SmartBus Series

FIELD-MOUNT REMOTE METER CONTROLLERS

SETUP AND INSTALLATION GUIDE

SmartBus
by Omni

SmartBus™

Field-Mount Remote Meter Controllers

Setup & Installation Guide

Edition R07-08/06

Omni

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Please contact Omni Flow's Technical Communications Department with your inquiries or observations about Omni Flow documentation at:

12620 W. Airport Blvd., Suite 100, Sugar Land, Texas 77478, USA ♦ **Phone:** 281-240-6161 **Fax:** 281-240-6162 ♦ **E-mail:** techsupport@omniflow.com or sales@omniflow.com ♦ **Website:** http://www.omniflow.com

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1 Before You Begin

IN CHAPTER 1

Before You Begin:

Welcome to the Omni Flow Computers, Inc. (Omni Flow) SmartBus revolution! The SmartBus field-mount Remote Meter Controller (RMC) provides the entire spectrum of liquid and gas flow measurement, control, and communications in a single unit. In this chapter you will find information about using this guide, getting technical support, legally using SmartBus technology, and storing and unpacking the RMC.

To take full advantage of the RMC, please take a moment to read this chapter and always refer to this Setup & Installation Guide when installing the RMC and connecting devices to it. This guide also serves as reference in helping you get acquainted with SmartBus technology. If you need help along the way, do not hesitate to contact Omni Flow's support staff.

1.1. About This Guide & SmartBus Documentation

The SmartBus Series Setup & Installation Guide contains basic information about RMC features, architecture, field installation, device connectivity, networking, and SmartCom - the RMC configuration, operation and communications software. This guide is only part of the documentation set that integrates the SmartBus product series.

1.1.1. SmartBus Core Documentation

HYPERLINKS

SmartBus electronic documents contain interactive hyperlinks in blue. When clicked with your mouse, these links take you to cross-references within the same document, or to other documents. E-mail address links open your E-mail client software with the address (To) field filled-in. If you are connected to the Internet, links denoted "www.omniflow.com" (without quotes) take you to Omni Flow's website.

The following list represents the RMC SmartBus product core documentation.

- RMC Setup & Installation Guide (this document in print and electronic versions)
- Online SmartCom Help (integrated with SmartCom software)
- Component Kit Setup & Installation Instructions (included with upgrade and replaceable hardware components—see Section 3.6 "Component Upgrade & Replacement")

All of the SmartBus documentation is available in electronic format. We produce our electronic documentation using HTML, Microsoft HTML Help, Adobe Acrobat® Portable Document Format (PDF), and related web technologies. Viewing these documents requires special reader software for PCs, which is free, widely used, and easily available . Our electronic documents also contain interactive hyperlinks (see sidebar note).

As of May 2006, SmartBus documentation is available only in English.

1.1.2. Target Audience

You do not need to be an expert in order to benefit from using SmartBus technology. However, some features require a certain degree of expertise and advanced knowledge of liquid and gas measurement and electronic instrumentation. Applying the great variety of SmartBus RMC features requires different levels of technical knowledge. In general, SmartBus documentation is targeted towards the following users:

- System/Project Managers and Integrators
- Field Engineers and Programmers
- Instrumentation Technicians and Installers
- Instrument Operators
- Trainees

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1.1.5. Modifications

Omni Flow's policy of product development and continuous improvement of processes assures that our products will incorporate emerging technologies and changing user requirements. We are constantly upgrading our technology as the result of research and customer requests. In this spirit, we may make any changes to SmartBus documentation we deem necessary and without prior notice.

1.2. About Omni Flow Computers, Inc.

Omni Flow Computers, Incorporated (Omni Flow) is the world's leading developer and manufacturer of custody transfer flow computing technology products. Our mission is to continue to achieve higher levels of customer and user satisfaction by applying the company vision and values: our people, our products, and quality excellence.

1.2.1. Mission Statement

OMNI, the largest independent manufacturer of fiscal flow computers for the energy industry, is dedicated to conducting business with integrity; applying specialized knowledge & experience; providing reliable products and services with commitment to customer and employee satisfaction.

1.2.2. Products, Technology, & Services

Our products have become the international flow computing standard. Omni Flow Computers pursues a policy of product development and continuous improvement. As a result, the industry considers our products as the "brain" and "cash register" of liquid and gas flow custody transfer metering systems. Omni Flow technology is established as the global standard in electronic hydrocarbon measurement.

Our customer, sales, and training services are unrivaled in the industry. We offer technical support worldwide and from our corporate or authorized representative offices.

1.2.3. Staff

Our staff is knowledgeable and professional. They represent the energy, intelligence, and strength of our company, adding value to our products and services. With customers and users in mind, we are committed to quality in everything we do, devoting our efforts to deliver the highest caliber workmanship. Teamwork with uncompromising integrity is our lifestyle.

1.3. About User Support & Contacting Omni Flow

If you require user support, please contact a local representative or our corporate offices. Our staff and representatives will enthusiastically work with you to ensure the sound performance of your Omni SmartBus System.

Below is information on contacting Omni Flow Computers, Incorporated (Omni Flow). Our corporate headquarters office hours are Monday through Friday, 8:00am to 5:00pm, U.S. Central Standard Time.

Mailing Address:

Omni Flow Computers, Inc.
12620 W. Airport Blvd. Ste 100
Sugar Land, Tx 77478 USA

Phone: 281-240-6161

Fax: 281-240-6162

Website Address:

http://www.omniflow.com

E-mail Addresses:

sales@omniflow.com

techsupport@omniflow.com

1.4. About SmartBus Technology

SmartBus is founded upon the proven flow computing technology developed by Omni Flow. With the SmartBus Series of Remote Meter Controllers, Omni Flow developed the most advanced, integral, and smartest devices ever for electronic liquid and gas measurement applications. Chapter 2 "Introducing the SmartBus Remote Meter Controller" describes this technology in more detail.

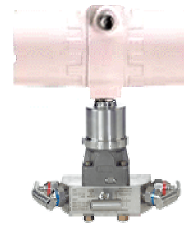
1.4.1. SmartBus RMC Series

Figure 1-1 shows the different RMC models. The SmartBus Series of Remote Meter Controllers comprises the following products:

- **RMC 255** → This is the most complete model that integrates the remote meter controller with the display, handheld remote control unit, multivariable sensor, multi-purpose firmware, and SmartCom software.
- **RMC 250** → This model has the remote meter controller with the multivariable sensor, multi-purpose firmware, and SmartCom software.
- **RMC 205** → The remote meter controller with display, handheld remote control unit, multi-purpose firmware, and SmartCom software make up this model.
- **RMC 200** → Our base unit of the SmartBus series, consisting of the remote meter controller, multi-purpose firmware, and SmartCom software.
- **RMD 200** → This unit consists of a stand-alone remote meter display and handheld remote control unit.

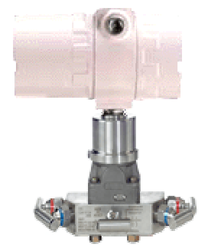
RMC 255

Remote Meter Controller with Display and Multivariable Sensor



RMC 250

Remote Meter Controller with Multivariable Sensor



RMC 205

Remote Meter Controller with Display

RMC 200

Remote Meter Controller (base unit)

RMD 200

Remote Meter Display (stand-alone unit)

Figure 1-1. The SmartBus Series of Remote Meter Controllers.

1.4.2. Features at a Glance

Omni Flow's SmartBus Remote Meter Controller (RMC) technology consists of the following features:

- Single meter run real-time information processing.
- Support for forward & reverse flow totalization
- Field-mount construction with explosion-proof enclosure.
- 32-bit processor, floating point math coprocessor, 1 megabyte (MB) of static random-access memory (SRAM), and 2 megabytes (MB) of flash memory.
- Multi-purpose firmware for industry-standard liquid and gas flow metering applications with preprogrammed algorithms, flow equations, and process variable calculations.
- Windows®-based RMC configuration and operating software (SmartCom).
- Support for major flowmeter and transmitter types, distributed control and supervisory control and data acquisition systems (DCS/SCADA), and multiple device connectivity.
- Networking/Internetworking-enabled via optional state-of-the-art Ethernet 10BaseT Network Interface Card (NIC) with multi-protocol processor and high-speed communications coprocessor. Supports TCP/IP (encapsulated Modbus) and Modbus/TCP protocols.
- Industry-standard RS-232 and RS-485 serial communications.
- Analog and Serial I/O.
- Optional Multivariable pressure sensor (static or gauge pressure, temperature, and differential pressure) for gas and liquid applications (in some models).
- Optional Integrated or stand-alone, 8-line by 20-character, graphical, backlit, liquid crystal display (LCD) with 2MB Flash memory and 512 KB SRAM.
- Optional infrared handheld remote control unit for accessing RMC user-defined displays, database, and settings with editing capabilities.

ORDERING RMC COMPONENTS

To order optional, upgrade, replacement, and spare parts for your RMC, contact Omni Flow Computers, Inc. or one of our authorized representatives. For more information, contact our corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

Website:
www.omniflow.com

1.4.3. Warranty, Licenses, & Product Registration

The first few pages of this guide include product warranty and licenses for use of SmartBus RMC firmware and of SmartCom Configuration Software. We recommend that you read this information before using the RMC, its companion software, and documentation.

1.5. Storing, Handling, & Unpacking the RMC

CAUTION!

POTENTIAL FOR DATA LOSS!

SmartBus RMCs leave the factory with a fully charged nickel-metal hydride (Ni-MH) battery as random-access memory (RAM) power backup. RAM data, including configuration settings, accumulated totals, and custom user settings may be lost if the RMC is without an external power source for more than 30 days. Observe caution when storing the RMC. Always backup your RMC configuration settings using SmartCom software before disconnecting power. The RAM backup battery is rechargeable. You need to apply power to the RMC for 24 hours to recharge the Ni-MH battery.

Store the SmartBus product appropriately in its original packing until you are ready to install it. Make sure the storage facility is climatized to keep RMC components free of dust, moisture, static electricity, electromagnetic fields, and extreme temperature and weather conditions. Storage temperatures range from -40°C to +85°C (-40°F to +185°F) for both the Remote Meter Controller (RMC) and Remote Meter Display (RMD) units (see Section 1.6 "SmartBus RMC Technical Specifications"). You can stack up to five packed units placed one on top of the other. Avoid placing any heavy objects on top of SmartBus products.

When unpacking the RMC, verify the contents of your package. Inspect for any damage that may have occurred during shipping. Unpack only when you are ready to install the RMC.

Always handle the SmartBus product with care. Be careful not to drop it and avoid electrostatic discharges. When handling the display assembly, take extreme care to avoid scratching or breaking glass domes. Read the safety tips listed in Section 3.1 "Safety" before handling and installing SmartBus products.

When installing, use extreme care to keep dust and moisture from components until you have securely mounted the RMC, installed conduits, run wires, and replaced covers. Always follow safety guidelines. For more information, see Chapter 3 "Field Installation & Wiring".

1.6. SmartBus RMC Technical Specifications

Following are the shared processing characteristics and individual technical specifications for each SmartBus model. Some of these specs correspond to optional expansion components.

1.6.1. RMC Processing Characteristics

Processor:	32-bit at 20MHz with floating point coprocessor
Memory:	2MB Flash; 1MB SRAM (RMC); 512KB (RMD)
Process I/Os:	Single meter run; 4 to 8 RTD/4–20mA/1–5V selectable analog inputs; 2 RTD excitation current source outputs; 2 analog outputs; 2 flow pulse inputs; 1 density pulse input
Digital I/Os:	6 digital inputs; 6 digital outputs
Communication Ports:	3 to 5 RS-485 serial ports, 1 RS-232/RS-485 selectable serial port; 1 network interface port (Ethernet 10BaseT TCP/IP)
Software:	User-configurable, multi-purpose firmware in Flash memory; SmartCom Windows®-based RMC configuration software with real-time data access

1.6.2. RMC 255

Base Components:	Remote Meter Controller, display, and multivariable pressure transmitter
Operating Temperature:	-40°C to +85°C (-40°F to +185°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Power:	10.2W Nominal, 425mA @ 24VDC
Classification:	Class 1, Div 1; Groups B, C, & D
Enclosure:	Explosion-proof Class I, Division I (Type 4X), with 1.9cm (¾”) conduit feed-through cavity and tempered, scratch-resistant glass display view port
Display & Remote Control:	8-line x 20-character, backlit, graphical LCD; infrared port and handheld remote control unit
Multivariable Sensor:	Multivariable Pressure Transducer for DP, SP (absolute or gauge), meter body temperature; and with RTD input for process temperature
Weight:	9.5Kgs (21Lbs)
Dimensions:	Width: 14cm (5½”); Length: 31.1cm (12¼”); Height: 36.1cm (14¼”)

1.6.3. RMC 250

Base Components:	Remote Meter Controller and multivariable pressure transmitter
Operating Temperature:	-40°C to +85°C (-40°F to +185°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Power:	8W nominal, 330mA @ 24VDC
Classification:	Class 1, Div 1; Groups B, C, & D
Enclosure:	Explosion-proof Class I, Division I (Type 4X), with 1.9cm (¾”) conduit feed-through cavity
Multivariable Sensor:	Multivariable Pressure Transducer for DP, SP (absolute or gauge), meter body temperature; and with RTD input for process temperature
Weight:	9Kgs (20Lbs)
Dimensions:	Width: 14cm (5½”); Length: 24.5cm (9⅝”); Height: 36.1cm (14¼”)

1.6.4. RMC 205

Base Components:	Remote Meter Controller and display
Operating Temperature:	-40°C to +85°C (-40°F to +185°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Power:	10.2W Nominal, 425mA @ 24VDC
Classification:	Class 1, Div 1; Groups B, C, & D
Enclosure:	Explosion-proof Class I, Division I (Type 4X), with 1.9cm (¾") conduit feed-through cavity and tempered, scratch-resistant glass display view port
Display & Remote Control:	8-line x 20-character, backlit, graphical LCD; infrared port and handheld remote control unit
Weight:	5Kgs (11Lbs)
Dimensions:	Width: 14cm (5½"); Length: 31.1cm (12¼"); Height: 15.2cm (6")

1.6.5. RMC 200

Base Components:	Remote Meter Controller (base unit only)
Operating Temperature:	-40°C to +85°C (-40°F to +185°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Power:	8W Nominal, 330mA @ 24VDC
Classification:	Class 1, Div 1; Groups B, C, & D
Enclosure:	Explosion-proof Class I, Division I (Type 4X), with 1.9cm (¾") conduit feed-through cavity
Weight:	3.9Kgs (8.5Lbs)
Dimensions:	Width: 14cm (5½"); Length: 24.5cm (9⅝"); Height: 15.2cm (6")

1.6.6. RMD 200

Base Components:	Remote Meter Display (stand-alone unit)
Processor:	32-bit at 20MHz
Memory:	2MB Flash; 512KB SRAM (RMD)
Operating Temperature:	-40°C to +85°C (-40°F to +185°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Power:	2.2W nominal, 90mA @ 24VDC
Classification:	Class 1, Div 1; Groups B, C, & D
Enclosure:	Explosion-proof Class I, Division I (Type 4X), with 1.9cm (¾”) conduit feed-through cavity and tempered, scratch-resistant glass display view port
Display & Remote Control:	8-line x 20-character, backlit, graphical LCD; infrared port and handheld remote control unit
Weight:	3Kgs (6.5Lbs)
Dimensions:	Width: 14cm (5½”); Length: 14cm (5½”); Height: 24.6cm ($9^{11}/_{16}$”)

1.6.7. Multivariable Sensor

Base Components:	Differential pressure (DP) sensor; static pressure (SP) sensor; meter body temperature sensor, Process RTD input.
Operating Temperature:	-40 to +125 °C (-40 to +257 °F)
Storage Temperature:	-55 to +125 °C (-67 to +257 °F)
Differential Pressure:	0-250 in H_2O (0-0.62 to 0-62.2 kPa)
Absolute (Static) Pressure:	0-3,626 psia (0-250 to 0-25000 kPa)
Gauge (Static) Pressure:	0-3,626 psig (0-250 to 0-25000 kPa)

1.6.8. RMD Specifications

CPU:	20 Mhz MC68332	
Memory:	2 Mbytes FLASH, 512 Kbytes SRAM	
Power:	Supply:	18 to 30 VDC @ 2.2 W
	Protection:	400mA solid state fuse
		Reverse Polatity Protection
		36V Transient Suppression
Display:	8 x 20 Character Graphics	
Environmental:	Operating Temp:	0 to 50°C (32° to 122°F)
	Storage Temp:	-20° to 60°C (-4° to 140°F)
	Operating Humidity:	90% RH Non-Condensing @ 60°C

1.6.9. RMC Specifications

CPU: 20MHz MC68332 (CPU32 Core)
System Integration Module (SIM)
Time Processor Unit (TPU)
Queued Serial Module (QSM)
Precision Interval Timer (PIT)
Integrated Watchdog Timer

Floating Point Coprocessor: 20MHz 68881/68882

Memory: 2 Mbytes 0 wait state FLASH
1 Mbyte 0 wait state battery backed SRAM
8 Kbytes non-volitle EEPROM
Field Programmable

Power Requirements:

Supply: 18 to 30 VDC @ 4.2 to 6 W

CPU Board	~ 4.2 W Nominal
Analog/Serial Expansion	~ 0.6 W Nominal
Display (Full Backlight)	~ 2.2 W Nominal
Ethernet Expansion	~ 1 W Nominal

Protection: 1.25A fuse, 1.1A solid state fuse
Reverse Polatity Protection
36V Transient Suppression

Isolation: 36V Input Terminal to DC Return
60V DC Return to Earth Ground

Fused Outputs: (5) 24VDC @ 100mA
(1) 24VDC @ 400mA for Display Power

Environmental:

Operating Temp:	- 40° to 85°C (- 40° to 185°F)
Storage Temp:	- 40° to 85°C (- 40° to 185°F)
Operating Humidity:	≤ 90% RH Non-Condensing

Notes: At Temperatures above 65°C (149°F) the discharge rate of the battery could exceed the charge rate.

At temperatures below freezing the LCD Display may freeze and not function properly, however it will return to normal when the temperature rises above freezing.

1.6.10. RMC I/O

Analog Inputs ~ 4 (8 with Optional Analog/Serial Expansion Board):

Nominal Range:	Voltage ~	0 to 5VDC
	Current ~	0 to 20mA
	100Ω RTD ~	- 100° to 200°C (- 148° to 392°F)
	Over Range ~	10% of full scale
Resolution:	24 bit delta-sigma A/D	
	19 bits effective resolution	
Accuracy:	± .020% of Span @ 0 to 60°C	
	± .025% of Span @ - 40° to 85°C	
Impedance:	Voltage ~	400KΩ
	Current ~	150Ω
	100Ω RTD ~	1MΩ

Analog Outputs ~2:

Nominal Range:	Current ~	3 to 24mA
	Over Range ~	10% of full scale
Resolution:	12 bits	
Accuracy:	± .020% of Span @ 0 to 60°C	
	± .025% of Span @ - 40° to 85°C	

Digital Inputs ~ 6:

12 to 30VDC Optically Isolated
5KΩ Impedence

Digital Outputs ~ 6:

24VDC @ 100mA
Fused Source, Optically Isolated

Flow Pulse Inputs ~2:

Frequency:	0 to 12KHz
Low Level:	50mVAC (0V Threshold)
High Level:	4 to 12VDC (3.5 Threshold)

Density Frequency Inputs ~ 1:

Frequency:	10KHz maximum
Level:	2 to 12V P-P
Impedence:	10KΩ

Ethernet (Optional Expansion Board):

22MHz Communications Processor
256 Kbytes FLASH
128 Kbytes RAM
Field Programmable
10BaseT

Introducing the SmartBus Remote Meter Controller

2

Each product of the SmartBus Series of remote meter controllers consists of one or a combination of the following devices (see Section 1.4.1 "SmartBus RMC Series"):

- Remote Meter Controller (base unit model RMC 200; and models 205, 250, 255)
- Multivariable Sensor (integrated in models RMC 250, 255)
- Remote Meter Display (integrated in models RMC 205, 255; and stand-alone model RMD 200)

In this chapter, you will get acquainted with each of these RMC devices. We also describe the basic features and architecture that characterizes SmartBus technology. Technical specifications of the SmartBus Series are at the end of the chapter.

2.1. SmartBus RMC Architecture

SmartBus architectural features are unique and streamlined for high-efficiency. SmartBus architecture is designed for modularity, durability, reliability, and simplicity.

- **Modularity:** The RMC's modular design provides flexibility and easy maintenance. The number of Analog and Serial I/O may be increased with an optional I/O Expansion Board. Networking/Internetworking capabilities may be added to the RMC by installing the optional Ethernet (10BaseT) Network Interface Card, which includes Transmission Control Protocol/Internet Protocol (TCP/IP) and ModBus/TCP support. The flexible design allows integrating a display and/or a multivariable sensor to the RMC base unit. This modular design makes the RMC extremely easy to maintain. Internal circuitry is effortlessly upgraded or repaired by simply replacing the affected component without having to replace the entire unit and with minimum downtime.

- **Durability:** The RMC's explosion-proof casing is specially designed for hazardous environments. The enclosure conforms to the Class I, Division I Type 4X and IP-66 specifications. The RMC is also built for extended performance under extreme temperatures.

- **Reliability:** The internal circuitry includes built-in transient voltage protection via photo-optical isolation. A 32-bit processor with floating point math coprocessor, combined with 2 megabytes (MB) of flash programmable memory (Flash) for firmware, and 1 MB of battery backed-up static random-access memory (SRAM), provides more than enough processing power for your measurement application needs. Calculation cycle times of 500 milliseconds or less facilitate accurate signal processing, measurement calculations, and data communications.

- **Simplicity:** The RMC's modular, compact design is simple. Integrated within a single unit is the entire gamut of liquid and gas flow measurement, communication, and control functions. The firmware incorporates all major calculation standards used in the industry. Flash memory chips contain the firmware, allowing it to be upgraded from any PC computer. A single, comprehensive Windows®-based software program (SmartCom) provides real-time data access and allows the user to configure and operate multiple SmartBus units in any liquid or gas metering application.

The RMC architecture is the physical result of Omni Flow's SmartBus technology development. We built SmartBus technology through extensive research, multidisciplinary expertise, field-proven hardware, and state-of-the-art software, and by incorporating the latest networking/Internetworking technology. Figure 2-1 illustrates this architecture.

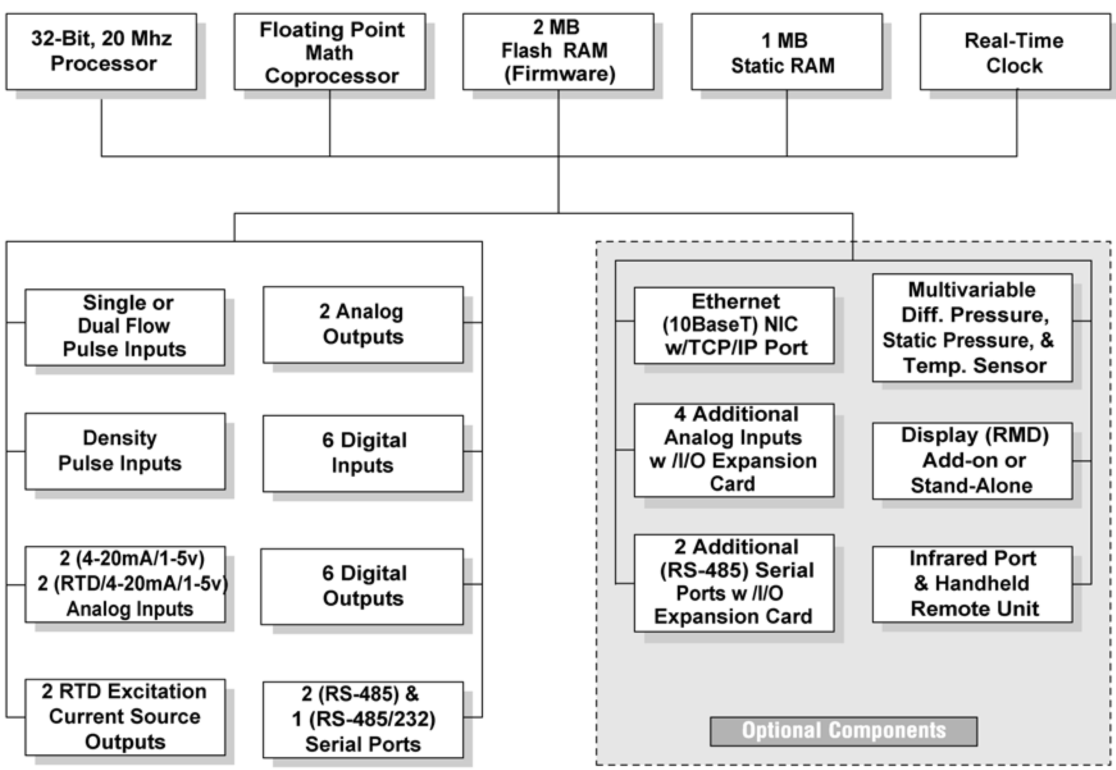


Figure 2-1. SmartBus RMC Architecture.

2.2. Component Upgrade & Replacement

The RMC's modular design allows easy removal and replacement of upgraded, replacement, and add-on PCBs or assemblies; there is no need to replace the entire RMC unit. If a PCB or assembly is damaged it may be repairable; worst case may require the PCB or assembly to be replaced with a new one. For units that run under extreme environmental and operating conditions, it may be desireable to maintain an inventory of spare components.

Announcements will be made for releases of RMC hardware, firmware, and software upgrades and new versions. If replacement parts are needed for the RMC, order only from Omni Flow or from our authorized representatives. Each individual component package includes installation instructions.

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

Contact our corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

Website:
www.omniflow.com

Table 2-1 lists the RMC components that may be purchased individually from Omni Flow. For more information, contact our sales department (see sidebar note for more ordering and contact information).

Table 2-1. RMC replaceable components.

RMC Component	Omni Part Number			
Processor Board	10320000			
Filter Board	10320100			
Terminal Board	10320200			
Remote I/O Terminal Board	21200011			
Analog–Serial I/O Expansion Board (A/S)	10320500			
Analog–Serial I/O Expansion Adapter Board (1)	10320650			
Ethernet 10BaseT Network Interface Card (E)	10320700			
Display Assembly	21200004			
Handheld Remote Control Unit	S0100004			
Stand-Alone Mounting Assembly Kit (bracket, clamp, screws)	70000023			
RMC Firmware (for flash memory) Available at www.omniflow.com	N/A			
SmartCom Software Available at www.omniflow.com	N/A			
Multivariable:				
Mulitvariable 205 Sensor	M0400010			
Cable Parts List:				
Length Required	**RJ45**	**DE-15**	**DB-25**	**DC-37**
15 Foot	K0200415	K0201515	K0202515	K0203715
25 Foot	K0200425	K0201525	K0202525	K0203725
50 Foot	K0200450	K0201550	K0202550	K0203750

Notes: **(1)** *The Analog–Serial I/O Expansion Adapter Board is required only if the RMC is without an Ethernet Network interface card and you are wanting to add the analog-serial I/O expansion Board.*

2.2.1. Fuse Replacement

The RMC positive input power terminal has a 5×20mm, 1.25 ampere replaceable glass fuse located on the Terminal Board. This fuse is available from many electrical parts distributors. Table 2-2 lists the major fuse manufacturers and corresponding part numbers for this fuse.

Table 2-2. Major manufacturers and part numbers for 5×20mm, 1.25A replaceable glass fuse.

Fuse Manufacturer	Part Number
Little Fuse	217-1.25
Bussmann	BK-GDB-1.25
Wickman	19193-050

Requesting Technical Support

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techsupport@omniflow.com

Website:
www.omniflow.com

2.3. Photo-Optical Isolation

RMC microprocessor circuitry is isolated via photo-optical devices (opto-couplers) from all field wiring to prevent accidental damage to the electronics, including that caused by static electricity. Photo-optical isolation also inhibits electrical noise from inducing measurement errors. Isolation of process inputs provides high common-mode rejection, allowing the user greater freedom when wiring transmitter loops. Furthermore, it minimizes ground loop effects and isolates and protects the flow computer from pipeline electromagnetic interference (EMI) and electric transient currents.

Figure 2-2 illustrates the photo-optical isolation process. The light-emitting diode (LED) converts transducer signals into high frequency pulses of light. The photo-transistor detects the pulses of light and transmits these to the RMC. Note that there is no electrical connection between the transducers and the RMC circuits.

Ordering RMC Optional, Upgrade, & Replacement Components

For information on ordering optional and replacement components for the RMC, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

Phone:
281-240-6161

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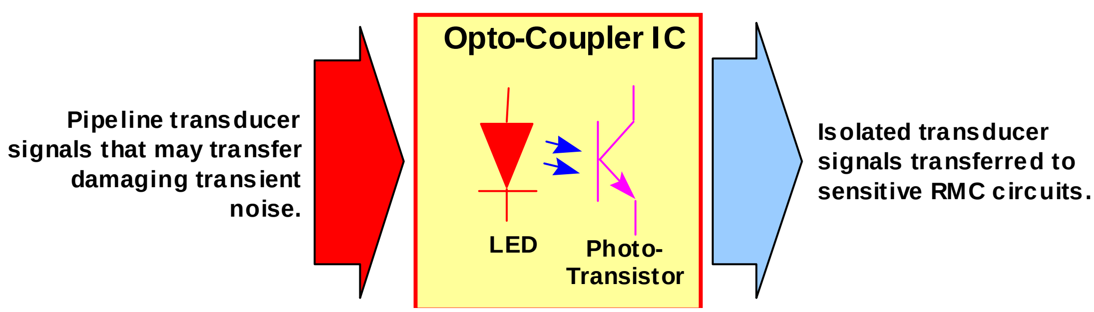

Figure 2-2. Photo-optical Isolation – How it works.

2.4. Remote Meter Controller

The remote meter controller is the base unit that integrates each product of the SmartBus Series (except the stand-alone display model RMD 200). The RMC base unit architecture incorporates the following core components:

- Processor Board
- Terminal Board
- Filter Board
- Analog–Serial I/O Expansion Board (optional)
- Ethernet 10BaseT Network Interface Card (optional)

Figure 2-3 shows the RMC unit fully loaded with all optional circuitry components. The basic RMC unit comes with the processor board, terminal board, and filter board.

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

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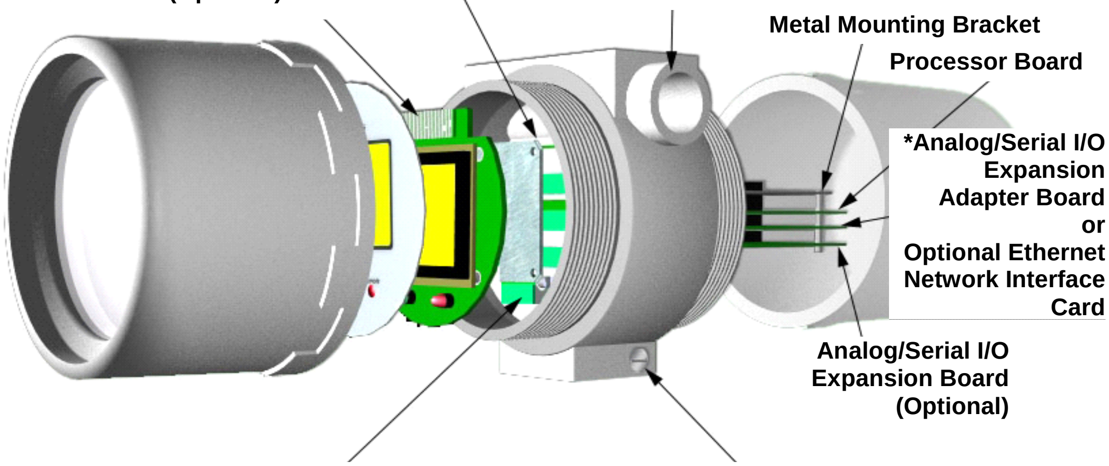

Figure 2-3. Internal RMC Components. *(*Note: The Analog/Serial I/O Expansion Adapter Board is required if adding the Analog/Serial I/O Expansion board. The Ethernet module can replace the Adapter board if desiring to also add Ethernet capability.)*

2.4.1. Processor Board

The RMC processor board (shown in Figure 2-4) contains the central processing unit (CPU) of the SmartBus system. It consists of the following main components:

- 32-bit microprocessor at 20 megahertz (MHz)
- 1 megabyte (MB) of static random-access memory (SRAM)
- 2 MB of Flash memory for firmware
- Floating point math coprocessor at 20MHz
- Real-time clock
- User-configurable jumpers for analog input, turbine pulse input, and serial port settings.
- Mounting bracket with printed jumper settings and location labels, and printed transmit/receive color reference of serial port indicator LEDs.

The hardware real-time clock will continue to operate even when the RMC suffers power loss. The firmware logs the time of power failure once power is restored to the RMC.

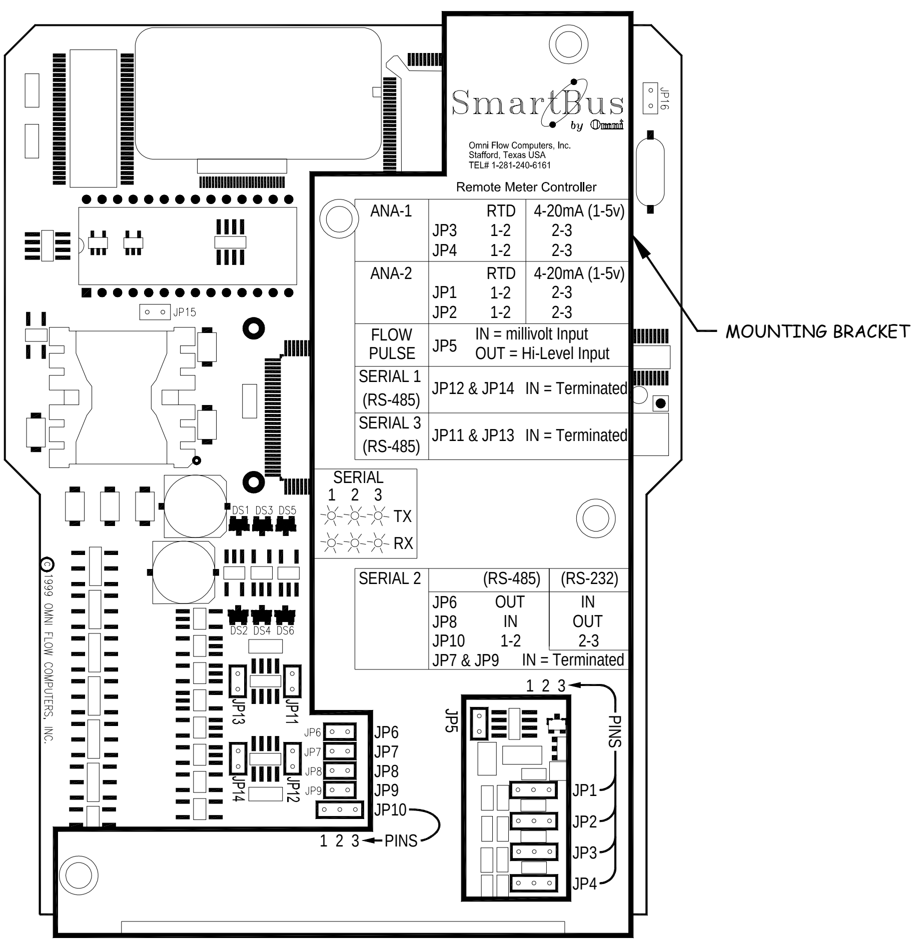

Figure 2-4. RMC Processor Board (P/N 10320000) with Mounting Bracket.

2.4.2. Terminal Board

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the RMC, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

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SYSTEM DIAGNOSTIC/ HEARTBEAT LED

The system diagnostic or heartbeat LED pulsates once per second if the RMC is operating normally.

Figure 2-5 shows the SmartBus RMC I/O terminal board. The terminal board has the following components:

- Individual, removable plug-in terminal blocks for:
  - 4 Analog inputs: 2 selectable RTD/4–20mA/1–5V and 2 selectable 4–20mA/1–5V.
  - 2 resistance temperature detector (RTD) excitation current source outputs.
  - 2 Analog outputs.
  - Single or dual pulse fidelity flow pulse inputs.
  - 1 density pulse input.
  - 6 digital inputs.
  - 6 digital outputs.
  - 3 serial ports: 2 RS-485 and 1 selectable RS-232/485.
  - Connections for optional components:
    - Analog–Serial I/O expansion board (adds 4 analog inputs and 2 RS-485 serial ports).
    - Ethernet network interface card (NIC) (adds 10BaseT networking with TCP/IP or ModBus/TCP port).
  - Multiple direct current (DC) power output connections.
  - Multiple DC return connections.
  - Power supply input connections.
  - Multiple chassis-to-ground connections.
- Individual 4–20mA/1–5V configuration jumpers for each analog I/O channel.
- Individual indicator LEDs for:
  - Digital inputs.
  - Digital outputs.
  - System diagnostic/heartbeat.
- Safety fuse (1 ampere, fast-blow)
- System diagnostic switch

Subsequent chapters describe these components in more detail. Some signal interface connections require additional jumper settings, as described in Chapter 4 "Connecting the Signal I/O".

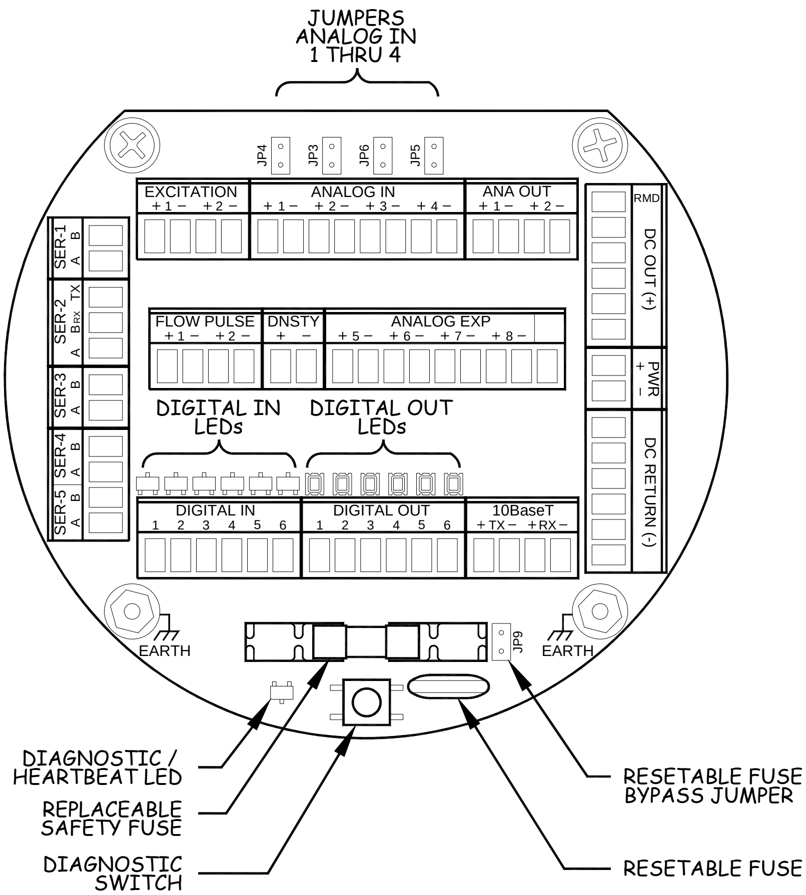

Figure 2-5. RMC Terminal Board (P/N 10320200).

2.4.3. Filter Board

The filter board (shown in Figure 2-6) provides the connectivity between the field wiring connected to the terminal board, and internal RMC circuitry. It serves as an environmental seal, preventing dust and other external elements from getting inside RMC circuitry. This board is also a barrier against radio frequency interference (RFI) caused by handheld radios, mobile phones, and other field communications devices that may affect electronic operations.

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the RMC, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

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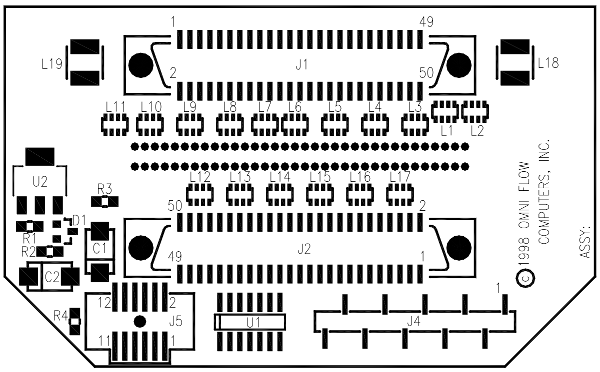

Figure 2-6. RMC Filter Board (P/N 10320100).

2.4.4. Optional Analog–Serial I/O Expansion Board

If more than 4 Analog Inputs and/or 3 Serial Ports (standard configuration) are required, install the optional Analog–Serial I/O Expansion Board. The Analog–Serial I/O Expansion Board plugs into the optional Ethernet Network Interface Board. If the RMC does not have the Ethernet Board (see Section 2.3.5 "Optional Ethernet 10BaseT Network Interface Board"), then the Adaptor Board (P/N 10320650) will be required along with this Analog–Serial I/O Expansion Board.

The Optional Analog–Serial I/O Expansion Board shown in Figure 2-7 has the following features:

- ❑ 4 Analog Inputs: each selectable between 4-20mA or 1-5V.
  These are labeled as Analog In Expansion on the I/O Terminal Board.

- ❑ 2 Serial Ports: RS-485 with termination jumpers.
  These are labeled as SER–4 and SER–5 on the I/O Terminal Board.

ANALOG–SERIAL I/O EXPANSION BOARD ADAPTER

When ordering an optional Analog–Serial I/O Expansion Board, request an Adaptor Board if your RMC does not have an Ethernet Module installed.

The Adaptor Board is plugged into the CPU Board then the Analog–Serial I/O Expansion Board is plugged into the Adaptor Board. This is only required if the RMC does <u>not</u> have the optional Ethernet Interface Board.

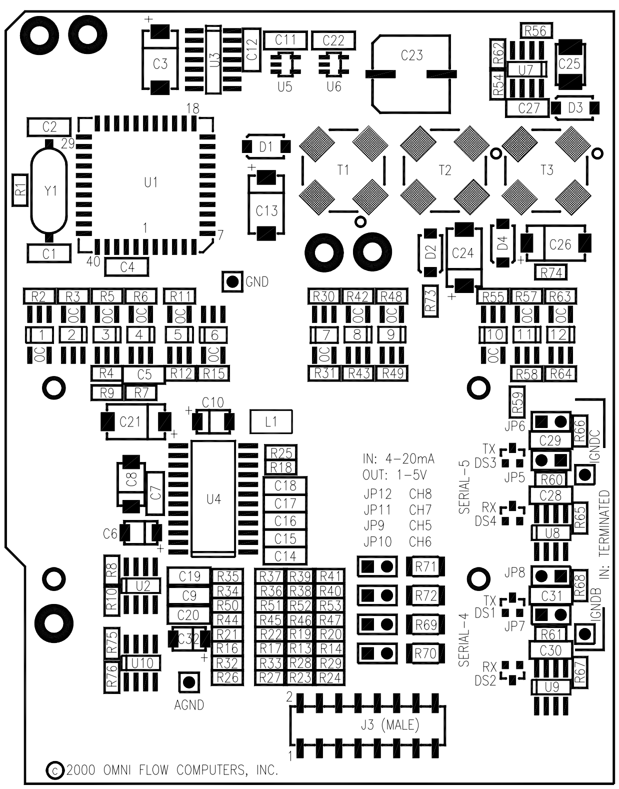

Figure 2-7. RMC Optional Analog–Serial I/O Expansion Board (P/N 10320500).

2.4.5. Optional Ethernet 10BaseT Network Interface Board

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the RMC, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

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The optional Ethernet 10BaseT Network Interface Board provides networking and Internetworking to a local area network (LAN) or wide area network (WAN). With integrated Transmission Control Protocol/ Internet Protocol (TCP/IP) support, you can alternately connect the RMC to your company's intranet or to the Internet. The Ethernet Interface Board shown in Figure 2-8, has its own coprocessor to handle communications.

Features of this Ethernet Interface Board include:

- Integrated multi-protocol processor (IMP) that accepts multiple protocols for different layers of the ISO/OSI Networking Reference Model.
- High-speed, 1 kilobyte (KB), deep first-in-first-out (FIFO) communications coprocessor interface to RMC processor.
- 512KB of high-speed Flash memory.
- 128KB of zero wait state static RAM.
- Ethernet 10BaseT (IEEE 802.3) over unshielded twisted-pair (UTP) cable (copper wiring) with RJ-45 connector.
- TCP/IP protocol stack for Internet/intranet communications, providing multiple virtual connections for other protocols (web server, e-mail, etc.).
- Modbus/TCP protocol
- Multiple simultaneous connections
- Transmit, receive, and link status indicator light-emitting diodes (LEDs) for debugging.
- Highly integrated single-chip IEEE 802.3 Ethernet standard physical interface for carrier sense multiple access/collision detection (CSMA/CD) on twisted-pair networks.

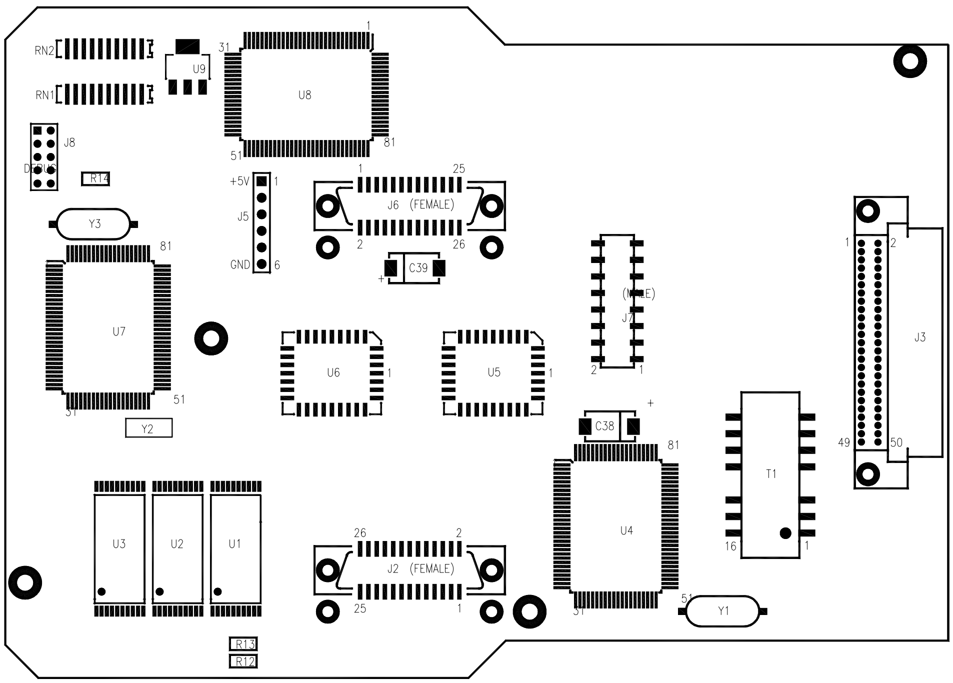

Figure 2-8. RMC Optional Ethernet 10BaseT Network Interface Card (P/N 10320700).

2.5. Multivariable Sensor (Optional)

SmartBus models RMC 255 and RMC 250 provide for the integration of an optional Multivariable Rosemount 205 Transducer (shown in Figure 2-9). The multivariable module incorporates a high-accuracy capacitance sensor for differential pressure, a high-accuracy piezoresistive sensor for static pressure, and a four-wire RTD input for process temperature measurement.

TCP/IP Protocol Suite

The Transmission Control Protocol/ Internet Protocol (TCP/IP) suite comprises protocols for media access, packet transport, session communications, file transfer, e-mail, and terminal emulation. Being the basis of the Internet, this protocol set is a widely published, open standard independent of any specific hardware or software company, yet supported by many developers. It is available on most computers and works with many different operating systems. This allows TCP/IP to run over Ethernet, token-ring, and X.25 networks, and dial-up connections.

TCP/IP is routable, with reliable and efficient data-delivery mechanisms, and uses a common expandable addressing scheme. These protocol characteristics allow you to send datagrams over specific routes, permitting any system to address any other system, and add new networks without service disruptions.

TCP works at the transport layer protocol above IP in the protocol stack, providing reliable data delivery over connection-oriented links. IP works at the session layer regulating data packet forwarding by tracking addresses, routing outgoing messages, and recognizing incoming messages.

Omni Flow is among the few electronic measurement technology developers that support TCP/IP.

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the RMC, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

Phone:
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Figure 2-9. Optional RMC Multivariable 205 Sensor with manifold.

2.6. Remote Meter Display

Smartbus models RMC 255 and RMC 205 integrate the 8-line by 20-character, backlit, graphical liquid crystal display (LCD). The RMD 200 consists of a stand-alone remote meter display unit (shown in Figure 2-10). An explosion-proof (Type 4X) enclosure with a conduit feed-through cavity and tempered scratch-resistant glass, houses the display assembly.

The display front panel provides an infrared sensor port for a handheld remote control unit (see Section 2.6 "Handheld Remote Control Unit"). Indicator light-emitting diodes (LEDs) point out IR, remote, active alarm, and transmit and receive activity.

Figure 2-10. Remote Meter Display.

2.7. Handheld Remote Control Unit

The handheld remote control unit (shown in Figure 2-11) provides access to the RMC from a maximum operating distance of two feet. It works with direct line of sight to the infrared port located on the front of the RMC display or stand-alone Remote Meter Display (RMD 200).

The Handheld Remote allows the user to scroll through the different user-defined menus and data displays of each RMC with a display or connected to the RMD. The remote also provides limited editing capabilities of RMC configuration settings, and allows the user to scan the RMC database.

The handheld remote is rated intriniscally safe for Class I, Div I , Groups B, C, & D, T.3. (See side bar for recommended batteries for use in the Handheld remote.)

Figure 2-11. Handheld Remote Control Unit (P/N S0100004).

ORDERING RMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

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CAUTION! REMOTE FUNCTION

When operating more than one RMD at a time, care must be taken that the RMDs are mounted more than 1½ ft from each other. If the units are mounted closer than 1 ½ ft this could cause multiple units to see the remote at the same time. Therefore any changes made to one unit could also affect an adjacent unit.

CAUTION! CHANGING THE BATTERIES

The remote requres two (AAA) batteries.

Alkaline AAA

Duracell mn2400/LRO3

RadioShack 23-876

Energizer E92/LO3/AM4

Do not change batteries in hazardous area. See Section 3.1 "Safety" for more information.

2.7.1. Remote Control Key Usage

The IR (InfraRed) remote is used to access configuration menus and data within the RMC via the RMD. The remote has six buttons which provide eight different functions. The two wide keys at the top can be pressed on either side to provide two different functions. The cluster of four buttons on the bottom provide left, right, up and down functions. Their usage changes slightly depending upon what type of display you are working on.

Types of Displays:

Menu
Data List
Choice List
Data Edit
Help

Buttons:

Edit:
Used to change a data entry value being displayed, or clearing a data entry, when in a data edit display. It can also be used to change the display format of floating point numbers on a data edit display.

Help:
Used to display a screen containing help information relating to a Menu screen, data display or general RMD help. Pressing Back exits the help screen and returns to the previous display.

Back:
Used to go back a Menu level, abort a data entry or exit help displays.

Enter:
Used to make Menu selections or to accept data entries.

Up:
Used to traverse a Menu or Data list. In data entry mode it is used to select roll through numbers and text characters.

Down:
Used to traverse a Menu or Data list. In data entry mode it is used to select roll through numbers and text characters.

Left:
Used to make selections in Choice displays and for moving the cursor in data entry to the character to be changed.

Right:
Used to make selections in Choice displays and for moving the cursor in data entry to the character to be changed.

2.8. SmartBus Firmware & Software

SmartBus units come with pre-programmed firmware and Windows® PC-based configuration software (SmartCom). These programs enable the RMC to perform a great diversity of liquid and gas measurement tasks, such as:

- Single meter run totalizing, proving, and data archiving
- Bi-directional totalization
- Flow and sampler control.
- Direct interface to gas chromatographs, smart transmitters, and multivariable transmitters.
- Ethernet 10BaseT networking and TCP/IP Internetworking
- Communication protocols to directly interface with distributed control systems (DCS), programmable logic controllers (PLCs), supervisory control and data acquisition (SCADA) host systems, local/wide area networks (LANs/WANs), and intranets/extranets/Internet (communication with mobile wireless devices available soon).

The RMC database literally has tens of thousands of database variables that you can access, providing for highly customized solutions. It also provides the tightest communications coupling between SCADA systems and the metering system.

2.8.1. Interrupt-Driven Processing

This is a very important aspect of the firmware. It provides for a multi-tasking environment in which the RMC can undertake priority tasks concurrently with other unrelated activity. This also allows for high-speed digital signals to be output at the same time as measurement computations. Serial communications are output to a printer or host computer, without degradation in speed or tasking.

The RMC contains all custody transfer measurement programs in Flash memory. This prevents damage due to electrical noise and tampering with the integrity of calculation specifications. Flash memory allows for upgrade of the firmware with a simple install operation from a disk or downloaded from the Omni Flow website at www.omniflow.com. The RMC also accomodates for static random access memory (SRAM) programming.

2.8.2. Cycle Time

The firmware performs all time-critical measurement functions every 500 milliseconds. This provides greater accuracy of measurement calculations and permits a faster response by pipeline operations in critical control functions, such as opening or closing valves.

2.8.3. Real-Time Access

RMC firmware and software enable real-time access to all data. Configuration of data and changes can be made on the fly with immediate implementation. The ability to display real-time data and create reports is also possible.

2.8.4. Online Diagnostic & Calibration

Omni Flow has built in extensive diagnostic functions into SmartBus firmware, which allows a technician to locally or remotely troubleshoot a possible problem without interrupting online measurement. Calibration of analog signals is preformed with SmartCom PC-Based software.

2.8.5. Data Integrity & Security

Multiple user passwords and priveliges, extensive audit trail and monitoring routines, and other control functions provide flexible RMC security access and data integrity protection.

2.8.6. SmartCom Configuration Software

Online or offline configuration of the SmartBus RMC is possible using a PC running a Windows® operating system using SmartCom software supplied with the RMC. This software allows the user to copy, modify, and save to disk entire configurations. Customized displays, database mappings, and reports using customized report templates that are uploaded to the RMC can also be created. All operating functions are accessible with this software.

SmartCom permits online/offline access to measurement, configuration, and calibration data. This software also provides for collection of historical reports —including alarms, interval (snapshot) reports of any time sequence, batch, and prove reports— and full remote user-intervention capabilities.

2.8.7. User Database Mapping

The User Database in the RMC provides flexibility to setup the selected RMC to meet installation requirements. Any internal database item can be mapped to any user database address as any data type.

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3 Field Installation & Wiring

IN CHAPTER 3

Field Installation & Wiring:

Omni Flow builds the SmartBus Series of Remote Meter Controllers (RMCs) for typical field conditions present in outdoor environments such as metering stations, pipelines, refineries, distribution terminals, and similar facilities. The RMC's robust design and explosion-proof enclosure provide heavy-duty performance that is safe and reliable even in hazardous areas. But for this to hold true, follow the applicable industry-standard guidelines, adopt proper safety practices, and use sound judgement when installing and operating the RMC.

This chapter includes RMC field installation and wiring recommendations which serve as an additional reference to the applicable standards. Read this chapter before installing the RMC.

3.1. Safety

DISCLAIMER

Omni Flow Computers, Incorporated disclaims any liability due to losses or damages caused by improper installation and operation of our products. We are not responsible for accidents or losses that are a consequence of unsafe practices or unqualified staff.

By nature, oil and gas industry facilities are hazardous. Since the RMC is an electronic device that requires electrical power to function, there are additional risks associated with the field installation and operation of this device. Following is a list of basic safety precautions that **must** be followed when installing the field-mount RMC.

- Only qualified technicians knowledgeable in applicable industry standards and electrical safety should install and handle the RMC.
- Do not apply power to the RMC during installation, wiring, or servicing. Make certain that power is removed from any live devices and connections to the RMC. Do not unscrew and open the RMC enclosure caps while power is applied.
- Always connect the RMC grounding lug to earth-ground before mounting the RMC. **The grounding lug must always remain connected to earth, even when the RMC is not powered.** Make sure that there is appropriate grounding and shielding of the total measurement installation
- To avoid costly potential data loss, always backup configuration data and user settings, using SmartCom software, before disconnecting power to the RMC or making any changes to its settings.
- Before connecting or disconnecting any devices and power, make sure that the area is non-hazardous and take the necessary precautions to avoid static electricity buildup. Static discharges in hazardous areas such as oil and gas facilities are a human fatality and property risk. Furthermore, static discharges can damage device electronics.

- ❑ Wear appropriate protective gear and static-free clothing. In all cases, use only appropriate safety equipment such as flame-resistant clothing properly treated to avoid static buildup and respiratory protection equipment. Discharge any static buildup in your body in a safe place prior to entering the installation area.
- ❑ Ensure that the total installation has appropriate electromagnetic compatibility and immunity (EMC/EMI).
- ❑ All equipment, devices, and associated wiring must be suitable for the installation.
- ❑ Properly use only certified tools, hardware, and wires for installing electrical field devices. Make sure that all tools, devices, wires, fuses, and other apparatus meet isolation, grounding, and shielding requirements prior to use and installation.
- ❑ Make sure that the applied voltage, temperature, and pressure of the RMC are within the maximum and/or minimum limits (see Section 1.6 "SmartBus Technical; Specifications").
- ❑ Do not disassemble, reassemble, or burn RMC system components. Properly dispose of unneeded parts and components.
- ❑ Strictly obey all applicable safety rules, guidelines, and standards. The organizations listed below are principal entities that establish applicable industry and governmental codes, guides, and generally accepted standard. This list is not all inclusive, and different countries, states, municipalities, local industry/trade associations, and union agreements may impose additional safety requirements.
  - ♦ International Organization for Standardization (ISO)
  - ♦ Canadian Standards Association (CSA)
  - ♦ European Community Norms (CE)
  - ♦ Institute of Electrical and Electronics Engineers (IEEE)
  - ♦ National Association of Corrosion Engineers (NACE)
  - ♦ National Electric Code (NEC)
  - ♦ Underwriters Laboratories, Inc. (UL)
  - ♦ Factory Mutual Research Corporation (FM)

Always use good judgment and common sense when assessing safety issues, requirements, and practices. Your life may depend on it!

DISCLAIMER

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Phone:
281-240-6161

E-mail:
techsupport@omniflow.com

Website:
www.omniflow.com

3.2. Mounting

STAND-ALONE, VERTICAL MOUNTING ASSEMBLY KIT

If mounting the RMC on a vertical pole, order the **Stand-alone Mounting Assembly Kit** direct from Omni Flow, which includes a mounting bracket, clamp, screws, and all the needed hardware for this type of installation. For more information, see Section 2.2 "Component Upgrade & Replacement". Contact our corporate sales department in the United States at:

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When selecting a mounting location, make sure there is enough space around the RMC for disassembling the enclosure and for easy access to the terminal and processor boards. Access to the terminal board for wiring and the processor board for RMC jumper settings is required.

Prior to mounting, inspect the RMC for any missing or damaged parts. To avoid damaging internal components during mounting, securely screw the end caps into place. For Smartbus models with multivariable pressure sensor (RMC 255, RMC 250), make sure that the sensor unit is properly assembled.

3.2.1. Mounting the RMC on a Vertical Pipe

Mount the SmartBus RMC on a stand-alone, standard 2-inch vertical pipe or pole. Mount the vertical pipe directly on the pipeline using a saddle clamp, or spike it into the ground. Use the U-bolt and bracket included in the mounting kit supplied with the unit to mount the RMC (with or without the multivariable sensor) or the RMD on the stand-alone pipe, as shown in Figure 3-1, Figure 3-2 and Figure 3-3 respectively.

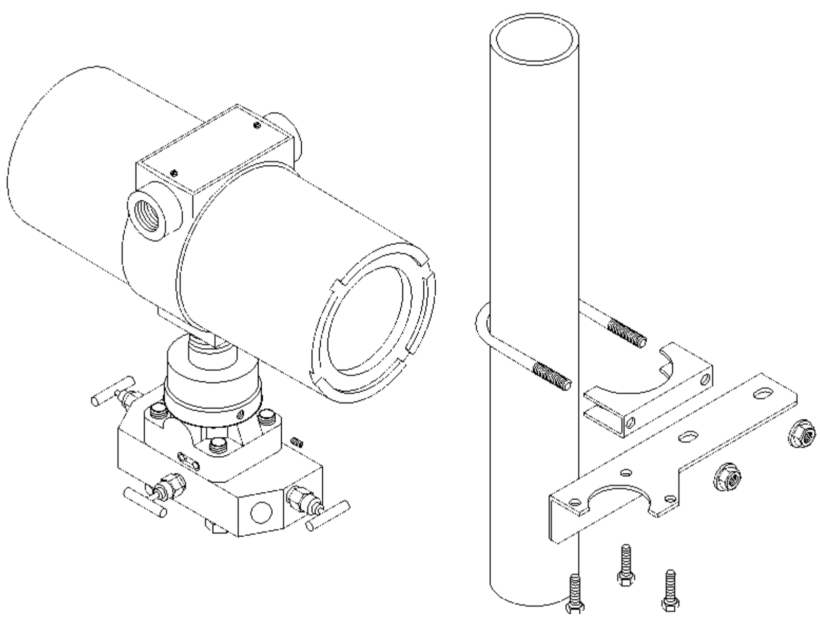

Figure 3-1. Mounting RMC with multivariable sensor (Models RMC 255, RMC 250) to a 2" standard vertical pipe, using supplied mounting kit.

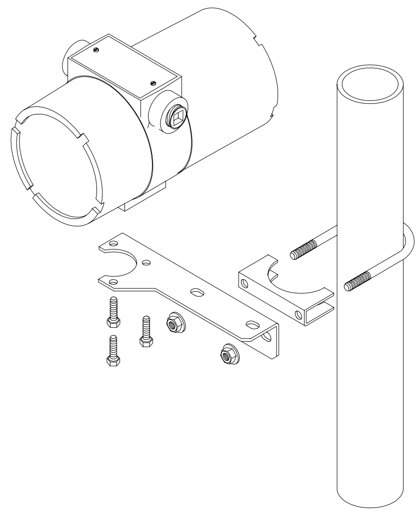

Figure 3-2. Mounting RMC without multivariable sensor (Models RMC 205, RMC 200) to a 2" standard vertical pipe, using supplied mounting kit.

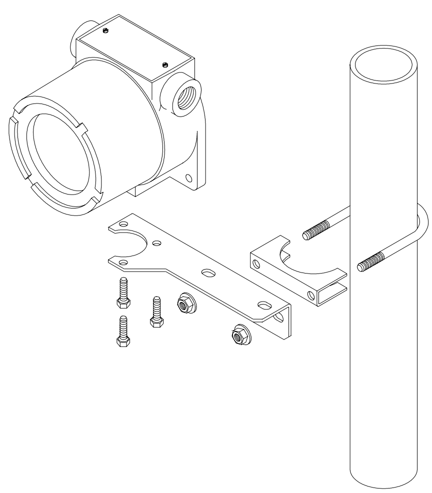

Figure 3-3. Mounting the stand-alone display unit (RMD 200) to a 2" standard vertical pipe, using supplied mounting kit.

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techsupport@omniflow.com

Website:
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3.2.2. Mounting Positions of RMCs with Display

Mount RMCs with displays (RMC 205, RMC 255, RMD 200) at eye level. The Display Board assembly (along with Alignment Plate) can be rotated in 90-degree increments to accommodate the desired mounting position, as shown in Figure 3-4 and Figure 3-5. Avoid the 180-degree position because the Certification/Caution label will not be visible for easy viewing or inspection..

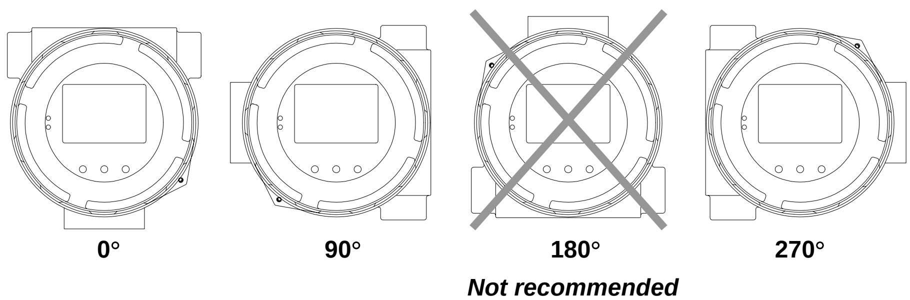

Figure 3-4. Mounting positions of RMC models with display.

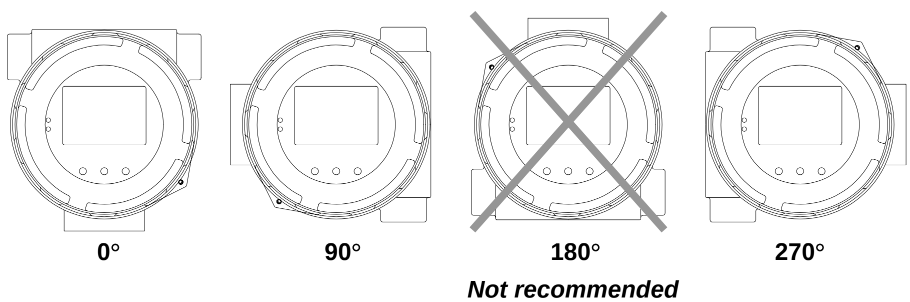

Figure 3-5. RMD mounting positions.

3.3. Grounding & Shielding

A proper connection between the RMC and earth-ground will help protect the metering system, including the RMC, from electrical transients, lightning, and stray currents. A proper earth-ground to the RMC is required in every installation, **even when it is powered-down**. RMC mounting methods are subject to the grounding configuration of the meter run installation and cathodic protection of the pipeline, among other factors.

For grounding purposes, the RMC has a chassis-ground lug at the lower right side (on the base) of the enclosure. Using a 10–14AWG (12 AWG recommended) stranded wire, connect the earth-ground to the RMC ground lug in conformance with the applicable industry standard for installations in your locale. Use as short of a grounding wire as possible. On pipelines with cathodic protection, you **must** electrically insulate the RMC from the pipeline.

RMC Extended Terminal Box

If you are going to connect many devices to an RMC, it is recommended that you build and use an extended terminal box. The devices can be wired to this terminal box. You can then wire the terminal box to your RMC. This setup allows the use of multi-conductor cables with a smaller gauge to be wired to the RMC, and avoids wire clutter within the RMC.

3.4. General Wiring Tips

Wire all RMC circuits according to the U.S. National Electrical Code (NEC). Wiring methods specified in the Canadian Electrical Code and the European Norms are also applicable. Following is a list of tips to consider in addition to the cabling standards.

- Connect external wiring to the RMC terminal board cage-clamp type screw terminals.
- Depending on wiring distance, use 26 to 22 American Wire Gauge (AWG) twisted-pair copper wire.
- Strip off the insulation from wire ends from approximately 0.48cm (3/16”), inspecting the bare wire for nicks and frays.
- Insert and pull the wire through one of the round 1.9cm (3/4”) conduit feed-through cavity openings on either side of the RMC enclosure and over the terminal board.
- Insert the stripped end of the wire completely into the terminal clamp. Using the appropriate standard screwdriver, screw-in the clamp to secure the wire end in place.
- Inspect each connection making sure that there are no frayed strands protruding from the clamp and that each screw has not caught any wire insulation.
- When installing horizontal cable assemblies, only use connecting hardware and patch cords or jumpers of the same performance category or higher.
- Avoid cable stretching by making sure that the pulling tension does **not** exceed 110 Newton (25 pounds-force).
- Avoid any cable stress that may be caused by cable twist during pulling or installation, tightly cinched cable ties and staples, tight bend radii, and tension in suspended cable runs.

RMC Power-On/Off

The RMC powers-on by wiring an external power supply to the RMC power input. To power-off, simply disconnect the power from the RMC power input terminals. Always power-off the RMC before handling any internal circuitry or connecting any devices.

3.5. Power I/O Connection

⚠ CAUTION! ⚠

POTENTIAL FOR DATA LOSS!

SmartBus RMCs leave the factory with a fully charged nickel-metal hydride (Ni-MH) battery as random-access memory (RAM) power backup. RAM data, including configuration settings, accumulated totals, and custom user settings may be lost if the RMC is without an external power source for more than 30 days. Observe caution when storing the RMC. Always backup your RMC configuration settings using SmartCom software before disconnecting power. The RAM backup battery is rechargeable. You need to apply power to the RMC for 24 hours to recharge the Ni-MH battery.

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Figure 3-6 shows the RMC power I/O circuitry. The RMC requires an external DC power source between 18VDC and 30VDC @ 1Amp. Connect the DC power source to the terminals (labeled PWR + & –) located on the terminal board.

For short wiring runs, less than 25 feet, use 22 AWG wire. For longer wiring runs, heavier gauge wire may be required. The positive input power terminal has a 5×20mm, 1.25Amp replaceable glass fuse, and a 1.1 A electronic resettable fuse. If the electronic resettable fuse fails, it can be by-passed by inserting jumper JP9. The terminal board also has DC outputs (positive) and DC return inputs (negative) for powering other devices connected to the RMC. Five of the DC output power terminals have an individual, nominal 100 mA electronic resettable fuse. The sixth DC output is equipped with a 400 mA fuse to power the LCD display when installed.

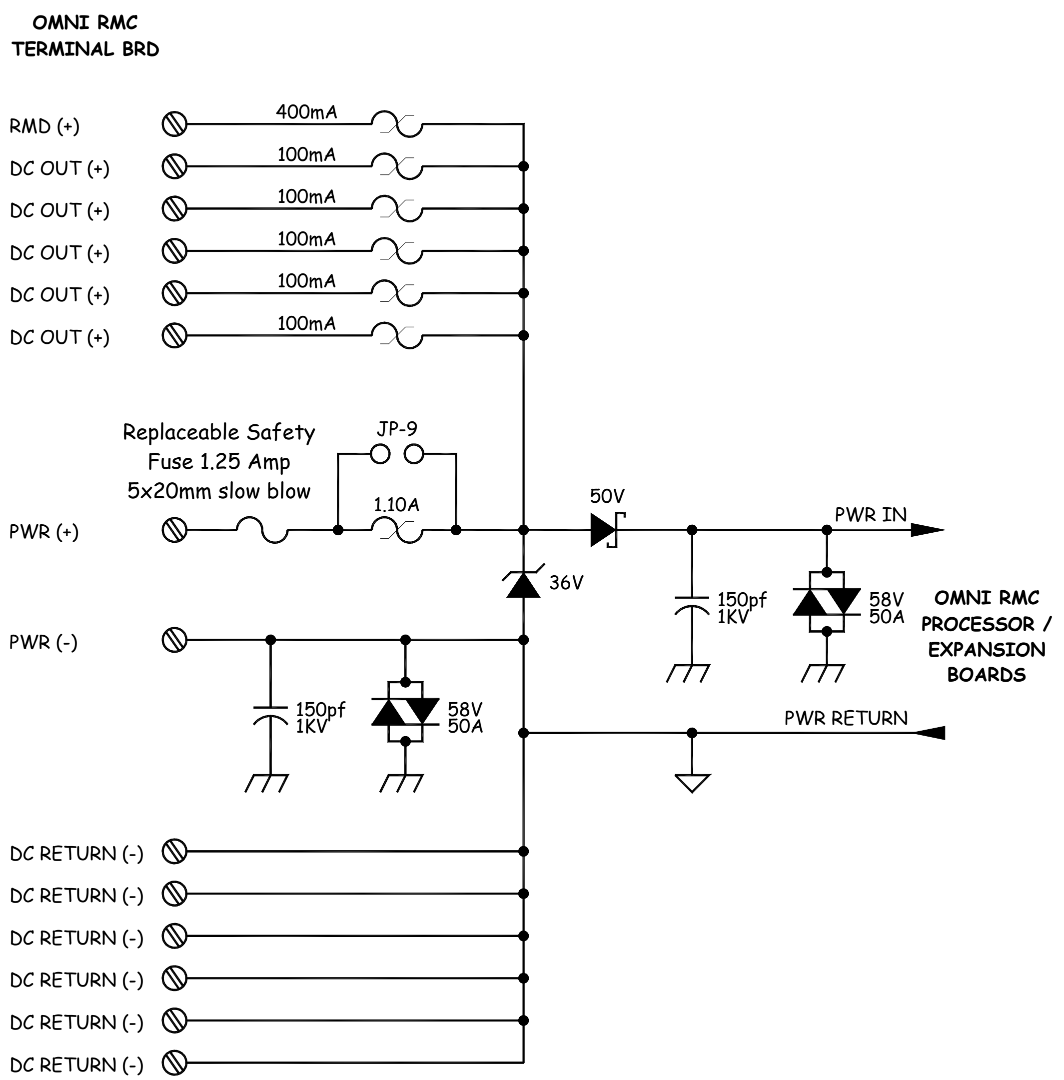

Figure 3-6. Power supply connection on RMC terminal board.

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4 Connecting the Signal I/O

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The Terminal Board (shown in Figure 4-1) provides removable input/output (I/O) terminals that support many industry-standard process measurement signals. Some of these terminals are dedicated to specific I/O signal types. Other I/Os allow the user to select the signal type via hardware jumpers and configuration software. The RMC I/O may be expanded and networking capabilities may be added, by choosing to install optional circuit boards. These I/O features offer flexibility to setup the RMC in conformance with most signal measurement requirements.

The following signal I/O types are available for the RMC:

- Analog inputs and outputs (additional inputs available on optional I/O expansion board)
- Resistance temperature detector (RTD) excitation current source outputs
- Flow pulse frequency inputs
- Density pulse frequency inputs
- Digital inputs and outputs
- RS-232 and two-wire RS-485 serial communications (additional RS-485 serial ports available on optional I/O expansion board)
- Optional Ethernet 10BaseT networking interface with Transmission Control Protocol/ Internet Protocol (TCP/IP) and ModBus/TCP support

This chapter describes the I/O features, hardware jumper settings, and expandable options available for connecting specific signal types to the RMC. These features apply to both liquid and gas flow metering systems. In addition to the setup described in this chapter, you will need to further configure the RMC using the PC-based SmartCom software.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

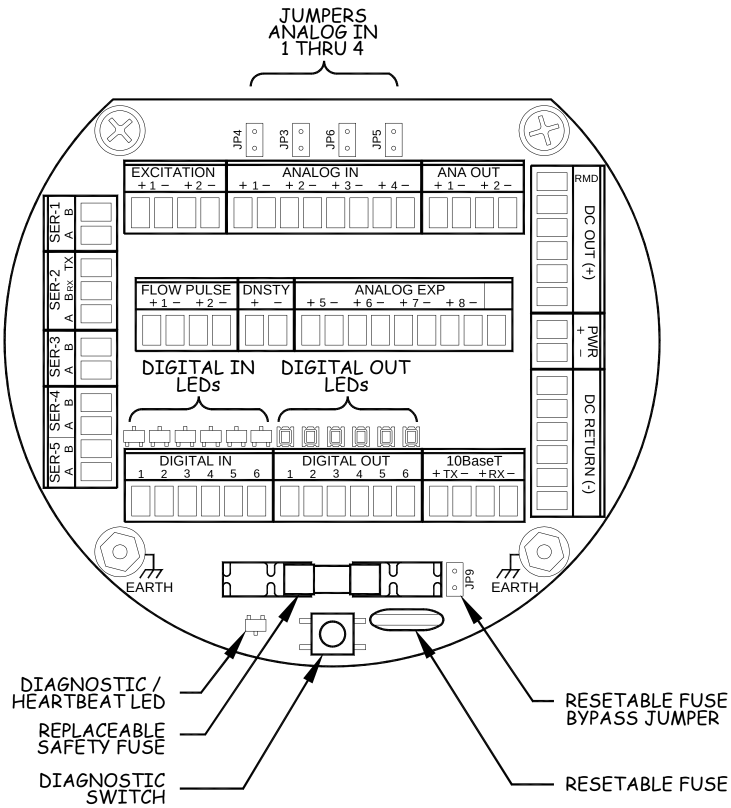

Figure 4-1. RMC Terminal Board.

4.1. Analog I/O Signals

Standard RMC configuration provides four analog inputs, two analog outputs, and two RTD excitation current source outputs. Four additional analog inputs are available on the optional Analog–Serial I/O Expansion Board.

The RMC uses highly accurate analog-to-digital and digital-to-analog converters to convert I/O signals. Opto-couplers within RMC circuitry electronically isolate the analog circuits from the digital processing. All I/O signals are temperature-compensated within the RMC.

4.1.1. Analog Inputs

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The four standard RMC analog inputs are labeled “ANALOG IN” 1 to 4 on the I/O Terminal Board. The four optional analog inputs, labeled “ANALOG EXP” 5 to 8, provide connections to the I/O Expansion Board. All analog inputs support 1–5V or 4–20mA signal types. Analog inputs 1 and 2 additionally support low-level, signals suitable for RTD sensors.

Select which signal type to use for a particular analog input by setting the corresponding hardware jumpers. These jumpers are located on the I/O Terminal Board, CPU Board, and I/O Expansion Board. Figure 4-2 shows the location of the analog input 1–5V/4–20mA selection jumpers on the Terminal Board. Table 4-1 indicates the available signal type selections and jumper settings for each analog input.

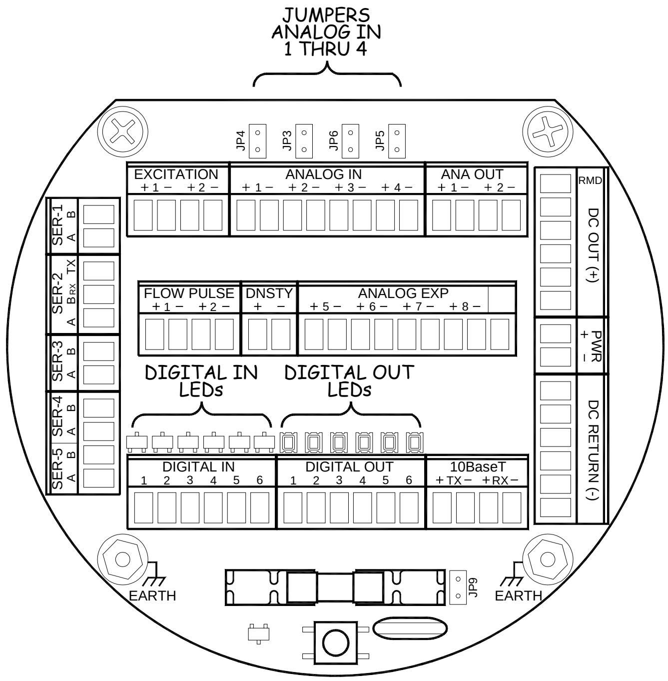

Figure 4-2. Location of analog input signal selection jumpers on terminal board.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Table 4-1. Jumper settings for analog inputs.

Input #	Signal Types	Jumper Settings		
		Terminal Board	**Processor Board**	**Expansion Board**
1	1–5V	JP4 → Out	JP3 & JP4 → Pins 2 & 3	
	4–20mA	JP4 → In	JP3 & JP4 → Pins 2 & 3	
	RTD	JP4 → Out	JP3 & JP4 → Pins 1 & 2	
2	1–5V	JP3 → Out	JP1 & JP2 → Pins 2 & 3	
	4–20mA	JP3 → In	JP1 & JP2 → Pins 2 & 3	
	RTD	JP3 → Out	JP1 & JP2 → Pins 1 & 2	
3	1–5V	JP6 → Out		
	4–20mA	JP6 → In		
4	1–5V	JP5 → Out		
	4–20mA	JP5 → In		
5	1–5V			JP9 → Out
	4–20mA			JP9 → In
6	1–5V			JP10 → Out
	4–20mA			JP10 → In
7	1–5V			JP11 → Out
	4–20mA			JP11 → In
8	1–5V			JP12 → Out
	4–20mA			JP12 → In

Note: *The maximum DC common mode voltage for any input terminal is +20VDC with respect to DC return.*

4.1.2. Analog Outputs

The two analog outputs, labeled "ANA OUT" 1 and 2 on the I/O Terminal Board, support 4-20mA signal types. To produce an analog output signal, the RMC passes digital signals through opto-couplers and then to precision digital-to-analog converters, which produce accurate DC currents. The resolution of the digital-to-analog conversion is 12 binary bits.

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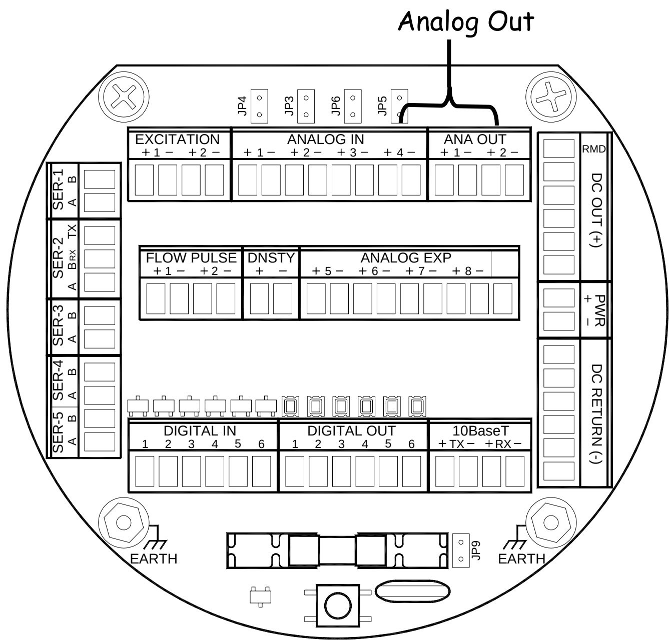

Figure 4-3. Location of analog output connections on the terminal board.

RMC analog outputs can drive a maximum load resistance value that varies depending upon the voltage level of the power supply feeding the RMC. Use the load resistance nomograph shown in Figure 4-4 to determine the maximum load resistance allowed for a particular analog output signal connection.

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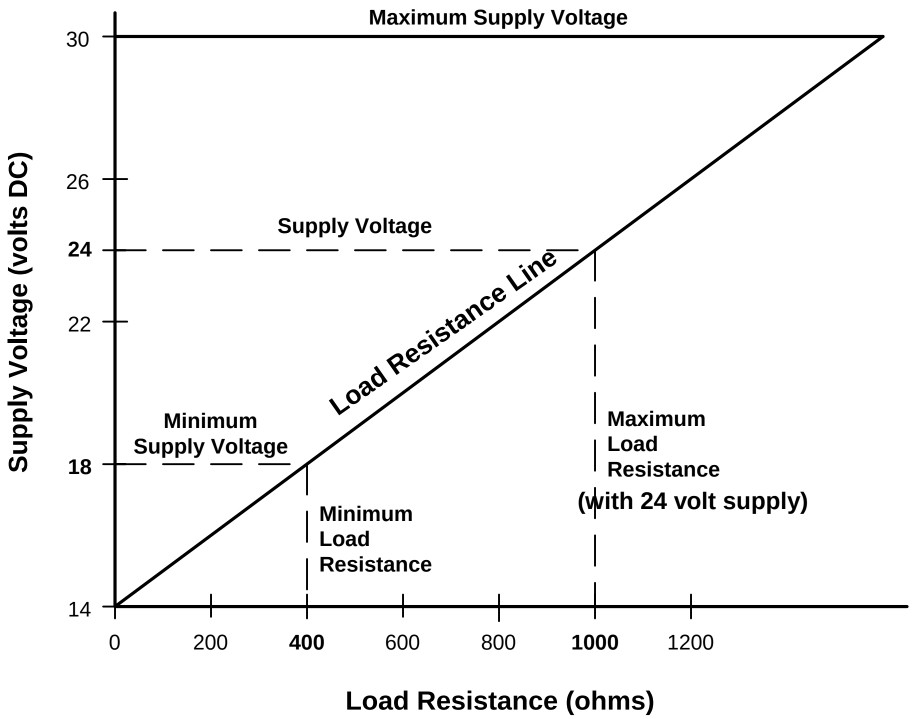

Figure 4-4. Load resistance nomograph for RMC analog outputs.

4.1.3. RTD Excitation Current Source Outputs

Two (nominal 3 mA) RTD excitation source outputs, labeled “EXCITATION” 1 and 2 on the terminal board, support four-wire, 100Ω RTD temperature probes. Excitation source 1 shall be used with Analog Input 1 (configured for RTD), Excitation source 2 shall be used with Analog Input 2 (configured for RTD). See Chapter 6 “Connecting Transmitters”.

4.2. Pulse Input Signals

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

The RMC provides two flow pulse inputs and one density pulse input. The input pulse trains are processed then passed through opto-couplers within the RMC to provide electrical isolation. All three pulse inputs share a common signal return.

4.2.1. Flow Pulse Inputs

The RMC flow pulse inputs, labeled "FLOW PULSE" 1 and 2 on the Terminal Board, support low-level (30 millivolt AC peak-to-peak minimum) and high-level (18 to 30VDC supply voltage level) turbine flowmeter signal types. The flow pulse signal inputs can accept 0–12kHz signal frequencies. Setup these inputs as either 1 single or 1 dual pulse from within the PC-based SmartCom software.

Signal coupling can be AC or DC with the trigger threshold at 3.5VDC for high-level inputs. Flow pulse input signals can be selected as low-level AC millivolt signals, or high-level voltage pulse signals. In the high-level signal mode, the input signal high voltage must exceed 3.5VDC and the input signal low voltage must drop below 1.5VDC. The maximum signal input should not exceed the supplied voltage.

Select only one signal type to use for both flow pulse inputs by setting the corresponding hardware jumper. The jumper will set both inputs to accept the same signal level (i.e., either high or low). Hence, you cannot select one flow input as a high-level signal and the other as a low-level signal. Figure 4-5 shows the location of this jumper on the processor board.

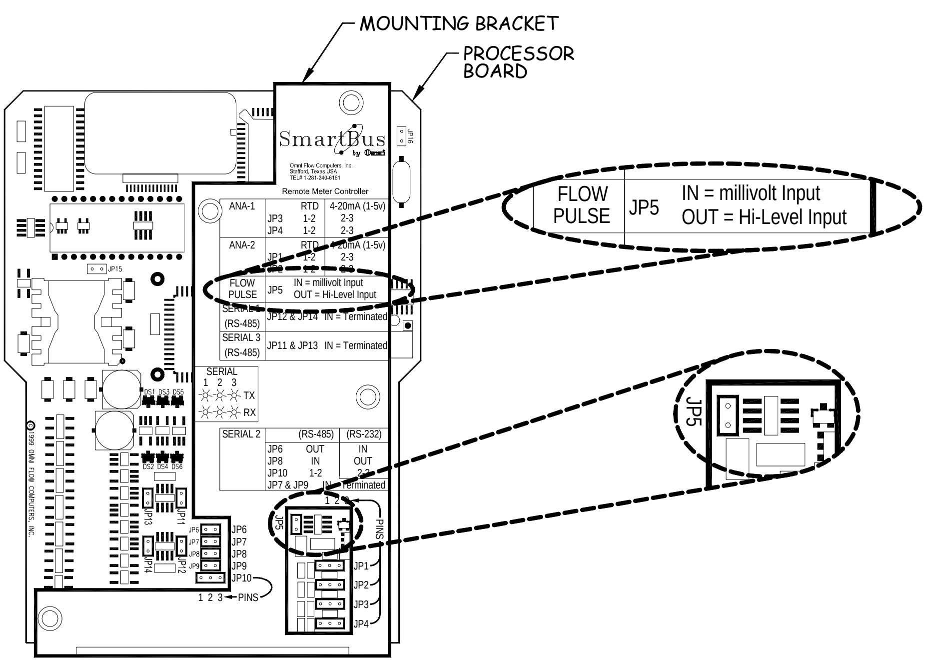

Figure 4-5. Location of flow pulse input signal selection jumper JP5 on the processor board.

4.2.2. Dual Pulse Fidelity and Integrity Checking

The object of pulse fidelity checking is to reduce flowmeter measurement uncertainty caused by added or missing pulses due to electrical transients or equipment failure. Correct totalizing of flow must be maintained whenever possible. This is achieved with correct installation practices and by using turbine or positive displacement flowmeters that provide two pulse train outputs.

The two pulse trains are called the 'A' pulse and the 'B' pulse. In normal operation, both signals are equal in frequency and count but always are asynchronous in phase or time. The American Petroleum Institute Manual of Petroleum Measurement Standards (API MPMS Chapter 5, Section 5) describes several levels of pulse fidelity checking ranging from Level E to Level A. Level A is the most stringent method, requiring automatic totalizer corrections whenever the pulse trains are different for any reason.

For all practical purposes, Level A as described in the API MPMS, Chapter 5.5 is practically unachievable. The SmartBus RMC implements a significantly enhanced Level B pulse security method by not only continuously monitoring and alarming of error conditions, but also correcting for obvious error situations, such as a total failure of a pulse train or by rejecting simultaneous transient pulses. No attempt is made to correct for ambiguous errors, such as missing or added pulses. These errors are detected, alarmed, and quantified only.

Enhanced Level B pulse fidelity and integrity checking can be achieved by connecting the two RMC flow pulse inputs suitably phased from a dual pulse equipped flowmeter. In addition, you must select the corresponding configuration settings in the RMC using SmartCom software.

Hardware on the RMC continuously monitors the phase and sequence of the two pulse trains. It also monitors the frequency of the pulse trains. The RMC determines the correct sequence of flowmeter pulses based upon the time interval between pulses rather than the absolute phase difference. This is done by comparing the leading edges of both pulse trains at a set clock interval. Maintaining a minimum phase shift between the pulse trains, as indicated in Table 4-2, ensures that related pulse edges of each channel are, in worst case, at least five clock samples apart.

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Table 4-2. Phase shift difference between dual pulse trains

Maximum Pulse Input Frequency	Maximum Phase Shift Required
1.5kHz	45°
3.0kHz	90°
6.0kHz	180°

4.2.3. Density Pulse Inputs

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

The RMC density pulse frequency input, labeled "DNSTY" on the Terminal Board, supports pulse frequency signals from digital densitometers. Input load impedance is 10kΩ and signal coupling is AC with a 1V trigger threshold. The digital densitometer must output 1.5V peak–to–peak to reliably trigger the RMC's density input.

4.3. Digital I/O Signals

The RMC provides six digital status inputs and six digital control outputs for controlling prover functions, remote totalizing, sampler operation, meter tube control, injection pump control, and other miscellaneous devices. Digital I/O signals are passed through opto-couplers within the RMC to provide electrical isolation. The power and returns for all digital I/O signals are common with the DC power terminals; therefore, do not exceed the maximum load allowed for RMC digital inputs or outputs, as indicated in this section.

4.3.1. Digital Inputs

The six RMC digital inputs are labeled "DIGITAL IN" 1 to 6 on the Terminal Board. The voltages applied to each RMC digital input must not exceed 30VDC at the RMC DC terminals.

Each digital input has a green status indicator light-emitting diode (LED). When the green LED is glowing, the corresponding digital input is receiving a DC voltage greater than 4.5V and the point is active. These LEDs are located on the Terminal Board above each corresponding digital input, as shown in Figure 4-6.

Digital Input #6 additionally supports prover detector switch signals. If the RMC is controlling a prover, connect the prover detector switch to this RMC input only.

4.3.2. Digital Outputs

The six RMC digital outputs are labeled "DIGITAL OUT" 1 to 6 on the Terminal Board. The maximum output current load that each individual digital output supports is approximately 100mA.

Each individual digital output has a resettable fuse and a dual indicator LED (green/red). When the LED is glowing green, the corresponding digital output is active. When the LED is red, this indicates a fault caused by a low impedance to DC return. To reset this condition, break the circuit and reconnect after the fault has been corrected. Observe all safety procedures when doing this. These LEDs are located on the Terminal Board above each corresponding digital output, as shown in Figure 4-7.

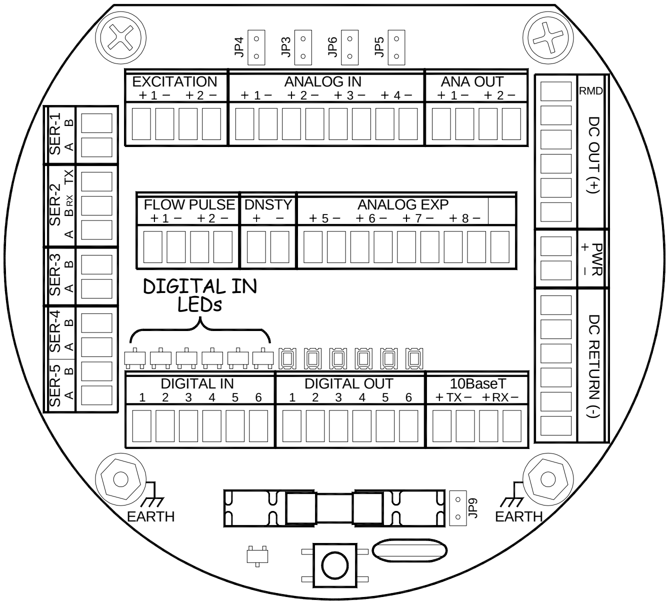

Figure 4-6. Location of digital input indicator LEDs on the terminal board.

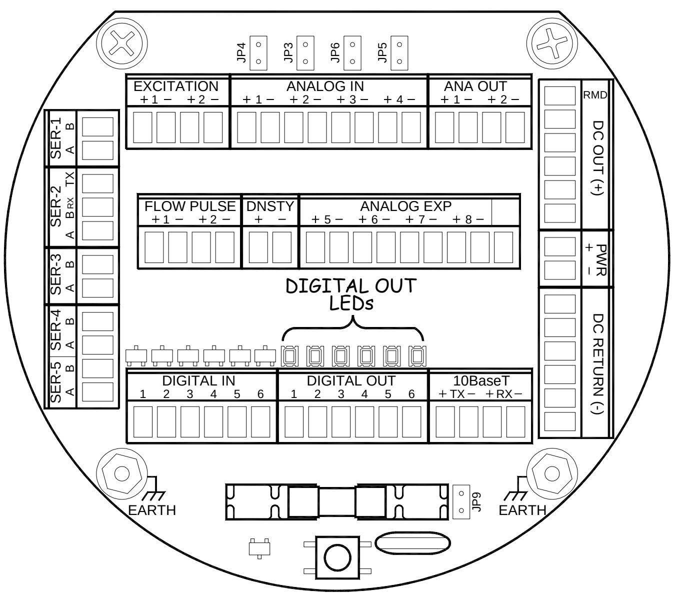

Figure 4-7. Location of digital output indicator LEDs on the terminal board.

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4.4. Serial I/O Signals

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

The standard hardware configuration of the RMC has two dedicated RS-485 Serial Ports (1 & 3) and one selectable RS-232/485 Serial Port. The Analog–Serial I/O Expansion Board, when installed as an option, provides two additional RS-485 Serial Ports (4 & 5). RS-485 serial ports support two-wire connection. RS-232 serial ports are three wire (RX/TX, TX/RX, and RTN).

4.4.1. Serial Port Jumper Settings

Selection jumpers for Serial Ports 1 thru 3 are located on the Processor Board. See Figure 4-8 for serial ports 1 and 3. See Figure 4-9 for serial port 2 jumper settings locations.

Selection jumpers for Serial Ports 4 and 5 are located on the I/O Expansion Board.

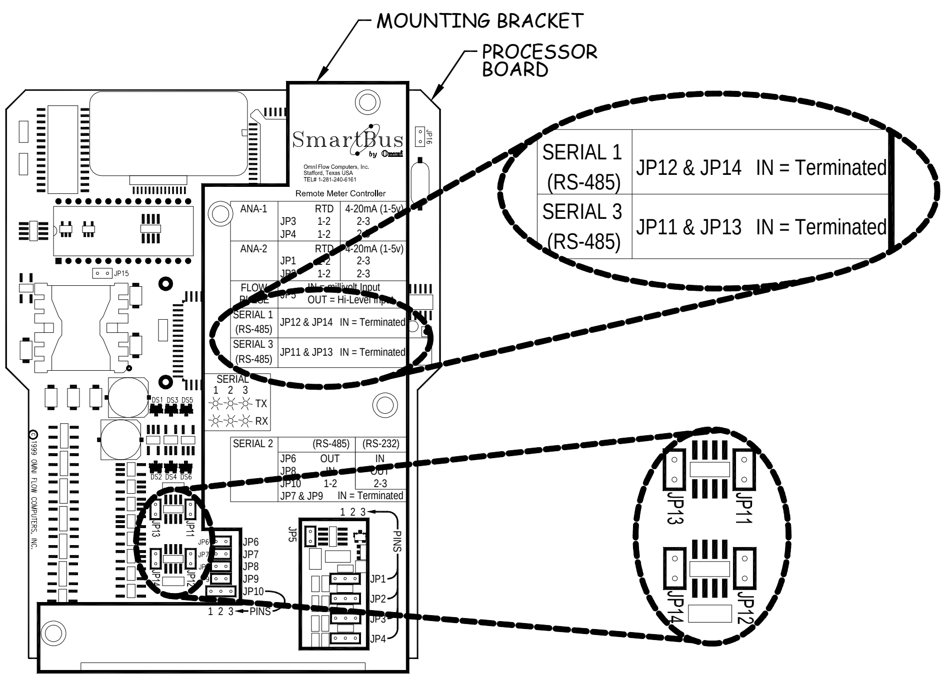

Figure 4-8. Location of RS-485 Serial Ports 1 & 3 selection jumpers on the processor board.

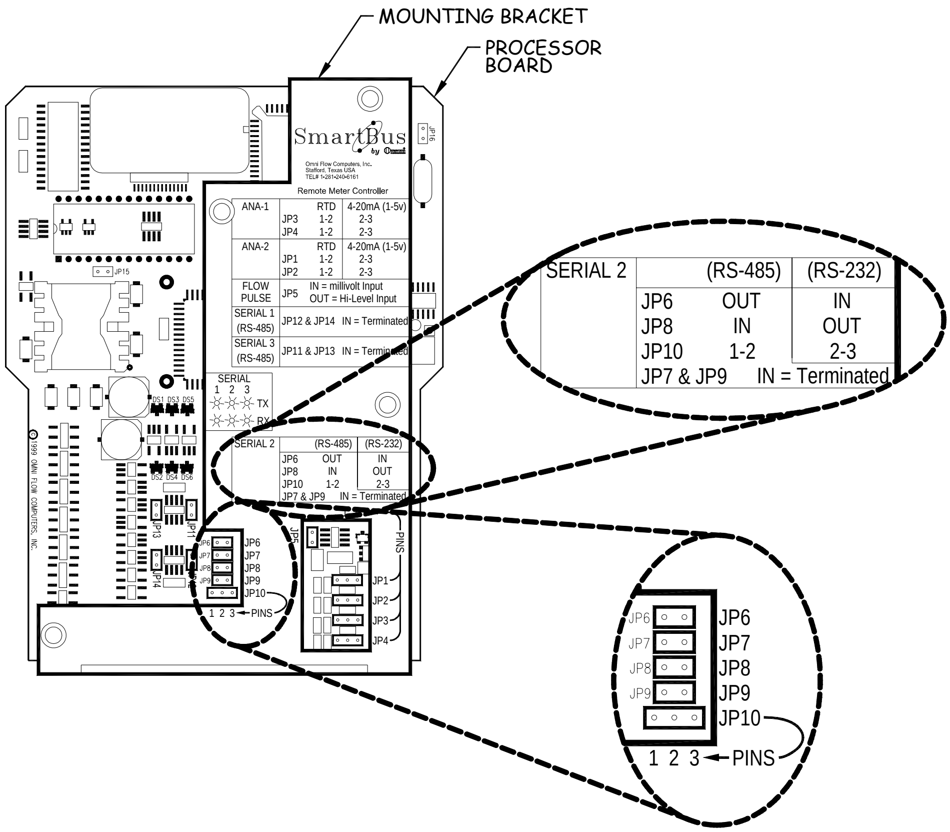

Figure 4-9. Location of RS-232/485 Serial Port 2 selection jumpers on the processor board.

4.4.2. Serial Port Indicator LEDs

A RED transmit (TX) LED indicator and a GREEN receive (RX) LED indicator are provided on the processor board for each individual serial port. When the transmit LED is glowing red, the corresponding serial port is actively sending (output) signals. When the receive LED is glowing green, then the serial port is receiving (input) signals. Figure 4-10 shows the location of serial port (#1, #2, #3) LED indicators.

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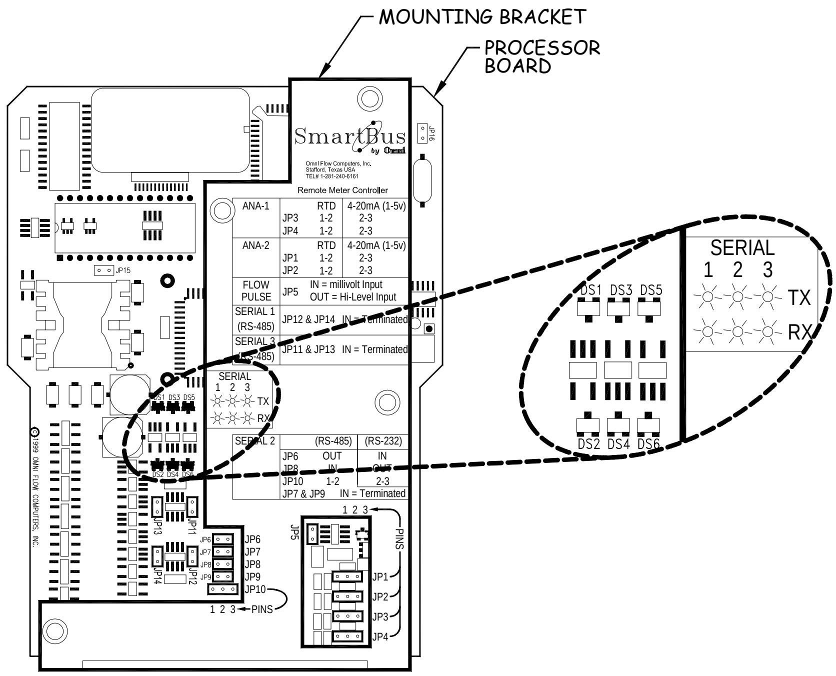

Figure 4-10. Location of serial port indicator LEDs on the processor board.

RS-485 Serial Device Connectivity

Some serial devices that connect to the RMC may not fully comply to the RS-485 standard. In these cases, you may have to crossover (swap) the A and B channel connections to the devices respective to the RMC; i.e., the RMC A channel is wired to the B channel of the connecting device, and the RMC B channel to the device's A channel. Always consult the manufacturer's documentation before connecting any devices to the RMC.

4.4.3. RS-485 Serial Devices

The RS485 data wires are labeled "A" and "B", but some manufacturers label their wires "+" and "–". If this is the case, the "+" wire should be connected to the "A" line, and the "-" wire to the "B" line. Reversing the polarity will not damage a RS-485 device, but it will not communicate. Most installations, connect A to A and B to B.

RS-485 allows multiple devices (up to 32) to communicate at half-duplex on a single pair of wires at distances up to 4000 feet (1200 meters) A signal ground wire to tie the signal ground of each of the nodes to one common ground may be required for long runs.

Make these connections using unshielded twisted-pair (UTP) copper. Use 22-18 AWG for runs less than 1000ft and 20 or 18 AWG for runs greater than 1000ft. Shielded twisted-pair (STP) wire may be used, but it may have an attenuating effect due to a higher capacitance per foot, thereby limiting the maximum wire run length to less than 4000ft.

4.4.4. RS-485 Terminated/Non-terminated Connection

The RS-485 serial ports support two-wire, terminated or non-terminated connections. Configure each serial port as required, see Figure 4-8 and Figure 4-9 for jumper settings.

Equipment that is not terminated properly may cause data transmission errors. A terminated device produces the maximum signal transfer. When interfacing with one piece of equipment with a short cable run (under 150 feet) in an electrically 'clean' environment (like an office) then you probably do not need the cable to be terminated. If on the other hand you are using 2 or more RS-485 devices in an industrial environment with hundreds of feet of cable runs - terminating both ends of the cable at the end points would be required.

RS-485 transmission wires must have only one beginning and one end. Therefore, do not configure these transmission wires in a 'star' topology; both ends of the wire must be terminated. In a multi-drop configuration, this means to terminate the two end devices. The RMC may or may not be at the end of the wire so it may or may not be one of the terminating devices. In a point-to-point connection, this simply means to terminate both the RMC and the other device.

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4.4.5. Communications Parameters and Signal Interface Specifications

Set the RMC serial communications parameters —such as: protocol type, baud rate, number of stop bits, and parity settings— using the PC-based SmartCom™ configuration software. Table 4-3 indicates the signal specifications of the RMC serial I/O interface.

Table 4-3. RMC serial I/O interface signal specifications

	RS-232	RS-485
Data Output Voltage	±7.5V (typical)	4V (typical)
Load Impedance	1.5kΩ	120Ω
Short Circuit Current	10mA (limited)	20mA
Input Low Threshold	-3.0V	0.4V (differential input)
Input High Threshold	+3.0V	
Baud Rates	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, & 115.2 kbps	
Common Mode Voltage	±36V DC Power Return	
Indicator LEDs	Receive & Transmit	

4.4.6. Analog–Serial I/O Expansion Board

This board has 4 additional Analog Inputs and 2 additional Serial Ports. Configure each analog input for either 4–20mA or 1–5V signals via individual jumpers located on the expansion board (see Table 4-4, Table 4-5, and Figure 4-11). The two serial ports support the 2-wire RS-485 (EIA/TIA-485) standard interface for serial communications.

Table 4-4. Analog Inputs 5 thru 8 Jumper settings.

Analog Input	Jumper I.D.	Jumper Placement	
		4–20mA Mode	1–5V Mode
5	JP9	In	Out
6	JP10	In	Out
7	JP11	In	Out
8	JP12	In	Out

Table 4-5. Serial Ports 4 & 5 (RS-485) Termination settings.

Serial Port	Jumper I.D.	Jumper Placement	
		Terminated	Non-Terminated
4	JP5	In	Out
	JP6	In	Out
5	JP7	In	Out
	JP8	In	Out

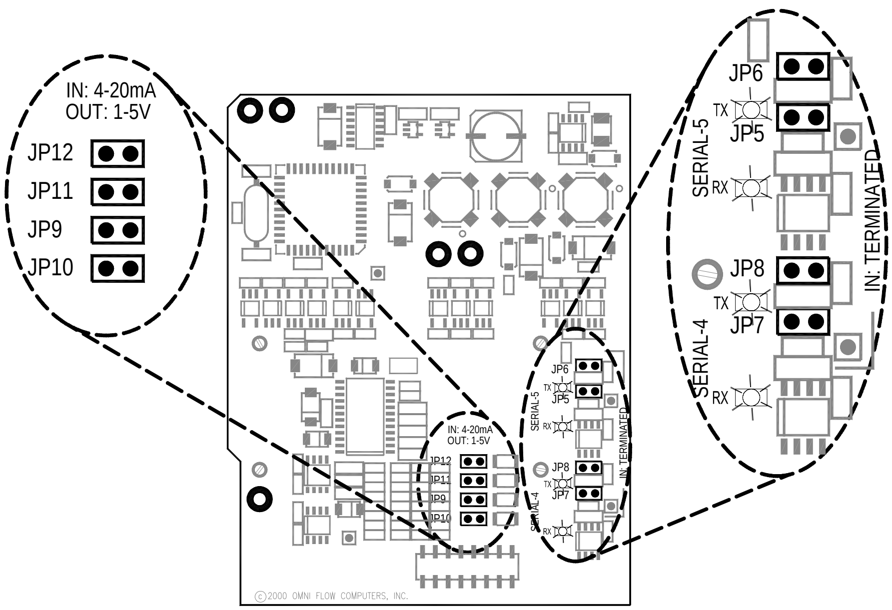

Figure 4-11. Analog–Serial I/O Expansion Board, Jumper locations.

4.5. Ethernet 10BaseT Signals

The Ethernet Network Interface Board adds 10BaseT connectivity to local area networks (LANs) and wide area networks (WANs). This interface also supports the Transmission Control Protocol/Internet Protocol (TCP/IP) suite and related Internet/Intranet Technologies. Refer to Section 2.3.5 "Optional Ethernet 10BaseT Network Interface Board" for more information.

4.5.1. Ethernet (10BaseT) Basics

- 10BaseT:
  "10' stands for 10 Mbps data rate
  "Base" stands for baseband signaling
  "T" stands for twisted pair
- Maximum distance between active devices (card/cable modem, hubs, etc.) is 328 feet or 100 meters, unrepeated, in a point-to-point wiring configuration.
- At minimum, use CATEGORY 3 cable (2 pair). DO NOT use flat telephone cable.
  Category 3 - 10 Mbps speed
  Category 4 - 16/20 Mbps speed
  Category 5 - 100 Mbps speed

4.5.2. Cable Selection

Select cables which conform to EIA/TIA 568B AT&T 258A wiring standards for CAT 5E, two pair RJ45 to RJ45 Patch Cords or Crossover Cables. See Figure 4-14 for Patch Cords and Figure 4-15 for Crossover Cables.

Note: Four pair Patch Cords may be selected for installation; cable pairs 1 and 4 are not used. EIA/TIA 568A may also be used the only difference between these two standards is the assignment of the Green and Orange pairs of wires.

4.5.3. Cable Installation

- Avoid sharp bends (90 degree).
- Keep cable run as far as possible from fluorescent lighting.
- Avoid installing cable in conduits with electrical wiring.

NETWORKING UTP CABLE STANDARDS

Unshielded twisted-pair (UTP) wiring installations should conform to IEEE Ethernet 10BaseT 802.3 or the ANSI/EIA/TIA 586-A network and telecommunications cable standards. Alternately, you may also refer to AT&T's Direct Inside Wiring (DIW) and IBM's Type 3 cable specifications.

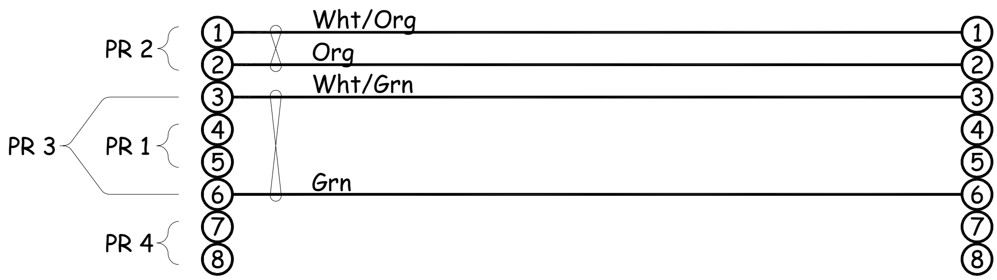

Figure 4-14 Wiring diagram for 10BaseT Patch Cords using a Hub/Switch between the RMC and another TCP/IP device.

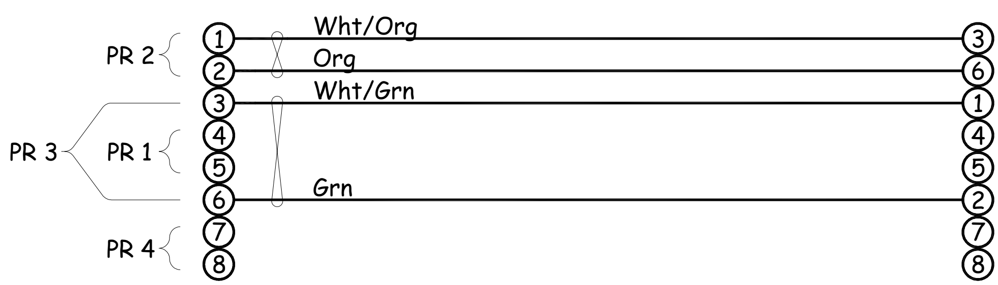

Figure 4-15 Wiring diagram for 10BaseT Crossover Cable without a Hub/Switch between the RMC and another TCP/IP device (i.e., point-to-point)

4.5.4. IP Addressing

Internet Protocol (IP) technology was developed in the 1970s to support some of the first research computer networks. Two versions of IP technology exist today. Most networked computers in use today use IP version 4 (IPv4), but an increasing number of educational and research institutions have adopted the next generation IP version 6 (Ipv6). The RMC uses the IPv4 addressing scheme and thus it will be the focus of this topic.

An IPv4 address consists of four bytes (32 bits). These bytes are also known as octets.

The RMC defaults to a factory IP address of 10.0.0.1

For readability purposes, humans typically work with IP addresses in a notation called **dotted decimal**. This notation places periods between each of the four numbers (octets) that comprise an IP address. For example, an IP address that computers see as

00001010 00000000 00000000 00000001

is written in dotted decimal as

10.0.0.1

Because each byte contains 8 bits, each octet in an IP address ranges in value from a minimum of 0 to a maximum of 255. Therefore, the full range of IP addresses is from **0.0.0.0** through **255.255.255.255**. That represents a total of 4,294,967,296 possible IP addresses.

IPv4 Address Classes

The IPv4 address space can be subdivided into 5 classes – Class A, B, C, D and E. Each class consists of a contiguous subset of the overall IPv4 address range. *(Class D and Class E are reserved for special use by the governing bodies that administer IP addresses).*

With a few special exceptions explained further below, the values of the leftmost four bits of an IPv4 address determine its class as follows:

Class	Commencing bits	Starting address	Finishing address
A	0xxx	0.0.0.0	127.255.255.255
B	10xx	128.0.0.0	191.255.255.255
C	110x	192.0.0.0	223.255.255.255

All **Class C** addresses, for example, have the commencing three bits set to ‘110’, but each of the remaining 29 bits may be set to either ‘0’ or ‘1’ independently 9 as represented by an x in these bit positions):

110xxxxx xxxxxxxx xxxxxxxx xxxxxxxx

Converting the above to dotted decimal notation, it follows that all Class C addresses fall in the range from 192.0.0.0 through 223.255.255.255.

IP Address Class A, Class B, Class C

Class A, Class B, and Class C are three classes of address used on IP networks in common practice, with three exceptions as explained next.

IP loopback Address

127.0.0.1 is the **loopback** address in IP. Loopback is a test mechanism of network adapters. Messages sent to 127.0.0.1 do not get delivered to the network. Instead, the adaptor intercepts all loopback meassages and returns them to the sending application. IP applications often use this feature to test the behavior of their network interface.

As with broadcast, IP officially reserves the entire range from **127.0.0.0** through **127.255.255.255** for loopback purposes. Nodes should not use this range on the internet, and it should not be considered part of the normal Class A range.

Zero Addresses

As with the IP loopback range, the address range from 0.0.0.0 through 0.255.255.255 should not be considered part of the normal Class A range. 0.x.x.x address serve no particular function in IP, but nodes attempting to use them will be unable to communicate properly on the internet.

Private Address

The IP standard defines specific address ranges within Class A, Class B, and Class C reserved for use by private networks (Intranets). The table below lists these reserved ranges of the IP address space.

Class	Private starting address	Private finishing address
A	10.0.0.0	10.255.255.255
B	172.16.0.0	172.31.255.255
C	192.168.0.0	192.168.255.255

Nodes are effectively free to use addresses in the private ranges if they are not connected to the internet, or if they reside behind firewalls or other gateways that use Network Address Translation (NAT).

4.5.5. IP Network Partitioning

Computer networks consist of individual segments of network cable. The electrical properties of cable limit the useful size of any given segment such that even a modestly-sized local-area-network (LAN) will require several of them. Gateway devices like routers and bridges connect these segments together although not in a perfectly seamless way.

Besides partitioning through the use of cable, subdividing of the network can also be done at a higher level. **Subnets** support virtual network segments that partition traffic flowing through the cable rather than the cables themselves. The subnet configuration often matches the segment layout one-to-one, but subnets can alos subdivide a given network segment.

Benefit of Network Addressing

Network addressing fundamentally organizes hosts into groups. This can improve security (by isolating critical nodes) and can reduce network traffic (by preventing transmissions between nodes that do not need to communicate with each other). Overall, network addressing becomes even more powerful when introducing subnetting and/or supernetting.

A **subnet** allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance. *(see below)*

4.5.6. Subnet Mask

Perhaps the most recognizable aspect of subnetting is the subnet mask. Like IP addresses, a subnet mask contains four bytes (32 bits) and is often written using the same "dotted-decimal" notation. For example, a very common subnet mask in its binary representation.

11111111 11111111 11111111 00000000

is typically shown in the equivalent, more readable form 255.255.255.0

The RMC ships with a default factory subnet mask of 255.0.0.0

Applying a Subnet Mask

Subnetting allowsnetwork administrators some flexibility in defining relationships among network hosts. Hosts on different subnets can only "talk" to each other through specialized network gateway devices like routers. The ability to filter traffic between subnets can make more bandwidth available to applications and can limit access in desirable ways.

A subnet mask neither works like an IP address, nor does it exist independently from them. Instead, subnet masks accompany an IP address and the two values work together. Applying the subnet mask to an IP address splits the address into two parts, an "extended network address" and a host address.

The subnet mask is a 32 bit value that is expressed in dotted decimal notation such as 255.255.255.0. When converted to binary, the bits that are '1' designate the portion of the IP address used for the network address with '0' designating the portion that is the node address. In the example above, only the last byte of the IP address would be used to designate the node since 255 = "11111111". For two devices to communicate directly the network address portions must be identical otherwise they will look for a gateway to go through. The node address portion must also be different from each other and different than any other node on the network. Your network administrator will usually be the one to decide on IP address and subnet masks.

4.5.7. MAC Address

A MAC address, short for Media Access Control, is a unique code assigned to most forms of networking hardware. The address is permanently assigned to a network device, such as a network interface card when it is manufactured, uniquely identifying that card from any other network interface card in the world. It consists of a 48-bit hexadecimal number (12 characters) as in 00-30-CB-57-F5.

When you're connected to the Internet from your computer (or host as the Internet protocol thinks of it), a correspondence table relates your IP address to your computer's physical (MAC) address on the LAN.

The MAC address of the RMC Ethernet board can be located on the edge of the board between the RX, and HEARTBEAT LEDs of the circuit board. You will see only the last 6 characters (example: C357F5) on the paper label, not all 12 characters. The first 6 characters are not shown on the label as they can always be assumed to be 0030CB for an RMC ethernet module. The first 6 characters are unique to OMNI Flow Computers. *(Note: While the RMC and LMC always use 0030CB as the first 6 characters of the MAC address, the omni SE module always uses 0090C2 as the first 6 characters of its MAC address.)*

Joining the 12 characters together using the above label as an example would give you a MAC address of 00-30-CB-C3-57-F5.

4.5.8. Configuring the Ethernet Port

Referse to OMNI Technical Bulletin TB020101B applicable to the OMNI flow computer Serial Ethernet module for instructions on how to use the OMNI Network Utility software to access and configure the RMC Ethernet module. The Technical Bulletin and the software can be downloaded from the website at www.omniflow.com.

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Connecting Flowmeters 5

In Chapter 5

Connecting Flowmeters:

RMC liquid and gas flow signal connectivity features support a wide range of flowmeters, including flow pulse transmitters, linear analog flowmeters, differential pressure (DP) head devices, ultrasonic flowmeters, coriolis mass flow pulse transmitters, and multivariable sensors. The RMC additionally provides support for dual pulse integrity and fidelity checking. In addition to the setup described in this chapter, you will need to further configure the RMC using the PC-based SmartCom software.

5.1. Pulse Frequency Flow Transmitters

The SmartBus RMC provides I/O terminals for connecting volume flow pulse signals produced by turbine and other positive displacement flowmeters. The RMC also supports mass flow pulses, such as those produced by coriolis meters transmitters that produce flow pulse frequencies include: turbine, positive displacement, ultrasonic, mass, and multivariable flowmeters applicable to liquid and gas measurement.

Read the Documentation!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

RMC Flow Pulse Inputs #1 and #2 can be wired as either high-level DC voltage or low-level AC millivolt pulse signals. High-level pulse input signals are usually obtained from flowmeter preamplifiers. The RMC is also capable of enhanced Level B pulse fidelity and pulse integrity checking by connecting two flow pulse inputs suitably phased from a dual-pulse equipped flowmeter.

To set up the RMC to receive high-level DC voltage pulse inputs from a preamplifier, remove jumper JP5 on the processor board. If the RMC is to receive low-level AC millivolt signals, insert jumper JP5.

Refer to Section 4.2.1 “Flow Pulse Inputs” for more details and signal type specifications. Following are examples of typical wiring configurations for connecting pulse–producing flowmeters to the RMC.

5.1.1. Single Pickoff Turbine & Positive Displacement Flowmeters

Use either RMC Flow Pulse Input #1 or #2 when wiring a turbine or positive displacement flowmeter with a single pickoff coil to thr RMC. Remember to configure SmartCom for a flow pulse input when doing this. Figure 5-1 shows the wiring of a turbine flowmeter high-level DC voltage frequency pulse signal. Figure 5-2 represents wiring of a low-level AC millivolt signal.

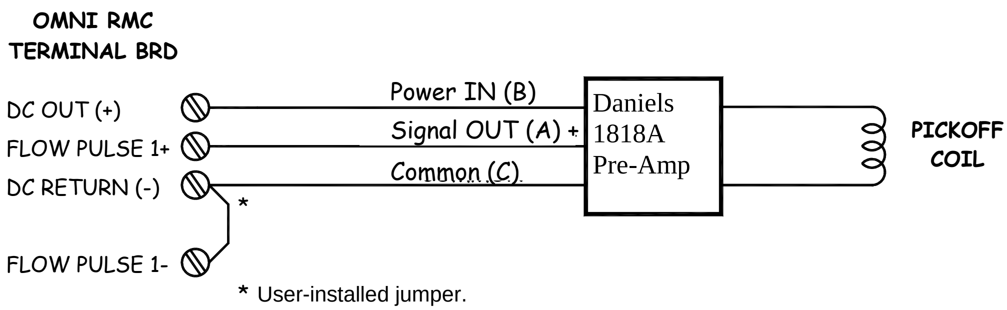

Figure 5-1. Wiring a turbine flowmeter DC high-level pulse signal to RMC Pulse Input #1. *Processor Board JP5=OUT*

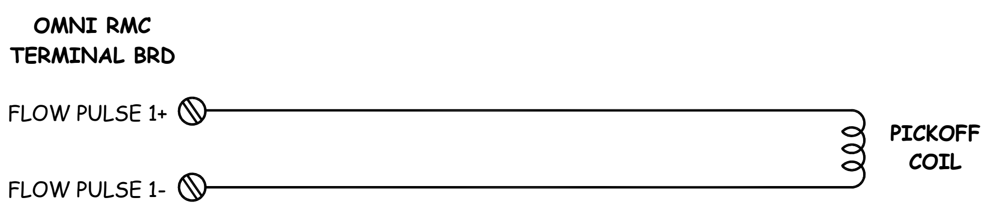

Figure 5-2. Wiring a turbine flowmeter AC low-level pulse signal to RMC Pulse Input #1. *Processor Board JP5=IN*

5.1.2. Dual Pickoff Flowmeters

Turbine or positive displacement flowmeters equipped with dual pickoffs, which provide two pulse train outputs, are necessary for implementing pulse fidelity and integrity checking. When applying pulse fidelity checking, begin with and maintain a perfect noise-free installation. Ensure that each pulse train input to the RMC is a clean, low-impedance signal that will not be subject to extraneous noise or electromagnetic transients. Any regular occurrence of these types of events must cause the equipment and/or wiring to be suspect. Pulse fidelity check circuitry does ***not*** facilitate continuous operation with a poor wiring installation prone to noise or transient pickup.

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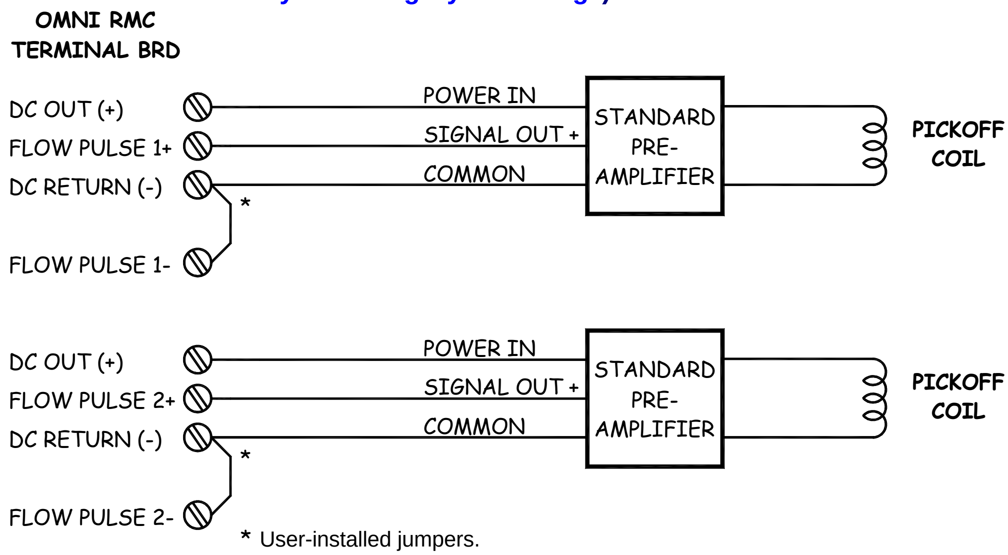
To achieve pulse fidelity and integrity checking, use both RMC Pulse Inputs #1 and #2 when wiring a flowmeter equipped with dual pickoff coils (see Section 4.2.2 "Dual Pulse Fidelity and Integrity Checking").



READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Figure 5-Figure 5-3 shows the wiring configuration for a flowmeter that outputs dual, high-level frequency pulse signals. Figure 5-4 represents the wiring diagram for dual, low-level frequency pulse signals.

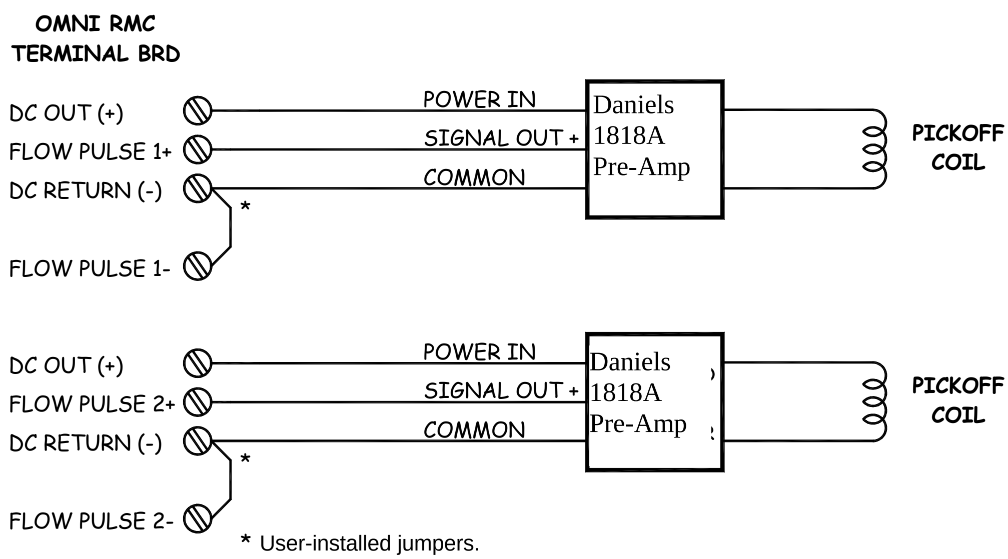


Figure 5-3. Wiring dual, DC high-level frequency pulse signals from a dual pickoff coil turbine flowmeter to RMC Pulse Inputs #1 and #2 using preamplifiers. *Processor Board JP5=Out*

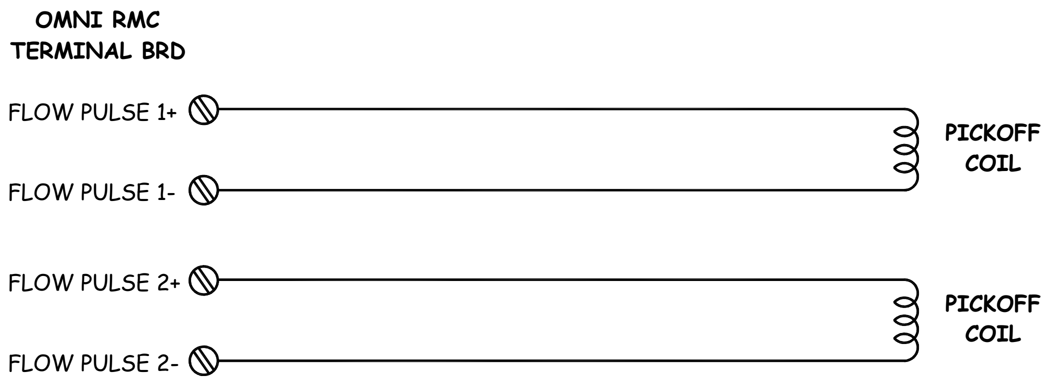


Figure 5-4. Wiring dual, AC low-level frequency pulse signals from a dual pickoff coil turbine flowmeter to RMC Pulse Inputs #1 and #2. *Processor Board JP5=In*

5.1.3. Faure Herman® Flowmeter Preamplifiers

Faure Herman® turbine flowmeters are usually used in liquid applications only. These flowmeters have a preamplifier that connects to the RMC flow pulse input. Remove jumper JP5 on the Processor Board to set the RMC to receive high-level pulse inputs. Figure5-5, Figure5-6, and Figure5-7 show the wiring connections for a Faure Herman® flowmeter preamplifier.

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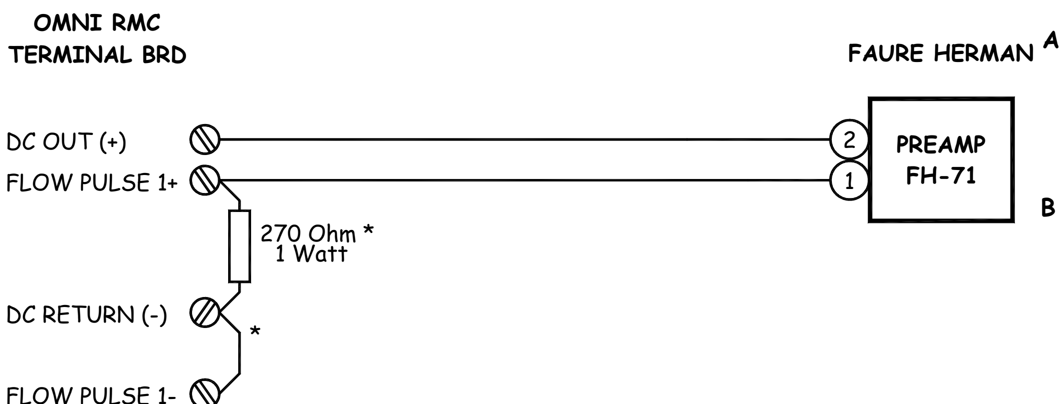

* User-supplied components.

Figure 5-5. Wiring a Faure Herman® Preamplifier Model FH-71 to RMC Pulse Input #1.

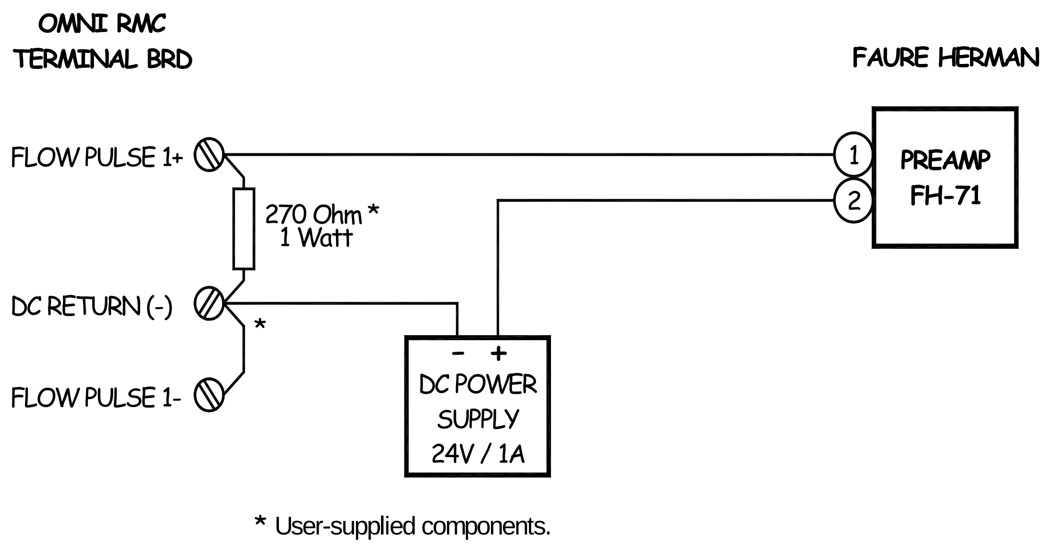

Figure 5-6. Wiring a Faure Herman® Preamplifier Model FH-71 to RMC Pulse Input #1 powered by external supply.

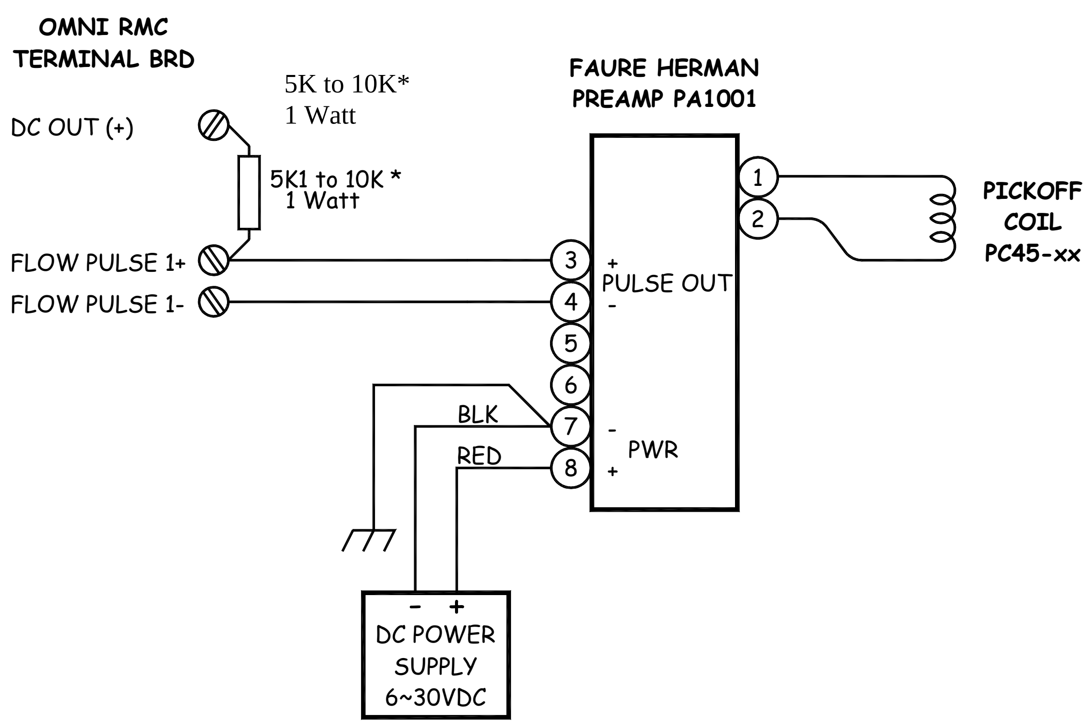

Figure 5-7. Wiring a Faure Herman® Preamplifier Model PA1001 with Pickoff Coil PC45-xx powered by an external supply to RMC Pulse Input #1.

5.1.4. Daniel Industries® Universal Preamplifiers

Daniel Industries® Flowmeters come with a universal preamplifier that connects to the RMC flow pulse input. Therefore, remove jumper JP5 on the Processor Board to set the RMC to receive high-level pulse inputs. Figure 5-8 and Figure 5-9 show the wiring connections for a Daniel Industries flowmeter preamplifier.

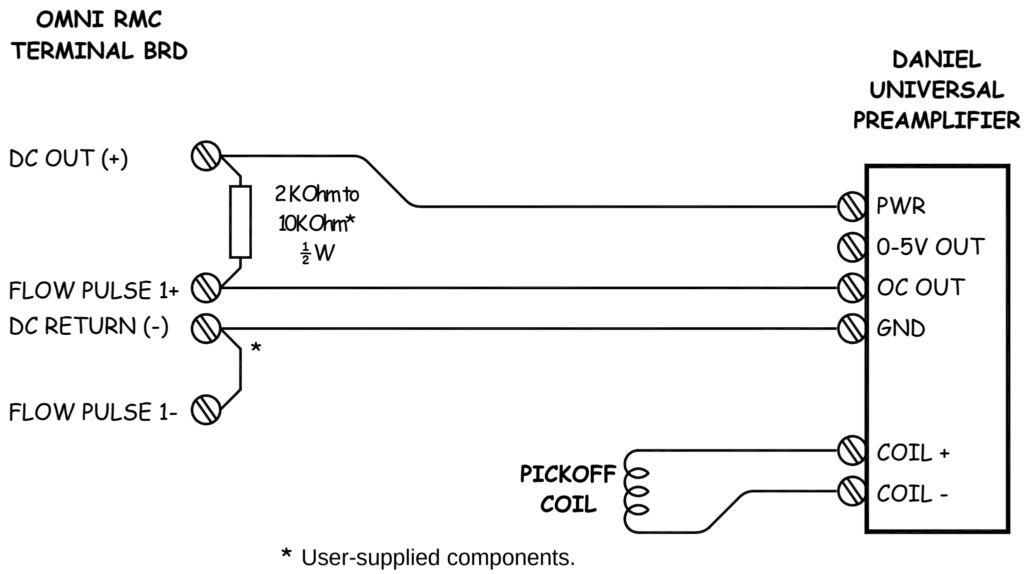

Figure 5-8. Wiring a Daniel Instruments® Universal Preamplifier to RMC Pulse Input #1, using the preamp open collector (OC) output.

READ THE DOCUMENTATION!
Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

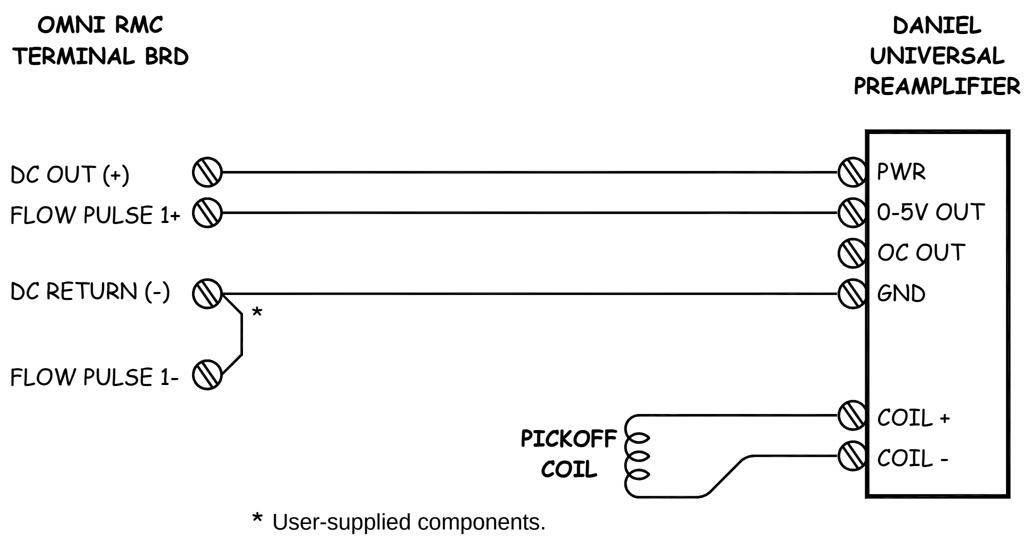

Figure 5-9. Wiring a Daniel Instruments™ Universal Preamplifier to RMC Pulse Input #1, using the preamp 0–5V output.

5.2. Linear Analog Flow Transmitters & Differential Pressure Head Devices

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Linear analog and differential pressure (DP) flowmeters connect to the RMC just as any other 4–20mA or 1–5V analog transmitter (see Section 6.1 "Miscellaneous Analog Transmitters"). Figure 5-10 and Figure 5-11 respectively show the wiring of these flowmeters to an RMC analog input in high-leg and low-leg wiring modes (refer to Section 4.1.1 "Analog Inputs").

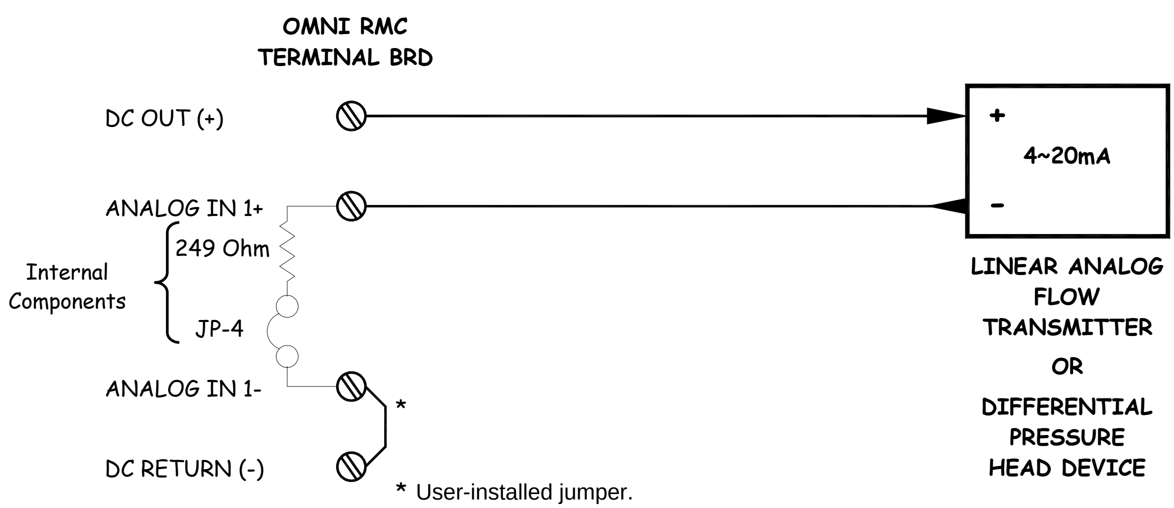

Figure 5-10. Wiring either a linear analog or a differential pressure flowmeter to RMC Analog Input #1 in a high-leg wiring configuration.

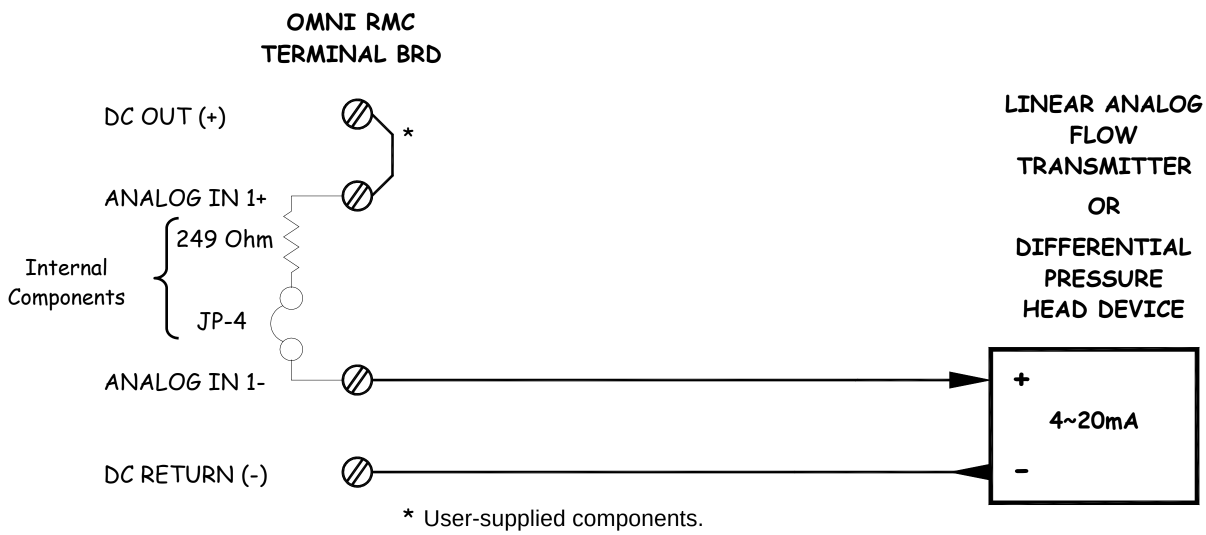

Figure 5-11. Wiring either a linear analog or a differential pressure flowmeter to RMC Analog Input #1 in a low-leg wiring configuration.

5.3. Ultrasonic Flowmeters

Ultrasonic meters are smart digital inferential instrumentation devices that measure bidirectional (forward/reverse) fluid flow. Typically, these devices are used in gas metering systems to measure linear gas velocity and the speed of sound in gas. However, ultrasonic technology may also be employed in liquid applications. The RMC supports the major brands of ultrasonic flowmeters by Instromet, FMC Kongsberg, and Daniel Industries. Support for the SICK ultrasonic is also planned in the future).

Ultrasonic meters incorporate multiple pairs of transducers that transmit ultrasonic (acoustic) pulses which travel bi-directionally, in either a single (axial or diagonal) or double (swirl) reflection path, to and from each transducer in the pair. These flowmeters apply time travel methodology to analyze the ultrasonic pulses and determine the fluid velocity and fluid speed of sound. The methods are based upon the fact that the ultrasonic pulses travel (between a transducer pair) faster downstream with the flow than upstream against the flow. The gas flow velocity is determined from this upstream/downstream travel time differential of the ultrasonic pulses within the multiple reflection paths. When there is no gas flow in the pipeline, the upstream and downstream travel times are the same; i.e., the time differential is zero.

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5.3.1. Instromet® Q-Sonic® Ultrasonic Gas Flowmeters

The Instromet® Q-Sonic® Ultrasonic Gas Flowmeter employs 3 or 5 acoustic transducer pairs with a minimum of one axial path and two swirl paths.

The SmartBus RMC communicates with the Q-Sonic via a two-wire RS-485 serial connection and/or by way of an RMC flow pulse input. The RMC receives flow rate and profile corrected gas velocity transmitted serially by the Q-Sonic, and can also receive live flow pulse frequency signals through the direct-connect between the flowmeter and the RMC flow pulse input terminals. For serially transmitted data, RMC firmware will temperature-compensate the meter tube area and calculate flow rate based upon the profile corrected velocity of gas transmitted by the flowmeter. If the calculated flow rate is not within reasonable limits, the RMC will use the transmitted flow rate as the actual flow rate. The RMC firmware can also totalize gas flow based upon the flow pulse frequency input when the flow transmitted by the Q-Sonic is in the correct direction (forward/reverse) and the pulse frequency is within limits. This live flow pulse input signal will also be used in the event of a communications failure between the Q-Sonic and the SmartBus RMC.

Figure 5-12 shows the typical wiring required for connecting an Instromet Q-Sonic flowmeter to the RMC. A two-wire RS-485 interface connects to either RMC serial port terminal block. For signal redundancy, it is recommended that the forward and reverse flow pulse signals are wired to the RMC flow pulse inputs, as shown on the next page.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

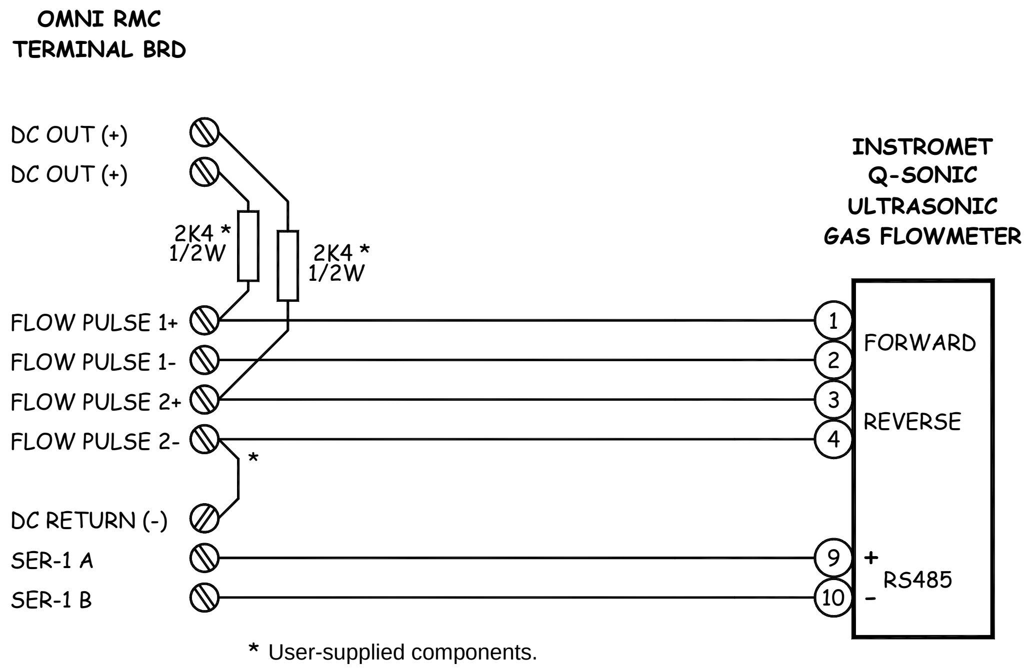

Figure 5-12. Wiring an Instromet® Q-Sonic® Ultrasonic Gas Flowmeter to RMC Serial Port #1, with the recommended bi-directional (forward/reverse) pulse outputs wired to RMC Pulse Inputs 1 & 2.

5.3.2. FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeters

The FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeter employs six acoustic transducer pairs for gas flow measurement. The SmartBus RMC communicates with the MPU 1200 via a two-wire RS-485 serial connection. As an option a live flow signal from the ultrasonic flowmeter may be connected directly to the RMC flow pulse inuts. Figure 5-13 shows this wiring option.

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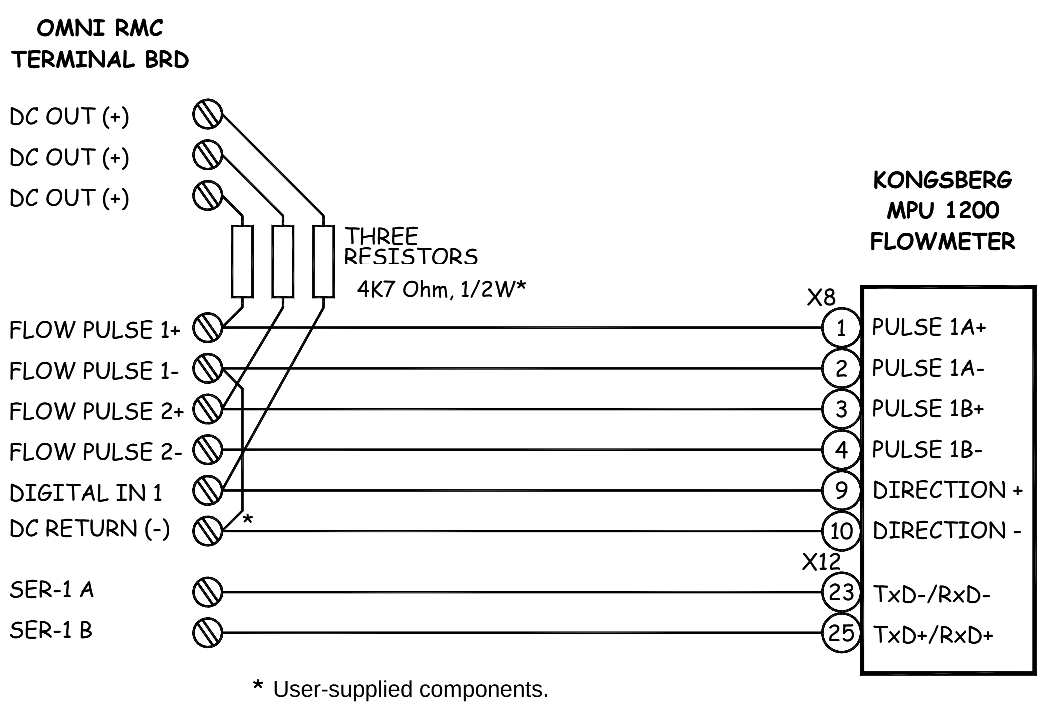


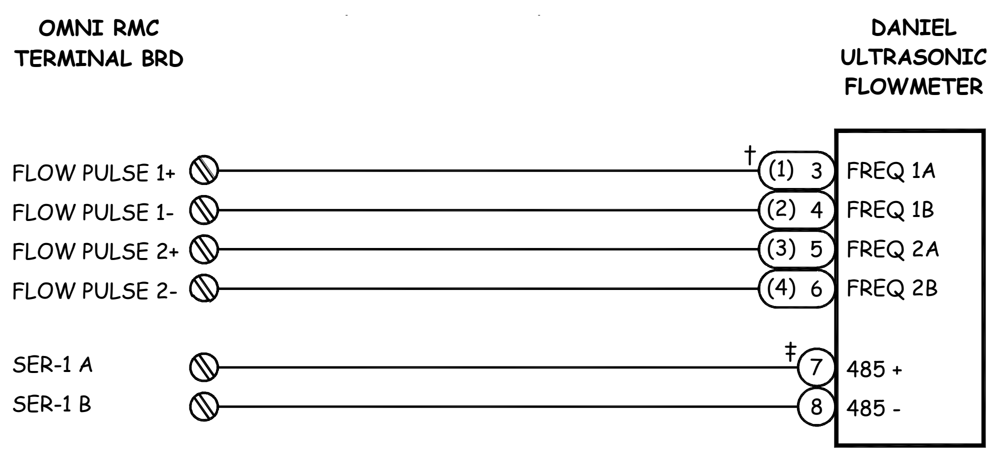
Figure 5-13. Wiring FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeter to RMC Serial Port #1, with the recommended bi-directional (forward/reverse) pulse outputs wired to RMC Flow Pulse Inputs #1 & #2.

5.3.3. Daniel Industries® Ultrasonic Gas Flowmeters

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Daniel Industries® Ultrasonic Gas Flowmeters connect to the SmartBus RMC using the Daniel Diagnostics and Frequency Interface (DFI). The DFI is an optional accessory to the Daniel ultrasonic flowmeter that adds frequency pulse output capability, indicating volumetric flow rate. In addition, the DFI adds a RS-485 serial port to the Daniel ultrasonic meter. Figure 5-14 shows how to wire a Daniel ultrasonic flowmeter to the RMC.



†Connector P2 on Peripherals Boards:
Pins 3-6 used on Boards 3-3400-011 & 3-3400-017.
Pins 1-4 used on Board 3-3400-016.
‡Connector P2 on 3400 Series Terminal board.

Figure 5-14. Wiring a Daniel Industries® Ultrasonic Gas Flowmeter to RMC Flow Pulse Inputs #1 & #2, and an RS-485 serial port.

5.3.4. SICK® Ultrasonic Gas Flowmeter (Future)

5.4. Multivariable Transmitters

As an option, Omni Flow can equip the RMC with an Optional Multivariable 205 Rosemount Transducer for orifice metering applications (see Section 2.4 "Multivariable Sensor").

5.4.1. Micro Motion® Elite™ RFT9739 & 1700 / 2700 Multivariable Transmitters

Micro Motion® Elite™ RFT9739 & 1700 / 2700 series transmitters are used in liquid or gas measurement and can come equipped with sensors that measure volume and mass flow, fluid density, temperature, differential pressure, and calculated viscosity. The RMC connects to these transmitters via two-wire RS-485 serial communications and/or by using the RMC signal input terminals that correspond to each process variable signal outputted by the transmitter.

Figure 5-15 shows how to connect the RMC with the Micro Motion transmitter using any RS-485 serial port in a two-wire configuration. Alternately, you can also wire the different transmitter process variable signals directly to the corresponding RMC signal inputs (e.g.: flow pulse inputs, density pulse inputs, analog inputs), as shown in Figure 5-16. For more details, refer to the documentation of Micro Motion Elite transmitters and sensors.

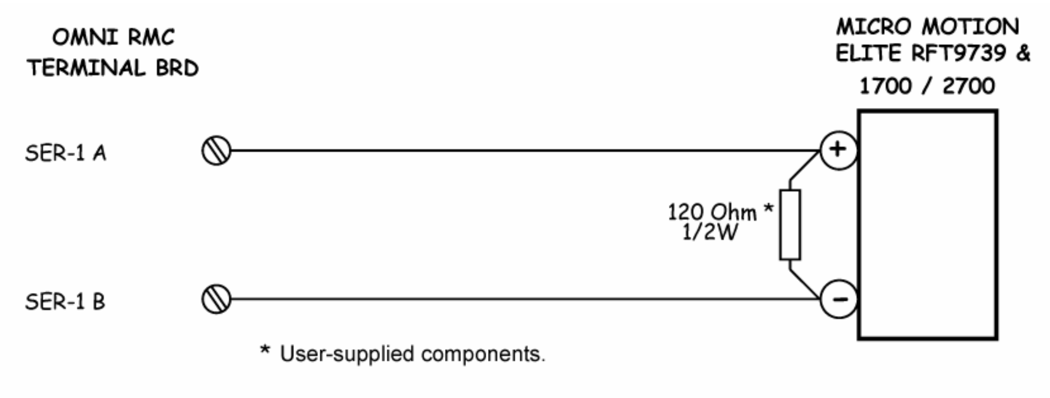


Figure 5-15. Wiring a Micro Motion® Elite™ RFT9739 & 1700 / 2700 Transmitter to an RMC RS-485 serial port. *(NOTE: Flow must always be wired as a flow pulse signal input into the RMC)*

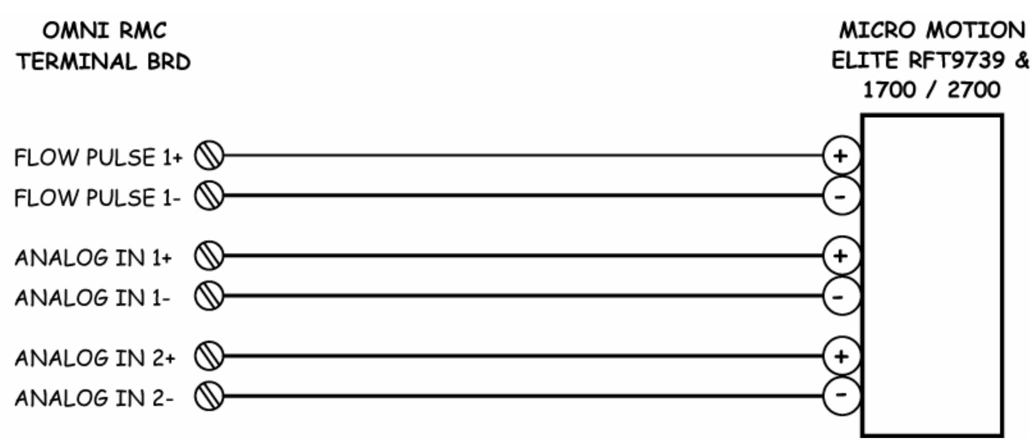


Figure 5-16. Wiring a Micro Motion® Elite™ RFT9739 transmitter to RMC Flow Pulse Input #1, Density Analog Input #1, and Analog Input #2.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

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IMPORTANT!

Provide a safe and suitable means of disconnecting power and signal from each individual Rosemount 3095 transmitter. Because of the power requirements of the RS-485 serial ports, the 3095 cannot be made 'intrinsically safe'. Follow proper safety procedures before removing the covers from any devices or junction boxes located in hazardous areas. Refer to Rosemount 3095 documentation for correct transmitter and sensor installation.

SmartBus™

IN CHAPTER 6

Connecting Transmittters:

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

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6 Connecting Transmitters

The RMC provides connectivity for a wide variety of transmitter types, typically used in liquid and gas metering applications to measure different process variables (e.g.: temperature, pressure, density, relative density, sediment and water, viscosity). The RMC has analog I/O, RTD excitation source outputs, density pulse inputs, and selectable jumpers for wiring 1–5V or 4–20mA transducer signals and digital densitometer frequency pulse signals.

For more information, refer to Chapter 4 "Connecting the Signal I/O". In addition to the setup described in this chapter, you will need to further configure the RMC using SmartCom software.

6.1. Miscellaneous Analog Transmitters

Because there may be a high density of wires connected to the RMC back panel terminal board, it is recommend that 22-24AWG (gauge) wire be used wherever possible. Transducers should also be wired using 22-24 gauge twisted-pair wire. Terminate the ground shields at the RMC end. To prevent ground loops, tape back and insulate shields at the transducer end (see Section 3.3 "Grounding & Shielding" and Section 3.4 "General Wiring Tips").

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Connect the transducer in series with either the power or the return line of the transducer current loop. By setting the appropriate jumpers on the terminal board, configure the RMC to accept either 1–5V or 4–20mA signals (see Section 4.1.1 "Analog Inputs"). Requesting Technical Support

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Figure 6-1 and Figure 6-2 respectively show the wiring of a transducer to an RMC analog input in a high-leg configuration and a low-leg wiring mode.

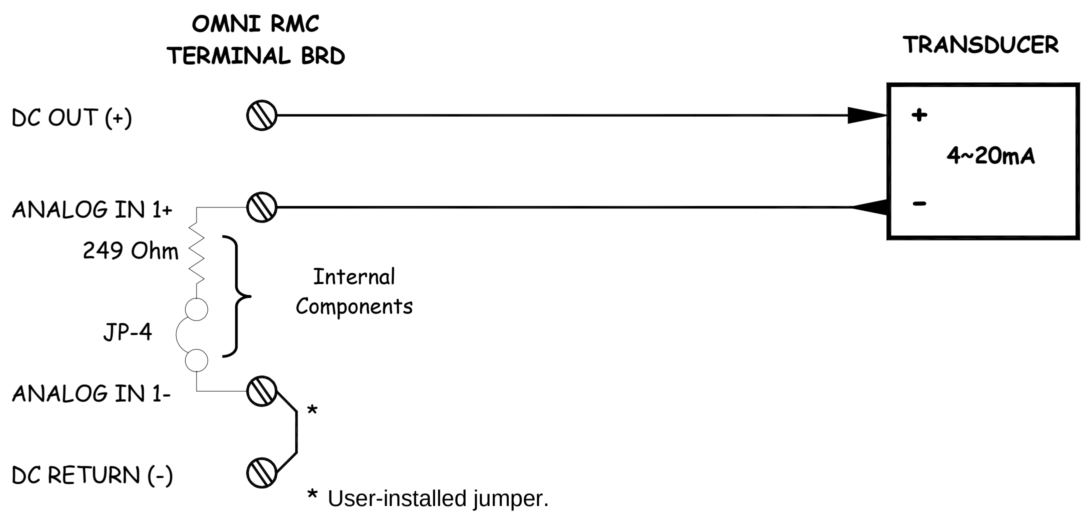

Figure 6-1. Wiring a 4–20mA transducer signal to RMC Analog Input #1 in a high-leg wiring configuration.

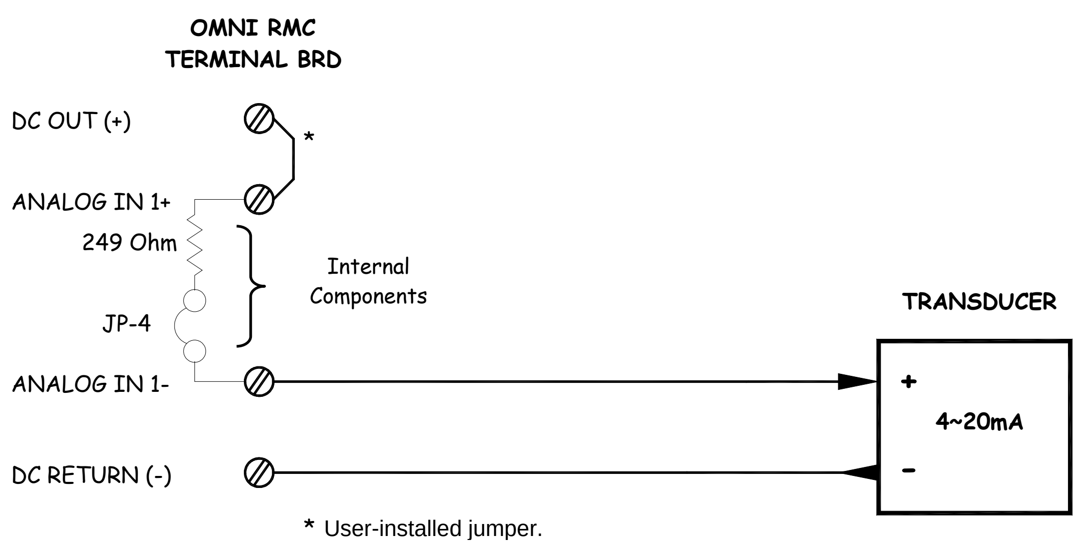

Figure 6-2. Wiring a 4–20mA transducer signal to RMC Analog Input #1 in a low-leg wiring configuration.

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6.2. RTD Probes

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Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Figure 6-3 shows the wiring of a 100-ohm resistance temperature detector (RTD) transmitter in a four-wire configuration. Up to two RTD temperature signals may be wired to an RMC using analog inputs #1 and/or #2. See Section 4.1.1 "Analog Inputs" for required jumper settings. Wire the two RMC excitation current source outputs to the corresponding RTD probe inputs. Also, configure the RMC using SmartCom software for either the DIN curve ($\alpha = 0.00385$) or the American curve ($\alpha = 0.00392$). For more information, see Section 4.1 "Analog I/O Signals"".

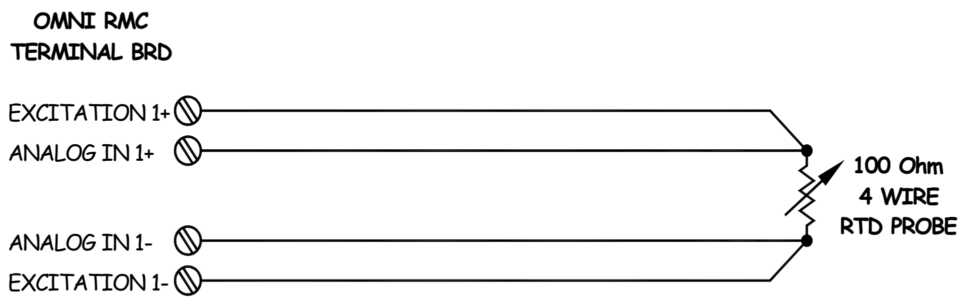

Figure 6-3. Wiring a 100Ω RTD probe to RMC Analog Input #1 and Excitation Output #1 in a 4-wire configuration.

6.3. Frequency Pulse Densitometers

The RMC supports the major brands of frequency pulse type liquid and gas density transducers. These include, but are not limited to, Solartron®, Sarasota®, and UGC® brands of digital densitometers.

Density transducers may also provide densitometer temperature and densitometer pressure signals used to correct and compensate density measurement accuracy. The digital densitometer manufacturer usually supplies correction factors for their devices.

Typically, density transducers have a sensing element that consists of a thin, cylindrical tube, usually made of metal, through which the fluid flows. The transducer causes the inner tube to vibrate at its natural resonant frequency. As the flowing fluid is in contact with the vibrating tubes, it too vibrates. The mass of fluid in the tube modifies this resonant frequency, allowing the fluid's density to be determined. An increase in the fluid mass decreases the natural frequency of vibration. Therefore, fluid density is a function inversely proportional to the measured frequency.

RMC density pulse input impedance is 10kΩ. The densitometer must output 1.5 volts peak-to-peak to reliably trigger the RMC density input (see Section 4.2.3 "Density Pulse Inputs").

6.3.1. Solartron® Liquid and Gas Density Transducers

With Solartron® 7830/35 and 7840/45 Series of liquid density transducers, and Model 7812 gas density transducers, continuous online measurement of liquid or gas density is available. These densitometers produce frequency pulse signals. The liquid density transducers also provide a 4-wire, 100-ohm platinum resistance thermometer (RTD) for liquid temperature measurement. The 7812 gas density transducer has a PT100 temperature sensor for verifying temperature equalization, which is necessary when there is a temperature differential between the pipeline gas and the sample gas surrounding the sensing element.

Figure 6-4 and Figure 6-6 respectively show how to wire Solartron 7830/35 and 7840/45 liquid densitometers, and 7812 gas densitometers to the SmartBus RMC. Figure 6-5 and Figure 6-7 show examples of wiring Solartron densitometers to the RMC with safety barriers.

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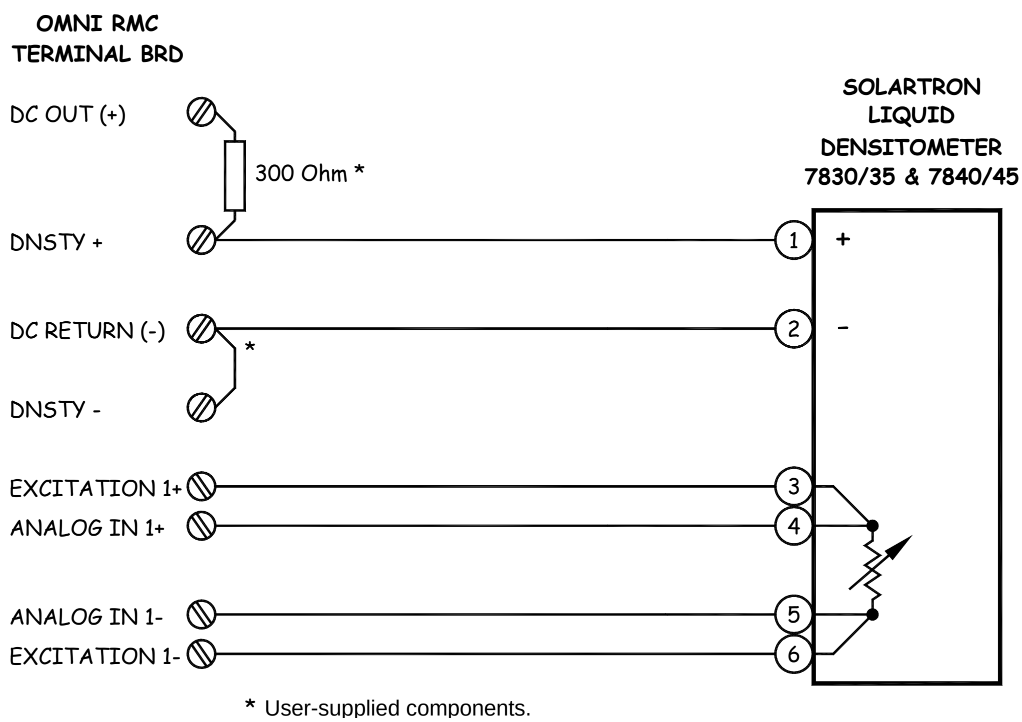

Figure 6-4. Wiring Solartron® 7830/35 and 7840/45 Liquid Density Transducers to the RMC.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

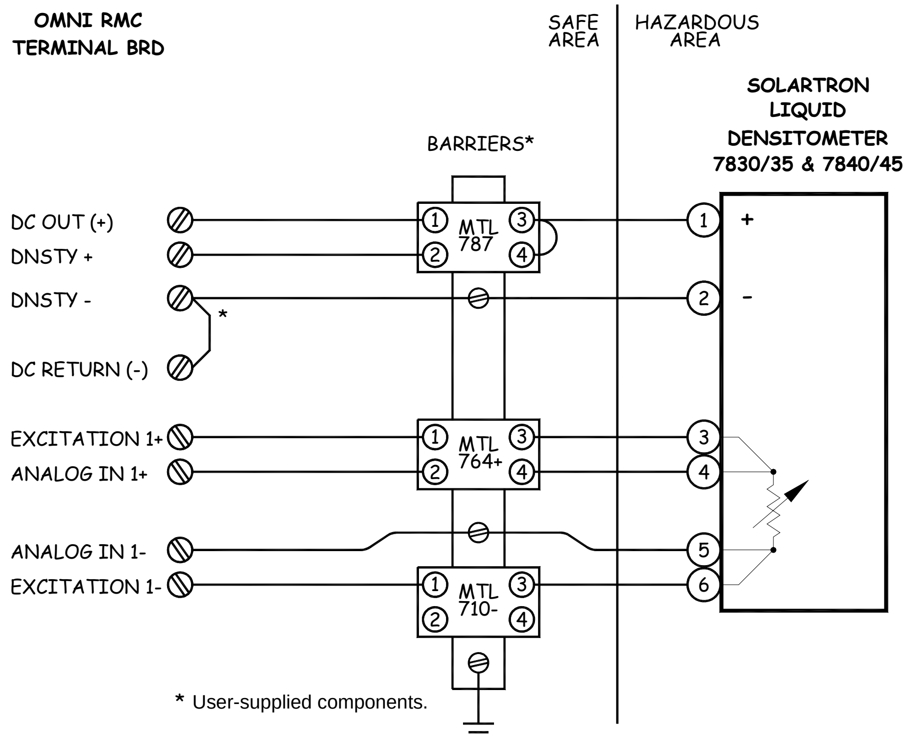

Figure 6-5. Wiring Solartron® 7830/35 and 7840/45 Liquid Density Transducers to the RMC with safety barriers.

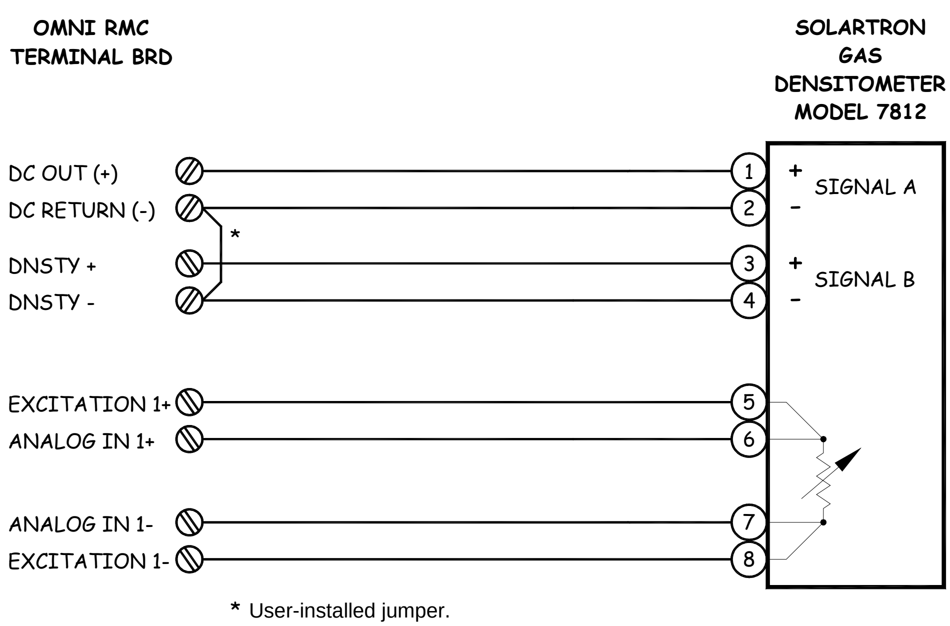

Figure 6-6. Wiring Solartron® 7812 Gas Density Transducers to the RMC.

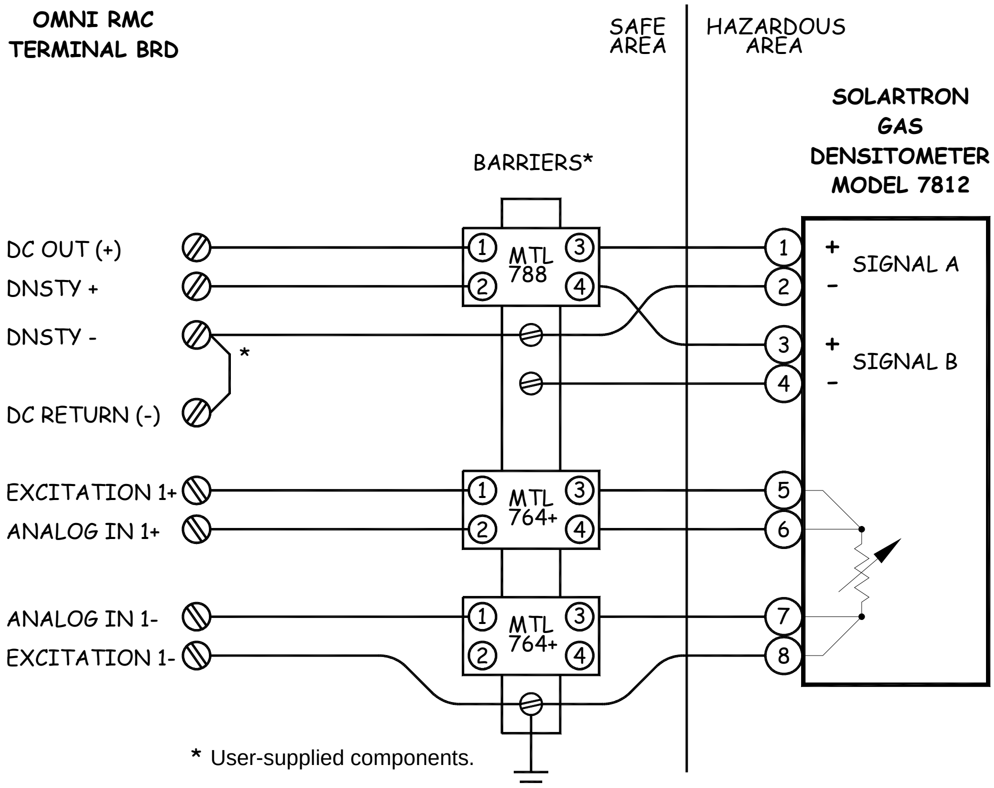

Figure 6-7. Wiring Solartron® 7812 Gas Density Transducers to the RMC with safety barriers.

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6.3.2. Sarasota® Densitometers

Sarasota® densitometers produce a voltage pulse signal that represents the fluid density measurement. These densitometers have a 4-wire, 100-ohm RTD probe to monitor the temperature of the device. Figure 6-8 and Figure 6-9 respectively show how to wire Sarasota densitometers to the RMC without and with safety barriers.

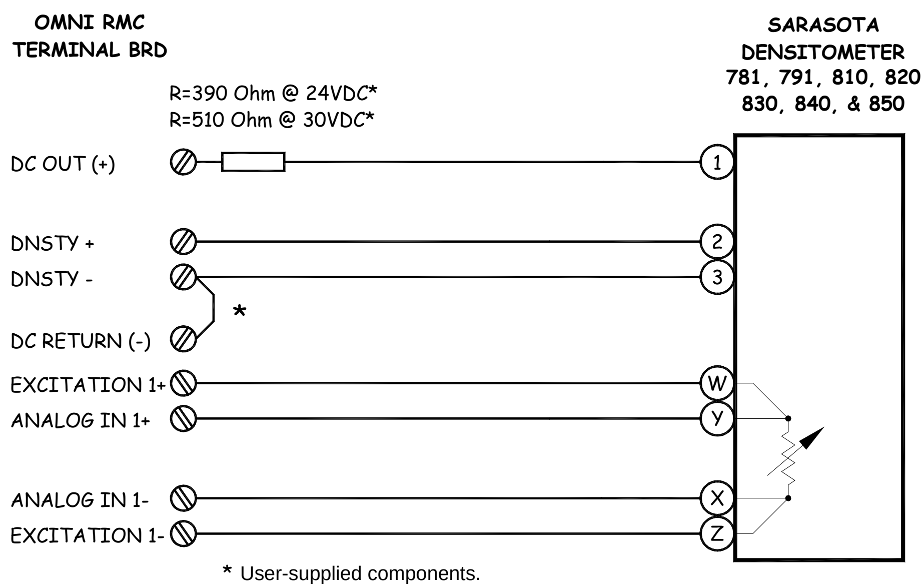

Figure 6-8. Wiring Sarasota® Liquid Density Transducers to the RMC.

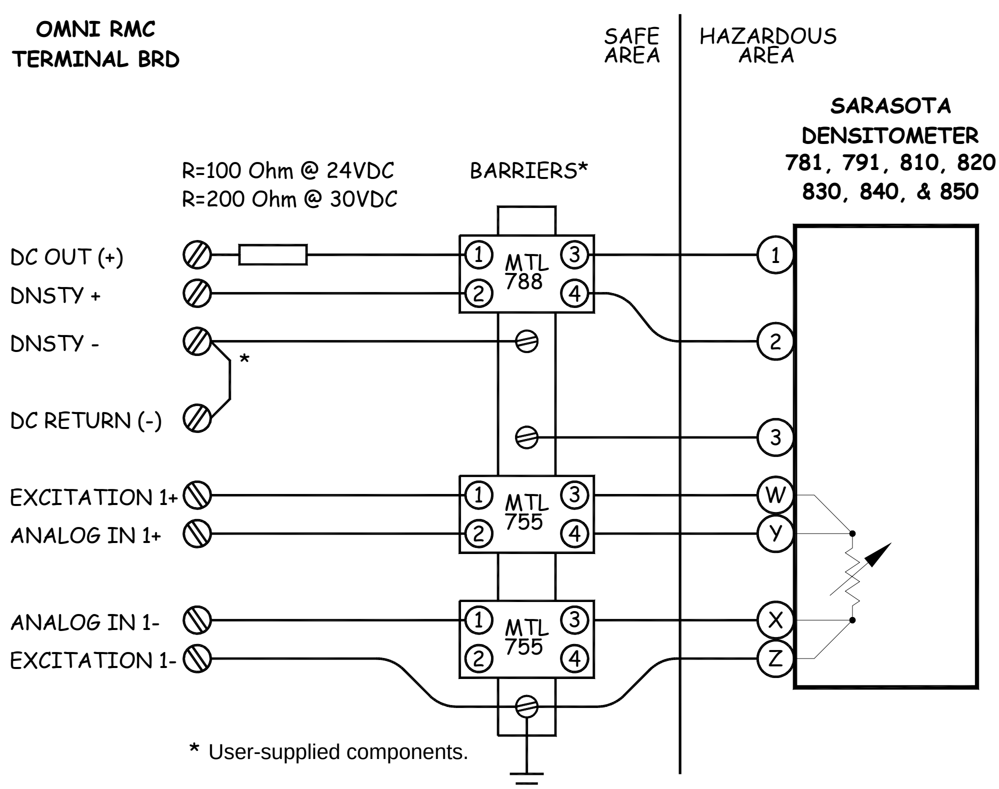

Figure 6-9. Wiring Sarasota® Liquid Density Transducers to the RMC with safety barriers.

6.3.3. UGC® Densitometers

The UGC densitometer output provides an open collector transistor that requires an external pull-up resistor to 24VDC. Figure 6-10 and Figure 6-11 respectively show how to wire UGC densitometers to the RMC without and with safety barriers.

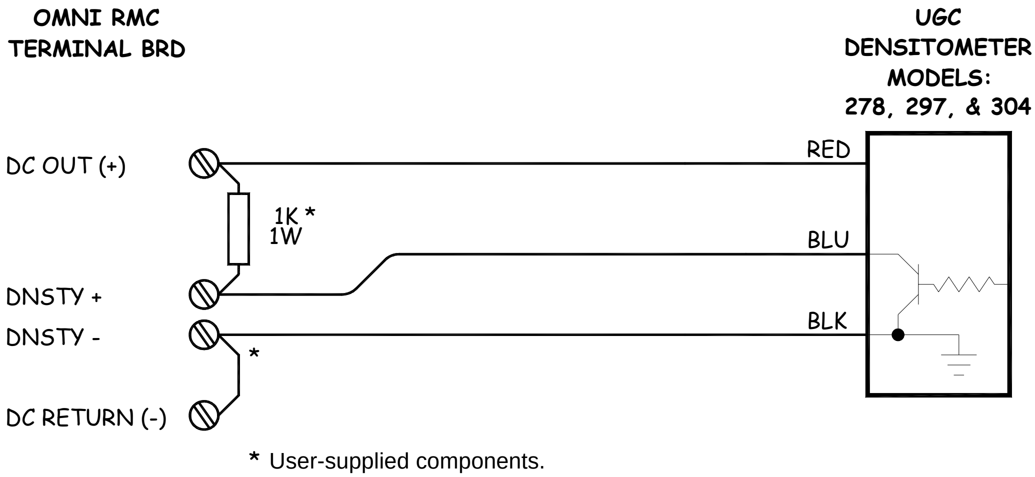

Figure 6-10. Wiring UGC® Liquid Density Transducers to the RMC.

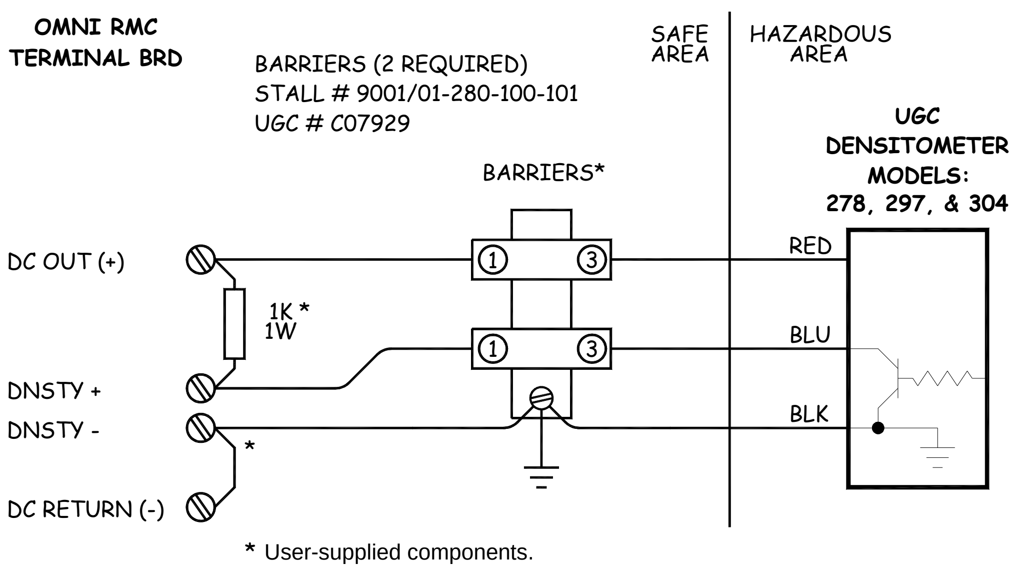

Figure 6-11. Wiring UGC® Liquid Density Transducers to the RMC with safety barriers.

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7 Connecting Provers

The RMC provides connectivity with the most common types of provers typically used for dynamic proving of flowmeters that produce a high-resolution electrical pulse, such as turbine and displacement type meters. Use only RMC Digital Input #6 to connect prover detector switches. In addition to the setup described in this chapter, you will need to further configure the RMC using SmartCom software.

Proving is performed to calibrate or verify the accuracy of flowmeters. The most common types of provers are pipe provers, uni or bi-directional, compact provers, and master-meter provers.

Pipe provers come in different sizes and shapes for permanent or mobile installation. These can be classified as either conventional pipe provers or reduced volume provers, depending upon the amount of volume pulses collected during a prove pass, as established by industry standards and custody transfer specified requirements. Pipe provers also are classified as either unidirectional or bi-directional. Unidirectional provers launch the displacer in only one direction between detector switches during a prove run or pass. Bi-directional provers allow the displacer to travel in both forward and reverse flow directions, for which a prove run is one round-trip and a prove pass is a one-way trip of the displacer between detector switches.

A master-meter prover is a flowmeter that is designated as the reference for comparing its performance with the performance of other flowmeters at the same metering station.

7.1. Conventional Pipe Provers

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

As established by industry standards, conventional pipe provers have a volume between detector switches equivalent to 10,000 or more direct or unaltered (whole) meter pulses counted during a prove pass. Conventional pipe provers are classified as either unidirectional or bi-directional and are typically larger and bulkier than small volume provers.

The RMC connects to unidirectional and bi-directional conventional pipe provers with their detector switches either in a normally opened position or in a normally closed position. These wiring options are shown in Figure 7-1 and Figure 7-2, respectively. Remember, use only Digital Input #6 for connecting prover detectors.

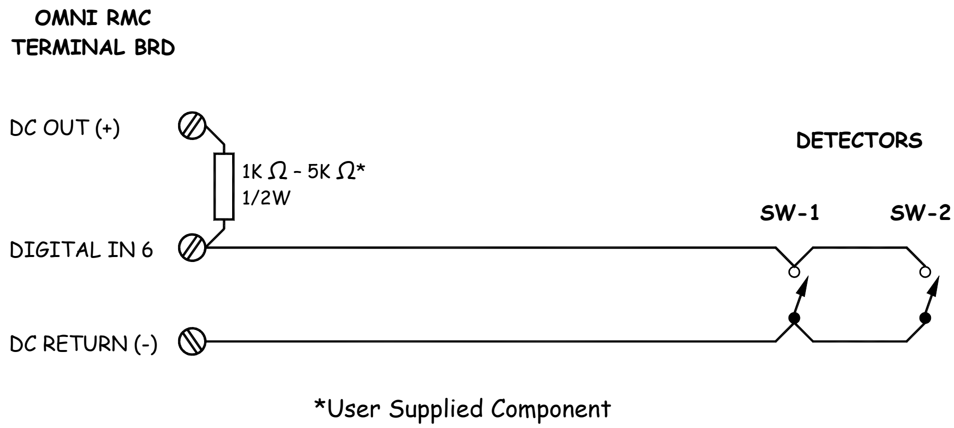

Figure 7-1. Wiring normally open conventional pipe prover detector switches to RMC Digital Input #6. (Configure SmartCom for positive edge trigger)

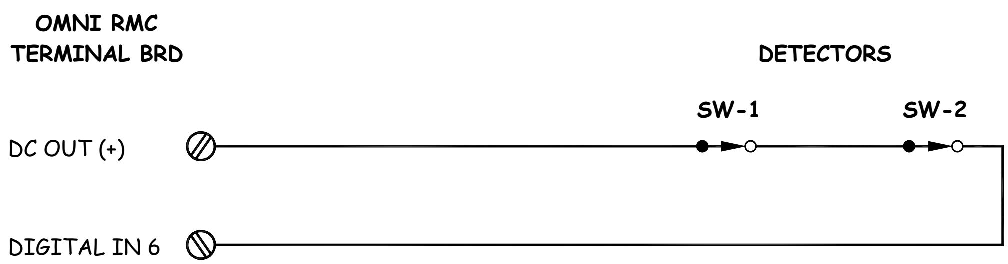

Figure 7-2. Wiring normally closed conventional pipe prover detector switches to the RMC Digital Input #6. (Configure SmartCom for negative edge trigger)

7.2. Small Volume or Compact Provers

Industry standards define small volume provers or compact provers as having a volume between the detector switches of less than 10,000 direct or unaltered, whole (integer) meter pulses to be counted during a prove pass. Hence, these provers are typically more compact and more portable than conventional pipe provers. Small volume provers, like conventional pipe provers, can also be either unidirectional or bi-directional.

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7.2.1. Double-Chronometry Pulse Interpolation

DOUBLE-CHRONOMETRY PULSE INTERPOLATION WITH CONVENTIONAL PIPE PROVERS

Although not required by industry standards, conventional pipe provers (see Section 7.1) can be fitted for double-chronometry proving, in which caseFigure 7-3 also applies.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

Because of their low volume capacity, small volume or reduced volume provers require applied pulse interpolation techniques together with high-precision low bounce detectors for meter pulse discrimination. Because of the smaller volume, the resolution of the detector switches must also be improved for a more accurate pulse measurement reading. Industry standards require that you determine the flowmeter discrimination to 0.01% uncertainty of the meter pulse measurement. The pulse interpolation method typically used to achieve this level of meter pulse discrimination in small volume proving applications is known as double-chronometry (see sidebar note).

In double-chronometry meter pulse interpolation, the fractional meter pulses generated between detector switches are interpolated from the amount of unaltered, whole meter pulses accumulated during the prove run. This is done to determine a very accurate, pulse per unit-volume calculation. Two high-speed timers (counters) and gating logic, controlled by the detector switch signals and the meter pulses, are responsible for the highly accurate calculation. For double-chronometry readings to be acceptable, both timers must collectively accumulate at least 20,000 clock pulses during the proving run. The RMC typically accumulates many more clock pulses than this in a prove run, exceeding industry standard requirements and further assuring reliability to the calculation accuracy. Figure 7-3 shows how to wire a small volume prover to the RMC for double chronometry proving. Use only RMC Digital Input #6 to connect prover detector switches.

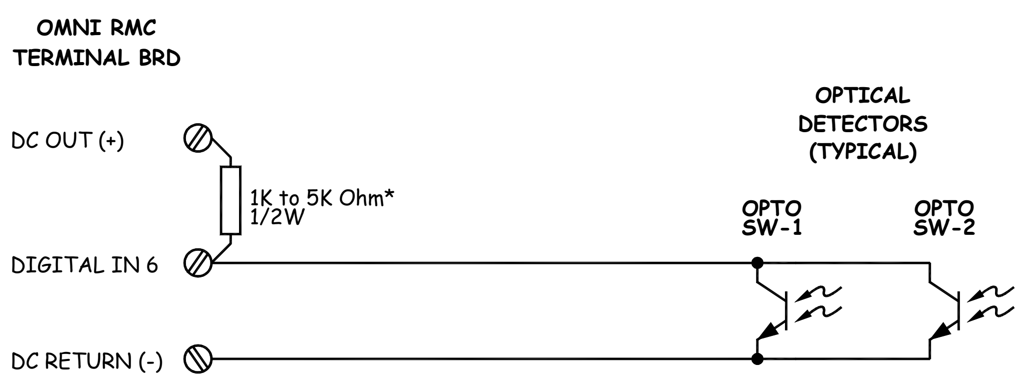

Figure 7-3. Wiring small volume prover detector switches to the RMC for double chronometry proving. (Configure SmartCom for negative edge trigger).

7.2.2. Brooks® Compact Provers

The Brooks® Compact Prover is an industry recognized brand of unidirectional small volume prover. Inside this prover is a flow tube, which consists of a piston fitted with a coaxial poppet valve. A pneumatic spring plenum pressure, which works together with a hydraulic system, controls the piston. Built-in, solid state electronics and incorporated logic provide raw data proving pulses. Figure 7-4 shows how to wire a Brooks® Compact Prover to the RMC I/O terminals.

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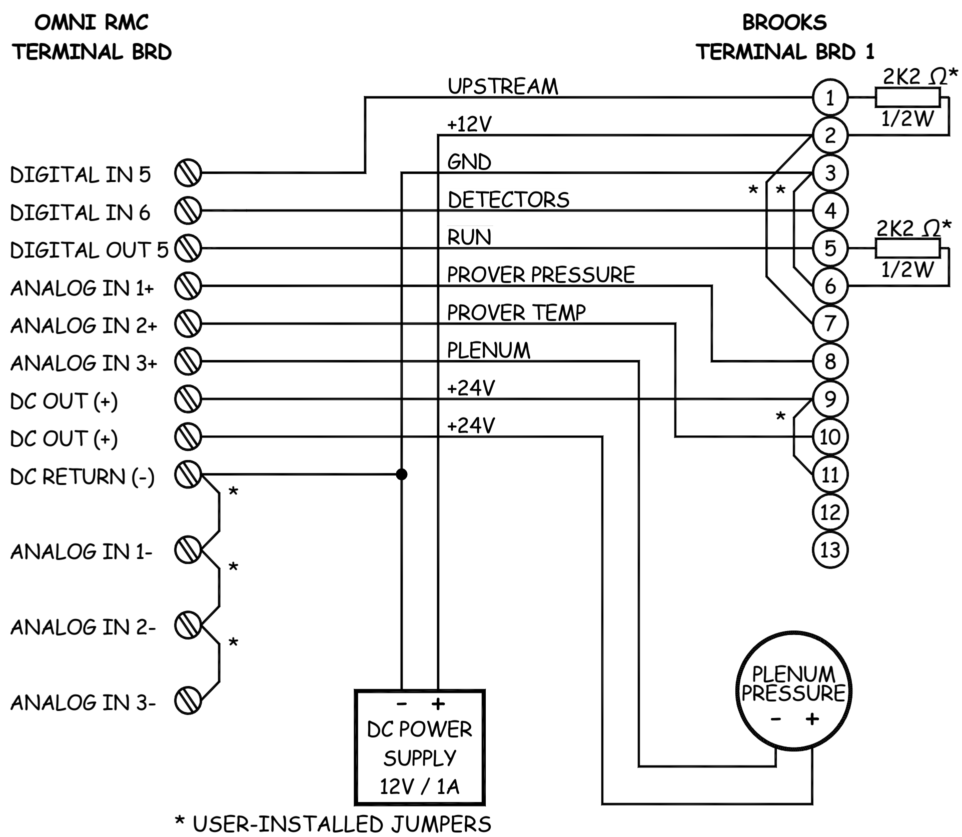

Figure 7-4. Wiring a Brooks® Compact Prover to the SmartBus RMC. (Configure SmartCom for negative edge trigger).

7.2.3. Calibron Systems Syncrotrak® Flow Provers

The Calibron Syncrotrak® Flow Prover is an industry recognized brand of unidirectional small volume prover. This prover has a flow tube with a valve-in-piston and an electro-mechanical piston return mechanism. These provers are available in loading rack, portable, and stationary model versions. Figure 7-5 shows how to wire a Syncrotrak® Flow Prover to the RMC I/O terminals.

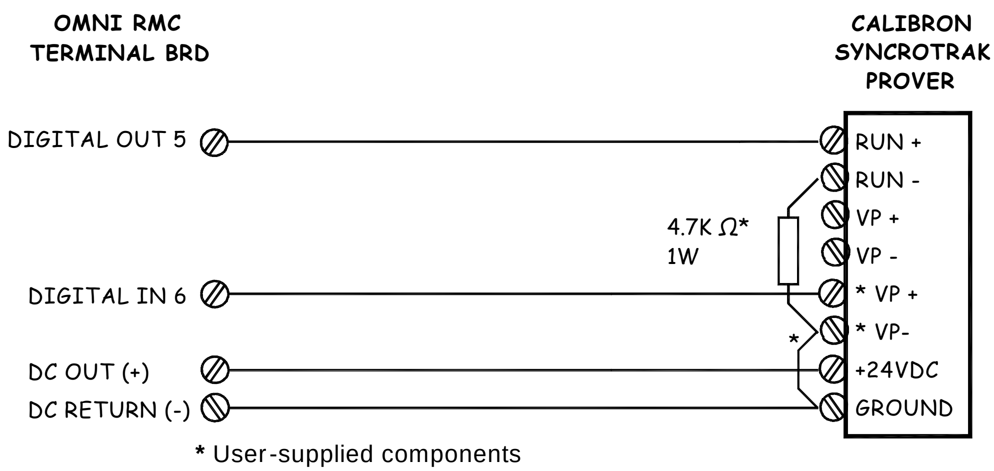

Figure 7-5. Wiring a Calibron Syncrotrak® Flow Prover to the SmartBus RMC. (Configure SmartCom for negative edge trigger).

7.3. Master-Master Provers (future)

Master-meter provers can be used for calibrating most types of liquid flowmeters and turbine type gas flowmeters. A master-meter prover is a flowmeter used as reference to compare its output with the output of other flowmeters at the same metering station. This type of prover provides an indirect method of proving flowmeters.

Master-meter proving is typically applied when the direct method of proving a flowmeter (using a certified prover) is not logistically feasible. However, the flowmeter chosen as a master-meter prover must be verified directly against a certified prover before using it in flowmeter proving applications.

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8 Connecting Other Devices

IN CHAPTER 8

Connecting Other Devices:

The SmartBus RMC is compatible with a large number of electronic devices. This chapter describes how to connect the RMC to various devices using its analog outputs, digital I/O, and serial communications capabilities. In addition to the setup described in this chapter, you will need to further configure the RMC using SmartCom software.

8.1. RMC Analog Outputs

The RMC provides analog outputs for connecting to remote telemetry units (RTUs), flow controllers, chart recorders, and control valves. Each analog output sources 4–20mA into a load wired to the DC power return. The RMC provides a digital-to-analog conversion with an approximate resolution of 12 binary bits. Figure 8-1 shows the wiring of a device to an RMC analog output. This example illustrates a standard chart recorder, but the wiring is representative of any device that receives analog signals.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

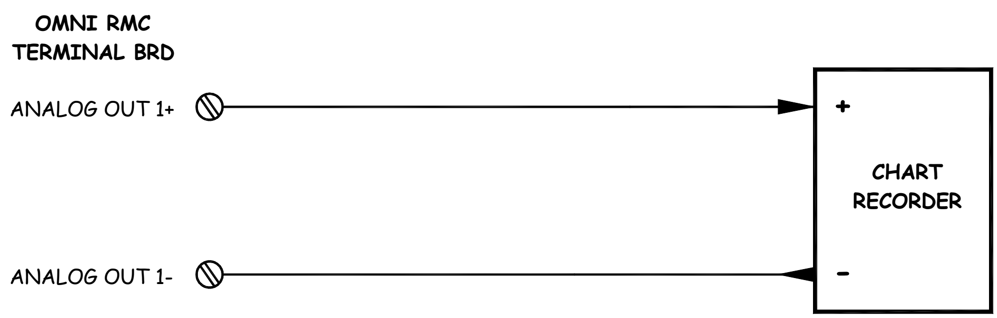

Figure 8-1. Wiring a standard chart recorder to RMC Analog Output #1.

8.2. Miscellaneous Digital I/O Devices

Six RMC status inputs and six RMC digital control outputs provide connectivity for control of prover functions, remote totalizing, sampler operation, meter tube control, injection pump control, batching operations, remote alarms, and other various digital device signals. The power and returns for all RMC digital I/O are common with the RMC DC power terminals. For more details, refer to Section 4.3 "Digital I/O Signals".

The RMC supports various digital I/O devices such as pushbuttons, relay coils, switches, programmable logic controllers (PLCs), and other miscellaneous devices. Figure 8-2 shows an example of how to wire an RMC digital I/O as an input. Figure 8-3 is an example of wiring an RMC digital I/O as an output.

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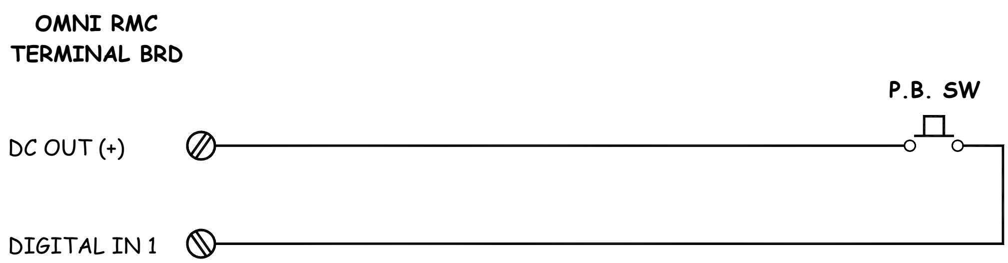

Figure 8-2. Wiring a pushbutton switch to RMC Digital Input #1.

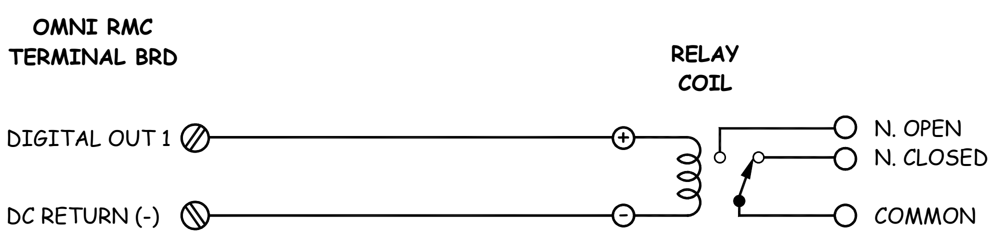

Figure 8-3. Wiring a relay coil to RMC Digital Output #1 and to an RMC DC return terminal.

8.3. Miscellaneous Serial I/O Devices

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

The RMC provides two standard (EIA/TIA) RS-485 serial ports (Serial Ports 1 & 3) and one selectable RS-485/RS-232 serial port (Serial Ports 2) for connecting to serial I/O devices. Select the required termination and communication type for each serial port via jumpers on the processor board, see Section 4.4.1 "Serial Port Jumper Settings".

Select the RMC serial communications parameters —such as protocol type, baud rate, stop bits, and parity settings— from within SmartCom configuration software. For more information on the RMC's serial I/O signal specifications, see see Section 4.4 "Serial I/O Signals".

8.3.1. RS-232 Serial Port 2

RS-232 serial communications allows interconnect to printers, PCs/laptops, and Supervisory Control and Data Acquisition (SCADA) systems. Connect these devices to an RMC RS-232 serial port with direct wiring, by modem, via radio, or in peer–to–peer networks. This serial port also provides access to the RMC database.

Serial Port 2, selected as an RS-232 interface, provides three terminals located on the I/O Terminal Board (labeled A/GND, B/RX, and TX). Figure 8-4 shows wiring a printer, Figure 8-5 and Figure 8-6 respectively show examples of how to wire a point–to–point connection and via modem to a serial I/O device.

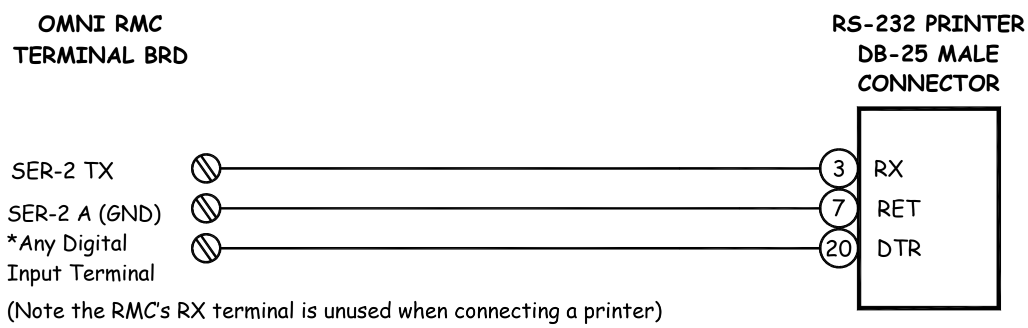

Figure 8-4. Wiring a printer to RMC Serial Port #2 selected as an RS-232 interface.

**Required if using hardware handshaking. Digital Input number must be selected in SmartCom if using hardware handshaking otherwise set number of nulls to approximately 150-200 in SmartCom for Baud Rate of 9600.*

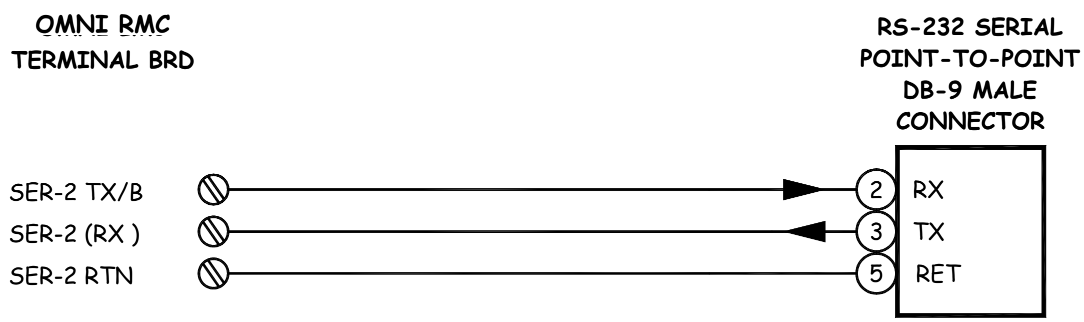

Figure 8-5. Wiring a miscellaneous serial device or a computer COM port in a point-to-point configuration to RMC Serial Port #2 selected as a RS-232 serial interface.

READ THE DOCUMENTATION!

Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

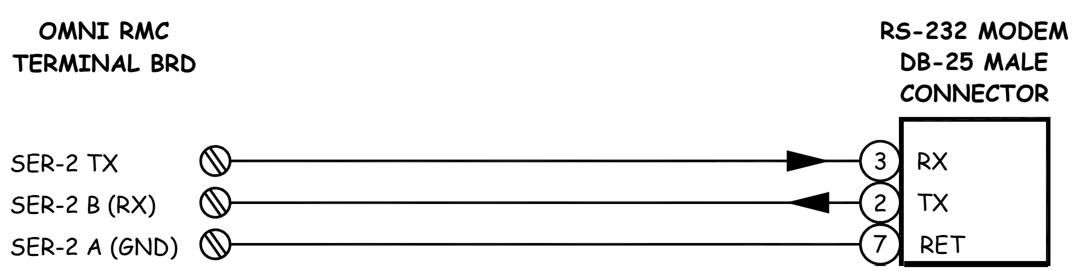

Figure 8-6. Wiring a miscellaneous serial device via modem to RMC Serial Port #2 selected as a RS-232 serial interface.

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8.3.2. RS-485 Serial Ports

RS-485 Serial Device Connectivity

Some serial devices that connect to the RMC may not fully comply to the EIA/TIA RS-485 standard. In these cases, you may have to crossover (invert) the A and B channel connections to the devices respective to the RMC; i.e., the RMC A channel is wired to the B channel of the connecting device, and the RMC B channel to the device's A channel. Sometimes the symbols '+' and "-" are used in place of A and B. Always consult the manufacturer's documentation before connecting any devices to the RMC.

Each RMC RS-485 serial port has two terminals (labeled A and B) for connecting to other devices that support the standard EIA/TIA RS-485 interface (see sidebar note). RS-485 serial communications provides interconnect multiple RMCs, PLCs, multivariable transmitters, and other devices in a point–to–point configuration and in multidrop lines. Figure 8- is an example of wiring a serial I/O device to an RMC RS-485 serial port.

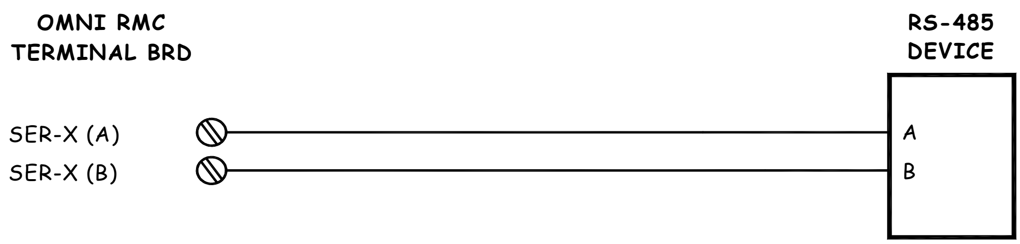

Figure 8-7. Wiring a miscellaneous serial device to an RMC RS-485 serial port.

8.4. Gas Chromatographs

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SmartBus RMCs provide connectivity for Daniel Industries Danalyzer® and Applied Automation® brands of gas chromatographs (GCs). These GCs connect to RMC serial ports either directly, via modem, or by radio link. Depending upon installation equipment and setup requirements , use either an RS-232 or an RS-485 interface.

A GC is used in chromatograph analysis to determine the composition of a gas mixture. Typically, GCs are applied in the gas industry to determine the heating value used to calculate gas energy flow rate. Other gas mixture properties, such as relative density (specific gravity), compressibility factors, molecular weight, volume, and supercompressibility for correcting volumetric flow rate, are also derived from chromatograph analysis. Most GC systems consist of: a gas supply; sample conditioning system; process chromatograph composed of an oven containing an injection port, column(s), and detector; and a microprocessor-based controller.

8.4.1. Daniel Danalyzer® System Gas Chromatographs

The Danalyzer® GC and controller model 2350 provide a user-programmable, real-time, multistream, and automatic gas analyzer system with data acquisition, peak detection, and selectable automatic periodic recalibration that assure a high-accuracy chromatograph analysis. Figure 8-8 and Figure 8-9 illustrate how to wire a Danalyzer controller to the RMC.

READ THE DOCUMENTATION!
Always refer to the documentation supplied by the corresponding manufacturer before wiring devices to the RMC.

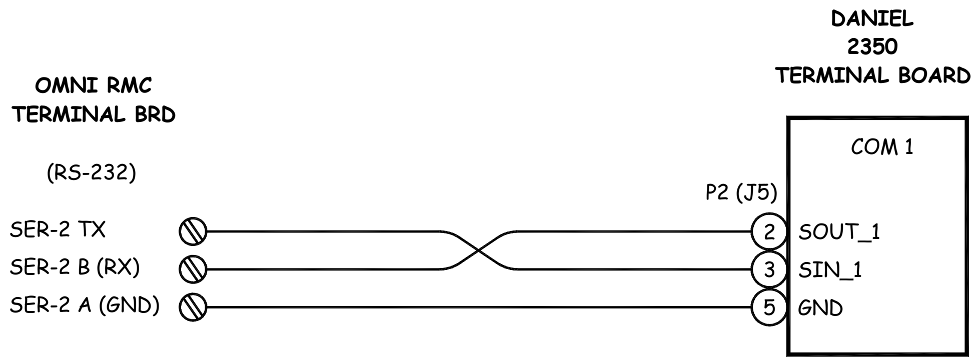

Figure 8-8. Wiring a Danalyzer GC controller to RMC Serial Port #2 selected as an RS-232 interface.

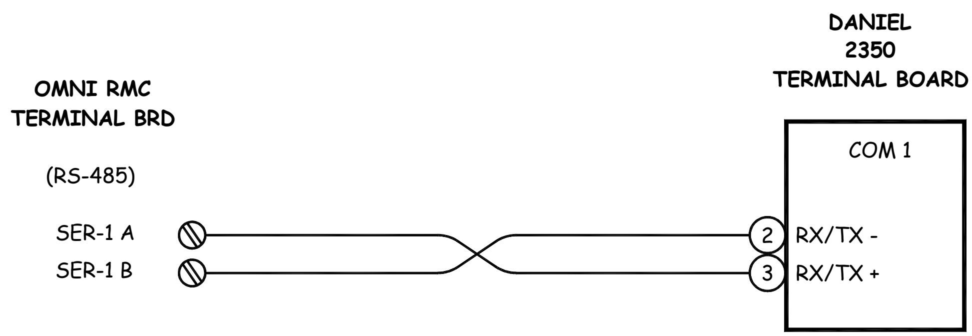

Figure 8-9. Wiring a Danalyzer GC controller to an RMC RS-485 serial port.

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8.4.2. ABB Totalflow® Process Gas Chromatograph Systems

Figure 8-10 and Figure 8-11 respectively illustrate how to wire an ABB Totalflow® GC system to an RMC serial port selected as an RS-232 and an RS-485 interface.

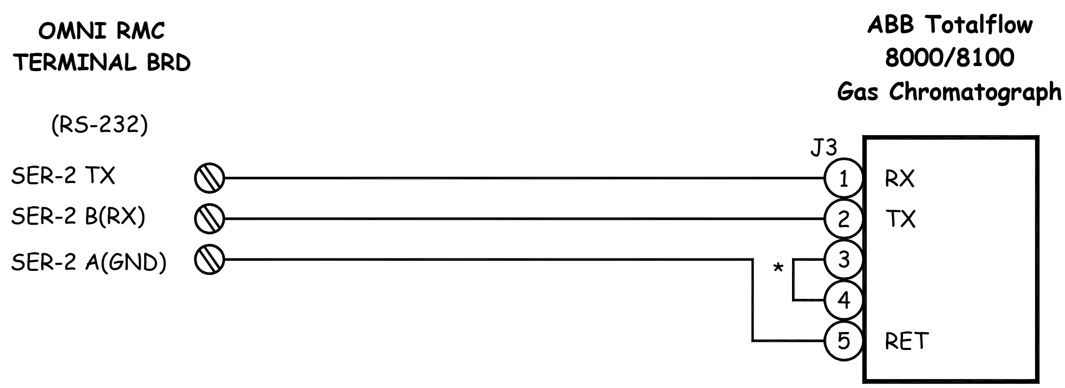

Figure 8-10. Wiring an ABB Totalflow® GC system to RMC Serial Port #2 selected as an RS-232 interface.

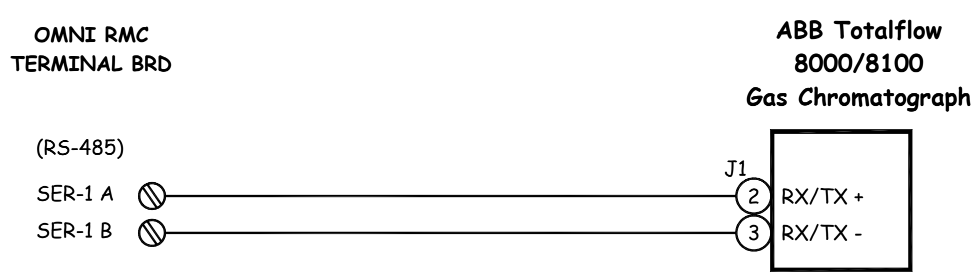

Figure 8-11. Wiring an ABB Totalflow® GC system serial port #1 to an RMC port configured as an RS-485 interface.

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9 Remote I/O Terminal Board

IN CHAPTER 9

Information on Remote I/O Terminal Board:

The RMC Remote I/O Terminal Board is an interface between the RMC and Field Wiring. Due to the fact that the RMC housing has only two ¾ inch conduit feed-through hubs, the number and size of wires, which can be routed into the RMC housing is limited. Therefore four custom cable assemblies are provided as an option when all I/O inputs are required for measurement. These cables bring all of the terminal points located on the terminal board within the RMC housing out to the Remote I/O Terminal Board. This will allow easy access for field wiring of multiple sensors, serial, and Ethernet devices. The Remote I/O Terminal Board also allows the use of heavier wire gauge for field wiring.

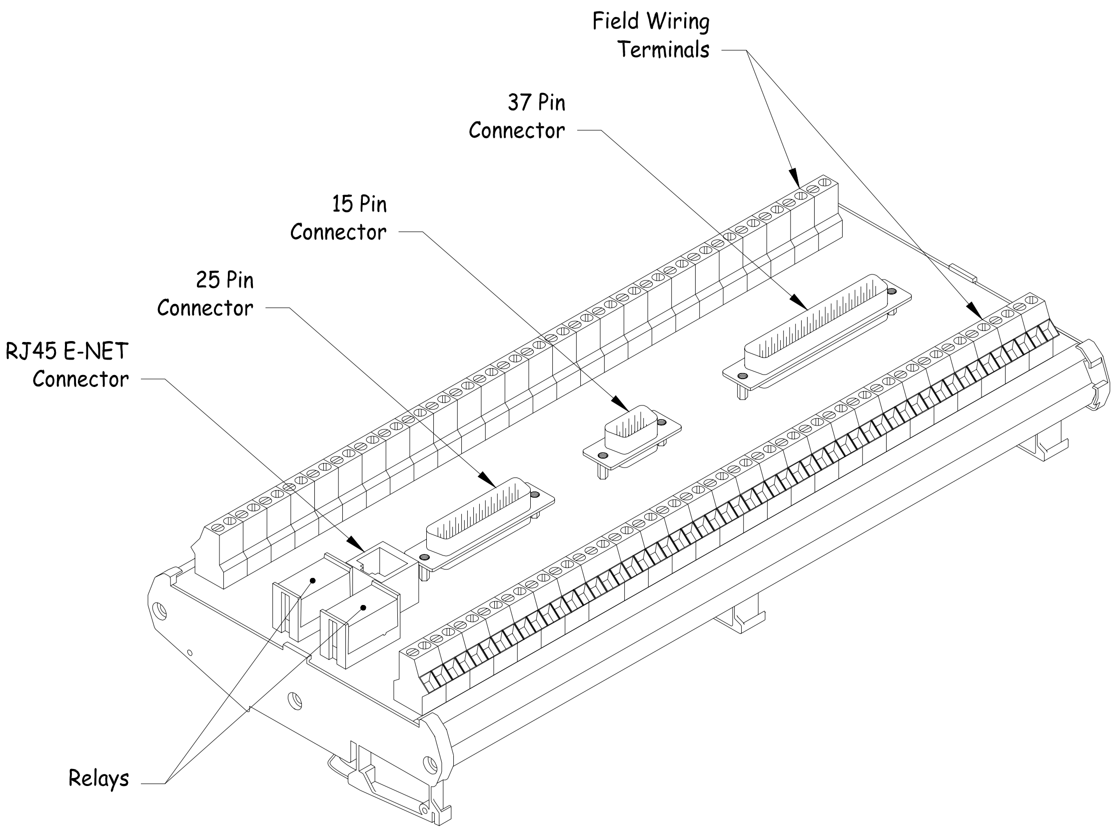

Figure 9-1 Remote I/O Terminal Board (P/N 21200011)

9.1. Design features of the Remote I/O Terminal Board

All signals routed into the I/O Box from the "Field" are terminated at the Cage-Clamp Screw Terminals. Each terminal is labeled on the I/O Board. These signals include the following:

- Power (18 to 30 VDC, fused at 1.25 Amp) with an LED Power On Indiactor
- 8 Analog Inputs
- 2 Analog Outputs
- 2 RTD Excitation
- 6 Digital Inputs with LEDs to provide a visual indication of operating
- 6 Digital Outputs with LEDs to provide a visual indication of operating
- 2 Flow Pulse Inputs
- 1 Density Input
- 5 Serial Ports
- 1 Ethernet Port (10 BaseT)
- 10 DC Power Outputs (100mA Fused) and Returns with LEDs that indicate Power Out Faults.
- (These DC Outputs are provided for the user to power any device sinking less that 100mA)
- 2 Form C Relays with 24VDC coil voltage and a **contact rating** of 5 Amps @ 250 VAC.

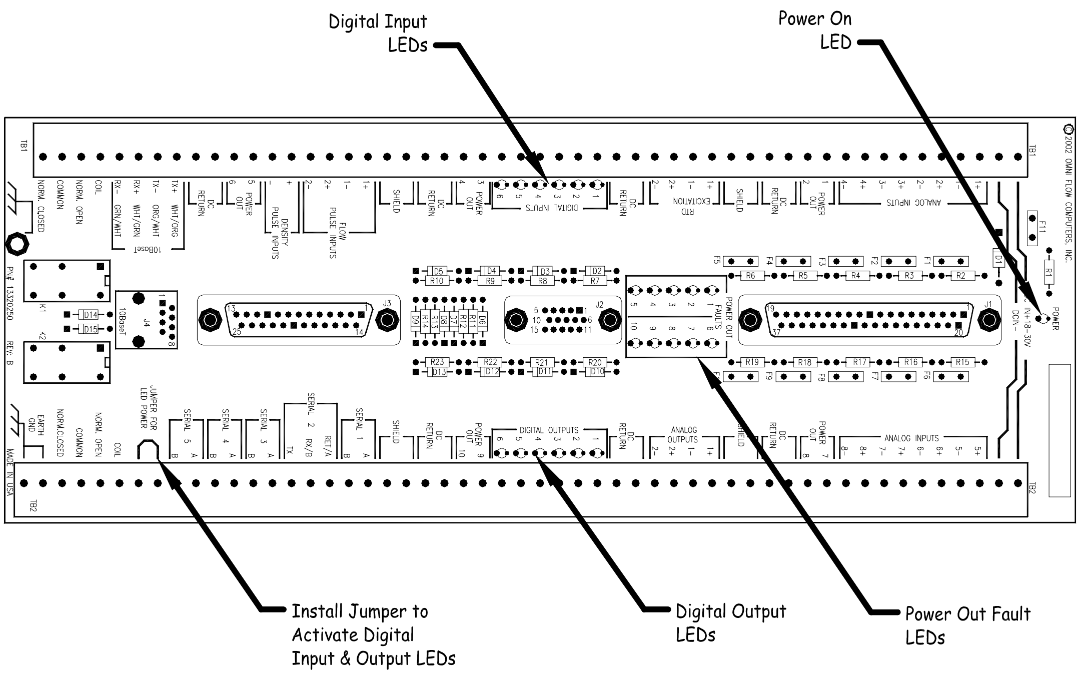

Figure 9-2 Top View of Remote I/O board (P/N 21200011)

9.2. Equipment Required

The Remote I/O Terminal Board is designed to be mounted in a user supplied NEMA 4X enclosure. There are two pieces of ¾ inch Seal-Tite conduit which is routed from the Remote I/O Terminal box to the RMC. The terminals on the I/O Terminal Board will accept wire size from the ranges of 26 to 14 AWG (0.14 to 2.5 mm^2).

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The cables are then routed from inside the box, through the conduit, which are then terminated inside the RMC housing. The cable assemblies have a molded connector on the end that plugs into mating connectors on the Remote I/O Terminal Board, the other end of the cable is blunt-cut, which is routed (fed) through the conduit. The blunt-cut end is then stripped and terminated using ferules to the assigned terminals inside the RMC housing. Each wire inside the cable assemblies are unique in color; no two wires have the same color assignment.

For proper installation of the Remote I/O Terminal Board the following is a list of the equipment required.

- Cables (See Chart Below)
- Flexible Conduit (3/4 inch)
- Nema 4X Box and Mounting Hardware Recommended I/O Box: (or equivalent) Vynckier No. VJ1412HWLL2, with optional mounting plate No. MP1412A

CABLING NOTE:

Cable Assemblies are available in 10, 15, 25, and 50 foot lengths.

Select one of each Cable Assembly according to length required for installation.

Table 9-1. Cable Parts List

Length Required	RJ45	DE-15	DB-25	DC-37
15 Foot	K0200415	K0201515	K0202515	K0203715
25 Foot	K0200425	K0201525	K0202525	K0203725
50 Foot	K0200450	K0201550	K0202550	K0203750

9.3. Installation procedure

1. Select mounting position for the RMC.
2. Select mounting location for the Remote I/O Box in a safe area *with access to Earth Ground.* (customer supplied).
3. Determine cable length required.
   ***Note**: Maximum cable length is 50 foot.*
4. Run two ¾ inch flex conduit from Remote I/O Box to the RMC.
5. *Pull cables thru conduit, starting from inside the I/O Box*.
   Note: Do not secure the end at the RMC until cables have been pushed thru.
6. Cables shall be paired up as follows: cables K02004***xx*** with K02037***xx*** and cables K02015***xx*** with K02025***xx***. (Note: ***xx*** = 15, 25, or 50 feet for the cable length desired)
7. Attach Cable Assemblies to the Connectors on the I/O Board.
8. Leave a service loop inside the Nema 4X Box to eliminate strain on the cables and to provide removal and installation of the I/O Board and its components.
9. Secure the cables with Ty-Wraps to prevent them from being pulled out of the Box from the other end.
10. At the RMC, cut the cables to 14 inches in length from the end of the conduit.
11. Strip the cable jackets back 8 inches and temporarily tape the end of each cable to prevent unraveling.
    ***Note**: There is no need to strip back the insulation on the Ethernet cable.*
12. Carefully route wires through the conduit fittings and RMC Housing into the Terminal Board area.
13. Slip sleeving over the Drain (Grounding) Wires on the three cable assemblies. (One drain wire for each of the three cable assemblies).
14. Strip wires and add Ferules to the ends of each wire.
15. See wiring diagram (Figure 9.4) for installation.
16. Each wire is unique in color; no two colors alike see wire chart (Figure 9.5).
17. If necessary, pull cable slack back into the Remote I/O Box, seal and secure conduit at each end.
18. Add conduit and field wiring as necessary to connect to sensors, power in, and serial devices.

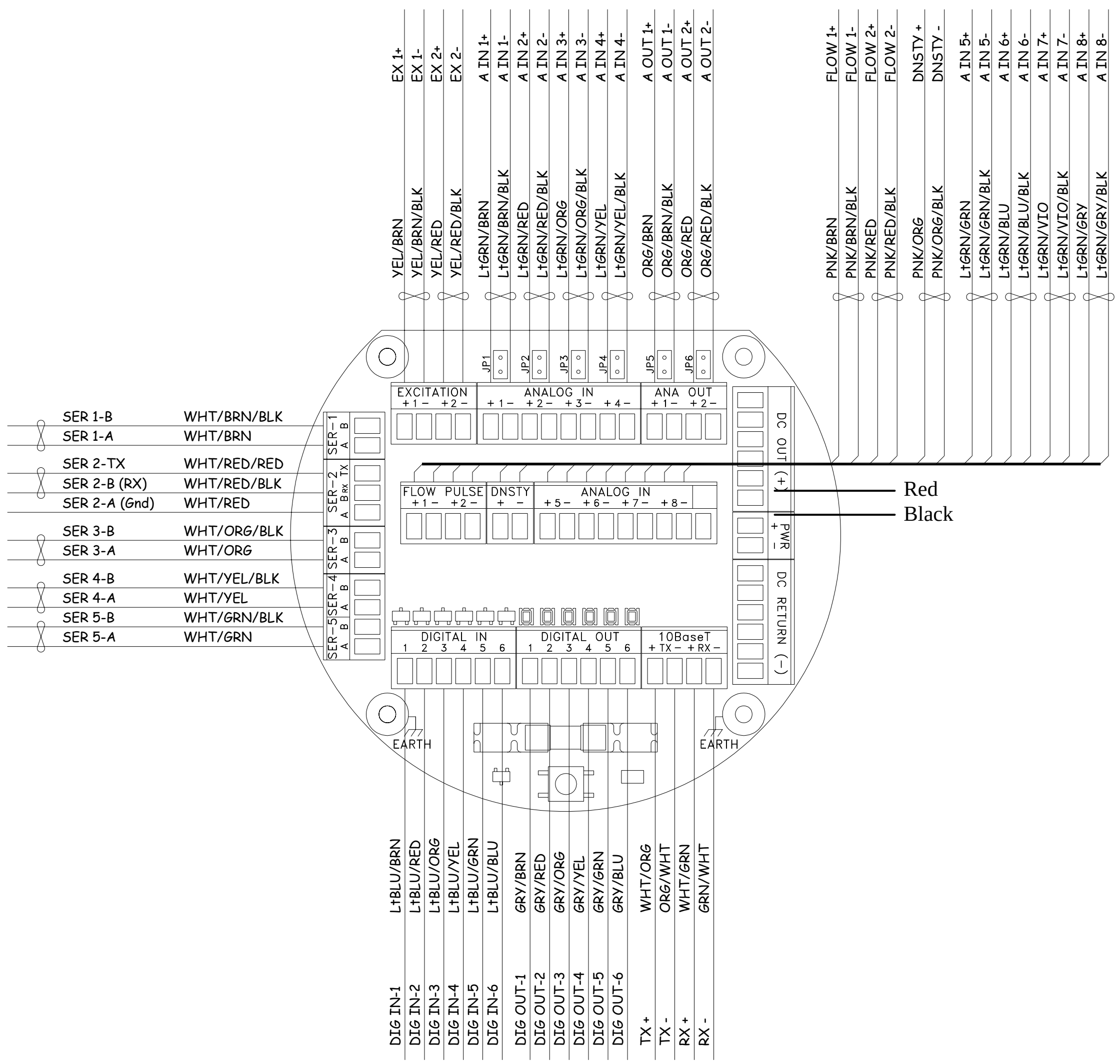

Figure 9.4 Terminal Board Wiring Diagram

9.3.1. Tables for Blunt-Cut Cables

The tables below define the Signal Name, Pin Number and Color Code for each of the three I/O Cables. Use these tables in conjunction with the Wiring Diagram on the previous page.

Table 9-2. Cable Assembly K02025***xx*** *(8 Pair + 3 Single)* *(Note: **xx**= 15, 25 or 50 foot)*

SIGNAL	PIN #	COLOR	SIGNAL	PIN #	COLOR
Serial 1-A	16	Wht/Brn	Serial 5-A	13	Wht/Grn
Serial 1-B	17	Wht/Brn/Blk	Serial 5-B	12	Wht/Grn/Blk
Serial 2-Gnd	18	Wht/Red	Flow Pulse 1+	3	Pnk/Brn
Serial 2-RX	19	Wht/Red/Blk	Flow Pulse 1-	4	Pnk/Brn/Blk
Serial 2-TX	20	Wht/Red/Red	Flow Pulse 2+	5	Pnk/Red
Serial 3-A	22	Wht/Org	Flow Pulse 2-	6	Pnk/Red/Blk
Serial 3-B	23	Wht/Org/Blk	Density +	7	Pnk/Org
Serial 4-A	24	Wht/Yel	Density -	8	Pnk/Org/Blk
Serial 4-B	25	Wht/Yel/Blk	Digital IN 6	1	LtBlu/Blu
			Digital OUT 6	14	Gry/Blu

Table 9-3. Cable Assembly K02015***xx*** (10 Conductor) *(Note: **xx**= 15, 25 or 50 foot)*

SIGNAL	PIN #	COLOR	SIGNAL	PIN #	COLOR
Digital IN 1	1	LtBlu/Brn	Digital OUT 1	11	Gry/Brn
Digital IN 2	2	LtBlu/Red	Digital OUT 2	12	Gry/Red
Digital IN 3	3	LtBlu/Org	Digital OUT 3	13	Gry/Org
Digital IN 4	4	LtBlu/Yel	Digital OUT 4	14	Gry/Yel
Digital IN 5	5	LtBlu/Grn	Digital OUT 5	15	Gry/Grn

Table 9-4. Cable Assembly K02037***xx*** (13 Pair) *(Note: **xx**= 15, 25 or 50 foot)*

SIGNAL	PIN #	COLOR	SIGNAL	PIN #	COLOR
Excitation 1+	16	Yel/Brn	DC Power Rtn	1	Blk
Excitation 1-	17	Yel/Brn/Blk	DC Power IN +	2	Red
Excitation 2+	18	Yel/Red	Analog OUT 1+	34	Org/Brn
Excitation 2-	19	Yel/Red/Blk	Analog OUT 1-	35	Org/Brn/Blk
Analog IN 1+	3	LtGrn/Brn	Analog OUT 2+	36	Org/Red
Analog IN 1-	4	LtGrn/Brn/blk	Analog OUT 2-	37	Org/Red/Blk
Analog IN 2+	5	LtGrn/Red	Analog IN 5+	22	LtGrn/Grn
Analog IN 2-	6	LtGrn/Red/Blk	Analog IN 5-	23	LtGrn/Grn/Blk
Analog IN 3+	7	LtGrn/Org	Analog IN 6+	24	LtGrn/Blu
Analog IN 3-	8	LtGrn/Org/Blk	Analog IN 6-	25	LtGrn/Blu/Blk
Analog IN 4+	9	LtGrn/Yel	Analog IN 7+	26	LtGrn/Vio
Analog IN 4-	10	LtGrn/Yel/Blk	Analog IN 7-	27	LtGrn/Vio/Blk
			Analog IN 8-	28	LtGrn/Gry
			Analog IN 8-	29	LtGrn/Gry/Blk

9.3.2. LED INDICATORS

There is an LED indicator at the top of the board (labeled **POWER**) that indicates a DC power source is applied. There are two sets of LEDs on the Remote I/O Terminal Board, one set monitors the Digital Inputs & Outputs (6 ea) channels, the other set monitors the Power Out lines (10 ea).

The LEDs that monitor the Digital I/O signals (labeled **DIGITAL INPUTS** and **DIGITAL OUTPUTS**) provide a visual status of each channel. Two terminals on the Remote I/O Terminal Board (labeled **JUMPER FOR LED POWER**) must be jumpered together for the LEDs to become active. Otherwise, these terminals may be left unconnected to save power consumption.

The **POWER OUT FAULT** LED's are activated whenever a fault condition exists on one of the 10 power out terminals, causing a resettable fuse to trip. The fault LED's are numbered corresponding to the **POWER OUT** terminal numbers.

9.3.3. RELAYS

Two general purpose 24VDC 5 Amp single-pole double-throw relays are provided to control various electrical devices. Each relay is activated by supplying a 24VDC voltage to the "COIL" terminal located near the bottom of the terminal board. The "COMMON, "NORM. OPEN", and "NORM. CLOSED" terminals can then be wired to the external devices as required. The relays are in sockets, and may be replaced by gently pulling away the retainer clip while pulling out the relay. The relays are compatible with the digital outputs from the RMC. To control a relay using one of the digital outputs, connect a wire from the desired output to the "Coil" of the relay.

9.4. Grounding

A proper connection between the RMC Remote I/O Terminal Board and earth-ground will help protect the metering system including the RMC, from electrical transients, lightning, and stray currents. The RMC and RMC Remote I/O Terminal Board shall be grounded in every installation. Mounting methods are subject to the grounding configuration of the meter run installation and cathodic protection of the pipeline, among other factors.

Connect earth ground to both the RMC and the Remote I/O Terminal Board in conformance with the applicable industry standard for installations in your locale. Ground wire shall be as short as possible. Use 10-14 AWG (12 AWG recommended) stranded wire.

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