2100802-001 (AB)

TOTALFLOW®

*X*Series Remote Controller

User's Manual

TOTALFLOW
MEASUREMENT & CONTROL SYSTEMS

ABB

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Introduction

About the Manual

This manual is written to provide an experienced flow meter technician with the requirements necessary to install, setup and operate a Totalflow XSeries Remote Controller System.

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 get a broad picture of the content without reading every word. Also, there are overviews at the beginning of each chapter that provides you with an idea of what is in the chapter, and how it fits into the overall manual.

Highlights This manual provides the following information:

Chapter	Description
1) System Description	Provides a description of the Totalflow, XSeries system components and specifications.
2) Installation	Includes unpacking and detailed procedures for setup and installation.
3) XRC Startup	Provides you with a tutorial on how to get a newly installed XRC system up and running.
4) Maintenance	Provides instructions on how to remove and replace major modules.
5) Troubleshooting	Provides a description of the XRC front panel error messages and provides a troubleshooting chart on how to correct most problems.
Appendix A: Modbus Register Table	Provides a listing of all valid Modbus Registers.
Appendix B: Definitions & Acronyms	Provides quick access to the majority of terms and abbreviations, as well as their definitions.
Appendix C: Drawings	Provides a place to put drawings that accompany a unit.

Getting Help

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

If you require assistance, call:

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

Before You Call

- Know your Totalflow's 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 problem.
- Know your software version, board and optional part numbers.

Key Symbols

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

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

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

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

WARNING Intended to draw your 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 Precaution" 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 Certification Drawings shipped with this unit for specific guidelines. Extra copies of the certification drawings, referenced on the unit Name Tag, can be obtained, free of charge, by contacting Totalflow Technical Support at the number listed in the "Getting Help" section.

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.
- Only a properly trained technician should work on any equipment with power still applied.
- When opening covers or removing parts, exercise extreme care "live parts or connections can be exposed".
- 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 accomplished, 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 unit is installed or to be installed in a hazardous location, technician must follow the guidelines stipulated in the Certification Drawings shipped with this unit.
- Access to 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.

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

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

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 XSeries Model electronic boards are surface mount and field repair should not be attempted. Most fuses automatically reset themselves, but if a know problem exists, the board should be sent in for repair or replacement.

Chapter 1
System Description

Overview

This Chapter introduces you to the Totalflow® XSeries Remote Controllers (XRC). The XSeries are low power, microprocessor based units designed to meet a wide range of automation, monitor, control, alarming and measurement applications. Four models are available: Models XRC6490, 6790, 6890 and 6990.

The letters XRC stand for Extendable Remote Controller. As their name implies, they are expandable to meet your needs, while maintaining backward compatibility with legacy Totalflow systems.

Each model is packaged in an enclosure that can accommodate the Main Electronic Board (XRC-195 Board), Liquid Crystal Display, a variety of batteries, remote communication device (except 6990), and additional I/O Modules. The XRC6490 can accommodate up to 3 I/O Modules, the XRC6790 can accommodate up to 6 I/O Modules, the XRC6890 can accommodate up to 14 I/O Modules and Rack Mount XRC6990 can accommodate up to 6 I/O modules per Main Electronic Board.

The XRC is powered by a battery system, which can be charged using; either solar panel, 24Vdc or 120/240 VAC chargers. It is optimized for extremely low power consumption and is primarily designed for remote operation in harsh environments.

Highlights This Chapter covers the following topics:

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Functionality The XRC system has built-in, pre-engineered applications for data collection, trending and long term data storage. The XRC can be used for oil and gas production, transmission and distribution site monitoring and control, water and waste system monitoring and control, etc.

This system can be programmed for advanced control or shutdown logic using the IEC 61131 Control Language. An extensive applications library is available from Totalflow Projects Engineering as needed, or new application programs can be developed for you by Totalflow.

It is also possible for experienced IEC 61131 programmers in your company, or other companies, to design application programs for any XRC device.

XSeries Remote Controller Hardware

The Totalflow® XSeries Remote Controller (XRC) Models are housed in an aluminum case. With the exception of the size of the cases all models use identical components. These are the components of the XRC:

- Enclosure
- XRC-195 Board (Model 6990 may have up to two)
- Battery Compartment
- Communication Compartment
- Liquid Crystal Display (LCD) (Model 6990 may have up to two)
- Charger or Solar Panel
- Optional Modular I/O
- Optional Keypad (Model 6990 may have up to two)

XRC-195 Board The XRC-195 board is mounted on the inside of the door. All XRC on board input and output connections are made with snap-in connector terminals mounted directly on the board. The board uses a low power processor running at 11.0592 MHz with 512 K SRAM and 512 KPROM and 32K E^2PROM. Other circuitry processes the inputs from the on board I/O and provides the interface to the LCD as well as the PCCU and optional key pad. Remote communications are handled by the RS232 and RS485 communication modules that plug directly into the board. The following XRC-195 Board drawing shows all the major functional parts and their locations when mounted.

Communication Enclosure A removable communications enclosure can be provided that has been pre-drilled for mounting of many popular communications devices such as radios, cellular phones, modems, etc. This feature is not available in the XRC6990.

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Battery Compartment

The XRC system houses an internal main battery.

- **XRC6490:** The battery sets in a central compartment directly behind the removable battery plate.
- **XRC6790:** The battery sets in a central compartment directly behind a hinged cover plate holding the DIN rail and installed modular components.
- **XRC6890:** The battery sets on the floor of the main compartment and houses the various optional battery packs that are available for the XRC; from one 8 ampere hours up two 70 ampere hour batteries.
- **XRC6990:** The 30 ampere hour battery sets on the floor of the enclosure.

Solar Panel

The XRC is configurable for a 10-Watt, 20-Watt or 30-Watt solar panel. The panel is designed for mounting on a 2-inch extension pipe above the XRC, on top of or the side of a meter house. As the XRC6990 is not designed for outside installations, Solar Panel chargers must be configured to mount outside of the building.

Additional Features

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

- Programmable bi-level security system prevents unauthorized communication and configuration of the XRC (See Chapter 3)
- Internal crystal controlled clock providing a highly stable time base for the system
- Optional battery packs to extend operation for longer periods without power
- Three available charging sources
  - External solar panel (standard)
  - External AC power
  - External 24/12 VDC power
- LCD (liquid crystal display) programmable to allow monitoring of operations (for example, displays flow rate, volumes, etc.)
- Rugged, aluminum, powder coated, NEMA 4X enclosure, lockable to prevent internal access
- Optional ability to allow rapid data collection over several communication links.
- Additional I/O for valve control, pressure, level monitoring, remote communication, etc.
- Optional Keypad

Standard Enclosure

The standard enclosure consists of hinged-door box in varying sizes for the XRC6490, 6790 and 6890 (see Figure 1–1 through Figure 1–3). The door provides a watertight, corrosion resistant seal between the outside elements and the XRC components. It is designed to meet Class I, Division 2, Groups C&D and is NEMA 4X rated. It is designed for mounting in harsh environments (cold, hot, wet and salty). Opening the door's latch(s) allows access to electronics, battery, radio and modular components. This door may be locked for security purposes.

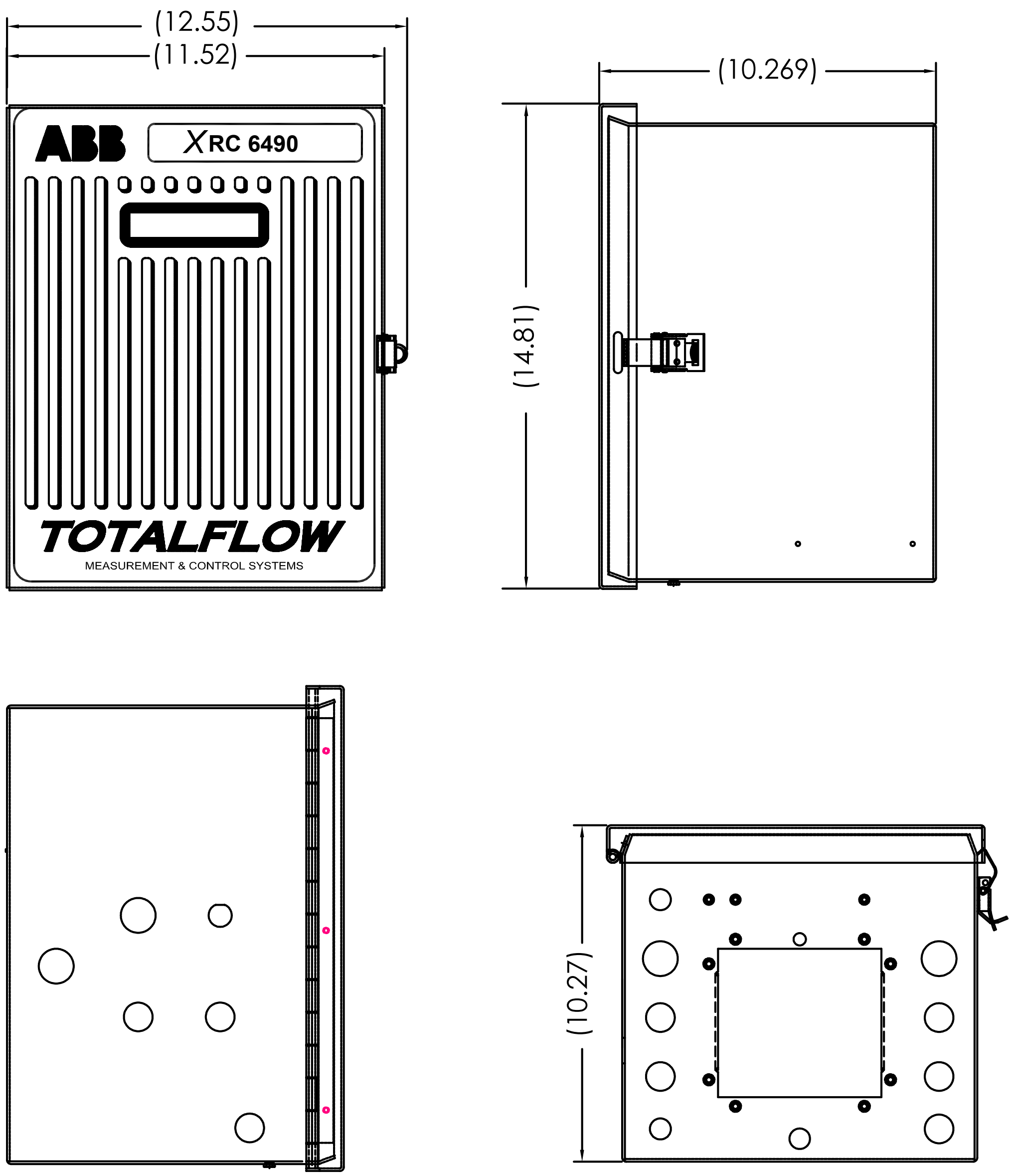

Figure 1–1 Model XRC6490

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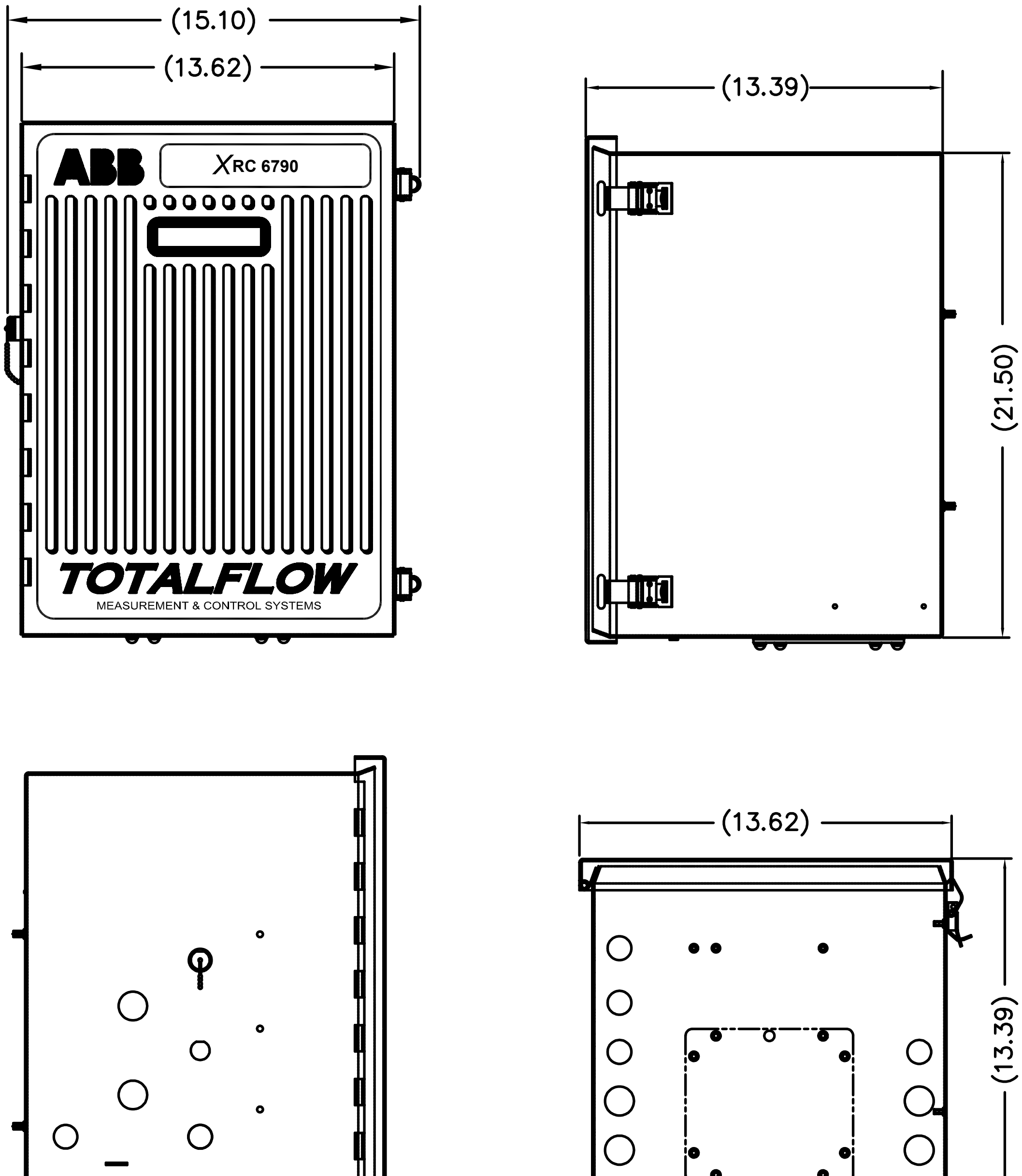

Figure 1–2 Model XRC6790

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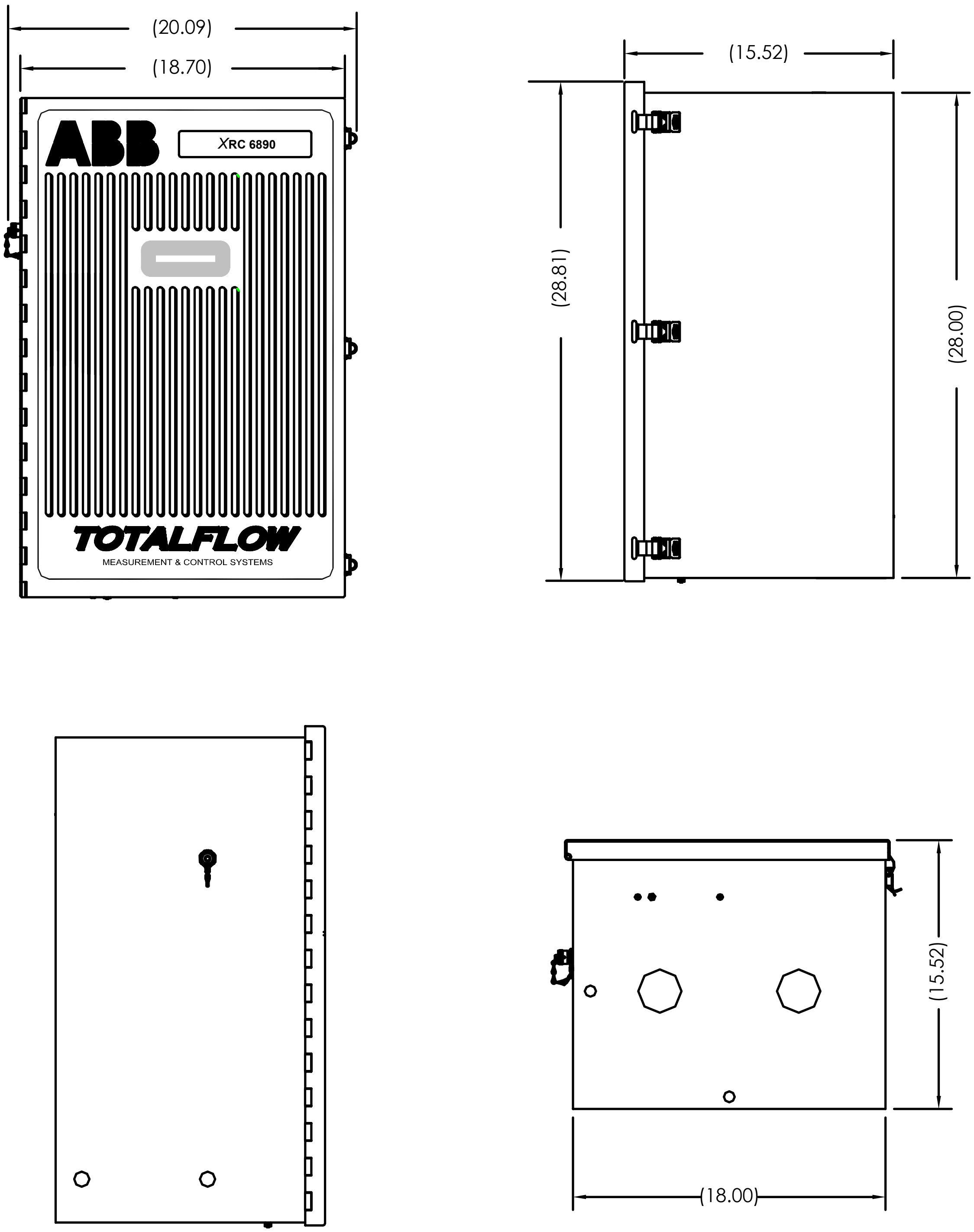

Figure 1–3 Model XRC6890

Rack Mount Enclosure

The XRC6990 enclosure is designed for 19" Rack Mount (see Figure 1–4). This enclosure may be configured to house up to 2 XRC-195 boards, up to 2 LCD displays and up to 2 optional Key Pads. This unit is not designed for exposure to the elements. With the exception of the local PCCU Connector, all terminals are located on the back panel of the enclosure.

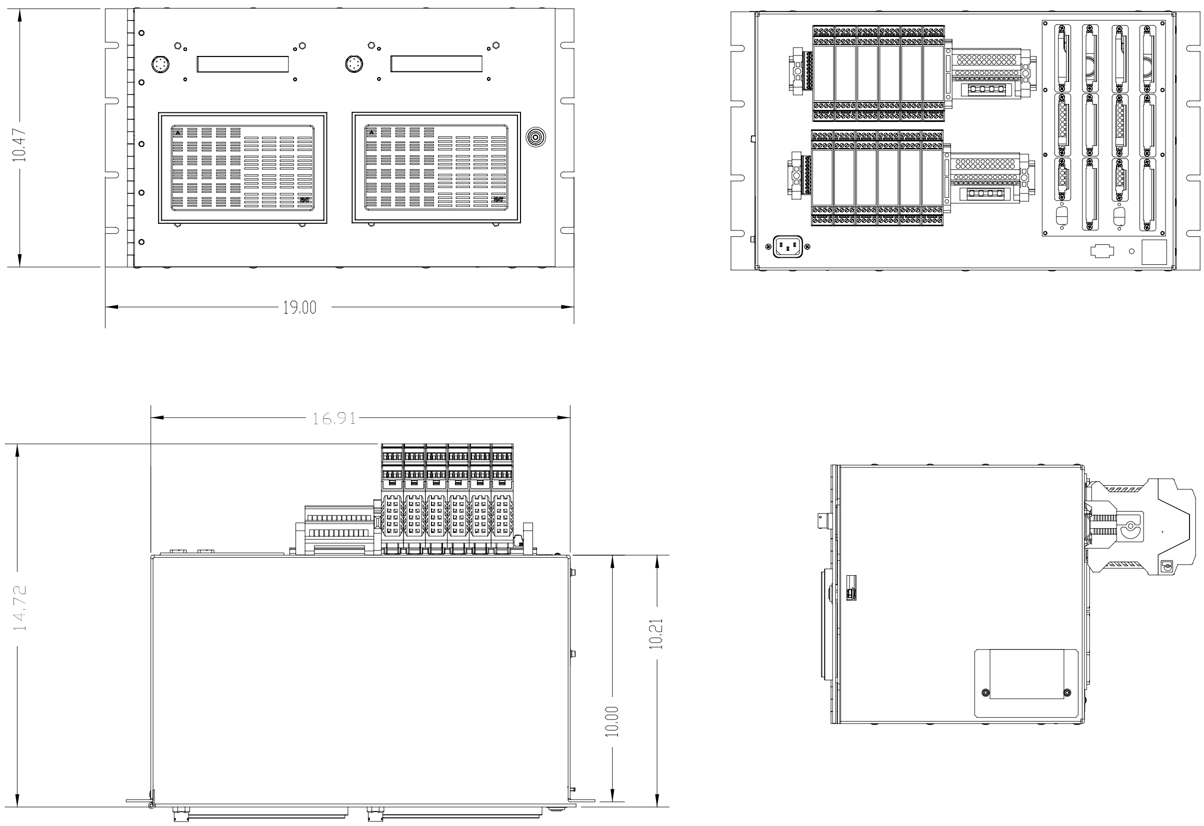

Figure 1–4 XRC6990 Rack Mount

XRC General Specifications

Dimensions

XRC Model	Width	Height	Depth
6490	11.52” (292.61mm)	14.81” (376.17mm)	10.27” (260.83mm)
6790	15.10” (383.54mm)	18.80” (477.52mm)	13.38” (339.85mm)
6890	20.09” (510.29mm)	28.91” (734.31mm)	15.52” (394.21mm)
6990	16.91” (429.51mm) [1]	10.47” (265.93mm)	10.21” (259.33mm)[2]

Installed Depth

XRC Model	Pipe Mounted	Direct Mounted
6490	12.75” (323.85mm)	11.00” (279.40mm)
6790	15.75” (400.05mm)	14.00” (355.60mm)
6890	18.01” (457.45mm)	16.26” (413.00mm)

Enclosure

XRC Model	Weight (w/o battery)	Max I/O Modules	Max Battery Capacity
6490	8.86 lbs. (3.31k)	3	26 AH
6790	29.0 lbs. (13.17k)	6	42 AH
6890	45.5 lbs. (16.98k)	12	140 AH
6990	12.0 lbs. (5.44k)	14	30 AH

Humidity 0–95% Non-Condensing

Mounting Wall, Pipe or Rack Mount

Operating Temp. -40° F to 140° F (-40 to 60°C)

Certification (all but 6990) CSA/NRTL Class 1, Division 2, Groups C & D hazardous area classification. (ATEX Zone 2 pending). XRC6990 is General Purpose

EMC Requirements

EMMISSIONS: *European Regions:*

- EN55022 Class A Emissions (Radiated & Conducted)

North America Regions:

- CFR 47, Part 15, Subpart B, Class A, FCC Emissions
- ICES-003 Issue 2, Rev. 1, Class A ITE Emissions

IMMUNITY: *European Regions:*

- EN50082-1:98 Immunity
- EN61000-4-2:95, ESD, ± 8 kV Air, ± 4 kV Contact
- EN61000-4-3:95 RF Immunity, 10 V/m
- EN61000-4-4:95 EFT, 1 kV
- EN61000-5-5:95 Surge; 1 kV line to line, 2 kV line to earth
- EN61000-4-6:95 Conducted Susceptibility, 3 Vrms
- EN610004-8:93 Power Frequency Magnetic Field 3 A/m
- EN610004-11:94 Voltage DIP and interrupt

[1] Enclosure width does not include mounting rail. Total width is 19” (482.6mm)

[2] Enclosure depth does not include TFIO Modules mounted. Depth with Modules: 14.72” (373.89mm)

XRC-195 Electronic Board Specifications

The *X*RC-195 Electronic Board (extendable Remote Controller, part number 2100355) is designed as a general- purpose RTU motherboard that mounts in all *X*Series enclosures. It has the same footprint as its counterpart, the *X*FC-195 Board (extendable Flow Computer motherboard). See Figure 1–5 for XRC Board layout.

Power	Nominal 12 VDC Battery
Charger	Solar or 14-26 VDC
Memory	• Data stored in 512K SRAM. (lithium battery backup) • Applications programs stored in 512K Flash. • Flash loader stored in 512K PROM • Registry and Configuration files stored in 32K E^2PROM • Transducer factory calibration data stored in separate E^2PROM
Comm. Ports	1 - dedicated – Local Configuration port used with our PCCU32 software 2 - RS232 or RS485 via Plug-In Modules
Microprocessor	High integration microcontroller with 20 bit address bus (1M), operating at 11MHz
LCD Interface	Dedicated Interface for 2 X 24 Liquid Crystal Display (LCD)
Keypad Interface	Dedicated Interface for Optional ABB supplied Keypad Equipment
I/O Expansion	Dedicated I^2C Serial I/O Bus for TFIO module expansion
Security Switch	On/Off Bi-level on-board Security (See Chapter 3 for details)
Time Bas Stability	± 7.5 ppm (parts per million)
I/O Scan Rate	1 time per second
Analog Inputs	5 Single-ended Channels, 0–10VDC or 0–20ma current loop.
Analog to Digital Resolution	• 18 Bit Maximum Resolution (0.00038% FS) • 18 Bit Nominal Resolution (0.0015% FS)
Digital Inputs	4 -configurable as active or passive (Selectable de-bounce enable/disable)
Pulse Inputs	2 of the above listed 4 DIs can be used as pulse inputs (DI1 and DI2) (up to 20 KHz)
Digital Outputs	4 -Open channel FET Transistor Switches

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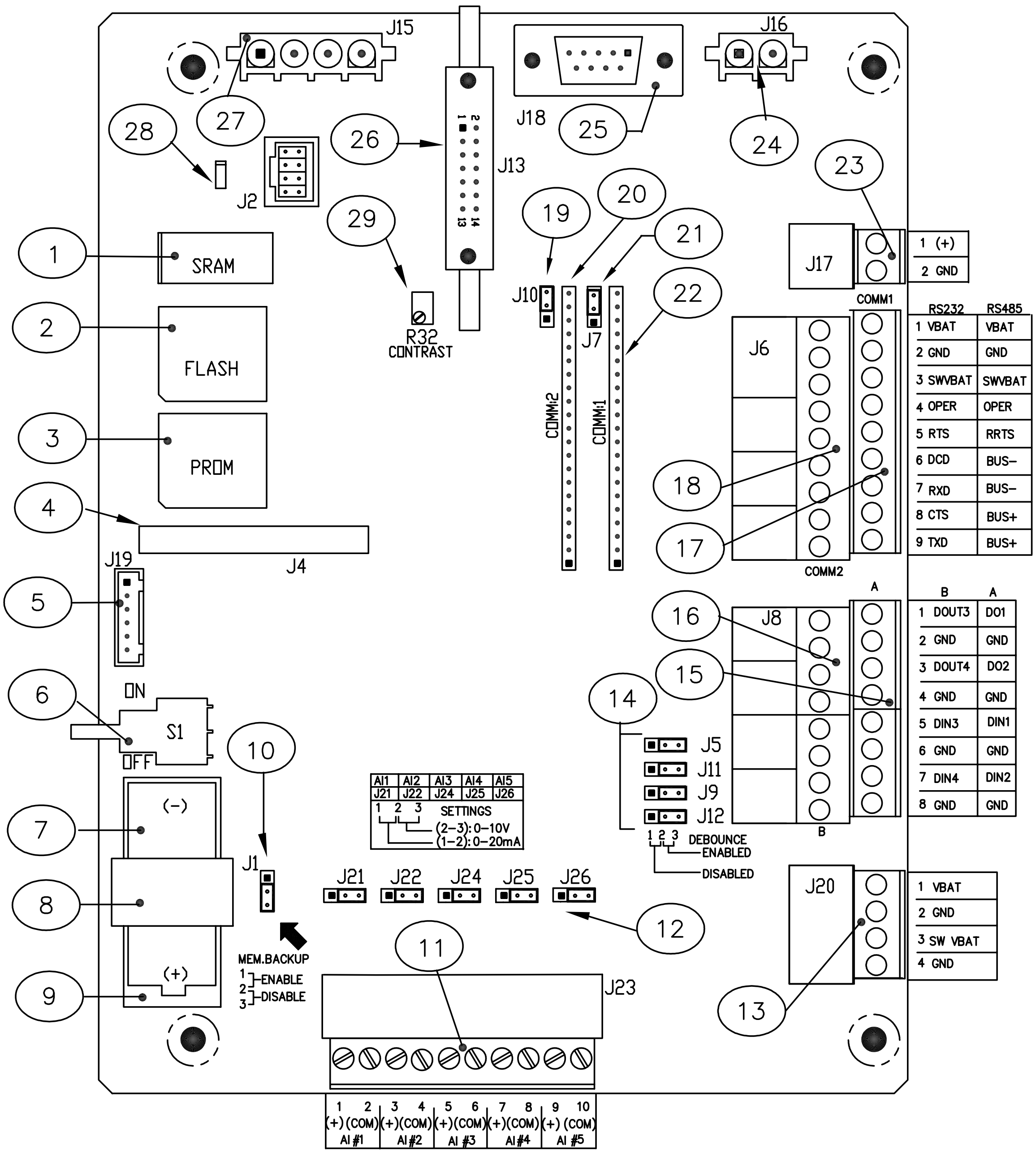

Figure 1–5 Complete View XRC-195 Board

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XRC-195 Board Specifications, Cont.

Table 1–1 XRC Board Component Descriptions

ID Number	Description	ID Number	Description
1	SRAM (Lithium backed)	15	A-PI/DI/DO Connectors
2	Flash Program Memory	16	B- PI/DI/DO Connectors
3	Prom Loader/Utilities Memory	17	Remote Comm 1: Connectors
4	Factory Maintenance Interface	18	Remote Comm 2: Connectors
5	Keypad Connector	19	Remote Comm 2: RS-485 Term. Jumper
6	Security Switch	20	Remote Comm 2: Module Plug-in
7	Lithium Battery	21	Remote Comm 1: RS-485 Term. Jumper
8	Battery Cover	22	Remote Comm 1: Module Plug-in
9	Battery Mounting Bracket	23	External Charger Connector
10	Memory Backup Enable/Disable	24	Battery Connection
11	Analog Input Connectors	25	I/O Module Interface
12	Analog Input Selection Jumper	26	LCD Display Interface
13	Aux. Power Output Connectors	27	PCCU Interface
14	DeBounce Enable/Disable	28	SDRIVE: 32K E2Prom
		29	Contrast Potentiometer

XSeries On-board Input/Output

Totalflow's XRC features the base I/O listed below:

- 5 User A/I's
- 4 User D/O's
- 4 User D/I’s (2 may be used as High Speed P/I’s (D/I 1 and D/I 2))
- 2 RS232 or 485 Comm Ports
- 1 Dedicated Local Communication Port
- Interface for TFIO Modules

The Main Electronic Board (XRC-195 Board) is an enhanced replacement for previous versions of the RTU Main Electronic Board. In the next few pages, you will see the specifications for Digital/Pulse Input, Digital Output and Analog Input. To see a complete overview of the XRC-195 Board, see Figure 1–5.

Comm. Ports You have the ability to program up to two on-board communication ports on the XRC-195 Board. Normally COMM 0 is the local port required for reading the XRC with a laptop computer running PCCU32. COMM 1 and COMM 2 can be configured for any combination of RS 232 or RS 485. See Figure 1–5 for On-Board Communication Ports.

Digital Input

The Totalflow XRC provides 4 digital inputs(2 of which may be used as high speed pulse inputs) as a means to monitor inputs from external equipment with the XRC. See Figure 1–5, Item #s 15 & 16.

When connecting or disconnecting any wires to the XRC-195 Board, you should remove all power sources and make sure that you are grounded properly.

Digital Inputs

The Digital Input reads an external contact. Below you will find the electrical and input specifications as well as information on enabling or disabling DeBounce.

Electrical Specification (each point):

- Open circuit voltage: 5VDC (Internally pulled up to 5VDC Nom.)
- Short circuit leakage current: -395uA typical.
- Input capacitance: 0.1 ufd typical.
- Maximum allowable voltage range on input -0.5VDC to 15VDC.
- Maximum frequency input 100Hz @ 50% duty cycle with de-bounce enabled.
- Maximum frequency input 10KHz @ 50% duty cycle with de-bounce disabled.

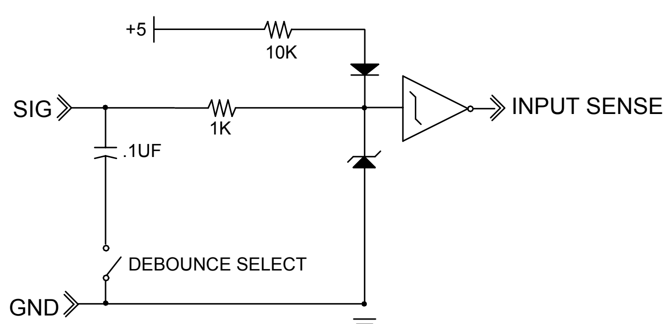
Input Specification

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

DeBounce

The XRC-195 Board includes Jumper Pins to enable or disable debounce. See Figure 1–5, Item# 14 for the Jumpers. The inclusion of the Debounce capacitor when enabled allows the unit to ignore noise when manual switches are set. When disabled, the high speed pulses are received exactly as sent. If input is received as a solid state signal, then debounce is not needed, it should be disabled.

Typical Point Schematic



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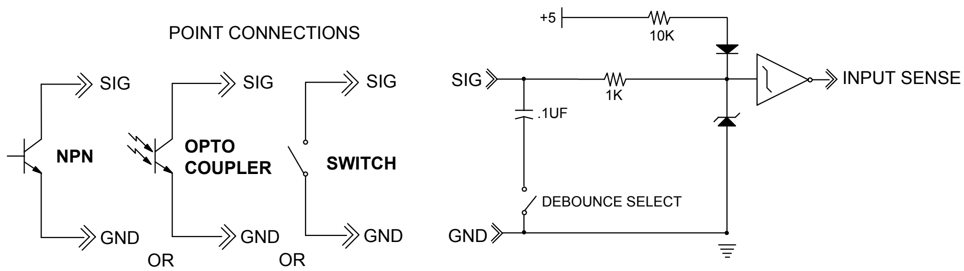
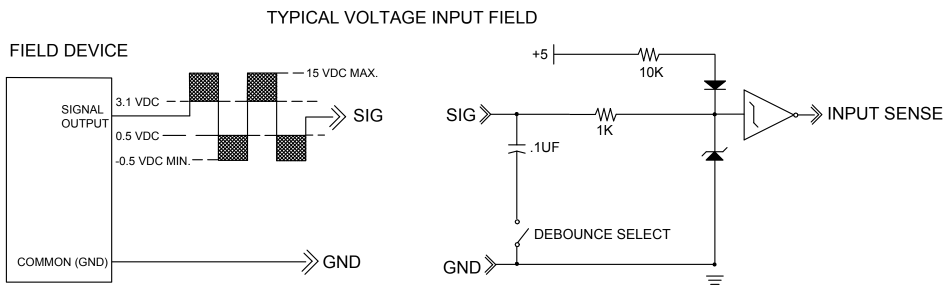
Digital Input, Cont.

Example Connections





Digital Output

The Totalflow XRC provides 4 digital (12Vdc) outputs as a means to control external equipment with the XRC. See Figure 1–5, Item Nos. 15 & 16.

When connecting or disconnecting any wires to the XRC-195 Board, you should remove all power sources and make sure that you are grounded properly.

Digital Outputs

If the digital output is used in conjunction with a measurement device; AGA3, AGA7 or Liquid Measurement, the following outputs can be triggered when the following conditions occur:

• Differential pressure over high limit	• Volume Set Point
• Differential Pressure under low limit	• Flowing Temperature Low
• Static Pressure over high limit	• Flowing Temperature High
• Static Pressure under low limit	• Flow Rate Low
• Low Charger voltage	• Flow Rate High
• Remote Sense is ON	• Trip on Digital Input

Other Applications are:

- Custom programmable by Totalflow or user programmable with IEC 61131 programming language.

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Digital Output, Cont.

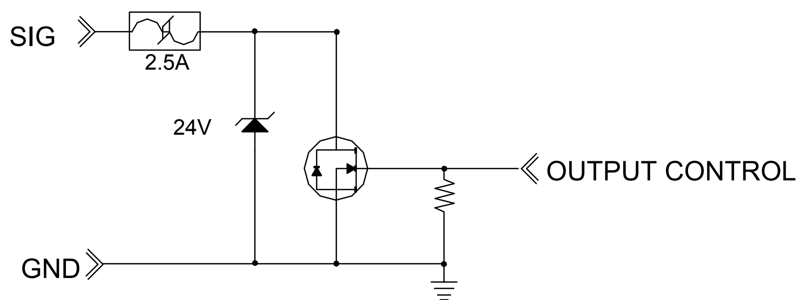
Electrical Specification (each point):

- Open circuit voltage: 0VDC
- Short circuit leakage current: 0uA typical.
- Output capacitance: 1000pF typical.
- Maximum allowable voltage range on output -0.5VDC to 26.5VDC.

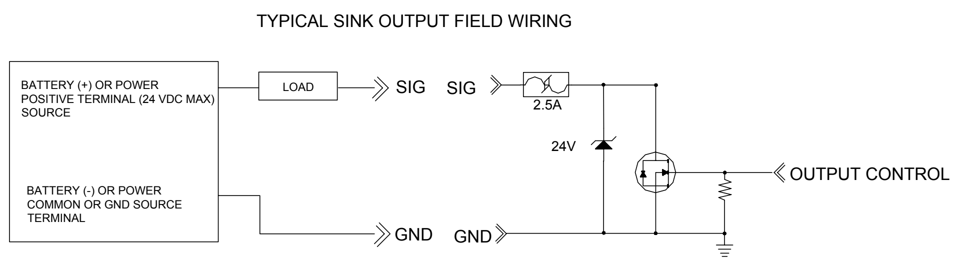
Input Specification

- Open Drain FET type.
- "ON" Resistance: 0.1Ω Typical (Including PTC fuse resistance).
- Maximum pulse current: 3A for 5 seconds.
- Maximum continuous sink current: 2A.

Typical Point Schematic



Example Connections



Analog Inputs

Electrical Specification (each point):

• Voltage Mode:	0-10V
• Current Mode:	0-20mA
• Maximum Voltage mode input before soft over-range:	10.7V
• Maximum allowable continuous input current:	22.8mA
• Typical Input Impedance Voltage Mode:	91.24K Ohms
• Typical Input Impedance Current Mode:	249.3 Ohms

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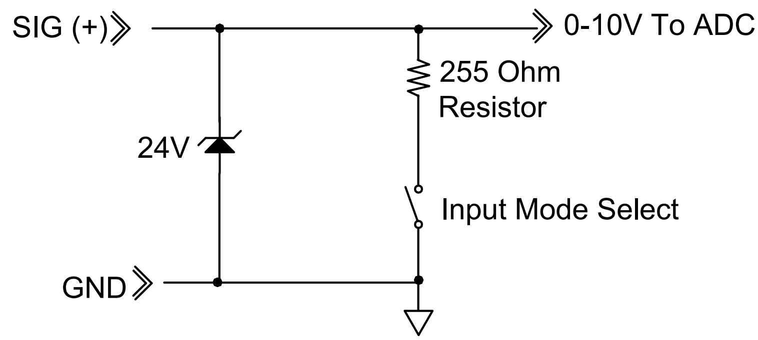
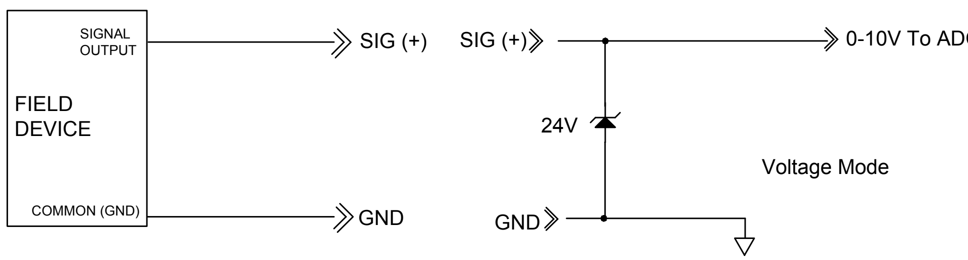
Analog Inputs, Cont.

Typical Point Schematic

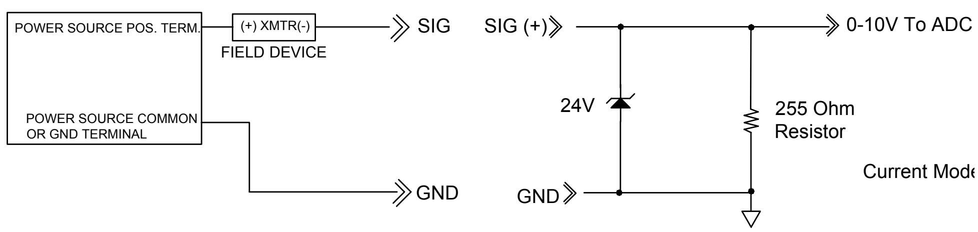


Example Connections

TYPICAL VOLTAGE ANALOG INPUT FIELD WIRING



TYPICAL 2 WIRE 4--20mA FIELD DEVICE WIRING



Display Function

During operation of the XRC, the front panel LCD continuously scrolls through the operating parameters. Table 1–1 shows typical displayed parameters when used with an AGA-3 flow tube, however any parameter with a Register Address can be displayed. The duration that the parameter is displayed can vary from 1 to 255 seconds (default is 5 seconds); a setting of 0 seconds will set any display to off. See "Program Display" in Chapter 3 (and PCCU32 help files) for more details.

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Display Function, Cont.

Table 1–2 Typical XRC Display Options

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

Functions of the XRC

Primary functions of the XRC reflect a design that is practical and efficient. The XRC is simple to use and easy to learn. It allows you to perform the following with minimum effort, maximum speed and greater accuracy.

Capabilities

- Monitoring of the operational limits to insure detection and reporting of malfunctions or abnormal site conditions
- Remote Communications
- Realtime measurement and control
- Acceptance and storage of system parameters from PCCU32 4.3 or greater
- Storage of data records
- Storage of operational events
- Expandable I/O count to support most customer applications
- Multiple enclosure sizes provided to fit specific I/O requirements
- Custom IEC 61131 Applications to fit specific customer requirements

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Functions of the XRC, Cont.

Applications

- AGA3 orifice meter run (an external transducer required)
- ISO 5167 orifice meter run (an external transducer required)
- V-Cone meter run (an external transducer required)
- AGA7 rotary/turbine meter run
- Wedge meter (liquid and gas) (an external transducer required)
- CO2 (NIST 14) (an external transducer required)
- Real-time Data Logger (Trending)
- Valve Control (feedback controller)
- RAMS (Alarming, Exception reporting)
- Operators (simple math/logic functions)
- IEC 61131 (complex math/logic)
- Selectable Units (user selectable engineering units)
- Display / Keypad Handler
- I/O Subsystem
- Tank Level application
- Therms Master application
- Therms Slave application
- Multiple protocols (Totalflow proprietary low power, Modbus Slave (RTU/ASCII), Modbus Master (RTU/ASCII), LevelMaster, BTU 8000/8001, Enron Modbus, Square D, MotorSaver, ABB 2010T Multivariable, Altronics and others

XRC Display Function

During the operation of the XRC the front panel LCD continuously scrolls through the operating parameters. Your system will come with a group of standard system displays, however any parameter with a Register Address can be displayed.

See "Program Display" in Chapter 3 for more details.

Display Annunciators

One of the primary functions of the XRC is for monitoring operational conditions; therefore, the XRC indicates when an unusual or “alarm” condition is occurring, see Figure 1–6. For how to use the display to troubleshoot, refer to Chapter 5; Troubleshooting.

Using new technology adaptable for multi-tube devices, the status and alarm code locations are programmable. This allows the user to program each annunciator to reflect different application or tube types. The single tube device will come with a standard display pre-programmed, but changeable (see Table 1–2).

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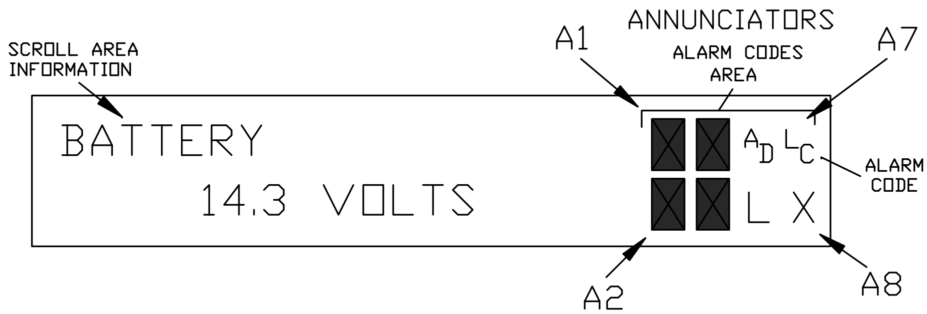

Figure 1–6 Liquid Crystal Display and Indicators

Table 1–3 Status and Alarm Description

Indicator	Description
I/O Sub-System	
L_L	*Low Lithium Battery Alarm*: When LL (low lithium) is displayed, lithium battery voltage is below 2.5 Vdc. A new lithium battery measures approximately 3.6 Vdc.
L_C	*Low Charger*. Displayed if XRC battery charging voltage is (+)0.4 Vdc or is less than or equal to battery voltage.
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 Protocols	
→	*Transmitting Data:*
←	*Receiving Data:*
!	*Nak*. Negative Acknowledgement w/packet list.
+	*Ack*. Positive Acknowledge of receipt of request.
⍑	*Waiting for Ack*. Waiting for response after transmission.
Ұ	I*D Recognized.*

Table Continued on Next Page

Table 1–2 Status and Alarm Description, Cont.

Indicator	Description
Communications Protocols, Cont.	
ǂ	*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.
M	*MODBUS ASCII*: Modbus ASCII protocol is selected for the port assigned to this annunciator.
m	*MODBUS RTU:* Modbus RTU protocol is selected for the port assigned to this annunciator.
R	*LevelMaster Protocol.* LevelMaster protocol is selected for the port assigned to this annunciator.
L	*Local Protocol*. Displayed when PCCU part is active and running TOTALFLOW Local Protocol.
¥	*Packet Protocol.* The Totalflow Packet Protocol selected on this port.
Valve Control	
V	Displayed when Valve Control option Enabled.
⎡	Valve Control option installed. Valve is in full open position.
⎦	Valve Control option installed. Valve is in full closed position.
↑	Valve Control option installed. Valve is opening (open signal is being sent to valve actuator).
↓	Valve Control option installed. Valve is closing. (close signal is being sent to valve actuator).
ö	Valve Control option installed. Valve controller override conditions met (DP/SP override set point or Low Battery).
$^{L}{}_{L}$	Valve Control option installed. Local Lock-out is initiated.

Table Continued on Next Page

Status and Alarms Description, Cont.

Table 1–2 Status and Alarm Description, Cont.

Indicator	Description
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 HOLD flag is active. Also displayed when transmitters are being calibrated or A to D Converter cannot be read.
A	*Alarm Condition.* Need to view alarm. You 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 Differential Pressure, Absolute Static Pressure or temperature readings exceed maximum counts or are less than minimum counts.

Laptop Computer running PCCU32

PCCU32 Software running in a laptop Windows environment offers you the most capabilities for programming the XRC. Many of the new features designed into the XRC cannot be accessed by the FS/2 due to it’s limited capabilities. The Windows environment features user friendly help files and easy to follow menus. Having help files readily accessible to the user is comparable to having a virtual teacher on location. Easy to follow menus and icons, step the user through many required choices.

The laptop computer connects via the cable directly to the connector on the side of the XRC. Once this physical connection has been made, you may begin communicating through the software.

Also see Technical Bulletin #44 for “Terminal Mode” Connection.

FS/2 Handheld PCCU

The FS/2 Portable Calibration & Collection Unit (PCCU) is a hand held device running the DOS version of PCCU. This equipment allows the user to perform only the most basic of operations and program the minimal features of the XRC. Because the device functions in the DOS environment, help files, icons and drop down menus are not available. Therefore this device is more limited.

The FS/2 PCCU connects via the cable directly to the connector on the side of the XRC. Once this physical connection has been made, you may begin communication with the XRC through the program.

Optional Equipment

Key Pad

The XSeries models may be configured to include the optional Keypad (see Figure 1–7) located on the front cover of the unit. Keypad entry allows the user to monitor programmed display items without using additional equipment. See Figure 1–8 through Figure 1–10.

FYI For you to be able to view various display items, those items must be pre-programmed for keypad entry. You may either program all the display items for an application or individual display items within the application using PCCU32.

Log On Press the ENT button in the lower right hand corner of the keypad. See Figure 1–7.

Security When prompted, enter the 4-digit security code.

Viewing Use the up and down arrow keys located in the upper right hand corner to scroll through the various instantiated applications (Multiple Tube Device).

Selectin When you have located the item you wish to change/display, press the ENT button.

Changing After viewing the item for change, press the = key located in the lower right corner of the keypad. If entering a negative figure, press the +/- key to toggle the minus sign on or off. Enter the new figure. Press Enter.

FYI You may change only those values that are not live from this screen.

Validate When setting up the XRC Display items, you may also set Data Limits so that when you change a programmed value, it must be valid between the High and Low Limit, otherwise it will return and “invalid” code. This is called Validate Keypad Entry, and must be set to “yes” to be active.

Time Out Based on how you have programmed the display setup, you may set the “Scroll Lock Timeout”. After the programmed time has elapsed, it will return to regular operation. This includes exiting the security system. To re-enter the keypad program, you will need to re-enter your security code.

SPACE Pressing this button will have the effect of leaving a blank space(s) between characters during data entry.

MENU Pressing the MENU button and then the group number and item number will take you directly to the specified screen.

REG Pressing the REG button and then entering the “application.array.index” of the register you would like displayed will take you directly to the specified register.

ESC To exit the program, press the ESC key in the lower left corner once for each level you are viewing. When the screen begins to scroll again, you have exited the program completely.

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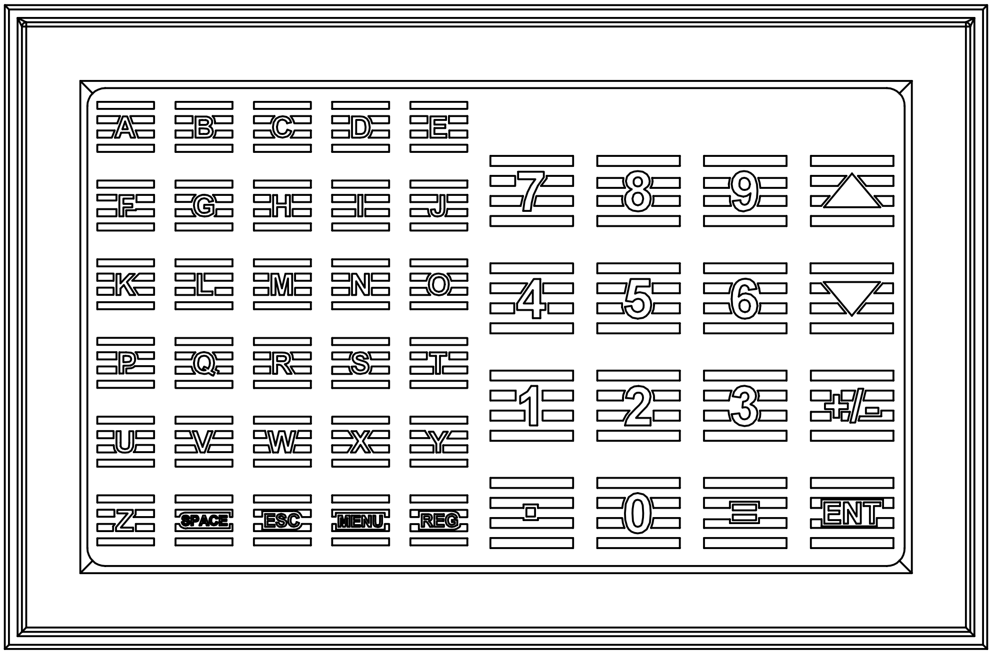

Figure 1–7 Optional Keypad (P/N 2100652-xxx)

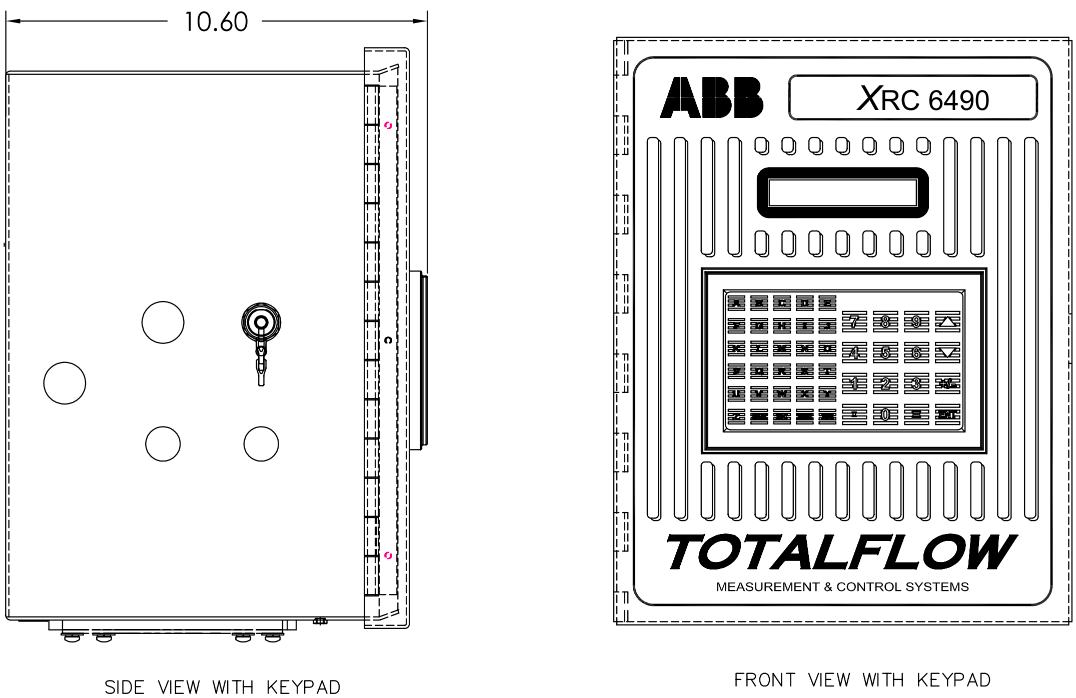

Figure 1–8 XRC6490 with Optional Key Pad

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Key Pad, Cont.

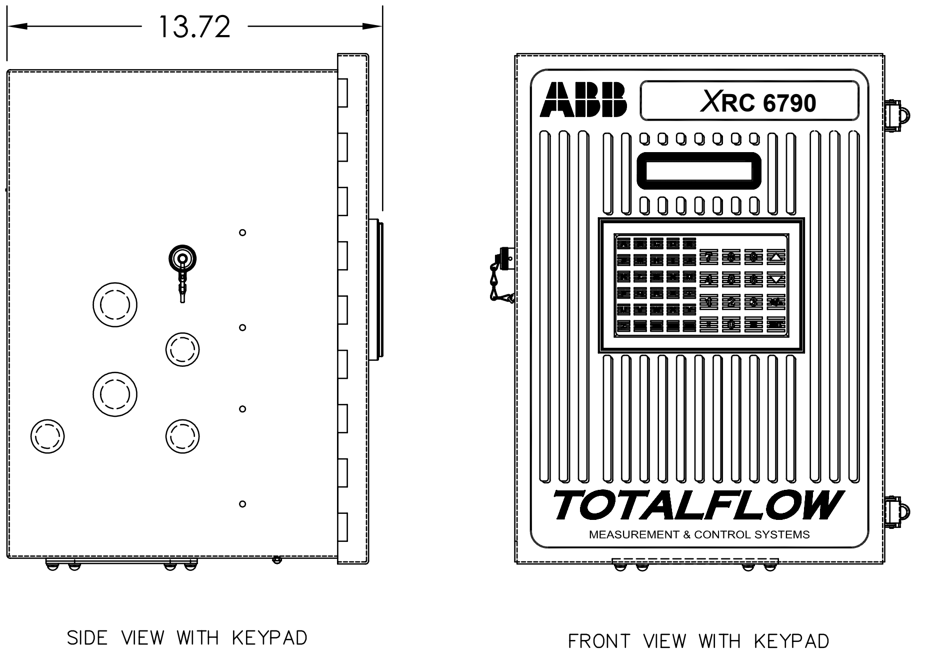

Figure 1–9 XRC6790 With Optional Keypad

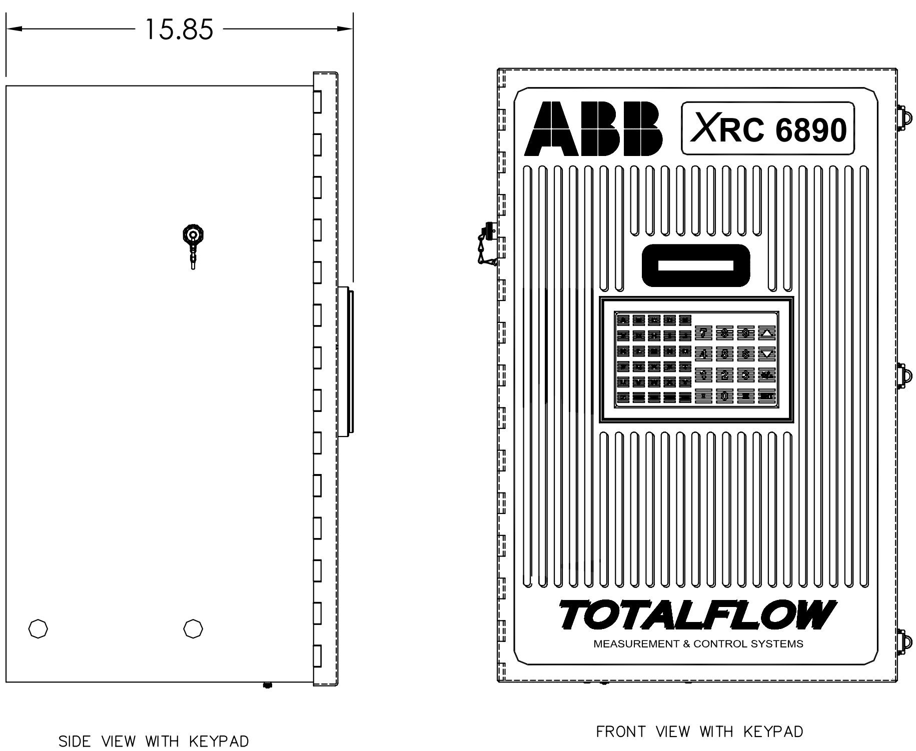

Figure 1–10 XRC6890 With Optional Keypad

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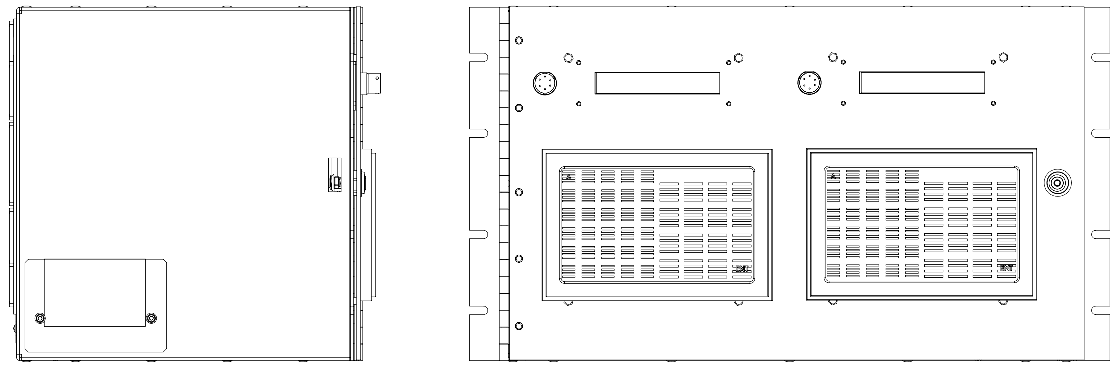
Key Pad, Cont.



SIDE VIEW WITH KEYPAD FRONT VIEW WITH KEYPAD

Figure 1–11 XRC6990 with Dual Keypads

Totalflow Input/Output Modules

In addition to Totalflow's enhanced on-board input/output capabilities, the hardware functionality of the XSeries can be extended in a flexible and friendly way by adding modular I/O as needed (see Figure 1–12). Totalflow I/O (TFIO) modules are designed to accommodate low power, harsh environment and economical cost requirements. The system automatically recognizes the module types and configures the I/O Scanner subsystem accordingly.

The modules are interfaced to the XRC-195 Board by an I2C bus. On top of this bus, Totalflow has implemented an efficient I/O protocol to exchange information between the modules and the XRC-195 Board. The bus operates in a master/slave mode, with the Main Board acting as master.

The XRC6490 (as shown in Figure 1–13) systems support up to 3 modules. For example, 3 analog input modules can be connected to the I2C bus. Since each module supports 8 analog inputs, then a total of 24 analog inputs can be added to the I2C bus. The XRC6790 (as shown in Figure 1–14) systems support up to 6 modules. The XRC6890 (see Figure 1–15) supports upto 14 and XRC6990 (see Figure 1–16) support up to 6 per XRC Board.

The I/O module hardware is packaged in DIN mount enclosures that employ Phoenix contact technology for field wiring. The modules also interconnect with each other to provide the necessary power and interface signals along their bus. Installation consists of snapping the Phoenix connector onto the DIN rail and moving the module into position directly beside and snapped to the next module. Likewise, in removing a module, it must first be separated from the module on either side, then removed from the DIN rail.

For additional information, please refer to the TFIO Module User's Manual (Part No.2101226-001).

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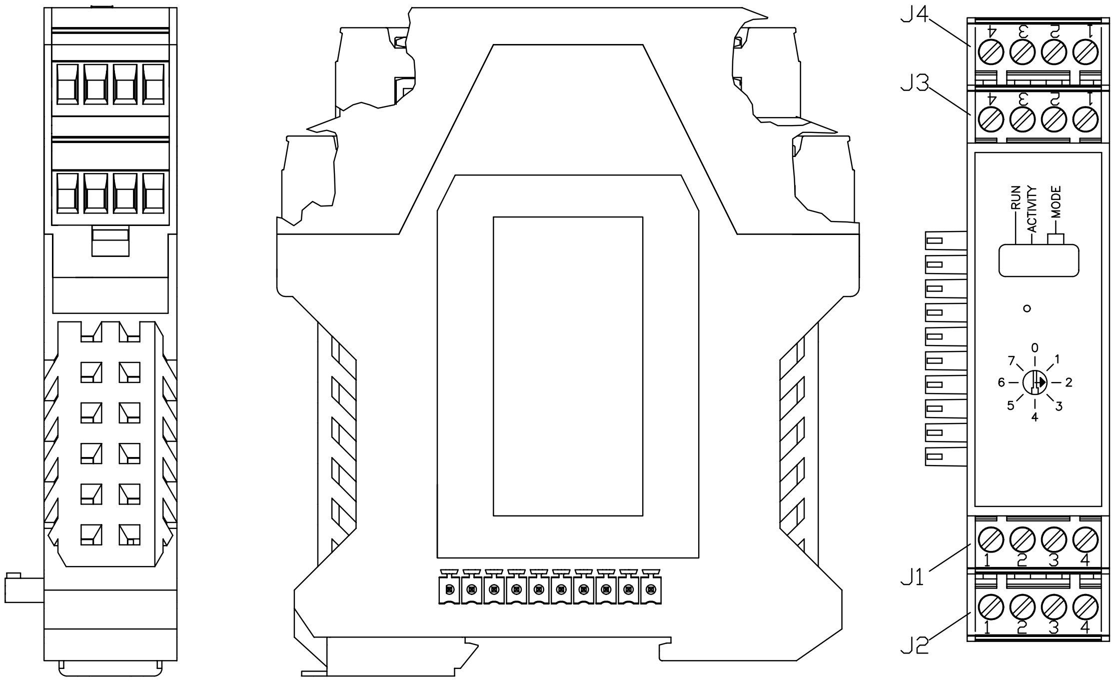

Figure 1–12 TFIO Module Housing

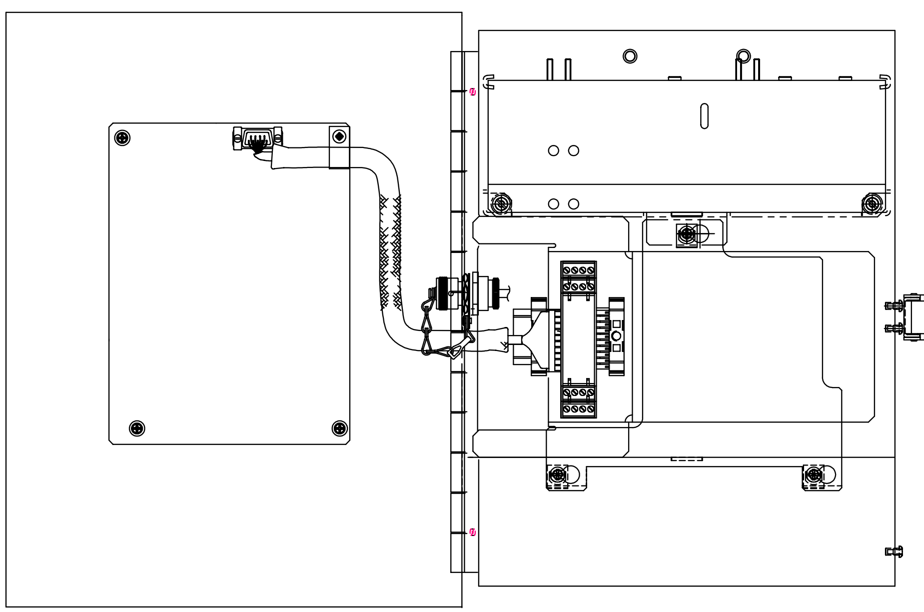

Figure 1–13 XRC6490 Inside View

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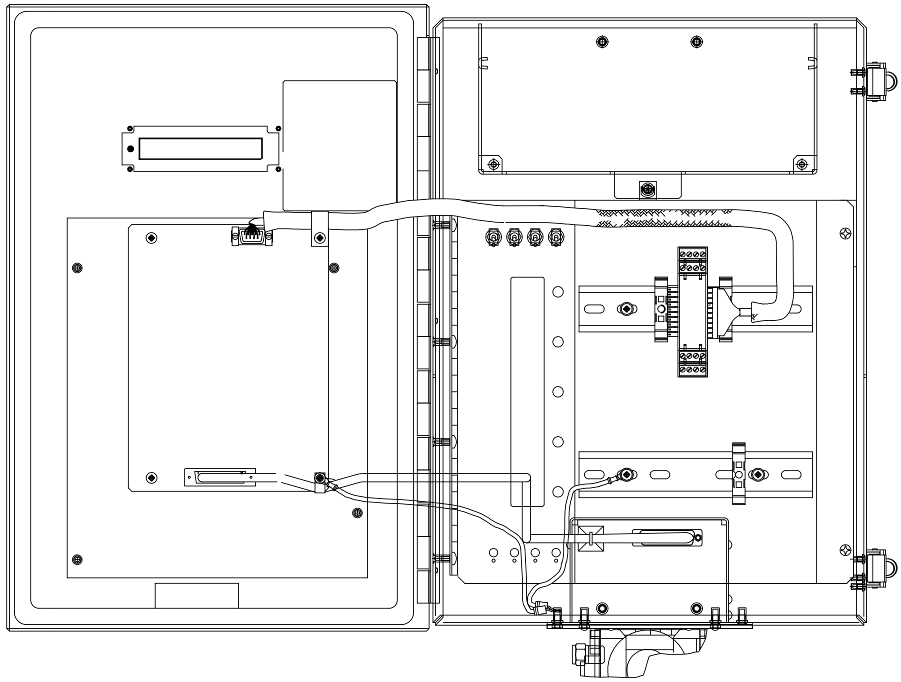

Figure 1–14 XRC6790 Inside View

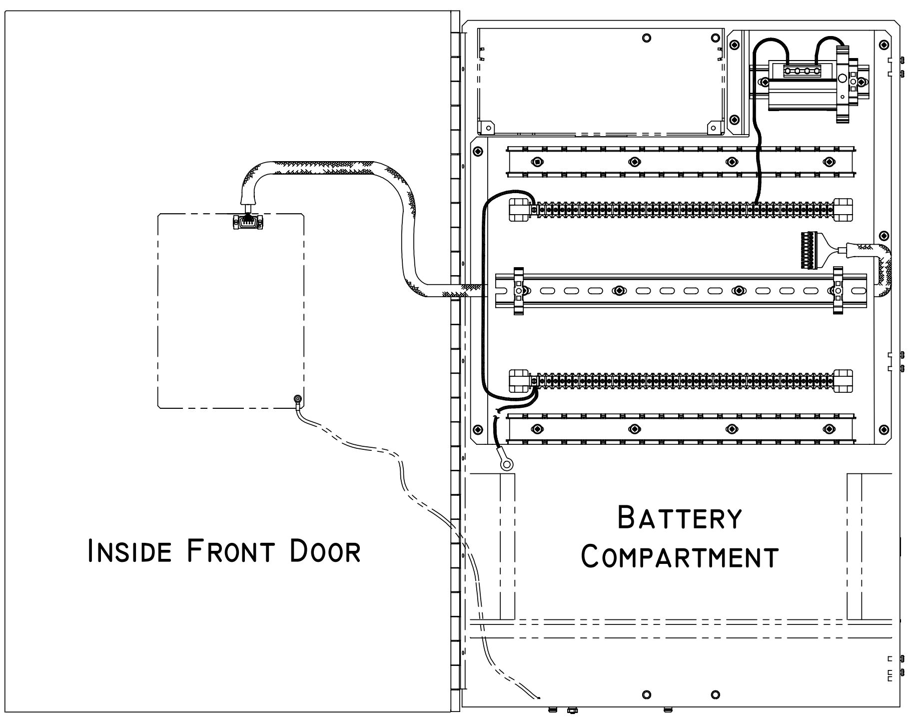

Figure 1–15 XRC6890 Inside View

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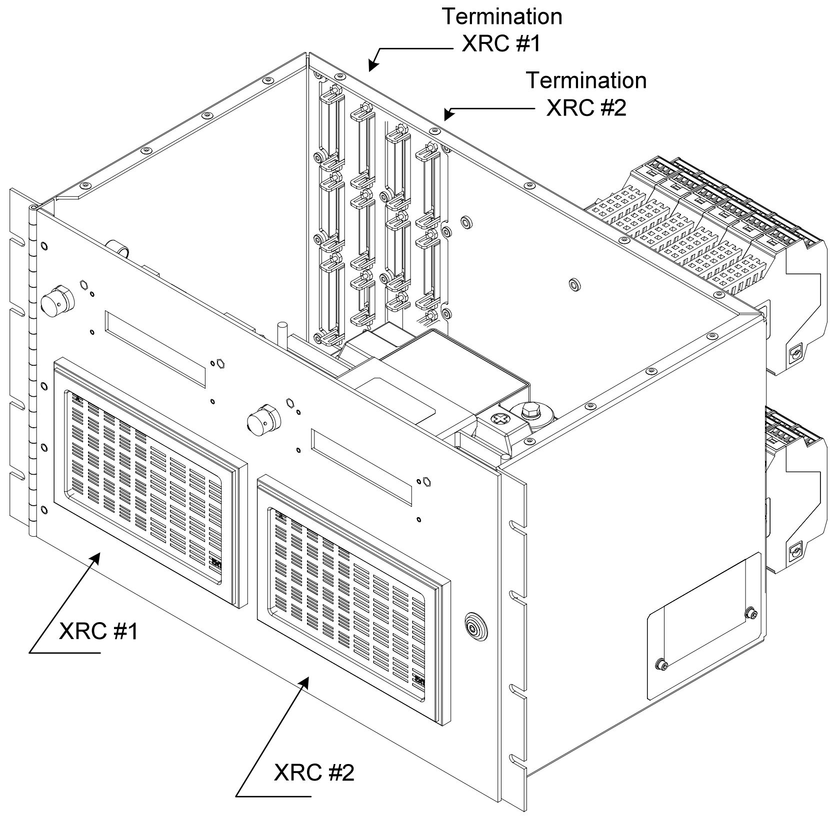

Figure 1–16 XRC6990 Inside View

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Chapter 2
Installation

Overview

This Chapter provides you with the information for installation and setup. By the time you finish this Chapter you will have the XRC unpacked, installed, field wired and ready for operation. For safe and trouble free installation follow all instructions and advisories. Due to is configuration, the XRC6990 Installation Instructions and it's optional equipment are grouped together near the end of this Chapter.

FYI

Read through this Chapter before you begin the installation, to plan your installation. Also before you begin, refer to the wiring diagrams delivered with the new XRC. You may store these in the back of this manual under the tab Wiring Diagrams.

Installation procedures, presented within this Chapter, are applicable to all XRC Models.

Highlights

This Chapter covers the following topics:

Unpacking & Inspection

Unpacking

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

Carefully remove the items from each carton.

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Inspection

- Inspect the shipping carton for damage. If the shipping carton is damaged, keep it until the contents have been inspected for damage.
- Inspect the unit exterior for dents, chipped paint, etc.
- Inspect the LCD window for breakage.
- Open the housing by first removing the bolt and releasing the latch/latches.
- Visually inspect the Digital PC Board, cables, and connectors for damage.

Damaged Components

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

Pipe Saddle Mount Installation

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

Materials Supplied

- XRC mounting bracket and hardware

Material Not Supplied

Optional equipment may be ordered from Totalflow:

- One pipe Saddle
- One 2” pipe of suitable length

Instructions

Step	Procedure
1.	Position pipe saddle on meter run (see Figure 2–1). Select a location that allows easy user access and is close to equipment.
2.	Temporarily attach Saddle on meter run pipe using U-bolt and associated hardware, do not tighten.
3.	Screw 2” mounting pipe into Saddle. Place level against pipe and vertically align. Adjust pipe, mounted in saddle, until vertical alignment is achieved.
4.	After vertical alignment, securely tighten 2” pipe in Saddle then securely tighten Saddle mounting bolts. Be certain pipe is securely installed in Saddle.

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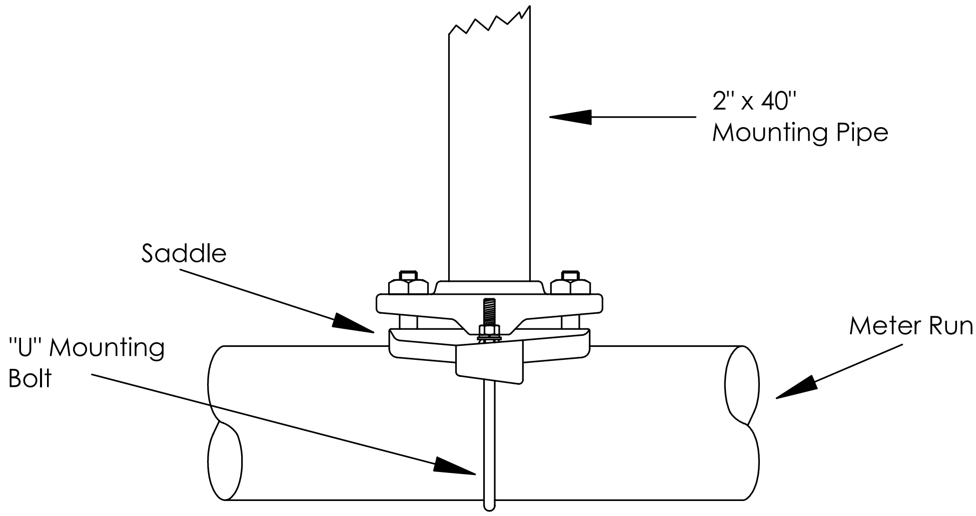

Figure 2–1 Typical Pipe Saddle Installation

FYI

The following procedures are to be followed when installing an XRC on 2” mounting pipe as shown in Figure 2–2 through Figure 2–4. To install the XRC, it is recommended that two people perform the installation. One to hold unit in position and the other to install and tighten mounting brackets.

Method of installation must be consistent with customers company policy.

Instructions

Step	Procedure, Cont.
5.	Position the XRC in position on the 2” mounting pipe and secure in place with two U-bolts, flat washers, lock washers and two 9/16” bolts as shown in Figure 2–5.

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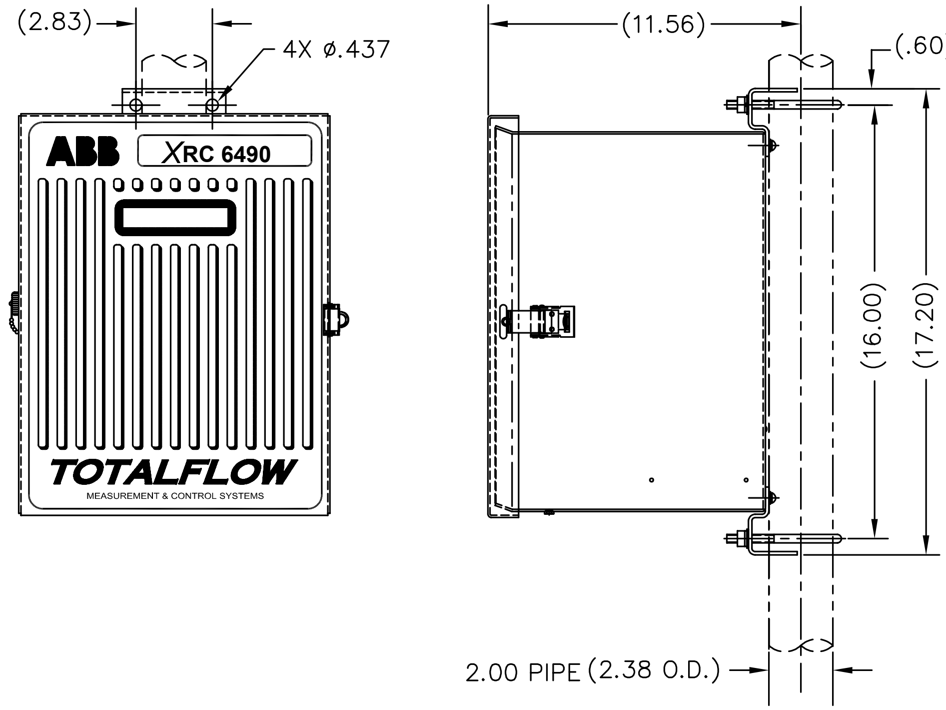

Figure 2–2 Model XRC6490, Pipe Mounted

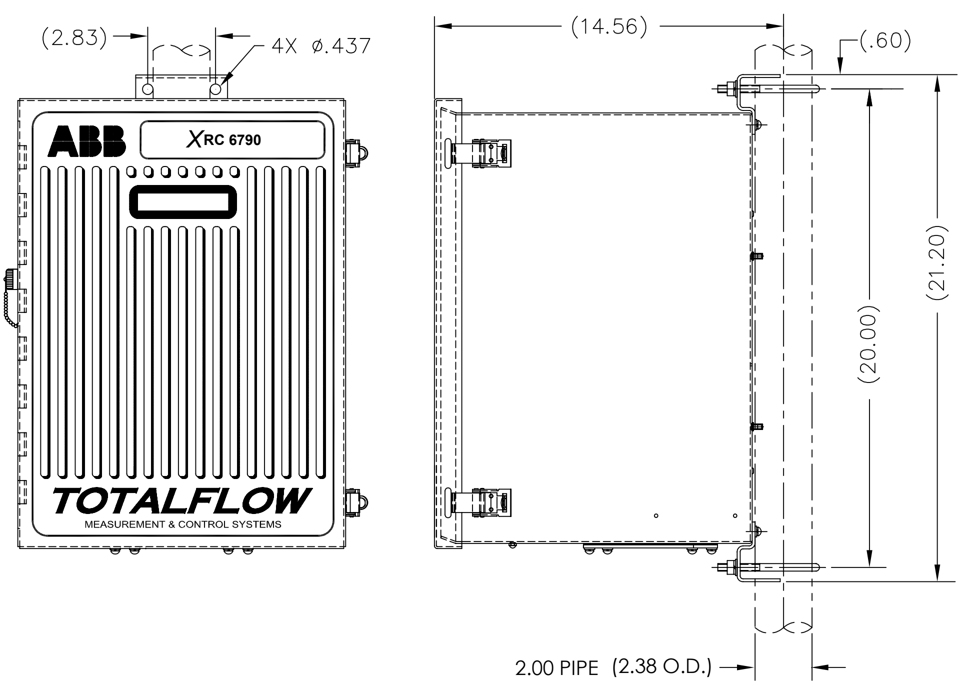

Figure 2–3 Model XRC6790, Pipe Mounted

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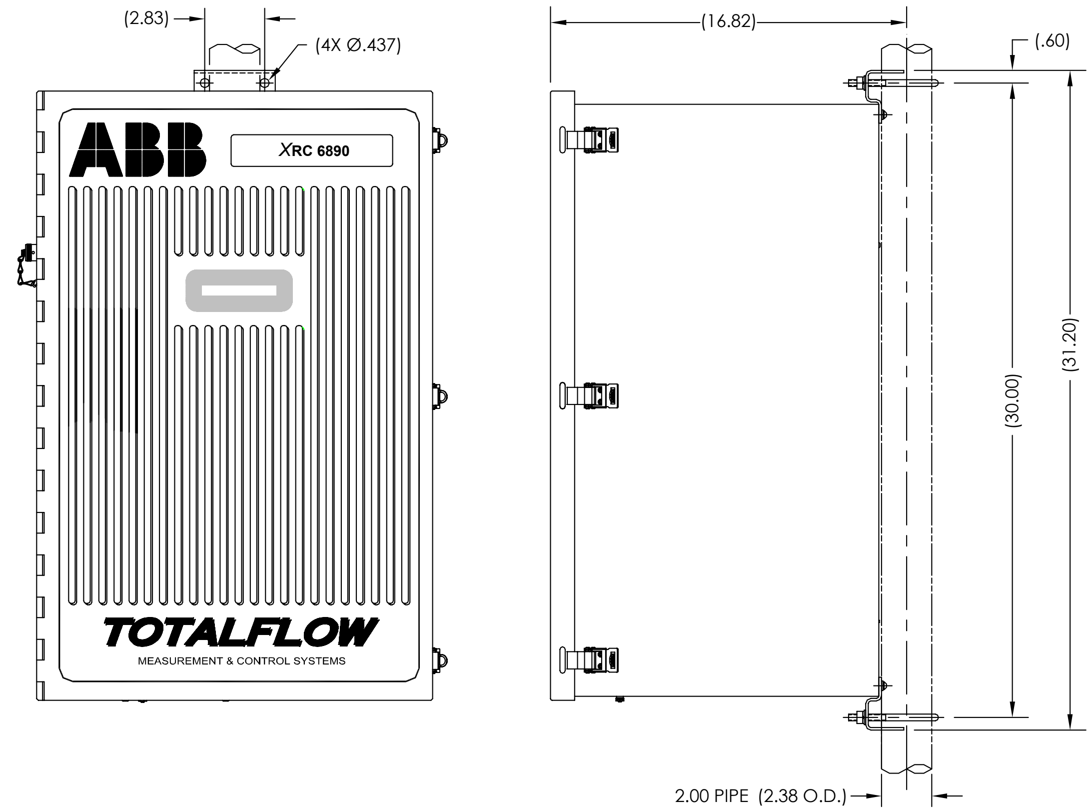

Figure 2–4 Model XRC6890, Pipe Mounted

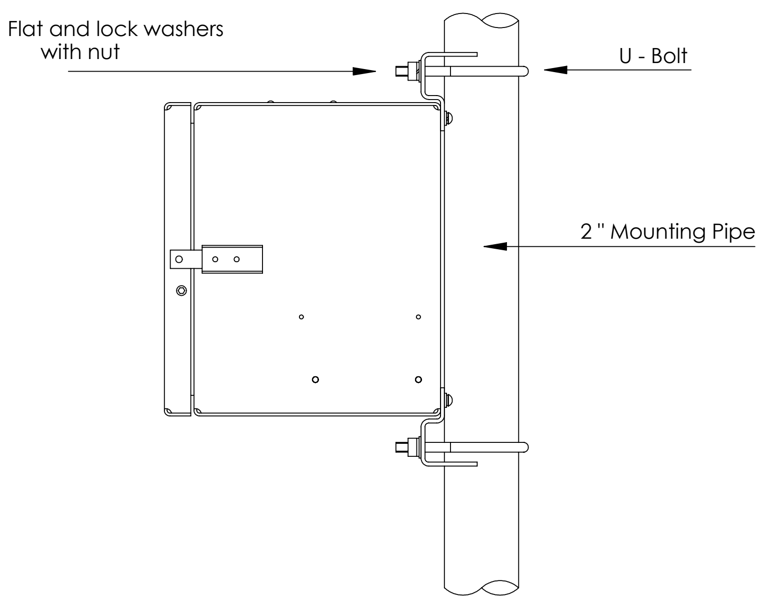

Figure 2–5 XRC Pipe Mounting

Wall Mount Installation

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

Optionally Supplied Materials

- Two U-bolts w/ fastening hardware
- Enclosure mounting brackets

Material Not Supplied

- Four 1/4” machine bolts
- #10 screws

Caution 

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

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

Instructions

Step	Procedure
1.	Refer to Figure 2–6 through Figure 2–8 Outline Drawings, drill mounting holes in wall supports.
2.	Install mounting brackets on back of XRC as shown.
3.	Lift and align XRC wall mounting brackets with mounting holes drilled in wall.
4.	Insert 1/4” diameter machine bolts through XRC mounting brackets into wall. Securely tighten all bolts to secure unit to wall.

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Wall Mount Installation, Cont.

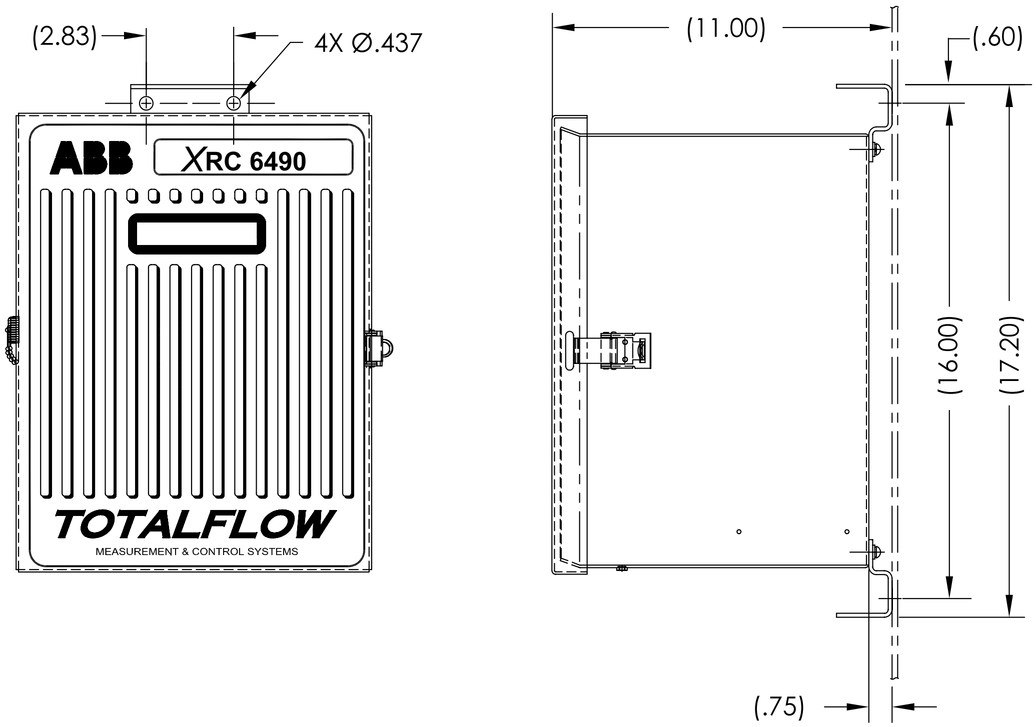

Figure 2–6 Model XRC6490, Wall Mounted

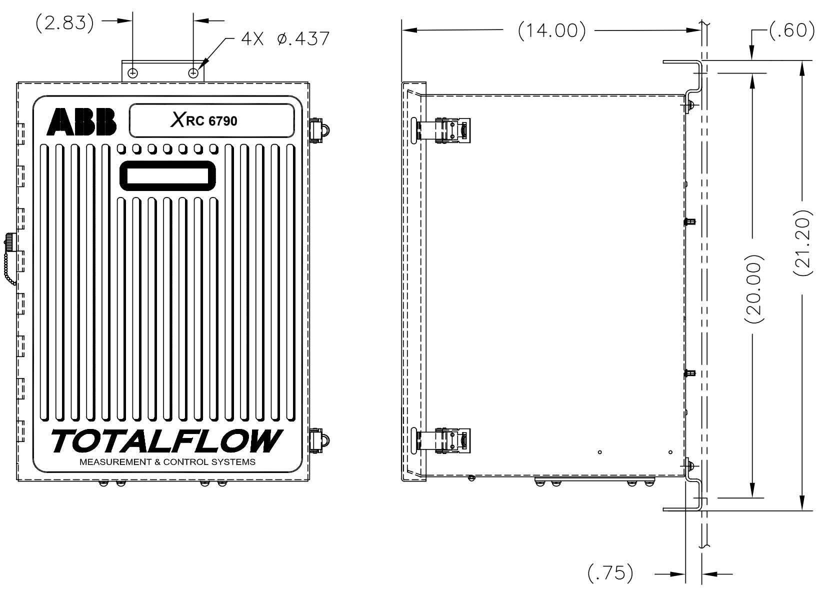

Figure 2–7 Model XRC6790, Wall Mounted

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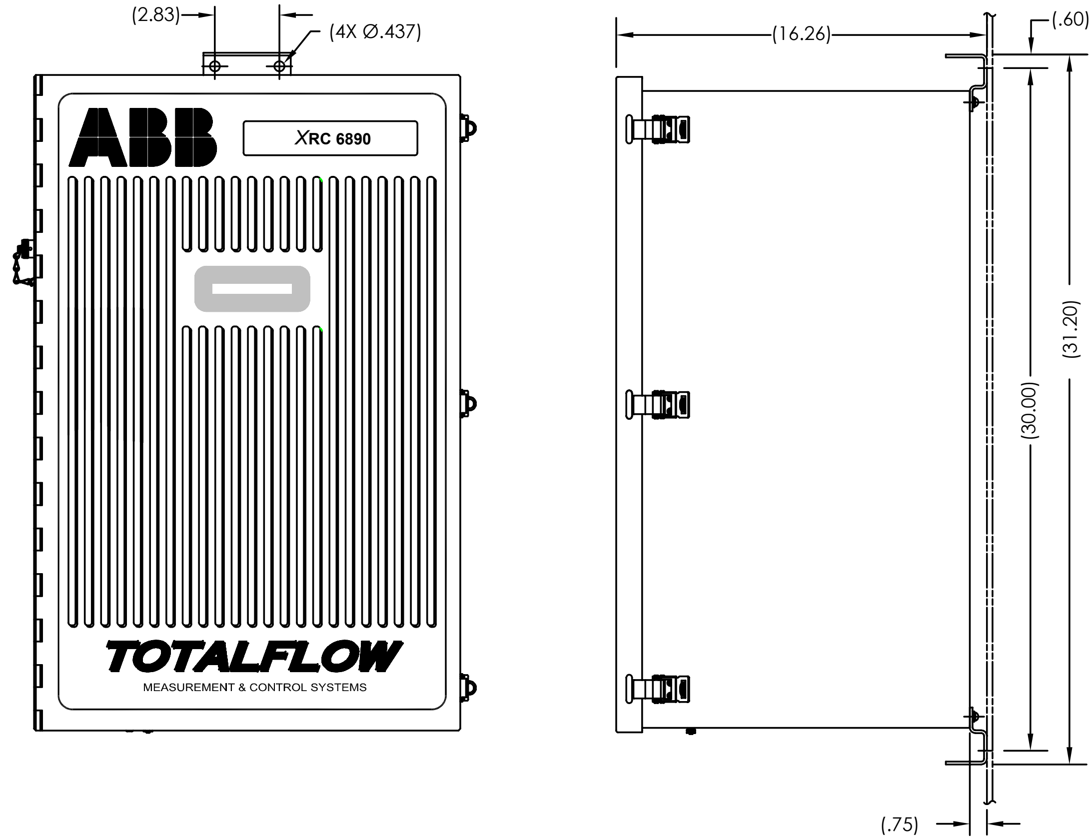

Figure 2–8 Model XRC6890, Wall Mounted

Battery Pack Installation

A battery pack provides the XRC with it's operating power. The battery is packed and shipped separately. Before installation, inspect power cables, where they terminate on battery pack, and connector for breakage.

Installation In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses. For a complete overview of the XRC-195 Board, see Figure 1–5.

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

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Battery Pack Installation, Cont.

Instructions

Step	Procedure
1.	Insert battery pack into lower compartment. Insert battery pack with its long dimension facing outward.
2.	Connect battery pack connector to Digital Board Battery Connection J16 connector (see Figure 2–9), located in upper right corner of Board.
3.	Observe LCD, the display should be on and scrolling through the startup diagnostics sequence.

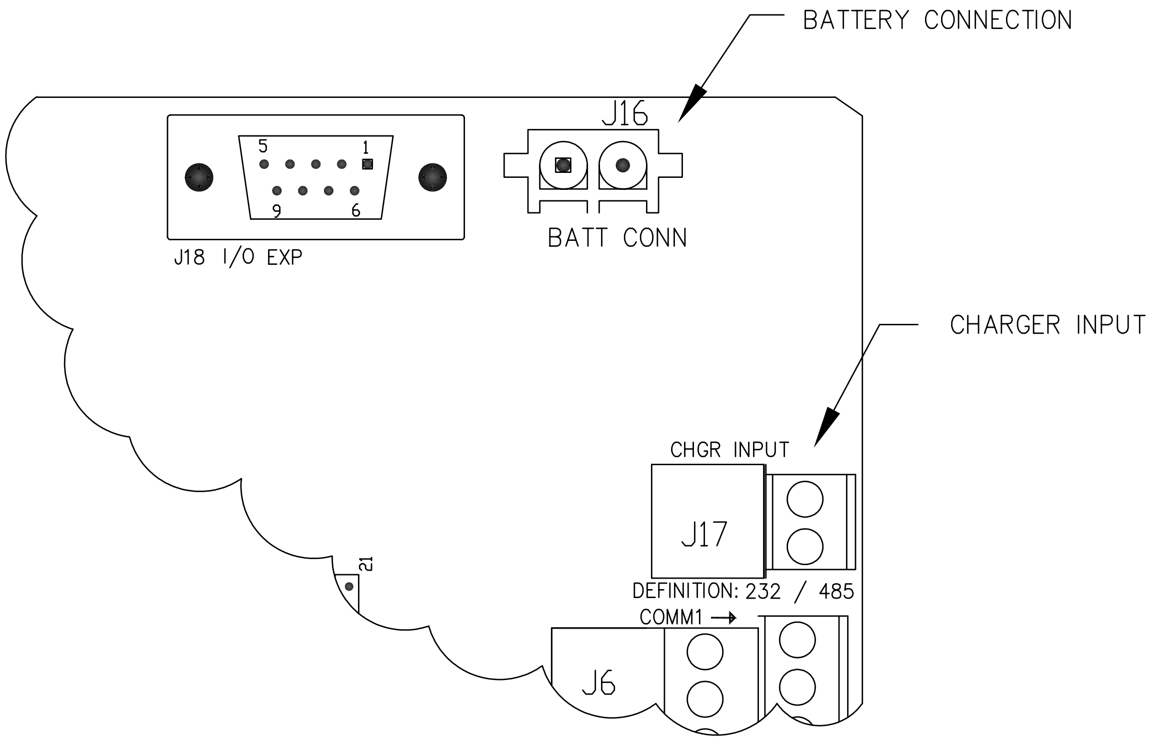

Figure 2–9 XRC-195 Board Battery and Charger Input Connections

Solar Panel Installation

The Solar Panel is designed for outdoor mounting on a 2” extension pipe installed on upper end of XRC 40” mounting pipe as shown in Figure 2–10. Solar panel must be mounted within 12 feet of XRC (other cable lengths available). For wall mounted XRC it can be mounted on top or side of meter house.

CAUTION Do not connect solar panel power cable to the XRC unless main battery pack has been connected to J16 (see Figure 2–9). For a complete overview of the XRC-195 board, see Figure 1–5.

FYI If installation procedures are required for mounting Solar Panel on top or side of meter house, customer should contact Totalflow's Service Department; see “Getting Help” in the Introduction section of this manual.

Materials Supplied

- One Solar Panel
- Two U-Bolts and fastening hardware
- Solar panel cable (Standard is 12’, other lengths are available)
- Solar Panel Mounting Bracket (if not already attached to Solar Panel)

Material not Supplied

- Cable ties
- One 9-inch extension of 2-inch pipe or other suitable length of pipe, threaded on one end.
- One 2-inch coupling.

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

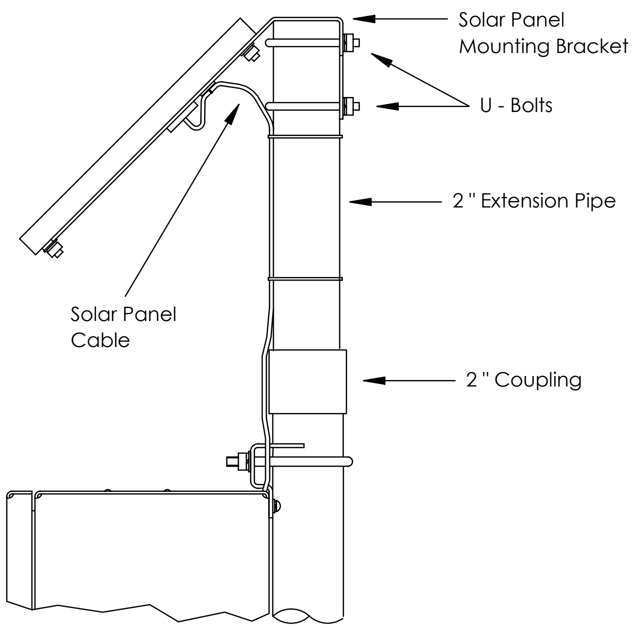

Figure 2–10 Typical Solar Panel Installation

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Solar Panel Installation, Cont.

Procedure

Our standard solar panel must be mounted within 12 feet of XRC. For Solar Panel mounting, the following materials are required.

In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses. For a complete overview of the XRC-195 board, see Figure 1–5.

Instructions

Step	Procedure
1.	Attach 2” pipe coupling to top end of XRC 40” mounting pipe. Securely tighten.
2.	Install 2” pipe extension into coupling and securely tighten.
3.	Before installation of the panel, check solar panel using digital voltmeter to verify polarity and output voltage. Voltage will vary depending on amount of sun, angle to sun, etc
4.	Install Solar Panel on mounting bracket, if required, with provided hardware. Install Solar Panel Cable if required.

CAUTION DO NOT connect other end of Solar Panel Cable to XRC until instructed to do so.

5.	Attach Solar Panel mounting plate to top end of 2” extension pipe with U-bolts and associated mounting hardware. Do not tighten U-bolts until Solar Panel has been correctly orientated.
6.	For northern hemispheres, position Solar Panel facing south. For southern hemispheres, position Solar Panel facing north. For optimum charging, solar panel should not be in shadows for the majority of the day. Panel should be kept clean for maximum charging.
7.	Remove CHGR Input terminal block (J17) from Digital Board. Insert Solar Panel power cable through an access hole on side of case. Allow enough power cable for field wiring to CHGR Input +/- terminations on J17.
8.	Before making connections to terminal block, trim wire ends back 1/4”. Loosen terminal block securing screws, insert wire then retighten. Connect Solar Panel (+) lead to (+) terminal and (-) wire to (-) terminal. Verify main battery pack is connected and then reinstall terminal block with wires attached.
9.	Following connection of Solar Panel power cable, secure cable to 2’ extension pipe and mounting pipe cable with plastic tie-wraps provided.

AC Charging Unit Installation

The AC Power Charging Unit maintains a constant voltage charge on installed battery pack. There are many different types and styles. Each unit will come with wiring instructions. Generally, you should follow the steps listed below.

Materials Supplied

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

- AC Charging Unit
- Coupling nipple

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 customer supplied primary AC power source.

Installation

In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses. For a complete overview of the XRC-195 board, see Figure 1–5.

Instructions

Step	Procedure
1.	The AC Charging Unit is shipped separately. When unit is received, unpack and inspect all components for evidence of damage. Report damage to shipping carrier and to Totalflow's Service Department.
2.	Remove one of the plugs from the side of XRC so that AC charging unit can be mounted without obstruction.
3.	Feed AC Charger DC power lines into XRC. Allow enough cable to extend into unit for connection to CHGR Input +/- terminals J17 (see Figure 2–9) on the Main Electronic Board.
4.	Connect AC Battery Pack Charger to XRC using supplied sealing ring and nut (see Figure 2–11). To prevent moisture from entering XRC after installing AC Battery Pack Charger, be certain associated connector, at Charger has a metal backed sealing “O” ring and metal locking nut attached.

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Step	Procedure, Cont.
5.	Before connecting Charger wiring, trim wire ends back 1/4" and remove associated CHGR Input J17 terminal block (see Figure 2–12) from Digital Board. Loosen terminal block securing screws, insert black wire into plus (+) terminal (top) and white wire in negative (-) terminal (bottom). Retighten screws and reinstall terminal block with wires attached.
6.	Plumb the conduit and associated AC wiring into the AC Charger conduit box (see Figure 2–13). 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 AC Charger. Connect the ground wire to the green screw.
7.	Verify that the DC power wires are terminated properly inside the cabinet and verify that the main battery pack is plugged into J16 (see Figure 2–9). Apply AC power to the AC Charger.
8.	Monitor DC charging voltage by observing the XRC display. LCD should indicate CHARGER 13.0 - 13.5 VOLTS.

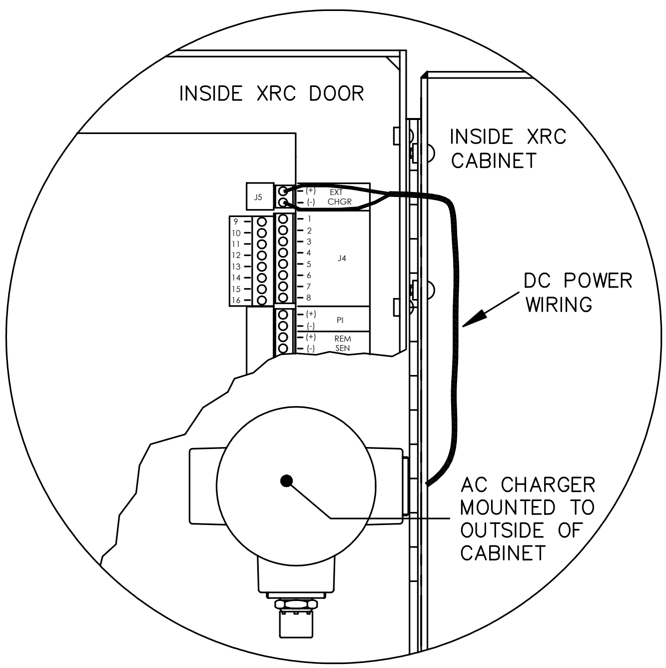

Figure 2–11 Mounting AC Charger

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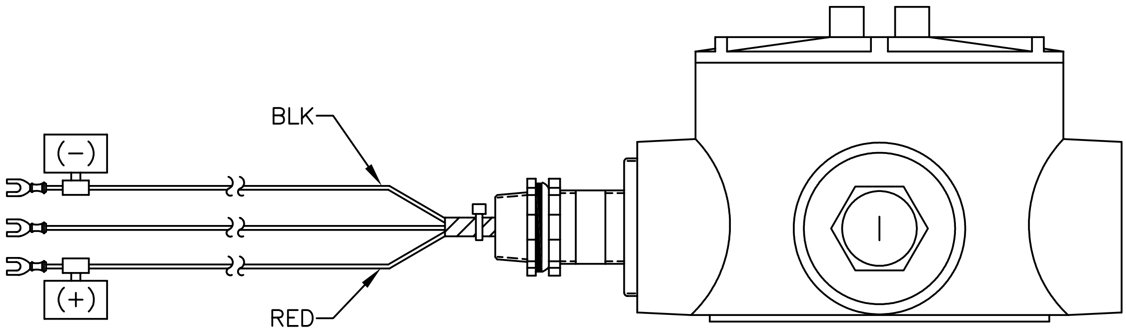

Figure 2–12 DC Wiring Instructions

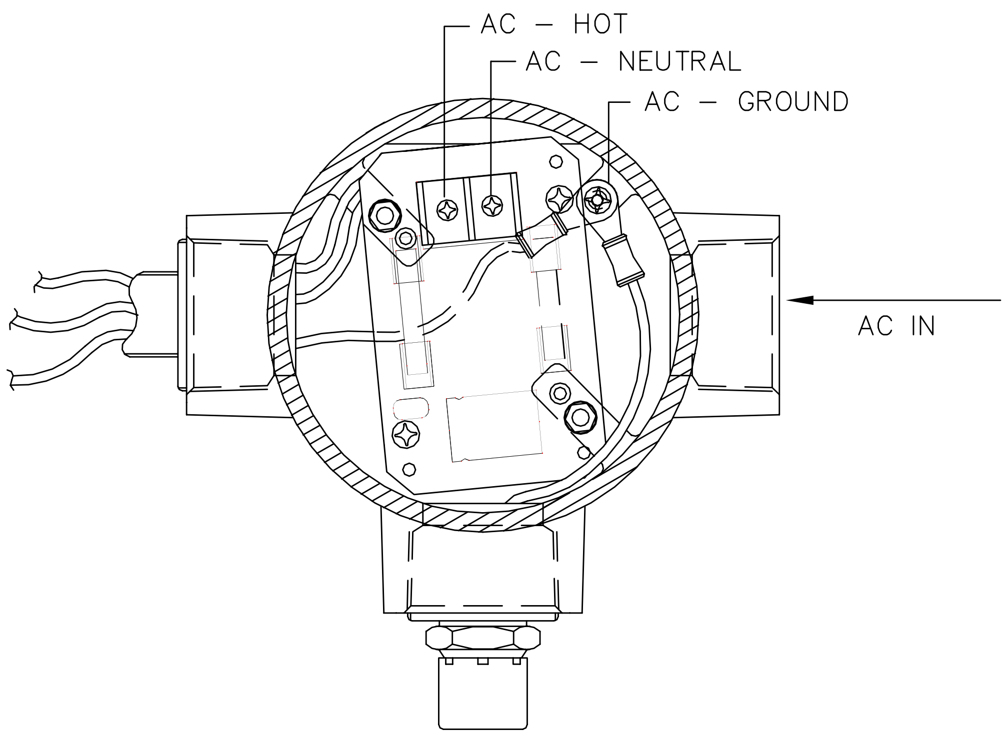

Figure 2–13 AC Wiring Instructions

XRC6990 Rack Mount Installation

Overview

The XRC6990 is intended for rack mounting. For purposes of these instructions, we assume that the mounting rack is already in place and that instructions are not required for mounting the unit into the rack (see Figure 2–14).

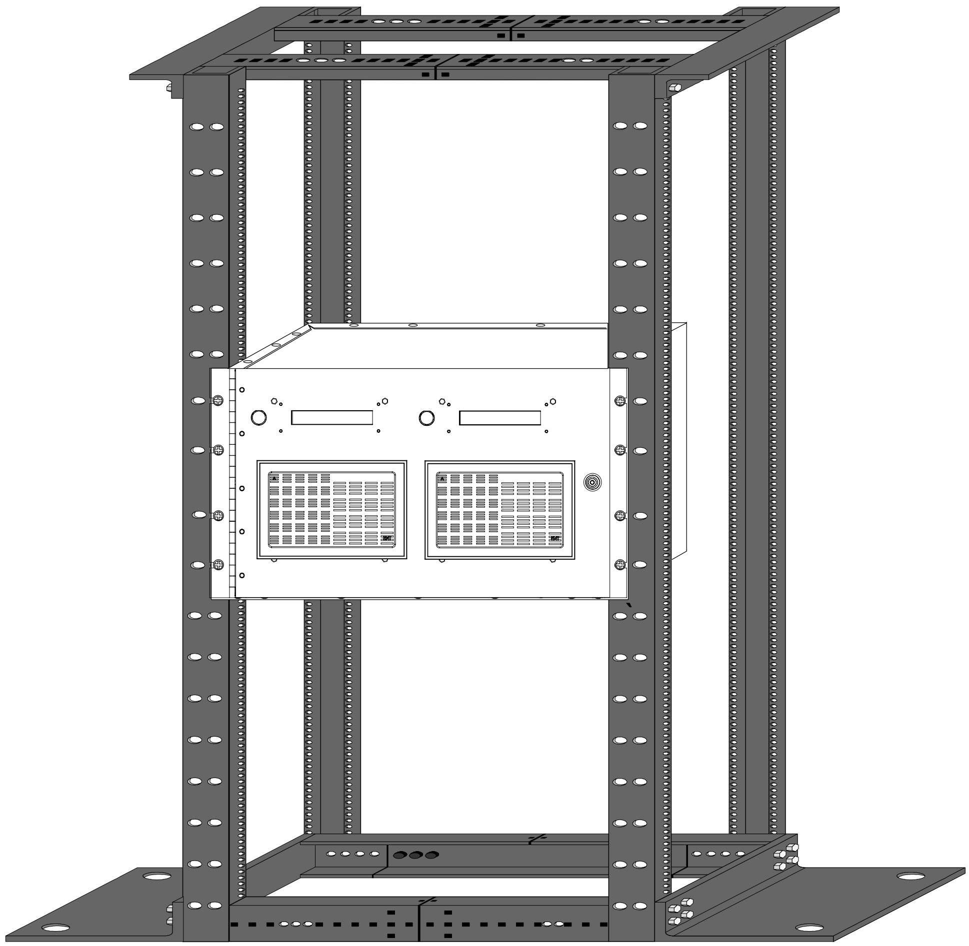

Figure 2–14 XRC6990 Rack Mount

Termination Panel

User connections to the XRC6990 are made on the termination panel on the rear of the enclosure. No internal wiring connections should have to be made by the user. Two termination panels are available depending upon whether the user ordered a single XRC6990 or a Dual Unit with two XRC controller boards.

Terminal designations on the back panel are identical to designated pin outs on the XRC Main Electronic Board(s). Any wiring instruction (WI) or User Drawing (UD) applicable to the XRC will be applicable to the XRC6990, but wired to the corresponding Plug on the rear of the enclosure. Table 2–1 Shows XRC Jumper/Termination panel correlation.

Continued on Next Page

Table 2–1 XRC Main Electronic Board to Termination Panel Correlation Chart

XRC Main Electronic Board	XRC6990 Termination Panel
J6-Comm 1	P6A
J6-Comm 2	P6B
J8-Digital I/O A	P8A
J8-Digital I/O B	P8B
J20-AuxPwr Output	P20
J23-Analog Inputs	P23
J18-TFIO Modules	P18

Dual Unit

Wiring to a XRC6990 Dual Unit, is reflected by two Termination Panels on the rear of the enclosure, two XRC-195 boards in the interior and two display and local communication ports on the front. Likewise if units are configured for the Optional Keypad, there will be two separate keypads on the front.

As wiring for the Dual Unit configuration is identical for each unit, all discussions will focus on the single unit configuration.

Figure 2–15 Shows the Single Unit and Dual Unit Termination Panel.

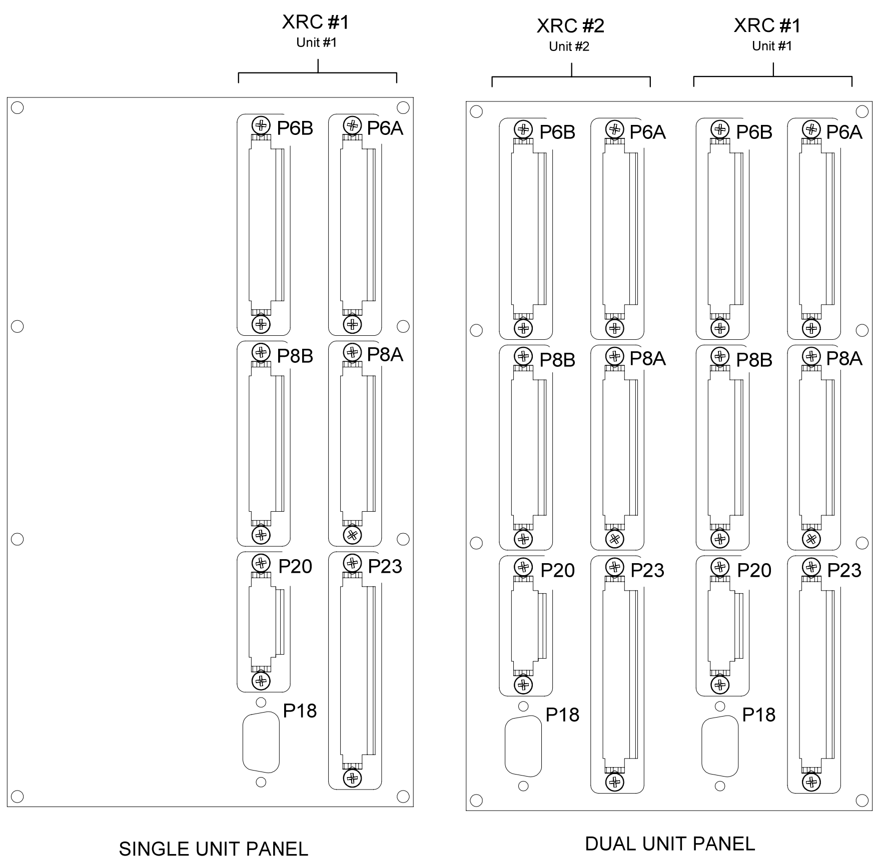

Figure 2–15 Single and Dual Unit Termination Panels

XRC Communication, Jumper Settings and Field Wiring

The XRC Main Electronic Board may require some basic setup and wiring.

The standard XRC enclosure allows the user access to the Main Electronic Board for Configuration of jumpers, communication modules and switches. All user wiring is wired directly to this board.

While the XRC Panel Mount Main Electronic Board(s) are pre-wired inside of the Rack Mount enclosure to the termination panel on the rear of the enclosure, it may be necessary to configure some of the jumpers, communication modules and switches that are located inside of the enclosure on the Main Electronic Board(s).

Communication Wiring

You have the ability to program up to two communication ports on the XRC-195 Board. COMM 0 is the local port required for reading the XRC with a laptop computer running PCCU32 or the DOS based FS/2 device. COMM 1 and COMM 2 can be configured for any combination of RS 232 or RS 485. See Figure 2–16 for On-Board Communications Wiring inside the Standard XRC enclosure. See Figure 2–17 for Communication Wiring on the rear termination panel of the XRC6990 Panel Mount enclosure.

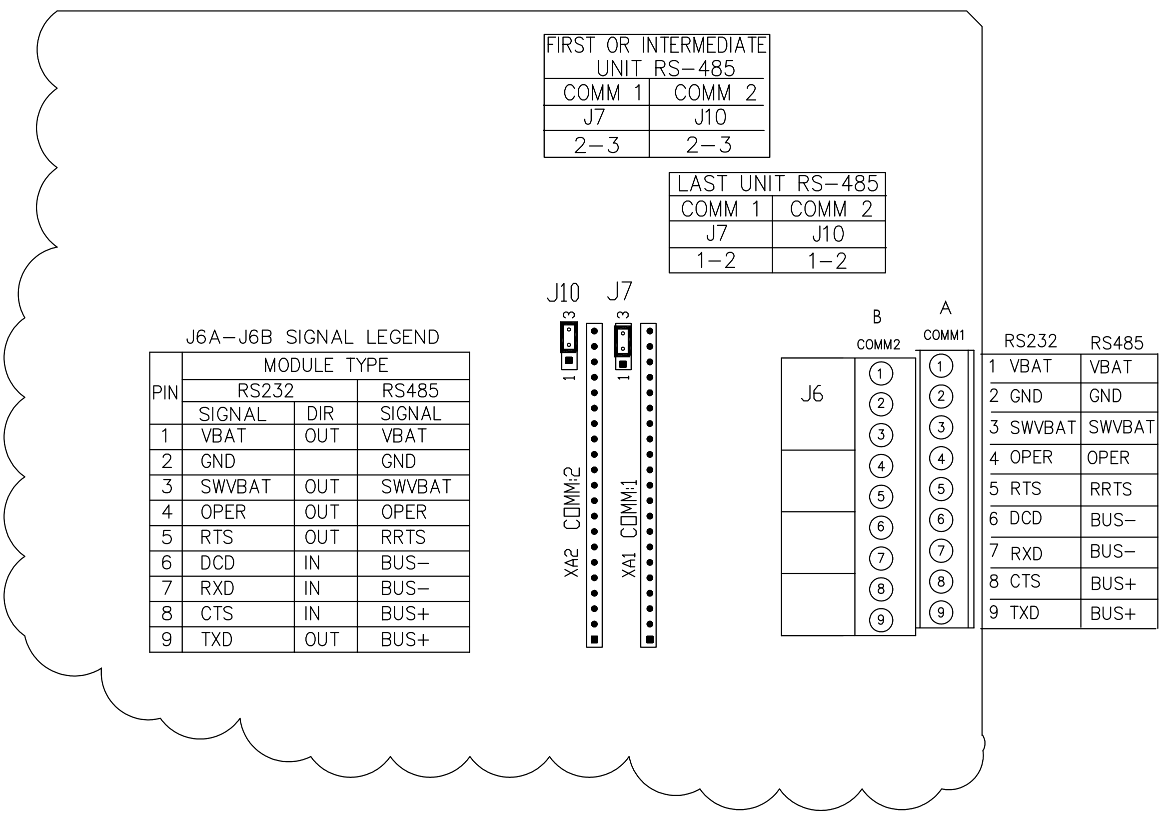

Figure 2–16 XRC Standard Communication Wiring

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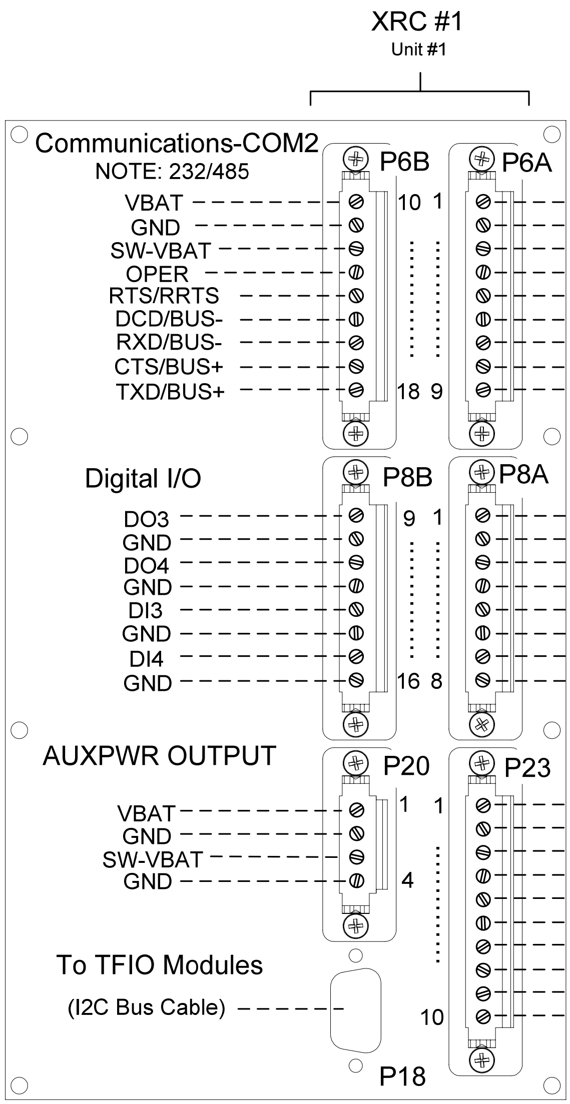

Figure 2–17 XRC Panel Mount Field Wiring Diagram

CAUTION

The XRC-195 Board, as with any electronic board, is susceptible to damage by static electricity or improper handling. To prevent this from occurring, user should wear a grounding strap.

Remove power to unit prior to changing Jumper settings or field wiring to on-board I/O.

Communication Modules

If the unit is configured for remote communications, XA1 and/or XA2 will contain a 21 Pin Communication Module specific to either RS-232, RS-422 or RS-485. If using the RS-485 Communication Module, J7 and/or J10 jumpers will require termination on last unit or only unit on 485 Bus.

Continued on Next Page

Board Configuration

Table 2–1 is a brief description of each configuration point on the XRC Main Electronic Board and it's function. The board diagram shows the location of these items (see Figure 2–16).

Other Field Wiring

For other wiring connections directly on the XRC Main Electronic Board, use Figure 2–17. When wiring to the termination panel on the back of the Panel Mount XRC unit, use Figure 2–15.

Table 2–2 XRC On-Board Jumper Settings

Jumper No.	Description
J7 & J10	**RS-485 Termination.** When multiple XRC's are daisy-chained together on a single RS-485 bus, the bus must be properly terminated. When the XRC is the "last" or "only" unit on the bus, the jumper should be across pins 1 & 2. If the unit is "first" or "intermediate" the jumper should be across pins 2 & 3.
J5, J9, J11 & J12	**Pulse Input Debounce.** When using any of the Digital Inputs as Pulse Inputs you may want to enable Debounce for that input. Debounce enables an RC Time Constant that will tend to "Debounce" noisy relay or switch closures. However, if your PI is monitoring a fairly high-speed input, enabling Debounce could cause you to lose some of the pulses.
J21, J22, J24, J25 & J26	**Analog Input Configuration.** The XRC Controller Board supports both "Voltage Input" and Current Loop Input" AI's. A jumper across pins 2 & 3 establishes the associated AI as a 0-10VDC Voltage Input. A jumper across pins 1 & 2 establishes the associated AI as a 0-20 milliamps Current Loop Input.
J1	**Lithium Battery Backup.** J1 enables and disables Memory Backup via the lithium cell. A jumper across pins 1 & 2 enables RAM memory backup. If the jumper is removed (or across pins 2 & 3) the lithium cell is NOT enabled for memory backup. Should power be lost, or disconnected, while the lithium cell is NOT enabled the XRC Main Processor Board will execute a Cold Boot and all historical data WILL be lost.
S1	**Security Switch.** If the Security Switch is ON and a local connection is made to the unit via PCCU, the proper Security Code must be entered. If the proper Security Code is not setup in PCCU the operator will be unable to configure the XRC. If the Security Switch is turned OFF, the user will be able to configure the XRC without secure access.

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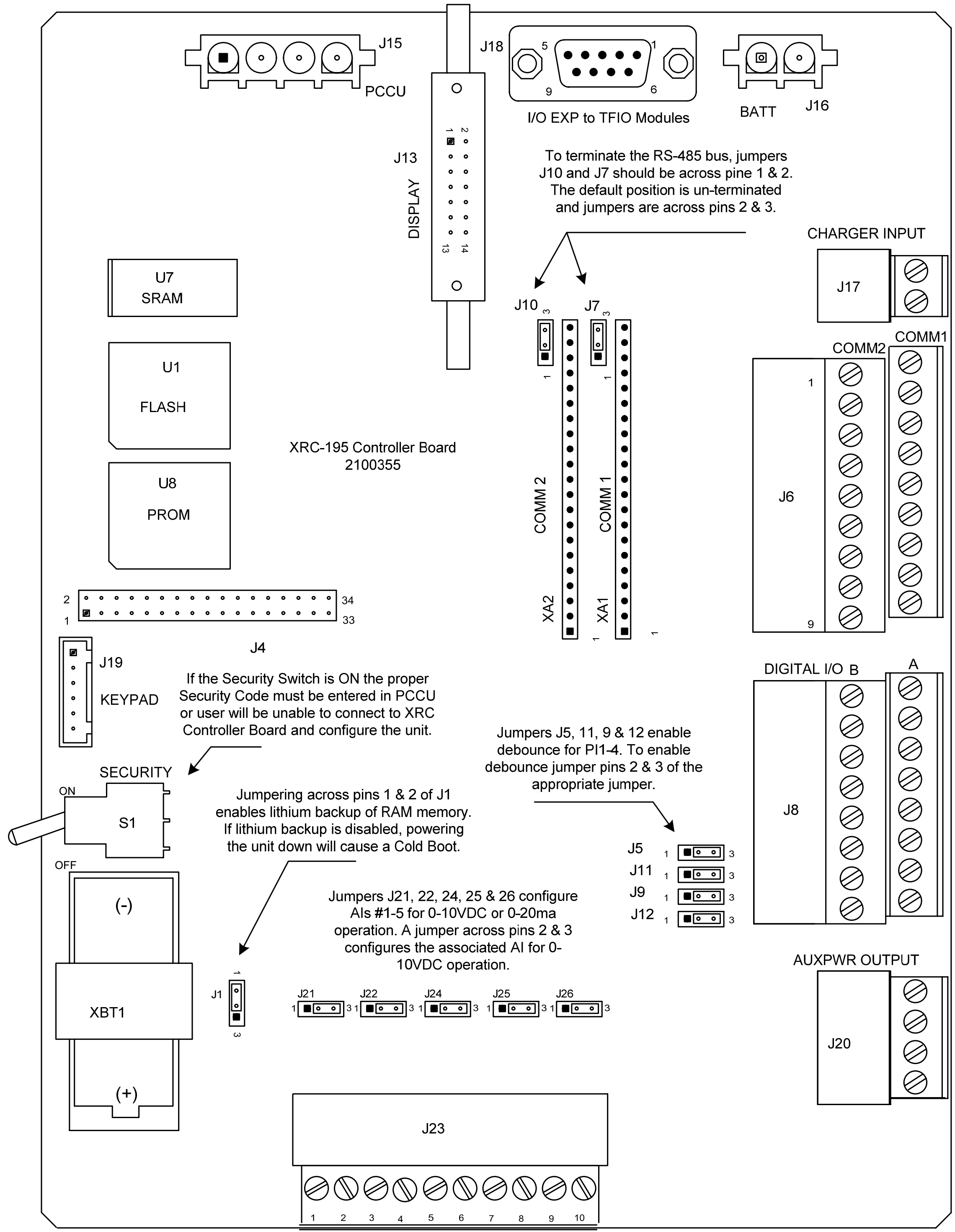

Figure 2–18 XRC Main Electronic Board Jumper Configuration

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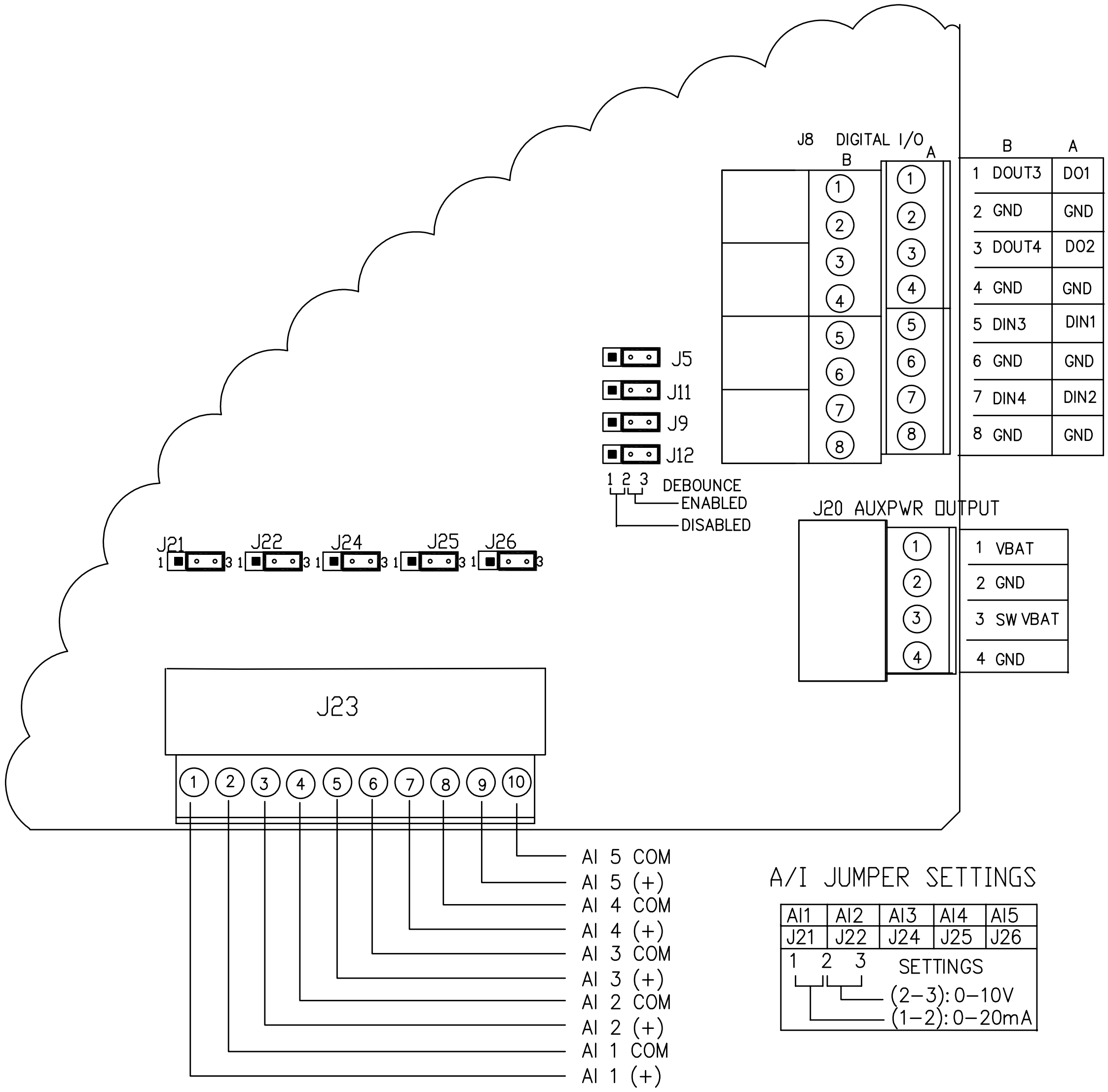

Figure 2–19 Other Field Wiring I/O Connections

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Chapter 3
XRC Startup

Overview

This Chapter generally describes the steps required to get a newly installed XRC system up and running. Specific information required to complete each step (depending on your equipment choice) is discussed in the PCCU32 help files, or the Operations Manual for the FS/2 Portable Calibration and Collection Unit.

Highlights

In this Chapter you will learn about:

FYI

Before you begin you should complete the tasks outlined in Chapter 2.0, Installation.

Options

The two equipment options for programming the XRC are the Windows based PCCU32 Software or the DOS based FS/2 device, these are discussed in more detail below.

PCCU32 Installation and Setup

Totalflow's® PCCU32 4.3 (or later) Software is required to communicate with XSeries equipment. Previous versions of PCCU32 are not compatible.

PCCU32 Software running in a laptop Windows environment offers you the most capabilities for programming. The Windows environment features user friendly help files and easy to follow menus. Having help files readily accessible to the user is comparable to having a virtual teacher on location. Easy to follow menus and icons, step the user through many required choices.

Installation

Step	Procedure
1.	Insert PCCU32 disk into PC drive. If CD drive is set to Auto Play, the installation program should begin, otherwise, go to Start, Run and type in D:\Disk1\setup.exe, D being the CD Drive designation.
2.	Follow screen prompts during installation.
3.	Another screen prompt will ask for User Information. Complete information and enter Serial Number in appropriate space, carefully entering both numbers and dashes. Select Next to continue.
4.	When installation is complete, press Finish. A new Totalflow PCCU32 window will appear. This contains the shortcuts created in the Start Menu. You may copy the PCCU32 shortcut to the desktop if desired. Note: For a standalone desktop shortcut, right-click on the shortcut, select Create Shortcut and drag it to the desktop.

Connecting To Local Port

The laptop computer connects to the Local Port located on the side of a standard enclosure, or on the front panel of the Panel Mount enclosure via a RS-232 MMI (Man Machine Interface) cable (See Figure 3–1).

Communicate

Step	Procedure
1.	Connect the MMI cable to the designated port on your PC, default is Com1, and to the *Local Port* located on the unit.
2.	Although we previously discussed shortcuts, lets do the traditional way of clicking on the *Windows Start* button, selecting *Programs*, *Totalflow PCCU32* (or correct program folder if changed during installation), then select *PCCU32*. This will display PCCU32's initial screen.

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Figure 3–1 RS-232 MMI Communication Cables

Step	Procedure, Cont.
3.	With the MMI cable connected, click on the *Connect* Icon (left-most icon at the top of the screen). The [Local Connect] screen will appear with some labeled buttons.

TIP If the Invalid Security Code screen should appear, enter four zeros (0000) for the new code and click OK. The XRC should have defaulted to 0000 on Start-up.

Step	Procedure, Cont.
4.	The *Local Connect* screen displays six buttons, *Collect Historical Data, Entry, Monitor, Calibrate, Valve Control and Registry*. Clicking on the *Entry Setup* will take you to the *Station Setup* screen. Links in the “Tree View” portion of the screen will move you to screens for setup and Daily operations.

Setting up the XRC

Overview

As previously instructed, once physically connected to the XRC, you instruct the Host Software to connect to the device. At this time, the software will actually read the device default values programmed at the factory. These preset values are based on the type of product you ordered and programmed for the most widely used configuration.

Depending on the programming device you are using, the following are the minimum required entries. Specific information required to complete each step (depending on your equipment choice) is discussed in the PCCU32 help files, or the Operations manual for the FS/2 Portable Calibration and Collection Unit.

Station ID

The station identifier code should uniquely identify one station from that of others. If running a multiple tube station, the station ID is the same for all tubes on that XRC. If left blank on a single tube device, it will be the same as the device ID.

Description	Format	Note
Station ID	XXXXXXXXXX	10 digit alphanumeric

Device ID / Application ID

The device identifier should uniquely identify each application/tube on a multi-tube device. On a single tube installation, the identifier code should uniquely identify one XRC from that of others and will be the same as the Station ID.

Description	Format	Note
Device/Application ID	XXXXXXXXXX	10 digit alphanumeric

Location

In WINCCU, the host software, the location field can hold up to 24 alphanumeric characters to describe its location. An example would be the county name or road number.

Description	Format	Note
Location	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 XRC.

Date/Time

The XRC date and time should be set correctly.

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

Program Display

The XRC comes from the factory with a set default displays as shown below in Table 3–1. By default, each display item remains on the display for 5 seconds. You have the ability to change this default to zero (item not displayed) or any value from 1 to 255 seconds. You are also able to change the engineering units, and data format for display purposes.

If your station is configured for measurement tubes or other applications, additional items will be scrolled.

Table 3–1 XRC Displayed Items

Description	Format	Note
DATE/TIME	MM/DD/YY HH:MM:SS	24 hour clock
BATTERY	NN.N VOLTS	Battery Voltage Volts
CHARGER	NN.N VOLTS	Charger Voltage
STATION ID	XXXXXXXXXX	10 Character alphanumeric identifier
DEVICE ID	XXXXXXXXXX	10 Character alphanumeric application or tube identifier

Security System

The Main Electronic Board (XRC-195 Board) has a bi-level security system built in. For the purpose of this manual, we will refer to this as the Hardware Security. When the XRC is accessed through PCCU32 or WinCCU Host software packages, this will have a third level of security included. We will refer to this as the Software Security.

The Hardware Security System is designed to have two levels of user access, Read (Level 1) and Read/Write (Level 2) privileges. User access by default has full Read/Write privileges; allowing the operator to change the various operational parameters including; orifice plate, meter run diameters, alarm limits, etc. To restrict the access, security codes for Level 1 and Level 2 must be setup (see instructions below).

The Software Security System is designed to have a Password Administrator who sets up the accounts and privileges for himself as well as the other PCCU32/WinCCU users. These privileges includes being able to instantiate applications and make changes to the functionality of the XRC, i.e. Application Editing and Downloading Files to a device. See the help files in the host software package for more information. When connecting remotely via WinCCU, position of the S1 Security Switch is not significant as long as WinCCU Security Code is equal to the level of access requested. Security is always passed and checked when using remote communications to communicate to the XRC using PCCU or WinCCU.

Additionally, the administrator may "Force Login" access by using tools available in PCCU32 and WinCCU. See Host Software help files for additional information.

CAUTION

If the Security Switch S1 located on the XRC-195 Board is in the OFF position (disabled), no security code has to be entered to access the operating parameters via PCCU32 (locally) even if there is one programmed into the device.

Modbus access to the meters is NOT protected by the Security System.

Table 3–2 Hardware Security Setup

Description	Format	Note	Access
Security Code Level 1	XXXX	4 digit numeric	Read Only
Security Code Level 2	XXXX	4 digit numeric	Read/Write

Hardware Security

Instructions

Step	Procedure
1.	To setup Hardware Security, set S1 Security Switch on the XRC-195 Board to the OFF position.
2.	Connect locally using the PCCU Cable and open communication to the unit using PCCU32.
3.	Go to the *Entry Screen* in PCCU32.
4.	In PCCU32 on the Station Setup screen, enter a four digit code for

	Level 1 Security (Read only).
5.	Additionally, enter a four digit code for *Level 2 Security* (Read/Write).
6.	Click the *Send* button located at the bottom of the *Station Setup* window.
7.	To enable Hardware Security, set S1 Security Switch on the XRC-195 Board to the ON position. The hardware security is now operational. Physically disconnect the PCCU cable from the meter.

FYI

The XRC does not send an error message when you have breeched the security level, it simply does not accept value changes. Always re-read the active PCCU screen to verify the XRC has accepted the change(s).

Setting the XRC-195 Board S1 Security Switch to the OFF position will deactivate the Hardware Security.

To reset the Security Code to default settings of 0000, Cold Start the unit.

8.	To access the meter using the Security System, go to *System Setup* in PCCU32 or WinCCU and enter the applicable security code on the *Setup Screen* and click *Close*. The security code will remain a part of the software setup and will use that setting each time a connection is made to a device.

CAUTION

The XRC enclosure may be padlocked to reduce access to the S1 Security Switch.

When communicating remotely via WinCCU, care must be taken to setup the required access code in WinCCU. Security Switch position on XRC-195 Board will not disable codes previously setup in Hardware Security. See WinCCU Help Files for additional information.

On Board I/O Calibration

Overview

The calibration mode enables the calibration of the Analog Inputs, Analog Outputs and Pulse Inputs.

Hold Mode

When calibrating, PCCU will instruct the XRC to ignore live values for the period of time the XRC is being calibrated. This prevents real time XRC calculations from being affected during the calibration. During this time the XRC uses the last known value at the time calibration mode was entered. (This is called the "HOLD" mode.)

To exit the Hold mode, perform any of the following:

1. Unplug DATA cable at XRC connector
2. Exit Calibration mode

Analog Input Calibration

Overview

The Totalflow XRC comes standard with 5 analog inputs on the XRC-195 Board (see Figure 3–2). As you enter calibration, the XRC enters the Hold Mode and displays the current values. To see a complete overview of the XRC-195 Board, see Figure 1–5.

The Current Values section will display the current values continuously by checking the "Update" box. 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 you need to complete the following procedures.

Instructions

Step	Procedure
1.	From the Local Connect screen in PCCU32, select Calibrate.
2.	In Tree View window, open Onboard I/O by clicking on the "+" .
3.	Under Onboard I/O, click on Analog In's. Select either the AI 1 tab or the AI 2 tab.
4.	Connect an accurate power source capable of 1 - 5 volts or 4 - 20 ma to the AI terminals to be calibrated. Make sure the jumpers on the termination panel are in the 4 - 20 ma position if a 4 -20 ma source is used. This puts a 250 ohm resistor across the terminals to convert the 4 - 20 ma to 1 - 5 volts.
5.	Under Calibration, select either 3 Point or 5 Point for number of calibration points. 3 Point for low, 50% and 100% values and 5 Point for low, 25%, 50%, 75% and 100% values.

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Analog Input Calibration, Cont.

Step	Procedure, Cont.
6.	In the Current Value box, check the Update button. This causes the AI to look for it's source at the terminals instead of a Test Value.
7.	Begin the calibration starting with the first selection, Low Calculation Point.
8.	Apply appropriate input, 1 volt or 4 ma to the AI terminals.
9.	Enter a value (typically zero) representing the Low Cal Point and representing the desired engineering units. 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.

10.	Move to the 100% Calibration Value.
11.	Apply 5 volts or 20 ma to the AI terminals (depending upon jumpeer settings).
12.	Enter a value representing full range and representing the desired engineering units. Click the OK button.
13.	If 3 Point calibration was selected, move to the 50% Calibration Value.
14.	Apply 3 volts or 12 ma to the AI terminals (depending upon jumpeer settings).

TIP If Performing a 5 point calibration, you will need to add additional steps for the 25% and 75% Calculation points.

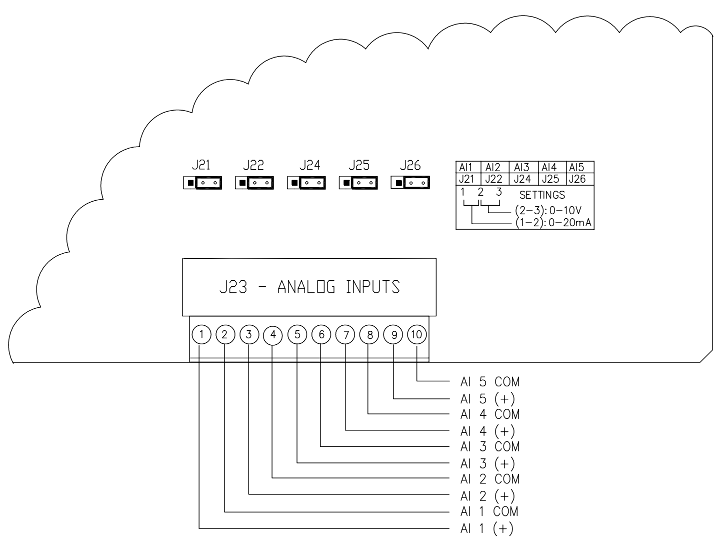

Figure 3–2 XRC-195 Board- Analog Input Calibration Points

Pulse and Digital Input Calibration

Overview

Totalflow XRC comes standard with 2 high speed Pulse Inputs on board. These may also be used as Digital Inputs. The following procedure is for calibrating Pulse Inputs. As you enter the calibration screen and have selected the P/I that you would like to calibrate, the XRC enters the Hold Mode and displays the current values and their register number.

The Current Values section will display the current values continuously by checking the "Update" box. When different pulse 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 you need to complete the following procedure.

Instructions

Step	Procedure
1.	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, use a factor of 1.

CAUTION Please take into consideration that these inputs may have the DeBounce enabled or disabled. This feature is discussed in detail in Chapter 1 On-Board Input/Output section. Look at Jumpers J5, J11, J9 and J12 on the XRC-195 Board.

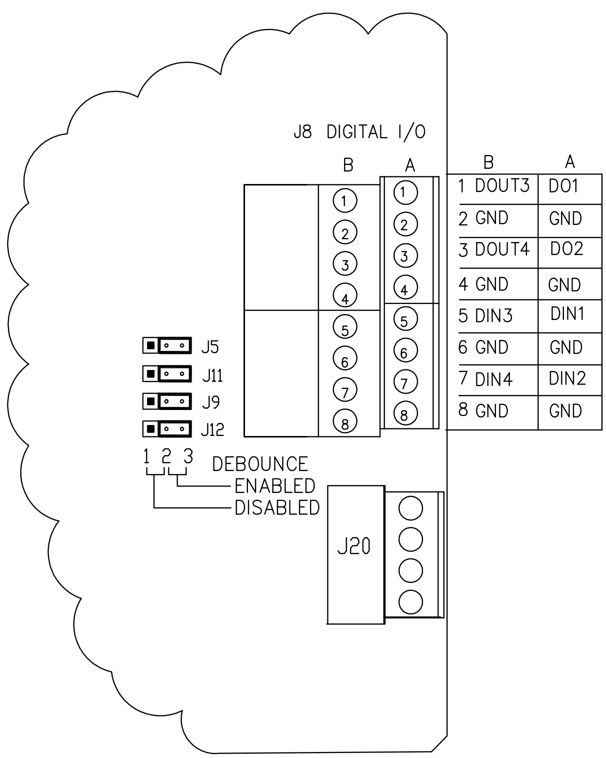

Figure 3–3 195 Board- Analog Input Calibration Points

Chapter 4
Maintenance

Overview

This Chapter provides you with standard Maintenance information and instructions on how to remove and install components of the XRC.

Highlights

In this Chapter you will learn how to:

Maintenance Support

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

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

How to Use This Chapter

We recommend that you develop regularly scheduled maintenance program. By establishing such a maintenance program XRC 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 problem(s) result in a failure.

Maintaining Cleanliness of XRC

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

Front Mounted LCD

The user is informed of operational problems and operational limit violations by observing the alarm codes on the right side of the LCD display. XRC alarm troubleshooting procedures are presented in the Troubleshooting Chapter.

Returning Part(s) for Repair

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

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

Backing up Configuration Files

Before you begin any maintenance on your XRC, you should collect the data and back up all configuration files to your laptop's hard drive or a floppy disk. This safeguards your data and allows you to re-start the unit without the hassle of re-configuring the XRC should any problem arise.

Although there are “Save” buttons in the Entry Mode screens which allows the user to backup “Entry” mode data items, a complete system backup is only accomplished by using the “Save and Restore Utility”. When using this utility to backup files, the user should also download the files to the S: drive in case of a “Cold” start.

- While in PCCU, use the Save and Restore Utility found under File Utilities in the Operate drop down menu.

Changing XRC Clock

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

Clock Change Not Crossing an Hour Boundary:

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

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

Forward Clock Change Crossing an Hourly Boundary:

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

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

Backward Clock Change Crossing an Hourly Boundary:

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

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

FYI

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

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

Downloading a New Flash

The occasion may arise that new software be downloaded to the XRC Flash Memory. As some flash files require the unit to be "Cold Started", technician should take precaution to collect data and perform a "Save and Restore" backup.

Instructions

Step	Procedure
1.	Connect the PCCU cable to the device.
2.	In Windows, Click Start, select Programs, Totalflow PCCU32 folder and then Flash Loader. The Flash Loader program will start.
3.	Enter the path and file name or click the browse […] button to locate the flash file.
4.	Select X-Series for the Device type.
5.	Select the correct computer Com Port.
6.	Verify that Program Flash is displayed for the Mode option.
7.	Although the Block size can be selected, the default size of 512 is recommended.
8.	Click the Next button to see the following screen:
9.	Click the Start Download button. As the program sequences through the steps, it will provide the status in the Current Status window and check off the three sequences shown above the Start Download button as they complete. During the download, a progress bar plus the number of bytes downloaded is continually updated. During the download sequence an Abort button replaces the Start Button, but would typically only be used if the user realized he/she had selected the wrong file.
10.	After a successful download, a dialog box will appear, plus the device will commence checksum verification and then start-up. Acknowledge the dialog box by clicking the OK button.
11.	Click the Close button to close the Flash Loader program.

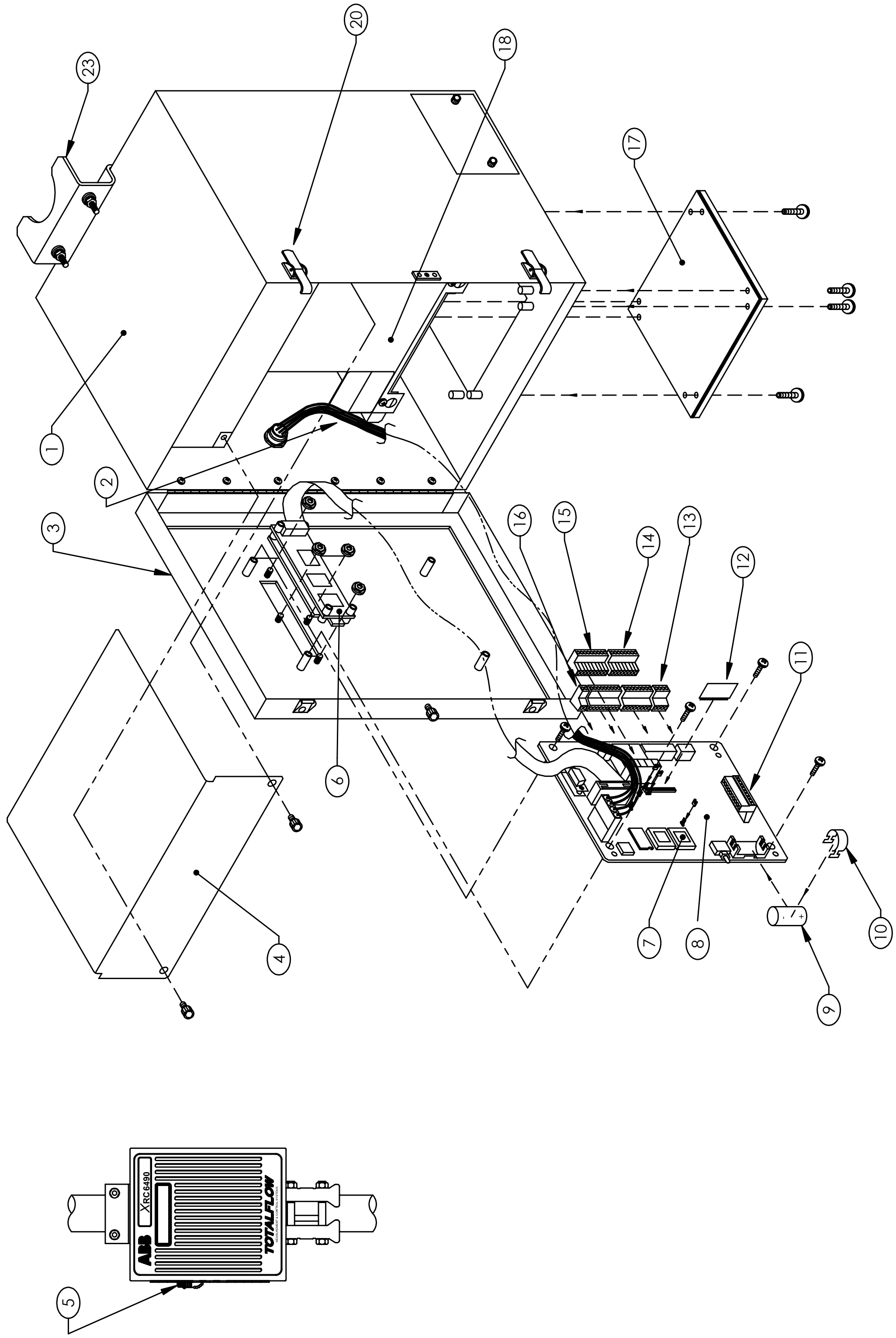

Figure 4–1 XRC6490 Component/Cable Locations

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Components and Spare Parts, Cont.

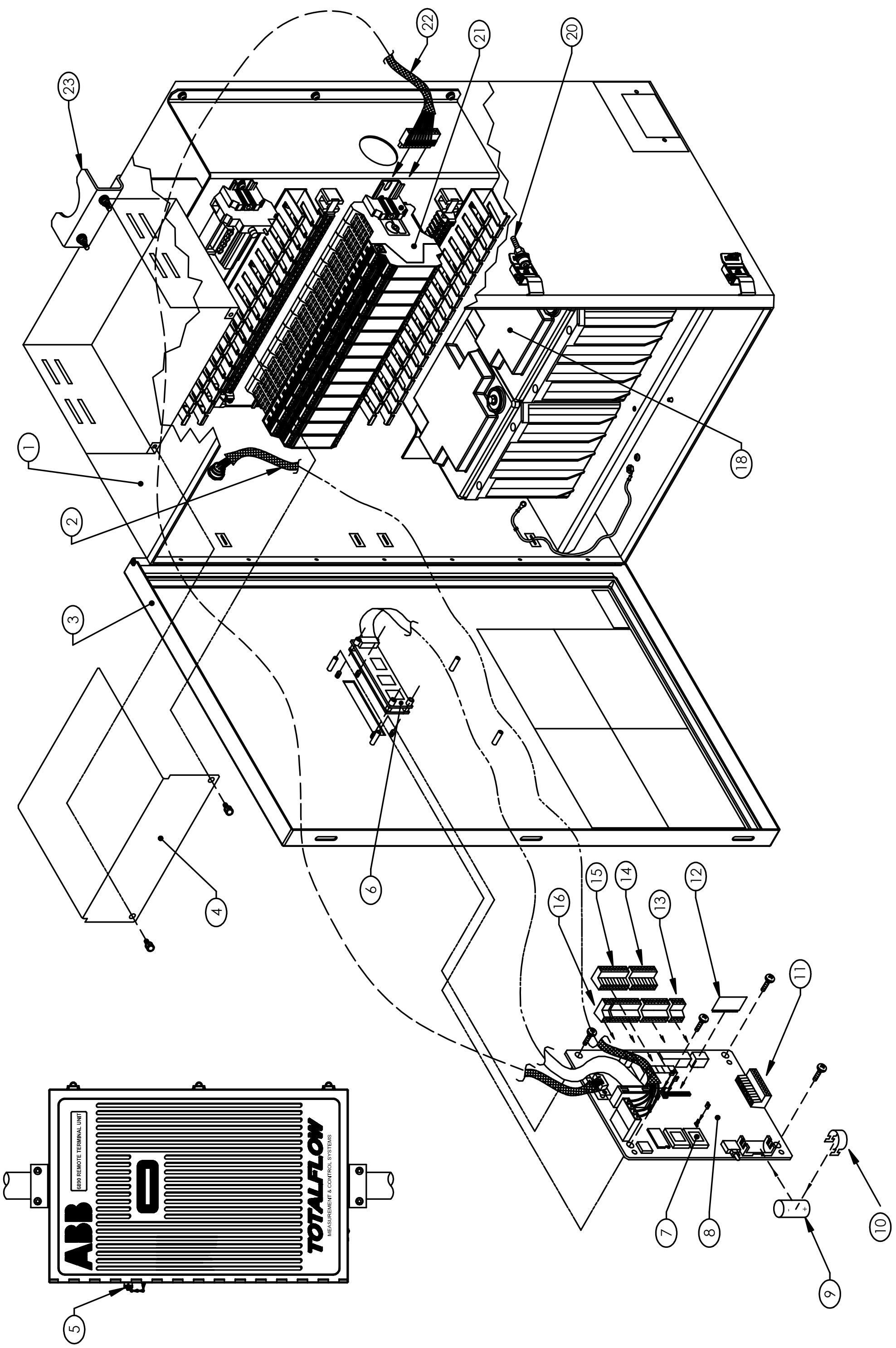

Figure 4–2 XRC6890 Component/Cable Locations

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Table 4–1 XRC6490 and 6890 Component Identifications

ID No.	Description	Spare Part Number
1	Enclosure	N/A
2	PCCU Internal Cable	2000073-xxx
3	Door (6490)	1800308-xxx
3	Door (6790)	1800309-xxx
3	Door w/keypad (6490)	2100548-xxx
3	Door w/keypad (6790)	2100924-xxx
4	Communication Bracket	2015260-xxx
5	External PCCU Connector Cap	1215000-xxx
6	LCD Display	2012804-xxx
7	Prom	2100806-xxx
8	XRC-195 Board	2100355-xxx
9	Lithium Battery	1487010-xxx
10	Battery Keeper	2100856-xxx
11	Phoenix Connector (10 pin)	1800389-xxx
12	RS485 Remote Communication Module	2015193-xxx
12	RS232 Remote Communication Module	2015192-xxx
13	Phoenix Connector (4 pin)	1220017-002
14	Phoenix Connector (8 pin)	1220017-005
15	Phoenix Connector (9 pin)	1800388-xxx
16	Phoenix Connector (2 pin)	1220017-001
17	Conversion Plate (6490 only)	2015353-xxx
18	Batteries	See Table 4–2
19	Battery/Compartment Cover (6490 only)	N/A
20	Door Latch	1800423-XXX
21	I/O Module Assembly (shown 6890 only)	N/A
22	TFIO Interface Module Cable (shown 6890 only)	2100391-xxx
23	Mounting Bracket for Enclosure	2015224-xxx

Continued on Next Page

Table 4–2 Additional Spare Parts

Description	Spare Part Number
Pipe Saddle Mounting Kit (12”)	1310000-012x
Pipe Saddle Mounting Kit (10”)	1310000-010x
Pipe Saddle Mounting Kit (8”)	S00515
Pipe Saddle Mounting Kit (6”)	S00510
Pipe Saddle Mounting Kit (4”)	S00505
Pipe Saddle Mounting Kit (3”)	S00500
Pipe Saddle Mounting Kit (2”)	S00495
Key Pad Kit	2100652
PCCU Collection Cable to Laptop	2015240-xxx
Solar Panel Charger (10 Watt)	1488010-xxx
Solar Panel Charger (30 Watt)	1488010-xxx
Solar Panel Charger (20 Watt)	2015095-xxx
Hole Plug ½”	1800408-xxx
Hole Plug ¾”	1800407-xxx
LCD Nylon Standoff	1800536-xxx
FCU Diagnostic Test Kit	2017373-005
FCU Diagnostic Test Kit w/ Multi-Meter	2017373-004
LCD Window w/adhesive (Hoffman)	1800553-xxx
Battery, 8AH	2015113-xxx
Battery, 26/30AH	2015052-001
Battery, 38/42 AH	2015052-004
Battery, 16 AH	2015052-003
Battery, 13 AH	2015052-002
Battery, 70 AH	2015052-010
Battery Charger 115AC/12DC	2011720-007
Battery Charger 230AC/12DC	2011720-008
Power Supply Converter 120VAC/DC	2018200-004
Power Supply Converter 240VAC/DC	2018200-005
Battery Charger 115AC/12DC	2100269-001
Battery charger 230AC/12DC	2100269-002
Communication Mounting Bracket	2015260-005

Replacing XRC Battery Pack

This section presents the procedures for removal and installation of XRC battery pack. To access battery pack, open XRC door. Battery pack is located behind front mounted keeper plate (model 6490 only).

CAUTION When removing battery pack, DO NOT remove the Lithium battery from the Main Electronic Board (XRC-195 Board). This prevents any data stored within the on-board RAM, from being lost.

Procedures In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses.

Step	Procedure
1.	Make sure the J1 (see Figure 4–3) memory backup jumper covers the top two pins to enable the memory backup.
2.	Either make sure "LL" battery alarm is not being displayed on XRC LCD or measure lithium battery and make sure it is > 3.0V.
3.	Disconnect the battery charger from XRC-195 Board terminals CHGR INPUT +/- J17 (see Figure 4–4).
4.	Before removing battery pack, disconnect the Battery Cable from the XRC-195 Board connector J16 (see Figure 4–4).

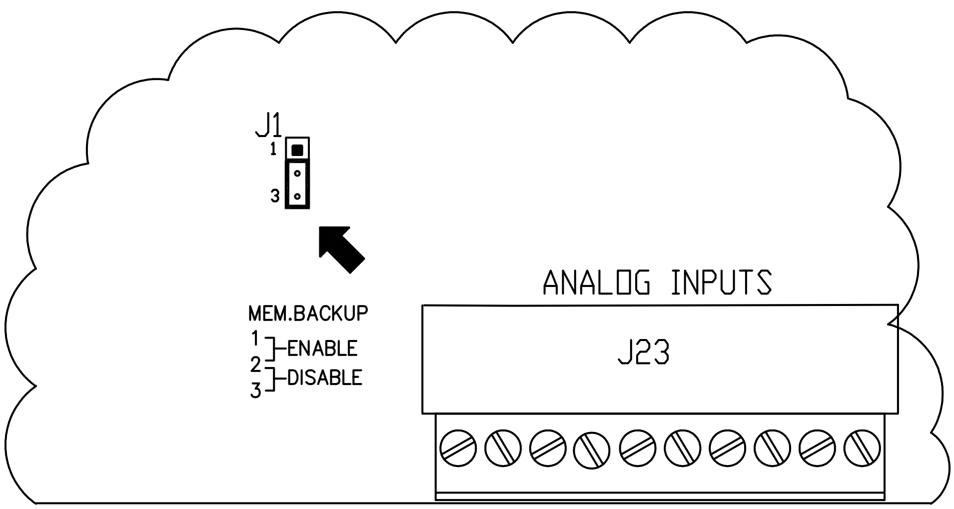

Figure 4–3 Memory Backup Enable Jumper

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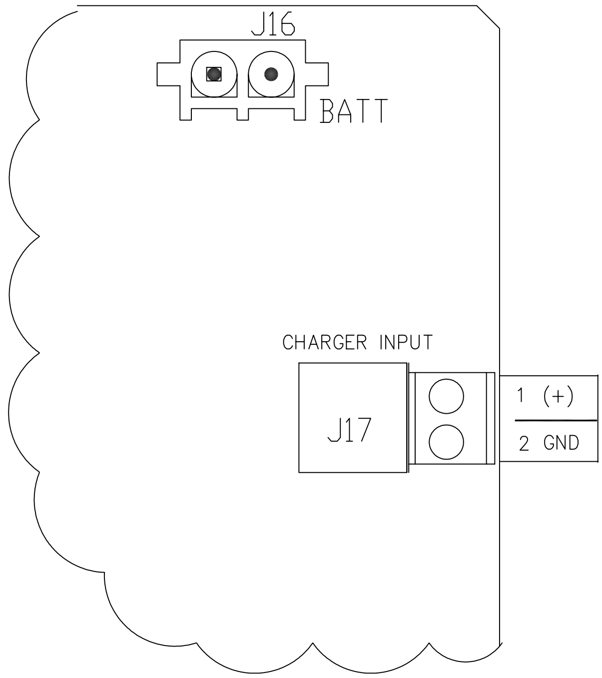

Figure 4–4 XRC Battery and Charger Connections

Step	Procedure, Cont.
5.	Remove keeper plate (see Figure 4–1, Item 16-6490 only), which secures battery pack in its mounting location, by slightly loosening the three mounting screws. It is not necessary to remove screws.
6.	Remove battery pack from battery compartment.
7.	Insert new battery pack into battery compartment. Battery pack must be positioned so its longest dimension fits snugly against keeper plate when plate is installed. Reinstall keeper plate (see Figure 4–1, Item 16-6490 only),and tighten the keeper plate mounting screws.
8.	Reconnect battery pack cable to XRC-195 (see Figure 4–4).connector J16.
9.	Reconnect battery charger to XRC-195 Board terminals CHGR INPUT +/- terminals J17 (see Figure 4–4).
10.	After closing XRC door, check door mounted LCD for normal operational readings.

Replacing XRC-195 Board

The XRC-195 Board is mounted to the backside of access door. It is mounted, to the door, on standoffs. Refer to Figure 4–1 or Figure 4–2.

CAUTION

The XRC-195 Board, as with any electronic board, is susceptible to damage by static electricity or improper handling. To prevent this from occurring, user should wear a grounding strap.

A grounding strap is a conductive device used to make connection between the person handling the board, and a high quality ground point. Before handling the board you must install ground strap on your body then connect it to a grounded point. This discharges electrical static buildup from the body to ground, preventing static from discharging to the board.

Before removal of XRC-195 Board, be certain any data has been saved to an external storage medium. Failure to do so could result in data loss when XRC-195 Board is removed.

Procedures

In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses.

Step	Procedure
1.	Before XRC-195 Board (see Figure 4–1 or Figure 4–2, Item 10) removal, disconnect the following associated connectors in this order. • If used, disconnect external charging source J17 (see Figure 4–5 Item 21). • Disconnect battery pack connector J16 (Item 22). • Slide out to the right; the following green terminal strips from its associated XRC-195 Board connector. DO NOT lift connectors upward. Tape an identifier to each connector so it will be correctly reinserted into the same Board mounting connector during reinstallation of XRC-195 Board. ▪ J6-COMM 2 (Item# 18) ▪ J6-COMM 1 (Item # 17) ▪ J8-B (Item# 16) ▪ J8-A (Item# 15) ▪ J20 (Item# 13) ▪ J23 (Item# 11) • Disconnect PCCU Port connector J15 (Item# 25). • LCD Interface connector J13 (Item# 24). • Remove cable from J18 (Item# 23) if External I/O Modules are installed.

Continued on Next Page

Replacing XRC-195 Board, Cont.

Step	Procedure, Cont.
2.	Remove four mounting screws and lock washers securing the XRC-195 Board to door mounted standoffs (see Figure 4–1 or Figure 4–2).

FYI When removing the XRC-195 Board, grasp its outer edges. This prevents damage to circuitry and components.

Step	Procedure, Cont.
3.	Replace and secure XRC-195 Board on four standoffs and secure in place using four screws and lock washers. DO NOT over tighten screws. Doing so could cause damage to Board or associated circuitry.

4.	Reinstall connectors, removed in Step 1, to their associated Board mounted connectors in the following order.
	• LCD Connector J13 (see Figure 4–5, Item# 24)
	• PCCU Connector J15 (Item# 25)
	• I/O Module Cable J18 (Item# 23)
	• Communications:
	    ▪ J6-COMM 2 (Item# 18)
	    ▪ J6-COMM 1 (Item# 17)
	• On board I/O:
	    ▪ J8-B (Item# 16)
	    ▪ J8-A (Item# 15)
	• J23 Analog Input (Item# 11)
	• J20 Auxiliary Power (Item# 13)
	• Battery Pack J16 (Item# 22)
	• Charger J17 (Item# 21)

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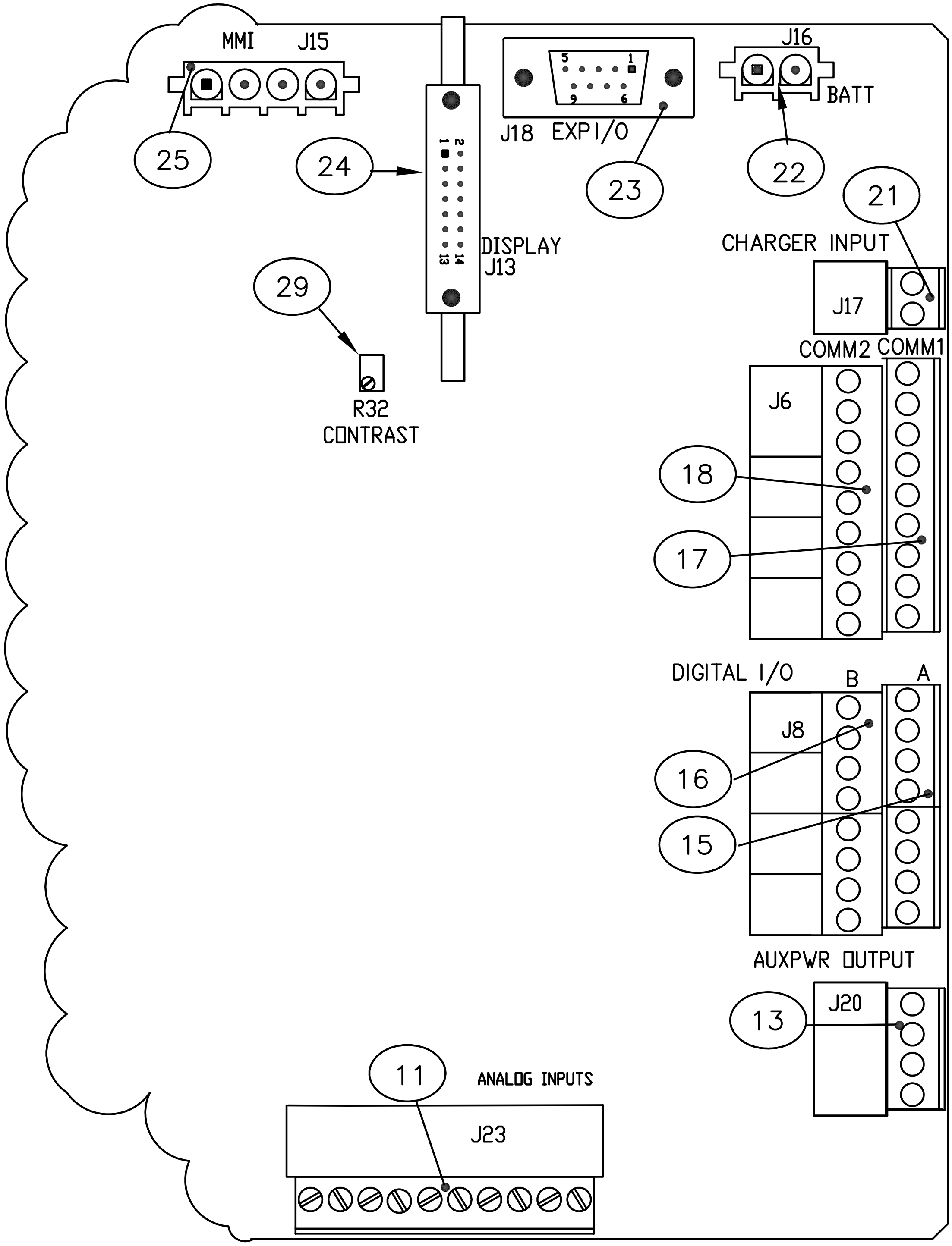

Figure 4–5 XRC Board Connections

Replacing Liquid Crystal Display (LCD) Board

The LCD Board is mounted on the backside of hinged doors behind XRC-195 Board. To access and remove Display Board, perform the following procedures.

Instructions In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses.

Step	Procedure
1.	To access the LCD Board, open the Totalflow unit door (see Figure 4–1 or Figure 4–2, Item 3). Board is located behind XRC-195 Board (Figure 4–1 or Figure 4–2, Item 6).
2.	Disconnect the external charging unit J17 (see Figure 4–5) from the XRC-195 Board.
3.	Disconnect the Battery Pack connector J16 (see Figure 4–5) from the board mounted connector.

CAUTION DO NOT remove the Board mounted Lithium battery since it provides power to RAM. It is recommended that historical flow data be downloaded before accessing and removing LCD Board to prevent potential loss of stored data.

Step	Procedure
4.	Disconnect LCD Board cable connector from XRC-195 Board Display Interface connector J13 (see Figure 4–1 or Figure 4–2, Item# 24).
5.	Remove four XRC-195 Board mounting screws and lock washers. DO NOT let screws and lock washer fall onto Board circuitry.
6.	Move Board away from door then support it so its circuitry does not come in contact with any metal surface.
7.	Using a 3/16” nut driver, remove four Display Board hexagonal mounting standoffs. Lift Board from door mounted standoffs. If Board is being returned to Totalflow for service, it is recommended that attached ribbon cable be left connected and returned with Display Board.

TIP To adjust display contrast, use an extra small screw driver to turn potentiometer R32 completely clockwise. Complete to step 8, then move screw back counter clockwise until screen is readable.

Step	Procedure
8.	To reinstall Display Board, perform procedures 1 to 7 in reverse order. DO NOT over tighten screws. Once Display Board is reinstalled, apply power to XRC, adjust contrast potentiometer R32 (see Figure 4–5, Item# 29) for optimum display, and verify information displayed on LCD is correct.

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Chapter 5
Troubleshooting

Overview

As an aid to troubleshooting the XRC, this chapter will provide troubleshooting guidelines for the various subsystems.

This Chapter contains a troubleshooting flowchart (see Figure 5–1). As you follow the logic in this flowchart, you will be directed to specific test instructions that are found in this Chapter or you may be directed to the Power Troubleshooting Flowchart (see Figure 5–4) or possibly the Communication Troubleshooting Flowchart (see Figure 5–8). In addition to these flowcharts, this Chapter contains step by step procedures for troubleshooting an XRC with or without an installed radio communication unit.

Highlights This Chapter covers the following topics:

Continued on Next Page

Focus

This section primarily focuses on the electronic/electrical connections, and issues related to equipment malfunction. The flowchart in Figure 5–1 may help to determine which tests to begin with. It should be noted, that it is not intended to cover every issue, but provide general guidance.

Troubleshooting Support

If troubleshooting instructions do not lead to a resolution and assistance is required, user can contact the Totalflow Service Department.

USA: (800) 442–3097 or International: 001–918-338-4880

Visual Alarm Codes

As noted in Chapter 1, the units LCD Annunciator area shows many different status indicators related to device operations. This section contains info on those codes that reflect errors or provide information useful in troubleshooting. 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.

SLEEP Mode

Totalflow units are designed to go into a low power mode, SLEEP, when an insufficient amount of voltage is present for a period of time. At issue here, is locating the reason for the SLEEP alarm, simply “waking up” the unit will not suffice, therefore issues relating to the systems power supply should be investigated.

Solar Panel

When a Solar Panel is attached to the XRC to provide a charging source for the battery, cleanliness and positioning play an important roll, as do proper electrical and cabling techniques. More detailed information on power consumption may be found at www.abb.com/totalflow.

Communication

Troubleshooting the communications for this unit requires that both pieces of equipment be tested; 1) the XRC Comm Ports and 2) 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 Communications
- RS485 Communications
- RS422 Communications

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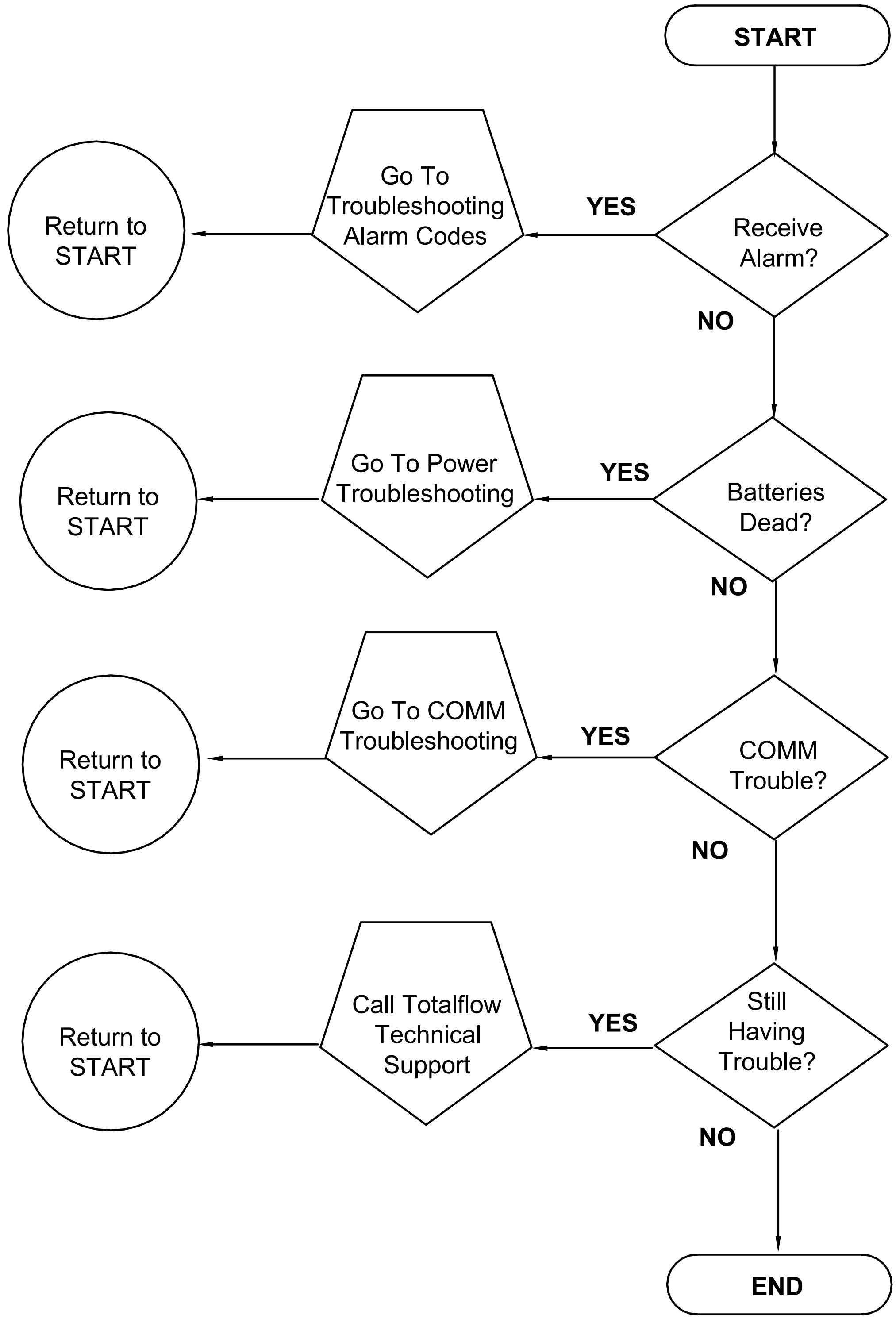

Figure 5–1 Troubleshooting Flowchart

Troubleshooting Visual Alarm Codes

Overview

When a visual indicator is present (see Figure 5–2) the following section will assist in determining the probable cause and steps required to correct the condition.

For the purpose of troubleshooting, only those codes considered to be alarms or codes used to assist troubleshooting are discussed here. The entire list of Status and Alarm codes may be found in Chapter 1, Table 1–3. Table 5–1 contains a description of each XRC 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.

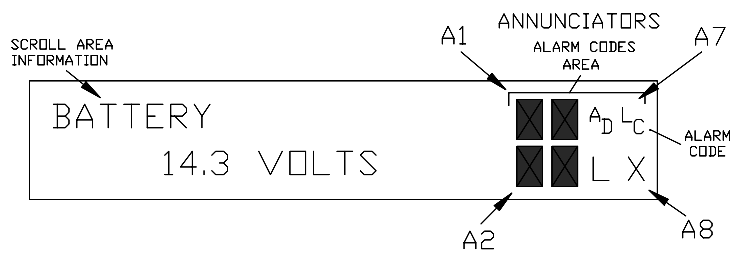

Figure 5–2 Liquid Crystal Display and Indicators

Table 5–1 Visual Alarm Codes

Indicator	Description	Alarm
	I/O Sub-System	
L_L	*Low Lithium Battery Alarm*: When L_L (low lithium) is displayed, lithium battery voltage is below 2.5 Vdc. If battery voltage is above 2.5VDC, A1 appears shaded. A new lithium battery measures approximately 3.6 Vdc.	Y
L_C	*Low Charger.* Displayed if XRC battery charging voltage is less than (+)0.4 Vdc higher than battery voltage. If charging voltage is (+)0.4 Vdc greater than battery voltage then annunciator is shaded.	Y
	Measurement Application	
A_D	*A to D Failure.* Displayed if A to D Converter Absolute Differential Pressure, Absolute Static Pressure or temperature readings exceed maximum counts or are less than minimum counts. If A to D Converter readings are within range, AD is shaded.	Y
	Communication Protocols	
→	Transmitting Data: Sending a response	N
←	Receiving Data: Processing request.	N

Continued on Next Page

Table 5–1 Visual Alarm Codes, Cont.

Indicator	Description	Alarm?
Communication Protocols, Cont.		
!	Nak. Negative Acknowledgement w/packet list.	N
+	Ack. Positive Acknowledge of receipt of request.	N
	Waiting for Ack. Waiting for response after transmission.	N
?	Exception Alarm Processing.	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
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
L	Local Protocol. Displayed when PCCU port is active and running Totalflow Local Protocol.	N
¥	ID Recognized. The ID has been recognized but is waiting for “Sync”.	N

Troubleshooting a Blank LCD Screen

When the Liquid Crystal Display is blank, this means that the unit has entered Sleep Mode. This generally indicates the battery voltage has dropped below 10.9 VDC.

Instructions

Step	Procedure
1.	Make a local connection with the XRC. This wakes up the unit so that you may check all alarm conditions and determine the problem.
2.	Check battery pack cable. It must make a good secure electrical connection with the Main Board BAT CONN connector J16 (see Figure 5–3).
3.	Check battery pack cable is securely connected.
4.	Check battery pack voltage. If voltage is low, replace with another battery pack.

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Troubleshooting a Blank LCD Screen, Cont.

Step	Procedure, Cont.
5.	If voltage is still low, investigate power issues following the Power Troubleshooting Flow Chart (see Figure 5–4).

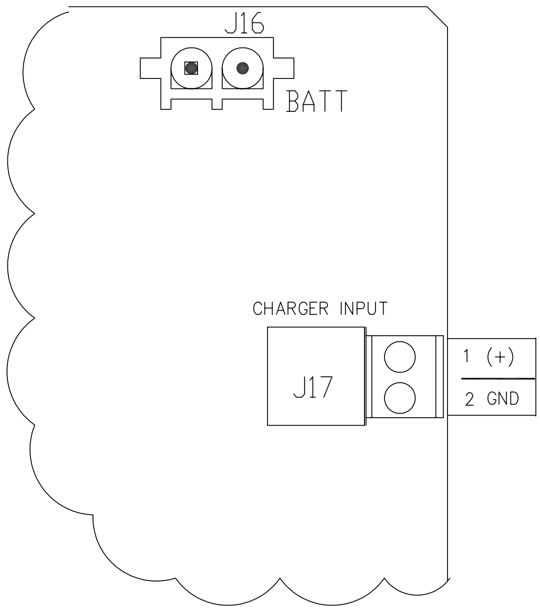

Figure 5–3 Battery Charger and Battery Pack Connections

Troubleshooting a Low Lithium Alarm (LL)

When the Low Lithium alarm appears, the lithium battery should be replaced immediately. Failure to replace Lithium Battery could result in loss of data following a power loss. Instructions for replacing Lithium Battery may be found in Chapter 4 Maintenance.

Troubleshooting a Low Charger Alarm (LC)

The Low Charger alarm is typically displayed if battery charging voltage is less than (+)0.4 VDC higher than battery voltage or low light conditions exist and system is charged using a Solar Power Charger.

Instructions

Step	Procedure
1.	Check battery pack cable. It must make a good secure electrical connection with the Main Board BAT CONN connector J16 (see Figure 5–3).
2.	Check battery pack cable is securely connected.
3.	Check Battery Pack charging source in PCCU. Under I/O Subsystem in the tree view, open ON BOARD and select Auxiliary I/O. Charger Voltage and Battery Voltage are displayed here. If Charger is less than +0.4 VDC proceed to Power Troubleshooting section.

Troubleshooting a Analog to Digital Failure Alarm (AD)

XRC must be have a Measurement Tube Application running to receive this error. If the A to D Failure alarm code is present, or if the device is in the SLEEP mode, but is still receiving minimum voltage, it may be necessary to test the data link between the Main Processor Board and the transducer. Follow the instructions below to check 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 A to D Converter readings are within range, AD is shaded.

Instructions

Step	Procedure
1.	Begin by collecting data from unit.
2.	View event log in PCCU for codes (see PCCU Help Files for more information): –99 A/D converter could not be read –100 A/D converter could be read again.
3.	If event code is found, follow guidelines for returning Transducer to Totalflow for repair or replacement. If event code is not found, continue to next step.

Continued on Next Page

Troubleshooting a Analog to Digital Failure Alarm (AD), Cont.

Step	Procedure, Cont.
4.	In the PCCU Entry screen, monitor the readings by clicking on the I/O subsystem, On Board and Analog Inputs. Check SP, DP and temperature to determine which measurement channel is causing the alarm. A) If alarm is caused by the SP or DP channel, equalize and vent manifold. • If alarm disappears, 1) SP or DP cell is not ranged properly or 2) Manifold may have blockage. • If alarm is still present, replace Transducer. B) If alarm is caused by the temperature channel, Skip to Step 9, otherwise go to next step.
5.	Set XMV back to "Factory" calibration. If this corrects the alarm, recalibrate XMV to correct field calibration. If alarm is not corrected, continue to next step.
6.	Perform "Warm" start on unit: Verify that unit is not displaying a LL (Low Lithium) alarm, then remove power from unit. Restore power to unit. If A/D Failure alarm is not corrected, continue to next step.
7.	Perform Save and Restore function. Follow procedure in "Chapter 4 Maintenance" for Backing up Configuration Files. Be sure to Restore these files to the S: Drive.
8.	Perform a Cold Start on unit following Reset Procedures covered in this chapter. If problem is not corrected, continue to next step.
9.	Check RTD wiring at XMV.
10.	Perform the following three procedures found next in this Chapter: A) RTD Continuity Test B) RTD Resistive Test C) RTD Impedance Test
11.	Contact Totalflow to repair or replace XMV.

Resistive Temperature Detector (RTD) Continuity Test

Should the readings from the RTD be suspect, follow the Instructions below to test the RTD Probe.

Required Equipment

- Digital MultiMeter w/ alligator clip leads

Instructions

Step	Procedure
1.	Begin by disconnecting power and communications from XMV.
2.	Disconnect RTD from XMV.
3.	Perform continuity test on wires leading to probe. Set DMM to 200 OHM or Continuity Audio.
4.	Check continuity of 1st wire pair (typically Red or Black) by connecting one lead to each wire. Meter should read zero or close to zero.
5.	If there is continuity, skip to step no. 7. If there is NO continuity, verify wiring at RTD head is correct.
6.	If wiring at connection head is correct, the RTD is defective. Replace probe.
7.	Check continuity of 2nd wire pair (typically White) by connecting one lead to each wire. Meter should read zero or close to zero.
8.	Check continuity of each wire (1st pair either Red or Black as identified in step 4) to probe or shield. If there IS continuity, the RTD is defective, Replace probe. If there is NO continuity, continue to next step
9.	If there is continuity, skip to step no. 11. If there is NO continuity, RTD is defective. Replace Probe.
10.	Check continuity of each 2nd wire pair (White or as identified in step 7) to probe or shield. If there IS continuity, the RTD is defective, Replace probe. If there is NO continuity, continue to next step
11.	Check continuity of each 1st wire pair (as identified in Step 4) to each 2nd wire pair (as identified in step 7). Meter should read approximately 100 to 140 Ohms, continue to Step 12. If NOT, RTD is defective and should be replaced.
12.	If Probe is still not functioning correctly, re-check wiring using supplied diagram. If no wiring error was found, perform RTD Current Source Troubleshooting.

RTD Current Source (Resistive) Test

If 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 it is receiving power.

Required Equipment

- Totalflow Diagnostics Kit 2017373
- Digital MultiMeter w/ alligator clip leads

Instructions

Step	Procedure
1.	Begin by disconnecting power and communications from XMV if not already done.
2.	Disconnect RTD from XMV if not already done.
3.	Set DMM to 200 mVDC.
4.	Select RTD Test Resistance value by selecting resistor test connector from FCU Diagnostic Kit, or make one using a resistor appropriate for your unit: • Substitute 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 FCU display should read either: • 100 OHM Resistor – 31.0°F to 33.0°F • 123 OHM Resistor – 140.8°F to 142.8°F

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RTD Current Source (Resistive) Test, Cont.

Step	Procedure, Cont.
10.	If either of the measured values are outside of range, remove power and replace Termination Board Connector Cable (1801415-xxx).
11.	Return power and perform steps 9 and 10. If either of the measured values are outside of range, remove power and replace Termination Board (2101873-xxx).
12.	Return power and perform steps 9 and 10. If either of the measured values are outside of the range, remove power and replace Main Processor Board (2101471-xxx) and EXIMV (2101465-xxx).

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 it is receiving power.

Required Equipment

- Ice Bath
- Digital MultiMeter

Instructions

Step	Procedure
1.	Immerse RTD Probe in ice bath.
2.	Perform a Continuity check between any two similar color wires. Measured resistance should be 1 OHM or less.
3.	Perform a Continuity check between any two dissimilar color 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, RTD Probe is defective. Replace RTD.

Power Troubleshooting

Overview

This section focuses on determining what has caused the XRC to loose 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 XRC to loose power. Notice that the Power Troubleshooting Flowchart (see Figure 5–4) takes you through several tests, but also directs you to the Communication Troubleshooting Flowchart located further in this Chapter.

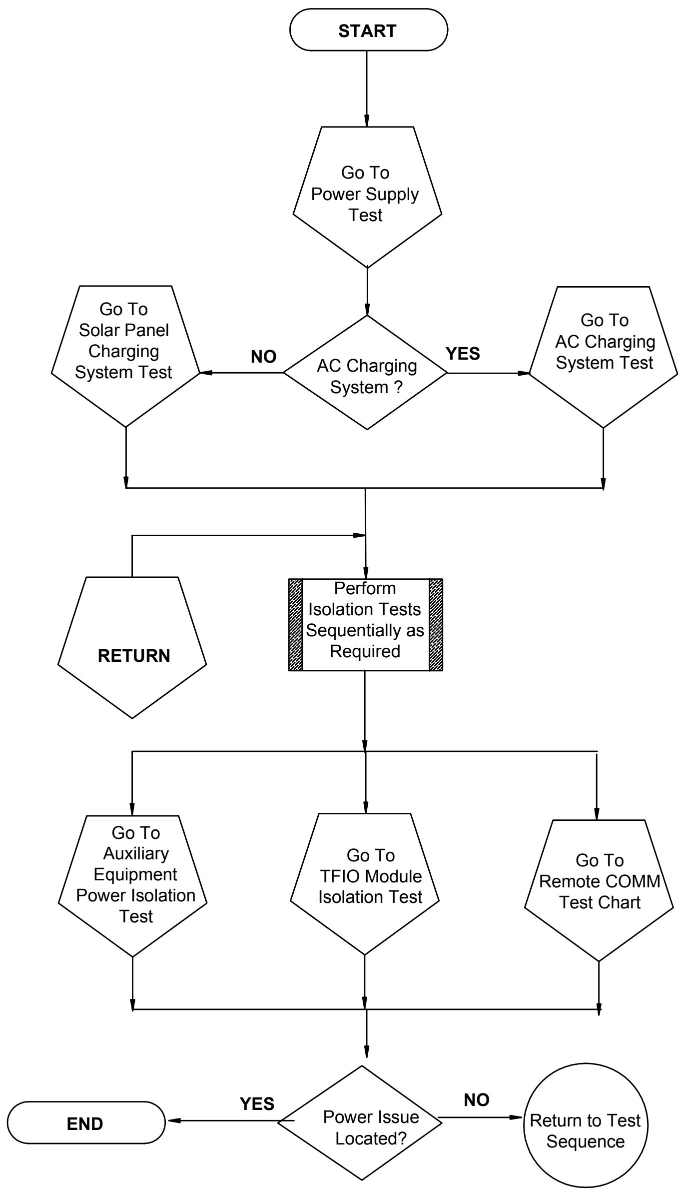

Figure 5–4 Power Troubleshooting Flowchart

Power Supply Test

Various equipment configurations will necessitate moving to one or more additional tests from this location.

Instructions

Step	Procedure
1.	Check that the power supply voltage setting, the power supply current rating, and the cables used for the installation meet the recommended requirements. If this is a new installation and external equipment is being powered from the XRC, call Totalflow Tech Support for help in evaluating your cable and power supply installation requirements. Correct and retest as necessary.
2.	Check for a poor cable connection in the cable between the XRC and the Battery Pack (J16) and Charging Source (J17) Verify all field wiring screw terminals are tight. Correct and retest as necessary.
3.	Verify that there are no other devices that may drop an excessive voltage across them in the power supply circuit (to the XRC). Correct and retest as necessary.
4.	Disconnect Charging Source cable at XRC Board J17.
5.	Replace Battery with a known good battery, using Battery Pack Replacement Procedure located in “Chapter 4, Maintenance”.
6.	Reconnect Charging Source cable to XRC Board J17.
7.	Measure voltage at the Charging Source cable. Measure voltage at Battery Pack. Compare voltage. If charging source voltage is less than (+)0.4 VDC higher than Battery voltage, return to Figure 5–4 and continue.

Solar Panel Charging System Test

If your system setup includes an Solar Panel Charger connected to the XRC Board, and it is not supplying the required voltage to the XRC unit, you may need to test the Solar Panel. The following instructions contain the steps required to do so.

Instructions

Step	Procedure
1.	Check solar panel angle and direction. In northern hemisphere, panel should face due south and in southern hemisphere, due north. Correct and retest as necessary.

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Step	Procedure, Cont.
2.	Check solar panel for any physical damage or obstructions to sunlight. Sunlight obstruction prevents solar panel from receiving enough sunlight to charge installed battery pack. Correct and retest as necessary.
3.	Solar panel should be positioned so it receives the most sunlight. Do not place it in a shaded area. Correct and retest as necessary.
4.	Check solar panel wiring to be certain it is correctly connected to associated XRC-195 Board termination block J17. Correct and retest as necessary.
5.	Measure Solar Panel Voltage at connector using a DMM connecting the (+) and (-) leads to the (+) and (-) Solar Panel Wires. Loaded Voltage should be greater than or equal to specification listed in Table 5–2. If Solar Panel is not above minimum, replace Solar Panel continue to Step 2.
6.	Disconnect Solar Panel from XRC Board.
7.	Set DMM range to read over 20 VDC.
8.	Determine if Open Circuit voltage is greater than or equal to specification listed in Table 5–2, by clipping positive lead of the DMM to positive wire and clipping negative lead of the DMM to negative wire. If Solar Panel is not above minimum, continue to next step.
9.	Using selected Resistor from Table 5–2 for your Solar Panel Wattage, attach selected Resistor between the two Solar Panel wires.
10.	Clip the positive lead of the DMM to the one side of the Test Resistor.
11.	Clip the negative lead of the DMM to the other side of the Test Resistor.
12.	Determine if Loaded Voltage is greater than or equal to specification listed in Table 5–2. If Solar Panel is not above minimum, replace Solar Panel and retest.
13.	If a issue still exists, return to the Power Troubleshooting flowchart and continue testing.

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Solar Panel Charging System Test, Cont.

Table 5–2 Specifications for Solar panels

Panel	Max	Volts @P_{Max}	Open Circuit	Load Resistance	Loaded Voltage
10	10W	16.8V	21V	30 Ω 25W	16–18VDC
20	20W	16.8V	21V	15 Ω 25W	16–18VDC
30	30W	16.8V	21V	10 Ω 40W	16–18VDC

AC Charging System Test

If your system setup includes an AC Charger connected to the XRC Board, and it is not supplying the required voltage to the unit, you may need to test the AC Charger. The following instructions contain the steps required to do so.

Instructions

Step	Procedure
1.	Check DC wiring to XRC termination block connector J17 (see Figure 5–5). Be certain wiring is correct. Correct and retest as necessary.
2.	Check input AC power supply voltage to external AC charging unit. Be certain primary AC voltage is correct. Correct and retest as necessary.
3.	If primary AC voltage input level is correct, wiring to XRC-195 Board terminal is correct and there is no DC output from the charger, replace charger fuse (see Figure 5–5). Correct and retest as necessary.
4.	If fuse is not faulty or there is no charger DC output voltage after replacing fuse, replace AC charging unit. Correct and retest as necessary.
5.	If a issue still exists, return to the Power Troubleshooting flowchart and continue testing.

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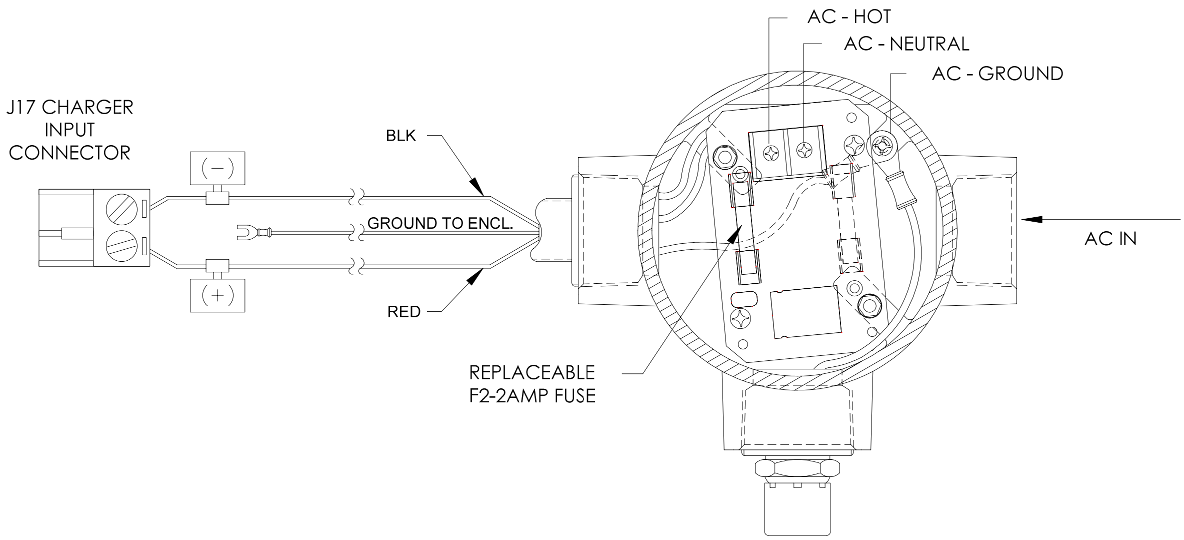

Figure 5–5 AC-DC Charger Wiring Instructions

Auxiliary Equipment Isolation Test

This test will need to be performed if your 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.

Instructions

Step	Procedure
1.	Disconnect Solar Panel Charger or AC Charger.
2.	Disconnect Battery Pack Cable from XRC-195 Board and substitute known “Good Battery”, if not already done.
3.	Disconnect any Auxiliary Equipment that draws power from XRC or Battery Pack. This is not limited to, but should include removing the J20 Auxiliary Power Output connector if used.
4.	Connect Current Measurement Troubleshooting Cable (Part No. 2017350-xxx see Figure 5–6), to known “Good Battery” and re-connect to XRC-195 Board.
5.	Using DMM, connect to Troubleshooting Cable and measure Average Current. If equal to or greater than 80 ma at 12 VDC, disconnect Battery Pack, reconnect one Auxiliary item, continue to next step. If Average Current is less than specification, Replace Main Electronic Board following instructions in Chapter 4, Maintenance.

Continued on Next Page

Auxiliary Equipment Isolation Test, Cont.

Step	Procedure, Cont.
6.	Re-connect Battery Pack and measure Average Current. If Average Current is less than or equal to equipment specification, disconnect Battery Pack, reconnect next Auxiliary item, continue to next step.
7.	Repeat Step 6 until all Auxiliary items have been tested and/or equipment causing the power drain has been located. If power drain has not been located, return to Power Troublshooting Flow Chart (see Figure 5–4).

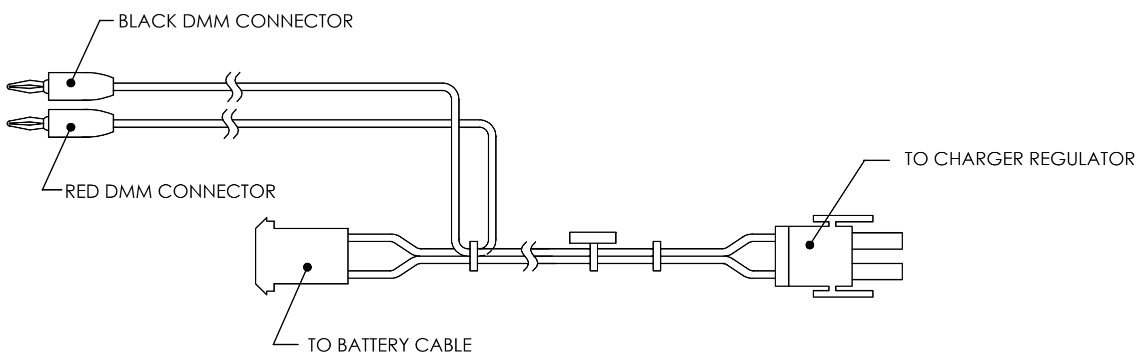

Figure 5–6 Current Measurement Troubleshooting Cable

TFIO Module Isolation Test

If unit is configured to include TFIO Modules, this test will need to be performed if your units Battery Pack output voltage is not remaining consistent and no errors were found during the previous Auxiliary Equipment Isolation Test.

Instructions

Step	Procedure
1.	Disconnect Solar Panel Charger or AC Charger.
2.	Disconnect Battery Pack Cable from XRC-195 Board and substitute known “Good Battery”, if not already done.
3.	Disconnect TFIO Module Cable from J18 I/O Expansion Connector, Remote Communications equipment and auxiliary equipment.
4.	Connect Current Measurement Troubleshooting Cable (Part No. 2017350-xxx see Figure 5–6), to known “Good Battery” and connect to XRC-195 Board.

Continued on Next Page

TFIO Module Isolation Test, Cont.

Step	Procedure, Cont.
5.	Using DMM, measure Average Current. If equal to or greater than 80 ma at 12 VDC, disconnect Battery Pack, reconnect TFIO Module Cable with one module connected, continue to next step.
6.	Using DMM, measure Average Current. Low Power TFIO Modules generally do not draw over 0.30 ma at 12 VDC. If Average Current drops less than or equal to .30 ma, disconnect Battery Pack, connect one additional module. Repeat this step for additional modules until all have been connected or equipment fault has been located. If power drain has not been located, return to Power Troublshooting Flow Chart (see Figure 5–4).

SLEEP Mode

The SLEEP mode is a safety feature, which maintains the RAM but discontinues data measurement calculations and control functions. When the XRC is in the SLEEP mode the word SLEEP is displayed on the LCD. If XRC battery voltage falls below 11VDC, the XRC enters SLEEP mode.

If battery voltage is still below 10.9 VDC, when you disconnect locally, the XRC returns to SLEEP mode. If battery voltage is above 11VDC, XRC remains awake.

The XRC has a "real time clock" which maintains time and date during the SLEEP mode and writes an event record when entering and leaving the SLEEP mode.

Upon wake-up, the XRC performs the following functions:

- Stores present calculation periods accumulations in historical record,
- Zeros present calculation periods accumulations and
- End current daily record and start new daily record.

Step	Procedure
1.	Connect locally to the XRC. This should WAKE-UP the unit for you to determine the cause
2.	Check battery pack cable. It must make a good secure electrical connection with XRC-195 Board BAT CONN connector J16 (see Figure 5–3).
3.	If battery pack cable is securely connected, check battery pack voltage. If voltage is low, replace with another battery pack.

Reset Procedures

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

Cold Start A cold start clears all the data that is stored in RAM as well as resetting all entered variables to their factory default values or to the most recent values written to the S:Drive during a “Save and Resore”. A cold start should be used for new XRC 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.

Hardware Procedure In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses.

Step	Procedure
1.	If an external charging source is connected, it must be disconnected. Slide external battery pack charger CHGR INPUT +/- terminal block J17 (see Figure 5–3) from the XRC-195 Board green terminal block.
2.	Disconnect battery pack connector from XRC-195 Board BAT CONN connector J16 (see Figure 5–3).
3.	Disable Memory Backup J1 (see Figure 5–7), by moving the pin jumper to pins 2 and 3.
4.	To return to service reconnect 12 Vdc battery pack connector to XRC-195 Board BAT CONN connector J16 (see Figure 5–3) and observe LCD .
5.	If removed, reconnect external battery pack charging source to CHGR INPUT connector J17 (see Figure 5–3).
6.	Enter all necessary parameters or send a saved station file. See chapter 3, XRC Startup.
7.	When XRC has been cold started, the 24 hour clock will be reset to 00:00:00.
8.	Enable Memory Backup J1 (see Figure 5–7), by moving the pin jumper to pins 1 and 2.

Software Procedures Where the hardware restart requires physically disconnecting and reconnecting jumpers from the Main Board, performing a software restart involves typing in a command in PCCU. If an error was made while typing, you must begin the procedure again.

Step	Procedure
1.	Using PCCU, in the terminal mode, type this command exactly as shown: boot=COLD

Continued on Next Page

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

Instructions In the following procedure, the common name for a component, its jumper number if available (Abbreviated J) or part is followed by a number in parentheses.

Step	Procedure
1.	If an external charging source is connected, it must be disconnected. Slide external battery pack charger CHGR INPUT +/- terminal block J17 (see Figure 5–3) from the XRC-195 Board green terminal block.
2.	Enable Memory Backup J1 (see Figure 5–7), by moving the pin jumper to pins 1 and 2.
3.	Disconnect battery pack connector from XRC-195 Board BAT CONN connector J16 (see Figure 5–3). The XRC is now out of service.
4.	To place XRC in service, connect battery pack connector J16 (see Figure 5–3).
5.	Connect the CHGR INPUT +/- terminal block J17 (see Figure 5–3).

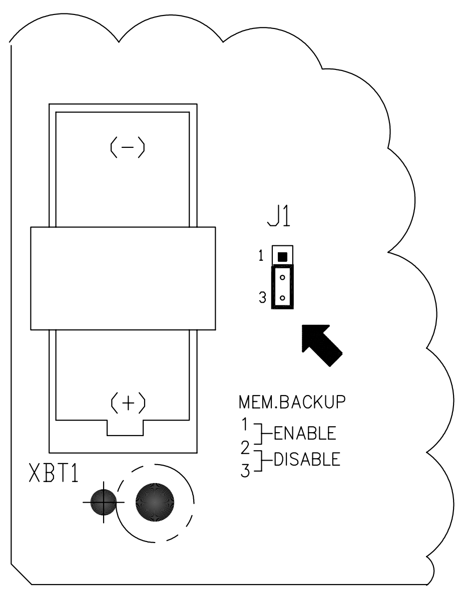

Figure 5–7 Lithium Battery Backup Enable/Disable

Troubleshooting Communications

Communications Overview

These troubleshooting procedures are applicable to all XSeries Remote Controllers with an installed radio. Use Figure 5–8 as an aid for troubleshooting communication problems. The three basic types of radio communications that can be used between the XRC and a radio receiver, are:

- RS-232 Communications, using a RS-232 Module
- RS-485 Communications, using a RS-485 Module
- RS-422 Communications (available, but not detailed)

The radio/modem may be powered one of two ways. Always on, or Switched. Your specific system set up will determine what steps you need to power the Radio/Modem.

When switching power to a radio with Inhibit (SLEEP) mode, the Communication Port 1 or 2 Switched Power line, will go to the radios inhibit (SLEEP) Mode input. Power out will go to the radios.

CAUTION

Before removal or installation of either the above communication interface modules, it is important that you disconnect XRC external battery charger and main XRC battery pack cable connectors from XRC-195 Board. Refer to Figure 5–3.

Setting Up Communication

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

- Verify RS-232 or RS485 Interface Modules and jumpers are installed or set correctly.
- Verify that radio cable or wiring is correctly installed at the radio.
- Verify field wiring terminations on the XRC195 board.
- Check XRC identifier (ID). Log the ID for future reference.
- Log XRC access security code, baud rate, listen cycle, protocol and interface for future reference.

FYI

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

- If you have the Comm Port assigned to an annunciator, the XRC displays the → after it recognizes the XRC ID.
- Check baud rate of XRC transmission and timing. The baud rate and timing settings can be changed when PCCU is in ENTRY mode. Default settings are 1200 baud and listening time is 4 seconds and communications interface is turned off.
- Minimum power required for operating remote communications is 11.9 VDC (default), or as set by user. Should the power fall below this level, remote communications will be terminated.
- Test remote communications using RS-232 Troubleshooting Cable (2011781-xxx). Use RS-232 to RS-485 communication Converter (1800255-xxx) in conjunction with RS-232 Troubleshooting cable to test RS-485 remote communications.

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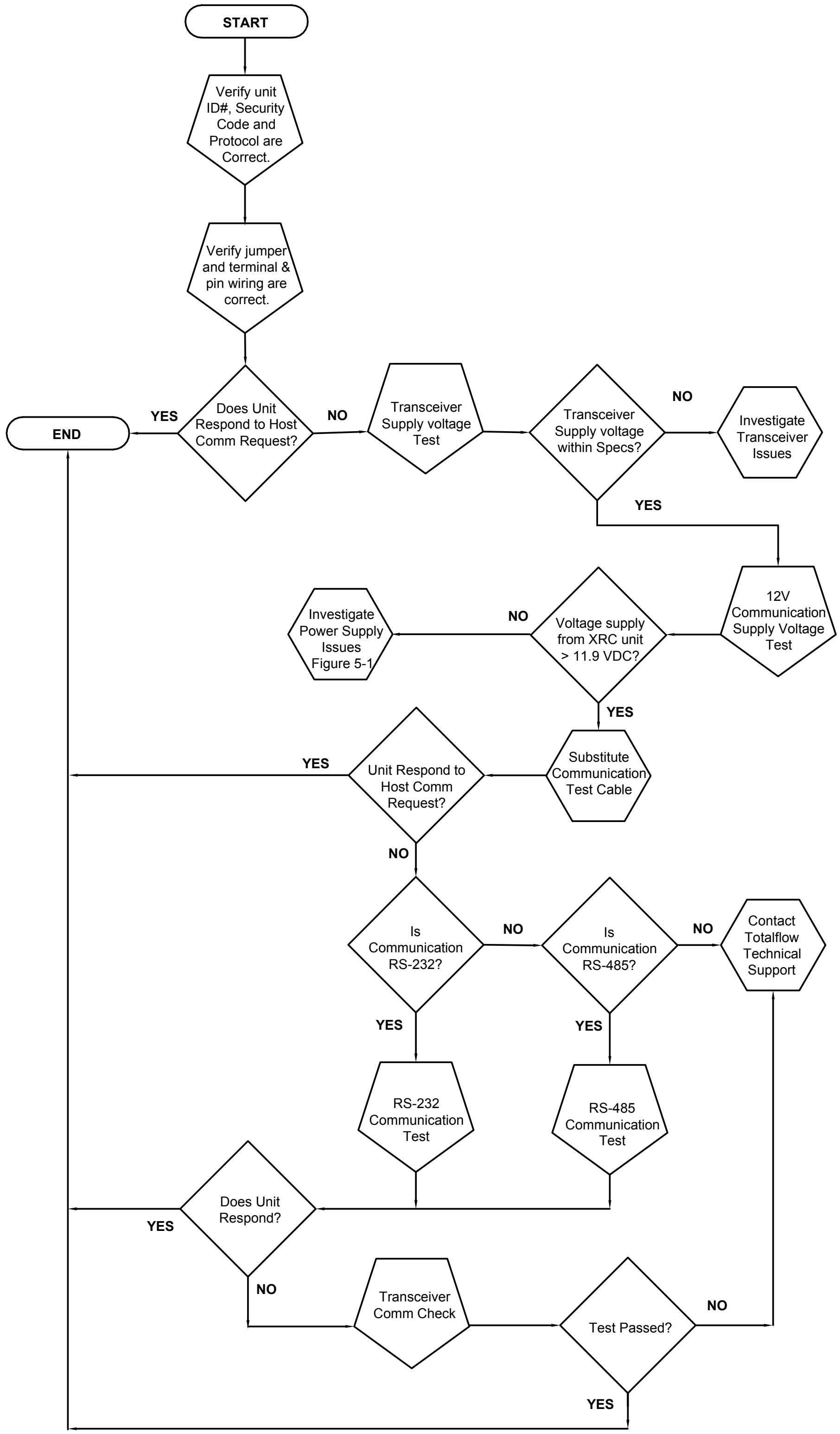

Figure 5–8 Communication Troubleshooting Flow Chart

Transceiver Supply Voltage Test

Using wiring information and guidelines supplied by transceiver manufacturer, verify that transceiver is receiving manufacturer's suggested voltage. If unit is receiving sufficient voltage, continue to the OEU Wiring Voltage Test.

FYI If transceiver is not receiving sufficient voltage, investigate power supply issues. These may involve wiring irregularities at either the AC Charger/Power Supply system or XFC/XRC Board.

12V Communication Supply Voltage Test

Instructions If Transceiver does not feature a SLEEP Mode and power is supplied through an optional Relay, perform Step 1, Switched Power Supply Voltage Test.

If Transceiver features a SLEEP Mode, or is continuously powered, perform Step 2.

Step	Procedure
1.	If Transceiver does not feature a SLEEP Mode and receives power through the XRC-195 Switched Power, activate Serial Port 1 or 2 *Switched Power Out* (Pin 3) and, using a Digital Multimeter (DMM) set to Volts DC, measure voltage at J6 between: *J6-2 (GND) and* *J6-3 (SWVBAT)* If Voltage should be greater than 11.9VDC for this unit. If voltage is equal to or less than 11.9, return to test sequence outlined in the Power Troubleshooting Flowchart (see Figure 5–4).
2.	If Transceiver features a SLEEP Mode or is continuously powered, using a Digital Multimeter (DMM) set to Volts DC, measure voltage at J6 between: *J6-2 (GND) and* *J6-1 (VBAT)* If Voltage should be greater than 11.9VDC for this unit. If voltage is equal to or less than 11.9, return to test sequence outlined in the Power Troubleshooting Flowchart (see Figure 5–4).

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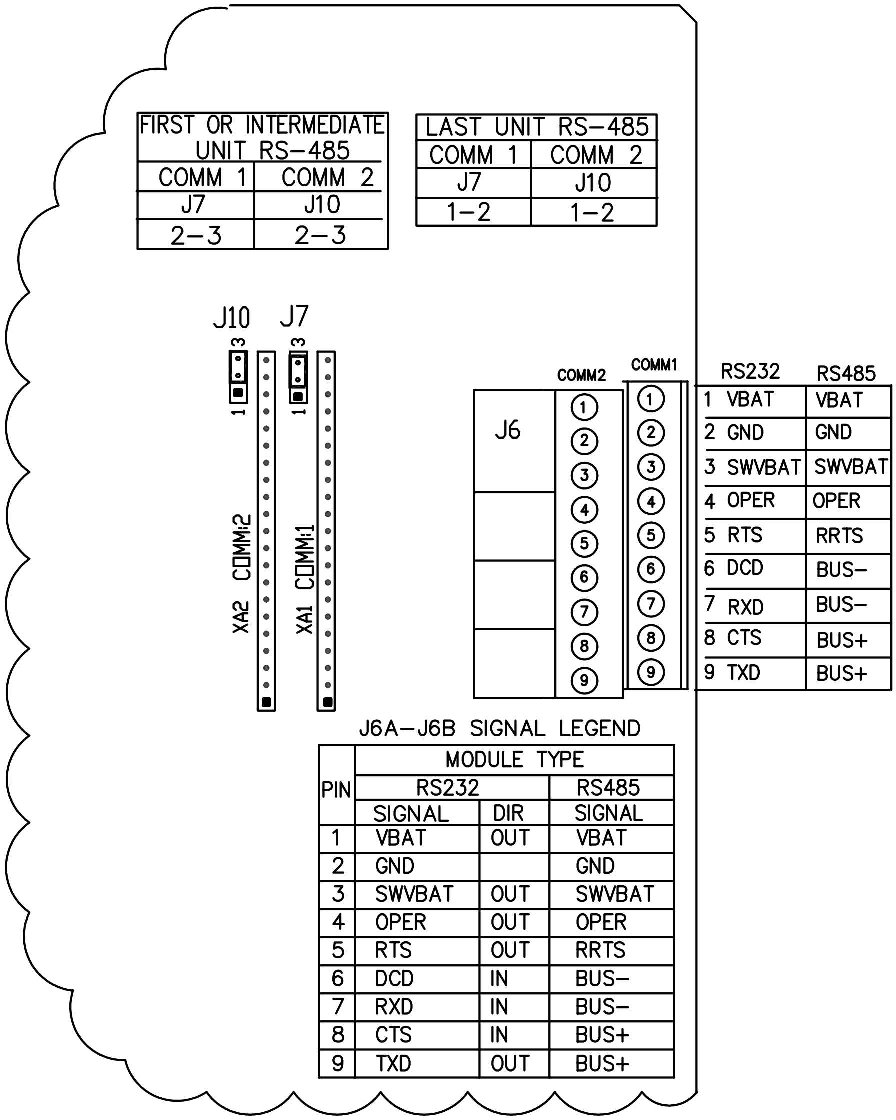

Figure 5–9 XRC-195 Communication Wiring

Transceiver Check

Instructions

Step	Procedure
1.	If available, use a wattmeter to check transceiver output power. Refer to manufacturer's documentation for measuring instructions.
2.	If available, use two (2) hand-held transceivers, and verify communication path between Master and Remote sites. Voice activated interface can be used if available.
3.	Verify that transceiver is set to the correct frequency. Refer to manufacturer's documentation for checking frequency instructions.
4.	If a directional antenna is used, verify the orientation to the antenna to the Master site.

FYI If a communication problem still exists, and the unit has passed the Transceiver Check test, contact Totalflow Customer Service for additional help.

RS-232 Communication Test

The following RS-232 Serial Communication Test procedure is directed from Figure 5–8 and will assist the user in what may be the possible cause for indicated error message.

Before performing this test, please verify that the field wiring is correct (see Table 5–3).

Table 5–3 RS-232 Field Wiring on XRC-195 Board

	Description
PIN	**Jumper 6–Comm 1 and 2**
1	V Battery
2	Ground
3	Switched V Battery
4	Operate
5	Request to Send
6	DCD
7	RXD Receive Data
8	CTS Clear to Send
9	TXD Transmit Data

Continued on Next Page

TIP When troubleshooting RS-232 mode, verify termination settings of Comm 1 J17 and Comm 2 J10 on XRC-195 have pins 2 and 3 jumpered.

Instructions

Step	Procedure
TIP	Voltage on the following steps may be hard to see using a Digital Multimeter. If available, an oscilloscope will provide a more accurate reading. To verify, the Host software must be continuously polling the XRC. Generally speaking, these tests performed on the Terminal Board will only verify incorrect or damaged wiring. If all previous testing passed, and all wiring, jumper and terminations have been verified correct, the board will need to be replaced. Contact Totalflow Customer Service. See “Getting Help” in the introduction of this manual for instructions.
1.	Using an oscilloscope, measure Receiving Data voltage on Termination Panel J8 or J10 between: COMM 1 or 2, Pin 2 (Ground) and Pin 7 (Receive Data) When the unit is receiving data from Host, voltage should vary between -5 VDC and +5VDC. This would indicate that the unit is receiving data, continue to Step 2. If unit is not receiving data, investigate wiring issues (see Table 5–3).
2.	Using an oscilloscope, measure Request to Send voltage on Termination Panel J6 between: COMM 1 or 2, Pin 2 (Ground) and Pin 5 (Request to Send) When unit is communicating to with Host, voltage should be +5VDC and remain +5VDC until XRC transmit stops. This would indicate that the unit is transmitting data, continue to Step 3. If unit is not receiving data, investigate wiring issues (see Table 5–3).
3.	Using an oscilloscope, measure Transmit Data voltage on Termination Panel J8 or J10 between: COMM 1 or 2, Pin 2 (Ground) and Pin 9 (Transmit Data) When the unit is transmitting to Host, voltage should vary between -5 VDC and +5VDC. This would indicate that the unit is transmitting data. If unit is still not responding, continue to next test as directed in Figure 5–8.

RS-485 Communication Test

The following RS-485 Serial Communication Test procedure is directed from Figure 5–8 and will assist the user in what may be the possible cause for indicated error message.

Before performing this test, please verify that the field wiring (see Table 5–4)is correct.

TIP When troubleshooting RS-485 mode, verify termination settings of COMM 1 J7 and COMM 2 J10 on XRC Board are correctly jumpered (see Table 5–5).

Table 5–4 RS-485 Field Wiring on XRC-195 Board

	Description
PIN	**J6–COMM 1 and 2**
1	V Battery
2	Ground
3	Switched V Battery
4	Operate
5	RRTS Remote Request to Send
6	Bus (-)
7	Bus (-)
8	Bus (+)
9	Bus (+)

Table 5–5 RS-485 Terminations

Serial Comm Port	**1**	**2**
Jumper	J7	J10
First or Intermediate Unit	Pins 2–3	Pins 2–3
Last or Only Unit	Pins 1–2	Pins 1–2

RS-485 Communication Test

Before performing this test on the XRC-195 Board, please verify that the wiring is correct (see Table 5–4).

FYI Voltage on the following steps may be hard to see using a Digital Multimeter. If available, an oscilloscope will provide a more accurate reading. To verify, the Host software must be continuously polling the meter.

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Termination Panel RS-485 Communication Test, Cont.

FYI Generally speaking, these tests performed on the Termination Panel will only verify incorrect or damaged wiring. If all previous testing passed, and all wiring, jumper and terminations have been verified correct, the Termination Panel may need replaced, but does not typically fail. Contact Totalflow Customer Service. See "Getting Help" in the introduction of this manual for instructions.

Instructions

Step	Procedure
1.	Using an oscilloscope, measure Line Driver voltage on XRC-195 Board J6 between: COMM 1 or 2, Pin 6 or 7 (BUS-) and Pin 8 or 9 (BUS+) When the unit is receiving data from Host, voltage should vary between +5 VDC and 0 VDC. This would indicate that the unit is receiving data.
2.	Using an oscilloscope, measure Remote Request to Send voltage XRC-195 Board J6 between: COMM 1 or 2, Pin 2 (Ground) and Pin 5 (RRTS) When the unit is transmitting data, voltage should vary between +5 VDC and 0 VDC. This would indicate that the RRTS is working correctly.
3.	If any inaccuracy exists, investigate wiring errors or damaged wires.

FYI If a communication problem still exists, and the unit has passed the tests in steps 1 and 2, additional testing will be required. Call Totalflow Technical Support for additional help.

Appendix A
Register Documents

Standard Registers

Alarm System Application Registers (Rev AB)

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0-15	Alarm Records	Structure	Read/Write	1, 16
1.0-15	Exception Blocks	Structure	Read/Write	1, 17
2.0-15	Alarm Constants	Float	Read/Write	2
3.0	Report Counter	Byte	Read Only	3
3.1	Current Number of Alarms	Byte	Read Only	4
3.2	Alarms Last Reported	Byte	Read Only	5
3.3	Alarm Reset	Byte	Write Only	6
3.4	Auto Clear	Byte	Read/Write	7
3.5	Cry-Out Enable	Byte	Read/Write	8
3.6	Cry-Out Frequency	Byte	Read/Write	9
3.7	Cry-Out Now	Byte	Read Only	10
3.8	Ignore DCD	Byte	Read/Write	11
3.9	Clear Cry-Out Timer	Byte	Write Only	
3.10	Clear Logged Alarms	Byte	Write Only	12
3.11	Cry-Out Timer	Byte	Read/Write	13
3.12	Alarm Mode	Byte	Read/Write	14
3.13	Cryout Holdoff (hours)	Byte	Read/Write	15
4.0	Alarms Report	Structure	Read Only	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.
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 communications 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 you correct the situation that is generating an alarm, you 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. How the alarm operates. 'Normal' indicates that while the alarm variable's value is in alarm, an alarm is indicated, even after the alarm is acknowledged by the host. 'One Shot' indicates the alarm is logged when the alarm variable's value goes into alarm, after the alarm is acknowledged by the host the alarm is not logged again until the value leaves the alarm state and then returns to the alarm state. 'Current State' indicates that before the alarm is sent to the host (either by a exception request or by cryout) the current value of the alarm variable is checked and if the current value indicates that the alarm variable is no longer is alarm, no alarm is logged and sent to the host.
15. Delay sending cryout alarms for the specified time period in hours.
16. The structure of each entry when read:

```
typedef struct              /* Alarm Log Record */
{
byte num;                   /* Alarm Number */
uint16 user_code;           /* User's Alarm Code */
byte type;                  /* Variable Type */
VAR_VALUE data;             /* Alarm Value */
VAR_REF ref;                /* Variable Reference */
JULIAN dt;                  /* Date/Time of Alarm */
char appl_id[11];           /* id of application */
} ALARM_REC;
```

where VAR_REF is:

```
typedef struct              /* Variable Reference */
{
byte app;                   /* Application Reference */
byte array;                 /* Variable Type */
byte index;                 /* Variable Index */
```

```
} VAR_REF;
```

and VAR_VALUE is:

```
typedef union                    /* Variable Value Union */
{
float f;
long l;
unsigned long ul;
int i;
uint16 ui;
char c;
byte uc;
} VAR_VALUE;
```

The structure of each entry when read:

```
typedef struct                   /* Download  */
{
char type;                       /* Alarm Type Logic */
uint16 user_code;                /* User's Alarm Code */
char enable_flags;               /* Alarm Enable Flags */
VAR_REF in;                      /* Alarm Input */
VAR_REF threshold;               /* Alarm Threshold */
VAR_REF out1;                    /* Alarm Output Value */
char trigger_type;               /* Alarm Trigger Type */
VAR_REF trigger;                 /* Alarm Trigger  */
char reset;                      /* Reset Logic */
char filter;                     /* Filter Type */
float filter_threshold;          /* Filter Threshold */
char filt_units;                 /* Filter Units */
char logvar;                     /* Log Type */
} ALARMPAGE;
```

where enable_flags are:

```
/* bits in enable_flags */
#define ALARM_ENABLE 1
#define EXCEPTION_ENABLE 2
#define FILE_ENABLE 4
#define OUTPUT1_ENABLE 8
```

where trigger_type is defined as:

```
/* Alarm Triggers */
```

#define CONTINUOUS 0

#define DIGITAL_IN 3

#define DIGITAL_OUT 1

#define COIL_TRIGGER 2

Where alarm type is defined as:

/ Alarm Types */*

#define NOALARM_ 0

#define GT_ 1

#define LT_ 2

#define ON_ 3

#define OFF_ 4

#define AND_ 5

#define OR_ 6

#define GE_ 7

#define LE_ 8

#define NAND_ 9

#define NOR_ 10

where reset logic is:

/ Alarm Reset */*

#define AUTO_POLL 0

#define AUTO_CLEAR 1

#define MANUAL 2

where filter units are:

/ Filter Units */*

#define SECONDS_ 0

#define MINUTES_ 1

#define HOURS_ 2

#define DAYS_ 3

where filter type is:

/ Filter Types */*

#define CONSECUTIVE 0

#define PERCENT 1

where log type is:

/ Alarm Value Log */*

#define CURRENT 0

#define THRESHOLD 1

#define TRIGGER 2

#define PEAK 3

Display Application Registers (Rev AA)

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	
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

Display Application Register Notes

1. If the number of files being written is greater than the number of file 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 number written is greater than number present, spare displays will be created. If number written is less than number present, excess displays will be deleted.
3. X.0.2 – X.0.4 are used to navigate from group to group, 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 display parameters in arrays 1 through 4, Display Save should be written to written the new parameters to 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. You can also plot Trend data.
13. Used to show digital states such as “Open/Close”, “Running/Idle/Stopped”.
14. Normally used with DIs in “Push to Read’ mode. If x.4.3 is assigned, Display will scroll from group to group while the DI is pressed. If x.4.4 is assigned, Display will scroll 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.

Holding Register Application (Rev AA)

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
(X).2	Holding Array (X) Register 3	Programmable	Read/Write	1
(X).(X)	Holding Array (X) Register (X)	Programmable	Read/Write	1
252.0	Holding Array 1 Description	String	Read/Write	2
252.1	Holding Array 2 Description	String	Read/Write	2
252.2	Holding Array 3 Description	String	Read/Write	2
252.(X)	Holding Array (X) Description	String	Read/Write	2
253.0	Holding Array 1 Data Type	Byte	Read/Write	3
253.1	Holding Array 2 Data Type	Byte	Read/Write	3
253.2	Holding Array 3 Data Type	Byte	Read/Write	3
253.(X)	Holding Array (X) Data Type	Byte	Read/Write	3
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

Holding Register Notes

1. The number, type, and size of Holding Register arrays are user programmable.
2. Each Holding Register array can be assigned a 24 character name.
3. 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)

4. 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 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.

5. The number of registers in each Holding Register array is limited only by available memory.

6. Up to 250 Holding Register arrays can be allocated, however, available memory will probably be exhausted first.

Operations Application Registers (Rev AB)

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
5.1	Periodic Operations 2 Register 2	Register	Read/Write	2
5.2	Periodic Operations 3 Register 2	Register	Read/Write	2

Register	Description	Type	Access	Note
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
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

Register	Description	Type	Access	Note
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
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

Register	Description	Type	Access	Note
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
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

Register	Description	Type	Access	Note
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
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
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

Register	Description	Type	Access	Note
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
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

Register	Description	Type	Access	Note
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
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

Register	Description	Type	Access	Note
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
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

Operations Application Register Notes:

1. Periodic Operations can be executed at a cyclic interval (such as every 5 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 53contains 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.

System Application Registers (Rev AD)

Register	Description	Type	Access	Note
0.0.0	Board Part Number	String	Read Only	
0.0.1	Software Part Number	String	Read Only	
0.0.2	Software Description	String	Read Only	
0.0.3	System Date/Time	String	Read/Write	1
0.0.4	Device ID	String	Read/Write	
0.0.5	Location	String	Read/Write	
0.0.6	Read Level Security Code	String	Read/Write	
0.0.7	Write Level Security Code	String	Read/Write	
0.0.8	Execute Command File	String	Write Only	2
0.0.9	User Description	String	Read/Write	
0.0.10	Write System Log Entry	String	Write Only	
0.10.11	Logon for TFSecure	String	Read/Write	
0.1.0	Number of App Enumerations	Byte	Read Only	3
0.1.1-(X)	Application Enumerations	Byte	Read Only	3
0.2.1-(X)	Application Descriptions	String	Read Only	3
0.3.0	Number of Applications	Byte	Read/Write	4
0.3.1-(X)	Application Table	Byte	Read/Write	4
0.4.1-(X)	Application Names	String	Read/Write	4
0.5.1-(X)	Application Revisions	String	Read Only	4
0.6.1-(X)	Application Parameters	String	Read/Write	4
0.7.0	Low Charger	Byte	Read/Write	
0.7.1	Very Low Battery	Byte	Read/Write	
0.7.2	Wakeup (Obsolete)	Byte	Write Only	
0.7.3	Security Switch	Byte	Read Only	
0.7.4	Low Lithium Battery	Byte	Read Only	
0.7.5	Format S Drive	Byte	Write Only	5
0.7.6	Clear Registry	Byte	Write Only	6
0.7.7	I2C LED Control	Byte	Read/Write	
0.7.8	Debug monitor task info	Byte	Read/Write	13
0.7.9	Calibration Indication, 0=no cal, 1=cal	Byte	Read Only	12
0.7.10	Digital Out toggle diag	Byte	Read/Write	
0.7.11	Enable chkmem reboot on error	Byte	Read/Write	
0.7.12	Diagnostics log test	Byte	Read/Write	
0.7.13	Diagnostics copy memory	Byte	Read/Write	14
0.7.14	AMU Temperature Units	Byte	Read/Write	
0.7.15	AMU Installed	Byte	Read/Write	
0.7.16	AMU Ap Units	Byte	Read/Write	
0.7.17	AMU Dp Units	Byte	Read/Write	
0.7.18	Log out user in secure mode	Byte	Write Only	
0.7.19	Confirm User LogOut	Byte	Read Only	

Register	Description	Type	Access	Note
0.8.0	Last 2 byte of FLASH	Int16	Read Only	7
0.8.1	Year	Int16	Read/Write	1
0.8.2	Month	Int16	Read/Write	1
0.8.3	Day	Int16	Read/Write	1
0.8.4	Hour	Int16	Read/Write	1
0.8.5	Minute	Int16	Read/Write	1
0.8.6	Second	Int16	Read/Write	1
0.8.7	FLASH Checksum	Uint16	Read Only	
0.8.8	Day of Week	Int16	Read/Write	1
0.8.9	App type mask for syslog	Int16	Read/Write	
0.9.0	System Date/Time	Uint32	Read/Write	1
0.9.1	Available Task Memory	Uint32	Read Only	8
0.9.2	Available RAM File Space	Uint32	Read Only	8
0.9.3	Board Serial Number	Uint32	Read Only	
0.9.4	Customer ID	Uint32	Read Only	
0.9.5	In-Service Date	Uint32	Read Only	9
0.9.6	Run time since boot, in seconds	Uint32	Read Only	
0.9.7	If tubes, tsec loop time	Uint32	Read Only	
0.10.0	Current CPU usage (%)	Float	Read Only	8
0.10.1	Average CPU usage (%)	Float	Read Only	8
0.10.2	Low Battery Sleep Threshold	Float	Read/Write	10
0.10.3	Always Read Zero, Dummy Write	Float	Read/Write	
0.10.4	System Time (HHMMSS.0)	Float	Read/Write	1
0.10.5	System Date (MMDDYY.0)	Float	Read/Write	1
0.10.6	Always Read One(1.0)	Float	Read Only	
0.10.7	Low batt thresh for radio protocols	Float	Read/Write	
0.12.0	Factory Configuration	String	Read Only	11
0.12.1-(X)	Application Part Numbers	String	Read Only	3
0.13.0	I/O point under calibration	Uint32	Read/Write	12

System Application Register Notes

1. The system date/time can be read in several formats. Register 0.0.3 contains a string MM/DD/YY HH:MM:SS. Register 0.9.0 contains a 32 bit Julian (#seconds since midnight 1/1/1970). Registers 0.8.1 through 0.8.8 are 16 bit integers commonly used by MODBUS protocols with the values in register 0.8.8 ranging from 1 (for Monday) to 7 (for Sunday). Registers 0.10.4 and 0.10.5 contain floating point formats used by ENRON versions of MODBUS protocols.

2. The system allows the execution of batch command files. A batch command file is a text file containing a sequence of terminal mode commands. Any commands which can be executed from terminal mode can be placed in a file and executed in batch mode by writing the file name to register 0.0.8. Batch commands can be scheduled by configuring a periodic operation to write the file name to register 0.0.8.

3. Each FLASH image is an assembly of applications. The number and type of applications a FLASH image contains can be read from register array 1. Register 0.1.0 contains the number of

applications. Registers 0.1.1 through 0.1.(0.1.0) contains the application type codes for each application in the FLASH image. Supported application type codes:

0 - System

1 - I/O Subsystem

2 - Display

3 - Communications

4 - Aga-3 Measurement

5 - Aga-7 Measurement

6 - Liquid Measurement

7 - Trend System

8 - Alarm System

9 - Valve Control

10 - Holding Registers

11 - Therms Master

12 - XMV Interface

13 - IEC-61131 Environment

14 - Therms Slave

15 - Tank Interface

16 - Pump Interface

17 - FS2 Interface

18 - Operations

19 - Host Interface

255- Unused slot.

Application descriptions can be read from registers 0.2.1 through 0.2.(0.1.0).
Application part numbers can be read from registers 0.12.1 through 0.12.(0.1.0).

4. For an application to execute, it must be instantiated in the application table. Register 0.3.0 contains the size of the application instantiation table. Registers 0.3.1 through 0.3.(0.3.0) contain the application type codes of instantiated applications. Registers 0.4.1 through 0.4.(0.3.0) contain the names of instantiated applications. Registers 0.5.1 through 0.5.(0.3.0) contain the revision code of the instantiated applications. Registers 0.6.1 through 0.6.(0.3.0) contain the start parameters of the instantiated applications.

5. The serial EPROM non-volatile file system (S:\) can be cleared and reformatted by writing either the ASCII character 83 (“S”) or 115 (“s”) to register 0.7.5. This should only be done if file system corruption is suspected. Reformatting the S drive deletes the protected REGISTRY.TXT file.

6. In addition to REGISTRY.TXT, another protected registry area resides in the serial EPROM. Among other things, this area contains the board serial number and factory configuration part number. This registry data can be cleared by writing to register 0.7.6. It should only be written by TOTALFLOW support.

7. Register 0.8.0 contains a special check sum used by the IEC download utility.

8. The number of applications that can be instantiated are limited by available resources. When instantiating applications, memory, file space, and processor usage should be monitored carefully to determine if the device is being overloaded.

9. The in service date is set the first time the system date/time is set. It is used by TOTALFLOW customer support to determine when a device was put in service.

10. Register 0.10.2 contains the sleep threshold voltage. When the battery voltage falls below this threshold the device enters sleep mode.

11. Register 0.12.0 contains the part number of the setup configuration programmed at the factory.
12. Register 0.13.0 contains the register address of the analog input point that is currently being calibrated. In addition register 0.7.9 contains either a 0 or 1 to indicate that there is an input point being calibrated.
13. Turns on and off special task monitoring.
14. Copies memory to "memfile.log" on Heap corrupt detect.

Trend System Application Registers (Rev AA)

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
0.0-(X)	Trend File 1 Date/Time Stamp	Uint32	Read Only	1
1.0-(X)	Trend File 1 Variable 1	Programmable	Read Only	2
2.0-(X)	Trend File 1 Variable 2	Programmable	Read Only	2
(X).0-(X)	Trend File 1 Variable (X)	Programmable	Read Only	3
16.0-(X)	Trend File 2 Date/Time Stamp	Uint32	Read Only	1
17.0-(X)	Trend File 2 Variable 1	Programmable	Read Only	2
18.0-(X)	Trend File 2 Variable 2	Programmable	Read Only	2
(X).0-(X)	Trend File 2 Variable (X)	Programmable	Read Only	3
32.0-(X)	Trend File 3 Date/Time Stamp	Uint32	Read Only	1
33.0-(X)	Trend File 3 Variable 1	Programmable	Read Only	2
34.0-(X)	Trend File 3 Variable 2	Programmable	Read Only	2
(X).0-(X)	Trend File 3 Variable (X)	Programmable	Read Only	3
48.0-(X)	Trend File 4 Date/Time Stamp	Uint32	Read Only	1
49.0-(X)	Trend File 4 Variable 1	Programmable	Read Only	2
50.0-(X)	Trend File 4 Variable 2	Programmable	Read Only	2
(X).0-(X)	Trend File 4 Variable (X)	Programmable	Read Only	3
240.0	Number of Trend Files	Byte	Read Only	3
241.0	Trend File 1 Name	String	Read Only	4
241.1	Trend File 2 Name	String	Read Only	4
241.2	Trend File 3 Name	String	Read Only	4
241.(X)	Trend File (X) Name	String	Read Only	3
242.0	Trend File 1 Description	String	Read Only	5
242.1	Trend File 2 Description	String	Read Only	5
242.2	Trend File 3 Description	String	Read Only	5
242.(X)	Trend File (X) Description	String	Read Only	3
243.0	Trend File 1 Number of Variables	Byte	Read Only	2
243.1	Trend File 2 Number of Variables	Byte	Read Only	2
243.2	Trend File 3 Number of Variables	Byte	Read Only	2
243.(X)	Trend File (X) #Variables	Byte	Read Only	3

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
244.0	Trend File 1 Number of Records	Uint32	Read Only	6
244.1	Trend File 2 Number of Records	Uint32	Read Only	6
244.2	Trend File 3 Number of Records	Uint32	Read Only	6
244.(X)	Trend File (X) # Records	Uint32	Read Only	3

Trend System Register Notes:

1. Trend System time stamps are 32 bit Julian format (#seconds since 1/1/1970).
2. A maximum of 15 variables/file can be accessed through registers. The number and type of Trend System variables are defined in the Trend System files. Register 0 references the most recent record of a Trend file, register 1 the next most recent, and so on.
3. A maximum of 15 files can be accessed through registers.
4. 12 character file names.
5. 24 character descriptions.
6. The number of records is limited only by available file space.

Communication Registers

Communication Application Registers (Rev AA)

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
0.6	Protocol	Byte	Read/Write	7
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
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
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
3.0	Protocol Directory	String	Read/Write	17

REGISTER	DESCRIPTION	TYPE	ACCESS	NOTE
3.1	Modem Dial String	String	Read/Write	
3.2	Modem Initialization String	String	Read/Write	
4.0	Request/Response Timing DO	Register	Read/Write	18
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

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.
4. Only 5, 7, or 8 Data bits supported.
5. 0 = None, 1 = Even, 2 = Odd.
6. 0 or 1 = 1, 2 = 2 Stop Bits.
7. Supported Protocols:

   0 - Totalflow Local
   1 - Modbus ASCII
   2 - Totalflow CCU
   3 - Local Terminal Emulation
   4 - Local User Interface Console
   5 - Modbus RTU
   7 - Tank Gauge
   8 - Modbus HOST ASCII
   9 - Modbus HOST RTU
   10 - ADP HOST
   11 - ETS HOST

   All protocols may not be supported by the FLASH image. Protocol must be one of the enumerations listed in array 5 (see note 19).
8. 0 = 4 seconds, 1 = 2 seconds, 2 = 1 seconds, 3 = Always On.
9. 1 = Time of Day, 2 = Time of Day/Cycle
10. 0 = 32 Bit Totalflow, 64 = 32 Bit, 65 = 16 Bit Word Swapped, 66 = 16 Bit Modicon, 68 = 16 Bit ROS Modulo 10000
11. Use only as directed by Totalflow support.
12. Used by many host protocols (MODBUS Host, ADP Host, ETS Host…) Appends NULL characters to transmitted packets.
13. 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.
14. 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.

15. Communications Schedule is used to conserve power during times of inactivity.

16. Not all protocols maintain communications statistics.

17. Some protocols scan a directory for request blocks or register maps. If you wish to share a register map across ports, change the protocol directory to point to a common directory.

18. By assigning this register to a digital output, an oscilloscope can be used to measure protocol request/response timing. When using multiple XMVs on a common bus, this can be used to verify each device is reliably being scanned once a second (API 21.1 compliance).

19. 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.

FS2 Application Registers (Rev AA)

FS2 Byte Registers

REGISTER	DESCRIPTION	Type
0.0	Fs2 Dump Database(DB2 Collect)	Read-number of days = all/Write select number of days
0.1	FS2 Locate and lock selected Display	Write
0.2	Trend Append to DB2 Collect	Read/Write
0.3	Contract Day	Read/Write
0.4	Incremental Features Flags(set to 0xFF for Xseries)	Read/Write – see note 1
0.5	Feature Flags	Read/Write
0.6	Lock Calcs(Dummy return value =1, For"LC" command.	Read Only
0.7	Remote Protocol Selection(Totalflow Remote = 2, Modbus Ascii=3)	Read/Write
0.8	Remote Protocol Stop bits selection(1 stop bit = 1, 2 Stop bits =3)	Read/Write
0.9	Remote Protocol Interface selection(Modem = 64, RS485=1, RS232=0, RS422=2)	Read/Write
0.10	Display Time for selected display item	Read/Write
0.11	Calc cp_test(aga7Test701)	Write

FS2 Byte Register Usage Notes:

Note 1:

1. FS2 Feature Flag Bits:

```
0x02,   2  /* Pulse Input       */
0x10,  16  /* Valve Support     */
0x20,  32  /* BC Ext Char       */
0x40,  64  /* API AGA85 Calc */
0x80, 128  /* External Features */
```

FS2 32-bit Integer Registers

REGISTER	DESCRIPTION	TYPE
1.0	FS2 Code(Composed of the Incremental features,features and e Rev codes –4145FFE0 = AEFFE0)	Read/Write
1.1	External Feature Flags 1	Read/Write
1.2	External Feature Flags 2	Read/Write
1.3	Remote Key Up Delay RCA format to and from FS2	Read/Write.In ms
1.4	Remote Key Down Delay RCA format to and from FS2	Read/Write.In ms
1.5	Remote Key Power Up Delay RCA format to and from FS2	Read/Write.In ms

FS2 Floating Point Registers

REGISTER	DESCRIPTION	TYPE
2.0	FS2 Cal Ratio(Kludge for FS2 Read returns 1.0,Write=Nop) Allows FS2 to not break during a ap or dp calibration.)	Read/Write
2.1	aga7PeriodUVol or aga3Volume	Read Only
2.2	aga7VpAccVol or aga3VpAccVol	Read Only
2.3	aga7DayVol or aga3ScaledPrevContractDayVol	Read Only
2.4	aga7VpAccUvol or 1.0 for aga3	Read Only
2.5	aga7Cflow or aga3Cflow	Read Only
2.6	aga7AccUvol or aga3OrifD	Read Only
2.7	aga7Cuflow or aga3PipeD	Read Only
2.8	aga7Windowacf or aga3FluidViscosity	Read Only
2.9	aga7Faux or aga3Faux	Read Only
2.10	aga7Pb or aga3Pb	Read Only
2.11	aga7Tb or aga3Tb	Read Only
2.12	aga7 PI Curr or aga3DpCurr	Read Only
2.13	aga7ApFixed or Dp MIDptCal	Read Only
2.14	aga7PiKfac or Dp LOptCal	Read Only
2.15	Ap/Dp Thermal Ratio Returns incrementing modulo 10 value On successive accesses	Read Only

FS2 String Registers

REGISTER	DESCRIPTION	TYPE
3.0	FS2 Formatted Time/Date MM/DD/YY HH:MM	Read/Write
3.1	Returns "0000" to allow FS2 Temperature correction to not fail	Read
3.2	FS2 Tube Revision	Read/Write
3.3	FS2 Tube Version – "M" for AGA7 and "E" for AGA3	Read/Write

FS2 Structure Registers

REGISTER	DESCRIPTION	TYPE
4.0	FS2 Code – composed of FS2 Features and FS2 Incremental Features	Read/Write
4.1	FS2 Extended Feature Flags 1	Read/Write – see note 1
4.2	FS2 Extended Feature Flags 2. Not used, for expansion of features	Read/Write
4.3	Returns to FS2 VCInomrec	Read – see note 2
4.4	FS2 set of VCInomset	Write – see note 3

FS2 Structure Registers Note:

```
XFEAT_FLAGS1=00ABDFAD (GAUGE_PR_XFEAT+\
                           RKD_XFEAT+\
                           SEQEVTS_XFEAT+\
                           RXKD_XFEAT+\
                           MODBUS_XFEAT+\
                           DISP_XFEAT+\
                           FIVE_PT_CALIB_XFEAT+\
                           DB2_CMDS_XFEAT+\
                           AUX_PORT_XFEAT+\
                           DSP_CMD_XFEAT+\
                           RAMS_XFEAT+\
                           CRYOUT_XFEAT+\
                           TANKGAUGE_XFEAT+\
                           MODEM_XFEAT+\
                           COMM_SCHEDULE_XFEAT+\
                           MODHOST_XFEAT+\
                           AOV_XFEAT)

typedef struct
     {
       byte      active;   /* 1=NOM active, 0=NOM inactive */
       N_NOMPER  cur_per;  /* ccu/pccu info on CURR NOM period */
       N_NOMPER  next_per; /* ccu/pccu info on NEXT NOM period */
```

```
  N_NOMPER  last_per; /* ccu/pccu info on LAST NOM period */
  N_NOMSTAT cur_stat; /* CURR NOM period status */
  N_NOMSTAT last_stat;/* LAST NOM period status */
}N_NOMREC;
```

FS2 Nomrec read:

```
n_nomrec->cur_per.target_vol
n_nomrec->next_per.target_vol
n_nomrec->last_per.target_vol
n_nomrec->cur_stat.actual_vol
n_nomrec->cur_stat.perc_onsched
n_nomrec->last_stat.actual_vol
n_nomrec->last_stat.perc_onsched
```

```
/* This structure is for writing */
     typedef struct
     {
       byte      per_chng;
       N_NOMPER  cur_per;  /* ccu/pccu cfg for CURR NOM period */
       N_NOMPER   next_per;/* ccu/pccu cfg for NEXT NOM period */
     }N_NOMSET;
```

FS2 Nomset set:

```
n_nomset->cur_per.target_vol
n_nomset->next_per.target_vol
```

FS2 Cal DP Registers

REGISTER	DESCRIPTION	TYPE
5.0	Zero Cal	Read/Write
5.1	LOptCal	Read/Write
5.2	MLOptCal	Read/Write
5.3	MIDptCal	Read/Write
5.4	MHIptCal	Read/Write
5.5	HIptCal	Read/Write
5.6	Bias	Read/Write
5.15	FINISHCal – A write to this register initiates the Calibration	Read/Write

FS2 Cal AP Registers

REGISTER	DESCRIPTION	TYPE
6.0	Zero Cal	Read/Write
6.1	LOptCal	Read/Write

REGISTER	DESCRIPTION	TYPE
6.2	MLOptCal	Read/Write
6.3	MIDptCal	Read/Write
6.4	MHIptCal	Read/Write
6.5	HIptCal	Read/Write
6.6	Bias	Read/Write
6.15	FINISHCal – A write to this register initiates the Calibration	Read/Write

FS2 Cal TF Registers

REGISTER	DESCRIPTION	USAGE
7.0	Zero Cal	Read/Write
7.1	LOptCal	Read/Write
7.2	MLOptCal	Read/Write
7.3	MIDptCal	Read/Write
7.4	MHIptCal	Read/Write
7.5	HIptCal	Read/Write
7.6	Bias	Read/Write
7.15	FINISHCal – A write to this register initiates the Calibration	Read/Write

FS2 Cline Registers

REGISTER	DESCRIPTION	TYPE
8.0	AmuDP_CURVELINE_0_OFFSET Dummy write, Read returns 1.0	Read/Write
8.1	AmuDP_CURVELINE_1_OFFSET Dummy write, Read returns 1.0	Read/Write
8.2	AmuAP_CURVELINE_0_OFFSET Dummy write, Read returns 1.0	Read/Write
8.3	AmuAP_CURVELINE_1_OFFSET Dummy write, Read returns 1.0	Read/Write
8.4	DPTHERMALRatio Dummy write, Read returns an incrementing modulo 10 value on successive reads	Read/Write
8.5	APTHERMALRatio Dummy write, Read returns an incrementing modulo 10 value on successive reads	Read/Write

Array 0 - Communication Status - Byte

App.Array.Reg	Description
app.0.0	Number of XMV’s

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Communication Status	1	2	3	4	5	6	7	8
	registers: app.0.x							

Note: Array 254 is write only, and is stored in array 0. Array 0 can be read and write.

Array 1 - Calibration Flags - Uint16

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DP Cal Flags	0	3	6	9	12	15	18	21
SP Cal Flags	1	4	7	10	13	16	19	22
TF Cal Flags	2	5	8	11	14	17	20	23
	registers: app.1.x							

Note: Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.

Array 2 - Scroll Text - Uint16

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Scroll Text 1	0	7	14	21	28	35	42	49
Scroll Text 2	1	8	15	22	29	36	43	50
Scroll Text 3	2	9	16	23	30	37	44	51
Scroll Text 4	3	10	17	24	31	38	45	52
Scroll Text 5	4	11	18	25	32	39	46	53
Scroll Text 6	5	12	19	26	33	40	47	54
Scroll Text 7	6	13	20	27	34	41	48	55
	registers: app.2.x							

Array 3 - Raw Values - Float

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DP raw value	0	3	6	9	12	15	18	21
SP raw value	1	4	7	10	13	16	19	22
TF raw value	2	5	8	11	14	17	20	23
	registers: app.3.x							

Array 4 - Scaled Values - Float

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DP scaled value	0	3	6	9	12	15	18	21
SP scaled value	1	4	7	10	13	16	19	22
TF scaled value	2	5	8	11	14	17	20	23
	registers: app.4.x							

Array 5 - Calibration User Values

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DP Zero Transducer	0	48	96	144	192	240	288	336
DP Cal Point 1	1	49	97	145	193	241	289	337
DP Cal Point 2	2	50	98	146	194	242	290	338
DP Cal Point 3	3	51	99	147	195	246	291	339
DP Cal Point 4	4	52	100	148	196	244	292	340
DP Cal Point 5	5	53	101	149	197	245	293	341
DP Cal Bias	6	54	102	150	198	246	294	342
DP Cal Abort	14	62	110	158	206	254	302	350
DP Cal Complete	15	63	111	159	207	255	303	351
SP Zero Transducer	16	64	112	160	208	256	304	352
SP Cal Point 1	17	65	113	161	209	257	305	353
SP Cal Point 2	18	66	114	162	210	258	306	354
SP Cal Point 3	19	67	115	163	211	259	307	355
SP Cal Point 4	20	68	116	164	212	260	308	356
SP Cal Point 5	21	69	117	165	213	261	309	357
SP Cal Bias	22	70	118	166	214	262	310	358
SP Cal Abort	30	78	126	174	222	270	318	366
SP Cal Complete	31	79	127	175	223	271	319	367
TF Zero Transducer	32	80	128	176	224	272	320	368
TF Cal Point 1	33	81	129	177	225	273	321	369
TF Cal Point 2	34	82	130	178	226	274	322	370
TF Cal Point 3	35	83	131	179	227	275	323	371
TF Cal Point 4	36	84	132	180	228	276	324	372
TF Cal Point 5	37	85	133	181	229	277	325	373
TF Cal Bias	38	86	134	182	230	278	326	374
TF Cal Abort	46	94	142	190	238	286	334	382
TF Cal Complete	47	95	143	191	239	287	335	383
	registers: app.5.x							

Note: The calibration registers in array 5 should only be written by the PCCU32 calibration screen.

Array 8 – Scroll Lock Flags – Byte

	XMV							
Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
DP Scroll Lock	0	3	6	9	12	15	18	21
SP Scroll Lock	1	4	7	10	13	16	19	22
TF Scroll Lock	2	5	8	11	14	17	20	23
	registers: app.8.x							

Note: The scroll lock registers in array 8 are written by the PCCU32 calibration screen to lock the pressure (DP or SP) being calibrated on the XMV.

Arrays 9 - 14

		XMV							
Description	**Array**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Scroll Trigger	9	0	1	2	3	4	5	6	7
Abs/Gauge 1	10	0	1	2	3	4	5	6	7
Metric/English 2	11	0	1	2	3	4	5	6	7
Enable	12	0	1	2	3	4	5	6	7
Scan Trigger	13	0	1	2	3	4	5	6	7
# Displays	14	0	1	2	3	4	5	6	7
		registers: app.ary.x							

NOTES:

1. Device Static Pressure type. If the XMV is an ABB 2010, Array 10 should be set to 0 (Absolute). If the XMV is a Rosemount 3095, this register should be set to 1 (Gauge).
2. If the XMV is an ABB 2010, Array 11 should be set to 0 (Metric). If the XMV is a Rosemount 3095, this register should be set to 1 (English).
3. Registers in array 12 control the scan triggers in array 13. When a register in array 12 is ENABLED (1), the corresponding register in array 13 is TRIGGERED (1). When a register in array 12 is DISABLED (0), the corresponding register in array 13 is always 0.
4. 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.

Arrays 15-46 Displays for each XMV

		XMV							
Type	**Description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
byte	Display Interval	15	19	23	27	31	35	39	43
string	Line 1 Text/Register	16	20	24	28	32	36	40	44
string	Line 2 Text/Register	17	21	25	29	33	37	41	45

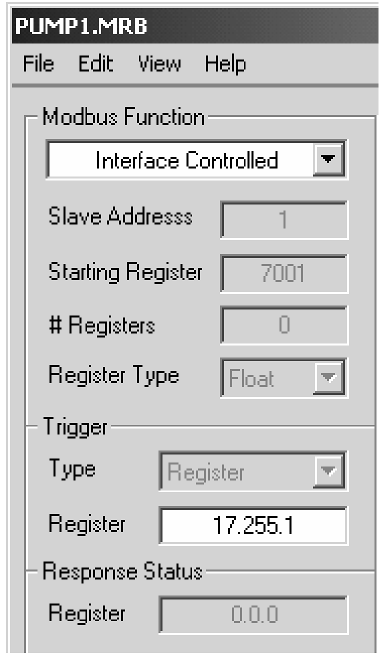
		XMV							
Type	Description	1	2	3	4	5	6	7	8
string	Data Format	18	22	26	30	34	38	42	46
		array: app.XX.X							

1. Each array has the number of registers to match the number of displays for that XMV, as set in array 14.
2. For example, Display 1, Line 1 for XMV 2 is app.20.0
3. Each display can be configured with its own display interval. This is the minimum amount of time the display is scrolled.
4. 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”).
5. 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”.

Arrays 47 - 58 Setup

			XMV							
Type	Description	Ary	1	2	3	4	5	6	7	8
string	Description Strings	47	0	1	2	3	4	5	6	7
byte	Output Units: AP [1]	48	0	1	2	3	4	5	6	7
byte	Output Units: DP [1]	49	0	1	2	3	4	5	6	7
byte	Output Units: TF [1]	50	0	1	2	3	4	5	6	7
string	Output Units: AP - String	51	0	1	2	3	4	5	6	7
string	Output Units: DP - String	52	0	1	2	3	4	5	6	7
string	Output Units: TF - String	53	0	1	2	3	4	5	6	7
byte	Modbus Slave Address [2]	54	0	1	2	3	4	5	6	7
uint16	Modbus Register Address [3]	55	0	1	2	3	4	5	6	7
byte	Text Writeback Enable	56	0	1	2	3	4	5	6	7
uint32	Number of Polls	57	0	1	2	3	4	5	6	7
uint32	Number of Errors	58	0	1	2	3	4	5	6	7
byte	MB Response Status	254	0	1	2	3	4	5	6	7
MB struct	Modbus Buffer [4]	255	0	1	2	3	4	5	6	7
			registers: app.ary.disp							

Notes:
1. 0=Metric 1=English
2. Default Slave Address is xmv # (1-8)
3. Default MB register is 21 for 32 bit Modbus. Use 401 for 16 bit Modbus
4. A MRB must be installed in the Modbus directory of the communication port being used to talk to each XMV. The Modbus function should be “Interface Driven” and the Trigger Register set to app.255.xmv. For example:



Therms Master Application Registers (Rev AB)

Therms Master Btu Byte Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
0.0	Components 7001 Read trigger.	Read/Write
0.1	Reset New Data trigger.	Read/Write
0.2	Component Index 3001 Read status.	Read/Write
0.3	3058 New Data Write status.	Read/Write
0.4	Components 7001 Read status.	Read/Write
0.5	Components Index Select 1-16 or 17-32.	Read/Write
0.6	Components 7017 Read trigger.	Read/Write
0.7	Components 7017 Read status.	Read/Write
0.8	BTU8000 7200 Read status.	Read/Write
0.9	Use Cycle Time Vs. New Data.(Implemented 6\03\04)	Read/Write

Therms Master Btu Integer Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
1.0	Components Table #1 Index #1.	Read/Write
1.1	Components Table #1 Index #2.	Read/Write
1.2	Components Table #1 Index #3.	Read/Write
1.3	Components Table #1 Index #4.	Read/Write
1.4	Components Table #1 Index #5.	Read/Write
1.5	Components Table #1 Index #6.	Read/Write
1.6	Components Table #1 Index #7.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
1.7	Components Table #1 Index #8.	Read/Write
1.8	Components Table #1 Index #9.	Read/Write
1.9	Components Table #1 Index #10.	Read/Write
1.10	Components Table #1 Index #11.	Read/Write
1.11	Components Table #1 Index #12.	Read/Write
1.12	Components Table #1 Index #13.	Read/Write
1.13	Components Table #1 Index #14.	Read/Write
1.14	Components Table #1 Index #15.	Read/Write
1.15	Components Table #1 Index #16.	Read/Write
1.16	Components Table #2 Index #1.	Read/Write
1.17	Components Table #2 Index #2.	Read/Write
1.18	Components Table #2 Index #3.	Read/Write
1.19	Components Table #2 Index #4.	Read/Write
1.20	Components Table #2 Index #5.	Read/Write
1.21	Components Table #2 Index #6.	Read/Write
1.22	Components Table #2 Index #7.	Read/Write
1.23	Components Table #2 Index #8.	Read/Write
1.24	Components Table #2 Index #9.	Read/Write
1.25	Components Table #2 Index #10.	Read/Write
1.26	Components Table #2 Index #11.	Read/Write
1.27	Components Table #2 Index #12.	Read/Write
1.28	Components Table #2 Index #13.	Read/Write
1.29	Components Table #2 Index #14.	Read/Write
1.30	Components Table #2 Index #15.	Read/Write
1.31	Components Table #2 Index #16.	Read/Write
1.32	Analysis time.	Read/Write
1.33	Current Stream	Read/Write
1.34	Stream Mask.	Read/Write
1.35	Current Month.	Read/Write
1.36	Current Day.	Read/Write
1.37	Current Year.	Read/Write
1.38	Current Hour	Read/Write
1.39	Current Minutes	Read/Write
1.40	Cycle time start Month	Read/Write
1.41	Cycle time start Day	Read/Write
1.42	Cycle time start Year	Read/Write
1.43	Cycle time start Hour	Read/Write
1.44	Cycle time start Minutes	Read/Write
1.45	Bit Flags Transmitter	Read/Write
1.46	Bit Flags Transmitter	Read/Write
1.47	Bit Flags Stream 1 Low	Read/Write
1.48	Bit Flags Stream 1 High	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
1.49	Bit Flags Stream 2Low	Read/Write
1.50	Bit Flags Stream 2 High	Read/Write
1.51	Bit Flags Stream 3Low	Read/Write
1.52	Bit Flags Stream 3 High	Read/Write
1.53	Bit Flags Stream 4 Low	Read/Write
1.54	Bit Flags Stream 4 High	Read/Write
1.55	Bit Flags Stream 5 Low	Read/Write
1.56	Bit Flags Stream 5 High	Read/Write
1.57	New Data Flag	Read/Write
1.58	Cal/Analysis Flag	Read/Write
1.59	Not Used	N/A

Therms Master Btu Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
2.0	Mole % - Component #1	Read/Write
2.1	Mole % - Component #2	Read/Write
2.2	Mole % - Component #3	Read/Write
2.3	Mole % - Component #4	Read/Write
2.4	Mole % - Component #5	Read/Write
2.5	Mole % - Component #6	Read/Write
2.6	Mole % - Component #7	Read/Write
2.7	Mole % - Component #8	Read/Write
2.8	Mole % - Component #9	Read/Write
2.9	Mole % - Component #10	Read/Write
2.10	Mole % - Component #11	Read/Write
2.11	Mole % - Component #12	Read/Write
2.12	Mole % - Component #13	Read/Write
2.13	Mole % - Component #14	Read/Write
2.14	Mole % - Component #15	Read/Write
2.15	Mole % - Component #4	Read/Write
2.16	GPM - Component #1	Read/Write
2.17	GPM - Component #2	Read/Write
2.18	GPM - Component #3	Read/Write
2.19	GPM - Component #4	Read/Write
2.20	GPM - Component #5	Read/Write
2.21	GPM - Component #6	Read/Write
2.22	GPM - Component #7	Read/Write
2.23	GPM - Component #8	Read/Write
2.24	GPM - Component #9	Read/Write
2.25	GPM - Component #10	Read/Write
2.26	GPM - Component #11	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
2.27	GPM - Component #12	Read/Write
2.28	GPM - Component #13	Read/Write
2.29	GPM - Component #14	Read/Write
2.30	GPM - Component #15	Read/Write
2.31	GPM - Component #16	Read/Write
2.32	Btu Dry.	Read/Write
2.33	Btu Saturated	Read/Write
2.34	Specific Gravity	Read/Write
2.35	Compressibility	Read/Write
2.36	Wobbe Index	Read/Write
2.37	Total Un-normalized mole	Read/Write
2.38	Total GPM	Read/Write
2.39	Ratio#1 - Unused	Read/Write

Therms Master Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
3.0	N2 – Btu Stream Component.	Read/Write
3.1	CO2 – Btu Stream Component.	Read/Write
3.2	H2S – Btu Stream Component.	Read/Write
3.3	H2O – Btu Stream Component.	Read/Write
3.4	HE – Btu Stream Component.	Read/Write
3.5	C1 – Btu Stream Component.	Read/Write
3.6	C2 – Btu Stream Component.	Read/Write
3.7	C3 – Btu Stream Component.	Read/Write
3.8	NC4 – Btu Stream Component.	Read/Write
3.9	IC4 – Btu Stream Component.	Read/Write
3.10	NC5 – Btu Stream Component.	Read/Write
3.11	IC5 – Btu Stream Component.	Read/Write
3.12	NC6 – Btu Stream Component.	Read/Write
3.13	NC7 – Btu Stream Component.	Read/Write
3.14	NC8 – Btu Stream Component.	Read/Write
3.15	NC9 – Btu Stream Component.	Read/Write
3.16	NC10 – Btu Stream Component.	Read/Write
3.17	O2 – Btu Stream Component.	Read/Write
3.18	CO – Btu Stream Component.	Read/Write
3.19	H2 – Btu Stream Component.	Read/Write
3.20	AR – Btu Stream Component.	Read/Write
3.21	AIR – Btu Stream Component.	Read/Write
3.22	C6PLUS – Btu Stream Component.	Read/Write
3.23	BTU – Btu Stream Component.	Read/Write
3.24	GF – Btu Stream Component.	Read/Write
3.25	SGF – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
3.26	CPCV – Btu Stream Component.	Read/Write
3.27	VISCOSITY – Btu Stream Component.	Read/Write
3.28	DENSITY – Btu Stream Component.	Read/Write
3.29	FT – Btu Stream Component.	Read/Write
3.30	FP – Btu Stream Component.	Read/Write
3.31	C7PLUS – Btu Stream Component.	Read/Write
3.32	C8PLUS – Btu Stream Component.	Read/Write
3.33	H2OCONTENT – Btu Stream Component.	Read/Write
3.34	H2OBIAS – Btu Stream Component.	Read/Write
3.35	EOAXMAP – Btu Stream Component.	Read/Write
3.36	NEOC5 – Btu Stream Component.	Read/Write
3.37	C3PRIME – Btu Stream Component.	Read/Write
3.38	C4PLUS – Btu Stream Component.	Read/Write
3.39	SATBTU – Btu Stream Component.	Read/Write
3.40	Z – Btu Stream Component.	Read/Write
3.41	WOBBE – Btu Stream Component.	Read/Write
3.42	STREAM NUMBER.	Read/Write
3.43	STREAM TIME.	Read/Write

Therms Master Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
4.0	N2 – Btu Stream Component.	Read/Write
4.1	CO2 – Btu Stream Component.	Read/Write
4.2	H2S – Btu Stream Component.	Read/Write
4.3	H2O – Btu Stream Component.	Read/Write
4.4	HE – Btu Stream Component.	Read/Write
4.5	C1 – Btu Stream Component.	Read/Write
4.6	C2 – Btu Stream Component.	Read/Write
4.7	C3 – Btu Stream Component.	Read/Write
4.8	NC4 – Btu Stream Component.	Read/Write
4.9	IC4 – Btu Stream Component.	Read/Write
4.10	NC5 – Btu Stream Component.	Read/Write
4.11	IC5 – Btu Stream Component.	Read/Write
4.12	NC6 – Btu Stream Component.	Read/Write
4.13	NC7 – Btu Stream Component.	Read/Write
4.14	NC8 – Btu Stream Component.	Read/Write
4.15	NC9 – Btu Stream Component.	Read/Write
4.16	NC10 – Btu Stream Component.	Read/Write
4.17	O2 – Btu Stream Component.	Read/Write
4.18	CO – Btu Stream Component.	Read/Write
4.19	H2 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
4.20	AR – Btu Stream Component.	Read/Write
4.21	AIR – Btu Stream Component.	Read/Write
4.22	C6PLUS – Btu Stream Component.	Read/Write
4.23	BTU – Btu Stream Component.	Read/Write
4.24	GF – Btu Stream Component.	Read/Write
4.25	SGF – Btu Stream Component.	Read/Write
4.26	CPCV – Btu Stream Component.	Read/Write
4.27	VISCOSITY – Btu Stream Component.	Read/Write
4.28	DENSITY – Btu Stream Component.	Read/Write
4.29	FT – Btu Stream Component.	Read/Write
4.30	FP – Btu Stream Component.	Read/Write
4.31	C7PLUS – Btu Stream Component.	Read/Write
4.32	C8PLUS – Btu Stream Component.	Read/Write
4.33	H2OCONTENT – Btu Stream Component.	Read/Write
4.34	H2OBIAS – Btu Stream Component.	Read/Write
4.35	EOAXMAP – Btu Stream Component.	Read/Write
4.36	NEOC5 – Btu Stream Component.	Read/Write
4.37	C3PRIME – Btu Stream Component.	Read/Write
4.38	C4PLUS – Btu Stream Component.	Read/Write
4.39	SATBTU – Btu Stream Component.	Read/Write
4.40	Z – Btu Stream Component.	Read/Write
4.41	WOBBE – Btu Stream Component.	Read/Write
4.42	STREAM NUMBER.	Read/Write
4.43	STREAM TIME.	Read/Write

Therms Master Stream 3 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
5.0	N2 – Btu Stream Component.	Read/Write
5.1	CO2 – Btu Stream Component.	Read/Write
5.2	H2S – Btu Stream Component.	Read/Write
5.3	H2O – Btu Stream Component.	Read/Write
5.4	HE – Btu Stream Component.	Read/Write
5.5	C1 – Btu Stream Component.	Read/Write
5.6	C2 – Btu Stream Component.	Read/Write
5.7	C3 – Btu Stream Component.	Read/Write
5.8	NC4 – Btu Stream Component.	Read/Write
5.9	IC4 – Btu Stream Component.	Read/Write
5.10	NC5 – Btu Stream Component.	Read/Write
5.11	IC5 – Btu Stream Component.	Read/Write
5.12	NC6 – Btu Stream Component.	Read/Write
5.13	NC7 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
5.14	NC8 – Btu Stream Component.	Read/Write
5.15	NC9 – Btu Stream Component.	Read/Write
5.16	NC10 – Btu Stream Component.	Read/Write
5.17	O2 – Btu Stream Component.	Read/Write
5.18	CO – Btu Stream Component.	Read/Write
5.19	H2 – Btu Stream Component.	Read/Write
5.20	AR – Btu Stream Component.	Read/Write
5.21	AIR – Btu Stream Component.	Read/Write
5.22	C6PLUS – Btu Stream Component.	Read/Write
5.23	BTU – Btu Stream Component.	Read/Write
5.24	GF – Btu Stream Component.	Read/Write
5.25	SGF – Btu Stream Component.	Read/Write
5.26	CPCV – Btu Stream Component.	Read/Write
5.27	VISCOSITY – Btu Stream Component.	Read/Write
5.28	DENSITY – Btu Stream Component.	Read/Write
5.29	FT – Btu Stream Component.	Read/Write
5.30	FP – Btu Stream Component.	Read/Write
5.31	C7PLUS – Btu Stream Component.	Read/Write
5.32	C8PLUS – Btu Stream Component.	Read/Write
5.33	H2OCONTENT – Btu Stream Component.	Read/Write
5.34	H2OBIAS – Btu Stream Component.	Read/Write
5.35	EOAXMAP – Btu Stream Component.	Read/Write
5.36	NEOC5 – Btu Stream Component.	Read/Write
5.37	C3PRIME – Btu Stream Component.	Read/Write
5.38	C4PLUS – Btu Stream Component.	Read/Write
5.39	SATBTU – Btu Stream Component.	Read/Write
5.40	Z – Btu Stream Component.	Read/Write
5.41	WOBBE – Btu Stream Component.	Read/Write
5.42	STREAM NUMBER.	Read/Write
5.43	STREAM TIME.	Read/Write

Therms Master Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
6.0	N2 – Btu Stream Component.	Read/Write
6.1	CO2 – Btu Stream Component.	Read/Write
6.2	H2S – Btu Stream Component.	Read/Write
6.3	H2O – Btu Stream Component.	Read/Write
6.4	HE – Btu Stream Component.	Read/Write
6.5	C1 – Btu Stream Component.	Read/Write
6.6	C2 – Btu Stream Component.	Read/Write
6.7	C3 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
6.8	NC4 – Btu Stream Component.	Read/Write
6.9	IC4 – Btu Stream Component.	Read/Write
6.10	NC5 – Btu Stream Component.	Read/Write
6.11	IC5 – Btu Stream Component.	Read/Write
6.12	NC6 – Btu Stream Component.	Read/Write
6.13	NC7 – Btu Stream Component.	Read/Write
6.14	NC8 – Btu Stream Component.	Read/Write
6.15	NC9 – Btu Stream Component.	Read/Write
6.16	NC10 – Btu Stream Component.	Read/Write
6.17	O2 – Btu Stream Component.	Read/Write
6.18	CO – Btu Stream Component.	Read/Write
6.19	H2 – Btu Stream Component.	Read/Write
6.20	AR – Btu Stream Component.	Read/Write
6.21	AIR – Btu Stream Component.	Read/Write
6.22	C6PLUS – Btu Stream Component.	Read/Write
6.23	BTU – Btu Stream Component.	Read/Write
6.24	GF – Btu Stream Component.	Read/Write
6.25	SGF – Btu Stream Component.	Read/Write
6.26	CPCV – Btu Stream Component.	Read/Write
6.27	VISCOSITY – Btu Stream Component.	Read/Write
6.28	DENSITY – Btu Stream Component.	Read/Write
6.29	FT – Btu Stream Component.	Read/Write
6.30	FP – Btu Stream Component.	Read/Write
6.31	C7PLUS – Btu Stream Component.	Read/Write
6.32	C8PLUS – Btu Stream Component.	Read/Write
6.33	H2OCONTENT – Btu Stream Component.	Read/Write
6.34	H2OBIAS – Btu Stream Component.	Read/Write
6.35	EOAXMAP – Btu Stream Component.	Read/Write
6.36	NEOC5 – Btu Stream Component.	Read/Write
6.37	C3PRIME – Btu Stream Component.	Read/Write
6.38	C4PLUS – Btu Stream Component.	Read/Write
6.39	SATBTU – Btu Stream Component.	Read/Write
6.40	Z – Btu Stream Component.	Read/Write
6.41	WOBBE – Btu Stream Component.	Read/Write
6.42	STREAM NUMBER.	Read/Write
6.43	STREAM TIME.	Read/Write

Therms Master Btu Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
7.0	Master Stream ID.	Read/Write- see note 1
7.1	Number Slaves.	Read/Write

Note: 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

Therms Master Btu Var Int32 Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
8.0	N/A	
8.1	Current Stream 1 Time.	Read/Write
8.2	Current Stream 2 Time.	Read/Write
8.3	Current Stream 3 Time.	Read/Write
8.4	Current Stream 4 Time.	Read/Write
8.5	Elapsed Stream 1 Time.	Read/Write
8.6	Elapsed Stream 2 Time.	Read/Write
8.7	Elapsed Stream 3 Time.	Read/Write
8.8	Elapsed Stream 4 Time.	Read/Write

Therms Master Slave Data Trigger Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
9.0	Slave Data Send Trigger.	Read/Write

Note: For succeeding slaves the register offset for each slave = (slavenum * 1) + Index
Example: index register for slave data trigger for slave 2 = (1 * 1) + 0

Therms Master Current Stream Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
10.0	N2 – Btu Stream Component.	Read/Write
10.1	CO2 – Btu Stream Component.	Read/Write
10.2	H2S – Btu Stream Component.	Read/Write
10.3	H2O – Btu Stream Component.	Read/Write
10.4	HE – Btu Stream Component.	Read/Write
10.5	C1 – Btu Stream Component.	Read/Write
10.6	C2 – Btu Stream Component.	Read/Write
10.7	C3 – Btu Stream Component.	Read/Write
10.8	NC4 – Btu Stream Component.	Read/Write
10.9	IC4 – Btu Stream Component.	Read/Write
10.10	NC5 – Btu Stream Component.	Read/Write
10.11	IC5 – Btu Stream Component.	Read/Write
10.12	NC6 – Btu Stream Component.	Read/Write
10.13	NC7 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
10.14	NC8 – Btu Stream Component.	Read/Write
10.15	NC9 – Btu Stream Component.	Read/Write
10.16	NC10 – Btu Stream Component.	Read/Write
10.17	O2 – Btu Stream Component.	Read/Write
10.18	CO – Btu Stream Component.	Read/Write
10.19	H2 – Btu Stream Component.	Read/Write
10.20	AR – Btu Stream Component.	Read/Write
10.21	AIR – Btu Stream Component.	Read/Write
10.22	C6PLUS – Btu Stream Component.	Read/Write
10.23	BTU – Btu Stream Component.	Read/Write
10.24	GF – Btu Stream Component.	Read/Write
10.25	SGF – Btu Stream Component.	Read/Write
10.26	CPCV – Btu Stream Component.	Read/Write
10.27	VISCOSITY – Btu Stream Component.	Read/Write
10.28	DENSITY – Btu Stream Component.	Read/Write
10.29	FT – Btu Stream Component.	Read/Write
10.30	FP – Btu Stream Component.	Read/Write
10.31	C7PLUS – Btu Stream Component.	Read/Write
10.32	C8PLUS – Btu Stream Component.	Read/Write
10.33	H2OCONTENT – Btu Stream Component.	Read/Write
10.34	H2OBIAS – Btu Stream Component.	Read/Write
10.35	EOAXMAP – Btu Stream Component.	Read/Write
10.36	NEOC5 – Btu Stream Component.	Read/Write
10.37	C3PRIME – Btu Stream Component.	Read/Write
10.38	C4PLUS – Btu Stream Component.	Read/Write
10.39	SATBTU – Btu Stream Component.	Read/Write
10.40	Z – Btu Stream Component.	Read/Write
10.41	WOBBE – Btu Stream Component.	Read/Write
10.42	STREAM NUMBER.	Read/Write
10.43	STREAM TIME.	Read/Write

Therms Master Slave Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
11.0	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
Bit 3 : No/Yes(0/1) – Send stream 4 to this slave

Therms Master StreamTime String Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
12.0	Current Stream 1 Time, String formatted..	Read
12.1	Current Stream 2Time, String formatted..	Read
12.2	Current Stream 3 Time, String formatted..	Read
12.3	Current Stream 4 Time, String formatted..	Read

Therms Master Slave Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
13.0	Slave Data Send Status.	Read/Write

Note: For succeeding slaves the register offset for each slave = (slavenum * 1) + Index
Example: index register for slave data send status for slave 2 = (1 * 1) + 0

Therms Display String Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
14.0	Analyzer Alarm, string based on value in App.15.17, 0 = “Normal”, Not 0 = “Fault”	Read
14.1	Stream 1 Alarm, string based on value in App.15.24, 0 = “Normal”, Not 0 = “Fault”	Read
14.2	Stream 2 Alarm, string based on value in App.15.25, 0 = “Normal”, Not 0 = “Fault”	Read
14.3	Stream 3 Alarm, string based on value in app.15.26, 0 = “Normal”, Not 0 = “Fault”	Read
14.4	Stream 4 Alarm, string based on value in App.15.27, 0 = “Normal”, Not 0 = “Fault”	Read
14.5	Analyzer Mode, string based on value in App.1.59, 1 = “Hold”, 2 = “Run”, 3 = “SingleCycle”, 4 = “Abort”, 5 = “Calibrate”, 6 = “StartUp”.	Read
14.6	Helium Psi, string based on value in App.15.11, 0 = “Normal”, Not 0 = “Low”	Read
14.7	Cal Psi, string based on value in App.15.12, 0 = “Normal”, Not 0 = “Low”	Read

Therms Status Btu Integer Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
15.0	Set Next State(3061)	Read/Write
15.1	Auto Calibration during startup	Read/Write
15.2	Auto Peak Detection during startup	Read/Write
15.3	Auto Run after startup	Read/Write
15.4	Number of Calibration cycles	Read/Write
15.5	Number of Calibration cycles to Average	Read/Write
15.6	Low Carrier Mode.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
15.7	Low Power Mode.	Read/Write
15.8	Pre-Purge Selection.	Read/Write
15.9	Normal Status.	Read/Write
15.10	Fault Status.	Read/Write
15.11	Carrier Bottle Low.(3072	Read/Write
15.12	Calibration Bottle Low.(3073)	Read/Write
15.13	Manually Update Response Factors	Read/Write
15.14	Auto Update Response Factors Selection	Read/Write
15.15	Disable Stream Switching.	Read/Write
15.16	Transmitter Current Warning	Read/Write
15.17	Transmitter Current Fault.(3078)	Read/Write
15.18	Transmitter Initial Warning.	Read/Write
15.19	Transmitter Initial Fault	Read/Write
15.20	Stream 1 Current Warning	Read/Write
15.21	Stream 1 Current Warning	Read/Write
15.22	Stream 1 Current Warning	Read/Write
15.23	Stream 1 Current Warning	Read/Write
15.24	Stream 1 Current Fault(3085)	Read/Write
15.25	Stream 2 Current Fault(3086)	Read/Write
15.26	Stream 3 Current Fault.(3087)	Read/Write
15.27	Stream 4 Current Fault(3088).	Read/Write

Therms Status Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
16.0	Ground Ref. (7200)	Read/Write
16.1	Power- Battery Voltage (7201)	Read/Write
16.2	Mandrel Temp (7202)	Read/Write
16.3	Carrier Press. (7203)	Read/Write
16.4	Aux. Press. (7204)	Read/Write
16.5	AI-6 Spare (7205)	Read/Write
16.6	Ambient Temp(7206)	Read/Write
16.7	Voltage Ref. (7207)	Read/Write

Therms Slave Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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
251.23	BTU – Btu Stream Component.	Read/Write
251.24	GF – Btu Stream Component.	Read/Write
251.25	NEOC5 – Btu Stream Component.	Read/Write

Therms Slave Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Slave Stream 3 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Master Slave Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Master Slave Analysis Trend File

ARRAY.REGISTER	DESCRIPTION	TYPE
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
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Salve Application Registers (Rev AA)

Therms Slave Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
0.0	N2 – Btu Stream Component.	Read/Write
0.1	CO2 – Btu Stream Component.	Read/Write
0.2	H2S – Btu Stream Component.	Read/Write
0.3	H2O – Btu Stream Component.	Read/Write
0.4	HE – Btu Stream Component.	Read/Write
0.5	C1 – Btu Stream Component.	Read/Write
0.6	C2 – Btu Stream Component.	Read/Write
0.7	C3 – Btu Stream Component.	Read/Write
0.8	NC4 – Btu Stream Component.	Read/Write
0.9	IC4 – Btu Stream Component.	Read/Write
0.10	NC5 – Btu Stream Component.	Read/Write
0.11	IC5 – Btu Stream Component.	Read/Write
0.12	NC6 – Btu Stream Component.	Read/Write
0.13	NC7 – Btu Stream Component.	Read/Write
0.14	NC8 – Btu Stream Component.	Read/Write
0.15	NC9 – Btu Stream Component.	Read/Write
0.16	NC10 – Btu Stream Component.	Read/Write
0.17	O2 – Btu Stream Component.	Read/Write
0.18	CO – Btu Stream Component.	Read/Write
0.19	H2 – Btu Stream Component.	Read/Write
0.20	AR – Btu Stream Component.	Read/Write
0.21	AIR – Btu Stream Component.	Read/Write
0.22	C6PLUS – Btu Stream Component.	Read/Write
0.23	BTU – Btu Stream Component.	Read/Write
0.24	GF – Btu Stream Component.	Read/Write
0.25	SGF – Btu Stream Component.	Read/Write
0.26	CPCV – Btu Stream Component.	Read/Write
0.27	VISCOSITY – Btu Stream Component.	Read/Write
0.28	DENSITY – Btu Stream Component.	Read/Write
0.29	FT – Btu Stream Component.	Read/Write
0.30	FP – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
0.31	C7PLUS – Btu Stream Component.	Read/Write
0.32	C8PLUS – Btu Stream Component.	Read/Write
0.33	H2OCONTENT – Btu Stream Component.	Read/Write
0.34	H2OBIAS – Btu Stream Component.	Read/Write
0.35	EOAXMAP – Btu Stream Component.	Read/Write
0.36	NEOC5 – Btu Stream Component.	Read/Write
0.37	C3PRIME – Btu Stream Component.	Read/Write
0.38	C4PLUS – Btu Stream Component.	Read/Write
0.39	SATBTU – Btu Stream Component.	Read/Write
0.40	Z – Btu Stream Component.	Read/Write
0.41	WOBBE – Btu Stream Component.	Read/Write
0.42	STREAM NUMBER.	Read/Write
0.43	STREAM TIME.	Read/Write

Therms Slave String Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
1.0	String formatted stream time	Read

Therms Slave Stream 1 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Slave Stream 2 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Slave Stream 3 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
253.0	N2 – Btu Stream Component.	Read/Write
253.1	CO2 – Btu Stream Component.	Read/Write

ARRAY.REGISTER	DESCRIPTION	TYPE
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

Therms Slave Stream 4 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
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
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

ARRAY.REGISTER	DESCRIPTION	TYPE
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

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
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

I/O Subsystem

I/O Subsystem Data Array Registers

7.0.0 AI 32bit integer array

REGISTER	DESCRIPTION
7.0.0	AI 1Analog to Digital Converter counts minus its ground reference counts.
7.0.1	AI 2 Analog to Digital Converter counts minus its ground reference counts
7.0.2	AI 3 Analog to Digital Converter minus its ground reference
7.0.3	AI 4 Analog to Digital Converter minus its ground reference
7.0.4	AI 5 Analog to Digital Converter minus its ground reference
7.0.5	Charger Voltage Analog to Digital Converter minus its ground reference
7.0.6	Battery Voltage Analog to Digital Converter minus its ground reference
7.0.7	Ground reference ADC counts

7.1.0 AI 16bit integer array

REGISTER	DESCRIPTION
7.1.0	AI 1Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.
7.1.1	AI 2 Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.
7.1.2	AI 3 Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.
7.1.3	AI4 Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.
7.1.4	AI5 Calibration Bit Flags 0x0080=Factory, 0x0040=Field any thing else then in calibration sequence mode.

7.2.0 AI 8bit integer array

REGISTER	DESCRIPTION
7.2.0	AI 1 status flags
7.2.1	AI 2 status flags
7.2.2	AI 3 status flags
7.2.3	AI 4 status flags
7.2.4	AI 5 status flags
7.2.5	Charger Voltage status flags
7.2.6	Battery Voltage status flags
7.2.7	Ground reference status flags

7.3.0 AI 32bit floating-point array

REGISTER	DESCRIPTION
7.3.0	AI 1 scaled reading
7.3.1	AI 2 scaled reading
7.3.2	AI 3 and scaled to degrees Fahrenheit
7.3.3	AI 4 scaled reading
7.3.4	AI 5 scaled reading
7.3.5	Charger Voltage
7.3.6	Battery Voltage
7.3.7	Ground
7.3.8	AI 1 ADC count value for calibration 1 (lo)
7.3.9	AI 1 ADC count value for calibration 2
7.3.10	AI 1 ADC count value for calibration 3 (mid)
7.3.11	AI 1 ADC count value for calibration 4
7.3.12	AI 1 ADC count value for calibration 5 (hi)
7.3.13	AI 2 ADC count value for calibration 1 (lo)
7.3.14	AI 2 ADC count value for calibration 2
7.3.15	AI 2 ADC count value for calibration 3 (mid)
7.3.16	AI 2 ADC count value for calibration 4
7.3.17	AI 2 ADC count value for calibration 5 (hi)
7.3.18	AI 3 ADC count value for calibration 1 (lo)
7.3.19	AI 3 ADC count value for calibration 2
7.3.20	AI 3 ADC count value for calibration 3 (mid)
7.3.21	AI 3 ADC count value for calibration 4
7.3.22	AI 3 ADC count value for calibration 5 (hi)
7.3.23	AI 4 ADC count value for calibration 1 (lo)
7.3.24	AI 4 ADC count value for calibration 2
7.3.25	AI 4 ADC count value for calibration 3 (mid)
7.3.26	AI 4 ADC count value for calibration 4
7.3.27	AI 4 ADC count value for calibration 5 (hi)
7.3.28	AI 5 ADC count value for calibration 1 (lo)
7.3.29	AI 5 ADC count value for calibration 2
7.3.30	AI 5 ADC count value for calibration 3 (mid)
7.3.31	AI 5 ADC count value for calibration 4
7.3.32	AI 5 ADC count value for calibration 5 (hi)
7.3.33	AI 1 calibration curve fit segment 1 offset
7.3.34	AI 1 calibration curve fit segment 2 offset
7.3.35	AI 1 calibration curve fit segment 3 offset
7.3.36	AI 1 calibration curve fit segment 4 offset
7.3.37	AI 2 calibration curve fit segment 1 offset
7.3.38	AI 2 calibration curve fit segment 2 offset
7.3.39	AI 2 calibration curve fit segment 3 offset
7.3.40	AI 2 calibration curve fit segment 4 offset

REGISTER	DESCRIPTION
7.3.41	AI 3 calibration curve fit segment 1 offset
7.3.42	AI 3 calibration curve fit segment 2 offset
7.3.43	AI 3 calibration curve fit segment 3 offset
7.3.44	AI 3 calibration curve fit segment 4 offset
7.3.45	AI 4 calibration curve fit segment 1 offset
7.3.46	AI 4 calibration curve fit segment 2 offset
7.3.47	AI 4 calibration curve fit segment 3 offset
7.3.48	AI 4 calibration curve fit segment 4 offset
7.3.49	AI 5 calibration curve fit segment 1 offset
7.3.50	AI 5 calibration curve fit segment 2 offset
7.3.51	AI 5 calibration curve fit segment 3 offset
7.3.52	AI 5 calibration curve fit segment 4 offset
7.3.53	AI 1 calibration curve fit segment 1 span
7.3.54	AI 1 calibration curve fit segment 2 span
7.3.55	AI 1 calibration curve fit segment 3 span
7.3.56	AI 1 calibration curve fit segment 4 span
7.3.57	AI 2 calibration curve fit segment 1 span
7.3.58	AI 2 calibration curve fit segment 2 span
7.3.59	AI 2 calibration curve fit segment 3 span
7.3.60	AI 2 calibration curve fit segment 4 span
7.3.61	AI 3 calibration curve fit segment 1 span
7.3.62	AI 3 calibration curve fit segment 2 span
7.3.63	AI 3 calibration curve fit segment 3 span
7.3.64	AI 3 calibration curve fit segment 4 span
7.3.65	AI 4 calibration curve fit segment 1 span
7.3.66	AI 4 calibration curve fit segment 2 span
7.3.67	AI 4 calibration curve fit segment 3 span
7.3.68	AI 4 calibration curve fit segment 4 span
7.3.69	AI 5 calibration curve fit segment 1 span
7.3.70	AI 5 calibration curve fit segment 2 span
7.3.71	AI 5 calibration curve fit segment 3 span
7.3.72	AI 5 calibration curve fit segment 4 span

7.4.0 AI structure array

This array returns an "AISTRUCT" structure consisting of a floating-point value and a 16bit integer status. Only through internal use, data export function only report the first data member that is the floating-point array equivalent. The Tube applications need this array to perform all of its event, and error detection. Reading the same index form the 3 & 2 arrays can generate the combined data.

REGISTER	DESCRIPTION
7.4.0	AI 1
7.4.1	AI 2
7.4.2	AI 3
7.4.3	AI 4
7.4.4	AI 5
7.4.5	Charger
7.4.6	Battery
7.4.7	Ground

7.5.0 AI floating-point Calibration Array

REGISTER	DESCRIPTION
7.5.0	AI 1 Zero Transducer write user value
7.5.1	AI 1 00% low calibration point write user value
7.5.2	AI 1 25% calibration point write user value
7.5.3	AI 1 50% calibration point write user value
7.5.4	AI 1 75% calibration point write user value
7.5.5	AI 1 100% calibration point write user value
7.5.6	AI 1 Bias write user value
7.5.7	Reserved
7.5.8	Reserved
7.5.9	Reserved
7.5.10	Reserved
7.5.11	Reserved
7.5.12	Reserved
7.5.13	Reserved
7.5.14	Reserved
7.5.15	AI 1 Finish and start using new calibration
7.5.16	AI 2 Zero Transducer write user value
7.5.17	AI 2 00% low calibration point write user value
7.5.18	AI 2 25% calibration point write user value
7.5.19	AI 2 50% calibration point write user value
7.5.20	AI 2 75% calibration point write user value
7.5.21	AI 2 100% calibration point write user value
7.5.22	AI 2 Bias write user value

REGISTER	DESCRIPTION
7.5.23	Reserved
7.5.24	Reserved
7.5.25	Reserved
7.5.26	Reserved
7.5.27	Reserved
7.5.28	Reserved
7.5.29	Reserved
7.5.30	Reserved
7.5.31	AI 2 Finish and start using new calibration
7.5.32	Reserved
7.5.33	Reserved
7.5.34	Reserved
7.5.35	Reserved
7.5.36	Reserved
7.5.37	Reserved
7.5.38	RTD Bias write user value
7.5.39	Reserved
7.5.40	Reserved
7.5.41	Reserved
7.5.42	Reserved
7.5.43	Reserved
7.5.44	Reserved
7.5.45	Reserved
7.5.46	Reserved
7.5.47	Reserved
7.5.48	AI 3 Zero transducer
7.5.49	AI 3 00% calibration point write user value
7.5.50	AI 3 25% calibration point write user value
7.5.51	AI 3 50% calibration point write user value
7.5.52	AI 3 75% calibration point write user value
7.5.53	AI 3 100% calibration point write user value
7.5.54	AI 3 Bias write user value
7.5.55	Reserved
7.5.56	Reserved
7.5.57	Reserved
7.5.58	Reserved
7.5.59	Reserved
7.5.60	Reserved
7.5.61	Reserved
7.5.62	Reserved
7.5.63	AI 3 Finish and start using new calibration
7.5.64	AI 4 Zero transducer

REGISTER	DESCRIPTION
7.5.65	AI 4 00% calibration point write user value
7.5.66	AI 4 25% calibration point write user value
7.5.67	AI 4 50% calibration point write user value
7.5.68	AI 4 75% calibration point write user value
7.5.69	AI 4 100% calibration point write user value
7.5.70	AI 4 Bias write user value
7.5.71	Reserved
7.5.72	Reserved
7.5.73	Reserved
7.5.74	Reserved
7.5.75	Reserved
7.5.76	Reserved
7.5.77	Reserved
7.5.78	Reserved
7.5.79	AI 4 Finish and start using new calibration
7.5.80	AI 5 Zero transducer
7.5.81	AI 5 00% calibration point write user value
7.5.82	AI 5 25% calibration point write user value
7.5.83	AI 5 50% calibration point write user value
7.5.84	AI 5 75% calibration point write user value
7.5.85	AI 5 100% calibration point write user value
7.5.86	AI 5 Bias write user value
7.5.87	Reserved
7.5.88	Reserved
7.5.89	Reserved
7.5.90	Reserved
7.5.91	Reserved
7.5.92	Reserved
7.5.93	Reserved
7.5.94	Reserved
7.5.95	AI 5 Finish and start using new calibration

7.2.4096 DI bit array

REGISTER	DESCRIPTION
7.2.4096	DI 1 current state
7.2.4097	DI 2 current state
7.2.4098	DI 3 current state
7.2.4099	DI 4 current state
7.2.4100	Security switch
7.2.4101	MMI connection
7.2.4102	Low lithium power status

7.2.8192 DO bit array

REGISTER	DESCRIPTION
7.2.8192	DO 1 active closed value=1
7.2.8193	DO 2 active closed value=1
7.2.8194	DO 3 active closed value=1
7.2.8195	DO 4 active closed value=1
7.2.8196	DO 1 set state and returns the prior state
7.2.8197	DO 2 set state and returns the prior state
7.28198	DO 3 set state and returns the prior state
7.2.8199	DO 4 set state and returns the prior state
7.2.8200	Switch Battery Voltage 1
7.2.8201	Switch Battery Voltage 2
7.2.8202	Communication module 1 enable
7.2.8203	Communication module 2 enable
7.2.8204	LDC power
7.2.8205	I2C power supply module control
7.2.8206	Auxiliary Power control

7.0.12288 through 12293 PI 32bit unsigned integer Array

REGISTER	DESCRIPTION
7.0.12288	PI 1 number of High to Low transitions occurring in the last second
7.0.12289	PI 2 number of High to Low transitions occurring in the last second
7.0.12290	PI 1 previous second value
7.0.12291	PI 2 previous second value
7.0.12292	PI 1 total transition counter since start
7.0.12293	PI 2 total transition counter since start

THE DISCOVERY ARRAYS

There are three arrays used to get general information about the IO hardware installed on the X-Series devices. The dynamic and flexible IO design makes it necessary to provide a mechanism for system configuration programs like PCCU32 to identify the exact hardware types and numbers installed.

The IO subsystem application array 255 provides the method of identifying the index range along with a list of hardware modules found to be installed at the time the XRC system was started.

The IO subsystem application array 254 provides PCCU32 with information that identifies the configuration file part number and revision to use to build the entry mode screen.

The IO subsystem application array 253 provides the firmware part number and version for the individual IO modules installed.

For an example on how to use these arrays pick a XRC configuration that has two I2C modules installed and list the actual discovery register access need to obtain its unique configuration.

Index	255 array	254 array	253 array	Comments
16	0x0005	???	???	# Modules installed
17	0x0000	2100772-001	2100772-001	Onboard AI's
18	0x0001	2100772-001	2100772-001	Onboard DI's
19	0x0002	2100772-001	2100772-001	Onboard DO's
20	0x0003	2100772-001	2100772-001	Onboard PI's
21	0x0400	2100773-001	2100563-006AG	I2C Digital Module
22	0x0500	2100774-001	2100715-004AE	I2C AO Module
23	0xffff	???	???	Not defined

7.255.16 through 132 Hardware Installed

7.255.16 Returns the number of Hardware drivers installed (onboard + I2C off-board).

7.255.17 7.255.N+16 Returns an encoded 16bit value. Bits 15-8 is the hardware group type number, bits 7-0 is its instance type. The following table shows the possible values that can be returned from this array, the array sequence is from the top of the table to the bottom skipping the values that are not connected.

Table A–1 Discovery information for hardware drivers installed.

Unique Code	Description
0x0000-0x0003	Onboard AMU AI's, DIs, DOs, Pis
0x0100-0x0107	Reserved I2C address 0x10-0x1F
0x0200-0x0207	Reserved I2C address 0x20-0x2F
0x0300-0x0307	Reserved I2C address 0x30-0x3F
0x0400-0x0407	I2C TFIO 8/COMBO DIGITAL MODULE address 0x40-0x4F
0x0500-0x0507	I2C TFIO 4/AO (4-20MA) address 0x50-0x5F
0x0600-0x0607	Reserved I2C address 0x60-0x6F
0x0700-0x0707	I2C TFIO 8/AI (TYPE II) address 0x70-0x7F
0x0800-0x0807	I2C TFIO 4/Thermocouple/RTD Module address 0x80-0x8F
0x0900-0x0907	Reserved I2C address 0x90-0x9F
0x0A00-0x0A07	Reserved I2C address 0xA0-0xAF
0x0B00-0x0B07	Reserved I2C address 0xB0-0xBF
0x0C00-0x0C07	I2C TFIO COMBO IO/VC INTF address 0xC0-0xCF
0x0D00-0x0D07	Reserved I2C address 0xD0-0xDF
0x0E00-0x0E07	Reserved I2C address 0xE0-0xEF
0xFFFF	Indexed past end of array

7.254.17 through 132 Ini Partnumbers for Hardware Installed

7.254.17 7.254.N+16 (where N='s the value returned from 7.255.16.) This array returns a string identifying to PCCU32 the entry mode configuration files part number and revision. The following table show the possible can be returned from this array.

Table A–2 Discovery PCU32 Ini Partnumbers.

255 array Result	254 array Result
0x0000-0x0003	2100772-001
0x0100-0x0107	Reserved I2C address 0x10-0x1F
0x0200-0x0207	Reserved I2C address 0x20-0x2F
0x0300-0x0307	Reserved I2C address 0x30-0x3F
0x0400-0x0407	2100773-001
0x0500-0x0507	2100774-001
0x0600-0x0607	Reserved I2C address 0x60-0x6F
0x0700-0x0707	2100775-001
0x0800-0x0807	2100998-001
0x0900-0x0907	Reserved I2C address 0x90-0x9F
0x0A00-0x0A07	Reserved I2C address 0xA0-0xAF
0x0B00-0x0B07	Reserved I2C address 0xB0-0xBF
0x0C00-0x0C07	2100776-001
0x0D00-0x0D07	Reserved I2C address 0xD0-0xDF
0x0E00-0x0E07	Reserved I2C address 0xE0-0xEF
0xFFFF	Indexed past end of array

7.253.17 through 132 IO Modules Firmware–Revision

7.253.17 7.253.N+16 (where N='s the value returned from 7.255.16.) This array returns a string identifying the firmware and revision for installed IO modules. The following table show the possible can be returned from this array.

Table A–3 Discover Firmware number and revision of IO modules.

255 array Returned	253 array Returned
0x0000-0x0003	2100772-001
0x0100-0x0107	Reserved I2C address 0x10-0x1F
0x0200-0x0207	Reserved I2C address 0x20-0x2F
0x0300-0x0307	Reserved I2C address 0x30-0x3F
0x0400-0x0407	2100563-006AG
0x0500-0x0507	2100715-004AE
0x0600-0x0607	Reserved I2C address 0x60-0x6F
0x0700-0x0707	2100575-003AC
0x0800-0x0807	2101024-001 or 2101027-001
0x0900-0x0907	Reserved I2C address 0x90-0x9F
0x0A00-0x0A07	Reserved I2C address 0xA0-0xAF
0x0B00-0x0B07	Reserved I2C address 0xB0-0xBF
0x0C00-0x0C07	2100576-005AF
0x0D00-0x0D07	Reserved I2C address 0xD0-0xDF
0x0E00-0x0E07	Reserved I2C address 0xE0-0xEF
0xFFFF	Indexed past end of array

Tube Applications

AGA3 Tube Application Registers (Rev AM)

Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
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	1
0.7	AGA-3 1992 Static Select Bits	Read/Write	2
0.8	AGA-3 1992 Dynamic Select Bits	Read/Write	3
0.9	Volume Calc Type	Read/Write	4
0.10	Calc Units	Read Only	
0.11	Report Units	Read Only	
0.12	Super Compressibility Method	Read/Write	5
0.13	Use Square Root Average flag	Read/Write	
0.14	Characteristic Record Type	Read/Write	6
0.15	Use Fixed H2O	Read/Write, for Fw calculation	
0.16	Gravity Config flags	Read/Write, live analysis configuration	7
0.17	BTU Config flags	Read/Write, live analysis configuration	7
0.18	Nitrogen Config flags	Read/Write, live analysis configuration	7
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration	7
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration	7
0.21	Water Config flags	Read/Write, live analysis configuration	7
0.22	Helium Config flags	Read/Write, live analysis configuration	7
0.23	Methane Config flags	Read/Write, live analysis configuration	7
0.24	Ethane Config flags	Read/Write, live analysis configuration	7
0.25	Propane Config flags	Read/Write, live analysis configuration	7
0.26	Normal Butane Config flags	Read/Write, live analysis configuration	7
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration	7

0.28	Normal Pentane Config flags	Read/Write, live analysis configuration	7
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration	7
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration	7
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration	7
0.32	Normal Octane Config flags	Read/Write, live analysis configuration	7
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration	7
0.34	Normal Decane Config flags	Read/Write, live analysis configuration	7
0.35	Oxygen Config flags	Read/Write, live analysis configuration	7
0.36	Carbon Monoxide Config flags	Read/Write, live analysis configuration	7
0.37	Hydrogen Config flags	Read/Write, live analysis configuration	7
0.38	Argon Config flags	Read/Write, live analysis configuration	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	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	9
0.53	Aux Contact 2 select bits low byte	Read/Write	9
0.54	Hold tube analog inputs	Read/Write	
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge	
0.56	Number of samples before AD Fail Set or Released	For Internal Use Only	
0.57	Current number of consecutive bad AD readings	For Internal Use Only	
0.58	Vol period Complete flag	Read/Write	10
0.59	Log period Complete flag	Read/Write	11
0.60	Day period Complete flag	Read/Write	12

0.61	tubeCheckPoint control	Read/Write	14
0.62	Canadian Event Log Inhibit Flag	Read Only	15
0.63	Stop Logging Events	Read Only	16
0.64	Log in Gage Pressure	Read/Write	17
0.65	Log DP Check	Write Only	18
0.66	Reserved for Selectable Units	Read/Write	19
0.67	Reserved for Selectable Units	Read/Write	19/20
0.68	Reserved for Selectable Units	Read/Write	19

Tube Byte Register Usage Notes:

1. Used for 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. Used only for 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. Used only for 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.

10. The flag is used in testing the XRC. The flag will be set to a “1” when a volume calculation and all operations associated with it are complete. Typically a test sets the flag to “0”. Then does something to cause a calculation. It then waits until the flag is “1” to evaluate the results of the test.

11. The flag is used in testing the XRC. The flag will be set to a “1” when all operations associated a log period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.

12. The flag is used in testing the XRC. The flag will be set to a “1” when all operations associated a day period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.

13. 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 */
```

14. This is for internal use only. A logic 1 disables tube cold and warm start functions.

15. When this flag is 1 no events are allowed and no parameter changes are allowed from any protocol.

16. When this flag is 1 no events are allowed and no parameter changes are allowed.

17. When this bit is logic 1 and the transducer is a gage transducer pressure logging in Log and Day records is done Gage Pressure. The log gage pressure is computed by subtracting the barometric pressure from the average of the input pressure over the log/day period.

18. With pressure applied to SP.

19. Used only with Selectable Units.

20. Gas orifice only.

Tube 16-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	Note
1.0	Primary Element Mask	Read Only, indicates primary element type	1
1.1	Calc Method Mask	Read Only, indicates calculation methods supported	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.	3
1.5	Live Analysis Update Interval	Read/Write, live analysis updates are expected in this interval, expressed in	

ARRAY.REGISTER	DESCRIPTION	USAGE	Note
		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	4
1.11	Aux Contact 2 Select Bits	Read/Write, control bits	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	5
1.20	AP Status Flags	Read Only	6
1.21	TF Status Flags	Read Only	7
1.22	PI Status Flags	Read Only	8
1.23	Ext Status Flags	Read Only	9

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.

Tube 32-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
2.0	Log period, Seconds	Read/Write	
2.1	Julian timestamp of most recent AIU download	Read/Write	1
2.2	Julian timestamp of most recent live component update (not aiu)	Read/Write	1
2.3	Julian timestamp of prev day period	Read Only	1
2.4	Total Slip Seconds	Read Only	
2.5	Last Slip Seconds Time	Read Only	

Note: Julian time is number of seconds since midnight, 1/1/1970.

Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	FORMAT	USAGE	NOTE
3.0	Current AP / cal checks	PSI	Read/Write	1
3.1	AP High Limit	PSI	Read/Write	1
3.2	AP Low Limit	PSI	Read/Write	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	2
3.8	Flow Rate Low Limit		Read/Write	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	
3.13	Zba		Read/Write	
3.14	Orifice coef of expansion	In/Deg F	Read/Write	
3.15	Pipe coef of expansion	In/Deg F	Read/Write	
3.16	Barometric Pressure	PSIA	Read/Write	
3.17	F(t) for Fpv NX19		Read/Write	
3.18	F(p) for Fpv NX19		Read/Write	
3.19	Fixed Analysis BTU	BTU/SCF	Read/Write	
3.20	Fixed Analysis Gravity		Read/Write	
3.21	Fixed Analysis Nitrogen	Mole %	Read/Write	
3.22	Fixed Analysis Carbon Dioxide	Mole %	Read/Write	
3.23	Fixed Analysis Hydrogen Sulfide	Mole %	Read/Write	

ARRAY.REGISTER	DESCRIPTION	FORMAT	USAGE	NOTE
3.24	Fixed Analysis Water	Mole %	Read/Write	
3.25	Fixed Analysis Helium	Mole %	Read/Write	
3.26	Fixed Analysis Methane	Mole %	Read/Write	
3.27	Fixed Analysis Ethane	Mole %	Read/Write	
3.28	Fixed Analysis Propane	Mole %	Read/Write	
3.29	Fixed Analysis Normal Butane	Mole %	Read/Write	
3.30	Fixed Analysis Iso-Butane	Mole %	Read/Write	
3.31	Fixed Analysis Normal Pentane	Mole %	Read/Write	
3.32	Fixed Analysis Iso-Pentane	Mole %	Read/Write	
3.33	Fixed Analysis Normal Hexane	Mole %	Read/Write	
3.34	Fixed Analysis Normal Heptane	Mole %	Read/Write	
3.35	Fixed Analysis Normal Octane	Mole %	Read/Write	
3.36	Fixed Analysis Normal Nonane	Mole %	Read/Write	
3.37	Fixed Analysis Normal Decane	Mole %	Read/Write	
3.38	Fixed Analysis Oxygen	Mole %	Read/Write	
3.39	Fixed Analysis Carbon Monoxide	Mole %	Read/Write	
3.40	Fixed Analysis Hydrogen	Mole %	Read/Write	
3.41	Fixed Analysis Argon	Mole %	Read/Write	
3.42	Fixed H2O Content	Ppm	Read/Write	
3.43	Fixed H2O Bias	Ppm	Read/Write	
3.44	Live Analysis Gravity Accumulator		Read/Write	
3.45	Live Analysis BTU Accumulator	Btu/SCF	Read/Write	
3.46	Live Analysis Nitrogen Accumulator	Mole %	Read/Write	
3.47	Live Analysis Carbon Dioxide Accumulator	Mole %	Read/Write	
3.48	Live Analysis Hydrogen Sulfide Accumulator	Mole %	Read/Write	
3.49	Live Analysis Water Accumulator	Mole %	Read/Write	
3.50	Live Analysis Helium Accumulator	Mole %	Read/Write	
3.51	Live Analysis Methane Accumulator	Mole %	Read/Write	
3.52	Live Analysis Ethane Accumulator	Mole %	Read/Write	
3.53	Live Analysis Propane Accumulator	Mole %	Read/Write	
3.54	Live Analysis Normal Butane Accumulator	Mole %	Read/Write	
3.55	Live Analysis Iso-Butane Accumulator	Mole %	Read/Write	
3.56	Live Analysis Normal Pentane Accumulator	Mole %	Read/Write	
3.57	Live Analysis Iso-Pentane Accumulator	Mole %	Read/Write	
3.58	Live Analysis Normal Hexane Accumulator	Mole %	Read/Write	
3.59	Live Analysis Normal Heptane Accumulator	Mole %	Read/Write	
3.60	Live Analysis Normal Octane Accumulator	Mole %	Read/Write	
3.61	Live Analysis Normal Nonane Accumulator	Mole %	Read/Write	

ARRAY.REGISTER	DESCRIPTION	FORMAT	USAGE	NOTE
3.62	Live Analysis Normal Decane Accumulator	Mole %	Read/Write	
3.63	Live Analysis Oxygen Accumulator	Mole %	Read/Write	
3.64	Live Analysis Carbon Monoxide Accumulator	Mole %	Read/Write	
3.65	Live Analysis Hydrogen Accumulator	Mole %	Read/Write	
3.66	Live Analysis Argon Accumulator	Mole %	Read/Write	
3.67	Log Site Code in Event Log			
3.68	Valve Control Accumulated Volume	MCF	Read/Write	
3.69	Aux Contact 1 Volume Setpoint	MCF	Read/Write	
3.70	Aux Contact 2 Volume Setpoint	MCF	Read/Write	
3.71	Last calc period Nitrogen	Mole %	Read/Write	
3.72	Last calc period CO2	Mole %	Read/Write	
3.73	Last calc period H2S	Mole %	Read/Write	
3.74	Last calc period H2O	Mole %	Read/Write	
3.75	Last calc period HE	Mole %	Read/Write	
3.76	Last calc period C1	Mole %	Read/Write	
3.77	Last calc period C2	Mole %	Read/Write	
3.78	Last calc period C3	Mole %	Read/Write	
3.79	Last calc period NC4	Mole %	Read/Write	
3.80	Last calc period IC4	Mole %	Read/Write	
3.81	Last calc period NC5	Mole %	Read/Write	
3.82	Last calc period IC5	Mole %	Read/Write	
3.83	Last calc period NC6	Mole %	Read/Write	
3.84	Last calc period NC7	Mole %	Read/Write	
3.85	Last calc period NC8	Mole %	Read/Write	
3.86	Last calc period NC9	Mole %	Read/Write	
3.87	Last calc period NC10	Mole %	Read/Write	
3.88	Last calc period O2	Mole %	Read/Write	
3.89	Last calc period CO	Mole %	Read/Write	
3.90	Last calc period H2	Mole %	Read/Write	
3.91	Last calc period AR	Mole %	Read/Write	
3.92	Last calc period AIR	Mole %	Read/Write	
3.93	Last calc period C6PLUS	Mole %	Read/Write	
3.94	Last calc period BTU	Btu/SCF	Read/Write	
3.95	Last calc period GRAVITY		Read Only	
3.96	current contract day accumulated energy	MBTU	Read Only	
3.97	yesterdays contract day accumulated energy	MBTU	Read Only	
3.98	Current Energy rate	MBTU	Read Only	
3.99	Month Accum Volume	MCF	Read Only	
3.100	Month Accum Volume, Not Reset by Reset Vol	MCF	Read Only	

ARRAY.REGISTER	DESCRIPTION	FORMAT	USAGE	NOTE
3.101	Month Accum Energy	MMBTU	Read Only	
3.102	Month Accum Energy, Not Reset by Reset Vol	MMBUT	Read Only	
3.103	Fixed Ap		Read/Write	
3.104	Current Flow Rate		Read Only	
3.105	Previous Month Accumulated Volume		Read Only	
3.106	Previous Month Accumulated Volume not affected by reset volume command		Read Only	
3.107	Previous Month Energy		Read Only	
3.108	Previous Month Energy not affected by reset volume command		Read Only	
3.109	Reserved for Selectable Units		Read/Write	
3.110	Reserved for Selectable Units		Read/Write	
3.111	Reserved for Selectable Units		Read/Write	
3.112	Reserved for Selectable Units		Read/Write	
3.113	Reserved for Selectable Units		Read/Write	
3.114	Reserved for Selectable Units		Read/Write	

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.

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	TYPE
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

Tube String Registers

ARRAY.REGISTER	DESCRIPTION	TYPE
5.0	Tube ID	Read/Write
5.1	Tube last analyis time	Read Only
5.2	Tube Description	Read/Write

Tube Last Calculation Period Analysis Registers, Floating Point, Read Only

ARRAY.REGISTER	DESCRIPTION	FORMAT	TYPE
10.0	Last Calc Nitrogen	Mole %	Read Only
10.1	Last Calc Carbon Dioxide	Mole %	Read Only
10.2	Last Calc Hydrogen Sulfide	Mole %	Read Only
10.3	Last Calc Water	Mole %	Read Only
10.4	Last Calc Helium	Mole %	Read Only
10.5	Last Calc Methane	Mole %	Read Only
10.6	Last Calc Ethane	Mole %	Read Only
10.7	Last Calc Propane	Mole %	Read Only
10.8	Last Calc Normal Butane	Mole %	Read Only
10.9	Last Calc Iso-Butane	Mole %	Read Only
10.10	Last Calc Normal Pentane	Mole %	Read Only
10.11	Last Calc Iso-Pentane	Mole %	Read Only
10.12	Last Calc Normal Hexane	Mole %	Read Only
10.13	Last Calc Normal Heptane	Mole %	Read Only
10.14	Last Calc Normal Octane	Mole %	Read Only
10.15	Last Calc Normal Nonane	Mole %	Read Only
10.16	Last Calc Normal Decane	Mole %	Read Only
10.17	Last Calc Oxygen	Mole %	Read Only
10.18	Last Calc Carbon Monoxide	Mole %	Read Only
10.19	Last Calc Hydrogen	Mole %	Read Only
10.20	Last Calc Argon	Mole %	Read Only
10.21	Last Calc Air	Mole %	Read Only
10.22	Last Calc Heavy Hydrocarbons	Mole %	Read Only
10.23	Last Calc Heat Content	Btu/SCF	Read Only
10.24	Last Calc Specific Gravity		Read Only

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. 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.

Tube Log Period Registers

ARRAY	DESCRIPTION	USAGE	NOTE
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	1
250	Log Period Record		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   - 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;
```

Tube Daily Registers

ARRAY	DESCRIPTION	USAGE	NOTE
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	1
251	Daily Record		2

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;
```

Tube Event Registers

ARRAY	DESCRIPTION	USAGE	NOTE
252	Event Log Record		1

Note: 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;
```

AGA-3 Tube Registers

The following register tables describe registers unique to AGA-3 measurement tubes.

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
6.0	1985 Static Factor Select Bits	Read/Write	1
6.1	Misc Select Bits	Read/Write	2
6.2	Vol - Flow Rate unit selection for volume	Read/Write	3
6.3	Vol - Flow Rate unit selection for flow rate	Read/Write	4
6.4	Auto Fb Calc	Read/Write	5

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 */

3. Vol - Flow Rate unit selection for volume

    0 = MCF
    1 = MMCF

4. 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.

5. For AGA-3 1985

AGA-3 Float Registers

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
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	

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
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	
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	1
7.20	Last Vol Period volume scaled per chkmcf	Read Only	1
7.21	Accumulated Volume scaled per chkmcf	Read Only	1
7.22	Today's contract day volume scaled per chkmcf	Read Only	1
7.23	Yesterday's contract day volume scaled per chkmcf	Read Only	1
7.24	Flow Rate Hi limit scaled per chkmcf	Read Only	1
7.25	Flow Rate Lo limit scaled per chkmcf	Read Only	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), AGA3-1985	Read Only	

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
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	

Note: These vary based on Vol - Flow Rate unit selection. See 0.42.

AGA-3 String Registers

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
8.0	Rate Unit String		1
8.1	Volume Unit String starting at MCF		1
8.2	Volume Unit String starting at SCF		1

Note: These vary based on Vol - Flow Rate unit selection. See 0.42.

AGA3 Int32 Registers

ARRAY.REGISTER	DESCRIPTION	TYPE	NOTE
9.0	Tube Current Alarm Bits	Read Only	1

Note: 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

AGA7 Tube Application Registers (Rev AH)

Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
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	1
0.13	Use Square Root Average flag	Read/Write	
0.14	Characteristic Record Type	Read/Write	2
0.15	Use Fixed H2O	Read/Write, for Fw calculation	
0.16	Gravity Config flags	Read/Write, live analysis configuration	3
0.17	BTU Config flags	Read/Write, live analysis configuration	3
0.18	Nitrogen Config flags	Read/Write, live analysis configuration	3
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration	3
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration	3
0.21	Water Config flags	Read/Write, live analysis configuration	3
0.22	Helium Config flags	Read/Write, live analysis configuration	3
0.23	Methane Config flags	Read/Write, live analysis configuration	3
0.24	Ethane Config flags	Read/Write, live analysis configuration	3

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
0.25	Propane Config flags	Read/Write, live analysis configuration	3
0.26	Normal Butane Config flags	Read/Write, live analysis configuration	3
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration	3
0.28	Normal Pentane Config flags	Read/Write, live analysis configuration	3
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration	3
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration	3
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration	3
0.32	Normal Octane Config flags	Read/Write, live analysis configuration	3
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration	3
0.34	Normal Decane Config flags	Read/Write, live analysis configuration	3
0.35	Oxygen Config flags	Read/Write, live analysis configuration	3
0.36	Carbon Monoxide Config flags	Read/Write, live analysis configuration	3
0.37	Hydrogen Config flags	Read/Write, live analysis configuration	3
0.38	Argon Config flags	Read/Write, live analysis configuration	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	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	5
0.53	Aux Contact 2 select bits low byte	Read/Write	5
0.54	Hold tube analog inputs	Read/Write	
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge	

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
0.56	Number of samples before AD Fail Set or Released	For Internal Use Only	
0.57	Current number of consecutive bad AD readings	For Internal Use Only	
0.58	Vol period Complete flag	Read/Write	6
0.59	Log period Complete flag	Read/Write	7
0.60	Day period Complete flag	Read/Write	8
0.61	tubeCheckPoint control	Read/Write	9
0.62	Canadian Event Log Inhibit Flag	Read Only	10
0.63	Stop Logging Events	Read Only	11
0.64	Log in Gage Pressure	Read/Write	12
0.65	Log DP Check	Read/Write	13
0.66	Reserved for Selectable Units	Read/Write	14
0.67	Reserved for Selectable Units	Read/Write	14 & 15
0.68	Reserved for Selectable Units	Read/Write	14

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 –

   Bits 0-1 rates times

   0 = /hour, 1 = /day, 2 = N/A, 3 = N/A

   Bits 2-4 corrected volume, rate quantity units

   0 = scf, 4 = dscf, 8 = cscf, 12 = mscf

   16 = dmscf, 20 = cmscf, 28 = mmscf

   Bits 5-7 uncorrected volume, rate quantity units

   0 = acf, 32 = dacf, 64 = cacf, 96 = macf,

   128 = dmacf, 160 = cmacf, 224 = mmacf
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.
6. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when a volume calculation and all operations associated with it are complete. Typically a test sets the flag to “0”. Then does something to cause a calculation. It then waits until the flag is “1” to evaluate the results of the test.

7. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when all operations associated a log period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.
8. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when all operations associated a day period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.
9. This is for internal use only. A logic 1 disables tube cold and warm start functions.
10. When this flag is 1 no events are allowed and no parameter changes are allowed from any protocol.
11. When this flag is 1 no events are allowed and no parameter changes are allowed.
12. When this bit is logic 1 and the transducer is a gage transducer pressure logging in Log and Day records is done Gage Pressure. The log gage pressure is computed by subtracting the barometric pressure from the average of the input pressure over the log/day period.
13. With pressure applied to SP.
14. Used only with Selectable Units.
15. Gas orifice only.

Tube 16-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
1.0	Primary Element Mask	Read Only, indicates primary element type	1
1.1	Calc Method Mask	Read Only, indicates calculation methods supported	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.	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	4
1.11	Aux Contact 2 Select Bits	Read/Write, control bits	4

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
1.12	Return number of events available	Write, Canadian Event Log	
1.13	Therms Stream Id	Read/Write Analysis 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	5
1.20	AP Status Flags	Read Only	6
1.21	TF Status Flags	Read Only	7
1.22	PI Status Flags	Read Only	8
1.23	Ext Status Flags	Read Only	9

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. 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.

Tube 32-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
2.0	Log period	Read/Write, seconds	
2.1	Julian timestamp of most recent AIU download	Read/Write	1
2.2	Julian timestamp of most recent live component update (not aiu)	Read/Write	1
2.3	Julian timestamp of prev day period	Read Only	1

Note: Julian time is number of seconds since midnight, 1/1/1970.

Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
3.0	Current AP / cal checks	Read/Write, psi	1
3.1	AP High Limit	Read/Write, psi	1
3.2	AP Low Limit	Read/Write, psi	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	2
3.8	Flow Rate Low Limit	Read/Write	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	
3.13	Zba	Read/Write	
3.14	Orifice 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 %	

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
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 %	
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	Last calc period Nitrogen	Read Only, mole %	
3.72	Last calc period CO2	Read Only, mole %	
3.73	Last calc period H2S	Read Only, mole %	
3.74	Last calc period H2O	Read Only, mole %	
3.75	Last calc period HE	Read Only, mole %	

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
3.76	Last calc period C1	Read Only, mole %	
3.77	Last calc period C2	Read Only, mole %	
3.78	Last calc period C3	Read Only, mole %	
3.79	Last calc period NC4	Read Only, mole %	
3.80	Last calc period IC4	Read Only, mole %	
3.81	Last calc period NC5	Read Only, mole %	
3.82	Last calc period IC5	Read Only, mole %	
3.83	Last calc period NC6	Read Only, mole %	
3.84	Last calc period NC7	Read Only, mole %	
3.85	Last calc period NC8	Read Only, mole %	
3.86	Last calc period NC9	Read Only, mole %	
3.87	Last calc period NC10	Read Only, mole %	
3.88	Last calc period O2	Read Only, mole %	
3.89	Last calc period CO	Read Only, mole %	
3.90	Last calc period H2	Read Only, mole %	
3.91	Last calc period AR	Read Only, mole %	
3.92	Last calc period AIR	Read Only, mole %	
3.93	Last calc period C6PLUS	Read Only, mole %	
3.94	Last calc period BTU	Read Only, BTU/SCF	
3.95	Last calc period GRAVITY	Read Only	
3.96	current contract day accumulated energy	Read Only, MBTU	
3.97	yesterdays contract day accumulated energy	Read Only, MBTU	
3.98	Current Energy rate	Read Only MBTU/HR	
3.99	Month Accum Volume	Read Only, MCF	
3.100	Month Accum Volume, Not Reset by Reset Vol	Read Only, MCF	
3.101	Month Accum Energy	Read Only, MMBTU	
3.102	Month Accum Energy, Not Reset by Reset Vol	Read Only, MMBTU	
3.103	Fixed Ap	Read / Write	
3.104	Current Flow Rate	Read Only	
3.105	Previous Month Accumulated Volume	Read Only	
3.106	Previous Month Accumulated Volume not affected by reset volume command	Read Only	
3.107	Previous Month Energy	Read Only	
3.108	Previous Month Energy not affected by reset volume command	Read Only	
3.109	Reserved for Selectable Units	Read/Write	
3.110	Reserved for Selectable Units	Read/Write	
3.111	Reserved for Selectable Units	Read/Write	
3.112	Reserved for Selectable Units	Read/Write	
3.113	Reserved for Selectable Units	Read/Write	

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
3.114	Reserved for Selectable Units	Read/Write	

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.

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	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
4.8	AC 2 DI Register	Read/Write

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

Tube Last Calculation Period Analysis Registers, Floating Point, Read Only

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 %

ARRAY.REGISTER	DESCRIPTION	USAGE
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
10.24	Last Calc Specific Gravity	Read Only

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.

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)

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. 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;
```

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

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;
```

Tube Event Registers

ARRAY	DESCRIPTION	USAGE
252	Event Log Record	See note 1)

Tube Event Registers Usage Notes:

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;
```

AGA-7 Tube Registers

The following register tables describe registers unique to AGA-7 measurement tubes.

AGA-7 Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
6.0	AGA-7 Factor Select Bits	Read/Write	1
6.1	Misc Select Bits	Read/Write	2
6.2	Units scale selection for uncorrected vol units	Read/Write	3
6.3	Units scale selection for corrected volume units	Read/Write	4
6.4	Units scale selection for flow rate units	Read/Write	5
6.5	AGA7 test Calculations	Write	

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

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

ARRAY.REGISTER	DESCRIPTION	USAGE
		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 volume	Read Only, units scaled per Units scale 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
7.39	Last Calc Fpv	Read Only
7.40	Last Calc Pressure Correction Factor	Read Only

ARRAY.REGISTER	DESCRIPTION	USAGE
	(Fps)	
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

AGA-7 String Registers

ARRAY.REGISTER	DESCRIPTION	NOTE
8.0	Corrected Rate Units String	1
8.1	Corrected Volume Units String	1
8.2	Uncorrected Rate Units String	1
8.3	Uncorrected Volume Units String	

Note: These strings vary per Units scale selection. See 6.2, 6.3, and 6.4.

AGA-7 Int32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	NOTE
9.0	Tube Current Alarm Bits	Read Only	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

Enron Tube Registers (Rev AA)

Enron Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
100.0	Enron status read then clear value	Read
100.1	Enron status read do not clear value	Read

Enron Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
101.0	Enron Log Event	Write

Enron Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
102.0	Enron Model = 6000	Read
102.1	Enron Prom	Read
102.2	Enron Time	Read/Write
102.3	Enron Date	Read/Write
102.4	Enron Revision	Read

Enron Bool Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
103.0	Low Battery	Read

Enron Var Bytes Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
104.0	User Byte	Read/Write
104.1	Event array offset index	Read/Write

Enron Var Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
105.0	Enron Modbus Events First Pass since startup	Read/Write
105.1	Enron Manual Event Acknowledge=1	Write
105.2	Events Read Record Pointer	Read/Write
105.3	Events Acknowledged Record Pointer	Read/Write
105.4	Number of unacknowledged Events	Read/Write
105.5	Last Events Record Pointer	Read
105.6	User Int	Read/Write

ARRAY.REGISTER	DESCRIPTION	USAGE
105.7	Log Record Number used by next access.	Read/Write

Enron Var Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
106.0	Enron Modbus Daily Record Position	Read
106.1	Enron Modbus Hourly Record Position	Read
106.2	Number of unacknowledged Events	Read
106.3	Enron Station ID	Read/Write
106.4	Contract Hour	Read/Write
106.5	User Float	Read/Write

Enron Var Daily Record Register

ARRAY.REGISTER	DESCRIPTION	USAGE
107.0	Enron Day Record	Read (see note 1)

Note1:

The Enron Daily data record is formed from the tube's daily records, and is in the following form:

Daily AGA7 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
	32		Daily Flow Record Length

Daily AGA3 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
DP_avg	4	FLOAT	Average Dp during flow
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Volume	4	FLOAT	Volume for the day (MCF)

Field	Size	Type	Description
Energy	4	FLOAT	Energy for the day (MMBTU)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
	36		Daily Flow Record Length

Thermo Daily AGA7 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
Uncor Volume	4	FLOAT	Uncorrected Volume for the day (MACF)
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
N2	4	FLOAT	Trended N2
CO2	4	FLOAT	Trended CO2
GR	4	FLOAT	Trended GR
BTU	4	FLOAT	Trended BTU
	48		Daily Flow Record Length

Thermo Daily AGA3 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
DP_avg	4	FLOAT	Average Dp during flow
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
N2	4	FLOAT	Trended N2
CO2	4	FLOAT	Trended CO2
GR	4	FLOAT	Trended GR
BTU	4	FLOAT	Trended BTU
	52		Daily Flow Record Length

Enron Var Hourly Record Register

ARRAY.REGISTER	DESCRIPTION	USAGE
108.0	Enron Log Record	Read (see note 2)

Note 2:
The Enron Hourly data record is formed from the tube's hourly records, and is in the following form:

Hourly AGA7 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
	32		Daily Flow Record Length

Hourly AGA3 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
DP_avg	4	FLOAT	Average Dp during flow
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
	36		Daily Flow Record Length

Thermo Hourly AGA7 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
Uncor Volume	4	FLOAT	Uncorrected volume MACF
AP_avg	4	FLOAT	Average Ap during flow (psig)

Field	Size	Type	Description
TF_avg	4	FLOAT	Average temperature (degrees F)
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
N2	4	FLOAT	Trended N2
CO2	4	FLOAT	Trended CO2
GR	4	FLOAT	Trended GR
BTU	4	FLOAT	Trended BTU
	48		Hourly Flow Record Length

Thermo Hourly AGA3 Archive Flow Records

Field	Size	Type	Description
Date	4	FLOAT	Log Date: MMDDYY.0
Time	4	FLOAT	Log Time: HHMM.SS
Volume	4	FLOAT	Volume for the day (MCF)
Energy	4	FLOAT	Energy for the day (MMBTU)
DP_avg	4	FLOAT	Average Dp during flow
AP_avg	4	FLOAT	Average Ap during flow (psig)
TF_avg	4	FLOAT	Average temperature (degrees F)
Extension	4	FLOAT	Uncorrected volume MACF
Flow Time	4	FLOAT	Number of minutes of flow in period (MMMM.SS)
N2	4	FLOAT	Trended N2
CO2	4	FLOAT	Trended CO2
GR	4	FLOAT	Trended GR
BTU	4	FLOAT	Trended BTU
	52		Hourly Flow Record Length

Enron Var Event Record Register

ARRAY.REGISTER	DESCRIPTION	USAGE
109.0	Enron Event Record	Read (see note 3)
109.0	Enron Acknowledge Events	Write

Event Log Record

Field	Size	Type	Description
Event Type	2	INTEGER	16 BIT mask for describes event type
Register #	2	INTEGER	16 BIT Register # of affected value
DATE	4	FLOAT	Date of this log record: MMDDYY.0
TIME	4	FLOAT	Time of this log record: HHMMSS.0
OLD VALUE	4	FLOAT	Value changed from...
NEW VALUE	4	FLOAT	Value changed to...
	20		Event Record Size

Event Code / Register Cross Reference

Event Code	Register	Description
0	0	
1	7004	New date and time
2	0	
3	0	
4	0	
5	7006	Contract day starting hour
6	0	
7	0	
8	5007	AIU Stream ID
9	1026	Use fixed analysis on error?
10	1012	Reset volume
11	1028	Wakeup from sleep
12	0	
13	65535	Watchdog
14	7128	Accumulated volume rollover
15	0	
16	1024	Attached to AIU stream?
17	0	
18	0	
19	0	
20	1010	RTD installed
21	1011	Use fixed temperature
22	0	
23	0	
24	0	SS/Monel orifice plate
25	0	Use Fb
26	0	Use Fr
27	0	Use Y
28	0	Use Ftb
29	0	Use Fpb
30	0	Use Ftf
31	0	Use Fg
32	0	Use Fpv
33	0	Use Fa
34	1014	Use contact on charger low
35	1015	Contact on DP low
36	1016	Contact on DP hi
37	1017	Contact on AP low
38	1018	Contact on AP hi

Event Code	Register	Description
39	1019	Contact on remote sense
40	1021	Auto re-open
41	1020	Contact on vol set point
42	0	Use Fw
43	0	Use Faux
44	0	
45	0	
46	0	
47	0	
48	0	
49	0	
50	7129	Well log code (Site Code)
51	1012	Accumulated volume reset
52	0	
53	0	
54	0	
55	0	
56	0	
57	0	
58	0	
59	0	
60	0	Fb
61	7070	Orifice diameter
62	7072	Pipe diameter
63	7037	Specific gravity
64	7119	DP lo limit
65	7120	DP hi limit
66	7121	AP lo limit
67	7122	AP hi limit
68	7038	CO2 mole percent
69	7039	N2 mole percent
70	7130	AP lo calibration
71	7131	AP mid calibration
72	7132	AP hi calibration
73	7133	DP lo calibration
74	7134	DP mid calibration
75	7135	DP hi calibration
76	7118	DP zero cutoff
77	7061	Temperature base
78	7062	Pressure base
79	7059	Fixed temperature

Event Code	Register	Description
80	7060	Temperature bias
81	7064	Viscosity
82	7063	Ratio of specific heats
83	7067	Ft - gravity adjusted temp
84	7068	Fp - gravity adjusted press
85	7036	BTU/SCF
86	7013	AP pressure marker
87	7014	DP pressure marker
88	0	
89	0	
90	0	
91	0	
92	0	
93	0	
94	0	
95	0	
96	0	
97	0	
98	0	
99	0	
100	7066	Faux
101	0	
102	1025	Initial analysis OK?
103	0	
104	0	
105	0	
106	0	
107	0	
108	3007	Z method
109	0	
110	0	
111	3005	AGA calculation type
112	7065	Fixed cd
113	0	
114	0	
115	7069	Zba
116	7003	Software revision change
117	3010	Volume calculation period
118	5002	Log Period
119	7051	H2S content
120	7058	H20 content

Event Code	Register	Description
121	7053	Helium content
122	7040	Methane content
123	7041	Ethane content
124	7042	Propane content
125	7044	N-Butane content
126	7043	I-Butane content
127	7046	N-Bentane content
128	7045	I-Pentane content
129	7047	N-Hexane content
130	7048	N-Heptane content
131	7049	N-Octane content
132	7050	N-Nonane content
133	7057	N-Decane content
134	7054	Oxygen content
135	7055	Carbon Monoxide content
136	7071	Orif coef of expansion
137	7073	Pipe coef of expansion
138	7074	Barometric pressure
139	0	
140	0	
141	0	
142	0	
143	1007	Calculated or Fixed Cd in vol calc
144	7056	Fixed Argon mole percent
145	7052	Fixed hydrogen mole percent
146	7128	Accumulated volume rollover
147	0	
148	0	
149	0	
150	0	
151	0	
152	0	
153	0	
154	0	
155	0	
156	0	
157	1005	Use Faux
158	1006	Static pressure tap up/downstream
159	1002	Use Y expansion factor
160	1003	Use Fpv factor
161	1004	Use Fw water vapor factor

Event Code	Register	Description
162	1013	Reset Log Period
163	0	
164	1001	Use Linear/Sqrt Averaging
165	1023	Hold last read analog values (AP, DP, TF)
166	3021	Maximum number of events log records
167	3028	Maximum number of day period records
168	3026	Maximum number of log period records
169	0	
170	0	
171	5013	Partition memory free space
172	1027	Use fixed water content in wet gas calcs
173	7075	Water content (LBS/MMSCF)
174	7076	Water content bias
175	1029	Use Fixed Test Mode AP, DP, and RTD values

Note: Event code 13 is watchdog event and it returns Register == 65535.

Undefined events(event type =0) return Register = 7129 and oldval = -(event code) newval=0

Event codes with a defined data type, but 0 for the Register will return with Register = event code and with valid old and new values.

New Event Log Codes

Event name	Code	Description
EV_undef0	0	Undefined
EV_new_tod	1	2 new date and time
EV_undef2	2	Undefined
EV_undef3	3	Undefined
EV_undef4	4	Undefined
EV_c_hr	5	30 contract day starting hour
EV_undef6	6	Undefined
EV_undef7	7	Undefined
EV_aiustr	8	58 AIU stream ID
EV_urbsb_6	9	43 bit 6 Use fixed anlys. on error?
EV_resetvol	10	25 reset volume
EV_wakeup	11	26 wakeup from sleep
EV_sleep	12	38 go to sleep
EV_watchdog	13	39 watchdog timeout
EV_rollover	14	40 accumulated volume rollover
EV_secode	15	45 security code changed
EV_urbsb_5	16	43 bit 5 attached to AIU stream?
EV_undef17	17	undefined calibration adjust
EV_undef18	18	undefined manual flow data adjust

Event name	Code	Description
EV_urbsb_7	19	43 bit 7 is AP present?
EV_urbsb_0	20	43 bit 5 RTD installed
EV_urbsb_1	21	43 bit 5 use fixed temperature
EV_urbsb_2	22	43 bit 2 undefined 43:bit 2
EV_urbsb_3	23	43 bit 3 undefined 43:bit 3
EV_urbsb_4	24	43 bit 5 ss/monel orifice plate
EV_agasb_3	25	41 bit 3 use Fb
EV_agadb_2	26	42 bit 2 use Fr
EV_agadb_1	27	42 bit 1 use Y
EV_agasb_1	28	41 bit 1 use Ftb
EV_agasb_0	29	41 bit 0 use Fpb
EV_agadb_0	30	42 bit 0 use Ftf
EV_agasb_2	31	41 bit 2 use Fg
EV_agadb_4	32	42 bit 4 use Fpv
EV_agadb_3	33	42 bit 3 use Fa
EV_auxcbit_0	34	44 bit 0 use contact on charger lo
EV_auxcbit_1	35	44 bit 1 contact on dp lo
EV_auxcbit_2	36	44 bit 2 contact on dp hi
EV_auxcbit_3	37	44 bit 3 contact on ap lo
EV_auxcbit_4	38	44 bit 4 contact on ap hi
EV_auxcbit_5	39	44 bit 5 contact on remote sense
EV_auxcbit_6	40	44 bit 6 auto re-open
EV_auxcbit_7	41	44 bit 7 contact on vol set point
EV_agadb_5	42	42 bit 5 use Fw
EV_agasb_4	43	41 bit 4 use Faux
EV_agapi_0	44	51 bit 0 use Fpm (TURBINE_REV)
EV_agapi_1	45	51 bit 1 use Ftm (TURBINE_REV)
EV_agapi_2	46	51 bit 2 use s (TURBINE_REV)
EV_agapi_3	47	51 bit 3 use Faux (TURBINE_REV)
EV_agapi_4	48	51 bit 4 undefined
EV_fixedap	49	49 fixed ap value (TURBINE_REV)
EV_sitecode	50	35 well log code (Site Code)
EV_accvol	51	23 accumulated volume reset
EV_miscpi_0	52	52 bit 0 rtd installed (TURBINE)
EV_miscpi_1	53	52 bit 1 use rtd (TURBINE)
EV_miscpi_2	54	52 bit 2 auto start TEG (TURBINE)
EV_miscpi_3	55	52 bit 3 check security code(TURBINE)
EV_miscpi_4	56	52 bit 4 use fixed ap (TURBINE)
EV_oldacf	57	55 accum ACF before reset (TRB)
EV_newacf	58	56 initial volume reset value(TRB)
EV_acfroll	59	57 accum ACF rollover date (TRB)
EV_fb	60	3 Fb

Event name	Code	Description
EV_orifd	61	4 orifice diameter
EV_piped	62	5 pipe diameter
EV_grav	63	6 specific gravity
EV_dplolim	64	7 dp lo limit
EV_dphilim	65	8 dp hi limit
EV_aplolim	66	9 ap lo limit
EV_aphilim	67	10 ap hi limit
EV_co2	68	11 CO2 mole percent
EV_n2	69	12 N2 mole percent
EV_aplocal	70	13 ap lo calibration
EV_apmidcal	71	14 ap mid calibration
EV_aphical	72	15 ap hi calibration
EV_dplocal	73	16 dp lo calibration
EV_dpmidcal	74	17 dp mid calibration
EV_dphical	75	18 dp hi calibration
EV_zerocut	76	19 dp zero cutoff
EV_tb	77	20 temperature base
EV_pb	78	21 pressure base
EV_fixedt	79	22 fixed temperature
EV_tbias	80	24 temperature bias
EV_visc	81	28 viscosity
EV_cpcv	82	29 ratio of specific heats
EV_ft	83	31 Ft - gravity adjusted temp
EV_fp	84	32 Fp - gravity adjusted press
EV_btu	85	37 BTU/SCF
EV_apmarker	86	33 ap pressure marker
EV_dpmarker	87	34 dp pressure marker
EV_auxcpi_0	88	53 bit 0 contact on charger low (TRB)
EV_auxcpi_1	89	53 bit 1 contact on acf low (TRB)
EV_auxcpi_2	90	53 bit 2 contact on acf hi (TRB)
EV_auxcpi_3	91	53 bit 3 contact on ap lo (TRB)
EV_auxcpi_4	92	53 bit 4 contact on ap hi (TRB)
EV_auxcpi_5	93	53 bit 5 contact on remote sense (TRB)
EV_auxcpi_6	94	53 bit 6 contact auto re-open (TRB)
EV_auxcpi_7	95	53 bit 7 contact on vol set point (TRB)
EV_acflolim	96	46 acf lo limit (TURBINE)
EV_acfhilim	97	47 acf hi limit (TURBINE)
EV_flowpd	98	50 flow period (TURBINE)
EV_faux_pi	99	54 Faux (TURBINE)
EV_faux	100	54 Faux
EV_meterfact	101	48 K (TURBINE)
EV_aiuflag	102	59 Initial analys. OK?

Event name	Code	Description
EV_liqK0	103	61 vcf K0
EV_liqK1	104	62 vcf K1
EV_liqK2	105	63 vcf K2
EV_liqtype	106	64 liquid type
EV_liq_conv	107	65 calculation units type
EV_zmethod	108	66 z method
EV_agasb_5	109	41 bit 5 upstream tap
EV_agadb_6	110	42 bit 6 tap type
EV_calctype	111	69 aga calculation type
EV_fixed_Cd	112	70 fixed cd
EV_pref_temp	113	undefined pipe reference temp
EV_oref_temp	114	undefined orifice reference temp
EV_Zba	115	73 zba
EV_revcode	116	75 software revision change
EV_vcalper	117	76 volume calculation period
EV_logper	118	undefined volume log period
EV_h2s	119	78 h2s content
EV_h2o	120	79 h20 content
EV_he	121	80 helium content
EV_c1	122	81 methane content
EV_c2	123	82 ethane content
EV_c3	124	83 propane content
EV_nc4	125	84 n-butane content
EV_ic4	126	85 i-butane content
EV_nc5	127	86 n-pentane content
EV_ic5	128	87 i-pentane content
EV_nc6	129	88 n-hexane content
EV_nc7	130	89 n-heptane content
EV_nc8	131	90 n-octane content
EV_nc9	132	91 n-nonane content
EV_nc10	133	92 n-decane content
EV_o2	134	93 oxygen content
EV_co	135	94 carbon monoxide content
EV_bore_coef	136	98 orif coef of expansion
EV_pipe_coef	137	99 pipe coef of expansion
EV_barometer	138	100 barometric pressure
EV_undef139	139	undefined
EV_undef140	140	undefined
EV_undef141	141	undefined
EV_cht	142	104 Characteristic type
EV_apisb_3	143	101 bit 3 Use Fixed/calculated Cd
EV_ar	144	96 fixed Argon mole percent

Event name	Code	Description
EV_h2	145	95 fixed hydrogen mole percent
EV_undef146	146	40 accumulated volume rollover
EV_evl_stop	147	106 Event log full (CANADIAN EVENT)
EV_evl_collect	148	107 Event log collected (CANADIAN)
EV_operator	149	108 Password mode operator change
EV_password_enable	150	109 Password mode password enable
EV_password_table	151	110 Password mode password table
EV_a2dfail	152	111 A to D converter could not be read
EV_apmlocal	153	112 Ap mid lo calibration event
EV_apmhical	154	113 Ap mid hi calibration event
EV_dpmlocal	155	114 Dp mid lo calibration event
EV_dpmhical	156	115 Dp mid hi calibration event
EV_apisb_4	157	101 bit 4 Use Faux
EV_apisb_5	158	101 bit 5 static pressure tap up/downstream
EV_apidb_1	159	102 bit 1 Use Y expansion factor
EV_apidb_4	160	102 bit 4 Use Fpv factor
EV_apidb_5	161	102 bit 5 Use Fw water vapor factor
EV_resetlog	162	Reset Log Periods
EV_undef163	163	Log Period changed
EV_sqrtavg	164	Linear Square Root Averaging
EV_hold	165	Hold last read analog values
EV_maxevts	166	Maximum number of events
EV_maxdays	167	Maximum number of day periods
EV_maxlogs	168	Maximum number of log periods
EV_lcommbuff	169	Size of Local Comm Buff
EV_rcommbuff	170	Size of Remote Comm Buff
EV_freespace	171	Extended Memory Free Space
EV_usefixedh2o	172	Use Fixed Water Content
EV_h2ocontent	173	Water Content (LBS/MMSCF)
EV_h2obias	174	Water Content bias
EV_testmode	175	Use fixed test mode analogs
EV_romchksum	176	ROM check sum
EV_XAI_PT5	177	Xternal analog input cal pt 5
EV_XAI_PT4	178	Xternal analog input cal pt 4
EV_XAI_PT3	179	Xternal analog input cal pt 3
EV_XAI_PT2	180	Xternal analog input cal pt 2
EV_XAI_PT1	181	Xternal analog input cal pt 1
EV_XAI2_PT5	182	Xternal analog input cal pt 5
EV_XAI2_PT4	183	Xternal analog input cal pt 4
EV_XAI2_PT3	184	Xternal analog input cal pt 3
EV_XAI2_PT2	185	Xternal analog input cal pt 2
EV_XAI2_PT1	186	Xternal analog input cal pt 1

Event name	Code	Description
EV_Apiochannel	187	// Ap ai io channel
EV_Dpiochannel	188	// Dp ai io channel
EV_analper	189	// Analysis expected in this period
EV_batt_type	-1	does not log an event
EV_dptaps	190	ISO tap type set=FLNG
EV_reset_pi1	191	Reset PI 1
EV_reset_pi2	192	Reset PI 2
EV_pi1_flow_window	193	Flow Window for PI 1
EV_pi2_flow_window	194	Flow Window for PI 2
EV_pi1_k_factor	195	PI 1 k factor
EV_pi2_k_factor	196	PI 2 k factor
EV_hv_sel	197	apisb bit 7 1=mass based energy calc
EV_mpt_cal	198	multipoint cal event
EV_mpt_win_size	199	multipoint window cal size event
EV_mpt_mfac0	200	
EV_mpt_mfac1	201	
EV_mpt_mfac2	202	
EV_mpt_mfac3	203	
EV_mpt_mfac4	204	
EV_mpt_mfac5	205	
EV_mpt_mfac6	206	
EV_mpt_mfac7	207	
EV_mpt_mfac8	208	
EV_mpt_mfac9	209	
EV_mpt_mfac10	210	
EV_mpt_vfac0	211	
EV_mpt_vfac1	212	
EV_mpt_vfac2	213	
EV_mpt_vfac3	214	
EV_mpt_vfac4	215	
EV_mpt_vfac5	216	
EV_mpt_vfac6	217	
EV_mpt_vfac7	218	
EV_mpt_vfac8	219	
EV_mpt_vfac9	220	
EV_mpt_vfac10	221	
EV_mpt_slp0	222	
EV_mpt_slp1	223	
EV_mpt_slp2	224	
EV_mpt_slp3	225	
EV_mpt_slp4	226	
EV_mpt_slp5	227	

Event name	Code	Description
EV_mpt_slp6	228	
EV_mpt_slp7	229	
EV_mpt_slp8	230	
EV_mpt_slp9	231	
EV_mpt_off0	232	
EV_mpt_off1	233	
EV_mpt_off2	234	
EV_mpt_off3	235	
EV_mpt_off4	236	
EV_mpt_off5	237	
EV_mpt_off6	238	
EV_mpt_off7	239	
EV_mpt_off8	240	
EV_mpt_off9	241	
EV_cal_baro	242	
EV_clrevtlog	245	
EV_clrlogrecs	246	
EV_clrdayrecs	247	
EV_testfb	248	
EV_fixeddp	249	
EV_primelem	250	event prime element change
EV_Abar	251	Average Relative Adjustment value has changed
EV_delta_A_low	252	Allowable Deviation from Avg Relative Adjustment l
EV_delta_A_hi	253	high limit -- meter has failed
EV_0_flo_main	254	New Value entered for zero flow condition on main rotor
EV_0_flo_sense	255	New Value entered
EV_VCONE_TBLEN	300	vcone table length changed
EV_VCONE_CF00	301	vcone table flow coefficient 0 changed
EV_VCONE_CF01	302	vcone table flow coefficient 1 changed
EV_VCONE_CF02	303	vcone table flow coefficient 2 changed
EV_VCONE_CF03	304	vcone table flow coefficient 3 changed
EV_VCONE_CF04	305	vcone table flow coefficient 4 changed
EV_VCONE_CF05	306	vcone table flow coefficient 5 changed
EV_VCONE_CF06	307	vcone table flow coefficient 6 changed
EV_VCONE_CF07	308	vcone table flow coefficient 7 changed
EV_VCONE_CF08	309	vcone table flow coefficient 8 changed
EV_VCONE_CF09	310	vcone table flow coefficient 9 changed
EV_VCONE_CF10	311	vcone table flow coefficient 10 changed
EV_VCONE_CF11	312	vcone table flow coefficient 11 changed
EV_VCONE_CF12	313	vcone table flow coefficient 12 changed
EV_VCONE_CF13	314	vcone table flow coefficient 13 changed
EV_VCONE_CF14	315	vcone table flow coefficient 14 changed

Event name	Code	Description
EV_VCONE_CF15	316	vcone table flow coefficient 15 changed
EV_VCONE_REN00	318	vcone table reynolds number 0 changed
EV_VCONE_REN01	319	vcone table reynolds number 1 changed
EV_VCONE_REN02	320	vcone table reynolds number 2 changed
EV_VCONE_REN03	321	vcone table reynolds number 3 changed
EV_VCONE_REN04	322	vcone table reynolds number 4 changed
EV_VCONE_REN05	323	vcone table reynolds number 5 changed
EV_VCONE_REN06	324	vcone table reynolds number 6 changed
EV_VCONE_REN07	325	vcone table reynolds number 7 changed
EV_VCONE_REN08	326	vcone table reynolds number 8 changed
EV_VCONE_REN09	327	vcone table reynolds number 9 changed
EV_VCONE_REN10	328	vcone table reynolds number 10 changed
EV_VCONE_REN11	329	vcone table reynolds number 11 changed
EV_VCONE_REN12	330	vcone table reynolds number 12 changed
EV_VCONE_REN13	331	vcone table reynolds number 13 changed
EV_VCONE_REN14	332	vcone table reynolds number 14 changed
EV_VCONE_REN15	333	vcone table reynolds number 15 changed
EV_VCONE_SLOPE	334	vcone table slope changed
EV_VCONE_OFFSET	335	vcone table offset changed
EV_fac_recal	336	recalibrate to factory standards
EV_old_Comm_poll	337	Western Gas characteristics poll old protocol*/
EV_old_Comm_collect	338	Western Gas historical collect old protocol*/
EV_new_Comm_poll	339	Western Gas characteristics poll new protocol*/
EV_new_Comm_collect	340	Western Gas historical collect new protocol*/
EV_ap_change	341	AP Register Assignment Changed
EV_dp_change	342	DP Register Assignment Changed
EV_tf_change	343	TF Register Assignment Changed
EV_rs_change	344	RS Register Assignment Changed
EV_ac_change	345	AC Register Assignment Changed
EV_pi_change	346	PI Register Assignment Changed
EV_RsnoFlow	347	RemoteSense Noflow action changed
EV_VCONE_TYPE	348	Vcone type
EV_Gauge	349	Gauge type Changed
EV_tflocal	350	TF lo calibration
EV_tfmlocal	351	TF mid lo calibration
EV_tfmidcal	352	TF mid calibration
EV_tfmhical	353	/TF mid hi calibration
EV_tfmhical	354	TF hi calibration
EV_tfmarker	355	TF calibration marker

Enron Var Tube ID Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
110.0	Tube Id[0] and Tube Id[1]	Read/Write
110.1	Tube Id[2] and Tube Id[3]	Read/Write
110.2	Tube Id[4] and Tube Id[5]	Read/Write
110.3	Tube Id[6] and Tube Id[7]	Read/Write
110.4	Tube Id[8] and Tube Id[9]	Read/Write

Enron Var Tube ID Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
111.0	FCU Id[0] and FCU Id[1]	Read
111.1	FCU Id[2] and FCU Id[3]	Read
111.2	FCU Id[4] and FCU Id[5]	Read
111.3	FCU Id[6] and FCU Id[7]	Read
111.4	FCU Id[8] and FCU Id[9]	Read
111.5	FCU Id[10] and FCU Id[11]	Read
111.6	FCU Id[12] and FCU Id[13]	Read
111.7	FCU Id[14] and FCU Id[15]	Read
111.8	FCU Id[16] and FCU Id[17]	Read
111.9	FCU Id[18] and FCU Id[19]	Read
111.10	FCU Id[20] and FCU Id[21]	Read
111.11	FCU Id[22] and FCU Id[24]	Read

Enron Var Location Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
112.0	LOC[0] and LOC[1]	Read/Write
112.1	LOC[2] and LOC[3]	Read/Write
112.2	LOC[4] and LOC[5]	Read/Write
112.3	LOC[6] and LOC[7]	Read/Write
112.4	LOC[8] and LOC[9]	Read/Write
112.5	LOC[10] and LOC[11]	Read/Write
112.6	LOC[12] and LOC[13]	Read/Write
112.7	LOC[14] and LOC[15]	Read/Write
112.8	LOC[16] and LOC[17]	Read/Write
112.9	LOC[18] and LOC[19]	Read/Write
112.10	LOC[20] and LOC[21]	Read/Write
112.11	LOC[22] and LOC[24]	Read/Write

Enron Var PartNumber Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
113.0	PartNum[0] and PartNum[1]	Read
113.1	PartNum[2] and PartNum[3]	Read

ARRAY.REGISTER	DESCRIPTION	USAGE
113.2	PartNum[4] and PartNum[5]	Read
113.3	PartNum[6] and PartNum[7]	Read
113.4	PartNum[8] and PartNum[9]	Read
113.5	PartNum[10] and PartNum[11]	Read

Enron Tube Revision Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
114.0	Rev[0] and Rev[1]	Read
114.1	Rev[2] and Rev[3]	Read

Enron Bool APDB Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
115.0	Apdb Ftf	Read/Write
115.1	Apdb Y	Read/Write
115.2	Apdb Fr	Read/Write
115.3	Apdb Fa	Read/Write
115.4	Apdb Fpv	Read/Write
115.5	Apdb Fw	Read/Write
115.6	Apdb UsePipeTap	Read/Write
115.7	Apdb HaveTapCfg	Read/Write

Enron Bool APISB Registers

ARRAY.REGISTER	**DESCRIPTION**	**USAGE**
116.0	Apisb Bit0	Read/Write
116.1	Apisb Bit1	Read/Write
116.2	Apisb Bit2	Read/Write
116.3	Apisb Live CD	Read/Write
116.4	Apisb Faux	Read/Write
116.5	Apisb UpStrm	Read/Write
116.6	Apisb Bit6	Read/Write
116.7	Apisb Mass	Read/Write

Enron Bool APIDB Registers

ARRAY.REGISTER	**DESCRIPTION**	**USAGE**
117.0	Apidb Bit0	Read/Write
117.1	Apidb Y	Read/Write
117.2	Apidb Bit2	Read/Write
117.3	Apidb Bit3	Read/Write
117.4	Apidb Fpv	Read/Write
117.5	Apidb Fw	Read/Write

117.6	Apidb Bit6	Read/Write
117.7	Apidb Bit7	Read/Write

Enron Bool BSB Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
118.0	Bsb Rtd	Read/Write
118.1	Bsb FixedTemp	Read/Write
118.2	Bsb Bit2	Read/Write
118.3	Bsb ChkSecCode	Read/Write
118.4	Bsb Orif	Read/Write
118.5	Bsb AttchStrm	Read/Write
118.6	Bsb FixOnErr	Read/Write
118.7	Bsb ApPresent	Read/Write

Enron Bool CB Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
119.0	Cb ChgrLo	Read/Write
119.1	Cb DpLo	Read/Write
119.2	Cb DpHi	Read/Write
119.3	Cb ApLo	Read/Write
119.4	Cb ApHi	Read/Write
119.5	Cb RemSen	Read/Write
119.6	Cb AutoReOpen	Read/Write
119.7	Cb VolSetPt	Read/Write

Enron Bool SB Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
120.0	Sb Fpb	Read/Write
120.1	Sb Ftb	Read/Write
120.2	Sb Fg	Read/Write
120.3	Sb Fb	Read/Write
120.4	Sb Fws	Read/Write
120.5	Sb UpStrm	Read/Write
120.6	Sb SwCharMask	Read/Write
120.7	Sb HvMask	Read/Write

Enron Event Modbus Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
121.0 –121.174	Event Code Array Modbus Registers to return	Read/Write

Enron Event Record Size Register

ARRAY.REGISTER	DESCRIPTION	USAGE
122.0	Event Record size	Read

Enron Bool CB2 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
123.0	Cb ChgrLo	Read/Write
123.1	Cb DpLo	Read/Write
123.2	Cb DpHi	Read/Write
123.3	Cb ApLo	Read/Write
123.4	Cb ApHi	Read/Write
123.5	Cb RemSen	Read/Write
123.6	Cb AutoReOpen	Read/Write
123.7	Cb VolSetPt	Read/Write

Enron Var Bool Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
124.0	First Analysis Flag	Read

Enron Var LP Record Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
125.0	LPRdp	Read
125.1	LPRap	Read
125.2	LPRtf	Read
125.3	LPRext	Read
125.4	LPRvol	Read
125.5	LPRbtu	Read
125.6	LPRftime	Read
125.7	LPRptime	Read

Enron Var DP Record Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
126.0	DPRdp	Read
126.1	DPRap	Read
126.2	DPRtf	Read
126.3	DPRext	Read
126.4	DPRvol	Read
126.5	DPRbtu	Read
126.6	DPRftime	Read
126.7	DPRptime	Read

Enron Var Mnth Accum Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
127.0	MnthVol	Read
127.1	MnthVolNr	Read
127.2	PrevMnthVol	Read
127.3	PrevMnthVolNr	Read
127.4	MnthEgyl	Read
127.5	MnthEgyNr	Read
127.6	PrevMnthEgy	Read
127.7	PrevMnthEgyNr	Read

Enron Var Uint32 Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
128.0	CurrTime	Read/Write
128.1	LPRTime	Read
128.2	DPRTime	Read
128.3	ColdDate	Read
128.4	AiustrLong	Read
128.5	LogpCnt	Read
128.6	PsecsVolptot	Read
128.7	OsaFlosecs	Read
128.8	OsaFlags	Read
128.9	User Int32	Read/Write

Enron Var Tube Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
129.0	PrimeElem	Read
129.1	VolpCnt	Read
129.2	DPRFirst	Read
129.3	DpTaps	Read/Write
129.4	PiWindow	Read

Enron Var Tube Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
130.0	Tbias	Read/Write
130.1	VolRollSp	Read
130.2	VcomPicnt	Read
130.3	MCFDayErate	Read
130.4	MMBtuHr	Read

Enron Var Tube Last Calc Float Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
131.0	LastCalcDp	Read
131.1	LastCalcAp	Read
131.2	LastCalcTemp	Read
131.3	LastCalcVol	Read
131.4	LastCalcExt	Read
131.5	LastCalcCp	Read
131.6	LastCalcY	Read
131.7	LastCalcFpv	Read
131.8	LastCalcFw	Read
131.9	LastCalcFaux	Read
131.10	LastCalcQv	Read
131.11	LastCalcFip	Read
131.12	LastCalcEv	Read
131.13	LastCalcBoreD	Read
131.14	LastCalcPipeD	Read
131.15	LastCalcRhob	Read
131.16	LastCalcQm	Read
131.17	LastCalcCd	Read
131.18	LastCalcBtu	Read
131.19	LastCalcGf	Read
131.20	LastCalc301Fr	Read
131.21	LastCalc301Fpb	Read
131.22	LastCalc301Ftb	Read
131.23	LastCalc301Ftf	Read
131.24	LastCalc301Fg	Read
131.25	LastCalc301Fa	Read
131.26	LastCalc301Fpv	Read
131.27	LastCalc701Fr	Read
131.28	LastCalc701Fpb	Read
131.29	LastCalc701Ftb	Read
131.30	LastCalc701Ftf	Read
131.31	LastCalc701Fg	Read
131.32	LastCalc701Fa	Read
131.33	LastCalc701Fpv	Read

Enron Var AFTs Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
132.0	Logp_Acc_Aft	Read
132.1	Logp_Tot_Aft	Read
132.2	Dayp_Acc_Aft	Read
132.3	Dayp_Tot_Aft	Read
132.4	Volp_Acc_Aft	Read
132.5	Volp_Tot_Aft	Read

Enron Var String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
133.0	Enron Daily Gas Quality Trend File Name	Read/Write
133.1	Enron Hourly Gas Quality Trend File Name	Read/Write

Enron Var Trend Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
134.0	Gas Quality Daily Trend Record Size	Read
134.1	Current Daily Trend Record Position	Read
134.2	Gas Quality Hourly Trend Record Size	Read
134.3	Current Hourly Trend Record Position	Read

Enron Var Trend Log Record Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
135.0	Gas Quality Daily Trend Record based on Day record number match	Read
135.1	Gas Quality Daily Trend Record based on Current record position	Read
135.2	Gas Quality Daily Trend Record based on Trend record number	Read
135.3	Gas Quality Hourly Trend Record based on Hourly record number match	Read
135.4	Gas Quality Hourly Trend Record based on Current record position	Read
135.5	Gas Quality Hourly Trend Record based on Trend record number	Read

Thermo Enron Record Registers

ARRAY.REGISTER	DESCRIPTION	USAGE
136.0	Gas Quality Daily Thermo Record	Read
136.1	Gas Quality Hourly Thermo Record	Read

Selectable Units

AGA3 Selectable Units Tube Registers (Rev AE)

Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
0.0	Contract Hour	Read/Write, 0-23	None
0.1	Reset Volume Command	Write	None
0.2	Reset Log Period Command	Write	None
0.3	Calibration Hold Mode	Read/Write	None
0.4	AP/DP/TF Over Range Flags	Read Only	None
0.5	Tube Database Rev	Read Only	None
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)	None
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)	None
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)	None
0.9	Volume Calc Type	Read/Write, see note 4)	None
0.10	Calc Units	Read Only	None
0.11	Report Units	Read Only	None
0.12	Super Compressibility Method	Read/Write, see note 5)	None
0.13	Use Square Root Average flag	Read/Write	None
0.14	Characteristic Record Type	Read/Write, see note 6)	None
0.15	Use Fixed H2O	Read/Write, for Fw calculation	None
0.16	Gravity Config flags	Read/Write, live analysis configuration, see note 7)	None
0.17	BTU Config flags	Read/Write, live analysis configuration, see note 7)	None
0.18	Nitrogen Config flags	Read/Write, live analysis configuration, see note 7)	None
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration, see note 7)	None
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration, see note 7)	None
0.21	Water Config flags	Read/Write, live analysis configuration, see note 7)	None
0.22	Helium Config flags	Read/Write, live analysis configuration, see note 7)	None
0.23	Methane Config flags	Read/Write, live analysis configuration, see note 7)	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
0.24	Ethane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.25	Propane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.26	Normal Butane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.28	Normal Pentane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.32	Normal Octane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.34	Normal Decane Config flags	Read/Write, live analysis configuration, see note 7)	None
0.35	Oxygen Config flags	Read/Write, live analysis configuration, see note 7)	None
0.36	Carbon Monoxide Config flags	Read/Write, live analysis configuration, see note 7)	None
0.37	Hydrogen Config flags	Read/Write, live analysis configuration, see note 7)	None
0.38	Argon Config flags	Read/Write, live analysis configuration, see note 7)	None
0.39	Number of live components	Read/Write	None
0.40	Get/release calc lock	Read/Write	None
0.41	Tube analysis stream index	Read/Write	None
0.42	Flow rate / volume scale flags	Read/Write, see note 8)	None
0.43	Aux contact 1 re-open interval	Read/Write	None
0.44	Aux contact 1 current state	Read Only	None
0.45	Aux contact 1 manual set	Read/Write	None
0.46	Aux contact 2 re-open interval	Read/Write	None
0.47	Aux contact 2 current state	Read Only	None
0.48	Aux contact 2 manual set	Read/Write	None
0.49	Remote Sense Action	Read/Write	None
0.50	Remote Sense State	Read Only	None
0.51	Events Available	Write, Canadian Event Log	None
0.52	Aux Contact 1 select bits low byte	Read/Write, see note 9)	None
0.53	Aux Contact 2 select bits low byte	Read/Write, see note 9)	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
0.54	Hold tube analog inputs	Read/Write	None
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge	None
0.56	Number of samples before AD Fail Set or Released	For Internal Use Only	None
0.57	Current number of consecutive bad AD readings	For Internal Use Only	None
0.58	Vol period Complete flag	Read/Write (see note 10)	None
0.59	Log period Complete flag	Read/Write (see note 11)	None
0.60	Day period Complete flag	Read/Write (see note 12)	None
0.61	tubeCheckPoint control	Read/Write (see note 14)	None
0.62	Canadian Event Log Inhibit Flag	Read Only (see note 15)	None
0.63	Stop Logging Events	Read Only (See Note 16)	None
0.64	Log in Gage Pressure	Read/Write (See Note 17)	None
0.65	Log DP Check	Read/Write (See Note 18)	None
0.66	Use fixed Sp on Error	Read/Write (See Note 19)	None
0.67	Use fixed Dp on Error	Read/Write (Notes 19 & 20)	None
0.68	Use fixed Tf on Error	Read/Write (See Note 19)	None
6.0	Aga3 1992 Static Bits see	Read/Write, See note 1)	None
6.1	Aga3 1992 Miscellaneous Bits	Read/Write, see note 13)	None
6.2	Vol - Flow Rate unit selection for volume	Not Applicable	None
6.3	Vol - Flow Rate unit selection for flow rate	Not Applicable	None
6.4	Auto Fb Calc	Not Applicable	None
6.5	Heating Value Select 0=Vol Based 1=Mass Based	Read/Write	None
6.6	Select DP tap type see note 3)	Read/Write	None
6.7	Last Calc Heat Value Select	Read Only Not used	None
6.8	1 = unitTable was changed	Internal Only	None
6.9	1 = busy moving use files	Internal Only	None
6.10	1 = remote changed use files	Internal Only	None
6.11	1 = pccu changed use files	Internal Only	None
6.12	Move image to use	Internal Only	None

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 –

   0x01, 1 /* Spare */
   0x02, 2 /* Spare */
   0x04, 4 /* Spare */
   0x08, 8 /* Use Calculated Cd */
   0x10, 16 /* Use Faux */
   0x20, 32 /* Static Pressure Tap is Upstream */
   0x40, 64 /* Spare */
   0x80, 128 /* Spare */

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, 2=AGA-3 1992, 10=ISO_5167-1.
5. Super-Compressibility Method: Only two methods allowed: 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: Not used in selectable units application
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.
10. The flag is used in testing the XRC. The flag will be set to a "1" when a volume calculation and all operations associated with it are complete. Typically a test sets the flag to "0". Then does something to cause a calculation. It then waits until the flag is "1" to evaluate the results of the test.
11. The flag is used in testing the XRC. The flag will be set to a "1" when all operations associated a log period event are complete. Typically a test sets the flag to "0" and waits until the flag becomes a "1". Then the logged data would be evaluated.
12. The flag is used in testing the XRC. The flag will be set to a "1" when all operations associated a day period event are complete. Typically a test sets the flag to "0" and waits until the flag becomes a "1". Then the logged data would be evaluated.
13. 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 */

14. This is for internal use only. A logic 1 disables tube cold and warm start functions.
15. When this flag is 1 no events are allowed and no parameter changes are allowed from any protocol.
16. When this flag is 1 no events are allowed and no parameter changes are allowed.
17. When this bit is logic 1 and the transducer is a gage transducer pressure logging in Log and Day records is done Gage Pressure. The log gage pressure is computed by subtracting the barometric pressure from the average of the input pressure over the log/day period.
18. With pressure applied to SP.
19. Used only with Selectable Units.
20. Gas orifice only.

Tube 16-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
1.0	Primary Element Mask	Read Only, indicates primary element type, see note 1)	None
1.1	Calc Method Mask	Read Only, indicates calculation methods supported, see note 2)	None
1.2	Calc Units Mask	Read Only, not used	None
1.3	Report Units Mask	Read Only, not used	None
1.4	Super Comp Method Mask	Read Only, indicates super-compressibility methods that may be selected. See note 3)	None
1.5	Live Analysis Update Interval	Read/Write, live analysis updates are expected in this interval, expressed in seconds	None
1.6	Volume Calc period	Read/Write, seconds	None
1.7	Daily Record Capacity	Read/Write, number of daily records, change to this value deletes existing database and starts new database	None
1.8	Log Record Capacity	Read/Write, number of log period records, change to this value deletes existing database and starts new database	None
1.9	Event Record Capacity	Read/Write, number of event records, change to this value deletes existing database and starts new database	None
1.10	Aux Contact 1 Select Bits	Read/Write, control bits, see note 4)	None
1.11	Aux Contact 2 Select Bits	Read/Write, control bits, see note 4)	None
1.12	Return number of events available	Write, Canadian Event Log	None
1.13	Therms Stream Id	Read/Write Analysis Stream Id	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
1.14	Modbus address of analyzer	Read/Write	None
1.15	Therms use fixed or last good	Read/Write	None
1.16	Daily Record Sequence Number	Read Only	None
1.17	Log Record Sequence Number	Read Only	None
1.18	Event Record Sequence Number	Read Only	None
1.19	DP Status Flags	Read Only, see note 5)	None
1.20	AP Status Flags	Read Only, see note 6)	None
1.21	TF Status Flags	Read Only, see note 7)	None
1.22	PI Status Flags	Read Only, see note 8)	None
1.23	Ext Status Flags	Read Only, see note 9)	None

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.

Tube 32-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	Group Name
2.0	Log period	Read/Write, seconds	None
2.1	Julian timestamp of most recent AIU download	Read/Write, see note 1)	Date/Time
2.2	Julian timestamp of most recent live component update (not aiu)	Read/Write, see note 1)	Date/Time

ARRAY.REGISTER	DESCRIPTION	USAGE	Group Name
2.3	Julian timestamp of prev day period	Read Only, see note 1)	Date/Time
9.0	Tube Current Alarm Bits	Read Only, See note 2)	None

Tube 32-bit Integer Register Notes:

1. Julian time is number of seconds since midnight, 1/1/1970.
2. 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

Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.0	Current Xducr AP / cal checks	Read/Write, see note 1)	Transducer Pressure
3.1	AP High Limit	Read/Write, see note 1)	Abs Pressure
3.2	AP Low Limit	Read/Write, see note 1)	Abs Pressure
3.3	Current Xducr Temp	Current Line Temperature	Transducer Temperature
3.4	Fixed Temp	Fixed Temperature Input	Temperature
3.5	Temp High Limit	Temperature Limit	Temperature
3.6	Temp Low Limit	Temperature Limit	Temperature
3.7	Flow Rate High Limit	Read/Write, see note 2)	Base Volume
3.8	Flow Rate Low Limit	Read/Write, see note 2)	Base Volume
3.9	DP/ACF Percent High for Day	Read Only	Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.10	DP/ACF Percent Low for Day	Read Only	Percent
3.11	Fixed F(b) AGA-3 1985	Read/Write	None
3.12	Fixed Cd AGA-3 1992	Read/Write	None
3.13	Zba	Read/Write	None
3.14	Orifice coef of expansion	Read/Write	Expansion
3.15	Pipe coef of expansion	Read/Write	Expansion
3.16	Calibrate Screen Barometric Pressure	Read/Write	Barometric Pressure
3.17	F(t) for Fpv NX19	Read/Write	None
3.18	F(p) for Fpv NX19	Read/Write	None
3.19	Fixed Analysis BTU	Read/Write, see note 3)	HV Volume / HV Mass
3.20	Fixed Analysis Gravity	Read/Write	None
3.21	Fixed Analysis Nitrogen	Read/Write	Mole Percent
3.22	Fixed Analysis Carbon Dioxide	Read/Write	Mole Percent
3.23	Fixed Analysis Hydrogen Sulfide	Read/Write	Mole Percent
3.24	Fixed Analysis Water	Read/Write	Mole Percent
3.25	Fixed Analysis Helium	Read/Write	Mole Percent
3.26	Fixed Analysis Methane	Read/Write	Mole Percent
3.27	Fixed Analysis Ethane	Read/Write	Mole Percent
3.28	Fixed Analysis Propane	Read/Write	Mole Percent
3.29	Fixed Analysis Normal Butane	Read/Write	Mole Percent
3.30	Fixed Analysis Iso-Butane	Read/Write	Mole Percent
3.31	Fixed Analysis Normal Pentane	Read/Write	Mole Percent
3.32	Fixed Analysis Iso-Pentane	Read/Write	Mole Percent
3.33	Fixed Analysis Normal Hexane	Read/Write	Mole Percent
3.34	Fixed Analysis Normal Heptane	Read/Write	Mole Percent
3.35	Fixed Analysis Normal Octane	Read/Write	Mole Percent
3.36	Fixed Analysis Normal Nonane	Read/Write	Mole Percent
3.37	Fixed Analysis Normal Decane	Read/Write	Mole Percent
3.38	Fixed Analysis Oxygen	Read/Write	Mole Percent
3.39	Fixed Analysis Carbon Monoxide	Read/Write	Mole Percent
3.40	Fixed Analysis Hydrogen	Read/Write	Mole Percent
3.41	Fixed Analysis Argon	Read/Write	Mole Percent
3.42	Fixed H2O Content	Read/Write	Water
3.43	Fixed H2O Bias	Read/Write	Water
3.44	Live Analysis Gravity Accumulator	Read/Write,	None
3.45	Live Analysis BTU Accumulator	Read/Write	HV Volume / HV Mass
3.46	Live Analysis Nitrogen Accumulator	Read/Write	Mole Percent
3.47	Live Analysis Carbon Dioxide	Read/Write	Mole Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
	Accumulator		
3.48	Live Analysis Hydrogen Sulfide Accumulator	Read/Write	Mole Percent
3.49	Live Analysis Water Accumulator	Read/Write	Mole Percent
3.50	Live Analysis Helium Accumulator	Read/Write	Mole Percent
3.51	Live Analysis Methane Accumulator	Read/Write	Mole Percent
3.52	Live Analysis Ethane Accumulator	Read/Write	Mole Percent
3.53	Live Analysis Propane Accumulator	Read/Write	Mole Percent
3.54	Live Analysis Normal Butane Accumulator	Read/Write	Mole Percent
3.55	Live Analysis Iso-Butane Accumulator	Read/Write	Mole Percent
3.56	Live Analysis Normal Pentane Accumulator	Read/Write	Mole Percent
3.57	Live Analysis Iso-Pentane Accumulator	Read/Write	Mole Percent
3.58	Live Analysis Normal Hexane Accumulator	Read/Write	Mole Percent
3.59	Live Analysis Normal Heptane Accumulator	Read/Write	Mole Percent
3.60	Live Analysis Normal Octane Accumulator	Read/Write	Mole Percent
3.61	Live Analysis Normal Nonane Accumulator	Read/Write	Mole Percent
3.62	Live Analysis Normal Decane Accumulator	Read/Write	Mole Percent
3.63	Live Analysis Oxygen Accumulator	Read/Write	Mole Percent
3.64	Live Analysis Carbon Monoxide Accumulator	Read/Write	Mole Percent
3.65	Live Analysis Hydrogen Accumulator	Read/Write	Mole Percent
3.66	Live Analysis Argon Accumulator	Read/Write	Mole Percent
3.67	Log Site Code in Event Log		None
3.68	Valve Control Accumulated Volume	Read/Write	Valve Accumulator
3.69	Aux Contact 1 Volume Setpoint	Read/Write	Cout Volume
3.70	Aux Contact 2 Volume Setpoint	Read/Write	Cout Volume
3.71	Last calc period Nitrogen	Read Only	Mole Percent
3.72	Last calc period CO2	Read Only	Mole Percent
3.73	Last calc period H2S	Read Only	Mole Percent
3.74	Last calc period H2O	Read Only	Mole Percent
3.75	Last calc period HE	Read Only	Mole Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.76	Last calc period C1	Read Only	Mole Percent
3.77	Last calc period C2	Read Only	Mole Percent
3.78	Last calc period C3	Read Only	Mole Percent
3.79	Last calc period NC4	Read Only	Mole Percent
3.80	Last calc period IC4	Read Only	Mole Percent
3.81	Last calc period NC5	Read Only	Mole Percent
3.82	Last calc period IC5	Read Only	Mole Percent
3.83	Last calc period NC6	Read Only	Mole Percent
3.84	Last calc period NC7	Read Only	Mole Percent
3.85	Last calc period NC8	Read Only	Mole Percent
3.86	Last calc period NC9	Read Only	Mole Percent
3.87	Last calc period NC10	Read Only	Mole Percent
3.88	Last calc period O2	Read Only	Mole Percent
3.89	Last calc period CO	Read Only	Mole Percent
3.90	Last calc period H2	Read Only	Mole Percent
3.91	Last calc period AR	Read Only	Mole Percent
3.92	Last calc period AIR	Read Only	Mole Percent
3.93	Last calc period C6PLUS	Read Only	Mole Percent
3.94	Last calc period BTU	Read Only	HV Volume / HV Mass
3.95	Last calc period GRAVITY	Read Only	None
3.96	current contract day accumulated energy	Read Only	Total Energy
3.97	yesterdays contract day accumulated energy	Read Only	Total Energy
3.98	Current Energy rate	Not used, see reg app.7.27	Energy Rate
3.99	Current Month Accumulated Volume	Read Only	Total Volume
3.100	Current Month Accumulated Volume not affected by reset volume command	Read Only	Total Volume
3.101	Current Month Accumulated Energy	Read Only	Total Energy
3.102	Current Month Accumulated Energy not affected by reset volume command	Read Only	Total Energy
3.103	Fixed Ap	Read / Write	Abs Pressure
3.104	Current Flow Rate	Read Only	Base Volume
3.105	Previous Month Accumulated Volume	Read Only	Total Volume
3.106	Previous Month Accumulated Volume not affected by reset volume command	Read Only	Total Volume
3.107	Previous Month Energy	Read Only	Total Energy
3.108	Previous Month Energy not	Read Only	Total Energy

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
	affected by reset volume command		
3.109	Ap high error value	Read/Write	Abs Pressure
3.110	Ap low error value	Read/Write	Abs Pressure
3.111	Dp high error value	Read/Write	Diff Pressure
3.112	Dp low error value	Read/Write	Diff Pressure
3.113	Tf high error value	Read/Write	Temperature
3.114	Tf low error value	Read/Write	Temperature

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
7.0	Current Cal DP / cal checks	Read/Write	Transducer Diff Pressure
7.1	DP High Limit	Read/Write	Diff Pressure
7.2	DP Low Limit	Read/Write	Diff Pressure
7.3	DP Zero CutOff	Read/Write	Diff Pressure
7.4	Current Flow Rate	Read Only	Base Volume
7.5	Last Vol Period volume	Read Only	Base Volume
7.6	Accumulated Volume	Read Only	Total Volume
7.7	Today's contract day volume	Read Only	Total Volume
7.8	Orifice diameter	Read/Write	Dimensional
7.9	Pipe diameter	Read/Write	Dimensional
7.10	Pressure base	Read/Write	Abs Pressure
7.11	Temperature base	Read/Write	Temperature
7.12	Fixed F(aux)	Read/Write	None
7.13	Ratio of specific heats	Read/Write	None
7.14	Fluid viscosity	Read/Write	Viscosity
7.15	C-Prime	Read Only	None
7.16	Non-Flow weighted Accum AP	Read Only	Abs Pressure
7.17	Minute Flow Secs	Read Only	None
7.18	Yesterday's contract day volume	Read Only	Total Volume
7.19	Current Flow Rate	Read Only	Volume Flow
7.20	Last Vol Period volume	Read Only	Base Volume
7.21	Accumulated volume	Read Only	Total Volume
7.22	Today's contract day volume	Read Only	Total Volume
7.23	Yesterday's contract day volume	Read Only	Total Volume
7.24	Flow Rate Hi limit	Read Only	Volume Flow
7.25	Flow Rate Lo limit	Read Only	Volume Flow
7.26	One second Mass Flow	Read Only	Mass Flow
7.27	One second Energy Rate	Read Only	Energy Rate
7.28	Last Calc Base Density		Density

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
7.29	Last Calc Line Density		Density
7.30	Last Calc Base Compressibility		None
7.31	Last Calc Flowing Compressibility		None
7.32	Last Calc fpv	Read Only	None
7.33	Last Calc mass	Read Only	Base Mass
7.34	Last Calc energy	Read Only	Base Energy
7.35	Current day Mass	Read Only	Total Mass
7.36	DPRecord Day Mass	Read Only	Log Mass
7.37	Current day average base Density	Read Only	Density
7.38	DPRecord day average base Density	Read Only	Denstiy
7.39	Current day average flowing Density	Read Only	Density
7.40	DPRecord average flowing Density	Read Only	Density
7.41	Current day average barometric pressure	Read Only	Barometric Pressure
7.42	DPRecord day average barometric pressure	Read Only	Barometric Pressure
7.43	Orifice Reference Temperature	Read/Write	Orifice Ref Temp
7.44	Pipe Reference Temperature	Read/Write	Pipe Ref Temp
7.45	Last Calc Extension	Read Only (see note 4)	LCP Integral
7.46	Last Calc Specific Heat Ratio	Read Only	None
7.47	Last Calc Viscosity	Read Only	Viscosity
7.48	Last Calc base compressibility of air	Read Only	None
7.49	Last Calc Fip	Read Only (see note 5)	LCP Fip
7.50	Last Calc static pressure	Read Only	Abs Pressure
7.51	Last Calc differential pressure	Read Only	Diff Pressure
7.52	Last Calc Temperature base	Read Only	Abs Pressure
7.53	Last Calc Pressure base	Read Only	Temperature
7.54	Last Calc Fixed Temperature	Read Only	Temperature
7.55	Last Calc Faux	Read Only	None
7.56	Last Calc Fw	Read Only	None
7.57	Last Calc orifice ID	Read Only	Dimensional
7.58	Last Calc pipe ID	Read Only	Dimensional
7.59	Last Calc Beta	Read Only	None
7.60	Last Calc Y	Read Only	None
7.61	Last Calc Ev	Read Only	None
7.62	Last Calc Reynolds Number	Read Only	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
7.63	Last Calc Cd	Read Only	None
7.64	Last Calc Cp	Read Only	None
7.65	Last Calc Cp_s	Read Only	None
7.66	Last Calc qm	Read Only	Base Mass Flow
7.67	Last Calc Qv	Read Only	Base Volume Flow
7.68	Today's Accumulated Mass	Read Only	Total Mass
7.69	Today's Contract Day Accumulated Mass	Read Only	Total Mass
7.70	Yesterday's Contract Day Accumulated Mass	Read Only	Total Mass
7.71	Today's Accumulated Energy	Read Only	Total Energy
7.72	Today's Contract Day Accumulated Energy	Read Only	Total Energy
7.73	Yesterday's Contract Day Accumulated Energy	Read Only	Total Energy
7.74	Current Ap	Read Only	Abs Pressure
7.75	Current Tf	Read Only	Temperature
7.76	Barometric Pressure	Read/Write	Barometric
7.77	Current Dp	Read Only	Diff Pressure

Tube Floating Point Register Notes:

1. Static pressure values are in absolute or gauge 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.
3. The units for this group are dependent on the value of the heating select bit accesed via register app.6.5. For a "0" the group is HV Volume, for "1" the group is HV Mass.
4. LCP Integral – this is the square root of the static pressure * differential pressure / flowing temperature. For Selectable Units this field is always calculated as:

   static pressure: bar

   diff pressure: mbar

   temperature: deg Kelvin
5. LCP Fip – for the current implementation Fip is calculated as follows:

   Fip = xpt * sqrt_rgrav * sqrt((2 * Mair / Rgc) * (1/Zba)) * Fpv

   Where: xpt = see note 4 above

   Sqrt_rgrav = square root of the real specific gravity

   Mair = 28.9625

   Rgc = 0.0831451

   Zba = compressibility of air as entered by the user

   Fpv = calculated super compressibility

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	GROUP NAME
4.0	AP Register	Read/Write	None
4.1	DP Register	Read/Write	None
4.2	TF Register	Read/Write	None
4.3	PI Register	Read/Write	None
4.4	RS Register	Read/Write	None
4.5	AC 1 Register	Read/Write	None
4.6	AC 1 DI Register	Read/Write	None
4.7	AC 2 Register	Read/Write	None
4.8	AC 2 DI Register	Read/Write	None

Tube String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
5.0	Tube ID	Read/Write	None
5.1	Tube last analyis time	Read Only	None

Tube Last Calculation Period Analysis Registers, Floating Point, Read Only

ARRAY.REGISTER	DESCRIPTION	USAGE	
10.0	Last Calc Nitrogen	Read Only, mole %	Mole Percent
10.1	Last Calc Carbon Dioxide	Read Only, mole %	Mole Percent
10.2	Last Calc Hydrogen Sulfide	Read Only, mole %	Mole Percent
10.3	Last Calc Water	Read Only, mole %	Mole Percent
10.4	Last Calc Helium	Read Only, mole %	Mole Percent
10.5	Last Calc Methane	Read Only, mole %	Mole Percent
10.6	Last Calc Ethane	Read Only, mole %	Mole Percent
10.7	Last Calc Propane	Read Only, mole %	Mole Percent
10.8	Last Calc Normal Butane	Read Only, mole %	Mole Percent
10.9	Last Calc Iso-Butane	Read Only, mole %	Mole Percent
10.10	Last Calc Normal Pentane	Read Only, mole %	Mole Percent
10.11	Last Calc Iso-Pentane	Read Only, mole %	Mole Percent
10.12	Last Calc Normal Hexane	Read Only, mole %	Mole Percent
10.13	Last Calc Normal Heptane	Read Only, mole %	Mole Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	
10.14	Last Calc Normal Octane	Read Only, mole %	Mole Percent
10.15	Last Calc Normal Nonane	Read Only, mole %	Mole Percent
10.16	Last Calc Normal Decane	Read Only, mole %	Mole Percent
10.17	Last Calc Oxygen	Read Only, mole %	Mole Percent
10.18	Last Calc Carbon Monoxide	Read Only, mole %	Mole Percent
10.19	Last Calc Hydrogen	Read Only, mole %	Mole Percent
10.20	Last Calc Argon	Read Only, mole %	Mole Percent
10.21	Last Calc Air	Read Only, mole %	Mole Percent
10.22	Last Calc Heavy Hydrocarbons	Read Only, mole %	Mole Percent
10.23	Last Calc Heat Content	Read Only, BTU/SCF	See note 1)
10.24	Last Calc Specific Gravity	Read Only	None

The group depends on the heating value selected. For energy/mass the group is HVMass_grp. For energy/volume the group is HVVolume_grp.

Tube Use File Units Get Registers (11.0 … 11.63):

This read only register returns the units string that a usefile group is currently set to. The format of the command is app.11.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile).

Tube Use File String Register (12.0 … 12.63):

This read only register returns the register number that will return the units a usefile group is currently set. The format of the command is app.12.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile). A typical response would be app.11.group number.

Tube Use File Units Get Registers (13.0 .. 13.63):

This read only register returns the group name, as a string, assigned to usefile group. The format of the command is app.13.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile).

Tube Use File Image Register (14.0 … 14.63):

This read/write register is use to set usefile image group units. The register numbers may range from “0” to MAX_GROUPS-1 (currently “63” for a usefile). The register number is actually a use file group number Data values entered into these register are transferred to use file upon execution of register set command app.6.11=1. **Note: Executing the app.6.11=1 command will cause the data base to be reset loosing all long term data in the tube application.**

The command app.14.group number will return:

App.14.group number=AA,BBCC,DDDD

Where: AA = group number in decimal

BB = conversion group number in decimal

CC = unit number in decimal

DDDD = the flag field in ascii-hex

On write the command must be entered as AA,BB,CC,DDDD exactly. The comma separator field is important as well a each digit. The allowed ranges for each field is determined by the entries in the Unit_Tab.dat file.

Tube Read/Write Use File Registers (array.15 … array.22):

These registers are used to read/write the individual fields of use file group. The table below describes the each field. Each group has its own allowable set of fields. The registers are not intended to customer use.

The fields are accessed as follows: app.array.group number.

Array	Field	Comment
15	Conversion group number	This field tells the conversion application what type of variable to convert. For example absolute pressures, temperature etc.
16	Unit Number	The index into a conversion groups list of possible conversions. This corresponds to the units selected by the user. Each conversion group has a different list of units.
17	Pre Multiplier Bit	This register accesses the pre multiplier bit of the units flag. It tells the conversion application that the group has a pre multiplier associated with it.
18	Pre Multiplier Field	This field accesses the actual pre multiplier index. The index may range from 0 to 31. The index number to index into a list of pre multipliers (M-1000, MM-1000000, etc).
19	Meter Factor	This bit tells a conversion application if a meter factor is in pulse/quantity or quantity/pulse. It is used in conjunction with the UVol flag field to indicate a pulse input. If the UVol bit field is set the meter factor field is used in generating a “units” string. If not, it is ignored.
20	UVol Bit	This bit tells the conversion application that register is a pulse type.
21	Post Multiplier Bit	This register accesses the post multiplier bit of the units flag. This tells the conversion application that a group has a post multiplier associated with it.
22	Post Multiplier Field	This field accesses the actual post multiplier index. The index may range from 0 to 31. The index number to index into a list of post multipliers (/s, /hr etc).

Tube Use File Register (23.0):

This command is used internally by the system to upload and or download a “usefile”. Execution of this command can cause a system database reset.

Tube Use File Register (24.0 … 24.63):

This read/write register is use to set usefile group units. The register numbers may range from “0” to MAX_GROUPS-1 (currently “63” for a usefile). The register number is actually a use file group number. Data values are immediately used unlike the tube image register command app.14.group number which requires the app.6.11=1 command to make them take effect.

This means the data in the data base may contain mixed values. **This command is to be used for test purposes only.**

The command app24.group number will return:

App.24.group number=AA,BBCC,DDDD

Where: AA = group number in decimal

BB = conversion group number in decimal

CC = unit number in decimal

DDDD = the flag field in ascii-hex

On write the command must be entered as AA,BB,CC,DDDD exactly. The comma separator field is important as well a each digit. The allowed ranges for each field is determined by the entries in the Unit_Tab.dat file.

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.

Tube Log Period Registers

ARRAY	DESCRIPTION	USAGE	GROUP NAME
200	Log Period Static Pressure	Floating Point	Abs Pressure, see note 5)
201	Log Period Diff. Pressure	Floating Point	Diff Pressure
202	Log Period Temperature	Floating Point	Temperature
204	Log Period Extension	Floating Point	LCP Integral, see note 3)
205	Log Period Volume	Floating Point	Log Volume
206	Log Period Heating Value	Floating Point	HV Volume / HV Mass, see note 4)
207	Log Period Flow time	Floating Point	None
208	Log Period Total time	Floating Point	None
209	Log Period Alarm bits	32 bits, see note 1)	None
210	Log Period Mass	Floating Point	Log Mass
211	Log Period Average Base Density	Floating Point	Density
212	Log Period Average Flowing Density	Floating Point	Density
213	Log Period Average Barometric Pressure	Floating Point	Barometric Pressure
250	Log Period Record	See note 2)	None

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 */
   float         mass;              /* Day Mass */
   float     contract_baro;         /* Average Contract Day baro pressure */
   float     avg_base_density;      /* Average Day base density */
   float     avg_line_density;      /* Average Day flowing density */
   float     avg_dayrec_tfrq;       /* Not used  */
} LOGRECORD;
```

3. LCP Integral – this is the square root of the static pressure * differential pressure / flowing temperature. For Selectable Units this field is always calculated as:

   static pressure: bar
   diff pressure: mbar
   temperature: deg Kelvin

4. The units for this group are dependent on the value of the heating select bit accessed via register app.6.5. For a “0” the group is HV Volume, for “1” the group is HV Mass.

5. If the transducer is a gage transducer and gage logging is selected then the value logged here will be the log period average pressure – log period average barometric pressure. The units will be those defined in the absolute pressure group.

Tube Daily Registers

ARRAY	DESCRIPTION	USAGE	GROUP NAME
220	Daily Static Pressure	Floating Point	Abs Pressure, see note 5)
221	Daily Diff. Pressure	Floating Point	Diff Pressure
222	Daily Temperature	Floating Point	Temperature
224	Daily Extension	Floating Point	LCP Integral, see note 3)
225	Daily Volume	Floating Point	Log Volume
226	Daily Heating Value	Floating Point	HV Volume / HV Mass, see note 4)

ARRAY	DESCRIPTION	USAGE	GROUP NAME
227	Daily Flow time	Floating Point	None
228	Daily Total time	Floating Point	None
229	Daily Alarm bits	32 bits, See note 1)	None
230	Daily Period Mass	Floating Point	Log Mass
231	DailyPeriod Average Base Density	Floating Point	Density
232	Daily Period Average Flowing Density	Floating Point	Density
233	DailyPeriod Average Barometric Pressure	Floating Point	Barometric Pressure
251	Daily Record	See note 2)	None

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 */
    float        mass;              /* Day Mass */
    float       contract_baro;      /* Average Contract Day baro pressure */
    float       avg_base_density;   /* Average Day base density */
    float       avg_line_density;   /* Average Day flowing density */
    float       avg_dayrec_tfrq;    /* Not used  */
  } DAYRECORD;
```

3. LCP Integral – this is the square root of the static pressure * differential pressure / flowing temeperature. For Selectable Units this field is always calculated as:

   static pressure: bar
   diff pressure: mbar
   temperature: deg Kelvin

4. The units for this group are dependent on the value of the heating select bit accesed via register app.6.5. For a “0” the group is HV Volume, for “1” the group is HV Mass.

5. If the transducer is a gage transducer and gage logging is selected then the value logged here will be the log period average pressure – log period average barometric pressure. The units will be those defined in the absolute pressure group.

Tube Event Registers

ARRAY	DESCRIPTION	USAGE
252	Event Log Record	See note 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;
```

AGA7 Selectable Units Tube Registers (Rev AD)

Tube Byte Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
0.0	Contract Hour	Read/Write, 0-23	None
0.1	Reset Volume Command	Write	None
0.2	Reset Log Period Command	Write	None
0.3	Calibration Hold Mode	Read/Write	None
0.4	AP/ACF/TF Over Range Flags	Read Only	None
0.5	Tube Database Rev	Read Only	None
0.6	AGA-3 1985 Dynamic Select Bits	Read/Write, used only for AGA-3, 1985, other tubes or calculation methods ignore this value	None
0.7	AGA-3 1992 Static Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value	None
0.8	AGA-3 1992 Dynamic Select Bits	Read/Write, used only for AGA-3, 1992, other tubes or calculation methods ignore this value	None
0.9	Volume Calc Type	Read/Write	None
0.10	Calc Units	Read Only	None
0.11	Report Units	Read Only	None
0.12	Super Compressibility Method	Read/Write, see note 1)	None
0.13	Use Square Root Average flag	Read/Write	None
0.14	Characteristic Record Type	Read/Write, see note 2)	None
ARRAY.REGISTER	DESCRIPTION	USAGE	None
0.15	Use Fixed H2O	Read/Write, for Fw calculation	None
0.16	Gravity Config flags	Read/Write, live analysis configuration, see note 3)	None
0.17	BTU Config flags	Read/Write, live analysis	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
		configuration, see note 3)	
0.18	Nitrogen Config flags	Read/Write, live analysis configuration, see note 3)	None
0.19	Carbon Dioxide Config flags	Read/Write, live analysis configuration, see note 3)	None
0.20	Hydrogen Sulfide Config flags	Read/Write, live analysis configuration, see note 3)	None
0.21	Water Config flags	Read/Write, live analysis configuration, see note 3)	None
0.22	Helium Config flags	Read/Write, live analysis configuration, see note 3)	None
0.23	Methane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.24	Ethane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.25	Propane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.26	Normal Butane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.27	Iso-Butane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.28	Normal Pentane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.29	Iso-Pentane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.30	Normal Hexane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.31	Normal Heptane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.32	Normal Octane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.33	Normal Nonane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.34	Normal Decane Config flags	Read/Write, live analysis configuration, see note 3)	None
0.35	Oxygen Config flags	Read/Write, live analysis configuration, see note 3)	None
0.36	Carbon Monoxide Config flags	Read/Write, live analysis configuration, see note 3)	None
0.37	Hydrogen Config flags	Read/Write, live analysis configuration, see note 3)	None
0.38	Argon Config flags	Read/Write, live analysis configuration, see note 3)	None
0.39	Number of live components	Read/Write	None
0.40	Get/release calc lock	Read/Write	None
0.41	Tube analysis stream index	Read/Write	None
0.42	Flow rate / volume scale flags	Read/Write, see note 4)	None
0.43	Aux contact 1 re-open interval	Read/Write	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
0.44	Aux contact 1 current state	Read Only	None
0.45	Aux contact 1 manual set	Read/Write	None
0.46	Aux contact 2 re-open interval	Read/Write	None
0.47	Aux contact 2 current state	Read Only	None
0.48	Aux contact 2 manual set	Read/Write	None
0.49	Remote Sense Action	Read/Write	None
0.50	Remote Sense State	Read Only	None
0.51	Events Available	Write, Canadian Event Log	None
0.52	Aux Contact 1 select bits low byte	Read/Write, see note 5)	None
0.53	Aux Contact 2 select bits low byte	Read/Write, see note 5)	None
0.54	Hold tube analog inputs	Read/Write	None
0.55	Static pressure absolute/gauge select	Read/Write, 0=absolute, 1=gauge	None
0.56	Number of samples before AD Fail Set or Released	For Internal Use Only	None
0.57	Current number of consecutive bad AD readings	For Internal Use Only	None
0.58	Vol period Complete flag	Read/Write (see note 6)	None
0.59	Log period Complete flag	Read/Write (see note 7)	None
0.60	Day period Complete flag	Read/Write (see note 8)	None
0.61	tubeCheckPoint control	Read/Write (see note 9)	None
0.62	Canadian Event Log Inhibit Flag	Read Only (see note 10)	None
0.63	Stop Logging Events	Read Only (See Note 11)	None
0.64	Log in Gage Pressure	Read/Write (See Note 12)	None
0.65	Log DP Check	Read/Write (See Note 18)	None
0.66	Use fixed Sp on Error	Read/Write (See Note 19)	None
0.67	Use fixed Dp on Error	Read/Write (Notes 19 & 20)	None
0.68	Use fixed Tf on Error	Read/Write (See Note 19)	None
6.0	AGA-7 Factor Select Bits	Read/Write, See note 13)	None
6.1	Misc Select Bits	Read/Write, See note 14)	None
6.2	Units scale selection for uncorrected vol units	Read/Write, See note 15)	None
6.3	Units scale selection for corrected volume units	Read/Write, See note 16)	None
6.4	Units scale selection for flow rate units	Read/Write, See note 17)	None
6.5	AGA7 test Calculations	Write	None
6.6	Heating Value Select 0=Vol Based 1=Mass Based	Read/Write	None
6.7	Last Calc Heat Value Select	Read Only Not used	None
6.8	1 = unitTable was changed	Internal Only	None
6.9	1 = busy moving use files	Internal Only	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
6.10	1 = remote changed use files	Internal Only	None
6.11	1 = pccu changed use files	Internal Only	None
6.12	Move image to use	Internal Only	None

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. Not used in Selectable Units XFC/XRC devices. Selections made using group flow rates for Volume, Uncorrected Volume, Mass and Energy.
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.
6. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when a volume calculation and all operations associated with it are complete. Typically a test sets the flag to “0”. Then does something to cause a calculation. It then waits until the flag is “1” to evaluate the results of the test.
7. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when all operations associated a log period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.
8. The flag is used in testing the XFC/XRC. The flag will be set to a “1” when all operations associated a day period event are complete. Typically a test sets the flag to “0” and waits until the flag becomes a “1”. Then the logged data would be evaluated.
9. This is for internal use only. A logic 1 disables tube cold and warm start functions.
10. When this flag is 1 no events are allowed and no parameter changes are allowed from any protocol.
11. When this flag is 1 no events are allowed and no parameter changes are allowed.
12. When this bit is logic 1 and the transducer is a gage transducer pressure logging in Log and Day records is done Gage Pressure. The log gage pressure is computed by subtracting the barometric pressure from the average of the input pressure over the log/day period.
13. 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*/
14. 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 */

15. Units scale selection for uncorrected volume – Not used in selectable units
16. Units scale selection for corrected volume – Not Used in selectable units
17. Units scale selection for flow rate – Not Used in selectable units
18. With pressure applied to SP.
19. Used only with Selectable Units.
20. Gas orifice only.

Tube 16-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
1.0	Primary Element Mask	Read Only, indicates primary element type, see note 1)	None
1.1	Calc Method Mask	Read Only, indicates calculation methods supported, see note 2)	None
1.2	Calc Units Mask	Read Only, not used	None
1.3	Report Units Mask	Read Only, not used	None
1.4	Super Comp Method Mask	Read Only, indicates super-compressibility methods that may be selected. See note 3)	None
1.5	Live Analysis Update Interval	Read/Write, live analysis updates are expected in this interval, expressed in seconds	None
1.6	Volume Calc period	Read/Write, seconds	None
1.7	Daily Record Capacity	Read/Write, number of daily records, change to this value deletes existing database and starts new database	None
1.8	Log Record Capacity	Read/Write, number of log period records, change to this value deletes existing database and starts new database	None
1.9	Event Record Capacity	Read/Write, number of event records, change to this value deletes existing database and starts new database	None
1.10	Aux Contact 1 Select Bits	Read/Write, control bits, note 4)	None
1.11	Aux Contact 2 Select Bits	Read/Write, control bits, see note 4)	None

1.12	Return number of events available	Write, Canadian Event Log	None
1.13	Therms Stream Id	Read/WriteAnalysis Stream Id	None
1.14	Modbus address of analyzer	Read/Write	None
1.15	Therms use fixed or last good	Read/Write	None
1.16	Daily Record Sequence Number	Read Only	None
1.17	Log Record Sequence Number	Read Only	None
1.18	Event Record Sequence Number	Read Only	None
1.19	ACF Status Flags	Read Only, see note 5)	None
1.20	AP Status Flags	Read Only, see note 6)	None
1.21	TF Status Flags	Read Only, see note 7)	None
1.22	PI Status Flags	Read Only, see note 8)	None
1.23	Ext Status Flags	Read Only, see note 9)	None

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. 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.

Tube 32-bit Integer Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
2.0	Log period	Read/Write, seconds	None
2.1	Julian timestamp of most recent AIU download	Read/Write, see note 1)	None
2.2	Julian timestamp of most recent live component update (not aiu)	Read/Write, see note 1)	None

2.3	Julian timestamp of prev day period	Read Only, see note 1)	None
9.0	Tube Alarm Bits	Read Only, See note 2)	None

Tube 32-bit Integer Register Notes:

1. Julian time is number of seconds since midnight, 1/1/1970.
2. 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

Tube Floating Point Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.0	Current AP / cal checks	Read/Write, see note 1)	Transducer Pressure
3.1	AP High Limit	Read/Write see note 1)	Abs Pressure
3.2	AP Low Limit	Read/Write see note 1)	Abs Pressure
3.3	Current Temp	Deg F	Transducer Temperature
3.4	Fixed Temp	Deg F	Temperature
3.5	Temp High Limit	Deg F	Temperature
3.6	Temp Low Limit	Deg F	Temperature
3.7	Flow Rate High Limit	Read/Write, see note 2)	Base Volume

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.8	Flow Rate Low Limit	Read/Write, see note 2)	Base Volume
3.9	DP/ACF Percent High for Day	Read Only	Percent
3.10	DP/ACF Percent Low for Day	Read Only	Percent
3.11	Fixed F(b) AGA-3 1985	Read/Write	None
3.12	Fixed Cd AGA-3 1992	Read/Write	None
3.13	Zba	Read/Write	None
3.14	Orifice coef of expansion	Read/Write	Expansion
3.15	Pipe coef of expansion	Read/Write	Expansion
3.16	Barometric Pressure	Read/Write	Barometric Pressure
3.17	F(t) for Fpv NX19	Read/Write	None
3.18	F(p) for Fpv NX19	Read/Write	None
3.19	Fixed Analysis BTU	Read/Write, see note 3)	HV Volume / HV Mass
3.20	Fixed Analysis Gravity	Read/Write	None
3.21	Fixed Analysis Nitrogen	Read/Write	Mole Percent
3.22	Fixed Analysis Carbon Dioxide	Read/Write	Mole Percent
3.23	Fixed Analysis Hydrogen Sulfide	Read/Write	Mole Percent
3.24	Fixed Analysis Water	Read/Write	Mole Percent
3.25	Fixed Analysis Helium	Read/Write	Mole Percent
3.26	Fixed Analysis Methane	Read/Write	Mole Percent
3.27	Fixed Analysis Ethane	Read/Write	Mole Percent
3.28	Fixed Analysis Propane	Read/Write	Mole Percent
3.29	Fixed Analysis Normal Butane	Read/Write	Mole Percent
3.30	Fixed Analysis Iso-Butane	Read/Write	Mole Percent
3.31	Fixed Analysis Normal Pentane	Read/Write	Mole Percent
3.32	Fixed Analysis Iso-Pentane	Read/Write	Mole Percent
3.33	Fixed Analysis Normal Hexane	Read/Write	Mole Percent
3.34	Fixed Analysis Normal Heptane	Read/Write, mole %	3.34
3.35	Fixed Analysis Normal Octane	Read/Write	Mole Percent
3.36	Fixed Analysis Normal Nonane	Read/Write	Mole Percent
3.37	Fixed Analysis Normal Decane	Read/Write	Mole Percent
3.38	Fixed Analysis Oxygen	Read/Write	Mole Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.39	Fixed Analysis Carbon Monoxide	Read/Write	Mole Percent
3.40	Fixed Analysis Hydrogen	Read/Write	Mole Percent
3.41	Fixed Analysis Argon	Read/Write	Mole Percent
3.42	Fixed H2O Content	Read/Write	Water
3.43	Fixed H2O Bias	Read/Write	Water
3.44	Live Analysis Gravity Accumulator	Read/Write	None
3.45	Live Analysis BTU Accumulator	Read/Write	HV Volume / HV Mass
3.46	Live Analysis Nitrogen Accumulator	Read/Write	Mole Percent
3.47	Live Analysis Carbon Dioxide Accumulator	Read/Write	Mole Percent
3.48	Live Analysis Hydrogen Sulfide Accumulator	Read/Write	Mole Percent
3.49	Live Analysis Water Accumulator	Read/Write	Mole Percent
3.50	Live Analysis Helium Accumulator	Read/Write	Mole Percent
3.51	Live Analysis Methane Accumulator	Read/Write	Mole Percent
3.52	Live Analysis Ethane Accumulator	Read/Write	Mole Percent
3.53	Live Analysis Propane Accumulator	Read/Write	Mole Percent
3.54	Live Analysis Normal Butane Accumulator	Read/Write	Mole Percent
3.55	Live Analysis Iso-Butane Accumulator	Read/Write	Mole Percent
3.56	Live Analysis Normal Pentane Accumulator	Read/Write	Mole Percent
3.57	Live Analysis Iso-Pentane Accumulator	Read/Write	Mole Percent
3.58	Live Analysis Normal Hexane Accumulator	Read/Write	Mole Percent
3.59	Live Analysis Normal Heptane Accumulator	Read/Write	Mole Percent
3.60	Live Analysis Normal Octane Accumulator	Read/Write	Mole Percent
3.61	Live Analysis Normal Nonane Accumulator	Read/Write	Mole Percent
3.62	Live Analysis Normal Decane Accumulator	Read/Write	Mole Percent

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.63	Live Analysis Oxygen Accumulator	Read/Write	Mole Percent
3.64	Live Analysis Carbon Monoxide Accumulator	Read/Write	Mole Percent
3.65	Live Analysis Hydrogen Accumulator	Read/Write	Mole Percent
3.66	Live Analysis Argon Accumulator	Read/Write	Mole Percent
3.67	Log Site Code in Event Log		None
3.68	Valve Control Accumulated Volume	Read/Write	Valve Accumulator
3.69	Aux Contact 1 Volume Setpoint	Read/Write	Cout Volume
3.70	Aux Contact 2 Volume Setpoint	Read/Write	Cout Volume
3.71	Last calc period Nitrogen	Read Only	Mole Percent
3.72	Last calc period CO2	Read Only	Mole Percent
3.73	Last calc period H2S	Read Only	Mole Percent
3.74	Last calc period H2O	Read Only	Mole Percent
3.75	Last calc period HE	Read Only	Mole Percent
3.76	Last calc period C1	Read Only	Mole Percent
3.77	Last calc period C2	Read Only	Mole Percent
3.78	Last calc period C3	Read Only	Mole Percent
3.79	Last calc period NC4	Read Only	Mole Percent
3.80	Last calc period IC4	Read Only	Mole Percent
3.81	Last calc period NC5	Read Only	Mole Percent
3.82	Last calc period IC5	Read Only	Mole Percent
3.83	Last calc period NC6	Read Only	Mole Percent
3.84	Last calc period NC7	Read Only	Mole Percent
3.85	Last calc period NC8	Read Only	Mole Percent
3.86	Last calc period NC9	Read Only	Mole Percent
3.87	Last calc period NC10	Read Only	Mole Percent
3.88	Last calc period O2	Read Only	Mole Percent
3.89	Last calc period CO	Read Only	Mole Percent
3.90	Last calc period H2	Read Only	Mole Percent
3.91	Last calc period AR	Read Only	Mole Percent
3.92	Last calc period AIR	Read Only	Mole Percent
3.93	Last calc period C6PLUS	Read Only	Mole Percent
3.94	Last calc period BTU	Read Only	HV Volume / HV Mass
3.95	Last calc period GRAVITY	Read Only	None

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
3.96	current contract day accumulated energy	Read Only	Total Energy
3.97	yesterdays contract day accumulated energy	Read Only	Total Energy
3.98	Current Energy rate	Not used, see reg app.7.27	Energy Rate
3.99	Month Accumulated Volume	Read Only,see note 4)	Month Volume Total
3.100	Month Accumulated Volume not reset by “reset vol” command	Read Only,see note 4)	Month Volume Total
3.101	Months Accumulated Energy	Read Only,see note 4)	Month Energy Total
3.102	Month Accumulated Energy not reset by “reset vol” command	Read Only,see note 4)	Month Energy Total
3.103	Fixed Ap	Read / Write	Abs Pressure
3.104	Current Flow Rate	Read Only	Base Volume
3.105	Previous Month Accumulated Volume	Read Only	Total Volume
3.106	Previous Month Accumulated Volume not affected by reset volume command	Read Only	Total Volume
3.107	Previous Month Energy	Read Only	Total Energy
3.108	Previous Month Energy not affected by reset volume command	Read Only	Total Energy
3.109	Ap high error value	Read/Write	Abs Pressure
3.110	Ap low error value	Read/Write	Abs Pressure
3.111	Dp high error value	Read/Write	Diff Pressure
3.112	Dp low error value	Read/Write	Diff Pressure
3.113	Tf high error value	Read/Write	Temperature
3.114	Tf low error value	Read/Write	Temperature
7.0	Current Pulse Count	Read Only	None
7.1	Pulse Input High Limit	Read/Write	Abase Volume
7.2	Pulse Input Low Limit	Read/Write	Abase Volume
7.3	Pulse Input K Factor	Read/Write	None
7.4	Pulse Input Flow Window	Read/Write	None
7.5	Fixed Pressure Input	Read/Write	See note 5)
7.6	Current Flow Rate scaled	Read Only	Volume Flow
7.7	Current Contract Day Volume scaled	Read Only	Total Volume
7.8	Accumulated Volume scaled	Read Only	Total Volume
7.9	Yesterday's volume scaled	Read Only	Total Volume
7.10	Current Uncorrected Flow Rate scaled	Read Only	AVolume Flow
7.11	Current Contract Day Uncorrected Volume scaled	Read Only	ATotal Volume
7.12	Accumulated Uncorrected volume scaled	Read Only	ATotal Volume

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
7.13	Yesterday's Uncorrected volume scaled	Read Only	ATotal Volume
7.14	Accumulated Uncorrected Volume scaled	Read/Write	ATotal Volume
7.15	Pressure base	Read/Write	Absolute Pressure
7.16	Temperature base	Read/Write	Temperature
7.17	Fixed F(aux)	Read/Write	None
7.18	Cprime Test	Read Only	None
7.19	C-Prime	Read Only	None
7.20	ACF	Read Only	Abase Volume
7.21	Non-Flow weighted Accum AP	Read Only	Absolute Pressure
7.22	Window Flow Secs	Read Only	None
7.23	Current Flow Rate	Read Only	Base Volume Flow
7.24	Current Contract Day Volume	Read Only	Total Volume
7.25	Accumulated Volume	Read Only	Total Volume
7.26	Yesterday's volume	Read Only	Total Volume
7.27	Current Uncorrected Flow Rate	Read Only	Abase Volume Flow
7.28	Current Contract Day Uncorrected Volume	Read Only	ATotal Volume
7.29	Accumulated Uncorrected volume	Read Only	ATotal Volume
7.30	Yesterday's Uncorrected volume	Read Only	ATotal Volume
7.3	Flow Rate High limit scaled	Read/Write	Volume Flow
7.32	Flow Rate Low limit scaled	Read/Write	Volume Flow
7.33	Last Period Volume	Read Only	Base Volume
7.34	Last Period Uncorrected Volume	Read Only	ABase Volume
7.35	Window Uncorrected Volume	Read Only	ABase Volume
7.36	One second massflow rate	Read Only	Mass Flow
7.37	One second energy rate	Read Only	Energy Flow
7.38	Last calculated Base Density	Read Only	Density
7.39	Last calculated Line Density	Read Only	Density
7.40	Last Calculated base compressibility	Read Only	None
7.41	Last Calculated flowing compressibility	Read Only	None
7.42	Last Calculated ftb	Read Only	None
7.43	Last Calculated tpb	Read Only	None
7.44	Last Calculated fpv	Read Only	None
7.45	Last Calculated mass	Read Only	Base Mass
7.46	Last Calculated energy	Read Only	Base Energy
7.47	One Second Turbine Frequency	Read Only	Frequency
7.48	Last Log Period Turbine Frequency	Read Only	Frequency
7.49	Current daily Average Turbine	Read Only	Frequency

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
	Frequency		
7.50	Previous Daily Average Turbine Frequency	Read Only	Frequency
7.51	Current Accumulated Day Mass	Read Only	Total Mass
7.52	Previous Day Logged Mass	Read Only	Log Mass
7.53	Current Day Average Base Density	Read Only	Density
7.54	Previous Day Average Base Density	Read Only	Density
7.55	Current Day Average Line Density	Read Only	Density
7.56	Previous Day Average Line Density	Read Only	Density
7.57	Current Day Average Barometric Pressure	Read Only	Barometric Pressure
7.58	Previous Day Average Barometric Pressure	Read Only	Barometric Pressure
7.59	Last Calc Static Pressure	Read Only	Absolute Pressure
7.60	Last Calc Flowing Temperature	Read Only	Temperature
7.61	Last Calc Barometric Pressure	Read Only	Barometric Pressure
7.62	Last Calc Pressure Base	Read Only	Absolute Pressure
7.63	Last Calc Temperature Base	Read Only	Temperature
7.64	Last Calc C Prime	Read Only	None
7.65	Last Calc One second CPrime	Read Only	None
7.66	Last Calc ACF	Read Only	ABase Volume
7.67	Last Calc Faux	Read Only	None
7.68	Last Calc Measured Pressure	Read Only	Absolute pressure
7.69	Last Calc Measured Temperature	Read Only	Temperature
7.70	Last Calc Specific Heat Ratio	Read Only	None
7.71	Last Calc Viscosity	Read Only	Viscosity
7.72	Last Calc Z base of Air	Read Only	None
7.73	Today’s Accumulated Mass	Read Only	Total Mass
7.74	Contract Day Accumulated Mass	Read Only	Total Mass
7.75	Yesterday’s Contract Day Accumulated Mass	Read Only	Total Mass
7.76	Today’s accumulated Energy	Read Only	Total Energy
7.77	Contract Day Accumulated Energy	Read Only	Total Energy
7.78	Yesterday’s Contract Day Accumulated Energy	Read Only	Total Energy
7.79	Current Static Pressure in system units	Read Only	Absolute Pressure
7.80	Current flowing Temperature in system units	Read Only	Temperature
7.81	Current Barometric Pressure in	Read Only	Barometric Pressure

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
	system units		

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.
3. The group depends on the heating value selected. For energy/mass the group is HVMass_grp. For energy/volume the group is HVVolume_grp.
4. Not currently implemented in the selectable units device
5. The group for this value depends on the type of static pressure transducer used. If an absolute transducer is used the group is the absolute pressure group. If a gage transducer is used the units are the gage pressure group. The units for the gage and absolute pressure units must be the same.

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	GROUP NAME
4.0	AP Register	Read/Write	None
4.1	ACF Register	Read/Write	None
4.2	TF Register	Read/Write	None
4.3	PI Register	Read/Write	None
4.4	RS Register	Read/Write	None
4.5	AC 1 Register	Read/Write	None
4.6	AC 1 DI Register	Read/Write	None
4.7	AC 2 Register	Read/Write	None
4.8	AC 2 DI Register	Read/Write	None

Tube String Registers

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
5.0	Tube ID	Read/Write	None
5.1	Tube last analyis time	Read Only	None
5.2	Tube Description	Read/Write	None

Tube Last Calculation Period Analysis Registers, Floating Point, Read Only

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
10.0	Last Calc Nitrogen	Read Only	Mole Percent
10.1	Last Calc Carbon Dioxide	Read Only	Mole Percent
10.2	Last Calc Hydrogen Sulfide	Read Only	Mole Percent
10.3	Last Calc Water	Read Only	Mole Percent
10.4	Last Calc Helium	Read Only	Mole Percent
10.5	Last Calc Methane	Read Only	Mole Percent
10.6	Last Calc Ethane	Read Only	Mole Percent
10.7	Last Calc Propane	Read Only	Mole Percent
10.8	Last Calc Normal Butane	Read Only	Mole Percent
10.9	Last Calc Iso-Butane	Read Only	Mole Percent
10.10	Last Calc Normal Pentane	Read Only	Mole Percent
10.11	Last Calc Iso-Pentane	Read Only	Mole Percent
10.12	Last Calc Normal Hexane	Read Only	Mole Percent
10.13	Last Calc Normal Heptane	Read Only	Mole Percent
10.14	Last Calc Normal Octane	Read Only	Mole Percent
10.15	Last Calc Normal Nonane	Read Only	Mole Percent
10.16	Last Calc Normal Decane	Read Only	Mole Percent
10.17	Last Calc Oxygen	Read Only	Mole Percent
10.18	Last Calc Carbon Monoxide	Read Only	Mole Percent
10.19	Last Calc Hydrogen	Read Only	Mole Percent
10.20	Last Calc Argon	Read Only	Mole Percent
10.21	Last Calc Air	Read Only	Mole Percent
10.22	Last Calc Heavy Hydrocarbons	Read Only	Mole Percent
10.23	Last Calc Heat Content	Read Only, BTU/SCF	See note 1)
10.24	Last Calc Specific Gravity	Read Only	None

1. The group depends on the heating value selected. For energy/mass the group is HVMass_grp. For energy/volume the group is HVVolume_grp.

Tube Use File Units Get Registers (11.0 … 11.63):

This read only register returns the units string that a usefile group is currently set to. The format of the command is app.11.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile).

Tube Use File String Register (12.0 … 12.63):

This read only register returns the register number that will return the units a usefile group is currently set. The format of the command is app.12.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile). A typical response would be app.11.group number.

Tube Use File Units Get Registers (13.0 .. 13.63):

This read only register returns the group name, as a string, assigned to usefile group. The format of the command is app.13.group number. Where group number range from “0” to MAX_GROUPS-1 (currently “63” for a usefile).

Tube Use File Image Register (14.0 … 14.63):

This read/write register is use to set usefile image group units. The register numbers may range from “0” to MAX_GROUPS-1 (currently “63” for a usefile). The register number is actually a use file group number Data values entered into these register are transferred to use file upon execution of register set command app.6.11=1. **Note: Executing the app.6.11=1 command will cause the data base to be reset loosing all long term data in the tube application.**

The command app.14.group number will return:

App.14.group number=AA,BBCC,DDDD

Where: AA = group number in decimal

BB = conversion group number in decimal

CC = unit number in decimal

DDDD = the flag field in ascii-hex

On write the command must be entered as AA,BB,CC,DDDD exactly. The comma separator field is important as well a each digit. The allowed ranges for each field is determined by the entries in the Unit_Tab.dat file.

Tube Read/Write Use File Registers (array.15 … array.22):

These registers are used to read/write the individual fields of use file group. The table below describes the each field. Each group has its own allowable set of fields. The registers are not intended to customer use.

The fields are accessed as follows: app.array.group number.

Array	Field	Comment
15	Conversion group number	This field tells the conversion application what type of variable to convert. For example absolute pressures, temperature etc.
16	Unit Number	The index into a conversion groups list of possible conversions. This corresponds to the units selected by the user. Each conversion group has a different list of units.
17	Pre Multiplier Bit	This register accesses the pre multiplier bit of the units flag. It tells the conversion application that the group has a pre multiplier associated with it.
18	Pre Multiplier Field	This field accesses the actual pre multiplier index. The index may range from 0 to 31. The index number to index into a list of pre multipliers (M-1000, MM-1000000, etc).
19	Meter Factor	This bit tells a conversion application if a meter factor is in pulse/quantity or quantity/pulse. It is used in conjunction with the UVol flag field to indicate a pulse input. If the UVol bit field is set the meter factor field is used in generating a “units” string. If not, it is ignored.
20	UVol Bit	This bit tells the conversion application that register is a pulse type.
21	Post Multiplier Bit	This register accesses the post multiplier bit of the units flag. This tells the conversion application that a group has a post multiplier associated with it.
22	Post Multiplier Field	This field accesses the actual post multiplier index. The index may range from 0 to 31. The index number to index into a list of post multipliers (/s, /hr etc).

Tube Use File Register (23.0):

This command is used internally by the system to upload and or download a “usefile”. Execution of this command can cause a system database reset.

Tube Use File Register (24.0 … 24.63):

This read/write register is use to set usefile group units. The register numbers may range from "0" to MAX_GROUPS-1 (currently "63" for a usefile). The register number is actually a use file group number. Data values are immediately used unlike the tube image register command app.14.group number which requires the app.6.11=1 command to make them take effect.

This means the data in the "data base" may contain mixed values. **This command is to be used for test purposes only.**

The command app24.group number will return:

App.24.group number=AA,BBCC,DDDD

Where: AA = group number in decimal

BB = conversion group number in decimal

CC = unit number in decimal

DDDD = the flag field in ascii-hex

On write the command must be entered as AA,BB,CC,DDDD exactly. The comma separator field is important as well a each digit. The allowed ranges for each field is determined by the entries in the Unit_Tab.dat file.

Tube PI Calibration Byte Registers:

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
31.0	Meter Factor Type	Read/Write, see note 1)	None
30.1	Meter Factor Units	Read Only, see note 2)	None
30.2	Number of cal Points	Read/Write, see note 3)	None
30.3	Calibrate abort	Read/write, see note 4)	None
30.4	Complete Calibrate	Read/write, see note 5)	None
30.5	Multipoint Calibrate Enable	Read/Write, see note 6)	None

1. If 0 then the meter factor type is volume/pulse, if 1 then the meter factor type is pulse/volume. An event (356) is logged whenever this field is changed.
2. This field is not currently used and is reserved for future use.
3. This field selects the number of cal points to be used. A maximum of eleven may be currently selected. This field only takes effect when register app.30.4 (Complete Calibration) is sent. All points above the selected point are zeroed out. An event (199) is logged when a calibration is completed and the number of points changes.
4. Sending this command with a value of "1" aborts any calibration in progress. It always returns "0" on read.
5. This command when sent with a value of "1" completes a calibration in progress. An event (198) is logged when this command is sent. Upon reception this command, the entered values for each point are compared against the old values and events are generated if old and new values are not the same.
6. This command enables the multipoint calibration feature. An event (358) is generated anytime this field is changed.

Tube PI Calibration Float Registers:

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
31.0	Last Calculated Dynamic K	Read Only	Transducer PI
31.1	Test PI Count	Read/write	c_pic
31.2	Return Test Dynamic K Calculation	Read Only, see note 1)	Transducer PI
31.3	Check Point	Read/Write, see note 2)	c_pic

1. Reading this location will return a compute dynamic k using the data inputted using command app.31.1 (test PI count). This allows testing of the inputted data table. See section "Calculation of Dynamic K Factor" at the end of this document for additional information.
2. This command is used to enter table calibration check points so an audit trail can be established with event logging. On a write, input a test pulse count. On read, the system software will calculate a dynamic k factor based on the test count entered with write. An event (359) will be logged with the old value being the test count and the new value being the computed dynamic k factor. The value returned will by the command will be the computed dynamic k factor.

Tube PI Calibration Frequency Registers:

This is frequency halve of a frequency, meter factor point pair. An event is logged if the old value is different from the new value upon reception of a calibration complete command (app.30.4=1). The event logged is equal to 211 + point number – 1;

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
32.0	Frequency Point 1	Read/Write	Frequency
32.1	Frequency Point 2	Read Only	Frequency
32.2	Frequency Point 3	Read/Write	Frequency
32.3	Frequency Point 4	Read/Write	Frequency
32.4	Frequency Point 5	Read/Write	Frequency
32.5	Frequency Point 6	Read/Write	Frequency
32.6	Frequency Point 7	Read/Write	Frequency
32.7	Frequency Point 8	Read/Write	Frequency
32.8	Frequency Point 9	Read/Write	Frequency
32.9	Frequency Point 10	Read/Write	Frequency
32.10	Frequency Point 11	Read/Write	Frequency

Tube PI Calibration Meter Factor Registers

This is meter factor halve of a frequency, meter factor point pair. An event is logged if the old value is different from the new value upon reception of a calibration complete command (app.30.4=1). The event logged is equal to 210 + point number – 1;

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
33.0	Meter Factor Point 1	Read/Write	Transducer PI
33.1	Meter Factor Point 2	Read Only	Transducer PI
33.2	Meter Factor Point 3	Read/Write	Transducer PI

ARRAY.REGISTER	DESCRIPTION	USAGE	GROUP NAME
33.3	Meter Factor Point 4	Read/Write	Transducer PI
33.4	Meter Factor Point 5	Read/Write	Transducer PI
33.5	Meter Factor Point 6	Read/Write	Transducer PI
33.6	Meter Factor Point 7	Read/Write	Transducer PI
33.7	Meter Factor Point 8	Read/Write	Transducer PI
33.8	Meter Factor Point 9	Read/Write	Transducer PI
33.9	Meter Factor Point 10	Read/Write	Transducer PI
33.10	Meter Factor Point 11	Read/Write	Transducer PI

Tube PI Calibration String Factor Registers (34.0 … 34.11)

This command returns as string the meter factor register for point N. Its is used by the host (PCCU32) to display the register number.

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.

Tube Log Period Registers

ARRAY	DESCRIPTION	USAGE	GROUP NAME
200	Log Period Static Pressure	Floating Point	Abs Pressure, see note 5)
201	Log Period Diff. Pressure	Floating Point	Diff Pressure
202	Log Period Temperature	Floating Point	Temperature
204	Log Period Extension	Floating Point	LCP Integral, see note 3)
205	Log Period Volume	Floating Point	Log Volume
206	Log Period Heating Value	Floating Point	HV Volume / HV Mass, see note 4)
207	Log Period Flow time	Floating Point	None
208	Log Period Total time	Floating Point	None
209	Log Period Alarm bits	32 bits, see note 1)	None
210	Log Period Mass	Floating Point	Log Mass
211	Log Period Average Base Density	Floating Point	Density
212	Log Period Average Flowing Density	Floating Point	Density
213	Log Period Average Barometric Pressure	Floating Point	Barometric Pressure
214	Log Period Turbine Frequency	Floating Point	Frequency Group

250	Log Period Record	See note 2)	None

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. 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 */
float     mass;           /* Day Mass */
float     contract_baro;  /* Average Contract Day baro pressure */
float     avg_base_density; /* Average Day base density */
float     avg_line_density; /* Average Day flowing density */
float     avg_dayrec_tfrq;  /* Average Day turbine frequency */
} LOGRECORD;
```

3. LCP Integral – this is the square root of the static pressure * differential pressure / flowing temperature. For Selectable Units this field is always calculated as:

   static pressure: bar
   diff pressure: mbar
   temperature: deg Kelvin

4. The units for this group are dependent on the value of the heating select bit accessed via register app.6.5. For a “0” the group is HV Volume, for “1” the group is HV Mass.

5. If the transducer is a gage transducer and gage logging is selected then the value logged here will be the log period average pressure – log period average barometric pressure. The units will be those defined in the absolute pressure group.

Tube Daily Registers

ARRAY	DESCRIPTION	USAGE	GROUP NAME
220	Daily Static Pressure	Floating Point	Abs Pressure, see note 5)
221	Daily Diff. Pressure	Floating Point	Diff Pressure
222	Daily Temperature	Floating Point	Temperature
224	Daily Extension	Floating Point	LCP Integral, see note 3)
225	Daily Volume	Floating Point	Log Volume
226	Daily Heating Value	Floating Point	HV Volume / HV Mass, see note 4)
227	Daily Flow time	Floating Point	None
228	Daily Total time	Floating Point	None
229	Daily Alarm bits	32 bits, See note 1)	None
230	Daily Period Mass	Floating Point	Log Mass
231	DailyPeriod Average Base Density	Floating Point	Density
232	Daily Period Average Flowing Density	Floating Point	Density
233	DailyPeriod Average Barometric Pressure	Floating Point	Barometric Pressure
234	Daily average Turbine Frequency	Floating Point	Frequency Group
251	Daily Record	See note 2)	None

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 */
float       mass;            /* Day Mass */
```

```
float      contract_baro;    /* Average Contract Day baro pressure */
float      avg_base_density; /* Average Day base density */
float      avg_line_density;  /* Average Day flowing density */
float      avg_dayrec_tfrq;   /* Average Day turbine frequency */
} DAYRECORD;
```

3. LCP Integral – this is the square root of the static pressure * differential pressure / flowing temperature. For Selectable Units this field is always calculated as:

   static pressure: bar

   diff pressure: mbar

   temperature: deg Kelvin

4. The units for this group are dependent on the value of the heating select bit accessed via register app.6.5. For a “0” the group is HV Volume, for “1” the group is HV Mass.

5. If the transducer is a gage transducer and gage logging is selected then the value logged here will be the log period average pressure – log period average barometric pressure. The units will be those defined in the absolute pressure group.

Tube Event Registers

ARRAY	DESCRIPTION	USAGE
252	Event Log Record	See note 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;
```

Enron AGA3 Selectable Units Tube Registers (Rev AA)

The following default MRM files are built using File Utilities – Modbus Slave Register Editor and are loaded during the save and restore operation for Enron SU Xseries units.

Reference Configuration File:

XRC – 2101662.

EnronEvt: SU3EnEvt, Type = 6 (mbEvent), Reg = 32, APP.109.0

Event acknowledge is a set boolean to Reg = 32, APP.109.0

EnronDay: SU3EnDay, Type = 5 (mbDayLogRec), Reg = 701, APP.107.0

EnronHr: SU3EnHr, Type = 5 (mbDayLogRec), Reg = 702, APP.108.0

SU3E1028 – (1001-1028)

SU3E3068 – (3001-3068)

SU3E5016 – (5001-5016)
SU3E7193 – (7001-7193)

Modbus Register Map: Register Groups

Registers	Type	Description
32	Event Record	Event or Alarm Records
700	Archive Record	Hourly or Daily Records
1000	BOOLEAN	Digital or Discrete, 1 bit
3000	INTEGER	16 Bit integers
5000	LONG	32 Bit integers
7000	FLOAT	32 Bit IEEE floating point

Proposed map indexing:

Type	Tube 1	Tube 2	Tube 3	Tube 4
Boolean	1001	1301	1601	1901
Integer	3001	3301	3601	3901
Long	5001	5301	5601	5901
Float	7001	7301	7601	7901
Event Rec.	32	33	34	35
Day Rec.	701	703	705	707
Log Rec.	702	704	706	708

Modbus Register Mapping for Tube 1: Boolean Registers

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
1001	Tube	0	13	164	Tube->Flags Bit(SQRT_ACCUM = 01)
1002	Tube	117	1	159	Tube->vcom.aga.apidb Bit(Y = 02)
1003	Tube	117	4	160	Tube->vcom.aga.apidb Bit(FPV = 0x10)
1004	Tube	117	5	161	Tube->vcom.aga.apidb Bit(Fw = 0x20)
1005	Tube	116	4	157	Tube->vcom.aga.apisb Bit(FWS= 0x10)
1006	Tube	116	5	158	Tube->vcom.aga.apisb Bit(UPSTRM = 0x20)
1007	Tube	116	3	143	Tube->vcom.aga.apisb Bit(Fb = 0x08)
1008	Tube	115	7	110	Tube->vcom.aga.agadb Bit(HaveTAPCfg = 0x80)
1009	Tube	115	6	110	Tube->vcom.aga.agadb Bit(USE_PIPETAP = 0x40)
1010	Tube	118	0	20	Tube->vcom.aga.urbsb Bit(RTDM = 0x01)
1011	Tube	118	1	21	Tube->vcom.aga.urbsb Bit(FFM = 0x02)
1012	Tube	0	1	51	Tube->resetvol
1013	Tube	0	2	162	Tube->resetlog
1014	Tube	119	0	34	Tube->accfg[0],auxcbit Bit(CLOM = 0x01)

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
1015	Tube	119	1	35	Tube->accfg[0],auxcbit Bit(DPLM = 0x02)
1016	Tube	119	2	36	Tube->accfg[0],auxcbit Bit(DPHM = 0x04)
1017	Tube	119	3	37	Tube->accfg[0],auxcbit Bit(APLM = 0x08)
1018	Tube	119	4	38	Tube->accfg[0],auxcbit Bit(APHM = 0x10)
1019	Tube	119	5	39	Tube->accfg[0],auxcbit Bit(RESM = 0x20)
1020	Tube	119	6	40	Tube->accfg[0],auxcbit Bit(AOPM = 0x40)
1021	Tube	119	7	41	Tube->accfg[0],auxcbit Bit(VOLM = 0x80)
1022	Tube	0	45	Xx	Tube->ac[0].coutst
1023	Tube	0	3	165	Tube->hold
1024	Tube	118	5	16	Tube->vcom.aga.urbsb Bit(LIVEAX = 0x20)
1025	Tube	124	0	102	Tube->accum.axaccum.first_anl
1026	Tube	118	6	9	Tube->vcom.aga.urbsb Bit(FIXAXERR = 0x40)
1027	Tube	0	15	172	Tube->vcom.aga.use_fixed_h2o
1028	Sys	7	2	11	WakeupSystem()
1029	Tube	104	0	175	User Byte Test_mode analogs
1030	Tube	118	7	Xx	Tube->vcom.aga.urbsb Bit(APCALC = 0x80)
1031	Tube	120	0	Xx	Tube->vcom.aga.agasb Bit(Fb = 0x01)
1032	Tube	120	1	Xx	Tube->vcom.aga.agasb Bit(Ftb = 0x02)
1033	Tube	120	4	Xx	Tube->vcom.aga.agasb Bit(FAUX = 0x10)
1034	Tube	120	2	Xx	Tube->vcom.aga.agasb Bit(Fb = 0x04)
1035	Tube	119	1	Xx	Tube->accfg[0],auxcbit Bit(DPLM = 0x02)
1036	Tube	119	2	Xx	Tube->accfg[0],auxcbit Bit(DPHM = 0x04)
1037	Sys	7	3	Xx	Security Sw.
1038	Sys	7	4	Xx	Low Lithium
1039	Ios	2	4096	Xx	DI1(XFC & XRC)
1039	Ios	2	4102	Xx	DI1(6200)
1040	Tube	104	0	Xx	User Byte RTC
1041	Ios	2	4097	Xx	DI2(XFC & XRC)
1042	Sys	7	0	Xx	Low Charger
1043	Tube	103	0	Xx	Low Battery
1044	Tube	104	0	Xx	User Byte Low Radio Battery
1045	Ios	197	7	Xx	VCI DI1
1046	Ios	197	6	Xx	VCI DI2
1047	Ios	197	5	Xx	VCI DI3
1048	Ios	197	4	Xx	VCI DI4
1049	Ios	196	7	Xx	VCI DO1
1050	Ios	196	6	Xx	VCI DO2
1051	Ios	196	5	Xx	VCI DO3
1052	Ios	196	4	Xx	VCI DO4
1053	Ios	2	8192	Xx	Do1

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
1054	Ios	2	8193	Xx	Do2
1055	Tube	0	48	Xx	Tube->ac[1].coutst
1056	Tube	6	5	197	Heating Value Select
1057	Tube	6	7	Xx	Last Calc Heating Value Select
1058	Tube	123	0	88	Tube->accfg[1],auxcbit Bit(CLOM = 0x01)
1059	Tube	123	1	89	Tube->accfg[1],auxcbit Bit(DPLM = 0x02)
1060	Tube	123	2	90	Tube->accfg[1],auxcbit Bit(DPHM = 0x04)
1061	Tube	123	3	91	Tube->accfg[1],auxcbit Bit(APLM = 0x08)
1062	Tube	123	4	92	Tube->accfg[1],auxcbit Bit(APHM = 0x10)
1063	Tube	123	5	93	Tube->accfg[1],auxcbit Bit(RESM = 0x20)
1064	Tube	123	7	95	Tube->accfg[1],auxcbit Bit(VOLM = 0x80)
1065	Tube	123	6	94	Tube->accfg[1],auxcbit Bit(AOPM = 0x40)
1066	Ios	197	3	Xx	VCI DI5
1067	Ios	197	2	Xx	VCI DI6
1068	Ios	197	1	Xx	VCI DI7
1069	Ios	197	0	Xx	VCI DI8
1070	Ios	196	3	Xx	VCI DO5
1071	Ios	196	2	Xx	VCI DO6
1072	Ios	196	1	Xx	VCI DO7
1073	Ios	196	0	Xx	VCI DO8

Int16 Registers

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
3001	Tube	129	0	250	Tube->vcom.aga.primelem
3002	Tube	1	0	Xx	Tube->primary_element_mask
3003	Tube	0	9	111	Tube->vcom.aga.calctype
3004	Tube	1	1	Xx	Tube->calc_method_mask
3005	Tube	0	10	Xx	Tube->vcom.aga.stor_units
3006	Tube	1	2	Xx	Tube->calc_units_mask
3007	Tube	0	12	108	Tube->vcom.aga.zmethod
3008	Tube	1	3	Xx	Tube->zmethod_mask
3009	Tube	0	0	5	Tube->contract_hour
3010	Tube	1	6	117	Tube->volper
3011	Comm(1)	0	11	XX	Commparms->mbAddress
3012	Comm(1)	0	2	XX	Commparms->baud
3013	Comm(1)	0	3	XX	Commparms->bits
3014	Comm(1)	0	4	XX	Commparms->parity
3015	Comm(1)	0	5	XX	Commparms->stop
3016	Comm(1)	1	0	XX	Commparms->powerup
3017	Comm(1)	1	1	XX	Commparms->keydelay

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
3018	Comm(1)	1	2	XX	Commparms->unkeydelay
3019	Comm(1)	0	6	XX	Commparms->protocol
3020	Comm(1)	0	7	XX	Commparms->establish
3021	Tube	1	9	166	Tube->MaxEvts
3022	Tube	105	5	Xx	Enron_var->ELRlast
3023	Tube	105	2	Xx	Enron_var->ELRread
3024	Tube	105	3	Xx	Enron_var->ELRack
3025	Tube	105	4	Xx	Enron_var->ELRnum
3026	Tube	1	8	168	Tube->MaxLogs
3027	Tube	1	17	Xx	Tube->LPRcurr
3028	Tube	1	7	167	Tube->MaxDays
3029	Tube	1	16	166	Tube->DPRcurr
3030	Tube	129	2	Xx	Tube->DPRfirst
3031	Tube	129	1	Xx	Vol period count
3032	Tube	110	0	Xx	TubeId[0]
3033	Tube	110	1	Xx	TubeId[2]
3034	Tube	110	2	Xx	TubeId[4]
3035	Tube	110	3	Xx	TubeId[6]
3036	Tube	110	4	Xx	TubeId[8]
3037	Tube	112	0	Xx	LOCId[0]
3038	Tube	112	1	Xx	LOCId[2]
3039	Tube	112	2	Xx	LOCId[4]
3040	Tube	112	3	Xx	LOCId[6]
3041	Tube	112	4	Xx	LOCId[8]
3042	Tube	112	5	Xx	LOCId[10]
3043	Tube	112	6	Xx	LOCId[12]
3044	Tube	112	7	Xx	LOCId[14]
3045	Tube	112	8	Xx	LOCId[16]
3046	Tube	112	9	Xx	LOCId[18]
3047	Tube	112	10	Xx	LOCId[20]
3048	Tube	112	11	Xx	LOCId[22]
3049	Tube	113	0	Xx	PartNum[0]
3050	Tube	113	1	Xx	PartNum[2]
3051	Tube	113	2	Xx	PartNum[4]
3052	Tube	113	3	Xx	PartNum[6]
3053	Tube	113	4	Xx	PartNum[8]
3054	Tube	113	5	Xx	PartNum[10]
3055	Tube	111	0	Xx	FCUId[0] PartName
3056	Tube	111	1	Xx	FCUId[2] PartName
3057	Tube	111	2	Xx	FCUId[4] PartName
3058	Tube	111	3	Xx	FCUId[6] PartName
3059	Tube	111	4	Xx	FCUId[8] PartName

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
3060	Tube	111	5	Xx	FCUId[10] PartName
3061	Tube	111	6	Xx	FCUId[12] PartName
3062	Tube	111	7	Xx	FCUId[14] PartName
3063	Tube	111	8	Xx	FCUId[16] PartName
3064	Tube	111	9	Xx	FCUId[18] PartName
3065	Tube	111	10	Xx	FCUId[20] PartName
3066	Tube	111	11	Xx	FCUId[22] PartName
3067	Tube	114	0	Xx	Rev[0]
3068	Tube	114	1	Xx	Rev[1]
3069	Tube	6	6	190	Tube->vcom.aga.su.dptaps
3070	Comm(1)	0	9	xx	Schedule mode
3071	Comm(1)	2	0	xx	Schedule start time
3072	Comm(1)	2	0	xx	Schedule min
3073	Comm(1)	2	3	xx	Schedule duration
3074	Comm(1)	2	2	xx	Schedule interval
3075	Comm(1)	2	1	xx	Schedule stop time
3076	Comm(1)	0	10	xx	Schedule Exception retry limit
3077	Comm(2)	0	9	xx	Schedule mode
3078	Comm(2)	2	0	xx	Schedule start time
3079	Comm(2)	2	0	xx	Schedule min
3080	Comm(2)	2	3	xx	Schedule duration
3081	Comm(2)	2	2	xx	Schedule interval
3082	Comm(2)	2	1	xx	Schedule stop time
3083	CIMM(1)	0	9	xx	Schedule mode
3084	CIMM(1)	2	0	xx	Schedule start time
3085	CIMM(1)	2	0	xx	Schedule min
3086	CIMM(1)	2	3	xx	Schedule duration
3087	CIMM(1)	2	2	xx	Schedule interval
3088	CIMM(1)	2	1	xx	Schedule stop time
3089	CIMM(1)	0	10	xx	Schedule Exception retry limit
3090	CIMM(1)	2	2	xx	Schedule interval

UINT32 Registers

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
5001	Tube	128	0	164	Time/Date
5002	Tube	2	0	118	Tube->logper
5003	Tube	128	5	xx	Logpcnt
5004	Tube	128	1	Xx	Tube->LPRtime
5005	Tube	128	2	Xx	Tube->DPRtime
5006	Tube	2	1	Xx	Tube->anal_time_long

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
5007	Tube	128	4	8	Tube->accum.axaccum.curr.aiu.aiustr
5008	Tube	128	9	Xx	User Long Modbus Seed
5009	Tube	128	3	Xx	Cold Start Date
5010	Tube	128	6	Xx	Tube->accum.psecs.volptot
5011	Tube	128	7	Xx	Tube->accum.volptot.osa.flosecs
5012	Tube	128	8	Xx	Tube->accum.volptot.osa.aflags
5013	Ios	0	12288	Xx	C_pulsecnt(PI1) per second
5014	Ios	0	12289	Xx	C_pulsecnt(PI2) per second
5015	Ios	0	12292	Xx	Pulsecnt(PI1)
5016	Ios	0	12293	Xx	Pulsecnt(PI2)

Float Registers

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7001	Tube	102	0	xx	Enron Model
7002	Tube	102	1	xx	Enron Prom
7003	Tube	102	4	116	Enron Revision
7004	Tube	102	3	1	Enron Date
7005	Tube	102	2	xx	Enron Time
7006	Tube	106	4	5	Enron Var Chour
7007	Tube	106	0	xx	Enron Var daypos
7008	Tube	106	1	xx	Enron Var logpos
7009	Tube	106	2	xx	Enron Var numevts
7010	Tube	106	3	xx	Enron Var ID
7011	Ios	3	5	xx	Battery (Group 41)
7012	Ios	3	6	xx	Charger (Group 41)
7013	Tube	7	74	Xx	Current ap (Group 2)
7014	Tube	7	77	Xx	Current dp (Group 3)
7015	Tube	7	75	Xx	Current temp (Group 5)
7016	Tube	7	19	Xx	Current Flow Rate (Group 20)
7017	Tube	7	27	Xx	Current Energy Rate (Group 30)
7018	Tube	7	26	Xx	Current Mass Rate (Group 15)
7019	Tube	7	22	Xx	Today’s Accumulated Volume (Group 18)
7020	Tube	7	72	Xx	Contract Hour Energy (Group 28)
7021	Tube	7	69	Xx	Contract Hour Mass (Group 18)
7022	Tube	7	35	Xx	Current Day Mass (Group 13)
7023	Tube	7	36	Xx	Day Record Mass (Group 13)
7024	Tube	7	37	Xx	Current Day Avg Base Density (Group 8)
7025	Tube	7	38	Xx	Previous Day Avg Base Density (Group 8)
7026	Tube	7	39	Xx	Current Day Avg Line Density (Group 8)
7027	Tube	7	40	Xx	Previous Day Avg Line Density (Group 8)

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7028	Tube	7	41	Xx	Current Day Avg Baro Press (Group 4)
7029	Tube	7	42	Xx	Previous Day Record Avg Baro Press (Group 4)
7030	Tube	7	68	Xx	Today's Mass (Group 13)
7031	Tube	7	69	Xx	Contract Hour Mass (Group 13)
7032	Tube	7	70	Xx	Yesterdays Contract Hour Mass (Group 13)
7033	Tube	7	71	Xx	Today's Energy (Group 28)
7034	Tube	7	73	Xx	Yesterday's Contract Hour Energy (Group 28)
7035	Tube	3	99	Xx	Month Volume_Acc (Group 59)
7036	Tube	3	101	Xx	Month Energy_Acc (Group 61)
7037	Tube	7	78	Xx	Month Mass_Acc (Group 60)
7038	Tube	3	100	Xx	Month Volume_Acc nonresettable (Group 59)
7039	Tube	3	102	Xx	Month Energy_Acc nonresettable (Group 61)
7040	Tube	7	79	Xx	Month Mass_Acc nonresettable (Group 60)
7041	Tube	3	105	Xx	Prev Month Volume_Acc (Group 59)
7042	Tube	3	107	Xx	Prev Month Energy_Acc (Group 61)
7043	Tube	7	80	Xx	Prev Month Mass_Acc (Group 60)
7044	Tube	3	106	Xx	Prev Month Vol_Acc nonresettable (Group 59)
7045	Tube	3	108	Xx	Prev Month Eng_Acc nonresettable (Group 61)
7046	Tube	7	81	Xx	Prev Month Mass_Acc nonresettable (Group 60)
7047	Tube	7	76	Xx	Baro Pressure in System Units (Group 2)
7048	Tube	125	0	Xx	Enron Log Record Dp (Group 3)
7049	Tube	125	1	Xx	Enron Log Record Ap (Group 2)
7050	Tube	125	2	Xx	Enron Log Record Temperature (Group 5)
7051	Tube	125	3	Xx	Enron Log Record Extension (Group 0)
7052	Tube	125	4	Xx	Enron Log Record Volume (Group 17)
7053	Tube	125	5	Xx	Enron Log Record Energy (Group 27)
7054	Tube	125	6	Xx	Enron Log Record Flow Time (Group 0)
7055	Tube	125	7	Xx	Enron Log Record Period Time (Group 0)
7056	Tube	126	0	Xx	Enron Day Record Dp (Group 3)
7057	Tube	126	1	Xx	Enron Day Record Ap (Group 2)
7058	Tube	126	2	Xx	Enron Day Record Temperature (Group 5)
7059	Tube	126	3	Xx	Enron Day Record Extension (Group 0)
7060	Tube	126	4	Xx	Enron Day Record Volume (Group 17)
7061	Tube	126	5	Xx	Enron Day Record Energy (Group 27)

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7062	Tube	126	6	Xx	Enron Day Record Flow Time (Group 0)
7063	Tube	126	7	Xx	Enron Day Record Period Time (Group 0)
7064	Tube	3	19	85	Fixed analysis btu (Group9/10)
7065	Tube	3	20	63	Fixed analysis gf (Group 0)
7066	Tube	3	22	68	Fixed analysis co2 (Group 32)
7067	Tube	3	21	69	Fixed analysis n2 (Group 32)
7068	Tube	3	26	122	Fixed analysis c1 (Group 32)
7069	Tube	3	27	123	Fixed analysis c2 (Group 32)
7070	Tube	3	28	124	Fixed analysis c3 (Group 32)
7071	Tube	3	30	126	Fixed analysis ic4 (Group 32)
7072	Tube	3	29	125	Fixed analysis nc4 (Group 32)
7073	Tube	3	32	128	Fixed analysis ic5 (Group 32)
7074	Tube	3	31	127	Fixed analysis nc5 (Group 32)
7075	Tube	3	33	129	Fixed analysis nc6 (Group 32)
7076	Tube	3	34	130	Fixed analysis nc7 (Group 32)
7077	Tube	3	35	131	Fixed analysis nc8 (Group 32)
7078	Tube	3	36	132	Fixed analysis nc9 (Group 32)
7079	Tube	3	23	119	Fixed analysis h2s (Group 32)
7080	Tube	3	40	145	Fixed analysis h2 (Group 32)
7081	Tube	3	25	121	Fixed analysis he (Group 32)
7082	Tube	3	38	134	Fixed analysis o2 (Group 32)
7083	Tube	3	39	135	Fixed analysis co (Group 32)
7084	Tube	3	41	144	Fixed analysis ar (Group 32)
7085	Tube	3	37	133	Fixed analysis nc10 (Group 32)
7086	Tube	3	24	120	Fixed analysis h2o (Group 32)
7087	Tube	3	4	79	Fixed Tf (Group 5)
7088	Tube	130	0	80	Temperature bias (Group 57)
7089	Tube	7	11	77	Temperature base (Group 5)
7090	Tube	7	10	78	Pressure base (Group 2)
7091	Tube	7	13	82	Cpcv (Group 0)
7092	Tube	7	14	81	Viscosity (Group 7)
7093	Tube	3	12	112	Fixed Cd (Group 0)
7094	Tube	7	12	100	Faux (Group 0)
7095	Tube	3	17	83	Ft (Group 0)
7096	Tube	3	18	84	Fp (Group 0)
7097	Tube	3	13	115	Zba (Group 0)
7098	Tube	7	8	61	Orifice Id(Group 1)
7099	Tube	3	14	136	Orifice Expansion Coefficient (Group 6)
7100	Tube	7	9	62	Pipe Id (Group 1)
7101	Tube	3	15	137	Pipe Expansion Coefficient (Group 6)
7102	Tube	3	16	138	Barometer (Group 5)

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7103	Tube	3	42	173	Fixed h2o content (Group 48)
7104	Tube	3	43	174	Fixed h2o bias (Group 48)
7105	Tube	7	3	Xx	Dp zerocut (Group 3)
7106	Tube	7	2	64	Dp lolim (Group 3)
7107	Tube	7	1	65	Dp hilim (Group 3)
7108	Tube	3	2	66	Ap lolim (Group 2)
7109	Tube	3	1	67	Ap hilim (Group 2)
7110	Tube	3	6	Xx	Tf lolim (Group 5)
7111	Tube	3	5	Xx	Tf hilim (Group 5)
7112	Tube	3	8	Xx	Flow rate lolim (Group 20)
7113	Tube	3	7	Xx	Flow rate hilim (Group 20)
7114	Tube	3	69	Xx	Covolsp (Group 62)
7115	Tube	130	1	14	Volume Roll Setpoint(Group18)
7116	Tube	3	67	50	Event SiteCode (Group 0)
7117	Ios	4	2	Xx	Amu Rtd (Group 57)
7118	Ios	4	1	Xx	Amu Ap (Group 55)
7119	Ios	4	0	Xx	Amu Dp (Group 56)
7120	Tube	7	66	Xx	Last Calc qm (Group 14)
7121	Tube	7	67	Xx	Last Calc Qv (Group 19)
7122	Tube	7	5	Xx	Last Calc Vol (Group 16)
7123	Tube	7	33	Xx	Last Calc Mass (Group 11)
7124	Tube	7	34	Xx	Last Calc Energy (Group 26)
7125	Tube	7	50	Xx	Last Calc Ap (Group 2)
7126	Tube	7	51	Xx	Last Calc Dp (Group 2)
7127	Tube	7	54	Xx	Last Calc Tf (Group 5)
7128	Tube	7	28	Xx	Last Calc Rhob (Group 8)
7129	Tube	7	29	Xx	Last Calc Flowing Density (Group 8)
7130	Tube	7	30	Xx	Last Calc Zbase (Group 0)
7131	Tube	7	31	Xx	Last Calc Zflow (Group 0)
7132	Tube	7	32	Xx	Last Calc Fpv (Group 0)
7133	Tube	7	63	Xx	Last Calc Cd (Group 0))
7134	Tube	7	60	Xx	Last Calc Yexp (Group 0)
7135	Tube	7	61	Xx	Last Calc Ev (Group 0)
7136	Tube	7	59	Xx	Last Calc Beta (Group 0)
7137	Tube	7	62	Xx	Last Calc Reynolds (Group 0)
7138	Tube	7	57	Xx	Last Calc bore_d (Group 1)
7139	Tube	7	58	Xx	Last Calc pipe_d (Group 1)
7140	Tube	7	45	Xx	Last Calc Ext (Group 1)
7141	Tube	7	49	Xx	Last Calc Fip
7142	Tube	7	64	Xx	Last Calc Cp (Group 0)
7143	Tube	7	52	Xx	Last Calc Temp Base (Group 5)

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7144	Tube	7	53	Xx	Last Calc Pressure Base (Group 2)
7145	Tube	7	55	Xx	Last Calc faux (Group 0)
7146	Tube	7	56	Xx	Last Calc Fw (Group 0)
7147	Tube	7	43	Xx	Last Calc Orifice Ref Temp (Group 36)
7148	Tube	3	14	Xx	Orifice Expansion Coefficient (Group 6)
7149	Tube	7	44	Xx	Last Calc Pipe Ref Temp (Group 37)
7150	Tube	3	15	Xx	Pipe Expansion Coefficient (Group 6)
7151	Tube	7	46	Xx	Last Calc CpCv (Group 0)
7152	Tube	7	47	Xx	Last Viscosity (Group 7)
7153	Tube	7	48	Xx	Last Calc Z Base of Air (Group 0)
7154	Tube	3	94	Xx	Last Calc btu (Group 9/10)
7155	Tube	3	95	Xx	Last Calc Gravity (Group 32)
7156	Tube	3	72	Xx	Last Calc co2 (Group 32)
7157	Tube	3	71	Xx	Last Calc n2 (Group 32)
7158	Tube	3	76	Xx	Last Calc c1 (Group 32)
7159	Tube	3	77	Xx	Last Calc c2 (Group 32)
7160	Tube	3	78	Xx	Last Calc c3 (Group 32)
7161	Tube	3	80	Xx	Last Calc ic4 (Group 32)
7162	Tube	3	79	Xx	Last Calc nc4 (Group 32)
7163	Tube	3	82	Xx	Last Calc ic5 (Group 32)
7164	Tube	3	81	Xx	Last Calc nc5 (Group 32)
7165	Tube	3	83	Xx	Last Calc nc6 (Group 32)
7166	Tube	3	84	Xx	Last Calc nc7 (Group 32)
7167	Tube	3	85	Xx	Last Calc nc8 (Group 32)
7168	Tube	3	86	Xx	Last Calc nc9 (Group 32)
7169	Tube	3	73	Xx	Last Calc h2s (Group 32)
7170	Tube	3	90	Xx	Last Calc h2 (Group 32)
7171	Tube	3	75	Xx	Last Calc he (Group 32)
7172	Tube	3	88	Xx	Last Calc o2 (Group 32)
7173	Tube	3	89	Xx	Last Calc co (Group 32)
7174	Tube	3	91	Xx	Last Calc ar (Group 32)
7175	Tube	3	87	Xx	Last Calc nc10 (Group 32)
7176	Tube	3	74	Xx	Last Calc h2o (Group 32)
7177	Ios	5	63	Xx	AI1 cal complete
7178	Ios	5	53	Xx	AI1 cal pt 5
7179	Ios	5	52	Xx	AI1 cal pt 4
7180	Ios	5	51	Xx	AI1 cal pt 3
7181	Ios	5	50	Xx	AI1 cal pt 2
7182	Ios	5	49	Xx	AI1 cal pt 1
7183	Ios	4	3	Xx	AI1 value
7184	Ios	4	4	Xx	AI2 value

Modbus Register	App Type	App Array	App Reg	Event Code	Variable
7185	Ios	5	79	Xx	AI2 cal complete
7186	Ios	5	69	Xx	AI2 cal pt 5
7187	Ios	5	68	Xx	AI2 cal pt 4
7188	Ios	5	67	Xx	AI2 cal pt 3
7189	Ios	5	66	Xx	AI2 cal pt 2
7190	Ios	5	65	Xx	AI2 cal pt 1
7191	Tube	3	0	86	Ap Marker (Group 55)
7192	Tube	7	0	87	Dp Marker (Group 56)
7193	Tube	3	3	355	Temp Marker (Group 57)

Daily and Hourly Archive Register.

701 Tube.107.0 – Station 1 Tube 1 Daily Archive Record

702 Tube.108.0 – Station 1 Tube 1 Hourly Archive Record

Event Register.

32 Tube.109.0 – Tube 1 Event Record

Tube.109.0 – Read event record

Tube.109.0 – Write event acknowledge

Tube.136.0 – Station 1 Tube 1 Daily Gas Quality Record

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Appendix B
Definitions & Acronyms

TERM	DEFINITION
μ	Greek letter for “mu”. Often used in math and engineering as the symbol for “micro”. Pronounced as a long u.
μ FLO IMV	μFLO’s measurement and operational features are housed in this single unit assembly. The main electronic board (μFLO-195 Board), communication connection, power, SP, DP and Temperature readings are all housed in this unit.
μ FLO-2100767 Board	Main Electronic Board used in the μFLO Computers. It is housed on an integrated assembly and includes the IMV. It operates at 195 MHz while drawing minimal power.
μ Sec	Micro Second.
μFLO 6200	This Totalflow Flow Computer is housed in a small lightweight enclosure. It’s main feature is it’s low power, microprocessor based units designed to meet a wide range of measurement, monitor and alarming applications for remote gas systems, while being a cost effective alternative.
*.CSV file	See Comma Separated Values (I.E. spreadsheet format).
*.INI file	See Initialization File.
A/D	Analog-to-digital.
ABB Inc.	Asea, Brown & Boveri, parent company of Totalflow
Absolute Pressure	Gauge pressure plus barometric pressure. Totalflow devices use Static Pressure (SP) for flow calculations.
Absolute Zero	The zero point on the absolute temperature scale. It is equal to -273.16 degrees C, or 0 degrees K (Kelvin), or -459.69 degrees F, or 0 degrees R (Rankine).
Absorber	A tower or column that provides contact between natural gas being processed and a liquid solvent.
Absorption	The process of removing vapors from a stream of natural gas by passing the natural gas through liquids or chemicals which have a natural attraction to the vapors to be removed from the stream.
Absorption Factor	A factor which is an indication of the tendency for a given gas phase component to be transferred to the liquid solvent. It is generally expressed as A=L/KV where L and V are the moles of liquid and vapor, and K is the average value of the vapor-liquid equilibrium constant for the component of concern.
Absorption Oil	A hydrocarbon liquid used to absorb and recover components from the natural gas being processed.
AC	See Alternating Current.
Accuracy	How closely a measured value agrees with the correct value. Usually expressed as ± percent of full scale output or reading.
Acid Gas	See Gas, Acid.
ACK	See Acknowledgment.
Acknowledgment	This refers to a response over a remote communication device to a request such as a PING. Basically, saying, "I'm here, and I saw your request!"
ACM	See Analyzer Control Module.
Acoustics	The degree of sound. The nature, cause, and phenomena of the vibrations of elastic bodies; which vibrations create compressional waves or wave fronts which are transmitted through various media, such as air, water, wood, steel, etc.

TERM	DEFINITION
Active Analog Output	Analog Output to a host providing power to the host.
Active Mode	An operational mode used by the LevelMaster for measuring dual float levels by applying a signal to the primary windings, reading the voltage level on the secondary windings and using an algorithm to determine the oil and water levels.
Adapter	A mechanism or device for attaching non-mating parts.
ADC	See Analog-to-Digital Converter.
Address	A unique memory designation for location of data or the identity of a peripheral device; allows each device on a single communications line to respond to its own message.
Adiabatic Expansion	The expansion of a gas, vapor, or liquid stream from a higher pressure to a lower pressure in which there is no heat transfer between the gas, vapor, or liquid and the surroundings.
Adsorption	The process of removing natural gas liquids from a stream of natural gas by passing the natural gas through granular solids which have a natural attraction to the liquids to be removed from the stream.
Aerial	A length of wire designed to transmit or receive radio waves. (See also Antenna)
Aerosol Liquids	Minute liquid particles suspended in gas. Aerosols will behave like a fluid and can be transported by pipes and pumping. When aerosols contact each other they coalesce into droplets. Aerosols may be present in gas, or may be generated by glow shearing off the skim inside of a pipeline.
AGA	American Gas Association. Trade group representing natural gas distributors and pipelines.
AGA-10	American Gas Association Report No. 10, Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases. Method for calculation of the speed of sound in gases.
AGA-3	American Gas Association Report No. 3, Orifice Metering of Natural Gas. Method for calculating gas volume across an Orifice Plate. This method requires two pressure readings, Differential Pressure (DP) and Static Pressure (SP).
AGA-5	American Gas Association Report No. 5, Fuel Gas Energy Metering. Methods (Volume, Mass or Energy) for calculating BTUs without knowing the composition of the gas.
AGA-7	American Gas Association Report No. 7, Measurement of Gas by Turbine Meters. Method for calculating gas volume using a Pulse Meter. This method requires one pressure reading, Static Pressure (SP).
AGA-8	American Gas Association Report No. 8, Compressibility Factor of Natural Gas and Related Hydrocarbon Gases. Method for calculating the Super Compressibility Factor, Fpv.
AGA-9	American Gas Association Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters. Method for calculating gas based on transit-times.
AGC	Automatic Gain Control
AH	See Ampere-Hour.
AI	Analog Input
AIU	Analyzer Interface Unit.
Alkane	The simplest homologous series of saturated aliphatic hydrocarbons, consisting of methane, ethane, propane, butane; also know as olefins. Unsaturated hydrocarbons that contain one or more carbon-carbon double bonds.
Alkanolamine	See Amine.

TERM	DEFINITION
Alkynes	Unsaturated hydrocarbons that contain one or more carbon-carbon triple bonds.
Alphanumeric	A character set that contains both letters and digits.
Alternating Current	An electric current whose direction changes with a frequency independent of circuit components.
Aluminum Powder Coating	Totalflow aluminum enclosures have a baked-on Powder Coating designed to our specifications to ensure paint adhesion, weather resistance and durability.
Ambient Compensation	The design of an instrument such that changes in ambient temperature do not affect the readings of the instrument.
Ambient Conditions	The conditions around the transducer (pressure, temperature, etc.).
Ambient Pressure	Pressure of the air surrounding a transducer.
Ambient Temperature	The average or mean temperature of the surrounding air which comes in contact with the equipment and instruments under test.
Amine (Alkanolamine)	Any of several liquid compounds containing amino nitrogen generally used in water solution to remove, by reversible chemical reaction, hydrogen sulfide and/or carbon dioxide from gas and liquid hydrocarbon streams.
Ammeter	An instrument used to measure current.
Amp	See Ampere.
Ampere	The unit of electrical current. Also milliamp (one thousandth of an amp) and microamp (one millionth of an amp). One amp corresponds to the flow of about 6×10^{18} electrons per second.
Ampere-Hour	The quantity of electricity measured in ampere-hours (Ah) which may be delivered by a cell or battery under specified conditions. A current of one ampere flowing for one hour.
Ampere-Hour Efficiency	The ratio of the output of a secondary cell or battery, measured in ampere-hours, to the input required to restore the initial state of charge, under specified conditions.
Amplifier	A device which draws power from a source other than the input signal and which produces as an output an enlarged reproduction of the essential features of its input.
Amplitude	The highest value reached by voltage, current or power during a complete cycle.
Amplitude Modulation	Where audio signals increase and decrease the amplitude of the "carrier wave".
Amplitude Span	The Y-axis range of a graphic display of data in either the time or frequency domain. Usually a log display (dB) but can also be linear.
AMU	See Analog Measurement Unit.
AMU/IMV	Generic reference to the Measurement unit. See Analog Measurement Unit and Integral Multivariable Transducer for more definition.
Analog	A system in which data is represented as a continuously varying voltage/current.
Analog Input	Data received as varying voltage/current.
Analog Measurement Unit	A transducer for converting energy from one form to another. (e.g. Static and Differential pressure to electrical signals)
Analog Output	A voltage or current signal that is a continuous function of the measured parameter. Data that is transmitted as varying voltage/current.
Analog Trigger	A trigger that occurs at a user-selected point on an incoming analog signal. Triggering can be set to occur at a specific level on either an increasing or a decreasing signal (positive or negative slope).

TERM	DEFINITION
Analog-to-Digital Converter	An electronic device, often an integrated circuit, that converts an analog voltage to a number.
Analytical Module	Totalflow Analytical Module assembly contains the GC Module, Manifold and Analytical Processor. The modular design features Single Bolt removal.
Analytical Processor Assembly	The Analytical Processor board interfaces with the analog circuits to monitor temperatures, and pressures, and also control the processes. The data generated by the Analytical Processor is passed to the Digital Controller board.
Analyzer Control Module	Consists of various electronic components used for analysis.
Anemometer	An instrument for measuring and/or indicating the velocity of air flow.
Annealed	Toughen (steel or glass) by a process of gradually heating and cooling,
Annunciator	Display of a status on a screen.
ANSI	American National Standards Institute.
Antenna	A length of wire or similar that radiates (such as a transmitting antenna) or absorbs (such as a radio antenna) radio waves. The two basic types are: Yagi (directional) or Omni (bi-directional).
AO	Analog Output
AP	See Absolute Pressure.
API 14.3	American Petroleum Institute Report No. 14.3 addresses the 1992 equation regarding the AGA-3 method for calculating gas volume across an Orifice Plate.
API 21.1	American Petroleum Institute Report No. 21.1 addresses the equation regarding AGA-8 Fpv or Supercompressibility Factor and the energy content of the gas.
API Gravity	An arbitrary scale expressing the relative density of liquid petroleum products. The scale is calibrated in degrees API. The formula is: $DegAPI = \left[\frac{141.5}{\gamma(60°F / 60°F}\right] - 131.5$ where γ =relative density.
Archive	A file containing historical records in a compressed format for more efficient long term storage and transfer. Totalflow archive records are non-editable, meaning that when they are stored they may not be changed. These records are used during an audit of data.
Artificial Drives	Techniques for producing oil after depletion or in lieu of natural drives; includes water flooding, natural gas re-injection, inert gas injection, flue gas injection and in-situ combustion.
Artificial Lift	Any of the techniques, other than natural drives, for bringing oil to the surface.
ASCII	American Standard Code for Information Interchange. A very popular standard method of encoding alphanumeric characters into 7 or 8 binary bits.
ASME	American Society of Mechanical Engineers.
ASTM	American Society for Testing and Materials (ASTM International).
ASTM D 3588	ASTM International Standard Practice for calculating heat value, compressibility factor and relative density of gaseous fuels.
Asynchronous	A communications protocol where information can be transmitted at an arbitrary, unsynchronized point in time, without synchronization to a reference time or "clock".
ATC	Automatic temperature compensation.
ATEX	Term used for European Union’s New Approach Directive 94/9/EC which concerns equipment and protective systems intended for use in potentially explosive atomoshperes.

TERM	DEFINITION
Atmosphere (one)	A unit of pressure; the pressure that will support a column of mercury 760 mm high at 0 °C.
Atmospheric Pressure	The pressure exerted on the earth by the earth's atmosphere (air and water vapor). A pressure of 760 mm of mercury, 29.92 inches of mercury, or 14.696 pounds per square inch absolute is used as a (scientific) standard for some measurements. Atmospheric pressure may also refer to the absolute ambient pressure at any given location.
Audio Frequency	Generally in the range 20 Hz to 20 KHz.
Audit	To examine or verify data for accuracy. Totalflow's DB1 and DB2 records may be edited to generate a more accurate representation of data information.
Audit Trail	Using the Long Term Archive files to justify changes made to records that more accurately reflects the correct data. Peripheral information used to edit data is recorded without exception, to justify the accuracy of the edited data records.
Automatic Frequency Control	Similar to Automatic Fine Tune (AFT). A circuit that keeps a receiver in tune with the wanted transmission.
AWG	American Wire Gage.
AWG	Acronym for American Wire Gauge.
Back Pressure	Pressure against which a fluid is flowing. May be composed of friction in pipes, restrictions in pipes, valves, pressure in vessels to which fluid is flowing, hydrostatic head, or other resistance to fluid flow.
Backflush	Technique used in chromatography to reverse direction of the flow after the lighter components have been measured, allowing the heavier components to remain in the column until measured, shortening the length of the column.
Background Acquisition	Data is acquired by a DAQ system while another program or processing routine is running without apparent interruption.
Background Noise	The total noise floor from all sources of interference in a measurement system, independent of the presence of a data signal.
Backup	A system, device, file or facility that can be used as an alternative in case of a malfunction or loss of data.
Bandwidth	The range of frequencies available for signaling; the difference between the highest and lowest frequencies of a band expressed in Hertz.
Bar	Bar is equal to 1 atmosphere of pressure. I.e. .987 Standard atmospheric pressure or 14.5 lbs./psia.
Barometer	An instrument which measures atmospheric pressure.
Barrel	A unit of liquid volume measurement in the petroleum industry that equals 42 U.S. gallons (.159 cubic meters) for petroleum or natural gas liquid products, measured at 60 degrees Fahrenheit and at an equilibrium vapor pressure.
Base Pressure	The pressure used as a standard in determining gas volume. Volumes are measured at operating pressures and then corrected to base pressure volume. Base pressure is normally defined in any gas measurement contract. The standard value for natural gas in the United States is 14.73 psia, established by the American National Standards Institute as standard Z-132.1 in 1969.
Basic Sediment and Water	Waste that collects in the bottom of vessels and tanks containing petroleum or petroleum products.
Battery	Two or more electrochemical cells electrically interconnected in an appropriate series/parallel arrangement to provide the required operating voltage and current levels.
Baud	Unit of signaling speed. The speed in baud is the number of discrete conditions or events per second. If each event represents only one bit condition, baud rate equals bits per second (bps).

TERM	DEFINITION
Baud Rate	Serial communications data transmission rate expressed in bits per second (b/s).
Bbl	See Barrel.
Bcf	Abbreviation for one billion standard cubic feet or one thousand MMcf or one million Mcf.
BG Mix	A liquefied hydrocarbon product composed primarily of butanes and natural gasoline.
Bias	Term used when calibrating. Amounts to offset the actual measurement taken. On a LevelMaster, it refers to adjusting the measurement of the float level to agree with a calibrated measurement. On an RTD (Resistant Thermal Detector), it refers to adjusting the measurement of the temperature to agree with a calibrated temperature. This figure maybe either a positive or negative figure.
BIAS Current	A very low-level DC current generated by the panel meter and superimposed on the signal. This current may introduce a measurable offset across a very high source impedance.
Binary Number	System based on the number 2. The binary digits are 0 and 1.
Binary-Coded Decimal	A code for representing decimal digits in a binary format.
BIOS	Basic Input/Output System. A program, usually stored in ROM, which provides the fundamental services required for the operation of the computer. These services range from peripheral control to updating the time of day.
Bipolar	A signal range that includes both positive and negative values.
Bipolar Transistor	The most common form of transistor.
Bit	Binary Digit - the smallest unit of binary data. One binary digit, either 0 or 1. See also byte.
Bits Per Second	Unit of data transmission rate.
Blue Dot Technology	Technological changes to the DC and ACM Modules, decreasing noise by changing ground. Allows amplification of the results, gains resolution.
Board	Common name used to identify the Main Electronic Board. Also called Motherboard, Engine Card and Circuit Board.
Boiling Point	The temperature at which a substance in the liquid phase transforms to the gaseous phase; commonly refers to the boiling point of water which is 100°C (212°F) at sea level.
Bounce	Bouncing is the tendency of any two metal contacts in an electronic device to generate multiple signals as the contacts close or open. When you press a key on your computer keyboard, you expect a single contact to be recorded by your computer. In fact, however, there is an initial contact, a slight bounce or lightening up of the contact, then another contact as the bounce ends, yet another bounce back, and so forth. A similar effect takes place when a switch made using a metal contact is opened.
BP Mix	A liquefied hydrocarbon product composed primarily of butanes and propane.
BPS	See Bits Per Second.
Bridge	Generally a short-circuit on a PC board caused by solder joining two adjacent tracks.
Bridge Resistance	See Input impedance and Output impedance.
British Thermal Unit	Energy required to raise one pound of water one degree Fahrenheit. One pound of water at 32 F° requires the transfer of 144 BTUs to freeze into solid ice.
Browser	Software which formats Web pages for viewing; the Web client
BS&W	See Basic Sediment and Water.

TERM	DEFINITION
Btu	See British Thermal Unit.
Btu Factor	A numerical representation of the heating value of natural gas which may be calculated or presented to indicate varying relationships (e.g., the number of Btu contained in one standard cubic foot or the number of MMBtu contained in one Mcf of gas. The factor for a given relationship will vary depending upon whether the gas is “dry” or “saturated”.
Btu Method	A method of allocating costs between different operations or between different products based upon the heat content of products produced in the various operations or of the various produced products.
Btu per Cubic Foot	A measure of the heat available or released when one cubic foot of gas is burned.
Btu, Dry	Heating value contained in cubic foot of natural gas measured and calculated free of moisture content. Contractually, dry may be defined as less than or equal to seven pounds of water per Mcf.
Btu, Saturated	The number of Btu’s contained in a cubic foot of natural gas fully saturated with water under actual delivery pressure, temperature and gravity conditions. See BTU, DRY.
Btu/CV	Used to express the heating content of gas. See British Thermal Units or Calorific Value.
BtuMMI	Refers to the interface program or software that operates the Btu Analyzer.
Buffer	(1) A temporary storage device used to compensate for a difference in data rate and data flow between two devices (typically a computer and a printer); also called a spooler; (2) An amplifier to increase the drive capability, current or distance, of an analog or digital signal.
Burst Pressure	The maximum pressure applied to a transducer sensing element or case without causing leakage.
BUS	A data path shared by many devices (e.g., multipoint line) with one or more conductors for transmitting signals, data, or power.
Bus Master	A type of controller with the ability to read and write to devices on the computer bus.
Busbar	A heavy, rigid conductor used for high voltage feeders.
Butane (C4H10)	A saturated hydrocarbon (Alkane) with four carbon atoms in it’s molecule (C_4H_{10}). A gas at atmospheric pressure and normal temperature, but easily liquefied by pressure. Generally stored and delivered in liquefied form and used as a fuel in gaseous form, obtained by processing natural gas as produced and also from a process in petroleum refining. Contains approximately 3,260 Btu per cubic foot.
Butane, Normal	see Normal Butane.
Butylene (C4H8)	A saturated hydrocarbon (Alkane) with four carbon atoms in it’s molecule (C_4H_8). A gas at room temperature and pressure, but easily liquefied by lowering the temperature or raising the pressure. This gas is colorless, has a distinct odor, and is highly flammable. Although not naturally present in petroleum in high percentages, they can be produced from petrochemicals or by catalytic cracking of petroleum.
Byte	A group of binary digits that combine to make a word. Generally 8 bits. Half byte is called a nibble. Large computers use 16 bits and 32 bits. Also used to denote the amount of memory required to store one byte of data.
C10H22	The molecular formula for Decane.
C1H4	The molecular formula for Methane.
C2H4	The molecular formula for Ethylene.
C2H6	The molecular formula for Ethane.

TERM	DEFINITION
C3H6	The molecular formula for Propylene.
C3H8	The molecular formula for Propane.
C4H10	The molecular formula for Butane.
C4H8C	The molecular formula for Butylene.
C5+	A standard abbreviation for Pentanes Plus (IC5, NC5 and C6+).
C5H12	The molecular formula for Pentane.
C6+	A standard abbreviation for Hexane Plus.
C6H14	The molecular formula for Hexane.
C7H16	The molecular formula for Heptane.
C8H18	The molecular formula for Octane.
C9H20	The molecular formula for Nonane.
Cache Memory	Fast memory used to improve the performance of a CPU. Instructions that will soon be executed are placed in cache memory shortly before they are needed. This process speeds up the operation of the CPU.
Calibrate	To ascertain, usually by comparison with a standard, the locations at which scale or chart graduations should be placed to correspond to a series of values of the quantity which the instrument is to measure, receive or transmit. Also, to adjust the output of a device, to bring it to a desired value, within a specified tolerance for a particular value of the input. Also, to ascertain the error in the output of a device by checking it against a standard.
Calorie	The quantity of thermal energy required to raise one gram of water 1°C at 15°C.
Calorimeter	An apparatus which is used to determine the heating value of a combustible material.
Capacitor	An electronic component that stores electrical charge.
Capacity	The total number of ampere-hours (or watt-hours) that can be withdrawn from a cell/battery under specified conditions of discharge.
CAR	Carrier Gas (located on NGC8200 series Feed-Through Assembly).
Carbon	Base of all hydrocarbons and is capable of combining with hydrogen in many proportions, resulting in numberless hydrocarbon compounds. The carbon content of a hydrocarbon determines, to a degree, the hydrocarbon's burning characteristics and qualities.
Carbon Dioxide	Colorless, odorless and slightly acid-tasting gas, consisting of one atom of carbon joined to two atoms of oxygen. C02. Produced by combustion or oxidation of materials containing carbon. Commonly referred to as dry ice when in its solid form.
Carrier Gas	Totalflow recommends that Helium be used as a carrier gas. Carrier gas is used in the “Mobile Phase” of chromatography, pushing the sample gas through the columns (“Stationary Phase”). Because Helium has no heating value, it does not affect the Btu values.
Casinghead Gas	Natural gas that is produced from oil wells along with crude oil.
Catalyst	A substance that speeds up a chemical reaction without being consumed itself in the reaction. A substance that alters (usually increases) the rate at which a reaction occurs.
Catalytic	The process of altering, accelerating or instigating a chemical reaction.
Cathode	An electrode through which current leaves any nonmetallic conductor. An electrolytic cathode is an electrode at which positive ions are discharged, or negative ions are formed, or at which other reducing reactions occur. The negative electrode of a galvanic cell; of an electrolytic capacitor.

TERM	DEFINITION
Cavitation	The boiling of a liquid caused by a decrease in pressure rather than an increase in temperature.
CC	Cubic Centimeters. Measurement unit for measuring volume or capacity in one hundredth of a meter.
CC	Acronym for Cubic Centimeter.
C-Code	C language (IEC supported programming language)
CCU	See DosCCU, WINCCU, PCCU or WEBCCU.
CCV	See Closed Circuit Voltage.
Cd	Coefficient of Discharge factor.
CE	European Community Certification Bureau.
Cell	The basic electrochemical unit used to generate or store electrical energy.
Celsius (centigrade)	A temperature scale defined by 0°C at the ice point and 100°C at boiling point of water at sea level.
CENELEC	European Committee for Electro-technical Standardization. Also known as the European Standards Organization.
Centimeter	Acronym c. Metric measurement equal to .3937 inch.
Central Processing Unit	The central part of a computer system that performs operations on data. In a personal computer the CPU is typically a single microprocessor integrated circuit.
Ceramic Insulation	High-temperature compositions of metal oxides used to insulate a pair of thermocouple wires The most common are Alumina (Al2O3), Beryllia (BeO), and Magnesia (MgO). Their application depends upon temperature and type of thermocouple. High-purity alumina is required for platinum alloy thermocouples. Ceramic insulators are available as single and multihole tubes or as beads.
Certification	The process of submitting equipment to specific tests to determine that the equipment meets the specifications or safety standards.
Cf	A standard abbreviation for Cubic foot.
CFG	Configuration File. When saving new configuration files, the file is saved as a *.cfg file.
CFM	The volumetric flow rate of a liquid or gas in cubic feet per minute.
Character	A letter, digit or other symbol that is used as the representation of data. A connected sequence of characters is called a character string.
Characteristics	Detailed information pertaining to it's description. The XFC stores this information in the PROM chip. A feature or quality that makes somebody or something recognizable.
Charge	The conversion of electrical energy, provided in the form of a current from an external source, into chemical energy within a cell or battery.
Chip	Another name for integrated circuit or the piece of silicon on which semiconductors are created.
Chromatograph	An instrument used in chemical analysis, to determine the make-up of various substances, and often used to determine the Btu content of natural gas. Chromatography- A method of separating gas compounds by allowing it to seep through an adsorbent so that each compound is adsorbed in a separate layer.
CIM	Communication Interface Module. Totalflow's version is called TFIO Communication Interface Module.

TERM	DEFINITION
Circuit	1. The complete path between two terminals over which one-way or two-way communications may be provided. 2. An electronic path between two or more points, capable of providing a number of channels. 3. A number of conductors connected together for the purpose of carrying an electrical current. 4. An electronic closed-loop path among two or more points used for signal transfer. 5. A number of electrical components, such as resistors, inductances, capacitors, transistors, and power sources connected together in one or more closed loops.
Circuit board	Sometimes abbreviated PCB. Printed circuit boards are also called cards. A thin plate on which chips and other electronic components are placed. They fall into the following categories: Motherboard: Typically, the mother board contains the CPU, memory and basic controllers for the system. Sometimes call the system board or main board. Expansion board: Any board that plugs into one of the computer's expansion slots, including controller boards, LAN cards, and video adapters. Daughter Card: Any board that attaches directly to another board. Controller board: A special type of expansion board that contains a controller for a peripheral device. Network Interface Card (NIC): An expansion board that enables a PC to be connected to a local-area network (LAN). Video Adapter: An expansion board that contains a controller for a graphics monitor.
Class 1, Division 1	Class 1 refers to the presence of flammable gases, vapors or liquids. Division 1 indicates an area where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.
Class 1, Division 2	Class 1 refers to the presence of flammable gases, vapors or liquids. Division 2 indicates an area where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions.
Class 1, Zone 0	Class 1 refers to the presence of flammable gases, vapors or liquids. Zone 0 refers to a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is present continuously or for long periods or frequently.
Class 1, Zone 1	Class 1 refers to the presence of flammable gases, vapors or liquids. Zone 1 refers to a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is likely to occur in normal operation occasionally.
Class 1, Zone 2	Class 1 refers to the presence of flammable gases, vapors or liquids. Zone 2 refers to a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation.
Clean Gas	Gas that has no particles larger than one micron and no more than one milligram of solids per cubic meter.
Clear	To restore a device to a prescribed initial state, usually the zero state.
Clock	The source(s) of timing signals for sequencing electronic events (e.g. synchronous data transfer).
Closed Circuit Voltage	The difference in potential between the terminals of a cell/battery when it is discharging (on- load condition).
CM	Acronym for Cubic Meter.
Cm	Acronym for Centimeter.
CMM	Acronym for Cubic Meter per Minute.
CMOS	See Complimentary Metal-Oxide-Semiconductor.

TERM	DEFINITION
CNG	See Compressed Natural Gas
CO_2	A standard abbreviation for Carbon Dioxide.
Coalbed Methane	A methane-rich, sulfur-free natural gas contained within underground coal beds.
Coefficient of expansion	The ratio of the change in length or volume of a body to the original length or volume for a unit change in temperature.
Coil	A conductor wound in a series of turns.
Cold Start	A rebooting technique which will clear all operational errors, loose all data files, but will not damage configuration files if stored on the SDRIVE.
Cold Weather Enclosure	Totalflow insulated and heated enclosure designed to house either the NGC8200 or Btu 8000/8100 Chromatographs in inclement climates.
Collector	The semiconductor region in a bipolar junction transistor through which a flow of charge carriers leaves the base region.
Column	Hardware component used in gas chromatography to separate components into measurable units.
Combustible	Classification of liquid substances that will burn on the basis of flash points. A combustible liquid means any liquid having a flash point at or above 37.8°C (100°F) but below 93.3°C (200°F), except any mixture having components with flash points of 93.3°C (200°F) or higher, the total of which makes up 99 percent or more of the total volume of the mixture.
Comma Separated Values	These file types are importable records used by spreadsheet programs to display and manipulate data.
Communication	Transmission and reception of data among data processing equipment and related peripherals.
Communication Port	Comm. Port (abbreviation) refers to the host computer's physical communication's port being used to communicate with the equipment. Used by Totalflow when discussing local or remote communication with various equipment including the XFC, FCU, XRC, RTU and LevelMaster etc.
Compensation	An addition of specific materials or devices to counteract a known error.
Complimentary Metal-Oxide-Semiconductor	Family of logic devices that uses p-type and n-type channel devices on the same integrated circuit. It has the advantage of offering medium speed and very low power requirements.
Component	(1) A small object or program that performs a specific function and is designed in such a way to easily operate with other components and applications. Increasingly, the term is being used interchangeably with applet. (2) A part of a device.
Compressed Gas	A gas or mixture of gases having, in a container an absolute pressure exceeding 40 psi at 21.1°C (70°F). A gas or mixture having in a container, an absolute pressure exceeding 104 psi at 54.4°C (130°F) regardless of the pressure at (21.1°C (70°F). A liquid having a vapor pressure exceeding 40 psi at 37.8°C (70°F) as determined by ASTM D-323-72.
Compressed Natural Gas	Natural gas in high-pressure surface containers that is highly compressed (though not to the point of liquefaction). CNG is used extensively as a transportation fuel for automobiles, trucks and buses in some parts of the world. Small amounts of natural gas are also transported overland in high-pressure containers.
Compressibility	The property of a material which permits it to decrease in volume when subjected to an increase in pressure. In gas-measurement usage, the compressibility factor "Z" is the deviation from the ideal Boyle and Charles' law behavior. See SUPERCOMPRESSIBILITY FACTOR.
Compressibility Factor	See Supercompressibility Factor.

TERM	DEFINITION
Compressibility Factor	A factor usually expressed as “z” which gives the ratio of the actual volume of gas at a given temperature and pressure to the volume of gas when calculated by the ideal gas law without any consideration of the compressibility factor.
Concentration	Amount of solute per unit volume or mass of solvent or of solution.
Concurrent	Performing more than one task at a time.
Condensate	1) The liquid formed by the condensation of a vapor or gas; specifically, the hydrocarbon liquid separated from natural gas because of changes in temperature and pressure when the gas from the reservoir was delivered to the surface separators. 2) A term used to describe light liquid hydrocarbons separated from crude oil after production and sold separately.
Condensation	Liquefaction of vapor.
Condensed Phases	The liquid and solid phases; phases in which particles interact strongly.
Condensed States	The solid and liquid states.
Conduction	The conveying of electrical energy or heat through or by means of a conductor.
Configuration No.	The Configuration number is a suffix of the serial number which defines the characteristics of the unit.
Console Mode	A local user interface typically used with custom applications that are not supported through any other mechanism. Also referred to as Printer Console Mode.
Contact	Current carrying part of a switch, relay or connector.
Conversion Time	The time required, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available. This could include switching time, settling time, acquisition time, A/D conversion time, etc.
Coprocessor	Another computer processor unit that operates in conjunction with the standard CPU. Can be used to enhance execution speed. For example, the 8087 is designed to perform floating point arithmetic.
COR	See Corrected Runtime.
Corrected Runtime	Correction to signal made to decrease/increase “ZERO phase” and eliminate the shift between RT and COR for increased accuracy.
Cos	See Cosine.
Cosine	The sine of the complement of an arc or angle.
Counterclockwise	Movement in the direct opposite to the rotation of the hands of a clock.
Counts	The number of time intervals counted by the dual-slope A/D converter and displayed as the reading of the panel meter, before addition of the decimal point.
CPS	Cycles per second; the rate or number of periodic events in one second, expressed in Hertz (Hz).
CPU	See Central Processing Unit.
CPUC	California Public Utilities Commission
CRC	See Cyclic Redundancy Check.
Cryogenic Plant	A gas processing plant which is capable of producing natural gas liquids products, including ethane, at very low operating temperatures.
CSA	CSA International: Formerly Canadian Standards Association. Canadian certification agency.
CTS	Communication abbreviation for Clear To Send.
Cubic	Three-dimensional shape with six equal sides. Used in measuring volume.
Cubic Centimeter	Acronym CC. Metric volume equal to a 1 Centimeter to the 3^{rd} power.

TERM	DEFINITION
Cubic Foot	The most common unit of measurement of gas volume in the US. It is the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor.
Cubic Foot Metered	The quantity of gas that occupies one cubic foot under pressure and temperature conditions in the meter.
Cubic Foot, Standard	That quantity of gas which under a pressure of 14.73 psia and at a temperature of 60 degrees occupies a volume of one cubic foot without adjustment for water vapor content.
Cubic Meter	Acronym CM. Metric volume equal to 35.31467 Cubic Feet.
Cubic Meter Per Minute	Acronym CMM. Metric flow rate equal to 35.31467 Cubic Feet per Minute.
Cumulative Capacity	The total number of ampere-hours (or watt hours) that can be withdrawn from a cell/battery under specified conditions of discharge over a predetermined number of cycles or the cycle life.
Current	Current is measured in amps (milliamps and microamps). It is the passage of electrons. Conventional current flows from positive to negative. Electrons flow from negative to positive - called "electron flow".
Cursor	Dots used to indicate the location of the next character or symbol to be entered.
Custody Transfer	The legal and commercial transfer of a commodity such as natural gas, LNG, etc. from one party to another.
Custody Transfer Transaction	The Custody Transfer Transaction is the hand-off of the physical commodity from one operator to another.
Cut-Off Voltage	The cell/battery voltage at which the discharge is terminated.
CV	Calorific Value. European value of heating content.
CV1	Column 1 Vent (located on NGC8200 series Feed-Through Assembly).
CV2	Column 2 Vent (located on NGC8200 series Feed-Through Assembly).
CWE	Cold Weather Enclosure.
Cycle	One complete sequence of events. One complete alteration of an AC current or Volt. The discharge and subsequent charge of a rechargeable cell/battery is called a cycle.
Cycle Life	The number of cycles under specified conditions which were available from a rechargeable cell/battery before it fails to meet specified criteria as to performance.
Cycle Time	The time usually expressed in seconds for a controller to complete one on/off cycle.
Cyclic Redundancy Check	An ongoing verification of the validity of transmitted and received data providing assurance that the message conforms to a pre-agreed upon convention of communications.
D/A	See Digital-to-analog.
D/I	See Digital Input.
D/O	See Digital Output.
DAC	See Digital to Analog Converter.
DACU	Data Acquisition Control Unit.
Data Acquisition	Gathering information from sources such as sensors and AMUs in an accurate, timely and organized manner. Modern systems convert this information to digital data, which can be stored and processed by a computer.
Data Collect	Physically, locally or remotely, retrieving data stored with a Totalflow unit. This data is typically stored in records located in a data base format.
DB	See Decibel.

TERM	DEFINITION
DB1	Acronym for Data Base 1. This refers to the previous data base structure used to store data in Totalflow products.
DB2	Acronym for Data Base 2. This refers to the current data base structure used to store data in Totalflow products.
DC	See Direct Current
DCD	Communication abbreviation for Data Carrier Detect
DCS/PLC	Distribution Control System/Programmable Logic Controller
DDE	See Digital Data Exchange. Also called Dynamic Data Exchange. May refer to Totalflow's DDE Server TDS32.
Dead Weight Tester	Portable pressure tester used to check calibration and to calibrate AMU's utilizing a system of calibrated weights.
De-bounce	De-bouncing is any kind of hardware device or software that ensures that only a single signal will be acted upon for a single opening or closing of a contact. When you press a key on your computer keyboard, you expect a single contact to be recorded by your computer. In fact, however, there is an initial contact, a slight bounce or lightening up of the contact, then another contact as the bounce ends, yet another bounce back, and so forth. A similar effect takes place when a switch made using a metal contact is opened. The usual solution is a de-bouncing device or software that ensures that only one digital signal can be registered within the space of a given time (usually milliseconds)
Decane (C10H22)	A hydrocarbon (Alkane) flammable colorless liquid with ten carbon atoms.
Decibel	A logarithmic measure of the ratio of two signal levels. A practical unit of gain.
Decimal	A numbering system based on 10.
Default	A value assigned or an action taken automatically unless another is specified.
Degree	An incremental value in the temperature scale, i.e., there are 100 degrees between the ice point and the boiling point of water in the Celsius scale and 180°F between the same two points in the Fahrenheit scale.
Delivery Point	Point at which gas leaves a transporter's system completing a sale or transportation service transaction between the pipeline company and a sale or transportation service customer.
Demand Day	That 24-hour period specified by a supplier-user contract for purposes of determining the purchaser's daily quantity of gas used (e.g., 8 AM to 8 AM, etc.). This term is primarily used in pipeline-distribution company agreements. It is similar to, and usually coincides with, the distribution company "Contract Day".
Demand Load	The rate of flow of gas required by a consumer or a group of consumers, often an average over a specified short time interval (cf/hr or Mcf/hr). Demand is the cause; load is the effect.
Demand Meters	A device which indicates or records the instantaneous, maximum or integrated (over a specified period) demand.
Demand, Average	The demand on a system or any of its parts over an interval of time, determined by dividing the total volume in therms by the number of units of time in the interval.
Density	Mass per unit Volume: D=MV
Desaturization	Doesn't cause the composition of the gas to change, enabling a more representative sample of gas.
Detector Bead	See Thermal Conductivity Detector.
Deviation	The difference between the value of the controlled variable and the value at which it is being controlled.

TERM	DEFINITION
Dew Point	The temperature at any given pressure at which liquid initially condenses from a gas or vapor. It is specifically applied to the temperature at which water vapor starts to condense from a gas mixture (water dew point) or at which hydrocarbons start to condense (hydrocarbon dew point).
Dewar	A glass or metal container made like a vacuum bottle that is used especially for storing liquefied gases. Also called “Dewar flask”.
DG	Display Group. When display group files are created
Diaphragm	A bellows inside a displacement type gas meter. Also, a membrane separating two different pressure areas within a control valve or regulator.
Differential	For an on/off controller, it refers to the temperature difference between the temperature at which the controller turns heat off and the temperature at which the heat is turned back on. It is expressed in degrees.
Differential Input	A signal-input circuit where SIG LO and SIG HI are electrically floating with respect to ANALOG GND (METER GND, which is normally tied to DIG GND). This allows the measurement of the voltage difference between two signals tied to the same ground and provides superior common-mode noise rejection.
Differential Pressure	The pressure difference between two points in a system. For example, the difference in pressure between the upstream and downstream taps of an orifice plate, used to measure volume passing through the orifice.
Digit	A measure of the display span of a panel meter. By convention, a full digit can assume any value from 0 through 9, a 1/2-digit will display a 1 and overload at 2, a 3/4-digit will display digits up to 3 and overload at 4, etc. For example, a meter with a display span of ±3999 counts is said to be a 3-3/4 digit meter.
Digital	A signal which has distinct states, either on or off (0 or 1). Digital computers process data as binary information having either true of false states.
Digital Controller Assembly	The Digital Controller Assembly contains the Digital Electronic Board, Mounting Assembly and optionally a VGA Display. The Digital Controller board provides control parameters to the Analytical Processor board, stores and processes the data sent from the Analytical Processor board. The Digital Controller also processes communication with other devices.
Digital Data	Information transmitted in a coded form (from a computer), represented by discrete signal elements.
Digital Data Exchange or Dynamic Data Exchange	A Microsoft data exchange format generally used to transfer data from one program to another. It is a very simple format to use and Totalflow customers often use TDS to acquire data from Totalflow devices and then transfer the data to an Excel spreadsheet using DDE. The Totalflow Driver, TDS32, supports DDE and its network version, NetDDE.
Digital Electronics	The branch of electronics dealing with information in binary form.
Digital Input	Refers to the signal received in binary format.
Digital Output	Refers to the signal emitted in binary format. An output signal which represents the size of an input in the form of a series of discrete quantities.
Digital to Analog Conversion	The process of translating discrete data into a continuously varying signal. Common uses are to present the output of a digital computer as a graphic display or as a test stimulus.
Digital-to-Analog Converter	An electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current.
DIN	Deutsches Institut für Normung. German Institute for Standardization set of standards recognized throughout the world.
DIN Rail	Rail on which modules are mounted. Allows modules to snap on and slide right and left.
Diode	A semiconductor that allows current to flow in one direction only.

TERM	DEFINITION
DIP Switches	A bank of switches typically used in setting the hardware configuration and base address of an option card.
Direct Current	A current that does not change in direction and is substantially constant in value.
Direct Memory Access	A method by which information can be transferred from the computer memory to a device on the bus without using the processor.
Discharge	The conversion of chemical energy of a cell/battery into electrical energy and withdrawal of the electrical energy into a load.
Discharge Rate	The rate, usually expressed in amperes, at which electrical current is taken from the cell/battery.
Discrete Manifold	Also called Tubing Manifold. Used in instances when the XFC is not mounted directly on the Orifice, usually pipe mount or wall mount.
Distillates	The distillate or middle range of petroleum liquids produced during the processing of crude oil. Products include diesel fuel, heating oil, kerosene and turbine fuel for airplanes.
Distillation	The first stage in the refining process in which crude oil is heated and unfinished petroleum products are initially separated.
Distribution	The act or process of distributing gas from the city gas or plant that portion of utility plant used for the purpose of delivering gas from the city gate or plant to the consumers, or to expenses relating to the operating and maintenance of distribution plant.
Distribution Company	Gas Company which obtains the major portion of its gas operating revenues from the operation of a retail gas distribution system, and which operates no transmission system other than incidental connections within its own system or to the system of another company. For purposes of A.G.A. statistics, a distribution company obtains at least 90 percent of its gas operating revenues from sales to ultimate customers, and classifies at least 90 percent of mains (other than service pipe) as distribution. Compare INTEGRATED COMPANY; TRANSMISSION COMPANY, GAS.
Dkt	Abbreviation for Decatherm, equivalent to one MMBtu.
DMM	Digital Multi-Meter.
DN	Inside diameter standard.
DOS	Disk Operating System.
DOS CCU	Refers to the DOS version of the Calibration and Collection Unit. Also known as FS/2, hand held or Dog Bone.
DOT Matrix	A group of dots/pixels forming a character or symbol, usually five dots across and seven dots down.
DOT/Pixel	An active element that forms a character or symbol when combined in a matrix.
Download	This refers to a Totalflow procedure in which any file(s) located on a laptop PC or storage device, may be copied to the on-board memory of a Totalflow Host device for purposes of restoring, configuration or repair.
Downstream	The oil industry term used to refer to all petroleum activities from the processing of refining crude oil into petroleum products to the distribution, marketing, and shipping of the products. Also see Upstream.
Downstream Pipeline	The pipeline receiving natural gas at a pipeline inter-connect point.
DP	See Differential Pressure.
DRAM	See Dynamic Random Access memory.
Drift	A change of a reading or a set point value over long periods due to several factors including change in ambient temperature, time, and line voltage.

TERM	DEFINITION
Drip Gasoline	Hydrocarbon liquid that separates in a pipeline transporting gas from the well casing, lease separation, or other facilities and drains into equipment from which the liquid can be removed.
Driver (Hardware)	An electronic circuit that provides input to another electronic circuit.
Driver (Software)	A program that exercises a system or system component by simulating the activity of a higher level component.
Drivers	Software that controls a specific hardware device, such as interface boards, PLCs, RTUs, and other I/O devices.
Droplet Liquids	Large liquid particles
Dry Contact	Contacts which neither break nor make a circuit. 0 Ohms.
Dry Gas	Has no more than seven pounds of water per million cubic feet of gas. Gas has less than 0.1 PPM of liquid at the coldest ambient condition expected at the coldest point in the system. The liquid can be water, oil, synthetic lubrication, glycol, condensed sample or any other non vapor contaminate.
DSP	Digital Signal Processor.
Dual Element Sensor	A sensor assembly with two independent sensing elements.
Dual-Access Memory	Memory that can be sequentially accessed by more than one controller or processor but not simultaneously accessed. Also known as shared memory.
Duplex	The ability to both send and receive data simultaneously over the same communications line.
Duplex Wire	A pair of wires insulated from each other and with an outer jacket of insulation around the inner insulated pair.
Duty Cycle	The total time to one on/off cycle. Usually refers to the on/off cycle time of a temperature controller.
DVI	The Port Manager and communication engine of the iVision SCADA System. This software can multiplex among several communication formats and thus supporting several vendor’s equipment over a single radio frequency. It “pushes” new data to the iVision database, saving time and network resources by not transmitting redundant data. The DVI includes the Totalflow WinCPC code and thus supports all Totalflow software and functions – including WinCCU, TDS, PCCU, Report by exception, cryout, etc.
Dynamic Random Access memory	This is the most common form of computer memory It needs to be continually refreshed in order to properly hold data, thus the term "dynamic."
E^2Prom	See Electrically Erasable Programmable Read-Only Memory. Also called EEPROM.
Earth	Can mean a connection to the earth itself or the negative lead to the chassis or any point to zero voltage.
EC	European Community.
Echo	To reflect received data to the sender. i.e. depressed on a keyboard are usually echoed as characters displayed on the screen.
Edit	Making changes to information, data or configuration files.
EEPROM	See Electrically Erasable Programmable Read-Only Memory. The PROM can be erased by electricity.
EFI	Electromechanical Frequency Interface.
EFM	See Electronic Flow Measurement.
EFR	Enhance Feature Release.
Electrical Interference	Electrical noise induced upon the signal wires that obscures the wanted information signal.

TERM	DEFINITION
Electrically Erasable Programmable Read-Only Memory	ROM that can be erased with an electrical signal and reprogrammed. Also referred to as the S Drive. It is a persistent drive that will not loose it's memory unless manually reprogrammed. Also called E^2Prom. Totalflow's XFC and XRC have a Serial EEPROM on board, which generally holds registry, application configuration and warranty information (non-volatile).
Electrode	The site, area, or location at which electrochemical processes take place.
Electromagnetic Compatibility	Term used for European Union's New Approach Directive 89/336/EEC which means the device or system is able to function in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.
Electromagnetic Interference	Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like.
Electronic Flow Measurement	Historically, flow measurement was tracked using a chart recording technology. Developments in the field of electronics allowed for electronic measurement devices to overtake the chart recording market. This field continues to develop into peripheral markets, making the "Flow Meter" a valuable asset with multi-tasking "Control" capabilities. Totalflow's answer to this developing market is the XSeries equipment.
EMC	See Electromagnetic Compatibility
EMI	See Electromagnetic Interference.
Emitter	One terminal of a transistor.
EN	Euro Norm (European Standard)
Enagas	Spain's Certification Board
Encoder	A device that converts linear or rotary displacement into digital or pulse signals. The most popular type of encoder is the optical encoder, which uses a rotating disk with alternating opaque areas, a light source, and a photodetector.
Environmental Conditions	All conditions in which a transducer may be exposed during shipping, storage, handling, and operation.
EP Mix	A liquefiable hydrocarbon product consisting primarily of ethane and propane.
EPROM	See Erasable Programmable Read-Only Memory. The PROM can be erased by ultraviolet light or electricity.
Erasable Programmable Read-Only Memory	ROM that can be erased using Ultraviolet Light. The EPROM maybe re-programmed by removing the EPROM from the circuit and using special equipment to write to it.
Ethane (C2H6)	A colorless hydrocarbon gas of slight odor having a gross heating value of 1,773 Btu per cubic foot and a specific gravity of 1.0488. It is a normal constituent of natural gas.
Ethylene (C2H4)	A colorless unsaturated hydrocarbon gas of slight odor having a gross heating value of 1,604 Btu per cubic foot and a specific gravity of 0.9740. It is usually present in manufactured gas, constituting one of its elements and is very flammable.
EU	European Union. Formerly known as the European Community (EC). Members of this union are replacing individual national regulations of member countries with a series of Directives. These Directives are legislative instruments which oblige member states to introduce them into their existing laws. These directives harmonize a variety of existing practices, preserve the different legal traditions and settle constraints for further developments.
Event	Important incident: an occurrence, especially one that is particularly significant.

TERM	DEFINITION
Event File	Stored records specifying a notable change. The XFC stores up to 200 records, containing: Time, Day, Description, Old Value, New Value.
Events	Signals or interrupts generated by a device to notify another device of an asynchronous event. The contents of events are device-dependent.
Ex	Potential Explosive.
EXIMV	Explosion Proof Integral Multivariable Transducer.
Expansion Board	A plug-in circuit board that adds features or capabilities beyond those basic to a computer, such as a data acquisition system expansion board.
Expansion Factor	Correction factor for the change in density between two pressure measurement areas in a constricted flow.
Expansion Slots	The spaces provided in a computer for expansion boards than enhance the basic operation of the computer.
Explosion-proof Enclosure	Explosion Proof Enclosure for Class 1 Division 1 locations. An enclosure that can withstand an explosion of gases within it and prevent the explosion of gases surrounding it due to sparks, flashes or the explosion of the container itself, and maintain an external temperature which will not ignite the surrounding gases.
Extended Binary Coded Decimal Interchange Code	EBCDIC. An eight-bit character code used primarily in IBM equipment. The code allows for 256 different bit patterns.
External Multivariable Transducer	Multivariable Transducer located outside of the Flow Computer enclosure. Used in multi-tube configurations and on systems where the actual Flow Computer is located at a distance from the flowing tube.
External Transducer	DP/SP Transducer located outside the enclosure. All electronics are located inside the enclosure and communicate via a ribbon cable.
F.O.B.	Abbreviation of free on board with the cost of delivery to a port and loading onto a ship included.
Fa	Orifice Thermal Expansion factor.
Fahrenheit	A temperature scale defined by 32° at the ice point and 212° at the boiling point of water at sea level.
Faux	Full Well Stream Factor.
Fb	Basic Orifice factor.
FBD	Function Block Diagram (IEC supported programming language)
FCC	Federal Communications Commission.
FCU	Flow computer unit
Feed Points	Connections between gas feeder lines and distribution networks.
Feedback	Occurs when some or all of the output of the device (such as an amplifier) is taken back to the input. This may be accidental (such as the acoustic feedback from a speaker to microphone) or intentional , to reduce distortion.
Feeder (Main)	A gas main or supply line that delivers gas from a city gate station or other source of supply to the distribution networks.
Feed-Through Assembly	The Feed-Through Assembly also serves as the connection for sample streams, carrier gas and calibration streams, and contains the vents for sample and column gases.
FET	Field-effect transistor. Transistor with electric field controlling output: a transistor, with three or more electrodes, in which the output current is controlled by a variable electric field.
Fg	Specific Gravity factor.
Field Pressure	The pressure of natural gas as it is found in the underground formations from which it is produced.

TERM	DEFINITION
File	A set of related records or data treated as a unit.
Film Liquids	Aerosols liquids who have contacted each other and become adhered to the inside of the pipeline.
Firmware	A computer program or software stored permanently in PROM or ROM or semi-permanently in EPROM.
Firmware Version	This refers to the version of firmware contained in the equipment.
Fixed-Point	A format for processing or storing numbers as digital integers.
Flag	Any of various types of indicators used for identification of a condition or event; for example, a character that signals the termination of a transmission.
Flameproof Enclosure “d”	Enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.
Flammable	A liquid as defined by NFPD and DOT as having a flash point below 37.8°C (100°F).
Flange	For pipe, a metal collar drilled with bolt holes and attached to the pipe with its flat surface at right angles to the pipe axis so that it can be securely bolted to a mating flange on a valve, another pipe section, etc.
FLASH	Re-programmable memory onboard an XFC/XRC, similar to an EPROM, except that it can be programmed while in circuit using a Boot Loader Program to write to it. Generally used for the operating system and application code space (non-volatile).
Flash ADC	An Analog to Digital Converter whose output code is determined in a single step by a bank of comparators and encoding logic.
Flash Point	The temperature at which a liquid will yield enough flammable vapor to ignite. There are various recognized industrial testing methods; therefore the method used must be stated.
Flash Vapors	Gas vapors released from a stream of natural gas liquids as a result of an increase in temperature or a decrease in pressure.
Flow	Travel of liquids or gases in response to a force (i.e. pressure or gravity).
Flow Computer, XSeries	A device placed on location to measure SP, DP and temperature (to calculate flow) of gases or liquids being transferred, for remote unattended operation.
Flow Formulas	In the gas industry, formulas used to determine gas flow rates or pressure drops in pipelines, regulators, valves, meters, etc.
Flow Rate	Actual speed or velocity of fluid movement .
Flowmeter	A device used for measuring the flow or quantity of a moving fluid.
Fluids	Substances that flow freely; gases and liquids.
FM	Factory Mutual Research Corporation. An organization which sets industrial safety standards.
FM Approved	An instrument that meets a specific set of specifications established by Factory Mutual Research Corporation.
Font	The style of lettering used to display information.
Footprint	The surface space required for an object.
Fpb	Pressure Base factor.
FPM	Flow velocity in feet per minute.
FPS	Flow velocity in feet per second.
Fpv	See Supercompressibility Factor.
Fr	Reynolds Number factor.

TERM	DEFINITION
Fractionation	The process of separating a steam of natural gas liquids into its separate components.
Freezing Point	The temperature at which the substance goes from the liquid phase to the solid phase.
Frequency	The number of cycles per second for any periodic waveform - measured in cycles per second - now called Hertz. The number of repeating corresponding points on a wave that pass a given observation point per unit time.
Frequency Modulation	Modulation where the frequency of the sinewave carrier alters with the amplitude of the modulating signal.
Frequency Output	An output in the form of frequency which varies as a function of the applied input.
FRP	Fiberglass Reinforced Polyurethane. A non-flexible material used for LevelMaster sensors.
FS/2	Ruggadized handheld computer device for programming and collecting data from an XFC. Also referred to a Husky or Dog Bone.
FT^3	A standard abbreviation for Cubic Foot.
Ftb	Temperature Base factor.
Ftf	Flowing Temperature factor.
Fuel Oils	The heavy distillates from the oil refining process that are used primarily for heating, for fueling industrial processes, for fueling locomotives and ships, and for fueling power generation systems.
Full Bridge	Wheatstone bridge configuration utilizing four active elements or strain gauges.
Full Duplex	Simultaneous, two-way (transmit and receive), transmission.
Function	A set of software instructions executed by a single line of code that may have input and/or output parameters and returns a value when executed.
Fuse	A short length of wire that will easily burn out when excessive current flows.
Fw	Water Vapor factor.
G	The symbol used for giga or gigabyte.
Gain	The factor by which a signal is amplified, sometimes expressed in dB.
Gain Accuracy	A measure of deviation of the gain of an amplifier from the ideal gain.
Gal	An abbreviation for one gallon.
Gas	That state of matter which has neither independent shape nor volume. It expands to fill the entire container in which it is held. It is one of the three forms of matter, the other two being solid and liquid.
Gas Chromatograph	An analytical instrument that separates mixtures of gas into identifiable components by means of chromatography.
Gas Chromatograph Module	Software module used in conjunction with PCCU32 and WINCCU to interact with Btu Chromatograph equipment and software.
Gas Chromatograph Module Coefficient	A co-efficient generated by the factory allowing user to start calibration on location without having a calibration gas available.
Gas Chromatography	Preferred method for determining the Btu value of natural gas.
Gas Field	A district or area from which natural gas is produced.
Gas Injection	An enhanced recovery technique in which natural gas is injected under pressure into a producing reservoir through an injection well to drive oil to the well bore and the surface.
Gas Processing	The separation of components by absorption, adsorption, refrigeration or cryogenics from a stream of natural gas for the purpose of making salable liquid products and for treating the residue gas to meet required specifications.

TERM	DEFINITION
Gas, Acid	The hydrogen sulfide and/or carbon dioxide contained in, or extracted from, gas or other streams.
Gas, Associated	Gas produced in association with oil, or from a gas cap overlying and in contact with the crude oil in the reservoir. In general, most states restrict associated gas production since its indiscriminate production could reduce the ultimate oil recovery. Also, since some wells producing associated gas cannot be shut-in without also shutting-in the oil production, natural gas pipelines are generally required to take associated gas produced from oil wells on a priority basis.
Gas, C1	See Methane.
Gas, C2	See Ethane.
Gas, C3	See Propane.
Gas, C5+	Pentanes Plus (IC5, NeoC5, NC5 and C6+)
Gas, C6+	Hexanes Plus (C6, C7, C8, C9, C10, C11, etc.).
Gas, CO2	See Carbon Dioxide.
Gas, Dry	Gas whose water content has been reduced by a dehydration process. Gas containing little or no hydrocarbons commercially recoverable as liquid product. Specified small quantities of liquids are permitted by varying statutory definitions in certain states.
Gas, IC4	See Iso-Butane.
Gas, IC5	See Iso-Pentane.
Gas, Liquefied Petroleum (LPG)	A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples.
Gas, Manufactured	A gas obtained by destructive distillation of coal, or by the thermal decomposition of oil, or by the reaction of steam passing through a bed of heated coal or coke, or catalyst beds. Examples are coal gases, coke oven gases, producer gas, blast furnace gas, blue (water) gas, and carbureted water gas. Btu content varies widely.
Gas, Natural	A naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in porous geologic formations beneath the earth's surface, often in association with petroleum. The principal constituent is methane.
Gas, NC4	See Normal Butane.
Gas, NC5	See Normal Pentane.
Gas, NeoC5	See Neo-Pentane.
Gas, Non-associated	Free natural gas not in contact with, nor dissolved in, crude oil in the reservoir.
Gas, Oil	A gas resulting from the thermal decomposition of petroleum oils, composed mainly of volatile hydrocarbons and hydrogen. The true heating value of oil gas may vary between 800 and 1600 Btu per cubic foot depending on operating conditions and feedstock properties.
Gas, Sour	Gas found in its natural state, containing such amounts of compounds of sulfur as to make it impractical to use, without purifying, because of its corrosive effect on piping and equipment.
Gas, Sweet	Gas found in its natural state, containing such small amounts of compounds of sulfur that it can be used without purifying, with no deleterious effect on piping and equipment.
Gas, Unconventional	Gas that can not be economically produced using current technology.
Gas, Wet	Wet natural gas is unprocessed natural gas or partially processed natural gas produced from strata containing condensable hydrocarbons. The term is subject to varying legal definitions as specified by certain state statutes.

TERM	DEFINITION
Gate Station	Generally a location at which gas changes ownership, from one party to another, neither of which is the ultimate consumer. It should be noted, however, that the gas may change from one system to another at this point without changing ownership. Also referred to as city gate station, town border station, or delivery point.
Gathering	The act of operating extensive low-pressure gas lines which aggregate the production of several separate gas wells into one larger receipt point into an interstate pipeline.
Gathering Agreement	Agreement between a producer and a gathering system operator specifying the terms and conditions for entry of the producer's gas into the gathering system.
Gathering Line	A pipeline, usually of small diameter, used in gathering gas from the field to a central point.
Gathering Station	A compressor station at which gas is gathered from wells by means of suction because pressure is not sufficient to produce the desired rate of flow into a transmission or distribution system.
Gathering System	The gathering pipelines plus any pumps, tanks, or additional equipment used to move oil or gas from the wellhead to the main pipeline for delivery to a processing facility or consumer.
Gauge Factor	A measure of the ratio of the relative change of resistance to the relative change in length of a piezoresistive strain gage.
Gauge Pressure	Absolute pressure minus local atmospheric pressure.
Gauge, Pressure	Instrument for measuring the relative pressure of a fluid. Types include gauge, absolute, and differential.
Gauging Tape Measurements	This refers to a manual method of measuring the level of a liquid in a tank. These measurements may be used to calibrate float levels.
GC	See Gas Chromatograph.
GC Module Assembly	The GC Module is comprised of 3 parts; Columns, Valves and Electronic Interface. The Valves control flow of gas within the system. The Columns perform the separation of the gas into component parts for analysis. The Electronic Interface contains pressure and temperature sensors to monitor and detect the different gas components as they leave the GC Columns.
GCM	See Gas Chromatograph Module
GCMC	See Gas Chromatograph Module Coefficient.
GCN	Gravity, Carbon Dioxide and Nitrogen compounds. Used in NX-19 GCN Supercompressibility Factor.
GCNM	Gravity, Carbon Dioxide, Nitrogen and Methane compounds. Used in NX-19 GCNM Supercompressibility Factor.
GDF	Gasde of France
Gj	An abbreviation for gigajoule, equivalent to one thousand megajoules or one billion joules.
GND	See Ground.
GOST	Russian Government Standards for Importation.
GPA 2145-03	Gas Processors Association Physical Constants for Paraffin Hydrocarbons and other Components of Natural Gas
GPA 2172-96	Gas Processors Association Calculation of Gross Heating Value, Relative Density and Compressibility of Natural Gas Mixtures from Compositional Analysis.
GPM	Gallons of liquid per thousand cubic feet.
GPS 2261	See Gas Processors Standard 2261.

TERM	DEFINITION
GPV	Gauge Port Vent. Refers to the NGC8200 Port designed to equalize the pressure inside of the explosion-proof enclosure.
GPV	Gauge Port Valve (located on NGC8200 series Feed-Through Assembly).
GRD	See Ground.
Gross Heating Value	The heating value measured in a calorimeter when the water produced during the combustion process is condensed to a liquid state. The heat of condensation of the water is included in the total measured heat.
Ground	1) An electronically neutral circuit having the same potential as the surrounding earth. Normally, a non-current carrying circuit intended for the safety purposes. A reference point for an electrical system. 2) A large conducting body (as the earth) used as a common return for an electric circuit and as an arbitrary zero of potential. 3) Reference point for an electrical system.
Grounding Strap	A grounding strap is a conductive device used to make connection between the person handling the board, and a high quality ground potential.
H2	The molecular formula for Hydrogen.
H2S	The molecular formula for Hydrogen Sulfide.
Half Duplex	Communication transmission in one direction at a time.
Handshake	An interface procedure that is based on status/data signals that assure orderly data transfer as opposed to asynchronous exchange.
Handshaking	Exchange of predetermined signals between two devices establishing a connection. Usually part of a communications protocol.
Hardware	The physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, cables, and so on. It does not include data or computer programs.
Harmonic	A sinusoidal component of a waveform that is a whole multiple of the fundamental frequency. An oscillation that is an integral sub-multiple of the fundamental is called a sub-harmonic.
HART	Communication Interface.
Hazardous Area	Area in which an explosive gas atmosphere is present or may be expected to be present.
Heat	Thermal energy. Heat is expressed in units of calories or Btu's
Heat Capacity	The amount of heat required to raise the temperature of a body (of any mass) one degree Celsius.
Heat of Condensation	The amount of heat that must be removed from one gram of a vapor at it's condensation point to condense the vapor with no change in temperature.
Heat of Vaporization	The amount of heat required to vaporize one gram of a liquid at its boiling point with no change in temperature. Usually expressed in J/g. The molar heat of vaporization is the amount of heat required to vaporize one mole of liquid at its boiling point with no change in temperature and usually expressed ion kJ/mol.
Heat Transfer	A form of energy that flows between two samples of matter because of their differences in temperature.
Heating Value	The amount of heat developed by the complete combustion of a unit quantity of a material. Heating values for natural gas are usually expressed as the Btu per Cf of gas at designated conditions (temperature and pressure) and either on the dry or water saturated basis.
Heavy Crude	Crude oil of 20-degree API gravity or less; often very thick and viscous.
Heavy Ends	The portion of a hydrocarbon mixture having the highest boiling point. Hexanes or heptanes and all heavier hydrocarbons are usually the heavy ends in a natural gas stream.

TERM	DEFINITION
Heavy Hydrocarbons	More susceptible to increases in temperature and decreases in pressure, thus causing liquids to form.
Heptane (C7H16)	A saturated hydrocarbon (Alkane) with 7 carbon atoms in it's molecule (C7H16). A liquid under normal conditions.
Hertz	Cycles per second. A measure of frequency or bandwidth.
Hexadecimal	A numbering system to the base 16, 0 through F.
Hexane (C6H14)	A saturated hydrocarbon (Alkane) with six carbon atoms in it's molecule (C6H14). A liquid under normal conditions.
Hexane Plus or Heptane Plus	The portion of a hydrocarbon fluid mixture or the last component of a hydrocarbon analysis which contains the hexanes (or heptanes) and all hydrocarbons heavier than the hexanes (or heptanes).
Hierarchical	A method of organizing computer programs with a series of levels, each with further subdivisions, as in a pyramid or tree structure.
Hold	Meter HOLD is an external input which is used to stop the A/D process and freeze the display. BCD HOLD is an external input used to freeze the BCD output while allowing the A/D process to continue operation.
Host	The primary or controlling computer in a multiple part system.
Host Console	Host Console via Local Port uses the PCCU cable between the computer and the device's Local PCCU port but running Remote Protocol. Host Console via Remote Port uses the remote protocol
Hub	A market or supply area pooling/delivery where gas supply transaction point occur that serve to facilitate the movement of gas between and among interstate pipelines. Transactions can include a change in title, a change in transporter, or other similar items.
HV	See Heating Value.
Hydrocarbon	A chemical compound composed solely of carbon and hydrogen. The compounds having a small number of carbon and hydrogen atoms in their molecules are usually gaseous; those with a larger number of atoms are liquid, and the compounds with the largest number of atoms are solid.
Hydrogen Sulfide	A flammable, very poisonous and corrosive gas with a markedly disagreeable odor, having the chemical formula of H_2S that is a contaminant in natural gas and natural gas liquids.
Hyperterm	Terminal emulation program provided with Windows.
Hysteresis	The maximum difference between output readings for the same measured point, one point obtained while increasing from zero and the other while decreasing from full scale. The points are taken on the same continuous cycle. The deviation is expressed as a percent of full scale.
I/O	See Input/Output.
I/O Address	A method that allows the CPU to distinguish between the different boards in a system. All boards must have different addresses.
I^2C	Inter-Integrated Circuit. Serial communications bus to I/O modules (developed by Phillips Semiconductor)
IAR	Maker and distributor of the Embedded Workbench, a compiler, assembler, linker development system for the Z80/64180 microprocessor family.
IC	See Integrated Circuit
IC4	A standard abbreviation for Isobutane.
IC5	A standard abbreviation for Isopentane.
Icon	A graphic functional symbol display. A graphic representation of a function or functions to be performed by the computer.

TERM	DEFINITION
ID	Identification Number. You must assign an ID to the unit. Units are communicated to by this ID number, therefore the ID assigned in the software must agree with the hardware.
IEC	International Electrotechnical Commission. Developers of the IEC-61131-3 standard. Programming Language used by Totalflow for user applications in XSeries equipment.
$IECE_x$	The IEC scheme for certification to standards relating to equipment for use in explosive atmospheres.
IEEE	Institute of Electrical and Electronics Engineers
IIC	Inter-Integrated Circuit. Also see I^2C.
IL	Instruction List (IEC supported programming language)
Impedance	The total opposition to electrical flow (resistive plus reactive).
IMV	See Integral Multivariable Transducer.
Inch of Mercury	A pressure unit representing the pressure required to support a column of mercury one inch high at a specified temperature; 2.036 inches of mercury (at 32 degrees F and standard gravity of 32.174 ft/sec2) is equal to a gauge pressure of one pound per square inch.
Inch of Water	A pressure unit representing the pressure required to support a column of water one inch high. Usually reported as inches W.C. (water column) at a specified temperature; 27.707 inches of water (at 60o and standard gravity of 32.174 ft/sec2) is equal to a gauge pressure of one pound per square inch.
Industry Canada	Canadian Certification.
Inerts	Elements or compounds not acted upon chemically by the surrounding environment. Nitrogen and carbon dioxide are examples of inert components in natural gas. Inerts dilute the natural gas and since they do not burn or combust, have no heating value.
Initialization File	Generic file used to support the display of Totalflow application data in PCCU32.
Input	That part of a circuit that accepts a signal for processing.
Input Impedance	The resistance measured across the excitation terminals of a transducer.
Input Sense	To examine or determine the status of the input.
Input/Output	The transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.
Instantiate	Starting an instance of an object.
Instrument Manifold	Manifold type used when XFC is mounted directly on the Orifice.
Insulator	Any material that resists the flow of electrical current.
Integral Multivariable Transducer	A Multivariable Transducer that is an integral part of the flow computer, measuring DP and SP. This refers only to the transducer portion of the device and makes no assumption whether or not the circuitry is located as part of the unit, or if the circuitry is located on the Mother Board and attached via wiring. Also see Multivariable Transducer.
Integrated Circuit	A circuit component consisting of a piece of semiconductor material containing up to thousands of transistor and diodes. A chip.
Integrating ADC	An ADC whose output code represents the average value of the input voltage over a given time interval.
Interface (computer)	Usually refers to the hardware that provides communication between various items of equipment.
Interface (liquid)	The area between two liquids that are not easily mixed, i.e. oil and water.

TERM	DEFINITION
Interference	A disturbance to the signal in any communications system.
Intrinsically Safe	An instrument which will not produce any spark or thermal effects under normal and specified fault conditions, that is capable of causing ignition of a specified gas mixture.
Inverter	A circuit in both analogue and digital systems that provides an output that is inverse to the input.
Inverter, DC to AC	Converts DC to AC at a high frequency.
ioINT	Interrupt signal from the I/O modules.
ioVBB	i/o Battery Voltage- Unregulated 13.8 volts. Host supplies 2.5 amps to the I/O modules.
ioVDD	Unregulated 5.6 volts from the host for I/O modules.
ISA	Instrument Society of America.
ISO	International Standards Organization.
ISO 5167	International Standards Organization Report No. 5167, Measurement of Fluid Flow by Means of Pressure Differential Devices.
ISO 6976-95	International Standards Organization Report No. 6976-95, Calculation of Calorific Values, Density, Relative Density and Wobbe Index from Composition.
Isobutane (C4H10)	A hydrocarbon of the same chemical formula as butane but different molecular structure, resulting in different physical properties, notably lower boiling point. Gross heating value 3261 Btu/cu. ft. gas.
Isokenetic Sampling	Laboratory technique where gas sample is tested after removing liquids, therefore not allowing the atomized liquid to return to the gaseous state, changing the sample accuracy.
Isolation	The reduction of the capacity of a system to respond to an external force by use of resilient isolating materials.
Isopentane (C5H12)	A hydrocarbon of the paraffin series having a chemical formula of C5H12 and having its carbon atoms branched.
IUPAC	Acronym for International Union of Pure and Applied Chemistry. It is an international non-governmental organization devoted to the advancement of chemistry. It is most well known as the recognized authority in developing standards for the naming of the chemical elements and their compounds
IVision	SCADA system designed for oil and gas applications
Joule	The basic unit of thermal energy.
Joule-Thompson Effect	The change in gas temperature which occurs when the gas is expanded at constant enthalpy from a higher pressure to a lower pressure. The effect for most gases at normal pressure, except hydrogen and helium, is a cooling of the gas creating condensation.
K	Kilo. 1) In referring to computers, a "kilo" is 1024 or 2 to the 10th power (Note that it is actually slightly more than an even 1000.). 2) the standard metric prefix for 1,000, or 10^3, used with units of measure such as volts, hertz, and meters.
Kbytes/s	A unit for data transfer that means 1,000 or 10^3 bytes/s.
Kerosene	An oily liquid obtained in the distilling of gasoline in a temperature range from 174-288 degree C. A hydrocarbon of specific gravity of 0.747 to 0.775. Used as fuel for some internal combustion engines, heating equipment, and illuminating purposes. A heavy grade known as range oil is used for cooking and heating.
KHz	Electronic abbreviation for Kilohertz.
kilobyte	1024 bytes.
Kilowatt	Equivalent to 1000 watts.

TERM	DEFINITION
kilowatt-hour	A unit of energy when one kilowatt of power is expended for one hour. Example A radiator bar is usually rated at 1,000 watts and this switched on for one hour consumes one kilowatt-hour of electricity.
KPa	Kilopascal-Measure of Pressure
kw	See Kilowatt.
kwh	See Kilowatt-hour.
LACT	Lease Automatic Custody Transfer.
Lag	1) A time delay between the output of a signal and the response of the instrument to which the signal is sent. 2) A time relationship between two waveforms where a fixed reference point on one wave occurs after the same point of the reference wave.
Latent Heat of Vaporization	Represents the amount of heat required to vaporize a liquid. In the instance of natural gas, the equation appears: 1 Btu = heat to change. This is the most likely scenario for causing gas to liquefy.
LCD	Liquid Crystal Display.
LD	Ladder Diagram (IEC supported programming language)
LED	Light Emitting Diodes.
LevelMaster	Intelligent Digital Level Sensor and is designed for custody transfer accuracy in demanding level measurement applications in tanks. LevelMaster is the name of the Totalflow's Tank Gauging System.
Life	For rechargeable batteries, the duration of satisfactory performance, measured in years (float life) or in the number of charge/discharge cycles (cycle life).
Life Cycle	The minimum number of pressure cycles the transducer can endure and still remain within a specified tolerance.
Light Crude	Crude oil with a high API gravity due to the presence of a high proportion of light hydrocarbon fractions.
Light Ends	The portion of a liquid hydrocarbon mixture having the lowest boiling points which are easily evaporated.
Light Hydrocarbons	The low molecular weight hydrocarbons such as methane, ethane, propane and butanes. More Volatile.
Linearity	The maximum deviation of the calibration curve from a straight line between zero and full scale, expressed as a percent of full scale output and measured on increasing measurement only.
Liquefiable Hydrocarbons	The components of natural gas that may be recovered as liquid products.
Liquefied Natural Gas	Natural gas which has been liquefied by reducing its temperature to minus 260 degrees Fahrenheit at atmospheric pressure. It remains a liquid at -116 degrees Fahrenheit and 673 psig. In volume, it occupies 1/600 of that of the vapor at standard conditions. Natural gasoline and liquefied petroleum gases fall in this category.
Liquefied Petroleum Gas	A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions, but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples.
Liquid Crystal Display	A reflective display that requires very low power for operation.
LNG	See Liquefied Natural Gas.
Load (electrical)	A load is an energy consuming device. The device can be an actual device such as a bulb of a flash light, radio, cassette player, motor, etc., a resistor or a constant current load.

TERM	DEFINITION
Load (units)	The amount of gas delivered or required at any specified point or points on a system; load originates primarily at the gas consuming equipment of the customers. Also, to load a pressure regulator is to set the regulator to maintain a given pressure as the rate of gas flow through the regulator varies. Compare DEMAND.
Location File	This is a file containing the configuration of the Location or site and the LevelMasters assigned to the Location. You may have a file that contains everything or a file for each Location name. The information from the file is displayed on the main MasterLink screen in the form of a tree structure. See the Main Screen topic for more information.
Location Name	Location Name is the top of the hierarchy tree of a Location File. Included in the Location Name is the LevelMaster's name, ID, S/N, Sensor File and Configuration no.
Log Period	In a XFC, the specified length between writing the calculated accumulated volume to record. You may record volumes as often as every minute and as seldom as every hour. More frequent recording reduces the number of days of records possible between collection.
Long Term	For Totalflow's purpose, the application of this term refers to storing data over a period of time that is greater than a minimal time. Such as data collected weekly versus data collected weekly but stored indefinitely.
LPG	See Liquefied Petroleum Gas.
LSB	Least Significant Byte
M	Mega, the prefix for 1,048,576, or 2^{20}, when used with byte to quantify data or computer memory. Also 1000, as in MCF or 1000 Cubic Ft.
Manifold	The conduit of an appliance which supplies gas to the individual burners. Also, a pipe to which two or more outlet pipes are connected.
Manifold Assembly	The Manifold Assembly is comprised of the Manifold Plate, Heater, Valves, and various Cables to other major components. The Manifold Plate and Heater maintain constant temperature for the GC Module and Columns. The Valves control Stream processing, Carrier and Calibrations gases. The Cables complete the information chain from the GC Module to the Analytical Processor and the Digital Controller Assembly.
Man-Machine Interface	Software program that converts machine instructions and commands into a user interface.
Manometer	A two-armed barometer.
Manual Reset	The switch in a limit controller that manually resets the controller after the limit has been exceeded.
MasterLink	MasterLink is the name of the software program used to communicate with the LevelMaster for purposes of doing setup, calibration, troubleshooting, generating site files, monitoring levels and collecting data.
Mbytes/s	A unit for data transfer that means 1 million or 10^6 bytes/s.
Mcf	The quantity of natural gas occupying a volume of 1000 cubic feet at a temperature of 60° Fahrenheit and at a pressure of 14.73 psia.
Mean Temperature	The average of the maximum and minimum temperature of a process equilibrium.
Measurement Unit Assembly	μFLO's measurement and operational features are housed in this single unit assembly. The main electronic board (μFLO-195 Board), communication connection, power, SP, DP and Temperature readings are all housed in this unit.
Mega	Multiplier indicating that a quantity should be multiplied by 1,000,000.
Melting Point	The temperature at which a substance transforms from a solid phase to a liquid phase.

TERM	DEFINITION
Membrane	The pH-sensitive glass bulb is the membrane across which the potential difference due to the formation of double layers with ion-exchange properties on the two swollen glass surfaces is developed. The membrane makes contact with and separates the internal element and filling solution from the sample solution.
Memory	Electronic devices that enable a computer to store and recall information. In its broadest sense, memory refers to any hardware capable of serving that end, e.g., disk, tape, or semiconductor storage.
Menu	The list of available functions for selection by the operator, usually displayed on the computer screen once a program has been entered.
MEPAFLOW	SICK Engineering's Menu-based Measurement and Parameterization Software for the TotalSonic system (MMI).
Mercaptans	Compounds of carbon, hydrogen and sulfur found in sour crude and gas; the lower mercaptans have a strong, repulsive odor and are used, among other things, to odorize natural gas.
Meter	Acronym M. Metric measurement equal to 1.09361 yards.
Meter Manifold	Gas piping between gas service line and meter. Also, gas piping supplying two or more meters.
Meter, Orifice	A meter using the differential pressure across an orifice plate as a basis for determining volume flowing through the meter. Ordinarily, the differential pressure is charted.
Meter, PD	See Meter, Positive Displacement.
Meter, Positive Displacement	An instrument which measures volume on the basis of filling and discharging gas in a chamber.
Meter, Turbine	1) Pulse meter. 2)A velocity measuring device in which the flow is parallel to the rotor axis and the speed of rotation is proportional to the rate of flow. The volume of gas measured is determined by the revolutions of the rotor and converting them to a continuously totalized volumetric reading.
Methane (C1H4)	A hydrocarbon (Alkane) with the lightest molecule. A gas under normal conditions. The first of the paraffin series of hydrocarbons. The chief constituent of natural gas. Pure methane is odorless and has a heating value of 1012 Btu per cubic foot. Typically mixed with a sulfur compound to aid in leak detection.
microFlo Computer	See µFLO.
Microprocessor	This term is commonly used to describe the CPU. More specifically, it refers to the part of the CPU that actually does the work, since many CPUs now contain L1 and L2 caches on-chip.
Milli	One thousandth e.g. one milli-watt - 1mW. one milli-amp - 1mA. one milli-volt - 1mV.
Millimeter	Acronym mm. Metric measurement equal to .03937 inch.
MIPS	Million instructions per second. The unit for expressing the speed of processor machine code instructions.
Mj	Abbreviation for megajoule, equivalent to one million joules.
Mm	Acronym for Millimeter.
MMBtu	A thermal unit of energy equal to 1,000,000 Btu's, that is, the equivalent of 1,000 cubic feet of gas having a heating content of 1,000 BTUs per cubic foot, as provided by contract measurement terms.
MMcf	A million cubic feet. See CUBIC FOOT. (1,000,000 CF)
MMI	See Man-Machine Interface.

TERM	DEFINITION
Modbus	Messaging structure developed and used to establish master-slave/client-server communication between intelligent devices. Generic protocol supported by most process automation vendors.
Modem	Modulator-Demodulator. A device used to convert serial digital data from a transmitting terminal to a signal suitable for transmission over a common carrier, or to reconvert the transmitted signal to digital data for acceptance by a receiving terminal.
Module	Typically a board assembly and its associated mechanical parts, front panel, optional shields, and so on. A module contains everything required to occupy one or more slots in a mainframe.
Mol%	See Mole Percent.
Mole Percent	The number of moles of a component of a mixture divided by the total number of moles in the mixture.
MRB	Modbus Request Block. When requesting storage space after adding a new Modbus application, the file is saved as a *.mrb file.
MRM	Modbus Register Map. When requesting storage space after adding a new Modbus register, the file is saved as a *.mrm file.
MS	Milliseconds. One-thousandth of a second.
MSB	Most Significant Byte
Mueller Bridge	A high-accuracy bridge configuration used to measure three-wire RTD thermometers.
Multiplex	A technique which allows different input (or output) signals to use the same lines at different times, controlled by an external signal. Multiplexing is used to save on wiring and I/O ports.
Multi-tasking	A property of an operating system in which several processes can be run simultaneously.
Multi-tube Sites	Locations where many flow tubes are all within a prescribed distance allowing one flow meter with multitube capabilities, such as the XSeries product line, to monitor and maintain flow records for each tube in one Flow Computer.
Multivariable Transducer	Transducer supplying more than 1 variable. Totalflow uses this term to encompass units that read Static Pressure, Differential Pressure. Historically these units were coined AMU for Analog Measurement Unit. As a result of advanced technology, the unit no longer functions as only an analog measurement unit. Therefore the newer terminology, Multivariable Transducer, more aptly describes the functionality of this design. The abbreviation IMV refers to the Integral version of the multivariable. The abbreviation XIMV, refers to the XSeries IMV version of the multivariable, which contains the circuitry as part of the unit and the abbreviation IMVX, refers to the Explosion Proof IMV, where the required circuitry resides on the Main Processor Board. See each instance for additional explanation.
MW	Acronym for Molecular Weight.
N2	A standard abbreviation for Nitrogen.
NAK	See Negative Acknowledgement
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie (Standards study group for measurement and process control technology in the chemical industry).
Natural Gas	See Gas, Natural.
Natural Gas Distillate	Material removed from natural gas at the "heavy end" portion; that is, aliphatic compounds ranging from C4 to C8 (butanes and heavier).

TERM	DEFINITION
Natural Gas Liquids	The hydrocarbon components: propane, butanes, and pentanes (also referred to as condensate), or a combination of them that are subject to recovery from raw gas liquids by processing in field separators, scrubbers, gas processing and reprocessing plants, or cycling plants. The propane and butane components are often referred to as liquefied petroleum gases or LPG.
Natural Gasoline	A mixture of hydrocarbons, mostly pentanes and heavier, extracted from natural gas, which meets vapor pressure and other specifications.
NBS	National Bureau of Standards.
NC	See Normally Closed.
NC4	A standard abbreviation for Normal Butane.
NC5	A standard abbreviation for Normal Pentane.
NEC	National Electrical Codes
Negative Acknowledgment	This refers to a response over a remote communication device, such as a PING. Basically, saying, "I don’t acknowledge your request!" This is the opposite of ACK. NAK is a slang term that means that you disagree or do not acknowledge something.
NEMA	National Electrical Manufacturers Association.
NEMA, Type 3R	A standard from the National Electrical Manufacturers Association. Enclosure constructed for indoor/outdoor use to provide protection against falling dirt, rain, sleet and snow and remain undamaged by external formation of ice.
NEMA, Type 4	A standard from the National Electrical Manufacturers Association. Enclosure constructed for indoor/outdoor use to provide protection against falling dirt, rai, sleet, snow, windblown dust, splashing water, and hose-directed water and remain undamaged by external formation of ice.
NEMA, Type 4X	A standard from the National Electrical Manufacturers Association. Enclosure constructed as for Type 4 with protection against corrosion.
NeoC4	A standard abbreviation for Neobutane.
NeoC5	A standard abbreviation for Neopentane.
Network	A group of computers that are connected to each other by communications lines to share information and resources.
Newton Meter	Torque measurement unit equal to 8.84 Inch Pounds.
NGC	Natural Gas Chromatograph
NGC Termination Panel	The NGC8200 Termination Panel acts as a connection to the outside world. It features Transient Protection, a built-in voltage regulator, Positive Temperature Co-efficient Fuses (PTC) and many other safeguards to protect the remainder of the system from electrical damage. All outside communications and I/O are channeled through this board. It is designed to be a low cost, field replaceable maintenance solution and is designed to operate on either 12V or 24V.
NGC8206	Totalflow NGC8200 Gas Chromatograph, with C6+. The NGC is designed to continually analyze natural gas streams, on-site, determine composition, calorific value, and store the analysis information. It is designed for natural gas streams, 800 to 1500 Btu/scf (29.8 to 55.9 Megajoules/meter^3) with less than 100 PPM H2S. The unit is a fully functional gas chromatograph for “Pipeline Quality” natural gas, designed to analyze natural gas streams, dry of both hydrocarbon liquids and water. The unit can collect and retain analysis information for one to four independent sample streams. Applicable installations include: Transmission, Distribution, Custody Transfer with Metrology quality results, Production, Gas Gathering and End User Gas Markets.
NGL	See Natural Gas Liquids.
NGL	A standard abbreviation for Natural Gas Liquids.

TERM	DEFINITION
Nm	Abbreviation for Newton Meter. Metric Torque measurement.
NO	See Normally Open.
Noise	An undesirable electrical signal. Noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Unwanted disturbances superimposed upon a useful signal that tends to obscure its information content.
Nonane (C9H20)	A hydrocarbon (Alkane) flammable colorless liquid with nine carbon atoms.
Non-hazardous area	Area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions.
Non-Persistent	Refers to data that is no longer available after a Warm Start.
Normal Butane	An aliphatic compound of the paraffin series having the chemical formula of C4H10 and having all of its carbon atoms joined in a straight chain.
Normal Pentane	A hydrocarbon of the paraffin series having a chemical formula of C5H12 and having all its carbon atoms joined in a straight chain.
Normally Closed	Designation which states that the contacts of a switch or relay are closed or connected when at rest. When activated, the contacts open or separated.
Normally Open	Designation which states that the contacts of a switch or relay are normally open or not connected. When activated the contacts close or become connected.
Norsok	Norwegian Certification Bureau
NPN	Negative-Positive-Negative (Transistor).
NPT	National Pipe Thread.
NRTL	Nationally Recognized Testing Laboratory.
Null	A condition, such as balance, which results in a minimum absolute value of output.
NX-19	American Gas Association Report referring to a specific method to calculate the Supercompressibility factor.
O2	A standard abbreviation for oxygen.
Octane (C8H18)	A hydrocarbon (Alkane) flammable colorless liquid with eight carbon atoms. Is the 100 point on the Octane Rating Scale.
OCV	See Open Circuit Voltage.
ODBC	See Open Database Connectivity.
OEU	Optional Equipment Unit.
Offset	The difference in temperature between the set point and the actual process temperature. Also, referred to as droop.
OHM	The unit of resistance usually shown as the symbol "R". One thousand ohms is written "k" and one million ohms is written "M". Resistance is measured with a multimeter, set to the "ohms range".
Ohmeter	An instrument used to measure electrical resistance.
OLE	Object Linking and Embedding. A set of system services that provides a means for applications to interact and interoperate. Based on the underlying Component Object Model, OLE is object-enabling system software. Through OLE Automation, an application can dynamically identify and use the services of other applications, to build powerful solutions using packaged software. OLE also makes it possible to create compound documents consisting of multiple sources of information from different applications.

TERM	DEFINITION
Ole for Process Control	This is a data interchange format and supporting software. Typically, vendors (such as ABB) write OPC server drivers which can talk to their devices. SCADA system vendors (again like ABB) write OPC clients that can gather data from OPC Servers. The idea is to provide a universal way to collect data into a SCADA system regardless of the equipment vendor. This standard was developed and is maintained by the OPC Foundation. The Totalflow Driver, TDS32, supports OPC.
Ole for Process Control Database	A programming interface to databases. IVision supports the OLEDB interface.
OLEDB	See Ole for Process Control Database.
Olefins	Basic chemicals made from oil or natural gas liquids feedstocks; commonly used to manufacture plastics and gasoline. Examples are ethylene and propylene.
OOP	Object-Oriented Programming. The XFC/XRC architecture incorporates an object-oriented approach.
OPC	See Ole for Process Control.
Open Circuit	A complete break in a metal conductor path.
Open Circuit Voltage	The difference in potential between the terminals of a cell/battery when the circuit is open (no-load condition).
Open Collector	A single NPN transistor with the base connected to the logic driving circuitry and with the emitter grounded. The collector is the output pin of the gate.
Open Database Connectivity	A widely accepted application-programming interface (API) for database access. It is based on the Call-Level Interface (CLI) specifications from X/Open and ISO/IEC for database APIs and uses Structured Query Language (SQL) as its database access language. Using ODBC, you can create database applications with access to any database for which your end-user has an ODBC driver. This allows access for authorized users to databases over any network, including the Internet. The iVision SCADA system provides an ODBC driver, making the database accessible to authorized users anywhere on a corporate network, or even over the Internet if the network is properly configured.
Operating System	Base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices.
Optional Equipment Unit	Totalflow enclosure designed to house optional power and communication devices.
Orifice Meter	Device to record differential pressure measurement which uses a steel plate with a calibrated hole or orifice to generate a drop in pressure between the two sides of the plate. Also the primary element of the meter run.
Orifice Plate	A plate of non-corrosive material which can be fastened between flanges or in a special fitting perpendicular to the axis of flow and having a concentric circular hole. The primary use is for the measurement of gas flow.
ORing	Boolean algebra logical function. Described as the addition or summing of switches or inputs, in the case of Boolean elements, the 0 and 1 represent two possible states of a premise or hypothesis: True or False, On or Off. When adding Boolean elements not real numbers, you will find these results: 1 or 1 = 1 1 or 0 = 1 0 or 1 = 1 0 or 0 = 0
O-Ring	A flat ring made of rubber or plastic, used as a gasket.
Output	That part of a circuit where the processed signal is available.
Output Impedance	The resistance as measured on the output terminals of a pressure transducer.

TERM	DEFINITION
Output Noise	The RMS, peak-to-peak (as specified) ac component of a transducer's dc output in the absence of a measurand variation.
P/I	See Pulse Input.
Parameter	(1) Characteristic. For example, *specifying parameters* means defining the characteristics of something. In general, parameters are used to customize a program. For example, file names, page lengths, and font specifications could all be considered parameters. (2) In programming, the term *parameter* is synonymous with argument, a value that is passed to a routine.
Parity	A technique for testing transmitting data. Typically, a binary digit is added to the data to make the sum of all the digits of the binary data either always even (even parity) or always odd (odd parity).
Parts per Million	Acronym PPM.
Passive Analog Output	Analog Output to a host that is powered by an outside source.
PCCU	Portable Collection and Calibration Unit.
PCCU32	Windows version of PCCU communications software to process, archive and collect data from the Totalflow equipment. Generally run from a laptop.
Peak Area	The retention time the element takes to exit the column. This is used in calculating the amount of each component in the sample or Mole %.
Pentane (C5H12)	A saturated hydrocarbon (Alkane) with five carbon atoms in it's molecule (C5H12). A liquid under normal conditions.
Pentane, Normal	See Normal Pentane.
Pentanes Plus	A hydrocarbon mixture consisting mostly of normal pentane and heavier components.
Peripheral	The input/output and data storage devices attached to a computer such as disk drives, printers, keyboards, displays, data acquisition systems, etc.
Persistent	Refers to data that remains available after a Warm Start.
PEX	A flexible material used for LevelMaster sensors.
PGC	Process Gas Chromatograph
Phase	A time based relationship between a periodic function and a reference. In electricity, it is expressed in angular degrees to describe the voltage or current relationship of two alternating waveforms.
Phenol	Hydrocarbon derivative containing an [OH] group bound to an aromatic ring.
Physical Change	A change in which a substance changes from one physical state to another but no substances with different composition are formed. Example Gas to Liquid - Solid.
PID	Proportional, Integral, Derivative. A three mode control action where the controller has time proportioning, integral (auto reset) and derivative rate action.
Piezoceramic	A ceramic material that has piezoelectric properties similar to those of some natural crystals.
Pipeline Condensate	Liquid hydrocarbons that have condensed from gas to liquid as a result of changes in pressure and temperature as gas flows in a pipeline. Pipeline condensate only remains as a liquid under high-pressure conditions and would vaporize at atmospheric pressure.
Plant Products	All liquid hydrocarbons and other products (including sulfur and excluding residue gas) recovered in a gas processing plant.
PLC	See Programmable logic controller
Plunger Lift	A technique used to optimize gas production. A Steel plunger is inserted into the production tubing in the well. The flow is turned off and this shut-in causes plunger to fall allowing fluid to collect above plunger. Different techniques are used to decide how long to shut in and flow the well.

TERM	DEFINITION
Polarity	In electricity, the quality of having two oppositely charged poles, one positive one negative.
Polling	A snapshot view of the readings taken by the Totalflow equipment.
Port	A communications connection on a computer or a remote controller. A place of access to a device or network, used for input/output of digital and analog signals.
Positive Temperature Co-efficient	An increase in resistance due to an increase in temperature.
Positive Temperature Co-efficient Fuse	Opens circuit when high current condition occurs. Closes when condition no longer exists. Replaces typical fuses, which require replacement when blown.
POU	Program Organization Unit. This is Softing's term for an 'independent programming unit'. Programs, functions, etc.
Power Supply	A separate unit or part of a circuit that supplies power to the rest of the circuit or to a system.
PPM	Acronym for parts per million.
Pressure Base	The contractual, regulatory or standard ambient pressure at which natural gas is measured or sampled expressed in psia (pounds per square inch absolute).
Pressure Differential	Difference in pressure between any two points in a continuous system.
Pressure Markers	Pressure testing at different levels of pressure. Used for comparison purposes.
Pressure, Absolute	See PSIA.
Pressure, Atmospheric	See Atmospheric Pressure.
Pressure, Gas	In the natural gas industry pressure is measured by the force applied to a designated area. PSI and OSI refer to how much pressure (pound or ounce) is applied to one square inch. Inches Water Column (In.W.C.) is also used to express gas pressure and is measured using a manometer for lower pressure readings. 1 PSIG=27.21 Inches Water Column.
Pressure, Gauge	See PSIG.
Primary Cell (or Battery)	A cell or battery which is not intended to be recharged and is discarded when the cell or battery has delivered all its electrical energy.
PRM	Acronym for Pressure Regulator Module.
Probe	A generic term that is used to describe many types of temperature sensors.
Process Gas	Gas use for which alternate fuels are not technically feasible, such as in applications requiring precise temperature controls and precise flame characteristics.
Program	A list of instructions that a computer follows to perform a task.
Programmable Logic Controller	A highly reliable special-purpose computer used in industrial monitoring and control applications. PLCs typically have proprietary programming and networking protocols, and special-purpose digital and analog I/O ports.
Programmable Read Only Memory	Computer memory in which data can be written to. ROM is used for storing programs (e.g. operating systems) and characteristic files on a permanent basis. (non-volatile)
Programmed I/O	The standard method a CPU uses to access an I/O device-- each byte of data is read or written by the CPU.
PROM	See Programmable Read Only Memory
Propane (C3H8)	A saturated hydrocarbon (Alkane) gas, the molecule of which is composed of three carbon and eight hydrogen atoms. Propane is present in most natural gas and is the first product refined from crude petroleum. It has many industrial uses and may be used for heating and lighting. Contains approximately 2,500 Btu per cubic foot.

TERM	DEFINITION
Proportional, Integral, Derivative	PID Controllers are designed to eliminate the need for continuous operator attention. An example would be the cruise control in a car or a house thermostat. These controllers are used to automatically adjust some variable to hold the measurement (or process variable) at the set-point. The set-point is where you would like the measurement to be. Error is defined as the difference between set-point and measurement.
Propylene (C3H6)	A saturated hydrocarbon (Alkane) gas, the molecule of which is composed of three carbon and six hydrogen atoms. At room temperature and pressure, propylene is a gas. It is colorless, highly flammable, and has a odor similar to garlic. It is found in coal gas and can be synthesized by cracking petroleum. The main use of propylene is as a monomer, mostly for the production of polypropylene.
Protocol	A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.
PSI	Pounds per Square Inch.
PSIA	Pounds per Square Inch Absolute. Absolute pressure uses a perfect vacuum as the zero point. A perfect vacuum is 0 PSIA. PSIA=PSIG + Atmospheric Pressure.
PSID	Pounds per square inch differential. Pressure difference between two points.
PSIG	Pounds per Square Inch Gauge. Gauge pressure uses the actual atmospheric pressure as the zero point.
PSIS	Pounds per square inch standard. Pressure referenced to a standard atmosphere.
PTB	Physikalisch Technische Bundesanstalt (Federal Physical Technical Office) or Technical Institute for Certification.
PTC	See Positive Temperature Co-efficient Fuse.
Pulse Input	Any digital input to a meter (usually a turbine) that is used to measure pulses over a time period. This calculates volume and flow rate for each period of time.
Pulse Mode	An operational mode used by the LevelMaster for measuring single float levels by transmitting a pulse to the primary windings, reading the voltage level on both the primary and secondary windings and using a calculation whereby one is subtracted from another to determine the single fluid level.
Pulse Output	Any digital output that is used to measure pulses over a period of time. Frequency of Pulses in a predetermined time frame represents a value to be used in calculating volume and flow rate.
Radio Frequency	RF for short. That part of the spectrum from approx. 50kHz to gigahertz.
Radio Frequency Interference	Electromagnetic radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits.
RAM	See Random Access Memory.
RAM Disk	A lithium backed storage chip. Also see Random Access Memory.
RAMS	Acronym for Remote Alarms Monitoring System.
Random Access Memory	Onboard read/write volatile memory, generally used for application variables and the file system. Data stored is lost if power is removed (volatile).
Range	Those values over which a transducer is intended to measure, specified by its upper and lower limits.
Rangeability	The ratio of the maximum flowrate to the minimum flowrate of a meter.
Rated Capacity	The number of ampere-hours a cell/battery can deliver under specific conditions (rate of discharge, cut-off voltage, temperature).
Raw Gas	Natural gas that has not been processed.

TERM	DEFINITION
Raw Mix Liquids	A mixture of natural gas liquids that has not been fractionated or separated into its various components.
RBUS	Communication abbreviation for Results Bus.
RCV	Communication abbreviation for Received.
RD	Acronym for Relative Density.
RDrive	Refers to Totalflow’s SRam Drive (solid state memory chip) located on the main board, used to store data and configuration files. The RDrive is a lithium backed, volatile memory chip and is not affected by a warm start.
Read Only Memory	Computer memory in which data can be routinely read but written to only once using special means when the ROM is manufactured. ROM is used for storing data or programs (e.g. operating systems) on a permanent basis.
Real Time	Data acted upon immediately instead of being accumulated and processed at a later time.
Real Time Data Base	The iVision SCADA system has an in-memory RTDB for the data it collects from various devices. Real-time generally means that the data is acquired often enough that the user can make operational changes to the process while it is still useful to do so. On a factory floor, this can be in milliseconds. For remote devices which may require a couple of hours of drive time to reach, real-time can be thought of in tens of minutes or even hours. The iVision data base can meet either of these requirements.
Real Time Operating System	Any operating system where interrupts are guaranteed to be handled within a certain specified maximum time, thereby making it suitable for control of hardware in embedded systems and other time-critical applications. RTOS is not a specific product but a class of operating system.
Recharge/Charge	The conversion of electrical energy, provided in the form of a current from an external source (charger), into chemical energy within a cell/battery.
Recommended Standard 232	This is the standard interface for full-duplex data communication conducted with two way independent channels. It employs unbalanced signaling and refers to point-to-point communications between one driver and one receiver in a 4-wire bus system. The RS-232 (single-ended) transmits at a relatively slow data rate (up to 20K bits per second) and short distances (up to 50 Ft. @ the maximum data rate).
Recommended Standard 422	This is the standard interface for half-duplex communications conducted with a dual-state driver. It employs balanced signaling and refers to multi-drop communications between one driver and up to ten receivers, known as “straight-through” cabling in a 4-wire bus system. The RS-422 (Differential) transmits a much faster data rate (up to 100K bits per second) and longer distances (up to 4000 Ft. @ the maximum data rate).
Recommended Standard 485	This is the standard interface for half-duplex communications conducted in the tri-state or common mode. It employs balanced signaling and refers to true multi-point communications between up to 32 drivers and 32 receivers, in 2-wire bus system. The RS-485 (Differential) transmits a much faster data rate (up to 100K bits per second) and longer distances (up to 4000 Ft. @ the maximum data rate). It also supports more nodes per line because it uses lower impedance drivers and receivers.
Record	A collection of unrelated information that is treated as a single unit.
Register	A storage device with a specific capacity, such as a bit, byte or word.
Relay	Electromechanical device containing a coil and set of contacts. The contacts close when the coil is activated.
Remote	Not hard-wired; communicating via switched lines, such as telephone lines. Usually refers to peripheral devices that are located a site away from the CPU.

TERM	DEFINITION
Remote Controller, XSeries.	Totalflow's XSeries Remote Controller is a low power, microprocessor based unit designed to meet a wide range of automation, monitor, control, alarming and measurement applications.
Remote Terminal Unit	An industrial data collection device similar to a PLC, designed for location at a remote site, that communicates data to a host system by using telemetry (such as radio, dial-up telephone, or leased lines).
Repeatability	The ability of a transducer to reproduce output readings when the same measurand value is applied to it consecutively, under the same conditions, and in the same direction. Repeatability is expressed as the maximum difference between output readings.
Residue Gas	The portion of natural gas remaining in a gaseous state after recovery of certain components through gas processing.
Resistance	The measure of the ability of a material to pass a current.
Resistance Temperature Characteristic	A relationship between a thermistor's resistance and the temperature.
Resistant Thermal Detector	A metallic probe that measures temperature based upon its coefficient of resistivity.
Resistor	Passive component with a known resistance. The value of resistance is usually shown by a set of colored bands on the body of the component.
Resolution	The smallest significant number to which a measurement can be determined. For example, a converter with 12-bit resolution can resolve 1 part in 4096.
Response Factor	A calculated value determined by analyzing a known substance under precise conditions (temperature, pressure, carrier flow rate) which equals the area of the peak divided by the weight or volume of the injected substance. This calculated value is then used as a response multiplier or offset for analyzing a "sample" of this same substance from another source. In the case of Natural gas, each component will have it's own Response Factor.
Response Time	1) The length of time required for the output of a transducer to rise to a specified percentage of its final value as a result of a step change of input. 2) The time required by a sensor to reach 63.2% of a step change in temperature under a specified set of conditions. Five time constants are required for the sensor to stabilize at 600 of the step change value.
Restore	This refers to a Totalflow procedure in which all the Station or Configuration files are restored to the SDRIVE from the file located on the laptop. This process is very helpful prior to doing a Cold Start when you want to continue using the Configuration and Station files.
Reynolds Number	The ratio of inertial and viscous forces in a fluid defined by the formula Re = rVD/μ, where: r = Density of fluid, μ = Viscosity in centipoise (CP), V = Velocity, and D = Inside diameter of pipe.
RFI	See Radio Frequency Interference.
Ribbon Cable	A flat cable in which the conductors are side by side rather than in a bundle.
Rich Gas	Natural gas which, based on its content of liquefiable hydrocarbons, is suitable for processing in a gas plant for recovery of plant products.
ROM	See Read Only Memory
RRTS	Communication abbreviation for Remote Ready To Send.
RS-232	See Recommended Standard 232.
RS-422	See Recommended Standard 422.
RS-485	See Recommended Standard 485.
RT	See Runtime.
RTD	See Resistant Temperature Detector.

TERM	DEFINITION
RTDB	See Real Time Data Base.
RTOS	See Real Time Operating System.
RTS	Communication abbreviation for Ready To Send.
RTU	See Remote Terminal Unit
Runtime	The time required for an acoustic signal to travel from point A to point B. This measurement is used in calculating the speed of Sound, gas velocity and volume in the TotalSonic Meter.
RXD	Communication abbreviation for Receive Data.
S/N	Serial Number. The whole Serial Number is made up of a prefix of 5 digits and the suffix, a 10 digit configuration number.
S1	Sample Line 1 (located on NGC8200 series Feed-Through Assembly).
S2	Sample Line 2 (located on NGC8200 series Feed-Through Assembly).
S3	Sample Line 3 (located on NGC8200 series Feed-Through Assembly).
S4	Sample Line 4 (located on NGC8200 series Feed-Through Assembly).
Saddle	A fitted plate held in place by clamps, straps, heat fusion, or welding over a hole punched or drilled in a gas main to which a branch line or service line connection is made. The saddle also may serve as a reinforcing member for repair.
Sample Loop	A tube with a given volume used in conjunction with a valve for measuring and holding the sample gas before pushing it into the chromatograph column.
Saturated BTU	The heating value of natural gas that is saturated with water vapor.
Saturated Hydrocarbons	Hydrocarbons that contain only single bonds. They are also called Alkanes or paraffin hydrocarbons.
Save	This refers to a Totalflow procedure in which all the Station or Configuration files are copied from the RDRIVE or the SDRIVE, to a file created on a laptop.
Savitsky-Golay Smoothing	Digital Signal Smoothing. A special class of a digital signal processing filter. Specifically determines the coefficients that are used for signal processing.
SCADA	See Supervisory Control and Data Acquisition
Scf	Abbreviation for one standard cubic foot, a measurement of a gas volume at a contractual, regulatory or standard specified temperature and pressure.
Schematic	Another name for a circuit diagram.
SCM	Acronym for Sample Conditioning Module.
Scroll	To move all or part of the screen material up to down, left or right, to allow new information to appear.
SD Card	Secure Digital Card.
SDRIVE	Totalflow's Serial E^2 PROM solid state memory chip, located on the Main Board (volatile memory, affected by a cold start), used to store configuration or station files.
Selectable Units	Selectable measurement units for various international and specialized application needs.
Self-Calibrating	A property of a DAQ board that has an extremely stable onboard reference and calibrates its own A/D and D/A circuits without manual adjustments by the user.
Semiconductor	Material that is nether a conductor nor insulator. Its properties can be altered by a control voltage.
Sensing Element	That part of the transducer which reacts directly in response to the input.
Sensor	A device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal.

TERM	DEFINITION
Sensor File	The Sensor File contains all the setup/calibration information of the unit. The Sensor File is a (.dat) file and by default is named after the base serial number proceeded by an "s", such as s00108.dat. Although the name can be overwritten, it is recommended that the default name be kept.
Serial I/O	A common form of data transmission, in which the bits of each character are sent one at a time over the line.
Serial Port	A communications interface that uses one data line to transfer data bits sequentially. On the IBM PC the serial port refers to a standard asynchronous serial interface which uses the 8250/16450/16550 family of UART's.
Service Life	The period of useful life (usually in hours or minutes) of a primary cell/battery before a predetermined cut-off voltage is reached.
Set Point	The temperature at which a controller is set to control a system.
Set-Point	A "level" or control point in a feedback system.
SFC	Sequential Function Chart (IEC supported programming language)
SG	Acronym for Specific Gravity.
Short Circuit	A connection of comparatively low resistance accidentally or intentionally made between points on a circuit between which the resistance is normally much greater. Also called a "bridge" or "short" such as when solder from two tracks touch on a PC board.
Shrinkage	The reduction in volume and/or heating value of a natural gas stream due to extraction or removal of some of its components.
SIG	See Signal.
Signal	Any communication between message-based devices consisting of a write to a signal register.
Signal Generator	A circuit that produces a variable and controllable signal.
Signed Integer	Can represent a number half the size of a “unsigned integer”, including a negative number.
Sink	Device such as a load that consumes power or conducts away heat.
Skip Days	Extra Daily records for recording events that require the start of a new day. i.e. Volume Reset, Backward Time change over the hour, and Contract Hour change.
SNAM	Italy’s Certification Board
SNR	Signal to Noise Ratio.
SoftCONTROL	Softing’s IEC compiler environment
Softing	Maker and distributor of the IEC compiler softCONTROL
Software	The non-physical parts of a computer system that include computer programs such as the operating system, high-level languages, applications programs, etc.
Solar cell	A cell that produces current under sunlight.
Solenoid	A coil of wire that is long compared to its diameter, through which a current will flow and produce a magnetic flux to push or pull a rod (called an armature).
SOS	See Speed of Sound.
Sour Gas	Natural gas that has a high concentration of H2S.
Source	Device that provides signal power or energy to a load.
SP	See Static Pressure
Span	The difference between the upper and lower limits of a range expressed in the same units as the range.

TERM	DEFINITION
Specific Gravity	The ratio of the mass of a solid or liquid to the mass of an equal volume of distilled water at 4°C (39°F) or of a gas to an equal volume of air or hydrogen under prescribed conditions of temperature and pressure. Also called *relative density*.
Speed of Gas	Rate at which gas travels through the pipeline. Used in flow calculations in the TotalSonic Meter. Calculations follow AGA 9 Report.
Speed of Sound	Rate at which sound travels through the medium. Used in flow calculations in the TotalSonic Meter. Calculations follow AGA 10 Report.
SPU	Signal Processing Unit (measurement transducer).
SQL	See Structured Query Language.
SRAM	See Static Random Access Memory
SSM	Acronym for Stream Selector Module.
ST	Structured Text (IEC supported programming language)
Stability	The quality of an instrument or sensor to maintain a consistent output when a constant input is applied.
Stable Gas	Is a vapor containing less than 0.1 PPM of liquid when vapor is cooled to 18.3°F (10°C) below the coldest ambient temperature possible at any point in the system.
Static Pressure	Equals PSIA or PSIG. Referenced to atmospheric pressure versus absolute pressure in a vacuum. It is defined as the pressure exerted by a non-moving liquid or gas. In the case of a gas well this would be the natural PSI of the gas inside of the well.
Static Random Access Memory	The place in your computer that programs reside when running. You can access any part of the memory, and it can easily be overwritten with new values. SRAM is much more expensive and physically larger than DRAM but much faster.
Status Output	Any digital output that uses “On” or “Off” conditions to determine the status of the assigned description. Changing from one to the other represents a change in the condition.
STP	Standard Temperature and Pressure
Structured Query Language	IBM developed this language in the 60’s as a way of accessing data from a relational database. It has a very simple syntax for simple functions but can become complex for sophisticated applications. This language is standardized by international standards bodies, and is almost universal in application. Almost all databases support SQL. The iVision RTDB supports SQL and this makes it extremely flexible within a corporate network. Authorized users throughout the organization can write SQL statements to acquire data from this database that they need for Marketing, Accounting, Engineering, or other functions.
Sulfur	A pale, yellow, non-metallic chemical element that may be found in a gas stream and which needs to be removed or reduced from the gas stream for corrosion control or health or safety reasons.
Supercompressibility Factor	A factor used to account for the following effect: Boyle's law for gases states that the specific weight of a gas is directly proportional to the absolute pressure, the temperature remaining constant. All gases deviate from this law by varying amounts, and within the range of conditions ordinarily encountered in the natural gas industry, the actual specific weight under the higher pressure is usually greater than the theoretical. The factor used to reflect this deviation from the ideal gas law in gas measurement with an orifice meter is called the "Supercompressibility factor Fpv". The factor is used to calculate corrected from volumes at standard temperatures and pressures. The factor is of increasing importance at high pressures and low temperatures.

TERM	DEFINITION
Supervisory Control and Data Acquisition	A common PC function in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by a PC.
Surge	A sudden change (usually an increase) in the voltage on a power line. A surge is similar to a spike, but is of longer duration.
SV	Sample Vent (located on NGC8200 series Feed-Through Assembly).
SW VBATT	Switched Battery Voltage. Cycles power to equipment to save power.
Switch	An electrical device for connecting and disconnecting power to a circuit, having two states, on (closed) or off (open). Ideally having zero impedance when closed and infinite impedance when open.
Synchronous	(1) Hardware - A property of an event that is synchronized to a reference clock. (2) Software - A property of a function that begins an operation and returns only when the operation is complete.
Syntax	Comparable to the grammar of a human language, syntax is the set of rules used for forming statements in a particular programming language.
System Noise	A measure of the amount of noise seen by an analog circuit or an ADC when the analog inputs are grounded.
TankMaster	Totalflow Control System for LevelMaster Tank Units.
Tap	To cut threads in a round hole so that other fittings or equipment can be screwed into the hole. Also to make an opening in a vessel or pipe.
TBUS	Communication abbreviation for Transmit Bus.
TCD	See Thermal Conductivity Detector.
TCP/IP	TCP/IP – This is the basic communication format for the Internet, and for much of what happens on a corporate network. Virtually all networked PCs and other computers have an “IP address” having the format xxx.xxx.xxx.xxx (xxx can range from 0 to 255 in most cases). You can see the ip address of your PC by going to the start menu, selecting run, and entering cmd. A “DOS Box” will be displayed on your screen. Type ipconfig to get the ip address. When you enter a URL (e.g., www.totalflow.com) in a browser, a DNS server (on the network) resolves this into an IP address and directs your request to the machine with that address.
TCR	Temperature Compensated Regulator.
TDS32	Totalflow DDE Server that allows Microsoft Windows applications with DDE capabilities to communicate with Totalflow’s equipment. For example data can be retrieved and placed in an Excel spreadsheet.
Temperature Coefficient	An experimental number used to modify the calibration of a device (Totalflow transducer) to account for changes in environmental temperature.
Temperature Error	The maximum change in output, at any measurand value within the specified range, when the transducer temperature is changed from room temperature to specified temperature extremes.
Temperature Range, Compensated	The range of ambient temperatures within which all tolerances specified for Thermal Zero Shift and Thermal Sensitivity Shift are applicable (temperature error).
Temperature, Ambient	The temperature of the air, atmosphere or other fluid that completely surrounds the apparatus, equipment or the work piece under consideration. For devices which do not generate heat, this temperature is the same as the temperature of the medium at the point of device location when the device is not present. For devices which do generate heat, this temperature is the temperature of the medium surrounding the device when the device is present and generating heat. Allowable ambient-temperature limits are based on the assumption that the device in question is not exposed to significant radiant-energy sources such as sunlight or heated surfaces.

TERM	DEFINITION
Temperature, Flowing	Temperature of the flowing fluid. Usually gas and measured by an RTD.
Terminal Mode	Man-Machine interface tool used as and engineering interface with equipment.
Termination	Placement of a connector on a cable.
Termination Panel	A circuit board with screw terminals or other connector system that allows convenient connection of field signals to a data acquisition or communication system.
TF.NET	Totalflow network used to access iVision/web data.
TFIO Module	Totalflow Input/Output module (i.e. quad AO)
Thermal Conductivity Detector	Universal detector that shows a response to all compounds. An electrical component that changes resistance based on the components ability to conduct heat. In chromatography, two TCDs are used, 1)as a reference detector and 2) as the sensor detector. The reference detector is exposed to only the carrier gas and the Sensor detector is exposed to the sample.
Thermistor	A temperature-sensing element composed of sintered semiconductor material which exhibits a large change in resistance proportional to a small change in temperature. Thermistors usually have negative temperature coefficients.
Thermistor Bead	See Thermal Conductivity Detector.
Thermocouple	A temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature.
Thermowell	A closed-end tube designed to protect temperature sensors from harsh environments, high pressure, and flows. They can be installed into a system by pipe thread or welded flange and are usually made of corrosion-resistant metal or ceramic material depending upon the application.
Therms Master	Totalflow application for Gas Analyzer.
Tolerance	The allowable percentage variation of any component from that stated on its body.
Totalflow	Product line of ABB Inc. Maker and distributor of the XSeries Flow Computers (XFC) and Remote Controllers (XRC).
TotalSonic MMI	TotalSonic's Man Machine Interface software program. May also be called MEPAFLOW 600.
Transducer	A device for converting energy from one form to another, specifically the measurement of pressure differential in natural gas gate stations. I.e. Pressure to voltage or current.
Transfer Rate	The rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate.
Transient	An abrupt change in voltage, of short duration (e.g. a brief pulse caused by the operation of a switch).
Transistor	A three leaded device (Collector, Base, Emitter) used for amplifying or switching. Also called a bi-polar transistor to distinguish it from Field Effect Transistor etc.
Transmitter	A device that converts audio, video or coded signals into modulated radio frequency signals which can be propagated by electromagnetic waves (radio waves).
Tranzorb	Transient Voltage Suppression device.
TRB	Tank Request Block Editor. When requesting storage space after adding a LevelMaster application, the file is saved as a *.trb file.
Tube	Cylinder for transporting or storing liquids: any long hollow cylinder used to transport or store liquids.

TERM	DEFINITION
Tuned Radio Frequency	An amplitude modulated (AM) receiver with one or more stages of radio frequency before the detector.
TXD	Communication abbreviation for Transmit Data.
UDINT	Unsigned Double Integer
UL	Underwriters Laboratories, Inc. An independent laboratory that establishes standards for commercial and industrial products.
Union	A form of pipe fitting where two extension pipes are joined at a separable coupling.
Universal Serial Bus	An external peripheral interface standard for communication between a computer and external peripherals over a cable using biserial transmission. It supports both isochronous and asynchronous data transfers.
Unsigned Integer	Can represent a number twice the size of a “signed integer”, but cannot represent a large negative number.
Upload	This refers to a Totalflow procedure in which any file(s) located in the on-board memory of a Totalflow Host is copied to a file created on a laptop PC.
UPS	Un-interruptible power supply. A power conditioning unit placed between the commercial power service and the protected device. The UPS uses line power to charge batteries, which, in the case of a power failure, can drive electronic circuitry to produce the appropriate AC requirements for some time period.
Upstream	Oil and natural gas exploration and production activities; plus gas gathering, processing and marketing operations.
Upstream Pipeline	The first pipeline to transport natural gas en route to an inter-connect point for delivery to another pipeline. See DOWNSTREAM PIPELINE.
USB	Acronym for Universal Serial Bus.
USB Client	Generally refers to the peripheral device (Slave or Client) that is driven by a computer (Master or Host). Examples are a printer and digital camera.
USB Host	Generally refers to the computer device (Master or Host) that drives a peripheral piece of equipment (Slave or Client). An example is a Laptop or Desktop Computer.
USX	Provider of the RTOS used by the XSeries product line
VAC	Volts of alternating current.
Vacuum	A pressure less than atmospheric pressure, measured either from the base of zero pressure or from the base of atmospheric pressure (PSIA).
Valve	A mechanical device for controlling the flow of fluids and gases; types such as gate, ball, globe, needle, and plug valves are used.
Valve Control	This feature provides automatic feedback control of Differential Pressure (DP), Static Pressure (SP), and Flow Rate for the purpose of positioning a flow valve to maintain a desired value of DP, SP, or Flow Rate.
Vapor Pressure	The pressure exerted by a liquid when confined in a specified tank or test apparatus.
VAS32	Totalflow’s Voice Alarm System. A software program that receives and transmits alarm notifications via cell, telephone or pager systems.
VBATT	Battery Voltage. The voltage output from the battery source.
VCI	Valve Control Interface.
VDC	Volts of direct current.
VDE	Verband der Elektrotechnik Elektronik Informationstechnik [Association for Electrical, Electronic & Information Technologies]
Velocity	The time rate of change of displacement; dx/dt.

TERM	DEFINITION
Vent	A normally sealed mechanism which allows for the controlled escape of gases from within a cell.
VGA	Video Graphic Array.
Virtual Memory	A method of making disk storage appear like RAM memory to the CPU, thus allowing programs that need more RAM memory than is installed to run in the system. This technique is slow compared to "real" memory.
Viscosity	The inherent resistance of a substance to flow.
VOG	Velocity of Gas.
Volatile Memory	A storage medium that loses all data when power is removed.
Volt	The unit of voltage or potential difference.. One thousand volts = 1kV.
Voltage	Electrical pressure, the force, which causes current to flow through a conductor. Voltage must be expressed as a difference of potential between two points since it is a relational term. Connecting both voltmeter leads to the same point will show no voltage present although the voltage between that point and ground may be hundred or thousands of volts.
Voltmeter	A meter for reading voltage. It is one of the ranges in a multimeter.
Volume Calculation Period	The specified length between reading and calculating volume data.
Volume Flow Rate	Calculated using the area of the full closed conduit and the average fluid velocity in the form, Q = V x A, to arrive at the total volume quantity of flow. Q = volumetric flowrate, V = average fluid velocity, and A = cross sectional area of the pipe.
VOS	Velocity of Sound.
Warm Start	A rebooting technique which will clear most operational errors, without damaging either the data or configuration files. This causes the equipment to boot from the RDRIVE, which is a solid state memory chip.
Watt	Symbol W. The unit of power. One watt is the product of one volt and one amp. Power (W) = Current (I) X Energy (E). (E = Volts)
Wavelength	The distance between two points of corresponding phase in consecutive cycles
Web Page	All the text, graphics, and sound visible with a single access to a Web site; what you see when you request a particular URL.
Web Server	The hardware and software required to make Web pages available for delivery to others on networks connected with yours.
Web Site	A collection of electronic "pages" of information on a Web server
Well, Development	A well drilled in order to obtain production of gas or oil known to exist.
Well, Disposal	A deep well in which to inject waste chemicals, etc., such as a well to dispose of salt brine from the solution mining of salt dome gas storage caverns.
Well, Exploratory	A well drilled to a previously untested geologic structure to determine the presence of oil or gas.
Well, Gas	A well which produces at surface conditions the contents of a gas reservoir; legal definitions vary among the states.
Well, Marginal	A well which is producing oil or gas at such a low rate that it may not pay for the drilling.
Well, Stripper	Non-associated gas well capable of producing no more than 90 Mcf/day at its maximum rate of flow.
Well, Wildcat	An exploratory well being drilled in unproven territory, that is, in a horizon from which there is no production in the general area.
Wellhead	The assembly of fittings, valves, and controls located at the surface and connected to the flow lines, tubing, and Casing of the well so as to control the flow from the reservoir.

TERM	DEFINITION
Wheatstone Bridge	Circuit design using two TCDs to measure components in chromatography.
WINCCU	Windows Central Collection Unit. Windows version of software to process, archive and manipulate data collected from the Totalflow products.
Window	In computer graphics, a defined area in a system not bounded by any limits; unlimited "space" in graphics.
Witness	In the field, where hydrocarbons are changing hands and actual cash register transactions being performed, it is not uncommon for one party or the other to request / require a representative or company employee be present during calibrations and or routine maintenance. Often this arrangement is contractually linked.
Wobbe Index	Calculated from the energy content, or a higher heating value of the gas, and the relative density of the gas ($Btu/RD^{1/2}$).
Wobbe Number	A number proportional to the heat input to a burner at constant pressure. In British practice, it is the gross heating value of a gas divided by the square root of its gravity. Widely used in Europe, together with a measured or calculated flame speed, to determine interchangeability of fuel gases.
Working Voltage	The highest voltage that should be applied to a product in normal use, normally well under the breakdown voltage for safety margin. See also Breakdown Voltage.
World Wide Web	An Internet service facilitating access to electronic information - also known as the Web, WWW, or W3.
Write	To record data in a storage device or on a data medium.
XDCR	See External Transducer.
XFC	See Flow Computer, XSeries.
XFC-195 Board	The main electronic board used in XSeries flow computers. The XFC-195 Board mounts on the inside of the enclosure’s front door.
XFC6200EX	Totalflow’s Class 1 Div 1 Flow Computer. This Totalflow Flow Computer is housed in an explosion proof housing and has similar operational features as the μFLO, with additional capabilities.
XIMV	See XSeries Integral Multivariable Transducer.
XMV	See Multivariable Transducer.
XRC	XSeries Remote Controller. Also see Remote Controller, XSeries.
XSeries	Totalflow’s new extendable equipment series featuring technology that is expandable and flexible for ever changing needs.
XSeries Integral Multivariable	Abbreviated XIMV. A smart Multivariable Transducer that is an integral part of the XSeries Flow Computer, measuring Static Pressure (SP), Differential Pressure (DP) and Flowing Temperature (Tf). This refers to both the transducer portion of the device and the circuitry required to supply measurements to the Main Processor Board, which is housed in a factory sealed unit. See Multivariable Transducer for more information.
Y	Expansion factor.
Zero Gas	Gas at atmospheric pressure.
Zero Offset	The difference expressed in degrees between true zero and an indication given by a measuring instrument.

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Appendix C
Drawing & Diagrams

This Chapter of the manual has been provided as a location for the user to place drawings that accompanies their new Totalflow units.

Totalflow recommends that a complete set of all drawings that accompany this Model be placed in this Chapter. This would ensure that the user have only drawings applicable to their units and drawings that are at the latest revision level.

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