

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.
	IMPORTANT	Indicates actions or procedures which may affect instrument operation or may lead to an instrument response which is not planned. Indique des actions ou des procédures qui peuvent affecter le fonctionnement de l'instrument ou peuvent conduire à une réponse de l'instrument qui n'est pas planifiée.
	Note	Indicates actions or procedures which may affect instrument operation or may lead to an instrument response which is not planned. Indique des informations supplémentaires sur des conditions ou des circonstances spécifiques pouvant affecter le fonctionnement de l'instrument.

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Section 1 - Introduction

The Sensia NUFLO Scanner 2105* flow computer provides gas, steam and liquid measurement capabilities in a low-power flow computer with optional wireless communications for installation and operational cost savings. The device is available in an explosion-proof model for Class I, Division 1 and Division 2 installations. The device shares the same flow computation capabilities as the NUFLO Scanner 2000 flow computer, but features a larger enclosure and four conduit openings (not including a bottom opening for a sensor connection) for added convenience in connecting external equipment.

The NUFLO Scanner 2105 flow computer can be networked with wired or wireless NUFLO Scanner 2000 series flow computers in a wireless mesh network administered by a QRATE Scanner 3000 series integrated control flow computer network manager. As a network manager, the QRATE Scanner 3000 series integrated control flow computer monitors and manages network performance and relays data to the host application, and NUFLO Scanner 2105 flow computer "nodes" relay data to and from each other and the QRATE Scanner 3000 series integrated control flow computer via antennas and ultra-low power wireless modules.

The NUFLO Scanner 2105 flow computer can be used as a stand-alone flow computer or as a Scanner slave device in a wireless mesh network mastered by the QRATE Scanner 3000 series integrated control flow computer. When the device is networked with a QRATE Scanner 3000 series integrated control flow computer, users have the added convenience of collecting all of their data in a single access point (the QRATE Scanner 3000 series integrated control flow computer) and accessing it via a web-browser interface.

Scanner devices can be seamlessly integrated into a comprehensive SCADA solution. See the Scanner SCADA Solutions brochure for details.

The NUFLO Scanner 2105 flow computer can be powered autonomously for up to 25 days at a time with a rechargeable smart battery pack or powered with dual lithium battery packs for up to one year. This is assuming the NUFLO Scanner 2105 flow computer is not powering other external devices or used in extreme temperatures. When the device is externally powered, the battery packs provide a valuable backup supply to help prevent interruption of operations during a power outage. The rechargeable smart battery pack may also be used with a solar panel as the primary power source for continuous, uninterrupted power. The instrument measures and computes standard volumes of gas, steam, petroleum liquids and generic liquids with a high degree of accuracy. These measurements are typically based on the differential pressure outputs of an orifice plate or a cone meter, or the linear pulse output of a turbine, positive displacement (PD) or vortex flowmeter. This combination is ideal for the gas and water measurement associated with coal bed methane operations.

Combining the differential pressure and static pressure inputs of an integral multi-variable transmitter (MVT) with a process temperature input, the instrument offers everything needed for an AGA 3 or cone meter run in a compact explosion-proof device. Similarly, compensated liquid measurements can be obtained with an orifice meter, cone meter, or averaging pitot tube meter (such as Annubar) installation, using flow calculations based on AGA 3, ISO 5167, cone, or averaging pitot tube calculation methods.

The instrument can be paired with a pulse output gas meter to obtain gas measurements in compliance with AGA 7 standards. Live temperature and pressure inputs and the AGA 7 algorithm allow computations based on gas turbine, rotary or vortex meters.

When liquid measurement is the goal and pressure inputs are not required, the NUFLO Scanner 2105 flow computer can be purchased without an integral MVT and remote-mounted to a liquid turbine meter, with an RTD in the flow line for temperature compensation. The NUFLO Scanner 2105 flow computer applies temperature and pressure corrections according to API MPMS Chapter 11.1 to give accurate measurement of hydrocarbon liquids.

The device is a complete alternative to the chart recorder that has a comparable installation cost due to its integral power source. High-speed communication via industry standard Modbus and Enron Modbus protocols makes it easy to integrate the NUFLO Scanner 2105 flow computer into other measurement systems. For a complete list of specifications, see [page 15](#).

*Mark of Sensia

The integrated PID control of the NUFLO Scanner 2105 flow computer along with the configuration and tuning controls built into the ModWorX software provides a powerful solution for a variety of control applications. The control valve position is regulated via a 4-20 mA output.

Firmware

The firmware version installed will appear on the display as the device boots up and will appear in the web-based interface (Slave Device General/System screen) when the instrument is connected to a QRATE Scanner 3000 series integrated control flow computer network manager. See the QRATE Scanner 3100 Web Interface Manual for more information on verifying firmware versions and updating firmware. See the QRATE Scanner 3000 series integrated control flow computer Modbus Protocol Manual for more information on registers supported.

Software and User Help Documents

To experience the full range of the NUFLO Scanner 2105 flow computer functionality, explore the complimentary software products and user documentation on the Sensia website.

Supporting software includes:

- **ModWorX***. PC application used to configure, calibrate, and download the device.
- **ScanData**. PC application that allows a user to view, export, and convert the data downloaded from the instrument and QRATE Scanner 3000 series integrated control flow computer. It provides many of the reporting functions in ModWorX and adds tools for creating professional custom reports.
- **ScanFlash***. Software utility for installing QRATE Scanner 3000 series integrated control flow computer firmware or uploading a configuration file to a NUFLO Scanner 2105 flow computer.

Software and hardware manuals are also available for download from the website.

IMPORTANT

To download software or user documentation, visit Sensia's Measurement website, <https://www.sensiaglobal.com/Measurement>, scroll to the bottom of the screen, and select **Flow Computers and Automation > 2000 Series NUFLO Scanner Flow Computer**. Click the link for the desired software install/manual.

When the NUFLO Scanner 2105 flow computer is networked with a QRATE Scanner 3000 series integrated control flow computer as a wireless slave device, the QRATE Scanner 3000 series web interface can be used to view NUFLO Scanner 2105 flow computer configuration settings, perform limited maintenance tasks, and download and view NUFLO Scanner 2105 flow computer archives. See the QRATE Scanner 3100 Web Interface User Manual for details.

Standard Features

The standard NUFLO Scanner 2105 flow computer ([Figure 1.1](#)) features an explosion-proof double-ended enclosure with a large LCD, a three-button keypad, integral MVT with vent plugs, and a battery option (either a smart battery pack or dual lithium double-D cell battery packs). Removal of the front windowed lid provides access to the keypad and field wiring terminals for a turbine input, one communications port, an RTD input, and a digital output. Removal of the rear solid lid provides access to the battery compartment and wireless communications port.

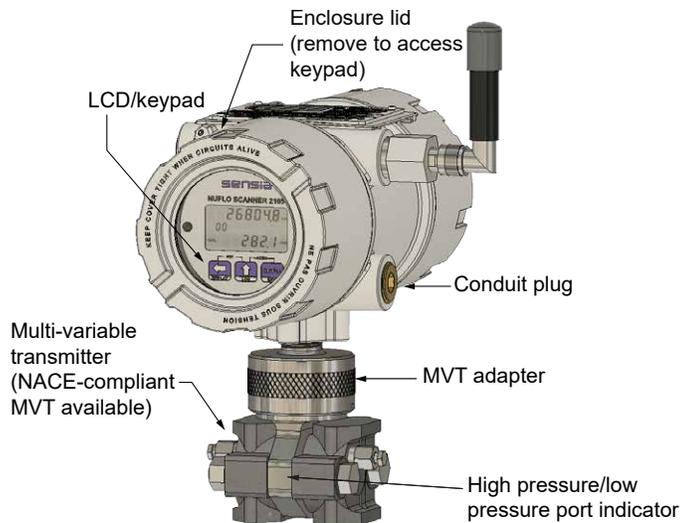


Figure 1.1 - NUFLO Scanner 2105 flow computer with optional integral MVT

Product Identification

Each device is labeled with a serial tag that identifies the product by model number and serial number and identifies the maximum operating pressure, working pressure, and differential pressure of the integral MVT (Figure 1.2). The tag content depicted in Figure 1.2 shows the electrical protection afforded by CSA certification.

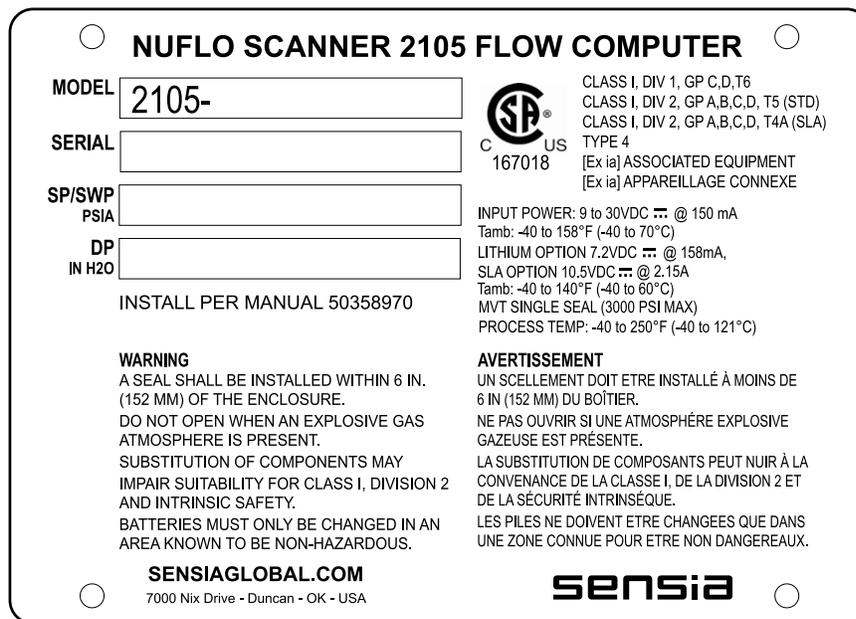


Figure 1.2 - Device serial tag

Optional Hardware

A variety of hardware options are available for customizing the NUFLO Scanner 2105 flow computer to a user’s specific needs.

Integral Pressure Sensor (MVT)

The NUFLO Scanner 2105 flow computer is available with no sensor or with an integral MVT. MVTs are available in NACE and non-NACE models, and with bottom ports (gas measurement) and side ports (liquid and steam measurement), as shown in [Figure 1.3, page 4](#).

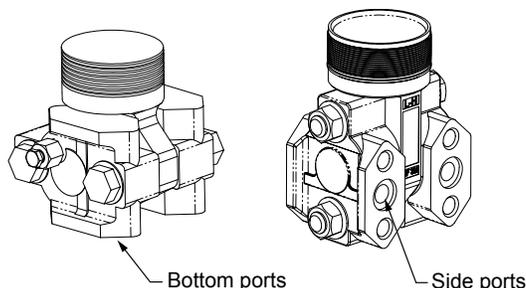


Figure 1.3 - MVT bottom ports and side ports

Battery Options

Dual Lithium Double-D Cell Battery Packs

Sensia's 7.2 V lithium battery packs provide backup power for the NUFLO Scanner 2105 flow computer and can support the NUFLO Scanner 2105 flow computer autonomously for up to 1 year. Battery life can vary significantly, depending on the input/output configuration in use. Be sure to turn off any unnecessary inputs or outputs so as to preserve battery life.

The instrument supports two double D cell battery packs simultaneously ([Figure 1.4](#)), allowing the user to change depleted batteries one at a time without interrupting operations, even when the device is operating on battery power alone. The batteries are held inside of the battery enclosure ([Figure 1.4](#)). For battery handling instructions, see [Dual Lithium Battery Pack Replacement, pg. 85](#) and [Lithium Battery Information, pg. B-1](#). Wiring diagrams are provided in [Internal Power Supply - Dual Lithium Battery Packs, pg. 60](#).

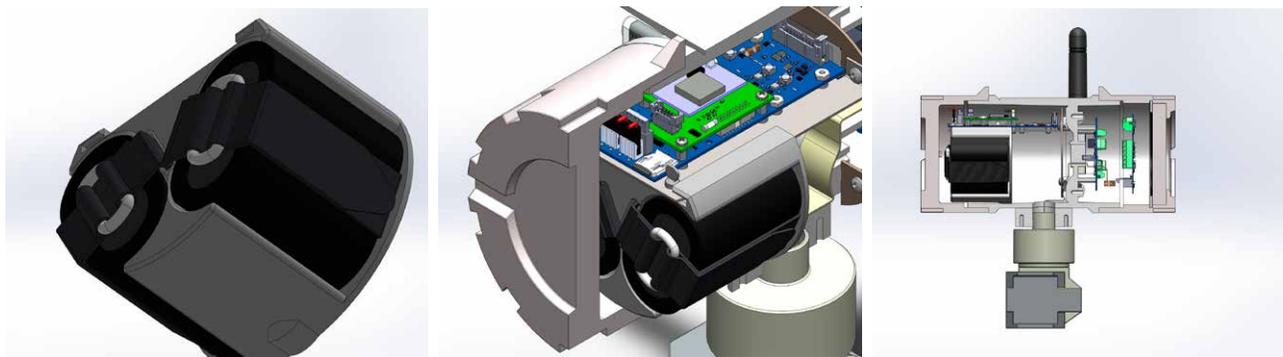


Figure 1.4 - Lithium battery pack (left), battery compartment just beneath the rear lid (middle), and NUFLO Scanner 2105 flow computer side-view

Smart Battery Pack

Sensia's 10.7 V smart battery pack has many features that make it very desirable as a battery backup or as a primary power source. These features include rechargeable batteries, an on-board coulomb counter and charge status tracking (doesn't lose track of the battery capacity as the battery is plugged in and unplugged), maximum power point tracking for operation with a solar panel, and an option to charge via a DC power adapter.

The smart battery pack has a 4.5 Ah capacity and provides backup power that can support the NUFLO Scan-

ner 2105 flow computer autonomously for up to 25 days without recharging. Battery life can vary significantly, depending on the input/output configuration in use. Be sure to turn off any unnecessary inputs or outputs so as to preserve battery life.

For battery handling instructions, see [Smart Battery Pack Replacement, pg. 86](#) and [Smart Battery Cell Information, pg. B-2](#). Wiring diagrams are provided in [Internal Power Supply - Smart Battery Pack, pg. 61](#).

Operation

The NUFLO Scanner 2105 flow computer supports one rechargeable smart battery pack (Figure 1.5, left). To indicate the status of the battery pack there are 8 indicator lights in total: 5 lights show remaining battery capacity, one light shows when the battery is charging, one light shows when charging is complete, and one light shows if a fault has occurred during charging.

After pressing the test button (shown in Figure 1.5, left), the battery level indicator lights will light up and show the battery capacity for 5 seconds. The five battery capacity indicator lights display the remaining battery capacity in the following way:

TABLE 1.1—BATTERY LEVEL INDICATION

NUMBER OF BATTERY INDICATORS LIT UP	BATTERY CAPACITY REMAINING (IN PERCENTAGE)
5	80% to 100%
4	61% to 80%
3	41% to 60%
2	21% to 40%
1	0% to 20%



Figure 1.5 - Smart battery pack indicator lights (left) and battery connector and DC power adapter plug in (right)

When the smart battery pack is connected to the NUFLO Scanner 2105 flow computer when external power is applied, the status indicator lights will periodically blink to show the remaining battery capacity. However, if the smart battery is being charged with a DC power adapter power supply, then the status indicator lights will no longer blink periodically, but will remain continuously illuminate in 5 second intervals.

Charging While Installed

The smart battery pack will be charged when the NUFLO Scanner 2105 flow computer is being externally powered. For the external power to charge the smart battery pack effectively a voltage between 16V to 30V must be applied. While the smart battery is being charged the Charging indicator light (see [Figure 1.5, pg. 5](#), left) will blink. When charging is complete the Charging indicator light will cease blinking and the Complete indicator light will illuminate, and will remain illuminated while the battery is fully charged.

Note	The charger or charging source may remain connected indefinitely without any risk of overcharging the smart battery pack.
Note	Loop power will not charge the battery pack.
IMPORTANT	If the Fault indicator light illuminates, unplug the smart battery from the NUFLO Scanner 2105 flow computer immediately, and replace the battery.
CAUTION	Where installed, do not exceed an ambient temperature of 60°C when charging the smart battery. Charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging if it reaches 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.

Charging With a DC Power Adapter

The smart battery may be removed from the NUFLO Scanner 2105 flow computer and rapidly charged via a DC power adapter through its DC power adapter plug (see [Figure 1.5, pg. 5](#), right). During charging the indicator lights for the remaining battery capacity will remain continuously illuminated and the Charging indicator light (see [Figure 1.5, pg. 5](#), left) will blink. When charging is complete the Charging indicator light will cease blinking and the Complete indicator light (see [Figure 1.5, pg. 5](#), left) will illuminate, and will remain illuminated while the battery is fully charged.

CAUTION	Do not exceed an ambient temperature of 60°C when charging the smart battery. Charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging if it reaches 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.
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WARNING	Before beginning the procedure of removing the battery ensure area is non-hazardous. Charging with a DC power adapter must also only be done in a non-hazardous area.
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IMPORTANT	If the Fault indicator light illuminates, unplug the smart battery from the DC power adapter immediately, and replace the battery.
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The procedure to remove the smart battery pack from the NUFLO Scanner 2105 flow computer is as follows (use [Figure 1.6, pg. 7](#) for reference):

1. Unscrew the end cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Disconnect the smart battery cable from the connector on the smart battery pack.
3. Unscrew the tension screw holding the smart battery pack in place on the battery mounting bracket.
4. Slide the smart battery pack off of the battery mounting bracket and out of the enclosure.
5. Replace the enclosure cover by threading it onto the enclosure in a clockwise direction.
6. Transport the removed battery to the location where it will be charged.

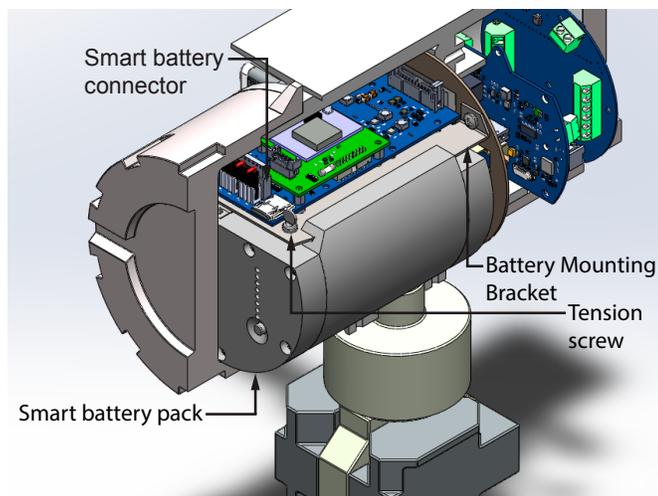


Figure 1.6 - Removal of the smart battery pack from the enclosure

The procedure to set up and charge the smart battery pack with a DC power adapter is as follows:

1. Plug the DC power adapter (Figure 1.7, left) into an outlet (as shown in Figure 1.7, middle).
2. Plug the barrel plug into the smart battery pack (as shown in Figure 1.7, right).
3. Allow the battery to charge until the "Complete" indicator light comes on. Unplug the DC power adapter plug from the smart battery pack.

IMPORTANT

When the battery is being charged from a DC power adapter power supply, it must be allowed to charge for a full 6 hours or until the Charging indicator light turns off and the Complete indicator light illuminates (indicating that the battery has reached about 95% of its maximum capacity). Doing this allows the battery to charge completely, and contributes to battery health and longevity.



Figure 1.7 - DC power adapter (left) plugging into a wall outlet (middle), and then into the smart battery pack (right)

Note

The charger or charging source may remain connected indefinitely without any risk of overcharging the smart battery pack.

The procedure to install the smart battery pack back into the NUFLO Scanner 2105 flow computer is as follows (use Figure 1.6 for reference):

1. Unscrew the end cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Slide the smart battery pack onto the battery mounting bracket and into of the enclosure.
3. Screw the tension screw on to help hold the smart battery pack in place.
4. Plug the smart battery pack cable from the main board into the smart battery pack connector.
5. Replace the enclosure cover by threading it onto the enclosure in a clockwise direction.

Charging With a Solar Panel (Smart Battery as Primary Power Source)

This option allows the smart battery pack to function as the primary power source for the NUFLO Scanner 2105 flow computer. With a solar panel, the smart battery should only require about 1-2 hours of light per day to continually power the instrument, and remain fully charged. [Figure 1.8](#) shows a tracking of the smart battery pack voltage and the charging current with a solar panel attached to it over a period of 26 days.

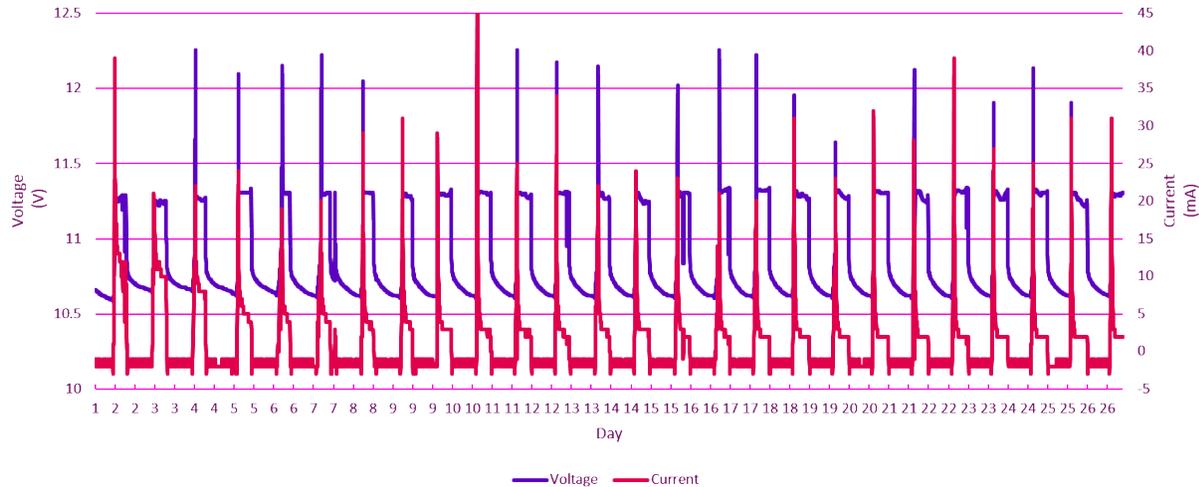


Figure 1.8 - Smart battery voltage and charging current with a solar cell attached

If a solar panel is attached (for solar panel installation see [Solar Panel Installation, pg. 37](#) to the external power input (for wiring see [External Power Supply \(Solar Power\), pg. 63](#), the integrated charger will use maximum power point tracking to automatically charge the battery according to the maximum power available from the solar panel. The smart battery pack maximum power point tracking will optimize the power received from the solar panel by varying the smart battery charge current to keep the solar panel's closed loop voltage at an optimal value. The intelligence of this feature allows the smart battery to be charged efficiently over a large range of light conditions including very low light.

IMPORTANT	If the Fault indicator light illuminates, unplug the smart battery from the NUFLO Scanner 2105 flow computer immediately, and replace the battery.
CAUTION	Do not exceed an ambient temperature of 60°C. Battery charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging at 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.

Discharging

Under normal conditions at room temperature, the smart battery pack should provide up to 25 days of continual power to the NUFLO Scanner 2105 flow computer before the battery requires recharging. This capacity will decrease as temperatures rise above room temperature, which means there will be a decrease in the time for which a fully charged smart battery can continually power the device before requiring recharging. With the on-board coulomb counter the remaining battery capacity can be tracked accurately, even while the smart battery is plugged and unplugged, as well as charged and discharged. [Figure 1.9, pg. 9](#) shows the profile of the remaining battery capacity as calculated by the coulomb counter versus the voltage of the smart battery pack.

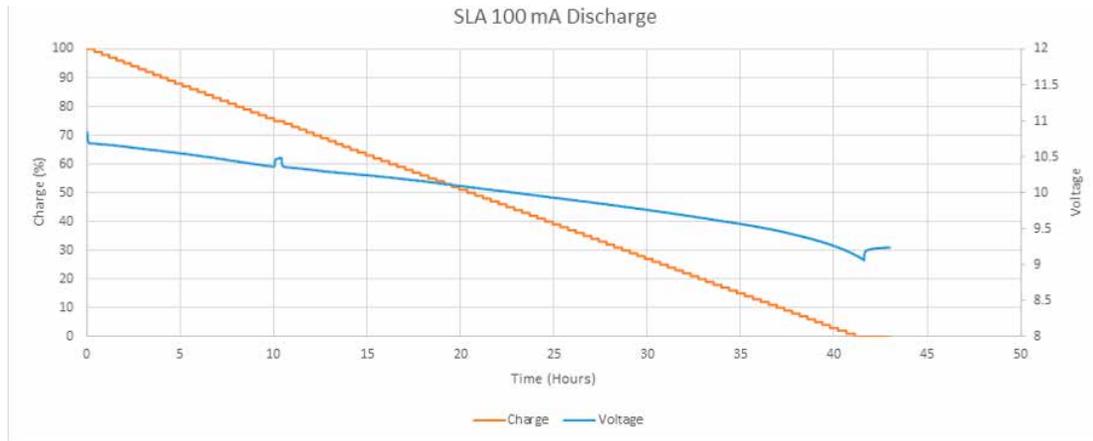
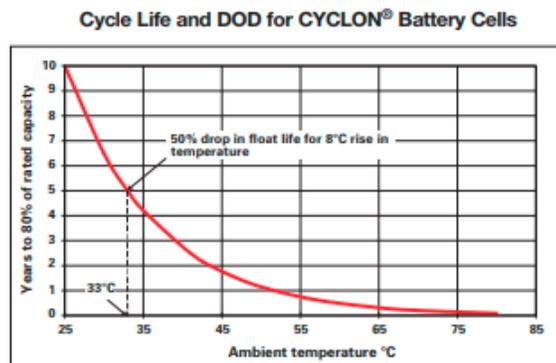


Figure 1.9 - Smart battery remaining capacity versus voltage supplied (under 100mA continuous discharge)

The service life of the smart battery pack will be dependent on the operating temperature. Figure 1.10 shows the service life of the smart battery pack cells at different temperatures assuming the service life is from 100% to 80% maximum capacity. Note the average operating temperature for your application, and refer to Figure 1.10 to determine what your expected smart battery service life will be.

Note	The state of health of the battery can also be read with Modbus (register shown on page C-32) or retrieved from within ModWorX.
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A ten year battery, such as a CYCLON battery single cell pack will last for five years at 33°C (91.4°F) and only 2 1/2 years at 41°C (105.8°F).

Figure 1.10 - Smart battery pack cells battery service life at different ambient temperatures [1]

Explosion-Proof Switch

An external explosion-proof switch (Figure 1.11) opens or closes a circuit when the button is pushed and held in position, allowing the user to manually pace the display parameters and to view daily logs within the display. In this configuration, the switch is wired to the main circuit board. See Momentary Switch (CSA, Class I, Div. 1 and 2), pg. A-5.

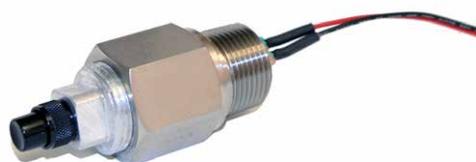


Figure 1.11 - Explosion-proof control switch

A control switch can be installed in any of the four threaded conduit openings in the top of the NUFLO Scanner 2105 flow computer enclosure.

CAUTION	If an explosion-proof control switch is ordered, the control switch will be factory-installed. Do not attempt to remove this switch from the conduit port. Doing so can damage other components. Contact the factory for assistance with repairs or replacement.
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RTD Assembly

The temperature input for NUFLO Scanner 2105 flow computer flow calculations is typically supplied by an RTD. Sensia offers three types of 4-wire RTDs to cover explosion-proof and weatherproof applications.

The Barton Model 21 explosion-proof RTD can be connected to the instrument without conduit in a Class I, Div. 1 installation and is CSA-certified for use in Class I, Groups B, C, and D; Class II, Groups E, F and G; and Class III hazardous area environments.

Sensia's weatherproof RTD is CSA-certified for use in Class I, Div. 2 hazardous area installations.

For installation details, see [Explosion-Proof RTD Assembly \(CSA, Class I, Div. 1\)](#), pg. A-8A-3 and [Weatherproof RTD Assembly \(CSA, Class I, Div. 2\)](#), pg. A-8. For wiring instructions, see [RTD Input](#), pg. 65.

Communications Adapters

Sensia offers two adapters for making walk-up laptop connections to the NUFLO Scanner 2105 flow computer without removing the enclosure. A USB connector uses an off-the-shelf USB connector cable, and an RS-485 connector uses a Sensia-supplied cable.

USB Communications Adapter (CSA Class I, Div. 1 and Div. 2)

The CSA-approved USB communications adapter ([Figure 1.12](#)) is designed to connect a device directly to a USB port of a laptop or PC. A user-supplied type A/B USB cable is required. The adapter is factory-installed when purchased with a device. It is available in two forms:

- Communications adapter (replacement part, no installation CD)
- Communications adapter kit (USB adapter socket, blanking plug, union nut and an installation CD for upgrading communications in a field unit)

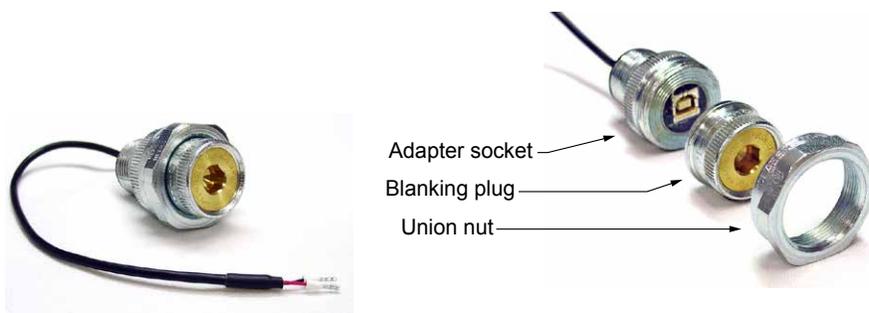


Figure 1.12 - USB communications adapter

If the USB adapter is purchased as a kit, see [USB Adapter Kit Installation](#), pg. A-11, for field installation instructions.

IMPORTANT	Do not connect the USB adapter to a computer until a USB driver is installed using the CD provided. ModWorX cannot connect to a NUFLO Scanner 2105 flow computer without these files. See Using the Adapter , pg. A-10.
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When the USB port is not in use, the blanking plug should be nested inside the union nut and the union nut screwed onto the adapter to cover the USB socket.

RS-485 Adapter (CSA Class I, Div. 1 and Div. 2)

The CSA-approved RS-485 explosion-proof communications adapter ([Figure 1.13](#)) is shipped pre-assembled in the NUFLO Scanner 2105 flow computer when it is ordered with the flow computer. The installed adapter is comprised of an RS-485 adapter socket, a blanking plug, and a union nut. A plug connector that mates with the RS-485 adapter socket when the adapter is in use is shipped with the device (uninstalled). This plug connector should be wired to an RS-485 converter cable (available from Sensia) and stored with the cable when the adapter is not in use. See [RS-485 Adapter Field Installation, pg. A-10](#) for field installation instructions. See [Figure 3.19](#) and [Figure 3.20, pg. 69](#) for instructions on connecting the plug connector to an RS-485 converter cable.

See [NUFLO Scanner 2105 flow computer Parts List, pg. 95](#) for part numbers.

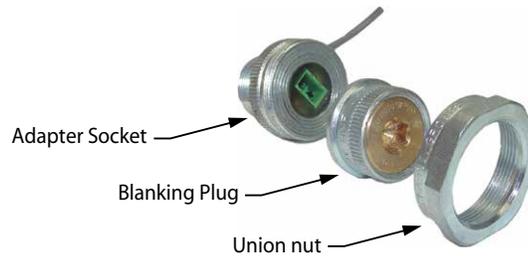


Figure 1.13 - RS-485 communications adapter

Pole-Mounting Kit

Sensia's pole mounting kit ([Figure 1.14](#)) is recommended for mounting a NUFLO Scanner 2105 flow computer to a 2-in. pipe with a 2 3/8-in. outside diameter. The kit consists of a stainless steel "L" mounting bracket with four mounting holes, two U-bolts, and four 10-mm M6 screws.

The bracket bolts directly to the mounting bosses along the left side of the enclosure, and the U-bolt secures the assembly to a pole. For installation instructions, see [Pole-Mounting the NUFLO Scanner 2105 Flow Computer, pg. 29](#). For part numbers, see [NUFLO Scanner 2105 flow computer Parts List, pg. 95](#).



Figure 1.14 - Pole mounting kit

Wireless Communications

The NUFLO Scanner 2105 flow computer wireless communications option includes a factory-installed wireless radio module and an explosion-proof coupler ([Figure 1.15, pg. 12](#)) that enables an external antenna to be safely used in a hazardous area. Equivalent antennas with a 1-watt maximum power rating and a frequency range of 2400 to 2483.5 MHz may also be used with the coupler.

Explosion-proof Coupler (CSA Class I, Div. 1 and Div. 2)

An explosion-proof coupler is factory-installed in the top right conduit opening of the NUFLO Scanner 2105

flow computer enclosure. The coupler's 12-inch coaxial cable connects to the radio module seated on the circuit board inside the Scanner enclosure as shown in [Figure 1.15](#). The coupler is approved for use with CSA (North America). For part numbers, see [Spare Parts, pg. 95](#).

Antenna Options

Direct-Mount Antenna

The Sensia-supplied right-angle antenna connects directly to the explosion-proof coupler. When installing the antenna, ensure that it is in a vertical position 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 10 dB in North America, and has a frequency range of 2400 to 2483.5 MHz. Antennas with equivalent ratings may also be used with the coupler. For part numbers, see [NUFLO Scanner 2105 flow computer Wireless Components, pg. 96](#).

For CSA compliance, the installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in [Hazardous Area Requirements for Wireless Communications, pg. 30](#).

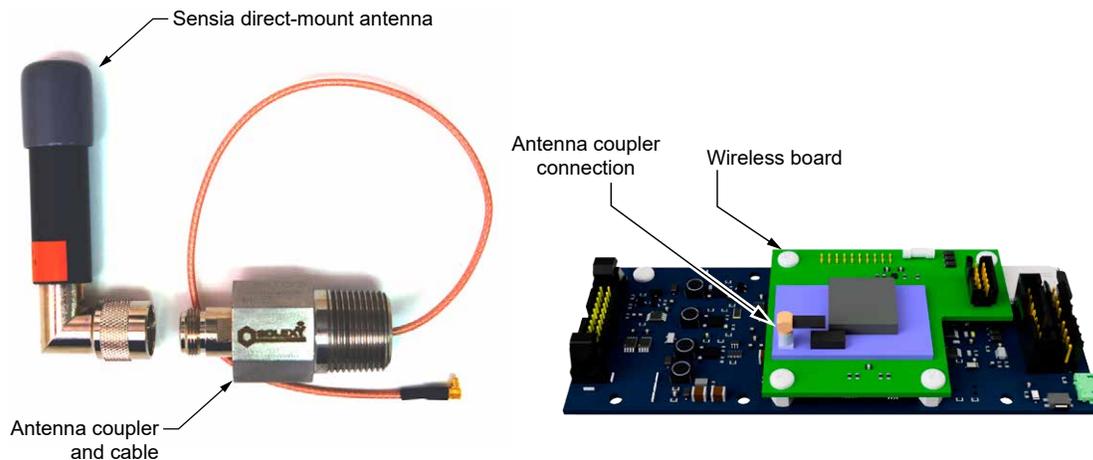


Figure 1.15 - Direct-mount antenna, explosion-proof antenna coupler, and coupler cable connection to the wireless radio module

Remote-Mount Antenna

In locations where a physical barrier restricts the use of a direct-connect antenna or where a longer transmission distance is required, a remote-mount antenna ([Figure 1.16, pg. 13](#)) 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 [NUFLO Scanner 2105 flow computer Wireless Components, pg. 96](#)). If purchasing equipment elsewhere, verify that the antenna does not exceed gain requirements (10 dB max for North America), and the cable does not exceed a maximum inductance of 2 $\mu\text{H}/\text{ft}$ (6.5 $\mu\text{H}/\text{m}$). See [Specifications, pg. 15](#) for additional details.

For CSA compliance, the installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in [Hazardous Area Requirements for Wireless Communications, pg. 30](#).

For installation instructions, see:

- [Remote-Mount Antenna \(for use with pole outside diameters up to 2 inches\), pg. 33](#)
- [Remote-Mount Antenna \(for use with pipe outside diameters of 2 3/8 inches\), pg. 34](#)



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 1.16 - Remote-mount antenna mounting options

Extended Range (Directional) Antennas

For situations where a site is at a distance from a wireless mesh network it may be necessary to use an extended range (or directional) antenna. This will give a transmit/receive range beyond that of the direct-mount or remote-mount antennas. During installation, it is important to ensure that there are no large structures between the antenna and the rest of the wireless mesh network that could interfere with signal transmission or reception.

The yagi antenna has a 60° beamwidth both vertically and horizontally, and has a maximum input power of 50W. This antenna is installed with a 12-inch coax lead terminated with a N-Male connector. The yagi antenna and connecting cable may be purchased from Sensia (see [NUFLO Scanner 2105 flow computer Wireless Components](#), pg. 96).

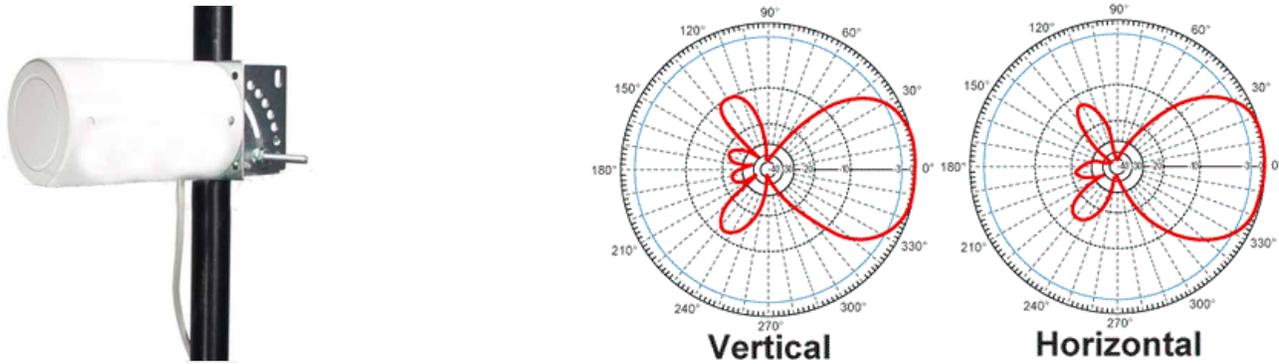


Figure 1.17 - Yagi antenna mounted on a pole (left) and yagi antenna beamwidth diagrams (right) [3]

The log periodic antenna has a 80° beamwidth horizontally and 60° beamwidth vertically, and has a maximum power input of 50W. This antenna is installed with a 9 inch coax lead terminated with a N-Male connector. The log periodic antenna and connecting cable may be purchased from Sensia (see [NUFLO Scanner 2105 flow computer Wireless Components, pg. 96](#)).

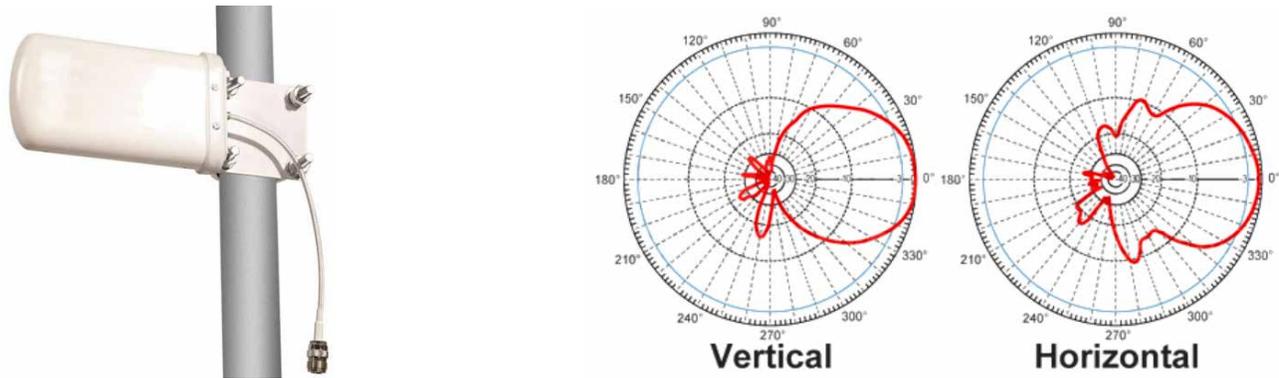


Figure 1.18 - Log periodic antenna mounted on a pole (left) and log periodic antenna beamwidth diagrams (right) [4]

If purchasing equipment elsewhere, verify that the antenna does not exceed gain requirements (10 dB max for North America). See [Specifications, pg. 15](#) for additional details.

For CSA compliance, the installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in [Hazardous Area Requirements for Wireless Communications, pg. 30](#).

Expansion Board

The NUFLO Scanner 2105 flow computer input/output expansion board option increases the number of flow runs that can be recorded simultaneously to three - one flow run and two turbine runs. The expansion board adds the following inputs to the NUFLO Scanner 2105 flow computer:

- 2 analog inputs (can be configured for 0-5 V, 1-5 V or 4-20 mA)
- 1 turbine meter input
- 1 pulse input

An analog output terminal is present on the expansion board but not functional. This output is instead implemented as an integrated analog output on the backplate board. For wiring procedures and diagrams, see [External power supply \(solar power\) on backplate board, pg. 63](#).

All inputs and outputs are configured with ModWorX software provided with each NUFLO Scanner 2105 flow computer. See the ModWorX Software User Manual for details.

See [Input/Output Expansion Board, pg. A-1](#) for more detail on the application, installation, and wiring of the NUFLO Scanner 2105 flow computer input/output expansion board option.

Specifications

TABLE 1.2—GENERAL SPECIFICATIONS

Approvals	CSA (US and Canada) Class I, Div. 1, Groups C and D, T6 (explosion-proof) Class I, Div. 2, Groups A,B,C,D, T5 or T4A (with smart battery) (non-sparking) (Tamb -40 °C to 70 °C)	
	Overvoltage Category: II	
	Type 4 enclosure	
	ANSI 12.27.01 single seal (0 to 3000 psi)	
	ASME Pressure Vessel Code (0 to 3000 psi); CRN 0F10472.5C	
Environmental Safety	Relative humidity 0% to 90% non-condensing	
	Altitude: Up to 2100 meters	
	Pollution Degree: 3	
Enclosure	Cast aluminum (less than 0.05% copper), painted with epoxy and polyurethane, double-ended with single window	
	Dimensions: 5.43 in. wide, 11.27 in. deep, 10.76 in. tall with MVT	
	5 conduit ports (including bottom sensor port), 3/4-in FNPT connections	
Weight	<i>Base unit (no MVT or batteries)</i>	7.4 lb (3.36 kg)
	<i>Base + MVT and 2 batteries</i>	16.7 lb (7.57 kg)
	<i>Base + MVT, direct-mount antenna, and 2 batteries</i>	17.3 lb (7.85 kg)
	Lifting and Carrying Instructions	<p>If lifting manually:</p> <ul style="list-style-type: none"> - ensure package is secured - use appropriate PPEs and proper carrying and lifting techniques - follow the path previously laid out - know the limit, use equipment if required <p>If carrying using equipment, follow equipment guidelines.</p>
System Power	CSA (North America): External user-provided power supply (9 to 30 VDC at 150 mA) with internal smart battery or lithium battery backup, standard.	
	Loop Power supply (18 V to 30 V) with internal smart battery or lithium battery backup. Loop Power supply will not charge the smart battery when connected.	
	10.7 V smart battery pack (containing 5 non-replaceable SLA batteries); device accommodates one pack. When charging, current may rise up to 2.15 A depending on the maximum current allowed by the power source.	
	7.2 V lithium battery pack containing two "D" batteries in series; device accommodates two packs.	
Operating Temperature	For normal operation: -40 °C to 70 °C (-40 °F to 158 °F) When charging smart battery: -40 °C to 60 °C (-40 °F to 140 °F)	
	LCD contrast is reduced below -30 °C (-22 °F)	
	WARNING	EXPLOSION RISK. Housing temperature must not exceed 70 °C (158 °F). Excessive temperatures, which could result from ambient conditions combined with radiated and conductive heat from the process, could cause the internal lithium battery to ignite or explode.

TABLE 1.2—GENERAL SPECIFICATIONS

LCD Display/ Keypad	8-digit readout of values (7-segment characters)	
	6-digit bottom readout of scrolling parameters and associated engineering units (11-segment characters for easy-to-read prompts)	
	View up to 12 user-defined parameters	
	View daily log data (see Viewing Daily and Hourly Logs, pg. 74 for log viewing switch option)	
	User-selectable units of measurement	
	0.3" character height	
	Configurable scan parameters and duration	
	Adjustable contrast and update period	
	3-key membrane switch	
	Password-protected security available	
Memory	Non-volatile memory for configuration and log data	
	256 KB standard	
Supported Meter Types	Turbine meter	
	Cone meter	
	Orifice meter	
	Ultrasonic meter	
	Positive displacement (PD) meter	
	Coriolis meter	
	Venturi meter	
Logging	Daily records: 768 (>2 years)	
	Interval records: 2304 (>3 months of 1-hour intervals), with main board; 6392 (up to 9 months of hourly logs), with expansion board; Adjustable from 5 seconds to 12 hours	
	Event/alarm records: 1152	
	Logs stored in non-volatile memory for up to 10 years	
Communications/ Archive Retrieval	Wired	RTU Modbus
		Two on-board RS-485 communications ports (300 to 38.4 K baud) available for wired communications
		Full download from main board in approximately 3 minutes
		Enron Modbus compliant downloads
		User-definable Modbus map with up to 25 floating point values
	Wireless	Optional SmartMesh wireless radio module available with or without external antenna. See Wireless SmartMesh Radio, pg. 19 .
		One onboard RS-485 communication port (300 to 38.4 K baud) available for wired communications *One of the two ports is used for the SmartMesh wireless radio.
		*See Communications Adapters, pg. 19 for explosion-proof RS-485 or USB communications adapter specifications.
Flow Rate Calculations	Natural Gas	AGA 3 (1992 and 2012), ISO 5167-2 (2003), ASME MFC-14M (2003), AGA 7 (2006), ASME MFC-12M (2006)
	Steam	ASME MFC-12M (2006), AGA 3 (1992 and 2012), ISO 5167 (2003)
	Liquids	API MPMS 5.3 (2009), AGA 3 (1992 and 2012), ISO 5167, AGA 7 (2006)

TABLE 1.2—GENERAL SPECIFICATIONS

Fluid Property Calculations	Natural Gas	AGA 8 (1994), AGA 3, Appendix F (1992), GPA 2145 (2008)		
	Steam	IAPWS Industrial Formulation 1997 (IF-97), ISO/TR 11582 (2012), Chisholm-Steven Wet Correction Method (for orifice and NUFLO cone), James Wet Correction Method (for orifice)		
	Liquids	API MPMS 11.1 (2004)		
I/O Summary	Main Board Only	Differential pressure input (1) via optional MVT sensor		
		Static pressure input (1) via optional MVT sensor		
		Turbine input (1)		
		Process temperature input (1)		
		Digital output *Moved to backplate board		
	Backplate Board	Digital output (1)		
		Analog output (1) (Also loop power)		
	With Optional Expansion Board	Pulse/frequency input (1)		
Analog input (2)				
Analog output *Moved to backplate board				
MVT Specifications	Linearized static pressure and differential pressure			
	Bottom ports, standard; side ports available by special order			
	NACE-compliant units available (See MVT Materials and Bolt Specifications , pg. 27 for bolt specifications.)			
	Process temperature: -40 °C to 121 °C (-40 °F to 250 °F)			
	User-adjustable sample time and damping			
	Stability: Long-term drift < ±0.05% of upper range limit (URL) per year over a 5-year period			
MVT Accuracy	Differential Pressure	± 0.05% of range except for 30 in. H2O range, which is 0.1%		
	Static Pressure	± 0.05% of range		
	Temperature Performance	± 0.25% of full scale over operating range		
	Stability	Long-term drift less than ± 0.05% of URL per year over a 5-year period		
	Resolution	24 bits		
	Effect on Differential Pressure for a 100-psi Pressure Change			
	Differential Pressure Range (in. H2O)	Zero Shift (% URL)	Span Shift (% reading)	
	± 30*	.05	.01	
	± 200**	.01	.01	
	± 400	.04	.01	
± 840	.04	.01		
*± Indicates bidirectional capabilities (for example, a range of 30 in. H2O is -30 to +30 H2O). ** Exception: 200 x 300 psi has a zero shift of .007% and a span shift of 0.01%.				

TABLE 1.2—GENERAL SPECIFICATIONS

MVT Pressure Ranges	Effect on Differential Pressure for a 100-psi Static Pressure Change		
	Static Pressure/SWP (psia)	Differential Pressure (in. H ₂ O)	Maximum Overrange Pressure (psia)
	100	± 30	150
	300	± 200 or 840	450
	500	± 30 or 200	750
	1500	± 200, 400, or 840	2250
	3000	± 200, 400, or 840	4500
	5300	± 200, 400, or 840	7420
* Custom ranges available by special order. For materials of construction, see MVT Materials and Bolt Specifications, pg. 27 .			
Inputs (Main Board)	Turbine Meter Input	Configurable sensitivity adjustment: 20 to 200 mV, peak-to-peak	
		Frequency range: 0 to 3500 Hz	
		Input amplitude: 20 to 3000 mV, peak-to-peak	
	Process Temperature Input	100-ohm platinum RTD with 2-wire, 3-wire, or 4-wire interface	
		Sensing range: -40 °C to 427 °C (-40 °F to 800 °F)	
		Accuracy: 0.2 °C (0.36 °F) over sensing range at calibrated temperature	
Temperature effect: 0.3 °C (0.54 °C) over operating range			
Output (Backplate Board)	Digital Output	Configurable as pulse output or alarm output	
		Solid-state relay	
		Output rating: 200 mA max @ 30 VDC	
	Configured as Pulse Output	Maximum frequency: 50 Hz	
		Configurable pulse duration (65,535 msec max)	
		Configurable pulse representation (1 pulse = 1 MCF)	
		Based on any accumulator (flow run or turbine meter run)	
	Configured as Alarm Output	Low/high	
		Out-of-range	
		Status/Diagnostic	
		Latched/Unlatched	
		Normally open/Normally closed	
	Analog Output (Also loop power)	4-20 mA, externally powered	
		Accuracy: 0.1% of full scale at 25 °C (77 °F)	
		Temperature drift: ±50 PPM/ °C (±27.8 PPM/°F)	
		Acceptable Voltage Range: 18 to 30 VDC	
		Maximum Output Load Resistance (Ohms) = [Supply (volts) - 8] / 0.02	
Represents any measured variable (e.g., differential pressure) or calculated parameter (e.g., flow rate)			
Regulates control valve in PID applications			
Optically isolated			
Resolution: 16 bits			

TABLE 1.2—GENERAL SPECIFICATIONS

Inputs (Expansion Board)	Pulse/Frequency Input	Accepts signal from turbine or PD meter
		Optically isolated
		Input: 3 to 30 VDC or contact closure
	Analog Inputs	Three-wire sensor interface (0 to 5 V, 1 to 5 V, 4 to 20 mA)
		Sensor power (CSA). 9 to 30 VDC (same as external power supply for main board)
		Note: If the Scanner is using loop power, then the Scanner will not be able to use the loop power to power the sensor. If the sensor power feature is utilized, then the Scanner will instead use battery power to operate the sensor. This may significantly reduce battery life.
		Accuracy: 0.1% of full scale
		Temperature effect: 0.25% of full scale over operating range
Resolution: 24 bits		
User-adjustable sample time and damping		

TABLE 1.3—HARDWARE OPTIONS

Communications Adapters	RS-485 (explosion-proof with cover in place)				
	USB (explosion-proof with cover in place)				
Expansion Board	Provides additional functionality for NUFLO Scanner 2105 flow computer devices				
RTD Temperature Sensor	One-piece RTD and cable assembly				
	See NUFLO Scanner 2105 flow computer Parts List, pg. 95 and RTD and Cable Assemblies (CSA-Approved), pg. 96 for available cable lengths and probe sizes.				
Wireless SmartMesh Radio	2.4 GHz, self-healing and self-sustaining network				
	Factory installed with stainless steel, explosion-proof antenna coupler, N female x 3/4 MNPT, with 12-in. coaxial cable and MMCX male connector				
	Transmits up to 985 ft (300 m) node-to-node				
	Supports communications with up to 20 remote NUFLO Scanner 2000 flow computer Series devices (each Scanner node can transmit and receive data)				
Radio Certifications	Europe: CE Mark, RED North America: FCC/IC				
Antenna		Direct Mount	Remote Mount	Extended Range- Yagi	Extended Range- Log Periodic
	Electrical Properties				
	Frequency Range	2.35 to 2.50 GHz	2.4 to 2.5 GHz	2.4 to 2.5 GHz	2.3 to 6.5 GHz
	Impedance	50 Ohms nominal @ 2.4 GHz	50 Ohms nominal @ 2.4 GHz	50 Ohms nominal @ 2.4 GHz	50 Ohm nominal @ 2.4 GHz
	Voltage Standing Wave Range (VSWR)	1.13:1	<1.5	<1.5:1	≤1.5:1
	Radiation	Omni-directional	Omni-directional	Directional	Directional
	Polarization	Vertical	Vertical	Horizontal or Vertical	Vertical
	Gain	>2.5 dBi	9 dBi	9dBi	≥20 dBi

TABLE 1.3—HARDWARE OPTIONS

Antenna	Direct Mount	Remote Mount	Extended Range- Yagi	Extended Range- Log Periodic	
	Mechanical Properties				
Connector	N male brass nickel-plated connector for use with N female explosion-proof coupler	N female brass nickel-plated connector, cable required for connection to N female explosion-proof coupler	N male brass nickel-plated connector for use with N female explosion-proof coupler	N male brass nickel-plated connector for use with N female explosion-proof coupler	
Height	3.75 in. (95.25 mm)	32.28 in. (800 mm)	6.0 in. (152 mm)	6.3 in. (162 mm)	
Shape	Right-angle	Straight	Straight	Straight	
Material	UV-resistant ABS	Fiberglass	UV-inhibited polymer	Fiberglass	
Operating Temperature	-40 °C to 80 °C (-40 °F to 178 °F)	-40 °C to 80 °C (-40 °F to 178 °F)	-20 °C to 60 °C (-4 °F to 140 °F)	-40 °C to 85 °C (-40 °F to 185 °F)	
Antenna Cable	Direct-Mount		Remote-Mount		
	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)		
	Pole Mount Hardware				
	—	N/A	Standard hardware (included with antenna) fits poles with outside diameters up to 2 in.		
—	N/A	Alternate pole mount kit available for pipe with outside diameter of 2 3/8 in.			
Control Switch	Explosion-proof switch, momentary contact, fits 3/4-in. female pipe thread, may be used as a keypad alternative				
Pole Mount Kit	Stainless steel pole mount kit for 2-in. pipe (2 3/8-in. outside diameter)				

TABLE 1.4—SCANNER COMPANION SOFTWARE

IMPORTANT		To download software or software user manuals, visit the Sensia website at https://sen-siaglobal.com/Measurement , scroll to the bottom of the screen, and select Flow Computers and Automation > 2000 Series NUFLO Scanner Flow Computer . Click the link for the desired software install/manual.
ModWorX	Features	Easy-to-use interface for field calibration, flow run maintenance, archive data downloads and reporting
		Real-time data polling
		Complete configuration
		Configuration upload for configuring multiple units
		Multi-level security
	<i>Field Calibration</i>	1 to 12 calibration points for each parameter
		Three methods: multi-point, set zero point, and verify (API compliant)
		Inputs automatically locked during calibration
	<i>Maintenance</i>	Change plate, cone (1 to 12 point linearization), gas composition, steam properties, flow coefficients, K-factor (1 to 12 point linearization), turbine flowmeter and generic API liquid parameters
	<i>Archive Data Downloads and Reporting</i>	Configurable downloads of “all” or “new” records
		Download types: daily, interval, and event/alarm records
		Downloads automatically saved in uneditable binary (.sdf) files
		Exports to .xls, .csv, .rtf, .html, Flow-Cal and PGAS formats
	<i>Report Types</i>	Daily logs (table or graph)
		Interval logs (table or graph)
		Event/Alarm logs
Configuration settings		
Calibration settings		
Snapshot (current status data and calculated parameters)		
ScanData	Data analysis, reporting, export and conversion tool	
	Tabular and trend presentations	
	Customized reports	
ScanFlash	Firmware management utility	
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 (135 MB for companion software installation, 30 MB for Adobe Reader, adequate space for data files)		
DirectX 9 graphics device with WDDM 1.0 or later driver		

Flow Rate and Fluid Property Calculations

The NUFLO Scanner 2105 flow computer 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 1.5—FLOW RATE STANDARDS

		Orifice	NUFLO Cone	Linear Pulse Output	Averaging Pitot Tube (Annubar)
FLOW RATE STANDARDS					
AGA 3 (1992)	The NUFLO Scanner 2105 flow computer supports the orifice metering calculations described in AGA Report No. 3 (1992). This meter covers pipe sizes of nominal 2 inch and larger; there is no stated maximum limit, but the largest size listed in the standard is nominal 36 inch. Beta ratio must be between 0.1 and 0.75. The AGA 3 orifice meter can be used to measure natural gas, hydrocarbon fuel gas and liquids.	◆			
AGA 3 (2012)	The NUFLO Scanner 2105 flow computer supports the orifice metering calculations described in AGA Report No. 3 (2012). The AGA 3 orifice meter covers pipe sizes of nominal 2 inch and larger; there is no stated maximum limit, but the largest size listed in the standard is nominal 36 inch. Beta ratio must be 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, hydrocarbon fuel gas and liquids.	◆			
ISO 5167-2 (2003)	The NUFLO Scanner 2105 flow computer supports the orifice metering calculations described in Part 2 of ISO 5167 (2003). This meter covers pipe sizes of nominal 50 mm (2 inch) to a maximum of 1000 mm (39 inch). Beta ratio must be between 0.1 and 0.75. The ISO orifice meter can be used to measure natural gas, hydrocarbon fuel gas and liquids.	◆			
ASME MFC-14M (2003)	For low flow applications, the NUFLO Scanner 2105 flow computer supports the small-bore orifice described in ASME MFC-14M (2003). Meter sizes between nominal 1/2 inch to 1-1/2 inch pipe size are covered by this standard. Beta ratio must be between 0.1 and 0.75. The ASME small-bore orifice meter can be used to measure natural gas, hydrocarbon fuel gas and liquids.	◆			
NUFLO Cone Meter User Manual	The NUFLO Scanner 2105 flow computer calculates fluid flow rate of cone meters using industry-recognized algorithms identified in the NUFLO Cone Meter User Manual. The cone meter can be used to measure natural gas, steam, 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.	The Flow Measurement Engineering Handbook by Richard Miller 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 flowmeters.		◆		

TABLE 1.6—FLUID PROPERTY AND ENERGY FLOW CALCULATIONS

		Natural Gas	Hydrocarbon Liquid	Steam
FLUID PROPERTY STANDARDS				
AGA 3:3 (1992), Appendix F	The heating value for energy measurement is calculated according to Part 3 of AGA Report No. 3 (1992), Appendix F, "Heating Value Calculation," using the data from GPA-2145 (2008).	◆	◆	
AGA 8 Detailed (1992)	Use of AGA 8-92DC requires a gas analysis (ie: 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). This equation is most accurate between temperatures of 17 °F and 143 °F (-8 °C to 62 °C) and at pressures up to 1750 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).	◆		
AGA 8 Gross (1994) 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 Report No. 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 1750 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.	◆		
IAPWS IF-97 (1997)	Saturated steam properties, including density (inverse specific volume), enthalpy (heat content) and viscosity are computed in accordance with the International Steam Tables, IF-97 (1997), for regions 2 and 4. The temperature range is from 32 °F to 662 °F (0 °C to 350 °C) and pressures up to 2380 psi (16.4 MPa) can be used. For saturated steam, only a pressure input is required; temperature is a calculated value. Steam mass and energy measurement can be accomplished with any meter type that can withstand the high temperatures involved. By use of proper installation methods, orifice meters, NUFLO cone meters, averaging pitot tubes, and some vortex-shedding meters can be used.			◆
API MPMS Chapter 11.1 (2004)	<i>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 11.1 (2004). For crude oils, the density range is 610.6 to 1163.5 kg/m³, temperature range is from -58 °F to 302 °F (-50 °C to 150 °C), and pressure range is from 0 to 1500 psig (0 to 10340 kPa). For DP meters, the viscosity at operating temperature is a required input to the flow computer, and it must be determined as accurately as possible.</i>		◆	
ISO/TR 11583 (Chisholm-Steven Method)	The Chisholm-Steven method described in ISO/TR 11583 is applicable when using an orifice or NUFLO Cone meter to measure steam with a quality less than 100%. Note: The Chisholm-Steven method is not applicable to the ASME small-bore orifice, averaging pitot tube, or turbine meter.			◆
James Equation	The James equation is a well-known method that can be used to correct orifice meters for the quality of saturated steam. Note: The James method is not applicable to the ASME small-bore orifice meter.			◆
ENERGY FLOW STANDARDS				
AGA 3:3 (1992), Appendix F	The heating value for energy measurement is calculated according to Part 3 of AGA Report No. 3 (1992), Appendix F, "Heating Value Calculation," using the data from GPA-2145 (2008).	◆	◆	

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Section 2 - Installing the NUFLO Scanner 2105 Flow Computer

Hazardous Area Installations

The NUFLO Scanner 2105 flow computer is CSA-certified for Class I, Divisions 1 and 2 hazardous area use. It is fully assembled at the time of shipment. The safety of any system, within which the instrument is being incorporated, is the responsibility of the assembler of that system. Carefully review the following hazardous area requirements before installing the device in a hazardous area. Once the instrument is mounted in a hazardous area, the cover should not be removed unless the area is void of combustible gas and vapors.



WARNING DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE IS PRESENT, or equivalent.

AVERTISSEMENT NE PAS OUVRIR SI UNE ATMOSPHÈRE EXPLOSIVE GAZEUSE EST PRÉSENTE.



WARNING A SEAL SHALL BE INSTALLED WITHIN 6 IN. OF THE ENCLOSURE, or equivalent.

AVERTISSEMENT UN SCELLEMENT DOIT ETRE INSTALLE A MOINS DE 6" DU BOITIER.



WARNING SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 and INTRINSIC SAFETY.

AVERTISSEMENT LA SUBSTITUTION DE COMPOSANTS PEUT NUIRE À LA CONVENANCE DE LA CLASSE I, DE LA DIVISION 2 et de la SÉCURITÉ INTRINSÈQUE.



WARNING BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT LES PILES NE DOIVENT ETRE CHANGEES QUE DANS UNE ZONE CONNUE POUR ETRE NON DANGEREUSE.

CAUTION Where installed, do not exceed an ambient temperature of 60°C if charging the smart battery. Battery charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging at 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.

Class I, Div. 1 (CSA) Installations

The NUFLO Scanner 2105 flow computer is CSA-certified as explosion-proof for Class I, Division 1, Groups C and D hazardous locations.

Wiring Precautions



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 NUFLO Scanner 2105 flow computer and other devices must be either armored MC-HL cable or standard cable routed through conduit. If standard cable is used, a conduit seal must be installed within 6 inches of the Scanner.

RTD Assembly Options (for Gas and Liquid Flow Runs Only)

The process temperature input is typically supplied by an RTD installed in a thermowell downstream of the primary DP source using a 2-wire, 3-wire, or 4-wire RTD assembly. To ensure accurate measurement, the location of the thermowell should conform to the relative standard.

Sensia's Barton Model 21 RTD, a 4-wire, 100-ohm explosion-proof RTD assembly, can be connected to the NUFLO Scanner 2105 flow computer enclosure without conduit or a conduit seal. For details, see [Explosion-](#)

[Proof RTD Assembly \(CSA, Class I, Div. 1\), pg. A-8A-3](#). RTDs that do not carry the explosion-proof rating can be used if they are routed through conduit and a conduit seal is installed within 6 inches of the NUFLO Scanner 2105 flow computer.

Class I, Div. 2 (CSA) Installations

The NUFLO Scanner 2105 flow computer is CSA-certified as weatherproof for Class I, Division 2, Groups A, B, C, and D hazardous locations.

Wiring Precautions



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-lbs. to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.

RTD Assembly Options (for Gas and Liquid Flow Runs Only)

The process temperature input is typically supplied by an RTD installed in a thermowell downstream of the primary differential pressure source. The location of the thermowell should conform to the relative standard to ensure accurate measurement. A 2-wire, 3-wire, or 4-wire RTD assembly may be used. A weatherproof RTD fitted with a weatherproof Type 4 strain relief is recommended for Div. 2 installations.

Pressure Precautions



WARNING

Before connecting the NUFLO Scanner 2105 flow computer to a flow line, consider the pressure rating of the sensor and the presence of harmful gases. 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. If H₂S is present, use a NACE sensor and take appropriate precautions to avoid exposure to this hazardous gas.

TABLE 2.1—MVT MATERIALS AND BOLT SPECIFICATIONS

MVT Materials of Construction					
Process Cover	316 SS (other materials available by special order)				
Process Cover Gasket	Glass-filled PTFE				
Diaphragm	316L SS (other materials available by special order)				
Vent/drain	SS bleed (316SS plug optional for NACE and coastal applications)				
Body Bolts and Nuts (non-process wetted)					
	B7/2H ① alloy steel	B7M/2HM ① alloy steel	316SS ②	17-4 PH SS	Inconel 718
Configuration					
Standard	Yes	No	Yes	Yes	Yes
NACE	No	Yes	No	No	Yes
Coastal	Yes ①	Yes ①	Yes	No	Yes
Max. Pressure Range	5300 ③ ④	1500	1500	3000	5300
Coating	Plated	Black oxide	None	None	None

¹ B7 and B7M alloy steel is susceptible to rust. Other materials may be preferred for offshore use.

² 316 SS bolts have a CRN safe working pressure limit of 2725 psi.

³ 5300-psi ranges require transducer code HP and have a CRN safe working pressure limit of 3625 psi. Single seal is limited to 3000 psi.

⁴ 5300-psi ranges require transducer code HP and are not available with a Canadian CRN. 5300-psi range has a CRN SWP limit of 3710 psi. Therefore, it is possible to measure to 3710 psi and remain in CRN compliance. Single seal is limited to 3000 psi.

Mounting Options

The NUFLO Scanner 2105 flow computer can be mounted using the following methods:

- **Direct-mount to an orifice or cone type DP meter.** The integral multi-variable sensor may be connected to the pressure taps with stabilizers or a heavy wall nipple with adapter flanges, and a 5-valve manifold (Figure 2.10, pg. 34). A bottom-port MVT is recommended for gas measurement; a side-mount MVT is recommended for liquid or steam measurement.
- **Pole-mount** (Figure 2.3, page 29). The instrument can be mounted on a 2-in. pole using the mounting bosses on the side of the enclosure and a Sensia pole mount kit. Tubing is used to connect the integral MVT to the orifice meter or cone meter.

The following accessories are also recommended:

- A 5-valve manifold for connecting process lines to the integral MVT
- An RTD assembly for process temperature input on gas flow runs and compensated liquid flow runs (not recommended for steam flow runs). See [RTD Assembly Options \(for Gas and Liquid Flow Runs Only\)](#), pg.

25 for a description of RTD options to meet specific hazardous area requirements.

- Tubing and/or pipe for plumbing process connections
- Explosion-proof signal cable for remote turbine connections (stranded, shielded cable is recommended)

Dimensions

Dimensions shown are for CSA-approved components.

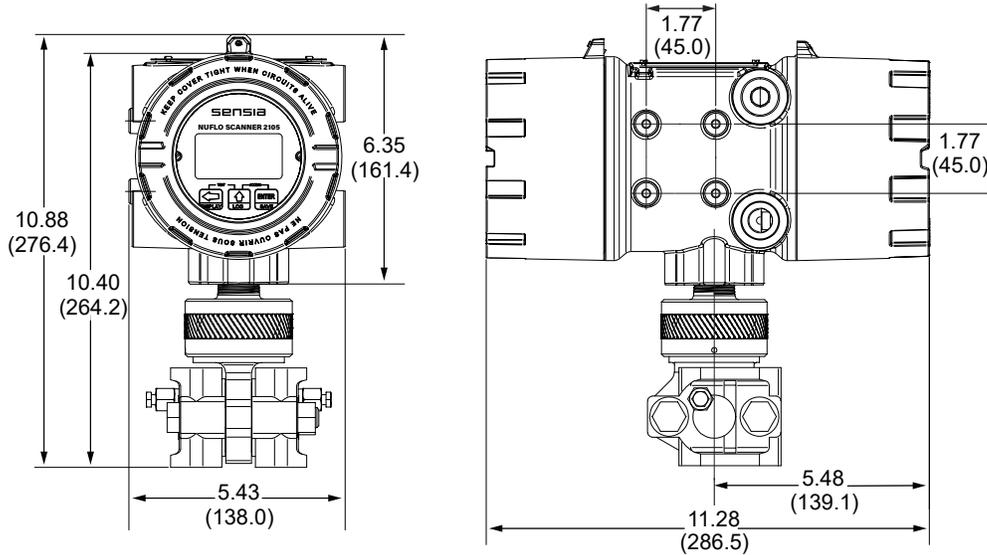


Figure 2.1 - NUFLO Scanner 2105 flow computer with direct-mount MVT; dimensions are shown in inches (mm)

Scanner 2105 with 4-port MVT Adapter Front and Side Views

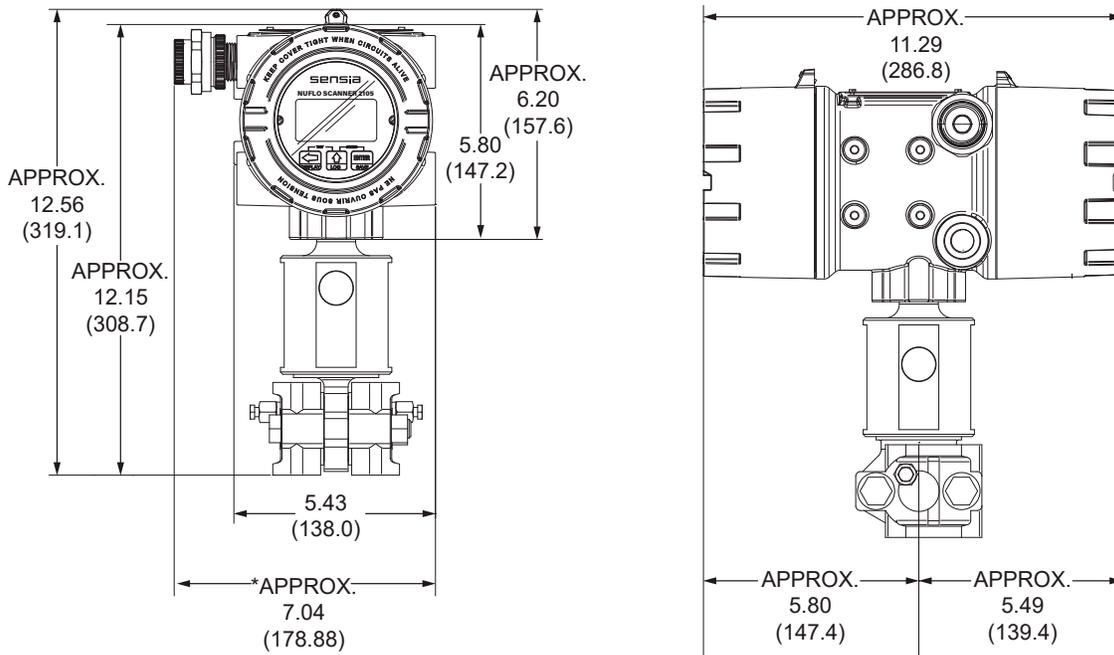


Figure 2.2 - NUFLO Scanner 2105 flow computer with hardware options; dimensions in inches (mm); for dimensions with

direct-mount antenna, see [Figure 2.4](#), pg. 30.

Pole-Mounting the NUFLO Scanner 2105 Flow Computer

Sensia's pole-mount kit is recommended for mounting any NUFLO Scanner 2105 flow computer configuration to a 2-in. pole ([Figure 2.3](#)). The kit consists of a stainless steel "L" mounting bracket with four mounting holes, two U-bolts, and four 10-mm M6 screws.

To install, perform the following steps:

1. Locate the mounting bosses on the side of the NUFLO Scanner 2105 flow computer enclosure.
2. Attach the mounting bracket to the bosses using the four 10 mm screws provided. For best strength, orient the bracket so that the flat surface of the "L" bracket is near the front of the NUFLO Scanner 2105 flow computer.
3. Position the device with bracket against the pole so that the bracket is directly in front of the pole.
4. Install the two U-bolts around the pole and through the mounting holes in the bracket.
5. Tighten the U-bolts securely. As a general torque guide, the U-bolts can be safely torqued to 25-30 ft-lbs.
6. Install and connect process piping between the NUFLO Scanner 2105 flow computer and the turbine meter with appropriate fittings. Process piping installation procedures vary with each application.

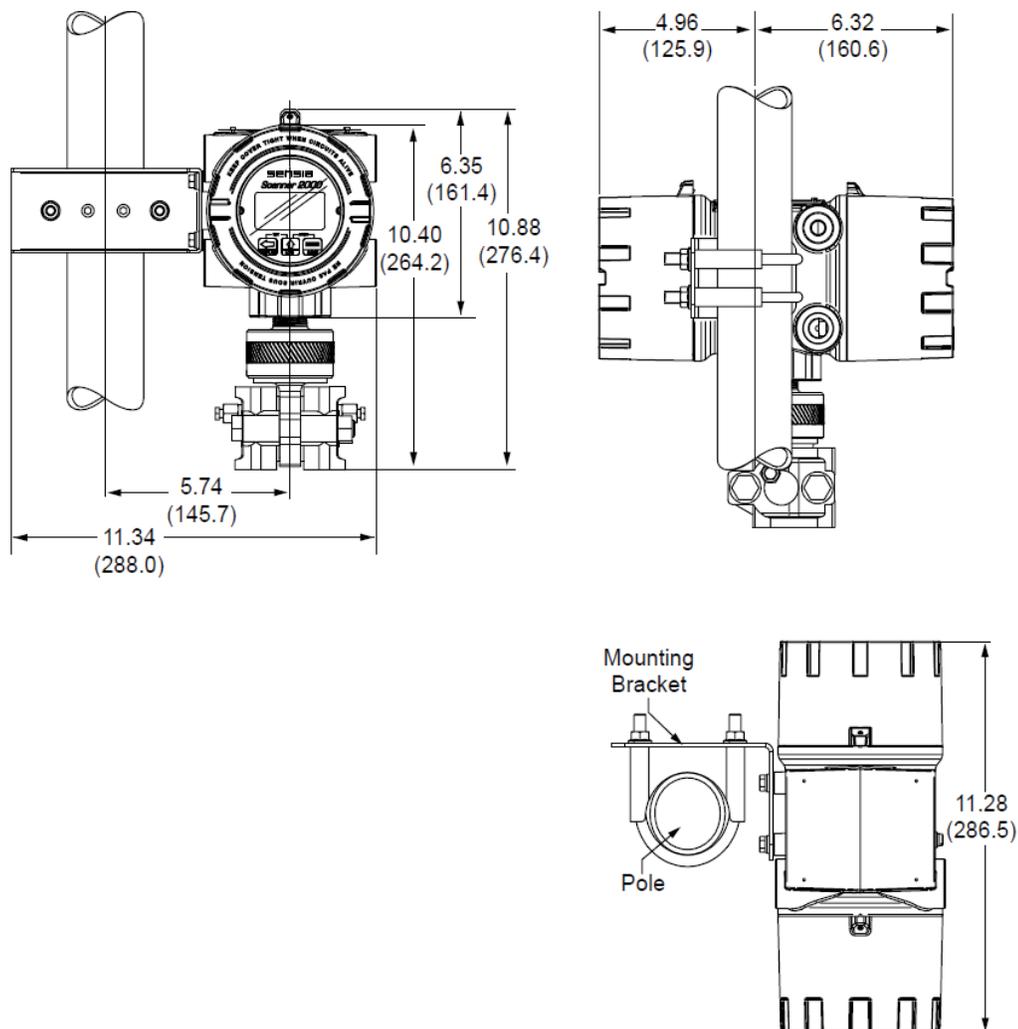


Figure 2.3 - NUFLO Scanner 2105 flow computer with MVT, remote-mounted on a 2-in. pole using a Sensia hardware kit;

dimensions are shown in inches (mm)

IMPORTANT

For liquid or steam installations requiring a side-port MVT and a block manifold, make sure the mounting hardware selected provides adequate clearance for process piping.

Hazardous Area Requirements for Wireless Communications

Each NUFLO Scanner 2105 flow computer wireless device is equipped with a wireless module connected to the main circuit board and an explosion-proof coupler that threads into an enclosure port. Antennas and antenna cable are optionally available. [Figure 2.4](#) shows installation dimensions for a device equipped with the direct-mount, right-angle antenna supplied by Sensia.

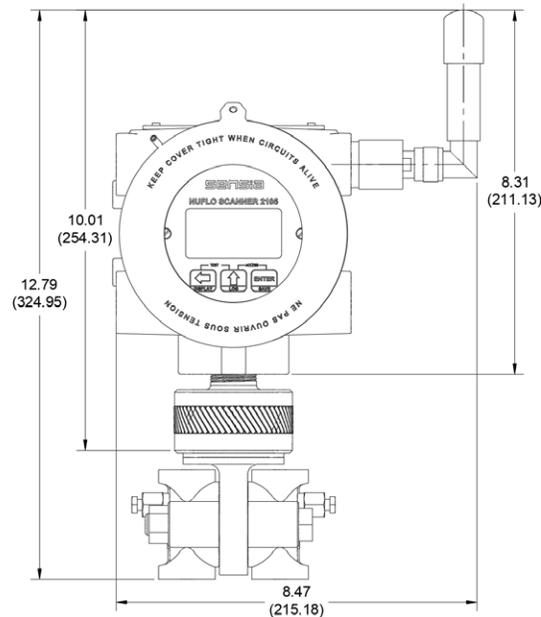


Figure 2.4 - NUFLO Scanner 2105 flow computer with direct-mount MVT and external antenna; dimensions are shown in inches (mm)

For CSA compliance, the installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in [Figure 2.5](#) and [Figure 2.6, page 31](#).

Sensia supplies the following antenna and antenna cable options:

- Direct-mount, right-angle antenna with N male connector
- Remote-mount antenna with N female connector
- Yagi antenna with N male connector
- Log periodic antenna with N male connector
- Type 400 male-to-male antenna cable in three lengths - 10, 20, and 30 feet

See [NUFLO Scanner 2105 flow computer Wireless Components, pg. 96](#) for ordering details.

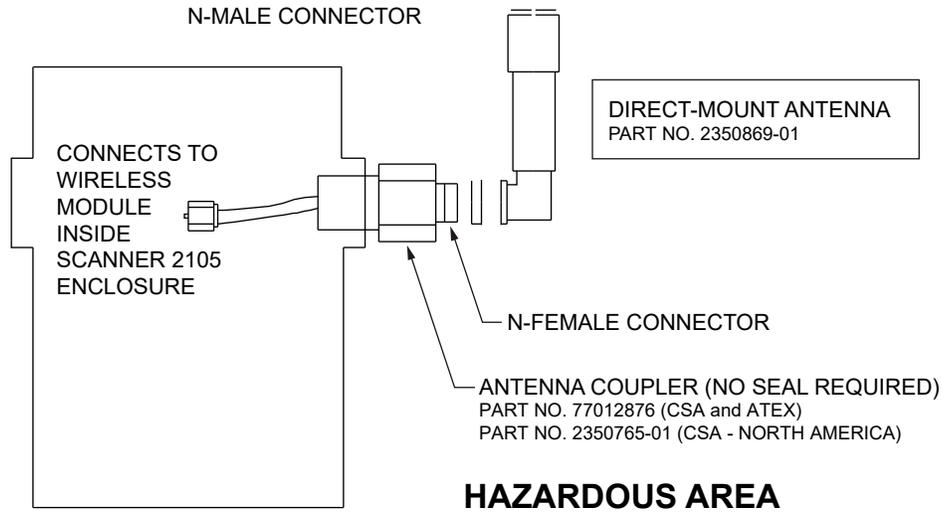


Figure 2.5 - Installation requirements for a direct-mount Sensia-supplied antenna

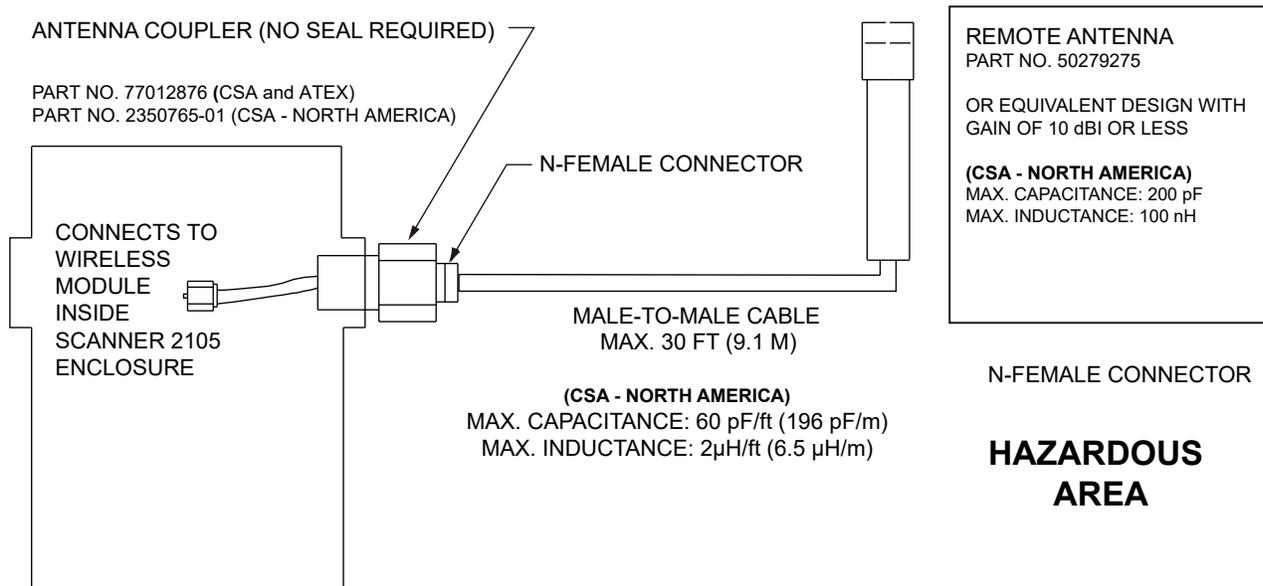


Figure 2.6 - Installation requirements for a remote-mount antenna

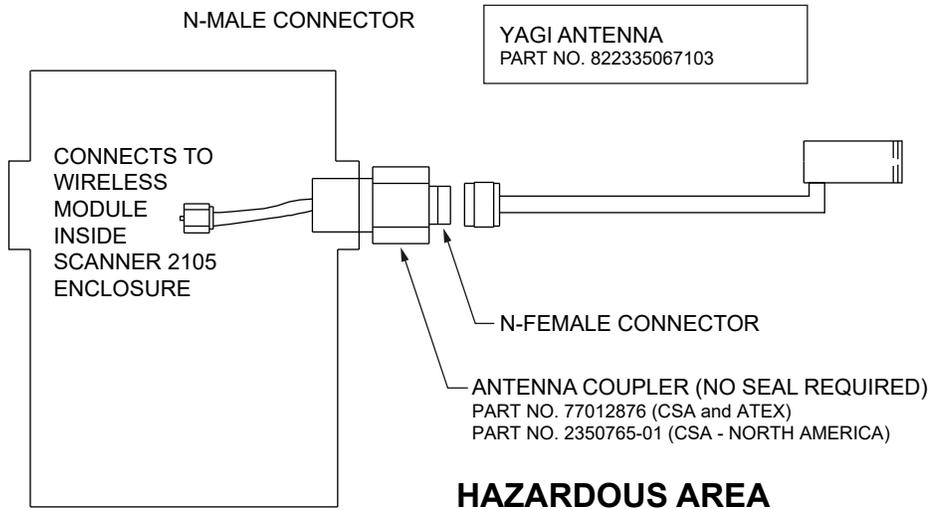


Figure 2.7 - Installation Requirements for a yagi antenna

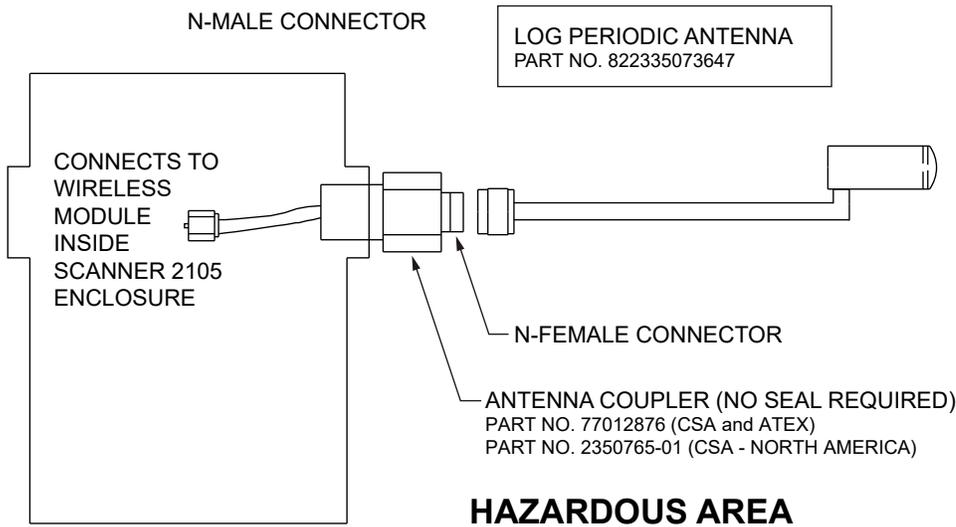


Figure 2.8 - Installation requirements for a log periodic antenna

FCC Radio Frequency Compliance

NUFLO Scanner 2105 flow computers that include the optional SmartMesh radio 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 the user's 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, the user is 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

NUFLO Scanner 2105 flow computers that include the optional SmartMesh radio 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

NUFLO Scanner 2105 flow computers that include the optional SmartMesh radio module comply with a broad range of country-specific radio frequency standards. The NUFLO Scanner 2105 flow computer wireless radio is approved for use in all of the regions listed on a radio compliance label (Figure 2.9) applied to the NUFLO Scanner 2105 flow computer enclosure.

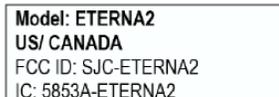


Figure 2.9 - Radio frequency compliance label applied to the NUFLO Scanner 2105 flow computer enclosure (content may change without notice)

Antenna Installation Options

Direct-Mount Antenna

Each NUFLO Scanner 2105 flow computer wireless device is equipped with a wireless module (installed on an advanced communications circuit board) and an explosion-proof coupler that threads into an enclosure port. Antennas and antenna cable are optionally available.

For CSA compliance, the installation of the antenna coupler, antennas, and antenna cable must meet the requirements shown in Figure 2.5 and Figure 2.6, page 31.

Remote-Mount Antenna (for use with 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 2.10, pg. 34 while following the instructions below:

1. Position the antenna with the shiny metal base against the vertical pole so that the capped end of the antenna is vertical in the air. Note the N-female cable connector is 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 ends 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.

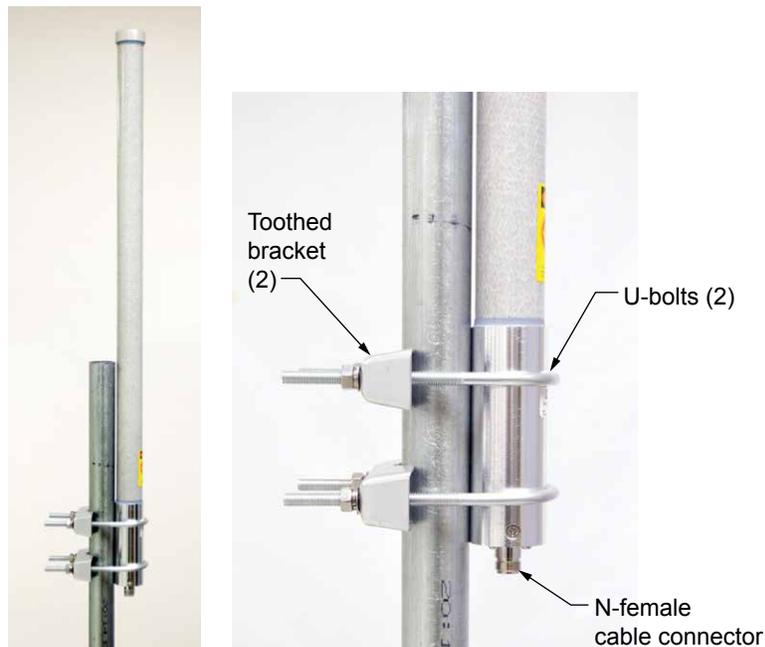


Figure 2.10 - Standard pole mount bracket (fits poles with an outside diameter of 2 inches or less)

Remote-Mount Antenna (for use with 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. outer 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 bag of supplied mounting hardware that includes the toothed brackets.

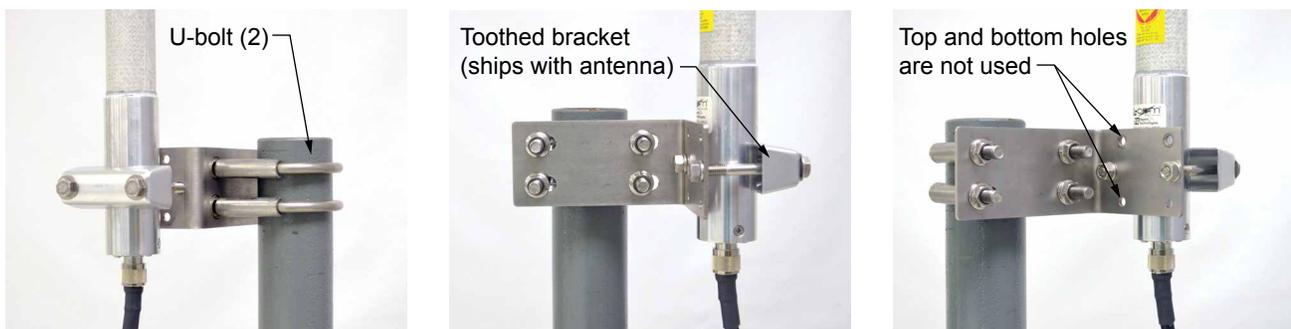


Figure 2.11 - Optional 2-in. pipe mount bracket

To install the antenna, reference [Figure 2.11, pg. 34](#) while following the instructions below:

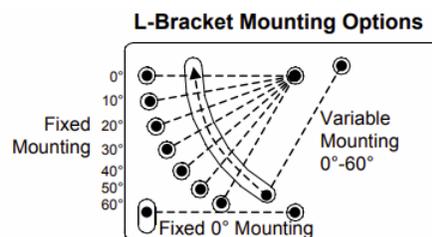
1. Remove one of the toothed brackets from the standard pole-mount kit antenna packaging for use with the optional hardware kit. The remaining hardware in the antenna package will not be used for this installation.
2. Position the L-shaped bracket against the pipe so that the pipe is on the outside of the “L” and secure it to the pipe with the two U-bolts and four U-bolt nuts ([Figure 2.11, pg. 34](#), left). The U-bolts will pass through the longest of the two bracket panels.
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 2.11, pg. 34](#), center and right).
6. Attach a lock washer and a nut to each of the bolts on the inside of the L-bracket to hold the toothed bracket loosely in place.
7. Position the antenna between the toothed bracket and the L-bracket so that the rounded edge of the toothed bracket fits snugly against the curvature of the shiny antenna base and 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 2.11, pg. 34](#), right).
9. Attach the antenna cable to the N-female connector at the bottom of the antenna.

Yagi Directional Antenna (for use for extended range applications)

The standard hardware supplied with Sensia’s yagi antenna can be used to mount the antenna to a pole with an outside diameter of 2 in. The supplied hardware includes two drain hole plugs, one U-bolt, two U-bolt nuts, one L-shaped bracket, and four pan head screws.

To install the antenna, reference [Figure 2.12](#) while following the instructions below:

1. Position the U-bolt around the pole and loosely attach to the L-shaped bracket with the two U-bolt nuts.
2. Slide the L-shaped bracket along the pole to the desired height and tighten the two U-bolt nuts enough to hold it onto the pole, but not so firmly as to prevent movement.
3. Tilt the L-shaped bracket to the desired angle (refer to [Figure 2.12, pg. 35](#)) and direction that you want to point the antenna, and then tighten the U-bolt nuts to firmly affix the L-shaped bracket to the pole.



L-Bracket shown for down-tilt mounting. For up-tilt, rotate bracket 180 degrees when attaching to antenna.

Figure 2.12 - L-bracket tilting instructions [2]

4. Orient the antenna for the desired polarization (refer to [Figure 1.17, pg. 14](#) for graphs), and use the four pan head screws to firmly affix the antenna to the L-shaped bracket.

5. Use the two drain hole plugs to plug the holes located on the side of the antenna.

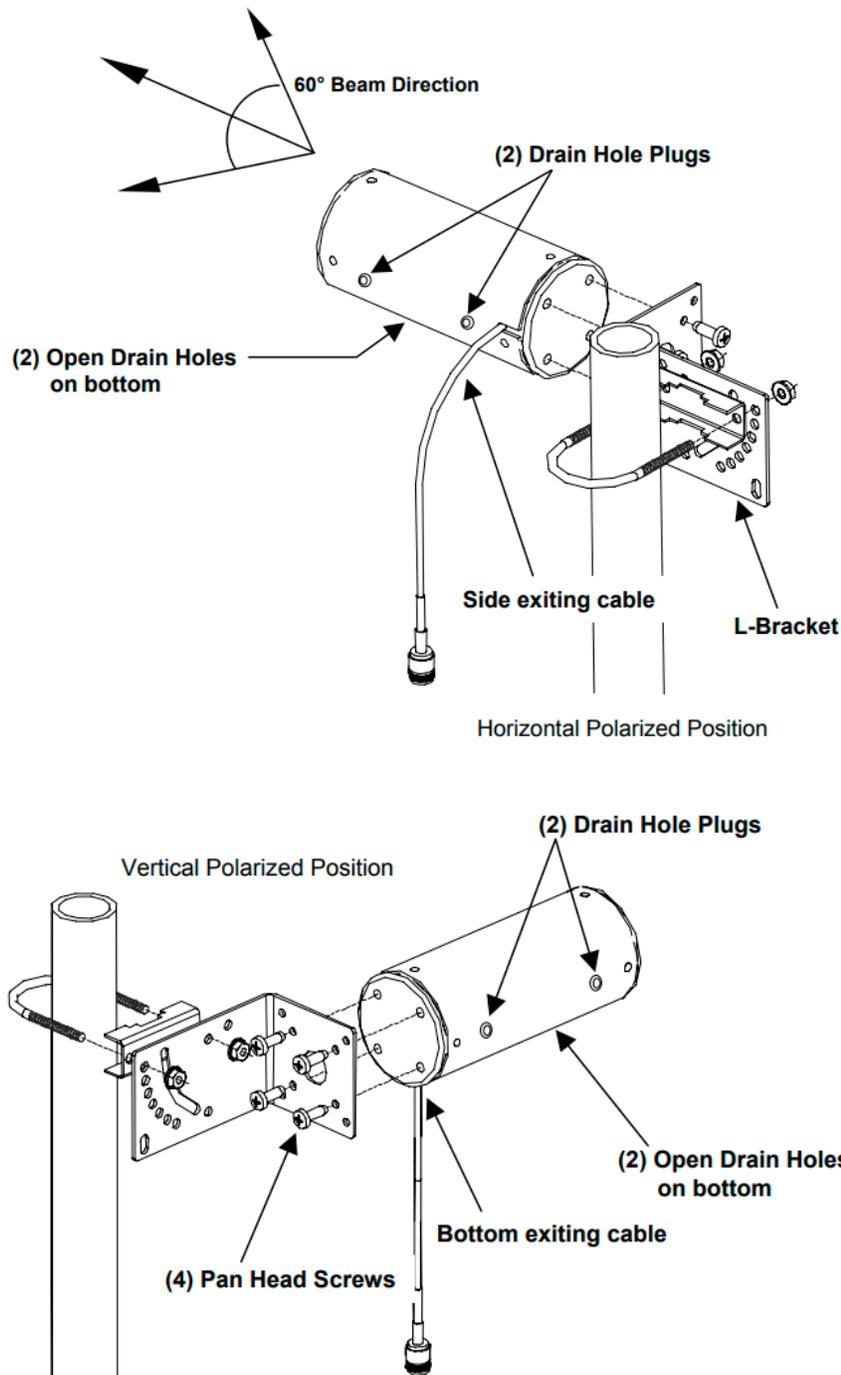


Figure 2.13 - Yagi antenna horizontal (top) and vertical (bottom) polarized installations [2]

Log Periodic Directional Antenna (for use for extended range applications)

The standard hardware supplied with Sensia's log periodic antenna can be used to mount the antenna to a pole with an outside diameter of 1.5 in. to 1.9 in. The supplied hardware includes two U-bolts, four U-bolt nuts, one L-shaped bracket, and two hex head screws.

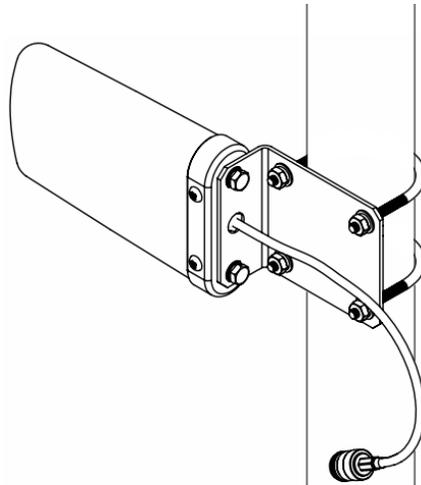


Figure 2.14 - Log periodic antenna installation [5]

To install the antenna, reference [Figure 2.14](#) while following the instructions below:

1. Position the top U-bolt around the pole and loosely attach to the L-shaped bracket with two U-bolt nuts.
2. Slide the L-shaped bracket along the pole to the desired height and tighten the two U-bolt nuts.
3. Position the bottom U-bolt around the pole and firmly attach to the L-shaped bracket with two U-bolts. Ensure that both the top and the bottom U-bolts are firmly holding the L-shaped bracket onto the pole.
4. Use the two hex head screws to firmly affix the antenna to the L-shaped bracket.

Solar Panel Installation

Mount the solar panel assembly to a pole or wall, using the supplied adjustable mounting bracket and manufacturer's instructions. The mounting bracket supplied with the 10-watt panel has two pivot points which allow the position of the solar panel to be adjusted after the assembly is mounted ([Figure 2.15](#)). For wiring, go to [External Power Supply \(Solar Power\)](#), pg. 63.

CAUTION

Where installed, do not exceed an ambient temperature of 60°C when charging the smart battery. Battery charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging at 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.



Figure 2.15 - Fully assembled solar panel example

Solar Panel Installation Best Practices

- Ensure the solar panel is appropriately sized for the geographical location and weather conditions.
- Avoid locations where shadows will significantly reduce the number of direct sunlight hours the solar panel will receive each day. It should not be mounted in areas shaded by structures, equipment, trees, or other objects (Figure 2.16).

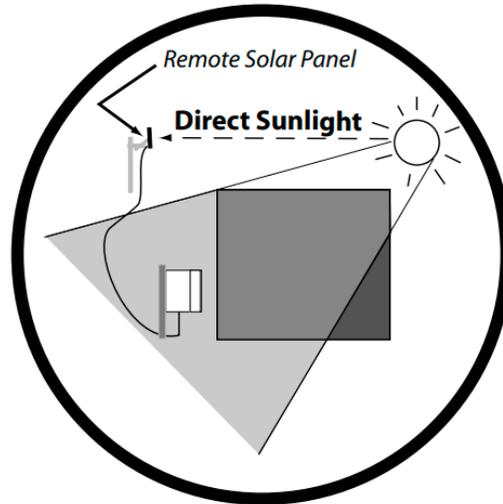


Figure 2.16 - Solar panel placement

Solar Panel Orientation

For optimum performance, adjust the angle of the bracket in accordance with the sun's location as follows:

1. Position the solar panel so that it is oriented in accordance with its geographic location. North of the equator, the solar panel should face true south. South of the equator, the solar panel should face true north.
2. Determine the latitude of the solar panel installation location from a map, internet map service, or GPS instrument.
3. Use the latitude to determine the appropriate tilt angle for the solar panel (see the Typical Latitude/Correction Angle chart in Figure 2.17). This tilt angle orients the solar panel in the direction of the midday sun during the winter months. While the sun's position changes throughout the year, this position ensures the most energy from the panel over the course of a year.
4. Loosen the pivot point of the solar bracket and tilt the solar panel to the prescribed angle as follows:
 - a. Make a photocopy of the Solar Panel Orientation Scales (go to page D-1) and cut out one of the scales. Trim as needed to align the top edge of the scale with the front face of the solar panel. Tape the scale to the side of the solar panel as shown in Figure 2.17, pg. 38.
 - b. Attach one end of a string to the top center point on the scale (small black circle in Figure 2.19, pg. 39) and a weight to the other end of the string (large white circle in Figure 2.19).
 - c. Pivot the solar panel until the string aligns with the desired angle on the scale.

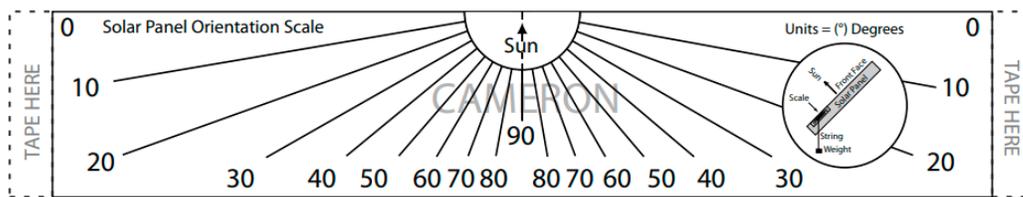
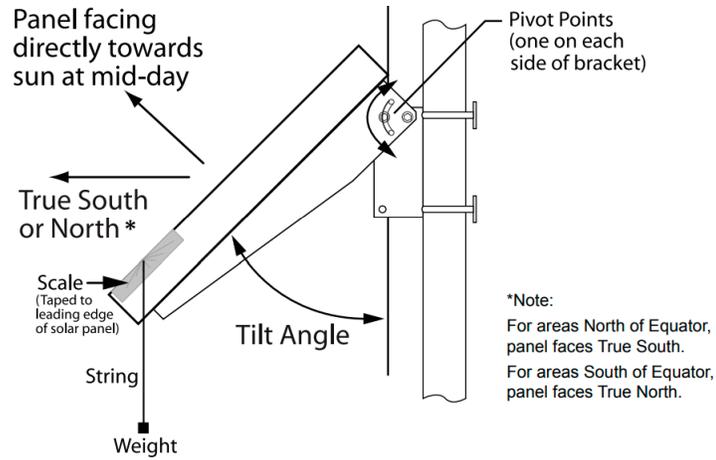


Figure 2.17 - Solar panel orientation scale sample (use full-size scales on page D-1)



Solar Panel Orientation

$$\text{Tilt Angle} = 90 - (\text{Latitude} * 0.89 + 24)$$

Typical Latitude/Correction Angle

Location	Latitude (°)	Tilt Angle (°)
Mexico City, Bombay	20	48
Key West, Taipei	25	44
Houston, Cairo	30	39
Albuquerque, Auckland	35	35
Denver, Madrid	40	30
Minneapolis, Milano	45	26
Winnipeg, Prague	50	21

Figure 2.18 - Solar panel orientation

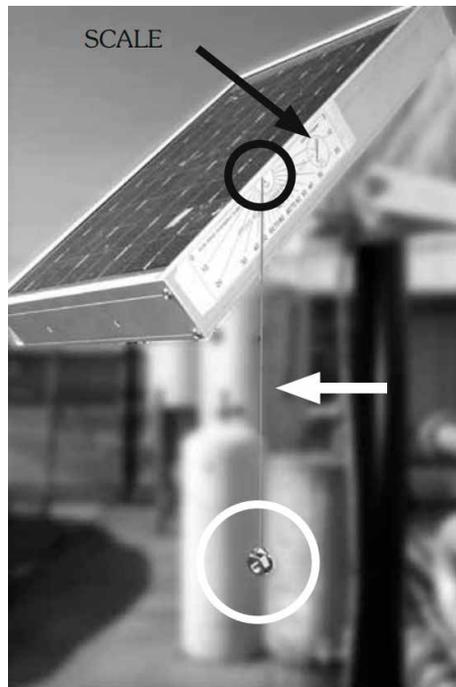


Figure 2.19 - Solar panel orientation scale

5. Tighten the pivot point bolts on the solar panel bracket to prevent movement.
6. Remove the scale, string, and weight.

Industry Standard Compliance

To ensure measurement accuracy, flow runs and turbine meter runs must be installed in accordance with industry standards. [Table 2.2—Industry Standards for Meter Installation](#) references the sections in these standards that apply specifically to flow run and hardware installation.

For a complete list of industry reference standards that serve as the basis for flow rate and fluid property calculations in the NUFLO Scanner 2105 flow computer, see [Modbus Communications Protocol, pg. C-1](#).

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 tapplings, corner pressure tapplings, D and D/2 pressure tapplings.
	API MPMS 21.1, Section 1.7	Installation of electronic gas measurement devices and associated communications, gauge/impulse lines, and cabling
	API MPMS 21.1, Section 1.8	Requirements for calibrating and verifying the accuracy of electronic gas measurement devices
	ASME MFC-14M, All sections	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, Sensia Part No. 9A-85165000, Sections 2 through 5	System components, impulse tubing considerations, best practices for installation, and 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.		

TABLE 2.2—INDUSTRY STANDARDS FOR METER INSTALLATION

Meter Type	Standard	Description
Turbine 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 flowmeters 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 21.1, Section 1.7	Installation of electronic gas measurement devices and associated communications, gauge/impulse lines, and cabling
	API MPMS 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 (<i>This section does not apply to the measurement of two-phase fluids.</i>)
	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.

Measuring Natural Gas via a Differential Pressure Meter

Note	This section contains installation guidelines for orifice and cone meters. If installing the NUFLO Scanner 2105 flow computer with an averaging pitot tube meter, refer to manufacturer instructions for installation.
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Best Practices for Orifice and Cone Meter Installation

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 NUFLO Scanner 2105 flow computer.
- If the NUFLO Scanner 2105 flow computer is mounted to a horizontal pipeline, make sure process connections are at the top of the line, and mount the NUFLO Scanner 2105 flow computer above the pressure connections at the pipe.
- If the NUFLO Scanner 2105 flow computer 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-inch/linear foot to avoid liquid entrapment.
- Mount the NUFLO Scanner 2105 flow computer 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.
- 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. (1000 mm) per ISO 5167; or greater than 2 in. (50 mm) per AGA 3.
- Pipe Reynolds numbers must be above 5000.
- 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 ¼ 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. See also the temperature warning on page 35.
- Gauge line length should be minimized to help prevent pulsation-induced errors.
- Gauge lines should slope downward to the meter at a minimum of one inch 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 NUFLO Scanner 2105 flow computer is mounted to a cone meter, consider the following best practices in addition to the best practices listed above.

- Position the cone meter so that there are zero to five pipe diameters upstream of the meter and zero to three pipe diameters 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 NUFLO Scanner 2105 flow computer sensor must also be situated upstream.
- Install shut-off valves directly on the DP meter pressure taps. Choose a shut-off 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 NUFLO Scanner 2105 flow computer 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 2.20, pg. 43](#) shows a typical direct-mount installation.



WARNING

HAZARDOUS AREA USE: The NUFLO Scanner 2105 flow computer is certified for hazardous area use only when installed in accordance with applicable standards and local wiring practices. Carefully review [Hazardous Area Installations, pg. 25](#), to determine specific installation requirements (cable glands, conduit seals, signal cable, RTD, etc.).

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 NUFLO Scanner 2105 flow computer MVT sensor.

3. 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 NUFLO Scanner 2105 flow computer enclosure can be rotated to face the desired direction.
4. Position the manifold so that all valves are accessible from the front of the instrument.

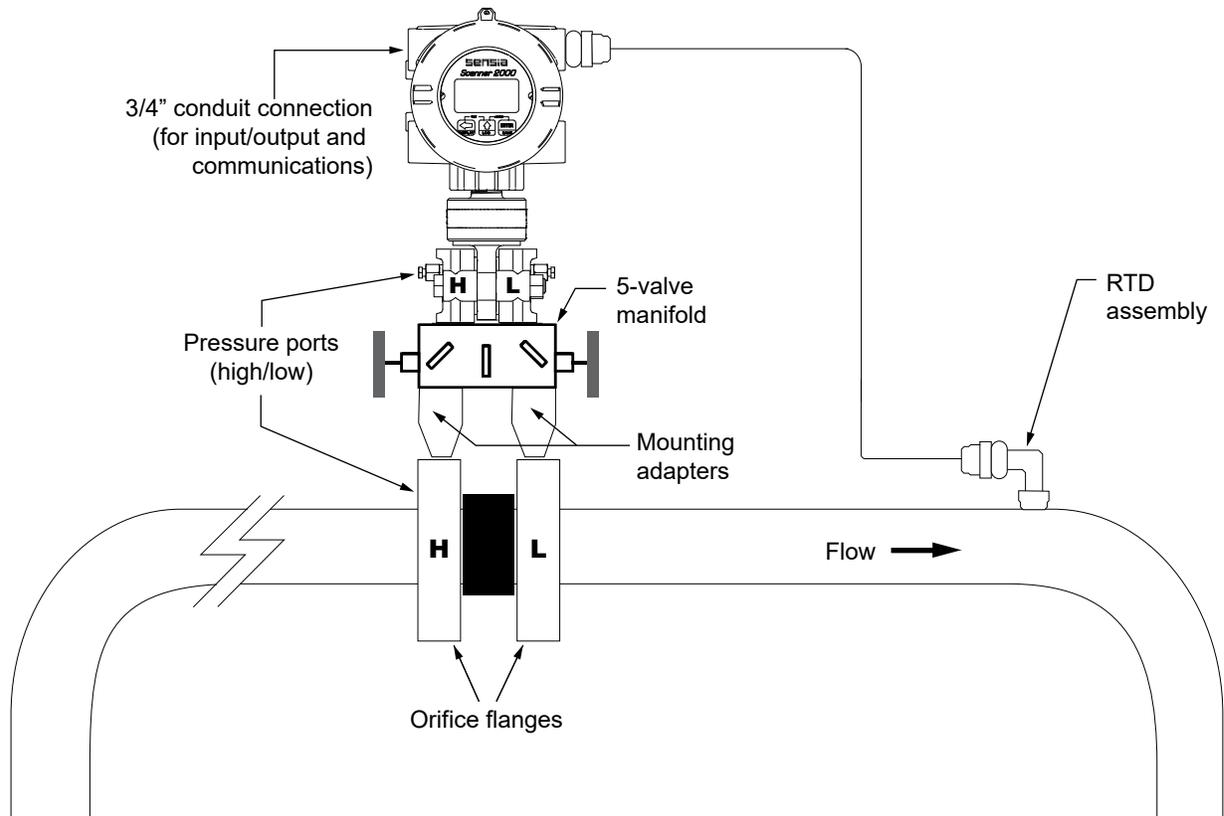


Figure 2.20 - Direct-mount installation in an orifice meter run (shown here with an orifice meter). The direct-mount method can be used with a cone meter as well.

5. Connect the NUFLO Scanner 2105 flow computer 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.

6. Install the RTD assembly in the thermowell. Route the RTD assembly cable through the conduit opening in the top of the NUFLO Scanner 2105 flow computer to connect to the main circuit board. The wiring diagram for the RTD assembly is provided in [Figure 3.11, pg. 65](#). For hazardous areas, review [Hazardous Area Installations, pg. 25](#).
7. Route any additional inputs/outputs or communications connections, etc. through the conduit opening in the top of the NUFLO Scanner 2105 flow computer. For hazardous areas, review [Hazardous Area Installations, pg. 25](#).
8. Perform a manifold leak test as described on [page 54](#).

9. Verify the zero offset, if required (and other calibration points, if desired). See the ModWorX Software User Manual for complete instructions. See also [Zero Offset \(Static Pressure or Differential Pressure\), pg. 54](#), [Static Pressure Calibration and Verification, pg. 55](#), and [Differential Pressure Calibration and Verification, pg. 56](#).

CAUTION

Do not put the Scanner into operation until the valves are positioned properly so that pressure is supplied to both sides of the MVT. For instructions on proper valve positions, see [Placing the Scanner into Operation, pg. 57](#).

Installation Procedure—Remote Mount to Orifice Meter or Cone Meter

A NUFLO Scanner 2105 flow computer 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 2.21, pg. 45](#) shows a typical remote-mount installation.

**WARNING**

HAZARDOUS AREA USE: The NUFLO Scanner 2105 flow computer is certified for hazardous area use only when installed in accordance with applicable standards and local wiring practices. Carefully review [Hazardous Area Installations, pg. 25](#) to determine specific installation requirements (cable glands, conduit seals, signal cable, RTD, etc.).

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 a manifold, shut-off valves, or sensor ports.

1. Verify that the meter is properly installed in the flow line (per manufacturer's instructions).
2. Mount the NUFLO Scanner 2105 flow computer to a 2-in. pipe or to a flat, vertical surface using bolts and the mounting holes in the enclosure.
3. Bolt a 5-valve flange-by-NPT manifold (as recommended by Sensia) to the NUFLO Scanner 2105 flow computer MVT sensor.
4. 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 NUFLO Scanner 2105 flow computer enclosure can be rotated to face the desired direction.
5. Position the manifold so that all valves are accessible from the front of the instrument.
6. Install tubing and fittings to connect the NUFLO Scanner 2105 flow computer and 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. Use of Teflon tape will void the explosion-proof rating of the instrument.

7. Install the RTD assembly in the thermowell. Route the RTD assembly cable through the conduit opening in the top of the NUFLO Scanner 2105 flow computer to connect to the main circuit board. The wiring diagram for the RTD assembly is provided by [Figure 3.11, pg. 65](#). For hazardous areas, review [Hazardous Area Installations, pg. 25](#).
8. Route any additional inputs/outputs or communications connections, etc. through the conduit opening in the top of the NUFLO Scanner 2105 flow computer. For hazardous areas, review [Hazardous Area Installations, pg. 25](#).
9. Perform a manifold leak test as described on [page 54](#).

10. Verify the zero offset, if required (and other calibration points, if desired). See the ModWorX Software User Manual for complete instructions. See also [Zero Offset \(Static Pressure or Differential Pressure\)](#), [pg. 54](#), [Static Pressure Calibration and Verification](#), [pg. 55](#), and [Differential Pressure Calibration and Verification](#), [pg. 56](#).

CAUTION

Do not put the Scanner into operation until the valves are positioned properly so that pressure is supplied to both sides of the MVT. For instructions on proper valve positions, see [Placing the Scanner into Operation](#), [pg. 57](#).

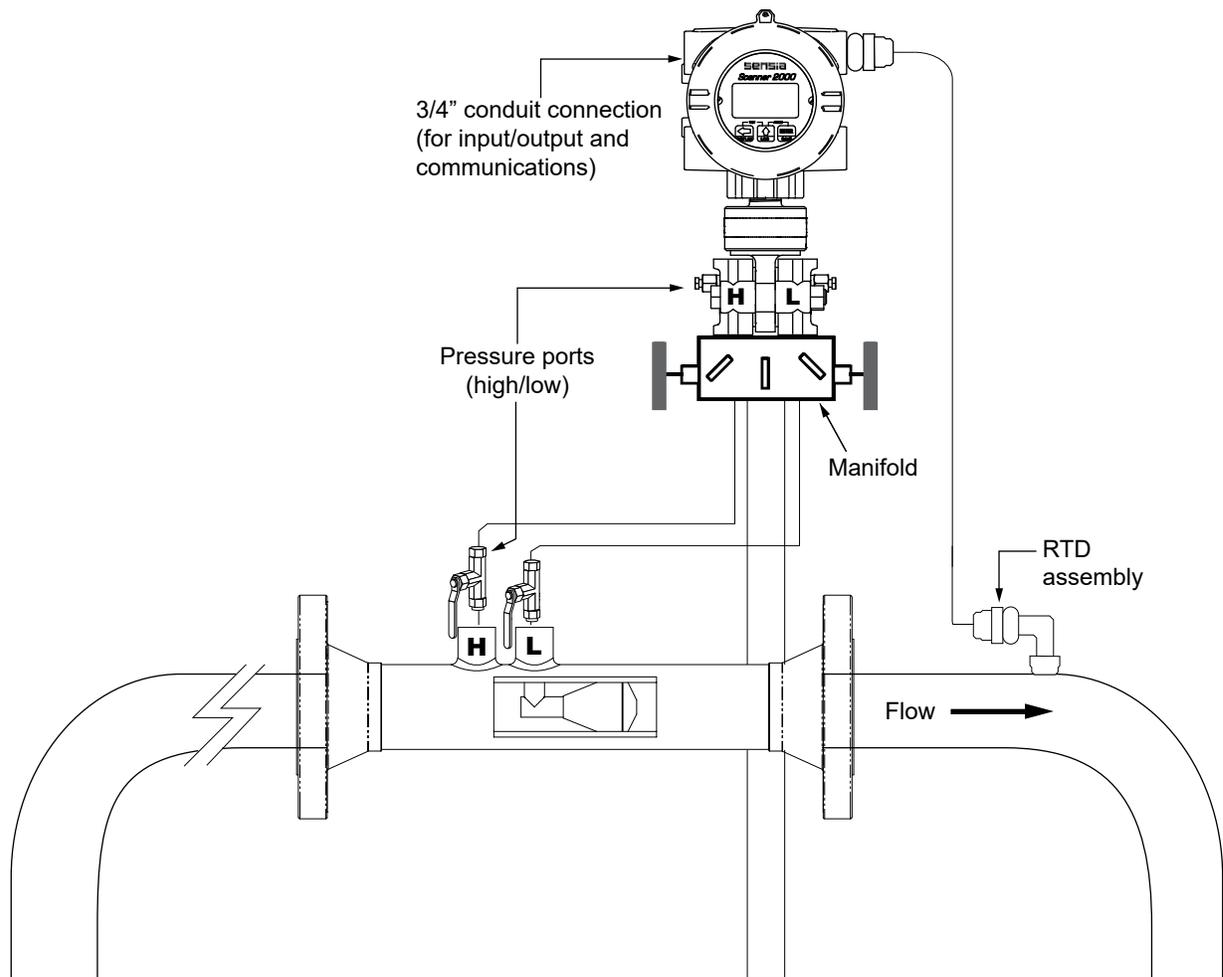


Figure 2.21 - Remote-mount gas run installation (shown here with a cone meter). The remote-mount method can be used with an orifice meter as well.

Measuring Steam via a Differential Pressure Meter

Note

This section contains installation guidelines for orifice and cone meters. If installing the NUFLO Scanner 2105 flow computer with an averaging pitot tube meter, refer to manufacturer instructions for installation.

Best Practices

The NUFLO Scanner 2105 flow computer calculates steam flow 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 NUFLO Scanner 2105 flow computer 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 (3/8 in. or 1/2 in., if possible)
- Hot legs should be as short as possible. If these sections must be more than 1 ft 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 side ports.
- Cold legs should be a minimum of 2 ft in length to allow proper convection cooling and should be run horizontally with a slope of approximately 1 inch per foot 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:

- DBP doesn't mix with water, and so doesn't become dilute over time; its specific gravity doesn't 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 that are rated for steam service. Periodic blowdowns are recommended for preventing buildup of scale.

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.



WARNING

EXPLOSION RISK: Housing temperature must not exceed 70 °C (158 °F). Excessive temperatures, which could result from ambient conditions combined with radiated and conductive heat from the process, which could cause an ignition or explosion if the dual lithium battery pack option is installed.

Installation Procedure—Remote Mount to Orifice Meter or Cone Meter

A NUFLO Scanner 2105 flow computer 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.



WARNING

HAZARDOUS AREA USE: The NUFLO Scanner 2105 flow computer is certified for hazardous area use only when installed in accordance with applicable standards and local wiring practices. Carefully review [Hazardous Area Installations, pg. 25](#) to determine specific installation requirements (cable glands, conduit seals, signal cable, RTD, etc.).

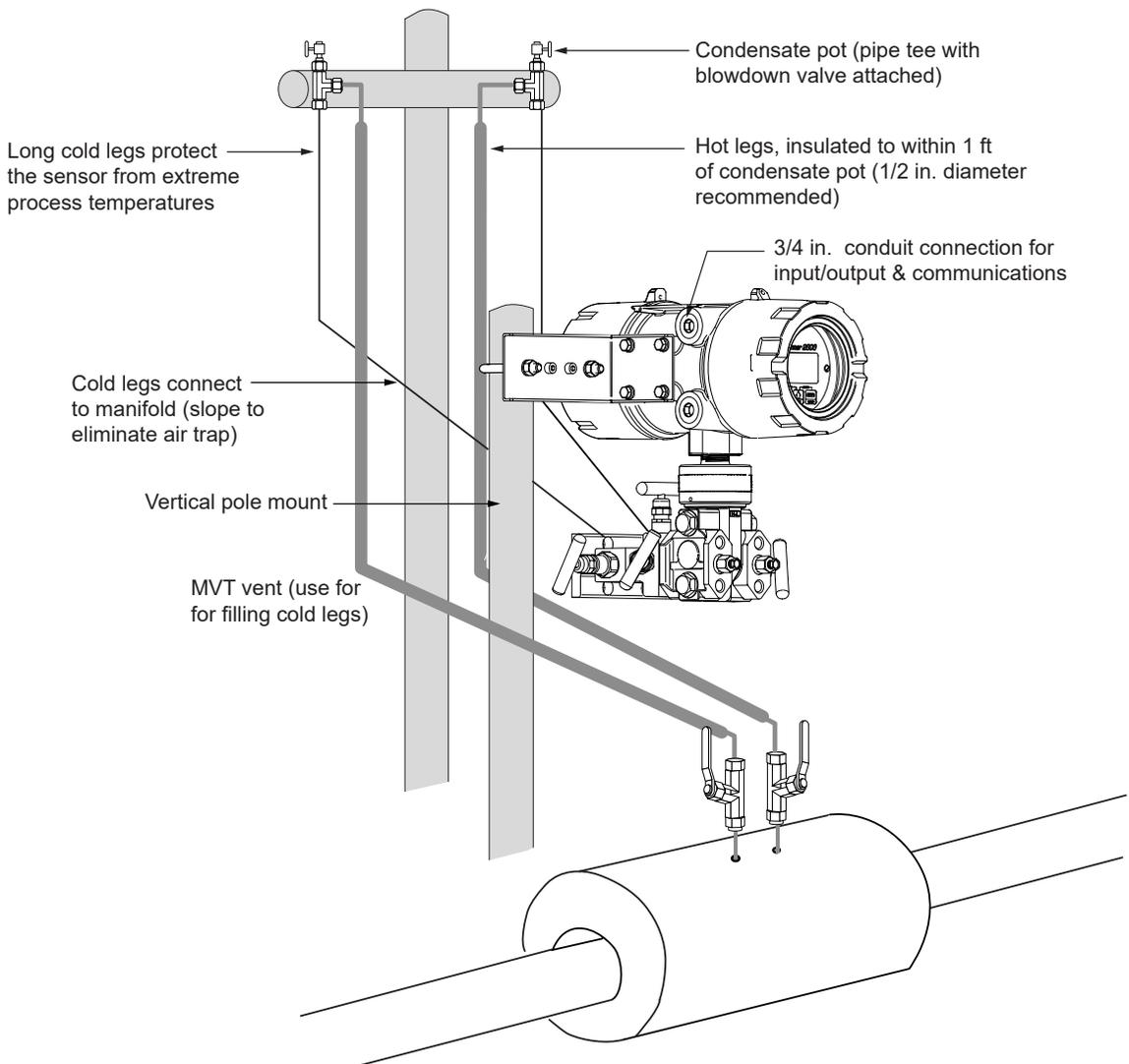


Figure 2.22 - Remote-mount steam run installation (shown here with a cone meter). The remote-mount method can be

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 2.22, pg. 47](#)) 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 MVTs. 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 NUFLO Scanner 2105 flow computer to a 2-in. pipe using the pole-mounting kit described on [page 29](#).
 3. Mount a set of pipe tees (which serve as condensate pots) typically on either side of the NUFLO Scanner 2105 flow computer at an elevation above the process connections of the NUFLO Scanner 2105 flow computer 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.
 6. Route any additional inputs/outputs or communications connections, etc. through the conduit opening in the top of the NUFLO Scanner 2105 flow computer. For hazardous areas, review [Hazardous Area Installations, pg. 25](#).
-

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 NUFLO Scanner 2105 flow computer 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. Make sure 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. Perform a manifold leak test as described on [page 54](#).
 11. Verify the zero offset, if required (and other calibration points, if desired). See the ModWorX Software User Manual for complete instructions. See also [Zero Offset \(Static Pressure or Differential Pressure\), pg. 54](#), [Static Pressure Calibration and Verification, pg. 55](#), and [Differential Pressure Calibration and Verification, pg. 5658](#).

CAUTION

Do not put the Scanner into operation until the valves are positioned properly so that pressure is supplied to both sides of the MVT. For instructions on proper valve positions, see [Hazardous Area Installations, pg. 25](#).

Measuring Liquid via a Differential Pressure Meter

Note

This section contains installation guidelines for orifice and cone meters. If installing the NUFLO Scanner 2105 flow computer with an averaging pitot tube meter, refer to manufacturer instructions for installation.

Best Practices

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 NUFLO Scanner 2105 flow computer is mounted to a horizontal pipeline, make sure process connections are horizontal with the pipeline, or sloped downwards towards the Scanner. Mount the NUFLO Scanner 2105 flow computer below the pressure taps at the pipe. Use the side (upper) ports as process connections and the bottom ports for draining and filling the DP housings.
- If the NUFLO Scanner 2105 flow computer is mounted to a vertical pipeline, install the sensor below the differential pressure source connections. Slope all tubing downward at least 1-inch/linear foot to avoid gas entrapment.
- Mount the NUFLO Scanner 2105 flow computer 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).
- 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 ¼ 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.

**WARNING**

EXPLOSION RISK: Housing temperature must not exceed 70 °C (158 °F). Excessive temperatures, which could result from ambient conditions combined with radiated and conductive heat from the process, could cause the internal lithium battery to ignite or explode.

- 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 one inch per foot.
- 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 NUFLO Scanner 2105 flow computer 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 zero to five pipe diameters upstream of the meter and zero to three pipe diameters 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 NUFLO Scanner 2105 flow computer sensor must also be situated upstream.
- Install shut-off valves directly on the DP meter pressure taps.
 - Choose a shut-off 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 NUFLO Scanner 2105 flow computer can be mounted directly to an orifice meter or cone meter for liquid measurement using a side-port MVT, a block manifold and two football flange adapters ([Figure 2.23, pg. 51](#)). The setup of the meter run and plumbing configurations can vary widely, depending upon existing on-site challenges.

CAUTION

When measuring liquid with a direct-mount NUFLO Scanner 2105 flow computer, process connections must be parallel to the horizontal center line of the meter, or below the center line 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 NUFLO Scanner 2105 flow computer 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. Route any additional inputs/outputs or communications connections, etc. through the conduit opening in the top of the NUFLO Scanner 2105 flow computer. For hazardous areas, review [Hazardous Area Installations, pg. 25](#).

- Verify that all manifold valves are closed, and fill the meter with process fluid.

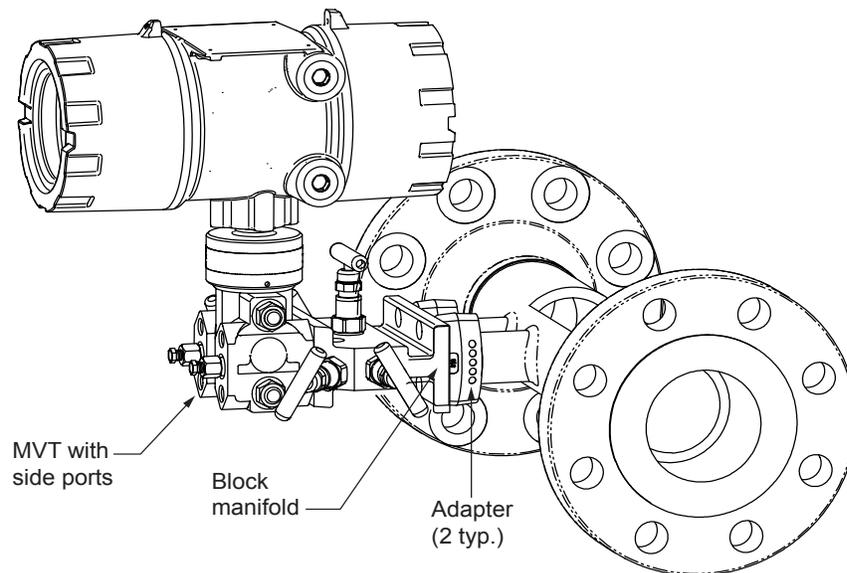


Figure 2.23 - Direct-mount liquid run installation (shown here with a cone meter). Downstream RTD is not shown.

- Loosen one of the vent screws in the side of the MVT.
- Open the equalizer valves and the vent valve on the manifold.
- Slowly open one of the bypass/block valves on the manifold. Process fluid should immediately spurt from the MVT vent.
- When air bubbles are no longer visible around the MVT vent, tighten the MVT vent screw.
- Loosen the other vent screw in the side of the MVT, and repeat Steps 7 through 9.
- Perform a manifold leak test as described on [page 54](#).
- Verify the zero offset, if required (and other calibration points, if desired). See the ModWorX Software User Manual for complete instructions. See also [Zero Offset \(Static Pressure or Differential Pressure\)](#), [pg. 54](#), [Static Pressure Calibration and Verification](#), [pg. 55](#), and [Differential Pressure Calibration and Verification](#), [pg. 56](#).

CAUTION

Do not put the Scanner into operation until the valves are positioned properly so that pressure is supplied to both sides of the MVT. For instructions on proper valve positions, see [Placing the Scanner into Operation](#), [pg. 57](#).

Installation Procedure—Remote Mount to Orifice Meter or Cone Meter

A NUFLO Scanner 2105 flow computer can be mounted remotely and connected to an orifice meter or cone meter with tubing for liquid measurement ([Figure 2.24](#), [pg. 52](#)). The setup of the meter run and plumbing configurations can vary widely, depending upon the challenges existing on location.



WARNING

HAZARDOUS AREA USE: The NUFLO Scanner 2105 flow computer is certified for hazardous area use only when installed in accordance with applicable standards and local wiring practices. Carefully review [Hazardous Area Installations](#), [pg. 25](#) to determine specific installation requirements (cable glands, conduit seals, signal cable, RTD, etc.).

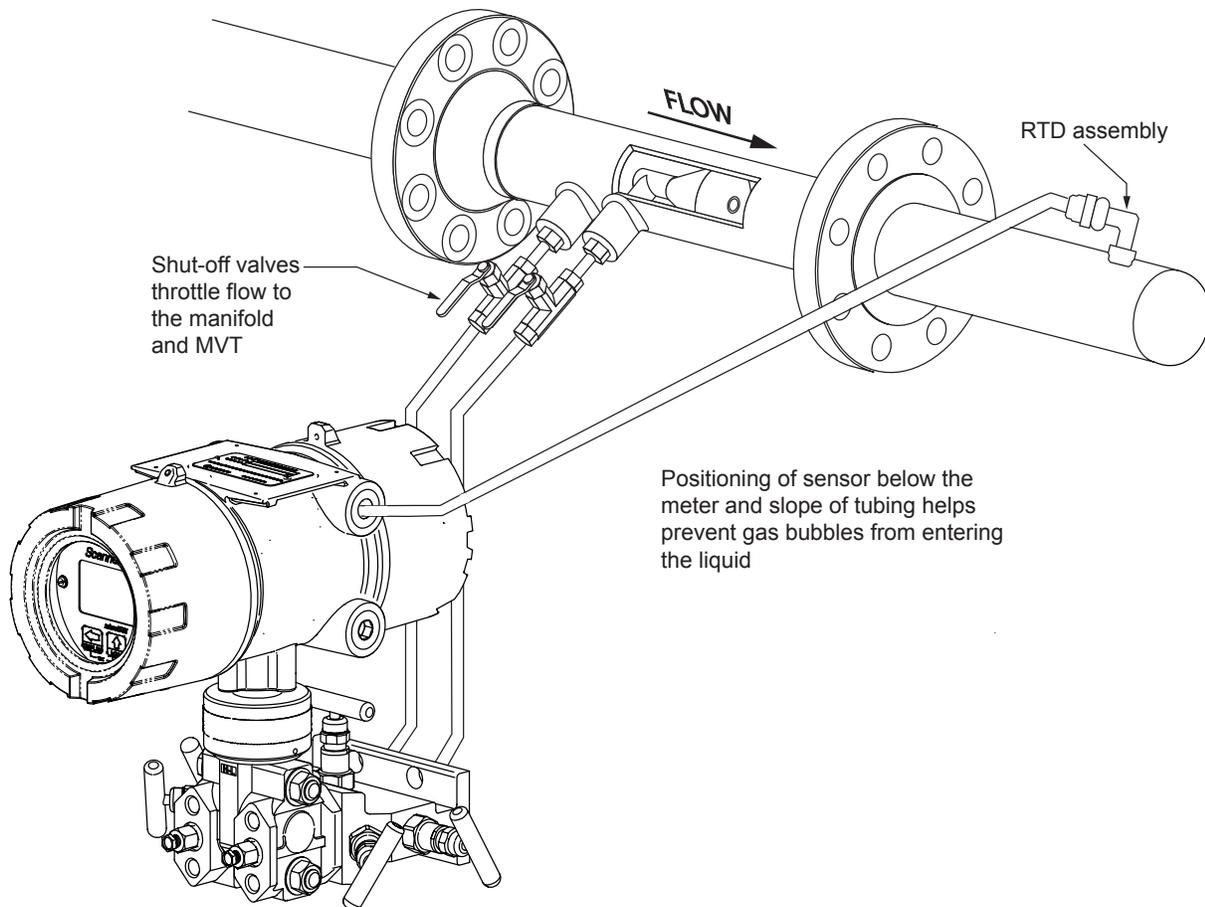


Figure 2.24 - Remote-mount liquid run installation (shown here with a cone meter). The remote-mount method can be used with an orifice meter as well.

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 MVT and block manifold (shown in [Figure 2.24](#)) 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 MVTs. 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 NUFLO Scanner 2105 flow computer 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. Install tubing and fittings to connect the high-pressure and low-pressure taps of the DP meter to the process connections of the block manifold. Install a pair of shut-off valves near the high and low ports of the DP meter. Use a suitable compound or tape on all threaded process connections.
4. Install the RTD assembly in the thermowell. Remove the plug from a conduit opening in the top of the NUFLO Scanner 2105 flow computer enclosure, route the RTD assembly cable through the conduit opening and connect it to the main circuit board. The wiring diagram for the RTD assembly is provided in [Figure 3.11, pg. 65](#). For hazardous areas, review [Hazardous Area Installations, pg. 25](#).

- Route any additional inputs/outputs or communications connections, etc. through the conduit opening in the top of the NUFLO Scanner 2105 flow computer. For hazardous areas, review [Hazardous Area Installations, pg. 25](#).

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.
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- 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.
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Bleeding with Process Fluid

- Make sure the shut-off valves in the tubing near the meter pressure taps are closed, and the meter is filled with process fluid.
- Open the equalizer and bypass/block valves on the block manifold. Make sure the vent valve is closed.
- Open one of the shut-off valves near the meter.
- Slowly loosen the corresponding vent screw on the MVT, and throttle the rate of flow from the vent with the shut-off valve.
- When air bubbles are no longer visible around the MVT vent, tighten the MVT vent screw.
- Repeat Steps 1 through 5 for the other leg.

Bleeding with a Different Seal Fluid

- Make sure the shut-off valves in the tubing near the pressure taps are open.
- Open the equalizer and bypass/block valves on the block manifold. Make sure the vent valve is closed.
- 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 that is long enough to elevate the funnel well above the meter pressure taps to force the fluid up the legs.
- Connect a hand pump or funnel to the fitting.
- Estimate the amount of fill fluid required to fill the tubing and push any air bubbles into the meter.
- Pour fill liquid into the funnel, tapping the tubing occasionally to dislodge any bubbles.
- When the leg is full of fluid, remove the fitting from the vent of the MVT and quickly replace the vent screw and tighten.
- Repeat Steps 1 through 7 for the other leg.
- Perform a manifold leak test as described on [page 54](#).
- Verify the zero offset, if required (and other calibration points, if desired). See the ModWorX Software User Manual for complete instructions. See also [Zero Offset \(Static Pressure or Differential Pressure\), pg. 54](#), [Static Pressure Calibration and Verification, pg. 55](#), and [Differential Pressure Calibration and Verification, pg. 56](#).

CAUTION	Do not put the Scanner into operation until the valves are positioned properly so that pressure is supplied to both sides of the MVT. For instructions on proper valve positions, see Placing the Scanner into Operation, pg. 57 .
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Preparations for Putting the NUFLO Scanner 2105 Flow Computer with MVT into Service

Manifold Leak Test

A manifold leak test is recommended prior to operating any differential pressure meter into service. Check the manifold for leaks as follows:

1. Verify that the instrument is approximately level and is properly connected to the pressure source.
2. Make sure the vent valve in the manifold is closed. (The bypass/block valves should be open.)
3. Close both bypass/block valves on the manifold to isolate pressure between the block valve and the MVT (Figure 2.25).

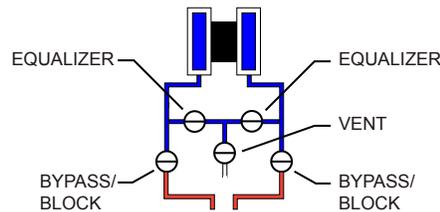


Figure 2.25 - Valve positions for manifold leak test

4. Open both equalizer valves to distribute pressure throughout.
5. Monitor the pressure readout and watch for a steady decrease in pressure. If leakage is indicated, depressurize the system by opening both bypass/block valves, then check all manifold and piping joints. Tighten connections as necessary.
6. If desired, spray all connections and valves with soapy water and observe for bubbling to detect the location of any leak(s). If leakage is indicated, depressurize the system by opening both bypass/block valves, then check all manifold and piping joints. Tighten connections and/or replace seals as necessary.
7. Repeat Steps 3 through 6 to retest the manifold for leaks.

An additional test can verify the condition of the equalizing valves. Assuming the above test has confirmed the system is leak free:

1. Close both equalizing valves and open the vent. Monitor the differential pressure reading for any change.
2. Repair or replace the manifold as required if the differential pressure varies.

Zero Offset (Static Pressure or Differential Pressure)

The static pressure input for the NUFLO Scanner 2105 flow computer is zeroed at the factory before shipment. However, changes in temperature and atmospheric pressure can cause the static pressure and differential pressure readings to vary. The inputs can be easily zeroed in the field, if necessary, prior to putting the NUFLO Scanner 2105 flow computer into service.

To zero the static pressure or differential pressure, perform the following tasks:

1. Close the bypass valves to isolate the pressure below the manifold (Figure 2.26, pg. 55).
2. Open the equalizer and vent valves.
3. Connect to the NUFLO Scanner 2105 flow computer with the ModWorX software, and apply zero pressure from the Calibrate Inputs screen (see the ModWorX Software User Manual for complete instructions).

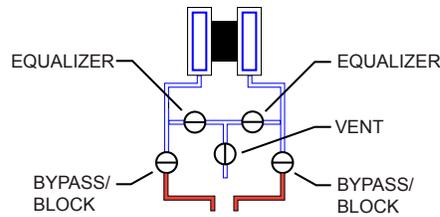


Figure 2.26 - Valve positions for zero offset

Static Pressure Calibration and Verification

Note	The pressure range stamped on the MVT is expressed as psia (absolute). However, NUFLO Scanner 2105 flow computer pressure inputs are recalibrated as psig (gauge) at the factory before the device is shipped. Therefore, pressure readings displayed on the LCD and in the ModWorX software are in terms of psig.
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The static pressure and differential pressure inputs are calibrated and verified before the NUFLO Scanner 2105 flow computer leaves the factory, and recalibration in the field may or may not be required. To comply with API standards for verification, “as found” readings should be recorded at approximately 0, 50, and 100 percent of the operating pressure range, increasing, and at 80, 20 and 0 percent of the operating pressure range, decreasing. For example, the static pressure measurements of a 1500-psi sensor should be verified at 0, 750, and 1500 psi, then at 1200, 300, and 0 psi.



WARNING

Do not subject the NUFLO Scanner 2105 flow computer to unnecessary shock or over-range pressure during maintenance operations.

To calibrate the static pressure, perform the following tasks:

1. Close the bypass valves to isolate the pressure below the manifold (Figure 2.27).
2. Open the equalizer valves and vent valve to purge the lines.
3. Close the vent valve.

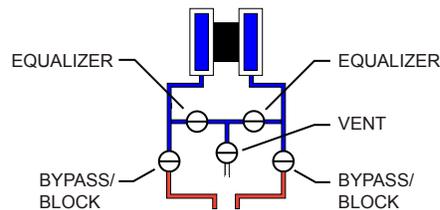


Figure 2.27 - Valve positions for static pressure calibration

4. Connect a static pressure simulator to the manifold (either side).
5. Connect to the NUFLO Scanner 2105 flow computer with the ModWorX software. Click on the **Calibrate Inputs** menu button and proceed through the calibration per instructions in the ModWorX Software User Manual.
6. At the appropriate software prompt, enter a known pressure.
7. Apply the same amount of pressure to the MVT using the simulator (see the ModWorX Software User Manual, Part No. 9A-30165025 for complete instructions). The ModWorX software will display a measured value and a percentage of change.
8. Repeat Steps 6 and 7 as necessary to enter multiple calibration points.
9. When all calibration points have been entered, click **Save Changes** to apply the new calibration settings.

- To verify the static pressure, perform the steps described in the calibration procedure above, except instead of choosing **Calibrate** from the Change Calibration Task window, choose **Verify**. You will be prompted to enter an applied value, and you will apply the same amount of pressure to the MVT, just as in the calibration process. The ModWorX software will display a measured value and a percentage of error. When you click **Save Changes**, the measured values are written to memory for reference.

Differential Pressure Calibration and Verification

The static pressure and differential pressure inputs are calibrated and verified before the NUFLO Scanner 2105 flow computer leaves the factory, and recalibration in the field may or may not be required. To comply with API standards for verification, “as found” readings should be recorded at approximately 0, 50, and 100 percent of the operating pressure range, increasing, and at 80, 20 and 0 percent of the operating pressure range, decreasing. For example, the differential pressure measurements of a 200-inches H₂O sensor should be verified at 0, 100, and 200 inches H₂O, then at 160, 40, and 0 inches H₂O.



WARNING

Do not subject the NUFLO Scanner 2105 flow computer to unnecessary shock or over-range pressure during maintenance operations.

To calibrate the differential pressure, perform the following tasks:

- Close the bypass valves to isolate the pressure below the manifold (Figure 2.28).

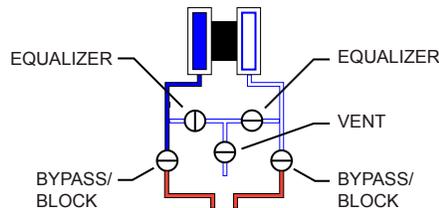


Figure 2.28 - Valve positions for differential pressure calibration

- Open the equalizer valves and vent valve to purge the lines.
- Close the high-pressure side equalizer valve, leaving the low-pressure side vented.
- Connect a pressure simulator to the high-pressure side of the manifold.
- Connect to the NUFLO Scanner 2105 flow computer with the ModWorX software. Click on the **Calibrate Inputs** menu button and proceed through the calibration per instructions in the ModWorX Software User Manual.
- At the appropriate software prompt, enter a known pressure.
- Apply the same amount of pressure to the high side of the MVT using the simulator (see the ModWorX Software User Manual for complete instructions). The ModWorX software will display a measured value.
- Repeat Steps 6 and 7 as necessary, to enter multiple calibration points, and apply the new measured values from the ModWorX interface.
- When all calibration points have been entered, click **Save Changes** to apply the new calibration settings.
- To verify the differential pressure, perform the steps described in the calibration procedure above, except instead of choosing **Calibrate** from the Change Calibration Task window, choose **Verify**. You will be prompted to enter an applied value, and you will apply the same amount of pressure to the MVT, just as in the calibration process. The ModWorX software will display a measured value and a percentage of error. When you click **Save Changes**, the measured values are written to memory for reference.

Placing the Scanner into Operation

To put the Scanner into operation, perform the following tasks:

1. Close the vent valve (Figure 2.29).
2. Open the equalizer valves.
3. Open the bypass/block valves to allow pressure to be supplied to both sides of the MVT.
4. Close the equalizer valves.
5. Open the vent valve (optional, some users may choose to leave the vent closed).

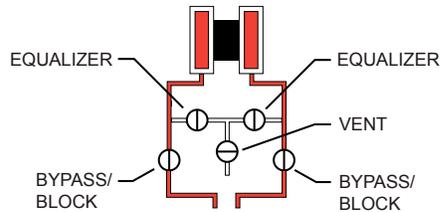


Figure 2.29 - Valve positions for closing the vent valve

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Section 3 - Wiring the NUFLO Scanner 2105 Flow Computer

Field Wiring Connections



WARNING

Do not connect/disconnect equipment or change batteries unless the area is known to be non-hazardous. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.



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-lbs. to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.

Note

All expansion board wiring procedures and diagrams can be found in [Input/Output Expansion Board, pg. A-1](#).

To wire the NUFLO Scanner 2105 flow computer for operation, complete the following field connections:

1. Disconnect the external power supply that will power the NUFLO Scanner 2105 flow computer using a disconnect breaker switch or other means of locking out power.
2. Unscrew the cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
3. Using a small standard blade screwdriver, remove the two #4-40 × 7/8" screws located to the right and left side of the display.
4. Lift the display/keypad assembly from the enclosure, making sure the circuit assembly does not contact the enclosure.
5. Complete wiring of the circuit board as follows:
 - a. Connect wiring for external power, if appropriate. See [External Power Supply \(CSA-Approved Devices\), pg. 62](#), [External Power Supply \(Solar Power\), pg. 63](#), or [External Power Supply \(Loop Power\), pg. 63](#) for a wiring diagram.
 - b. If the device is externally powered, route the protective earth grounding conductor into the enclosure with the incoming power conductors and terminate it to the screw in the top of the enclosure ([Figure 3.1](#)). Alternatively, connect an earth ground conductor to the external stainless steel ground lug of the enclosure and to a ground rod or other suitable system earth ground, as shown in ([Figure 3.1](#)).



Figure 3.1 - Ground screw locations

- c. Connect the flowmeter input wiring to terminal block, if appropriate. See [Figure 3.10, pg. 65](#).
 - d. Connect the process temperature input wiring, if appropriate. See [Figure 3.11, pg. 65](#).
 - e. Connect wiring for output signals, if appropriate. See [Figure 3.12, pg. 66](#), [Figure 3.19, pg. 69](#), and [Figure 3.20, pg. 69](#), for wiring diagrams.
6. Place the circuit assembly over the standoffs and fasten with the two #4-40 × 7/8" screws, ensuring that all connector wiring is inside the enclosure and in no position where it may be damaged when the enclosure cover is replaced.
 7. Recalibrate the NUFLO Scanner 2105 flow computer (if necessary).
 8. If external and internal power supplies were removed, reset the clock to ensure that the time stamps in the log data are accurate. The clock can be reset using the instrument keypad or ModWorX software.
 9. Replace the enclosure cover by threading it onto the enclosure in a clockwise direction.

Power Supply Wiring

Internal Power Supply - Dual Lithium Battery Packs

The NUFLO Scanner 2105 flow computer may be shipped with dual lithium battery packs. Installation and connection to power the NUFLO Scanner 2105 flow computer with the dual lithium battery packs is very easy and straight-forward.

- This procedure must be done in a non-hazardous area.
- The two lithium battery pack connections are three pin connectors located at the end of the main board in the rear compartment, shown in [Figure 3.3, pg. 61](#).
- Connect one battery pack cable to "Battery 1", and the other to "Battery 2", shown in [Figure 3.2](#).

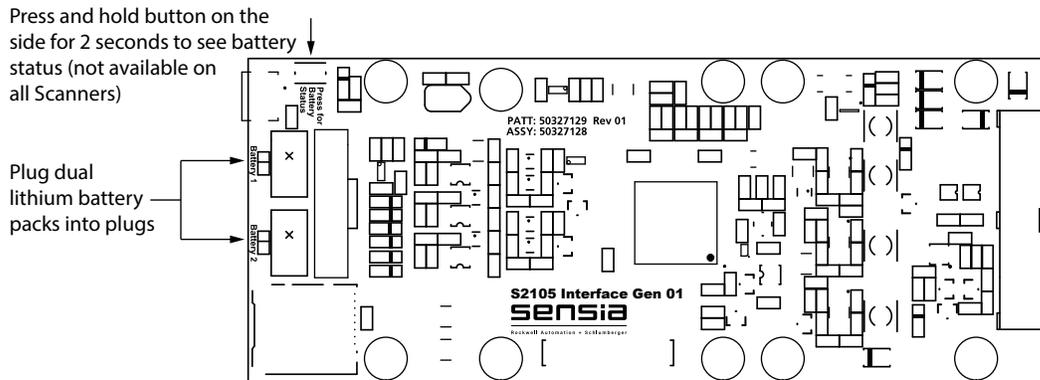


Figure 3.2 - Two lithium battery pack connections on the end of the main board ("Battery 1", "Battery 2")

- Slide the battery pack holder onto the battery mounting bracket and into the enclosure. Then tighten the battery mounting bracket screw to further hold the battery packs in place, and screw the back lid back onto the enclosure.

Low-power microprocessor technology enables the NUFLO Scanner 2105 flow computer to operate for up to one year on dual lithium battery packs with default configuration settings. Extreme cold temperatures may reduce battery life.

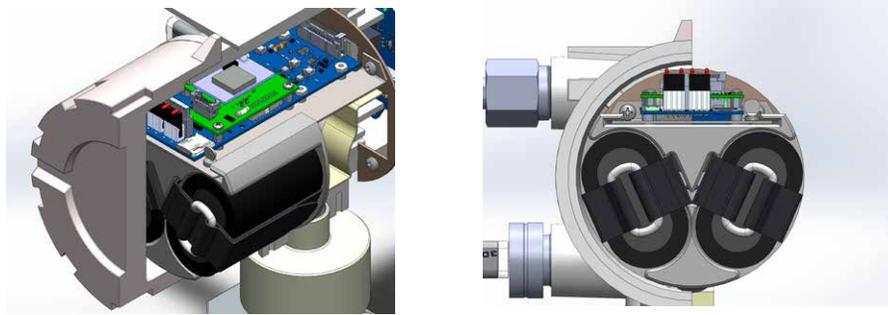


Figure 3.3 - Dual lithium battery pack installed

To maximize battery life, adhere to the following power conservation practices:

- Configure the calculation frequency to be 1 minute or longer.
- Configure the logging frequency to be 1 hour or longer.
- Use an RTD sample time no less than 5 seconds.
- Disconnect the NUFLO Scanner 2105 flow computer from the RS-232 to RS-485 converter when ModWorX software is not in use. When ModWorX is running, the computer powers the converter. When the software is not running, the device powers the converter, causing a current drain to the Scanner battery packs.
- Avoid operating the device at extremely cold temperatures.
- Avoid the use of digital outputs (pulse or alarm).
- Consider using "non-routing mode" for wireless devices to extend battery life of the slave device(s).

When an external power supply is used as the primary power source, the dual lithium battery pack serves as a backup power supply. The use of an alternate power source extends battery life and helps ensure that time-keeping and volume accumulation will not be interrupted during a power failure.

Internal Power Supply - Smart Battery Pack

The NUFLO Scanner 2105 flow computer may be shipped with a single smart battery pack. Installation and connection to power the NUFLO Scanner 2105 flow computer with the smart battery pack is very easy and straight-forward.

- The smart battery pack connection is an eight pin connector located at the end of the main board in the rear compartment, just before the "Battery 1" and "Battery 2" connections, shown in [Figure 3.5, pg. 62](#).
- Connect the smart battery pack to the smart battery pack connector, shown in [Figure 3.4](#).

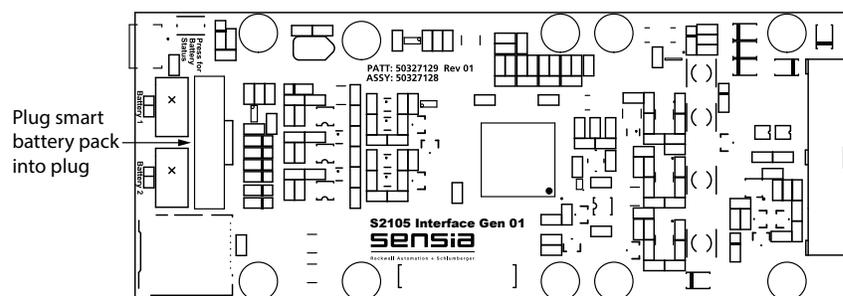


Figure 3.4 - Smart battery pack connection at the end of the main board

- Slide the battery pack holder onto the battery mounting bracket and into the enclosure. Then tighten the battery mounting bracket screw to further hold the battery packs in place, and screw the back lid back onto the enclosure.

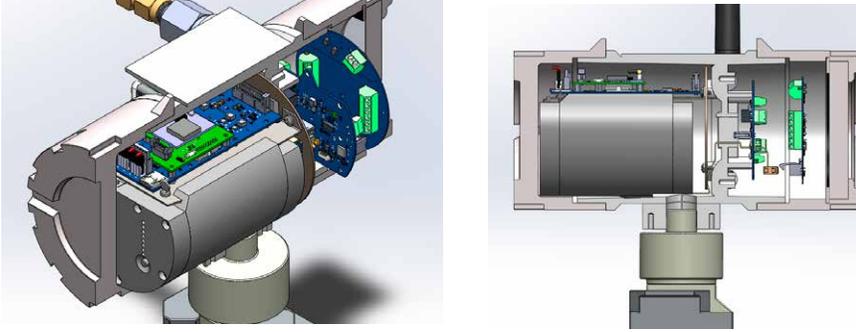


Figure 3.5 - Smart battery pack installed

Low-power microprocessor technology enables the NUFLO Scanner 2105 flow computer to operate for up to 25 days on a smart battery pack with default configuration settings. Extreme cold or heat temperatures may reduce battery life.

To maximize battery life, adhere to the following power conservation practices:

- Configure the calculation frequency to be 1 minute or longer.
- Configure the logging frequency to be 1 hour or longer.
- Use an RTD sample time no less than 5 seconds.
- Disconnect the NUFLO Scanner 2105 flow computer from the RS-232 to RS-485 converter when ModWorX software is not in use. When ModWorX is running, the computer powers the converter. When the software is not running, the NUFLO Scanner 2105 flow computer powers the converter, causing a current drain to the Scanner battery packs.
- Avoid operating the device at extremely cold temperatures.
- Avoid the use of digital outputs (pulse or alarm).
- Consider using "non-routing mode" for wireless devices to extend battery life of the slave device(s).

When an external power supply is used as the primary power source, the smart battery pack serves as a backup power supply. The use of an alternate power source extends battery life and helps ensure that time-keeping and volume accumulation will not be interrupted during a power failure.

CAUTION

Where installed, do not exceed an ambient temperature of 60°C when charging the smart battery. Battery charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging at 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.

External Power Supply (CSA-Approved Devices)

The CSA-approved NUFLO Scanner 2105 flow computer can be connected to a remote power supply by a two-conductor cable (Figure 3.6, pg. 63). The power supply and cable must be capable of supplying 9 to 30 VDC at 150 mA. The external power supply 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.

IMPORTANT

In all applications using an external power supply, a switch or circuit breaker must be included in the safe area external power supply installation 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.

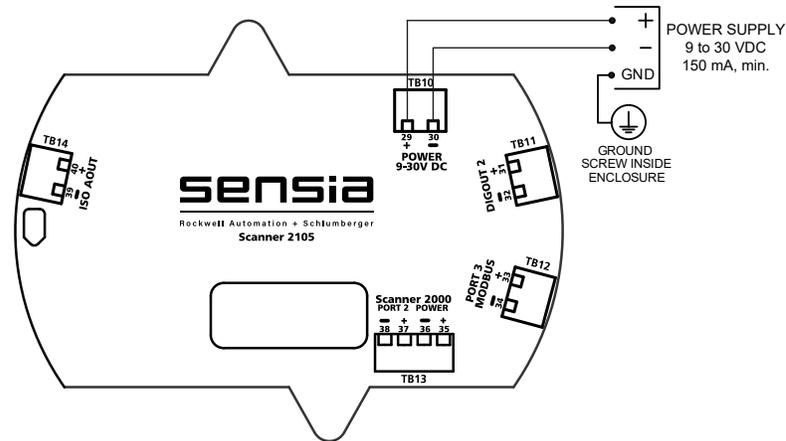


Figure 3.6 - External power supply wiring (CSA) on backplate board

External Power Supply (Solar Power)

The NUFLO Scanner 2105 flow computer has the capability of being powered through a solar panel (Figure 3.7). In this instance it is actually the smart battery pack that is acting as the primary power source, and the solar panel is simply charging the battery. In order for this solution to be most effective in keeping the smart battery pack fully charged, the solar panel should receive at least 1-2 hours of sunlight per day. The smart battery pack maximum power point tracking will optimize the power received from the solar panel by varying the smart battery charge current to keep the solar panel's closed loop voltage at an optimal value. More information on [Charging With a Solar Panel \(Smart Battery as Primary Power Source\)](#), pg. 8.

CAUTION	Where installed, do not exceed an ambient temperature of 60°C when charging the smart battery. Battery charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging at 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.
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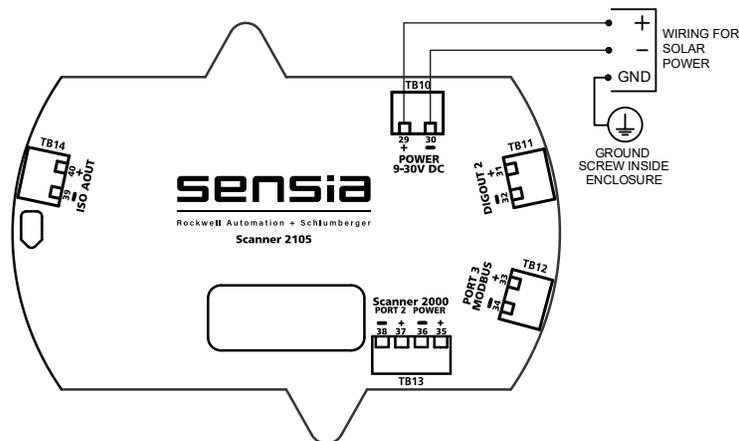


Figure 3.7 - External power supply (solar power) on backplate board

External Power Supply (Loop Power)

The NUFLO Scanner 2105 flow computer has the capability of being loop powered. That is, it can be powered over the analog output (Figure 3.8, pg. 64) wiring (this is true whether or not the analog output is enabled). When the analog output is wired, it may provide an analog reading from any parameter in the holding registers (if enabled), and the device may be powered over that wiring. This means that there is no additional power supply needed. The loop power supply must be capable of sourcing a minimum of 18 to 30 VDC.

For more information on the analog output, see [Analog Output, pg. 67](#).

For 4 to 20 mA analog output wiring see [Figure 3.15, pg. 67](#). For 1 to 5 V analog output wiring see [Figure 3.16, pg. 68](#).

The analog output on the expansion board ([Figure 3.9](#)), is no longer operational. This functionality has been moved to the backplate board.

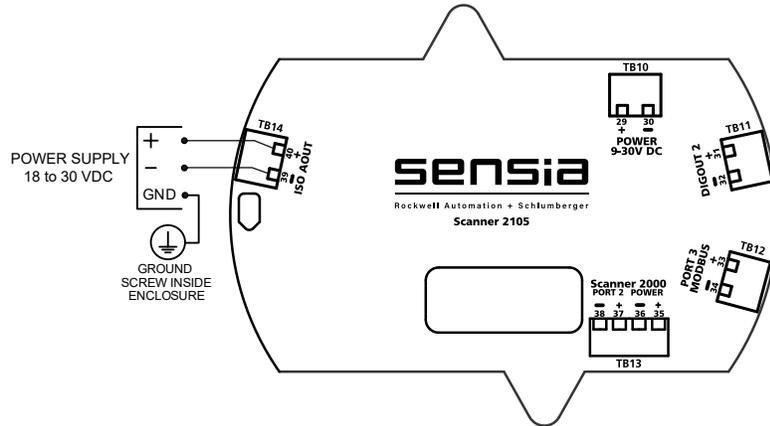


Figure 3.8 - Loop power as external supply (no analog output enabled) on backplate board

Note	Loop power will not charge the battery pack.
Note	If loop power is used as the external power source, it cannot power the sensor connected to the analog input. If the NUFLO Scanner 2105 flow computer sensor power is enabled, then the batteries will be used to power the sensor. Using the batteries in this way may significantly reduce the life of the batteries. It is recommended to only use the NUFLO Scanner 2105 flow computer sensor power if external power (that is not loop power) is available.
IMPORTANT	DO NOT USE the analog output on the expansion board, as the functionality has been removed and moved over to the backplate board.

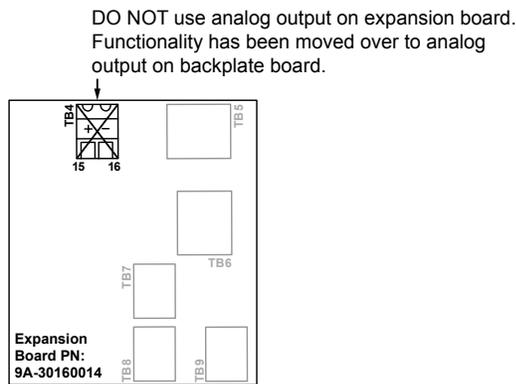


Figure 3.9 - DO NOT use analog output on expansion board

Input Wiring

Turbine Flowmeter Input

TFM1 on the main circuit board provides the turbine flowmeter input signal generated by a magnetic pickup, enabling the NUFLO Scanner 2105 flow computer to calculate and display instantaneous flow rates and accumulated totals. Wire as shown in [Figure 3.10](#).

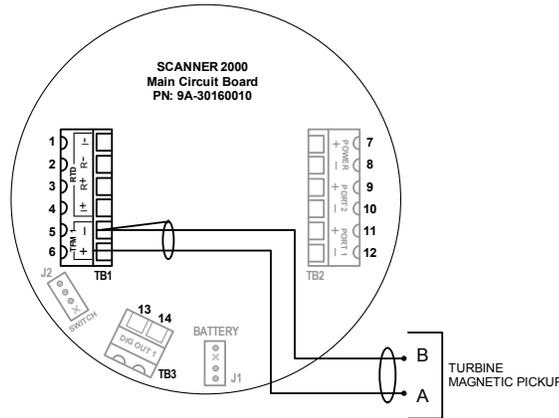


Figure 3.10 - Flowmeter input wiring

RTD Input

The RTD assemblies described in Appendix A of this manual are recommended for measuring temperature for use 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 3.11](#).

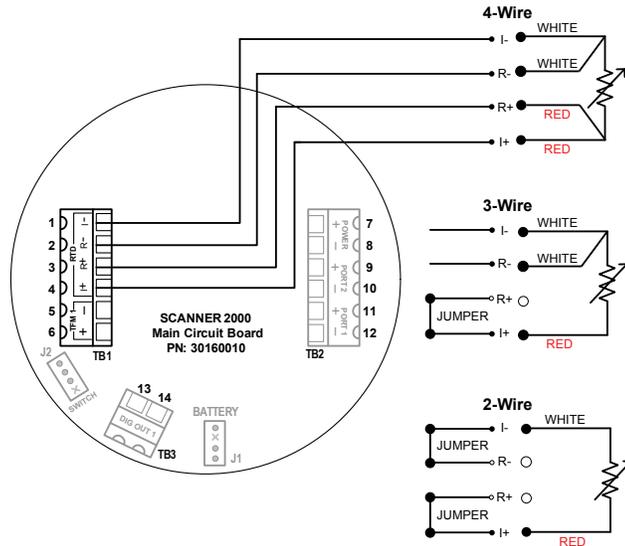


Figure 3.11 - Process temperature input wiring

Output Wiring

Digital Output (Pulse or Alarm)

The standard NUFLO Scanner 2105 flow computer supports a solid-state digital output that is configurable as either a pulse output or an alarm output. As a pulse output, the pulse width duration and pulse representation are both configurable. Because the circuit is isolated, it can be used in conjunction with any other feature on the instrument. A two-conductor cable from the NUFLO Scanner 2105 flow computer to the remote location is required. Wire as shown in [Figure 3.12](#).

Select the power supply and resistor, such that the current and power supply voltage are less than the maximum rating of the digital output circuit. The maximum output rating is 200 mA at 30 VDC. Maximum frequency is 50 Hz.

For reduced power consumption, turn the digital output feature off when it is not in use.

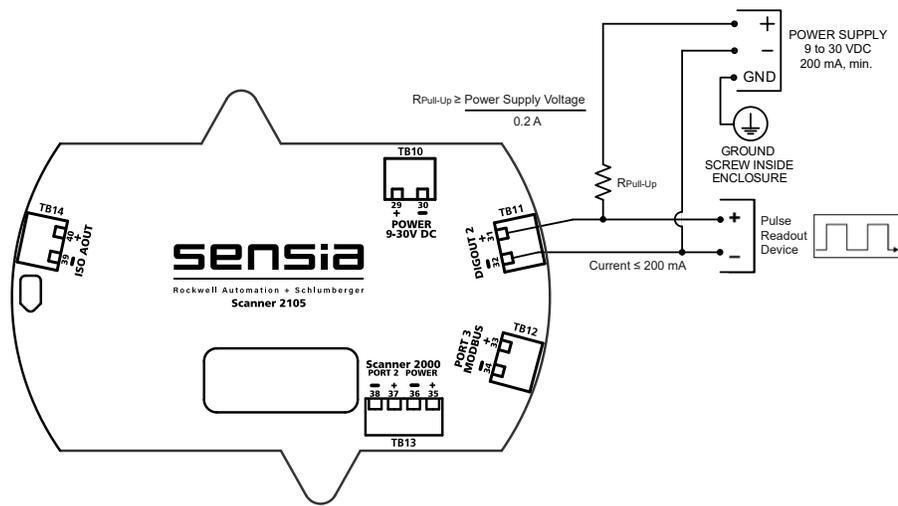


Figure 3.12 - Pulse output wiring on backplate board

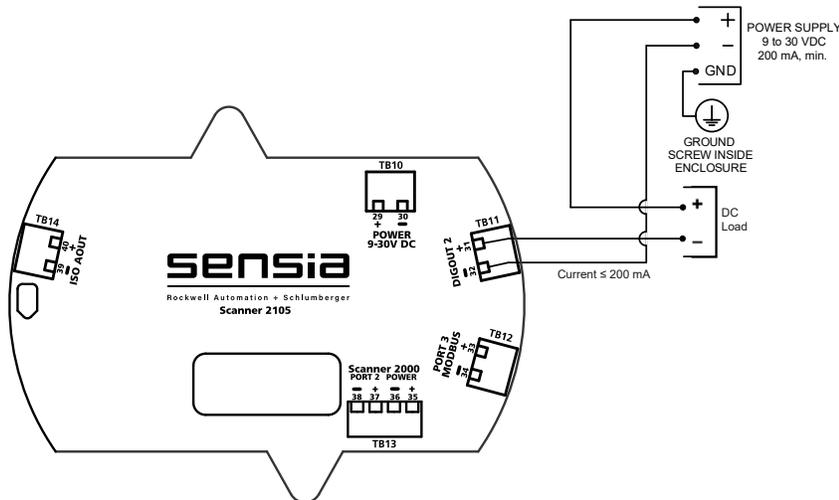


Figure 3.13 - Alarm (DC Load) output wiring on backplate board

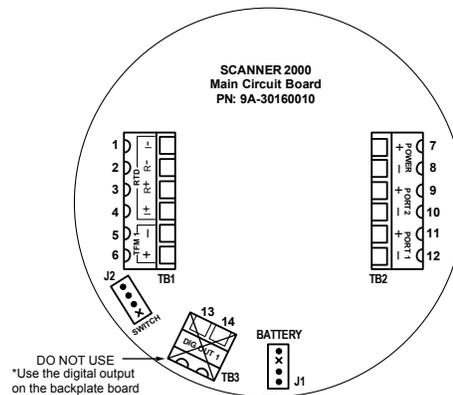


Figure 3.14 - DO NOT USE the main board digital output (functionality has been moved to the backplate board)

Note	Digital output functionality was removed from the "DIG OUT 1" (Figure 3.14) on the Scanner 2000 main board, and added to the "DIG OUT 2" (Figure 3.12, pg. 66) on the backplate board.
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Analog Output

The NUFLO Scanner 2105 flow computer analog output (also loop power) may be used to both power the device and to provide an analog output. For loop power wiring instructions (analog output disabled), see [Loop power as external supply \(no analog output enabled\) on backplate board, pg. 64](#). The analog output can be configured using ModWorX software to represent any parameter in the holding registers. This output requires a two-conductor cable to be connected to an 18 to 30 VDC power supply (voltage required is dependent on loop resistance) and the analog readout device to be located in the remote location. See the ModWorX Software User Manual for information on configuring and calibrating zero and full-scale values using ModWorX software. The graph in [Figure 3.17, pg. 68](#) 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 4 to 20 mA analog output wiring see [Figure 3.15](#). For 1 to 5 V analog output wiring see [Figure 3.16, pg. 68](#).

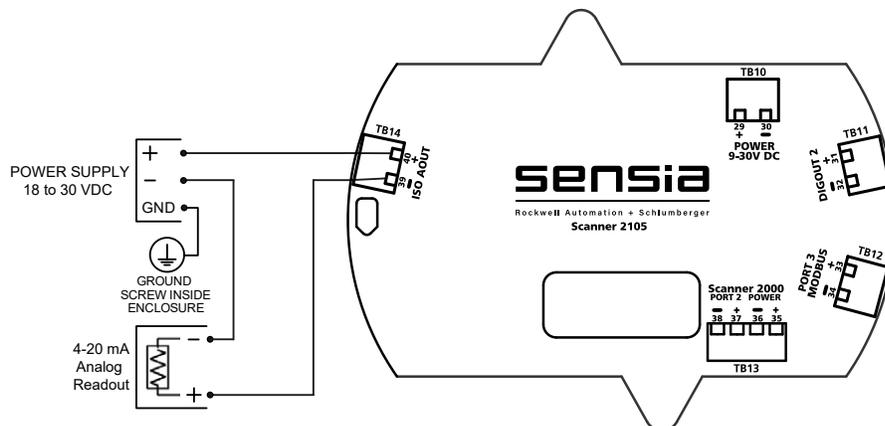


Figure 3.15 - 4 to 20 mA analog output with loop power as external supply on backplate board

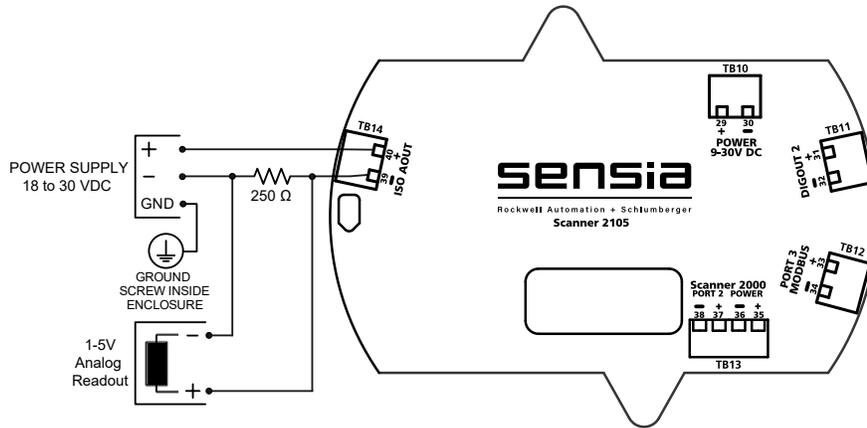


Figure 3.16 - 1 to 5 V analog output with loop power as external supply on backplate board

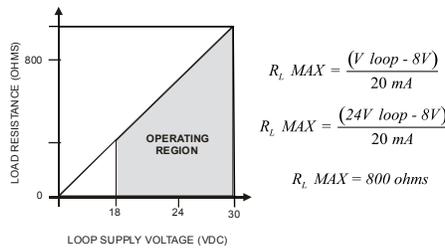


Figure 3.17 - Graph to show maximum load resistance calculation

IMPORTANT DO NOT USE the analog output on the expansion board, as the functionality has been removed and moved over to the backplate board.

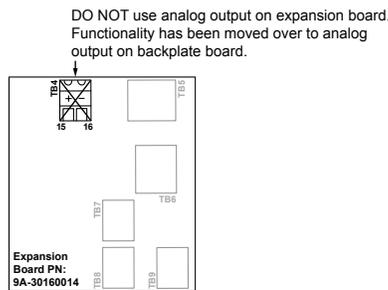


Figure 3.18 - DO NOT use analog output on expansion board

RS-485 Output—Permanent Computer Connection

The RS-485 output is required for communication with the interface software. The wiring diagram in [Figure 3.19, pg. 69](#) supports a permanent connection.

For optional walk-up connectivity, see [RS-485 Adapter \(CSA, Class I, Div. 1 and Div. 2\), pg. A-8](#) and [USB Adapter \(CSA, Class I, Div. 1 and Div. 2\), pg. A-10](#).

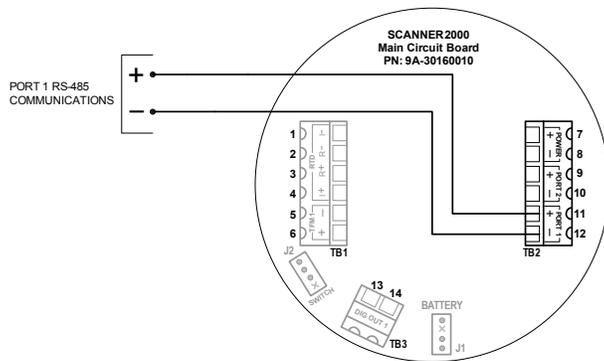


Figure 3.19 - RS-485 output (permanent connection)

Note	PORT 2 is unavailable, as it is used to connect to the display board to the backplate board (via connecting PORT 2 on the display board to TB13 on the backplate board). PORT 3 on the Scanner 2105 backplate board (Figure 3.16, pg. 68) is also not available for use.
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RS-485 Output—Laptop Computer Connection

The RS-485 output is required for communication with the interface software. The wiring diagram in Figure 3.20 supports a temporary laptop connections using an RS-232 to RS-485 converter.

For optional walk-up connectivity, see [RS-485 Adapter \(CSA, Class I, Div. 1 and Div. 2\), pg. A-8](#) and [USB Adapter \(CSA, Class I, Div. 1 and Div. 2\), pg. A-10](#).

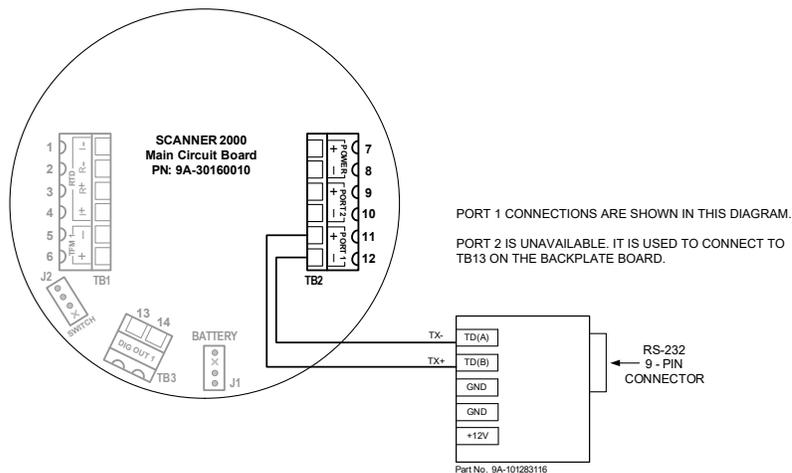


Figure 3.20 - RS-485 output (connection to laptop with 9-pin converter)

Note	PORT 2 is unavailable, as it is used to connect to the display board to the backplate board (via connecting PORT 2 on the display board to TB13 on the backplate board).
Note	All expansion board wiring procedures and diagrams can be found in Input/Output Expansion Board, pg. A-1 .

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Section 4 - Configuration and Maintenance

Configuration Tools

The NUFLO Scanner 2105 flow computer can be configured two ways:

- Sensia's free ModWorX interface software (PC installation) provides menus for configuring all functions supported by the NUFLO Scanner 2105 flow computer and is recommended for first-time use. See [Appendix A - Installation of NUFLO Scanner 2105 Flow Computer Hardware Options, pg. A-1](#) for instructions on connecting your laptop or PC to the instrument.
- The device keypad supports the most commonly used features for device maintenance. See [LCD/Keypad Functions, pg. 72](#) for details.

ModWorX Software

ModWorX interface software is a full-featured complimentary software program for calibrating and configuring the NUFLO Scanner 2105 flow computer. Up to 16 user-selectable parameters can be logged.

The software interface is designed around the most common needs of the field operator. A read-only Main screen ([Figure 4.1](#)) provides a quick reference to real-time totals and flow rates, input data, and system data. It is also home to four task-based menus: Calibrate, Maintain Flow Run, Maintain Turbine, or Configure. User manuals are linked to the software interface via tabs at the bottom of the screen for quick and easy access.

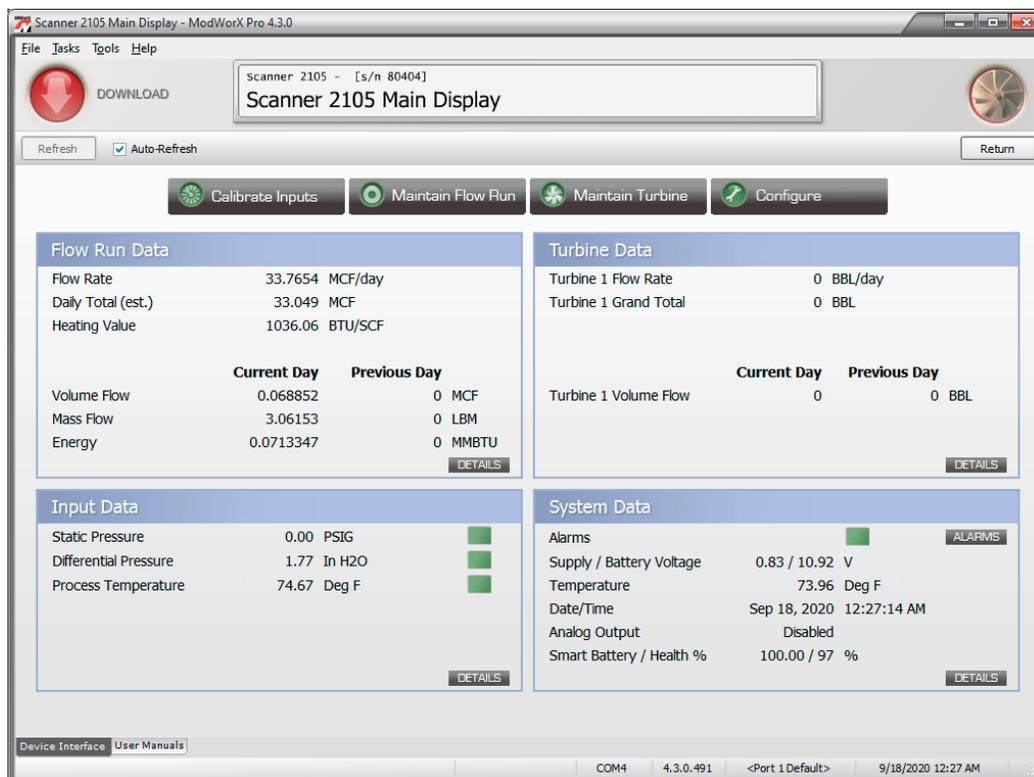


Figure 4.1 - ModWorX software interface

ModWorX Interface Software Functions

A laptop connection and the ModWorX software provided with the NUFLO Scanner 2105 flow computer are required for the calibration and configuration of the instrument. The NUFLO Scanner 2105 flow computer's natural gas and steam calculations typically require configuration of inputs including differential pressure,

static pressure, process temperature, and for AGA 7, a turbine meter input.

The NUFLO Scanner 2105 flow computer supports digital serial communications using EIA-RS-485 hardware with Modicon Modbus protocol. Either of two Modbus slave ports facilitates communications with a laptop or PC. The baud rate range for both ports is 300 to 38.4 K. Both ports are protected from high-voltage transients.

An RS-232 to RS-485 converter or NUFLO USB adapter is required for connecting the EFM to a laptop or PC. The converters available from Sensia require no handshaking or external power to operate. See [Spare Parts, pg. 95](#) for ordering information; see [Figure 3.19, pg. 69](#) and [Figure 3.20, pg. 69](#) for wiring instructions.

The NUFLO USB adapter provides an external USB port for connecting to a laptop, and is available as a kit for upgrading a NUFLO Scanner 2105 flow computer. See [USB Adapter \(CSA, Class I, Div. 1 and Div. 2\), pg. A-10](#) for details; see [Spare Parts, pg. 95](#) for ordering information.



WARNING

To prevent ignition of hazardous atmospheres, do not remove the NUFLO Scanner 2105 flow computer cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

Password-Protected Security

A keypad security access code prevents unauthorized personnel from altering the calibration or accumulated volume data in the instrument. The security feature may be disabled if this protection is not required.

Password-protected security access is enabled using the ModWorX software. When this feature is enabled, the user will be prompted for a four-digit password each time he attempts to enter a menu from the keypad ([Figure 4.2](#)). The ModWorX software is required for establishing or changing the password.



Figure 4.2 - LCD display of security password menu

LCD/Keypad Functions

From the three-button keypad on the front of the instrument, the user can perform the following tasks:

- Scroll through display parameters to view real-time measurements
- View daily flow totals
- Configure basic parameters such as slave address, baud rate, time, turbine K-factor, and orifice plate size
- Enter network ID and slave ID (for wireless communications only)
- Save the current total (recommended when changing batteries)
- Expedite a wireless connection to a QRATE Scanner 3000 series integrated control flow computer network
- Check the firmware version, time, date, temperature, and battery and system voltage levels

[Configuring Basic Parameters, pg. 74](#), guides users step-by-step through the configuration of these parameters using the keypad. [Figure 4.3, pg. 73](#), summarizes the functions that can be accessed with each button.

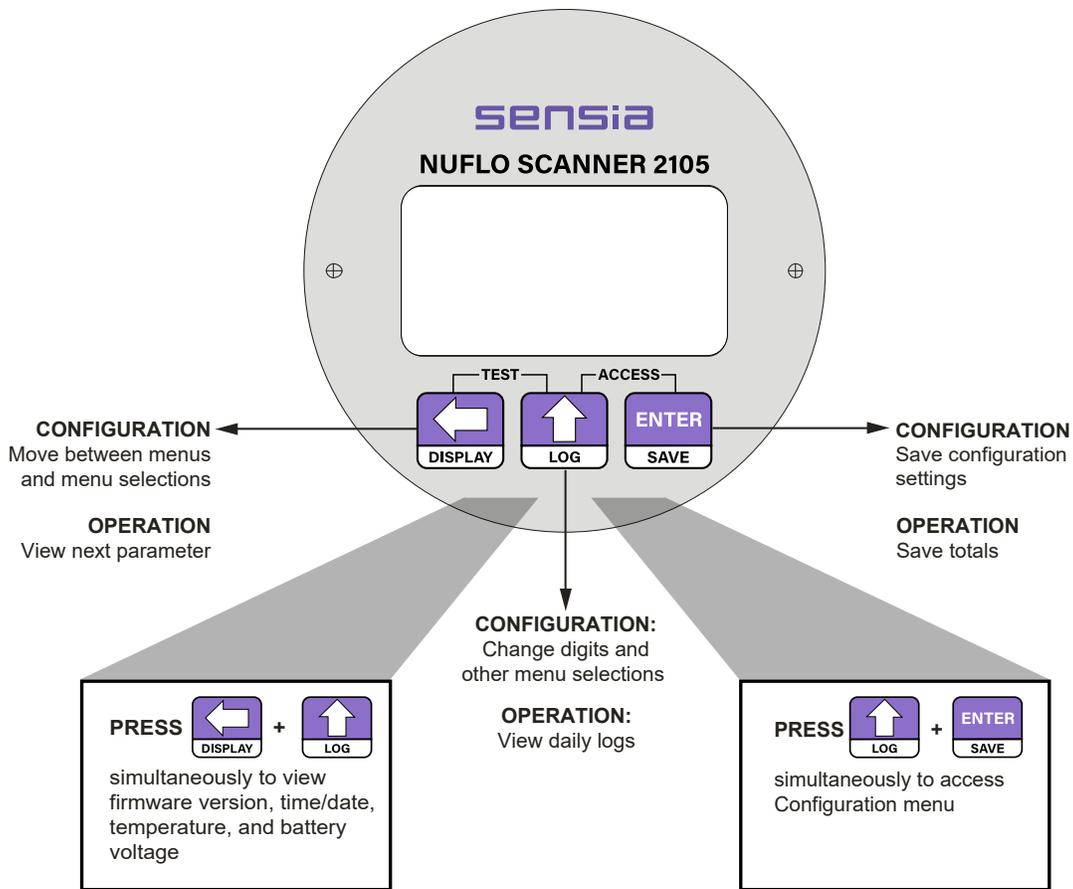


Figure 4.3 - Keypad functions

Viewing Real-Time Measurements

Up to 12 parameters can be configured for display on the LCD using ModWorX software. During normal operation, the LCD displays the selected parameters in a continuous scroll.

A user can stop the scrolling action and manually advance the parameter displayed on the screen by removing the cover of the instrument and pressing the LEFT ARROW button on the keypad (Figure 4.3). The parameter selected for display will appear as shown in Figure 4.4.

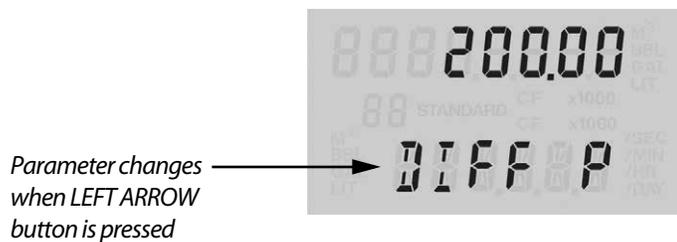


Figure 4.4 - LCD display of real-time measurements

Note	If the instrument is equipped with an explosion-proof switch, the user can manually control the parameter displayed without removing the instrument cover. See Explosion-Proof Switch, pg. 9 for more information.
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Viewing Daily and Hourly Logs

Up to 99 consecutive daily logs can be viewed using the keypad.

Pressing the LOG button changes the LCD display mode from normal operation (scrolling) to a daily log view mode (Figure 4.5). The two-digit flashing number or “log index” on the left side of the LCD represents the number of days that have passed since the log was saved. The user can increment or decrement the number by clicking the UP ARROW or DOWN ARROW buttons. For example, “01” will display the last daily log saved. An index of “05” will display the daily log saved 5 days ago.

By default, the top display shows flow volume, however the user can configure the display to show any of the 16 parameters available using ModWorX software. The bottom display shows the date. The entire log archive—up to 768 daily logs, 2304 adjustable interval logs, and 1152 event/alarm logs— can be viewed using ModWorX software.

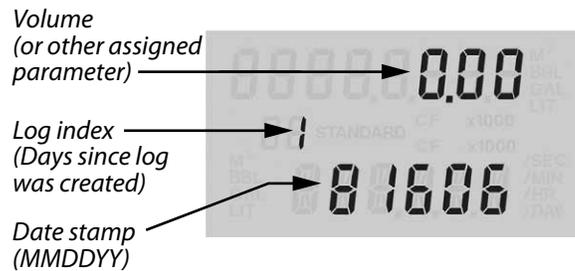


Figure 4.5 - LCD display of daily logs

Configuring Basic Parameters

Pressing the UP ARROW and ENTER buttons simultaneously allows the user to enter the configuration mode (Figure 4.6).



Figure 4.6 - In configuration mode, the parameter to be configured is displayed at the bottom of the LCD and the setting for that parameter is displayed in the top LCD.

The following parameters can be configured using the three-button keypad on the front of the instrument, as shown in Figure 4.3, pg. 73:

- slave address
- baud rate
- date and time
- contract hour
- plate size
- PID settings
- network ID (appears only when the NUFLO Scanner 2105 flow computer is equipped with a wireless radio module)
- slave ID (appears only when the NUFLO Scanner 2105 flow computer is equipped with a wireless radio module)
- K-Factor

All other instrument configuration is performed via the ModWorX software.

Because the keypad is protected beneath the lid of the instrument, the enclosure must be opened to access the keypad. For this reason, it is important to configure these settings before installing it in a hazardous area.



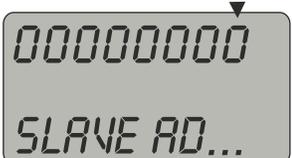
WARNING

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

Entering the Slave Address

The slave address is a setting used in Modbus communications. It is a number that ranges from 1 to 65535, excluding 252 to 255 and 64764, which are reserved. If the Modbus request message contains the matching address, the device will respond to the request. In network arrangements, the device must have a unique slave address. See [Entering a Port 1 Slave Address](#) for information about entering slave addresses. For more information about Modbus communications, refer to [Modbus Communications Protocol, pg. C-1](#). If Modbus communications are not used, leave the slave address at the factory setting.

TABLE 4.1—ENTERING A PORT 1 SLAVE ADDRESS

Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 
Locate the Slave Address setting.	PORT 1 SLAVE ADDRESS will appear in the lower display, and the right-most digit in the top display will begin blinking.	
Enter the Slave Address. (Range: 1 to 65535; excluding 252 to 255 and 64764)	<p>Press UP ARROW until the correct digit is displayed.</p> <p>Then press LEFT ARROW to select the next digit to the left.</p> <p>Repeat using UP and LEFT arrows to enter all remaining digits.</p> <p>Press ENTER.</p>	  

The Baud Rate menu prompt will appear immediately following the entry of the slave address. See *Entering the Baud Rate* below for the baud rate entry procedure.

Entering the Baud Rate

The baud rate is the number of bits per second that are on the serial port. This setting must match the setting of the master device polling the NUFLO Scanner 2105 flow computer or the serial port. This only applies to the Modbus communications; if Modbus communications are not used, leave the baud rate at the factory setting (9600). For more information about entering the baud rate, see [Entering the Port 1 Baud Rate](#).

TABLE 4.2—ENTERING THE PORT 1 BAUD RATE

Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 
Locate the Baud Rate setting.	Press ENTER. The words “PORT 1 BAUD RATE” will appear in the lower display.	 
Enter the baud rate.	Press UP ARROW until the correct baud rate is displayed.	
	Press ENTER. “PORT 2 SLAVE ADDRESS” will appear in the bottom display.	

Entering the Network ID

The network ID is a user-specified number that uniquely identifies the network in which a NUFLO Scanner 2105 flow computer is used to communicate wirelessly. The number must be between 1 and 65535. Use of the default value of 1 is NOT recommended, as this could cause a conflict with other networks using the same transmitter, resulting in failed communications with network nodes. See [Entering the Network ID](#) for instructions on entering a network ID.

TABLE 4.3—ENTERING THE NETWORK ID

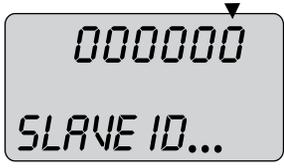
Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 
Locate the Network ID setting.	Press ENTER twice. The words “NETWORK ID” will appear in the lower display.	 
Enter the network ID. (Range: 1 to 65535)	Press UP ARROW until the correct digit is displayed.	
	Then press LEFT ARROW to select the next digit to the left.	
	Repeat using UP and LEFT arrows to enter all remaining digits.	
	Press ENTER. “SLAVE ID” will appear in the bottom display.	

The Slave ID menu prompt will appear immediately following the entry of the network ID. See *Entering the Slave ID* below for the slave ID entry procedure.

Entering the Slave ID

The slave ID is a unique NUFLO Scanner 2105 flow computer identifier used in establishing wireless communications with a QRATE Scanner 3000 series integrated control flow computer, and is equivalent to the slave address in serial communications. The number must be between 1 and 65535. See [Entering the Slave ID](#) for instructions on entering a slave ID.

TABLE 4.4—ENTERING THE SLAVE ID

Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 
Locate the Slave ID setting.	Press ENTER three times. The words "SLAVE ID" will appear in the lower display.	 
Enter the slave ID. (Range: 1 to 65535)	<p>Press UP ARROW until the correct digit is displayed.</p> <p>Then press LEFT ARROW to select the next digit to the left.</p> <p>Repeat using UP and LEFT arrows to enter all remaining digits.</p> <p>Press ENTER.</p>	  

Editing the Date and Time

A user can change the date and time from the keypad, as shown in [Editing the Date and Time](#).

TABLE 4.5—EDITING THE DATE AND TIME

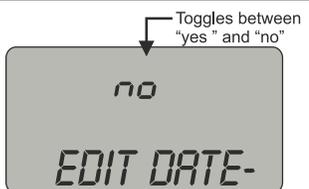
Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 
Locate the Date and Time setting.	<p>Press ENTER four times. The words "EDIT DATE-TIME" will appear in the lower display and the word "no" or "yes" will begin flashing in the top display (default is "no").</p> <p>Press the UP ARROW to change the setting in the top display to "YES."</p> <p>Press ENTER. "DATE MMDDYY" will appear in the bottom display, and the last two digits, representing the year, will begin flashing.</p>	   

TABLE 4.5—EDITING THE DATE AND TIME

<p>Enter the month, day and year. The format is MM.DD.YY.</p>	<p>To change the year, press the UP ARROW, repeatedly if necessary, until the last two digits of the year are displayed (for example, for 2006, enter “06”).</p>		
	<p>To change the day, press the LEFT ARROW. The two middle digits will begin flashing. Press the UP arrow until the correct day is displayed.</p>		
	<p>Repeat the previous Step to select the first two digits and enter the month.</p>		
	<p>Press ENTER. “TIME HHMMSS” will appear in the bottom display, and the last two digits, representing seconds, will begin flashing.</p>		
<p>Enter the time (hour, minute, and seconds). The format is HH.MM.SS.</p>	<p>To change the seconds displayed, press the UP ARROW, repeatedly if necessary, until the correct time (seconds) is displayed.</p>		
	<p>To change the minutes displayed, press the LEFT ARROW. The middle two digits will begin flashing. Press the UP ARROW until the correct time (minutes) is displayed.</p>		
	<p>Repeat the previous Step to select the first two digits and enter the hour (military time: Ex. 1 p.m. = 13).</p>		
	<p>Press ENTER. “CONTRACT HOUR” will appear in the bottom display.</p>		

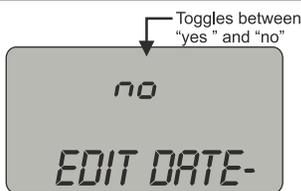
Editing the Contract Hour

A user can set the contract hour from the keypad, as shown in [Editing the Contract Hour](#). The contract hour determines the exact time the daily flow is logged, and is represented by a four-digit number displayed in military time.

TABLE 4.6—EDITING THE CONTRACT HOUR

<p>Enter the Access menu.</p>	<p>Press UP ARROW and ENTER simultaneously.</p>	
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TABLE 4.6—EDITING THE CONTRACT HOUR

Locate the Contract Hour setting.	Press ENTER four times. The words “EDIT DATE-TIME” will appear in the lower display and the word “no” or “yes” will begin flashing in the top display (default is “no”).		
	Press the UP ARROW to change the setting in the top display to “YES.”		
	Press ENTER. “DATE MMDDYY” will appear in the bottom display.		
	Press ENTER a second time. “CONTRACT HOUR” will appear in the bottom display.		
Enter the contract hour.	Press the UP ARROW, repeatedly if necessary, to change the contract hour. Each press of the button will increment the time by 1 hour.		
	Press ENTER. “SAVING” will appear in the bottom display. “PLATE CHANGE” will appear in the display.		

Editing the Plate Size

When Flow Run 1 is configured as an orifice type and security controls allow, a user can change the size of the orifice plate from the keypad, as shown in [Editing the Plate Size](#). The plate size is displayed in inches. If “Strict API compliance” is enabled in the Security menu of the ModWorX software, this parameter can be configured only from the ModWorX interface, which allows the operator to put the instrument into maintenance mode (locked inputs) while the plate change is in process. See Section 3 of the ModWorX Software User Manual for details.

TABLE 4.7—EDITING THE PLATE SIZE

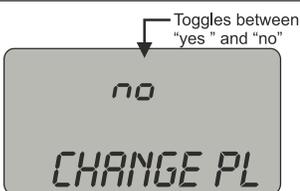
Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	 + 	
Locate the Plate Size setting.	Press ENTER five times. The words “CHANGE PLATE” will appear in the lower display and the word “no” or “yes” will begin flashing in the top display (default is “no”).		
	Press the UP ARROW to change the setting in the top display to “YES.”		
	Press ENTER. “PLATE SIZE - INCHES” will appear in the bottom display.		

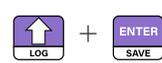
TABLE 4.7—EDITING THE PLATE SIZE

Enter the new plate size.	Press UP ARROW until the correct digit is displayed.		
	Then press LEFT ARROW to select the next digit to the left.		
	Repeat using UP and LEFT arrows to enter all remaining digits.		
	Press ENTER.		

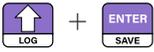
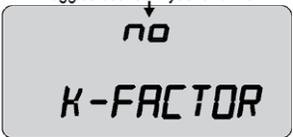
Editing the K-Factor

The K-Factor is the meter calibration factor, which is entered in terms of pulses/unit of volume. In firmware version 4.35 or greater, the user can set the linear K-Factor from the keypad if the “Strict API Compliance” setting is enabled in the Security menu of the ModWorX software. Note that the current K-Factor entry must be linear, not multipoint, or the K-Factor menu will not appear on the display. The K-Factor on the front panel of the device is displayed in terms of the units selected within the ModWorX software, and is typically displayed in pulses/gal. Please refer to the ModWorX Software User Manual for additional information about Strict API Compliance or meter calibration.

To Enter the K-Factor for Input 1:

Enter the Access menu.	Press UP ARROW and ENTER simultaneously.	
Locate the K-Factor setting.	Press ENTER six times. The words “K-FACTOR CHANGE” will appear in the lower display and the word “no” or “yes” will begin flashing in the top display (default is “no”).	
	Press UP ARROW to change the setting in the top display to “YES.”	
	Press ENTER. “T1 K-FACTOR PER [UNITS]” will appear in the bottom display. [UNITS] will be the units configured from ModWorX (typically GAL).	
Enter the new K-Factor.	Press UP ARROW until the correct digit is displayed.	
	Then press LEFT ARROW to select the next digit to the left.	
	Repeat using UP and LEFT arrows to enter all remaining digits.	
	Press ENTER.	

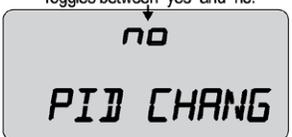
To Enter the K-Factor for Input 2:

<p>Enter the Access menu.</p>	<p>Press UP ARROW and ENTER simultaneously.</p>	
<p>Locate the K-Factor setting.</p>	<p>Press ENTER seven times. The words "K-FACTOR CHANGE" will appear in the lower display and the word "no" or "yes" will begin flashing in the top display (default is "no").</p> <p>Press UP ARROW to change the setting in the top display to "YES."</p> <p>Press ENTER. "T2 K-FACTOR PER [UNITS]" will appear in the bottom display. [UNITS] will be the units configured from ModWorX (typically GAL).</p>	<p>Toggles between "yes" and "no."</p> 
<p>Enter the new K-Factor.</p>	<p>Press UP ARROW until the correct digit is displayed.</p> <p>Then press LEFT ARROW to select the next digit to the left.</p> <p>Repeat using UP and LEFT arrows to enter all remaining digits.</p> <p>Press ENTER.</p>	

Configuring the PID Operational Mode

When a PID controller is configured and security controls allow, a user can change the basic operation of the controller from the keypad. The controller must be first configured and tuned using ModWorX Software. The menu will first prompt for the entry to determine if the controller should be Auto Mode: ON = Auto or OFF = Manual. If auto mode is selected, the controller Set Point can also be entered before exiting the PID menu section. If Manual mode is selected, a prompt for changing the override value is shown.

To Configure the PID Operational Mode:

<p>Enter the Access menu.</p>	<p>Press UP ARROW and ENTER simultaneously.</p>	
<p>Locate the PID Change setting.</p>	<p>Press ENTER eight times. The words "PID CHANGE" will appear in the lower display and the word "no" or "yes" will begin flashing in the top display (default is "no").</p> <p>Press the UP ARROW to change the setting in the top display to "YES."</p> <p>Press ENTER.</p>	<p>Toggles between "yes" and "no."</p> 

Locate the Mode setting.

The words "AUTO MODE" will appear in the lower display and the word "on" or "off" will begin flashing in the top display, depending on the current configuration.



Toggles between "on" and "off."



Press the UP ARROW to change the setting in the top display to "ON" for Auto Mode or "OFF" for Manual Mode.



Press ENTER. The words "SET POINT" will appear in the bottom display.



If Auto Mode was selected, enter the Set Point.

The decimal point should be blinking. Press the UP ARROW until the decimal point is in the desired position, then press the LEFT ARROW.



Press UP ARROW until the correct digit is displayed.



Then press LEFT ARROW to select the next digit to the left.



Repeat using UP and LEFT arrows to enter all remaining digits.

Press ENTER. "SAVING" will appear in the bottom display.



If Auto Mode was NOT selected, enter the override value.

The decimal point should be blinking. Press the UP ARROW until the decimal point is in the desired position, then press the LEFT ARROW.



Press UP ARROW until the correct digit is displayed.



Then press LEFT ARROW to select the next digit to the left.



Repeat using UP and LEFT arrows to enter all remaining digits.

Press ENTER. "SAVING" will appear in the bottom display.



Saving a Current Total

Press the ENTER/SAVE key on the keypad to save accumulated grand totals and previous day totals for flow run and turbine volume, energy, and mass to nonvolatile memory. Saving totals is recommended before removing power from the device. However, with dual lithium battery packs, battery packs can be changed one at a time to eliminate interruptions in operation. If power is removed and then restored to the unit, the last saved accumulated totals will be displayed in the LCD.

Expediting a Wireless Network Connection

The connection of a wireless NUFLO Scanner 2105 flow computer to a QRATE Scanner 3000 series integrated control flow computer network can take several minutes to complete. To expedite a connection, press

the ENTER/SAVE key on the keypad. This step is recommended only for devices that have been trying to connect for more than 2 minutes. If the device is not already connected, the connection process will be re-initiated. The connection status of a wireless device is automatically confirmed when the ENTER/SAVE button is pressed to save accumulated totals as discussed above. In the event the device is already connected, pressing the ENTER/SAVE key will have no affect on the device's network connection.

Similarly, when an optional momentary switch is installed in a wireless NUFLO Scanner 2105 flow computer, pressing the switch for any duration will also check the network connection status of the device and re-initiate the connection process if the device is not connected to the QRATE Scanner 3000 series integrated control flow computer network.

Checking System Status Parameters

Press and release the DISPLAY and LOG buttons simultaneously to view a series of scrolling system status parameters:

- Device firmware version and model number
- Time (HHMMSS)
- Date (MMDDYY)
- Device temperature in °F
- Device temperature in °C
- Battery voltage level
- System voltage level

When the system voltage is displayed, the device will show "SAVING" and then return to displaying real-time parameters.

Selecting a Calculation Period

Selecting an appropriate calculation period in the ModWorX software interface is an important step in configuring a NUFLO Scanner 2105 flow computer that is to be networked to a QRATE Scanner 3000 series integrated control flow computer. A calculation period of a minute is recommended. This period allows for optimization of power usage and management of high-traffic periods in large networks.

It is important to recognize that the calculation period controls only the frequency with which the NUFLO Scanner 2105 flow computer transmits real-time values to the QRATE Scanner 3000 series integrated control flow computer network manager, not the input sampling period. Input sampling occurs each second, so the value transmitted at the end of a 1-minute calculation period is actually the average of 60 samples collected over the previous 60 seconds. Choosing a calculation period of 1 minute or longer in no way compromises the accuracy of the input data.

Device Downloads

Archive files can be downloaded from a NUFLO Scanner 2105 flow computer using the ModWorX software supplied with the device. When a NUFLO Scanner 2105 flow computer is networked to a QRATE Scanner 3000 series integrated control flow computer network manager, a user can download NUFLO Scanner 2105 flow computer data over wired or wireless communications using the QRATE Scanner 3000 series integrated control flow computer web interface or an FTP client. See the Scanner Web Interface User Manual for instructions.

Reporting Tools

The proprietary .sdf files used to store NUFLO Scanner 2105 flow computer data can be opened with either ModWorX or ScanData software. To download software or software user manuals, visit the Sensia website at <https://sensiaglobal.com/Measurement>, scroll to the bottom of the screen, and select **Flow Computers and Automation > 2000 Series NUFLO Scanner Flow Computer**. Click the link for the desired software install/manual.

ModWorX

Users can download, view, export and print data logs within ModWorX using RS-485/USB communications.

ScanData

While ScanData performs the same basic reporting functions supported by ModWorX, it differs in two ways:

- ScanData automatically opens proprietary download files with the click of a mouse.
- ScanData provides the tools to create a professional, customized report and to create custom templates for repeated use. See the ScanData User Manual for details.

Section 5 - NUFLO Scanner 2105 Flow Computer Hardware Maintenance

The NUFLO Scanner 2105 flow computer is engineered to provide years of dependable service with minimal maintenance. Batteries require periodic replacement, and battery life depends on whether battery power is the primary or secondary power source, the configuration settings of the NUFLO Scanner 2105 flow computer, ambient temperature conditions, and wireless network parameters where applicable.

All configuration settings are stored in nonvolatile memory; therefore, configuration settings will not be lost in the event of battery failure.

The circuit assembly or keypad may also require replacement over the life of the instrument. Replacement procedures are provided in this section.



WARNING

Before servicing the NUFLO Scanner 2105 flow computer, disconnect all power/signal sources and verify that the atmosphere is free of hazardous gases.

Dual Lithium Battery Pack Replacement

The NUFLO Scanner 2105 flow computer may use dual lithium battery packs with a typical life expectancy of 1 year. Because the flat discharge characteristics of the lithium battery, it is difficult to determine how much life remains in a battery at any given time. To preserve configuration and accumulated volume data, replace the batteries in the dual lithium battery pack at 1-year intervals.

The lithium battery packs are secured inside the enclosure with a primary cell holder. All of the necessary connections for battery replacement are found on the end of the main board at the back of the enclosure.



CAUTION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type.

ATTENTION

Risque d'explosion si la pile n'est pas remplacé correctement. Remplacer uniquement par une pile de type identique ou équivalent.



WARNING

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.



WARNING

The lithium battery pack that powers the NUFLO Scanner 2105 flow computer is a sealed unit; however, should a lithium battery develop a leak, toxic fumes could escape upon opening the enclosure. Ensure that the instrument is in a well-ventilated area before opening the enclosure to avoid breathing fumes trapped inside the enclosure. Exercise caution in handling and disposing of spent or damaged battery packs. See additional information in [Lithium Battery Information, pg. B-1](#).

IMPORTANT

When two battery packs are used to power the device, it is recommended that both packs be replaced at regular intervals. Replacing the packs one at a time will ensure power retention to the unit and eliminate the loss of accumulated totals.

If both packs are to be removed at the same time for any reason, press the ENTER/SAVE key on the keypad before removing the packs to save accumulated grand totals and previous day totals for flow run and turbine volume, energy, and mass to nonvolatile memory. Once the battery packs are replaced and power is restored to the unit, the last saved accumulated totals will be displayed in the LCD. The instrument clock will need to be reset following battery replacement. All configuration and calibration settings are automatically saved to non-volatile memory and are not affected by a temporary loss of battery power.

Note	To retain power to the NUFLO Scanner 2105 flow computer, change the batteries one at a time.
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To replace a lithium battery pack in the NUFLO Scanner 2105 flow computer, perform the following steps:

1. Unscrew the cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Unclip the straps that are holding the battery cells in place.
3. Disconnect the battery from the "Battery 1" connector on the main board, pull on the strap to partially eject the battery, and remove the spent battery pack. For sustained power, replacing one battery pack at a time is recommended.

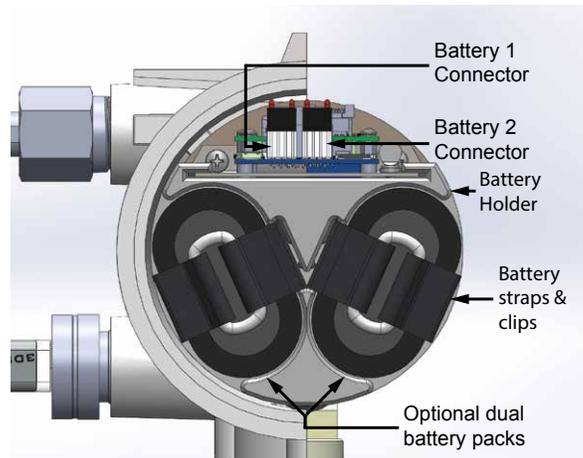


Figure 5.1 - Removal of the dual lithium battery packs from the enclosure

4. Insert a new battery pack in the enclosure in the same position as the original battery pack, plug the battery cable into the "Battery 1" connector on the main board.
5. Repeat steps 3 and 4 to replace the second battery pack ("Battery 2").
6. Re-clip the straps around the two batteries.
7. Replace the enclosure cover, threading it in a clockwise direction.

IMPORTANT	An interruption of power to the NUFLO Scanner 2105 flow computer will cause the internal clock time to be incorrect. If the scanner is connected to a mesh network, then the time will be updated automatically. Otherwise, reset the time using the keypad on the switchplate or the ModWorX software. See Editing the Date and Time, pg. 77 , for details.
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Smart Battery Pack Replacement

The NUFLO Scanner 2105 flow computer may use a rechargeable smart battery pack, which should only require changing when the state of health of the battery drops to 80% or less. Because of the limited capacity of the smart battery pack, it is recommended to either use a solar panel to continually charge the battery, or use the battery only as a backup power source. If the smart battery is the only source of power, then prior to replacement, it is recommended to either externally power the NUFLO Scanner 2105 flow computer, or to save the configuration and accumulated volume data.

Note	The state of health of the battery can be read with Modbus (register shown on page C-32) or retrieved from within ModWorX.
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WARNING

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

**WARNING**

The SLA batteries in the smart battery pack that powers the NUFLO Scanner 2105 flow computer are sealed; however, should a SLA battery become damaged, corrosive liquid could leak. Ensure that the instrument is in a well-ventilated area before opening the enclosure to avoid breathing fumes trapped inside the enclosure. Use corrosion resistant gloves, and exercise caution in handling and disposing of spent or damaged battery packs. See additional information in [Smart Battery Cell Information, pg. B-2](#).

IMPORTANT

When a smart battery pack is used to power the device, it is recommended to either charge it at regular intervals, or use a solar panel for continual charging. When replacing the smart battery pack, it is recommended to first save the data to eliminate the loss of accumulated totals.

Press the ENTER/SAVE key on the keypad before removing the smart battery pack to save accumulated grand totals and previous day totals for flow run and turbine volume, energy, and mass to nonvolatile memory.

Once the smart battery pack is replaced and power is restored to the unit, the last saved accumulated totals will be displayed in the LCD. The instrument clock will need to be reset following battery replacement. All configuration and calibration settings are automatically saved to non-volatile memory and are not affected by a temporary loss of battery power.

All of the necessary connections for battery replacement are found on the end of the main board at the back of the enclosure. To replace a smart battery pack in the NUFLO Scanner 2105 flow computer, perform the following steps:

1. Unscrew the cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Unscrew the tension screw holding the smart battery pack in place on the battery mounting bracket.
3. Disconnect the smart battery cable from the connector on the smart battery pack.
4. Slide the smart battery pack off of the battery mounting bracket and out of the enclosure.

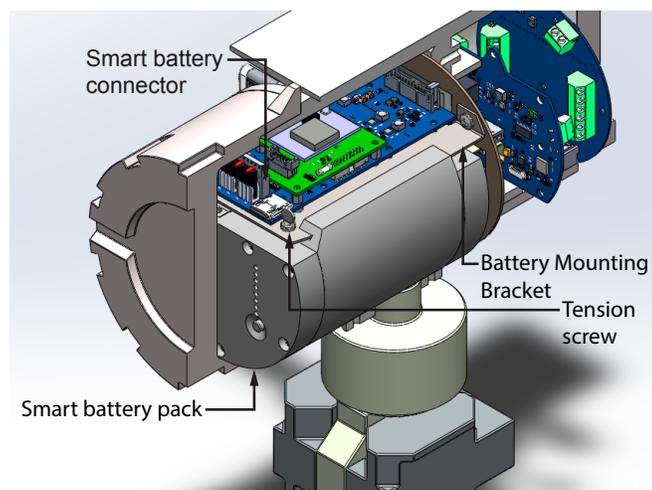


Figure 5.2 - Removal of the smart battery pack from the enclosure

5. Insert a new smart battery pack, sliding it onto the battery mounting bracket until it reaches its stopping point.
6. Connect the smart battery cable into the connector of the new smart battery pack.
7. Screw the tension screw into the battery mounting bracket to put tension on the smart battery pack and hold it in place.
8. Replace the enclosure cover, threading it in a clockwise direction.

IMPORTANT	An interruption of power to the NUFLO Scanner 2105 flow computer will cause the internal clock time to be incorrect. Reset the time using the keypad on the switchplate or the Mod-WorX software. See Editing the Date and Time, pg. 77 , for details.
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Circuit Assembly Replacement



WARNING

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

IMPORTANT

Static electricity can damage a circuit board. Handle new boards only by their edges, and use proper anti-static techniques (such as wearing anti-static wrist strap or touching metal to establish an earth ground) prior to handling a board.

IMPORTANT

If possible, download the configuration settings and all archive logs before replacing the circuit board.

To replace the circuit assembly, perform the following steps:

1. Unscrew the cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Remove the two #4-40 × 7/8" screws located to the right and left side of the display ([Figure 5.3](#)).

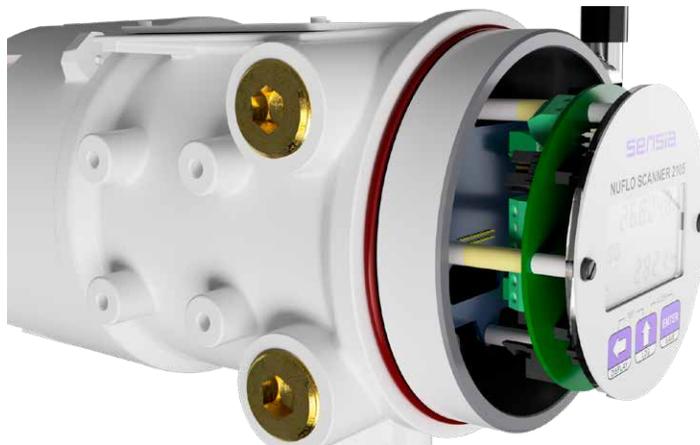


Figure 5.3 - LCD/keypad screw locations

3. Remove the display/keypad assembly from the enclosure.
4. Remove connections from display board to backplate board ([Figure 5.4, pg. 89](#)).

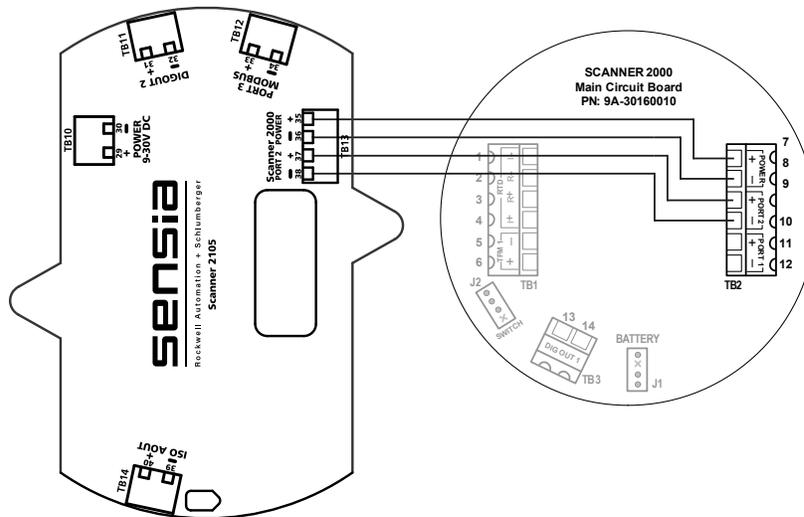


Figure 5.4 - Display board connections to backplate board

5. Record the locations of all cable connections to the circuit board.
6. Remove all wiring from terminal blocks TB1, TB2, and TB3, and J2, ensuring that all wiring that is connected to powered circuits is insulated with tape.

Note The battery out cable should only be disconnected during circuit board replacement.

7. If an expansion board is present, remove the standoff securing the board to the main circuit assembly and set the wireless board or expansion board aside. If the standoff is difficult to remove, consider pinching the standoff prongs together with a pair of needle-nose pliers while lifting the board with the other hand.
8. Disconnect the sensor ribbon cable from the J5 connector on the circuit board as follows:
 - a. Lift the latch from the black clip securing the ribbon cable (Figure 5.5).
 - b. When the latch is fully open, the ribbon cable will release freely.



Figure 5.5 - Latch securing the ribbon cable

9. Remove the original circuit board/keypad assembly from the enclosure.
10. Remove the two #4-40 × 5/16" screws fastening the circuit board to the keypad (Figure 5.6, pg. 90).
11. Remove the keypad ribbon cable from the J7 connector on the LCD side of the circuit board by pressing in on the sides of the black plastic clip and pulling gently on the clip. Do not pull on the ribbon cable; the cable will release freely when the clip opens (Figure 5.7, pg. 90).
12. Remove the replacement circuit board from its packaging.

13. Connect the keypad ribbon cable to the J7 connector on the LCD side of the new circuit board by sliding the end of the ribbon into the black clip as far as it will go and pressing the black plastic clip into the connector until it snaps.
14. Connect the circuit board to the keypad with the two #4-40 × 5/16" screws removed in Step 9.
15. Reconnect the sensor ribbon cable to the J5 connector at the top of the circuit board, by inserting the ribbon cable into the black clip and securing the latch on the clip to hold it tightly in place.
16. Reconnect the wiring from the display board to the backplate board as shown in [Figure 5.4, pg. 89](#).
17. If an expansion board was removed in step 7, replace it using the standoff provided with the new circuit board.

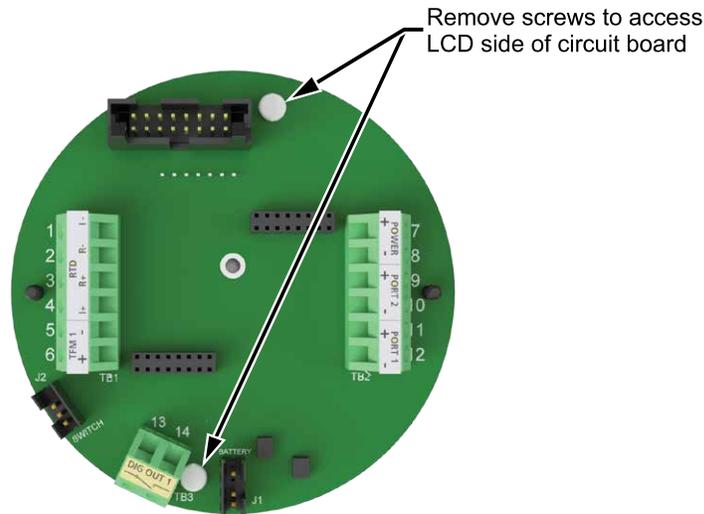
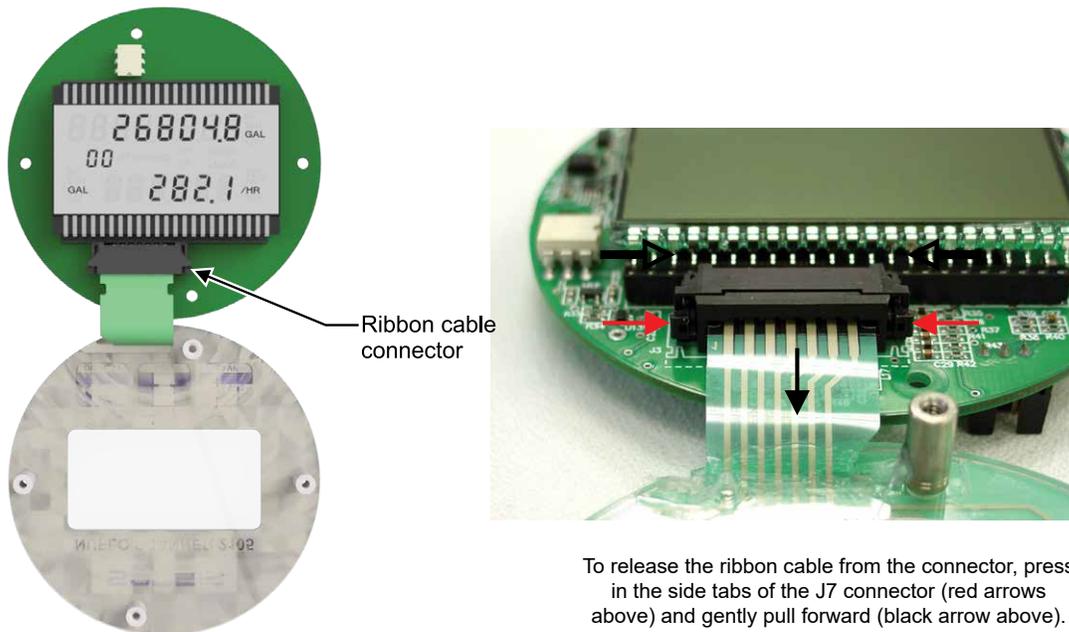


Figure 5.6 - Disassembly of circuit board/keypad assembly



To release the ribbon cable from the connector, press in the side tabs of the J7 connector (red arrows above) and gently pull forward (black arrow above).

Figure 5.7 - Keypad ribbon cable connector showing location of removal clips

18. Reconnect all wiring to terminal blocks TB1, TB2 and TB3.

19. Reattach the display/keypad assembly to the standoffs inside the enclosure with the two #4-40 × 7/8" screws removed in Step 2.
20. Recalibrate the NUFLO Scanner 2105 flow computer and replace the enclosure cover.

IMPORTANT

Do not overlook the need to recalibrate the NUFLO Scanner 2105 flow computer. Boards that are shipped independently of a NUFLO Scanner 2105 flow computer are not calibrated to compensate for atmospheric pressure; therefore, a NUFLO Scanner 2105 flow computer will not display accurate pressure readings until it is recalibrated.

21. Re-establish power to the peripheral circuitry.

Display/Keypad Replacement

**WARNING**

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

To replace the keypad of the NUFLO Scanner 2105 flow computer, perform the following steps:

1. Unscrew the cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
2. Remove the two #4-40 × 7/8" screws located to the right and left side of the display ([Figure 5.3, pg. 88](#)).
3. Remove the display/keypad assembly from the enclosure.
4. Remove the two #4-40 × 5/16" screws fastening the circuit assembly to the keypad ([Figure 5.5, pg. 89](#)).
5. Disconnect the keypad ribbon cable from the J7 connector on the LCD side of the circuit assembly as follows:
 - a. Grasp the black clip between the thumb and forefinger ([Figure 5.7, pg. 90](#)).
 - b. Squeeze both sides of the clip and gently pull to release the clip from the plastic connector that holds it in place. **DO NOT PULL** on the ribbon cable. When the black plastic clip is properly disengaged, the cable will release freely.
6. Remove the old keypad.
7. Connect the ribbon cable of the replacement keypad to the J7 connector on the LCD side of the circuit assembly as follows:
 - a. Insert the end of the ribbon cable into the plastic clip.
 - b. While holding the ribbon cable in place, press the black plastic clip into the connector until it snaps.
8. Mount the circuit assembly to the keypad with the two #4-40 × 5/16" screws removed in Step 4.
9. Mount the display/keypad assembly to the enclosure with the two #4-40 × 7/8" screws removed in Step 2.
10. Replace the enclosure cover and tighten.

Wireless Module Replacement

**WARNING**

To prevent ignition of hazardous atmospheres, do not remove the cover while circuits are alive. The NUFLO Scanner 2105 flow computer poses no hazard when opened in a safe area.

IMPORTANT

Before replacing the wireless module, remove all power from the NUFLO Scanner 2105 flow computer (battery and external power).

The wireless module ([Figure 5.8, pg. 93](#)) attaches to one header positioned just in front of the battery connectors (at the back of the enclosure) on the main board.

IMPORTANT

Pay close attention to the alignment of pins and headers before pressing boards together. Failure to correctly align pins and headers can result in broken pins or other damage to a circuit board.

1. Remove the damaged wireless board as follows:
 - a. Press the ENTER/SAVE key on the keypad to save accumulated grand totals and previous day totals for flow run and turbine volume, energy, and mass to nonvolatile memory.
 - b. Remove or turn off any external power being applied to the NUFLO Scanner 2105 flow computer.
 - c. Unscrew the back cover of the enclosure counter-clockwise until it separates from the main body of the enclosure.
 - d. Remove the battery cable connections from the connectors on the main board.
 - e. Unscrew the battery mounting bracket by removing the two screws at the back of the enclosure, and carefully pull it out of the enclosure without touching the circuit board to the sides of the enclosure.
 - f. Disconnect the antenna coupler cable from the wireless module.
 - g. Remove the standoffs securing the wireless board to the main board, remove the wireless board, and set it aside.
2. Install a new wireless module as follows:
 - a. Remove the standoffs from the wireless module packaging and push them into the holes for the wireless module on the main board until they snap into place.
 - b. Guide the wireless module over the standoffs and carefully align the pins on the underside of the wireless module with the headers on the main board. Then screw the module onto the standoffs.
 - c. Ensure that the pins and header are properly aligned, then gently press the wireless board onto the main board until the wireless board snaps into place over the standoffs.
 - d. Reattach the antenna cable coupler to the wireless module.
 - e. Screw the battery mounting bracket back onto the back of the enclosure with the two screws previously removed.
 - f. Plug the battery cable connections back into the main board.
 - g. Replace the enclosure cover, threading it in a clockwise direction.
 - h. If applicable, restore external power to the NUFLO Scanner 2105 flow computer.
 - i. Allow the NUFLO Scanner 2105 flow computer to detect the wireless module. Confirm the network ID and slave ID values in the device are acceptable using the keypad menu. Change the values if necessary. See [page 75](#) and [page 76](#) for detailed instructions.

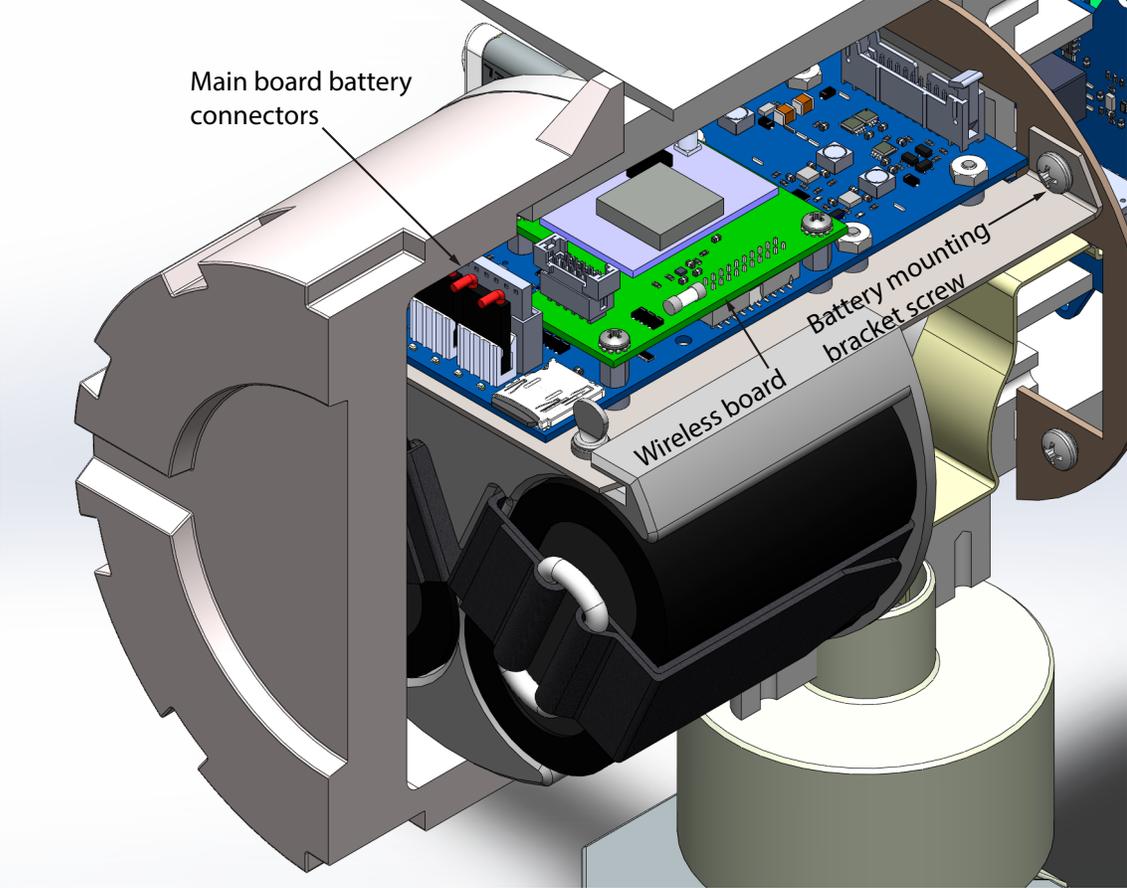


Figure 5.8 - Replacement of a NUFLO Scanner 2105 flow computer wireless module

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Section 6 - Spare Parts



WARNING

EXPLOSION HAZARD – Substitution of components may impair suitability for CSA, Class I, Division 1 or Division 2. Use of spare parts other than those identified by Sensia voids hazardous area 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.



CAUTION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type.

ATTENTION

Risque d'explosion si la pile n'est pas remplacé correctement. Remplacer uniquement par une pile de type identique ou équivalent.

Spare Parts Overview

Spare parts are presented in three tables below.

- [Table 6.1—NUFLO Scanner 2105 flow computer Parts List](#) contains common parts and those parts that are used in and approved for CSA-approved devices.
- [Table 6.2—NUFLO Scanner 2105 flow computer Wireless Components](#) contains parts that are specific to NUFLO Scanner 2105 flow computer devices equipped with wireless communications.
- [Table 6.3—RTD and Cable Assemblies \(CSA-Approved\)](#) contains RTD and cable assemblies for use with CSA-approved devices.

MVT Replacement

During factory calibration, the device is calibrated over temperature with the MVT attached and performance is adjusted accordingly. Replacing an MVT or circuit board in the field individually negates this fine-tuning and may result in some degradation of accuracy. If this is a concern, consult your Sensia representative to arrange for the device to be returned to the factory for MVT or circuit board replacement and recalibration.

TABLE 6.1—NUFLO SCANNER 2105 FLOW COMPUTER PARTS LIST

Qty.	Part Number	Description
1	50346458	Scanner 2105 Switchplate Assembly
1	9A-100002605	Desiccant, Humidisorb, Self Regenerate, 2 in. x 2 in. Packet with Adhesive
2	76525511	O-Ring, 120 mm x 4 mm, XD-I, for Explosion-Proof Enclosure
2	9A-100025380	Screw, Pan Head, Slotted, #4-40 X 7/8 Steel Black Oxide for Switchplate Assembly
2	9A-100025381	Washer, Flat, #4 Steel Black Oxide, for Switchplate Assembly
1	50268179	Kit, Pole Mount, Stainless Steel
1	50346916	4-Twisted Conductors Wiring Harness, 10 Inches Long (Red, White, Green and Black)
1	9A-30188004	NUFLO Scanner 2000 flow computer Expansion Board (TFM Input, Pulse Input, Dual Analog Input, 256 KB Memory)
For wireless components, see Table 6.2—NUFLO Scanner 2105 flow computer Wireless Components .		
2	9A-30099004	Battery Pack, 2 "D" Batteries in Series, 7.2 V, Lithium, with Current Limiting Resistor and Diode, Block Style, CSA-approved
1	50348350	Sealed Lead Acid Battery Pack
1	50361769	Smart Battery Cable Assembly
1	77020877	Sealed Lead Acid Battery Pack DC Power Adapter, Input: 100-240V AC, 50/60Hz, Output: 60W, 19.5V DC, 3.33A

TABLE 6.1—NUFLO SCANNER 2105 FLOW COMPUTER PARTS LIST

Qty.	Part Number	Description
1	9A-21-XX-YY see Table 6.3—RTD and Cable Assemblies (CSA-Approved)	Assembly, RTD and Cable, Explosion-Proof (Div. 1), Model 21, CSA-approved
1	9A-1100-1025B-xx see Table 6.3—RTD and Cable Assemblies (CSA-Approved)	Assembly, RTD and Cable, Weatherproof (Div. 2), CSA-approved (XX=cable length) Available cable lengths: 5, 10, 20, or 30 ft Probe adjustable up to 6 in.
1	9A-90017004	External RS-485 Communications Adapter, 3/4 in. NPT, Explosion-Proof Union, 2-Pin Connector, CSA-approved
1	2295524-01	External USB Communications Connector, 3/4 in. NPT, Explosion-Proof Union, 2-Conductor Wire, 12 in., CSA-approved
1	9A-30054001	Assembly, External Explosion-Proof Switch, CSA-approved, with Extension, Fits 3/4 in. Female Pipe Thread, Momentary Contact (Keypad Alternative)

TABLE 6.2—NUFLO SCANNER 2105 FLOW COMPUTER WIRELESS COMPONENTS

Qty.	Part Number	Description
1	2350869-01	Antenna, Short-haul, 2.4 GHz, 1/2 Wave Dipole, N Male, Right-Angle
1	50279275	Antenna, Short-Haul, Remote-Mount, 9 dBi 2.4 GHz Omni-directional, 32-in. long, N Female with pole-mount bracket (fits pole outside diameters up to 2-in.)
1	50278052	Antenna Bracket, 2-in. Pipe (2.375-in. Outside Diameter) for Remote-Mount Antenna Part No. 50279275
1	76527410	Antenna Cable with Connectors, Type 400, -40 °C to 70 °C (-40 °F to 158 °F), 10 ft
1	76527411	Antenna Cable with Connectors, Type 400, -40 °C to 70 °C (-40 °F to 158 °F), 20 ft
1	76527412	Antenna Cable with Connectors, Type 400, -40 °C to 70 °C (-40 °F to 158 °F), 30 ft
1	77012876	Antenna Coupler, N Coax, Male-to-Male (Female Thread), CSA and ATEX approved

TABLE 6.3—RTD AND CABLE ASSEMBLIES (CSA-APPROVED)

Select assemblies based on specific application. For Model 21 RTDs, cable length and probe length are specified in the part number: 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 Number	Description
1	9A-21-05-06	Model 21 RTD, Explosion-proof, 5-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-05-12	Model 21 RTD, Explosion-proof 5-ft Cable, 11.625-in. Probe for 12-in. Thermowell
1	9A-21-10-06	Model 21 RTD, Explosion-proof 10-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-10-12	Model 21 RTD, Explosion-proof 10-ft Cable, 11.625-in. Probe for 12-in. Thermowell

TABLE 6.3—RTD AND CABLE ASSEMBLIES (CSA-APPROVED)

Qty.	Part Number	Description
1	9A-21-30-06	Model 21 RTD, Explosion-proof 30-ft Cable, 7.625-in. Probe for 6-in. Thermowell
1	9A-21-30-12	Model 21 RTD, Explosion-proof 30-ft Cable, 11.625-in. Probe for 12-in. Thermowell
1	9A-1100-1025B-05	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

Electronics Replacement

The NUFLO Scanner 2105 flow computer contains three circuit board subassemblies (pre-assembled groupings of circuit boards and hardware). For disassembly instructions, see the NUFLO Scanner 2105 Service User Manual. Subassemblies 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 NUFLO Scanner 2105 flow computer 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—NUFLO Scanner 2105 Circuit Board Replacements

Qty.	Part Number	Description
1	9A-30160010ROHS-T	Scanner 2000 Main Circuit Board Assembly (Field Replacement)
1	9A-30160014ROHS-T	Scanner 2000 Expansion Circuit Board Assembly (Field Replacement)
1	50327128-T	Scanner 2105 Interface Circuit Board Assembly (Field Replacement)
1	50327130-T	Scanner 2105 Backplate Circuit Board Assembly (Field Replacement)
1	50346511-T	Smart Mesh Circuit Board Assembly (Field Replacement)

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Appendix A - Installation of NUFLO Scanner 2105 Flow Computer Hardware Options

Input/Output Expansion Board

With the installation of the NUFLO Scanner 2105 flow computer input/output expansion board, the instrument can support up to three flow runs simultaneously—a flow run and two turbine meter runs. All inputs are configured with ModWorX software provided with each NUFLO Scanner 2105 flow computer. See the ModWorX Software User Manual for details.

The expansion board shown in [Figure A.1, page A-2](#), includes the following inputs:

- 2 analog inputs (can be configured for 0-5 V, 1-5 V or 4-20 mA)
- 1 turbine meter input
- 1 pulse input

An analog output terminal is present on the expansion board but not functional. This output is instead implemented as an integrated analog output on the backplate board. For wiring procedures and diagrams, see [External power supply \(solar power\) on backplate board, pg. 63](#)

If the expansion board is ordered with a NUFLO Scanner 2105 flow computer, it is installed at the factory. If the board is purchased separately, the user will need to install it on the NUFLO Scanner 2105 flow computer main board using the following instructions.

Field Installation

IMPORTANT	Before installing the expansion board, remove all power from the NUFLO Scanner 2105 flow computer (battery and external power). Remove wiring from the main board if necessary to guide the expansion board into position.
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The expansion board attaches to two headers positioned between the two large green terminal blocks on the main board.

IMPORTANT	Pay close attention to the alignment of pins and headers before pressing boards together. Failure to correctly align pins and headers can result in broken pins, and ultimately, the replacement of a circuit board.
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To install, perform the following steps:

1. Remove the standoff from packaging and push it into the hole near the middle of the main board until it snaps into place.
2. Guide the expansion board over the standoff and align the pins on the under side of the expansion board with the headers on the main board. When the board is positioned correctly, the text on both boards should face the same direction.
3. Gently press the expansion board and the main board together until the expansion board snaps into place over the standoff.
4. Restore field wiring connections to the main board, if applicable, and install field wiring on the expansion board.
5. Restore power to the NUFLO Scanner 2105 flow computer and reboot the Scanner to allow it to detect the expansion board.

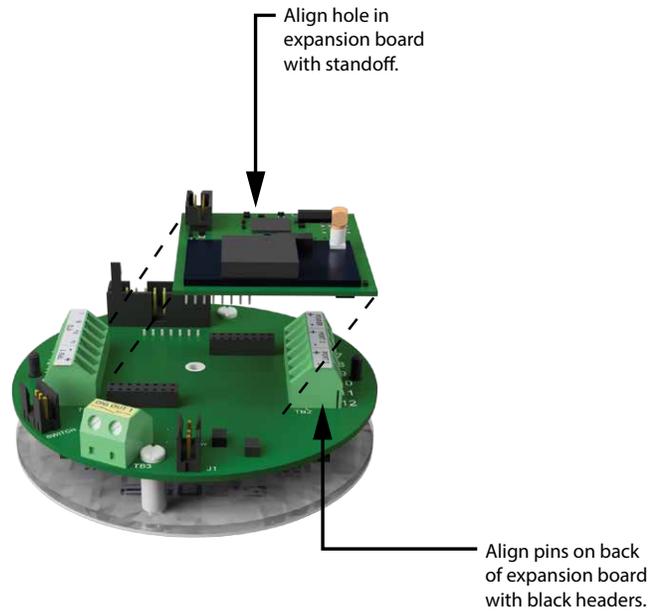


Figure A.1 - NUFLO Scanner 2105 flow computer input/output expansion board

Wiring Diagrams

Analog Inputs 1 and 2

The analog inputs, which can be configured for a 0-5 V, 1-5 V or 4-20 mA signal (as shown in [Figure A.2, pg. A-3](#)), can be used to receive readings from a pressure or temperature transmitter for use in AGA 7 gas calculations. Alternatively, they can be used to log measurements from any device with a 0-5 V, 1-5 V or 4-20 mA output.

The NUFLO Scanner 2105 flow computer may provide transmitter power to for an analog input device. The instrument's transmitter power output voltage is 11.75 VDC, and is limited to 20 mA.

If a 4-20 mA transmitter is used, a resistor must be added to the circuit, as shown in [Figure A.2, pg. A-3](#). The expansion board circuit will support a resistor range of 200 to 300 ohms; 250 ohms is recommended.

Note	If loop power is used as the external power source, it cannot power the sensor connected to the analog input. If the NUFLO Scanner 2105 flow computer sensor power is enabled, then the batteries will be used to power the sensor. Using the batteries in this way may significantly reduce the life of the batteries, as loop power will not charge the battery pack. It is recommended to only use the NUFLO Scanner 2105 flow computer sensor power if external power (that is not loop power) is available.
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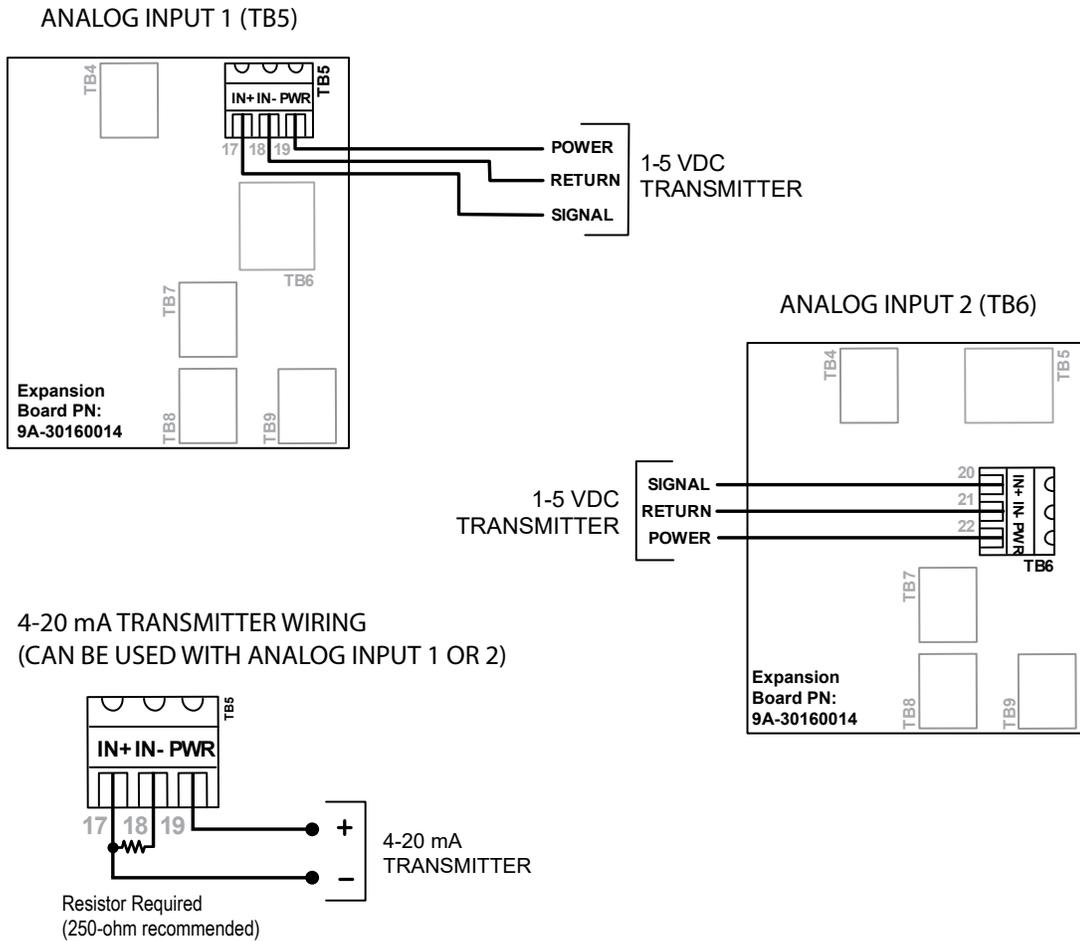


Figure A.2 - 0 to 5 V, 1 to 5 V and 4 to 20 mA analog input wiring

Pulse Input

The pulse input provides an optically isolated input for high-amplitude pulse (frequency) signals, which includes signals from a turbine meter equipped with a preamplifier (Figure A.3, pg. A-4, top diagram) or signals from a positive displacement meter (Figure A.3, bottom diagram).

The NUFLO Scanner 2105 flow computer can calculate flow from no more than two pulse (frequency) inputs at a time. Therefore, a pulse input can be used simultaneously with only one turbine input (main board or expansion board).

The pulse input can also be used as a status input for monitoring a parameter via Modbus registers.

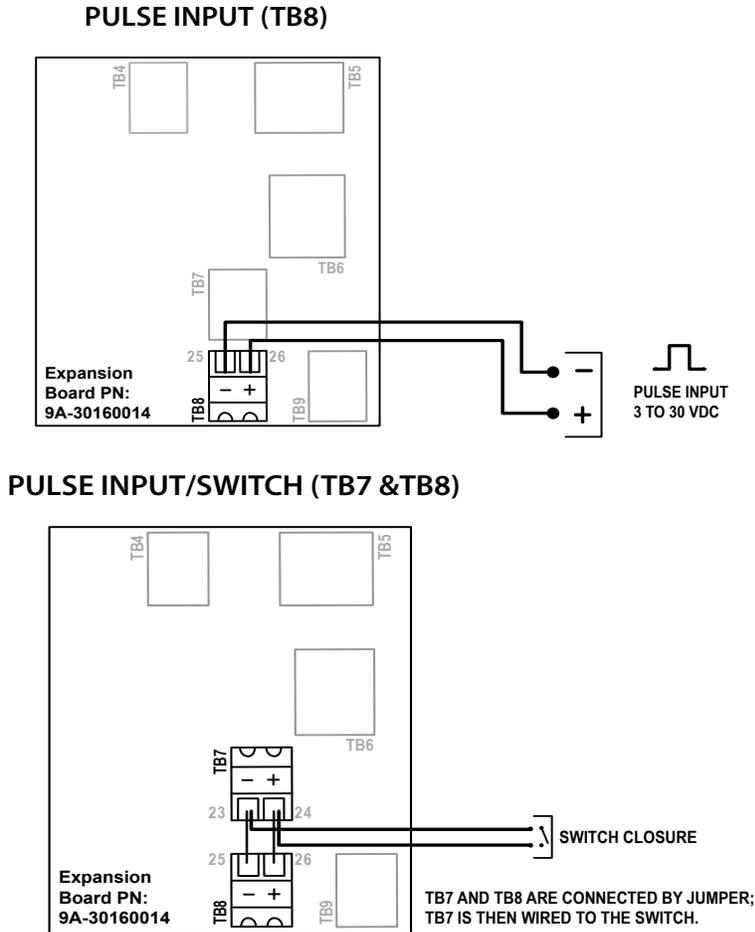


Figure A.3 - Pulse input wiring

Turbine Flowmeter Input 2

Turbine Input 2 (Figure A.4) accepts a turbine flowmeter input signal generated by a magnetic pickup. The NUFLO Scanner 2105 flow computer can be configured to use this signal to calculate and display instantaneous flow rates and accumulated totals. Turbine Input 2 is in addition to the turbine input on the main circuit board. When the expansion board is installed, a differential pressure flow run and two turbine runs can be monitored and logged simultaneously.

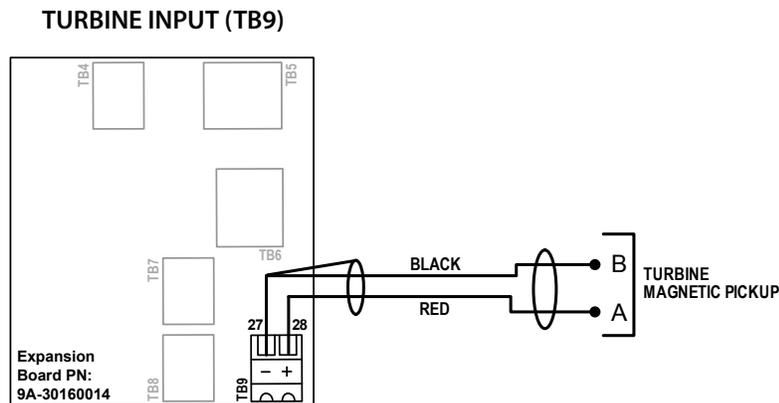


Figure A.4 - Turbine Input 2 wiring

Analog Output

The NUFLO Scanner 2105 flow computer analog output (also loop power) is used to both power the device and to provide an analog output. For wiring, see [External Power Supply \(Loop Power\)](#), pg. 63 and [Analog Output](#), pg. 67.

IMPORTANT	DO NOT USE the analog output on the expansion board (Figure A.5), as the functionality has been removed and moved over to the backplate board.
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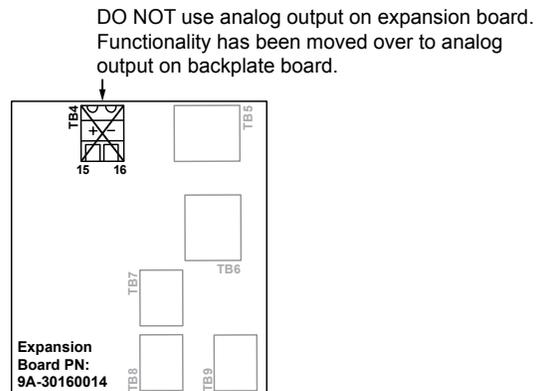


Figure A.5 - DO NOT use analog output on expansion board

Explosion-proof Control Switches

Momentary Switch (CSA, Class I, Div. 1 and 2)

An alternative to the automatic scroll display of parameters on the LCD, a momentary explosion-proof control switch ([Figure A.6](#)) allows the user to clear (zero) grand totals for flow run and turbine inputs, manually pace parameters displayed on the LCD, and view daily logs instantaneously without removing the instrument cover or connecting the instrument to a laptop computer. For wireless devices, it can also expedite connection to a QRATE Scanner 3000 series integrated control flow computer network (see [Expediting a Wireless Network Connection](#), pg. 82). The switch is available in a CSA-approved model for Div. 1 and Div. 2 installations.



Figure A.6 - Momentary explosion-proof control switch

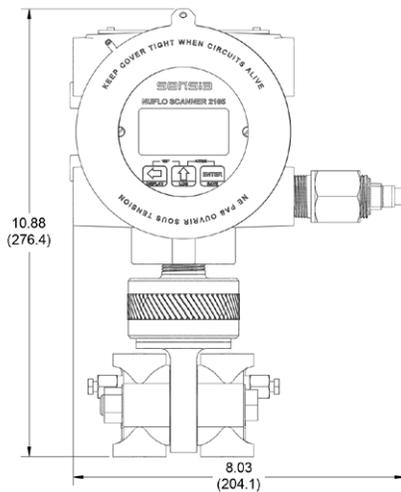


Figure A.7 - NUFLO Scanner 2105 flow computer dimensions with momentary explosion-proof control switch

The switch mounts in either threaded conduit opening in the instrument housing. If the switch is ordered with a NUFLO Scanner 2105 flow computer, it will be installed prior to shipment. To add a switch to an existing NUFLO Scanner 2105 flow computer, plug the switch into connector J2 on the main circuit board ([Figure A.8](#)).

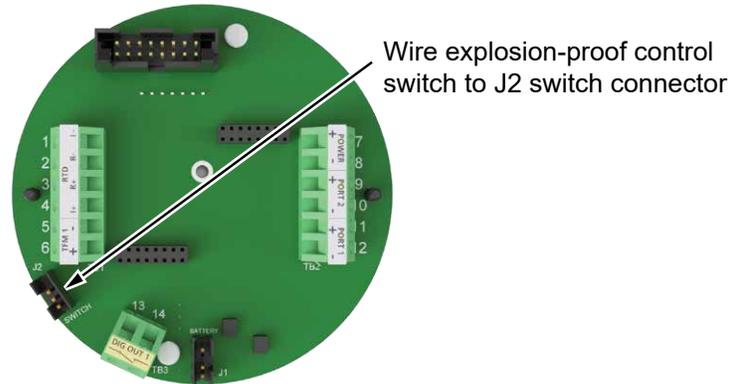


Figure A.8 - Wiring of momentary switch

To select a display parameter for viewing, press and release the push-button switch. With each subsequent press of the switch, the LCD will display a new parameter (Figure A.9). Parameters will appear in the order specified by the user when he configured the display. If the user does not press the button to manually advance to the next parameter, each parameter will be displayed for 30 seconds before the LCD resumes its automatic scroll.

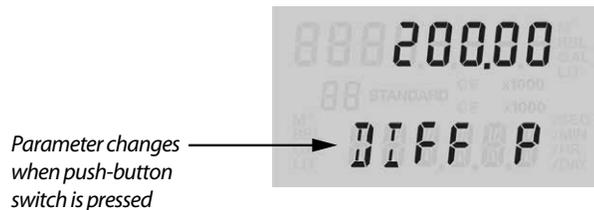


Figure A.9 - LCD display of real-time measurements

To access daily logs, press and hold the push-button switch for approximately 4 seconds. In the daily log viewing mode, the LCD will display the daily volume recorded (at the top), the date stamp (bottom), and a two-digit index that indicates the number of days since the log was created (Figure A.10). When you enter this mode, the LCD automatically displays the daily log value from the previous day, which is marked by an index value of "01."

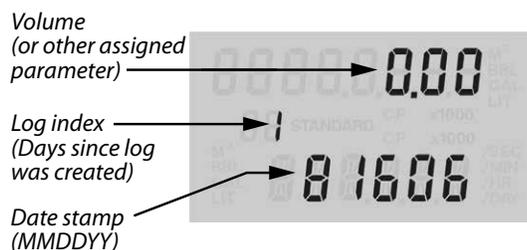


Figure A.10 - LCD display of daily logs

To view logs recorded prior to this date, press the push-button switch repeatedly. The index number will increase in value (02, 03, etc.) as the logs progress back in time, and the corresponding daily log volumes and dates will appear on the LCD. The log display will remain in view for 30 seconds before the LCD resumes its automatic scroll of display parameters. To clear (zero) grand totals for Flow Run 1, Turbine 1, and Turbine 2, press and hold the push-button switch for approximately 10 seconds and release.

RTD Assemblies

Explosion-Proof RTD Assembly (CSA, Class I, Div. 1)

The Barton Model 21 RTD, shown in [Figure A.11](#) is a 4-wire, 100-ohm weatherproof and explosion-proof RTD assembly that can be connected to the NUFLO Scanner 2105 flow computer enclosure without conduit in a Class I, Div. 1 installation. Factory-sealed, armored leads are covered in PVC. The RTD assembly can be ordered with tech cable lengths of 5, 10, or 30 ft, and is available with a 6-in. or 12-in. RTD probe. Cable length and probe length are specified in the model part number: 9A-21-XX-YY where XX is the cable length and YY is the probe length.

The Model 21 RTD is CSA-certified for use in Class I, Groups B, C, and D; Class II, Groups E, F and G; and Class III hazardous area environments.

Each RTD assembly is fitted with 1/2-in. and 3/4-in. connectors for adapting to various size conduit openings and threadolets. The RTD is field-adjustable for insertion lengths of up to 12 in. For wiring instructions, see [Figure 3.11, pg. 65](#). For part numbers, see [RTD and Cable Assemblies \(CSA-Approved\), pg. 96](#).

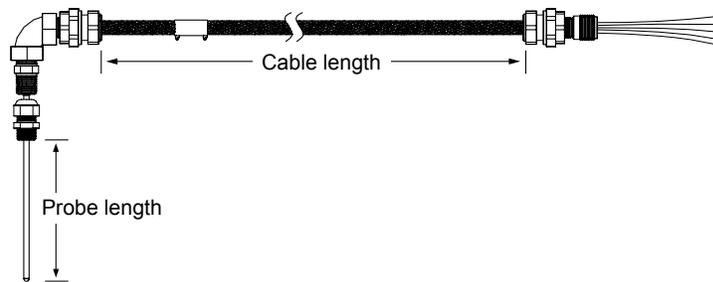


Figure A.11 - Explosion-proof (Div. 1) RTD assembly

Weatherproof RTD Assembly (CSA, Class I, Div. 2)

Sensia's weatherproof RTD is CSA-certified for use in Class I, Div. 2 hazardous area installations. This 4-wire, 100-ohm RTD assembly has a standard 6-in. adjustable probe and can be ordered with cable lengths of 5, 10, 20, or 30 ft. It is fitted with two 1/2-in. MNPT strain reliefs and a 1/2-in. × 3/4-in. reducer for adapting to various size conduit openings and threadolets. For wiring instructions, see [Figure 3.11, pg. 65](#). For part numbers, see [RTD and Cable Assemblies \(CSA-Approved\), pg. 96](#).

Communications Adapters

RS-485 Adapter (CSA, Class I, Div. 1 and Div. 2)

The explosion-proof communications adapter ([Figure A.12](#)) provides an RS-485 connection for connecting a laptop or PC to the instrument without removing the instrument cover. When the adapter is ordered with a NUFLO Scanner 2105 flow computer, it is factory installed. It may be relocated to either conduit opening in the instrument housing. Dimensions are shown in [Figure 2.2, pg. 28](#).

An RS-232 to RS-485 converter cable (available from Sensia) is required for connecting the adapter to a laptop computer. A variety of converter cable options are listed in the Spare Parts list of this manual ([page 95](#)).

The adapter is shipped pre-assembled in the NUFLO Scanner 2105 flow computer when it is ordered with the unit. The installed adapter is comprised of an RS-485 adapter socket, a blanking plug, and a union nut. A plug connector that mates with the RS-485 adapter socket when the adapter is in use is shipped with the device (uninstalled). This plug connector should be wired to an RS-485 converter cable, and stored with the cable when the COM adapter is not in use. Wiring instructions for connecting the plug connector to an RS-485 converter cable are provided in [Figure A.13, pg. A-9](#).

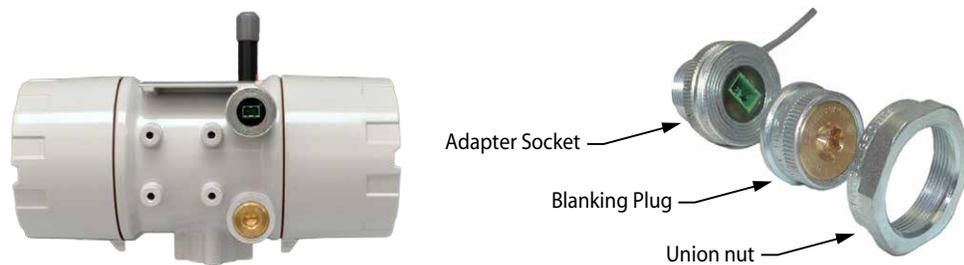


Figure A.12 - Explosion-proof communications adapter



WARNING

When a hazardous area is present, ensure the union nut and blanking plug are properly fitted in the conduit opening. The hazardous location rating applies only when the union nut and blanking plug are secured in place. When the union is broken, the device is no longer explosion-proof. Before disassembling the union nut and blanking plug, make sure the area is non-hazardous.

To connect a PC or laptop to the communications adapter, perform the following steps:

1. Unscrew the union nut to expose the connector socket shown in [Figure A.13](#). A blanking plug will be removed with the union nut. Store the union nut and blanking plug in a safe place. (They will need to be reinstalled when the adapter is not in use.)
2. Connect the plug connector to an RS-485 converter cable, if it is not already attached ([Figure A.13](#)).

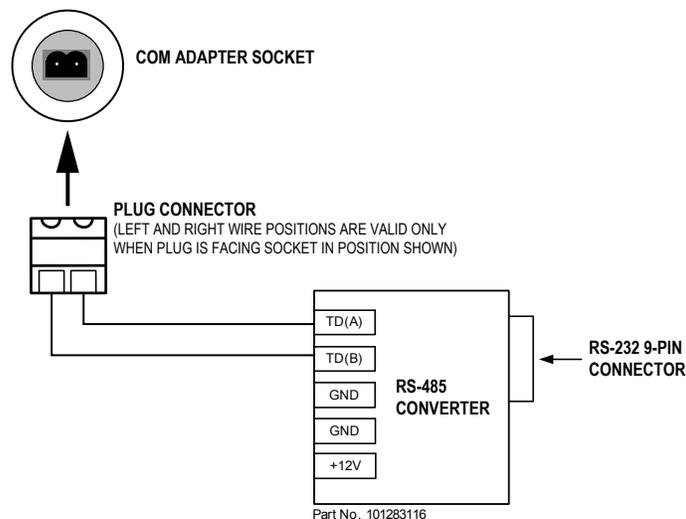


Figure A.13 - Wiring of plug connector to Sensia 9-pin RS-232 to RS-485 converter cable

3. Insert the plug connector into the adapter socket.
4. Connect the converter cable to the PC or laptop.

Disconnecting the RS-485 Adapter

To disconnect the adapter, remove the plug connector (with converter cable attached) from the socket, place the blanking plug inside the union nut (removed in Step 1 of the installation procedure) and screw the union nut onto the union half to cover the socket. Hand-tighten to ensure a snug connection.

Note

It is not necessary to disconnect the plug connector from the RS-232 to RS-485 converter cable when it is not in use. For best results, store the plug connector with the converter cable in a dry and easily accessible area.

RS-485 Adapter Field Installation



WARNING

If the communications adapter is purchased separately from the NUFLO Scanner 2105 flow computer, the conduit openings in the NUFLO Scanner 2105 flow computer enclosure will be sealed with brass or stainless steel plugs. Do not remove the plug from the enclosure to install the adapter unless the area is known to be non-hazardous.

To install a communications adapter purchased as an aftermarket accessory to an installed NUFLO Scanner 2105 flow computer, perform the following steps:

1. Thread the cable of the adapter through a conduit opening in the instrument housing and screw the adapter into place.
2. Connect the adapter cable to Port 1 on the main circuit board. See [Figure 3.19](#) or [Figure 3.20, pg. 69](#) for wiring diagrams.
3. Connect the plug connector to an RS-485 converter cable.
4. To connect to the NUFLO Scanner 2105 flow computer via the adapter, insert the plug connector into the adapter socket and connect the converter cable to the PC or laptop.

USB Adapter (CSA, Class I, Div. 1 and Div. 2)

The NUFLO USB Adapter ([Figure A.15](#)) allows a user to connect a computer to the NUFLO Scanner 2105 flow computer using a standard off-the-shelf USB connector cable for quick and easy downloads without opening the Scanner enclosure.

The USB adapter is comprised of a USB adapter socket, a blanking plug, and a union nut ([Figure A.15](#)). A CD containing the software for installing the driver is included with the adapter.

When the USB connection is ordered with a NUFLO Scanner 2105 flow computer, the USB adapter is pre-installed at the factory. No field wiring is required. If the USB adapter is purchased as a kit, see [USB Adapter Kit Installation, pg. A-11](#), for installation instructions.

IMPORTANT

Do not connect the USB adapter to a computer until a USB driver is installed using the CD provided. ModWorX cannot connect to a NUFLO Scanner 2105 flow computer without these files. See [Using the Adapter](#) below.

Disconnecting the USB Adapter

When the USB port is not in use, nest the blanking plug inside the union nut and screw the union nut onto the adapter to cover the USB socket ([Figure A.15<OV>](#)). Hand-tighten to ensure a snug connection.



Figure A.14 - NUFLO USB adapter and components

Using the Adapter

The CD supplied with the NUFLO USB Adapter contains the drivers required to enable USB communications for a NUFLO Scanner 2105 flow computer when the NUFLO USB Adapter is installed.

For step-by-step installation instructions, insert the CD in your computer and follow the instructions in the NUFLO USB Adapter_Readme file. The software will install the driver compatible with your computer's operating system.

To complete installation and connect to a NUFLO Scanner 2105 flow computer, a user-supplied universal serial bus USB A/B cable is required (Figure A.15).



Figure A.15 - User-supplied USB A/B cable

When the software is fully installed, the adapter can be connected to the computer and used to connect to the NUFLO Scanner 2105 flow computer via ModWorX (Tools/Select COM Port). For more information on ModWorX, see the ModWorX User Manual.



WARNING

When a hazardous area is present, ensure the union nut and blanking plug are properly fitted in the conduit opening. The explosion-proof rating applies only when the union nut and blanking plug are secured in place. When the union is broken, the device is no longer explosion-proof. Before disassembling the union nut and blanking plug, make sure the area is non-hazardous.

USB Adapter Kit Installation

The USB adapter is comprised of a USB adapter socket, a blanking plug, and a union nut. The blanking plug and union nut are connected to the adapter only when the USB port is not in use.

If the NUFLO USB adapter is purchased as a kit, install it in the NUFLO Scanner 2105 flow computer according to the steps below:

1. Remove the plug from a conduit opening in the NUFLO Scanner 2105 flow computer enclosure.
2. Thread the cable of the adapter through the conduit opening and screw the adapter into place.
3. Wire the adapter cable to Port 1 on the NUFLO Scanner 2105 flow computer main circuit board as shown in Figure A.16 (black wire to negative terminal).
4. If the USB port will not be used immediately, nest the blanking plug inside the union nut and screw the union nut onto the adapter to cover the USB socket. Hand-tighten to ensure a snug connection.

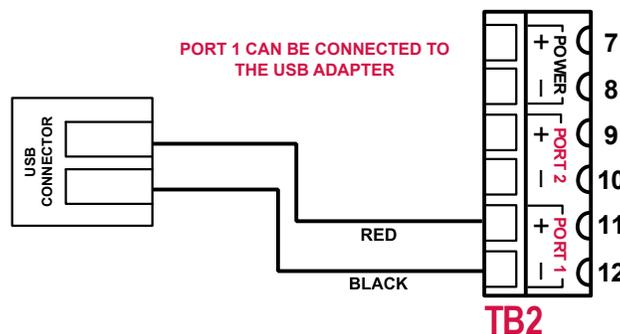


Figure A.16 - Wiring of NUFLO USB adapter (required only when purchased as a kit)

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Appendix B - Battery Information

Lithium Battery Information

Transportation Information


WARNING

The NUFLO Scanner 2105 flow computer contains lithium batteries. The internal component (thionyl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200. Before shipping a lithium battery or equipment containing a lithium battery, verify that the packaging and labeling conforms with the latest version of all applicable regulations.

The transport of the lithium batteries is regulated by the United Nations, "Model Regulations on Transport of Dangerous Goods," (special provisions 188, 230, and 310), latest revision.

Within the US the lithium batteries and cells are subject to shipping requirements under Part 49 of the Code of Federal Regulations (49 CFR, Parts 171, 172, 173, and 175) of the US Hazardous Materials Regulations (HMR), latest revision.

Shipping of lithium batteries in aircraft is regulated by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) requirements in Special Provisions A45, A88 and A99, latest revision.

Shipping of lithium batteries on sea is regulated the International Maritime Dangerous Goods (IMDG) requirements in special provisions 188, 230 and 310, latest revision.

Shipping of lithium batteries on road and rail is regulated by requirements in special provisions 188, 230 and 310, latest revision.

Lithium Battery Disposal

Once a lithium battery is removed from a device and/or is destined for disposal, it is classified as solid waste under EPA guidelines. Depleted lithium batteries are also considered to be hazardous waste because they meet the definition of Reactivity, as per 40 CFR 261.23(a)(2), (3) and (5). This document describes how the lithium reacts violently with water, forms potentially explosive mixtures with water, and when exposed to certain pH conditions, generates toxic cyanide or sulfide gases.

Federal law requires that depleted lithium battery packs be sent to a fully permitted Treatment, Storage and Disposal Facility (TSDF) or to a permitted recycling/reclamation facility.


WARNING

EXPLOSION/FIRE RISK. Never handle or store the lithium battery in an environment that will exceed 100° C (212° F). Consult the MSDS for complete handling instructions.

IMPORTANT

Do not ship lithium battery packs to Sensia. Sensia facilities are not permitted recycling/reclamation facilities.

CAUTION

Profiling and waste characterization procedures must be followed prior to shipping a lithium battery to a disposal site. It is the shipper's responsibility to comply with all applicable federal transportation regulations (see below).

Smart Battery Cell Information

Transportation Information


WARNING

The NUFLO Scanner 2105 flow computer contains SLA (Sealed Lead Acid) battery cells. Do not encase this battery or the NUFLO Scanner 2105 flow computer in a gas tight environment or enclosure. Lead acid batteries produce hydrogen gas during charging and overcharging. If not in a gas tight environment, and allowed to dissipate, this hydrogen gas should not accumulate to a critical concentration that could cause a spark or explosion.

The Department of Transportation (DOT) has classified these SLA battery cells as "non-spillable wet electric storage batteries". These battery cells are compliant with section 173.159 (d) of the 49 CFR, subchapter 173.159. These battery cells are therefore exempt and unregulated regarding shipping requirements of DOT 173.159, and do not have an assigned UN number, and do not require additional DOT hazard communication or placarding.

These battery cells may be shipped by ground or by air without restriction, but the box within which they are being shipped must be labeled "non-spillable" or "non-spillable battery". This label requirement is to inform transportation entities that all battery cells are in compliance with DOT HMR 49 Non-Hazardous Materials, and International Civil Aeronautics Organization (ICAO) and International Air Transport (IATA) Packaging Instruction 806 and Special Provision A67 Vibration and Pressure Differential Tests.

SLA Battery Disposal

Once the smart battery pack is removed from a device and is destined for disposal, it is classified as hazardous waste under EPA guidelines found in 40 CFR, part 273.2 (a)(2). Dispose in accordance with Federal, State, & Local Regulations.

Do not incinerate. Batteries should be shipped to a reclamation facility for recovery of the metal and plastic components as the proper method of waste management.


WARNING

SHORTING RISK. If SLA battery cells are removed from the smart battery pack, or the smart battery pack is opened, do not handle with metal jewelry or around shorting hazards. Consult the MSDS for complete handling instructions.

IMPORTANT

Do not ship lithium battery packs to Sensia. Sensia facilities are not permitted recycling/reclamation facilities.

CAUTION

To ship to a battery disposal site the shipper must ensure the battery cells are protected against short circuits, that the outer packaging plainly and durably reads "NONSPILLABLE" or "NONSPILLABLE BATTERY", that the battery cells are capable of withstanding test specified in 49 CFR 173.159(d), and that the battery cells are protected with absorbent if shipped at temperatures exceeding 55 °C (131°F) or case is cracked. It is the shipper's responsibility to comply with all applicable federal transportation regulations.

CAUTION

Where installed, do not exceed an ambient temperature of 60°C when charging the smart battery. Charging can raise the temperature by up to 20°C, and the battery monitor will shutdown charging if it reaches 80°C. The SLA batteries also have self-regulated thermal shutdown at 80°C.

Battery Safety Datasheets

To obtain the current MSDS for the lithium or SLA battery cells used to power the NUFLO Scanner 2105 flow computer, please email your request to info@sensiglobal.com.

Appendix C - Modbus Communications Protocol

Register Table Version: 16

Introduction

The communications protocol for the NUFLO Scanner 2105 flow computer is in accordance with Modicon, Inc. RTU Mode Modbus as described in *Modicon Modbus Protocol Reference Guide*, PI-MBUS-300 Rev. J, June 1996. All registers are implemented as 4X or holding registers. Reading of registers is implemented via function code 03H (Read Holding Registers). Writing to registers is implemented via function code 10H (Preset Multiple Registers). The instrument provides Enron Modbus compliant downloads for interval, daily and event records. For details on Enron Modbus, refer to *Specifications and Requirements for an Electronic Flow Measurement Remote Terminal Unit for Enron Corp.*, Dec. 5, 1994.

Supported Commands

The Modbus functions supported by the NUFLO Scanner 2105 flow computer are as follows:

Function Code (Hex)	Description
03	Read Holding Registers
05	Preset Boolean (for Enron event record acknowledgement)
10	Preset Multiple Registers
11	Report Slave ID

For the read holding and preset multiple registers, the instrument supports the full 250 bytes of data in a message. This corresponds to 125 registers in 16-bit holding register size and 62 registers in 32-bit holding register size.

The report slave ID function code returns the following registers:

- Product Code
- Register Table Number
- Firmware Version
- Manufacture Date
- Sales Date
- Serial Number 1
- Serial Number 2
- Connected Port
 - 0 = connected to Port 1
 - 1 = connected to Port 2
- Power Mode
- Port Mode
- Port Slave Address
- Port Baud Rate
- Port Bus Delay
- Port Bus Timeout
- Real Date
- Real Time

Data Types

Various data types are implemented in the NUFLO Scanner 2105 flow computer. The following table lists the formats and the numbers of bytes and registers associated with each type.

Data Type	Byte Count	Register Count
Floating Point (FP)	4	2
Floating Point (FP32)	4	1
Unsigned Word (U16)	2	1
Unsigned Long (U32)	4	2
Packed ASCII (PA)	2	1

The word ordering for multiple register data types, such as floating-point numbers or long integers, is for the most significant word to appear first in the message.

The Unsigned Word (U16) type is used for 16-bit integers and fits into one register.

The Packed ASCII (PA) type contains two bytes that are two unsigned characters. Generally, multiple Packed ASCII types are arranged consecutively for implementing strings. For example, the Device Name is a string of 20 unsigned characters that is implemented as 10 Packed ASCII registers. Here is an example of a device name that contains the string, "Test Well 413."

Register	Hexadecimal #	ASCII Characters
240	54 65	Te
241	73 74	st
242	20 57	<SPACE>W
243	65 6C	el
244	6C 20	I<SPACE>
245	34 31	41
246	33 FF	3<UNUSED>
247	FF FF	<UNUSED><UNUSED>
248	FF FF	<UNUSED><UNUSED>
249	FF FF	<UNUSED><UNUSED>

Unused characters at the end of each string will report 0xFF hexadecimal.

Security

To communicate with a NUFLO Scanner 2105 flow computer without the use of ModWorX software (i.e. via a third-party polling device), security permissions for the applicable NUFLO Scanner 2105 flow computer communications port must be set to the default (unrestricted) state. If a different security level is required, contact Sensia technical support for details. Security levels can be restored to default permissions with ModWorX software.

Registers

Each register has an Access type: read-only or read-write, as described below.

Access Type	Description
Read Only (RO)	Register can only be read
Read/Write (RW)	Register can be read and written

The registers are grouped into Modbus map blocks according to function. The NUFLO Scanner 2105 flow computer contains the following map functions.

Map	Starting Register	Firmware Supported
Control Registers	70	All
System Configuration	1000	All
Communications Configuration	1100	All
Real Time	1200	All
Power Configuration	1300	All
Archive Configuration	1400	All
Turbine 1 Configuration	2000	All
Turbine 1 Calibration	2030	All
Turbine 2 Configuration	2100	All
Turbine 2 Calibration	2130	All
Static Pressure Configuration	2200	All
Static Pressure Calibration	2230	All
RTD Configuration	2300	All
RTD Calibration	2330	All
Differential Pressure Configuration	2400	All
Differential Pressure Calibration	2430	All
Analog Input 1 Configuration	2500	All
Analog Input 1 Calibration	2530	All
Analog Input 2 Configuration	2600	All
Analog Input 2 Calibration	2630	All
Digital Input Configuration	2900	All
Flow Run 1 Configuration	3000	All
Flow Run 1 Calibration	3200	All
Flow Run Alarms	3600	All
Output Configuration	4000	All
Holding Registers (32-bit)	7000	All
Archive Preview Registers (32-bit)	7400	All
Holding Registers	8000	All
Archive Preview Registers	8800	All
User-Defined Register Pointers	9000	All
User-Defined Holding Registers	9100	All
Device Status Registers	9900	All

Note	All registers cited in this document refer to the address of the register that appears in the actual Modbus message. For example, register 8000 has an address of 0x1F40 hexadecimal in the message.
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Control Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
70	46	Control Register 1	U16	RW

The Control Registers allow specific functions to be implemented via the communications port. The following table shows the value to be written to the control register to implement the desired function.

Code	Function
20000	Transfers the polling totals and averages and polling run times to the previous polling totals, averages and previous run-time registers, increments the polling index register, and resets the polling totals, averages and polling run-time registers.
30000	Clears all flow totals
30001	Clears Flow Run 1 totals
30003	Clears Turbine 1 totals
30004	Clear Turbine 2 totals
30050	Clears all pulse output latches
30051	Clears a Pulse Output 1 latch
30061	Adds pulses specified in Control Register 2 to Pulse Output 1 Accumulator
30100	Clear all Alarm States
30101	Clear Flow Run Alarm Status
30102	Clear Input Alarm Status
40000	Loads factory defaults
40040	Resets the microcontroller (watchdog)
50050	Creates a partial archive record (daily and interval)

System Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access
1000	3E8	Product Code and Feature Privileges	U16	RO
1001	3E9	Register Table Version	U16	RO
1002	3EA	Firmware Version	U16	RO
1003	3EB	Manufacture Date	U16	RO
1004	3EC	Sales Date	U16	RO
1005	3ED	Serial Number High	U16	RO
1006	3EE	Serial Number Low	U16	RO
1007	3EF	Sensor Serial Number[0]	PA	RO
1008	3F0	Sensor Serial Number[1]	PA	RO
1009	3F1	Sensor Serial Number[2]	PA	RO
1010	3F2	Sensor Serial Number[3]	PA	RO
1011	3F3	Sensor Serial Number[4]	PA	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
1012	3F4	Sensor Serial Number[5]	PA	RO
1013	3F5	Expansion Board Manufacture Date	U16	RO
1014	3F6	Expansion Board Sales Date	U16	RO
1015	3F7	Expansion Serial Number High	U16	RO
1016	3F8	Expansion Serial Number Low	U16	RO
1017	3F9	Expansion Board Configuration	U16	RO

Product Code

The Product Code is a read-only parameter used for identifying a NUFLO Scanner 2105 flow computer device and its enabled advanced features (such as PID controller and Modbus Master) using the ModWorX software. This parameter is defined at the factory.

Firmware Version/Register Table Version

The Firmware Version and Register Table Version numbers are set by the factory and are read-only. To determine the version number, read the appropriate register and divide the value by 100. The general format for version numbers is A.BC. For example the firmware register number is read as 0xA7 hexadecimal. This represents the value 167 and a firmware version of 1.67.

Manufacture Date/Sales Date

These parameters are set at the factory and are read-only. These registers are formatted as MMY. For example, a value of 0912 represents the date September 2012.

Communications Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1100	44C	Port 1 - Port Usage 0 - Slave 1 - Master	U16	RW	0
1101	44D	Port 1 Slave Address [1 to 65535, excluding 252 to 255 and 64764]	U16	RW	1
1102	44E	Port 1 - Baud Rate 0 - 300 1 - 600 2 - 1200 3 - 2400 4 - 4800	U16	RW	5
		5 - 9600 6 - 19200 7 - 38400 8 - 57600 9 - 115200			
1103	44F	Port 1 - Bus Delay mS of delay before transmitting data	U16	RW	10
1104	450	Port 1 - Bus Timeout mS of delay before resetting communications	U16	RW	50
1105	451	Port 2 - Port Usage 0 - Slave Only	U16	RW	0
1106	452	Port 2 Network ID [1 to 65535]	U16	RW	1
1107	453	Port 2 - Slave ID [1 to 65535]	U16	RW	1

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1108	454	Port 2 - Bus Delay mS of delay before transmitting data	U16	RW	10
1109	455	Port 2 - Bus Timeout mS of delay before resetting communications	U16	RW	50

Real Time

This block of registers is used to set the instrument's internal clock. To set the time, it is recommended that all registers be written in one message. The time and date can also be read in the holding register groups as floating-point data.

Register (Decimal)	Register (Hex)	Description	Data Type	Access
1200	4B0	Year (Real Year = register value plus 2100)	U16	RW
1201	4B1	Month [1-12]	U16	RW
1202	4B2	Day [1-31]	U16	RW
1203	4B3	Hour [0-23]	U16	RW
1204	4B4	Minute [0-59]	U16	RW
1205	4B5	Second [0-59]	U16	RW

Power Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1300	514	Power Mode 0 - High Power 1 - Low Power	U16	RW	1
1301	515	Clock Override	U16	RW	0
1302	516	Internal System Sample Period [number of seconds between battery voltage and electronics temperature measurements]	U16	RW	3600
1303	517	External Sensor Power Control Sensor Warm-up Time [0 – 2048 sec] Add 32768 to lock sensor power on.	U16	RW	32770

Archive Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1400	578	Archive Reference Number	U16	RO	10000
1401	579	Contract Hour [0-23]	U16	RW	8 (AM)
1402	57A	Interval Period [5 seconds to 12 hours]	U16	RW	3600 seconds (1 hour)
1403	57B	Partial Records 0 - Not Enabled 1 – Enabled	U16	RW	0

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1404	57C	Number of Daily Records	U16	RO	768
1405	57D	Number of Interval Records	U16	RO	2304 (Std) 6392 (Exp. Board)
1406	57E	Number of Events Records	U16	RO	1152
1407	57F	Number of Parameters	U16	RW	11
1408	580	Archive Field 1	U16	RO	Date
1409	581	Archive Field 2	U16	RO	Time
1410	582	Archive Field 3	U16	RW	FR1 Volume
1411	583	Archive Field 4	U16	RW	FR1 Mass
1412	584	Archive Field 5	U16	RW	FR1 Energy
1413	585	Archive Field 6	U16	RW	Diff Pressure
1414	586	Archive Field 7	U16	RW	Static Pressure
1415	587	Archive Field 8	U16	RW	Process Temp
1416	588	Archive Field 9	U16	RW	FR1 Run Time
1417	589	Archive Field 10	U16	RW	T1 Volume
1418	58A	Archive Field 11	U16	RW	T1 Run Time
1419	58B	Archive Field 12	U16	RW	Unused
1420	58C	Archive Field 13	U16	RW	Unused
1421	58D	Archive Field 14	U16	RW	Unused
1422	58E	Archive Field 15	U16	RW	Unused
1423	58F	Archive Field 16	U16	RW	Unused

Turbine 1 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2000	7D0	T1 - Units See Units of Measurement, pg. C-49	U16	RW	102 – BBL
2001	7D1	T1 - Time Base 0 = Second 1 = Minute 2 = Hour 3 = Day	U16	RW	3
2002	7D2	T1 - Sampling Period (sec)	U16	RW	5
2003	7D3	T1 - Dampening Factor	U16	RW	0
2004	7D4	T1 - Input Configuration 0 - TFM Low (20 mV @ <1000 Hz) 1 - TFM Med (50 mV @ <1000 Hz) 2 - TFM High (100 mV @ <1000 Hz) 3 - TFM Max (200 mV @ <1000 Hz) 4 - Pulse Input (with expansion board)	U16	RW	1
2005	7D5	T1 - Override Enable 0 - Disabled 1 - Enabled	U16	RW	0
2006	7D6	T1 - Override Value	FP	RW	0.00
2008	7D8	T1 - Fail Value	FP	RW	0.00
2010	7DA	T1 - Low Frequency Cutoff	FP	RW	5.00
2012	7DC	T1 - Low Flow Cutoff	FP	RW	0.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2014	7DE	T1 - Sensor Range Low	FP	RW	0.00
2016	7E0	T1 - Sensor Range High	FP	RW	0.833333333
2018	7E2	T1 - Units Scale Factor	FP	RW	0.023809524
2020	7E4	T1 - Units Offset Factor	FP	RW	0
2022	7E6	T1 - Unit Description 1	LCD	RW	—
2023	7E7	T1 - Unit Description 2	LCD	RW	—
2024	7E8	T1 - Unit Description 3	LCD	RW	—

Turbine 1 Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2030	7EE	T1 - Calibration Type ¹	U16	RW	1
2031	7EF	T1 - Linear Factor	FP	RW	900.00
2033	7F1	T1 - Calibration Absolute Offset	FP	RW	0.00
2035	7F3	T1 - Factor 1	FP	RW	900.00
2037	7F5	T1 - Factor 2	FP	RW	1.00
2039	7F7	T1 - Factor 3	FP	RW	1.00
2041	7F9	T1 - Factor 4	FP	RW	1.00
2043	7FB	T1 - Factor 5	FP	RW	1.00
2045	7FD	T1 - Factor 6	FP	RW	1.00
2047	7FF	T1 - Factor 7	FP	RW	1.00
2049	801	T1 - Factor 8	FP	RW	1.00
2051	803	T1 - Factor 9	FP	RW	1.00
2053	805	T1 - Factor 10 ²	FP	RW	1.00
2055	807	T1 - Factor 11 ²	FP	RW	1.00
2057	809	T1 - Factor 12 ²	FP	RW	1.00
2059	80B	T1 - Frequency 1	FP	RW	1.00
2061	80D	T1 - Frequency 2	FP	RW	1.00
2063	80F	T1 - Frequency 3	FP	RW	1.00
2065	811	T1 - Frequency 4	FP	RW	1.00
2067	813	T1 - Frequency 5	FP	RW	1.00
2069	815	T1 - Frequency 6	FP	RW	1.00
2071	817	T1 - Frequency 7	FP	RW	1.00
2073	819	T1 - Frequency 8	FP	RW	1.00
2075	81B	T1 - Frequency 9	FP	RW	1.00
2077	81D	T1 - Frequency 10 ²	FP	RW	1.00
2079	81F	T1 - Frequency 11 ²	FP	RW	1.00
2081	821	T1 - Frequency 12 ²	FP	RW	1.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Turbine 2 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2100	834	T2 - Units See Units of Measurement, pg. C-49	U16	RW	102 – BBL
2101	835	T2 - Time Base	U16	RW	3 – Day
2102	836	T2 - Sampling Period (sec)	U16	RW	5
2103	837	T2 - Dampening Factor	U16	RW	0
2104	838	T2 - Input Configuration 0 - TFM Low (20 mV @ <1000 Hz) 1 - TFM Med (50 mV @ <1000 Hz) 2 - TFM High (100 mV @ <1000 Hz) 3 - TFM Max (200 mV @ <1000 Hz)	U16	RW	1
2105	839	T2 - Override Enable 0 - Disabled 1 - Enabled	U16	RW	0
2106	83A	T2 - Override Value	FP	RW	0.00
2108	83C	T2 - Fail Value	FP	RW	0.00
2110	83E	T2 - Low Frequency Cutoff	FP	RW	5.00
2112	840	T2 - Low Flow Cutoff	FP	RW	0.00
2114	842	T2 - Sensor Range Low	FP	RW	0.00
2116	844	T2 - Sensor Range High	FP	RW	0.83333333
2118	846	T2 - Units Scale Factor	FP	RW	0.02380952
2120	848	T2 - Units Offset Factor	FP	RW	0.00
2122	84A	T2 - Unit Description 1	LCD	RW	—
2123	84B	T2 - Unit Description 2	LCD	RW	—
2124	84C	T2 - Unit Description 3	LCD	RW	—

Turbine 2 Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2130	852	T2 - Calibration Type ¹	U16	RW	1
2131	853	T2 - Linear Factor	FP	RW	900.00
2133	855	T2 - Calibration Absolute Offset	FP	RW	0.00
2135	857	T2 - Factor 1	FP	RW	900.00
2137	859	T2 - Factor 2	FP	RW	1.00
2139	85B	T2 - Factor 3	FP	RW	1.00
2141	85D	T2 - Factor 4	FP	RW	1.00
2143	85F	T2 - Factor 5	FP	RW	1.00
2145	861	T2 - Factor 6	FP	RW	1.00
2147	863	T2 - Factor 7	FP	RW	1.00
2149	865	T2 - Factor 8	FP	RW	1.00
2151	867	T2 - Factor 9	FP	RW	1.00
2153	869	T2 - Factor 10 ²	FP	RW	1.00
2155	86B	T2 - Factor 11 ²	FP	RW	1.00
2157	86D	T2 - Factor 12 ²	FP	RW	1.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2159	86F	T2 - Frequency 1	FP	RW	1.00
2161	871	T2 - Frequency 2	FP	RW	1.00
2163	873	T2 - Frequency 3	FP	RW	1.00
2165	875	T2 - Frequency 4	FP	RW	1.00
2167	877	T2 - Frequency 5	FP	RW	1.00
2169	879	T2 - Frequency 6	FP	RW	1.00
2171	87B	T2 - Frequency 7	FP	RW	1.00
2173	87D	T2 - Frequency 8	FP	RW	1.00
2175	87F	T2 - Frequency 9	FP	RW	1.00
2177	881	T2 - Frequency 10 ²	FP	RW	1.00
2179	883	T2 - Frequency 11 ²	FP	RW	1.00
2181	885	T2 - Frequency 12 ²	FP	RW	1.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Static Pressure Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2200	898	SP - Units See Units of Measurement, pg. C-49 Units of Measurement, pg. C-49	U16	RW	301
2201	899	SP - Time Base	U16	RW	0
2202	89A	SP - Sampling Period	U16	RW	1
2203	89B	SP - Dampening Factor	U16	RW	0
2204	89C	SP - Input Configuration	U16	RW	1
2205	89D	SP - Override Enable 0 - Disabled 1 - Enabled 2 - Flow Dependent Averaging	U16	RW	2
2206	89E	SP - Override Value	FP	RW	0.00
2208	8A0	SP - Fail Value	FP	RW	0.00
2210	8A2	SP - Low Input Cutoff	FP	RW	0.00
2212	8A4	SP - Low Flow Cutoff	FP	RW	0.00
2214	8A6	SP - Sensor Range Low	FP	RO	from MVT
2216	8A8	SP - Sensor Range High	FP	RO	from MVT
2218	8AA	SP - Units Scale Factor	FP	RW	1.00
2220	8AC	SP - Units Offset Factor	FP	RW	0.00
2222	8AE	SP - Unit Description 1	LCD	RW	
2223	8AF	SP - Unit Description 2	LCD	RW	
2224	8B0	SP - Unit Description 3	LCD	RW	

Static Pressure Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2230	8B6	SP - Calibration Type ¹	U16	RW	0
2231	8B7	SP - Nominal Value	FP	RW	1.00
2233	8B9	SP - Calibration Absolute Offset	FP	RW	0.00
2235	8BB	SP - Calibration Actual 1	FP	RW	0.00
2237	8BD	SP - Calibration Actual 2	FP	RW	0.00
2239	8BF	SP - Calibration Actual 3	FP	RW	0.00
2241	8C1	SP - Calibration Actual 4	FP	RW	0.00
2243	8C3	SP - Calibration Actual 5	FP	RW	0.00
2245	8C5	SP - Calibration Actual 6	FP	RW	0.00
2247	8C7	SP - Calibration Actual 7	FP	RW	0.00
2249	8C9	SP - Calibration Actual 8	FP	RW	0.00
2251	8CB	SP - Calibration Actual 9	FP	RW	0.00
2253	8CD	SP - Calibration Actual 10 ²	FP	RW	0.00
2255	8CF	SP - Calibration Actual 11 ²	FP	RW	0.00
2257	8D1	SP - Calibration Actual 12 ²	FP	RW	0.00
2259	8D3	SP - Calibration Measured 1	FP	RW	0.00
2261	8D5	SP - Calibration Measured 2	FP	RW	0.00
2263	8D7	SP - Calibration Measured 3	FP	RW	0.00
2265	8D9	SP - Calibration Measured 4	FP	RW	0.00
2267	8DB	SP - Calibration Measured 5	FP	RW	0.00
2269	8DD	SP - Calibration Measured 6	FP	RW	0.00
2271	8DF	SP - Calibration Measured 7	FP	RW	0.00
2273	8E1	SP - Calibration Measured 8	FP	RW	0.00
2275	8E3	SP - Calibration Measured 9	FP	RW	0.00
2277	8E5	SP - Calibration Measured 10 ²	FP	RW	0.00
2279	8E7	SP - Calibration Measured 11 ²	FP	RW	0.00
2281	8E9	SP - Calibration Measured 12 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

RTD Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2300	8FC	PT - Units See Units of Measurement, pg. C-49	U16	RW	501
2301	8FD	PT - Time Base 0 = Second 1 = Minute 2 = Hour 3 = Day	U16	RW	0
2302	8FE	PT - Sampling Period (sec)	U16	RW	5
2303	8FF	PT - Dampening Factor	U16	RW	0
2304	900	PT - Input Configuration	U16	RW	0
2305	901	PT - Override Enable 0 - Disabled 1 - Enabled 2 - Flow Dependent Averaging	U16	RW	2
2306	902	PT - Override Value	FP	RW	0.00
2308	904	PT - Fail Value	FP	RW	60.00 °F
2310	906	PT - Low Input Cutoff	FP	RW	-100.00 °F
2312	908	PT - Low Flow Cutoff	FP	RW	-100.00
2314	90A	PT - Sensor Range Low	FP	RO	-40.00 °F
2316	90C	PT - Sensor Range High	FP	RO	300.00 °F
2318	90E	PT - Units Scale Factor	FP	RW	1.80
2320	910	PT - Units Offset Factor	FP	RW	32.00
2322	912	PT - Unit Description 1	LCD	RW	—
2323	913	PT - Unit Description 2	LCD	RW	—
2324	914	PT - Unit Description 3	LCD	RW	—

RTD Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2330	91A	PT - Calibration Type ¹	U16	RW	0
2331	91B	PT - Nominal Value	FP	RW	1.00
2333	91D	PT - Calibration Absolute Offset	FP	RW	0.00
2335	91F	PT - Calibration Actual 1	FP	RW	0.00
2337	921	PT - Calibration Actual 2	FP	RW	0.00
2339	923	PT - Calibration Actual 3	FP	RW	0.00
2341	925	PT - Calibration Actual 4	FP	RW	0.00
2343	927	PT - Calibration Actual 5	FP	RW	0.00
2345	929	PT - Calibration Actual 6	FP	RW	0.00
2347	92B	PT - Calibration Actual 7	FP	RW	0.00
2349	92D	PT - Calibration Actual 8	FP	RW	0.00
2351	92F	PT - Calibration Actual 9	FP	RW	0.00
2353	931	PT - Calibration Actual 10 ²	FP	RW	0.00
2355	933	PT - Calibration Actual 11 ²	FP	RW	0.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2357	935	PT - Calibration Actual 12 ²	FP	RW	0.00
2359	937	PT - Calibration Measured 1	FP	RW	0.00
2361	939	PT - Calibration Measured 2	FP	RW	0.00
2363	93B	PT - Calibration Measured 3	FP	RW	0.00
2365	93D	PT - Calibration Measured 4	FP	RW	0.00
2367	93F	PT - Calibration Measured 5	FP	RW	0.00
2369	941	PT - Calibration Measured 6	FP	RW	0.00
2371	943	PT - Calibration Measured 7	FP	RW	0.00
2373	945	PT - Calibration Measured 8	FP	RW	0.00
2375	947	PT - Calibration Measured 9	FP	RW	0.00
2377	949	PT - Calibration Measured 10 ²	FP	RW	0.00
2379	94B	PT - Calibration Measured 11 ²	FP	RW	0.00
2381	94D	PT - Calibration Measured 12 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Differential Pressure Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2400	960	DP - Units See Units of Measurement, pg. C-49	U16	RW	401
2401	961	DP - Time Base 0 = Second 1 = Minute 2 = Hour 3 = Day	U16	RW	0
2402	962	DP - Sampling Period (seconds)	U16	RW	1
2403	963	DP - Dampening Factor	U16	RW	0
2404	964	DP - Input Configuration	U16	RW	0
2405	965	DP - Override Enable 0 - Disabled 1 - Enabled 2 - Flow Dependent Averaging	U16	RW	2
2406	966	DP - Override Value	FP	RW	0.00
2408	968	DP - Fail Value	FP	RW	0.00
2410	96A	DP - Low Input Cutoff	FP	RW	0.00
2412	96C	DP - Low Flow Cutoff	FP	RW	0.00
2414	96E	DP - Sensor Range Low	FP	RO	from MVT
2416	970	DP - Sensor Range High	FP	RO	from MVT
2418	972	DP - Units Scale Factor	FP	RW	1.00
2420	974	DP - Units Offset Factor	FP	RW	0.00
2422	976	DP - Unit Description 1	LCD	RW	—

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2423	977	DP - Unit Description 2	LCD	RW	—
2424	978	DP - Unit Description 3	LCD	RW	—

Differential Pressure Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2430	97E	DP - Calibration Type ¹	U16	RW	0
2431	97F	DP - Nominal Value	FP	RW	1.00
2433	981	DP - Calibration Absolute Offset	FP	RW	0.00
2435	983	DP - Calibration Actual 1	FP	RW	0.00
2437	985	DP - Calibration Actual 2	FP	RW	0.00
2439	987	DP - Calibration Actual 3	FP	RW	0.00
2441	989	DP - Calibration Actual 4	FP	RW	0.00
2443	98B	DP - Calibration Actual 5	FP	RW	0.00
2445	98D	DP - Calibration Actual 6	FP	RW	0.00
2447	98F	DP - Calibration Actual 7	FP	RW	0.00
2449	991	DP - Calibration Actual 8	FP	RW	0.00
2451	993	DP - Calibration Actual 9	FP	RW	0.00
2453	995	DP - Calibration Actual 10 ²	FP	RW	0.00
2455	997	DP - Calibration Actual 11 ²	FP	RW	0.00
2457	999	DP - Calibration Actual 12 ²	FP	RW	0.00
2459	99B	DP - Calibration Measured 1	FP	RW	0.00
2461	99D	DP - Calibration Measured 2	FP	RW	0.00
2463	99F	DP - Calibration Measured 3	FP	RW	0.00
2465	9A1	DP - Calibration Measured 4	FP	RW	0.00
2467	9A3	DP - Calibration Measured 5	FP	RW	0.00
2469	9A5	DP - Calibration Measured 6	FP	RW	0.00
2471	9A7	DP - Calibration Measured 7	FP	RW	0.00
2473	9A9	DP - Calibration Measured 8	FP	RW	0.00
2475	9AB	DP - Calibration Measured 9	FP	RW	0.00
2477	9AD	DP - Calibration Measured 10 ²	FP	RW	0.00
2479	9AF	DP - Calibration Measured 11 ²	FP	RW	0.00
2481	9B1	DP - Calibration Measured 12 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Analog Input 1 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2500	9C4	A1 - Units	U16	RW	0
2501	9C5	A1 - Time Base	U16	RW	0
2502	9C6	A1 - Sampling Period	U16	RW	1
2503	9C7	A1 - Dampening Factor	U16	RW	0
2504	9C8	A1 - Input Configuration	U16	RW	0
2505	9C9	A1 - Override Enable	U16	RW	0
2506	9CA	A1 - Override Value	FP	RW	0.00
2508	9CC	A1 - Fail Value	FP	RW	0.00
2510	9CE	A1 - Low Input Cutoff	FP	RW	2.00
2512	9D0	A1 - Low Flow Cutoff	FP	RW	0.00
2514	9D2	A1 - Sensor Range Low	FP	RO	0.00
2516	9D4	A1 - Sensor Range High	FP	RO	0
2518	9D6	A1 - Units Scale Factor	FP	RW	1
2520	9D8	A1 - Units Offset Factor	FP	RW	0
2522	9DA	A1 - Unit Description 1	LCD	RW	—
2523	9DB	A1 - Unit Description 2	LCD	RW	—
2524	9DC	A1 - Unit Description 3	LCD	RW	—

Analog Input 1 Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2530	9E2	A1 - Calibration Type ¹	U16	RW	0
2531	9E3	A1 - Nominal Value	FP	RW	—
2533	9E5	A1 - Calibration Absolute Offset	FP	RW	0.00
2535	9E7	A1 - Calibration Actual 1	FP	RW	0.00
2537	9E9	A1 - Calibration Actual 2	FP	RW	0.00
2539	9EB	A1 - Calibration Actual 3	FP	RW	0.00
2541	9ED	A1 - Calibration Actual 4	FP	RW	0.00
2543	9EF	A1 - Calibration Actual 5	FP	RW	0.00
2545	9F1	A1 - Calibration Actual 6	FP	RW	0.00
2547	9F3	A1 - Calibration Actual 7	FP	RW	0.00
2549	9F5	A1 - Calibration Actual 8	FP	RW	0.00
2551	9F7	A1 - Calibration Actual 9	FP	RW	0.00
2553	9F9	A1 - Calibration Actual 10 ²	FP	RW	0.00
2555	9FB	A1 - Calibration Actual 11 ²	FP	RW	0.00
2557	9FD	A1 - Calibration Actual 12 ²	FP	RW	0.00
2559	9FF	A1 - Calibration Measured 1	FP	RW	0.00
2561	A01	A1 - Calibration Measured 2	FP	RW	0.00
2563	A03	A1 - Calibration Measured 3	FP	RW	0.00
2565	A05	A1 - Calibration Measured 4	FP	RW	0.00
2567	A07	A1 - Calibration Measured 5	FP	RW	0.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2569	A09	A1 - Calibration Measured 6	FP	RW	0.00
2571	A0B	A1 - Calibration Measured 7	FP	RW	0.00
2573	A0D	A1 - Calibration Measured 8	FP	RW	0.00
2575	A0F	A1 - Calibration Measured 9	FP	RW	0.00
2577	A11	A1 - Calibration Measured 10 ²	FP	RW	0.00
2579	A13	A1 - Calibration Measured 11 ²	FP	RW	0.00
2581	A15	A1 - Calibration Measured 12 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Analog Input 2 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2600	A28	A2 - Units	U16	RW	0
2601	A29	A2 - Time Base	U16	RW	0
2602	A2A	A2 - Sampling Period	U16	RW	1
2603	A2B	A2 - Dampening Factor	U16	RW	0
2604	A2C	A2 - Input Config	U16	RW	0
2605	A2D	A2 - Override Enable	U16	RW	0
2606	A2E	A2 - Override Value	FP	RW	0.00
2608	A30	A2 - Fail Value	FP	RW	0.00
2610	A32	A2 - Low Input Cutoff	FP	RW	2.00
2612	A34	A2 - Low Flow Cutoff	FP	RW	0.00
2614	A36	A2 - Sensor Range Low	FP	RO	0.00
2616	A38	A2 - Sensor Range High	FP	RO	0
2618	A3A	A2 - Units Scale Factor	FP	RW	1
2620	A3C	A2 - Units Offset Factor	FP	RW	0
2622	A3E	A2 - Unit Description 1	LCD	RW	—
2623	A3F	A2 - Unit Description 2	LCD	RW	—
2624	A40	A2 - Unit Description 3	LCD	RW	—

Analog Input 2 Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2630	A46	A2 - Calibration Type ¹	U16	RW	0
2631	A47	A2 - Nominal Value	FP	RW	—
2633	A49	A2 - Calibration Absolute Offset	FP	RW	0.00
2635	A4B	A2 - Calibration Actual 1	FP	RW	0.00
2637	A4D	A2 - Calibration Actual 2	FP	RW	0.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2639	A4F	A2 - Calibration Actual 3	FP	RW	0.00
2641	A51	A2 - Calibration Actual 4	FP	RW	0.00
2643	A53	A2 - Calibration Actual 5	FP	RW	0.00
2645	A55	A2 - Calibration Actual 6	FP	RW	0.00
2647	A57	A2 - Calibration Actual 7	FP	RW	0.00
2649	A59	A2 - Calibration Actual 8	FP	RW	0.00
2651	A5B	A2 - Calibration Actual 9	FP	RW	0.00
2653	A5D	A2 - Calibration Actual 10 ²	FP	RW	0.00
2655	A5F	A2 - Calibration Actual 11 ²	FP	RW	0.00
2657	A61	A2 - Calibration Actual 12 ²	FP	RW	0.00
2659	A63	A2 - Calibration Measured 1	FP	RW	0.00
2661	A65	A2 - Calibration Measured 2	FP	RW	0.00
2663	A67	A2 - Calibration Measured 3	FP	RW	0.00
2665	A69	A2 - Calibration Measured 4	FP	RW	0.00
2667	A6B	A2 - Calibration Measured 5	FP	RW	0.00
2669	A6D	A2 - Calibration Measured 6	FP	RW	0.00
2671	A6F	A2 - Calibration Measured 7	FP	RW	0.00
2673	A71	A2 - Calibration Measured 8	FP	RW	0.00
2675	A73	A2 - Calibration Measured 9	FP	RW	0.00
2677	A75	A2 - Calibration Measured 10 ²	FP	RW	0.00
2679	A77	A2 - Calibration Measured 11 ²	FP	RW	0.00
2681	A79	A2 - Calibration Measured 12 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, calibration points 10 through 12 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Digital Input Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2900	B54	Digital Mode	U16	RW	0

Flow Run 1 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3000	BB8	FR1 Volume Units See Units of Measurement, pg. C-49	U16	RW	201
3001	BB9	FR1 Time Base	U16	RW	3
3002	BBA	FR1 Flow Calculation Period (Number of seconds for each calculation)	U16	RW	60
3003	BBB	FR1 Dampening Factor	U16	RW	0

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3004	BBC	FR1 Flow Rate Calculation See Flow Rate Calculation Register, pg. C-20	U16	RW	0
3005	BBD	FR1 Override Enable 0 - Disabled 1 - Enabled	U16	RW	0
3006	BBE	FR1 Fluid Properties See Fluid Property Register, pg. C-21	U16	RW	12288
3007	BBF	FR1 Fluid Property Calculation (Number of flow rate calculation periods before each fluid property calculation)	U16	RW	1
3008	BC0	FR1 Material Type: Pipe 0 - SS (304/316), AGA 3 1992 1 - Carbon Steel 2 - Monel 3 - Brass 4 - Inconel 5 - Nickel 6 - HastC22 7 - Titanium 8 - SS (304), AGA 3 2012 9 - SS (316), AGA 3 2012 10 - Monel 400, AGA 3 2012	U16	RW	1
3009	BC1	FR1 Material Type: Plate 0 - SS (304/316), AGA 3 1992 1 - Carbon Steel 2 - Monel 3 - Brass 4 - Inconel 5 - Nickel 6 - HastC22 7 - Titanium 8 - SS (304), AGA 3 2012 9 - SS (316), AGA 3 2012 10 - Monel 400, AGA 3 2012	U16	RW	0
3010	BC2	FR1 Tap Type See Tap Type Register, pg. C-22	U16	RW	0
3011	BC3	FR1 Static Pressure Selection	U16	RW	32768
3012	BC4	FR1 Differential Pressure Selection	U16	RW	32768
3013	BC5	FR1 Process Temperature Selection	U16	RW	32768
3014	BC6	FR1 Turbine Source	U16	RW	0
3015	BC7	FR1 Mass Units	U16	RW	601
3016	BC8	FR1 Energy Units	U16	RW	701
3017	BC9	FR1 Override Value	FP	RW	0.00
3019	BCB	FR1 Fail Value	FP	RW	0.00
3021	BCD	FR1 Low Flow Cutoff	FP	RW	0.00
3023	BCF	FR1 Low Cutoff	FP	RW	0.00
3025	BD1	FR1 Base Temperature	FP	RW	60.00 °F
3027	BD3	FR1 Base Pressure	FP	RW	14.73 psi
3029	BD5	FR1 Atmospheric Pressure	FP	RW	14.73 psi

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3031	BD7	FR1 Pipe Size	FP	RW	2.067 in.
3033	BD9	FR1 Pipe Reference Temp	FP	RW	68.00 °F
3035	BDB	FR1 Plate Size	FP	RW	1.00 in.
3037	BDD	FR1 Plate Reference Temp	FP	RW	68.00 °F
3039	BDF	FR1 Isentropic Exponent - k	FP	RW	1.30
3041	BE1	FR1 Viscosity	FP	RW	0.010268 cP
3043	BE3	FR1 Cone Beta	FP	RW	0.500
3045	BE5	FR1 Cone Flow Coefficient	FP	RW	1.000
3047	BE7	FR1 Low Pressure Cutoff	FP	RW	1.000 in H2O
3049	BE9	FR1 Specific Gravity	FP	RW	0.60
3051	BEB	FR1 Heating Value	FP	RW	1031.426
3053	BED	FR1 Gas Fraction/Quality	FP	RW	1.00
3055	BEF	FR1 Configuration Parameter 1 (Absolute Density - Liquids) Base Liquid Density Fluid = Liquid : Base Density Fluid = Ngas : Base Liquid Oil Density	FP	RW	53.06376
3057	BF1	FR1 Configuration Parameter 2 Fluid = Liquid : Flowing Density Fluid = NGas : Base Liquid Water Density	FP	RW	62.30385
3059	BF3	FR1 Configuration Parameter 3 Oil Fraction	FP	RW	0.00
3061	BF5	FR1 Configuration Parameter 4	FP	RW	0.00
3063	BF7	FR1 GC - Methane (C1)	FP	RW	0.965222
3065	BF9	FR1 GC - Nitrogen (N2)	FP	RW	0.002595
3067	BFB	FR1 GC - Carbon Dioxide (CO2)	FP	RW	0.005956
3069	BFD	FR1 GC - Ethane (C2)	FP	RW	0.018186
3071	BFF	FR1 GC - Propane (C3)	FP	RW	0.004596
3073	C01	FR1 GC - Water (H2O)	FP	RW	0.00
3075	C03	FR1 GC - Hydrogen Sulfide (H2S)	FP	RW	0.00
3077	C05	FR1 GC - Hydrogen (H2)	FP	RW	0.00
3079	C07	FR1 GC - Carbon Monoxide (CO)	FP	RW	0.00
3081	C09	FR1 GC - Oxygen (O2)	FP	RW	0.00
3083	C0B	FR1 GC - I-Butane (i-C4)	FP	RW	0.000977
3085	C0D	FR1 GC - N-Butane (n-C4)	FP	RW	0.001007
3087	C0F	FR1 GC - I-Pentane (i-C5)	FP	RW	0.000473
3089	C11	FR1 GC - N-Pentane (n-C5)	FP	RW	0.000324
3091	C13	FR1 GC - N-Hexane (n-C6)	FP	RW	0.000664
3093	C15	FR1 GC - N-Heptane (n-C7)	FP	RW	0.00
3095	C17	FR1 GC - N-Octane (n-C8)	FP	RW	0.00
3097	C19	FR1 GC - N-Nonane (n-C9)	FP	RW	0.00
3099	C1B	FR1 GC - N-Decane (n-C10)	FP	RW	0.00
3101	C1D	FR1 GC - Helium (He)	FP	RW	0.00
3103	C1F	FR1 GC - Argon (Ar)	FP	RW	0.00
3105	C21	FR1 Unit Scale	FP	RW	1.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3107	C23	FR1 Unit Offset	FP	RW	0.00
3109	C25	FR1 Unit Description 1	LCD	RW	—
3110	C26	FR1 Unit Description 2	LCD	RW	—
3111	C27	FR1 Unit Description 3	LCD	RW	—
3112	C28	FR1 Mass Scale	FP	RW	1.00
3114	C2A	FR1 Mass Description 1	LCD	RW	—
3115	C2B	FR1 Mass Description 2	LCD	RW	—
3116	C2C	FR1 Mass Description 3	LCD	RW	—
3117	C2D	FR1 Energy Scale	FP	RW	1.00
3119	C2F	FR1 Energy Description 1	LCD	RW	—
3120	C30	FR1 Energy Description 2	LCD	RW	—
3121	C31	FR1 Energy Description 3	LCD	RW	—

Flow Rate Calculation Register

The flow rate calculation register is shown below.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—		LE		Wet Correction				—		Flow Rate Calculation					

LE - Liquid Estimation Selection (STEAM ONLY)	
0	Do not include Liquid Estimate
1	Include Liquid Estimate

Wet Correction	
0	No Wet Correction
1	Orifice - Chisholm-Steven
2	Orifice - James (STEAM ONLY)
3	Cone - Chisholm-Steven
6	Do Not Use
7	Correction Override

Flow Rate Calculation	
0	AGA 3 1992
1	Cone Spool
2	Cone Wafer
3	AGA 7
4	ISO 5167 - Orifice
8	Averaging Pitot Tube (Annubar)
9 to 10	Reserved
11	Venturi Meter
12	ISO 5167 Foxboro Integral Orifice
13	ASME MFC-14M (2003), Small-bore Orifice
14	AGA 3 2012

Fluid Property Register

The fluid property calculation register is shown below.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HV	SG	V	I _{sen}	LiqDC	—		GPA		SGRef						Fluid Property Calc

V - Viscosity Selection	
0	Calculated
1	Manual Entry
I_{sen} - Isentropic Exponent Selection	
0	Calculated
1	Manual Entry
LiqDC – Liquid Density Control	
0	For Liquids: Register 3057 contains the flowing density For NGas: Register 3057 contains the base liquid oil density
1	For Liquids: Register 3057 contains the coefficient of thermal expansion For NGas: Register 3057 contains the flowing liquid oil density
GPA - GPA Table Selection	
0	Use 2008 Table
1	Use 1996 Table
SGRef - Specific Gravity Reference	
0	US (AGA) – 14.73 psi, 60 °F
1	Canada, UK – 103.208 kPa, 15 °C

Fluid Property Calculation	
0	AGA 8 Detail
1	AGA 8 Gross
2	(FUTURE)
3	IF-97 (STEAM ONLY)
4	IF-97/James - (STEAM ONLY)
5 to 15	(FUTURE)
16	Generic Liquid
17	MPMS Ch. 11.1 - Crude Oil
18	MPMS Ch. 11.1 - Refined Products
19	MPMS Ch. 11.1 - Lube Oils
20	MPMS Ch. 11.1 - Special Products

Tap Type Register

The tap type calculation register is shown below.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
												Loc	Tap Type		

Loc (Pressure Tap Location)	
0	Upstream
1	Downstream

Tap Type	
0	Flange
1	Corner
2	D and D/2
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Flow Run 1 Calibration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3200	C80	FR1 Calibration Type ¹	U16	RW	512
3201	C81	FR1 Nominal Flow Coefficient	FP	RW	0.88
3203	C83	FR1 Coefficient Offset	FP	RW	0.00
3205	C85	FR1 Flow Coefficient 1	FP	RW	0.88
3207	C87	FR1 Flow Coefficient 2	FP	RW	0.00
3209	C89	FR1 Flow Coefficient 3	FP	RW	0.00
3211	C8B	FR1 Flow Coefficient 4	FP	RW	0.00
3213	C8D	FR1 Flow Coefficient 5	FP	RW	0.00
3215	C8F	FR1 Flow Coefficient 6	FP	RW	0.00
3217	C91	FR1 Flow Coefficient 7	FP	RW	0.00
3219	C93	FR1 Flow Coefficient 8	FP	RW	0.00
3221	C95	FR1 Flow Coefficient 9	FP	RW	0.00
3223	C97	FR1 Flow Coefficient 10 ²	FP	RW	0.00
3225	C99	FR1 Flow Coefficient 11 ²	FP	RW	0.00
3227	C9B	FR1 Flow Coefficient 12 ²	FP	RW	0.00
3229	C9D	FR1 Flow Coefficient 13 ²	FP	RW	0.00
3231	C9F	FR1 Flow Coefficient 14 ²	FP	RW	0.00
3233	CA1	FR1 Flow Coefficient 15 ²	FP	RW	0.00
3235	CA3	FR1 Flow Coefficient 16 ²	FP	RW	0.00
3237	CA5	FR1 Reynolds Number 1	FP	RW	1.00
3239	CA7	FR1 Reynolds Number 2	FP	RW	0.00
3241	CA9	FR1 Reynolds Number 3	FP	RW	0.00
3243	CAB	FR1 Reynolds Number 4	FP	RW	0.00
3245	CAD	FR1 Reynolds Number 5	FP	RW	0.00

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3247	CAF	FR1 Reynolds Number 6	FP	RW	0.00
3249	CB1	FR1 Reynolds Number 7	FP	RW	0.00
3251	CB3	FR1 Reynolds Number 8	FP	RW	0.00
3253	CB5	FR1 Reynolds Number 9	FP	RW	0.00
3255	CB7	FR1 Reynolds Number 10 ²	FP	RW	0.00
3257	CB9	FR1 Reynolds Number 11 ²	FP	RW	0.00
3259	CBB	FR1 Reynolds Number 12 ²	FP	RW	0.00
3261	CBD	FR1 Reynolds Number 13 ²	FP	RW	0.00
3263	CBF	FR1 Reynolds Number 14 ²	FP	RW	0.00
3265	CC1	FR1 Reynolds Number 15 ²	FP	RW	0.00
3267	CC3	FR1 Reynolds Number 16 ²	FP	RW	0.00

¹ The Calibration Type register must be configured using ModWorX. This register defines the type and number of calibration points used. If altered manually, calibration points must be entered in ascending order.

² When the NUFLO Scanner 2105 flow computer is connected to a QRATE Scanner 3000 series integrated control flow computer, flow coefficients 10 through 16 and Reynolds numbers 10 through 16 will not be transmitted to the QRATE Scanner 3000 series integrated control flow computer.

Flow Run Alarms

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3600	0E10	High Alarm Mask	U16	RW	65535
3601	0E11	Low Alarm Mask	U16	RW	35535
3602	0E12	FR Alarm Configuration 1	U16	RW	4095
3603	0E13	FR Alarm Configuration 2	U16	RW	4095
3604	0E14	FR Alarm Configuration 3	U16	RW	4095
3605	0E15	FR Alarm Configuration 4	U16	RW	4095
3606	0E16	FR Alarm Configuration 5	U16	RW	4095
3607	0E17	FR Alarm Configuration 6	U16	RW	4095
3608	0E18	FR Alarm Configuration 7	U16	RW	4095
3609	0E19	FR Alarm Configuration 8	U16	RW	4095
3610	0E1A	FR Alarm Configuration 9	U16	RW	4095
3611	0E1B	FR Alarm Configuration 10	U16	RW	4095
3612	0E1C	FR Alarm Configuration 11	U16	RW	4095
3613	0E1D	FR Alarm Configuration 12	U16	RW	4095
3614	0E1E	FR Alarm Configuration 13	U16	RW	4095
3615	0E1F	FR Alarm Configuration 14	U16	RW	4095
3616	0E20	FR Alarm Configuration 15	U16	RW	4095
3617	0E21	FR Alarm Configuration 16	U16	RW	4095
3618	0E22	FR Alarm High Setpoint 1	FP32	RW	100
3620	0E24	FR Alarm High Setpoint 2	FP32	RW	100
3622	0E26	FR Alarm High Setpoint 3	FP32	RW	100
3624	0E28	FR Alarm High Setpoint 4	FP32	RW	100
3626	0E2A	FR Alarm High Setpoint 5	FP32	RW	100
3628	0E2C	FR Alarm High Setpoint 6	FP32	RW	100
3630	0E2E	FR Alarm High Setpoint 7	FP32	RW	100

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
3632	0E30	FR Alarm High Setpoint 8	FP32	RW	100
3634	0E32	FR Alarm High Setpoint 9	FP32	RW	100
3636	0E34	FR Alarm High Setpoint 10	FP32	RW	100
3638	0E36	FR Alarm High Setpoint 11	FP32	RW	100
3640	0E38	FR Alarm High Setpoint 12	FP32	RW	100
3642	0E3A	FR Alarm High Setpoint 13	FP32	RW	100
3644	0E3C	FR Alarm High Setpoint 14	FP32	RW	100
3646	0E3E	FR Alarm High Setpoint 15	FP32	RW	100
3648	0E40	FR Alarm High Setpoint 16	FP32	RW	100
3650	0E42	FR Alarm Low Setpoint 1	FP32	RW	0.00
3652	0E44	FR Alarm Low Setpoint 2	FP32	RW	0.00
3654	0E46	FR Alarm Low Setpoint 3	FP32	RW	0.00
3656	0E48	FR Alarm Low Setpoint 4	FP32	RW	0.00
3658	0E4A	FR Alarm Low Setpoint 5	FP32	RW	0.00
3660	0E4C	FR Alarm Low Setpoint 6	FP32	RW	0.00
3662	0E4E	FR Alarm Low Setpoint 7	FP32	RW	0.00
3664	0E50	FR Alarm Low Setpoint 8	FP32	RW	0.00
3666	0E52	FR Alarm Low Setpoint 9	FP32	RW	0.00
3668	0E54	FR Alarm Low Setpoint 10	FP32	RW	0.00
3670	0E56	FR Alarm Low Setpoint 11	FP32	RW	0.00
3672	0E58	FR Alarm Low Setpoint 12	FP32	RW	0.00
3674	0E5A	FR Alarm Low Setpoint 13	FP32	RW	0.00
3676	0E5C	FR Alarm Low Setpoint 14	FP32	RW	0.00
3678	0E5E	FR Alarm Low Setpoint 15	FP32	RW	0.00
3680	0E60	FR Alarm Low Setpoint 16	FP32	RW	0.00
3682	0E62	FR Alarm Deadband 1	FP32	RW	10
3684	0E64	FR Alarm Deadband 2	FP32	RW	10
3686	0E66	FR Alarm Deadband 3	FP32	RW	10
3688	0E68	FR Alarm Deadband 4	FP32	RW	10
3690	0E6A	FR Alarm Deadband 5	FP32	RW	10
3692	0E6C	FR Alarm Deadband 6	FP32	RW	10
3694	0E6E	FR Alarm Deadband 7	FP32	RW	10
3696	0E70	FR Alarm Deadband 8	FP32	RW	10
3698	0E72	FR Alarm Deadband 9	FP32	RW	10
3700	0E74	FR Alarm Deadband 10	FP32	RW	10
3702	0E76	FR Alarm Deadband 11	FP32	RW	10
3704	0E78	FR Alarm Deadband 12	FP32	RW	10
3706	0E7A	FR Alarm Deadband 13	FP32	RW	10
3708	0E7C	FR Alarm Deadband 14	FP32	RW	10
3710	0E7E	FR Alarm Deadband 15	FP32	RW	10
3712	0E80	FR Alarm Deadband 16	FP32	RW	10

Output Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
4000	FA0	Pulse Out 1 - Source	U16	RW	16384
4001	FA1	Pulse Out 1 - Duration	U16	RW	10
4002	FA2	Pulse Out 1 - Decimal Location	U16	RW	2
4003	FA3	Pulse Out 1 - Data Pointer	U16	RW	108
4004	FA4	Pulse Out 1 - Scale Factor	FP	RW	1
4006	FA6	Pulse Out 1 - Low Level	FP	RW	0
4008	FA8	Pulse Out 1 - High Level	FP	RW	0
4010 to 4039	Reserved				
4040	FC8	Analog Out 1 - Source	U16	RW	0
4041	FC9	Analog Out 1 - Low Value	FP	RW	0
4043	FCB	Analog Out 1 - High Value	FP	RW	1700
4045	FCD	Analog Out 1 - Low Adjust	U16	RW	32768
4046	FCE	Analog Out 1 - High Adjust	U16	RW	32768

Holding Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8000	1F40	Interval Pointer	FP	RO
8002	1F42	Daily Pointer	FP	RO
8004	1F44	Event Counter	FP	RO
8006	1F46	Real Date	FP	RO
8008	1F48	Real Time	FP	RO
8010	1F4A	Flow Run Alarms	FP	RO
8012	1F4C	Flow Run Alarm Low	FP	RO
8014	1F4E	Flow Run Alarm High	FP	RO
8016	1F50	Diagnostic 1	FP	RO
8018	1F52	Diagnostic 2	FP	RO
8020	1F54	Diagnostic 3	FP	RO
8022	1F56	Diagnostic 4	FP	RO
8024	1F58	Polling Index	FP	RO
8026	1F5A	FR1 Grand Total	FP	RO
8028	1F5C	FR1 Instantaneous Flow Rate	FP	RO
8030	1F5E	FR1 Daily Total	FP	RO
8032	1F60	FR1 Interval Total	FP	RO
8034	1F62	FR1 Polling Total	FP	RO
8036	1F64	FR1 Previous Day Total	FP	RO
8038	1F66	FR1 Previous Interval	FP	RO
8040	1F68	FR1 Previous Polling Total	FP	RO
8042	1F6A	FR1 Grand Mass Total	FP	RO
8044	1F6C	FR1 Instantaneous Mass Flow Rate	FP	RO
8046	1F6E	FR1 Daily Mass Total	FP	RO
8048	1F70	FR1 Interval Mass Total	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8050	1F72	FR1 Polling Mass Total	FP	RO
8052	1F74	FR1 Previous Day Mass	FP	RO
8054	1F76	FR1 Previous Interval Mass	FP	RO
8056	1F78	FR1 Previous Polling Mass	FP	RO
8058	1F7A	FR1 Grand Energy Total	FP	RO
8060	1F7C	FR1 Instantaneous Energy Flow Rate	FP	RO
8062	1F7E	FR1 Daily Energy Total	FP	RO
8064	1F80	FR1 Interval Energy Total	FP	RO
8066	1F82	FR1 Polling Energy Total	FP	RO
8068	1F84	FR1 Previous Day Energy	FP	RO
8070	1F86	FR1 Previous Interval Energy	FP	RO
8072	1F88	FR1 Previous Polling Energy	FP	RO
8074	1F8A	FR1 Daily Estimated Total	FP	RO
8076	1F8C	FR1 Monthly Total	FP	RO
8078	1F8E	FR1 Previous Month Total	FP	RO
8080	1F90	FR1 Daily Run Time	FP	RO
8082	1F92	FR1 Interval Run Time	FP	RO
8084	1F94	FR1 Polling Run Time	FP	RO
8086	1F96	FR1 Previous Daily Run Time	FP	RO
8088	1F98	FR1 Previous Interval Run Time	FP	RO
8090	1F9A	FR1 Previous Polling Run Time	FP	RO
8092	1F9C	FR1 Static Pressure	FP	RO
8094	1F9E	FR1 Differential Pressure	FP	RO
8096	1FA0	FR1 Process Temperature	FP	RO
8098	1FA2	FR1 UnCorrected Volume	FP	RO
8100	1FA4	FR1 SqrtDP	FP	RO
8102	1FA6	FR1 Compressibility (Natural Gas); FR1 CTPL - Complete Correction Factor (Liquids)	FP	RO
8104	1FA8	FR1 Density	FP	RO
8106	1FAA	FR1 Base Compressibility (Natural Gas) FR1 CTL - Temperature Correction Factor (Liquids)	FP	RO
8108	1FAC	FR1 Base Density	FP	RO
8110	1FAE	FR1 Average Molecular Weight	FP	RO
8112	1FB0	FR1 Molar Fraction Sum	FP	RO
8114	1FB2	FR1 Mass Heating Value	FP	RO
8116	1FB4	FR1 Heating Value Volume Basis	FP	RO
8118	1FB6	FR1 Specific Gravity	FP	RO
8120	1FB8	FR1 Viscosity	FP	RO
8122	1FBA	FR1 Isentropic Exponent	FP	RO
8124	1FBC	FR1 Reynolds Number	FP	RO
8126	1FBE	FR1 Calculation Parameter 1	FP	RO
8128	1FC0	FR1 Calculation Parameter 2	FP	RO
8130	1FC2	FR1 Calculation Parameter 3	FP	RO
8132	1FC4	FR1 Calculation Parameter 4	FP	RO
8134	1FC6	FR1 Calculation Parameter 5	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8136	1FC8	FR1 Calculation Parameter 6	FP	RO
8138	1FCA	FR1 Calculation Parameter 7	FP	RO
8140	1FCC	FR1 Calculation Parameter 8	FP	RO
8142	1FCE	FR1 Calculation Parameter 9	FP	RO
8144	1FD0	FR1 Calculation Parameter 10	FP	RO
8146	1FD2	FR1 Calculation Parameter 11	FP	RO
8148	1FD4	FR1 Calculation Parameter 12	FP	RO
8150	1FD6	FR1 Calculation Parameter 13	FP	RO
8152	1FD8	FR1 Calculation Parameter 14	FP	RO
8154	1FDA	FR1 Calculation Parameter 15	FP	RO
8156	1FDC	FR1 Calculation Parameter 16	FP	RO
8158	1FDE	FR1 Grand Total [MCF]	FP	RO
8160	1FE0	FR1 Instantaneous Flow Rate [MCF]	FP	RO
8162	1FE2	FR1 Daily Total [MCF]	FP	RO
8164	1FE4	FR1 Interval Total [MCF]	FP	RO
8166	1FE6	FR1 Polling Total [MCF]	FP	RO
8168	1FE8	FR1 Previous Day [MCF]	FP	RO
8170	1FEA	FR1 Previous Interval [MCF]	FP	RO
8172	1FEC	FR1 Previous Polling Total [MCF]	FP	RO
8174	1FEE	FR1 Grand Mass Total [LBM]	FP	RO
8176	1FF0	FR1 Instantaneous Mass Rate [LBM]	FP	RO
8178	1FF2	FR1 Daily Mass Total [LBM]	FP	RO
8180	1FF4	FR1 Interval Mass Total [LBM]	FP	RO
8182	1FF6	FR1 Polling Mass Total [LBM]	FP	RO
8184	1FF8	FR1 Previous Day Mass [LBM]	FP	RO
8186	1FFA	FR1 Previous Interval Mass [LBM]	FP	RO
8188	1FFC	FR1 Previous Polling Mass [LBM]	FP	RO
8190	1FFE	FR1 Grand Energy Total [MMBTU]	FP	RO
8192	2100	FR1 Instantaneous Energy Rate [MMBTU]	FP	RO
8194	2002	FR1 Daily Energy Total [MMBTU]	FP	RO
8196	2004	FR1 Interval Energy Total [MMBTU]	FP	RO
8198	2006	FR1 Polling Energy Total [MMBTU]	FP	RO
8200	2008	FR1 Previous Day Energy [MMBTU]	FP	RO
8202	200A	FR1 Previous Interval Energy [MMBTU]	FP	RO
8204	200C	FR1 Previous Polling Energy [MMBTU]	FP	RO
8206	200E	FR1 Daily Estimated Total [MCF]	FP	RO
8208	2010	FR1 Monthly Total [MCF]	FP	RO
8210	2012	FR1 Previous Month Total [MCF]	FP	RO
8212	2014	FR1 Mass Heating Value [BASE]	FP	RO
8214	2016	FR1 Volumetric Heating Value [BASE]	FP	RO
8216	2018	T1 Grand Total	FP	RO
8218	201A	T1 Instantaneous Flow Rate	FP	RO
8220	201C	T1 Daily Total	FP	RO
8222	201E	T1 Interval Total	FP	RO
8224	2020	T1 Polling Total	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8226	2022	T1 Previous Day	FP	RO
8228	2024	T1 Previous Interval	FP	RO
8230	2026	T1 Previous Polling Total	FP	RO
8232	2028	T1 Daily Estimated Total	FP	RO
8234	202A	T1 Monthly Total	FP	RO
8236	202C	T1 Previous Month Total	FP	RO
8238	202E	T1 Daily Run Time	FP	RO
8240	2030	T1 Interval Run Time	FP	RO
8242	2032	T1 Polling Run Time	FP	RO
8244	2034	T1 Previous Daily Run Time	FP	RO
8246	2036	T1 Previous Interval Run Time	FP	RO
8248	2038	T1 Previous Polling Run Time	FP	RO
8250	203A	T1 Grand Total [GAL]	FP	RO
8252	203C	T1 Instantaneous Flow Rate [GAL]	FP	RO
8254	203E	T1 Daily Total [GAL]	FP	RO
8256	2040	T1 Interval Total [GAL]	FP	RO
8258	2042	T1 Polling Total [GAL]	FP	RO
8260	2044	T1 Previous Day [GAL]	FP	RO
8262	2046	T1 Previous Interval [GAL]	FP	RO
8264	2048	T1 Previous Polling Total [GAL]	FP	RO
8266	204A	T1 Daily Estimated Total [GAL]	FP	RO
8268	204C	T1 Monthly Total [GAL]	FP	RO
8270	204E	T1 Previous Month Total [GAL]	FP	RO
8272	2050	T1 Frequency	FP	RO
8274	2052	T1 Active K-Factor	FP	RO
8276	2054	T2 Grand Total	FP	RO
8278	2056	T2 Instantaneous Flow Rate	FP	RO
8280	2058	T2 Daily Total	FP	RO
8282	205A	T2 Interval Total	FP	RO
8284	205C	T2 Polling Total	FP	RO
8286	205E	T2 Previous Day	FP	RO
8288	2060	T2 Previous Interval	FP	RO
8290	2062	T2 Previous Polling Total	FP	RO
8292	2064	T2 Daily Estimated Total	FP	RO
8294	2066	T2 Monthly Total	FP	RO
8296	2068	T2 Previous Month Total	FP	RO
8298	206A	T2 Daily Run Time	FP	RO
8300	206C	T2 Interval Run Time	FP	RO
8302	206E	T2 Polling Run Time	FP	RO
8304	2070	T2 Previous Daily Run Time	FP	RO
8306	2072	T2 Previous Interval Run Time	FP	RO
8308	2074	T2 Previous Polling Run Time	FP	RO
8310	2076	T2 Grand Total [GAL]	FP	RO
8312	2078	T2 Instantaneous Flow Rate [GAL]	FP	RO
8314	207A	T2 Daily Total [GAL]	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8316	207C	T2 Interval Total [GAL]	FP	RO
8318	207E	T2 Polling Total [GAL]	FP	RO
8320	2080	T2 Previous Day Total [GAL]	FP	RO
8322	2082	T2 Previous Interval [GAL]	FP	RO
8324	2084	T2 Previous Polling Total [GAL]	FP	RO
8326	2086	T2 Daily Estimated Total [GAL]	FP	RO
8328	2088	T2 Monthly Total [GAL]	FP	RO
8330	208A	T2 Previous Month Total [GAL]	FP	RO
8332	208C	T2 Frequency	FP	RO
8334	208E	T2 Active K-Factor	FP	RO
8336	2090	SP Instantaneous Reading	FP	RO
8338	2092	SP Rate Of Change	FP	RO
8340	2094	SP Daily Average	FP	RO
8342	2096	SP Interval Average	FP	RO
8344	2098	SP Polling Average	FP	RO
8346	209A	SP Previous Daily Average	FP	RO
8348	209C	SP Previous Interval Average	FP	RO
8350	209E	SP Previous Polling Average	FP	RO
8352	20A0	SP Daily Run Time	FP	RO
8354	20A2	SP Interval Run Time	FP	RO
8356	20A4	SP Polling Run Time	FP	RO
8358	20A6	SP Previous Daily Run Time	FP	RO
8360	20A8	SP Previous Interval Run Time	FP	RO
8362	20AA	SP Previous Polling Run Time	FP	RO
8364	20AC	SP Instantaneous Reading [PSI]	FP	RO
8366	20AE	SP Rate of Change [PSI]	FP	RO
8368	20B0	SP Daily Average [PSI]	FP	RO
8370	20B2	SP Interval Average [PSI]	FP	RO
8372	20B4	SP Polling Average [PSI]	FP	RO
8374	20B6	SP Previous Daily Average [PSI]	FP	RO
8376	20B8	SP Previous Interval Average [PSI]	FP	RO
8378	20BA	SP Previous Polling Average [PSI]	FP	RO
8380	20BC	DP Instantaneous Reading	FP	RO
8382	20BE	DP Rate Of Change	FP	RO
8384	20C0	DP Daily Average	FP	RO
8386	20C2	DP Interval Average	FP	RO
8388	20C4	DP Polling Average	FP	RO
8390	20C6	DP Previous Daily Average	FP	RO
8392	20C8	DP Previous Interval Average	FP	RO
8394	20CA	DP Previous Polling Average	FP	RO
8396	20CC	DP Daily Run Time	FP	RO
8398	20CE	DP Interval Run Time	FP	RO
8400	20D0	DP Polling Run Time	FP	RO
8402	20D2	DP Previous Daily Run Time	FP	RO
8404	20D4	DP Previous Interval Run Time	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8406	20D6	DP Previous Polling Run Time	FP	RO
8408	20D8	DP Instantaneous Reading [INH2O]	FP	RO
8410	20DA	DP Rate of Change [INH2O]	FP	RO
8412	20DC	DP Daily Average [INH2O]	FP	RO
8414	20DE	DP Interval Average [INH2O]	FP	RO
8416	20E0	DP Polling Average [INH2O]	FP	RO
8418	20E2	DP Previous Daily Average [INH2O]	FP	RO
8420	20E4	DP Previous Interval Average [INH2O]	FP	RO
8422	20E6	DP Previous Polling Average [INH2O]	FP	RO
8424	20E8	PT Instantaneous Reading	FP	RO
8426	20EA	PT Rate Of Change	FP	RO
8428	20EC	PT Daily Average	FP	RO
8430	20EE	PT Interval Average	FP	RO
8432	20F0	PT Polling Average	FP	RO
8434	20F2	PT Previous Daily Average	FP	RO
8436	20F4	PT Previous Interval Average	FP	RO
8438	20F6	PT Previous Polling Average	FP	RO
8440	20F8	PT Daily Run Time	FP	RO
8442	20FA	PT Interval Run Time	FP	RO
8444	20FC	PT Polling Run Time	FP	RO
8446	20FE	PT Previous Daily Run Time	FP	RO
8448	2100	PT Previous Interval Run Time	FP	RO
8450	2102	PT Previous Polling Run Time	FP	RO
8452	2104	PT Instantaneous Reading [°F]	FP	RO
8454	2106	PT Rate of Change [°F]	FP	RO
8456	2108	PT Daily Average [°F]	FP	RO
8458	210A	PT Interval Average [°F]	FP	RO
8460	210C	PT Polling Average [°F]	FP	RO
8462	210E	PT Previous Daily Average [°F]	FP	RO
8464	2110	PT Previous Interval Average [°F]	FP	RO
8466	2112	PT Previous Polling Average [°F]	FP	RO
8468	2114	A1 Instantaneous Reading	FP	RO
8470	2116	A1 Rate Of Change	FP	RO
8472	2118	A1 Daily Average	FP	RO
8474	211A	A1 Interval Average	FP	RO
8476	211C	A1 Polling Average	FP	RO
8478	211E	A1 Previous Daily Average	FP	RO
8480	2120	A1 Previous Interval Average	FP	RO
8482	2122	A1 Previous Polling Average	FP	RO
8484	2124	A1 Daily Run Time	FP	RO
8486	2126	A1 Interval Run Time	FP	RO
8488	2128	A1 Polling Run Time	FP	RO
8490	212A	A1 Previous Daily Run Time	FP	RO
8492	212C	A1 Previous Interval Run Time	FP	RO
8494	212E	A1 Previous Polling Run Time	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8496	2130	A1 Instantaneous Reading [VOLT]	FP	RO
8498	2132	A1 Rate of Change [VOLT]	FP	RO
8500	2134	A1 Daily Average [VOLT]	FP	RO
8502	2136	A1 Interval Average [VOLT]	FP	RO
8504	2138	A1 Polling Average [VOLT]	FP	RO
8506	213A	A1 Previous Daily Average [VOLT]	FP	RO
8508	213C	A1 Previous Interval Average [VOLT]	FP	RO
8510	213E	A1 Previous Polling Average [VOLT]	FP	RO
8512	2140	A2 Instantaneous Reading	FP	RO
8514	2142	A2 Rate Of Change	FP	RO
8516	2144	A2 Daily Average	FP	RO
8518	2146	A2 Interval Average	FP	RO
8520	2148	A2 Polling Average	FP	RO
8522	214A	A2 Previous Daily Average	FP	RO
8524	214C	A2 Previous Interval Average	FP	RO
8526	214E	A2 Previous Polling Average	FP	RO
8528	2150	A2 Daily Run Time	FP	RO
8530	2152	A2 Interval Run Time	FP	RO
8532	2154	A2 Polling Run Time	FP	RO
8534	2156	A2 Previous Daily Run Time	FP	RO
8536	2158	A2 Previous Interval Run Time	FP	RO
8538	215A	A2 Previous Polling Run Time	FP	RO
8540	215C	A2 Instantaneous Reading [VOLT]	FP	RO
8542	215E	A2 Rate of Change [VOLT]	FP	RO
8544	2160	A2 Daily Average [VOLT]	FP	RO
8546	2162	A2 Interval Average [VOLT]	FP	RO
8548	2164	A2 Polling Average [VOLT]	FP	RO
8550	2166	A2 Previous Daily Average [VOLT]	FP	RO
8552	2168	A2 Previous Interval Average [VOLT]	FP	RO
8554	216A	A2 Previous Polling Average [VOLT]	FP	RO
8556	216C	Internal Temperature	FP	RO
8558	216E	Supply Voltage	FP	RO
8560	2170	Battery Voltage	FP	RO
8562	2172	Live FR1 Instantaneous Flow Rate [BASE]	FP	RO
8564		Reserved		
8566	2176	Live T1 Instantaneous Flow Rate [GAL]	FP	RO
8568	2178	Live T2 Instantaneous Flow Rate [GAL]	FP	RO
8570	217A	Live Turbine Frequency Differential	FP	RO
8572	217C	Live Turbine Frequency Ratio	FP	RO
8574	217E	Live Static Pressure	FP	RO
8576	2180	Live Differential Pressure	FP	RO
8578	2182	Live MVT Temperature	FP	RO
8580	2184	Live Bridge Voltage	FP	RO
8582	2186	Live Analog 1	FP	RO
8584	2188	Live Analog 2	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8586	218A	Live Production Temperature	FP	RO
8588	218C	Live RTD Resistance	FP	RO
8590	218E	PID Stage 1 Status	FP	RO
8592	2190	PID Stage 1 Output	FP	RO
8594	2192	PID Stage 2 Status	FP	RO
8596	2194	PID Stage 2 Output	FP	RO
8598	2196	PO1 Pulses	FP	RO
8600 to 8605	Reserved			
8606	219E	AO1 Output Current	FP	RO
8610	21A2	Smart Battery % Capacity	FP	RO
8612	21A4	Smart Battery Status	FP	RO
8614	21A6	AO1 DAC Output	FP	RO
8618	21A8	Pulse Mirror Control Register	FP	RO
8622 to 8625	Reserved			
8626	21B2	PI2 State	FP	RO
8628	21B4	PI2 Count	FP	RO
8630 to 8637	Reserved			
8638	21BE	Daily Archive Date	FP	RO
8640	21C0	Interval Archive Date	FP	RO
8642	21C2	Daily Archive Time	FP	RO
8644	21C4	Interval Archive Time	FP	RO
8646	21C6	Slave Data Point 01	FP	RO
8648	21C8	Slave Data Point 02	FP	RO
8650	21CA	Slave Data Point 03	FP	RO
8652	21CC	Slave Data Point 04	FP	RO
8654	21CE	Slave Data Point 05	FP	RO
8656	21D0	Slave Data Point 06	FP	RO
8658	21D2	Slave Data Point 07	FP	RO
8660	21D4	Slave Data Point 08	FP	RO
8662	21D6	Slave Data Point 09	FP	RO
8664	21D8	Slave Data Point 10	FP	RO
8666	21DA	Slave Data Point 11	FP	RO
8668	21DC	Slave Data Point 12	FP	RO
8670	21DE	Slave Data Point 13	FP	RO
8672	21E0	Slave Data Point 14	FP	RO
8674	21E2	Slave Data Point 15	FP	RO
8676	21E4	Slave Data Point 16	FP	RO
8678	21E6	Calc Block 0, Current Day [Default: Flow Extension]	FP	RO
8680	21E8	Calc Block 0, Current Interval [Default: Flow Extension]	FP	RO
8682	21EA	Calc Block 0, Current Polling [Default: Flow Extension]	FP	RO
8684	21EC	Calc Block 0, Previous Day [Default: Flow Extension]	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8686	21EE	Calc Block 0, Previous Interval [Default: Flow Extension]	FP	RO
8688	21F0	Calc Block 0, Previous Polling [Default: Flow Extension]	FP	RO
8690	21F2	Calc Block 1, Current Day	FP	RO
8692	21F4	Calc Block 1, Current Interval	FP	RO
8694	21F6	Calc Block 1, Current Polling	FP	RO
8696	21F8	Calc Block 1, Previous Day	FP	RO
8698	21FA	Calc Block 1, Previous Interval	FP	RO
8700	21FC	Calc Block 1, Previous Polling	FP	RO
8702	21FE	Calc Block 2, Current Day	FP	RO
8704	2200	Calc Block 2, Current Interval	FP	RO
8706	2202	Calc Block 2, Current Polling	FP	RO
8708	2204	Calc Block 2, Previous Day	FP	RO
8710	2206	Calc Block 2, Previous Interval	FP	RO
8712	2208	Calc Block 2, Previous Polling	FP	RO
8714	220A	Calc Block 3, Current Day	FP	RO
8716	220C	Calc Block 3, Current Interval	FP	RO
8718	220E	Calc Block 3, Current Polling	FP	RO
8720	2210	Calc Block 3, Previous Day	FP	RO
8722	2212	Calc Block 3, Previous Interval	FP	RO
8724	2214	Calc Block 3, Previous Polling	FP	RO
8726	2216	Polling Date	FP	RO
8728	2218	Polling Time	FP	RO
8730	221A	Previous Day FR1 Grand Total Volume [MCF]	FP	RO
8732	221C	Previous Interval FR1 Grand Total Volume [MCF]	FP	RO
8734	221E	Previous Polling FR1 Grand Total Volume	FP	RO
8736	2220	Previous Day FR1 Grand Total Mass [LBM]	FP	RO
8738	2222	Previous Interval FR1 Grand Total Mass [LBM]	FP	RO
8740	2224	Previous Polling FR1 Grand Total Mass	FP	RO
8742	2226	Previous Day FR1 Grand Total Energy [MMBTU]	FP	RO
8744	2228	Previous Interval FR1 Grand Total Energy [MMBTU]	FP	RO
8746	222A	Previous Polling FR1 Grand Total Energy	FP	RO
8748	222C	Previous Day T1 Grand Total Volume [GAL]	FP	RO
8750	222E	Previous Interval T1 Grand Total Volume [GAL]	FP	RO
8752	2230	Previous Polling T1 Grand Total Volume	FP	RO
8754	2232	Previous Day T2 Grand Total Volume [GAL]	FP	RO
8756	2234	Previous Interval T2 Grand Total Volume [GAL]	FP	RO
8758	2236	Previous Polling T2 Grand Total Volume [GAL]	FP	RO

Flow Calculation Parameter Registers (1-16)

The Flow Calculation Parameter Registers definition is dependent upon the flow rate calculation method that is implemented. The following table describes the function of each of these registers for each of the supported calculation methods.

Reg. Num	AGA 3	ISO 5167	Cone –Spool, Cone -Wafer	AGA 7
1	Pipe Size (Corrected)	Pipe Size (Corrected)	Pipe Size (Corrected)	Pipe Size (Corrected)
2	Plate Size (Corrected)	Plate Size (Corrected)	Plate Size (Corrected)	Temperature Ratio
3	Beta (Corrected)	Beta (Corrected)	Beta (Corrected)	Pressure Ratio
4	Plate Size (configured)	Plate Size (configured)	Plate Size (configured)	Supercompressibility
5	Stability Index	Stability Index	Stability Index	<Reserved>
6	Y	Y	Y	<Reserved>
7	Cd	Cd	Cd	<Reserved>
8	Ev	Ev	Ev	<Reserved>
9	Flow Extension ($\sqrt{H20 \cdot lbm/cf3}$)	Flow Extension ($\sqrt{pa \cdot kg/m3}$)	Flow Extension ($\sqrt{pa \cdot kg/m3}$)	<Reserved>
10	Flowing Density (kg/m3)	Flowing Density (kg/m3)	Flowing Density (kg/m3)	Flowing Density (kg/m3)
11	Quality (Vapor Liquid Fraction) FR1 CPL - Pressure Correction Factor (Liquids)	Quality (Vapor Liquid Fraction) FR1 CPL - Pressure Correction Factor (Liquids)	Quality (Vapor Liquid Fraction) FR1 CPL - Pressure Correction Factor (Liquids)	<Reserved for Non-Liquids> FR1 CPL - Pressure Correction Factor (Liquids)
12	Liquid Heating Value	Liquid Heating Value	Liquid Heating Value	<Reserved>
13	Liquid Flowing Density	Liquid Flowing Density	Liquid Flowing Density	<Reserved>
14	Estimated Liquid Mass Flow Rate	Estimated Liquid Mass Flow Rate	Estimated Liquid Mass Flow Rate	<Reserved>
15	Apparent Mass Flow Rate	Apparent Mass Flow Rate	Apparent Mass Flow Rate	Apparent Mass Flow Rate
16	Lockhart-Martinelli	Lockhart-Martinelli	Lockhart-Martinelli	<Reserved>

Base Units/Configured Units

The holding registers allow users to read data in terms of *configured* units of measurement and *base* units. The configured units follow the settings based on the Unit setting register and the unit scale and offset registers. The base units will always have the same unit of measurement independent of the unit, scale and offset settings. Also note that the log data is always in terms of base units. It is recommended to configure the units of measurement using the software.

Polling Registers

The NUFLO Scanner 2105 flow computer stores volumes, averaged values, and flow times since the last polling sequence in a set of polling registers. Additionally, the instrument stores the number of polls requested in the polling index.

The polling sequence is started by writing a value of 20,000 to the Control Register. This transfers the polling totals, averages, and run times to the previous polling registers, increments the polling index and resets the polling totals, averages and run-time registers. Note that the polling registers are displayed in base units and configured units.

Interval/Daily/Event Pointer Registers

These registers provide an index of the last record that was stored in the log data. These values start at 1 and increment with each newly created log. When the maximum number of records is reached, the pointer resets to 1 and starts incrementing again.

Archive Preview Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8800	2260	Daily Record 1, Parameter 1 (Date)	FP	RO
8802	2262	Daily Record 1, Parameter 2 (Time)	FP	RO
8804	2264	Daily Record 1, Parameter 3	FP	RO
8806	2266	Daily Record 1, Parameter 4	FP	RO
8808	2268	Daily Record 1, Parameter 5	FP	RO
8810	226A	Daily Record 1, Parameter 6	FP	RO
8812	226C	Daily Record 1, Parameter 7	FP	RO
8814	226E	Daily Record 1, Parameter 8	FP	RO
8816	2270	Daily Record 1, Parameter 9	FP	RO
8818	2272	Daily Record 1, Parameter 10	FP	RO
8820	2274	Daily Record 1, Parameter 11	FP	RO
8822	2276	Daily Record 1, Parameter 12	FP	RO
8824	2278	Daily Record 1, Parameter 13	FP	RO
8826	227A	Daily Record 1, Parameter 14	FP	RO
8828	227C	Daily Record 1, Parameter 15	FP	RO
8830	227E	Daily Record 1, Parameter 16	FP	RO
8832	2280	Daily Record 2, Parameter 1 (Date)	FP	RO
8834	2282	Daily Record 2, Parameter 2 (Time)	FP	RO
8836	2284	Daily Record 2, Parameter 3	FP	RO
8838	2286	Daily Record 2, Parameter 4	FP	RO
8840	2288	Daily Record 2, Parameter 5	FP	RO
8842	228A	Daily Record 2, Parameter 6	FP	RO
8844	228C	Daily Record 2, Parameter 7	FP	RO
8846	228E	Daily Record 2, Parameter 8	FP	RO
8848	2290	Daily Record 2, Parameter 9	FP	RO
8850	2292	Daily Record 2, Parameter 10	FP	RO
8852	2294	Daily Record 2, Parameter 11	FP	RO
8854	2296	Daily Record 2, Parameter 12	FP	RO
8856	2298	Daily Record 2, Parameter 13	FP	RO
8858	229A	Daily Record 2, Parameter 14	FP	RO
8860	229C	Daily Record 2, Parameter 15	FP	RO
8862	229E	Daily Record 2, Parameter 16	FP	RO
8864	22A0	Interval Record 1, Parameter 1 (Date)	FP	RO
8866	22A2	Interval Record 1, Parameter 2 (Time)	FP	RO
8868	22A4	Interval Record 1, Parameter 3	FP	RO
8870	22A6	Interval Record 1, Parameter 4	FP	RO
8872	22A8	Interval Record 1, Parameter 5	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8874	22AA	Interval Record 1, Parameter 6	FP	RO
8876	22AC	Interval Record 1, Parameter 7	FP	RO
8878	22AE	Interval Record 1, Parameter 8	FP	RO
8880	22B0	Interval Record 1, Parameter 9	FP	RO
8882	22B2	Interval Record 1, Parameter 10	FP	RO
8884	22B4	Interval Record 1, Parameter 11	FP	RO
8886	22B6	Interval Record 1, Parameter 12	FP	RO
8888	22B8	Interval Record 1, Parameter 13	FP	RO
8890	22BA	Interval Record 1, Parameter 14	FP	RO
8892	22BC	Interval Record 1, Parameter 15	FP	RO
8894	22BE	Interval Record 1, Parameter 16	FP	RO
8896	22C0	Interval Record 2, Parameter 1 (Date)	FP	RO
8898	22C2	Interval Record 2, Parameter 2 (Time)	FP	RO
8900	22C4	Interval Record 2, Parameter 3	FP	RO
8902	22C6	Interval Record 2, Parameter 4	FP	RO
8904	22C8	Interval Record 2, Parameter 5	FP	RO
8906	22CA	Interval Record 2, Parameter 6	FP	RO
8908	22CC	Interval Record 2, Parameter 7	FP	RO
8910	22CE	Interval Record 2, Parameter 8	FP	RO
8912	22D0	Interval Record 2, Parameter 9	FP	RO
8914	22D2	Interval Record 2, Parameter 10	FP	RO
8916	22D4	Interval Record 2, Parameter 11	FP	RO
8918	22D6	Interval Record 2, Parameter 12	FP	RO
8920	22D8	Interval Record 2, Parameter 13	FP	RO
8922	22DA	Interval Record 2, Parameter 14	FP	RO
8924	22DC	Interval Record 2, Parameter 15	FP	RO
8926	22DE	Interval Record 2, Parameter 16	FP	RO

Holding Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7000	1B58	Interval Pointer	FP	RO
7001	1B59	Daily Pointer	FP	RO
7002	1B5A	Event Counter	FP	RO
7003	1B5B	Real Date	FP	RO
7004	1B5C	Real Time	FP	RO
7005	1B5D	Flow Run Alarms	FP	RO
7006	1B5E	Flow Run Alarm Low	FP	RO
7007	1B5F	Flow Run Alarm High	FP	RO
7008	1B60	Diagnostic 1	FP	RO
7009	1B61	Diagnostic 2	FP	RO
7010	1B62	Diagnostic 3	FP	RO
7011	1B63	Diagnostic 4	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7012	1B64	Polling Index	FP	RO
7013	1B65	FR1 Grand Volume Total	FP	RO
7014	1B66	FR1 Instantaneous Flow Rate	FP	RO
7015	1B67	FR1 Daily Total	FP	RO
7016	1B68	FR1 Interval Total	FP	RO
7017	1B69	FR1 Polling Total	FP	RO
7018	1B6A	FR1 Previous Day Total	FP	RO
7019	1B6B	FR1 Previous Interval	FP	RO
7020	1B6C	FR1 Previous Polling Total	FP	RO
7021	1B6D	FR1 Grand Mass Total	FP	RO
7022	1B6E	FR1 Instantaneous Mass Flow Rate	FP	RO
7023	1B6F	FR1 Daily Mass Total	FP	RO
7024	1B70	FR1 Interval Mass Total	FP	RO
7025	1B71	FR1 Polling Mass Total	FP	RO
7026	1B72	FR1 Previous Day Mass	FP	RO
7027	1B73	FR1 Previous Interval Mass	FP	RO
7028	1B74	FR1 Previous Polling Mass	FP	RO
7029	1B75	FR1 Grand Energy Total	FP	RO
7030	1B76	FR1 Instantaneous Energy Flow Rate	FP	RO
7031	1B77	FR1 Daily Energy Total	FP	RO
7032	1B78	FR1 Interval Energy Total	FP	RO
7033	1B79	FR1 Polling Energy Total	FP	RO
7034	1B7A	FR1 Previous Day Energy	FP	RO
7035	1B7B	FR1 Previous Interval Energy	FP	RO
7036	1B7C	FR1 Previous Polling Energy	FP	RO
7037	1B7D	FR1 Daily Estimated Total	FP	RO
7038	1B7E	FR1 Monthly Total	FP	RO
7039	1B7F	FR1 Previous Month Total	FP	RO
7040	1B80	FR1 Daily Run Time	FP	RO
7041	1B81	FR1 Interval Run Time	FP	RO
7042	1B82	FR1 Polling Run Time	FP	RO
7043	1B83	FR1 Previous Daily Run Time	FP	RO
7044	1B84	FR1 Previous Interval Run Time	FP	RO
7045	1B85	FR1 Previous Polling Run Time	FP	RO
7046	1B86	FR1 Static Pressure	FP	RO
7047	1B87	FR1 Differential Pressure	FP	RO
7048	1B88	FR1 Process Temperature	FP	RO
7049	1B89	FR1 Uncorrected Volume	FP	RO
7050	1B8A	FR1 SqrtDP	FP	RO
7051	1B8B	FR1 Compressibility (Natural Gas); FR1 CTPL - Complete Correction Factor (Liquids)	FP	RO
7052	1B8C	FR1 Density	FP	RO
7053	1B8D	FR1 Base Compressibility (Natural Gas) FR1 CTL - Temperature Correction Factor (Liquids)	FP	RO
7054	1B8E	FR1 Base Density	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7055	1B8F	FR1 Average Molecular Weight	FP	RO
7056	1B90	FR1 Molar Fraction Sum	FP	RO
7057	1B91	FR1 Mass Heating Value	FP	RO
7058	1B92	FR1 Heating Value Volume Basis	FP	RO
7059	1B93	FR1 Specific Gravity	FP	RO
7060	1B94	FR1 Viscosity	FP	RO
7061	1B95	FR1 Isentropic Exponent	FP	RO
7062	1B96	FR1 Reynolds Number	FP	RO
7063	1B97	FR1 Calculation Parameter 1	FP	RO
7064	1B98	FR1 Calculation Parameter 2	FP	RO
7065	1B99	FR1 Calculation Parameter 3	FP	RO
7066	1B9A	FR1 Calculation Parameter 4	FP	RO
7067	1B9B	FR1 Calculation Parameter 5	FP	RO
7068	1B9C	FR1 Calculation Parameter 6	FP	RO
7069	1B9D	FR1 Calculation Parameter 7	FP	RO
7070	1B9E	FR1 Calculation Parameter 8	FP	RO
7071	1B9F	FR1 Calculation Parameter 9	FP	RO
7072	1BA0	FR1 Calculation Parameter 10	FP	RO
7073	1BA1	FR1 Calculation Parameter 11	FP	RO
7074	1BA2	FR1 Calculation Parameter 12	FP	RO
7075	1BA3	FR1 Calculation Parameter 13	FP	RO
7076	1BA4	FR1 Calculation Parameter 14	FP	RO
7077	1BA5	FR1 Calculation Parameter 15	FP	RO
7078	1BA6	FR1 Calculation Parameter 16	FP	RO
7079	1BA7	FR1 Grand Total [MCF]	FP	RO
7080	1BA8	FR1 Instantaneous Flow Rate [MCF]	FP	RO
7081	1BA9	FR1 Daily Total [MCF]	FP	RO
7082	1BAA	FR1 Interval Total [MCF]	FP	RO
7083	1BAB	FR1 Polling Total [MCF]	FP	RO
7084	1BAC	FR1 Previous Day [MCF]	FP	RO
7085	1BAD	FR1 Previous Interval [MCF]	FP	RO
7086	1BAE	FR1 Previous Polling Total [MCF]	FP	RO
7087	1BAF	FR1 Grand Mass Total [LBM]	FP	RO
7088	1BB0	FR1 Instantaneous Mass Rate [LBM]	FP	RO
7089	1BB1	FR1 Daily Mass Total [LBM]	FP	RO
7090	1BB2	FR1 Interval Mass Total [LBM]	FP	RO
7091	1BB3	FR1 Polling Mass Total [LBM]	FP	RO
7092	1BB4	FR1 Previous Day Mass [LBM]	FP	RO
7093	1BB5	FR1 Previous Interval Mass [LBM]	FP	RO
7094	1BB6	FR1 Previous Polling Mass [LBM]	FP	RO
7095	1BB7	FR1 Grand Energy Total [MMBTU]	FP	RO
7096	1BB8	FR1 Instantaneous Energy Rate [MMBTU]	FP	RO
7097	1BB9	FR1 Daily Energy Total [MMBTU]	FP	RO
7098	1BBA	FR1 Interval Energy Total [MMBTU]	FP	RO
7099	1BBB	FR1 Polling Energy Total [MMBTU]	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7100	1BBC	FR1 Previous Day Energy [MMBTU]	FP	RO
7101	1BBD	FR1 Previous Interval Energy [MMBTU]	FP	RO
7102	1BBE	FR1 Previous Polling Energy [MMBTU]	FP	RO
7103	1BBF	FR1 Daily Estimated Total [MCF]	FP	RO
7104	1BC0	FR1 Monthly Total [MCF]	FP	RO
7105	1BC1	FR1 Previous Month Total [MCF]	FP	RO
7106	1BC2	FR1 Mass Heating Value [BASE]	FP	RO
7107	1BC3	FR1 Volumetric Heating Value [BASE]	FP	RO
7108	1BC4	T1 Grand Total	FP	RO
7109	1BC5	T1 Instantaneous Flow Rate	FP	RO
7110	1BC6	T1 Daily Total	FP	RO
7111	1BC7	T1 Interval Total	FP	RO
7112	1BC8	T1 Polling Total	FP	RO
7113	1BC9	T1 Previous Day	FP	RO
7114	1BCA	T1 Previous Interval	FP	RO
7115	1BCB	T1 Previous Polling Total	FP	RO
7116	1BCC	T1 Daily Estimated Total	FP	RO
7117	1BCD	T1 Monthly Total	FP	RO
7118	1BCE	T1 Previous Month Total	FP	RO
7119	1BCF	T1 Daily Run Time	FP	RO
7120	1BD0	T1 Interval Run Time	FP	RO
7121	1BD1	T1 Polling Run Time	FP	RO
7122	1BD2	T1 Previous Daily Run Time	FP	RO
7123	1BD3	T1 Previous Interval Run Time	FP	RO
7124	1BD4	T1 Previous Polling Run Time	FP	RO
7125	1BD5	T1 Grand Total [GAL]	FP	RO
7126	1BD6	T1 Instantaneous Flow Rate [GAL]	FP	RO
7127	1BD7	T1 Daily Total [GAL]	FP	RO
7128	1BD8	T1 Interval Total [GAL]	FP	RO
7129	1BD9	T1 Polling Total [GAL]	FP	RO
7130	1BDA	T1 Previous Day [GAL]	FP	RO
7131	1BDB	T1 Previous Interval [GAL]	FP	RO
7132	1BDC	T1 Previous Polling Total [GAL]	FP	RO
7133	1BDD	T1 Daily Estimated Total [GAL]	FP	RO
7134	1BDE	T1 Monthly Total [GAL]	FP	RO
7135	1BDF	T1 Previous Month Total [GAL]	FP	RO
7136	1BE0	T1 Frequency	FP	RO
7137	1BE1	T1 Active K-Factor	FP	RO
7138	1BE2	T2 Grand Total	FP	RO
7139	1BE3	T2 Instantaneous Flow Rate	FP	RO
7140	1BE4	T2 Daily Total	FP	RO
7141	1BE5	T2 Interval Total	FP	RO
7142	1BE6	T2 Polling Total	FP	RO
7143	1BE7	T2 Previous Day	FP	RO
7144	1BE8	T2 Previous Interval	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7145	1BE9	T2 Previous Polling Total	FP	RO
7146	1BEA	T2 Daily Estimated Total	FP	RO
7147	1BEB	T2 Monthly Total	FP	RO
7148	1BEC	T2 Previous Month Total	FP	RO
7149	1BED	T2 Daily Run Time	FP	RO
7150	1BEE	T2 Interval Run Time	FP	RO
7151	1BEF	T2 Polling Run Time	FP	RO
7152	1BF0	T2 Previous Daily Run Time	FP	RO
7153	1BF1	T2 Previous Interval Run Time	FP	RO
7154	1BF2	T2 Previous Polling Run Time	FP	RO
7155	1BF3	T2 Grand Total [GAL]	FP	RO
7156	1BF4	T2 Instantaneous Flow Rate [GAL]	FP	RO
7157	1BF5	T2 Daily Total [GAL]	FP	RO
7158	1BF6	T2 Interval Total [GAL]	FP	RO
7159	1BF7	T2 Polling Total [GAL]	FP	RO
7160	1BF8	T2 Previous Day Total [GAL]	FP	RO
7161	1BF9	T2 Previous Interval [GAL]	FP	RO
7162	1BFA	T2 Previous Polling Total [GAL]	FP	RO
7163	1BFB	T2 Daily Estimated Total [GAL]	FP	RO
7164	1BFC	T2 Monthly Total [GAL]	FP	RO
7165	1BFD	T2 Previous Month Total [GAL]	FP	RO
7166	1BFE	T2 Frequency	FP	RO
7167	1BFF	T2 Active K-Factor	FP	RO
7168	1C00	SP Instantaneous Reading	FP	RO
7169	1C01	SP Rate Of Change	FP	RO
7170	1C02	SP Daily Average	FP	RO
7171	1C03	SP Interval Average	FP	RO
7172	1C04	SP Polling Average	FP	RO
7173	1C05	SP Previous Daily Average	FP	RO
7174	1C06	SP Previous Interval Average	FP	RO
7175	1C07	SP Previous Polling Average	FP	RO
7176	1C08	SP Daily Run Time	FP	RO
7177	1C09	SP Interval Run Time	FP	RO
7178	1C0A	SP Polling Run Time	FP	RO
7179	1C0B	SP Previous Daily Run Time	FP	RO
7180	1C0C	SP Previous Interval Run Time	FP	RO
7181	1C0D	SP Previous Polling Run Time	FP	RO
7182	1C0E	SP Instantaneous Reading [PSI]	FP	RO
7183	1C0F	SP Rate of Change [PSI]	FP	RO
7184	1C10	SP Daily Average [PSI]	FP	RO
7185	1C11	SP Interval Average [PSI]	FP	RO
7186	1C12	SP Polling Average [PSI]	FP	RO
7187	1C13	SP Previous Daily Average [PSI]	FP	RO
7188	1C14	SP Previous Interval Average [PSI]	FP	RO
7189	1C15	SP Previous Polling Average [PSI]	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7190	1C16	DP Instantaneous Reading	FP	RO
7191	1C17	DP Rate Of Change	FP	RO
7192	1C18	DP Daily Average	FP	RO
7193	1C19	DP Interval Average	FP	RO
7194	1C1A	DP Polling Average	FP	RO
7195	1C1B	DP Previous Daily Average	FP	RO
7196	1C1C	DP Previous Interval Average	FP	RO
7197	1C1D	DP Previous Polling Average	FP	RO
7198	1C1E	DP Daily Run Time	FP	RO
7199	1C1F	DP Interval Run Time	FP	RO
7200	1C20	DP Polling Run Time	FP	RO
7201	1C21	DP Previous Daily Run Time	FP	RO
7202	1C22	DP Previous Interval Run Time	FP	RO
7203	1C23	DP Previous Polling Run Time	FP	RO
7204	1C24	DP Instantaneous Reading [INH2O]	FP	RO
7205	1C25	DP Rate of Change [INH2O]	FP	RO
7206	1C26	DP Daily Average [INH2O]	FP	RO
7207	1C27	DP Interval Average [INH2O]	FP	RO
7208	1C28	DP Polling Average [INH2O]	FP	RO
7209	1C29	DP Previous Daily Average [INH2O]	FP	RO
7210	1C2A	DP Previous Interval Average [INH2O]	FP	RO
7211	1C2B	DP Previous Polling Average [INH2O]	FP	RO
7212	1C2C	PT Instantaneous Reading	FP	RO
7213	1C2D	PT Rate Of Change	FP	RO
7214	1C2E	PT Daily Average	FP	RO
7215	1C2F	PT Interval Average	FP	RO
7216	1C30	PT Polling Average	FP	RO
7217	1C31	PT Previous Daily Average	FP	RO
7218	1C32	PT Previous Interval Average	FP	RO
7219	1C33	PT Previous Polling Average	FP	RO
7220	1C34	PT Daily Run Time	FP	RO
7221	1C35	PT Interval Run Time	FP	RO
7222	1C36	PT Polling Run Time	FP	RO
7223	1C37	PT Previous Daily Run Time	FP	RO
7224	1C38	PT Previous Interval Run Time	FP	RO
7225	1C39	PT Previous Polling Run Time	FP	RO
7226	1C3A	PT Instantaneous Reading [°F]	FP	RO
7227	1C3B	PT Rate of Change [°F]	FP	RO
7228	1C3C	PT Daily Average [°F]	FP	RO
7229	1C3D	PT Interval Average [°F]	FP	RO
7230	1C3E	PT Polling Average [°F]	FP	RO
7231	1C3F	PT Previous Daily Average [°F]	FP	RO
7232	1C40	PT Previous Interval Average [°F]	FP	RO
7233	1C41	PT Previous Polling Average [°F]	FP	RO
7234	1C42	A1 Instantaneous Reading	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7235	1C43	A1 Rate Of Change	FP	RO
7236	1C44	A1 Daily Average	FP	RO
7237	1C45	A1 Interval Average	FP	RO
7238	1C46	A1 Polling Average	FP	RO
7239	1C47	A1 Previous Daily Average	FP	RO
7240	1C48	A1 Previous Interval Average	FP	RO
7241	1C49	A1 Previous Polling Average	FP	RO
7242	1C4A	A1 Daily Run Time	FP	RO
7243	1C4B	A1 Interval Run Time	FP	RO
7244	1C4C	A1 Polling Run Time	FP	RO
7245	1C4D	A1 Previous Daily Run Time	FP	RO
7246	1C4E	A1 Previous Interval Run Time	FP	RO
7247	1C4F	A1 Previous Polling Run Time	FP	RO
7248	1C50	A1 Instantaneous Reading [VOLT]	FP	RO
7249	1C51	A1 Rate of Change [VOLT]	FP	RO
7250	1C52	A1 Daily Average [VOLT]	FP	RO
7251	1C53	A1 Interval Average [VOLT]	FP	RO
7252	1C54	A1 Polling Average [VOLT]	FP	RO
7253	1C55	A1 Previous Daily Average [VOLT]	FP	RO
7254	1C56	A1 Previous Interval Average [VOLT]	FP	RO
7255	1C57	A1 Previous Polling Average [VOLT]	FP	RO
7256	1C58	A2 Instantaneous Reading	FP	RO
7257	1C59	A2 Rate Of Change	FP	RO
7258	1C5A	A2 Daily Average	FP	RO
7259	1C5B	A2 Interval Average	FP	RO
7260	1C5C	A2 Polling Average	FP	RO
7261	1C5D	A2 Previous Daily Average	FP	RO
7262	1C5E	A2 Previous Interval Average	FP	RO
7263	1C5F	A2 Previous Polling Average	FP	RO
7264	1C60	A2 Daily Run Time	FP	RO
7265	1C61	A2 Interval Run Time	FP	RO
7266	1C62	A2 Polling Run Time	FP	RO
7267	1C63	A2 Previous Daily Run Time	FP	RO
7268	1C64	A2 Previous Interval Run Time	FP	RO
7269	1C65	A2 Previous Polling Run Time	FP	RO
7270	1C66	A2 Instantaneous Reading [VOLT]	FP	RO
7271	1C67	A2 Rate of Change [VOLT]	FP	RO
7272	1C68	A2 Daily Average [VOLT]	FP	RO
7273	1C69	A2 Interval Average [VOLT]	FP	RO
7274	1C6A	A2 Polling Average [VOLT]	FP	RO
7275	1C6B	A2 Previous Daily Average [VOLT]	FP	RO
7276	1C6C	A2 Previous Interval Average [VOLT]	FP	RO
7277	1C6D	A2 Previous Polling Average [VOLT]	FP	RO
7278	1C6E	Internal Temperature	FP	RO
7279	1C6F	Supply Voltage	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7280	1C70	Battery Voltage	FP	RO
7281	1C71	Live FR1 Instantaneous Flow Rate [BASE]	FP	RO
7282		Reserved		
7283	1C73	Live T1 Instantaneous Flow Rate [GAL]	FP	RO
7284	1C74	Live T2 Instantaneous Flow Rate [GAL]	FP	RO
7285	1C75	Live Turbine Frequency Differential	FP	RO
7286	1C76	Live Turbine Frequency Ratio	FP	RO
7287	1C77	Live Static Pressure	FP	RO
7288	1C78	Live Differential Pressure	FP	RO
7289	1C79	Live MVT Temperature	FP	RO
7290	1C7A	Live Bridge Voltage	FP	RO
7291	1C7B	Live Analog 1	FP	RO
7292	1C7C	Live Analog 2	FP	RO
7293	1C7D	Live Production Temperature	FP	RO
7294	1C7E	Live RTD Resistance	FP	RO
7295	1C7F	PID Stage 1 Status	FP	RO
7296	1C80	PID Stage 1 Output	FP	RO
7297	1C81	PID Stage 2 Status	FP	RO
7298	1C82	PID Stage 2 Output	FP	RO
7299	1C83	PO1 Pulses	FP	RO
7300 to 7302		Reserved		
7303	1C87	AO1 Output Current	FP	RO
7307	1C8B	AO1 DAC Output	FP	RO
7311 to 7312		Reserved		
7313	1C91	PI2 State	FP	RO
7314	1C92	PI2 Count	FP	RO
7315 to 7318		Reserved		
7319	1C97	Daily Archive Date	FP	RO
7320	1C98	Interval Archive Date	FP	RO
7321	1C99	Daily Archive Time	FP	RO
7322	1C9A	Interval Archive Time	FP	RO
7323	1C9B	Slave Data Point 01	FP	RO
7324	1C9C	Slave Data Point 02	FP	RO
7325	1C9D	Slave Data Point 03	FP	RO
7326	1C9E	Slave Data Point 04	FP	RO
7327	1C9F	Slave Data Point 05	FP	RO
7328	1CA0	Slave Data Point 06	FP	RO
7329	1CA1	Slave Data Point 07	FP	RO
7330	1CA2	Slave Data Point 08	FP	RO
7331	1CA3	Slave Data Point 09	FP	RO
7332	1CA4	Slave Data Point 10	FP	RO
7333	1CA5	Slave Data Point 11	FP	RO
7334	1CA6	Slave Data Point 12	FP	RO
7335	1CA7	Slave Data Point 13	FP	RO
7336	1CA8	Slave Data Point 14	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7337	1CA9	Slave Data Point 15	FP	RO
7338	1CAA	Slave Data Point 16	FP	RO
7339	1CAB	Calc Block 0, Current Day [Default: Flow Extension]	FP	RO
7340	1CAC	Calc Block 0, Current Interval [Default: Flow Extension]	FP	RO
7341	1CAD	Calc Block 0, Current Polling [Default: Flow Extension]	FP	RO
7342	1CAE	Calc Block 0, Previous Day [Default: Flow Extension]	FP	RO
7343	1CAF	Calc Block 0, Previous Interval [Default: Flow Extension]	FP	RO
7344	1CB0	Calc Block 0, Previous Polling [Default: Flow Extension]	FP	RO
7345	1CB1	Calc Block 1, Current Day	FP	RO
7346	1CB2	Calc Block 1, Current Interval	FP	RO
7347	1CB3	Calc Block 1, Current Polling	FP	RO
7348	1CB4	Calc Block 1, Previous Day	FP	RO
7349	1CB5	Calc Block 1, Previous Interval	FP	RO
7350	1CB6	Calc Block 1, Previous Polling	FP	RO
7351	1CB7	Calc Block 2, Current Day	FP	RO
7352	1CB8	Calc Block 2, Current Interval	FP	RO
7353	1CB9	Calc Block 2, Current Polling	FP	RO
7354	1CBA	Calc Block 2, Previous Day	FP	RO
7355	1CBB	Calc Block 2, Previous Interval	FP	RO
7356	1CBC	Calc Block 2, Previous Polling	FP	RO
7357	1CBD	Calc Block 3, Current Day	FP	RO
7358	1CBE	Calc Block 3, Current Interval	FP	RO
7359	1CBF	Calc Block 3, Current Polling	FP	RO
7360	1CC0	Calc Block 3, Previous Day	FP	RO
7361	1CC1	Calc Block 3, Previous Interval	FP	RO
7362	1CC2	Calc Block 3, Previous Polling	FP	RO
7363	1CC3	Polling Date	FP	RO
7364	1CC4	Polling Time	FP	RO
7365	1CC5	Previous Day FR1 Grand Total Volume [MCF]	FP	RO
7366	1CC6	Previous Interval FR1 Grand Total Volume [MCF]	FP	RO
7367	1CC7	Previous Polling FR1 Grand Total Volume	FP	RO
7368	1CC8	Previous Day FR1 Grand Total Mass [LBM]	FP	RO
7369	1CC9	Previous Interval FR1 Grand Total Mass [LBM]	FP	RO
7370	1CCA	Previous Polling FR1 Grand Total Mass	FP	RO
7371	1CCB	Previous Day FR1 Grand Total Energy [MMBTU]	FP	RO
7372	1CCC	Previous Interval FR1 Grand Total Energy [MMBTU]	FP	RO
7373	1CCD	Previous Polling FR1 Grand Total Energy	FP	RO
7374	1CCE	Previous Day T1 Grand Total Volume [GAL]	FP	RO
7375	1CCF	Previous Interval T1 Grand Total Volume [GAL]	FP	RO
7376	1CD0	Previous Polling T1 Grand Total Volume	FP	RO
7377	1CD1	Previous Day T2 Grand Total Volume [GAL]	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7378	1CD2	Previous Interval T2 Grand Total Volume [GAL]	FP	RO
7379	1CD3	Previous Polling T2 Grand Total Volume [GAL]	FP	RO

Archive Preview Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7400	1CE8	Daily Record 1, Parameter 1 (Date)	FP	RO
7401	1CE9	Daily Record 1, Parameter 2 (Time)	FP	RO
7402	1CEA	Daily Record 1, Parameter 3	FP	RO
7403	1CEB	Daily Record 1, Parameter 4	FP	RO
7404	1CEC	Daily Record 1, Parameter 5	FP	RO
7405	1CED	Daily Record 1, Parameter 6	FP	RO
7406	1CEE	Daily Record 1, Parameter 7	FP	RO
7407	1CEF	Daily Record 1, Parameter 8	FP	RO
7408	1CF0	Daily Record 1, Parameter 9	FP	RO
7409	1CF1	Daily Record 1, Parameter 10	FP	RO
7410	1CF2	Daily Record 1, Parameter 11	FP	RO
7411	1CF3	Daily Record 1, Parameter 12	FP	RO
7412	1CF4	Daily Record 1, Parameter 13	FP	RO
7413	1CF5	Daily Record 1, Parameter 14	FP	RO
7414	1CF6	Daily Record 1, Parameter 15	FP	RO
7415	1CF7	Daily Record 1, Parameter 16	FP	RO
7416	1CF8	Daily Record 2, Parameter 1 (Date)	FP	RO
7417	1CF9	Daily Record 2, Parameter 2 (Time)	FP	RO
7418	1CFA	Daily Record 2, Parameter 3	FP	RO
7419	1CFB	Daily Record 2, Parameter 4	FP	RO
7420	1CFC	Daily Record 2, Parameter 5	FP	RO
7421	1CFD	Daily Record 2, Parameter 6	FP	RO
7422	1CFE	Daily Record 2, Parameter 7	FP	RO
7423	1CFF	Daily Record 2, Parameter 8	FP	RO
7424	1D00	Daily Record 2, Parameter 9	FP	RO
7425	1D01	Daily Record 2, Parameter 10	FP	RO
7426	1D02	Daily Record 2, Parameter 11	FP	RO
7427	1D03	Daily Record 2, Parameter 12	FP	RO
7428	1D04	Daily Record 2, Parameter 13	FP	RO
7429	1D05	Daily Record 2, Parameter 14	FP	RO
7430	1D06	Daily Record 2, Parameter 15	FP	RO
7431	1D07	Daily Record 2, Parameter 16	FP	RO
7432	1D08	Interval Record 1, Parameter 1 (Date)	FP	RO
7433	1D09	Interval Record 1, Parameter 2 (Time)	FP	RO
7434	1D0A	Interval Record 1, Parameter 3	FP	RO
7435	1D0B	Interval Record 1, Parameter 4	FP	RO
7436	1D0C	Interval Record 1, Parameter 5	FP	RO

Archive Preview Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7437	1D0D	Interval Record 1, Parameter 6	FP	RO
7438	1D0E	Interval Record 1, Parameter 7	FP	RO
7439	1D0F	Interval Record 1, Parameter 8	FP	RO
7440	1D10	Interval Record 1, Parameter 9	FP	RO
7441	1D11	Interval Record 1, Parameter 10	FP	RO
7442	1D12	Interval Record 1, Parameter 11	FP	RO
7443	1D13	Interval Record 1, Parameter 12	FP	RO
7444	1D14	Interval Record 1, Parameter 13	FP	RO
7445	1D15	Interval Record 1, Parameter 14	FP	RO
7446	1D16	Interval Record 1, Parameter 15	FP	RO
7447	1D17	Interval Record 1, Parameter 16	FP	RO
7448	1D18	Interval Record 2, Parameter 1 (Date)	FP	RO
7449	1D19	Interval Record 2, Parameter 2 (Time)	FP	RO
7450	1D1A	Interval Record 2, Parameter 3	FP	RO
7451	1D1B	Interval Record 2, Parameter 4	FP	RO
7452	1D1C	Interval Record 2, Parameter 5	FP	RO
7453	1D1D	Interval Record 2, Parameter 6	FP	RO
7454	1D1E	Interval Record 2, Parameter 7	FP	RO
7455	1D1F	Interval Record 2, Parameter 8	FP	RO
7456	1D20	Interval Record 2, Parameter 9	FP	RO
7457	1D21	Interval Record 2, Parameter 10	FP	RO
7458	1D22	Interval Record 2, Parameter 11	FP	RO
7459	1D23	Interval Record 2, Parameter 12	FP	RO
7460	1D24	Interval Record 2, Parameter 13	FP	RO
7461	1D25	Interval Record 2, Parameter 14	FP	RO
7462	1D26	Interval Record 2, Parameter 15	FP	RO
7463	1D27	Interval Record 2, Parameter 16	FP	RO

User-Defined Modbus Registers Configuration

The NUFLO Scanner 2105 flow computer provides a block of 25 floating point values that the user can assign to any register in the holding register map. This optimizes communication by allowing the parameters that are of interest for a given application to be organized and read in a single block read. For details on configuring User-Defined Holding Registers, see Section 3 of the ModWorX Software User Manual. Each of the user-defined holding registers is determined by a pointer value in the holding register map. It is easiest to configure the pointer values with the ModWorX software; however the pointer value can be determined with the following calculation: $(\text{Holding Register Number} - 8000) / 2$.

User-Defined Register Pointers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9000	2328	User-Defined Starting Address (Always 9100)	U16	RO
9001	2329	Register Pointer 1	U16	RW

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9002	232A	Register Pointer 2	U16	RW
9003	232B	Register Pointer 3	U16	RW
9004	232C	Register Pointer 4	U16	RW
9005	232D	Register Pointer 5	U16	RW
9006	232E	Register Pointer 6	U16	RW
9007	232F	Register Pointer 7	U16	RW
9008	2330	Register Pointer 8	U16	RW
9009	2331	Register Pointer 9	U16	RW
9010	2332	Register Pointer 10	U16	RW
9011	2333	Register Pointer 11	U16	RW
9012	2334	Register Pointer 12	U16	RW
9013	2335	Register Pointer 13	U16	RW
9014	2336	Register Pointer 14	U16	RW
9015	2337	Register Pointer 15	U16	RW
9016	2338	Register Pointer 16	U16	RW
9017	2339	Register Pointer 17	U16	RW
9018	233A	Register Pointer 18	U16	RW
9019	233B	Register Pointer 19	U16	RW
9020	233C	Register Pointer 20	U16	RW
9021	233D	Register Pointer 21	U16	RW
9022	233E	Register Pointer 22	U16	RW
9023	233F	Register Pointer 23	U16	RW
9024	2340	Register Pointer 24	U16	RW
9025	2341	Register Pointer 25	U16	RW

User-Defined Holding Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9100	238C	User-Defined Holding Register 1	FP	RO
9102	238E	User-Defined Holding Register 2	FP	RO
9104	2390	User-Defined Holding Register 3	FP	RO
9106	2392	User-Defined Holding Register 4	FP	RO
9108	2394	User-Defined Holding Register 5	FP	RO
9110	2396	User-Defined Holding Register 6	FP	RO
9112	2398	User-Defined Holding Register 7	FP	RO
9114	239A	User-Defined Holding Register 8	FP	RO
9116	239C	User-Defined Holding Register 9	FP	RO
9118	239E	User-Defined Holding Register 10	FP	RO
9120	23A0	User-Defined Holding Register 11	FP	RO
9122	23A2	User-Defined Holding Register 12	FP	RO
9124	23A4	User-Defined Holding Register 13	FP	RO
9126	23A6	User-Defined Holding Register 14	FP	RO
9128	23A8	User-Defined Holding Register 15	FP	RO

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9130	23AA	User-Defined Holding Register 16	FP	RO
9132	23AC	User-Defined Holding Register 17	FP	RO
9134	23AE	User-Defined Holding Register 18	FP	RO
9136	23B0	User-Defined Holding Register 19	FP	RO
9138	23B2	User-Defined Holding Register 20	FP	RO
9140	23B4	User-Defined Holding Register 21	FP	RO
9142	23B6	User-Defined Holding Register 22	FP	RO
9144	23B8	User-Defined Holding Register 23	FP	RO
9146	23BA	User-Defined Holding Register 24	FP	RO
9148	23BC	User-Defined Holding Register 25	FP	RO

Device Status

The device status includes alarm status and diagnostic information such as input status and calculation status. The NUFLO Scanner 2105 flow computer provides 16 user-configurable alarms designated as Flow Run Alarms. The user can assign the alarms to any parameter in the holding register map. Alarms can be defined as low alarms or high alarms. For details on configuring Flow Run Alarms, see Section 3 of the ModWorX Software User Manual. The current status of the alarms can be obtained by reading the Flow Run Alarm registers in the device status map. A bit value of 1 indicates an alarm condition. Also contained in the device status map are diagnostic registers. The bits in these registers provide system status for inputs (under range, above range or failed), calculation status (for confirming whether the flow run is working properly) and details regarding the health of the MVT.

Device Status Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9900	26AC	Flow Run Alarms High	U32	RW
9902	26AE	Input Status	U32	RW
9904	26B0	Calculation Status	U32	RW

Bit Definitions—Alarms and Diagnostics

Bit	Flow Run Alarm High	Flow Run Alarm Low	Diagnostic 1	Diagnostic 2	Diagnostic 3	Diagnostic 4
15	FRA16 High	FRA16 Low	FR1 Fail	FR1 High	Reserved	Reserved
14	FRA15 High	FRA15 Low	T1 Fail	T1 High	Reserved	Reserved
13	FRA14 High	FRA14 Low	T2 Fail	T2 High	T2 Calc Warning	Reserved
12	FRA13 High	FRA13 Low	SP Fail	SP High	T1 Calc Warning	Reserved
11	FRA12 High	FRA12 Low	DP Fail	DP High	Reserved	Reserved
10	FRA11 High	FRA11 Low	PT Fail	PT High	Reserved	Reserved
9	FRA10 High	FRA10 Low	A1 Fail	A1 High	Reserved	Reserved
8	FRA9 High	FRA9 Low	A2 Fail	A2 High	FR1 Calc Warning	Reserved

Bit	Flow Run Alarm High	Flow Run Alarm Low	Diagnostic 1	Diagnostic 2	Diagnostic 3	Diagnostic 4
7	FRA8 High	FRA8 Low	FR1 Override	FR1 Low	NA	Reserved
6	FRA7 High	FRA7 Low	T1 Override	T1 Low	NA	Reserved
5	FRA6 High	FRA6 Low	T2 Override	SP Low	MVT M3 Formula Fail	Reserved
4	FRA5 High	FRA5 Low	SP Override	Reserved	MVT M2 Formula Fail	Power Mode
3	FRA4 High	FRA4 Low	DP Override	DP Low	MVT M1 Formula Fail	Reserved
2	FRA3 High	FRA3 Low	PT Override	PT Low	MVT User Param. CRC Fail	Reserved
1	FRA2 High	FRA2 Low	A1 Override	A1 Low	MVT Fact. Param. CRC Fail	Device Seal
0	FRA1 High	FRA1 Low	A2 Override	A2 Low	MVT Not Present	Ext. Switch

The NUFLO Scanner 2105 flow computer produces low, high and fail conditions for the inputs (not the flow alarms) in accordance with the following table.

Status	Range Check
Low	Lower Range Limit - 20% of span
Fail Low	Lower Range Limit - 500% of span
High	Upper Range Limit + 20% of span
Fail High	Upper Range Limit + 500% of span

Units of Measurement

Enron Log Data

The NUFLO Scanner 2105 flow computer provides Enron Modbus compliant downloads. For detailed instructions on downloading interval, daily and event data, refer to *Specifications and Requirements for an Electronic Flow Measurement Remote Terminal Unit for Enron Corp.* If an Enron host is not available or is too cumbersome or inefficient for the host system, there are other methods that are available to retrieve the log data from the instrument. Contact Sensia technical support for details.

The following registers are used for interval, daily and event log registers. Interval and daily records contain 16 user-configurable values. For details on the archive configuration, see Section 3 of the ModWorX Software User Manual. All of the Enron registers have an access type of Read Only (RO).

Enron Registers

Register	Description	Data Type
32	Enron Modbus Event Log Register	Refer to Enron Event Record Format
700	Enron Modbus Interval Log	Refer to Enron Interval/Daily Record Format
701	Enron Modbus Daily Log	Refer to Enron Interval/Daily Record Format
7000	Interval Pointer [1 to 2304] standard, [1 to 6392] with expansion board	FP32
7001	Daily Pointer [1 to 768]	FP32
7002	Event Counter [1 to 1152]	FP32

Enron Interval/Daily Record Format

The interval and daily record contents are user-configurable. The following table shows the default values. For more information, see Section 3 of the ModWorX Software User Manual.

Enron Event Record Format

Parameter	Data Type
Status	U16
Address	U16
Time (HH:MM:SS)	FP32
Date (MMDDYY)	FP32
As-Found	FP32
As-Left	FP32

The status parameter in the event record can be decoded with the following table.

Alarm Decoding

Description	Bit
<Unassigned>	0 to 8
User Change/Event	9
Low Low Alarm	10
Low Alarm	11
Hi Alarm	12
Hi Hi Alarm	13
<Unassigned>	14
Alarm Set/Reset (1=Set, 0=Reset)	15

Log Capacity

LOG TYPE	CAPACITY
Interval Logs	2304 (Std) 6392 (w/ Expansion Board)
Daily Logs	768
Event Logs	1152

Appendix D - Solar Panel Location and Orientation

Site Survey

Specific information is required to adequately determine the suitability of using solar power. The peak sun hours/day rating is based on the average amount of hourly peak sunlight per day during the month with the least sunlight. The month with the least sunlight for the northern hemisphere is typically December. For the southern hemisphere, it is typically June.

Other factors, such as storm seasons and prolonged cloudy seasons in some regions, make other months of the year receive less usable sunlight. Keep in mind that the following recommendations are general and each site should be surveyed to determine system requirements. The site survey should include, but not be limited to the following:

- The degrees latitude of the area.
- The amount of obstruction to direct sunlight to the solar panel, man-made or natural, such as buildings, fences, towers, trees, or hills.
- The climactic conditions such as frequency of clouds, rain, fog, as well as smog or smoke.

The insolation maps in [Figure D.1](#) and [Figure D.2, pg. D-2](#) plot equivalent insolation based on the month of the year receiving the least sunlight in each area. Insolation is expressed as equivalent sun hours. These numbers are used as an index in designing solar systems.

Average Daily Solar Radiation Per Month DECEMBER

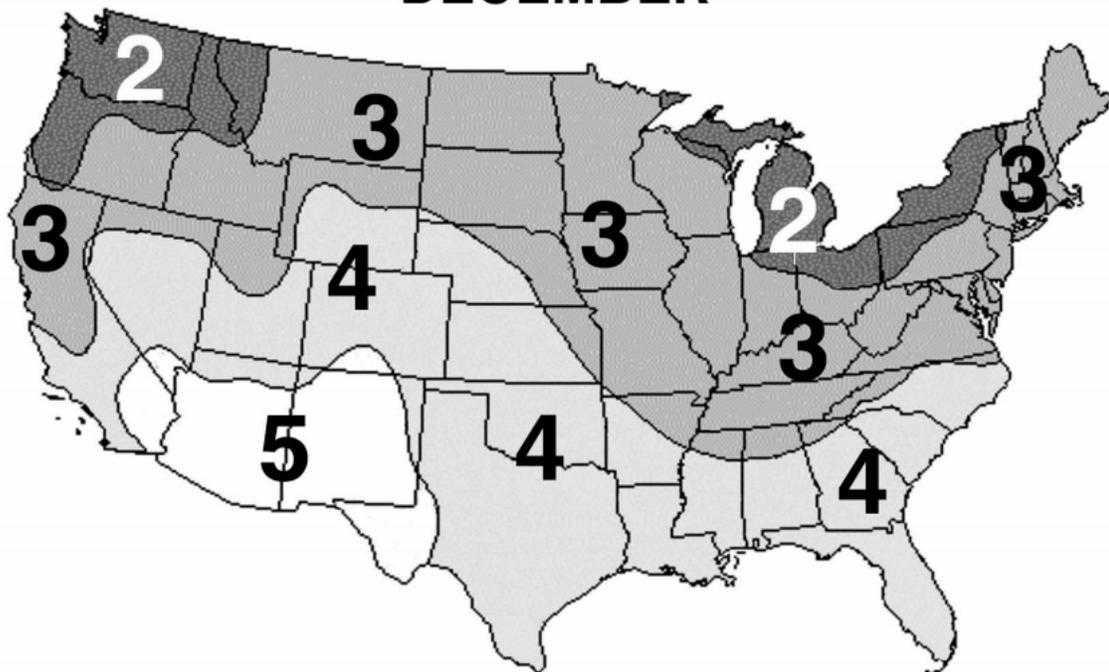


Figure D.1 - Solar insolation chart for the United States



Figure D.2 - Solar insolation chart for Europe

Solar Panel Location

Note All values are angles in degrees. Tilt and obstruction are measured in degrees from horizontal.

Variation

Variation is the difference between magnetic south and true south.

1. Use a magnetic compass to determine south in most locations.
2. Point the solar panel towards magnetic south. Then adjust for the appropriate degree variation for your area. See [Table D.1—Solar Panel Orientation, pg. D-3](#).

Latitude

Latitude is the angle of the site location from the equator. (The equator is 0° and the north and south poles are both 90° .) This angle is important in determining the tilt of the solar panel from horizontal to provide maximum efficiency. Tilt is the angle that the solar panel is pointing from the horizontal position. See [Table D.2— \(pg. D-3\)](#).

Angle of Obstruction

Determine the angle of obstruction by measuring the angle from the solar panel to the top of the obstruction due south of the panel. The angle measured should be less than the angle to the sun to prevent the obstruction from blocking sunlight to the panel during the winter solstice. See [Table D.1—Solar Panel Orientation, pg. D-3](#).

CAUTION

It is critical that the location of the solar panel is such that no shadows form on the surface of the solar panel. Any shadow falling across the solar panel will effectively stop operation of the solar panel because the internal cells are wired in series. If any one cell is blocked, the whole panel stops producing electricity.

Solar-Panel Tilt

To determine the tilt of the solar panel, first determine the latitude of the site location, then add the angles as indicated in [Table D.2—Angle Adjustment](#).

Maximum Angle of Obstruction

To determine the maximum angle of obstruction, subtract the latitude from 67°. The highest effective obstruction angle is 33° above the horizon.

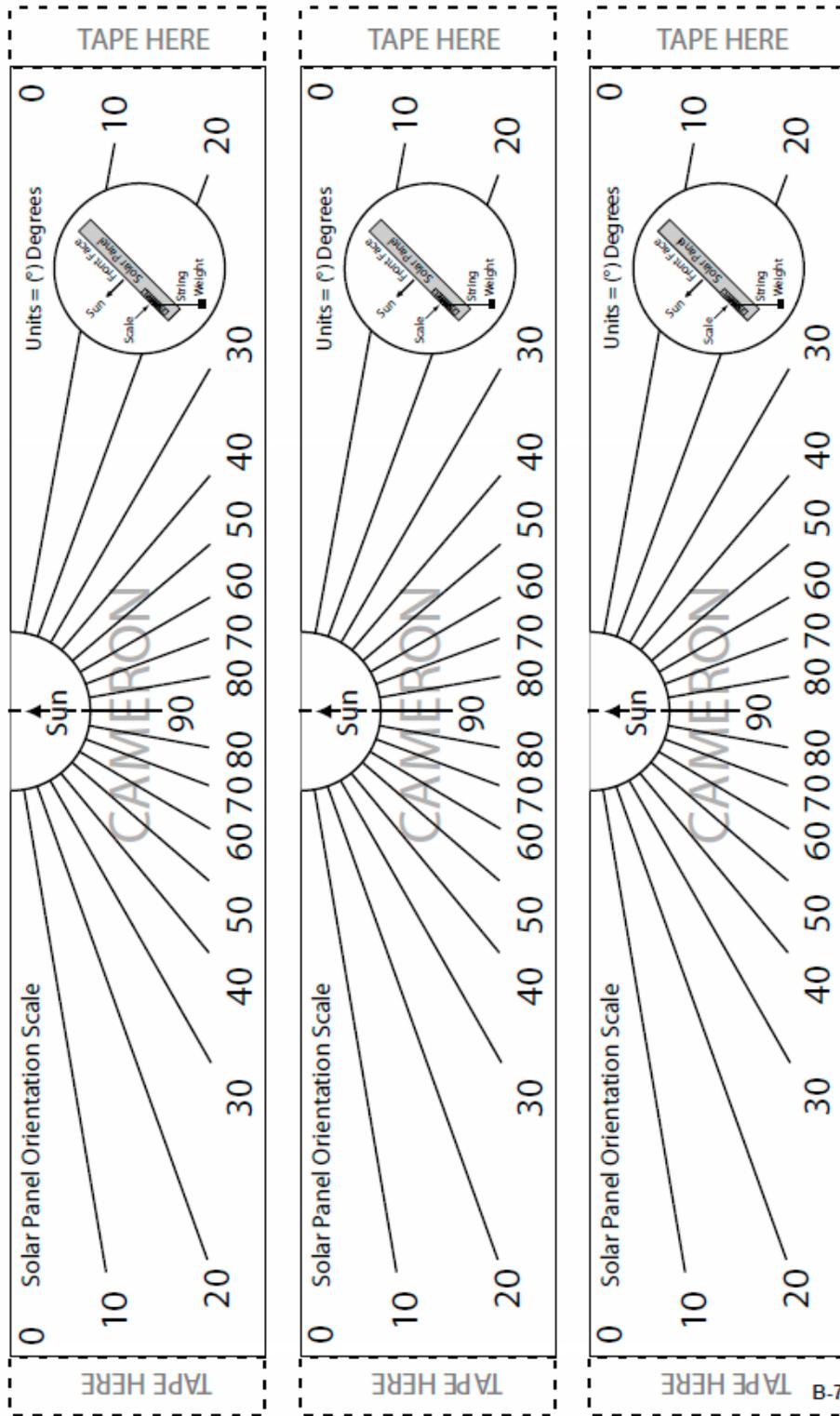
TABLE D.1—SOLAR PANEL ORIENTATION

Location	Variation	Latitude	Tilt	Obstruction
Brookwood, AL	1E	33	43	34
Bakersfield, CA	15E	35	45	32
Santa Fe Springs, CA	15E	34	44	33
Denver, CO	12E	40	50	27
Liberal, KS	9E	37	47	30
Lafayette, LA	5E	30	40	37
Duncan, OK	7E	34	44	33
Brownfield, TX	9E	33	43	34
Houston, TX	6E	30	40	37
Kilgore, TX	6E	32	42	35
Midland, TX	9E	32	42	35
Odessa, TX	9E	32	42	35
Casper, WY	12E	43	53	24

TABLE D.2—ANGLE ADJUSTMENT

Latitude	Horizontal
0° to 4°	10°
5° to 20°	Add 5° to latitude
21° to 45°	Add 10° to latitude
46° to 65°	Add 15° to latitude

Solar Panel Orientation Scales



References

- [1] EnerSys, User Manual, *Cylon App Guide_en*, December 2008.
- [2] L-com Global Connectivity, User Manual, *hg2409y_install*, February 2016
- [3] L-com Global Connectivity, Datasheet, *HG2409Y*, January 2017
- [4] L-com Global Connectivity, Datasheet, *HG2458-08LP*, May 2016
- [5] L-com Global Connectivity, Mechanical Drawing, *HG2458-08LP-NF*, July 2012

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