MEASUREMENT

QRATE Scanner 3300 Integrated Control Flow Computer

Installation, Operation & Maintenance Manual

Manual No. 50343919, Rev. 01

INTELLIGENT ACTION

Important Safety Information

Symbols and Terms Used in this Manual

⚠	**WARNING**	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
	AVERTISSEMENT	Un avertissement identifie des informations sur des pratiques ou des circonstances pouvant entraîner des blessures corporelles ou la mort, des dommages matériels ou des pertes économiques.
⚠	**CAUTION**	Caution, risk of electric shock
	ATTENTION	Attention, risque d'électrocution

CAUTION	Indicates actions or procedures which if not performed correctly may lead to personal injury or incorrect function of the instrument or connected equipment.
Attention	Indiquez les actions ou les procédures qui, si elles ne sont pas effectuées correctement, peuvent entraîner des blessures ou un mauvais fonctionnement de l'instrument ou de l'équipement connecté.
Note	Indicates actions or procedures which may affect instrument operation or may lead to an instrument response which is not planned.
Remarque	Indique des informations supplémentaires sur des conditions ou des circonstances spécifiques pouvant affecter le fonctionnement de l'instrument.

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Revision History

Revision	Description of Change	Issuer	Approver	Date
01	Production Release	AK	AK	02/08/2021

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Section 1 - Introduction

About the QRATE Scanner 3300 Integrated Control Flow Computer

The QRATE Scanner 3300* integrated control flow computer is uniquely designed to serve as a stand-alone flow computer or as a network manager capable of collecting and storing data from up to 20 NUFLO Scanner 2000 series flow computers. As a stand-alone flow computer, the QRATE Scanner 3300 offers dual flow stream and bidirectional measurement and control, as well as the processing power to handle the industry's most challenging flow computations for liquid and natural gas measurement. For operations requiring the monitoring of several measurement points, the QRATE Scanner 3300 combines up to 20 external wired or wireless NUFLO Scanner 2000 series flow computers into a single scalable local area network that can be managed via a web browser-based interface. Each of the three serial ports can support multiple wired NUFLO Scanner 2000 series flow computers or other external Modbus devices.

The QRATE Scanner 3300 is designed to be panel mounted. If desired, the display has also been designed in such a way as to all the main enclosure to be mounted on a rack while the kiosk touch display is mounted a distance away from it. The optional wireless communications may reduce cost by negating the need of running Ethernet to the device.

The device is approved by CSA for ordinary locations. It is designed for use with a 9-30 VDC external power supply.

The QRATE Scanner 3300 device computes the corrected (standard) amounts of fluid using signals from external turbine, positive displacement (PD), Venturi, Coriolis and ultrasonic flow meters and integral or remote pressure and temperature sensors. The measured fluids may be expressed as volume, mass or energy accumulations, or rates. See Table 1.4—Flow Rate Standards, page 15 and Table 1.5—Fluid Property and Energy Flow Calculations, page 16 for a detailed description of supported calculations.

The QRATE Scanner 3300 kiosk touch display, when the device is connected via Ethernet or Wi-Fi, allows the user to fully configure it directly through the display. This simplifies the steps necessary for setup, and also simplifies any additional calibration or configuration in the future.

In addition to its two integral flow runs, the device supports 17 inputs and outputs and communications with chromatographs, samplers, and densitometers.

The device logs daily and hourly flow data for each flow run, and provides one-second triggered logging for analysis of critical events. High-speed communication via Modbus and Enron Modbus protocols makes it easy to integrate the QRATE Scanner 3300 into other measurement systems. When configured for use with Modbus master protocol, each of the device's three serial ports can log up to 128 data points from external Modbus devices.

For a complete list of specifications, see Specifications, page 8.

*Mark of Sensia

Web Browser-Based Interface

A web browser-based interface equips you to configure flow runs, gas streams, and inputs/outputs, calibrate inputs, and view archive data from the kiosk touch display, a laptop, tablet, smartphone, or other browser-enabled mobile device without installing software. You need only an Ethernet connection and an IP address to connect to the device. Four user security levels are available for customizing access for up to 20 users. An electronic user manual (PDF) is embedded in the interface, providing searchable on-screen help. To position the manual alongside the user interface for simultaneous viewing, configure your kiosk touch display per the instructions provided in the QRATE Scanner 3300 Web Interface User manual.

Supporting Software and User Help Documents

To experience the full range of the QRATE Scanner 3300's functionality, explore the complimentary software products and user documentation available on the Sensia website. See Table 1.3—Scanner Companion Software, page 14.

Important **To download software or user documentation, visit Sensia's Measurement website, https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, select QRATE Scanner 3000 series integrated control flow computers, and click on the link for the desired software installation or user manual.**

Feature Comparison

Item	QRATE Scanner 3100	QRATE Scanner 3300
Panel Mounted		✓
Kiosk Touch Interface		✓
# of Flow Runs	2 + 20 Remote	2 + 20 Remote
Integrated MVT	✓	
Wi-Fi Expansion	✓	✓
Wireless Smart Mesh	✓	✓
Ethernet	✓	✓
Power Over Ethernet (Non-Certified)		✓
eFuse Protection		✓
Smart Battery Support		
Processors	Dual-Core ARM Cortex M4	Dual-Core ARM Cortex M4 + Co-Processor M4
Core Processor Speed	96 MHz	100 MHz
Memory	2.18 Mbyte RAM 97.5 Mbyte Non-Volatile	8.18 Mbyte RAM 129.5 Mbyte Non-Volatile
Transmitter Supply	Fixed 10.5V	Programable 9 - 24 V
Analog Inputs	4 x [4-20mA / 1-5V]	4 x [4-20mA / 1-5V] 3 x [PI / TFM / 4-20mA]
Analog Outputs	2	2 + HART (Future)
High Frequency Outputs		2 x Digitally Isolated Up to 10 kHz ±1 Hz resolution
Digital I/O	4 x Optical Isolated 2 x High Current Pulse Output Max 50 Hz	4 x Digitally Isolated 2 x High Current Pulse Output Max 500 Hz

Figure 1.1 - Feature Comparison between the QRATE Scanner 3100 and QRATE Scanner 3300 devices

Standard Features

The QRATE Scanner 3300 features an enclosure with a terminal board for inputs/outputs, a WiFi module and antenna, and a large touch display. See Section 3 - Wiring the QRATE Scanner 3300 Integrated Control Flow Computer, page 49 for wiring diagrams.

Product Identification

Each device is labeled with a serial tag that identifies the product by model number and serial number (Figure 1.2). The tag content depicted illustrates the electrical protection afforded by CSA certification. CSA-approved products are marked accordingly with the respective ratings and symbols.

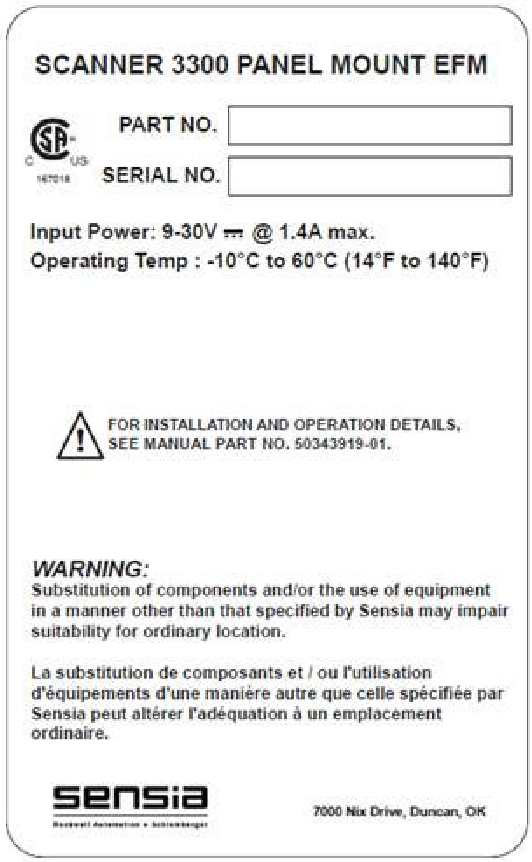

Figure 1.2 - Device serial tag

Hardware Options

The following hardware options are available for customizing the QRATE Scanner 3300 to your specific needs: panel mounting kit and wireless communication components. See the sections below for details.

⚠ **WARNING: PERSONAL RISK. Substitution of components and/or the use of equipment in a manner other than that specified by Sensia may impair suitability for ordinary locations. Sensia bears no legal responsibility for the performance of a product that has been serviced or repaired with parts that are not authorized by Sensia.**

⚠ **WARNING: PERSONAL RISK. Do not open equipment unless signal circuits and power have been switched off.**

Panel Mounting Kit

It is recommended that the QRATE Scanner 3300 is panel mounted (Figure 1.3). For installation instructions, see Panel Mounting the QRATE Scanner 3300, page 22.

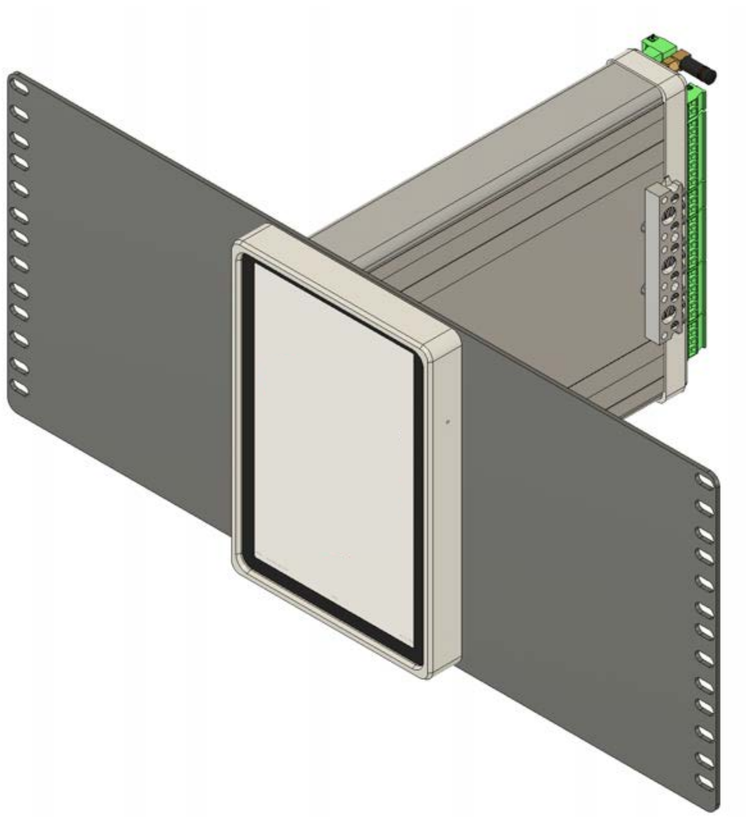

Figure 1.3 - QRATE Scanner 3300 panel mounted

Wireless Communications

The QRATE Scanner 3300 wireless communications option includes a factory-installed SmartMesh wireless radio module (Figure 1.4).

External SmartMesh Antenna

The Sensia-supplied SmartMesh antenna (Figure 1.4) connects directly to the device side antenna connection. When installing the antenna, ensure that it is in a vertical position well above ground level and positioned away from large structures that could interfere with signal transmission and reception.

Sensia's direct-mount antenna is rated for a maximum of 1 watt of power and a maximum antenna gain of 1.6 dB (in North America) and has a frequency range of 2.35 to 2.60 GHz. Antennas with equivalent ratings may also be used with the coupler.

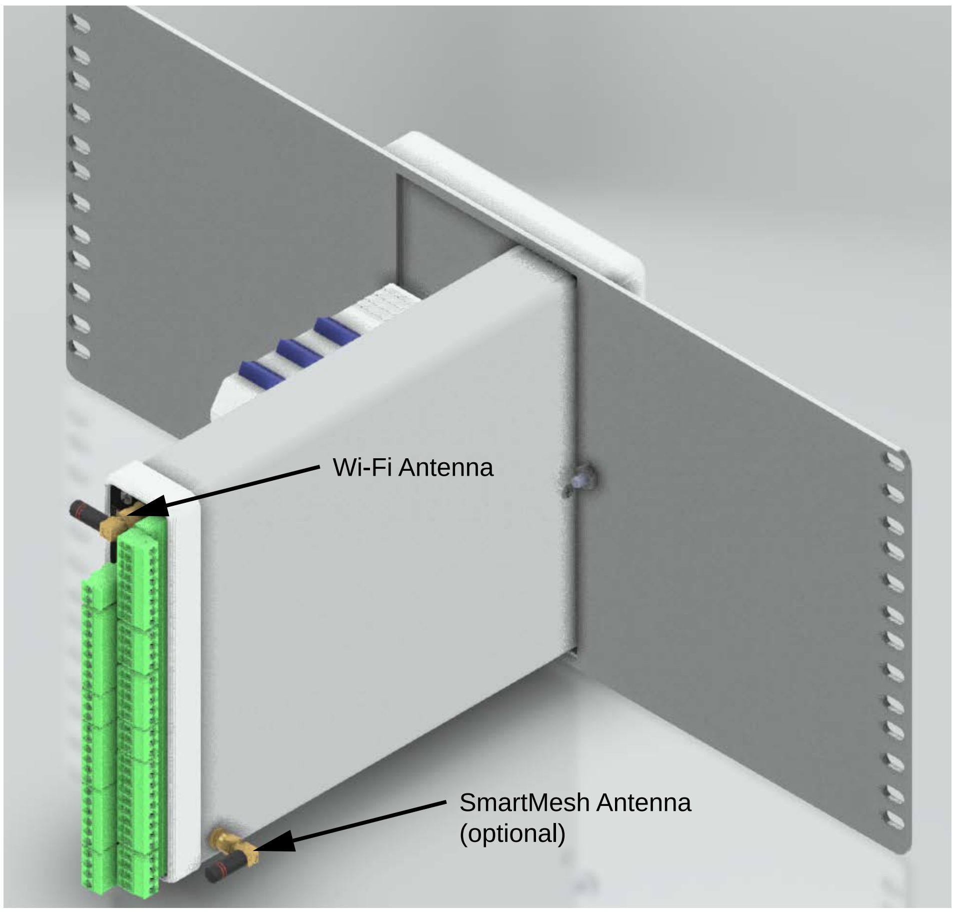

Figure 1.4 - Standard WiFi antenna and optional SmartMesh antenna

Remote-Mount Antenna

In locations where a physical barrier restricts the use of a direct-mount antenna or where a longer transmission distance is required, a remote-mount antenna (Figure 1.5) may be installed up to 30 ft (10 m) away and connected by cable to the antenna coupler. A remote-mount antenna and connecting cable may be purchased from Sensia (see Section 6 - QRATE Scanner 3300 Parts, page 73). If purchasing cable elsewhere, verify that the cable meets the maximum capacitance and inductance ratings (Figure 2.7, page 25) and that the cable length is adequate to connect to both the antenna and the coupler. See Specifications, page 8 for additional details.

The installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in Figure 2.7, page 25. For installation instructions, see:

- Remote-Mount Antenna for Pole Outside Diameters up to 2 Inches, page 27
- Remote-Mount Antenna for Pipe Outside Diameters of 2 3/8 Inches, page 28

Mounting hardware supplied with the Sensia remote-mount antenna (fits pole outside diameters up to 2 inches)

Optional hardware kit for mounting the Sensia remote-mount antenna to a 2-in. pipe (fits outside diameter of 2 3/8-in.)

Figure 1.5 - Remote-mount antenna mounting options

Configuration Lock

The configuration lock is located on the terminal board of the QRATE Scanner 3300 (Figure 1.6). The switch can be enabled to prevent unauthorized individuals from changing the configuration. By default, this configuration lock feature is disabled and the switch position is ignored. The configuration lock feature must be enabled via the **ADMINISTRATION>GENERAL>SECURITY** page of the QRATE Scanner 3300 Web Interface. For more information, see the QRATE Scanner 3300 Web Interface User Manual. After a device is fully configured, the lock can be enabled by changing the mechanical switch to the active position and enabling the switch in the web interface security settings.

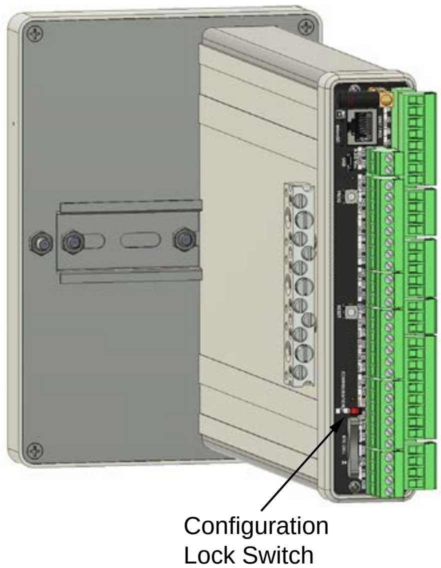

Figure 1.6 - Configuration lock switch

Specifications

Table 1.1—General Specifications		
Approvals	CSA (US and Canada) ordinary location	
Environmental Safety	Relative humidity: 0% to 95% non-condensing	
	Altitude: Up to 2000 meters	
Enclosure	Dimensions (L x W x H): 11.2” x 5.4” x 7.8”	
Weight	4 lb (1.88 kg), approximate	
System Power	External user-supplied power supply (9 to 30 VDC, 400 mA min. current rating)	
	Power over Ethernet (PoE) supply (44 to 57 VDC, 350 mA) Note: PoE Class 0 is available for non-certified products. Contact the factory for details.	
Real-time Clock	Accurate within 2 minutes/year over temperature range	
	Lithium coin cell battery maintains clock during loss of system power (lithium content: 0.11 g)	
Processor	32-bit dual-core ARM Cortex M4 + Co-Processor M4	
Operating Temperature	–10 °C to 60 °C (14 °F to 140 °F)	
Advanced Touch Display	8.0 in. with 1200 x 1920 resolution	
	Backlight is 1.4W	
	Displays up to 32 user-defined parameters (five at a time), with auto-scrolling	
	External power indicator	
	Wireless communications indicator	
	Parameter status indicators	
	Configurable background (dark or light) and scroll frequency	
	Touch screen used for advancing the display; simulating LCD and additional data; connecting to the web interface; viewing communication settings, serial number, and firmware version; and restoring factory default settings to the device	
Memory	8.18 MB RAM for processing	
	512 KB non-volatile memory for configuration data	
	64+1 MB on-board system flash memory	
	48 MB on-board archive flash memory	
Supported Meter Types	Turbine meter	
	Cone meter	
	Orifice meter	
	Ultrasonic meter	
	Positive displacement (PD) meter	
	Coriolis meter	
	Venturi meter	
Download Types	*Per Device*	Complete (all records, including slave device records as applicable) Local (integral flow records in a condensed file ideal for emailing) Events Triggered (one-second logs, including PID tuning)
	Per Flow Run	Daily Interval (hourly) Event Recent (past 7 days of interval logs)
	Per Slave	Daily Interval (hourly) Recent (past 7 days of interval logs)

Table 1.1—General Specifications		
Archive Capacity	Up to 58 archivable parameters per flow run	
	Daily log capacity	2,048 days
	Interval log capacity	2.8 years with 13 parameters (plus date, time and status) logged hourly Capacity varies with the number of parameters logged (13 to 58) and logging frequency (1 second to 12 hours)
	Triggered log capacity (1 to 19 parameters)	1,351,680 logs with one parameter logged; 135,168 logs with 19 parameters logged Configurable to log periodically (1 second to 12 hours) on a real-time period (daily, weekly, etc.) on device alarm, on digital input, or when activated remotely via the web browser
	Event Record Archives	Event/Alarm Record Capacity: 81,920 records User Change Records Capacity: 81,920 records * Stored in a FLASH non-volatile memory with employs a 16 kB page erase system (at least one page is partially erased with new entries).
	Downloadable via FTP, HTTP (web interface), or Enron Modbus protocol (see Scanner Data Manager User Manual for information on viewing data files)	
	Logs stored in non-volatile memory for up to 10 years	
Communications/ Archive Retrieval	*Wireless*	WiFi radio module available with right-angle antenna. WiFi and Ethernet together support up to two TCP/IP user-configurable ports with selectable slave protocols.
		WiFi Range is 50 m.
		Optional SmartMesh radio module available with or without external antenna. See Table 1.2—Hardware Options, page 13.
	Wired RS-485	Two dedicated ports (1 and 2) and one shared RS-485/RS-232 port (3)
		Software-selectable 120-Ω termination resistor
		Selectable master and slave protocols (Enron Modbus, Modbus RTU, Modbus TCP)
	Wired RS-232	Shared RS-485/RS-232 port (port 3)
		TXD, RXD, RTS, CTS
		Time-of-day digital output configuration
	Ethernet/TCP	One RJ-45 connection. WiFi and Ethernet together support up to two TCP/IP user-configurable ports with selectable slave protocols.
		Continuous use requires external power.
		Supports 10/100 Mbits/second
	Port Pass-Through	Any communications port can be routed to another port
		Ethernet can be bridged to serial communications for remotely interfacing with connected Modbus devices. (For example, a NUFLO Scanner 2000 series flow computers configured as a slave device using ModWorX* Pro software without changing wiring connections.)
Flow Rate Calculations	*Natural Gas*	AGA 3 (1992 and 2012), ISO 5167-2 (2003), ISO 5176-5, ASME MFC-14M (2003), AGA-7 (includes scope of AGA 11)
	Liquids	API MPMS 5.3, AGA 3, ISO 5167, AGA 7
Fluid Property Calculations	*Natural Gas*	AGA-8 part 1&2 (includes scope of AGA 10), AGA-3, AGA-5, GPA 2145-09, IF-97, ISO 6976
	Liquids	API MPMS Chapter 11.1 (2004)
	Pure Substances	IAPWS-IF97 (Steam) Quality-corrected saturated steam (Regions 4)
		IAPWS-IF97 (Steam-Water) Auto-selected Region saturated steam, water, dry steam, critical range (Regions 1 through 4)

Table 1.1—General Specifications	
Liquid Compensation and Correction Factors	Temperature and pressure compensation
	Meter factor compensation
	Shrinkage factor compensation
	Live BS&W correction
	Live density correction
	Dynamic oil fraction (watercut)—derived from flowing density or watercut analyzer; automatic base density updates from flowing density measurement
	Chisholm-Steven orifice meter multiphase correction for steam
	Chisholm-Steven cone meter multiphase correction for steam
Flow Streams	Two integral compensated flow run inputs
	Up to 20 remote flow runs via NUFLO Scanner 2000 series flow computers in local area Scanner network
	Three additional integral uncompensated pulse/frequency inputs
	Bidirectional flow measurement
	Up to 8 gas streams using gas chromatograph inputs or user-entered static compositions
	16-point calibrations for all inputs (linear factory and multipoint meter factor calibrations also supported); see Table 1.6—Flow Correction Factors, page 18 for information on multipoint meter factor calibration
	Stacked differential pressure and static pressure inputs for rangeability
RTD Inputs	2 channels
	100-Ω platinum RTD with 2-wire, 3-wire, or 4-wire interface
	Range: –40 °C to 427 °C (–40 °F to 800 °F), excluding RTD uncertainty
	Accuracy: ± 0.2 °C (0.36 °F) over sensing range at calibrated temperature
	Temperature effect: ± 0.3 °C (0.54 °F) over operating range
	A/D resolution: 24 bits
	Sample rate: 0.1 seconds to 12 hours
	Configurable shutoff for power savings when transducer warm-up period is not required
Analog Inputs	4 channels and 3 additional channels (current measurement only) configurable through Pulse/ Frequency Inputs
	1 to 5 V, 0 to 5 V, 4 to 20 mA, or 0 to 20 mA (AN IN 5,6,7 are 4 to 20 mA or 0 to 20 mA only)
	Accuracy: ± 0.030% of span maximum error at 25 °C (77 °F)
	Temperature effect: ± 0.25% of span over operating range
	Impedance: > 60 kΩ for 1 to 5 V input; approximately 250 Ω for 4 to 20 mA input
	Transmitter voltage supply is configurable: 8.5 V to 24 V
	Over-voltage protection: 30 VDC
	A/D resolution: 22 bits (minimum 20 effective bits)
	Linearity error: ± 0.020% max.; ± 0.010% typical
	Single-ended inputs
	Sample rate: 0.1 seconds to 12 hours
	Four previous calibrations available stored in device
	Configurable shutoff for saving power when transducer warm-up period is not required

Table 1.1—General Specifications

Pulse/Frequency Inputs	3 channels (configurable as either Pulse/Frequency Inputs or as Analog Inputs for current)	
	Maximum voltage: 30 VDC	
	Maximum frequency: 10,000 Hz	
	Gated transmitter power for each input channel	
	Transmitter voltage supply is configurable: 8.5 V to 24 V	
	Accumulation types: uncompensated gas volume, uncompensated liquid volume, mass	
	Volume: pulse represents discrete units of volume from a turbine, PD, Venturi, Coriolis, or ultrasonic meter	
	Mass: pulse represents discrete units of mass from a Coriolis meter	
	Configurable turbine sensitivity (20, 50, 100 mV, peak-to-peak)	
Analog Outputs	2 channels, channel 1 supports HART communication (Future)	
	Type 4 to 20 mA, galvanically isolated, externally powered	
	Accuracy (after calibration): ± 0.1% of span maximum error at 25 °C (77 °F)	
	Temperature drift: ±50 ppm/°C (±27.8 ppm/°F)	
	Maximum output load resistance (Ωs) = {supply (volts) – 8.0} / 0.02	
	Maximum voltage: 30 VDC	
	D/A resolution: 16 bits	
	Calibration (zero and full-scale) via software	
	Programmable output alarm value for use during loss of power or communication to CPU	
	Regulates control valve in PID control applications	
	Configurable to track any value including PID Control applications	
Digital I/O	6 channels, user-configurable as input or output, and two channels that are output only.	
	DIO1, DIO2, DIO3, and DIO4 are galvanically isolated with a max. output of 60 mA at 30 VDC	
	DIO5 and DIO6 are high-speed and non-isolated with a max. output of 500 mA at 30 VDC	
	Input Types	Control switch
		Pulse
		Open collector
		Contact closure
	Special Functions	Advance display
		Turn SmartMesh on/off
		Reset specific flow run total
		Reset specific pulse input total
		Unlatch specific digital inputs/output
		Acknowledge alarms
		Start or refresh WiFi
		Publish triggered archive record
		Release triggered archive latch
		Create partial archive
		Abort script program
		Reset script program

Table 1.1—General Specifications

Digital I/O (cont'd)	Output Modes	Pulse (based on pulse count or time period)
		Alarm (based on the status of any or all selected alarms; up to 32 user-configured alarms are selectable)
		Conditional (value above or below setpoint, out of setpoint range)
		Programmed [time of day or output state (normally open, normally closed)]
		Configurable to track any value including PID Control applications
		POUT1 and POUT2 mirror DO 5 and 6
	Pulse Output	Maximum frequency: 500 Hz
		Configurable pulse duration (10 msec to 1 day)
		Configurable pulse representation (1 pulse = 1 MCF) based on time or volume
		Based on any accumulator (flow run or turbine meter run)
	Alarm Output	Low/high
		Out-of-range
		Status/diagnostic
Web Interface—Local Device Management	Access data and device settings via the advanced display on the front of the device	
	Configure, calibrate, and maintain flow runs, inputs/outputs, and gas streams	
	Poll real-time data	
	Download data	
	View daily logs and up to 7 days of interval (recent) logs	
	Control user access with four levels of security	
	Configure communications with up to 20 wired or wireless NUFLO Scanner 2000 series flow computers	
	Display real-time data, flow rate calculation method, and input averages for up to 20 slave devices	
	Read and store configuration data from up to 20 slave devices	
	Read and store daily and interval archive records for up to 20 slave devices	
	Change gas composition and plate size in slave device configurations	
	Download slave data via FTP, HTTP, or Enron Modbus protocol	
	Synchronize slave device configuration and slave archive data	
	Read gas streams connected to slave devices	
	Clear slave device grand totals and alarms	
	Load factory default configuration file	
	Remotely reset slave device without cycling power	

Table 1.2—Hardware Options

Wireless SmartMesh Radio	2.4 GHz self-healing and self-sustaining network		
	Factory installed antenna coupler with 12-in. coaxial cable and MMCX male connector		
	Transmits up to 300 m (985 ft) node-to-node		
Radio Certifications	Supports communications with up to 20 remote NUFLO Scanner 2000 series flow computers (each Scanner node can transmit and receive data)		
	Radio certifications (by country): Europe: CE Mark, RED North America: FCC/IC		
Antenna		**Direct-Mount**	**Remote-Mount**
	Electrical Properties		
	Frequency Range	2.35 to 2.60 GHz	2.4 to 2.5 GHz
	Impedance	50 Ωs nominal at 2.45 GHz	50 Ωs nominal at 2.4 GHz
	Voltage Standing Wave Range (VSWR)	≤ 2.0 typical at center	<1.5
	Connector	SMA	N female brass nickel-plated connector, cable required for connection to SMA
	Height	25.6 mm (1.01 in.)	800 mm (32.28 in.)
	Shape	Elbow (right angle)	Straight
	Material	Weatherized plastic	Fiberglass
	Operating Temperature	–40 °C to 90 °C (–40 °F to 194 °F)	–40 °C to 80 °C (–40 °F to 176 °F)
	Pole Mount Hardware		
	—	N/A	Standard hardware (included with antenna) fits pole with outside diameter up to 2 in.
	—	N/A	Alternate remote-mount kit available for pipe with outside diameter of 2 3/8 in.
Antenna Cable	Length	N/A	10-, 20-, and 30-ft with connectors
	Type	N/A	Type 400
	Temperature Range	N/A	–40 °C to 70 °C (–40 °F to 158 °F)
Customer Tag	Stainless steel tag for customer-specified information, 3 in. × 3 in., wired on, 5 lines of text, 45 character per line maximum		

Table 1.3—Scanner Companion Software

Important	**To download software or software user manuals, visit the Sensia website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, select QRATE Scanner 3000 series integrated control flow computers, and click on the link for the desired software install/manual.**	
Scanner Logic IDE	Creates Scanner Logic scripts (SLOGIC) and compiles them into a logic-controller program file (SLBIN).	
	Performs live debugging on scripts, showing immediate and upcoming script sections to be debugged.	
	Uses a high-level procedural programming language designed to build logic controllers. In this way, the program resembles a state machine.	
Scanner Data Manager	Opens proprietary data files (.sdf) downloaded from the QRATE Scanner 3300 and provides tools for data analysis, reporting, export and conversion	
	Presents data in tabular and trend views	
	Includes tools for customizing reports	
ScanMap	Creates custom QRATE Scanner 3300 Modbus register maps, including user-specified units, rates, and register names for SCADA integration	
	Firmware-specific templates	
	Auto-generates protocol manual for printing or uploading to the web interface	
ScanFlash	Uploads firmware (BIN), configuration (SRF), Scanner Logic IDE file (SLBIN), and custom Modbus register map (PMAP) files to the QRATE Scanner 3300	
PC Requirements		
Windows 7 or later operating system		
1 GHz or faster 32-bit (x86) or 64-bit (x64) processor		
1 GB RAM (32-bit) or 2 GB RAM (64-bit) available hard disk space (360 MB for companion software installation, 30 MB for software for PDF reading, adequate space for data files)		
DirectX 9 graphics device with WDDM 1.0 or later driver		

Flow Rate and Fluid Property Calculations

The QRATE Scanner 3300 calculates flow rates and fluid properties for natural gas and liquid flow in accordance with the following industry standards. The calculations compensate for the effects of pressure, temperature, and fluid composition to determine mass and volume at specified base conditions. The fluid corrections typically require configuration of inputs including static pressure and temperature. The flow calculation requires configuration of differential pressure or pulse (frequency) inputs.

Table 1.4—Flow Rate Standards

Standard	Description	Orifice	NuFlo Cone	Linear Pulse Output	Venturi
AGA 3 (1992)	The QRATE Scanner 3300 supports the orifice metering calculations described in AGA Report No. 3 (1992). This meter covers pipe sizes of nominal 2-in. and larger; there is no stated maximum limit, but the largest size listed in the standard is nominal 36 inch. Beta ratio must lie between 0.1 and 0.75. The AGA 3 orifice meter can be used to measure natural gas and liquids.	♦			
AGA 3 (2012)	The QRATE Scanner 3300 supports the orifice metering calculations described in AGA Report No. 3 (2012). The AGA 3 orifice meter covers pipe sizes of nominal 2-in. and larger; there is no stated maximum limit, but the largest size listed in the standard is nominal 36-in. Beta ratio must lie between 0.1 and 0.75. The 2012 report offers an improved expansion factor correction and is recommended for use except where contractual or regulatory requirements specify the 1992 standard. The AGA 3 orifice meter can be used to measure natural gas and liquids.	♦			
ISO 5167-2 (2003)	ISO 5167-2 describes the measurement of natural gas and liquids with an orifice meter using pipe sizes of nominal 50 mm (2 in.) to a maximum of 1000 mm (39 in.). Beta ratio must lie between 0.1 and 0.75. In ASME MFC-3M (2004), the ISO-5167 orifice flow calculation was adopted without modification. The ISO orifice meter can be used to measure natural gas and liquids.	♦			
ISO 5167-4 (2003)	ISO 5167-4 provides information for calculating flow rates with Venturi tubes. It is applicable only to Venturi tubes in which the flow remains subsonic throughout the measuring section and where the fluid can be considered as single-phase. In addition, each of these devices can only be used within specified limits of pipe size, roughness, diameter ratio and Reynolds number. ISO 5167 4 is not applicable to the measurement of pulsating flow. It does not cover the use of Venturi tubes in pipes sized less than 50 mm or more than 1200 mm, or for where the pipe Reynolds numbers are below 20000.				♦
ISO 5167-5 (2016)	ISO 5167-5 specifies the geometry and method of use (installation and operating conditions) of cone meters when they are inserted in a conduit running full to determine the flow rate of the fluid flowing in the conduit.		♦		
ASME MFC-14M (2003)	For low flow applications, the QRATE Scanner 3300 supports the small bore orifice described in ASME MFC-14M for use with nominal 1/2-in. to 1-1/2-in. pipe sizes. Beta ratio must lie between 0.1 and 0.75. The ASME small bore orifice meter can be used to measure natural gas and liquids.	♦			
AGA 7 (2006)	AGA 7 provides the measurement standards used to calculate natural gas flow rates from linear pulse output meters, including turbine meters, vortex shedding meters, pulser-equipped positive displacement (PD) meters, Coriolis meters having volumetric pulse output, and other types. Linear pulse output meters can be used to measure natural gas and liquids.			♦	
Miller Handbook, Third Ed.	Richard Miller's Flow Measurement Engineering Handbook provides definitive information on selecting, sizing, and performing pipe-flow-rate calculations, using ISO and ANSI standards in both SI and US equivalents. This reference also presents physical property data, support material for important fluid properties, accuracy estimation and installation requirements for all commonly used flow meters. Applies to cone wafer only.				

Table 1.5—Fluid Property and Energy Flow Calculations

Standard	*Description*	*Natural Gas*	*Hydrocarbon Liquid*	*Steam*
AGA 5 (2009)	AGA 5 provides the methods for computing the mass, molar, and volumetric heating values of natural gas at reference temperature. AGA 5 is also used in calculating related properties, including Wobbe index, motor octane number, and net (inferior) volume heating value. *AGA 5 supports an intermediate calculation and therefore is not a standard fluid property selection in the QRATE Scanner 3300 Web Interface.*	♦	♦	
AGA 8, Part 1, Detailed (2017)	The worldwide standard for calculating the physical properties of natural gas and similar gases is the AGA 8 92DC equation originally described in AGA Report No. 8 (1992). The 2017 edition, Part 1, uses the same DETAIL equations of state as in the 1994 edition of AGA 8. However, the temperature, pressure, and gas composition limits have been modified in this edition. Use of this calculation requires a gas analysis, i.e. knowledge of the mole fractions of 21 gas components: the alkanes methane through decane, common diluents including nitrogen, carbon dioxide, hydrogen sulfide, and assorted trace components. In ISO 12213-2 (1997), the AGA 8 92DC equation was adopted without modification. The AGA 8 92DC equation is most accurate between temperatures of 17 °F and 143 °F (–8 °C to 62 °C) and at pressures up to 1,750 psia (12 MPa). If lesser accuracy is acceptable, the range can be extended from –200 °F to 400 °F (–130 °C to 200 °C) and pressures up to 20,000 psi (140 MPa). This fluid calculation will provide the computed value for Speed of Sound.	♦		
AGA 8, Part 1, Gross (2017); SGerg-88 (1988)	When the detailed composition of the gas is unknown, an alternative method of characterizing the gas is available. It is based on the gross properties: real gas relative density (gas gravity), and content of carbon dioxide and nitrogen. This method detailed in AGA 8 and ISO 12213-3 is based on the SGerg-88 equation. The Gross Characterization method should only be used at temperatures between 17 °F and 143 °F (–8 °C to 62 °C) and at pressures below 1,750 psia (12 MPa). Gravity range is from 0.554 to 0.87; up to 28.94% carbon dioxide, and up to 53.6% nitrogen. This method should not be used outside of these limits.	♦		
AGA 8, Part 2 (2017); Gerg-2012	AGA 8, Part II uses temperature, pressure, and gas molar composition to compute fluid density at base and flowing conditions. AGA 8, Part II is used with a flow calculation to determine fluid flow rate.	♦		
API MPMS Chapter 11.1 (2004)	The temperature and pressure correction factors for hydrocarbon liquids including crude oil, refined products (gasoline, jet fuel, fuel oils), lubricating oils, and special products are calculated according to API MPMS Chapter 11.1 (2004). For crude oils, the density range is 610.6 to 1,163.5 kg/m3, temperature range is from –58 °F to 302 °F (–50 °C to 150 °C), and pressure range is from 0 to 1,500 psig (0 to 10,340 kPa). For differential pressure meters, the viscosity at operating temperature is a required input to the flow computer, and it must be determined as accurately as possible.		♦	
API MPMS Chapter 20.1 (2011)	API MPMS Chapter 20.1, Section 1.9.5.4, provides procedure for computing net oil volume in an oil/water mixture when watercut is higher than normal and a dynamic sampling method, such as an online watercut analyzer, is used to measure watercut, incorporating a shrinkage factor where applicable.		♦	
GPA 2145 (2008)	GPA 2145 is a compilation of numerical values for the paraffin hydrocarbons and other compounds occurring in natural gas and natural gas liquids as well as for a few other compounds of interest to the industry. *GPA 2145 supports an intermediate calculation and therefore is not a standard fluid property selection in the QRATE Scanner 3300 Web Interface.*	♦		

Table 1.5—Fluid Property and Energy Flow Calculations

Standard	***Description***	***Natural Gas***	***Hydrocarbon Liquid***	***Steam***
ISO 6976 (2016)	ISO 6976 specifies methods for the calculation of the superior calorific value and the inferior calorific value, density, relative density and Wobbe index of dry natural gas and other combustible gaseous fuels, when the composition of the gas by mole fraction is known. *A simplified version of the AGA 5 calculation, ISO 6976 supports an intermediate calculation and therefore is not a standard fluid property selection in the QRATE Scanner 3300 Web Interface.*	♦		
IAPWS-IF97, Saturated Steam	IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. This calculation should be used when the steam is assumed to be at the saturation temperature at a given flowing pressure. Only a pressure input is required. Providing a steam quality measurement will yield an estimated liquid flowrate and produce accumulations for vapor and liquid water.			♦
IAPWS-IF97, All Regions	IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. This calculation should be used when measuring in regions off the saturation line operating conditions and when the water is liquid or super-heated. A pressure input and a temperature input are required. From the flowing condition inputs, the operating region of the water is detected: liquid water (Region 1), dry steam (Region 2), critical range (Region 3), and saturated steam (Region 4). All regions except liquid water are accumulated as vapor.			♦

Flow Correction Factors

The QRATE Scanner 3300 measures compensated petroleum liquid flow using an orifice or cone flow meter. For accuracy, these measurements often include a correction factor to compensate for the effect of gas or water on volume, or changes in calibration. Table 1.6 describes the correction factors configurable in the QRATE Scanner 3300 Web Interface.

Table 1.6—Flow Correction Factors

Flow Correction Factor	*Description*
Multipoint Meter Factor Correction (for Gas and Liquid)	The multipoint meter factor calibration method allows users to compensate for variations between calibrations without changing the meter K-factor from the value stamped on the meter at the factory. Meter factors are typically determined through calibrations performed by third-party test laboratories. You can enter the appropriate factor during calibration to account for any variation in the calibration curve over Reynolds numbers.
Chisholm-Steven Orifice Meter Multiphase Correction (for Steam)	The Chisholm-Steven correction method is used for over-reading prediction in wet vapor flow conditions (multiphase) for water at the flowing conditions along the saturation line. When provided with a quality measurement, the vapor flow is corrected and the estimated liquid flow is accumulated.
Crude Oil Shrinkage Factor	This correction factor allows users who are measuring crude oil to automatically correct their liquid volume measurements for the effects of gas content. When the oil is discharged from a pipeline to a stock tank at atmospheric conditions, the volatile components in the oil evaporate, causing a reduction in liquid volume. When live oils are metered (e.g., test separators), a shrinkage factor must be applied to correct the measured liquid volume from the metering pressure and temperature to stock tank conditions unless the meter is proved to stock tank conditions. Shrinkage volumes are typically obtained with a shrinkage tester. This correction method will correct the meter reading for both dissolved gas and for oil volume reduction. It will not compensate for the effects of fluid viscosity changes. Shrinkage volumes or factors are often used to mitigate safety and environmental concerns when live oil volumes are measured at high pressures or when the live oil contains hydrogen sulfide (H2S).
Base Sediment and Water (BS&W) Correction Factor	Crude oil generally contains some water. The BS&W correction provides a means of discounting the water content and totalizing only the crude. The correction can be based on a user-entered value (assumed to be constant) or on a watercut monitor/ BS&W monitor output to the QRATE Scanner 3300 via a 4-20 mA signal.

Section 2 - Installing the QRATE Scanner 3300 Integrated Control Flow Computer

Overview

The QRATE Scanner 3300 integrated control flow computer is fully assembled at the time of shipment and ready for mounting. The device is not installed in a hazardous location, and so Sensia recommends that operators configure the EFM after mounting. The user may configure the device via the web interface, using the touch screen controls (refer to Section 4 - Kiosk Display Interface, page 61). The QRATE Scanner 3300 receives its inputs from either a multi variable transmitter, or directly from a turbine meter (and pressure transducer, if relevant).

NOTE The kiosk mode can be viewed while one user is logged in to a device. However, only one user may make changes to the device through the web interface.

CSA Installations

The QRATE Scanner 3300 is CSA-certified for ordinary locations. Since this is the case, the installer must ensure that the device is installed in a non-hazardous area, and the wiring must be done as per the relevant wiring standards. The user may use copper conductors for wiring.

Wiring Precautions

Ensure all wiring between the hazardous location (where the multi variable transmitter is installed) and the non-hazardous location (where the QRATE Scanner 3300 is installed) follows the relevant wiring standards.

CAUTION **All field wiring must conform to the National Electrical Code, NFPA 70, Article 501-4(b) for installations within the United States or the Canadian Electric Code for installations within Canada. Local wiring ordinances may also apply. The cable used between the QRATE Scanner 3300 and other devices must be either armored MC-HL cable or standard cable routed through conduit.**

Multi Variable Transmitter Mounting

The multi variable transmitter (also referred to as the MVT) will have a multi variable transducer attached. It will receive the inputs from the transducers on the flow line, and transmit that information to the QRATE Scanner 3300. The multi variable transmitter (MVT) may be directly mounted in the flow line, or be remotely mounted on a 2-in. pole using the a U-bolt provided and the integral bracket, or mounted to a flat, vertical surface (shown in Figure 2.1, page 21).

The standard multi variable transducer (connected has process connections on the bottom, compensated liquid and steam applications may require the use of a side-port multi variable transducer and side-mount manifold (to help eliminate air in the process line). In such installations, an optional extension bracket is recommended to provide the necessary clearance for the multi variable transducer and manifold assembly. This bracket is shown in Figure 2.1, page 21. Contact your local Sensia sales office for details.

Tubing is used to connect the integral multi variable transducer to the orifice meter or cone meter. If a multi variable transducer will be used for steam measurement, a condensate pot must also be installed to protect the multi variable transducer from extreme temperatures. See Installation Procedure—Remote Connection to a Turbine Meter, page 36, for details.

The following accessories are also recommended:

- a multi variable transducer
- an RTD assembly for process temperature input on gas flow runs and compensated liquid flow runs (not recommended for steam flow runs)
- tubing and/or pipe for plumbing process connections
- signal cable for remote turbine connections (stranded, shielded cable is recommended)

The multi variable transmitter (MVT) may be mounted directly or remotely. To mount the MVT remotely, perform the following steps:

1. Determine the piping configuration that will best accommodate process connections and field wiring connections. If a side-port MVT and manifold is required (typically, only for compensated liquid and steam applications), an optional extension bracket may be connected to the standard bracket to provide additional clearance from the pipe.
2. Position the U-bolt around the pipe and through the support bracket provided with the U-bolt.
3. Align the mounting bracket against the pole so that the U-bolt passes through the mounting holes in the bracket. Place the mounting plate over the threaded ends of the U-bolt and against the bracket, and secure the U-bolt with the two nuts provided.
4. Install and connect process piping between the MVT and the turbine meter with appropriate fittings. Process piping installation procedures vary with each application.

WARNING: HAZARDOUS AREA USE. The MVT must be certified for hazardous area use and must be installed in accordance with applicable standards and local wiring practices. Carefully review and follow the MVT guidelines for hazardous area installation.

WARNING: Before connecting the MVT to a flow line, consider the pressure rating of the sensor. The tubing and fixtures used to connect the sensor to the manifold in the flow line must be manufactured from materials that are appropriate for the pressure ratings of the sensor used.

WARNING: If H2S is present, use a NACE sensor and take appropriate precautions to avoid exposure to this hazardous gas.

WARNING: All cable and cable glands must be rated for 80ºC.

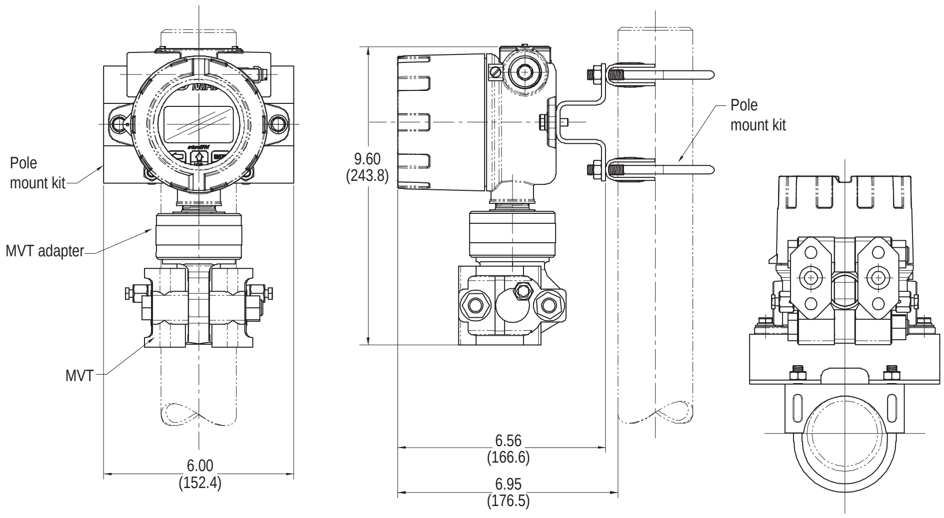

Figure 2.1 - MVT with a standard bottom-port multi variable transducer and manifold on a 2-in. pole

Panel Mounting the QRATE Scanner 3300

The QRATE Scanner 3300 may be panel mounted (Figure 2.2) side-by-side on a 4.5U panel. This is a convenient option as it allows the installation to be less laborious, and the device may be organize along side other display units. It is important to take the dimensions into account when planning how and where to panel mount the QRATE Scanner 3300 (Figure 2.3 and Figure 2.4, page 23).

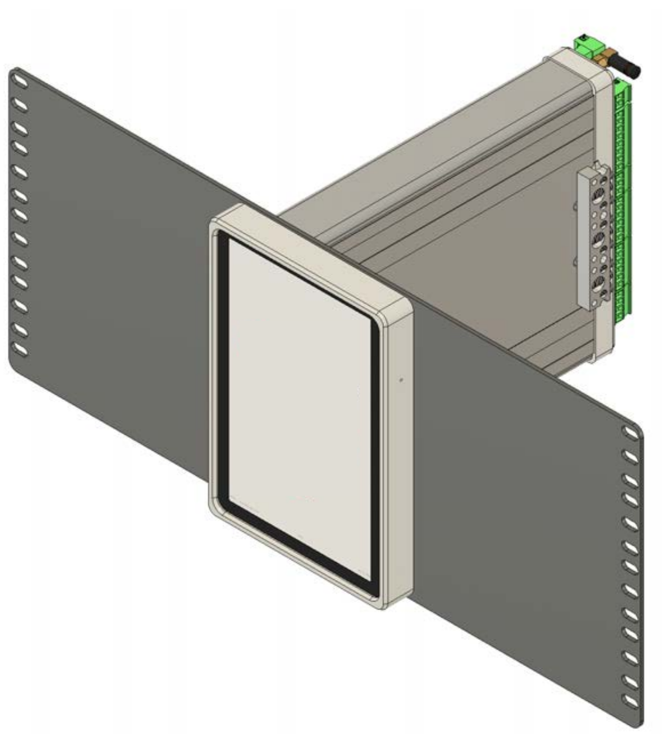

Figure 2.2 - QRATE Scanner 3300 mounted on panel

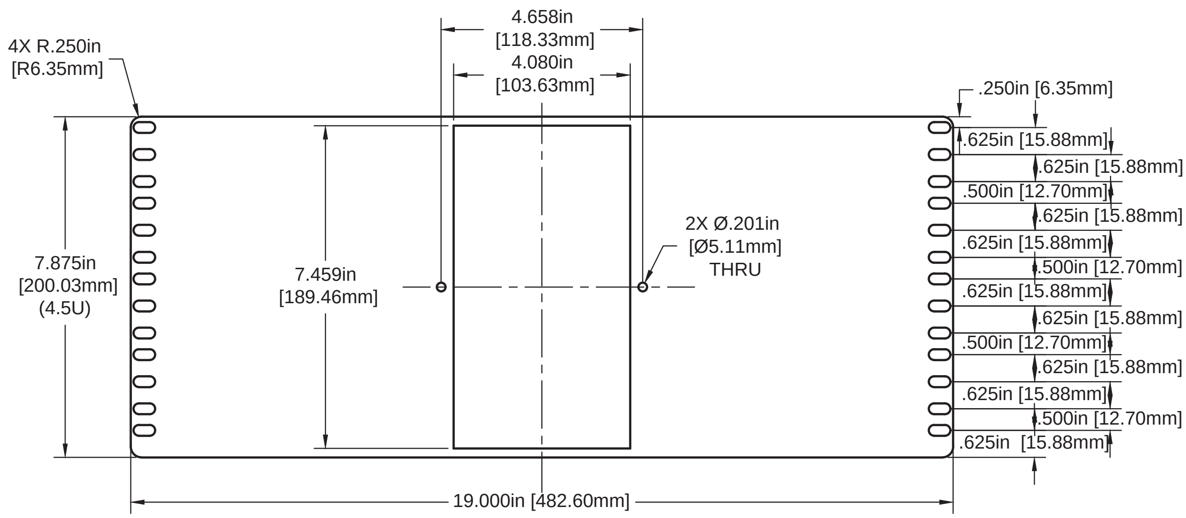

Figure 2.3 - 4.5U size panel on which the QRATE Scanner 3300 is mounted; dimensions in inches (mm)

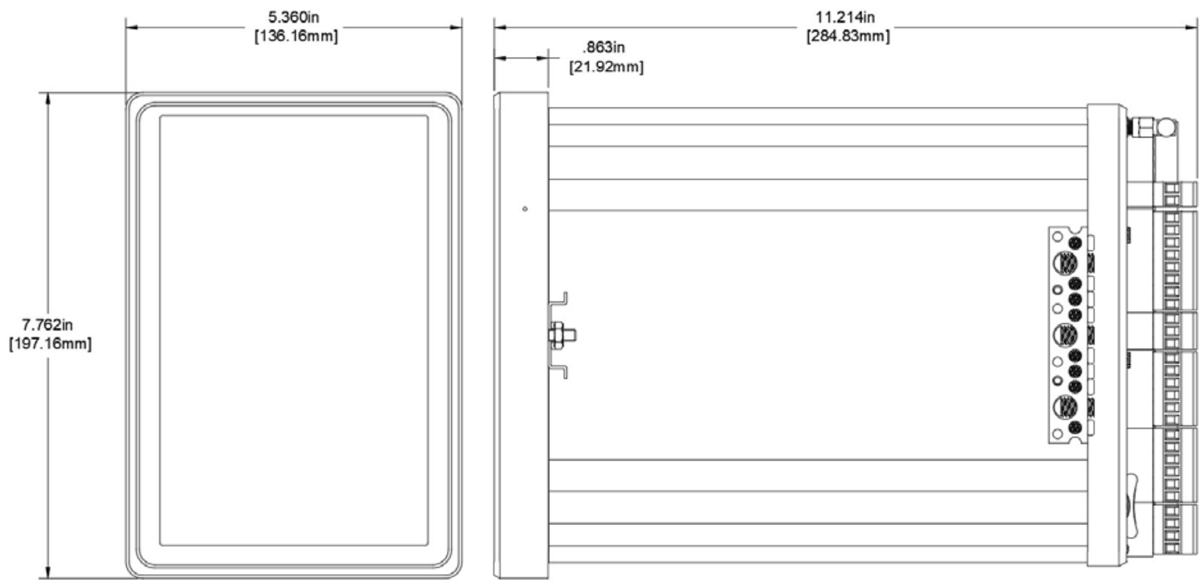

Figure 2.4 - *QRATE Scanner 3300 dimensions; dimensions in inches (mm)*

Install as follows:

1. Choose the location on the rack where the QRATE Scanner 3300 will be installed.
2. Securely fasten the panel on which the device will be mounted to the chosen location on the rack.
3. Slide the device enclosure into the allocated slot in the panel.
4. Using the included hardware, securely fasten it to the panel.
5. Using the terminals and terminal numbers listed in page 49, wire power, inputs, and outputs to the terminal board.
6. Engage power, inputs, and outputs.
7. Configure it as needed through the kiosk mode touch screen interface.

Requirements for Wireless Communications

Each QRATE Scanner 3300 wireless device is equipped standard with a WiFi module and antenna. A SmartMesh wireless module and antenna may be optionally installed. Figure 2.3, page 23 shows the installation dimensions.

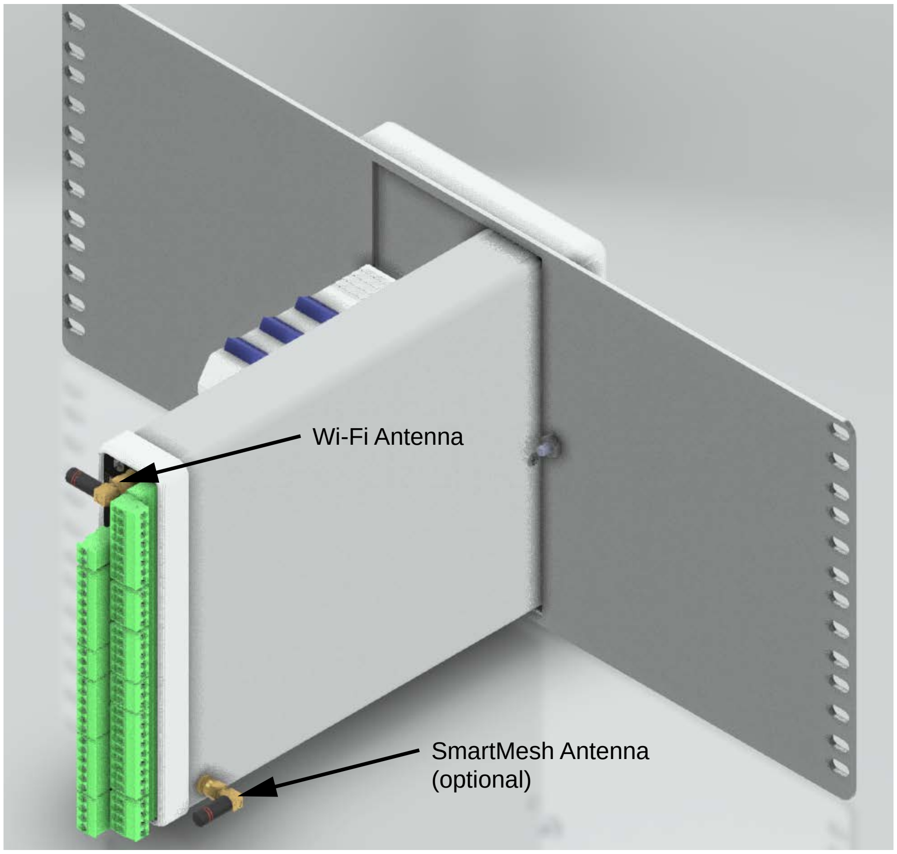

Figure 2.5 - WiFi and SmartMesh Wireless direct-mount antennas installed on QRATE Scanner 3300

The installation of the antenna coupler, antennas, and antenna cable for the SmartMesh wireless must meet the requirements shown in Figure 2.6, page 25 and Figure 2.7, page 25.

Sensia supplies the following antenna and antenna cable options for SmartMesh wireless:

- Direct-mount, right-angle antenna with SMA connector
- Remote-mount antenna with SMA connector
- Type 400 male-to-male antenna cable in three lengths - 10, 20, and 30 feet

See Table 6.2—Wireless Components, page 73 for ordering details.

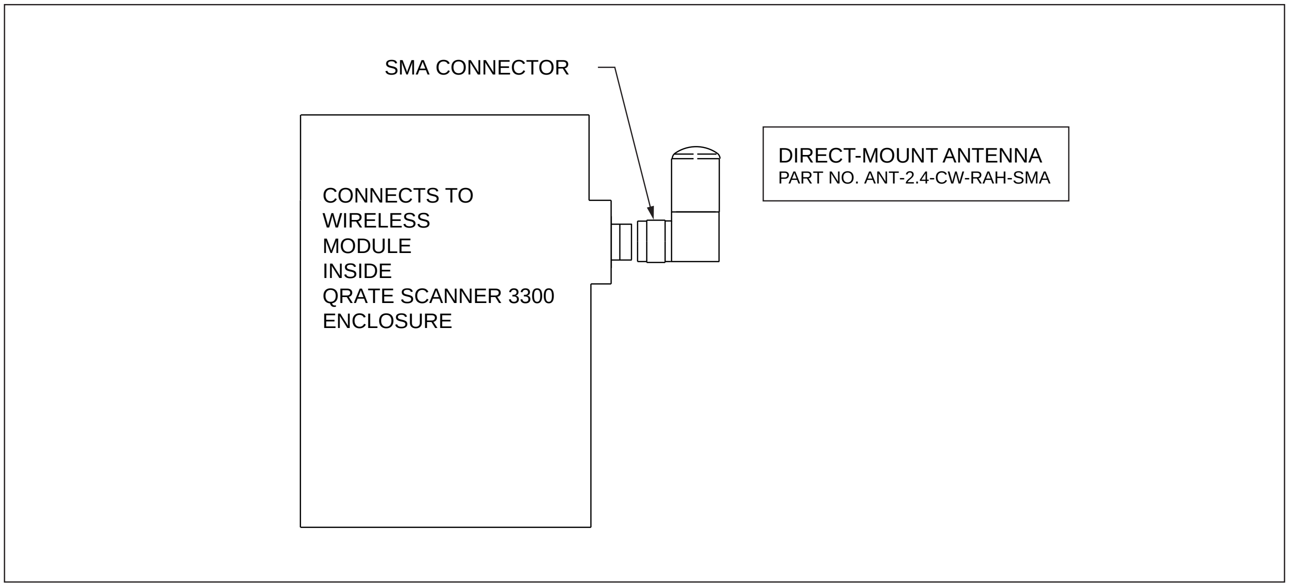

Figure 2.6 - Installation requirements for a direct-mount Sensia-supplied antenna

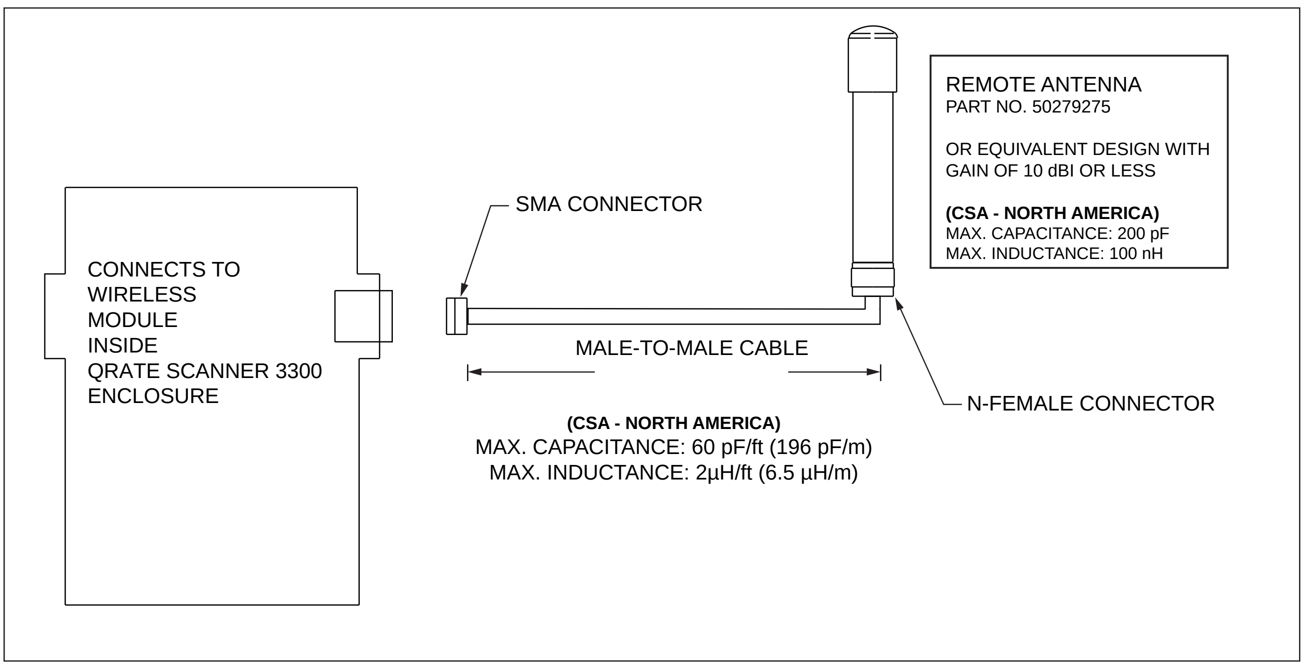

Figure 2.7 - Installation requirements for a remote-mount antenna

FCC Radio Frequency Compliance

QRATE Scanner 3300s that include the optional SmartMesh radio module comply with Federal Communications Commission (FCC) radio frequency (RF) exposure compliance requirements when the following requirements are met.

Important **To comply with FCC and IC RF exposure compliance requirements, the antenna must be installed to provide a separation distance of at least 20 cm from all persons. Changes or modifications to the installation that violate this requirement and are not authorized by the radio manufacturer could void your authority to operate the equipment.**

The SmartMesh radio has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that used with the receiver.
- Consult the dealer or an experienced radio/TV technician for help.

IC Radio Frequency Compliance

QRATE Scanner 3300s that include the optional SmartMesh radio module comply with Industry Canada (IC) license-exempt RSS standards. Operation is subject to the following conditions:

- The device may not cause interference.
- The device must accept any interference, including interference that may cause undesired operation of the device.

Radio Frequency Compliance Labeling

QRATE Scanner 3300s that include the optional SmartMesh and WiFi radio module comply with a broad range of country-specific radio frequency standards. The device wireless radio is approved for use in all of the regions listed on a radio compliance label (Figure 2.8) applied to the enclosure.

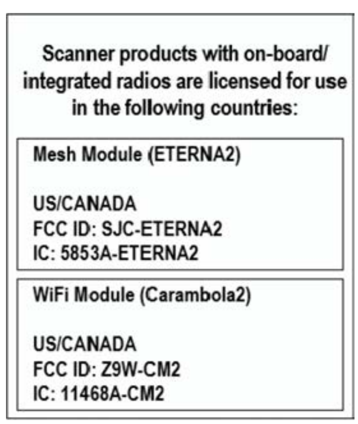

Figure 2.8 - Radio frequency compliance label applied to the QRATE Scanner 3300 enclosure (content may change without notice)

Antenna Installation Options

Direct-Mount Antenna

Each QRATE Scanner 3300 wireless device is equipped with a wireless module. Antennas and antenna cable are optionally available. The installation of the antennas and antenna cable must meet the requirements shown in Figure 2.6, page 25 and Figure 2.7, page 25.

Remote-Mount Antenna for Pole Outside Diameters up to 2 Inches

The standard hardware supplied with Sensia's remote-mount antenna can be used to mount the antenna to a pole with an outside diameter of 2 in. or less. The supplied hardware includes two U-bolts, two toothed brackets, four lock washers and four nuts.

Note If a 2-in. pipe with a 2 3/8-in. outside diameter is to be used, consider using Sensia's 2-in. pipe mount hardware kit.

To install the antenna, reference Figure 2.9 while following the instructions below:

1. Position the antenna with the shiny metal base against a vertical pole and the capped end of the antenna vertical in the air. Note the N-female cable connector at the bottom of the metal base for connecting antenna cable.
2. Position a U-bolt around the antenna and pole, placing the bend of the U-bolt against the antenna base.
3. Place a toothed bracket over the threaded legs of the U-bolt with the teeth facing the pole and slide the bracket snugly against the pole.
4. Install a lock washer and a nut on each of the two U-bolt legs extending through the toothed bracket.
5. Repeat steps 2 through 4 to install the second U-bolt and toothed bracket to secure the base of the antenna.
6. Attach the antenna cable to the N-female cable connector at the bottom of the antenna.

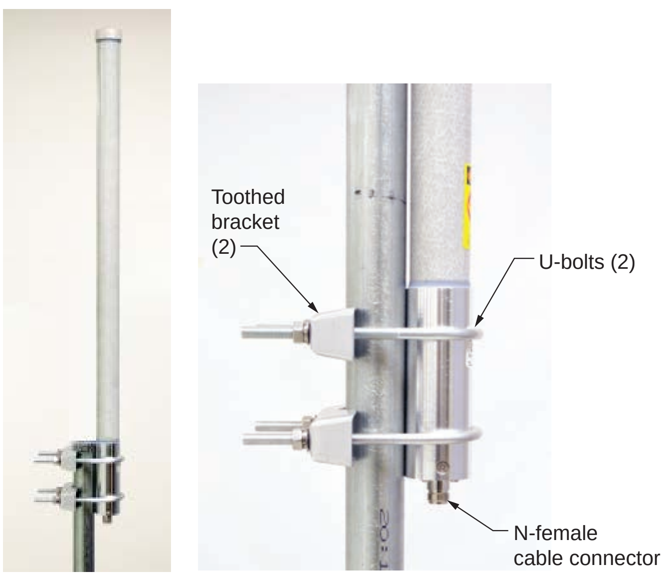

Figure 2.9 - Standard pole mount bracket (fits poles with an outside diameter of 2 in. or less)

Remote-Mount Antenna for Pipe Outside Diameters of 2 3/8 Inches

Sensia's optional pipe mount kit accommodates mounting the remote antenna to a 2-in. pipe with a 2 3/8-in. outside diameter. The hardware kit includes a stainless steel L-shaped bracket, two U-bolts, four U-bolt nuts, two stainless steel 5/16-18 bolts (3.25-in. long), two 5/16-in. lock washers, two 5/16-in. flat washers and two 5/16-in. nuts.

Important **One of the toothed brackets shipped with the standard pole-mount kit is also required for this installation. Do not discard the standard pole-mount kit antenna packaging before locating the toothed brackets.**

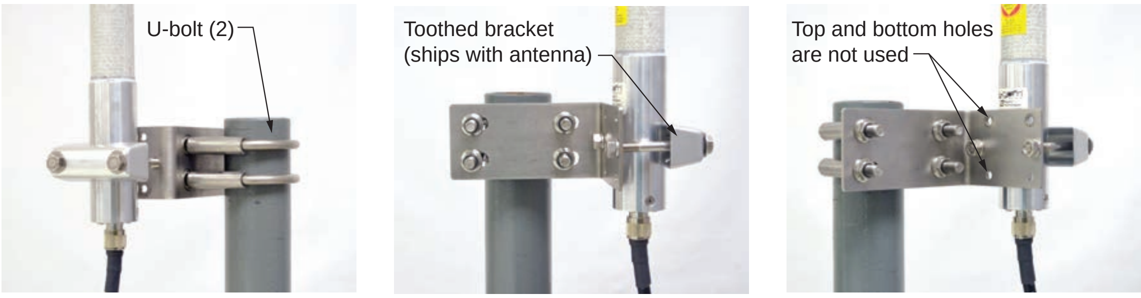

Figure 2.10 - Optional 2-in. pipe mount bracket

To install the antenna, reference Figure 2.10 while following the instructions below:

1. Remove one of the toothed brackets from the standard pole-mount kit antenna packaging for use with the optional hardware kit. The remaining hardware in the antenna package will not be used for this installation.
2. Position the L-shaped bracket against the pipe so that the pipe is on the outside of the "L" and secure it to the pipe with the two U-bolts and four U-bolt nuts (Figure 2.10, left). The U-bolts will pass through the widest panel of the "L" bracket.
3. Position the antenna against the bracket so that the shiny metal base is touching the bracket and the capped end of the antenna is vertical in the air. Note the N-female cable connector at the bottom of the metal base for connecting antenna cable.
4. Place the toothed bracket against the adjacent L-bracket panel (shortest of the two panels) so that the toothed, rounded edge faces the L-bracket panel and the holes in the toothed bracket align with the center holes in the L-bracket.
5. Place a flat washer over each of the 5/16-in. bolts and insert the bolts through the holes in the toothed bracket and through the center holes in the L-bracket panel (Figure 2.10, center and right).
6. Attach a lock washer and a nut to each of the bolts on the inside of the L-shaped bracket to hold the toothed bracket loosely in place.
7. Position the antenna between the toothed bracket and the L-shaped bracket so that the rounded edge of the toothed bracket fits snugly against the curvature of the shiny antenna base and the brackets clamp around the approximate center of the antenna base.
8. Holding the antenna in place, tighten the two 5/16-in. nuts on the inside of the L-bracket to secure the antenna (Figure 2.10, right).
9. Attach the antenna cable to the N-female cable connector at the bottom of the antenna.

Industry Standard Compliance

To ensure measurement accuracy, flow runs and turbine meter runs must be installed in accordance with the industry standards listed in Table 2.2—Industry Standards for Meter Installation, page 29. For a complete list of industry standards used in the development of flow rate and fluid property calculations, see Table 1.4—Flow Rate Standards, page 15 and Table 1.5—Fluid Property and Energy Flow Calculations, page 16.

Table 2.2—Industry Standards for Meter Installation

Meter Type	*Standard*	*Description*
Orifice Meter	*AGA 3, Section 2.6*	Specifications for orifice meters (to include beta ratios)
		Installation requirements for orifice plates, meter tubes, flow conditioners, and thermometer wells
		This standard is also distributed under the following names: API MPMS Chapter 14.3, Part 2; ANSI/API 14.3, Part 2-3100; and GPA 8185, Part 2.
	ISO 5167, Part 1	Installation of orifice plates inserted into a circular cross-section conduit running full
		Limitation of pipe size and Reynolds number
		ISO 5167 is applicable only to flow that remains subsonic throughout the measuring section and where the fluid can be considered single-phase. It is not applicable to the measurement of pulsating flow. It does not cover the use of orifice plates in pipe sizes less than 50 mm (2 in.) or more than 1000 mm (39 in.), or for pipe Reynolds numbers below 5000.
	ISO 5167, Part 2	Specifies orifice plates that can be used with flange pressure tappings, corner pressure tappings, D and D/2 pressure tappings.
	API MPMS Chapter 21.1, Section 1.7	Installation of electronic gas measurement devices and associated communications, gauge/impulse lines, and cabling
	API MPMS Chapter 21.1, Section 1.8	Requirements for calibrating and verifying the accuracy of electronic gas measurement devices
	ASME MFC-14M	Specifies low-flow orifice meters smaller than 2 inch pipe size, that can be used with flange taps and corner taps.
		Nominal pipe sizes (1/2 inch to 1-1/2 inch only)
		Beta ratio from 0.1 to 0.75
		Suitable for single-phase fluids only
		Subsonic flow only
		Not suitable for pulsating flow
Cone Meter	*NuFlo* Cone Meter User Manual, Sections 2 through 5*	System components, impulse tubing considerations, best practices for installation, installation procedures/diagrams for liquid and gas service
	ISO 5167, Part 1	Installation of orifice plates inserted into a circular cross-section conduit running full
		Limitation of pipe size and Reynolds number
		ISO 5167 is applicable only to flow that remains subsonic throughout the measuring section and where the fluid can be considered single-phase. It is not applicable to the measurement of pulsating flow. It does not cover the use of orifice plates in pipe sizes less than 50 mm (2 in.) or more than 1000 mm (39 in.), or for pipe Reynolds numbers below 5000.
	ISO 5167, Part 5	ISO 5167-5 describes the background information for calculating the flow rate and is applicable in conjunction with the requirements given in ISO 5167-1. Uncalibrated cone meters can only be used within specified limits of pipe size, roughness, β, and Reynolds number. This part of ISO 5167 is not applicable to the measurement of pulsating flow. It does not cover the use of uncalibrated cone meters in pipes sized less than 50 mm or more than 500 mm, or where the pipe Reynolds numbers are below 8×10^4 or greater than 1.2×10^7.

Table 2.2—Industry Standards for Meter Installation

Meter Type	*Standard*	*Description*
Venturi Meter	*ISO 5167, Part 1*	Installation of orifice plates inserted into a circular cross-section conduit running full
		Limitation of pipe size and Reynolds number
		ISO 5167 is applicable only to flow that remains subsonic throughout the measuring section and where the fluid can be considered single-phase. It is not applicable to the measurement of pulsating flow. It does not cover the use of orifice plates in pipe sizes less than 50 mm (2 in.) or more than 1,000 mm (39 in.), or for pipe Reynolds numbers below 5,000.
	ISO 5167, Part 3	ISO 5167-3 describes three Venturi meter variations: machined inlet, rough cast inlet, and welded sheet metal. Machined inlet meters are available in diameters up to 10 inches (250 mm), rough cast meters up to 30 inches (800 mm), and welded construction up to 47 in. (1,200 mm).
Turbine Meter/ Volumetic Pulse Meter	*AGA 7, Section 7*	Installation of gas turbine meters to include flow direction, meter orientation, meter run connections, internal surfaces, temperature well location, pressure tap location, and flow conditioning
		Illustrations of recommended installation configurations
		Environmental considerations, the use of other devices to improve meter performance, and precautionary measures
		This specification applies to axial-flow turbine flow meters for measurement of natural gas, typically 2-in. and larger bore diameter, in which the entire gas stream flows through the meter rotor.
	API MPMS Chapter 21.1, Section 1.7	Installation of electronic gas measurement devices and associated communications, gauge/impulse lines, and cabling
	API MPMS Chapter 21.1, Section 1.8	Requirements for calibrating and verifying the accuracy of electronic gas measurement devices
	API MPMS 5, Section 3	Description of unique installation requirements and performance characteristics of turbine meters in liquid hydrocarbon service *(This section does not apply to the measurement of two-phase fluids.)*
	ISO 5167, Part 1	Installation of orifice plates inserted into a circular cross-section conduit running full
		Limitation of pipe size and Reynolds number
		ISO 5167 is applicable only to flow that remains subsonic throughout the measuring section and where the fluid can be considered single-phase. It is not applicable to the measurement of pulsating flow. It does not cover the use of orifice plates in pipe sizes less than 50 mm (2 in.) or more than 1,000 mm (39 in.), or for pipe Reynolds numbers below 5,000.
Coriolis Meter /Mass Pulse Meter	*AGA 11*	AGA 11 was developed for the specification, calibration, installation, operation, maintenance and verification of Coriolis flow meters and is limited to the measurement of single phase natural gas, consisting primarily of hydrocarbon gases mixed with other associated gases usually known as "diluents."

Measuring Natural Gas via a Differential Pressure Meter

Best Practices

The QRATE Scanner 3300 calculates gas flow through outputs from a MVT connected to a differential pressure meter. For best measurement accuracy, ensure that the meter run complies with the following AGA 3 and ISO 5167 guidelines, as applicable:

- Do not place unit near vents or bleed holes that discharge corrosive vapors or gases.
- Consider the orientation of the meter run when determining the best position for mounting the MVT.
  - If the MVT is mounted to a horizontal pipeline, make sure process connections are at the top of the line, and mount the MVT above the pressure connections at the pipe.
  - If the MVT is mounted to a vertical pipeline, install the sensor above the differential pressure source connections, or install a condensate (drip) pot to prevent the accumulation of liquid in interconnecting tubes. Slope all tubing upward at least 1 in./LF to avoid liquid entrapment.
- Mount the MVT as near level and as free from vibration as possible.
- Ensure the high port of the sensor (marked H) is connected to the upstream side of the meter run.
- Flow should remain subsonic throughout the measuring section and should be single phase.
- Pipe diameters (D) should be between 2 in. (50 mm) and 39 in. (1,000 mm) per ISO 5167; or greater than 2 in. (50 mm) per AGA 3.
- Pipe Reynolds numbers must be above 5,000.
- *d* (orifice diameter) must be greater than or equal to 0.45 in. (11.5 mm).
- β (diameter ratio) must be greater than or equal to 0.1 and less than or equal to 0.75.
- Gauge lines should be of uniform internal diameter and constructed of material compatible with the fluid being measured. For most applications, the bore should be no smaller than 1/4 in. (6 mm) and preferably, 3/8 in. (10 mm) in diameter. The internal diameter should not exceed 1 in. (25 mm). If high-temperature fluids are likely to be encountered, make sure the measuring tube used is rated for the anticipated temperature range.
- Gauge line length should be minimized to help prevent pulsation-induced errors.
- Gauge lines should slope downward to the meter at a minimum of 1 in. per foot.
- If gauge lines must slope in more than one direction, do not allow more than one bend and install a liquid or gas trap, as applicable. A liquid trap should be installed at the lowest point in a gas service installation.
- Gauge lines should be supported to prevent sag and vibration.
- Where pulsation is anticipated, full-port manifold valves with a nominal internal diameter consistent with the gauge lines are recommended.

If the MVT is mounted to a cone meter, consider the following best practices as well:

- Position the cone meter so that there are 0 to 5 diameters of straight pipe upstream of the meter and 0 to 3 diameters of straight pipe downstream of the meter.
- Install the meter so that the static pressure tap is upstream of the differential pressure tap. The high side of the integral MVT must also be situated upstream.
- Install shutoff valves directly on the pressure taps. Choose a shutoff valve that is rated for the ambient temperatures of the location and the operating pressure of the pipe in which it will be installed, and suitable for use with dangerous or corrosive fluids or gases, if applicable. The valves must not affect the transmission of the differential pressure signal.

Installation Procedure—Direct Mount to Orifice Meter or Cone Meter

A MVT can be mounted directly to an orifice meter or cone meter for gas measurement. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location. Figure 2.11 shows a typical direct-mount installation.

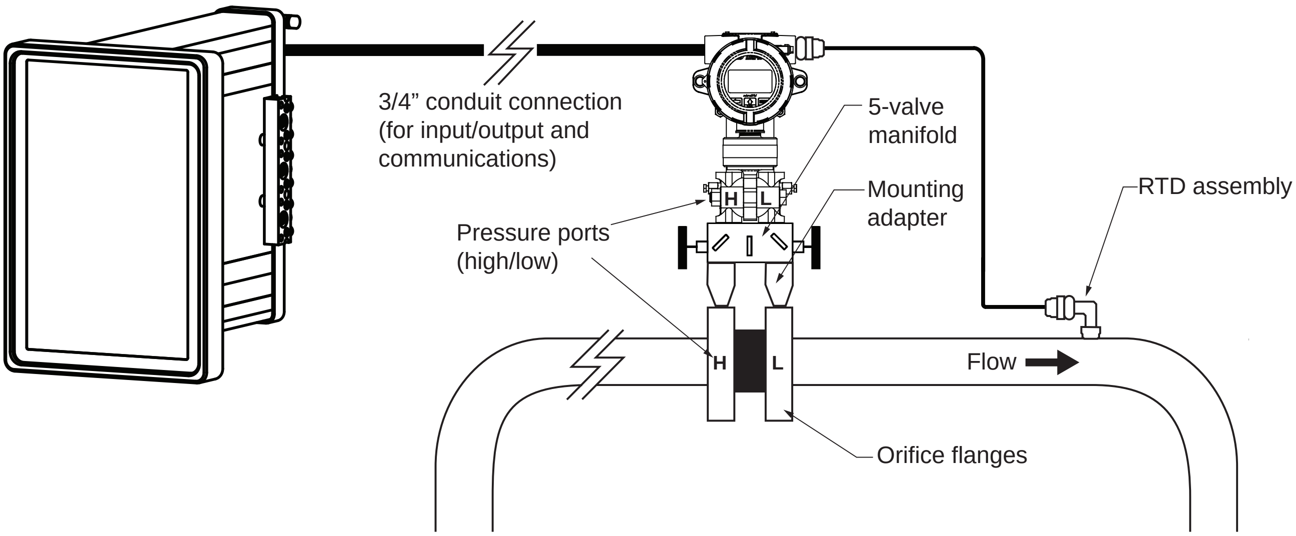

Figure 2.11 - Direct-mount installation in an orifice meter run (shown here with an orifice meter). The direct-mount method can be used with a cone meter as well.

1. Verify that the meter is properly installed in the flow line (per manufacturer’s instructions).
2. Connect the MVT and manifold assembly to the differential pressure meter. Hardware requirements will vary, depending upon the installation configuration. However, minimally, an adapter is required that can span between the threaded pressure tap/orifice flange connector and the non-threaded manifold. This adapter can be a one-piece stabilizer (often preferred for added strength and stability) or a short heavy wall pipe nipple attached to a futbol flange (available from Sensia). Use a suitable compound or tape on all threaded process connections.

CAUTION **Do not use Teflon tape on the threads of the union, adapter, or pipe plugs. Use of Teflon tape will void the explosion-proof rating of the instrument.**

3. Install the RTD assembly in the thermowell. Route the RTD assembly cable through the conduit opening in the top of the MVT to connect to the main circuit board. A wiring diagram for the RTD assembly is provided in Figure 3.8, page 54.
4. Follow guidelines outlined in MVT manual to perform a manifold leak test.
5. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
6. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Installation Procedure—Remote Mount to Orifice Meter or Cone Meter

A MVT can be mounted remotely and connected to an orifice meter or cone meter with tubing for gas measurement. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location. Figure 2.12 shows a typical remote-mount gas run installation.

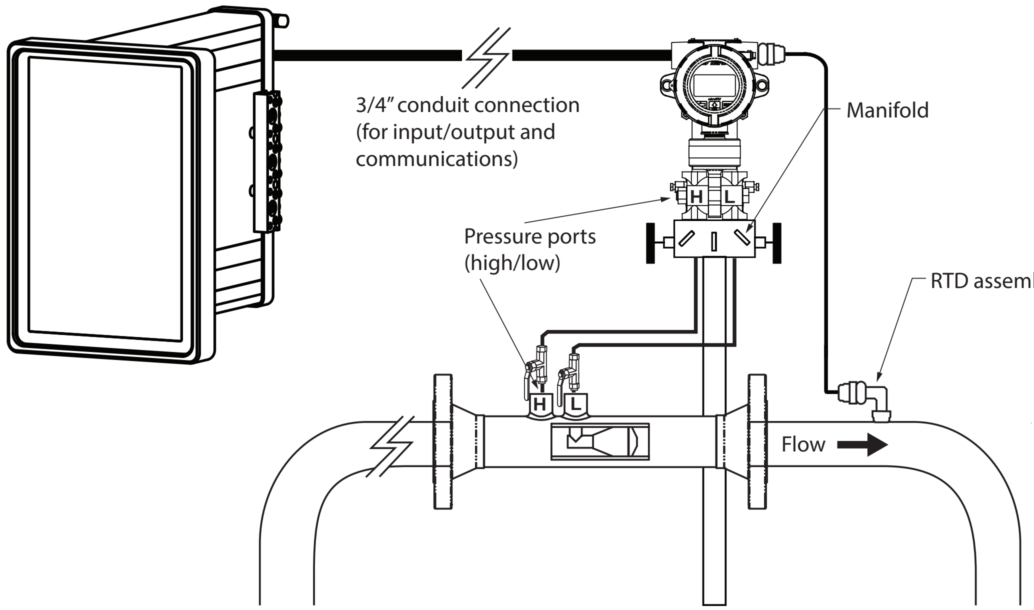

Figure 2.12 - Remote-mount gas cone meter run installation. The remote-mount method can be used with an orifice meter as well.

Note To prevent fittings from turning and to avoid putting tension on stainless steel tubing, use a backup wrench to attach stainless steel tubing to a manifold, shutoff valves, or sensor ports.

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Mount the MVT to a 2-in. pipe using the mounting bosses on the side of the enclosure and a Sensia pole mount kit. See Multi Variable Transmitter Mounting, page 20 for detailed mounting instructions.
3. Install tubing and fittings to connect the manifold assembly to the differential pressure meter, sloping the gauge lines downward to the meter at a minimum of one inch per foot. Use a suitable compound or tape on all threaded process connections.

CAUTION **Do not use Teflon tape on the threads of the union, adapter, or pipe plugs that may be installed in the enclosure.**

4. Install the RTD assembly in the thermowell. Route the RTD assembly cable to the back of the QRATE Scanner 3300 to connect to the terminal board. A wiring diagram for the RTD assembly is provided in Figure 3.8, page 54.
5. Follow guidelines outlined in MVT manual to perform a manifold leak test.
6. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
7. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Measuring Natural Gas via a Turbine Meter

Best Practices

The QRATE Scanner 3300 calculates gas flow through outputs from a MVT connected to a turbine meter (or directly from the output from the turbine meter) in accordance with AGA 7 and API MPMS Chapter 21.1 industry standards. For optimum performance, ensure that the turbine and MVT installation complies with the industry recommendations listed below:

- Install the turbine flowmeter in the meter run such that there are 10 nominal diameters of straight pipe upstream and 5 nominal diameters of straight pipe downstream of the meter. Both inlet and outlet pipe should be of the same nominal size as the meter.
- Straightening vanes are recommended for eliminating swirl conditions. If used, they should be installed 5 diameters of straight pipe upstream of the meter.
- Where an RTD is used to facilitate compensated gas measurement from a gas turbine meter, locate the RTD within 5 diameters of straight pipe downstream of the meter outlet and upstream of any valve or flow restriction.

Installation Procedure—Direct Mount to a Turbine Meter

A MVT can be mounted directly to a gas turbine meter for measuring natural gas. A pipe adapter and union are attached to the MVT, allowing a direct connection to the turbine meter.

An external pressure transducer is required for converting the pressure to a 4-20 mA or 1-5 V signal, and the MVT must be equipped with the analog input necessary to receive the pressure signal from the transducer.

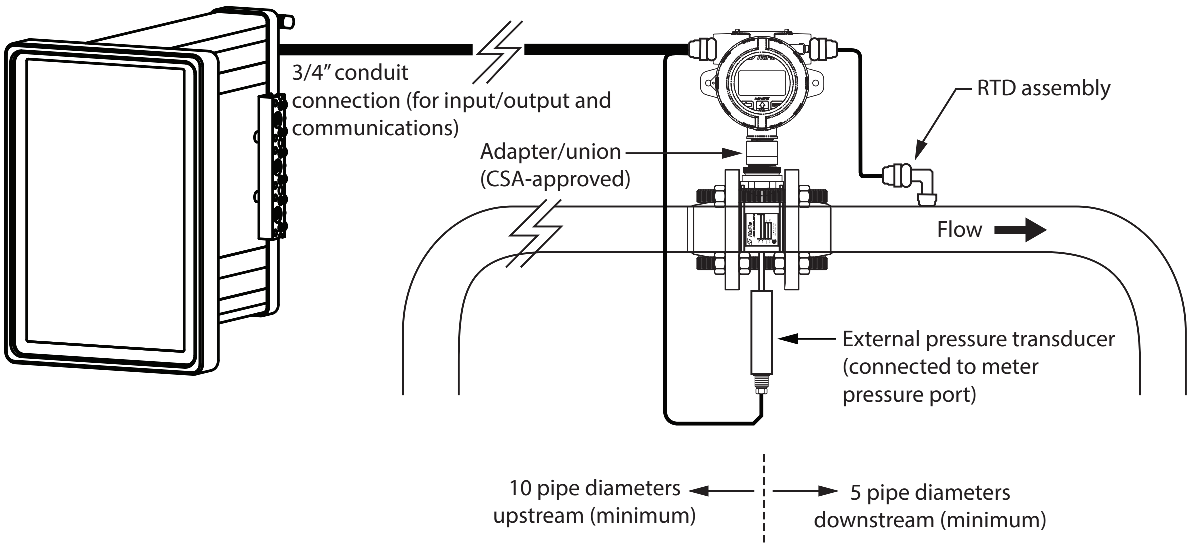

Figure 2.13 - Direct-mount installation for use with a gas turbine meter

To connect the MVT to a turbine meter using this method, perform the following steps:

1. Position the MVT above the gas turbine flowmeter.
2. Plug the MVT cable connector into the magnetic pickup of the turbine meter and hand-tighten the knurled nut on the connector.
3. Screw the MVT onto the flowmeter threads surrounding the magnetic pickup with the display facing the desired direction.

CAUTION **Do not use Teflon tape on the threads of the union, adapter, or pipe plugs. Use of Teflon tape will void the explosion-proof rating of the instrument.**

4. Tighten all sections of the pipe union.
5. Connect the pressure port of the turbine meter to the external pressure transducer.
6. Route the cable from the pressure transducer through an opening, and connect it to the analog input terminal of the MVT. A wiring diagram for the analog input is provided in Input Wiring, page 53.
7. Install the RTD assembly in the thermowell. Remove the plug from the unused conduit opening in the top of the MVT enclosure, route the RTD assembly cable through the conduit opening in the top of the MVT, and connect it to the main circuit board. A wiring diagram for the RTD assembly is provided in Figure 3.8, page 54.
8. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.

Installation Procedure—Remote Mount to a Turbine Meter

A MVT can be mounted remotely and connected to a gas turbine meter for measuring gas in accordance with AGA 7 calculations. Figure 2.14 shows an installation in which the pressure input is provided by the MVT. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

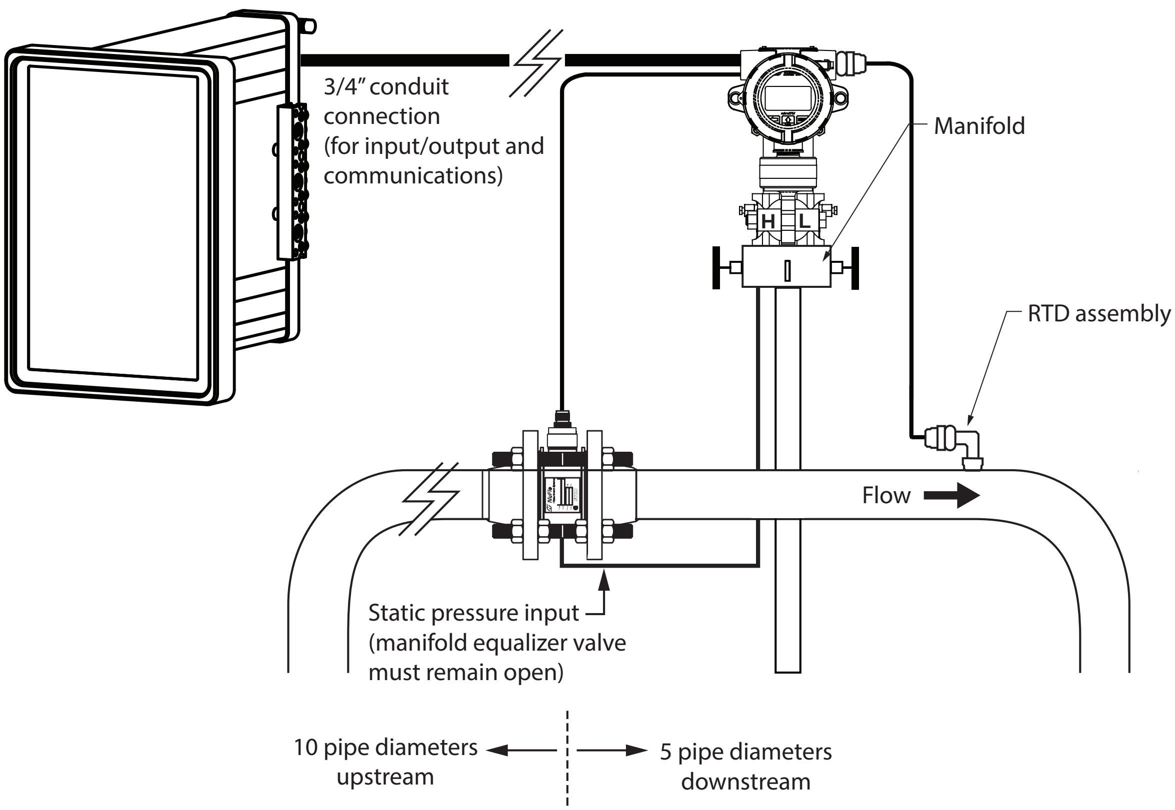

Figure 2.14 - Remote-mount installation in an AGA 7 turbine meter run

To connect the MVT to a turbine meter, perform the following steps:

1. Verify that the flowmeter and magnetic pickup are installed in the flow line.
2. Mount the MVT to a 2-in. pipe using the mounting bosses on the side of the enclosure and a Sensia pole mount kit. See Multi Variable Transmitter Mounting, page 20 for detailed mounting instructions.
3. Bolt a 3-valve flange-by-NPT manifold (as recommended by Sensia) to the MVT sensor. Position the manifold so that all valves are accessible from the front of the instrument.

4. Connect the pressure port of the turbine meter to either manifold process port with tubing. The unused pressure port can be used as a “vent” as required. Always leave the equalizer valves open to allow pressure to both sides of the transducer. Use a suitable compound or tape on all threaded process connections.

CAUTION **Do not use Teflon tape on the threads of the union, adapter, or pipe plugs that may be installed in the enclosure.**

5. A wiring diagram for the turbine input is provided in Figure 3.5, page 53. Install the RTD assembly in the thermowell. Route the RTD assembly to the MVT. A wiring diagram for the RTD assembly is provided in Figure 3.8, page 54.
6. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
7. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Installation Procedure—Remote Connection to a Turbine Meter

The QRATE Scanner 3300 can be directly connected to a gas turbine meter for measuring gas in accordance with AGA 7 calculations. Figure 2.15 shows an installation where the pressure is provided by an external transducer. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

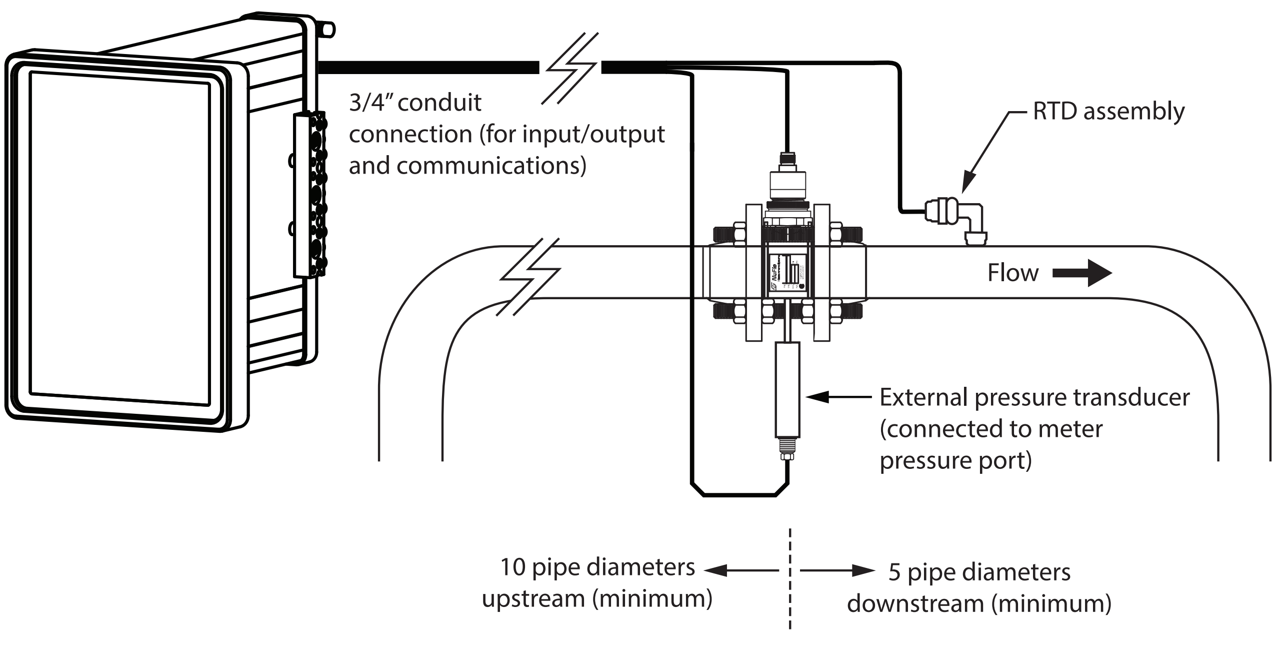

Figure 2.15 - Remote-mount installation in an AGA 7 turbine meter run

To connect the QRATE Scanner 3300 to a turbine meter, perform the following steps:

1. Verify that the flowmeter and magnetic pickup are installed in the flow line.
2. Plug the cable connector into the magnetic pickup of the turbine meter and hand-tighten the knurled nut on the connector.

CAUTION **Do not use Teflon tape on the threads of the union, adapter, or pipe plugs. Use of Teflon tape will void the explosion-proof rating of the instrument.**

3. Tighten all sections of the pipe union.
4. Connect the pressure port of the turbine meter to the external pressure transducer.
5. Route the cables from the turbine meter through the conduit, and connect them to the turbine meter terminals on the QRATE Scanner 3300. A wiring diagram for the analog inputs is provided on page 54.
6. Install the RTD assembly in the thermowell. Route the RTD assembly cable through the conduit and connect it to the terminals on the QRATE Scanner 3300. A wiring diagram for the RTD assembly is provided on page 54.
7. Route the cables from the pressure transducer through the conduit, and connect them to analog input terminals on the QRATE Scanner 3300. A wiring diagram for the analog inputs is provided on page 54.

Measuring Steam via a Differential Pressure Meter

Note Steam fluid types are only supported for flow rate calculation methods using orifice meters or cone meters.

Best Practices

The QRATE Scanner 3300 calculates steam flow through outputs from a MVT connected to a differential pressure meter in accordance with IF-97, AGA-3, and ISO-5167 industry standards. For optimum performance, ensure that the installation complies with the following industry recommendations:

Condensate Pots

- A condensate pot for a small-volume transducer like the QRATE Scanner 3300 MVT can be a simple pipe tee, oriented so that one port extends downward (into the cold leg), the opposite port extends upward and is closed by a pipe cap or blowdown valve, and the tee extends horizontally into the hot leg.
- The pots should be the highest point in the system.
- The pots should be mounted at the same level, and one or both should be adjustable vertically to remove zero shifts in the differential pressure measurement.

Hot Legs

- Hot legs should be large diameter (1/2 in. recommended)
- Hot legs should be as short as possible. If these sections must be more than 1ft in length, insulate them.
- Elbows and bends should not form any traps in which liquid can accumulate.
- Hot legs should be sloped along their entire length to allow liquids to drain back into the pipe.

Cold Legs

- Cold legs should enter the multi-variable sensor through its bottom ports. Side port installation is also available. Contact your sales representative or technical support for assistance with side port installation.
- Cold legs should not be insulated and should be a minimum of 2 ft in length to allow proper convection cooling of the process fluid to below 120 °F. The nominal rate of cooling is 100 °F/ft, with an ambient temperature of 70 °F.
- If the cold leg must be installed horizontally, ensure a slope of approximately 1 in./ft to allow air bubbles to float up into the pots.
- Elbows and bends should not form any traps for air bubbles.
- Cold legs should be filled with a suitable antifreeze. Dibutyl phthalate is recommended.

Antifreeze

Dibutyl phthalate (DBP) has the following advantages over glycol antifreeze:

- Does not mix with water, and therefore does not become dilute over time; its specific gravity does not shift.
- It is slightly denser than water, so it will stay in the pot permanently.
- It is non-flammable.
- It is much less toxic than glycol.
- It is available from industrial suppliers.

Valves

- Use only full-opening block valves that are rated for steam service.
- Use only blowdown valves rated for steam service. Periodic blowdowns are recommended to prevent scale build up.

CAUTION **Before starting the system, remove the caps and add water or antifreeze if necessary to completely fill the pots and cold legs. Air trapped in the lines will produce errors in differential pressure measurements.**

Installation Procedure—Direct Mount MVT to Orifice Meter or Cone Meter

A MVT can be mounted remotely and connected to an orifice meter or cone meter with tubing for steam measurement. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

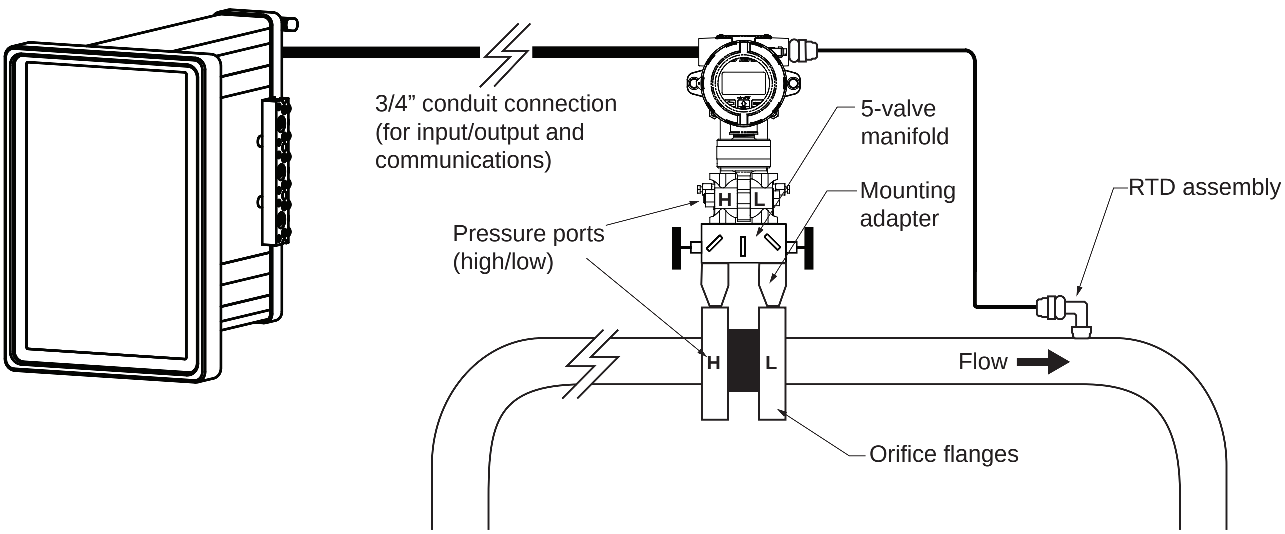

Figure 2.16 - Direct mount steam run installation

IMPORTANT When measuring steam, process connections must be designed to eliminate air pockets. This is achieved by making sure all tubing in the cold legs slopes upward. A bottom-port transducer and block manifold (shown in Figure 2.16) is recommended to help prevent air bubbles from being trapped in the sensor.

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Bolt a flange-by-flange 5-valve manifold (as recommended by Sensia) to the MVT.
   a. Locate the H and L markings on the integral MVT sensor body and position the MVT/manifold assembly so that the upstream side of the flow line can easily be connected to the sensor's "High" port and the downstream side of the flow line can be connected to the sensor's "Low" port. The MVT enclosure can be rotated to face the desired direction.
   b. Position the manifold so that all valves are accessible from the front of the instrument.

3. Connect the MVT and manifold assembly to the differential pressure meter. Hardware requirements will vary, depending upon the installation configuration. However, minimally, an adapter is required that can span between the threaded pressure tap/orifice flange connector and the non-threaded manifold. This adapter can be a one-piece stabilizer (often preferred for added strength and stability) or a short heavy wall pipe nipple attached to a futbol flange (available from Sensia). Use a suitable compound or tape on all threaded process connections.

Note To prevent fittings from turning and/or to avoid putting tension on stainless steel tubing, use a backup wrench to attach stainless steel tubing to shut-off valves or sensor ports.

CAUTION Whenever possible, locate the hot legs of a steam installation behind the QRATE Scanner 3300 safely out of the operator's normal reach. This will help prevent accidental burns.

4. Install tubing to connect the high-pressure and low-pressure process connections of the block manifold to the pipe tees installed in step 3. This tubing section is typically referred to as the cold legs of the installation, since it is filled with water.
5. To eliminate air bubbles, fill the cold legs with water or other fill fluid from the lowest point in the system, typically the MVT, using the following steps:
   a. Open the blowdown valve or remove the filling plug from one of the pipe tees/condensate pots.
   b. Open the equalizer and bypass/block valves on the block manifold. Ensure the vent valve is closed.
   c. Remove the corresponding (high pressure or low pressure) vent screw from the side of the MVT and insert a fitting to allow connection of a hand pump or funnel. If a funnel is used, attach a length of Tygon tubing that is long enough to elevate the funnel well above the condensate pot to force the fluid up the legs.
   d. Connect a hand pump or funnel to the fitting.
   e. Pour fill liquid into the funnel or pump it into the cold leg, tapping the cold leg occasionally to dislodge any bubbles.
   f. Observe the pipe tee/condensate pot and stop pouring when the fill liquid is visible at the top and no air bubbles can be seen.
   g. Remove the fitting from the vent of the MVT and quickly replace the vent screw and tighten.
   h. Close the blowdown valve or replace the filling plug from one of the pipe tees/condensate pots.
   i. Repeat steps a through h for the other cold leg.
6. To eliminate an offset of the differential pressure reading, open the equalizer valves on the block manifold, remove the caps from the seal pots, and adjust either seal pot vertically to bring the water levels to the exact same elevation.
7. Follow guidelines outlined in MVT manual to perform a manifold leak test.
8. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
9. Verify the zero offset (and other calibration points), if required.

IMPORTANT Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.

Installation Procedure—Remote Mount to Orifice Meter or Cone Meter

A MVT can be mounted remotely and connected to an orifice meter or cone meter with tubing for steam measurement. The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

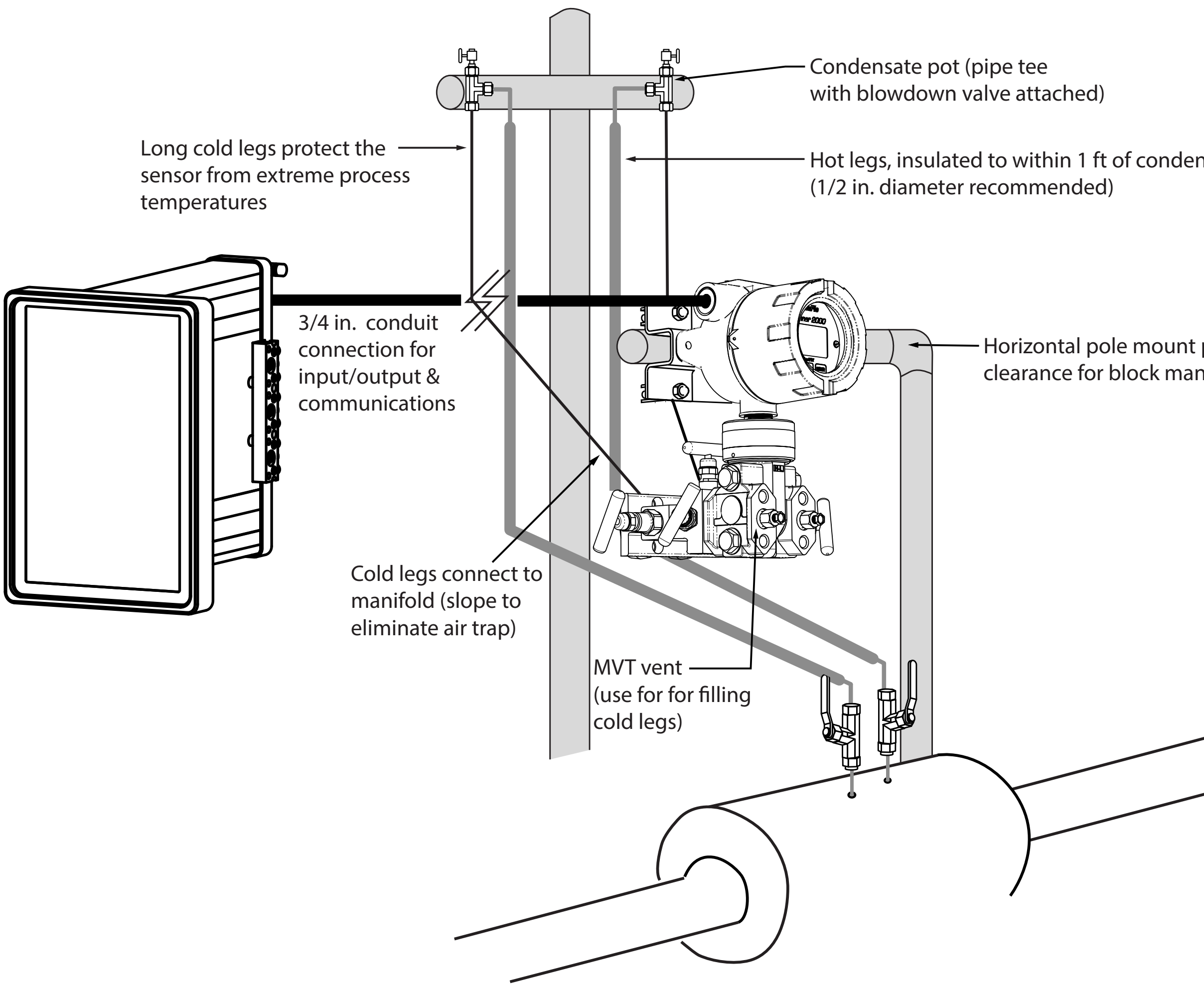

Figure 2.17 - Remote-mount steam run installation (shown here with a cone meter). The remote-mount method can be used with an orifice meter as well.

CAUTION **When measuring steam, process connections must be designed to eliminate air pockets. This is achieved by making sure all tubing in the cold legs slopes upward. A side-port MVT and block manifold (shown in Figure 2.17) is recommended to help prevent air bubbles from being trapped in the sensor.**

If a bottom-port transducer is used, the bottom process ports must be plugged or replaced with a drain valve, and side vents must be used for process connections. A block manifold is not recommended for use with bottom port transducers. Contact a Sensia field representative for assistance.

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Mount the MVT to a 2-in. pipe or to a flat, vertical surface using bolts and the mounting holes in the enclosure. A horizontal pipe is recommended, as additional hardware may be required for a vertical pipe mount to provide clearance for the manifold block.

3. Mount a set of pipe tees (which serve as condensate pots) typically on either side of the MVT at an elevation above the process connections of the MVT (for proper drainage). They should be a considerable distance (4 ft) from the sensor ports, but as close as possible to the pressure taps on the meter.
4. Install a pipe cap or a blowdown valve that is rated for steam service at the top of each pipe tee. A blowdown valve is recommended when the steam passing through the meter is known to be dirty.
5. Install tubing and fittings to connect the high-pressure and low-pressure taps of the DP meter to the pipe tees. This section is typically referred to as the hot legs of the installation, as this section of tubing encounters steam at its highest temperature. Install a shut-off valve near the high and low ports of the DP meter. Use a suitable compound or tape on all threaded process connections.

Note: To prevent fittings from turning and/or to avoid putting tension on stainless steel tubing, use a backup wrench to attach stainless steel tubing to shut-off valves, or sensor ports.

CAUTION **Whenever possible, locate the hot legs of a steam installation behind the MVT safely out of the operator's normal reach. This will help prevent accidental burns.**

7. Install tubing to connect the high-pressure and low-pressure process connections of the block manifold to the pipe tees installed in step 3. This tubing section is typically referred to as the ***cold legs*** of the installation, since it is filled with water.
8. To eliminate air bubbles, fill the cold legs with water or other fill fluid from the lowest point in the system, typically the MVT, using the following steps:
   a. Open the blowdown valve or remove the filling plug from one of the pipe tees/condensate pots.
   b. Open the equalizer and bypass/block valves on the block manifold. Ensure the vent valve is closed.
   c. Remove the corresponding (high pressure or low pressure) vent screw from the side of the MVT and insert a fitting to allow connection of a hand pump or funnel. If a funnel is used, attach a length of Tygon tubing that is long enough to elevate the funnel well above the condensate pot to force the fluid up the legs.
   d. Connect a hand pump or funnel to the fitting.
   e. Pour fill liquid into the funnel or pump it into the cold leg, tapping the cold leg occasionally to dislodge any bubbles.
   f. Observe the pipe tee/condensate pot and stop pouring when the fill liquid is visible at the top and no air bubbles can be seen.
   g. Remove the fitting from the vent of the MVT and quickly replace the vent screw and tighten.
   h. Close the blowdown valve or replace the filling plug from one of the pipe tees/condensate pots.
   i. Repeat steps a through h for the other cold leg.
9. To eliminate an offset of the differential pressure reading, open the equalizer valves on the block manifold, remove the caps from the seal pots, and adjust either seal pot vertically to bring the water levels to the exact same elevation.
10. Follow guidelines outlined in MVT manual to perform a manifold leak test.
11. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
12. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Measuring Liquid via a Differential Pressure Meter

Best Practices

The QRATE Scanner 3300 calculates liquid flow through outputs from a MVT connected to a differential pressure meter. To ensure measurement accuracy, ensure that the meter run complies with the following AGA 3 and ISO 5167 guidelines, as applicable:

- Do not place unit near vents or bleed holes that discharge corrosive vapors or gases.
- Consider the orientation of the meter run when determining the best position for mounting the Scanner.
  - If the MVT is mounted to a horizontal pipeline, make sure process connections are horizontal with the pipeline, or sloped downwards towards the Scanner. Mount the MVT below the pressure taps at the pipe. Use the side (upper) ports as process connections and the bottom ports for draining and filling the differential pressure housings.
  - If the MVT is mounted to a vertical pipeline, install the sensor below the differential pressure source connections. Slope all tubing downward at least 1 in./LF to avoid gas entrapment.
- Mount the MVT as near level as possible such that the operator has a clear view of the LCD, and can access the keypad easily when the enclosure cover is removed. The location should be as free from vibration as possible.
- Make sure the high port of the sensor (marked “H”) is connected to the upstream side of the meter run.
- Pipe diameters (D) should be between 2 in. (50 mm) and 39 in. (1000 mm) per ISO 5167; or greater than 2 in. (50 mm) per AGA 3.
- Pipe Reynolds numbers must be above 5000. Avoid high-viscosity liquids (greater than 15 cP).
- d (orifice diameter) must be greater than or equal to 0.45 in. (11.5 mm).
- Orifice β (diameter ratio) must be greater than or equal to 0.1 and less than or equal to 0.75.
- Gauge lines should be of uniform internal diameter and constructed of material compatible with the fluid being measured. For most applications, the bore should be no smaller than 1/4 in. (6 mm) and preferably, 3/8 in. (10 mm) in diameter. The internal diameter should not exceed 1 in. (25 mm). If high-temperature fluids are likely to be encountered, make sure the measuring tube used is rated for the anticipated temperature range.
- If there is possibility of freezing, the gauge lines can be filled with a suitable seal liquid. The seal liquid should be somewhat denser than the process fluid, should not dissolve in it, should have a sufficiently low freezing point, and should be non-toxic. Alternatively, heat tracing can be used.
- Gauge line length should be minimized to help prevent pulsation-induced errors.
- Gauge lines should slope upward to the meter at a minimum of 1 in./ft.
- If gauge lines must slope in more than one direction, do not allow more than one bend and install a gas trap.
- Gauge lines should be supported to prevent sag and vibration.
- Where pulsation is anticipated, full-port manifold valves with a nominal internal diameter consistent with the gauge lines are recommended.

If the MVT is mounted to a cone meter, consider the following guidelines in addition to the best practices listed above.

- Position the cone meter so that there are 0 to 5 diameters of straight pipe upstream of the meter and 0 to 3 diameters of straight pipe downstream of the meter.
- Install the meter so that the static pressure tap is upstream of the differential pressure tap. The high side of the MVT transducer must also be situated upstream.
- Install shutoff valves directly on the pressure taps. Choose a shutoff valve that is rated for the ambient temperatures of the location and the operating pressure of the pipe in which it will be installed, and for use with dangerous or corrosive fluids or gases, if applicable. The valves must not affect the transmission of the differential pressure signal.

Installation Procedure—Direct Mount to Orifice Meter or Cone Meter

A MVT can be mounted directly to an orifice meter or cone meter for liquid measurement using a side-port transducer, a block manifold and two football flange adapters (Figure 2.18). The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

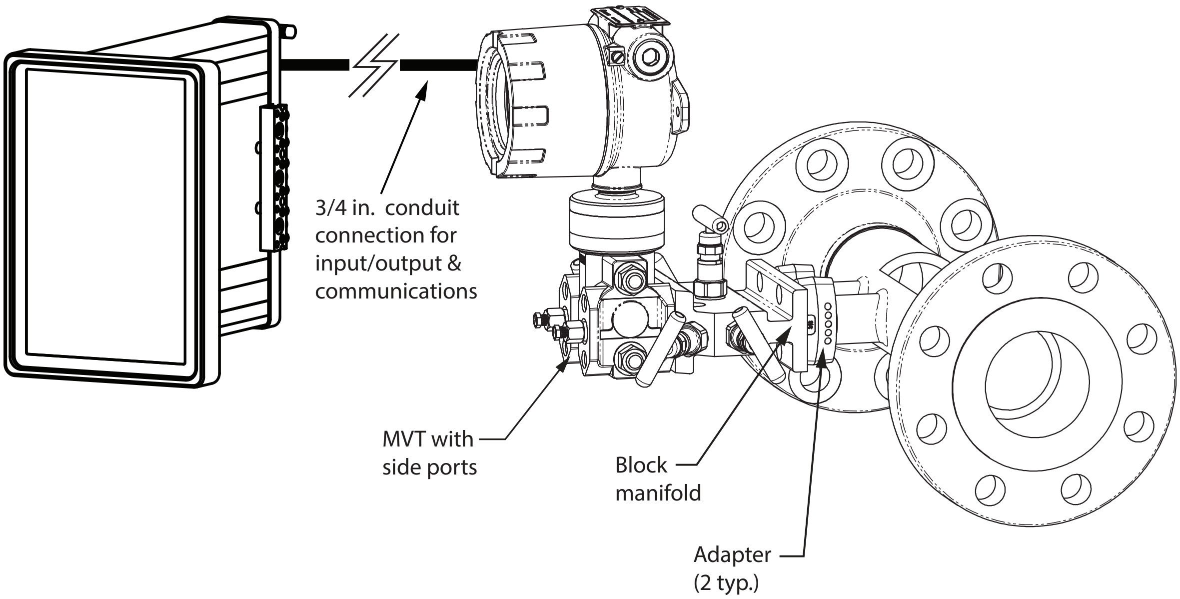

Figure 2.18 - Direct-mount liquid run installation (shown with a cone meter). Downstream RTD not shown.

CAUTION **When measuring liquid with a direct-mount MVT, process connections must be parallel to the horizontal centerline of the meter, or below the centerline to eliminate air pockets.**

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Screw a football flange adapter onto each meter pressure tap using pipe tape or pipe dope to seal the threads.
3. Align the bolt holes in the MVT and manifold, and install bolts to mate these components to the football flanges, using o-rings as appropriate. Torque the bolts to the manufacturer's specification.
4. Verify that all manifold valves are closed, and fill the meter with process fluid.
5. Loosen one of the vent screws in the side of the MVT.
6. Open the equalizer valves and the vent valve on the manifold.
7. Slowly open one of the bypass/block valves on the manifold. Process fluid should immediately spurt from the MVT vent.
8. When air bubbles are no longer visible around the MVT vent, tighten the MVT vent screw.
9. Loosen the other vent screw in the side of the MVT, and repeat steps 7 through 9.
10. Follow guidelines outlined in MVT manual to perform a manifold leak test.
11. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
12. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Remote Mount to Orifice Meter or Cone Meter

A MVT can be mounted remotely and connected to an orifice meter or cone meter with tubing for liquid measurement (Figure 2.19). The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.

CAUTION **When measuring liquid, process connections must be designed to eliminate air pockets. This is achieved by mounting the sensor below the metering device and sloping all tubing downward from the meter to the sensor. A side-port transducer and block manifold (shown in Figure 2.19) is recommended to help prevent air bubbles from being trapped in the sensor.**

If a bottom-port MVT is used, the bottom process ports must be plugged or replaced with a drain valve, and side vents must be used for process connections. A block manifold is not recommended for use with bottom port transducers. Contact a Sensia field representative for assistance.

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Mount the MVT to a 2-in. pipe using the mounting bosses on the side of the enclosure and a Sensia pole mount kit. See Multi Variable Transmitter Mounting, page 20 for detailed mounting instructions.
3. Install tubing and fittings to connect the high-pressure and low-pressure taps of the differential pressure meter to the process connections of the block manifold. Install a pair of shutoff valves near the high and low ports of the differential pressure meter. Use a suitable compound or tape on all threaded process connections.
4. Install the RTD assembly in the thermowell. A wiring diagram for the RTD assembly is provided in Figure 3.8, page 54.

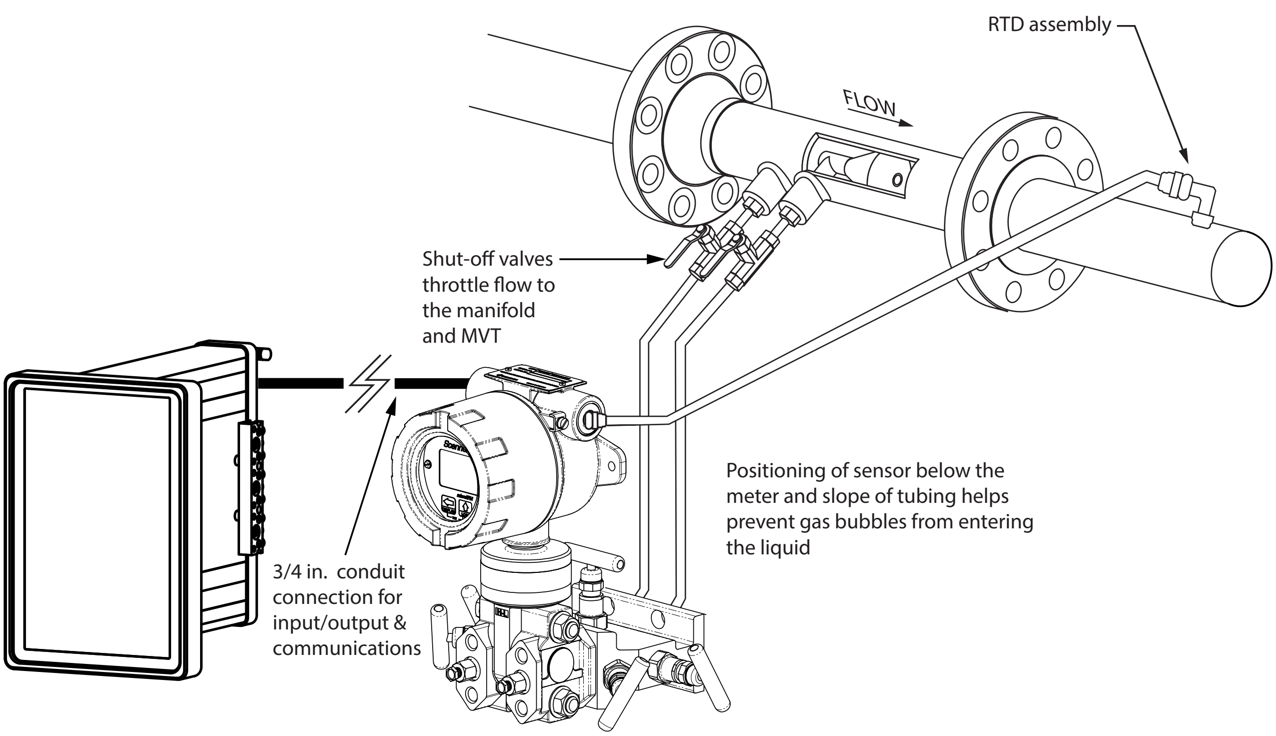

Figure 2.19 - Remote-mount liquid cone meter run installation. The remote-mount method can be used with an orifice meter as well.

Note To prevent fittings from turning and/or to avoid putting tension on stainless steel tubing, use a backup wrench to attach stainless steel tubing to shutoff valves, or sensor ports.

5. To eliminate air bubbles in the MVT, manifold and legs connecting them to the meter, fill the legs with fluid. Choose a fluid that is safe for the environment and stable when depressurized.

Important **If the process fluid does not present an environmental risk and is stable when depressurized, it may be used to bleed air from the lines. If the process fluid can contaminate the environment or is highly volatile when depressurized as with liquefied gases, a different seal fluid should be used to fill the legs. An ideal seal fluid is one that does not dissolve in the process fluid.**

---

6. If ***process fluid*** is to be used, bleed air from the lines as follows. If a different seal fluid is to be used, proceed to step 8.
   a. Make sure the shut-off valves in the tubing near the meter pressure taps are closed, and the meter is filled with process fluid.
   b. Open the equalizer and bypass/block valves on the block manifold. Make sure the vent valve is closed.
   c. Open one of the shut-off valves near the meter.
   d. Slowly loosen the corresponding vent screw on the MVT, and throttle the rate of flow from the vent with the shut-off valve.
   e. When air bubbles are no longer visible around the MVT vent, tighten the MVT vent screw.
   f. Repeat steps 7a through 7e for the other leg.
   g. Proceed to step 9.
7. If a fluid ***other than the process fluid*** is to be used, bleed air from the lines as follows:
   a. Make sure the shut-off valves in the tubing near the pressure taps are open.
   b. Open the equalizer and bypass/block valves on the block manifold. Ensure the vent valve is closed.
   c. Remove the vent screw from one side of the MVT and insert a fitting to allow connection of a hand pump or funnel. If a funnel is used, attach a length of Tygon tubing long enough to elevate the funnel well above the meter pressure taps to force the fluid up the legs.
   d. Connect a hand pump or funnel to the fitting.
   e. Estimate the amount of fill fluid required to fill the tubing and push any air bubbles into the meter.
   f. Pour fill liquid into the funnel, tapping the tubing occasionally to dislodge any bubbles.
   g. When the leg is full of fluid, remove the fitting from the MVT vent and quickly replace the vent screw and tighten.
   h. Repeat steps 8a through 8g for the other leg.
8. Follow guidelines outlined in MVT manual to perform a manifold leak test.
9. Wire outputs or COM connections from the MVT to the inputs or COM connections on the back of the QRATE Scanner 3300.
10. Verify the zero offset (and other calibration points), if required.

CAUTION **Do not put the MVT into operation until the valves are positioned properly so that pressure is supplied to both sides of the transducer.**

Measuring Compensated Liquid via a Turbine Meter

Best Practices

The QRATE Scanner 3300 calculates temperature- and pressure-compensated liquid flow through outputs from a MVT connected to a turbine meter (or directly from the output from the turbine meter) in accordance with API MPMS Ch. 11.1 and the measurement principles upon which the AGA 7 standard is based. When you supply a linear or multipoint calibration factor, the instrument performs the required compensation calculations based on the RTD and/or pressure inputs.

For optimum performance, ensure that the turbine and MVT installation complies with the industry recommendations listed below:

- Install the turbine flowmeter in the meter run such that there are at least 10 nominal diameters of straight pipe upstream and 5 nominal diameters of straight pipe downstream of the meter. Both inlet and outlet pipe should be of the same nominal size as the meter.
- Straightening vanes are recommended for eliminating swirl conditions. If used, they should be installed 5 diameters of straight pipe upstream of the meter. If a pressure transducer is installed, it is recommended that it be placed upstream of the flow straightener.

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Section 3 - Wiring the QRATE Scanner 3300 Integrated Control Flow Computer

Field Wiring Connections

CAUTION **All field wiring must conform to the National Electrical Code, NFPA 70, Article 501-4(b) for installations within the United States or the Canadian Electric Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must be rated for temperatures of 90 °C or higher, and have a wire range of 22 to 14 AWG. Terminal block screws must be tightened to a minimum torque of 5 to 7 in-lb. (0.57 to 0.79 joules) to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.**

WARNING: All cable and cable glands must be rated for 80ºC.

To wire the QRATE Scanner 3300 for operation, complete the following field connections:

1. The terminal board is at the rear of the enclosure. All wiring connections can be made to this board. Wire in accordance with the wiring diagrams shown on page 51 through page 59. See Figure 3.1 for help in locating the terminals by number.

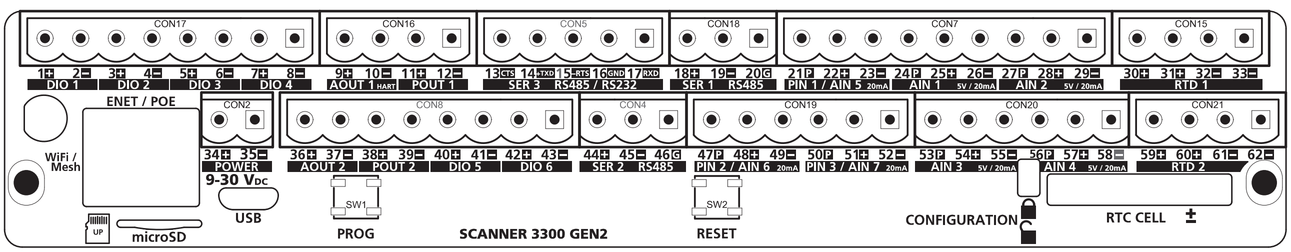


Figure 3.1 - Terminal board illustration with numbered terminals

2. Complete wiring of the terminal board as follows:
   a. Connect wiring for external power to POWER (Terminals 34 and 35), if desired.
   b. If the device is externally powered, route the protective earth grounding conductor to the enclosure with the incoming power conductors and terminate it to a screw on the side of the enclosure (Figure 3.2).

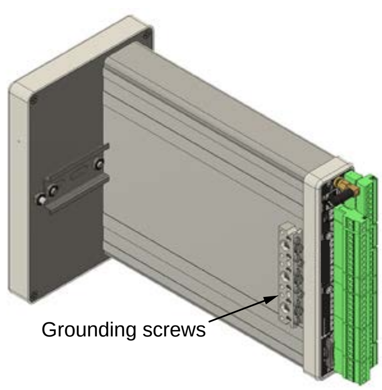


Figure 3.2 - External ground screw locations

c. Connect the pulse input wiring to PIN 1 to 3, as required. (Wiring on page 54 and specifications on page 11)

Terminal Block	Terminals
PIN 1 (AIN 5)	21(P), 22(+), 23(-)
PIN 2 (AIN 6)	47(P), 48(+), 49(-)
PIN 3 (AIN 7)	50(P), 51(+), 52(-)

d. Connect the process temperature input wiring to RTD 1 or RTD 2, as required. (Wiring on page 54 and specifications on page 10)

Terminal Block	Terminals
RTD 1	30(+), 31(+), 32(-), 33(-)
RTD 2	59(+), 60(+), 61(-), 62(-)

e. Connect analog input wiring to AIN 1 to 7, as required. (Wiring on page 56 and specifications on page 10)

Terminal Block	Terminals
AIN 1	24(P), 25(+), 26(-)
AIN 2	27(P), 28(+), 29(-)
AIN 3	53(P), 54(+), 55(-)
AIN 4	56(P), 57(+), 58(-)
AIN 5 (PIN 1)	21(P), 22(+), 23(-)
AIN 6 (PIN 2)	47(P), 48(+), 49(-)
AIN 7 (PIN 3)	50(P), 51(+), 52(-)

f. Connect analog output wiring to AOUT 1 (HART) (Future) and AOUT 2, as required. (Wiring on page 59 and specifications on page 11)

Terminal Block	Terminals
AOUT 1	9(+), 10(-)
AOUT 2	36(+), 37(-)

g. Connect digital input/output wiring to DIO 1 to 6, as required. (Wiring on page 57 to page 60 and specifications on page 55)

Terminal Block	Terminals
DIO 1	1(+), 2(-)
DIO 2	3(+), 4(-)
DIO 3	5(+), 6(-)
DIO 4	7(+), 8(-)
DIO 5	40(+), 41(-)
DIO 6	42(+), 43(-)

h. Connect serial communication wiring to SER 1 to 3, as required. (Wiring on page 59 and specifications on page 9)

Terminal Block	Terminals
SER 1 (RS485)	18(+), 19(-), 20(G)
SER 2 (RS485)	44(+), 45(-), 46(G)
SER 3 (RS485/232)	13(CTS), 14(+TXD), 15(-RTS), 16(GND), 17(RXD)

3. Configure and calibrate the QRATE Scanner 3300.

Power Supply Wiring

External Power Supply

The QRATE Scanner 3300 can be connected to a remote DC power supply (Figure 3.4). The power supply and cable must be capable of supplying 9 to 30 VDC at 400 mA minimum.

The external power supply used with CSA-approved units must be an approved SELV source, insulated from the AC main by double/reinforced insulation per CSA C22.2, No. 61010-1-04/UL 61010-1, 2nd Edition. .

Caution **All field wiring must conform to the National Electrical Code, NFPA 70, Article 501-4(b) for installations within the United States or as specified in Section 18-156 of the Canadian Electrical Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG and terminal block screws must be tightened to a minimum torque of 5 to 7 in-lb. to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.**

Important **In all applications using an external power supply, a switch or circuit breaker must be included in the safe area within easy reach of the operator. The switch or circuit breaker must be marked as the “disconnect” for the safe area external DC power supply.**

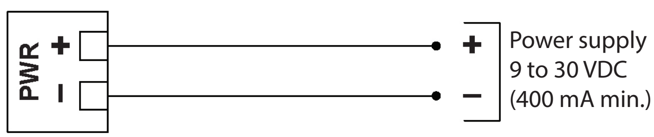


Figure 3.3 - External power supply

Transmitter Supply

The transmitter supply is used to supply power from the QRATE Scanner 3300 to external analog or pulse output devices. The transmitter supply configuration is done through the web-interface for each analog or pulse input (outputted on the "**P**" terminal). Keeping in mind that Pulse Input 1, 2, and 3 can be configured to be Analog In 5, 6, and 7, or vice versa.

For each analog or pulse input, the transmitter supply can be set to be always on, always off, or set to warm up the transducer before powering it. The output of the transmitter supply may also be programmed to 8.5 to 24 VDC for each of these inputs. This is not limited by the external power supply voltage level (ex. The transmitter power supply can be programmer to source 24 V, even if the external supply to the device is only 9V). If no transmitter power is required, the transmitter power may be disabled for all inputs.

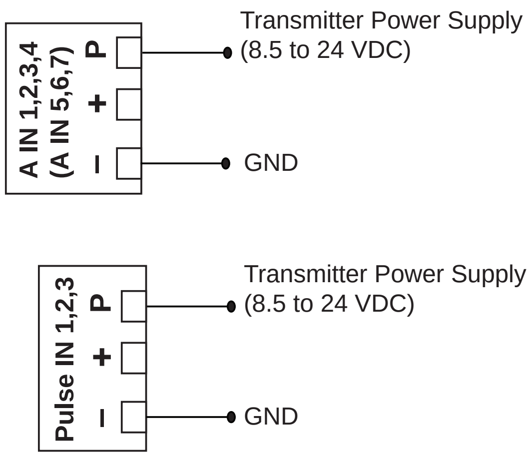


Figure 3.4 - Transmitter Power

Input Wiring

Pulse Inputs - Turbine Magnetic Pickup

Pulse inputs 1, 2 and 3 on the terminal board may be configured through the web-interface for an input signal generated by a magnetic pickup. For example, it may be configured for a magnetic pickup for a turbine meter, which enables the QRATE Scanner 3300 to calculate and display instantaneous flow rates and accumulated totals. Wire as shown in Figure 3.5.

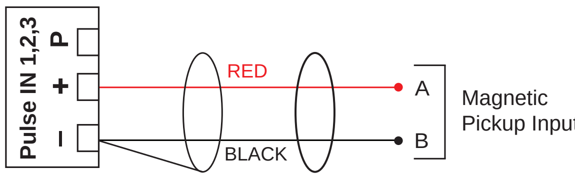


Figure 3.5 - Flowmeter input

Pulse Inputs - Digital DC Pulse

Pulse inputs 1, 2 and 3 on the terminal board may be configured through the web-interface for an input for high-amplitude pulse (frequency) signals, such as signals from a turbine meter equipped with a preamplifier. Wire as shown in Figure 3.6.

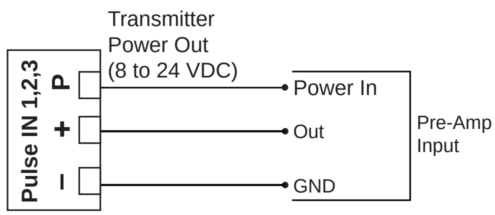


Figure 3.6 - Pulse input

Pulse Inputs - Contact Closure

Pulse inputs 1, 2 and 3 on the terminal board may be configured through the web-interface for an input for high-amplitude pulse (frequency) signals, such as signals from a positive displacement meter. Wire as shown in Figure 3.7.

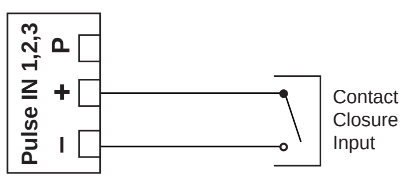


Figure 3.7 - Contact Closure Input

RTD Inputs

The 4-wire RTDs are recommended for measuring temperature in temperature-compensated gas and liquid calculations, though a 2- or 3-wire RTD may prove functional. Wiring is essentially the same for all three models, though wire color may vary as indicated. Wire as shown in Figure 3.8.

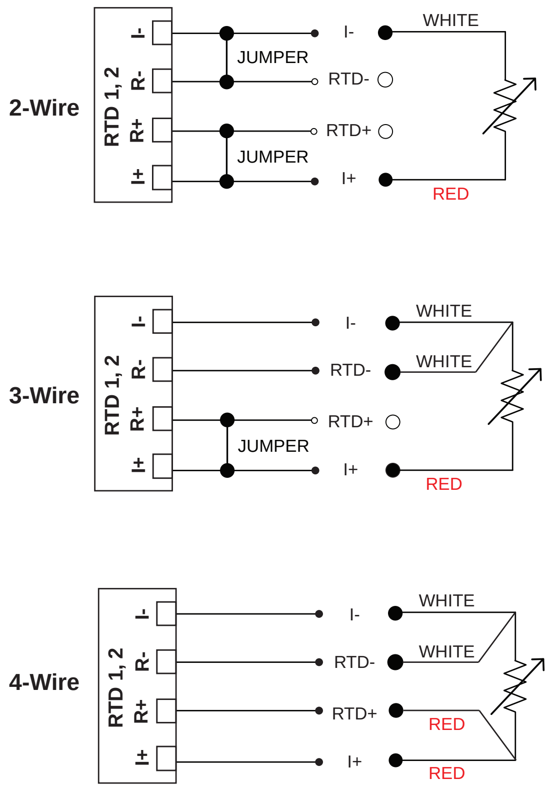


Figure 3.8 - Process temperature input

Analog Inputs - Voltage Input

The analog inputs can be used to receive readings from a pressure or temperature transmitter for use in any flow run. Analog Inputs 1 to 4 can be configured through the web-interface for 0 to 5 V or 1 to 5 V. Alternatively, they can be used to log measurements from any device with a compatible analog output.

Through the web-interface, the QRATE Scanner 3300 can be configured to provide 8 to 24 VDC at 20 mA for powering a 0 to 5 V or 1 to 5 V transmitter. For reduced power consumption, disable analog inputs in the QRATE Scanner 3300 web interface when they are not in use. Wire as shown in Figure 3.9.

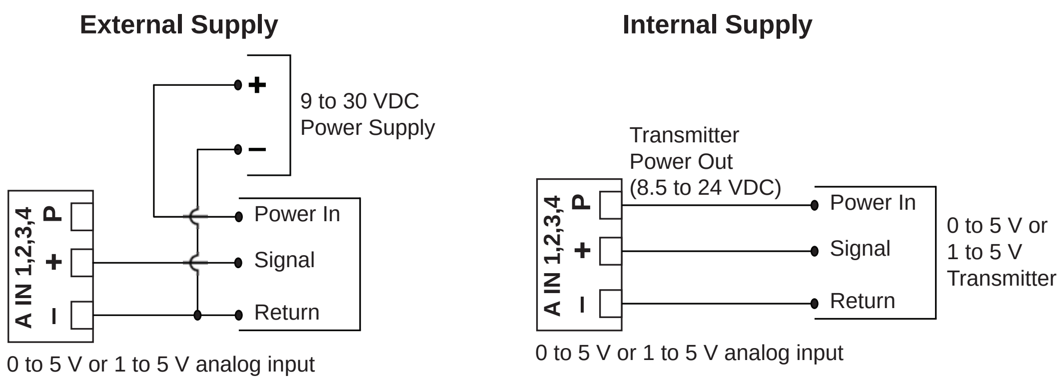


Figure 3.9 - Voltage Analog input

Analog Inputs - Current Input

The analog inputs can be used to receive readings from a pressure or temperature transmitter for use in any flow run. Analog Inputs 1 to 7 can be configured through the web-interface for 0 to 20 mA or 4 to 20 mA signals. Alternatively, they can be used to log measurements from any device with a compatible analog output. An on-board resistor is automatically enabled when a current input is configured in the QRATE Scanner 3300 web interface. Therefore, no external resistor is required for use with a current input.

Through the web-interface, the device can be configured to provide 8.5 to 24 VDC at 20 mA for powering a 0 to 20 mA or 4 to 20 mA transmitter. For reduced power consumption, disable analog inputs in the QRATE Scanner 3300 web interface when they are not in use. Wire as shown in Figure 3.10.

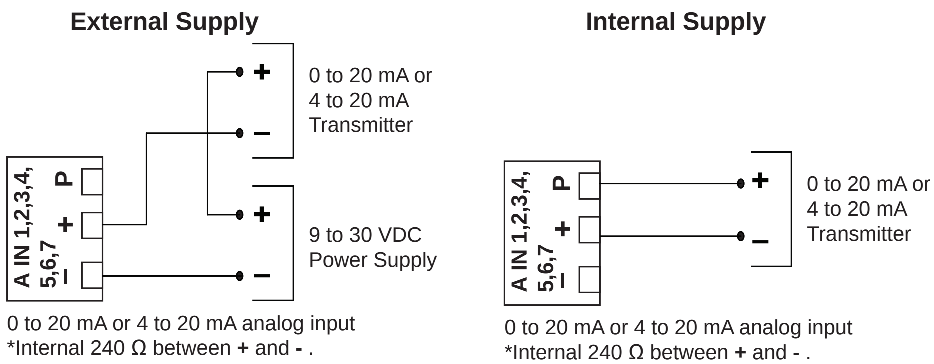


Figure 3.10 - Current Analog Input

Digital Inputs - Contact Closure

The digital contact closure input (Figure 3.11) provides an input for use with any relay contact switch. DIO 1 through DIO 4 are galvanically isolated and are limited to 60 mA. DIO 5 and DIO 6 are non-isolated and are limited to 500 mA. To configure a contact closure using the QRATE Scanner 3300 web interface, choose **Contact Closure** as the input type and select a trigger state to indicate whether the pulse will trigger when the signal is high or when it is low.

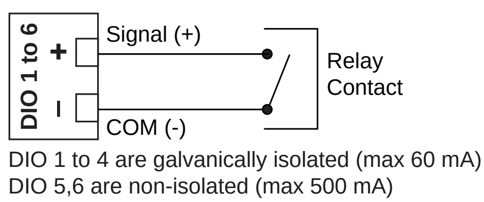


Figure 3.11 - Digital contact closure

Digital Inputs - Pulse

The digital pulse input (Figure 3.12) provides an input for use with any 3 to 30 VDC pulse-generating device. DIO 1 through DIO 4 are galvanically isolated and are limited to 60 mA. DIO 5 and DIO 6 are non-isolated and are limited to 500 mA.

To configure a pulse input using the web interface, choose **Pulse** as the input type, and select a trigger state to indicate whether the pulse will trigger when the signal is high or when it is low.

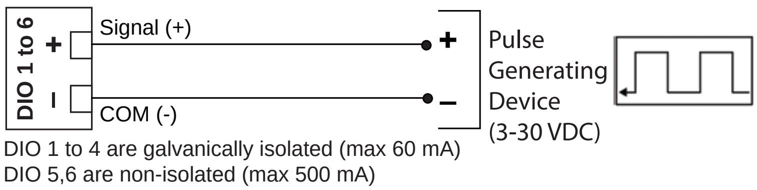
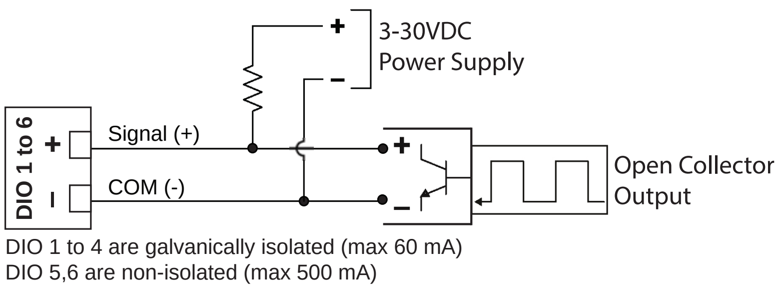


Figure 3.12 - Digital pulse input

Digital Inputs - Open Collector

The digital open collector input (Figure 3.13) provides an input for use with any device with an open collector output. DIO 1 through DIO 4 are galvanically isolated and are limited to 60 mA. DIO 5 and DIO 6 are non-isolated and are limited to 500 mA. DIO 5 and DIO 6 can be wired for use with an internal pull-up resistor, or with a customer-supplied resistor. When the internal pull-up resistor is used, signals can be transmitted over short distances without the use of an external power supply. However, DIO 1 through DIO 4 can only be wired with a customer-supplied resistor.

To configure an open collector input using the web interface, choose **Open Collector** (**Open Collector with Customer Supplied Pull-Up Resistor** or **Open Collector with Internal Pull-Up Resistor** for DIO 5 and DIO 6) as the input type, and select a trigger state to indicate whether the input is to trigger when the signal is high or when it is low.



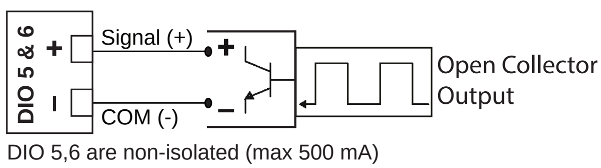


Figure 3.13 - Digital open collector input

Output Wiring

Analog (4 to 20 mA) Outputs

The 4 to 20 mA output (Figure 3.15) provides a linear current output that can be configured to represent any parameter in the holding registers using the web interface. This output requires a two-conductor cable connected to a 9 to 30 VDC power supply (voltage required is dependent on loop resistance) and a current readout device located in the remote location. The analog outputs are electrically isolated from each other and from the main electronics. See the QRATE Scanner 3300 Web Interface User Manual for information on configuring and calibrating zero and full-scale values.

The load resistance vs. loop supply voltage graph below shows the minimum voltage required to power the instrument for a given loop resistance. In addition, the mathematical relationship between loop voltage and load resistance is given. For example, if a power supply voltage of 24 volts is available to power the current loop, the maximum load resistance would be 800 ohms. Wire as shown in Figure 3.14.

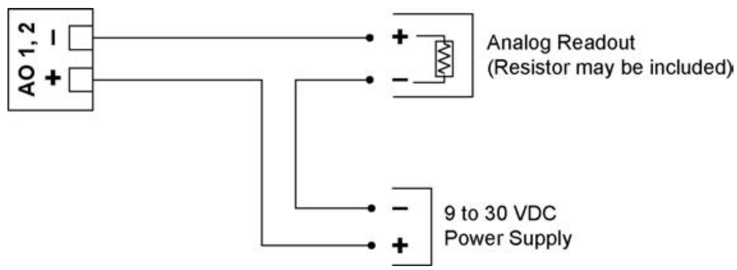
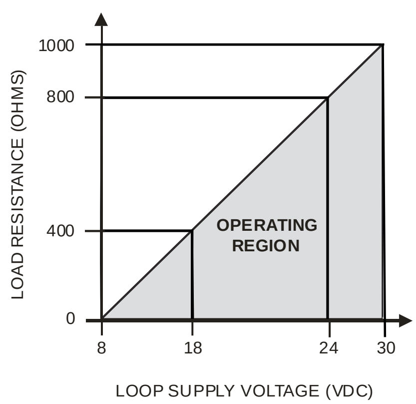


Figure 3.14 - Analog (4 to 20 mA) output wiring



$$R_L\ MAX = \frac{(V\ loop - 8V)}{20\ mA}$$

$$R_L\ MAX = \frac{(24V\ loop - 8V)}{20\ mA}$$

$$R_L\ MAX = 800\ ohms$$

Figure 3.15 - Analog (4 to 20 mA) output

Digital Outputs

The standard QRATE Scanner 3300 supports eight solid-state digital outputs that are configurable as pulse outputs, alarm outputs, conditional outputs, or programmed outputs using time of day or an output state as the trigger.

DIO 1 through DIO 4 are galvanically isolated and rated for a maximum of 60 mA at 30 VDC with a maximum frequency of 500 Hz. DIO 5 and 6 are non-isolated and rated for a maximum of 500 mA at 30 VDC with a maximum frequency of 500 Hz. Wire as shown in Figure 3.16. Because DIO 1 to 4 are isolated, they can be used with any other feature on the QRATE Scanner 3300. A two-conductor cable from the device to the remote location is required for each output.

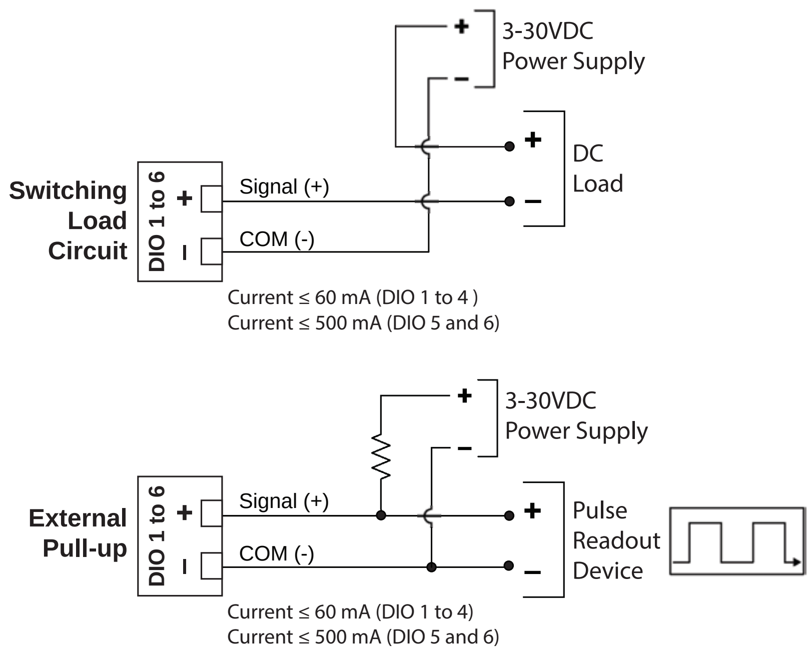


Figure 3.16 - Digital Output Wiring; DIO 1 to 4 are galvanically isolated; DIO 5 & 6 are non-isolated

Communications

RS-485 Communications

The QRATE Scanner 3300 supports digital serial communications using EIA-RS-485 hardware with Modicon Modbus protocol. RS-485 communications are supported by three ports with a baud range of 300 to 115.2K. Ports 1, 2, and 3 can be used simultaneously, if desired, and all three ports are protected from high-voltage transients. The circuit can be terminated by enabling an internal termination resistor in the web interface. See the QRATE Scanner 3300 Web Interface User Manual for details. Wire as shown in Figure 3.17.

Ports 1, 2, and 3 are designed for use with low-power peripherals such as radios, gas chromatographs, other wired Modbus devices, and wired NUFLO Scanner 2000 series flow computers configured slave devices, and are always enabled. If a large number of slave devices are to be connected to a QRATE Scanner 3300 network via a serial port, more than one communication port may be required, depending on archive periods and baud rates desired. The mode (RS-485 or RS-232) is automatically detected by the hardware.

Note Not all RS-485 devices, including converters, identify A and B terms consistently. If communications are not established, switch the wires.

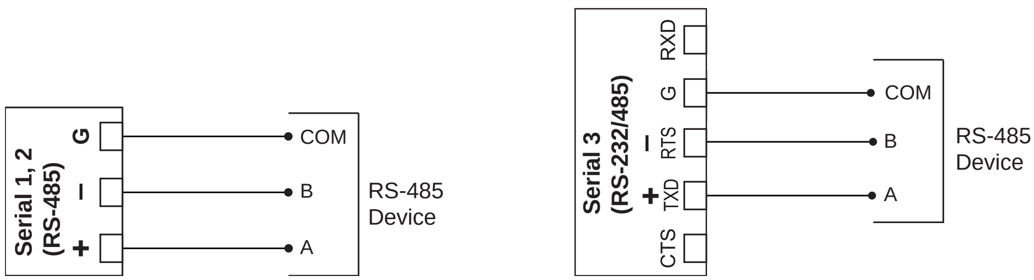


Figure 3.17 - RS-485 communications

Note PORT 3 (RS-232/485 3) automatically detects RS-232 and RS-485 based on voltage levels. If RS-232 is being used, the voltage levels must be valid in order to ensure the port detects RS-232 communication.

RS-232 Communications

Port 3, also supports both RS-232 and RS-485 communications. RS-232 communications are useful for short-range communications (typically 50 ft or less) with radios and some Modbus peripheral devices. Wire as shown in Figure 3.18.

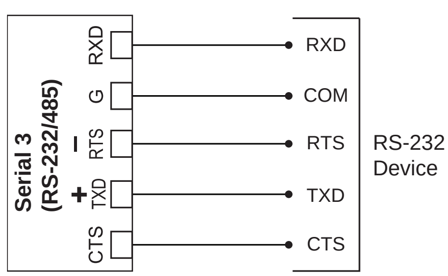


Figure 3.18 - RS-232 communications

Note PORT 3 (RS-232/485 3) automatically detects RS-232 and RS-485 based on voltage levels. If RS-232 is being used, the voltage levels must be valid in order to ensure the port detects RS-232 communication.

Ethernet Communications

An RJ-45 connector (Figure 3.1, page 49) provides the Ethernet communications required for accessing the web interface via a web browser and for transmitting data over two TCP ports. The TCP ports support Modbus TCP and Modbus-over-TCP protocols and can be configured individually (assigned to unique port numbers) using the web interface.

Section 4 describes two methods for using the Ethernet port to connect the QRATE Scanner 3300 to a PC or laptop.

Section 4 - Kiosk Display Interface

The QRATE Scanner 3300 touch screen display allows you to view the real-time measurements for up to 32 selected parameters, and gives access to the web interface to configure the device. If the User Configured Device Display is enabled, the parameters scroll continuously through the 5 fields provided. The screen may show Flow Run 1 Summary or Flow Run 2 Summary (Figure 4.1). Otherwise, the screen will simply show both summaries (Figure 4.2, page 62).

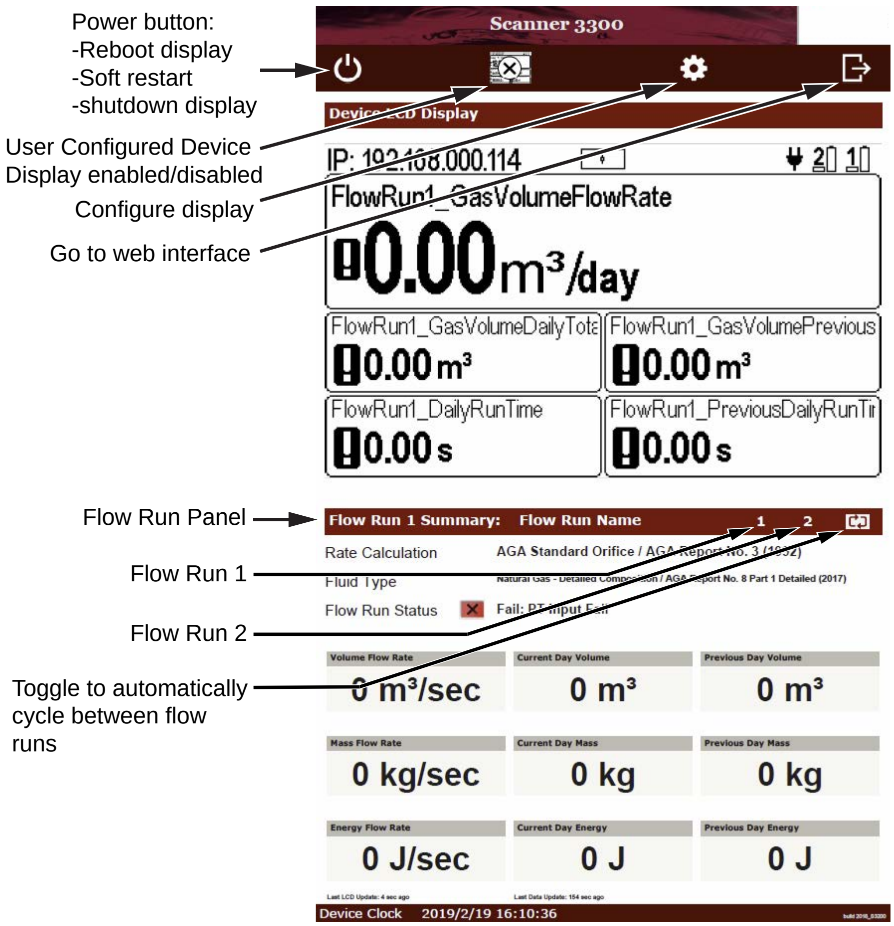


Figure 4.1 - Touch Display; User Configured Device Display enabled

Kiosk Display Navigation

The kiosk display has two primary functions: to display real-time measurements and/or flow runs, and to configure the QRATE Scanner 3300 through the web interface. In order to simplify the device operation and configuration, there are four navigation buttons at the top of the screen:

Power Button

The power button, located in the top-left, may be used to reboot the display, do a soft restart of the display, or shutdown the display. None of these options will affect the main circuit, but are only for the touch screen display.

- **Reboot Display.** Restarts the Android operating system and the physical display. The network connection will stop functioning until the Android reboot is complete.
- **Soft Reboot.** Restarts the application running on Android, but leaves the Android operating system and the physical display running. This will not affect the network connections.

- **Shut Down Display.** Used to turn off the Android operating system putting Android in a halt condition. The intent of this command is to turn off Android so you can power down the flow computer. This will causes the network connection to stop functioning.

Note The flow computer may eventually time out and a restart will occur. This happens if power is not removed from the QRATE Scanner 3300 after the touch screen display has been shutdown.

Enable/Disable User Configured Device Display Button

This button is used to enable or disable the user configured device display which shows selected real-time measurements as well as status information for the device. When enabled The kiosk display will show the user configured device display and will either show or cycle between Flow Run 1 and Flow Run 2 (as shown in Figure 4.1, page 61). If disabled, the display will show both flow runs at the same time (as shown in Figure 4.2).

Configure Display Button

This will open up the options to configure the kiosk display settings.

Web Interface Button

This will open up the web interface for the device and allow the user to configure the device based on the installation and purpose of the device. For additional information, see the QRATE Scanner 3300 Web Interface Manual.

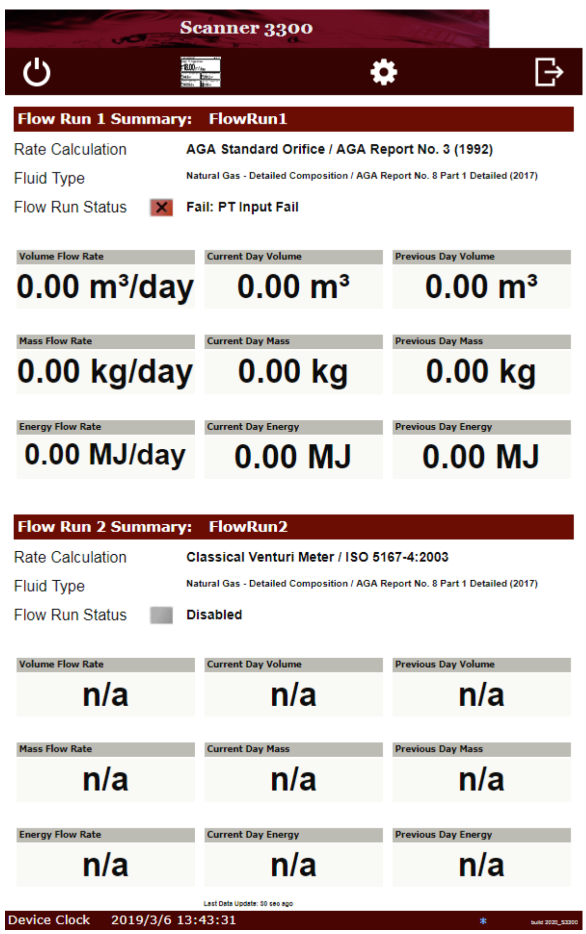


Figure 4.2 - Touch Display; User Configured Device Display disabled

User Configured Device Display

The user configured device display can be used to show a variety of information at a glance. This includes: IP Address, Scanner Logic status, Wireless/Wi-Fi status, and the status of selected parameters (i.e. if they are in alarm). If the user configured device display is disabled, then the QRATE Scanner 3300 touch screen will simply show a summary of Flow Run 1 and Flow Run 2.

IP Address

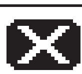
The IP address used to connect with a QRATE Scanner 3300 via the web interface is displayed at the top left of the user configured device display. The IP address is assigned when a user connects the device to the network for the first time. If no address appears in the user configured device display, check for a problem with the Ethernet connection.

Status Indicators (Glyphs)

When the user configured device display is enabled, a row of pictorial status indicators or "glyphs" appears in the top right corner of the user configured device display. You can use these glyphs to quickly assess the status of the touch display, wireless connectivity, and power connectivity once you become acquainted with the symbols and their meanings (Figure 4.2, page 62 and Table 4.1—User Configured Device Display Status Glyph Definitions).

Additionally, glyphs indicating the parameter status appear to the left of the parameter reading. You can use these glyphs to quickly identify the status of a parameter (fail, locked, high- or low-system alarm, etc.) See Table 4.2—Parameter Status Glyph Definitions, page 64 for more information about the parameter status glyphs.

Table 4.1—User Configured Device Display Status Glyph Definitions

	***Scanner Logic* -** RUN.
	***Scanner Logic* -** STOP.
	***Scanner Logic* -** FAIL.
	***External Power.*** An external power source has been detected.

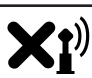
Wireless Communications Status		
*By default, this glyph will represent the Wireless Mesh Network. However, if Wi-Fi is present, then Wi-Fi will take over from the wireless module and this glyph will represent Wi-Fi signal strength instead.		
	Wireless Mesh Network	**Wi-Fi Signal Strength**
	The wireless transmitter is disabled.	Not applicable.
	No mesh nodes are configured.	Wireless Mesh is controlling the signal.
	At least one mesh node is configured but none are operational.	0 < Wi-Fi signal strength < 30
	One or more mesh nodes are configured and at least one is operational.	0 < Wi-Fi signal strength < 75
	Multiple mesh nodes are configured and all are operational.	75 < Wi-Fi signal strength < 100 (Full signal strength)

Table 4.2—Parameter Status Glyph Definitions

	***Fail.*** This parameter value is in a fail state.
	***High System Alarm.*** The parameter value exceeds the top end of the system operating range.
	***Locked.*** The parameter is in Maintenance mode, or is configured to use a user-specified override value.
	***Low System Alarm.*** The parameter value is below the low end of the system operating range (low end).
	***High User-Configured Alarm.*** The parameter value exceeds the user-configured high setpoint.
	***Low User-Configured Alarm.*** The parameter value is below the user-configured low setpoint.

Configurable Display Features

A number of display features for the user configured device display can be configured via the QRATE Scanner 3300 web interface with the proper user permissions.

- ***Orientation.*** By default, display orientation is set to “automatically detect” the orientation of the device. If the device is inverted, the display will automatically invert as well for optimum visibility. A user can also specify the orientation of the MVT port as upward or downward.
- ***Color Scheme.*** The touch display background can be configured as light gray or dark gray. Character color automatically adjusts to provide contrast for easy viewing.
- ***Message Delay.*** This setting determines the length of time a set of parameters is displayed between scrolls. The default setting is 10 seconds. The configurable range of values is 0 to 600 seconds (10 minutes).

Message Display Mode

Figure 4.3, page 65 illustrates the standard progression as parameters cycle through display groups on the touch screen. There are three message display modes:

- **Sequential Display Selections.** Display selections are shown in sequential order, filling as many display positions (A to E) as available. When the display group is advanced after the Message Delay, the next parameter selections are used to fill positions A to E. In this mode, a parameter selection can be given a priority of “Normal” or “Topmost.” If any selections are set to topmost priority, then they will only be shown in position A.
- **Grouped Display Selections.** Display parameter selections are organized into groups, with each parameter selection assigned to a display position. Groups are numbered 1 to 32 and are shown in numerical order, advancing after the message delay. Customize a display group by assigning the same group number to up to 5 of the parameter selections you wish to be displayed together and give each a unique position (A to E).
- **Controlled by Scanner Logic Script Program.** Display selections are organized as described in “Grouped Display Selections” above. However, the active group is controlled by the Scanner Logic Script program. Within the Scanner Logic Script program, the user can write commands to specify what display group number is shown (1 to 32) at different stages of the program execution.

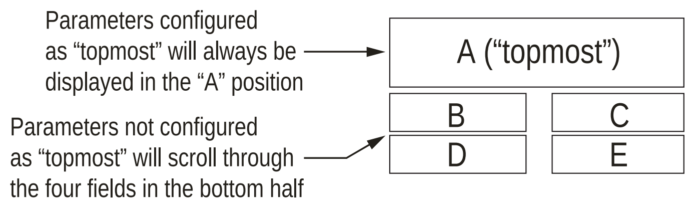


Figure 4.3 - Arrangement of parameters in Touch screen display

Web Interface Kiosk Mode

Using the touch display, a user can navigate to the Web Interface and configure the QRATE Scanner 3300. It is recommended to complete installation before proceeding with the configuration.

Note Only users with Administrator or Configuration Editor user access levels can change display features. See the QRATE Scanner 3300 Web Interface User Manual for instructions on setting user security levels.

Important When the device has been successfully setup with an Ethernet connection, you can configure the wireless network.

Important The QRATE Scanner 3300 web interface requires JavaScript to be enabled. For instructions about enabling JavaScript in the 5 most commonly used web browsers, see http://www.enable-javascript.com/.

IP Address Options

The QRATE Scanner 3300 accommodates both dynamic and static IP addresses.

Dynamic IP is considered the least restrictive means of supporting communications with the Scanner, and is often preferred by corporations with extensive IP needs. However, you should be aware that dynamic IP addresses are subject to change over time (the frequency of such changes is controlled by corporate network settings).

Static IP addresses are unchanging, which helps protect user access to the device but restricts the address from being used with any other device. A static IP address may be a consideration if you must access the device from a great distance and do not have a local contact near the device who can verify the IP address from the device display.

Note Static IP addresses can be disabled during firmware upgrades, requiring onsite assistance to restore the static IP address.

Dynamic IP is recommended for initial setup of the device. Once communication with the device is achieved, a static IP address can be assigned, if applicable. Basic instructions for changing an IP address are provided in the QRATE Scanner 3300 Web Interface User Manual linked to the web interface. Step-by-step instructions may vary with web utilities and computer operating systems. If you are unfamiliar with this process, seek assistance from an IT professional.

Important The following instructions will help guide you through an initial connection to the QRATE Scanner 3300 using the Scanner's dynamic IP address. If a static IP address is required for ongoing Scanner communications, the IP can be reconfigured in the web interface after this initial connection. See the static IP configuration instructions in the QRATE Scanner 3300 Web Interface User Manual for details.

First-Time Connecting the QRATE Scanner 3300

When first connecting to the QRATE Scanner 3300 and a wireless connection has not been configured yet, you will have to connect through the Ethernet port to configure the wireless network or to further configure the Ethernet network. An IP address will be assigned to the device during this process, and you can access the web interface from the touch screen using the button seen in Figure 4.2, page 62 (left).

Connecting QRATE Scanner 3300 to Existing Wired Network

To connect the QRATE Scanner 3300 to the local area network (LAN), use the following procedure:

1. Connect the power supply to the power terminal. The device will take approximately one minute to boot.
2. Connect an Ethernet cable from the terminal board RJ-45 connector to the device/router's LAN port. The device will detect the network automatically.
3. Use the button see in Figure 4.2, page 62 (left) to access the web interface.
4. On the *Device Login* screen, enter the appropriate user name and password. Default entries (case-sensitive) are:

   User Name: admin
   Password: scanner
5. Press the "Login" button on the screen.

Note If the loading stalls, click **Refresh**. If a connection to the QRATE Scanner 3300 is not established, verify the IP address and repeat step 4.

Important Changing the administrative password after the initial login is strongly recommended. See the "Security" section of the QRATE Scanner 3300 Web Interface User Manual for instructions on changing the administrative password, and setting up additional users with password-protected access.

Connecting the QRATE Scanner 3300 to Existing Wireless Network

To connect the QRATE Scanner 3300 to an existing wireless network, use the following procedure:

1. Configure your personal Wi-Fi enabled device as a Wi-Fi DHCP client for a dynamic IP address assignment.
2. Connect your personal Wi-Fi enabled device to the same network the device is connected to. The SSID and password of that network will have to be provided to you by the network administrator.
3. Use the button see in Figure 4.2, page 62 (left) to access the web interface.
4. On the *Device Login* screen, enter the appropriate user name and password. Default entries (case-sensitive) are:

   User Name: admin
   Password: scanner
5. Press the "Login" button on the screen.

Note If the loading stalls, click **Refresh**. If a connection to the QRATE Scanner 3300 is not established, verify the IP address and repeat step 4.

Important Changing the administrative password after the initial login is strongly recommended. See the "Security" section of the QRATE Scanner 3300 Web Interface User Manual for instructions on changing the administrative password, and setting up additional users with password-protected access.

Troubleshooting the Wireless Connection

If the Wi-Fi connection seems to be failing, consider the following steps to address the problem:

1. Check if the Wi-Fi subnet is the same as the Ethernet subnet. If so, change it to be different, as the QRATE Scanner 3300 will shutdown the Wi-Fi if these two subnets are identical.
2. Shut off the laptop and restart it.
3. If the QRATE Scanner 3300 is powered, but no wireless connectivity is detected on your computer or other browser-enabled device, it may be necessary to reset the device's IP address. Please contact Sensia technical support for assistance.

Adding Security to the WiFi Connection

Wi-Fi security is disabled at the factory during initial modem configuration, but users can enable security by logging into the modem web browser menu, as follows:

1. Open a web browser on a laptop or smartphone.
2. Enter the modem's IP/port address, 192.168.168.1:8080.
3. When prompted, enter the following user name and password to access the main modem screen:

   User Name: admin
   Password: admin
4. Click the **Wireless** tab in the top bar, and the **Radio 1** tab from the second bar at the top of the screen.
5. From the **Radio 1** tab, locate the "Encryption Type" field near the bottom of the screen.
6. Select an encryption type from the dropdown list.
7. Enter a password if desired, and click **Submit**.

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Section 5 - QRATE Scanner 3300 Integrated Control Flow Computer Maintenance

The QRATE Scanner 3300 is engineered to provide years of dependable service with minimal maintenance. All configuration settings are stored in nonvolatile memory; therefore, configuration settings will not be lost in the event of power failure or circuit removal.

Unit Replacement

The QRATE Scanner 3300 unit has been designed to simplify installation and replacement. In the event that the circuit requires replacement, it may be noted that the circuit may be replaced without the need to remove the enclosure from the rack.

Display Assembly Replacement Procedure

The QRATE Scanner 3300 display circuit is installed in a compartment (Figure 5.1) of the enclosure, and requires access to the power and Ethernet for circuit replacement.

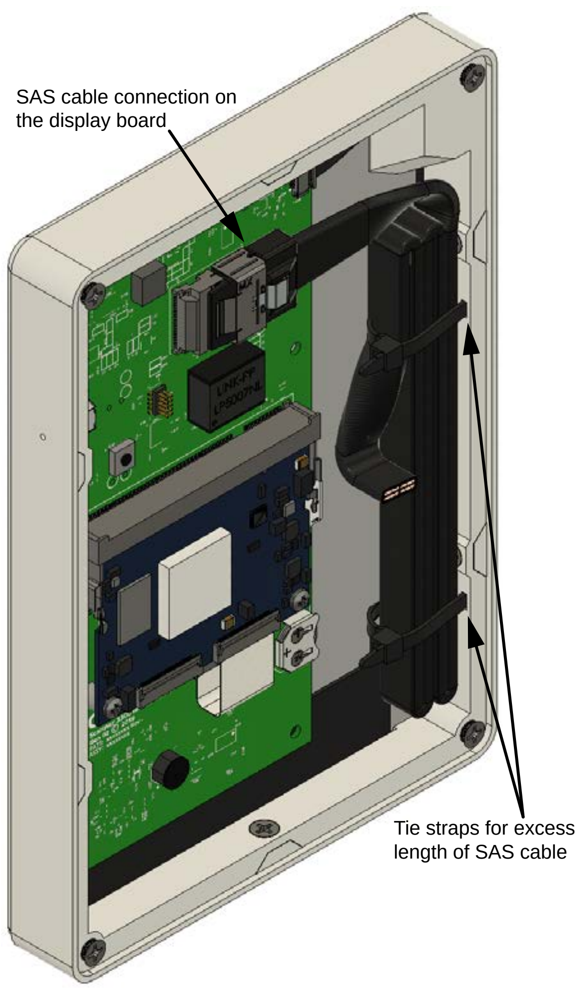

Figure 5.1 - QRATE Scanner 3300 display assembly.

To replace a QRATE Scanner 3300 circuit:

1. Remove external power (if applicable) and the Ethernet going to the device.

Note It is important that the Ethernet plug and any external power is removed in order to ensure that the QRATE Scanner 3300 is not powered during disassembly.

2. Unscrew the four screws on the back of the display assembly (shown in Figure 5.2).

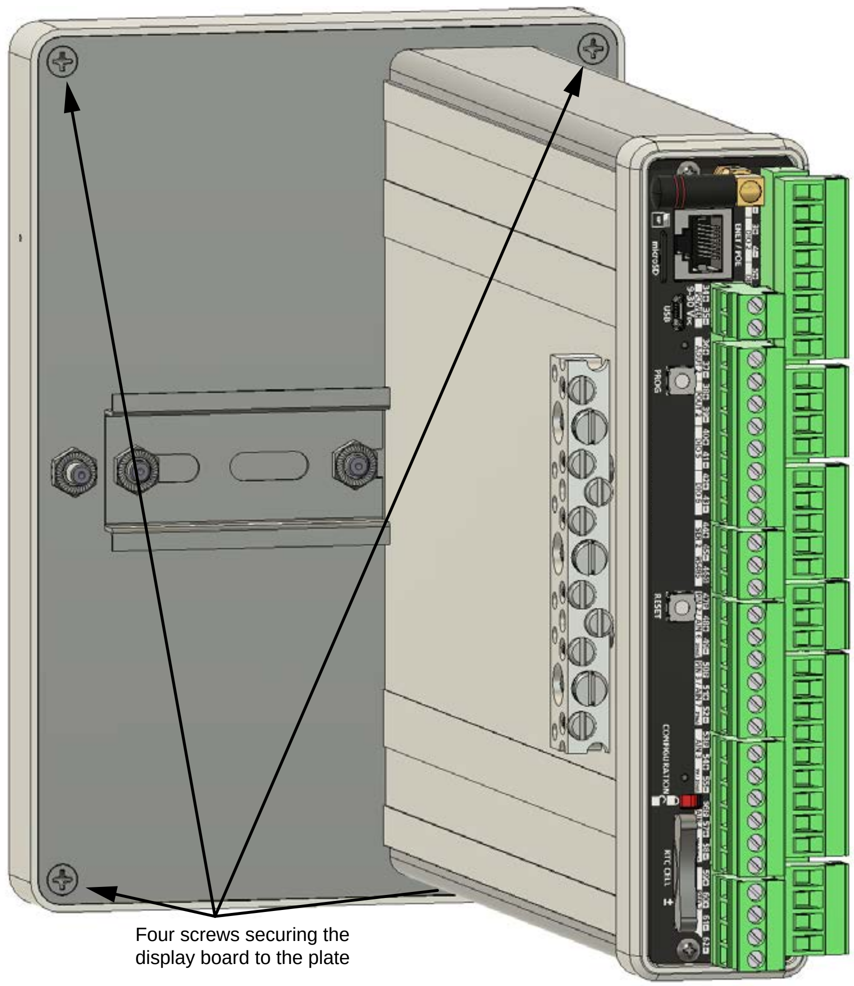

Figure 5.2 - Screws attaching the QRATE Scanner 3300 display assembly to the plate and main enclosure.

3. Gently remove the display assembly from the plate.

4. Cut and remove the tie straps (Figure 5.1, page 69) on the extra length of the SAS cable, and disconnect it from the display assembly (as shown in Figure 5.3).

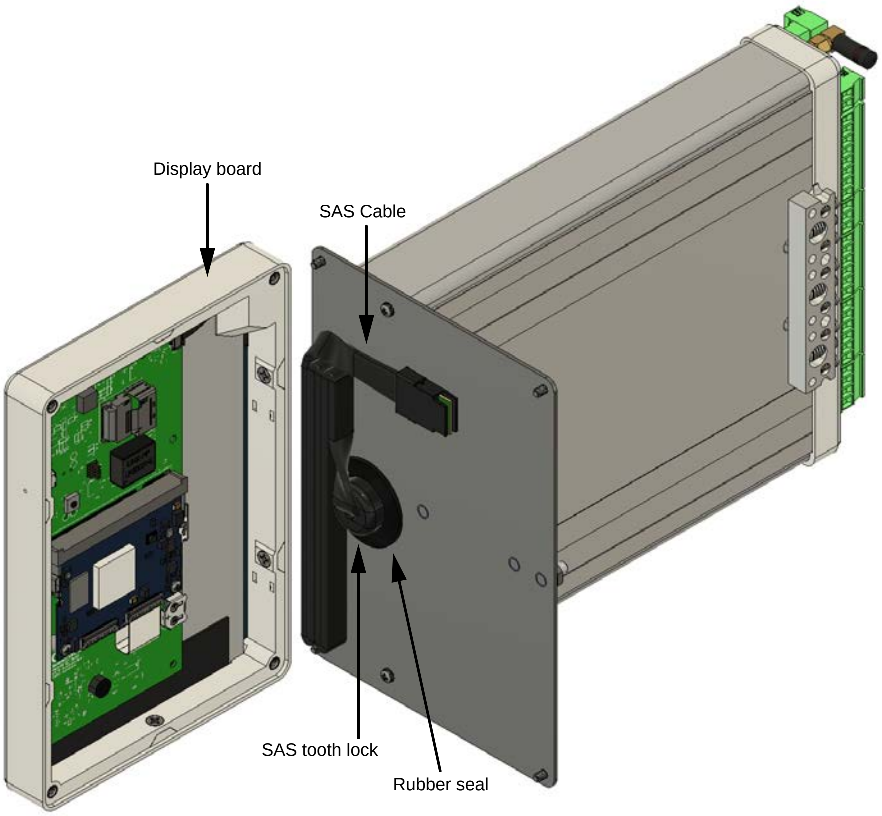

Figure 5.3 - QRATE Scanner 3300 display assembly and main enclosure assembly.

5. Put the old display assembly aside.
6. Remove packaging from the new display assembly, ensuring the new display assembly is protected from static.
7. Connect the SAS cable to the new display assembly, and tie wrap the excess length to the inside of the enclosure (as shown in Figure 5.1, page 69).
8. Use the four screws to attach the new display assembly to the plate (shown in Figure 5.2, page 70).
9. Connect external power (if applicable).
10. Connect Ethernet plug.

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Section 6 - QRATE Scanner 3300 Parts

Spare Parts and Optional Hardware

The lithium coin cell battery that controls the real-time clock and the desiccant packets are the only consumable parts within the QRATE Scanner 3300 that require periodic replacement.

The lithium coin cell batteries can last 8 years or longer, depending on operating conditions. Keeping a spare battery on hand can prevent the loss of the device time and date in the event the coin cell battery fails.

WARNING—ELECTRICAL HAZARD: Substitution of components may impair safety. Use of spare parts other than those identified by Sensia International Corporation voids CSA certification. Sensia bears no legal responsibility for the performance of a product that has been serviced or repaired with parts that are not authorized by Sensia.

Table 6.1—QRATE Scanner 3300 Parts

Qty.	*Part Number*	*Description*
Common Parts		
1*	9A-100002605	Desiccant, Humidisorb, Self Regenerate, 2 in. x 2 in. Packet with Adhesive
1	3J-40-0245-00	Battery, BR 2032, 3 V, 190 mAh, Lithium Coin
1	76522610	Connector, Power, 2-pin, Connects to the Terminal Strip
1	50352140	Panel, Mounting, 4.5U Panel, QRATE Scanner 3300
1	50363804	Panel, Mounting, 5U Panel, QRATE Scanner 3300
For wireless components, see Table 6.2—Wireless Components, page 73.		
CSA-Approved Parts		
1	9A-21-XX-YY (see Table 6.4—RTD and Cable Assemblies, page 74)	Assembly, RTD and Cable, CSA Weather-Proof (Division 2) & Explosion-Proof (Division 1)

** Recommended spare part*

Table 6.2—Wireless Components

Qty.	*Part No.*	*Description*
1	77012875	Cable, Antenna, 12-in long, Straight
1	50355465	Antenna, Short-Haul Wireless, 2.4 GHz, Right-Angle, 1.6 dBi, SMA Male Connector
1	50362403	Antenna Cable with Connector, Short-Haul Wireless, 3-ft, SMA Male to N Male, LMR-240 Coax. -40 degC to 85 degC (-40 degF to 185 degF)
1	50279275	Antenna, Short-Haul Wireless, Remote-Mount, 9 dBi 2.4 GHz Omnidirectional, 32-in. long, N Female with pole-mount bracket (fits pole outside diameters up to 2-in.)
1	50278052	Bracket, Pipe-Mount for Remote-Mount Antenna (fits pipe with 2.375-in. outside diameter)
1	76527410	Antenna Cable with Connectors, Short-haul Wireless, 10-ft, Type 400, Male/Female N Connector -40 degC to 70 degC (–40 degF to 158 degF)
1	76527411	Antenna Cable with Connectors, Short-haul Wireless, 20-ft, Type 400, Male/Female N Connector -40 degC to 70 degC (–40 degF to 158 degF)
1	76527412	Antenna Cable with Connectors, Short-haul Wireless, 30-ft, Type 400, Male/Female N Connector -40 degC to 70 degC (–40 degF to 158 degF)

Table 6.3—Wired Components

Qty.	Part No.	Description
1	50272960-05	Cable, Ethernet, 5 ft
1	50272960-10	Cable, Ethernet, 10 ft
1	50272960-20	Cable, Ethernet, 20 ft
1	50272960-30	Cable, Ethernet, 30 ft

Table 6.4—RTD and Cable Assemblies

Select assemblies based on specific application.

For Div. 2-approved RTDs - 9A-1100-1025B-X where X is the cable length.

For Div. 1-approved RTDs - 9A-21-XX-YY where XX is the cable length and YY is the probe length.
*Available cable lengths: 5, 10, or 30 ft. Probe nominally adjustable up to 6 in. or 12 in.

Qty.	Part No.	Description
1	9A-1100-1025B-5	Assembly, RTD and Cable, Weatherproof (Div. 2), 5-ft Cable, 6-in Probe
1	9A-1100-1025B-10	Assembly, RTD and Cable, Weatherproof (Div. 2), 10-ft Cable, 6-in Probe
1	9A-1100-1025B-20	Assembly, RTD and Cable, Weatherproof (Div. 2), 20-ft Cable, 6-in Probe
1	9A-1100-1025B-30	Assembly, RTD and Cable, Weatherproof (Div. 2), 30-ft Cable, 6-in Probe
1	9A-21-05-06	Model 21 RTD, CSA Explosion-proof, 5-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-05-12	Model 21 RTD, CSA Explosion-proof 5-ft Cable, 11.625-in. Probe for 12-in. Thermowell
1	9A-21-10-06	Model 21 RTD, CSA Explosion-proof 10-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-10-12	Model 21 RTD, CSA Explosion-proof 10-ft Cable, 11.625-in. Probe for 12-in. Thermowell
1	9A-21-30-06	Model 21 RTD, CSA Explosion-proof 30-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-30-12	Model 21 RTD, CSA Explosion-proof 30-ft Cable, 11.625-in. Probe for 12-in. Thermowell

The thermowell dimensions listed above refer to the maximum "U" dimensions that a probe will fit with a plastic bushing. Consult Sensia for sizing information if a union and nipple is to be used in place of a bushing. When using a bushing, select the shortest probe possible for a compact installation and best strength.

Electronics Replacement

The QRATE Scanner 3300 contains two circuit board subassemblies (pre-assembled groupings of circuit boards and hardware), and a terminal board. For disassembly instructions, see the QRATE Scanner 3300 Service User Manual. Sub-assemblies must be replaced without further disassembly.

Before attempting any repair work on the device, contact a Sensia technician to review the issues you are observing and determine if the problem requires hardware replacement.

CAUTION—EQUIPMENT DAMAGE RISK: Attempts to disassemble the QRATE Scanner 3300 in the field for the purpose of troubleshooting or repairs can damage the internals and cables beyond repair. Sensia does not warranty damage resulting from field replacement of any of the parts.

Table 6.5—QRATE Scanner 3300 Circuit Board Replacements

Qty.	*Part Number*	*Description*
1	50352115-T	Front Kiosk Display Assembly (Field Replacement)
1	50343776-T	QRATE Scanner 3300 Main Circuit Board Assembly (Field Replacement)
1	50346032-T	QRATE Scanner 3300 Advanced Display Adapter Circuit Board Assembly (Field Replacement)
1	50343778-T	QRATE Scanner 3300 Terminal Circuit Board Assembly (Field Replacement)
1	50327132-T	WiFi Circuit Board Assembly (Field Replacement)
1	50300464ROHS-T	Smart Mesh Circuit Board Assembly (Field Replacement)

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Appendix A - FTP Downloads

FTP downloads provide an alternative to the web interface download process and may be preferred for expediting downloads, particularly if you have no other need to log into the web interface. FTP downloads can be performed with a router connection to the QRATE Scanner 3300, or with a physical Ethernet cable connection between the PC/laptop and the device. The only piece of information required is the IP address of the device storing the archive files.

The following steps describe the FTP download process using the Windows FTP Command executable file.

Important **Other third-party FTP file managers, such as File Commander, provide a graphical interface. Please note that the QRATE Scanner 3300 currently supports only one FTP session at a time; some software programs require two simultaneous sessions to function properly.**

Downloading SDF Files from the QRATE Scanner 3300

To download SDF files using Windows FTP Command prompts, perform the following steps:

1. Access the *Command Prompt* window by clicking the **Start** button.
2. Type `cmd` and click **Enter**.
3. Type `ftp <IP address of the QRATE Scanner 3300 device>` and click **Enter**.
4. At the prompt, type `<your login name>` and click **Enter**.
5. At the prompt, type `<your login password>` and click **Enter**.
6. Type `cd archives` and click **Enter** to access the parent level of the directory. This directory contains three folders of SDF files: full, recent, and events.
7. Type `cd <file type>` (for example, cd full to select the full folder) and click **Enter**.
8. Type `ls` or `dir` to view a list of .sdf files inside the folder. The command "dir" provides additional details about the files such as archive timestamp and file size.
9. To download an .sdf file, type `get <complete filename> c:<location for saving the SDF file>` and click **Enter**.
10. To download a batch of .sdf files, type `bye` to exit the connection. The command prompt will display your default directory. Unlike the single file download process where you can specify the desired location of the download files as part of the command string, batch downloads require you to establish the intended location before the download command it issued.
11. If the current directory is not where the SDF files are to be stored, type `cd <desired directory path for storing SDF files>` and click **Enter**.
12. Type `cd archives\<file type>` (for example, cd archives\full) and click **Enter**.
13. Type `prompt` and click **Enter**.
14. Type `mget <*.sdf>` and click **Enter**. The batch of files should automatically be transferred to the directory path designated in step 11.

Note FTP clients are prone to timeouts. To restart following a timeout, type `open <QRATE Scanner 3300 IP address>`.

Note To move back one level in your directory path, type `cd ..`

Full Folder Contents	*Example Filename*
Daily Logs: QRATE Scanner 3300	S3300_FA01_D_Full.sdf
Interval Logs: QRATE Scanner 3300	S3300_FA01_I_Full.sdf
Triggered Logs: QRATE Scanner 3300	DeviceName_TR_Full.sdf
Daily Logs: NUFLO Scanner 2000 series flow computers configured as a slave device (up to 20 logs possible)	Slave01_SA01_D_Full.sdf
Interval Logs: NUFLO Scanner 2000 series flow computers configured as a slave device (up to 20 logs possible)	Slave01_SA01_I_Full.sdf
Local (All archive logs for the QRATE Scanner 3300 only, includes no logs for networked slave devices)	S3300_Local.sdf
Complete (Complete archive record for the QRATE Scanner 3300 and networked slave devices)	S3300_Complete.sdf
Event Logs: QRATE Scanner 3300	S3300_EA_Full.sdf
Event Logs: NUFLO Scanner 2000 series flow computers configured as a slave device	Slave01_SE01_Full.sdf
File Name Conventions	
QRATE Scanner 3300 Daily or Interval Logs	Example: S3300_FA01_D_Full.sdf, where FA01 = flow archive (FA01 or FA02) and D = type of log (D for daily or I for interval)
Slave Device Daily or Interval Logs	Example: Slave01_SA01_D_Full.sdf, where Slave 01 = slave ID (up to 20 possible), SA01 = slave archive (one for each slave device) and D = type of log (D for daily or I for interval)
QRATE Scanner 3300 Event Archive	Example: S3300_EA_Full.sdf, where EA = Event Archive
Slave Device Event Archive	Slave01_SE01_Full.sdf, where SE01 = slave archive (one for each slave device) and EA = Event Archive
QRATE Scanner 3300 Recent Logs (interval logs recorded within current 24-hour contract period)	S3300_FA01_I_20140823.sdf, where FA01 = flow archive (FA01 or FA02), I = type of log (D for daily or I for interval) and 20140823 = date stamp (year-month-day)

Slave Device Archive Logs

Slave archive logs can also be downloaded locally from a NUFLO Scanner 2000 series flow computers configured as a slave device using ModWorX™ Pro software.

Viewing and Sharing Downloaded Data

Sensia's Scanner Data Manager software opens the proprietary SDF files and provides an assortment of file sharing, conversion and reporting tools. See the Scanner Data Manager manual for more information. To download the Scanner Data Manager software and user manual, visit Sensia's Measurement website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, select **QRATE Scanner 3000 series integrated control flow computers**, and click the link for the Scanner Data Manager install or manual.

Appendix B - Firmware, Configuration, Scanner Logic, and Modbus Register Map Uploads

Firmware Uploads

The factory default firmware is easily restored using the QRATE Scanner 3300 web interface. Simply log into the device interface, select **ADMINISTRATION>GENERAL** from the taskbar, then click **Management** at the left of the screen. Under the "Firmware Management" section near the bottom of the screen, click **Restore Firmware**.

To upload new firmware, download the ScanFlash software utility and follow the upload instructions listed under ScanFlash Upload, page B-2.

Important **To download ScanFlash software, visit Sensia's Measurement website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, choose QRATE Scanner 3000 series integrated control flow computers, and click the link for the software install.**

Configuration Uploads

A user can load factory-set default configuration values, save the current configuration file, and upload an existing configuration file using the QRATE Scanner 3300 web interface. A configuration file can also be uploaded using ScanFlash software utility.

- To make configuration changes from the web interface, select **ADMINISTRATION>GENERAL** from the taskbar, then click **Management** at the left of the screen. Locate the "Configuration Management" section at the top of the screen.
  - To load default configuration values, click **Load Configuration Defaults** and click **OK** at the *Confirm* dialog prompt.
  - To save currently applied configuration values in a file that can be later uploaded to a device, right-click the **QRATE SCANNER 3300 CONFIGURATION FILE** link, then click **Save link as...** Rename the file and/or change the location where the file will be stored, if desired.
  - To upload a configuration file that was previously saved to your computer, click **Browse** next to "Load Configuration File," select the desired configuration file to upload, and click **Open**. From the interface screen, click **Submit**, click **OK** at the *Confirm* dialog, and wait for the file to upload.
- To upload a configuration file using ScanFlash, download the ScanFlash software utility and follow the upload instructions listed under ScanFlash Upload, page B-2.

Important **To download ScanFlash software, visit Sensia's Measurement website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, choose QRATE Scanner 3000 series integrated control flow computers, and click the link for the software install.**

Register Map Uploads

Using Sensia's ScanMap software, a user can create a set of user-defined Modbus register maps (.pmap) for customizing Modbus communications protocols. A .pmap file can be uploaded to a QRATE Scanner 3300 using the web interface or the ScanFlash software utility. Files are uploaded to the web interface by selecting **Administration>General>Installed Files**.

Important **To download ScanFlash or ScanMap software, visit Sensia's Measurement website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, choose QRATE Scanner 3000 series integrated control flow computers, and click the link for the desired software install. A ScanMap user manual is also available for download from this site.**

- To upload a register map via the web interface, log into the device, select **ADMINISTRATION>GENERAL** from the taskbar and click **Installed Files** at the left of the screen. To erase the map currently installed, click **Uninstall PMAP File** and click **OK** at the *Confirm* prompt. Then, click **Browse** under "Install Protocol Map File," select the desired configuration (.pmap) file to upload, and click **Open**. From the interface screen, click **Submit**, click **OK** at the *Confirm* dialog, and wait for the file to upload.
- To upload a register map file via the ScanFlash utility, follow the upload instructions under ScanFlash Upload, page B-2.

ScanFlash Upload

Important **To download ScanFlash software, visit Sensia's Measurement website at https://www.sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation, choose QRATE Scanner 3000 series integrated control flow computers, and click the link for the software install.**

Important **To upload firmware to the QRATE Scanner 3300, you must have Administrator-level user access. To upload configuration files or custom Modbus register maps, you must have Configuration Editor-level or Administrator-level user access.**

1. Download ScanFlash from the Sensia website, as noted above.
2. Open a web browser and enter the IP address of the QRATE Scanner 3300 to establish a connection to the device.
3. Download all historical data from the device.
4. Open ScanFlash (shown in Figure B.1) and ensure that the correct model is selected (i.e. 3300).
5. Enter the IP address for the device.
6. Close the browser and clear the browser cache.
7. Select the firmware (BIN), configuration (SCF), Scanner Logic (SLBIN), or Modbus map (PMAP) file to be uploaded.

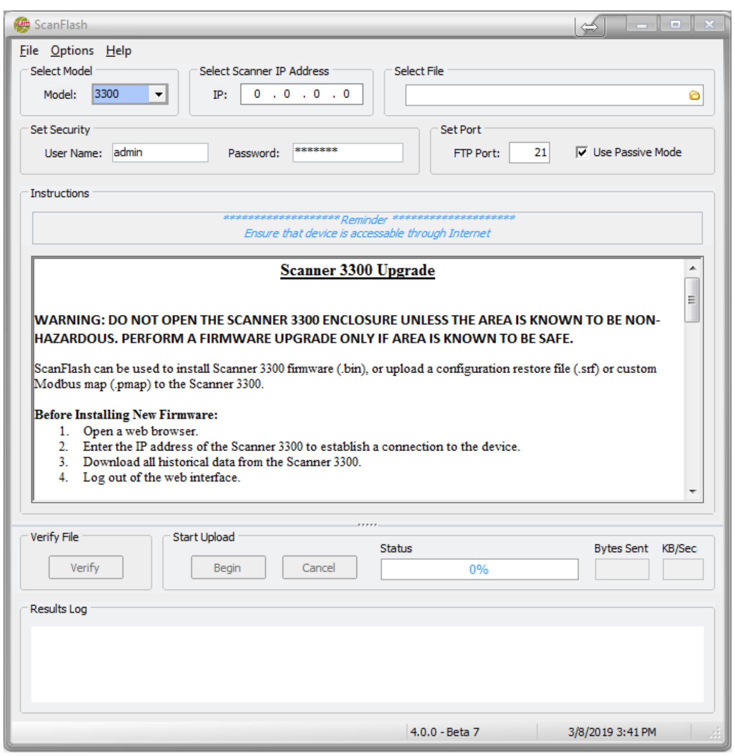

Figure B.1 - ScanFlash interface

8. Enter your user name and password for accessing the web interface. You must have the appropriate user access level to proceed. See the "Important" note above.
9. Enter the port that the network admin has forwarded, and follow their instructions on whether to select passive mode to be active.
10. Click **Verify** to confirm the connection and identify the current firmware version. The button will turn blue while the utility attempts to communicate with the device.
    - When a connection has been verified, the device's system information will appear in the Results log at the bottom of the screen.
    - If a connection cannot be made, an error message will appear. Check the IP address, username and password and click "Verify" again.
    - If connection still cannot be made, an error message will appear. If settings are all correct, toggle passive mode and click "Verify" again.
11. Click **Begin** to begin the file upload to the QRATE Scanner 3300.
12. Monitor the Status bar for percentage of upload completion. The process should take 3 to 4 minutes for firmware files and less than a minute for configuration and Modbus map files.

    When the firmware or configuration upload is completed, ScanFlash will automatically disconnect from the QRATE Scanner 3300. The Results log at the bottom of the screen will display "Successfully Flashed Scanner" and the utility will try to reconnect to the device to retrieve the version information. The Results log will display the updated version information if the new firmware is loaded and the reconnection is successful.

Note Verification may fail if the IP address has changed, as is typical with dynamic IP addresses. If the verification fails, check the upper left corner of the device display, enter the IP address displayed on the device, click **Verify** and confirm that the correct firmware is loaded. If desired, reset the device IP address after verification. For more information, consult the QRATE Scanner 3300 Web Interface User Manual.

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13. Open the web browser and login to the web interface.
14. Verify the date and time in the QRATE Scanner 3300 *Device Status* screen. If it is not correct, click on the *Administration* tab and click **Device Time** to update the date and time.

Troubleshooting a Failed Upload

If the upload does not complete as expected, communications may have been lost during the upload or the file you are attempting to upload (configuration or Modbus map) may have been created for use with a different version of firmware than that installed on the QRATE Scanner 3300.

If there is no apparent firmware version conflict, perform the following steps:

1. Click **Cancel** to abort the upload.
2. Remove power from the device.
3. Restore power to the device.
4. Restart ScanFlash and repeat the upload process.
5. If it is in a remote location and the network admin has completed port forwarding, toggle the passive mode, and then attempt to connect.

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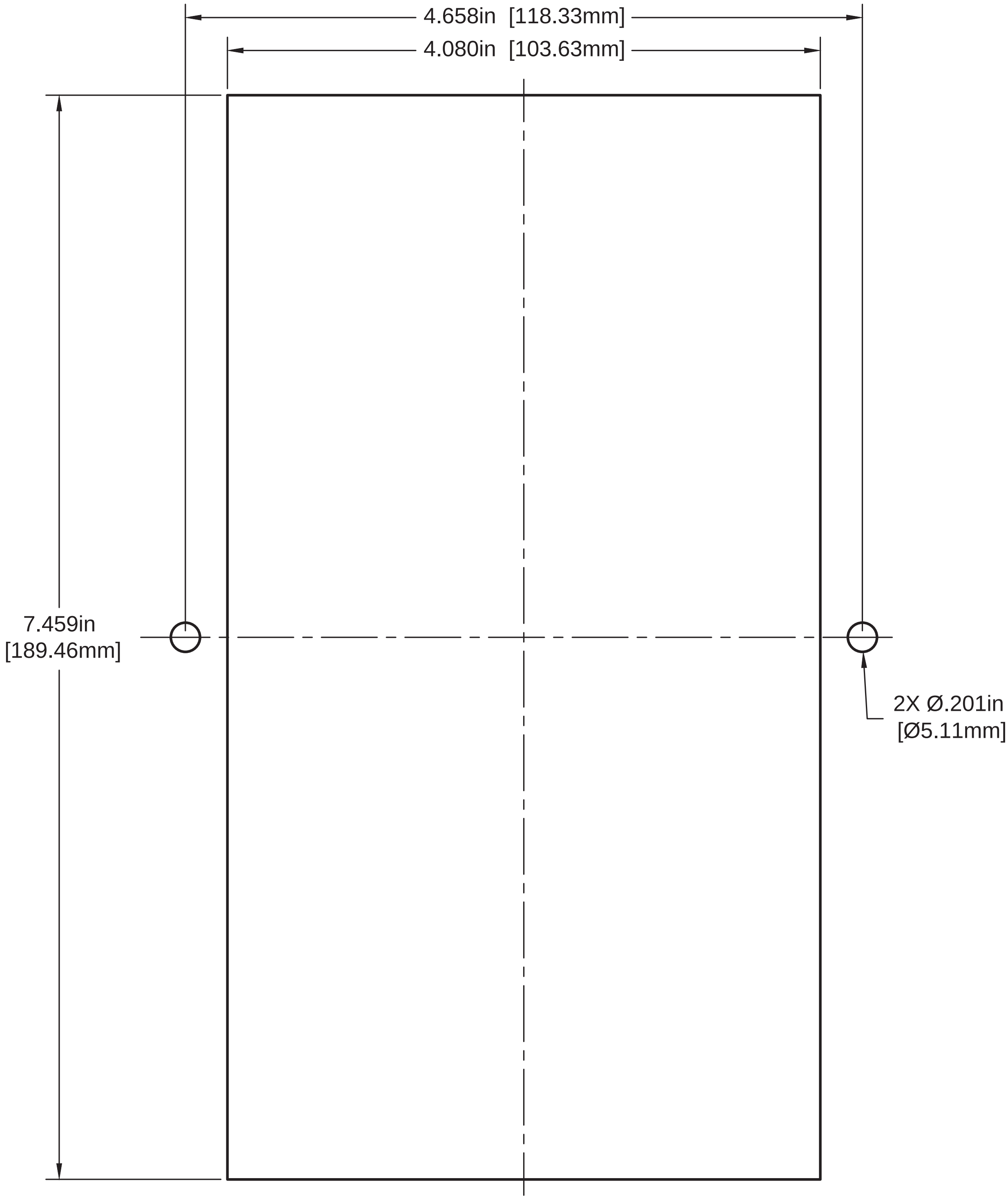
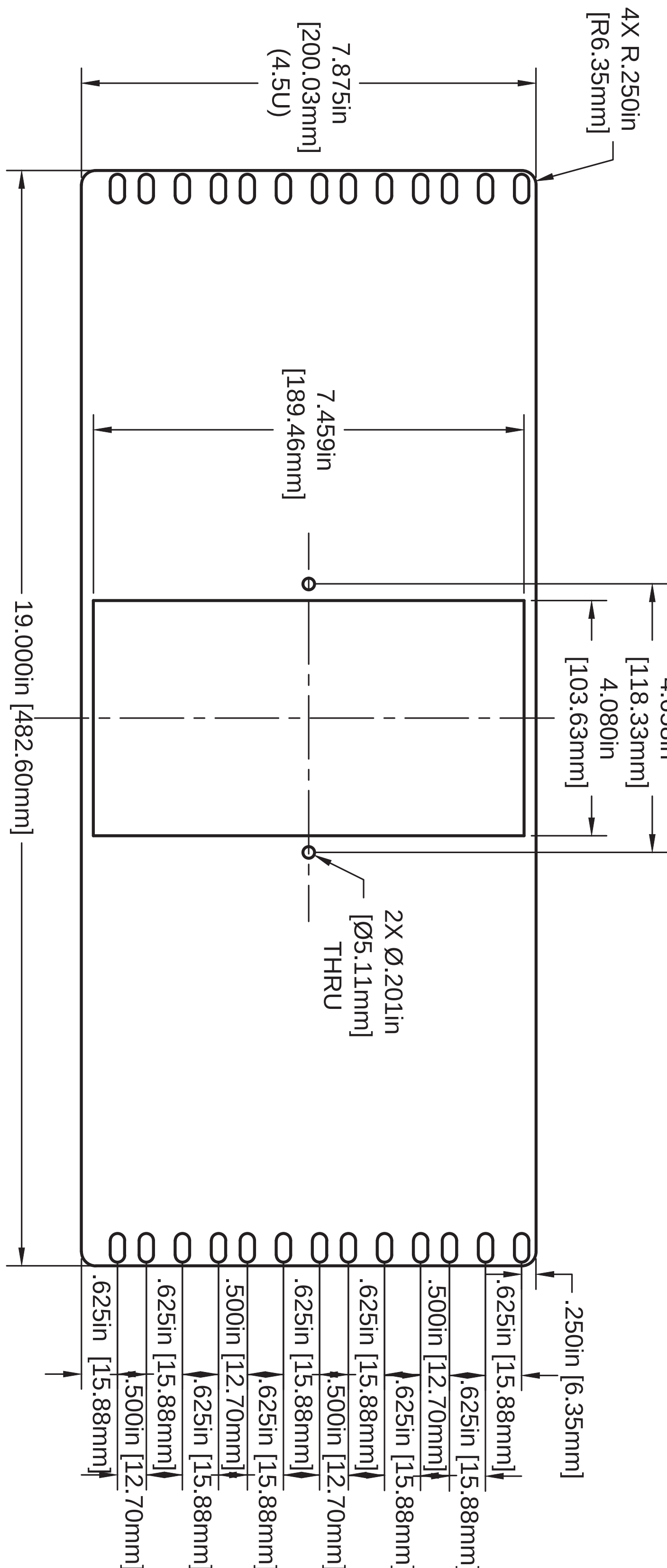
Appendix C - QRATE Scanner 3300 Panel Cutout




4X R.250in [R6.35mm]
7.875in [200.03mm] (4.5U)
7.459in [189.46mm]
19.000in [482.60mm]
4.658in [118.33mm]
4.080in [103.63mm]
2X Ø.201in [Ø5.11mm] THRU
.625in [15.88mm]
.500in [12.70mm]
.625in [15.88mm]
.625in [15.88mm]
.500in [12.70mm]
.625in [15.88mm]
.625in [15.88mm]
.500in [12.70mm]
.625in [15.88mm]
.625in [15.88mm]
.500in [12.70mm]
.625in [15.88mm]
.625in [15.88mm]
.250in [6.35mm]

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