-Bit Integer Register Usage Notes

1) Primary Element Mask: 1=Orifice Square Root

2) Calculation Method Mask: 2=AGA-3 1985, 4=AGA-3 1992; The sum of these values (6) indicates 2 and 4 are valid choices.

3) Super-Compressibility Method Mask: 1=NX19 with FIXED FT AND FP VALUES, 2=NX19 AUTO, 4=NX19 GRAVITY CO2 & N2, 8=NX19 CO2 & N2 & C1, 2048=AGA8 Gross, 4096=AGA8 Detail. The sum of these values (6159) indicates all of the choices listed above are valid.

4) Aux Contact Select Bits: 1=trip contact on low charger; 2=trip contact on Acf low; 4=trip contact on Acf high; 8=trip contact on Ap low; 16=trip contact on Ap high; 32=trip contact on Remote Sense; 64=auto re-open; 128=trip contact on volume set-point; 256=trip contact on tf low; 512=trip contact on tf high; 1024=trip contact on flow rate low; 2048=trip contact on flow rate high; 16384=reverse contact logic.

5) Acf Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=N/A; 8=zero flow; 16=N/A.

6) Ap Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=over-range; 8=zero flow; 32768=gauge pressure device.

7) Tf Status Flags: 1=low limit exceeded; 2=high limit exceeded; 4=over-range.

8) Pl Status Flags: 1=low limit exceeded; 2=high limit exceeded; 8=zero flow.

9) Ext Status Flags: 1=low limit exceeded; 2=high limit exceeded; 8=zero flow.

C.11.3 Tube 32-Bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
2.0	Log period	Read/Write, seconds
2.1	Julian timestamp of most recent AIU download	Read/Write, see note 1)
2.2	Julian timestamp of most recent live component update (not aiu)	Read/Write, see note 1)
2.3	Julian timestamp of prev day period	Read Only, see note 1)
2.4	Total slip seconds since boot	Read Only
2.5	Julian timestamp of last slip seconds	Read Only
2.6	Thread loop time (ms)	Read Only
2.7	Thread Min loop time (ms)	Read Only
2.8	Thread Max loop time (ms)	Read Only

C.11.3.1   Tube 32-Bit Integer Register Notes

1) Julian time is number of seconds since midnight, 1/1/1970.

C.11.4 Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
3.0	Current AP / cal checks	Read/Write, psi, see note 1
3.1	AP High Limit	Read/Write, psi, see note 1
3.2	AP Low Limit	Read/Write, psi, see note 1
3.3	Current Temp	Deg F
3.4	Fixed Temp	Deg F
3.5	Temp High Limit	Deg F
3.6	Temp Low Limit	Deg F
3.7	Flow Rate High Limit	Read/Write, see note 2
3.8	Flow Rate Low Limit	Read/Write, see note 2
3.9	DP/ACF Percent High for Day	Read Only
3.10	DP/ACF Percent Low for Day	Read Only
3.11	Fixed F(b) AGA-3 1985	Read/Write
3.12	Fixed Cd AGA-3 1992	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
3.13	Zba	Read/Write
3.14	Oriface coef of expansion	Read/Write, inches/Deg F
3.15	Pipe coef of expansion	Read/Write, inches/Deg F
3.16	Barometric Pressure	Read/Write, PSIA
3.17	F(t) for Fpv NX19	Read/Write
3.18	F(p) for Fpv NX19	Read/Write
3.19	Fixed Analysis BTU	Read/Write, BTU/SCF
3.20	Fixed Analysis Gravity	Read/Write
3.21	Fixed Analysis Nitrogen	Read/Write, mole %
3.22	Fixed Analysis Carbon Dioxide	Read/Write, mole %
3.23	Fixed Analysis Hydrogen Sulfide	Read/Write, mole %
3.24	Fixed Analysis Water	Read/Write, mole %
3.25	Fixed Analysis Helium	Read/Write, mole %
3.26	Fixed Analysis Methane	Read/Write, mole %
3.27	Fixed Analysis Ethane	Read/Write, mole %
3.28	Fixed Analysis Propane	Read/Write, mole %
3.29	Fixed Analysis Normal Butane	Read/Write, mole %
3.30	Fixed Analysis Iso-Butane	Read/Write, mole %
3.31	Fixed Analysis Normal Pentane	Read/Write, mole %
3.32	Fixed Analysis Iso-Pentane	Read/Write, mole %
3.33	Fixed Analysis Normal Hexane	Read/Write, mole %
3.34	Fixed Analysis Normal Heptane	Read/Write, mole %
3.35	Fixed Analysis Normal Octane	Read/Write, mole %
3.36	Fixed Analysis Normal Nonane	Read/Write, mole %
3.37	Fixed Analysis Normal Decane	Read/Write, mole %
3.38	Fixed Analysis Oxygen	Read/Write, mole %
3.39	Fixed Analysis Carbon Monoxide	Read/Write, mole %
3.40	Fixed Analysis Hydrogen	Read/Write, mole %
3.41	Fixed Analysis Argon	Read/Write, mole %
3.42	Fixed H2O Content	Read/Write, ppm
3.43	Fixed H2O Bias	Read/Write, ppm
3.44	Live Analysis Gravity Accumulator	Read/Write,
3.45	Live Analysis BTU Accumulator	Read/Write, BTU/SCF

ARRAY.REGISTER	DESCRIPTION	USAGE
3.46	Live Analysis Nitrogen Accumulator	Read/Write, mole %
3.47	Live Analysis Carbon Dioxide Accumulator	Read/Write, mole %
3.48	Live Analysis Hydrogen Sulfide Accumulator	Read/Write, mole %
3.49	Live Analysis Water Accumulator	Read/Write, mole %
3.50	Live Analysis Helium Accumulator	Read/Write, mole %
3.51	Live Analysis Methane Accumulator	Read/Write, mole %
3.52	Live Analysis Ethane Accumulator	Read/Write, mole %
3.53	Live Analysis Propane Accumulator	Read/Write, mole %
3.54	Live Analysis Normal Butane Accumulator	Read/Write, mole %
3.55	Live Analysis Iso-Butane Accumulator	Read/Write, mole %
3.56	Live Analysis Normal Pentane Accumulator	Read/Write, mole %
3.57	Live Analysis Iso-Pentane Accumulator	Read/Write, mole %
3.58	Live Analysis Normal Hexane Accumulator	Read/Write, mole %
3.59	Live Analysis Normal Heptane Accumulator	Read/Write, mole %
3.60	Live Analysis Normal Octane Accumulator	Read/Write, mole %
3.61	Live Analysis Normal Nonane Accumulator	Read/Write, mole %
3.62	Live Analysis Normal Decane Accumulator	Read/Write, mole %
3.63	Live Analysis Oxygen Accumulator	Read/Write, mole %
3.64	Live Analysis Carbon Monoxide Accumulator	Read/Write, mole %
3.65	Live Analysis Hydrogen Accumulator	Read/Write, mole %
3.66	Live Analysis Argon Accumulator	Read/Write, mole %
3.67	Log Site Code in Event Log	
3.68	Valve Control Accumulated Volume	Read/Write, MCF
3.69	Aux Contact 1 Volume Setpoint	Read/Write, MCF
3.70	Aux Contact 2 Volume Setpoint	Read/Write, MCF
3.71	current contract day accumulated energy	Read Only, MBTU
3.72	yesterdays contract day accumulated energy	Read Only, MBTU

ARRAY.REGISTER	DESCRIPTION	USAGE
3.73	Current Energy rate	Read Only MBTU/HR
3.74	Month Accum Volume	Read Only, MCF
3.75	Month Accum Volume, Not Reset by Reset Vol	Read Only, MCF
3.76	Month Accum Energy	Read Only, MMBTU
3.77	Month Accum Energy, Not Reset by Reset Vol	Read Only, MMBTU
3.78	Fixed AP value	Read/Write
3.79	Current SCF flow	Read Only
3.80	Previous Month Accumulated Volume	Read Only
3.81	Previous Month Accumulated Volume not affected by reset volume command	Read Only
3.82	Previous Month Energy	Read Only
3.83	Previous Month Energy not affected by reset volume command	Read Only

C.11.4.1 Tube Floating Point Register Notes

1) Static pressure values are in PSIA or PSIG depending on gauge pressure device selection. See Tube Byte Register 0.55.

2) Flow Rate Limits units depend on Flow rate / volume scale flags. See Tube Byte Register 0.42.

C.11.5 Tube Register Cross Reference

Tube register cross references are structures containing the register access values for data used by the tube but owned by another application. The following structure defines data type Register.

```
typedef struct {          // Register Struct
    byte app;                    // Application
    byte array;                  // Register array
    int16 index;                 // index into array
} Register;
```

ARRAY.REGISTER	DESCRIPTION	USAGE
4.0	AP Register	Read/Write
4.1	ACF Register	Read/Write
4.2	TF Register	Read/Write
4.3	PI Register	Read/Write
4.4	RS Register	Read/Write
4.5	AC 1 Register	Read/Write
4.6	AC 1 DI Register	Read/Write
4.7	AC 2 Register	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
4.8	AC 2 DI Register	Read/Write

C.11.6 Tube String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
5.0	Tube ID	Read/Write
5.1	Tube last analysis time	Read Only
5.2	Tube Description	Read/Write

C.11.7 Tube Last Calculation Period Analysis Registers, Floating Point

ARRAY.REGISTER	DESCRIPTION	USAGE
10.0	Last Calc Nitrogen	Read Only, mole %
10.1	Last Calc Carbon Dioxide	Read Only, mole %
10.2	Last Calc Hydrogen Sulfide	Read Only, mole %
10.3	Last Calc Water	Read Only, mole %
10.4	Last Calc Helium	Read Only, mole %
10.5	Last Calc Methane	Read Only, mole %
10.6	Last Calc Ethane	Read Only, mole %
10.7	Last Calc Propane	Read Only, mole %
10.8	Last Calc Normal Butane	Read Only, mole %
10.9	Last Calc Iso-Butane	Read Only, mole %
10.10	Last Calc Normal Pentane	Read Only, mole %
10.11	Last Calc Iso-Pentane	Read Only, mole %
10.12	Last Calc Normal Hexane	Read Only, mole %
10.13	Last Calc Normal Heptane	Read Only, mole %
10.14	Last Calc Normal Octane	Read Only, mole %
10.15	Last Calc Normal Nonane	Read Only, mole %
10.16	Last Calc Normal Decane	Read Only, mole %
10.17	Last Calc Oxygen	Read Only, mole %
10.18	Last Calc Carbon Monoxide	Read Only, mole %
10.19	Last Calc Hydrogen	Read Only, mole %
10.20	Last Calc Argon	Read Only, mole %
10.21	Last Calc Air	Read Only, mole %
10.22	Last Calc Heavy Hydrocarbons	Read Only, mole %
10.23	Last Calc Heat Content	Read Only, BTU/SCF

ARRAY.REGISTER	DESCRIPTION	USAGE
10.24	Last Calc Specific Gravity	Read Only

C.11.8 Tube Archive Registers, Read Only

The following registers access historical data records or record items. For all tube archive registers, register value 0 refers to the most recent record, 1 refers to the next most recent record, 2 refers to the next oldest record. The oldest record is referred to by register number MAX RECORDS – 1.

C.11.8.1 Tube Log Period Registers

ARRAY	DESCRIPTION	USAGE
200	Log Period Static Pressure	Floating Point, PSIA
201	Log Period Diff. Pressure	Floating Point, Inches H2O
202	Log Period Temperature	Floating Point, Deg F
204	Log Period Extension	Floating Point
205	Log Period Volume	Floating Point, MCF
206	Log Period Heating Value	Floating Point, MMBTU
207	Log Period Flow time	Unsigned Long, seconds
208	Log Period Total time	Unsigned Long, seconds
209	Log Period Alarm bits	32 bits, see note 1)
250	Log Period Record	See note 2)

C.11.8.2 Tube Log Period Usage Notes

1) Log Period Alarm Bits -

   0x00080000, 524288   - Flow rate high limit
   0x00040000, 262144   - Flow rate low limit
   0x00020000, 131072   - Temperature high limit
   0x00010000,   65536 - Temperature low limit
   0x00008000,   32768 - Static pressure high limit
   0x00004000,   16384 - Static pressure low limit
   0x00002000,   8192 - Acf high limit
   0x00001000,   4096 - Acf low limit
   0x00000800,   2048 - Zero flow
   0x00000400,   1024 - Back flow
   0x00000200,   512 - Remote sense (DI)
   0x00000100,   256 - contact out (DO)
   0x00000080,   128 - temperature channel A/D over-range
   0x00000040,   64 - static pressure channel A/D over-range
   0x00000020,   32 - differential pressure channel A/D over-range
   0x00000010,   16 - low charger
   0x00000008,   8 - low lithium battery
   0x00000004,   4 - AIU / analyzer data not received
   0x00000002,   2 - NX19 methane=1 / gravity=0 method
   0x00000001,   1 - calculation error

2) 2) Log Period Record definition –

```
        typedef struct
{
        unsigned long date;        /* Julian Date / Time */
        unsigned int  sn;          /* Sequence Number */
        float    Acf;              /* period avg ACF */
        float    ap;               /* period avg AP */
        float    tf;               /* period avg TEMP */
        float    ext;              /* period EXTENSION */
        float    vol;              /* period VOLUME */
        float    btu;              /* period ENERGY */
        unsigned int  ftime;       /* period FLOWTIME */
        unsigned int  ptime;       /* period TIME */
        unsigned char aflags[3];   /* period ALARMS */
        unsigned char vcode;       /* Verification Code */
} LOGRECORD;
```

C.11.9 Tube Daily Registers

ARRAY	DESCRIPTION	USAGE
220	Daily Static Pressure	Floating Point, PSIA
221	Daily Diff. Pressure	Floating Point, Inches H2O
222	Daily Temperature	Floating Point, Deg F
224	Daily Extension	Floating Point
225	Daily Volume	Floating Point, MCF
226	Daily Heating Value	Floating Point, MBTU
227	Daily Flow time	Unsigned Long, seconds
228	Daily Total time	Unsigned Long, seconds
229	Daily Alarm bits	32 bits, See note 1)
251	Daily Record	See note 2)

C.11.9.1   Tube Daily Register Usage Notes

1)   Daily Alarm Bits -

0x00080000, 524288	- Flow rate high limit
0x00040000, 262144	- Flow rate low limit
0x00020000, 131072	- Temperature high limit
0x00010000, 65536	- Temperature low limit
0x00008000, 32768	- Static pressure high limit
0x00004000, 16384	- Static pressure low limit
0x00002000, 8192	- Acf high limit
0x00001000, 4096	- Acf low limit
0x00000800, 2048	- Zero flow
0x00000400, 1024	- Back flow
0x00000200, 512	- Remote sense (DI)
0x00000100, 256	- contact out (DO)
0x00000080, 128	- temperature channel A/D over-range
0x00000040, 64	- static pressure channel A/D over-range
0x00000020, 32	- differential pressure channel A/D over-range

```
0x00000010,     16      - low charger
0x00000008,      8 - low lithium battery
0x00000004,      4 - AIU / analyzer data not received
0x00000002,      2 - NX19 methane=1 / gravity=0 method
0x00000001,      1 - calculation error
```

2) Daily Record definition –

```
typedef struct
{
    unsigned long date;              /* Julian Date / Time */
    unsigned int  sn;                /* Sequence Number */
    unsigned int  event;        /* Last Event Log Seq Num */
    unsigned int  firstlog;          /* First Log Period Seq Num */
    unsigned int  lastlog;           /* Last Log Period Seq Num */
    unsigned char c_hr;              /* Contract Hour */
    float       ext;                 /* Daily Extension */
    float       vol;                 /* Daily Volume */
    float       btu;                 /* Daily Energy */
    unsigned long ftime;             /* Daily Flowtime */
    unsigned long btime;             /* Daily Back-flowtime – 0 for AGA-7 */
    unsigned long ptime;             /* period TIME */
    unsigned char aflags[3];         /* period ALARMS */
    float       ap;                  /* Daily Avg AP */
    float       minap;               /* Daily Minimum AP */
    float       maxap;               /* Daily Maximum AP */
    float       aplpct;          /* Daily AP LO per cent */
    float       aphpct;              /* Daily AP HI per cent */
    float       Acf;                 /* Daily Avg ACF */
    float       minAcf;              /* Daily Minimum ACF */
    float       maxAcf;              /* Daily Maximum ACF */
    float       Acflpct;             /* Daily ACF LO per cent */
    float       Acfhpct;             /* Daily ACF HI per cent */
    float       tf;                  /* Daily Avg Temp */
    float       mintf;               /* Daily Minimum TF */
    float       maxtf;               /* Daily Maximum TF */
    float       tflpct;              /* Daily ACF LO per cent */
    float       tfhpct;              /* Daily ACF HI per cent */
    unsigned char vcode;             /* Verification Code */

} DAYRECORD;
```

C.11.10   Tube Event Registers

ARRAY	DESCRIPTION	USAGE
252	Event Log Record	See note 1)

C.11.10.1   Tube Event Registers Usage Notes

1) Tube Event Log Record definition –

```
typedef struct
{
    unsigned long  date;             /* Julian Date/Time */
    unsigned char  flags;            /* Event Flags     */
    unsigned int   sn;          /* Sequence Number  */
```

```
    unsigned int   code;                /* Event Code      */
    unsigned char  oldval[4];    /* Previous Value    */
    unsigned char  newval[4];           /* Current Value     */
    unsigned char  vcode;               /* Verification Code */
} EVTRECORD;
```

C.11.11   AGA-7 Tube Byte Registers

The following register tables describe registers unique to AGA-7 measurement tubes.

ARRAY.REGISTER	DESCRIPTION	USAGE
6.0	AGA-7 Factor Select Bits	Read/Write, See note 1)
6.1	Misc Select Bits	Read/Write, See note 2)
6.2	Units scale selection for uncorrected vol units	Read/Write, See note 3)
6.3	Units scale selection for corrected volume units	Read/Write, See note 4)
6.4	Units scale selection for flow rate units	Read/Write, See note 5)
6.5	AGA7 test Calculations	Write
6.6	Meter factor units, vol/pulse, pulses/vol	Read/Write

C.11.11.1   AGA-7 Byte Register Usage Notes

1)   AGA-7 Factor Select Bits –

0x01, 1   /* Use Fp   */
0x02, 2   /* Use Ft   */
0x04, 4   /* Use s   */
0x08, 8   /* Use Faux */
0x40, 64   /* Supports switchable characteristics, this bit not writable*/

2)   Misc Select Bits –

0x01,   1 /* RTD Installed   */
0x02,   2   /* Use RTD in calcs   */
0x04,   4   /* reserved   */
0x08,   8   /* Check security code*/
0x10,   16   /* use live ap in calcs */
0x20,   32   /* Use live analyzer data in volume calc */
0x40,   64   /* Use fixed analysis data on analyzer error */
0x80, 128/* reserved */

3)   Units scale selection for uncorrected volume -

0=ACF
1=DACF
2=CACF
3=MACF
4=DMACF
5=CMACF
6=MMACF

4) Units scale selection for corrected volume –
    0=SCF
    1=DSCF
    2=CSCF
    3=MSCF
    4=DMSCF
    5=CMSCF
    6=MMSCF
5) Units scale selection for flow rate –
    0 = /hour
    1 = /day
    2 = /flow window period
6) Meter factor units
    0=Vol/Pulses
    1=Pulses/Vol

C.11.12   AGA-7 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
7.0	Current pulse counts	Read Only
7.1	ACF High Limit	Read/Write, units scaled per Units scale selection, see 0.42
7.2	ACF Low Limit	Read/Write, units scaled per Units scale selection, see 0.42
7.3	K-factor	Read/Write
7.4	Flow window	Read/Write, seconds
7.5	Fixed static pressure value	Read/Write, PSIA or PSIG
7.6	Current corrected flow rate	Read Only, units scaled per Units scale selection, see 0.42
7.7	Today's contract day corrected volume	Read Only, units scaled per Units scale selection, see 6.3
7.8	Accumulated corrected volume	Read Only, units scaled per Units scale selection, see 6.3
7.9	Yesterday's corrected volume	Read Only, units scaled per Units scale selection, see 6.3
7.10	Current uncorrected flow rate	Read Only, units scaled per Units scale selection, see 6.2
7.11	Today's contract day uncorrected volume	Read Only, units scaled per Units scale selection, see 0.42
7.12	Accumulated uncorrected volume	Read Only, units scaled per Units scale selection, see 6.2
7.13	Yesterday's uncorrected	Read Only, units scaled per Units scale

ARRAY.REGISTER	DESCRIPTION	USAGE
	volume	selection, see 6.2
7.14	Accumulated uncorrected volume	Read Only, units scaled per Units scale selection, see 6.2
7.15	Pressure base	Read/Write, PSIA
7.16	Temperature base	Read/Write, Degrees F
7.17	Fixed F(aux)	Read/Write
7.18	C-prime test value	Read Only
7.19	Last calculated C-prime	Read Only
7.20	Last flow period actual volume	Read Only, ACF
7.21	Last flow period average Ap regardless of flow	Read Only, PSIA
7.22	Last flow period flow seconds	Read Only, seconds
7.23	Current flow rate	Read Only, SCF/Hour
7.24	Current contract day corrected volume	Read Only, SCF
7.25	Accumulated corrected volume	Read Only, SCF
7.26	Yesterday's corrected volume	Read Only, SCF
7.27	Current uncorrected flow rate	Read Only, ACF/Hour
7.28	Current contract day uncorrected volume	Read Only, ACF
7.29	Accumulated uncorrected volume	Read Only, ACF
7.30	Yesterday's uncorrected volume	Read Only, ACF
7.31	Corrected flow rate high limit	Read/Write, scaled per Units scale selection, see 6.4
7.32	Corrected flow rate low limit	Read/Write, scaled per Units scale selection, see 6.4
7.33	Last calculated corrected volume	Read Only, units scaled per Units scale selection, see 6.3
7.34	Last calculated uncorrected volume	Read Only, units scaled per Units scale selection, see 6.2
7.35	Last flow period pulse counts	Read Only, counts
7.36	Last Calc Ap, PSIA	Read Only
7.37	Last Calc Tf, Deg F	Read Only
7.38	Last Calc actual volume, ACF	Read Only

ARRAY.REGISTER	DESCRIPTION	USAGE
7.39	Last Calc Fpv	Read Only
7.40	Last Calc Pressure Correction Factor (Fps)	Read Only
7.41	Last Calc Temperature Correction Factor (Fts)	Read Only
7.42	Last Calc heating value, BTU/SCF	Read Only
7.43	Last Calc Specific Gravity	Read Only
7.44	DP/ACF Percent High for Day	Read Only
7.45	DP/ACF Percent Low for Day	Read Only

C.11.13   AGA-7 String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
8.0	Corrected Rate Units String	Note 1)
8.1	Corrected Volume Units String	Note 1)
8.2	Uncorrected Rate Units String	Note 1)
8.3	Uncorrected Volume Units String	

C.11.13.1   AGA-7 String Register Usage Notes

1)   These strings vary per Units scale selection. See 6.2, 6.3, and 6.4.

C.11.14   AGA-7 Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
9.0	Tube Current Alarm Bits	Read Only, See note 1)

C.11.14.1   AGA-7 Int32 Register Usage Notes

1)   Tube Alarm Bits -

        0x00080000, 524288   - Flow rate high limit
        0x00040000, 262144   - Flow rate low limit
        0x00020000, 131072   - Temperature high limit
        0x00010000, 65536   - Temperature low limit
        0x00008000, 32768   - Static pressure high limit
        0x00004000, 16384   - Static pressure low limit
        0x00002000,   8192   - Acf high limit
        0x00001000,   4096   - Acf low limit
        0x00000800,   2048   - Zero flow
        0x00000400,   1024   - Back flow
        0x00000200,   512   - Remote sense (DI)
        0x00000100,   256   - contact out (DO)
        0x00000080,   128   - temperature channel A/D over-range
        0x00000040,   64   - static pressure channel A/D over-range
        0x00000020,   32   - differential pressure channel A/D over-range
        0x00000010,   16   - low charger

0x00000008,   8 - low lithium battery
0x00000004,   4 - AIU / analyzer data not received
0x00000002,   2 - NX19 methane=1 / gravity=0 method
0x00000001,   1 - calculation error

C.12 XMV Interface Application Registers

Format for the register list is array#.register#. The XMV Interface application can be instantiated in any application slot.

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
200.0	XMV 1 Modbus Address	Byte	Read/Write	1
200.1	XMV 2 Modbus Address	Byte	Read/Write	1
200.2	XMV 3 Modbus Address	Byte	Read/Write	1
200.3	XMV 4 Modbus Address	Byte	Read/Write	1
200.4	XMV 5 Modbus Address	Byte	Read/Write	1
200.5	XMV 6 Modbus Address	Byte	Read/Write	1
200.6	XMV 7 Modbus Address	Byte	Read/Write	1
200.7	XMV 8 Modbus Address	Byte	Read/Write	1
200.8	XMV 9 Modbus Address	Byte	Read/Write	1
200.X	XMV (X+1) Modbus Address	Byte	Read/Write	1
201.0	XMV 1 Modbus Register	UInt16	Read/Write	2
201.1	XMV 2 Modbus Register	UInt16	Read/Write	2
201.2	XMV 3 Modbus Register	UInt16	Read/Write	2
201.3	XMV 4 Modbus Register	UInt16	Read/Write	2
201.4	XMV 5 Modbus Register	UInt16	Read/Write	2
201.5	XMV 6 Modbus Register	UInt16	Read/Write	2
201.6	XMV 7 Modbus Register	UInt16	Read/Write	2
201.7	XMV 8 Modbus Register	UInt16	Read/Write	2
201.8	XMV 9 Modbus Register	UInt16	Read/Write	2
201.X	XMV (X+1) Modbus Register	UInt16	Read/Write	2
202.0	XMV 1 Device Enable	Byte	Read/Write	3
202.1	XMV 2 Device Enable	Byte	Read/Write	3
202.2	XMV 3 Device Enable	Byte	Read/Write	3
202.3	XMV 4 Device Enable	Byte	Read/Write	3
202.4	XMV 5 Device Enable	Byte	Read/Write	3
202.5	XMV 6 Device Enable	Byte	Read/Write	3
202.6	XMV 7 Device Enable	Byte	Read/Write	3
202.7	XMV 8 Device Enable	Byte	Read/Write	3

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
202.8	XMV 9 Device Enable	Byte	Read/Write	3
202.X	XMV (X+1) Device Enable	Byte	Read/Write	3
203.0	XMV 1 Scan Trigger	Byte	Read Only	4
203.1	XMV 2 Scan Trigger	Byte	Read Only	4
203.2	XMV 3 Scan Trigger	Byte	Read Only	4
203.3	XMV 4 Scan Trigger	Byte	Read Only	4
203.4	XMV 5 Scan Trigger	Byte	Read Only	4
203.5	XMV 6 Scan Trigger	Byte	Read Only	4
203.6	XMV 7 Scan Trigger	Byte	Read Only	4
203.7	XMV 8 Scan Trigger	Byte	Read Only	4
203.8	XMV 9 Scan Trigger	Byte	Read Only	4
203.9	XMV 10 Scan Trigger	Byte	Read Only	4
204.0	XMV 1 Raw DP Value	Float	Read/Write	5
204.1	XMV 1 Raw SP Value	Float	Read/Write	5
204.2	XMV 1 Raw TF Value	Float	Read/Write	5
204.3	XMV 2 Raw DP Value	Float	Read/Write	5
204.4	XMV 2 Raw SP Value	Float	Read/Write	5
204.5	XMV 2 Raw TF Value	Float	Read/Write	5
204.6	XMV 3 Raw DP Value	Float	Read/Write	5
204.7	XMV 3 Raw SP Value	Float	Read/Write	5
204.8	XMV 3 Raw TF Value	Float	Read/Write	5
204.X	XMV # Raw DP Value	Float	Read/Write	5
204.(X+1)	XMV # Raw SP Value	Float	Read/Write	5
204.(X+2)	XMV # Raw TF Value	Float	Read/Write	5
205.0	XMV 1 Scaled DP Value	Float	Read Only	6
205.1	XMV 1 Scaled SP Value	Float	Read Only	6
205.2	XMV 1 Scaled TF Value	Float	Read Only	6
205.3	XMV 2 Scaled DP Value	Float	Read Only	6
205.4	XMV 2 Scaled SP Value	Float	Read Only	6
205.5	XMV 2 Scaled TF Value	Float	Read Only	6
205.6	XMV 3 Scaled DP Value	Float	Read Only	6
205.7	XMV 3 Scaled SP Value	Float	Read Only	6
205.8	XMV 3 Scaled TF Value	Float	Read Only	6
205.X	XMV # Scaled DP Value	Float	Read Only	6

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
205.(X+1)	XMV # Scaled SP Value	Float	Read Only	6
205.(X+2)	XMV # Scaled TF Value	Float	Read Only	6
206.0	XMV 1 Communication Status	Byte	Read/Write	7
206.1	XMV 2 Communication Status	Byte	Read/Write	7
206.2	XMV 3 Communication Status	Byte	Read/Write	7
206.3	XMV 4 Communication Status	Byte	Read/Write	7
206.4	XMV 5 Communication Status	Byte	Read/Write	7
206.5	XMV 6 Communication Status	Byte	Read/Write	7
206.6	XMV 7 Communication Status	Byte	Read/Write	7
206.7	XMV 8 Communication Status	Byte	Read/Write	7
206.8	XMV 9 Communication Status	Byte	Read/Write	7
206.X	XMV (X+1) Communication Status	Byte	Read/Write	7
207.0	XMV 1 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.1	XMV 2 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.2	XMV 3 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.3	XMV 4 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.4	XMV 5 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.5	XMV 6 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.6	XMV 7 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.7	XMV 8 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.8	XMV 9 Device Type (Absolute/Gauge)	Byte	Read/Write	8
207.X	XMV (X+1) Device Type (Absolute/Gauge)	Byte	Read/Write	8
208.0	XMV 1 Factory Units (Metric/English)	Byte	Read/Write	9
208.1	XMV 2 Factory Units (Metric/English)	Byte	Read/Write	9
208.2	XMV 3 Factory Units (Metric/English)	Byte	Read/Write	9
208.3	XMV 4 Factory Units (Metric/English)	Byte	Read/Write	9
208.4	XMV 5 Factory Units (Metric/English)	Byte	Read/Write	9
208.5	XMV 6 Factory Units (Metric/English)	Byte	Read/Write	9
208.6	XMV 7 Factory Units (Metric/English)	Byte	Read/Write	9
208.7	XMV 8 Factory Units (Metric/English)	Byte	Read/Write	9
208.8	XMV 9 Factory Units (Metric/English)	Byte	Read/Write	9
208.X	XMV (X+1) Factory Units (Metric/English)	Byte	Read/Write	9
209.0	XMV 1 Zero Transducer	Float	Read/Write	10
209.1	XMV 1 Calibration Point 1	Float	Read/Write	10

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
209.2	XMV 1 Calibration Point 2	Float	Read/Write	10
209.3	XMV 1 Calibration Point 3	Float	Read/Write	10
209.4	XMV 1 Calibration Point 4	Float	Read/Write	10
209.5	XMV 1 Calibration Point 5	Float	Read/Write	10
209.6	XMV 1 Calibration Bias	Float	Read/Write	10
209.14	XMV 1 Calibration Abort	Float	Write Only	10
209.15	XMV 1 Calibration Complete	Float	Write Only	10
209.16	XMV 2 Zero Transducer	Float	Read/Write	10
209.17	XMV 2 Calibration Point 1	Float	Read/Write	10
209.18	XMV 2 Calibration Point 2	Float	Read/Write	10
209.19	XMV 2 Calibration Point 3	Float	Read/Write	10
209.20	XMV 2 Calibration Point 4	Float	Read/Write	10
209.21	XMV 2 Calibration Point 5	Float	Read/Write	10
209.22	XMV 2 Calibration Bias	Float	Read/Write	10
209.30	XMV 2 Calibration Abort	Float	Write Only	10
209.31	XMV 2 Calibration Complete	Float	Write Only	10
209.32	XMV 3 Zero Transducer	Float	Read/Write	10
209.33	XMV 3 Calibration Point 1	Float	Read/Write	10
209.34	XMV 3 Calibration Point 2	Float	Read/Write	10
209.35	XMV 3 Calibration Point 3	Float	Read/Write	10
209.36	XMV 3 Calibration Point 4	Float	Read/Write	10
209.37	XMV 3 Calibration Point 5	Float	Read/Write	10
209.38	XMV 3 Calibration Bias	Float	Read/Write	10
209.46	XMV 3 Calibration Abort	Float	Write Only	10
209.47	XMV 3 Calibration Complete	Float	Write Only	10
209.X	XMV # Zero Transducer	Float	Read/Write	10
209.X+1	XMV # Calibration Point 1	Float	Read/Write	10
209. X+2	XMV # Calibration Point 2	Float	Read/Write	10
209. X+3	XMV # Calibration Point 3	Float	Read/Write	10
209. X+4	XMV # Calibration Point 4	Float	Read/Write	10
209. X+5	XMV # Calibration Point 5	Float	Read/Write	10
209. X+6	XMV # Calibration Bias	Float	Read/Write	10
209. X+7	XMV # Calibration Abort	Float	Write Only	10
209. X+8	XMV # Calibration Complete	Float	Write Only	10

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
212.0	XMV 1 DP Calibration Flags	Uint16	Read Only	11
212.1	XMV 1 SP Calibration Flags	Uint16	Read Only	11
212.2	XMV 1 TF Calibration Flags	Uint16	Read Only	11
212.3	XMV 2 DP Calibration Flags	Uint16	Read Only	11
212.4	XMV 2 SP Calibration Flags	Uint16	Read Only	11
212.5	XMV 2 TF Calibration Flags	Uint16	Read Only	11
212.6	XMV 3 DP Calibration Flags	Uint16	Read Only	11
212.7	XMV 3 SP Calibration Flags	Uint16	Read Only	11
212.8	XMV 3 TF Calibration Flags	Uint16	Read Only	11
212.X	XMV # DP Calibration Flags	Uint16	Read Only	11
212.X+1	XMV # SP Calibration Flags	Uint16	Read Only	11
212.X+2	XMV # TF Calibration Flags	Uint16	Read Only	11
214.0	XMV 1 Description	String	Read/Write	
214.1	XMV 2 Description	String	Read/Write	
214.2	XMV 3 Description	String	Read/Write	
214.3	XMV 4 Description	String	Read/Write	
214.4	XMV 5 Description	String	Read/Write	
214.5	XMV 6 Description	String	Read/Write	
214.6	XMV 7 Description	String	Read/Write	
214.7	XMV 8 Description	String	Read/Write	
214.X	XMV (X+1) Description	String	Read/Write	
215.0	XMV 1 Scroll Text Lock	Byte	Read/Write	
215.1	XMV 2 Scroll Text Lock	Byte	Read/Write	
215.2	XMV 3 Scroll Text Lock	Byte	Read/Write	
215.3	XMV 4 Scroll Text Lock	Byte	Read/Write	
215.4	XMV 5 Scroll Text Lock	Byte	Read/Write	
215.5	XMV 6 Scroll Text Lock	Byte	Read/Write	
215.6	XMV 7 Scroll Text Lock	Byte	Read/Write	
215.7	XMV 8 Scroll Text Lock	Byte	Read/Write	
215.8	XMV 9 Scroll Text Lock	Byte	Read/Write	
215.X	XMV (X+1) Scroll Text Lock	Byte	Read/Write	
216.0	XMV 1 Scroll Text Trigger	Byte	Read/Write	12
216.1	XMV 2 Scroll Text Trigger	Byte	Read/Write	12
216.2	XMV 3 Scroll Text Trigger	Byte	Read/Write	12

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
216.3	XMV 4 Scroll Text Trigger	Byte	Read/Write	12
216.4	XMV 5 Scroll Text Trigger	Byte	Read/Write	12
216.5	XMV 6 Scroll Text Trigger	Byte	Read/Write	12
216.6	XMV 7 Scroll Text Trigger	Byte	Read/Write	12
216.7	XMV 8 Scroll Text Trigger	Byte	Read/Write	12
216.8	XMV 9 Scroll Text Trigger	Byte	Read/Write	12
216.X	XMV (X+1) Scroll Text Trigger	Byte	Read/Write	12
217.0	XMV 1 DP Scroll Lock	Byte	Write Only	13
217.1	XMV 1 SP Scroll Lock	Byte	Write Only	13
217.2	XMV 1 TF Scroll Lock	Byte	Write Only	13
217.3	XMV 2 DP Scroll Lock	Byte	Write Only	13
217.4	XMV 2 SP Scroll Lock	Byte	Write Only	13
217.5	XMV 2 TF Scroll Lock	Byte	Write Only	13
217.6	XMV 3 DP Scroll Lock	Byte	Write Only	13
217.7	XMV 3 SP Scroll Lock	Byte	Write Only	13
217.8	XMV 3 TF Scroll Lock	Byte	Write Only	13
217.X	XMV # DP Scroll Lock	Byte	Write Only	13
217.(X+1)	XMV # SP Scroll Lock	Byte	Write Only	13
217.(X+2)	XMV # TF Scroll Lock	Byte	Write Only	13
218.0	XMV 1 Scroll Text Register 1	Uint16	Read Only	14
218.1	XMV 1 Scroll Text Register 2	Uint16	Read Only	14
218.2	XMV 1 Scroll Text Register 3	Uint16	Read Only	14
218.3	XMV 1 Scroll Text Register 4	Uint16	Read Only	14
218.4	XMV 1 Scroll Text Register 5	Uint16	Read Only	14
218.5	XMV 1 Scroll Text Register 6	Uint16	Read Only	14
218.6	XMV 1 Scroll Text Register 7	Uint16	Read Only	14
218.7	XMV 2 Scroll Text Register 1	Uint16	Read Only	14
218.8	XMV 2 Scroll Text Register 2	Uint16	Read Only	14
218.9	XMV 2 Scroll Text Register 3	Uint16	Read Only	14
218.10	XMV 2 Scroll Text Register 4	Uint16	Read Only	14
218.11	XMV 2 Scroll Text Register 5	Uint16	Read Only	14
218.12	XMV 2 Scroll Text Register 6	Uint16	Read Only	14
218.13	XMV 2 Scroll Text Register 7	Uint16	Read Only	14
218.14	XMV 3 Scroll Text Register 1	Uint16	Read Only	14

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
218.15	XMV 3 Scroll Text Register 2	Uint16	Read Only	14
218.16	XMV 3 Scroll Text Register 3	Uint16	Read Only	14
218.17	XMV 3 Scroll Text Register 4	Uint16	Read Only	14
218.18	XMV 3 Scroll Text Register 5	Uint16	Read Only	14
218.19	XMV 3 Scroll Text Register 6	Uint16	Read Only	14
218.20	XMV 3 Scroll Text Register 7	Uint16	Read Only	14
218.X	XMV # Scroll Text Register 1	Uint16	Read Only	14
218.(X+1)	XMV # Scroll Text Register 2	Uint16	Read Only	14
218. (X+2)	XMV # Scroll Text Register 3	Uint16	Read Only	14
218. (X+3)	XMV # Scroll Text Register 4	Uint16	Read Only	14
218. (X+4)	XMV # Scroll Text Register 5	Uint16	Read Only	14
218. (X+5)	XMV # Scroll Text Register 6	Uint16	Read Only	14
218. (X+6)	XMV # Scroll Text Register 7	Uint16	Read Only	14
219.0-(X)	XMV # of Displays	Byte	Read/Write	
220.0-(X)	XMV 1 Display (X) Interval	Byte	Read/Write	16
221.0-(X)	XMV 1 Display (X) Top Line	String	Read/Write	17
222.0-(X)	XMV 1 Display (X) Bottom Line	String	Read/Write	17
223.0-(X)	XMV 1 Display (X) Format	String	Read/Write	18
224.0-(X)	XMV 2 Display (X) Interval	Byte	Read/Write	16
225.0-(X)	XMV 2 Display (X) Top Line	String	Read/Write	17
226.0-(X)	XMV 2 Display (X) Bottom Line	String	Read/Write	17
227.0-(X)	XMV 2 Display (X) Format	String	Read/Write	18
228.0-(X)	XMV 3 Display (X) Interval	Byte	Read/Write	16
229.0-(X)	XMV 3 Display (X) Top Line	String	Read/Write	17
230.0-(X)	XMV 3 Display (X) Bottom Line	String	Read/Write	17
231.0-(X)	XMV 3 Display (X) Format	String	Read/Write	18
232.0-(X)	XMV 4 Display (X) Interval	Byte	Read/Write	16
233.0-(X)	XMV 4 Display (X) Top Line	String	Read/Write	17
234.0-(X)	XMV 4 Display (X) Bottom Line	String	Read/Write	17
235.0-(X)	XMV 4 Display (X) Format	String	Read/Write	18
236.0-(X)	XMV 5 Display (X) Interval	Byte	Read/Write	16
237.0-(X)	XMV 5 Display (X) Top Line	String	Read/Write	17
238.0-(X)	XMV 5 Display (X) Bottom Line	String	Read/Write	17
239.0-(X)	XMV 5 Display (X) Format	String	Read/Write	18

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
240.0-(X)	XMV 6 Display (X) Interval	Byte	Read/Write	16
241.0-(X)	XMV 6 Display (X) Top Line	String	Read/Write	17
242.0-(X)	XMV 6 Display (X) Bottom Line	String	Read/Write	17
243.0-(X)	XMV 6 Display (X) Format	String	Read/Write	18
244.0-(X)	XMV 7 Display (X) Interval	Byte	Read/Write	16
245.0-(X)	XMV 7 Display (X) Top Line	String	Read/Write	17
246.0-(X)	XMV 7 Display (X) Bottom Line	String	Read/Write	17
247.0-(X)	XMV 7 Display (X) Format	String	Read/Write	18
248.0-(X)	XMV 8 Display (X) Interval	Byte	Read/Write	16
249.0-(X)	XMV 8 Display (X) Top Line	String	Read/Write	17
250.0-(X)	XMV 8 Display (X) Bottom Line	String	Read/Write	17
251.0-(X)	XMV 8 Display (X) Format	String	Read/Write	18
255.255	Number of XMV's	Byte	Read/Write	19

C.12.1 XMV Application Register Notes

1) XMV Modbus Address is the address of the Modbus slave.

2) Each Modbus operation captures 3 register values. The XMV Modbus Register is the address of the first value to read. The read operation will capture the three consecutive register values beginning with this register.

3) Registers in array 202 control the scan triggers in array 203. When a register in array 202 is ENABLED (1), the corresponding register in array 203 is TRIGGERED (1). When a register in array 202 is DISABLED (0), the corresponding register in array 203 is always 0.

4) The MODBUS request blocks mentioned in note 5 should be configured to trigger off the corresponding register in array 203.

5) A MODBUS request block should be configured to read DP, SP, and TF from the XMV and store the data into the corresponding registers in array 204. The status of the scan request should be written to array 218. When the status written by the protocol is 0 (SUCCESS), the raw data is scaled and moved to array 205.

6) When the status written by the protocol is 0 (SUCCESS), the raw data is scaled and moved to array 205. Measurement applications should source their inputs from array 205.

7) The MODBUS request block for each XMV scan request should be configured to write the communication status to these status registers. When the comm status written is 0 (SUCCESS), the raw data registers (array 204) are processed (scaled) and written to the corresponding scaled data registers (array 205).

8) Device Static Pressure type. If the XMV is an ABB 2010, this register should be set to 0 (Absolute). If the XMV is a Rosemount 3095, this register should be set to 1 (Gauge).

9) If the XMV is and ABB 2010, this register should be set to 0 (Metric). If the XMV is a Rosemount 3095, this register should be set to 1 (English).

10) The calibration registers in array 209 should only be written by the PCCU32 calibration screen.

11) Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.

12) The MODBUS request block mentioned in note 4 above should be configured to trigger off the corresponding register in array 216.

13) The scroll lock registers in array 217 are written by the PCCU32 calibration screen to lock the pressure (DP or SP) being calibrated on the XMV.

14) The ABB 2010 series XMV allows the host to write 14 bytes of text to registers 1001-1007. The XMV interface application uses this feature to scroll user programmable displays on the XMV. A MODBUS request block must be configured to write the corresponding registers from array 218 to the XMV.

15) Each ABB 2010 XMV can be configured with a variable number of displays. The displays are scrolled one at a time on the device display. If number of displays are set to zero (0), three default displays (DP,SP,TF) are provided.

16) Each display can be configured with its own display interval. This is the minimum amount of time the display is scrolled.

17) The ABB 2010 display consists of 2 lines, 7 characters each. Each line can be up to 7 characters of text (such as "PSIA"), or a register (such as "11.7.0").

18) The display format can be specified as "Width.Decimal". To display a floating point register with three decimal places, set the format to "7.3". To display two decimal places, set the format to "7.2". To display integer registers, set the format to "7.0".

19) The XMV application supports a maximum of eight (25) XMVs.

C.13 Therms Master Application Registers

The Therms Master application registers allow access to the G4 EX data items. Usage and notes are specific to the Therms Master application. Format for the register list is array#.register# description. Application number depends on the order of application instantiation. Actual array numbers for the Therms Master application are offset by 100. Low order array numbers are used for the Communication application, since the G4 EX application is derived from a Communication application. Refer to the Communication Application Register section.

C.13.1 Therms Master Btu Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
100.0	Components 7001 Read trigger.	Read/Write
100.1	Reset New Data trigger.	Read/Write
100.2	3001 Poll status.	Read/Write
100.3	3058 Write status.	Read/Write
100.4	7001 Poll status.	Read/Write
100.5	Use Index 0-15 or 16-31.	Read/Write
100.6	7017 Read trigger.	Read/Write
100.7	7017 Poll status.	Read/Write
100.8	7200 Poll status.	Read/Write
100.9	3001 Read trigger.	Read/Write
100.10	7200 Read trigger.	Read/Write

C.13.2 Therms Master Btu Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
101.0	Components Table #1 Index #1.	Read/Write
101.1	Components Table #1 Index #2.	Read/Write
101.2	Components Table #1 Index #3.	Read/Write
101.3	Components Table #1 Index #4.	Read/Write
101.4	Components Table #1 Index #5.	Read/Write
101.5	Components Table #1 Index #6.	Read/Write
101.6	Components Table #1 Index #7.	Read/Write
101.7	Components Table #1 Index #8.	Read/Write
101.8	Components Table #1 Index #9.	Read/Write
101.9	Components Table #1 Index #10.	Read/Write
101.10	Components Table #1 Index #11.	Read/Write
101.11	Components Table #1 Index #12.	Read/Write
101.12	Components Table #1 Index #13.	Read/Write
101.13	Components Table #1 Index #14.	Read/Write
101.14	Components Table #1 Index #15.	Read/Write
101.15	Components Table #1 Index #16.	Read/Write
101.16	Components Table #2 Index #1.	Read/Write
101.17	Components Table #2 Index #2.	Read/Write
101.18	Components Table #2 Index #3.	Read/Write
101.19	Components Table #2 Index #4.	Read/Write
101.20	Components Table #2 Index #5.	Read/Write
101.21	Components Table #2 Index #6.	Read/Write
101.22	Components Table #2 Index #7.	Read/Write
101.23	Components Table #2 Index #8.	Read/Write
101.24	Components Table #2 Index #9.	Read/Write
101.25	Components Table #2 Index #10.	Read/Write
101.26	Components Table #2 Index #11.	Read/Write
101.27	Components Table #2 Index #12.	Read/Write
101.28	Components Table #2 Index #13.	Read/Write
101.29	Components Table #2 Index #14.	Read/Write
101.30	Components Table #2 Index #15.	Read/Write
101.31	Components Table #2 Index #16.	Read/Write
101.32	Analysis time.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
101.33	Current Stream	Read/Write
101.34	Stream Mask.	Read/Write
101.35	Current Month.	Read/Write
101.36	Current Day.	Read/Write
101.37	Current Year.	Read/Write
101.38	Current Hour	Read/Write
101.39	Current Minutes	Read/Write
101.40	Cycle time start Month	Read/Write
101.41	Cycle time start Day	Read/Write
101.42	Cycle time start Year	Read/Write
101.43	Cycle time start Hour	Read/Write
101.44	Cycle time start Minutes	Read/Write
101.45	Bit Flags Transmitter	Read/Write
101.46	Bit Flags Transmitter	Read/Write
101.47	Bit Flags Stream 1 Low	Read/Write
101.48	Bit Flags Stream 1 High	Read/Write
101.49	Bit Flags Stream 2Low	Read/Write
101.50	Bit Flags Stream 2 High	Read/Write
101.51	Bit Flags Stream 3Low	Read/Write
101.52	Bit Flags Stream 3 High	Read/Write
101.53	Bit Flags Stream 4 Low	Read/Write
101.54	Bit Flags Stream 4 High	Read/Write
101.55	Bit Flags Stream 5 Low	Read/Write
101.56	Bit Flags Stream 5 High	Read/Write
101.57	New Data Flag	Read/Write
101.58	Cal/Analysis Flag	Read/Write
101.59	Cal/Analysis Flag	Read/Write

C.13.3 Therms Master Btu Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
102.0	Mole % - Component #1	Read/Write
102.1	Mole % - Component #2	Read/Write
102.2	Mole % - Component #3	Read/Write
102.3	Mole % - Component #4	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
102.4	Mole % - Component #5	Read/Write
102.5	Mole % - Component #6	Read/Write
102.6	Mole % - Component #7	Read/Write
102.7	Mole % - Component #8	Read/Write
102.8	Mole % - Component #9	Read/Write
102.9	Mole % - Component #10	Read/Write
102.10	Mole % - Component #11	Read/Write
102.11	Mole % - Component #12	Read/Write
102.12	Mole % - Component #13	Read/Write
102.13	Mole % - Component #14	Read/Write
102.14	Mole % - Component #15	Read/Write
102.15	Mole % - Component #4	Read/Write
102.16	GPM - Component #1	Read/Write
102.17	GPM - Component #2	Read/Write
102.18	GPM - Component #3	Read/Write
102.19	GPM - Component #4	Read/Write
102.20	GPM - Component #5	Read/Write
102.21	GPM - Component #6	Read/Write
102.22	GPM - Component #7	Read/Write
102.23	GPM - Component #8	Read/Write
102.24	GPM - Component #9	Read/Write
102.25	GPM - Component #10	Read/Write
102.26	GPM - Component #11	Read/Write
102.27	GPM - Component #12	Read/Write
102.28	GPM - Component #13	Read/Write
102.29	GPM - Component #14	Read/Write
102.30	GPM - Component #15	Read/Write
102.31	GPM - Component #16	Read/Write
102.32	Btu Dry.	Read/Write
102.33	Btu Saturated	Read/Write
102.34	Specific Gravity	Read/Write
102.35	Compressibility	Read/Write
102.36	Wobbe Index	Read/Write
102.37	Total Un-normalized mole	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
102.38	Total GPM	Read/Write
102.39	Ratio#1 - Unused	Read/Write

C.13.4 Therms Master Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
103.0	N2 – Btu Stream Component.	Read/Write
103.1	CO2 – Btu Stream Component.	Read/Write
103.2	H2S – Btu Stream Component.	Read/Write
103.3	H2O – Btu Stream Component.	Read/Write
103.4	HE – Btu Stream Component.	Read/Write
103.5	C1 – Btu Stream Component.	Read/Write
103.6	C2 – Btu Stream Component.	Read/Write
103.7	C3 – Btu Stream Component.	Read/Write
103.8	NC4 – Btu Stream Component.	Read/Write
103.9	IC4 – Btu Stream Component.	Read/Write
103.10	NC5 – Btu Stream Component.	Read/Write
103.11	IC5 – Btu Stream Component.	Read/Write
103.12	NC6 – Btu Stream Component.	Read/Write
103.13	NC7 – Btu Stream Component.	Read/Write
103.14	NC8 – Btu Stream Component.	Read/Write
103.15	NC9 – Btu Stream Component.	Read/Write
103.16	NC10 – Btu Stream Component.	Read/Write
103.17	O2 – Btu Stream Component.	Read/Write
103.18	CO – Btu Stream Component.	Read/Write
103.19	H2 – Btu Stream Component.	Read/Write
103.20	AR – Btu Stream Component.	Read/Write
103.21	AIR – Btu Stream Component.	Read/Write
103.22	C6PLUS – Btu Stream Component.	Read/Write
103.23	BTU – Btu Stream Component.	Read/Write
103.24	GF – Btu Stream Component.	Read/Write
103.25	SGF – Btu Stream Component.	Read/Write
103.26	CPCV – Btu Stream Component.	Read/Write
103.27	VISCOSITY – Btu Stream Component.	Read/Write
103.28	DENSITY – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
103.29	FT – Btu Stream Component.	Read/Write
103.30	FP – Btu Stream Component.	Read/Write
103.31	C7PLUS – Btu Stream Component.	Read/Write
103.32	C8PLUS – Btu Stream Component.	Read/Write
103.33	H2OCONTENT – Btu Stream Component.	Read/Write
103.34	H2OBIAS – Btu Stream Component.	Read/Write
103.35	EOAXMAP – Btu Stream Component.	Read/Write
103.36	NEOC5 – Btu Stream Component.	Read/Write
103.37	C3PRIME – Btu Stream Component.	Read/Write
103.38	C4PLUS – Btu Stream Component.	Read/Write
103.39	SATBTU – Btu Stream Component.	Read/Write
103.40	Z – Btu Stream Component.	Read/Write
103.41	WOBBE – Btu Stream Component.	Read/Write
103.42	STREAM NUMBER.	Read/Write
103.43	STREAM TIME.	Read/Write

C.13.5 Therms Master Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
104.0	N2 – Btu Stream Component.	Read/Write
104.1	CO2 – Btu Stream Component.	Read/Write
104.2	H2S – Btu Stream Component.	Read/Write
104.3	H2O – Btu Stream Component.	Read/Write
104.4	HE – Btu Stream Component.	Read/Write
104.5	C1 – Btu Stream Component.	Read/Write
104.6	C2 – Btu Stream Component.	Read/Write
104.7	C3 – Btu Stream Component.	Read/Write
104.8	NC4 – Btu Stream Component.	Read/Write
104.9	IC4 – Btu Stream Component.	Read/Write
104.10	NC5 – Btu Stream Component.	Read/Write
104.11	IC5 – Btu Stream Component.	Read/Write
104.12	NC6 – Btu Stream Component.	Read/Write
104.13	NC7 – Btu Stream Component.	Read/Write
104.14	NC8 – Btu Stream Component.	Read/Write
104.15	NC9 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
104.16	NC10 – Btu Stream Component.	Read/Write
104.17	O2 – Btu Stream Component.	Read/Write
104.18	CO – Btu Stream Component.	Read/Write
104.19	H2 – Btu Stream Component.	Read/Write
104.20	AR – Btu Stream Component.	Read/Write
104.21	AIR – Btu Stream Component.	Read/Write
104.22	C6PLUS – Btu Stream Component.	Read/Write
104.23	BTU – Btu Stream Component.	Read/Write
104.24	GF – Btu Stream Component.	Read/Write
104.25	SGF – Btu Stream Component.	Read/Write
104.26	CPCV – Btu Stream Component.	Read/Write
104.27	VISCOSITY – Btu Stream Component.	Read/Write
104.28	DENSITY – Btu Stream Component.	Read/Write
104.29	FT – Btu Stream Component.	Read/Write
104.30	FP – Btu Stream Component.	Read/Write
104.31	C7PLUS – Btu Stream Component.	Read/Write
104.32	C8PLUS – Btu Stream Component.	Read/Write
104.33	H2OCONTENT – Btu Stream Component.	Read/Write
104.34	H2OBIAS – Btu Stream Component.	Read/Write
104.35	EOAXMAP – Btu Stream Component.	Read/Write
104.36	NEOC5 – Btu Stream Component.	Read/Write
104.37	C3PRIME – Btu Stream Component.	Read/Write
104.38	C4PLUS – Btu Stream Component.	Read/Write
104.39	SATBTU – Btu Stream Component.	Read/Write
104.40	Z – Btu Stream Component.	Read/Write
104.41	WOBBE – Btu Stream Component.	Read/Write
104.42	STREAM NUMBER.	Read/Write
104.43	STREAM TIME.	Read/Write

C.13.6 Therms Master Stream 3 Float Register

ARRAY.REGISTER	DESCRIPTION	USAGE
105.0	N2 – Btu Stream Component.	Read/Write
105.1	CO2 – Btu Stream Component.	Read/Write
105.2	H2S – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
105.3	H2O – Btu Stream Component.	Read/Write
105.4	HE – Btu Stream Component.	Read/Write
105.5	C1 – Btu Stream Component.	Read/Write
105.6	C2 – Btu Stream Component.	Read/Write
105.7	C3 – Btu Stream Component.	Read/Write
105.8	NC4 – Btu Stream Component.	Read/Write
105.9	IC4 – Btu Stream Component.	Read/Write
105.10	NC5 – Btu Stream Component.	Read/Write
105.11	IC5 – Btu Stream Component.	Read/Write
105.12	NC6 – Btu Stream Component.	Read/Write
105.13	NC7 – Btu Stream Component.	Read/Write
105.14	NC8 – Btu Stream Component.	Read/Write
105.15	NC9 – Btu Stream Component.	Read/Write
105.16	NC10 – Btu Stream Component.	Read/Write
105.17	O2 – Btu Stream Component.	Read/Write
105.18	CO – Btu Stream Component.	Read/Write
105.19	H2 – Btu Stream Component.	Read/Write
105.20	AR – Btu Stream Component.	Read/Write
105.21	AIR – Btu Stream Component.	Read/Write
105.22	C6PLUS – Btu Stream Component.	Read/Write
105.23	BTU – Btu Stream Component.	Read/Write
105.24	GF – Btu Stream Component.	Read/Write
105.25	SGF – Btu Stream Component.	Read/Write
105.26	CPCV – Btu Stream Component.	Read/Write
105.27	VISCOSITY – Btu Stream Component.	Read/Write
105.28	DENSITY – Btu Stream Component.	Read/Write
105.29	FT – Btu Stream Component.	Read/Write
105.30	FP – Btu Stream Component.	Read/Write
105.31	C7PLUS – Btu Stream Component.	Read/Write
105.32	C8PLUS – Btu Stream Component.	Read/Write
105.33	H2OCONTENT – Btu Stream Component.	Read/Write
105.34	H2OBIAS – Btu Stream Component.	Read/Write
105.35	EOAXMAP – Btu Stream Component.	Read/Write
105.36	NEOC5 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
105.37	C3PRIME – Btu Stream Component.	Read/Write
105.38	C4PLUS – Btu Stream Component.	Read/Write
105.39	SATBTU – Btu Stream Component.	Read/Write
105.40	Z – Btu Stream Component.	Read/Write
105.41	WOBBE – Btu Stream Component.	Read/Write
105.42	STREAM NUMBER.	Read/Write
105.43	STREAM TIME.	Read/Write

C.13.7 Therms Master Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
106.0	N2 – Btu Stream Component.	Read/Write
106.1	CO2 – Btu Stream Component.	Read/Write
106.2	H2S – Btu Stream Component.	Read/Write
106.3	H2O – Btu Stream Component.	Read/Write
106.4	HE – Btu Stream Component.	Read/Write
106.5	C1 – Btu Stream Component.	Read/Write
106.6	C2 – Btu Stream Component.	Read/Write
106.7	C3 – Btu Stream Component.	Read/Write
106.8	NC4 – Btu Stream Component.	Read/Write
106.9	IC4 – Btu Stream Component.	Read/Write
106.10	NC5 – Btu Stream Component.	Read/Write
106.11	IC5 – Btu Stream Component.	Read/Write
106.12	NC6 – Btu Stream Component.	Read/Write
106.13	NC7 – Btu Stream Component.	Read/Write
106.14	NC8 – Btu Stream Component.	Read/Write
106.15	NC9 – Btu Stream Component.	Read/Write
106.16	NC10 – Btu Stream Component.	Read/Write
106.17	O2 – Btu Stream Component.	Read/Write
106.18	CO – Btu Stream Component.	Read/Write
106.19	H2 – Btu Stream Component.	Read/Write
106.20	AR – Btu Stream Component.	Read/Write
106.21	AIR – Btu Stream Component.	Read/Write
106.22	C6PLUS – Btu Stream Component.	Read/Write
106.23	BTU – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
106.24	GF – Btu Stream Component.	Read/Write
106.25	SGF – Btu Stream Component.	Read/Write
106.26	CPCV – Btu Stream Component.	Read/Write
106.27	VISCOSITY – Btu Stream Component.	Read/Write
106.28	DENSITY – Btu Stream Component.	Read/Write
106.29	FT – Btu Stream Component.	Read/Write
106.30	FP – Btu Stream Component.	Read/Write
106.31	C7PLUS – Btu Stream Component.	Read/Write
106.32	C8PLUS – Btu Stream Component.	Read/Write
106.33	H2OCONTENT – Btu Stream Component.	Read/Write
106.34	H2OBIAS – Btu Stream Component.	Read/Write
106.35	EOAXMAP – Btu Stream Component.	Read/Write
106.36	NEOC5 – Btu Stream Component.	Read/Write
106.37	C3PRIME – Btu Stream Component.	Read/Write
106.38	C4PLUS – Btu Stream Component.	Read/Write
106.39	SATBTU – Btu Stream Component.	Read/Write
106.40	Z – Btu Stream Component.	Read/Write
106.41	WOBBE – Btu Stream Component.	Read/Write
106.42	STREAM NUMBER.	Read/Write
106.43	STREAM TIME.	Read/Write

C.13.8 Therms Master Btu Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
107.0	Master Stream ID.	Read/Write- see note 1

C.13.8.1 Therms Master Notes

1) Stream Id Bits:

Bit 0 : No/Yes(0/1) – Send stream 1 to this slave
Bit 1 : No/Yes(0/1) – Send stream 2 to this slave
Bit 2 : No/Yes(0/1) – Send stream 3 to this slave
Bit 3 : No/Yes(0/1) – Send stream 4 to this slave

C.13.9 Therms Master Btu Var Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
108.0	N/A	
108.1	Current Stream 1 Time.	Read/Write
108.2	Current Stream 2 Time.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
108.3	Current Stream 3 Time.	Read/Write
108.4	Current Stream 4 Time.	Read/Write
108.5	Elapsed Stream 1 Time.	Read/Write
108.6	Elapsed Stream 2 Time.	Read/Write
108.7	Elapsed Stream 3 Time.	Read/Write
108.8	Elapsed Stream 4 Time.	Read/Write

C.13.10 Therms Master Slave Data Trigger Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
109.0	Slave Data Send Trigger.	Read/Write

Note: For succeeding s;aves, the register offset for each slave = (slavenum*1) + Index. Example: The index register for the slave data trigger for slave 2 = (1*1) + 0.

C.13.11 Therms Master Current Stream Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
110.0	N2 – Btu Stream Component.	Read/Write
110.1	CO2 – Btu Stream Component.	Read/Write
110.2	H2S – Btu Stream Component.	Read/Write
110.3	H2O – Btu Stream Component.	Read/Write
110.4	HE – Btu Stream Component.	Read/Write
110.5	C1 – Btu Stream Component.	Read/Write
110.6	C2 – Btu Stream Component.	Read/Write
110.7	C3 – Btu Stream Component.	Read/Write
110.8	NC4 – Btu Stream Component.	Read/Write
110.9	IC4 – Btu Stream Component.	Read/Write
110.10	NC5 – Btu Stream Component.	Read/Write
110.11	IC5 – Btu Stream Component.	Read/Write
110.12	NC6 – Btu Stream Component.	Read/Write
110.13	NC7 – Btu Stream Component.	Read/Write
110.14	NC8 – Btu Stream Component.	Read/Write
110.15	NC9 – Btu Stream Component.	Read/Write
110.16	NC10 – Btu Stream Component.	Read/Write
110.17	O2 – Btu Stream Component.	Read/Write
110.18	CO – Btu Stream Component.	Read/Write
110.19	H2 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
110.20	AR – Btu Stream Component.	Read/Write
110.21	AIR – Btu Stream Component.	Read/Write
110.22	C6PLUS – Btu Stream Component.	Read/Write
110.23	BTU – Btu Stream Component.	Read/Write
110.24	GF – Btu Stream Component.	Read/Write
110.25	SGF – Btu Stream Component.	Read/Write
110.26	CPCV – Btu Stream Component.	Read/Write
110.27	VISCOSITY – Btu Stream Component.	Read/Write
110.28	DENSITY – Btu Stream Component.	Read/Write
110.29	FT – Btu Stream Component.	Read/Write
110.30	FP – Btu Stream Component.	Read/Write
110.31	C7PLUS – Btu Stream Component.	Read/Write
110.32	C8PLUS – Btu Stream Component.	Read/Write
110.33	H2OCONTENT – Btu Stream Component.	Read/Write
110.34	H2OBIAS – Btu Stream Component.	Read/Write
110.35	EOAXMAP – Btu Stream Component.	Read/Write
110.36	NEOC5 – Btu Stream Component.	Read/Write
110.37	C3PRIME – Btu Stream Component.	Read/Write
110.38	C4PLUS – Btu Stream Component.	Read/Write
110.39	SATBTU – Btu Stream Component.	Read/Write
110.40	Z – Btu Stream Component.	Read/Write
110.41	WOBBE – Btu Stream Component.	Read/Write
110.42	STREAM NUMBER.	Read/Write
110.43	STREAM TIME.	Read/Write

C.13.12   Therms Master Slave Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
111.0	Slave Steam Id.	Read/Write

Note: For succeeding slaves, the register offset for each slave = (slavenum * 1) + Index.

Example: Index register for slave stream ID for slave 2 = (1 * 1) + 0

Stream Id Bits:

Bit 0 : No/Yes(0/1) – Send stream 1 to this slave

Bit 1 : No/Yes(0/1) – Send stream 2 to this slave

Bit 2 : No/Yes(0/1) – Send stream 3 to this slave

C.13.13 Therms Master Stream Time String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
112.0	Current Stream 1 Time, String formatted.	Read
112.1	Current Stream 2Time, String formatted.	Read
112.2	Current Stream 3 Time, String formatted.	Read
112.3	Current Stream 4 Time, String formatted.	Read

C.13.14 Therms Master Slave Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
113.0	Slave Data Send Status.	Read/Write

Note: For succeeding slaves, the register offset for each slave = (slavenum*1) + Index. Index register for slave data send status for slave 2 = (1*1) + 0.

C.14 Therms Display Registers

114.0	Analyzer Alarm, string based on value in App.115.17, 0 = "Normal", Not 0 = "Fault"	Read
114.1	Stream 1 Alarm, string based on value in App.115.24, 0 = "Normal", Not 0 = "Fault"	Read
114.2	Stream 2 Alarm, string based on value in App.115.25, 0 = "Normal", Not 0 = "Fault"	Read
114.3	Stream 3 Alarm, string based on value in app.115.26, 0 = "Normal", Not 0 = "Fault"	Read
114.4	Stream 4 Alarm, string based on value in App.115.27, 0 = "Normal", Not 0 = "Fault"	Read
114.5	Analyzer Mode, string based on value in App.101.59, 1 = "Hold", 2 = "Run", 3 = "SingleCycle", 4 = "Abort", 5 = "Calibrate", 6 = "StartUp".	Read
114.6	Helium Psi, string based on value in App.115.11, 0 = "Normal", Not 0 = "Low"	Read
114.7	Cal Psi, string based on value in App.115.12, 0 = "Normal", Not 0 = "Low"	Read

C.14.1 Therms Staus Btu Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
115.0	Set Next State(3061)	Read/Write
115.1	Auto Calibration during startup	Read/Write
115.2	Auto Peak Detection during startup	Read/Write
115.3	Auto Run after startup	Read/Write
115.4	Number of Calibration cycles	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
115.5	Number of Calibration cycles to Average	Read/Write
115.6	Low Carrier Mode.	Read/Write
115.7	Low Power Mode.	Read/Write
115.8	Pre-Purge Selection.	Read/Write
115.9	Normal Status.	Read/Write
115.10	Fault Status.	Read/Write
115.11	Carrier Bottle Low.(3072	Read/Write
115.12	Calibration Bottle Low.(3073)	Read/Write
115.13	Manually Update Response Factors	Read/Write
115.14	Auto Update Response Factors Selection	Read/Write
115.15	Disable Stream Switching.	Read/Write
115.16	Transmitter Current Warning	Read/Write
115.17	Transmitter Current Fault.(3078)	Read/Write
115.18	Transmitter Initial Warning.	Read/Write
115.19	Transmitter Initial Fault	Read/Write
115.20	Stream 1 Current Warning	Read/Write
115.21	Stream 1 Current Warning	Read/Write
115.22	Stream 1 Current Warning	Read/Write
115.23	Stream 1 Current Warning	Read/Write
115.24	Stream 1 Current Fault(3085)	Read/Write
115.25	Stream 2 Current Fault(3086)	Read/Write
115.26	Stream 3 Current Fault.(3087)	Read/Write
115.27	Stream 4 Current Fault(3088).	Read/Write

C.14.2 Therms Status Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
116.0	Ground Ref. (7200)	Read/Write
116.1	Power- Battery Voltage (7201)	Read/Write
116.2	Mandrel Temp (7202)	Read/Write
116.3	Carrier Press. (7203)	Read/Write
116.4	Aux. Press. (7204)	Read/Write
116.5	AI-6 Spare (7205)	Read/Write
116.6	Ambient Temp(7206)	Read/Write
116.7	Voltage Ref. (7207)	Read/Write

C.14.3 Therms Stream SN Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
117.0	New Data Stream 1	Read/Write
117.1	New Data Stream 2	Read/Write
117.2	New Data Stream 3	Read/Write
117.3	New Data Stream 4	Read/Write

C.14.4 Therms Master Component Xref Index Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
118.0	Components Index Xref Index #1.	Read/Write
118.1	Components Index Xref Index #2.	Read/Write
118.2	Components Index Xref Index #3.	Read/Write
118.3	Components Index Xref Index #4.	Read/Write
118.4	Components Index Xref Index #5.	Read/Write
118.5	Components Index Xref Index #6.	Read/Write
118.6	Components Index Xref Index #7.	Read/Write
118.7	Components Index Xref Index #8.	Read/Write
118.8	Components Index Xref Index #9.	Read/Write
118.9	Components Index Xref Index #10	Read/Write
118.10	Components Index Xref Index #11	Read/Write
118.11	Components Index Xref Index #12	Read/Write
118.12	Components Index Xref Index #13	Read/Write
118.13	Components Index Xref Index #14	Read/Write
118.14	Components Index Xref Index #15	Read/Write
118.15	Components Index Xref Index #16	Read/Write
118.16	Components Index Xref Index #17	Read/Write
118.17	Components Index Xref Index #18	Read/Write
118.18	Components Index Xref Index #19	Read/Write
118.19	Components Index Xref Index #20.	Read/Write
118.20	Components Index Xref Index #21.	Read/Write
118.21	Components Index Xref Index #22.	Read/Write
118.22	Components Index Xref Index #23.	Read/Write
118.23	Components Index Xref Index #24.	Read/Write
118.24	Components Index Xref Index #25.	Read/Write
118.25	Components Index Xref Index #26.	Read/Write
118.26	Components Index Xref Index #27.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
118.27	Components Index Xref Index #28.	Read/Write
118.28	Components Index Xref Index #29.	Read/Write
118.29	Components Index Xref Index #30.	Read/Write
118.30	Components Index Xref Index #31.	Read/Write
118.31	Components Index Xref Index #32.	Read/Write

C.14.5 Therms Master Btu Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
119.0	Stream 1 Source App.	Read/Write
119.1	Stream 2 Source App.	Read/Write
119.2	Stream 3 Source App.	Read/Write
119.3	Stream 4 Source App.	Read/Write
119.4	Use Data From Source (Therms or NGC).	Read/Write
119.5	Stream 1 NGC Trigger.	Read/Write
119.6	Stream 2 NGC Trigger.	Read/Write
119.7	Stream 3 NGC Trigger.	Read/Write
119.8	Stream 4 NGC Trigger.	Read/Write
119.9	Therms Master MB Address.	Read/Write
119.10	Scan Enable 3001.	Read/Write
119.11	Scan Enable 7200.	Read/Write
119.12	Scan Enable 7001.	Read/Write
119.13	Scan Enable 7017.	Read/Write
119.14	Scan Enable 3058.	Read/Write
119.15	Use ABB Scan or 2251 Scans.	Read/Write
119.16	Use New Data Flag or Cycle Time	Read/Write

C.14.6 Therms Master Component Xrefed Index Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
120.0	Components Index Xrefed Index #1.	Read/Write
120.1	Components Index Xrefed Index #2.	Read/Write
120.2	Components Index Xrefed Index #3.	Read/Write
120.3	Components Index Xrefed Index #4.	Read/Write
120.4	Components Index Xrefed Index #5.	Read/Write
120.5	Components Index Xrefed Index #6.	Read/Write
120.6	Components Index Xrefed Index #7.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
120.7	Components Index Xrefed Index #8.	Read/Write
120.8	Components Index Xrefed Index #9.	Read/Write
120.9	Components Index Xrefed Index #10	Read/Write
120.10	Components Index Xrefed Index #11	Read/Write
120.11	Components Index Xrefed Index #12	Read/Write
120.12	Components Index Xrefed Index #13	Read/Write
120.13	Components Index Xrefed Index #14	Read/Write
120.14	Components Index Xrefed Index #15	Read/Write
120.15	Components Index Xrefed Index #16	Read/Write
120.16	Components Index Xrefed Index #17	Read/Write
120.17	Components Index Xrefed Index #18	Read/Write
120.18	Components Index Xrefed Index #19	Read/Write
120.19	Components Index Xrefed Index #20.	Read/Write
120.20	Components Index Xrefed Index #21.	Read/Write
120.21	Components Index Xrefed Index #22.	Read/Write
120.22	Components Index Xrefed Index #23.	Read/Write
120.23	Components Index Xrefed Index #24.	Read/Write
120.24	Components Index Xrefed Index #25.	Read/Write
120.25	Components Index Xrefed Index #26.	Read/Write
120.26	Components Index Xrefed Index #27.	Read/Write
120.27	Components Index Xrefed Index #28.	Read/Write
120.28	Components Index Xrefed Index #29.	Read/Write
120.29	Components Index Xrefed Index #30.	Read/Write
120.30	Components Index Xrefed Index #31.	Read/Write
120.31	Components Index Xrefed Index #32.	Read/Write

C.14.7 Therms Slave Var Modbus Address Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
121.0	Slave Modbus Address.	Read/Write

Note: For succeeding slaves, the register offset for each slave = (slavenum*1) + Index. Index register for slave data trigger for slave 2 = (1*1) + 0.

C.14.8 Therms Slave Var Modbus Address Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
122.0	Slave Scan Enable.	Read/Write

Note: For succeeding slaves, the register offset for each slave = (slavenum*1) + Index. Index register for slave data trigger for slave 2 = (1*1) + 0.

C.14.9 Therms Interface Control Get Request Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
123.0	Therms Master Interface Control Get Request Register	Read/Write

C.14.10 Therms Master Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
124.0	Scan Time for 3001	Read/Write
124.1	Scan Time for 7200	Read/Write

C.14.11 Therms Slave Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
251.0	N2 – Btu Stream Component.	Read/Write
251.1	CO2 – Btu Stream Component.	Read/Write
251.2	H2S – Btu Stream Component.	Read/Write
251.3	H2O – Btu Stream Component.	Read/Write
251.4	HE – Btu Stream Component.	Read/Write
251.5	C1 – Btu Stream Component.	Read/Write
251.6	C2 – Btu Stream Component.	Read/Write
251.7	C3 – Btu Stream Component.	Read/Write
251.8	NC4 – Btu Stream Component.	Read/Write
251.9	IC4 – Btu Stream Component.	Read/Write
251.10	NC5 – Btu Stream Component.	Read/Write
251.11	IC5 – Btu Stream Component.	Read/Write
251.12	NC6 – Btu Stream Component.	Read/Write
251.13	NC7 – Btu Stream Component.	Read/Write
251.14	NC8 – Btu Stream Component.	Read/Write
251.15	NC9 – Btu Stream Component.	Read/Write
251.16	NC10 – Btu Stream Component.	Read/Write
251.17	O2 – Btu Stream Component.	Read/Write
251.18	CO – Btu Stream Component.	Read/Write
251.19	H2 – Btu Stream Component.	Read/Write
251.20	AR – Btu Stream Component.	Read/Write
251.21	AIR – Btu Stream Component.	Read/Write
251.22	C6PLUS – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
251.23	BTU – Btu Stream Component.	Read/Write
251.24	GF – Btu Stream Component.	Read/Write
251.25	NEOC5 – Btu Stream Component.	Read/Write

C.14.12 Therms Slave Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
252.0	N2 – Btu Stream Component.	Read/Write
252.1	CO2 – Btu Stream Component.	Read/Write
252.2	H2S – Btu Stream Component.	Read/Write
252.3	H2O – Btu Stream Component.	Read/Write
252.4	HE – Btu Stream Component.	Read/Write
252.5	C1 – Btu Stream Component.	Read/Write
252.6	C2 – Btu Stream Component.	Read/Write
252.7	C3 – Btu Stream Component.	Read/Write
252.8	NC4 – Btu Stream Component.	Read/Write
252.9	IC4 – Btu Stream Component.	Read/Write
252.10	NC5 – Btu Stream Component.	Read/Write
252.11	IC5 – Btu Stream Component.	Read/Write
252.12	NC6 – Btu Stream Component.	Read/Write
252.13	NC7 – Btu Stream Component.	Read/Write
252.14	NC8 – Btu Stream Component.	Read/Write
252.15	NC9 – Btu Stream Component.	Read/Write
252.16	NC10 – Btu Stream Component.	Read/Write
252.17	O2 – Btu Stream Component.	Read/Write
252.18	CO – Btu Stream Component.	Read/Write
252.19	H2 – Btu Stream Component.	Read/Write
252.20	AR – Btu Stream Component.	Read/Write
252.21	AIR – Btu Stream Component.	Read/Write
252.22	C6PLUS – Btu Stream Component.	Read/Write
252.23	BTU – Btu Stream Component.	Read/Write
252.24	GF – Btu Stream Component.	Read/Write
252.25	NEOC5 – Btu Stream Component.	Read/Write

C.14.13 Therms Slave Stream 3 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE

ARRAY.REGISTER	DESCRIPTION	USAGE
253.0	N2 – Btu Stream Component.	Read/Write
253.1	CO2 – Btu Stream Component.	Read/Write
253.2	H2S – Btu Stream Component.	Read/Write
253.3	H2O – Btu Stream Component.	Read/Write
253.4	HE – Btu Stream Component.	Read/Write
253.5	C1 – Btu Stream Component.	Read/Write
253.6	C2 – Btu Stream Component.	Read/Write
253.7	C3 – Btu Stream Component.	Read/Write
253.8	NC4 – Btu Stream Component.	Read/Write
253.9	IC4 – Btu Stream Component.	Read/Write
253.10	NC5 – Btu Stream Component.	Read/Write
253.11	IC5 – Btu Stream Component.	Read/Write
253.12	NC6 – Btu Stream Component.	Read/Write
253.13	NC7 – Btu Stream Component.	Read/Write
253.14	NC8 – Btu Stream Component.	Read/Write
253.15	NC9 – Btu Stream Component.	Read/Write
253.16	NC10 – Btu Stream Component.	Read/Write
253.17	O2 – Btu Stream Component.	Read/Write
253.18	CO – Btu Stream Component.	Read/Write
253.19	H2 – Btu Stream Component.	Read/Write
253.20	AR – Btu Stream Component.	Read/Write
253.21	AIR – Btu Stream Component.	Read/Write
253.22	C6PLUS – Btu Stream Component.	Read/Write
253.23	BTU – Btu Stream Component.	Read/Write
253.24	GF – Btu Stream Component.	Read/Write
253.25	NEOC5 – Btu Stream Component.	Read/Write

C.14.14　　　Therms Master Slave Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
254.0	N2 – Btu Stream Component.	Read/Write
254.1	CO2 – Btu Stream Component.	Read/Write
254.2	H2S – Btu Stream Component.	Read/Write
254.3	H2O – Btu Stream Component.	Read/Write
254.4	HE – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
254.5	C1 – Btu Stream Component.	Read/Write
254.6	C2 – Btu Stream Component.	Read/Write
254.7	C3 – Btu Stream Component.	Read/Write
254.8	NC4 – Btu Stream Component.	Read/Write
254.9	IC4 – Btu Stream Component.	Read/Write
254.10	NC5 – Btu Stream Component.	Read/Write
254.11	IC5 – Btu Stream Component.	Read/Write
254.12	NC6 – Btu Stream Component.	Read/Write
254.13	NC7 – Btu Stream Component.	Read/Write
254.14	NC8 – Btu Stream Component.	Read/Write
254.15	NC9 – Btu Stream Component.	Read/Write
254.16	NC10 – Btu Stream Component.	Read/Write
254.17	O2 – Btu Stream Component.	Read/Write
254.18	CO – Btu Stream Component.	Read/Write
254.19	H2 – Btu Stream Component.	Read/Write
254.20	AR – Btu Stream Component.	Read/Write
254.21	AIR – Btu Stream Component.	Read/Write
254.22	C6PLUS – Btu Stream Component.	Read/Write
254.23	BTU – Btu Stream Component.	Read/Write
254.24	GF – Btu Stream Component.	Read/Write
254.25	NEOC5 – Btu Stream Component.	Read/Write

C.14.15 Therms Master Slave Analysis Trend File

ARRAY.REGISTER	DESCRIPTION	USAGE
255.0	N2 – Btu Stream Component.	Read/Write
255.1	CO2 – Btu Stream Component.	Read/Write
255.2	H2S – Btu Stream Component.	Read/Write
255.3	H2O – Btu Stream Component.	Read/Write
255.4	HE – Btu Stream Component.	Read/Write
255.5	C1 – Btu Stream Component.	Read/Write
255.6	C2 – Btu Stream Component.	Read/Write
255.7	C3 – Btu Stream Component.	Read/Write
255.8	NC4 – Btu Stream Component.	Read/Write
255.9	IC4 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
255.10	NC5 – Btu Stream Component.	Read/Write
255.11	IC5 – Btu Stream Component.	Read/Write
255.12	NC6 – Btu Stream Component.	Read/Write
255.13	NC7 – Btu Stream Component.	Read/Write
255.14	NC8 – Btu Stream Component.	Read/Write
255.15	NC9 – Btu Stream Component.	Read/Write
255.16	NC10 – Btu Stream Component.	Read/Write
255.17	O2 – Btu Stream Component.	Read/Write
255.18	CO – Btu Stream Component.	Read/Write
255.19	H2 – Btu Stream Component.	Read/Write
255.20	AR – Btu Stream Component.	Read/Write
255.21	AIR – Btu Stream Component.	Read/Write
255.22	C6PLUS – Btu Stream Component.	Read/Write
255.23	BTU – Btu Stream Component.	Read/Write
255.24	GF – Btu Stream Component.	Read/Write
255.25	NEOC5 – Btu Stream Component.	Read/Write

C.15 Therms Slave Application Registers

The Therms Slave application registers allow access to the G4 EX data items. Usage and notes are specific to the Therms Slave application. Format for the register list is array#.register# description. The application number depends on the order of application instantiation. Actual array numbers for the Therms Slave application are offset by 100. Low order array numbers are used for the Communication application, since the LevelMaster application is derived from a Communication application. Refer to the Communication Application Register section.

C.15.1 Therms Slave Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
100.0	N2 – Btu Stream Component.	Read/Write
100.1	CO2 – Btu Stream Component.	Read/Write
100.2	H2S – Btu Stream Component.	Read/Write
100.3	H2O – Btu Stream Component.	Read/Write
100.4	HE – Btu Stream Component.	Read/Write
100.5	C1 – Btu Stream Component.	Read/Write
100.6	C2 – Btu Stream Component.	Read/Write
100.7	C3 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
100.8	NC4 – Btu Stream Component.	Read/Write
100.9	IC4 – Btu Stream Component.	Read/Write
100.10	NC5 – Btu Stream Component.	Read/Write
100.11	IC5 – Btu Stream Component.	Read/Write
100.12	NC6 – Btu Stream Component.	Read/Write
100.13	NC7 – Btu Stream Component.	Read/Write
100.14	NC8 – Btu Stream Component.	Read/Write
100.15	NC9 – Btu Stream Component.	Read/Write
100.16	NC10 – Btu Stream Component.	Read/Write
100.17	O2 – Btu Stream Component.	Read/Write
100.18	CO – Btu Stream Component.	Read/Write
100.19	H2 – Btu Stream Component.	Read/Write
100.20	AR – Btu Stream Component.	Read/Write
100.21	AIR – Btu Stream Component.	Read/Write
100.22	C6PLUS – Btu Stream Component.	Read/Write
100.23	BTU – Btu Stream Component.	Read/Write
100.24	GF – Btu Stream Component.	Read/Write
100.25	SGF – Btu Stream Component.	Read/Write
100.26	CPCV – Btu Stream Component.	Read/Write
100.27	VISCOSITY – Btu Stream Component.	Read/Write
100.28	DENSITY – Btu Stream Component.	Read/Write
100.29	FT – Btu Stream Component.	Read/Write
100.30	FP – Btu Stream Component.	Read/Write
100.31	C7PLUS – Btu Stream Component.	Read/Write
100.32	C8PLUS – Btu Stream Component.	Read/Write
100.33	H2OCONTENT – Btu Stream Component.	Read/Write
100.34	H2OBIAS – Btu Stream Component.	Read/Write
100.35	EOAXMAP – Btu Stream Component.	Read/Write
100.36	NEOC5 – Btu Stream Component.	Read/Write
100.37	C3PRIME – Btu Stream Component.	Read/Write
100.38	C4PLUS – Btu Stream Component.	Read/Write
100.39	SATBTU – Btu Stream Component.	Read/Write
100.40	Z – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
100.41	WOBBE – Btu Stream Component.	Read/Write
100.42	STREAM NUMBER.	Read/Write
100.43	STREAM TIME.	Read/Write

C.15.2 Therms Slave String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
101.0	String formatted stream time	Read

C.15.3 Therms Slave Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
102.0	New Data flag Stream1	Read
102.1	New Data flag Stream2	Read
102.2	New Data flag Stream3	Read
102.3	New Data flag Stream4	Read

C.15.4 Therms Slave Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
251.0	N2 – Btu Stream Component.	Read/Write
251.1	CO2 – Btu Stream Component.	Read/Write
251.2	H2S – Btu Stream Component.	Read/Write
251.3	H2O – Btu Stream Component.	Read/Write
251.4	HE – Btu Stream Component.	Read/Write
251.5	C1 – Btu Stream Component.	Read/Write
251.6	C2 – Btu Stream Component.	Read/Write
251.7	C3 – Btu Stream Component.	Read/Write
251.8	NC4 – Btu Stream Component.	Read/Write
251.9	IC4 – Btu Stream Component.	Read/Write
251.10	NC5 – Btu Stream Component.	Read/Write
251.11	IC5 – Btu Stream Component.	Read/Write
251.12	NC6 – Btu Stream Component.	Read/Write
251.13	NC7 – Btu Stream Component.	Read/Write
251.14	NC8 – Btu Stream Component.	Read/Write
251.15	NC9 – Btu Stream Component.	Read/Write
251.16	NC10 – Btu Stream Component.	Read/Write
251.17	O2 – Btu Stream Component.	Read/Write
251.18	CO – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
251.19	H2 – Btu Stream Component.	Read/Write
251.20	AR – Btu Stream Component.	Read/Write
251.21	AIR – Btu Stream Component.	Read/Write
251.22	C6PLUS – Btu Stream Component.	Read/Write
251.23	BTU – Btu Stream Component.	Read/Write
251.24	GF – Btu Stream Component.	Read/Write
251.25	NEOC5 – Btu Stream Component.	Read/Write

C.15.5 Therms Slave Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
252.0	N2 – Btu Stream Component.	Read/Write
252.1	CO2 – Btu Stream Component.	Read/Write
252.2	H2S – Btu Stream Component.	Read/Write
252.3	H2O – Btu Stream Component.	Read/Write
252.4	HE – Btu Stream Component.	Read/Write
252.5	C1 – Btu Stream Component.	Read/Write
252.6	C2 – Btu Stream Component.	Read/Write
252.7	C3 – Btu Stream Component.	Read/Write
252.8	NC4 – Btu Stream Component.	Read/Write
252.9	IC4 – Btu Stream Component.	Read/Write
252.10	NC5 – Btu Stream Component.	Read/Write
252.11	IC5 – Btu Stream Component.	Read/Write
252.12	NC6 – Btu Stream Component.	Read/Write
252.13	NC7 – Btu Stream Component.	Read/Write
252.14	NC8 – Btu Stream Component.	Read/Write
252.15	NC9 – Btu Stream Component.	Read/Write
252.16	NC10 – Btu Stream Component.	Read/Write
252.17	O2 – Btu Stream Component.	Read/Write
252.18	CO – Btu Stream Component.	Read/Write
252.19	H2 – Btu Stream Component.	Read/Write
252.20	AR – Btu Stream Component.	Read/Write
252.21	AIR – Btu Stream Component.	Read/Write
252.22	C6PLUS – Btu Stream Component.	Read/Write
252.23	BTU – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
252.24	GF – Btu Stream Component.	Read/Write
252.25	NEOC5 – Btu Stream Component.	Read/Write

C.15.6 Therms Slave Stream 3 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
253.0	N2 – Btu Stream Component.	Read/Write
253.1	CO2 – Btu Stream Component.	Read/Write
253.2	H2S – Btu Stream Component.	Read/Write
253.3	H2O – Btu Stream Component.	Read/Write
253.4	HE – Btu Stream Component.	Read/Write
253.5	C1 – Btu Stream Component.	Read/Write
253.6	C2 – Btu Stream Component.	Read/Write
253.7	C3 – Btu Stream Component.	Read/Write
253.8	NC4 – Btu Stream Component.	Read/Write
253.9	IC4 – Btu Stream Component.	Read/Write
253.10	NC5 – Btu Stream Component.	Read/Write
253.11	IC5 – Btu Stream Component.	Read/Write
253.12	NC6 – Btu Stream Component.	Read/Write
253.13	NC7 – Btu Stream Component.	Read/Write
253.14	NC8 – Btu Stream Component.	Read/Write
253.15	NC9 – Btu Stream Component.	Read/Write
253.16	NC10 – Btu Stream Component.	Read/Write
253.17	O2 – Btu Stream Component.	Read/Write
253.18	CO – Btu Stream Component.	Read/Write
253.19	H2 – Btu Stream Component.	Read/Write
253.20	AR – Btu Stream Component.	Read/Write
253.21	AIR – Btu Stream Component.	Read/Write
253.22	C6PLUS – Btu Stream Component.	Read/Write
253.23	BTU – Btu Stream Component.	Read/Write
253.24	GF – Btu Stream Component.	Read/Write
253.25	NEOC5 – Btu Stream Component.	Read/Write

C.15.7 Therms Slave Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
254.0	N2 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
254.1	CO2 – Btu Stream Component.	Read/Write
254.2	H2S – Btu Stream Component.	Read/Write
254.3	H2O – Btu Stream Component.	Read/Write
254.4	HE – Btu Stream Component.	Read/Write
254.5	C1 – Btu Stream Component.	Read/Write
254.6	C2 – Btu Stream Component.	Read/Write
254.7	C3 – Btu Stream Component.	Read/Write
254.8	NC4 – Btu Stream Component.	Read/Write
254.9	IC4 – Btu Stream Component.	Read/Write
254.10	NC5 – Btu Stream Component.	Read/Write
254.11	IC5 – Btu Stream Component.	Read/Write
254.12	NC6 – Btu Stream Component.	Read/Write
254.13	NC7 – Btu Stream Component.	Read/Write
254.14	NC8 – Btu Stream Component.	Read/Write
254.15	NC9 – Btu Stream Component.	Read/Write
254.16	NC10 – Btu Stream Component.	Read/Write
254.17	O2 – Btu Stream Component.	Read/Write
254.18	CO – Btu Stream Component.	Read/Write
254.19	H2 – Btu Stream Component.	Read/Write
254.20	AR – Btu Stream Component.	Read/Write
254.21	AIR – Btu Stream Component.	Read/Write
254.22	C6PLUS – Btu Stream Component.	Read/Write
254.23	BTU – Btu Stream Component.	Read/Write
254.24	GF – Btu Stream Component.	Read/Write
254.25	NEOC5 – Btu Stream Component.	Read/Write

C.15.8 Therms Slave Analysis Trend File

ARRAY.REGISTER	DESCRIPTION	USAGE
255.0	N2 – Btu Stream Component.	Read/Write
255.1	CO2 – Btu Stream Component.	Read/Write
255.2	H2S – Btu Stream Component.	Read/Write
255.3	H2O – Btu Stream Component.	Read/Write
255.4	HE – Btu Stream Component.	Read/Write
255.5	C1 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
255.6	C2 – Btu Stream Component.	Read/Write
255.7	C3 – Btu Stream Component.	Read/Write
255.8	NC4 – Btu Stream Component.	Read/Write
255.9	IC4 – Btu Stream Component.	Read/Write
255.10	NC5 – Btu Stream Component.	Read/Write
255.11	IC5 – Btu Stream Component.	Read/Write
255.12	NC6 – Btu Stream Component.	Read/Write
255.13	NC7 – Btu Stream Component.	Read/Write
255.14	NC8 – Btu Stream Component.	Read/Write
255.15	NC9 – Btu Stream Component.	Read/Write
255.16	NC10 – Btu Stream Component.	Read/Write
255.17	O2 – Btu Stream Component.	Read/Write
255.18	CO – Btu Stream Component.	Read/Write
255.19	H2 – Btu Stream Component.	Read/Write
255.20	AR – Btu Stream Component.	Read/Write
255.21	AIR – Btu Stream Component.	Read/Write
255.22	C6PLUS – Btu Stream Component.	Read/Write
255.23	BTU – Btu Stream Component.	Read/Write
255.24	GF – Btu Stream Component.	Read/Write
255.25	NEOC5 – Btu Stream Component.	Read/Write

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