SmartBus Series

LOCAL METER CONTROLLERS

Setup and Installation Guide

SmartBus
by Omni

SmartBus™

Panel-Mount Local Meter Controllers

Setup & Installation Guide

Edition L03-09/06

Omni

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- **Phone:** 281-240-6161 **Fax:** 281-240-6162 ♦ **E-mail:** techsupport@omniflow.com or sales@omniflow.com
- **Website:** http://www.omniflow.com

Contents

4

9

1

Before You Begin

IN CHAPTER 1

Before You Begin:

Welcome to the Omni Flow Computers, Inc. (Omni Flow) SmartBus revolution! The SmartBus panel-mount Local Meter Controller (LMC) 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 LMC.

To take full advantage of the LMC, please take a moment to read this chapter and always refer to this Setup & Installation Guide when installing the LMC 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 LMC features, architecture, installation, device connectivity, networking, and SmartCom - the LMC 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 LMC SmartBus product core documentation.

- LMC 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

SmartBus technology was designed with the user in mind, making it very user friendly. 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 LMC 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, Texas 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 Local 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 Local Meter Controller" describes this technology in more detail.

1.4.1. SmartBus LMC Series

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

- ❑ **LMC 205** → This is the most complete model with display, multi-purpose firmware, and SmartCom software.
- ❑ **LMC 200** → This model has multi-purpose firmware, SmartCom software, with no display.

Figure 1.1 LMC 205 Local Meter Controller with Display.

Figure 1-2. LMC 200 Local Meter Controller without Display.

1.4.2. Features at a Glance

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

- Single meter run real-time information processing.
- Support for forward & reverse flow totalization.
- Panel-mount construction.
- 32-bit processor, floating point math coprocessor, 2 megabyte (MB) of static random-access memory (SRAM), and 4 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 LMC 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 state-of-the-art Ethernet 10/100BaseT Network Interface with multi-protocol processor and high-speed communications coprocessor.
- Industry-standard RS-232 and RS-485 serial communications.
- Integrated 8-line by 20-character, graphical, backlit, liquid crystal display (LCD). (Model LMC 205 only)

ORDERING LMC COMPONENTS

To order optional, upgrade, replacement, and spare parts for your LMC, 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

NOTE!

PULSE INPUT INFORMATION

Two of the four pulse input channels can be used to accept dual pulse transmission signals from a single flowmeter. Inputs 3 & 4 are reserved for future development with the intent to allow 2 single or 2 dual pulse input signals.

1.4.3. Warranty, Licenses, & Product Registration

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

1.5. Storing, Handling, & Unpacking the LMC

CAUTION!

POTENTIAL FOR DATA LOSS!

SmartBus LMCs 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 LMC is without an external power source for more than 30 days. Observe caution when storing the LMC. Always backup your LMC configuration settings using SmartCom software before disconnecting power. The RAM backup battery is rechargeable. Apply power to the LMC for 24 hours to recharge the Ni-MH battery.

Store your SmartBus product appropriately in its original packing until you are ready to install it. Make sure the storage facility is climatized to keep LMC components free of dust, moisture, static electricity, electromagnetic fields, and extreme temperature and weather conditions. Storage temperatures range from -20°C to +70°C (-4°F to +158°F) for both models of the Local Meter Controller (LMC), (see Section 1.6 "SmartBus LMC 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 LMC, 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 LMC.

Always handle your SmartBus product with care. Be careful not to drop it and avoid electrostatic discharges. When handling the LMC 205 with the display, take extreme care to avoid scratching or breaking the lens. 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. Always follow safety guidelines. For more information, see Chapter 3 "Field Installation & Wiring".

1.6. SmartBus LMC Technical Specifications

Following are the shared processing characteristics and individual technical specifications for each SmartBus model.

NOTE!

PULSE INPUT INFORMATION

As of June 2006 two of the four pulse input channels can be used to accept dual pulse transmission signals from a single flowmeter. Inputs 3 & 4 are reserved for future development with the intent to allow 2 single or 2 dual pulse input signals.

1.6.1. LMC Processing Characteristics

Processor:	32-bit at 20MHz with floating point coprocessor
Memory:	4MB Flash; 2MB SRAM
Process I/Os:	*4 flow pulse inputs*; 2 RTD/4–20mA/1–5V selectable analog inputs; 6 4-20mA/1-5V selectable analog inputs, 2 RTD excitation current source outputs; 4 analog outputs; 2 density pulse inputs
Digital I/Os:	6 digital inputs; 6 digital outputs
Communication Ports:	2 RS-485 serial ports, 3 RS-232/RS-485 selectable serial ports; 1 Ethernet 10/100BaseT TCP/IP network interface port (Second Ethernet Port Optional).
Software:	User-configurable, multi-purpose firmware in Flash memory; SmartCom Windows®-based LMC configuration software with real-time data access.
Approvals:	CE Approved

1.6.2. LMC 205

Base Components:	Local Meter Controller with display.
Operating Temperature:	-20 to +70 °C (-4 to +158 °F)
Storage Temperature:	-20 to +70 °C (-4 to +158 °F)
Power:	10.2W Nominal, 425mA @ 24VDC
Display:	8-line x 20-character, backlit, graphical LCD.
Weight:	9.5Kgs (21Lbs)
Dimensions:	Width: 9.5cm (3 ¾”); Length: 34.9cm (13 ¾”); Height: 19cm (7 ½”)

1.6.3. LMC 200

Base Components:	Local Meter Controller without display.
Operating Temperature:	-20 to +70 °C (-4 to +158 °F)
Storage Temperature:	-20 to +70 °C (-4 to +158 °F)
Power:	8W nominal, 330mA @ 24VDC
Weight:	9Kgs (20Lbs)
Dimensions:	Width: 5.7cm (2 ¼”); Length: 32.4cm (12 ¾”); Height: 20.3cm (8”)

1.6.4. LMC 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: 4 Mbytes 0 wait state FLASH
2 Mbyte 0 wait state battery backed SRAM
8 Kbytes non-volitle EPROM
Field Programmable

Power Requirements:

Supply: 18 to 30 VDC @ 8.5 to 12 W

CPU Board	~ 8.5 W Nominal
Front Panel (Full Backlight)	~ 2.2 W Nominal
Ethernet Expansion	~ 1.0 W Nominal

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

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

Fused Outputs: (10) 24VDC @ 100mA

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.

1.6.5. LMC I/O

Analog Inputs ~ 8:

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 ~ 4:

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 ~ 4:

Frequency:	0 to 12KHz
High Level:	4 to 12VDC (3.5 Threshold)

Density Frequency Inputs ~ 2:

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

Ethernet :

22MHz Communications Processor
512 Kbytes FLASH
256 Kbytes RAM
Field Programmable
10/100BaseT

Introducing the SmartBus Local Meter Controller

2

The SmartBus Series of Local Meter Controllers is available in one of two configurations. (see Section 1.4.1 "SmartBus LMC Series"):

- Local Meter Controller LMC 205; with front panel.
- Local Meter Controller LMC 200; without front panel.

In this chapter, you will get acquainted with both of these LMC 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 LMC Architecture

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

- **Expandable:** The LMC's modular design provides flexibility, and easy maintenance. Additional Networking/Internetworking capabilities may be added to the LMC by installing the optional Ethernet (10/100BaseT) Network Interface Card, which includes Transmission Control Protocol/Internet Protocol (TCP/IP) and (MODBUS/TCP) support.

- **Durability:** The LMC panel mount is specially designed for non-hazardous environments, and designed for internal installations.

- **Reliability:** The internal circuitry includes built-in transient voltage protection and photo-optical isolation. A 32-bit processor with floating point math coprocessor, combined with 4 megabytes (MB) of flash programmable memory (Flash) for firmware, and 2 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 LMC'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 standards and protocols 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 LMC 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.

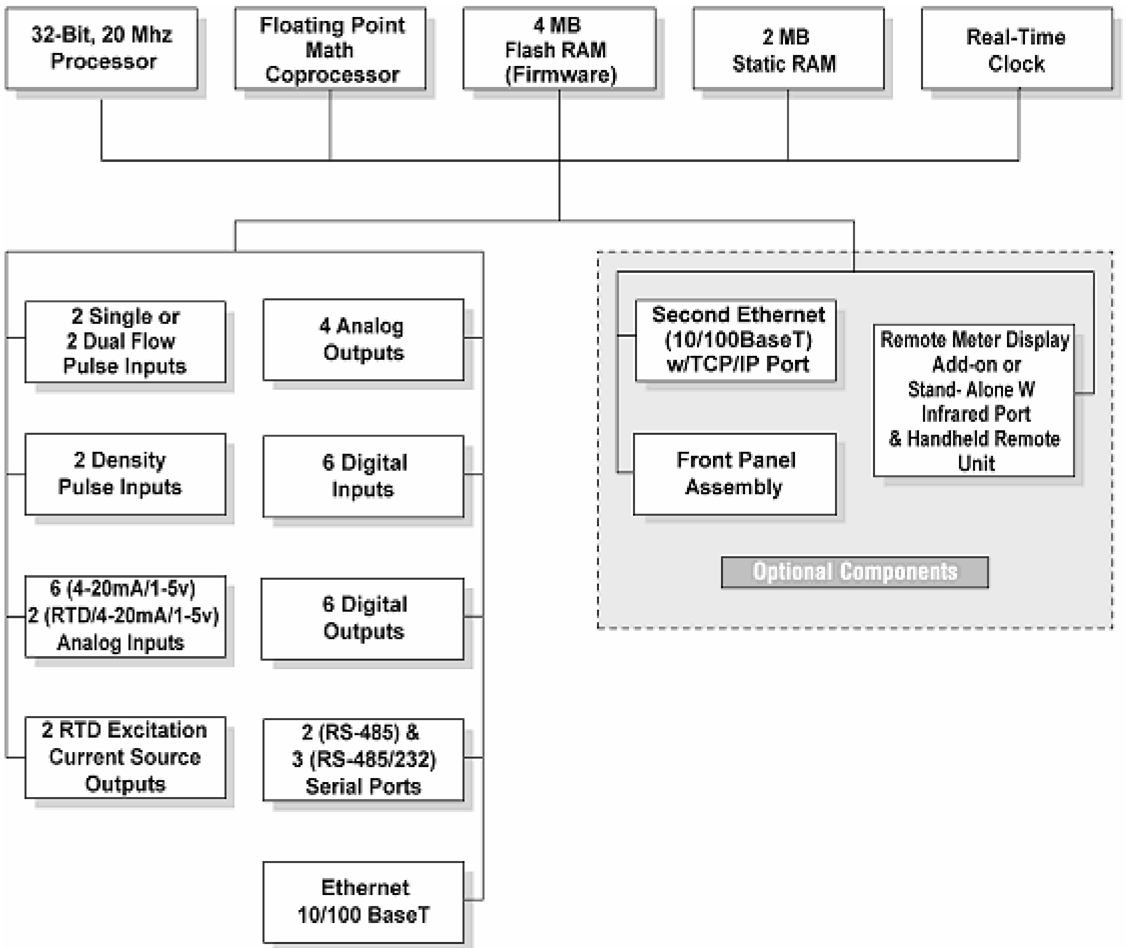

Figure 2-1. SmartBus LMC Architecture.

NOTE!
PULSE INPUT INFORMATION

As of June 2006 two of the four pulse input channels can be used to accept dual pulse transmission signals from a single flowmeter. Inputs 3 & 4 are reserved for future development with the intent to allow 2 single or 2 dual pulse input signals.

2.2. Photo-Optical Isolation

ORDERING LMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the LMC, see Section 3.6 "PC Board Upgrade & Replacement". Contact Omni;s corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

Website:
www.omniflow.com

LMC 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 LMC. Note that there is no electrical connection between the transducers and the LMC circuits.

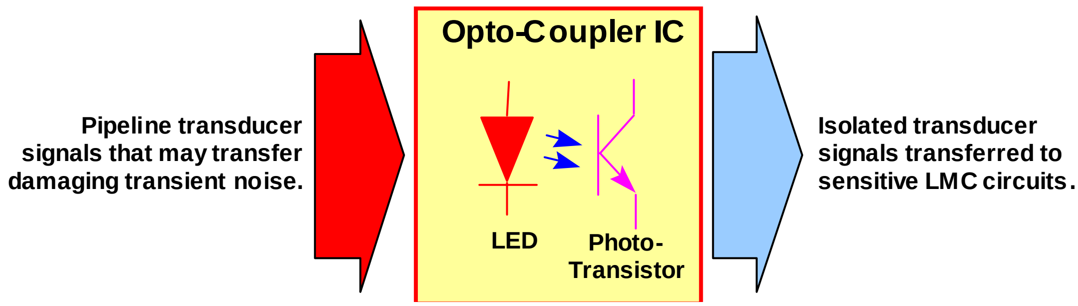

Figure 2-2. Photo-optical Isolation – How it works.

2.3. Local Meter Controller

The local meter controller architecture includes the following components:

- ❑ Processor Board with 10/100BaseT Network Interface
- ❑ Front Panel Assembly (LMC –FP model only)
- ❑ Power Supply Board
- ❑ Second Ethernet 10/100BaseT port Network Interface Card (optional)
- ❑ Remote I/O Terminal Board

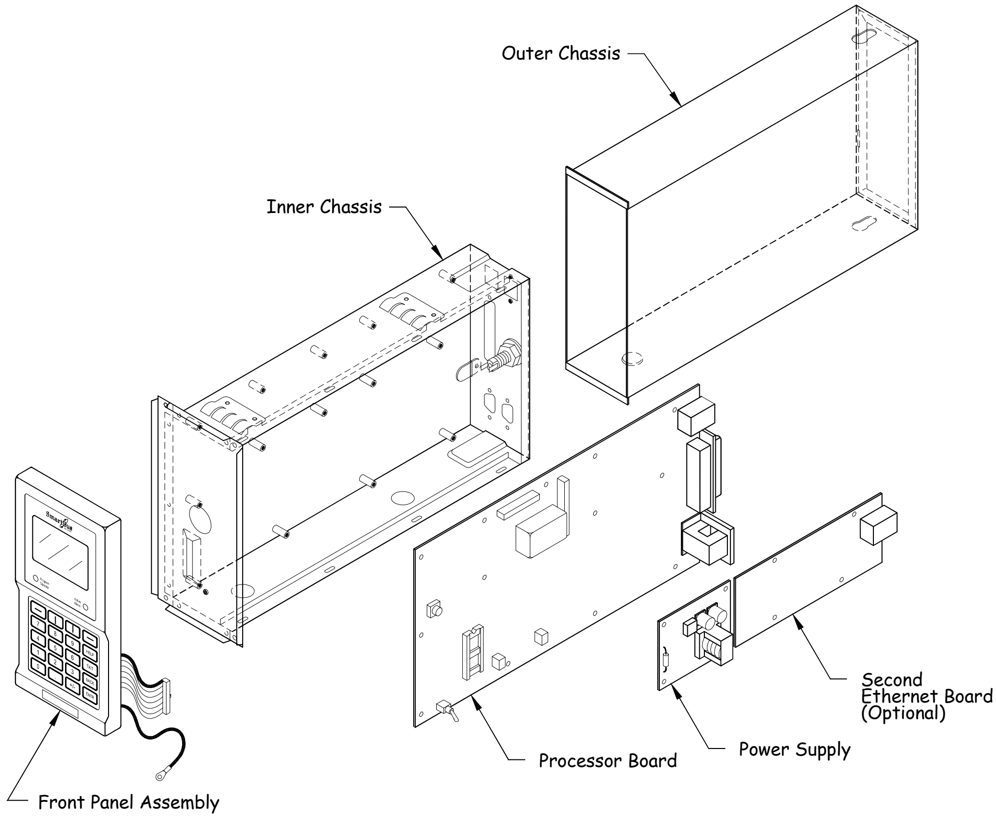

Figure 2-3. LMC 205 Components.

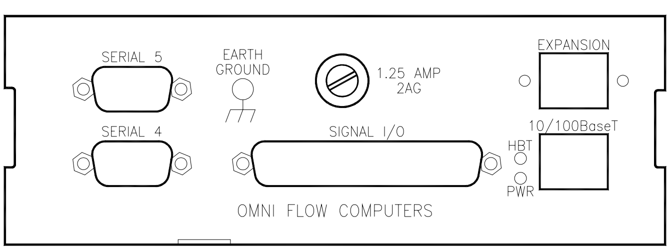

Figure 2-4. LMC 205 Back Panel Detail.

Ordering LMC Optional, Upgrade, & Replacement Components

For information on ordering optional and replacement components for the LMC, see Section 3.6 "PC Board Upgrade & Replacement". Contact Omni's corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

Website:
www.omniflow.com

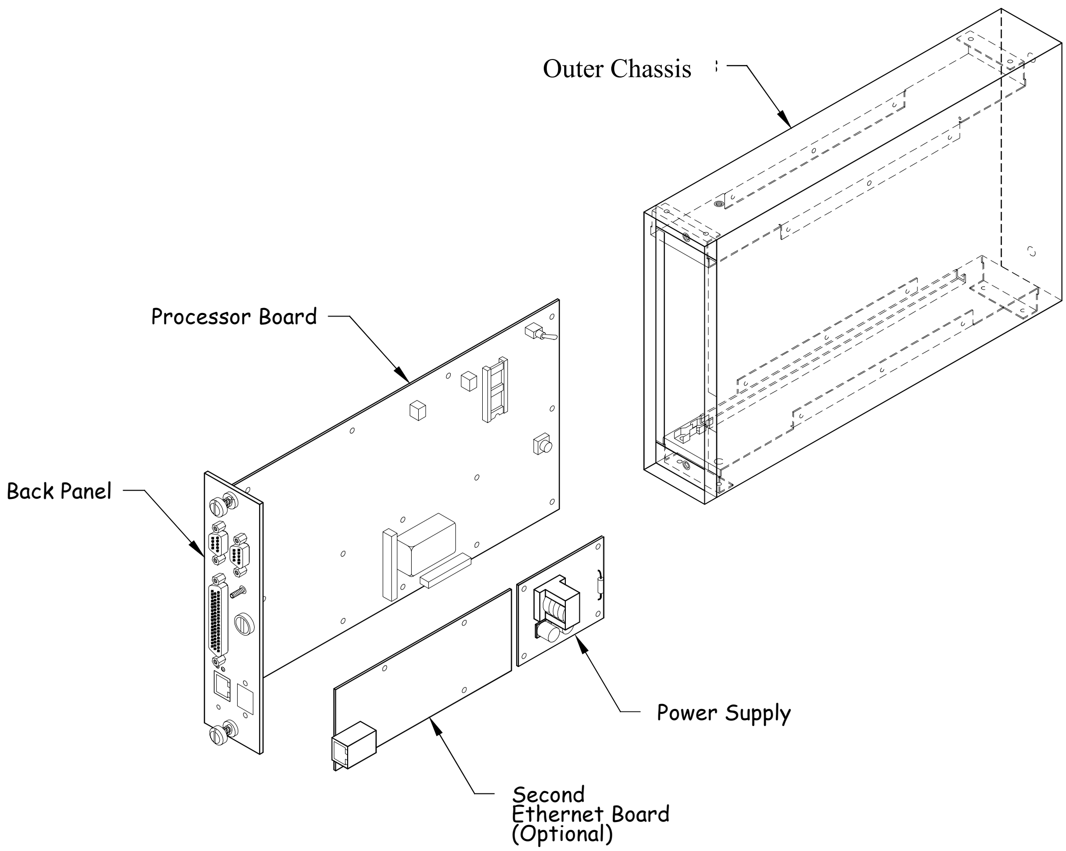

Figure 2-5. LMC 200 Components.

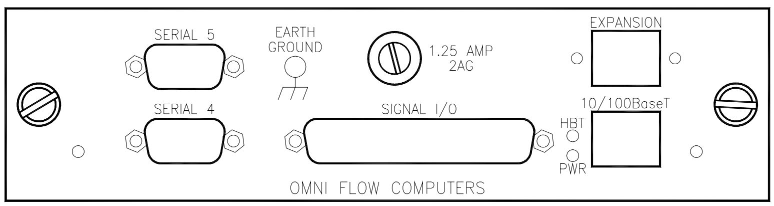

Figure 2-6. LMC 200 Back Panel Detail.

2.3.1. Processor Board

The LMC processor board (shown in Figure 2-7) contains the central processing unit (CPU) of the SmartBus system. It consists of the following main components:

- 32-bit microprocessor at 20 megahertz (MHz).
- 4 MB of Flash memory for firmware.
- 2 megabyte (MB) of static random-access memory (SRAM).
- Floating point math coprocessor.
- Real-time clock.
- User-configurable jumpers for analog input and serial port settings.
- Primary Ethernet 10/100BaseT TCP/IP Network Interface and connection for optional secondary Ethernet port module.
- Five Serial I/O Ports (2, 4 & 5 selectable between RS-232 and RS-485).

The hardware real-time clock will continue to operate for 60 days even when the LMC suffers power loss. The firmware logs the time of power failure once power is restored to the LMC.

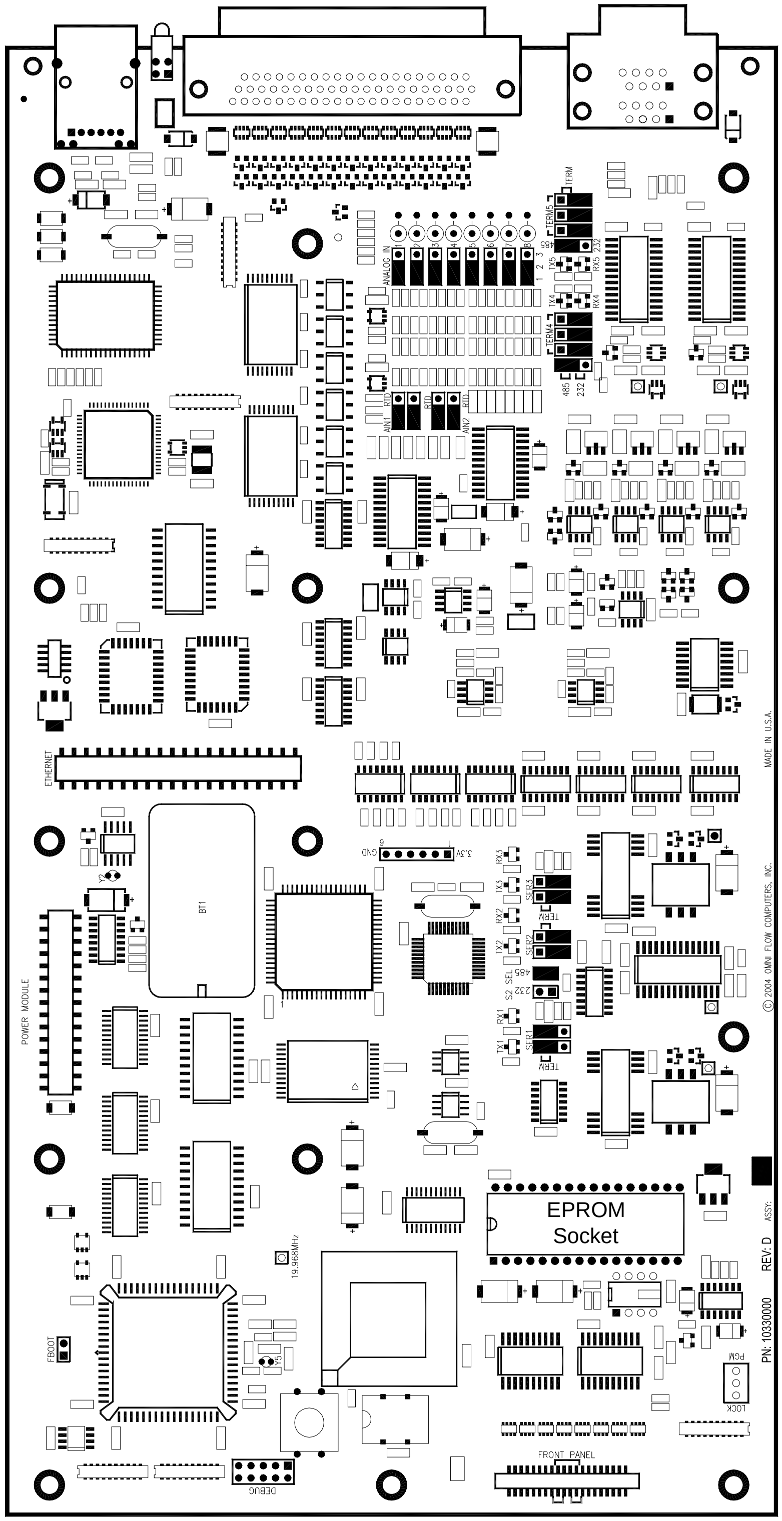

Figure 2-7. LMC Processor Board (P/N 11330000)

2.3.2. Power Supply Board

Figure 2-8 shows the SmartBus LMC Power Supply Board. There are no serviceable components on this board assembly.

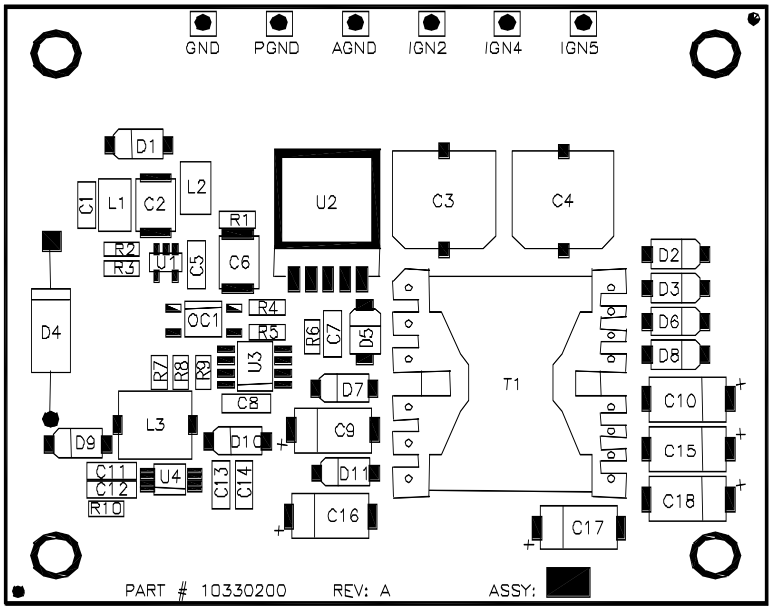

Figure 2-8 LMC Power Supply (P/N 11330200)

ORDERING LMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the LMC, see Section 3.6 "PC Board Upgrade & Replacement". Contact our corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

Website:
www.omniflow.com

2.3.3. Terminal Board

Figure 2-9 shows the SmartBus LMC I/O Terminal Board. The terminal board includes the following components:

- ❑ Individual terminals for:
  - ♦ 8 Analog Inputs: 2 selectable RTD/4–20mA/1–5V and 6 selectable 4–20mA/1–5V.
  - ♦ 2 Resistance Temperature Detector (RTD) Excitation current source outputs.
  - ♦ 4 Analog Outputs.
  - ♦ 4 Single or 2 Dual Flow Pulse Inputs.
  - ♦ 2 Density Pulse Input.
  - ♦ 6 Digital Inputs.
  - ♦ 6 Digital Outputs.
  - ♦ 3 Serial Ports: 2 RS-485 and 1 selectable RS-232/485. (2 additional RS-232/485 selectable ports are located on the LMC 200/205 back panel. Ethernet port connections are also located on the back panel.)
  - ♦ 10 Fused DC Power Output connections.
  - ♦ Multiple DC Return connections.
  - ♦ 2 DC Power Supply Input connections.
  - ♦ Multiple Earth Ground connections.
- ❑ LED Indicator for Power In.
- ❑ Safety Fuse (1.1 ampere, resetable).

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

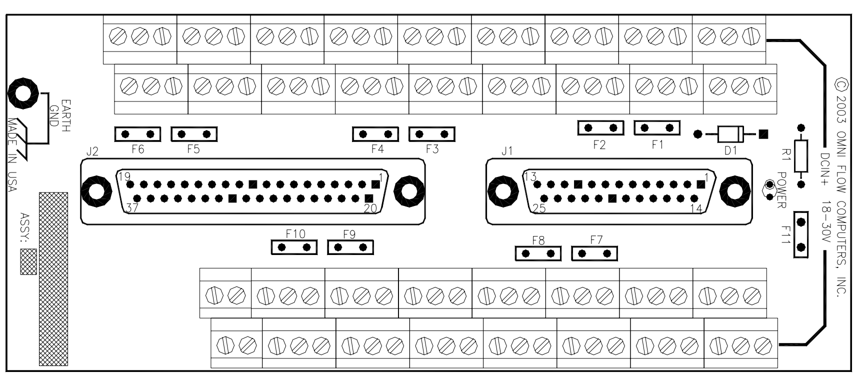

Figure 2-9. LMC I/O Terminal Board. (P/N 21300003)

2.3.4. Ethernet 10/100BaseT Network Interface

The Ethernet 10/100BaseT Network Interface provides networking and internetworking connection 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 LMC to your company's intranet or to the Internet. It has its own coprocessor to handle communications.

Features of this interface 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 LMC processor.
- ❑ 512 KB of high-speed Flash memory.
- ❑ 256 KB of zero wait state static RAM.
- ❑ Ethernet 10/100BaseT (IEEE 802.3) over unshielded twisted-pair (UTP) cable (copper wiring) with RJ-45 connectors.
- ❑ TCP/IP protocol stack for Internet/intranet communications, providing multiple virtual connections for other protocols (network printing, webserver, e-mail, etc.).
- ❑ Modbus/TCP protocol.
- ❑ Multiple simultaneous connections.
- ❑ Heartbeat, activity, 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.

An optional additional Ethernet 10/100BaseT Network Interface Card is available providing the same features as listed above. See Figure 2-10.

ORDERING LMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

For information on ordering optional and replacement components for the LMC, see Section 3.6 "PC Board Upgrade & Replacement". Contact our corporate sales department in the United States at:

Phone:
281-240-6161

E-mail:
sales@omniflow.com

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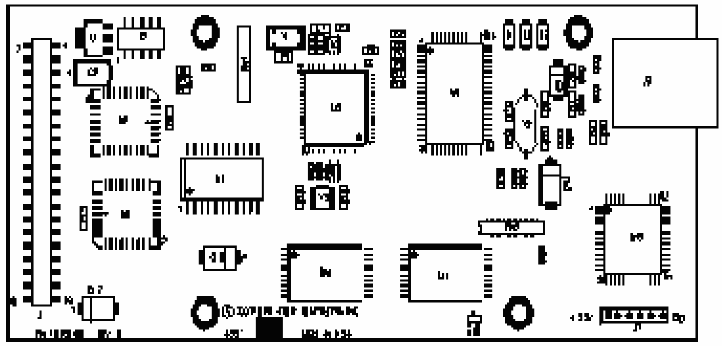

Figure 2-10. LMC Optional Ethernet 10/100BaseT Network Interface Card (P/N 11330400)

2.3.5. 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.

2.4. SmartBus Firmware & Software

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

- Single meter run totalizing, proving, and data archiving. *(see sidebar note)*
- Bi-directional totalization.
- Flow and sampler control.
- Direct interface to gas chromatographs, smart transmitters, and multivariable transmitters.
- Ethernet 10/100BaseT networking and TCP/IP Internetworking.
- Communications 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 LMC database literally has tens of thousands of user accessable database variables, that provide highly customizeable solutions. It also provides the tightest communications coupling between SCADA systems and the metering system.

ORDERING LMC OPTIONAL, UPGRADE, & REPLACEMENT COMPONENTS

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NOTE!

PULSE INPUT INFORMATION

Two of the four pulse input channels can be used to accept dual pulse transmission signals from a single flowmeter. Inputs 3 & 4 are reserved for future development with the intent to allow 2 single or 2 dual pulse input signals.

2.4.1. Interrupt-Driven Processing

This is a very important aspect of firmware. It provides for a multi-tasking environment in which the LMC 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 and serial communications are output to a printer or host computer, without degradation in speed or tasking.

The LMC 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 upgrade of the firmware with a simple install operation from a disk or downloaded from the Omni Flow website at www.omniflow.com.

2.4.2. Cycle Time

The firmware performs all time-critical measurement functions every 500 milliseconds or less. 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.

2.4.3. Real-Time Access

LMC 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.

2.4.4. 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 performed with SmartCom PC-based software.

2.4.5. Data Integrity & Security

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

2.4.6. SmartCom Configuration Software

Online or offline configuration of the SmartBus LMC is possible using a PC running the Windows® based SmartCom software supplied with the LMC. 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 LMC 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.

2.4.7. User Database

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

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3 Field Installation & Wiring

IN CHAPTER 3

Field Installation & Wiring:

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.

Omni Flow's SmartBus Series of Local Meter Controllers (LMCs) are designed for typical panel or wall mount conditions present in indoor environments such as metering stations, pipelines, refineries, distribution terminals, and similar facilities. This chapter includes LMC panel installation and wiring recommendations which serve as an additional reference to the applicable standards. Read this chapter before installing the LMC.

3.1. Safety

By nature, oil and gas industry facilities are hazardous. Following is a list of basic safety precautions that **must** be followed when installing the LMC.

- Only qualified technicians knowledgeable in applicable industry standards and electrical safety should install and handle the LMC.
- Do not apply power to the LMC during installation, wiring, or servicing. Make certain that power is removed from any live devices and connections to the LMC.
- Always connect the LMC ground lug to earth-ground. **The ground lug must always remain connected to earth, even when the LMC is not powered.** Make sure that there is appropriate grounding and shielding of the total measurement installation.
- Before disconnecting power to the LMC or making any changes to its settings, always backup configuration data and user settings using SmartCom software to avoid costly potential data loss.
- 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 LMC are within the maximum and/or minimum limits (see Section 1.6 "SmartBus Technical; Specifications").
- ❑ Do not disassemble, reassemble, or burn LMC 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; 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!

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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.

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Website:
www.omniflow.com

3.2. Mounting

ADAPTOR PLATE

Please specify that you will require an adaptor plate, when the LMC is replacing the following computers: 2500, 2300, Spectratec S500, or S600 (Floboss 600).

When selecting a mounting location, make sure there is enough space around the LMC for disassembling the enclosure and for easy access to the terminal and processor boards. Access to the I/O Terminal Board for wiring and to the Processor Board for jumper settings is required.

Prior to mounting, inspect the LMC for any missing or damaged parts.

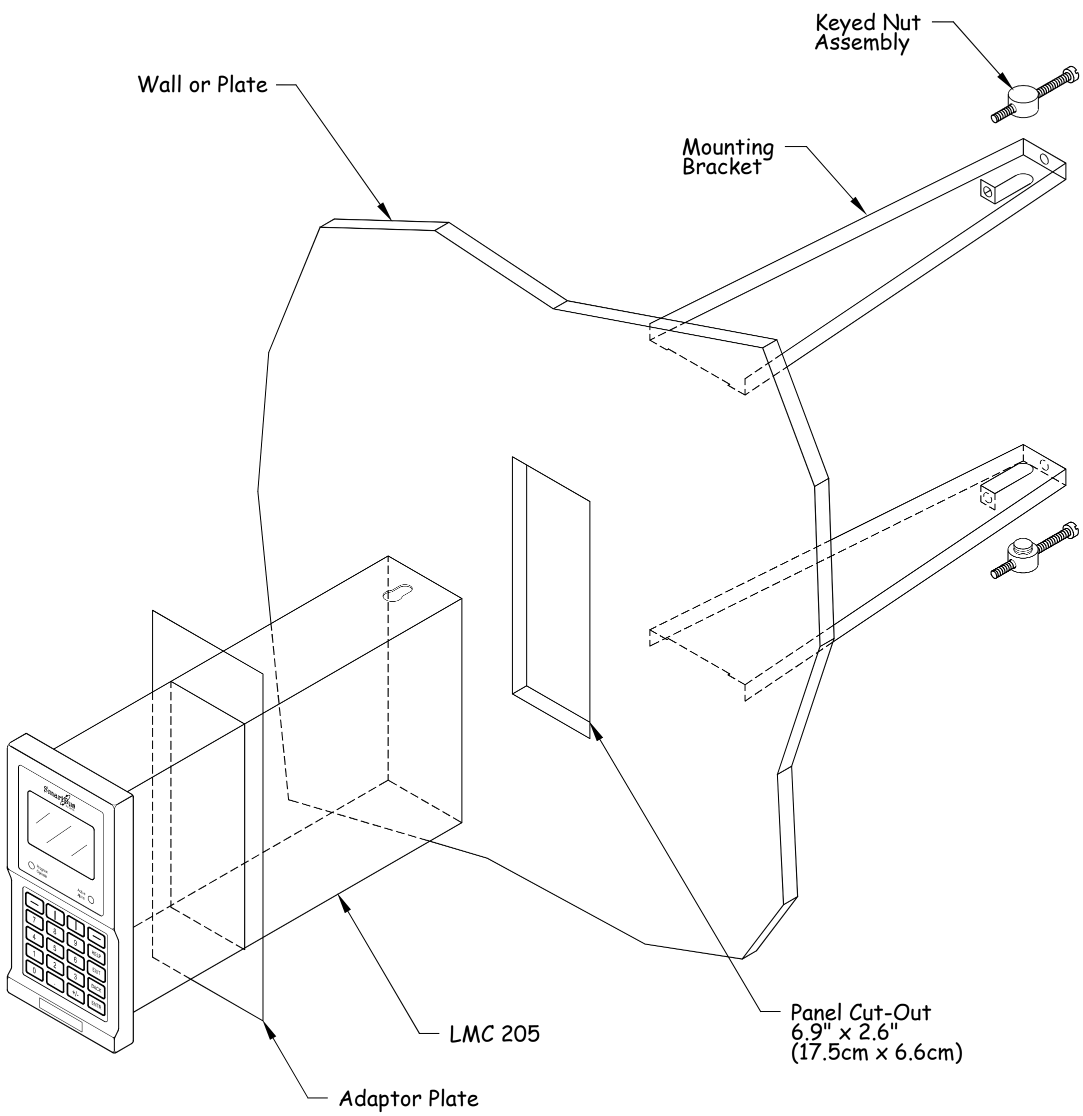

Figure 3-1. Wall or Panel Mounting the LMC 205.

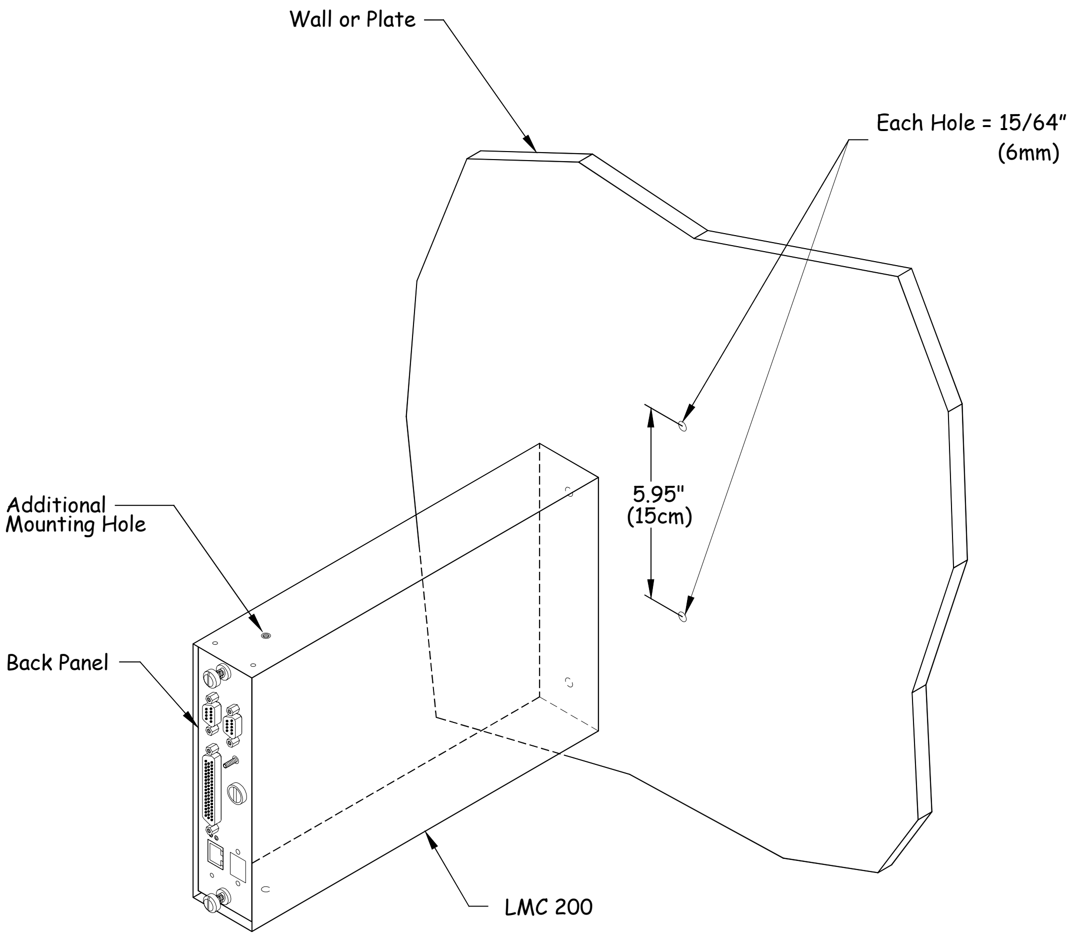

Figure 3-2. Wall or Panel Mounting the LMC 200.

3.3. Grounding

A proper connection between the LMC and earth-ground will help protect the metering system, including the LMC, from electrical transients, lightning, and stray currents. A proper earth-ground to the LMC is required in every installation, **even when it is powered-down**. LMC 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 LMC has a chassis-ground lug on the Back Panel of the enclosure. Using a 10–14AWG (12 AWG recommended) stranded wire, connect the earth-ground to the LMC ground lug in conformance with the applicable industry standard for installations in your locale. Use as short of a grounding wire as possible.

3.4. General Wiring Tips

Wire all LMC circuits according to the U.S. National Electrical Code (NEC). Wiring methods specified in the Canadian Electrical Code or 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 LMC I/O Terminal Board screw terminals.
- ❑ Depending on wiring distance, use 26 to 22 AWG twisted-pair copper wire.
- ❑ Strip off the insulation from wire end approximately 3/16" (0.48cm). Inspect the bare wire for nicks and frays.
- ❑ Insert the stripped end of the wire completely into the terminal clamp. Using the appropriate standard screwdriver, tighten the clamp to secure the wire 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.
- ❑ 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.

3.5. Power I/O Connection

Figure 3-2 shows the LMC power I/O circuitry. The LMC requires an external DC power source between 18 and 30VDC @ 1 Amp. Connect the DC power source to the terminals labeled DC (+) and (-) located on the I/O Terminal Board.

For short wiring runs less than 25 feet use 22AWG wire. For longer wiring runs, heavier gauge wire may be required. The positive input power terminal has a 1.1 Amp electronic resettable fuse located on the I/O Terminal Board and 1.25 Amp, 2AG replaceable glass fuse located on the LMC Back Panel. The I/O Terminal Board also has ten DC outputs labeled Power (+) and (-) for powering other devices connected to the LMC. These ten DC Power outputs have an individual, 100 mA electronic reset able fuse.

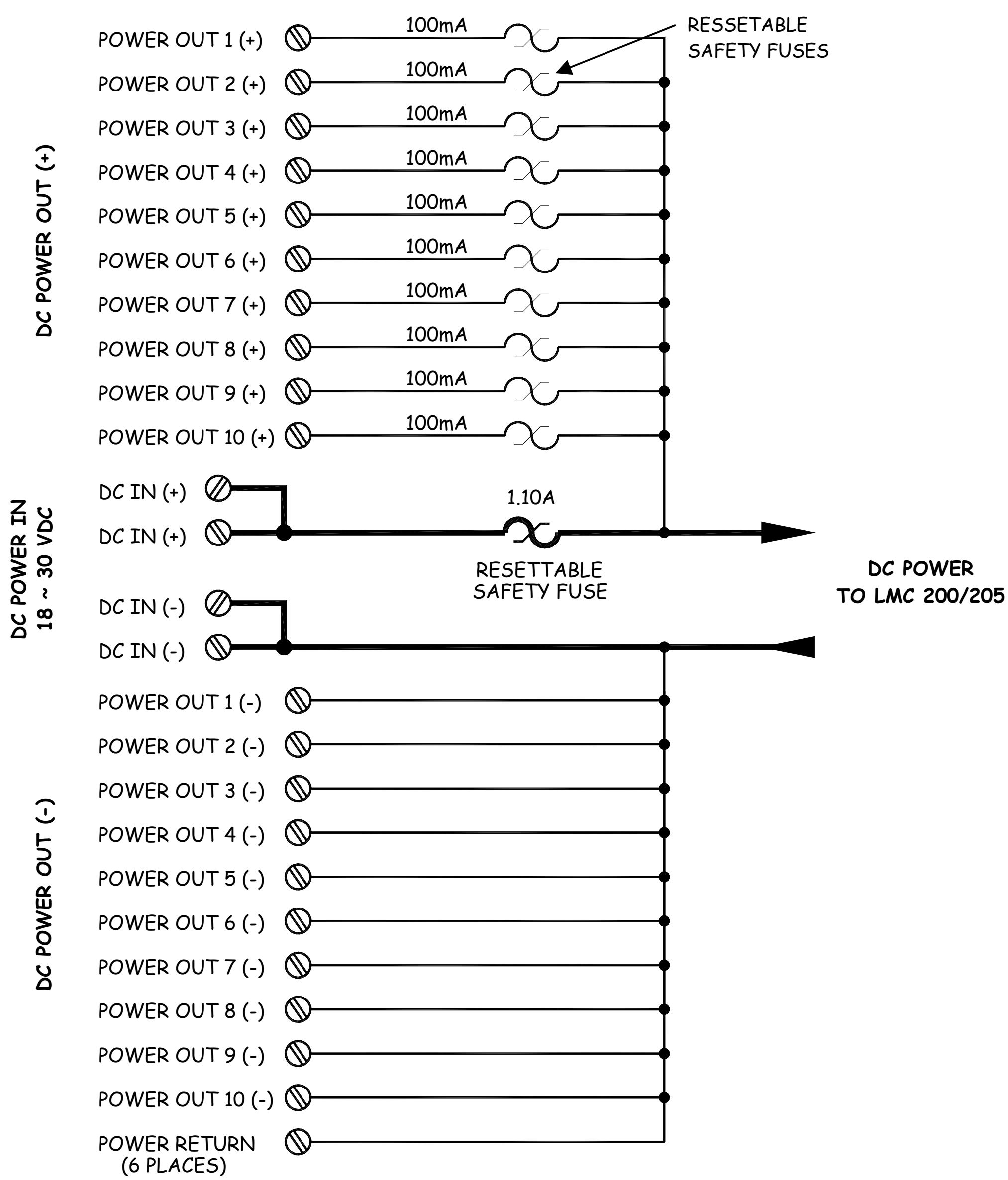

Figure 3-2. Power supply connection on LMC Terminal Board.

⚠ CAUTION! ⚠

POTENTIAL FOR DATA LOSS!

SmartBus LMCs 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 LMC is without an external power source for more than 30 days. Observe caution when storing the LMC. Always backup your LMC configuration settings using SmartCom software before disconnecting power. The RAM backup battery is rechargeable. Apply power to the LMC for 24 hours to recharge the Ni-MH battery.

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Phone:
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E-mail:
techsupport@omniflow.com

Website:
www.omniflow.com

3.6. PC Board Upgrade & Replacement

The LMC'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 LMC 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 those units that run under extreme environmental and operating conditions, it may be desireable to maintain an inventory of spare components.

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

OMNI FLOW TECHNOLOGY DEVELOPMENT

Omni Flow's policy of product development and continuous improvement of processes assures that our products will incorporate emerging technologies and changing user requirements as the need arises. We are constantly upgrading our technology as the result of research and customer requests.

LMC REPAIRS

If the LMC requires repairs, contact Omni Flow technical support for help. Attempting to repair the LMC yourself will void any warranties that may be in effect.

ORDERING LMC COMPONENTS

To order optional, upgrade, replacement, and spare parts for the LMC, 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

3.6.1. Add-ons & Replacements

Table 3-1 lists the LMC 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 3-1. LMC replaceable components.

LMC Component	Omni Part Number
Processor Board CPU Unit	11330000
*I/O Terminal Board Assembly for Field Wiring (Compact)	21300003
Power Supply Board	11330200
Optional 2nd Ethernet 10/100BaseT Port Network Interface Card	11330400
Front Panel Display Assembly	21300001
Mounting Bracket (1ea) Keyed Nut Kit (2 ea)	7000024
Adaptor Plate (optional)	H0100009
Keyed Nut Kit (2ea)	70000000
LMC Firmware (for flash memory) available at www.omniflow.com	N/A
SmartCom Software available at www.omniflow.com	N/A
LMC Y Cable available lengths: 5ft	K0216205
10ft	K0216210
15ft	K0216515
25ft	K0216525

*Note: **Do not** use P/N 10330301 printed on the I/O Terminal circuit board to order a replacement. The P/N on the board is applicable only to the board, not the entire assembly.

3.6.2. Fuse Replacement

DC Power into the LMC is protected by a 1.25 ampere 2AG, Slow-Blow replaceable glass fuse located on the Back Panel. This fuse is available from many electrical parts distributors. Table 3-2 lists the major fuse manufacturers and corresponding part numbers for this fuse.

Table 3-2. Major manufacturers and part numbers for 2AG, 1.25A replaceable glass fuse.

Fuse Manufacturer	Part Number
Little Fuse	229-1.25
Bussmann	C519-1.25A

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4 Connecting the Signal I/O

IN CHAPTER 4

Connecting the Signal I/O:

The LMC I/O Terminal Board (shown in Figure 4-1) supports 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. These I/O features offer flexibility to setup the LMC in conformance with most signal measurement requirements.

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

- Analog inputs and outputs.
- Resistance temperature detector (RTD) excitation current source outputs.
- Flow pulse frequency inputs.
- Density pulse frequency inputs.
- Digital inputs and outputs.
- RS-232 (three-wire) and RS-485 (two-wire) serial communications.
- Ethernet 10/100BaseT networking interface with Transmission Control Protocol/ Internet Protocol (TCP/IP) and Modbus/TCP support (an additional Ethernet Board is available as an option).

This chapter describes the I/O features, hardware jumper settings, and expandable options available for connecting specific signal types to the LMC. 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 LMC using the PC-Based SmartCom software.

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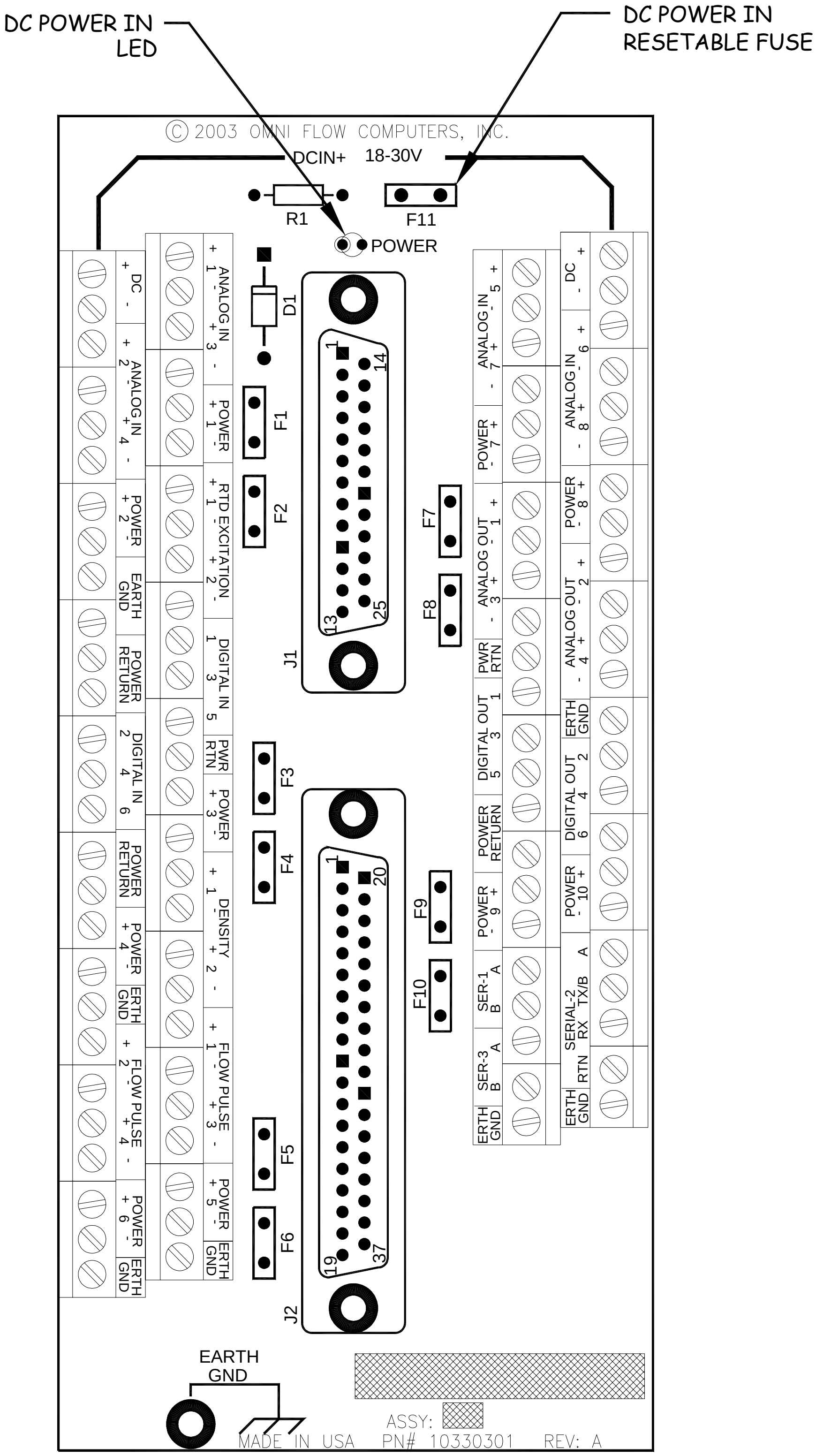

Figure 4-1. LMC I/O Terminal Board. (P/N 21300003)

4.1. Analog I/O Signals

READ THE DOCUMENTATION!

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

Standard LMC configuration provides eight analog inputs, four analog outputs, and two RTD excitation current source outputs. The LMC uses highly accurate analog-to-digital and digital-to-analog converters to convert I/O signals. Opto-couplers within LMC circuitry electronically isolate the analog circuits from the digital processing. All I/O signals are temperature-compensated within the LMC.

4.1.1. Analog Inputs

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The eight standard LMC analog inputs are labeled "ANALOG IN" 1 thru 8 on the I/O Terminal 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 processor board. Figure 4-2 shows the location of the jumpers. Table 4-1 and Table 4-2 define the available signal type selections and jumper settings for each analog input.

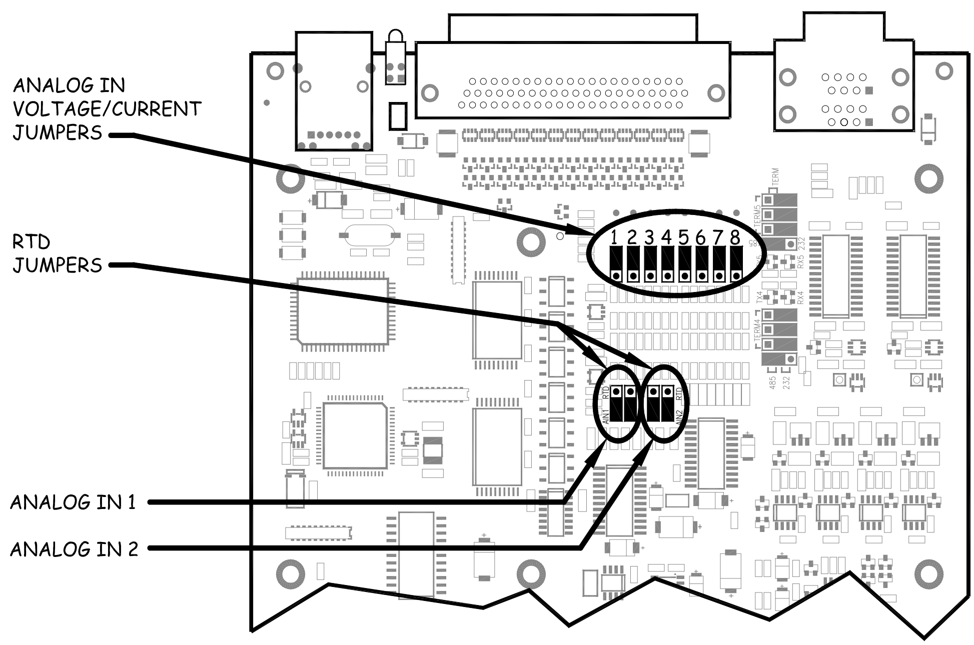


Figure 4-2. Location of analog input signal selection jumpers.

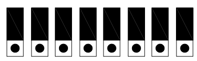
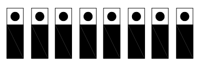
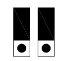
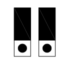
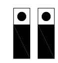
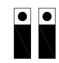
Table 4-1. Analog Inputs 1 thru 8 Voltage/Current Jumper Settings	
VOLTAGE/CURRENT JUMPERS	
	ANALOG INPUTS
Mode	1 2 3 4 5 6 7 8
4-20mA	
1-5V	

Table 4-2. Analog Inputs 1and 2 RTD Jumper Settings		
RTD JUMPERS		
	ANALOG INPUTS	
Mode	1	2
RTD		
4-20mA(1-5V)		

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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 type. To produce an analog output signal, the LMC 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.

LMC analog outputs can drive a maximum load resistance value that varies depending upon the voltage level of the power supply feeding the LMC. Use the load resistance nomograph shown in Figure 4-3 to determine the maximum load resistance allowed for a particular analog output signal connection.

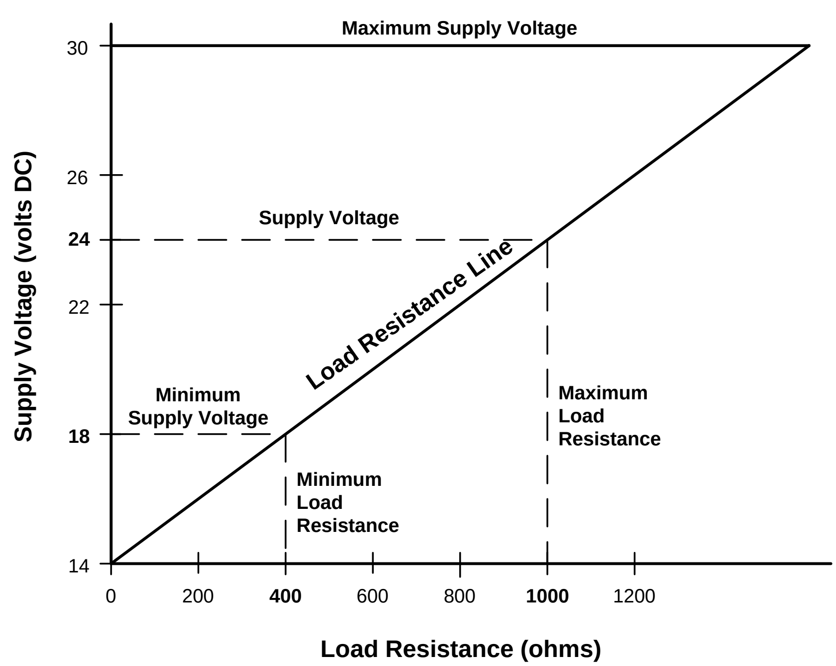

Figure 4-3. Load resistance nomograph for LMC analog outputs.

4.1.3. RTD Excitation Current Source Outputs

The two nominal 3 mA RTD excitation source outputs, labeled "EXCITATION" 1 and 2 on the I/O 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".

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4.2. Flow Pulse Input Signals

The LMC provides four flow pulse inputs and two density pulse inputs. *Note: (As of June 2006 two of the four pulse input channels can be used to accept dual pulse transmission signals from a single flowmeter. Inputs 3 & 4 are reserved for future development with the intent to allow 2 single or 2 dual pulse inputs.) The input pulse trains are processed then passed through opto-couplers within the LMC to provide electrical isolation.

The LMC flow pulse inputs, labeled "FLOW PULSE" 1 thru 4 on the terminal board, support high-level (18 to30VDC supply voltage level) turbine flowmeter signal types. The flow pulse signal inputs can accept 0–12kHz signal frequencies. Set up these inputs as either 2 single or 2 dual pulse inputs from within SmartCom software.

Signal coupling is DC with the trigger threshold at 3.5VDC for high-level inputs. 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.

Read the Documentation!

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

4.2.1. 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 LMC implements a significantly enhanced Level B pulse security method by not only continuous 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 LMC flow pulse inputs suitably phased from a dual pulse equipped flowmeter. In addition, you must select the corresponding configuration settings in the LMC using SmartCom software.

Hardware on the LMC continuously monitors the phase and sequence of the two pulse trains. It also monitors the frequency of the pulse trains. The LMC 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 4-3, ensures that related pulse edges of each channel are, in worst case, at least five clock samples apart.

READ THE DOCUMENTATION!

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

Table 4-3. Phase shift difference between dual pulse trains.

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

4.2.2. Density Pulse Inputs

The LMC density pulse frequency inputs, labeled “DENSITY” 1 and 2 on the terminal board, support 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 LMC’s density input.

4.3. Digital I/O Signals

The LMC 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 LMC 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 LMC digital inputs or outputs, as indicated in this section.

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4.3.1. Digital Inputs

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

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

4.3.2. Digital Outputs

The six LMC digital outputs are labeled "DIGITAL OUT" 1 thru 6 on the terminal board. The maximum output current load that each individual digital output supports approximately 100mA. Each individual digital output is protected by a resettable fuse.

4.4. Serial I/O Signals

The LMC has two dedicated RS-485 Serial Ports (1 and 3) and three selectable RS-232/485 Serial Ports (2, 4, and 5). RS-485 serial ports support two-wire connections. RS-232 serial ports are three-wire (RX/TX, TX/RX, and RTN). Serial Ports 1, 2, and 3 are located on the I/O Terminal Board, Serial Ports 4 and 5 are male DB-9 connectors located on the LMC Chassis Back Panel.

4.4.1. Serial Port Jumper Settings

Selection jumpers for the Serial Ports are located on the Processor Board. See Figure 4-4 for the location of these jumpers. Figure 4-5 provides a detailed view of the jumpers and LEDs for Serial Ports 1, 2, & 3 and Table 4-4 defines the available jumper settings of each port. Figure 4-6 provides a detailed view of the jumpers and LEDs for Serial Ports 4 & 5 and Table 4-5 defines the available jumper settings of both ports.

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 RED transmit

LED is on, the corresponding serial port is actively sending (output) signals. When the GREEN receive LED is on, then the serial port is receiving (input) signals.

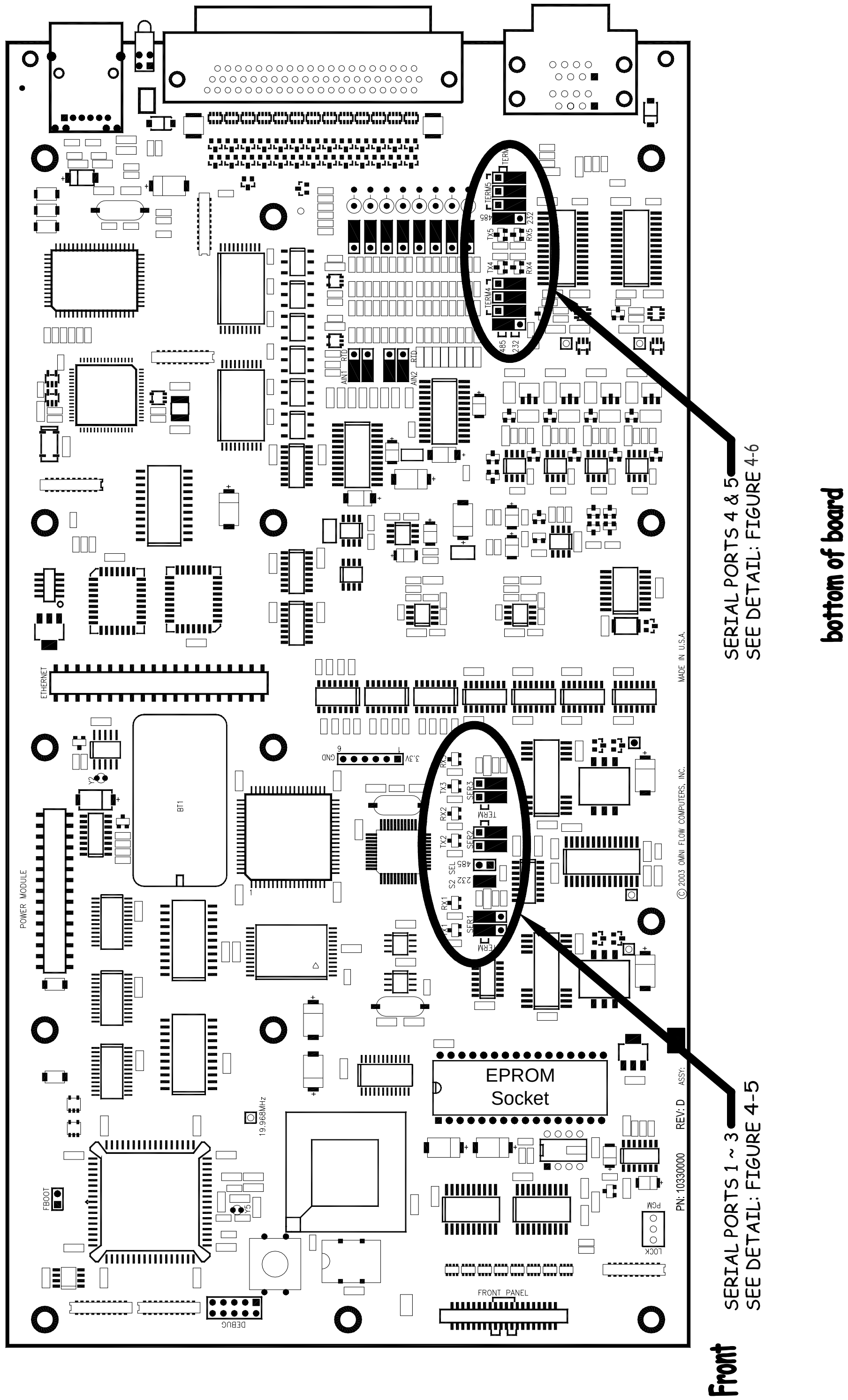


Figure 4-4. Location of Serial Port selection jumpers and LEDs on the Processor Board.

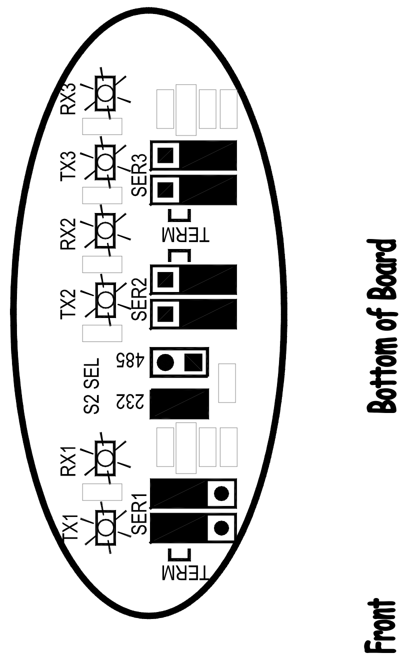


Figure 4-5. Detail of Serial Ports 1, 2 and 3 Jumpers and LEDs on the Processor Board. (View the jumpers in the same orientation as in figure 4-4.)

Table 4-4. Jumper Settings for Serial Ports 1, 2 & 3.

MODE	SERIAL PORT		
	1	2	3
RS-232	N/A		N/A
RS-485 Terminated			
RS-485 Unterminated			

****Jumpers are in the same orientation as in figure 4-4***

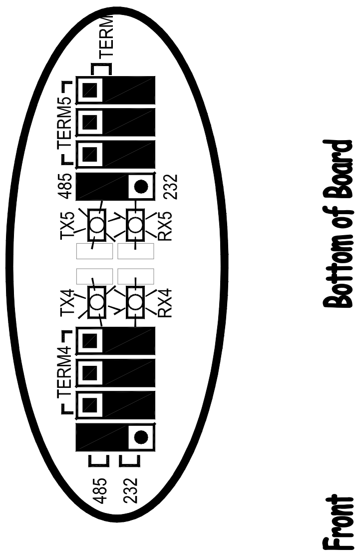
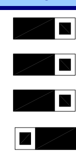
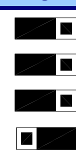
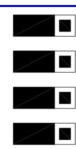
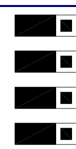
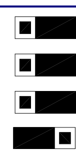
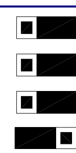


Figure 4-6. Detail of Serial Ports 4 and 5 Jumpers and LEDs on the Processor Board. (View the jumpers in the same orientation as in figure 4-4.)

Table 4-5. Jumper Settings for Serial Ports 4 & 5.

MODE	SERIAL PORT	
	4	5
RS-232		
RS-485 Terminated		
RS-485 Unterminated		

****Jumpers are in the same orientation as in figure 4-4***

4.4.3. RS-485 Serial Devices

RS-485 SERIAL DEVICE CONNECTIVITY

Some serial devices that connect to the LMC 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 LMC; i.e., the LMC A channel is wired to the B channel of the connecting device, and the LMC B channel to the device's A channel. Always consult the manufacturer's documentation before connecting any devices to the LMC.

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 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

READ THE DOCUMENTATION!

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

The RS-485 serial ports support two-wire, terminated or non-terminated connections. Configure each serial port as required, see Table 4-4 and Table 4-5 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 LMC 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 LMC and the other device.

4.4.5. Communications Parameters and Signal Interface Specifications

Set LMC serial communications parameters – such as: protocol type, baud rate, number of stop bits, and parity settings – using PC-Based SmartCom™ configuration software. Table 4-7 indicates the signal specifications of the LMC serial I/O interface.

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techsupport@omniflow.com

Website:
www.omniflow.com

Table 4-7. LMC 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 referenced to Power Return	
Indicator LEDs	Receive & Transmit	

4.5. Ethernet 10/100BaseT Signals

NETWORKING UTP CABLE STANDARDS

Unshielded twisted-pair (UTP) wiring installations should conform to IEEE Ethernet 10/100BaseT 802.3 or the ANSI/EIA/TIA 586-A network and telecommunications cabling standards. Alternately, refer to AT&T's Direct Inside Wiring (DIW) and IBM's Type 3 cable specifications.

The Ethernet Network Interface adds 10/100BaseT 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 2.3.4 "Ethernet 10/100BaseT Network Interface"for more information.

An additional Ethernet Network Interface Card is available as an option providing redundent Ethernet connectivity. Connection provided is a standard RJ45 connection on the Back Panel of the Chassis.

4.5.1. Ethernet (10/100BaseT) Basics

- 10/100BaseT:
  "10' stands for 10 Mbps data rate
  "100" for 100 Mbps data rate
  "Base" stand 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

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

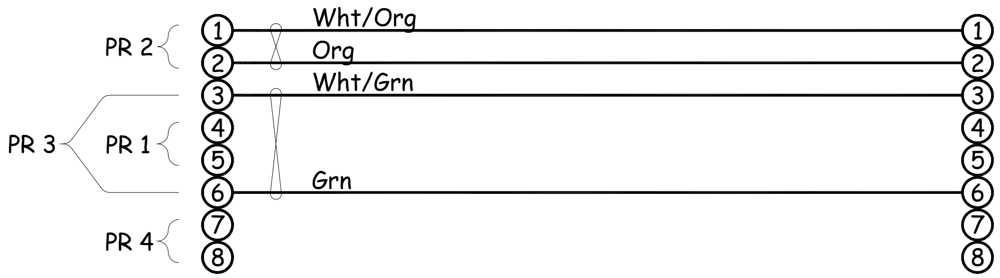

Figure 4-14 Wiring diagram for 10/100BaseT Patch Cords using a hub/switch between the RMC & another TCP/IP device.

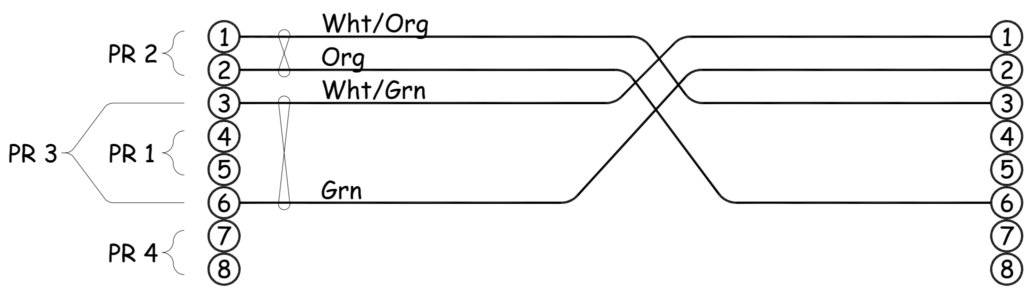

Figure 4-15 Wiring diagram for 10/100BaseT Crossover Cable without a Hub/Switch between the RMC & another TCP/IP Device (i.e., point-to-point)

4.5.4. Ethernet Light Status Condition

Devices (network cards, hubs, etc) include an LED to indicate a "LINK" (or OK) condition. Below is a general guide to LINK indications. These indicators will vary by manufacturer. Check your equipment's owners guide for specific information.

- "ON" (GREEN) Link between two devices is operational.
- "YELLOW/RED" Partitioned - Fault on network segment.
- "BLINKING" Data (packet) transmission.
- "OFF" No connection,
  No power to one or both of the network devices,
  or Network card drivers have not loaded correctly.

4.5.5. 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 LMC 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 LMC 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 byt 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	Leftmost bits	Start address	Finish 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 left most three bits to '110', but each of the remaining 29 bits may be set to either '0' or '1' independently 9as 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 addresse 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 loppback 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 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 start address	Private finish 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).

4.5.6. IP Network Partitioning

Computer networks consist of individual segments of network cable. The electrical properties of cabling limit the usefull 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 also 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)*

4.5.7. 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 LMC ships with a default factory subnet mask of 255.0.0.0

Applying a Subnet Mask

Subnetting allows network 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.

For a subnet mask to be valid, its leftmost bits must be set to '1'. For example,

00000000 00000000 00000000 00000000

is an invalid subnet mask because the leftmost bit is set to '0'. Conversely, the rightmost bits in a valid subnet mask must be set to '0', not '1'. Therefore,

11111111 11111111 11111111 11111111 is invalid

All valid subnet masks contain two parts: the left side with all mask bits set to '1' (the extended network portion) and the right side with all bits set to '0' (the host portion), such as the first example above.

4.5.8. 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 primary LMC Ethernet port can be located on the Main Processor next to positions U17 and U21 of the circuit board. The MAC address of the secondary (optional) LMC Ethernet port can be located directly on the module. You will see only the last 6 characters (example: C357F5) on the paper lable, 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 LMC 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-57-F5.

4.5.9. Configuring the Ethernet Port

Refere to Omni Technical Bulletin TB020101B applicable to the Omni Serial Ethernet module for instructions on how to use the Omni Network Utility software to access and configure the LMC Ethernet module. The Technical Bulletin and the software can be downloaded from the website at www.omniflow.com.

5 Connecting Flowmeters

IN CHAPTER 5

Connecting Flowmeters:

LMC liquid and gas flow signal connectivity features support an ample 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 LMC 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 LMC using the PC-Based SmartCom software.

5.1. Pulse Frequency Flow Transmitters

The SmartBus LMC provides I/O terminals for connecting volume flow pulse signals produced by turbine and other positive displacement flowmeters. The LMC 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 LMC.

LMC Flow Pulse Inputs 1 thru 4 shall be obtained as high-level DC voltage pulse signals. High-level pulse input signals are usually wired from flowmeter preamplifiers. The LMC 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.

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 LMC.

5.1.1. Single Pickoff Turbine & Positive Displacement Flowmeters

Use one of the four LMC Pulse Inputs when wiring a turbine or positive displacement flowmeter with a single pickoff coil to the LMC. 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.

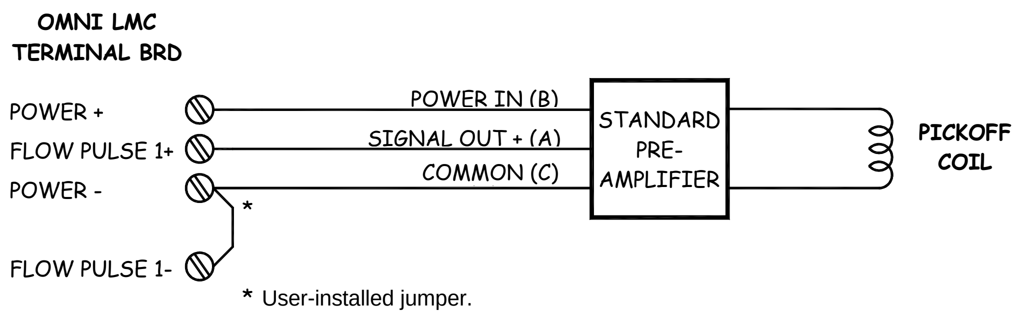

Figure 5-1. Wiring a turbine flowmeter high-level frequency pulse signal to LMC Pulse Input #1 using a preamplifier.

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 LMC is a clean, low-impedance signal that will not be subject to events such as extraneous noise or electromagnetic transients. Any regular occurrence of these types of events must cause the equipment and/or wiring to be suspect. Investigate and correct any such problem before proceeding. Pulse fidelity check circuitry does ***not*** facilitate continuous operation with a poor wiring installation prone to noise or transient pickup.

To achieve pulse fidelity and integrity checking, use both LMC 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"). Figure 5-2 shows the wiring configuration for a flowmeter that outputs dual, high-level frequency pulse signals.

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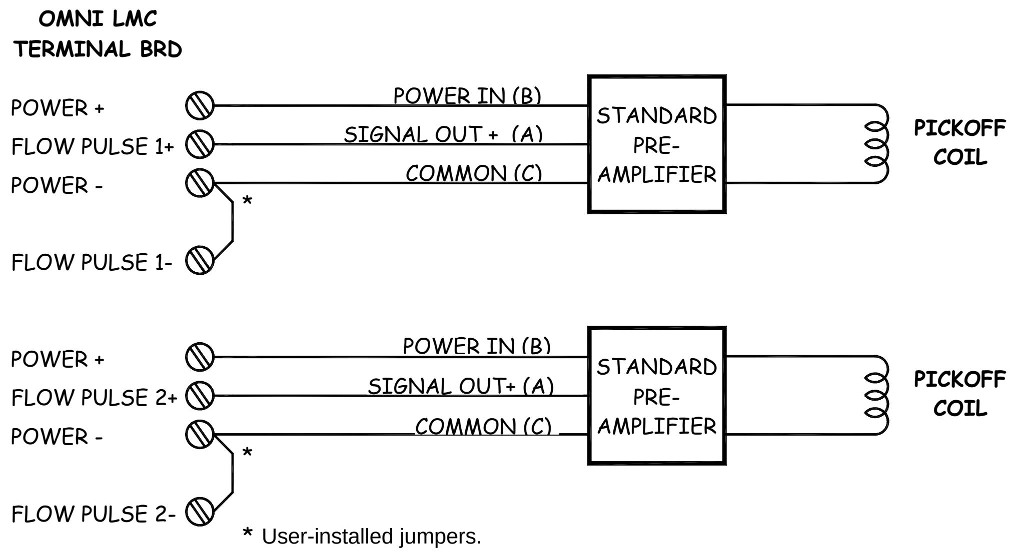

Figure 5-2. Wiring dual, high-level frequency pulse signals from a dual pickoff coil turbine flowmeter to LMC Pulse Inputs #1 and #2 using preamplifiers.

5.1.3. Faure Herman® Flowmeter Current Pulse Preamplifiers

Faure Herman® turbine flowmeters are usually used in liquid applications only. These flowmeters have a preamplifier that generate current pulses and connects to the LMC flow pulse input. Figure 5-3 and Figure 5-4 show the wiring connections for a Faure Herman flowmeter preamplifier.

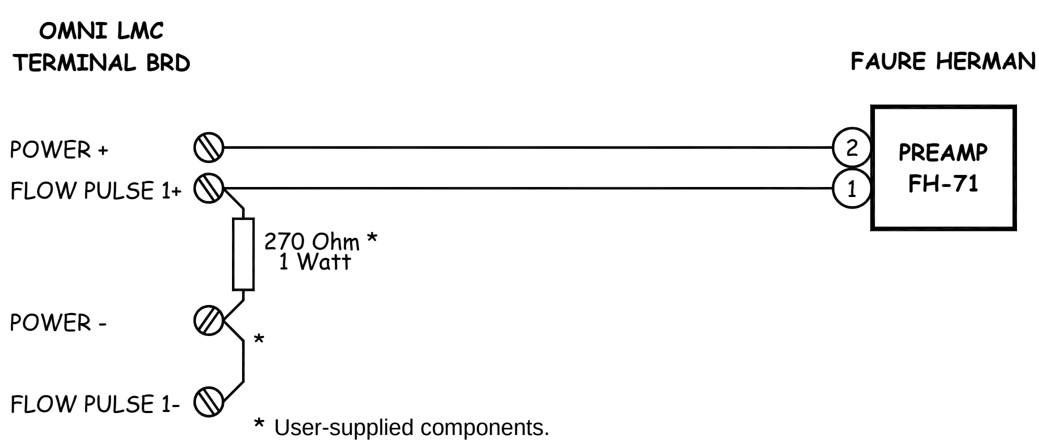

Figure 5-3. Wiring a Faure Herman® Current Pulse Preamplifier Model FH-71 to LMC Pulse Input #1.

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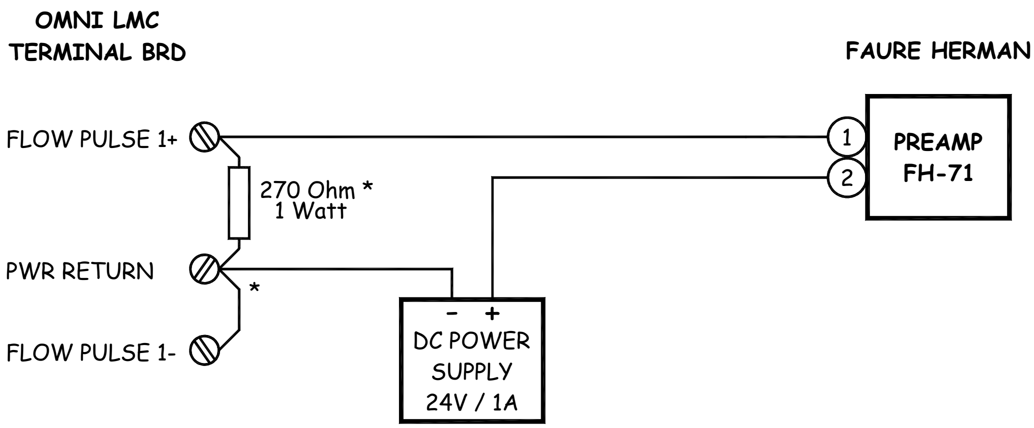
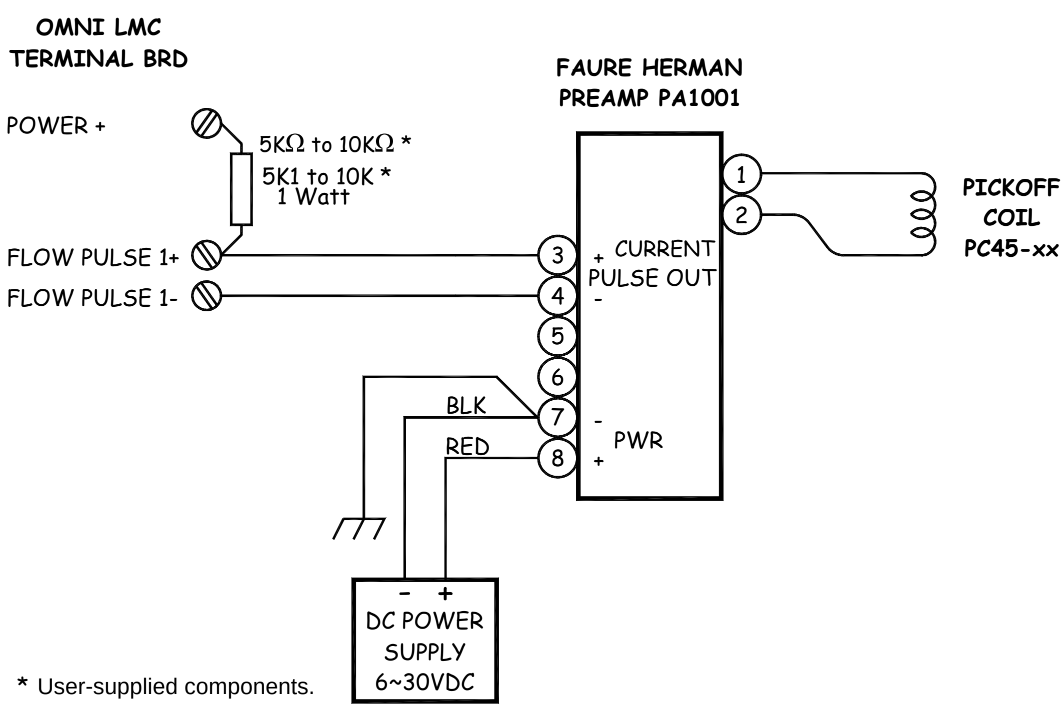


* User-supplied components.

Figure 5-4. Wiring a Faure Herman™ Current Pulse Preamplifier Model FH-71 to LMC Pulse Input #1 powered by external supply.



* User-supplied components.

Figure 5-5. Wiring a Faure Herman™ Current Pulse Preamplifier Model PA1001 with Pickoff Coil PC45-xx powered by external supply to LMC Pulse Input #1.

5.1.4. Daniel Industries® Universal Preamplifiers

READ THE DOCUMENTATION!

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

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Daniel Industries® Flowmeters come with a universal preamplifier that connects to the LMC flow pulse input. Figure 5-6 and Figure 5-7 show the wiring connections for a Daniel Industries flowmeter preamplifier.

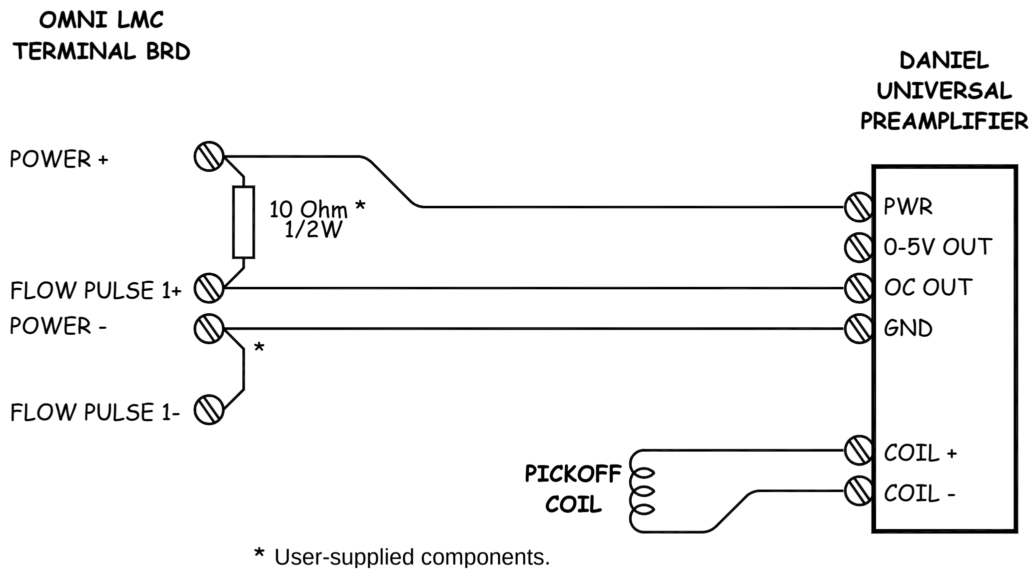

Figure 5-6. Wiring a Daniel Industries® Universal Preamplifier to LMC Pulse Input #1, using the preamp open collector (OC) output.

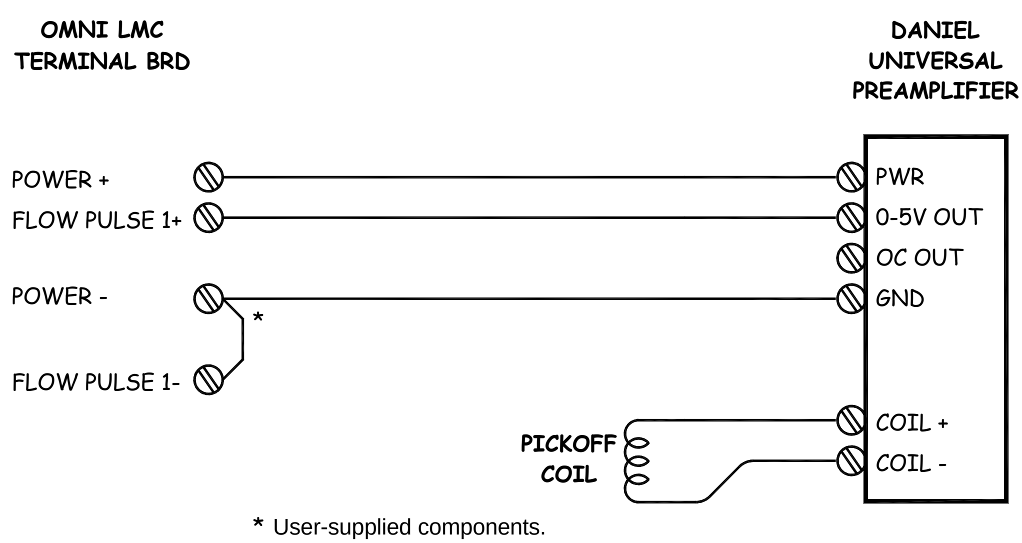

Figure 5-7. Wiring a Daniel Industries™ Universal Preamplifier to LMC Pulse Input #1, using the preamp 0–5V output.

5.2. Linear Analog Flow Transmitters & Differential Pressure Head Devices

Linear analog and differential pressure (DP) flowmeters connect to the LMC just as any other 4–20mA or 1–5V analog transmitter (see Section 6.1 "Miscellaneous Analog Transmitters"). Connecting these device types to the LMC Analog In as a high-leg or log-leg configuration are indicated in Figure 5-8 and Figure 5-9 respectively. Refer to Section 4.1.1 "Analog Inputs" for jumper location and settings.

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

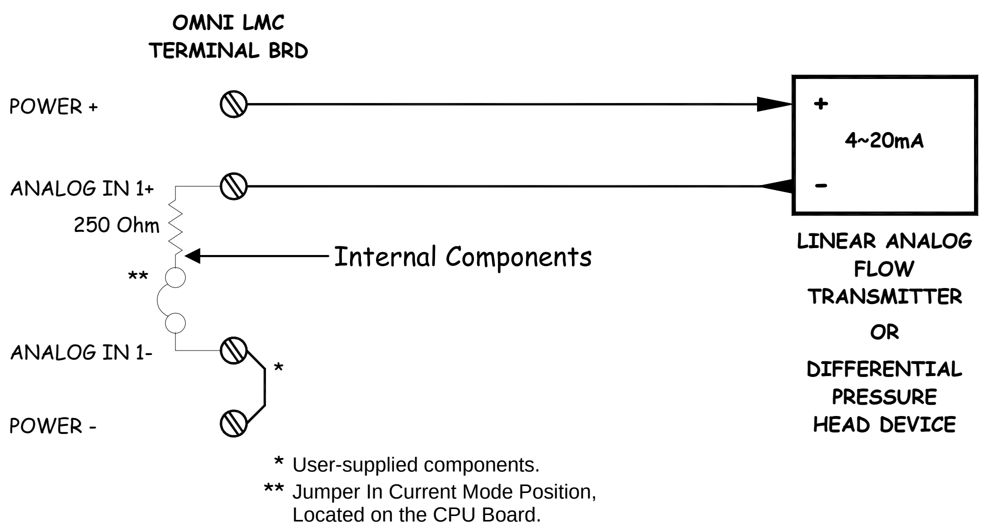

Figure 5-8. Wiring a linear analog or a differential pressure flowmeter to LMC Analog Input #1 in a high-leg wiring configuration.

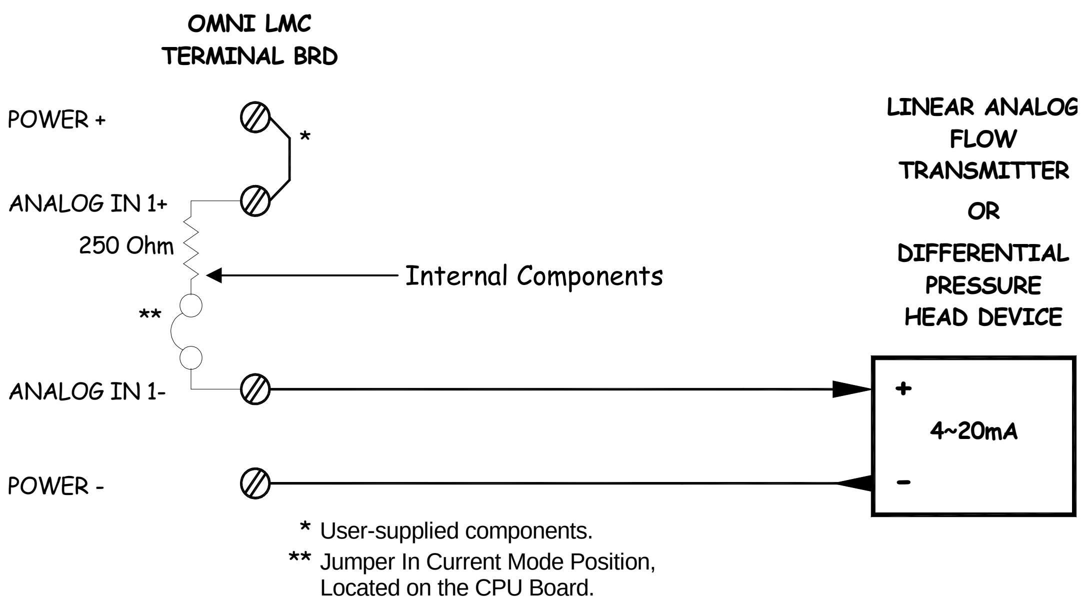

Figure 5-9. Wiring a linear analog or a differential pressure flowmeter to LMC Analog Input #1 in a low-leg wiring configuration.

5.3. Ultrasonic Flowmeters

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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 LMC supports the major brands of ultrasonic flowmeters by Instromet, FMC Kongsberg, and Daniel Industries.

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 speed of sound in the fluid. 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.

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 LMC communicates with the Q-Sonic via a two-wire RS-485 serial connection and/or by way of an LMC flow pulse input. The LMC 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 LMC flow pulse input terminals. For serially transmitted data, LMC 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 LMC will use the transmitted flow rate as the actual flow rate. The LMC 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 LMC.

Figure 5-10 shows the typical wiring required for connecting an Instromet Q-Sonic flowmeter to the LMC. Connect the two-wire RS-485 interface to any available LMC serial port configured for RS-485. For signal redundancy, it is recommended that the forward and reverse flow pulse signals are wired to the LMC flow pulse inputs.

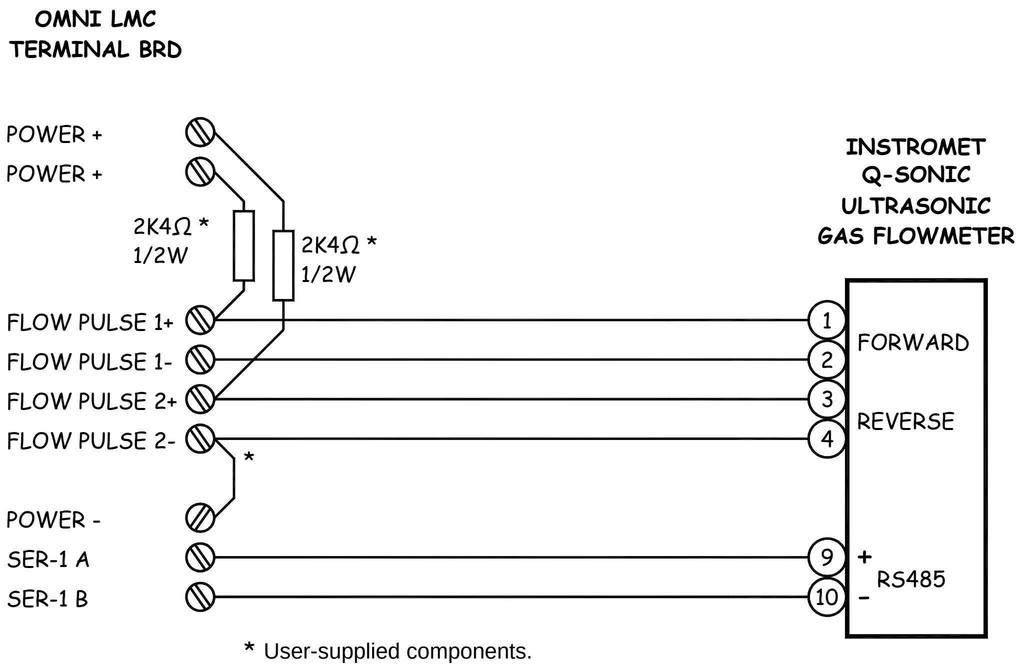

Figure 5-10. Wiring an Instromet® Q-Sonic® Ultrasonic Gas Flowmeter to LMC Serial Port #1, with the recommended bi-directional (forward/reverse) pulse outputs wired to LMC Pulse Inputs #1 & #2.

READ THE DOCUMENTATION!

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

5.3.2. FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeters

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The FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeter employs six acoustic transducer pairs for flow measurement. The SmartBus LMC 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 LMC flow pulse inputs. Figure 5-11 shows this wiring option.

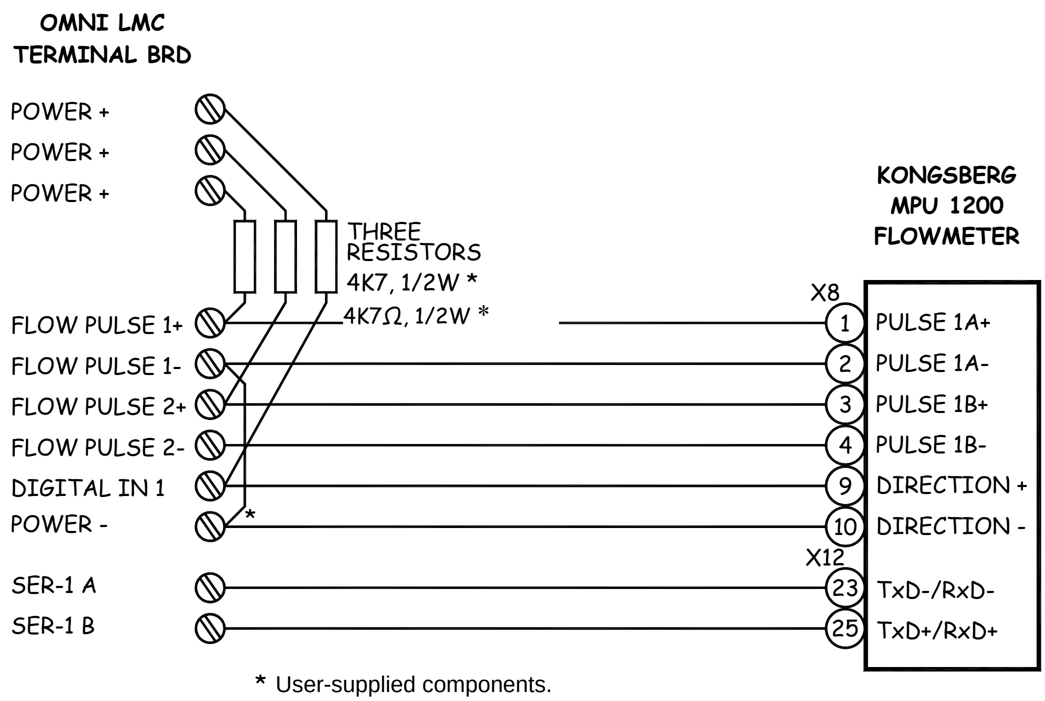


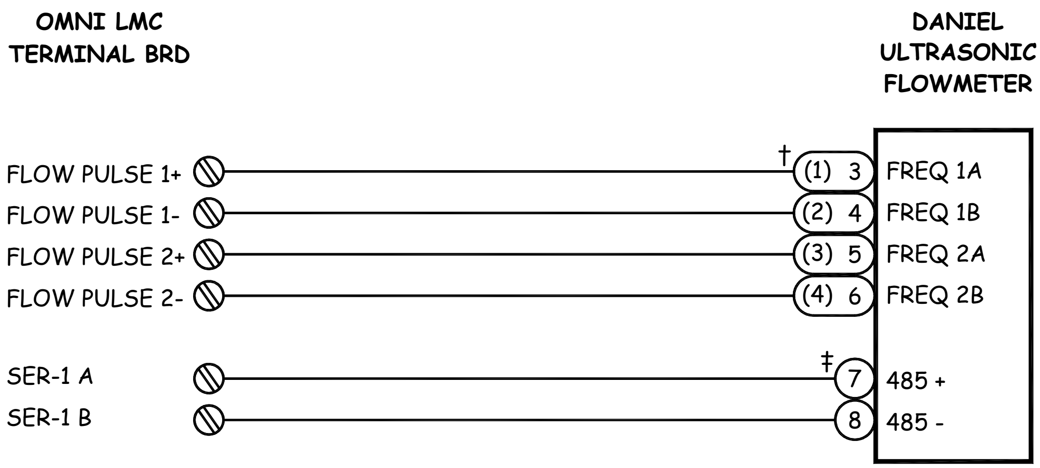
Figure 5-11. Wiring a FMC Kongsberg Metering® MPU 1200 Ultrasonic Gas Flowmeter to LMC Serial Port #1, with the recommended bi-directional (forward/reverse) pulse outputs wired to LMC Flow Pulse Inputs #1 & #2.

5.3.3. Daniel Industries® Ultrasonic Gas Flowmeters

Daniel Industries® Ultrasonic Gas Flowmeters connect to the SmartBus LMC 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 5-12 shows how to wire a Daniel ultrasonic flowmeter to the LMC.

READ THE DOCUMENTATION!

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



† Connector P2 on Peripheral 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 5-12. Wiring a Daniel Industries® Ultrasonic Gas Flowmeter to LMC Flow Pulse Inputs #1 & #2, and an RS-485 serial port.

5.4. Multivariable Transmitters

SmartBus LMCs can also provide support for multivariable transmitters, manufactured by other third parties.

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These devices are used in both liquid and gas metering applications. Following are descriptions of the theory of operation and LMC connectivity features for some of the popular brands of multivariable transmitters, including Micro Motion® Elite™ Transmitters and Rosemount® 3095 FB Modbus™ Multivariable Transmitters.

5.4.1. Micro Motion® Elite™ RFT9739 & 1700 / 2700 Series 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 LMC connects to these transmitters via two-wire RS-485 serial communications and/or by using the LMC signal input terminals that correspond to each process variable signal outputted by the transmitter.

Figure 5-13 shows how to connect the LMC with the Micro Motion transmitter using any RS-485 serial port in a two-wire configuration. Alternately, you can also wire the different RFT9739 process variable signals directly to the corresponding LMC signal inputs (e.g.: flow pulse inputs, density pulse inputs, analog inputs), as shown in Figure 5-14. For more details, refer to the documentation of Micro Motion transmitters and sensors.

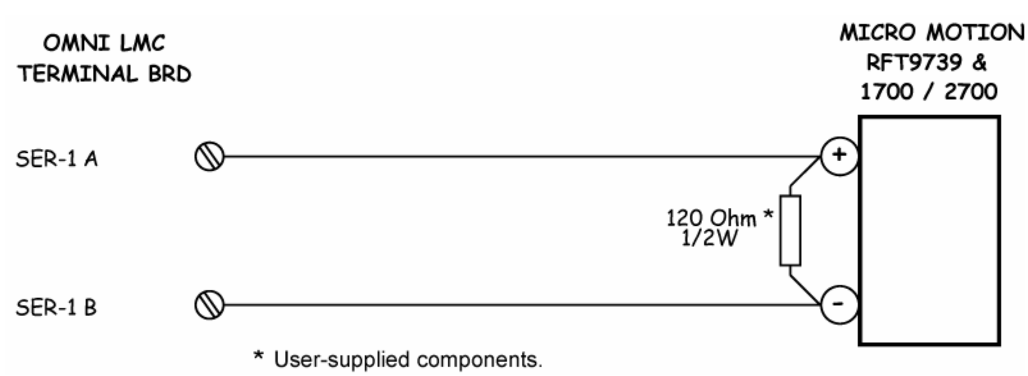

Figure 5-13. Wiring a Micro Motion® Elite™ RFT9739 & 1700 / 2700 Transmitter to an LMC RS-485 serial port. ***(NOTE: Flow must always be wired as a flow pulse signal input into the LMC)***

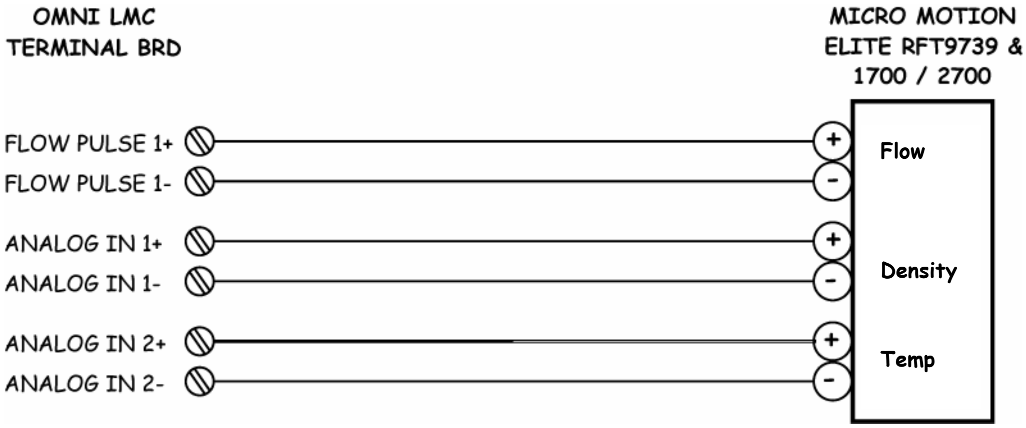

Figure 5-14. Wiring a Micro Motion® Elite™ RFT9739 & 1700 / 2700 transmitter to LMC Flow Pulse Input #1, Density Analog Input #1, and Analog Input #2.

READ THE DOCUMENTATION!

Always refer to the documentation supplied … manufacturer before wiring devices to the LMC.

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.

5.4.2. Rosemount® 3095FB Modbus™ Multivariable Transmitters

The Rosemount® 3095FB Modbus™ Multivariable Sensor Assembly is used to measure differential pressure (DP), static pressure (SP), and line temperature (T) in liquid and gas measurement systems. However, application of the 3095 is limited to differential head devices such as orifice meters, nozzles, and Venturi meters. The LMC accesses data from the 3095 transmitter via a two-wire RS-485 data link at 9600 baud using Modbus protocol.

Figure 5-15 represents a point–to–point wiring configuration between the LMC and the Rosemount 3095FB transmitter. Figure 5-16 shows wiring multiple 3095 transmitters to the LMC.

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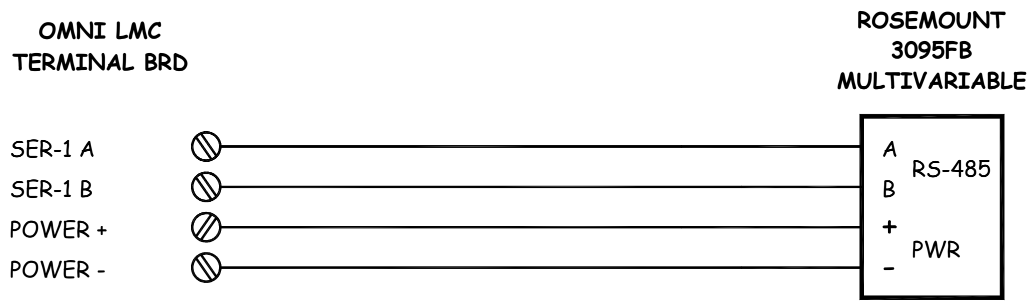

Figure 5-15. Wiring Rosemount® 3095 Modbus™ multivariable transmitters to LMC RS-485 serial ports in a point-to-point configuration.

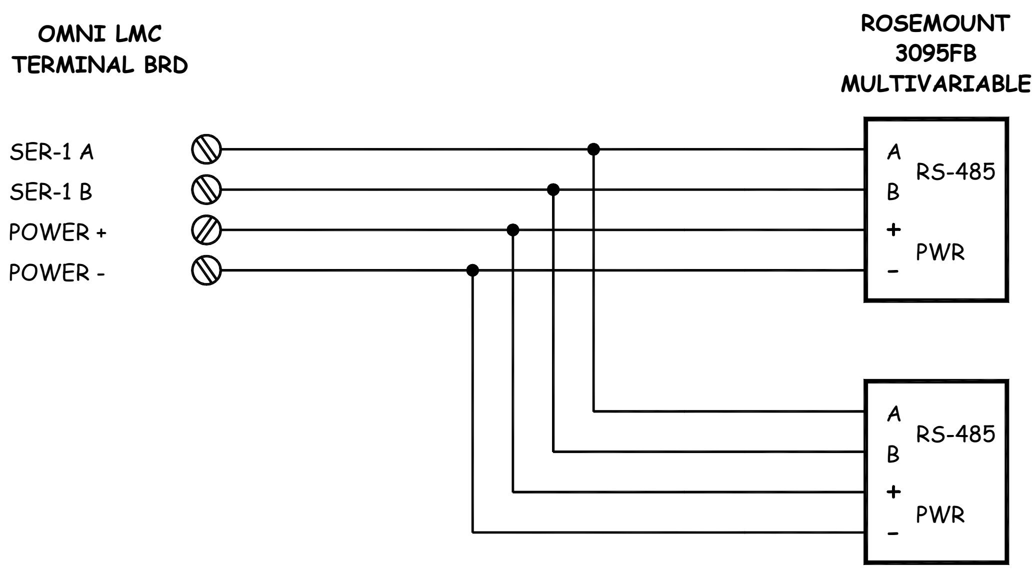

Figure 5-16. Wiring multiple Rosemount® 3095FB Modbus™ multivariable transmitters to the LMC.

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6 Connecting Transmitters

IN CHAPTER 6

Connecting Transmitters:

The LMC 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 LMC 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 LMC using SmartCom software.

6.1. Miscellaneous Analog Transmitters

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

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 CPU Board, configure the LMC to accept either 1–5V or 4–20mA signals (see Section 4.1.1 “Analog Inputs”). Figure 6-1 and Figure 6-2 respectively show the wiring of a transducer to an LMC analog input in a high-leg configuration and a low-leg wiring mode.

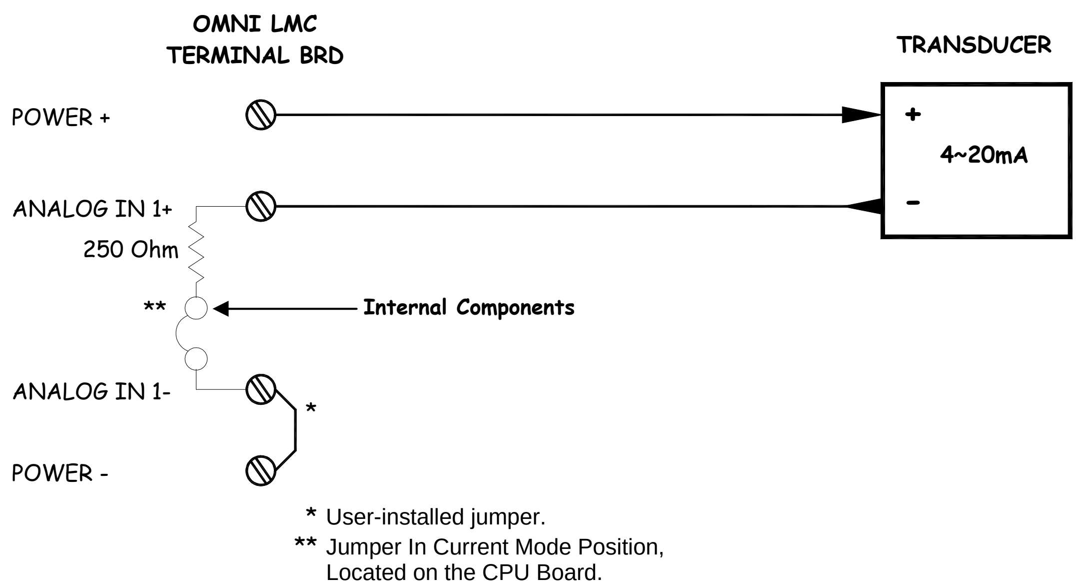

Figure 6-1. Wiring a 4–20mA transducer signal to LMC Analog Input #1 in a high-leg wiring configuration.

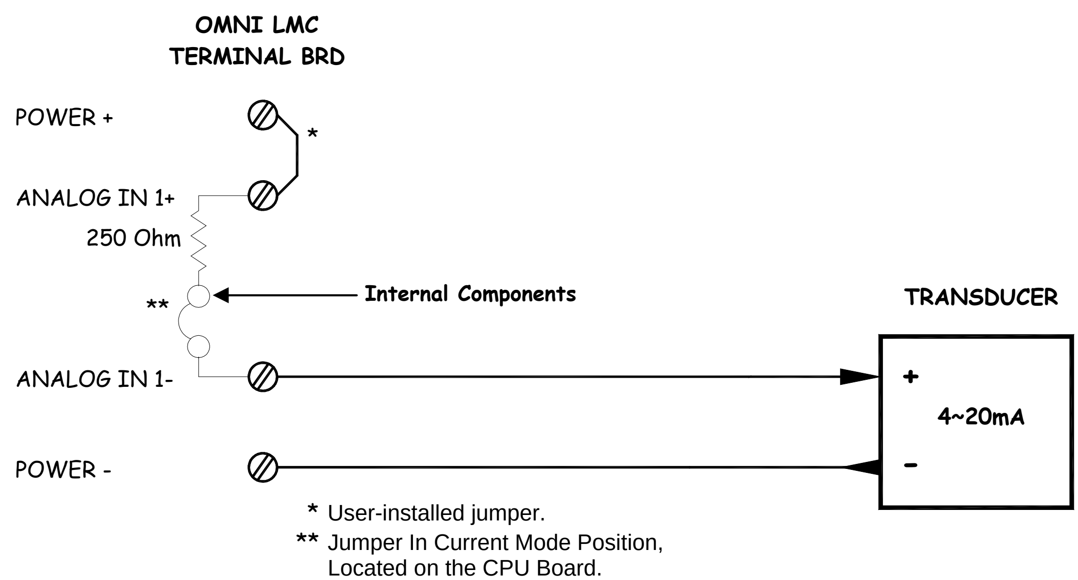

Figure 6-2. Wiring a 4–20mA transducer signal to LMC Analog Input #1 in a low-leg wiring configuration.

6.2. RTD Probes

READ THE DOCUMENTATION!

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

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 LMC using analog inputs #1 and/or #2. See Section 4.1.1 "Analog Inputs" for required jumper settings. Wire the two LMC excitation current source outputs to the corresponding RTD probe inputs. Also, configure the LMC using SmartCom software for either the DIN curve (α = 0.00385) or the American curve (α = 0.00392). For more information, see Section 4.1 "Analog I/O Signals".

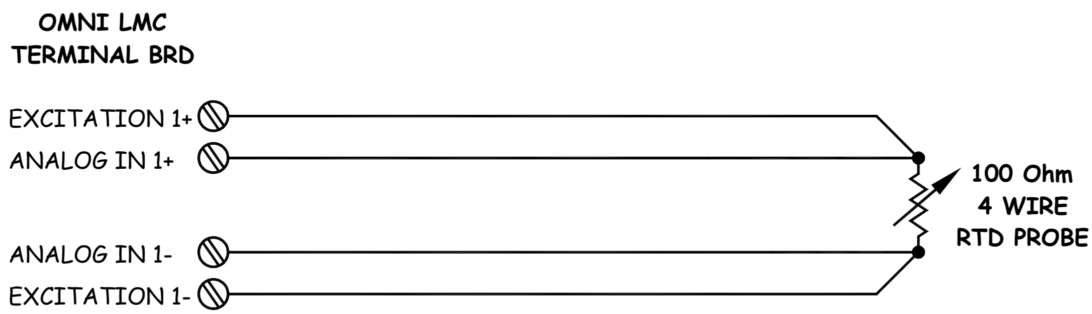

Figure 6-3. Wiring a 100Ω RTD probe to LMC Analog Input #1 and Excitation Output #1 in a 4-wire configuration.

6.3. Frequency Pulse Densitometers

The LMC 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.

LMC density pulse input impedance is 10kΩ. The densitometer must output 1.5 volts peak-to-peak to reliably trigger the LMC 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 LMC. Figure 6-5 and Figure 6-7 show examples of wiring Solartron densitometers to the LMC with safety barriers.

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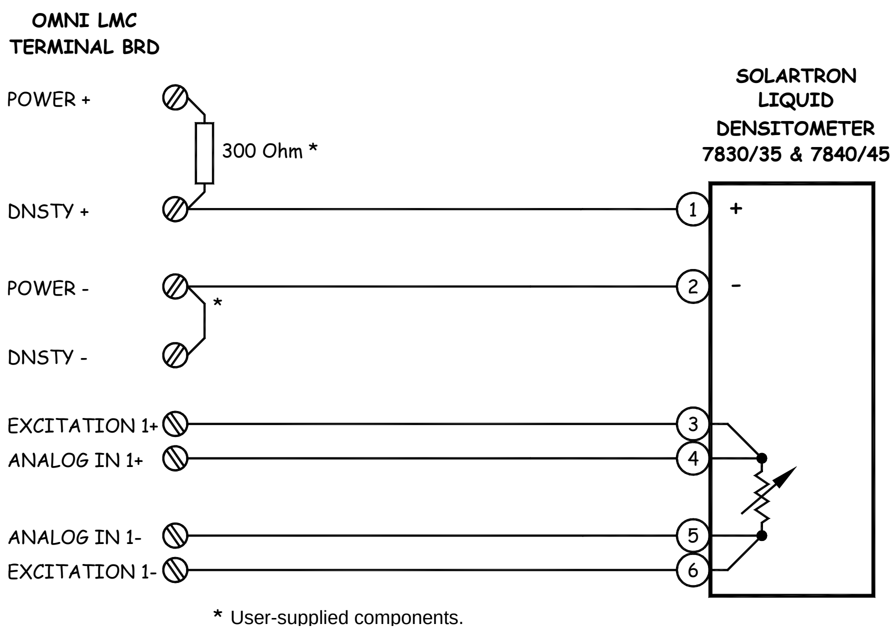

Figure 6-4. Wiring Solartron® 7830/35 and 7840/45 Liquid Density Transducers to the LMC.

READ THE DOCUMENTATION!

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

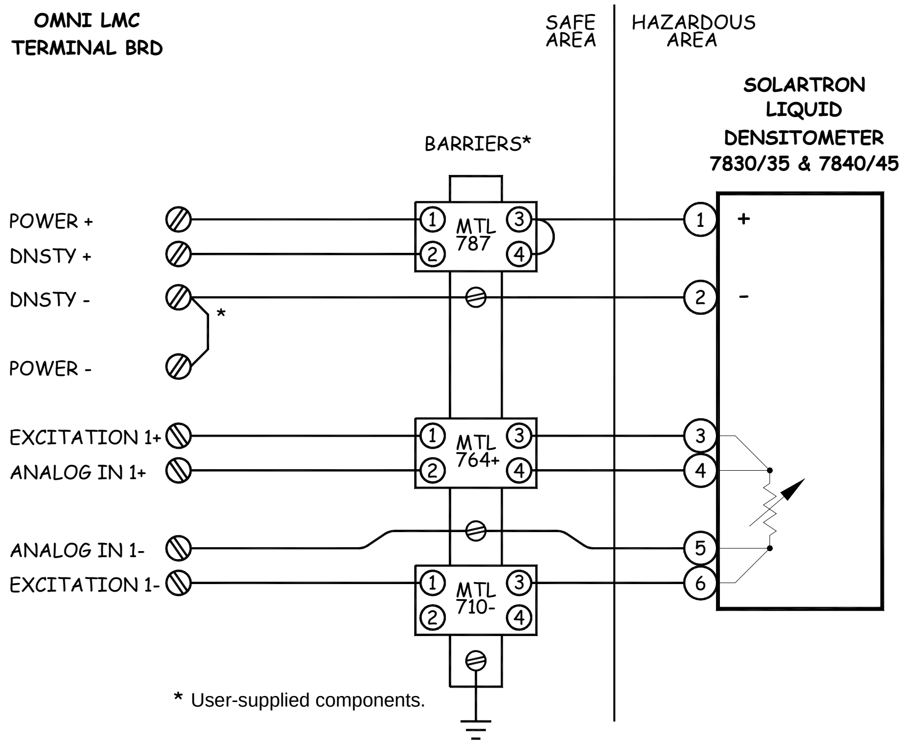

Figure 6-5. Wiring Solartron® 7830/35 and 7840/45 Liquid Density Transducers to the LMC with safety barriers.

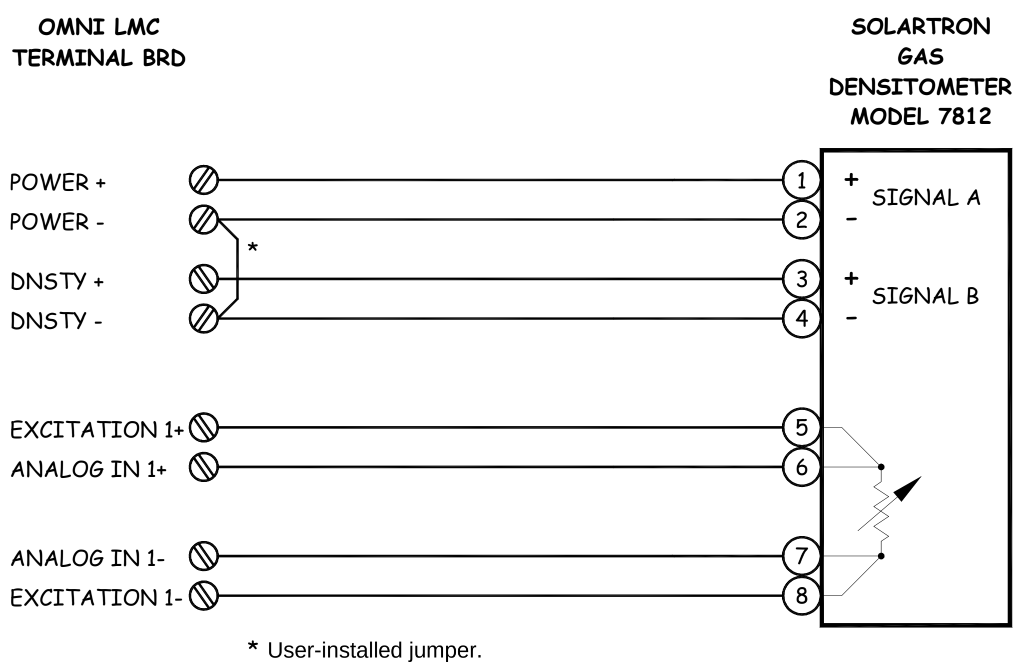

Figure 6-6. Wiring Solartron® 7812 Gas Density Transducers to the LMC.

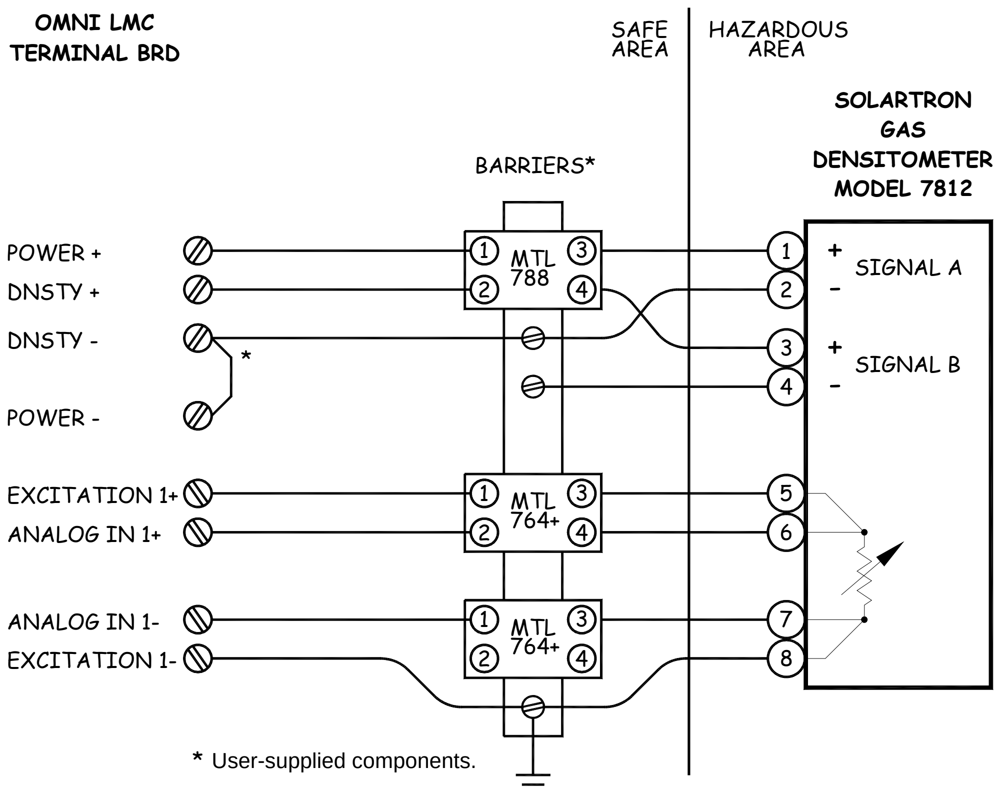

Figure 6-7. Wiring Solartron® 7812 Gas Density Transducers to the LMC with safety barriers.

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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 LMC without and with safety barriers.

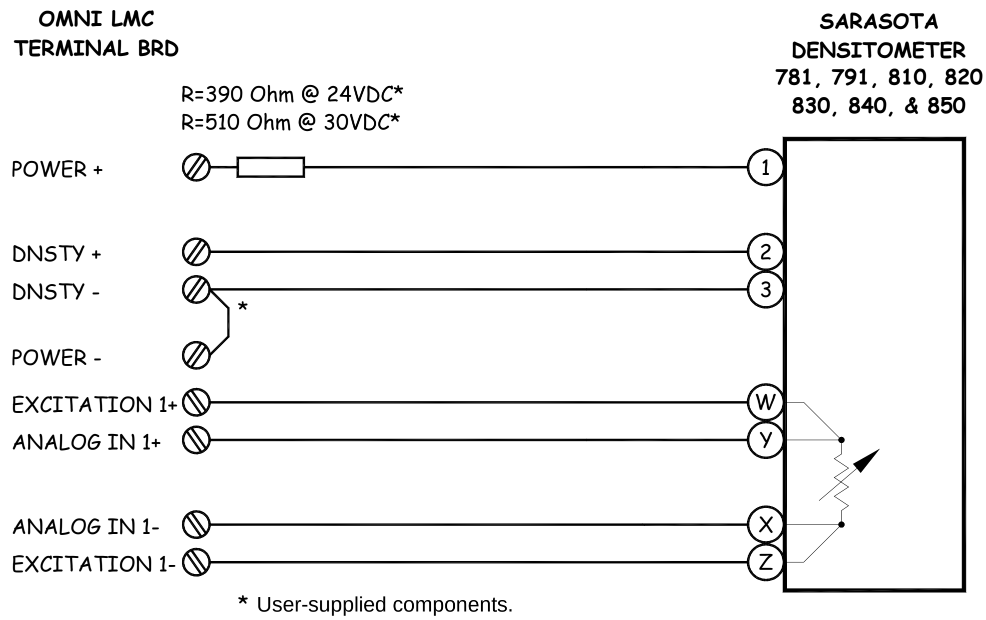


Figure 6-8. Wiring Sarasota® Liquid Density Transducers to the LMC.

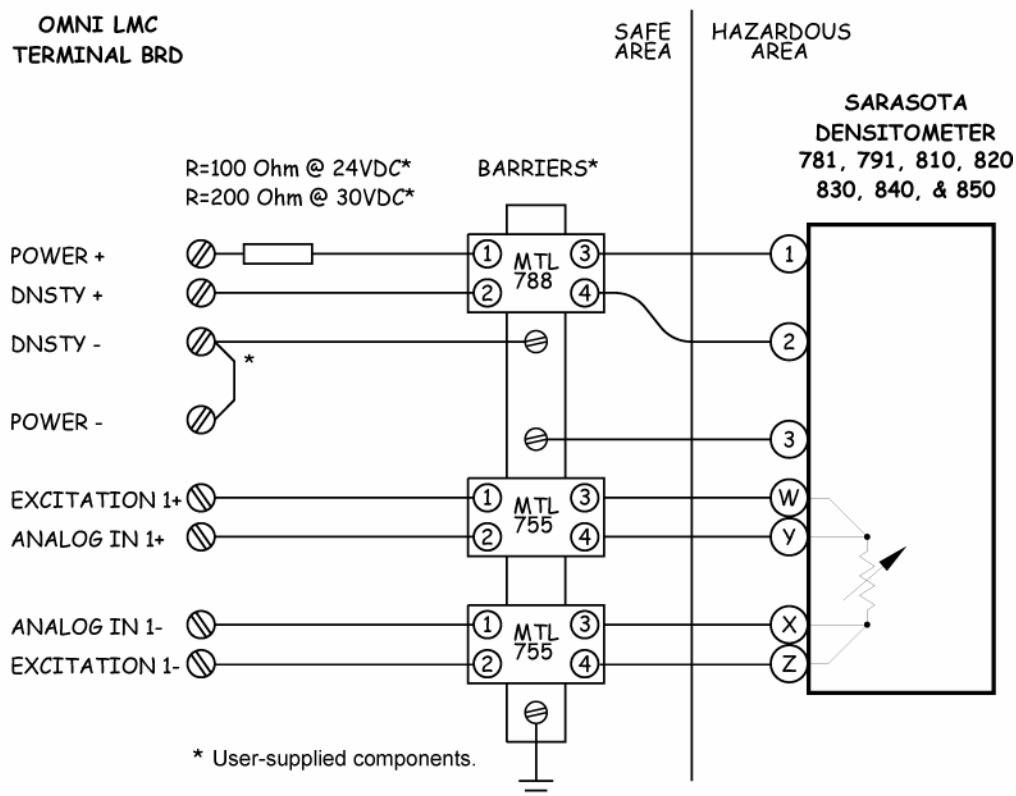
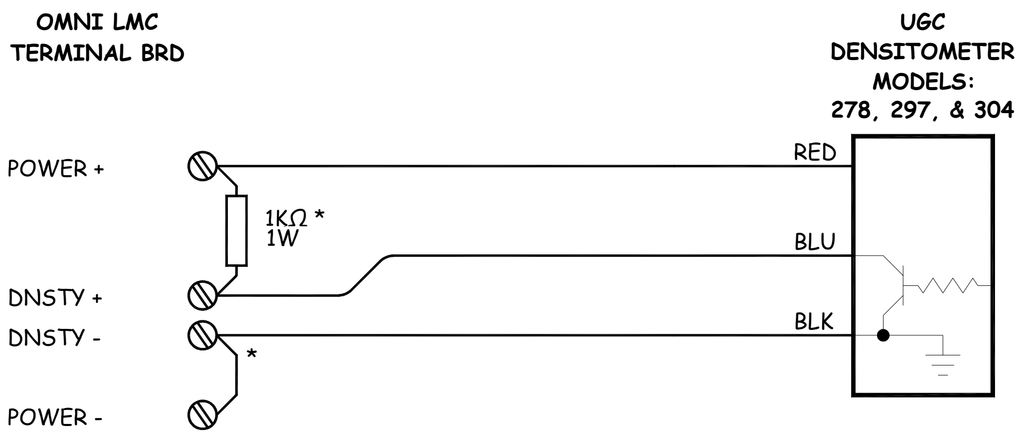


Figure 6-9. Wiring Sarasota® Liquid Density Transducers to the LMC with safety barriers.

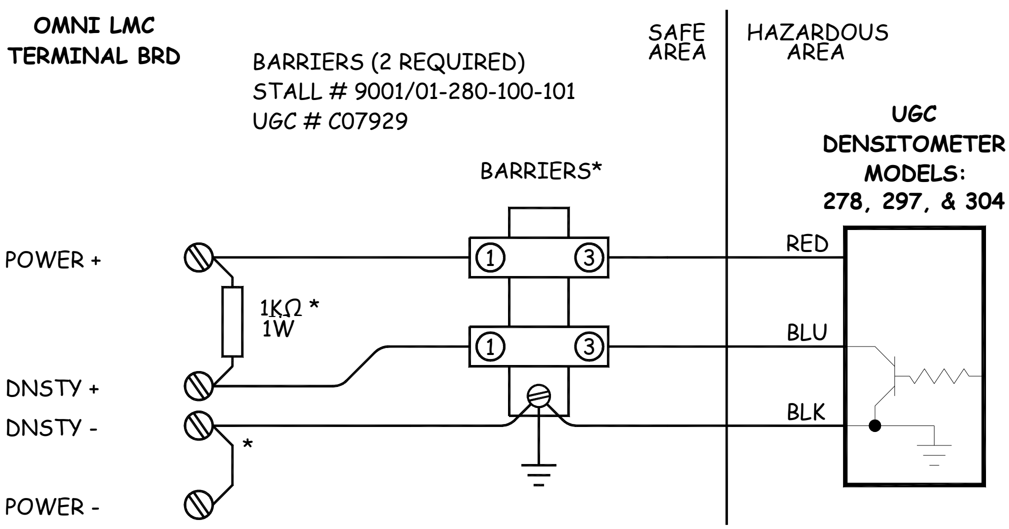
6.3.3. UGC® Densitometers

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 LMC without and with safety barriers.



* User-supplied components.

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



* User-supplied components.

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

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7 Connecting Provers

The LMC 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 LMC Digital Input #6 to connect prover detector switches.** In addition to the setup described in this chapter, you will need to further configure the LMC 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 LMC.

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 LMC 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.

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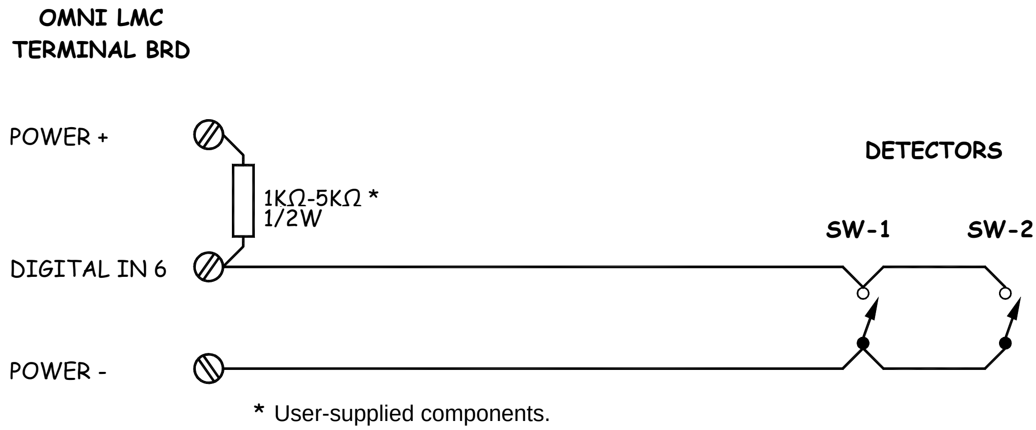

Figure 7-1. Wiring normally open conventional pipe prover detector switches to LMC Digital Input #6. **(Configure SmartCom for positive edge trigger)**

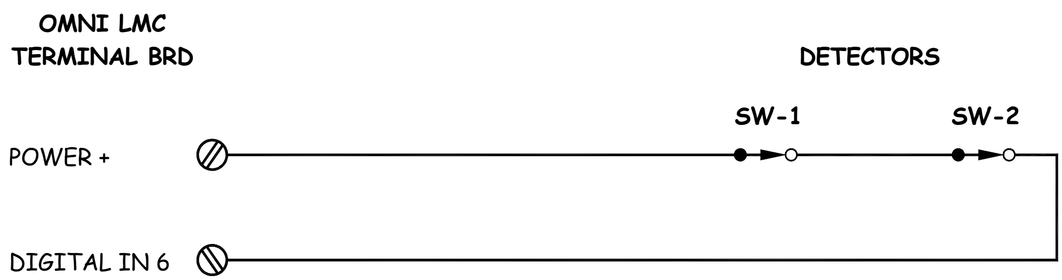

Figure 7-2. Wiring normally closed conventional pipe prover detector switches to the LMC Digital Input #6. **(Configure SmartCom for negative edge trigger)**

7.2. Small Volume 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 classified as either unidirectional or bi-directional.

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 case Figure 7-3 also applies.

READ THE DOCUMENTATION!

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

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 between 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 a double-chronometry reading to be acceptable, both timers must collectively accumulate at least 20,000 clock pulses during the proving run. The LMC 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 LMC for double chronometry proving. Use only Digital Input #6 to connect prover detector switches.

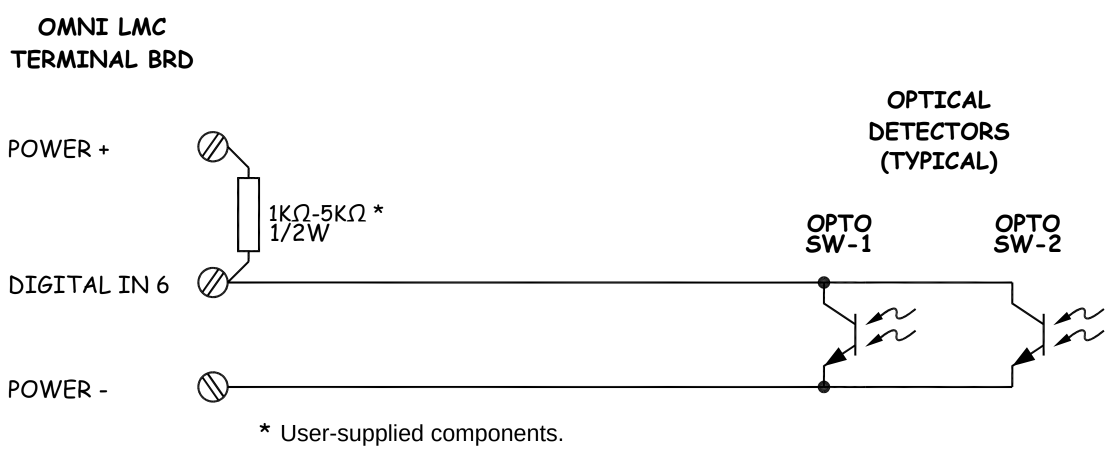

Figure 7-3. Wiring small volume prover detector switches to the LMC for double chronometry proving. **(Configure SmartCom for negative edge trigger)**

7.2.2. Brooks® Compact Provers

The Brooks® Compact Prover is a popular 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 LMC I/O terminals.

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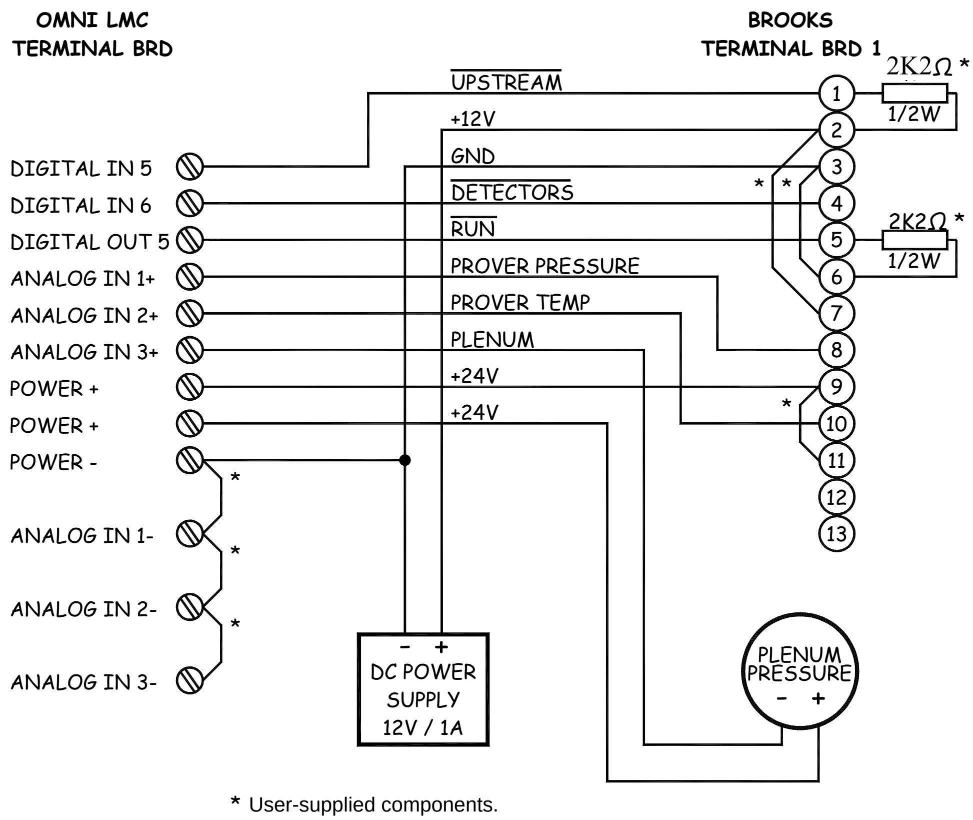

Figure 7-4. Wiring a Brooks® Compact Prover to the SmartBus LMC.

7.2.3. Calibron Systems SYNCROTRACK® Flow Provers

The Calibron SYNCROTRACK® Flow Prover is another popular 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 SYNCROTRACK® Flow Prover to the LMC I/O terminals.

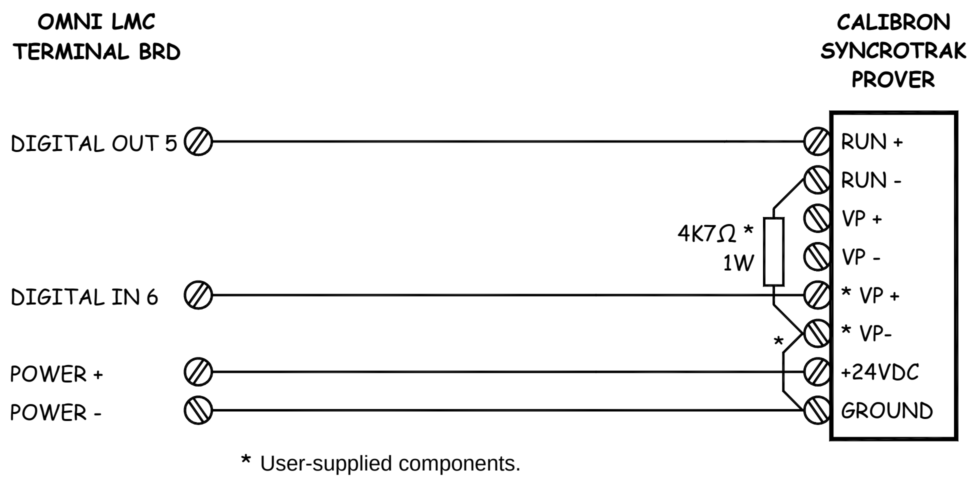

Figure 7-5. Wiring a Calibron SYNCROTRACK® Flow Prover to the SmartBus LMC.

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 LMC is compatible with a large number of electronic devices. This chapter describes how to connect the LMC 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 LMC using SmartCom software.

8.1. LMC Analog Outputs

The LMC 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 LMC 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 LMC 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 LMC.

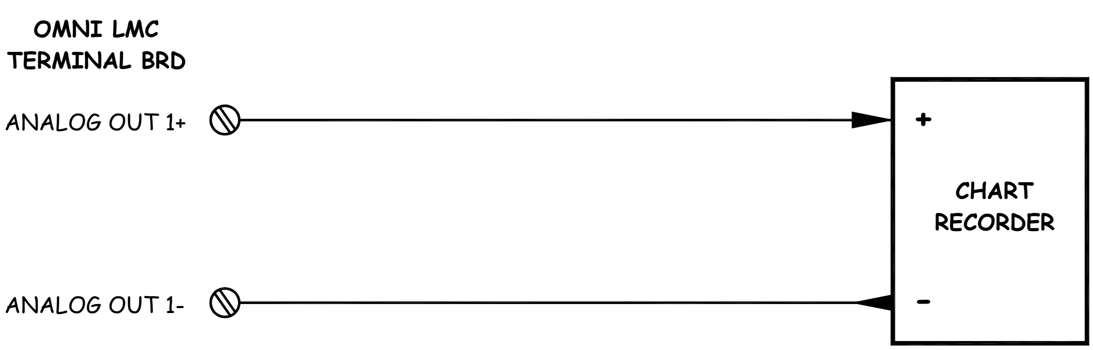

Figure 8-1. Wiring a standard chart recorder to LMC Analog Output #1.

8.2. Miscellaneous Digital I/O Devices

Six LMC status inputs and six LMC 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 LMC digital I/O are common with the LMC DC power terminals. For more details, refer to Section 4.3 "Digital I/O Signals".

The LMC 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 LMC digital I/O as an input. Figure 8-3 is an example of wiring an LMC digital I/O as an output.

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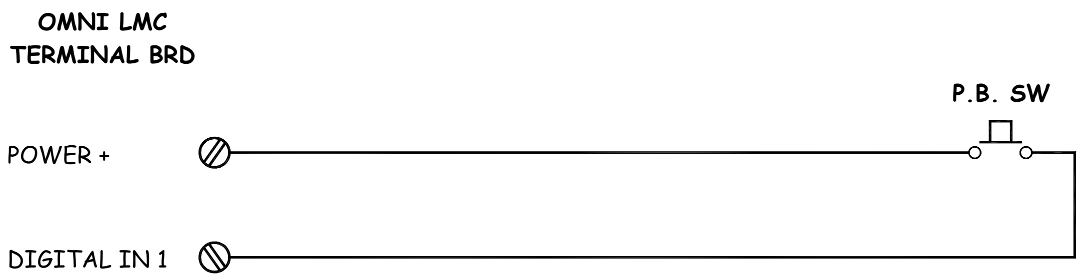

Figure 8-2. Wiring a pushbutton switch to LMC Digital Input #1.

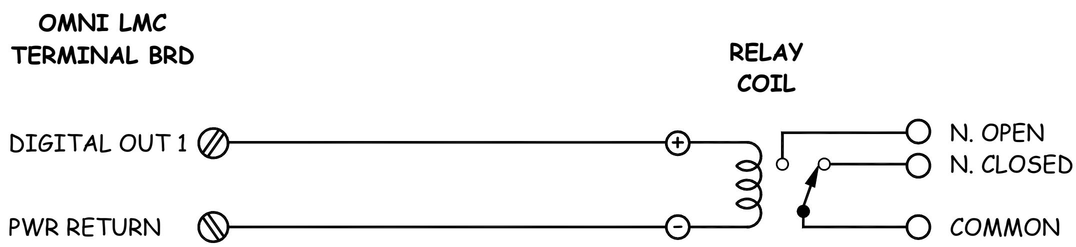

Figure 8-3. Wiring a relay coil to LMC Digital Output #1 and to an LMC DC return terminal.

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 LMC.

The LMC provides two standard (EIA/TIA) RS-485 serial ports (Serial Ports 1 & 3)and three selectable RS-485/RS-232 serial ports (Serial Ports 2, 4, & 5) for connecting to serial I/O devices.

Select the required communication type for each serial port via jumpers on the processor board, see Section 4.4.1 "Serial Port Jumper Settings".

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

8.3.1. RS-232 Serial Ports 2, 4, & 5

RS-232 serial communications allows interconnect to printers, PCs/laptops, and Supervisory Control and Data Acquisition (SCADA) systems. Connect these devices to an LMC 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 LMC database.

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

Serial Ports 4 & 5 are 9-pin Male D-Sub connectors located on the LMC Chassis Back Panel. There are two categories of devices that use serial cables for communication - DCE (Data Communications Equipment) and DTE (Data Terminal Equipment). DCE is a device such as a modem, plotter etc., while DTE is a Printer, Computer or Terminal, etc. The LMC RS-232 serial ports are of type DTE and provide communications between the LMC and other DTE or DCE devices. Figure 8-7 thru Figure 8-12 provides cable wiring diagrams for these two categories of devices.

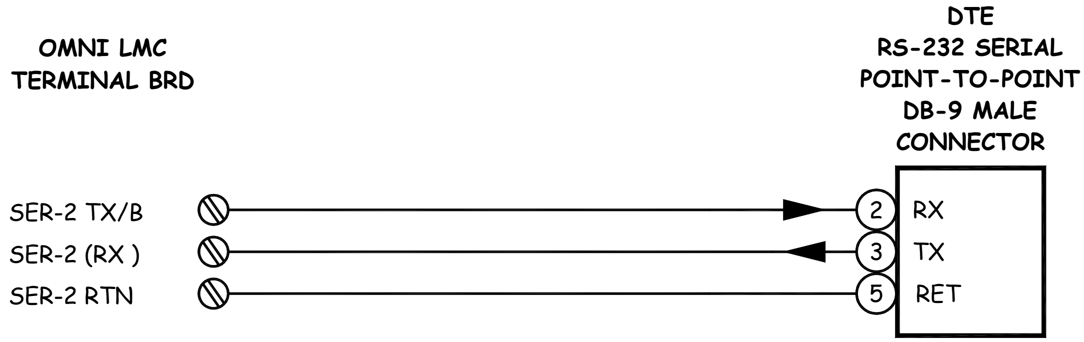

Figure 8-4. Wiring a miscellaneous serial device or a computer COM port in a point-to-point configuration to LMC Serial Port #2 selected as a RS-232 serial interface.

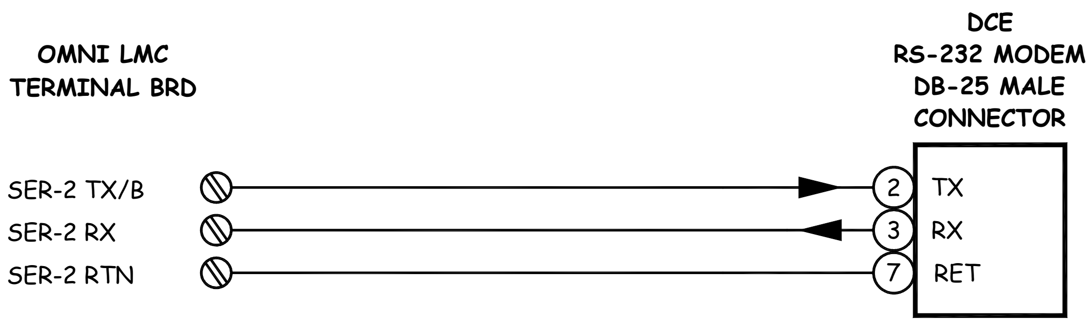

Figure 8-5. Wiring a miscellaneous serial device via modem to LMC Serial Port #2 selected as a RS-232 serial interface.
Note: *In DCE Devices, the TX signal behaves as a RX and the RX signal behaves as a TX.*

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READ THE DOCUMENTATION!

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

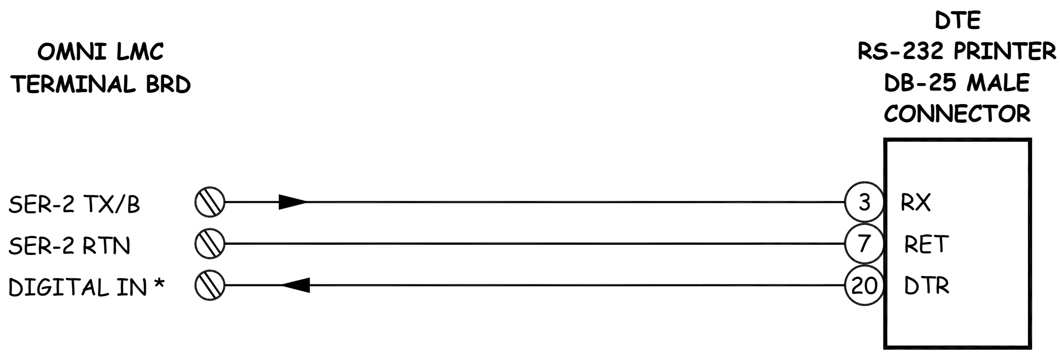

Figure 8-6. Wiring a printer to LMC Serial Port #2 selected as an RS-232 interface.

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

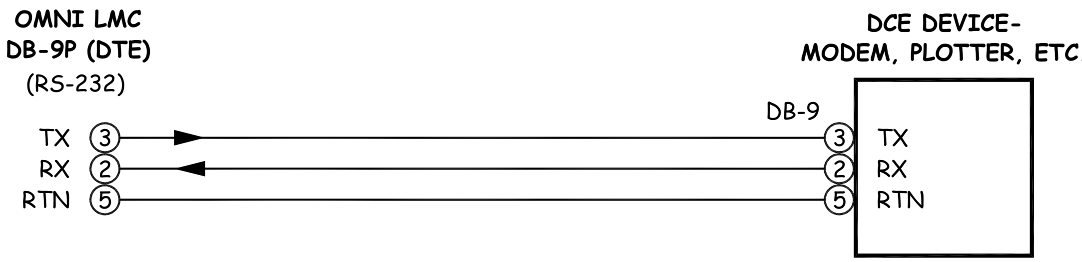

Figure 8-7. Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 9-pin DCE Device such as a Modem, Printer, Plotter, etc.
Note: *In DCE Devices, the TX signal behaves as a RX and the RX signal behaves as a TX.*

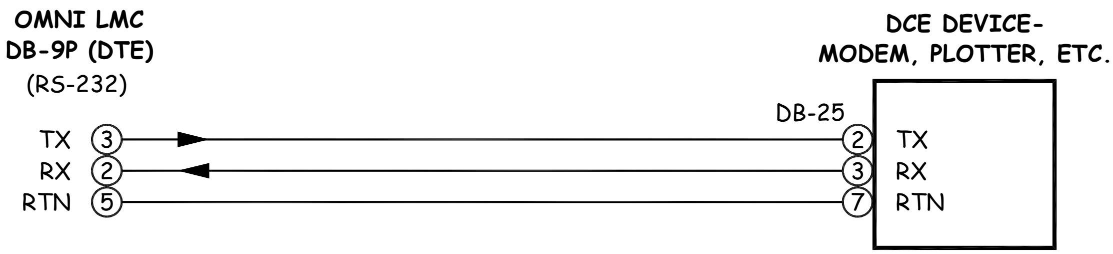

Figure 8-8. Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 25-pin DCE Device such as a Modem, Plotter, etc.
Note: *In DCE Devices, the TX signal behaves as a RX and the RX signal behaves as a TX.*

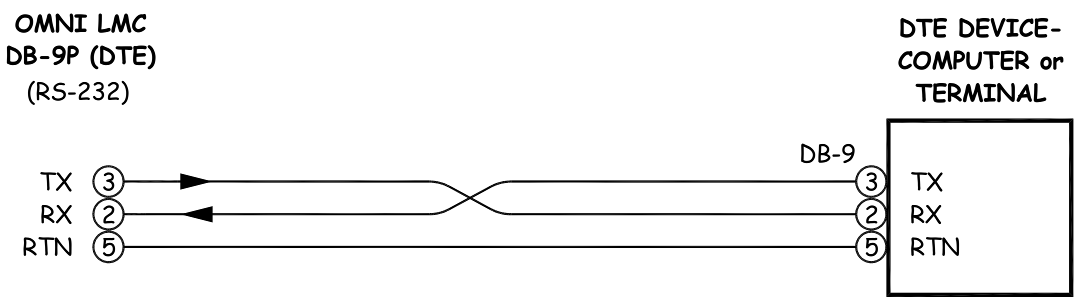

Figure 8-9. Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 9-pin DTE Device such as another Computer or Terminal.

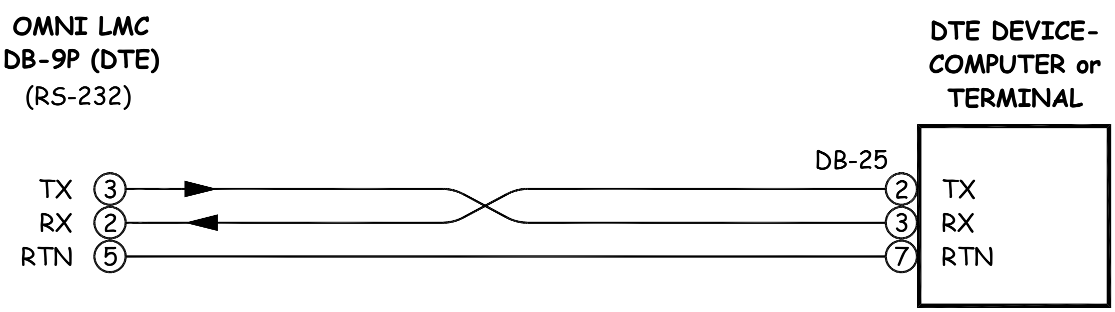

Figure 8-10 Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 25-pin DTE Device such as another Computer or Terminal.

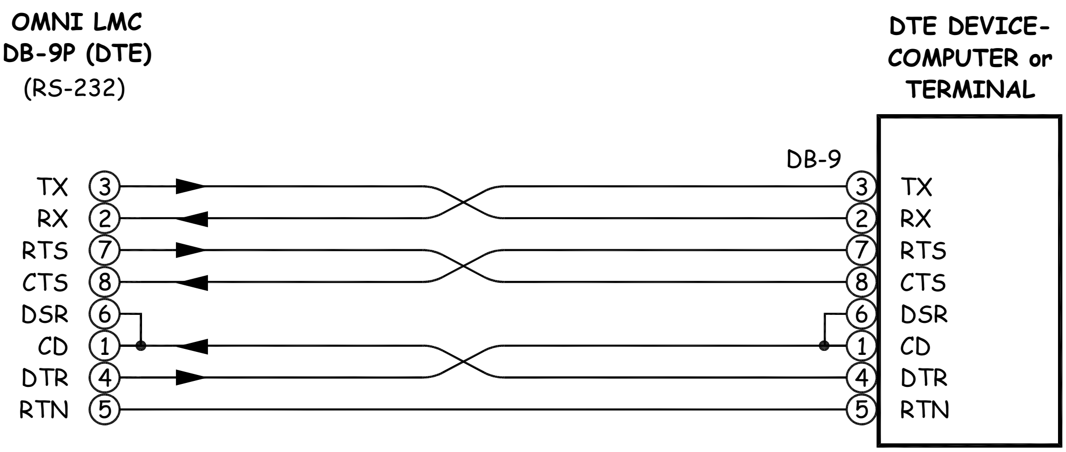

Figure 8-11 Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 9-pin DTE Device such as another Computer or Terminal that supports Hardware Handshaking.

RS-485 Serial Device Connectivity

Some serial devices that connect to the LMC 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 LMC; i.e., the LMC A channel is wired to the B channel of the connecting device, and the LMC B channel to the device's A channel. Always consult the manufacturer's documentation before connecting any devices to the LMC.

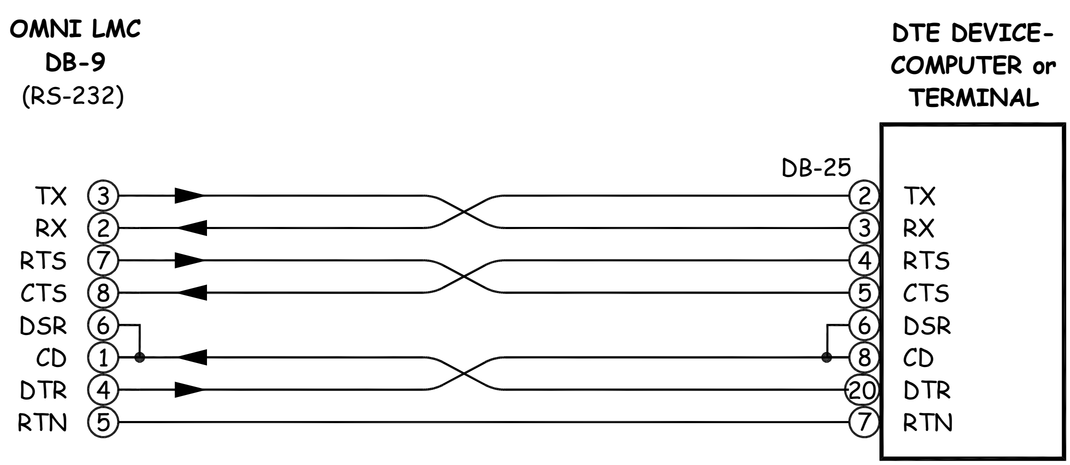

Figure 8-12 Wiring diagram for connecting LMC Serial Ports 4 or 5 to a 25-pin DTE Device such as another Computer or Terminal that supports Hardware Handshaking.

8.3.2. RS-485 Serial Ports

Each LMC 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 to multiple LMCs, PLCs, multivariable transmitters, and other devices in a point–to–point configuration and in multidrop lines.

Figure 8-13 is an example of wiring a serial device to LMC RS-485 Serial Port 1 (2 or 3) located on the I/O Terminal Board. Figure 8-14 is an example of wiring a serial device to Serial Port 4 or 5 located on the Chassis Back Panel.

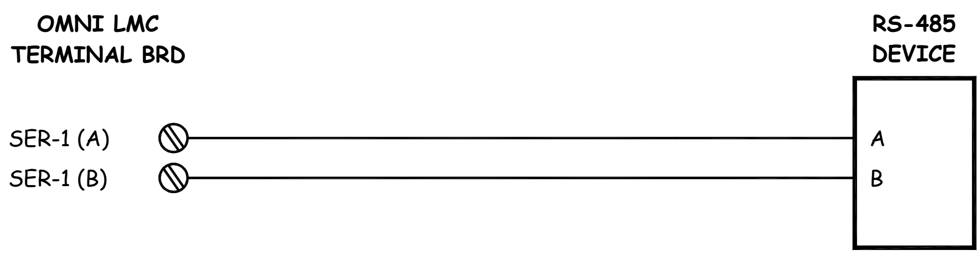

Figure 8-13 Wiring a miscellaneous serial device to an LMC RS-485 serial port.

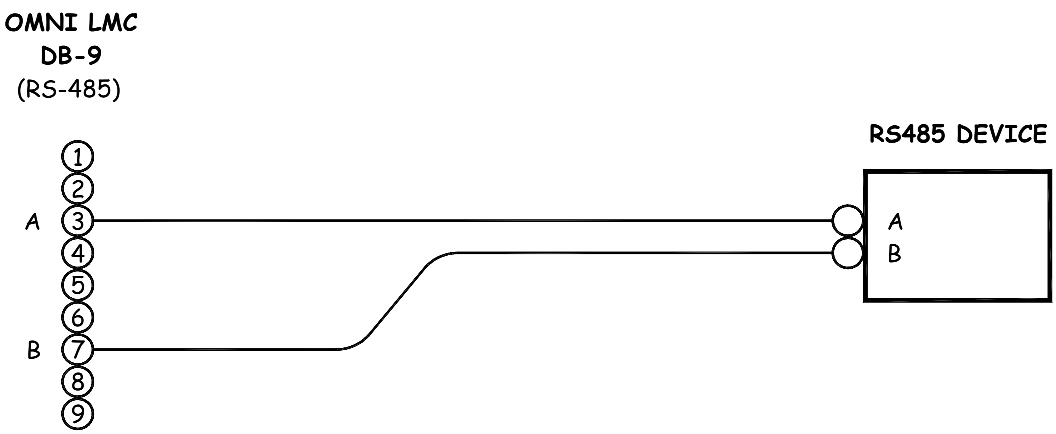

Figure 8-14 Wiring diagram for connecting LMC Serial Ports 4 or 5 to a RS485 Device.

8.4. Gas Chromatographs

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SmartBus LMCs provide connectivity for Daniel Industries Danalyzer® and Applied Automation® brands of gas chromatographs (GCs). These GCs connect to LMC 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 qualitatively and quantitatively determine the composition and individual components 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 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 8-15 and Figure 8-16 illustrate how to wire a Danalyzer controller to the LMC.

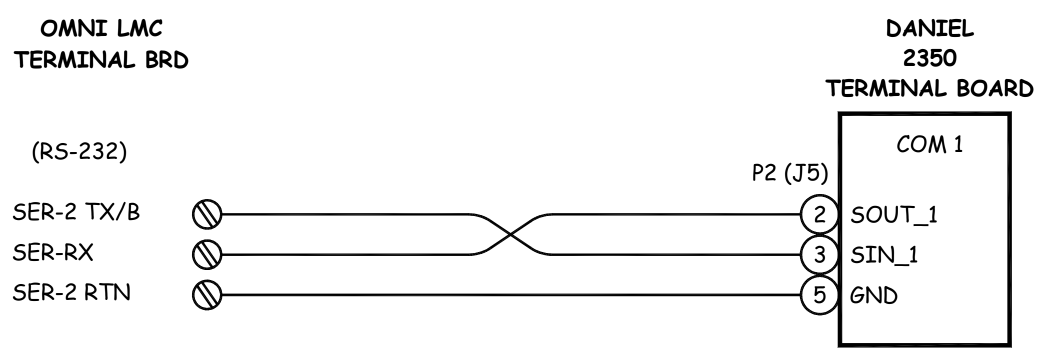

Figure 8-15. Wiring a Danalyzer GC controller to LMC Serial Port #2 configured as an RS-232 interface.

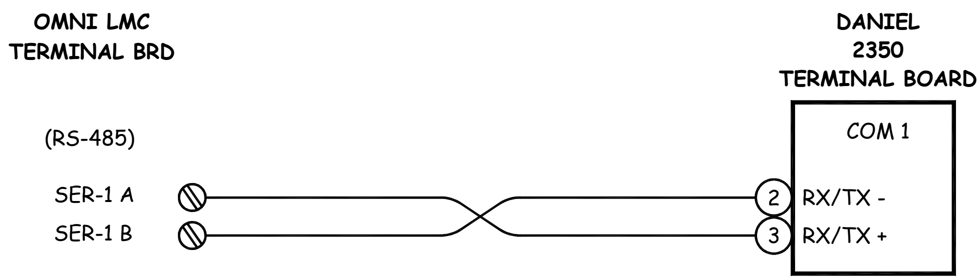

Figure 8-16. Wiring a Danalyzer GC controller to an LMC RS-485 serial port.

8.4.2. ABB Totalflow® Process Gas Chromatograph Systems

ABB Totalflow® GC systems have a modular design. Newer models provide enhanced modularity, automatic application detection, complete chromatogram capture and peak detection, backward compatibility, "point and click" and "plug and play" features, and parallel chromatography. Figure 8-17 and Figure 8-18 respectively illustrate how to wire an ABB® BTU GC system to an LMC serial port selected as an RS-232 and an RS-485 interface.

READ THE DOCUMENTATION!

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

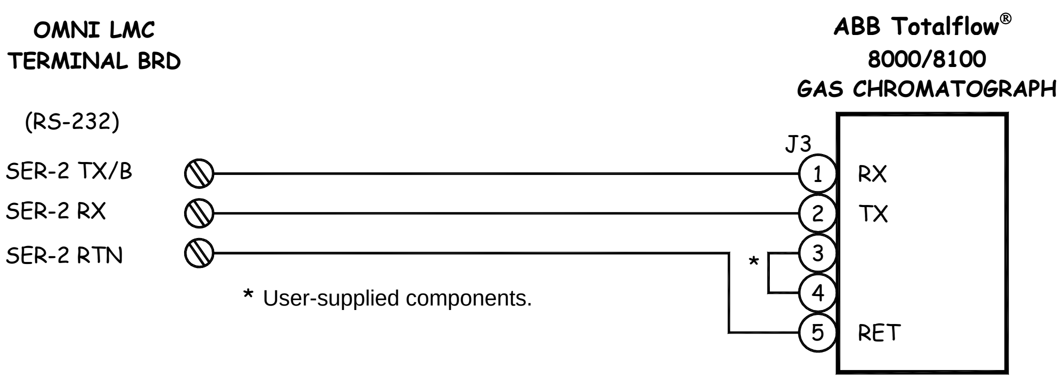

Figure 8-17. Wiring an ABB Totalflow® GC system to LMC Serial Port #2 configured as an RS-232 interface.

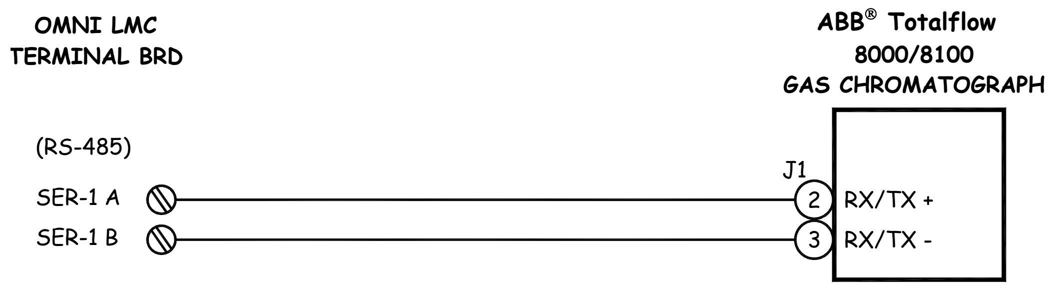

Figure 8-18. Wiring an ABB Totalflow® GC system Serial Port #1 to LMC configured as an RS-485 interface.

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9

I/O Terminal Board

IN CHAPTER 9

Information on Remote I/O Terminal Board:

The LMC I/O Terminal Board is an interface between the LMC and Field Wiring. A custom "Y" cable assembly is provided, routing I/O signals between the LMC Back Panel and the I/O Terminal Board which allows easy access for field wiring of multiple sensors, serial ports.

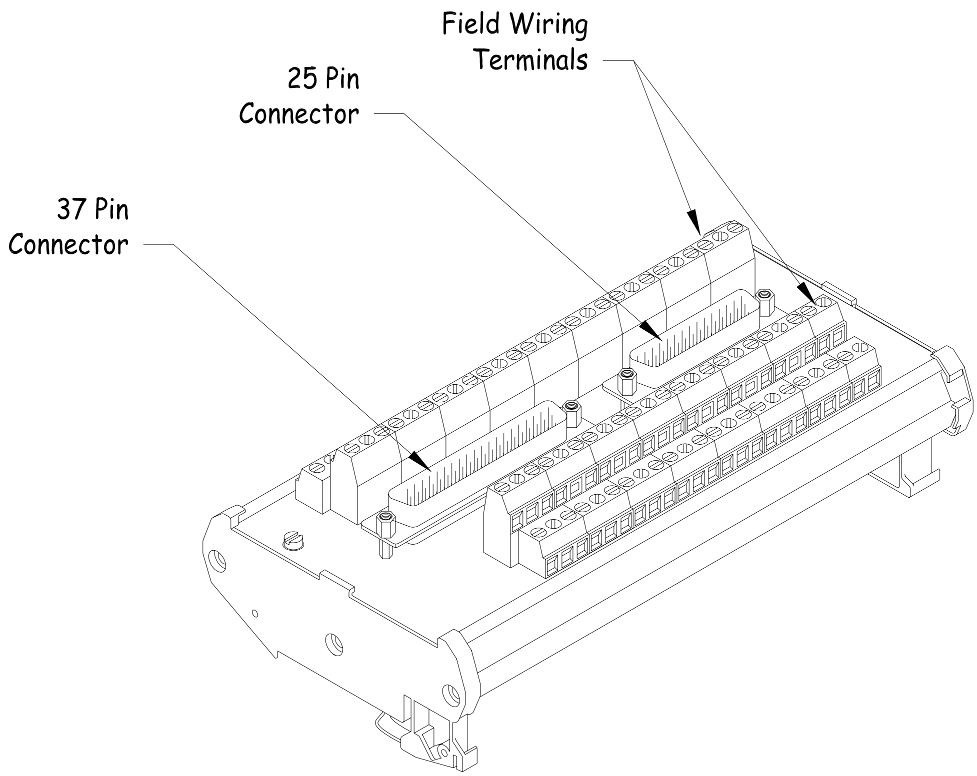

Figure 9-1. I/O Terminal Board Assembly. (P/N 21300003)

1. I/O Terminal Board Design Features

All signals routed in and out of the LMC from the "Field" are connected with Cage-Clamp Screw Terminals on the I/O Board. These terminals will accept wire size from 26 to 14 AWG (0.14 to 2.5 mm^2). Each input/output signal is labeled above the corresponding terminal on the I/O Board. These signals include the following:

- Power (18 to 30 VDC, fused at 1.25A 2AG slow blow) with an LED Power On Indicator
- 8 Analog Inputs
- 2 Analog Outputs
- 2 RTD Excitation
- 6 Digital
- 6 Digital Outputs
- 4 Flow Pulse Inputs
- 2 Density Inputs
- 3 Serial Ports
- 10 DC Power Outputs (100mA Fused) and Returns.

  (These DC Outputs are provided for the user to power any device sinking ≤100mA)

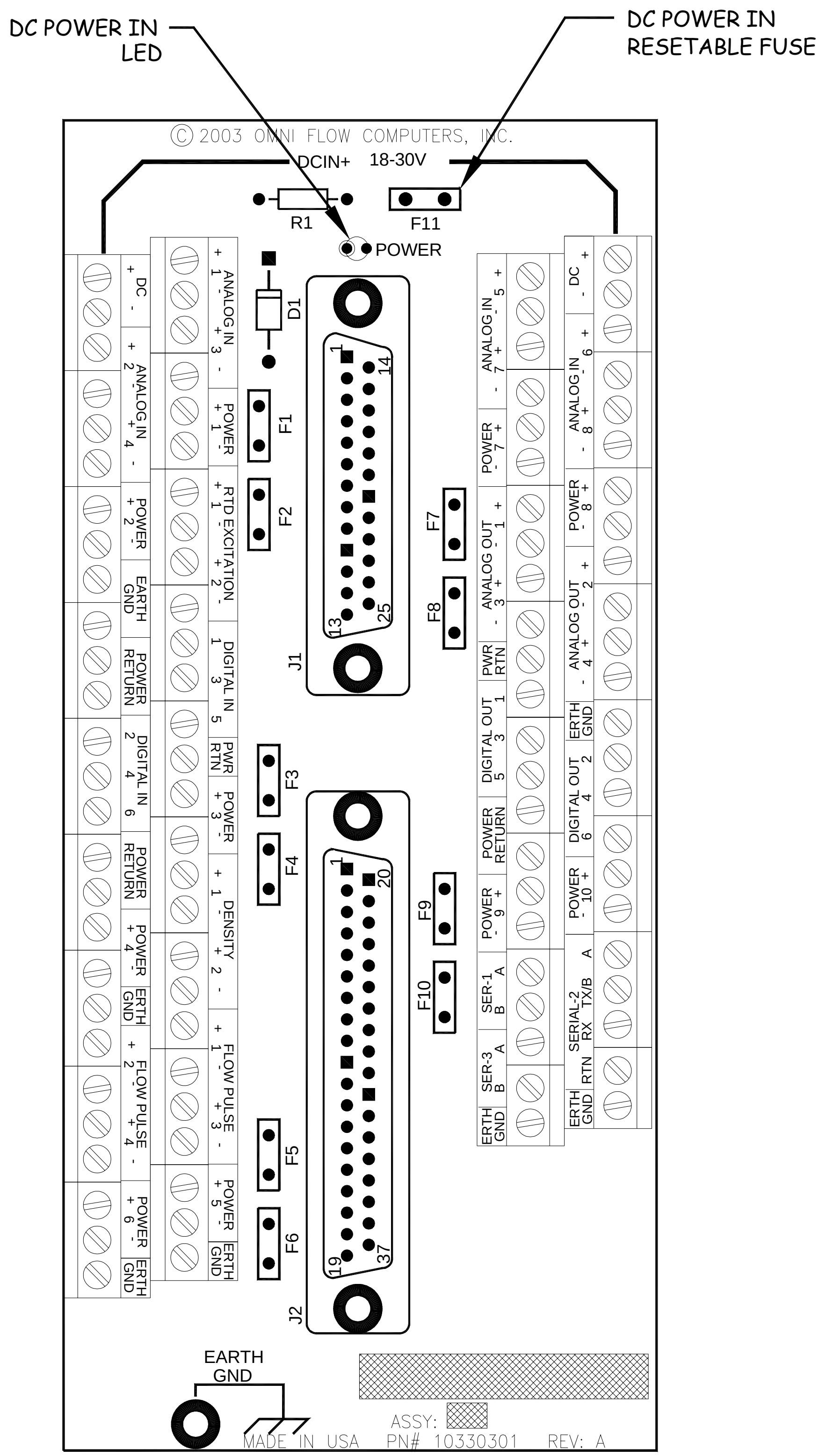

Figure 9-2. LMC I/O Terminal Board. (P/N 21300003)

9.1. I/O Terminal Board Cabling

The I/O Terminal Board Assembly is designed to be mounted onto either a 35mm DIN rail (per EN 50 022) or 32mm DIN rail (per EN 50 035). The maximum mounting distance from the LMC Chassis shall not exceed 22 feet (6.7m). An I/O "Y" cable is supplied with the LMC to handle most of your signal I/O. Cables are not supplied for either the 10/100BaseT Ethernet or Serial Ports (4&5) on the Back Panel. These cables are customer supplied items.

9.1.1. I/O "Y" Cable

The I/O "Y" Cable is routed from the LMC Back Panel to the I/O Terminal Board. The "Y" cable assembly has two molded D-Sub connectors on one end that plug into mating connectors on the I/O Terminal Board, the other end of the cable has a single D-Sub connector on the end that plugs into a mating connector on the LMC Back Panel. Select length required from Table 8.1 below.

If a customer supplied I/O termination fixture is required (the LMC I/O Terminal Board is not installed), the two D-Sub connectors can be cut-off and wires terminated discretly. The blunt-cut end is then stripped and terminated using ferules. Each wire inside the cable assemblies are unique in color; no two wires have the same color assignment. Follow the Wiring Color Code Chart in Tables 9-2 and 9-3.

CABLING NOTE:

Cable Assemblies are available in 5, 10, 15, and 25 foot lengths.

Select one Cable Assembly according to length required for installation.

Table 9-1. I/O "Y" Cable Selection Chart.

Length Required	Omni Part No.
5 Foot	K0216205
10 Foot	K0216210
15 Foot	K0216215
25 Foot	K0216225

9.1.2. Cable Installation

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

9.2. Installation Procedure

9.2.1. LMC with I/O Board Assembly

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1. Select mounting position for the LMC.
2. Select a secure mounting location for the I/O Terminal Board Assembly *with access to earth grounding* (customer supplied).
3. Determine cable length required.
   Note*: Maximum cable length is 25 foot.*
4. Attach the "Y" Cable Assembly to the Signal I/O Connector on the Back Panel.
5. Attach Ethernet and Serial Cables (if required) to the Back Panel.
6. Carefully route the cable(s) to the I/O Terminal Board area.
7. Secure the cable(s) with cable-ties to provide a strain relief.

9.2.2. LMC with customer supplied I/O Termination

1. Mount LMC as described above, steps 1, 3 thru 7.
2. If discrete wire termination is required for installation, cut the two D-Sub connectors off of the "Y" Cable assembly and follow the Wiring Chart in Tables 9-2 and 9-3.

Table 9-2. I/O Cable Pin Out - Color Code (DB25 end)

DC62 Pin #	SIGNAL	COLOR	DB25 Pin #
6	Analog In 1+	LtGrn/Brn	1
28	Analog In 1-	LtGrn/Brn/Blk	2
27	Analog In 2+	LtGrn/Red	3
48	Analog In 2-	LtGrn/Red/Blk	4
4	Analog In 3+	LtGrn/Org	5
5	Analog In 3-	LtGrn/Org/Blk	6
26	Analog In 4+	LtGrn/Yel	7
47	Analog In 4-	LtGrn/Yel/Blk	8
7	Excitation 1+	Yel/Brn	9
29	Excitation 1-	Yel/Brn/Blk	10
49	Excitation 2+	Yel/Red	11
50	Excitation 2-	Yel/Red/Blk	12
25	Analog In 5+	LtGrn/	14
46	Analog In 5-	LtGrn/	15
24	Analog In 6+	LtGrn/	16
45	Analog In 6-	LtGrn/	17
23	Analog In 7+	LtGrn/	18
44	Analog In 7-	LtGrn/	19
2	Analog In 8+	LtGrn/	20
3	Analog In 8-	LtGrn/	21
9	Analog Out 1+	Org/Brn	22
10	Analog Out 2+	Org/Red	23
30	Analog Out 3+	Org	24
51	Analog Out 4+	Org/Yel	25
8	Analog Out Rtn	Org/Blk	13

Table 9-3. I/O Cable Pin Out - Color Code (DC37 end)			
DC62 Pin #	**SIGNAL**	**COLOR**	**DC37 Pin #**
1	DC Power In +	Red	1
22	DC Power In –	Blk	2
20	DC Power In +	Red	3
21	DC Power In –	Blk	4
31	Digital In 1	LtBlu/Brn	5
32	Digital In 2	LtBlu/Red	6
52	Digital In 3	LtBlu/Org	7
53	Digital In 4	LtBlu/Yel	8
11	Digital In 5	LtBlu/Grn	9
33	Digital In 6	LtBlu/Blu	10
12	Digital Out 1	Gry/Brn	20
54	Digital Out 2	Gry/Red	21
34	Digital Out 3	Gry/Org	22
55	Digital Out 4	Gry/Yel	23
56	Digital Out 5	Gry/Grn	24
57	Digital Out 6	Gry/Blu	25
15	Serial 1-A	Wht/Brn	26
16	Serial 1-B	Wht/Brn/Blk	27
38	Serial 2-A	Wht/Red	28
17	Serial 2 TX/B	Wht/Red/Blk	29
18	Serial 2 RX	Wht/Red/Red	30
19	Serial 2 Rtn	Wht/Blk	31
39	Serial 3-A	Wht/Org	32
40	Serial 3-B	Wht/Org/Blk	33
14	Density In 1+	Pnk/Org	11
13	Density In 1-	Pnk/Org/Blk	12
36	Density In 2+	Pnk/Yel	13
35	Density In 2-	Pnk/Yel/Blk	14
58	Flow Pulse 1+	Pnk/Brn	34
37	Flow Pulse 1-	Pnk/Brn/Blk	16
59	Flow Pulse 2+	Pnk/Red	35
60	Flow Pulse 2-	Pnk/Red/Blk	17
41	Flow Pulse 3+	Pnk/Grn	36
42	Flow Pulse 3-	Pnk/Grn/Blk	18
61	Flow Pulse 4+	Pnk/Blu	37
62	Flow Pulse 4-	Pnk/Blu/Blk	19

9.3. Grounding

A proper connection between the LMC I/O Terminal Board and earth-ground will help protect the metering system including the LMC, from electrical transients, lightning, and stray currents. The LMC and LMC 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 LMC Chassis and the 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.