Installation Instructions

BMS Monitoring Connection Kit

Series LF007 Model IOT, 2½" – 3"

Series LF709 Model IOT, 2½" – 10"

⚠ WARNING

THINK SAFETY FIRST

Read this Manual BEFORE using this equipment.
Failure to read and follow all safety and use information can result in death, serious personal injury, property damage, or damage to the equipment.
Keep this Manual for future reference.

NOTICE

Use of integrated pressure sensors and monitoring connection kit does not remove the need to comply with all required instructions, codes, and regulations related to installation, operation, and maintenance of the backflow preventer.

Watts® is not responsible for data transmission failures due to power issues.

WATTS®

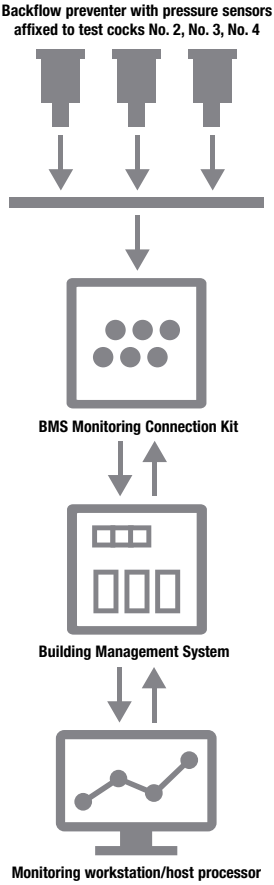
Contents

The IOT models of Series LF007 and LF709 double check valve backflow preventers include integrated sensors on test cocks No. 2, No. 3, and No. 4 to measure pressure fluctuations at the three locations. Pressure measurements allow assessment of the performance of the backflow preventer assembly.

The monitoring connection kit interfaces with both the pressure sensors on the valve assembly and the BMS controller, using an interface module that inputs DC voltage signals and outputs digital data values compatible with the Modbus RTU protocol. The module converts data at the rate of up to 25 conversions per second and stores the latest result in a buffer. The host processor requests data values by sending a Modbus query to the module, and the module responds in real time by communicating the memory buffer data values to the host processor. The module communication settings are stored in nonvolatile EEPROM (Electrically Erasable Programmable Read Only Memory), ensuring the settings are maintained if power is lost or removed.

The module can be configured with most any Modbus master program or with the utility software described in the appendix.

The illustration shows the flow of communication between the kit and the monitoring workstation (host processor) using the Modbus RTU protocol. The host processor sends a query to the module requesting data values, and the module responds immediately by communicating the latest set of stored values to the host processor.



Kit Components

The monitoring connection kit is an all-in one interface solution requiring attachment to a valve assembly, BMS controller, and power source. The kits includes the following items.

Interface module with mounting hardware

Data cable

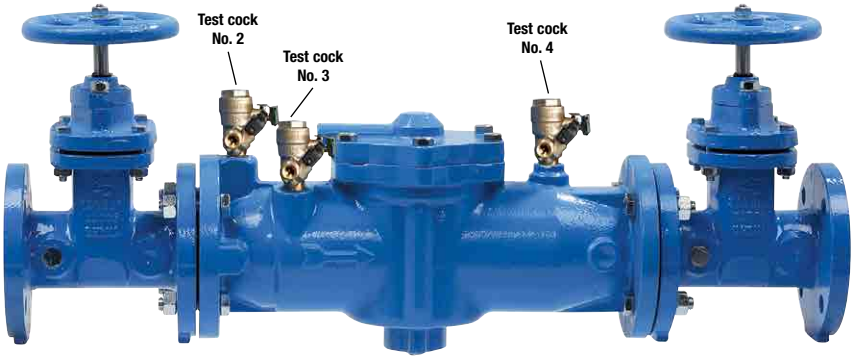
3 sensor cables

Power adapter

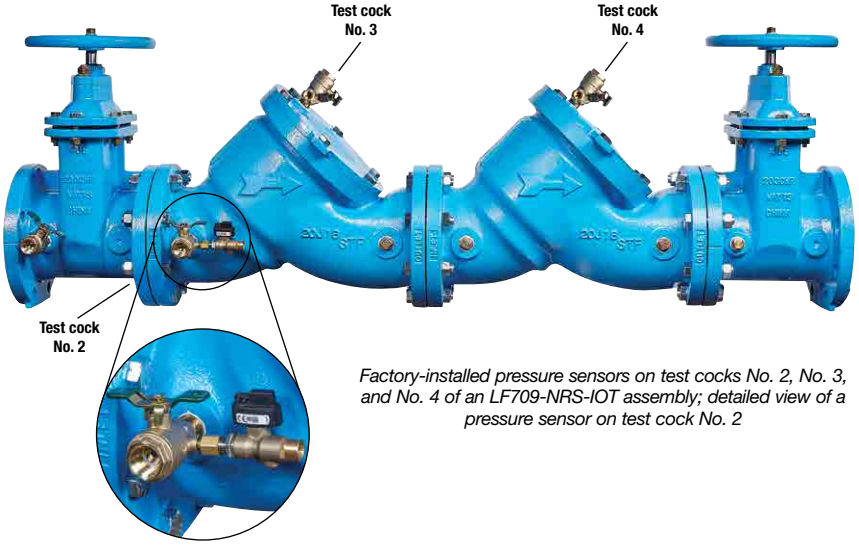
Requirements

- Series 007 Model IOT or 709 Model IOT backflow preventer
- Building Management/Automation System, or MODBUS RTU capable terminal
- Modbus RTU protocol
- RS-485 serial communications interface
- 110 VAC electrical outlet
- Suitable location within 8 ft of valve assembly to mount the kit

Retrofit an existing installation by installing both BMS Monitoring Connection Kit (88003067) and Sensor Module Replacement Kit (88003068).



Factory-installed pressure sensors on test cocks No. 2, No. 3, and No. 4 of an LF007-NRS-IOT assembly



Factory-installed pressure sensors on test cocks No. 2, No. 3, and No. 4 of an LF709-NRS-IOT assembly; detailed view of a pressure sensor on test cock No. 2

NOTICE

This is an electrical device. Use best practices for operating electronics in locations where water exposure is possible.

Kit Installation

Attach the monitoring connection kit to the pressure sensors integrated on the valve assembly and to the BMS controller feeding pressure measurements to a host processor.

1. Install the connection kit within 8 ft of valve assembly. (Mounting hardware included.)
2. Plug each sensor cable into one of the three integrated pressure sensors on the assembly.

   Each sensor cable port on the interface module is labeled for correct connection of the cable to the pressure sensor on the valve assembly. Connect the cables to the sensors in this order.

   Cable 1 to pressure sensor on test cock No. 2.

   Cable 2 to pressure sensor on test cock No. 3.

   Cable 3 to pressure sensor on test cock No. 4.
3. Connect the 3-conductor data cable to a BMS controller capable of RS-485 serial communication, using this terminal assignment.

   (B) Black wire Common GND

   (W) White wire DATA+

   (G) Green wire DATA-
4. Plug the power adapter into a GFI-protected, 110 VAC electrical outlet.

Interface Module Configuration

The interface module is a voltage input device that contains three inputs for analog voltage pressure sensors (included with backflow preventer) and a 16-bit analog-to-digital converter to perform the signal conversion to digital information. The analog-to-digital converter performs a total of 25 conversions per second. The module configuration can be completed by using most any Modbus master program or the utility software described in the appendix.

Features and Register Assignments

The interface module contains user-selectable communication settings. The user can select all features such as baud rate, parity type, and digital filtering. (See Table 1 Input Register Assignments for the complete list of features.) The register map format is used for consistency with the Modbus RTU protocol, and contains the register numbers in decimal format, register description, acceptable data values, and the definition of each value.

NOTE: All Modbus register values in the following table are represented as decimal numbers.

Table 1 Register Assignments

Functions: R – Read only; W – Write only; R/W – Read/Write; WP – Write-Protected

REGISTER	DESCRIPTION	FUNCTION	VALUE	DESCRIPTION
40001	Slave Address	R/W	1-DF	Factory set to 0x0001.
40002	UART Setup	R/W		**Bits 0-4 Baud Rate** 5=9600 6=19.2K 7=38.4K 8=57.6K 9=115.2K **Bits 5-6 Parity** 0=No Parity, 8-N-2 1=Odd 2=Even 3=No Parity, 8-N-1 Factory set to 0x0035 = 9600, 8, N, 1
40003	Modbus Delays	R/W	0-303F	**Bits 0-7** The Response Delay in milliseconds. This is required when the RS-485 adapter cannot tri-state immediately after the last character is transmitted from the host. Maximum value is 63mS. Factory default value is 3. **Bits 8-15** The End of Query Delay in milliseconds (48mS max). This is an additional time that the module waits before marking the end of the message. Slower host computers may not be able transmit a continuous message stream, thereby creating gaps between characters exceeding the normal 3.5 character times limit. Factory default value is 0. Factory set, 0x0003.
40033	Software Version	R		Factory set, Code Version
40048	Last Converted Chan, Conversion Counter	R	0-06FF	**Bits 0-7** The counter increments each conversion and rolled over after FF. The Conversion Counter indicates when the data registers have been updated. **Bits 8-10** Input channel last conversion stored. The information is useful when all channel data is read back with 1 query. The user can identify which channels have been converted since the last query as long as the time between queries is less than 8 conversion times. Initialized to '0x0000' on device reset.
40049	Channel 0 Data	R	0-FFFF	Data - Ch 0, Offset binary, zero=0x8000
40050	Channel 1 Data	R	0-FFFF	Data - Channel 1
40051	Channel 2 Data	R	0-FFFF	Data - Channel 2
40052	Channel 3 Data	R	0-FFFF	Data - Channel 3
40053	Channel 4 Data	R	0-FFFF	Data - Channel 4
40054	Channel 5 Data	R	0-FFFF	Data - Channel 5

Continued

Continued

REGISTER	DESCRIPTION	FUNCTION	VALUE	DESCRIPTION
40055	Channel 6 Data	R	0-FFFF	Data - Channel 6
40095	Misc. Setup	R/W	0-1	**Bit 0** – Normal Mode Rejection Setting 0 – 60Hz, 25 Hz Conversion Speed 1 – 50Hz, 20 Hz Conversion Speed Factory set to 0x0000.
40096	Signal Filtering	R/W	0-3F	This register controls all channels. Time constants are only approximate values. **Bits 0-3 Small Filter Time Constant (sec)** 0 0 1 0.5 2 1 3 2 4 4 5 8 6 16 7 32 **Bits 4-7 Large Filter Time Constant (sec)** 0 0 1 0.5 2 1 3 2 4-7 Reserved Factory set to 0x0000
40097	Setup Channel 0	R/W	0-F	Channel 0 range. Nonvolatile write-protected register. If the EEPROM cannot be written because of not being enabled, it replies with a Negative Acknowledge Exception response 07h. Modbus function code 10h is limited to 4 data values. **Range Bits 0-7 Hex** Disable Channel 00 ±10V 01 ±5V 02 Use ±5V only ±1V 03 ±0.100V 04 ±0.050V 05 ±0.025V 06 Factory set to 0x0001
40098	Setup Channel 1	R/W	0-F	Holds Channel 1 range. Factory set to 0x0001.
40099	Setup Channel 2	R/W	0-F	Holds Channel 2 range. Factory set to 0x0001.
40100	Setup Channel 3	R/W	0-F	Holds Channel 3 range. Factory set to 0x0001.
40101	Setup Channel 4	R/W	0-F	Holds Channel 4 range. Factory set to 0x0001.
40102	Setup Channel 5	R/W	0-F	Holds Channel 5 range. Factory set to 0x0001.

Continued

Continued

REGISTER	DESCRIPTION	FUNCTION	VALUE	DESCRIPTION
40103	Setup Channel 6	R/W	0-F	Holds Channel 6 range. Factory set to 0x0001.
40114	Trim Zero, 10V Range	WP	0	Forces all Channel Data Registers to 8000h, with input signal equal to zero. Apply calibration signal at least 15 seconds before calibrating to all channels. Calibration Acknowledge Exception Response. Calibration takes 20 seconds.
40115	Trim Zero, 5V Range	WP	0	Refer to Modbus register 40114.
40116	Trim Zero, 1V Range	WP	0	Refer to Modbus register 40114.
40117	Trim Zero, 0.1V Range	WP	0	Refer to Modbus register 40114. Apply calibration signal at least 1 minute before calibrating to all channels.
40118	Trim Zero, 0.05V Range	WP	0	Refer to Modbus register 40114. Apply calibration signal at least 1 minute before calibrating to all channels.
40119	Trim Zero, 0.025V Range	WP	0	Refer to Modbus register 40114. Apply calibration signal at least 1 minute before calibrating to all channels.
40146	Trim FS, 10V Range	WP	D000-FFFE	Forces all Channel Data Registers to written value, with appropriate input signal. Apply calibration signal at least 15 seconds before calibrating to all channels. Acknowledge Exception Response. Calibration takes 20 seconds.
40147	Trim FS, 5V Range	WP	D000-FFFE	Refer to Modbus Register 40146.
40148	Trim FS, 1V Range	WP	D000-FFFE	Refer to Modbus Register 40146.
40149	Trim FS, 0.1V Range	WP	D000-FFFE	Refer to Modbus Register 40146. Apply calibration signal at least 1 minute before calibrating to all channels.
40150	Trim FS, 0.05V Range	WP	D000-FFFE	Refer to Modbus Register 40146. Apply calibration signal at least 1 minute before calibrating to all channels.
40151	Trim FS, 0.025V Range	WP	D000-FFFE	Refer to Modbus Register 40146. Apply calibration signal at least 1 minute before calibrating to all channels.
40241	Control Register	W		0 – Normal operation (NOP) 1 – Remote Reset (write protected) 2 – Write Enable 5 – Initialize Host Communication setup

Factory Initial Values

The features of the interface module are initialized at the factory with a set of initial values. (See Table 2 Initial Input Values for the complete list of factory initial values.) For reference purposes, the Modbus slave address is preset to hex 0x01, the baud rate is 9600, Parity type is None, and the Stop Bits is “1”.

Table 2 Interface Module Initial Values

MODULE PARAMETER	VALUE
Slave Address	1
Baud Rate	9600
Parity Type	None
Modbus Response Delay	3mS
Modbus Query Delay	0mS
Conversion Rate	60Hz
Large Signal Filter	0 seconds
Small Signal Filter	0 seconds
Channel 0 Range	±5Vdc
Channel 1 Range	±5Vdc
Channel 2 Range	±5Vdc
Channel 3 Range	±5Vdc
Channel 4 Range	±5Vdc
Channel 5 Range	±5Vdc
Channel 6 Range	±5Vdc

Calibration

The interface module is shipped from the factory as fully calibrated devices. Throughout the lifetime of the module there may be need to verify or adjust the calibration of the device. The following verification and adjustment process should only be completed using NIST traceable calibration equipment. Perform the calibration steps in the order listed.

Required Equipment

- Computer running the utility software or another Modbus Master program.
- A NIST traceable DC Voltage Standard with ±10Vdc range.

Setup Steps

1. Allow unit to warm up for 15 minutes.
2. Short all the +Input pins together using short jumper wires.
3. Short all the -Input pins together using short jumper wires.
4. Connect the +Input wires to the Positive terminal on the DC voltage calibrator.
5. Connect the -Input wires to the Negative terminal on the DC voltage calibrator.
6. Install the utility software or another Modbus Master Program to communicate with, and calibrate with the module via serial port or a TCP/IP connection.

Trim Zero

1. Set the DC calibrator voltage output to +0.0000Vdc.
2. Use the utility software or a Modbus Master program to perform steps 3 and 5.
3. Set all channels to the same range. Start with ±10Vdc range, working downward per values in Table 3 Range Register Values.
4. Trim Zero on all channels.
   a. Write a value of 0x0002h to Control Register 40241 to Write-Enable the module.
   b. Retrieve Trim Zero register value for specific range from Table 4 Trim Zero Registers and Calibration Values.
   c. Write value of 0x00h to Range Trim Zero register (that is, 40114 for ±10V).
   d. Perform steps 4a to 4c to trim zero on each range.

Trim Span

1. Set the DC calibrator voltage output to +10.000Vdc.
2. Use the utility software or a Modbus Master program to perform steps 3 and 5.
3. Set all channels to the same range. Start with ±0.025Vdc range, working upward per values in Table 5 Trim Span Registers and Calibration Values.
4. Trim Span on each channel.
   a. Write a value of 0x0002h to Control Register 40241 to Write-Enable the module.
   b. Retrieve Trim Span register value for specific range from Table 4 Trim Zero Registers and Calibration Values.
   c. Write value of 0xfffe to Trim Span register (that is, 40146 for ±10V).
   d. Perform steps 4a to 4c to trim span on each range.

Table 3 Range Register Values

CHANNEL	RANGE CONTROL	RANGE VALUE	
Channel 0	40097	00	Disabled
Channel 1	40098	01	±10V
Channel 2	40099	02	±5V
Channel 3	40100	03	±1V
Channel 4	40101	04	±0.1V
Channel 5	40102	05	±0.05V
Channel 6	40103	06	±0.025V

Table 4 Trim Zero Registers and Calibration Values

RANGE	REGISTER	VALUE
±10Vdc	40114	0000
±5Vdc	40115	0000
±1Vdc	40116	0000
±0.1Vdc	40117	0000
±0.05Vdc	40118	0000
±0.025Vdc	40119	0000

Table 5 Trim Span Registers and Calibration Values

RANGE	REGISTER	VALUE
±0.025Vdc	40151	FFFE
±0.05Vdc	40150	FFFE
±0.1Vdc	40149	FFFE
±1Vdc	40148	FFFE
±5Vdc	40147	FFFE
±10Vdc	40146	FFFE

Data Conversion

The data values transmitted by the interface module fall in the range from -29490 to -9830. Each incremental integer represents 0.0089 psig. For example, an output value of -29490 is equivalent to 0 psig, whereas an output of -28366 is equivalent to 10 psig.

The module has been configured to display output data values as numerical values. Calculate the difference between the minimum value (-29490) and the output value *(x)*, then multiply by 0.0089.

NOTE: The output value will be a negative integer. Multiply the formula by -1 to convert the negative integer to a positive one.

$$(-1) \times (-29490 - (x)) \times 0.0089 = \text{pressure (psig)}$$

For example, where the output value equals 13500, the calculation is as follows:

$$(-1) \times (-29490 - (-13500)) \times 0.0089 = 142.31 \text{ psig}$$

Modbus RTU Functions

The Modbus RTU binary protocol uses a master-slave technique. Only the master device can initiate transactions. The slave device responds by supplying the requested data to the master or by performing the requested action in the query. The returned messages are considered response messages.

Eight different functions of the protocol allow control of every function within the module. The output data values are stored in registers and can be read by using either Function 03 or Function 04.

The first input data register is located at register 40049. There are seven consecutive registers (40049 to 40055) that contain the module data values (only registers 40049 to 40051 are used for transmitting pressure data; additional input data registers are unused). The values are stored in consecutive registers for fast reading of all the data values with one Modbus function call.

FUNCTION	DESCRIPTION
01	Return coil status of discrete output points
02	Read ON/OFF status of discrete inputs in the slave device
03	Read content of holding registers (4X references) in the slave device
04	Read content of input registers (3X references) in the slave device
05	Force state of a single coil (digital output) to either ON or OFF
06	Preset the state of a single register to a specific value
0F	Force the state of a sequence of coils (digital outputs) to a specific state
10	Preset a sequence of registers (4X references) to specific values

Function 01 – Read Coil Status

Returns the coil status of discrete digital output points. A typical function 01 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Starting Address HI Byte	
Addr LO	Starting Address LO Byte	
Data HI	Typically ZERO	
Data LO	Number of bits, limited to 1..64	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Register Number	Number of data bytes	Returns four bytes typically.
Data HI	Data Coils (27-20)	
Data LO	Data Coils (35-28)	
Data HI	Data Coils (43-36)	
Data LO	Data Coils (51-44)	
Error Check	Two Byte CRC	

Function 02 – Read Input Status

Read the ON/OFF status of discrete digital input bits in the slave device. A typical function 02 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Starting Address HI Byte	
Addr LO	Starting Address LO Byte	
Data HI	Typically ZERO	
Data LO	Number of bits, limited to 1..64	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Register Number	Number of data bytes	Returns four bytes typically.
Data HI	Data Coils (27-20)	
Data LO	Data Coils (35-28)	
Data HI	Data Coils (43-36)	
Data LO	Data Coils (51-44)	
Error Check	Two Byte CRC	

Function 03 – Read Holding Registers

Returns the contents of hold registers (4X references) in the slave device. A typical function 03 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Starting Register Address HI Byte	
Addr LO	Starting Register Address LO Byte	
Data HI	Typically ZERO	
Data LO	Number of registers	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Register Number	Number of data bytes	Returns four bytes typically.
Data HI	HI Byte (8-bits)	
Data LO	LO Byte (8-bits)	
Error Check	Two Byte CRC	

Function 04 – Read Input Register

Returns the contents of hold registers (3X references) in the slave device. A typical function 04 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Starting Register Address HI Byte	
Addr LO	Starting Register Address LO Byte	
Data HI	Typically ZERO	
Data LO	Number of registers	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Register Number	Number of data bytes	Returns four bytes typically.
Data HI	HI Byte (8-bits)	
Data LO	LO Byte (8-bits)	
Error Check	Two Byte CRC	

Function 05 – Force Single Coil

Forces the state of a single coil (digital output) to either the ON or OFF state. A typical function 05 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Coil Address HI Byte	
Addr LO	Coil Address LO Byte	
Data HI	Force Data HI	
Data LO	Force Data LO	
Data Values	The proper values are either 0xFF00 to enable (Turn ON) a bit or 0x0000 to disable (turn off) a bit.	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Coil Address HI Byte	Same value as in command above.
Addr LO	Coil Address LO Byte	Same value as in command above.
Data HI	Force Data HI	Same value as in command above.
Data LO	Force Data LO	Same value as in command above.
Error Check	Two Byte CRC	

Function 06 – Preset Single Register

Presets the state of a single register to a specific value. A typical function 06 command and response follow.

Command Usage

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Starting Register Address HI Byte	
Addr LO	Starting Register Address LO Byte	
Data HI	Force Data HI	
Data LO	Force Data LO	

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Addr HI	Register Address HI Byte	Same value as in command above.
Addr LO	Register Address LO Byte	Same value as in command above.
Data HI	Preset Data value HI	Same value as in command above.
Data LO	Preset Data value LO	Same value as in command above.
Error Check	Two Byte CRC	

Function 0F – Force Multiple Coils

Forces the state of multiple coils (digital outputs) in a digital output module. A typical function 0F command and response follow.

Command Usage

Address	One Byte Slave Address
Function	One Byte Function Number
Starting Addr HI	Starting Address HI Byte
Starting Addr LO	Starting Address LO Byte
Qty Coils HI	Number of Coils to Write HI
Qty Coils LO	Number of Coils to Write LO
Byte Count	Number of Data Bytes Transmitted
Force Data HI	Force Data HI
Force Data LO	Force Data LO

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Starting Addr HI	Starting Address HI Byte	Same value as in command above.
Starting Addr LO	Starting Address LO Byte	Same value as in command above.
Qty Coils HI	Qty Coils HI	Same value as in command above.
Qty Coils LO	Qty Coils LO	Same value as in command above.
Error Check	Two Byte CRC	

Function 10 – Preset Multiple Registers

Presets the state of multiple registers to specific values. A typical function 10 command and response follow.

Command Usage

Address	One Byte Slave Address
Function	One Byte Function Number
Starting Addr HI	Starting Register Address HI Byte
Starting Addr LO	Starting Register Address LO Byte
Num Registers HI	Number of Registers to Write HI
Num Registers LO	Number of Registers to Write LO
Byte Count	Number of Data Bytes Transmitted
Data HI	Force Data HI
Data LO	Force Data LO

Response Message

Address	One Byte Slave Address	
Function	One Byte Function Number	
Starting Addr HI	Starting Address HI Byte	Same value as in command above.
Starting Addr LO	Starting Address LO Byte	Same value as in command above.
Num Registers HI	Preset Data value HI	Same value as in command above.
Num Registers LO	Preset Data value LO	Same value as in command above.
Error Check	Two Byte CRC	

Modbus Exceptions

These Exception Codes are returned when an error is detected within the command messages transmitted to the module.

EXCEPTION	NAME	DESCRIPTION
01	Illegal Function	Generated when the module does not recognize the function code.
02	Illegal Data Address	Generated when the module does not support the specified data address in the command.
03	Illegal Data Value	Generated if the command data is out of range for the function.
06	Slave Busy	Generated during the first 3 seconds after the module is reset or powered up.
07	Negative Acknowledge	Generated if the command tries to write a value into the module EEPROM without being write-enabled first.

Specification

Interface

Communications via Modbus RTU protocol

Environmental

Temperature Range: Operating -13 °F to 158 °F (-25 °C to 70 °C)
Storage: -13 °F to +185 °F (25 °C to 85 °C)
Relative Humidity: 0 to 95% noncondensing

Appendix

NOTE: Setting the interface module to Default Mode requires removing the cover of the module to access the internal data converter.

Default Configuration

EEPROM in the interface module stores setup information and calibration constants and replaces the usual array of switches and ports necessary for specification such as baud rate, address, and parity. No batteries are used, which eliminates the need to open the kit.

EEPROM provides the ability to configure the module setup parameters remotely through the communications port without having to physically change settings. Each module has an input pin labeled DEFAULT*. By connecting this pin to Ground, the module is put in a known communications setup called Default Mode.

The Default Mode settings are 9600 baud, one start bit, eight data bits, one stop bit, no parity. Any address is recognized. The module answers to address “01” in Default Mode. Grounding the DEFAULT* pin does not change any of the setups stored in EEPROM. The setup information can be read back to determine all the setups stored in the module.

Put the module in Default Mode to change the setup information. The baud rate and parity setups can be changed without affecting the Default Mode values of 9600 baud and no parity. When the DEFAULT* pin is released, the module automatically performs an internal reset and configures itself to the baud rate and parity stored in the setup information.

Use Default Mode only with a single module connected to a computer for the purpose of identifying and modifying setup values. In most cases, a module in Default Mode cannot be used in a string with other modules.

For simplicity, Watts recommends performing all the setups while in Default Mode. Put the module in Default Mode by connecting the DEFAULT* terminal to the GND terminal using a jumper wire. When the module is in Default Mode, the serial parameters are internally set to 9600 Baud, 8 data bits, no parity, and one stop bit. The module responds to Modbus Slave address “01”.

NOTE: No other wiring connections are required on the analog or digital I/O pins to perform the module configuration.

Run the Utility Software

The Default* line being connected to the power supply ground is included within the wiring connections. This connection places the module in Default Mode. Default Mode forces the module into a known communications state and is best used for configuring the module. The Default Mode serial communications parameters are 9600 baud, eight data bits, no parity, and one stop bit. The module answers to Modbus Slave address “1” (0x01).

The module requires an application to change the setup register values. As the module communicate through the Modbus RTU protocol, a Modbus Master program or the utility software is required to change the module configuration.

The utility software is the best program to use when configuring the module. The utility software reads the module information, displays the information in easy-to-understand terms, allows changes to be made through drop-down menus, and then writes the new values to the module. The module parameters can also be stored to disc and recalled later.

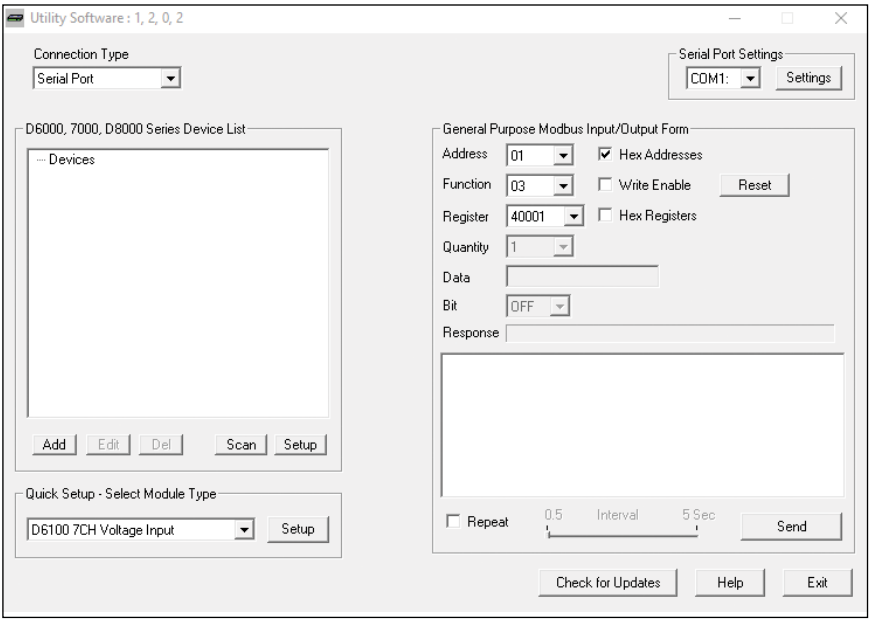
The utility software runs on Windows-based systems. Download the program from https://www.watts.com/performance-monitoring then run Setup.exe. The utility installs and creates a menu section named “DGH Data Acquisition.” The utility software resides under that selection.

Launch D6000 Utility Software to select, configure, and open the host serial communications port where the module is connected.

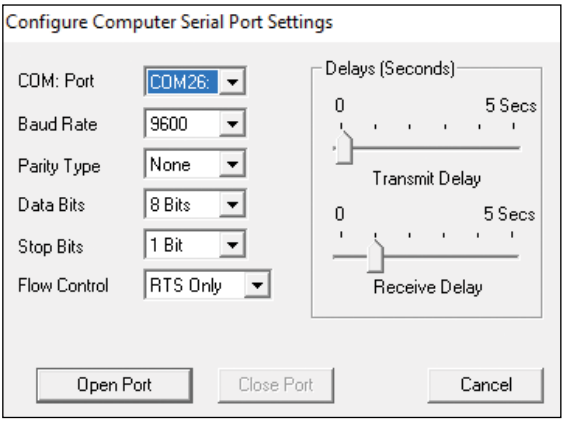
In the Connection Type field (upper left), select Serial Port.

Using the Quick Setup drop-down list (lower left), select D6100 7CH Voltage Input.

In the Serial Port Settings field (upper right), select the proper communications port and then click Settings.

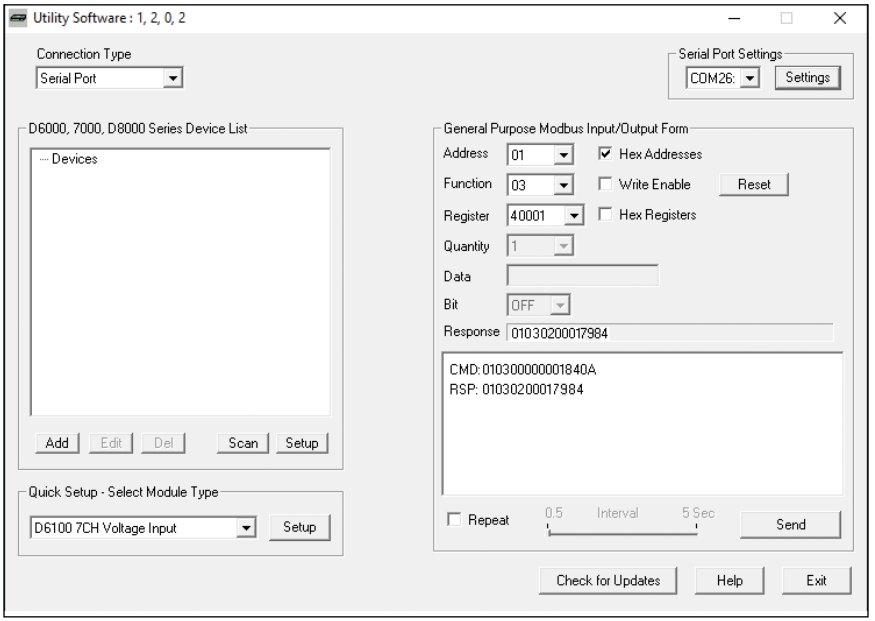


If the “Default*” line is connected to ground, then select 9600 baud rate, no parity, eight data bits, one stop bit, and RTS Only flow control. The Tx and Rx delays can be left in their default state. Otherwise, adjust the communications settings to match the settings in the connected module. Click Open Port to complete the serial port configuration process.



Test Communication

After the utility software serial port has been configured, check for valid communication between the computer and the module. Valid communication with the module is required before the configuration process can start. To test the communication, set the Modbus Address to 01 in Default Mode or set the Modbus Address to match the setting in the module. Set the Function selector to 03 and the Register selector to 40001. Click Send to verify communications. A data value is displayed in the Response field.



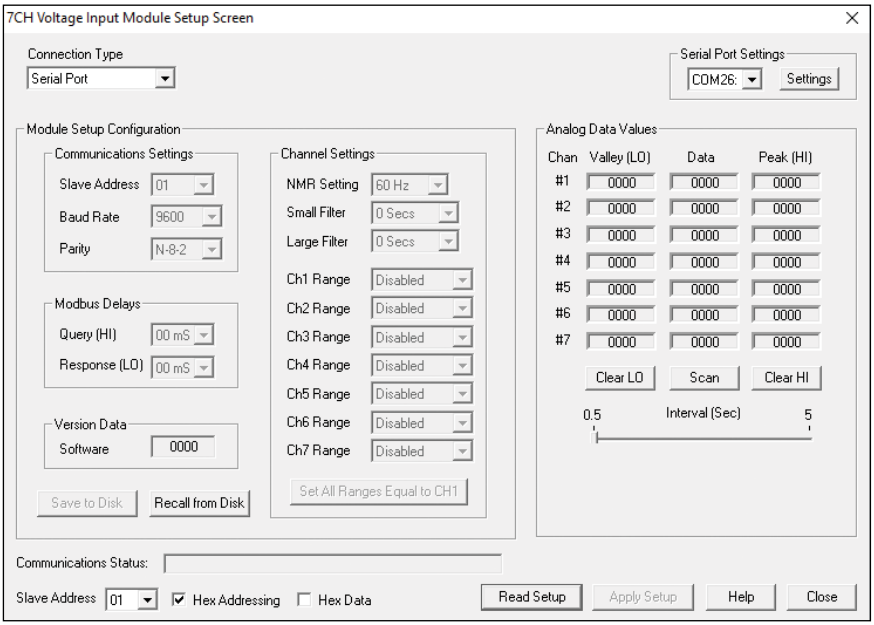
The preceding dialog box illustrates the Modbus function 03 being sent to Modbus slave address 01. Both the command and response messages are displayed beginning with CMD and RSP, respectively. This display format is provided for troubleshooting purposes as it displays each byte of information being sent to and received from the module. This format can be a troubleshooting tool or a way to become familiar with the formatting of the Modbus RTU protocol.

The response data value from register 40001 is located in the RSP: line. The data value returned is a 16-bit value located in the fourth and fifth bytes in the message (00 01). The “00 01” indicates that the register value is 0001. From the Input Register Assignments map, register 40001 contains the Modbus slave address value. In this case, the module slave address value is read back as 0001.

In the event that the module is not detected by the software, then the RSP: line reports “RSP: Timeout – No Response Detected!” Several things can contribute to this problem; for example, no power to the module, bad RS-485 wiring connection(s), invalid port settings, or RS-485 half-duplex handshaking problems. All can cause timeout errors. Timeout errors must be corrected before attempting to configure the module.

Set Up the Module

After a successful communication test has been performed, the module can be configured. Use the Quick Setup drop-down menu (lower left) to select module type D6100 7CH Voltage Input, then click Setup. A dialog box is displayed containing a list of all the user-selectable module values. The following dialog box applies to the seven-channel voltage input module.



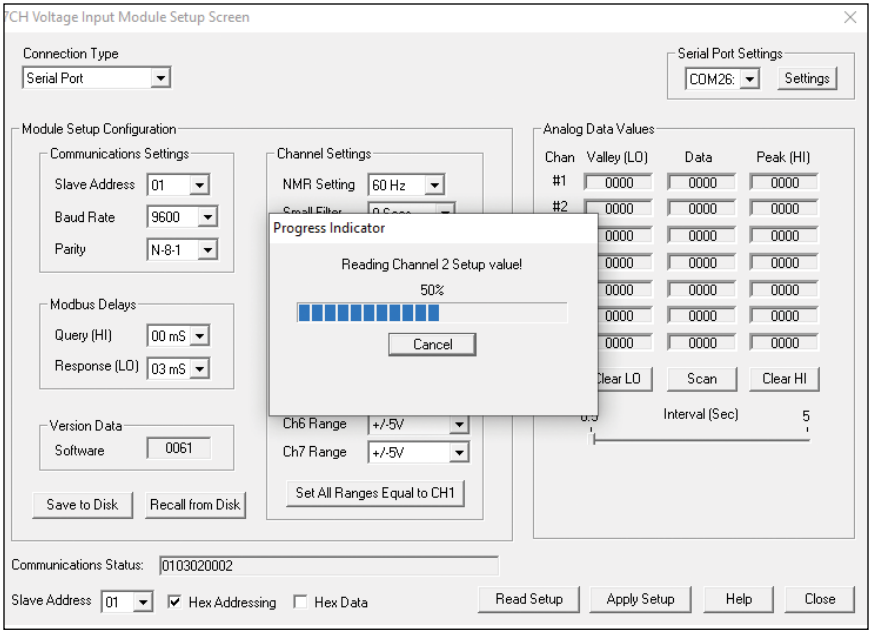
Ensure that 01 is entered in the Slave Address field (lower left), and then click Read Setup. The dialog box now populates with the existing configuration data inside the module.

The user-selectable values are displayed in an easy-to-understand format and new selections can be made through the drop-down menus, which facilitate the configuration process and eliminate the entry of erroneous values.

NOTICE

Ensure the channel ranges are set to ±5V for accurate measurement.

After the new module configuration settings have been changed to meet the application requirements, click Apply Setup transmit the new settings.

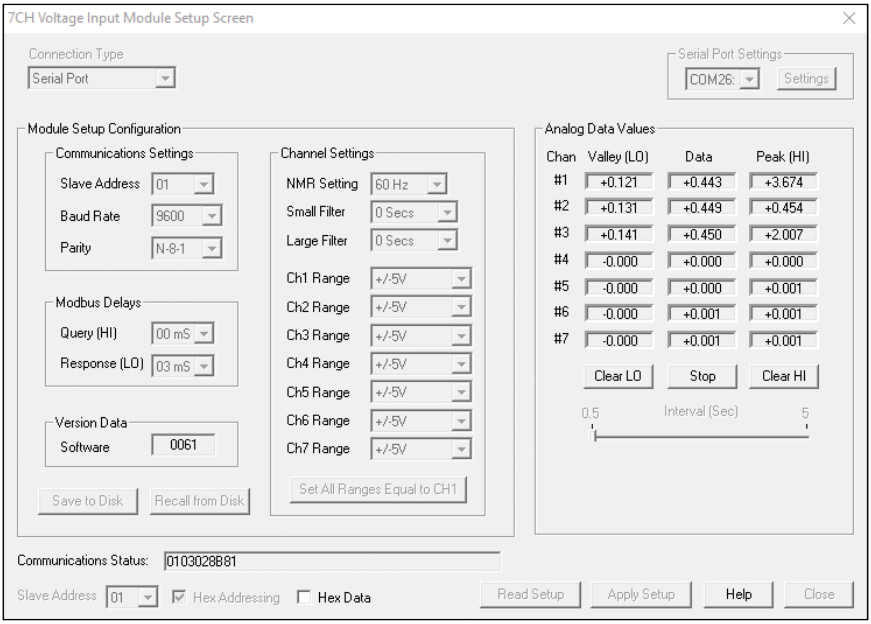


Scan the Module Data Values

After the module has been properly configured, the analog input module configuration dialog boxes can poll the module to verify the data from each channel. This feature is a troubleshooting or verification tool when the analog input signals are physically connected to the module.

The analog input dialog box contains a Scan function to start the scanning process. Each data channel is read by requesting the data values from data registers within the module. The analog input data registers are included in the Modbus Register map and the data register locations are specific to the module.

The data values are returned in hexadecimal percentage of Full Scale format where a value of 0x0000 represents the minus full scale input of the module. A value of 0xffff represents the positive full scale input of the module. These values can be used as a check to ensure that the channels are operating properly when analog input signals are applied to the input terminals.



The three sensor voltages are displayed in the Analog Data Values section, fields #1, #2, and #3. The data should read close to 0.5V.

Data entries in the Communication Status field (lower left) reflect polling of the interface module input registers.

The data values can also be displayed as a numerical value. The utility software knows the plus and minus full scale input limits for each channel. Uncheck Hex Data (lower left) to display the numeric values.

The scanning process also logs and displays the highest (peak) and lowest (valley) readings recorded during the scanning process. This is for indication purposes only.

A scan interval slide control is also provided to speed up or slow down the scanning process. This slide control allows the channels to be scanned at intervals from 0.5 to 5 seconds.

Click Stop to terminate scanning.

Limited Warranty: Watts Regulator Co. (the "Company") warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge.

THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance or alteration of the product.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**

USA: T: (978) 689-6066 • Watts.com
Canada: T: (888) 208-8927 • Watts.ca
Latin America: T: (52) 55-4122-0138 • Watts.com

IS-PressureSensing-IOT 2304 1915469