SPIRE METERING TECHNOLOGY

User's Manual and installation guide

wPrime Series: Domestic Metering

280W-R

Ultrasonic Water Meter

1. General information

1.1. Introduction:

Thank you for your purchase of the 280W-R. One of the most prominent meters in the wPrime series, the 280W-R is an ultrasonic water meter that uses advanced technology based on the ultrasonic transit time principle. The water meter does not have moving parts; therefore there is no need to worry about maintenance and replacing worn out parts. In addition, the accuracy remains constant over time.

The 280W-R is suitable for both commercial and industrial applications. The meter features a remote read-out (pulse, M-Bus, RS485 output, BACnet or Wireless). When equipped with an M-Bus module, the water meter can be networked through a two-wire bus to a central location for integrated resource management. An optional concentrator and data acquisition software make the whole system installation and integration easy. Spire Metering provides a complete AMR (automatic meter reading) solution as well.

1.2. General Safety:

Before installing your new 280W-R please consider the following:

- Read this instruction guide carefully and follow the factory directions.
- Injury or damage may occur if the user doesn't read and understand this installation guide.
- Consider handling and lifting instructions to avoid damage.
- Never hold and transport the meter by the electronics box, but instead only by the flanged or threaded joint
- Assembling and dismantling should be performed only when there is no pressure in the pipe
- Beware of sharp edges
- After installation, the tightness must be verified by pressurizing with cold water
- Use the meter only under the specified operating conditions. When conducting the pressure test, make sure the pressure does not exceed 2.5MPa. Otherwise, dangers may arise and will void the warranty
- The 280W-R water meter is not certified for use in hazardous environments. The local site safety codes and regulations must be observed.
- The 280W-R water meter contains Lithium batteries. Please check to see if they're working before using the water meter. The batteries must be recycled or disposed of properly.

1.3. Unpacking and Package Contents:

Your new 280W-R meter has been fully tested and calibrated. After carefully unpacking please inspect the meter for shipping damage. You should also have the following:

- The 280W-R meter (flowcell body and the integral electronic display).
- The installation Guide.
- Certificate of calibration.

2. Technical Information

2.1. Automatic Meter Reading:

AMR is a system that can be used for MBS (building management) or other networks. When equipped with a connection module, multiple 280W-Rs can be networked through a two-wire bus to a central location for integrated resource management. Spire Metering Technology provides an entire system of AMR solutions, making the system installation and integration very easy.

The SpireCapture™ system is a cutting-edge fixed AMR system which integrates both wired and wireless AMR/AMI technologies. It can accommodate a variety of metering networks, such as M-Bus, Pulse, RF wireless, GSM/GPRS, BACnet module, and TCP/IP. The data center software communicates with those networks through a standardized platform, which allows you to start with a simple AMR system and gradually expand to a larger metering system.

2.2. Built-in Time-Keeper

A time-keeper is integrated into the 280W-R meter. The time-keeper remains operating as long as the battery is alive. In case of battery failure, the time-keeper will not keep running, and the time data will be lost. The user must re-enter the proper time values after the battery failure is recovered. The user can also set the date and time as desired.

2.3. Battery Specifications

Lithium-Thionyl Chloride type battery
Nominal Capacity: 19 Ah
Nominal Voltage: 3.6V
Max Recommended Continuous Current: 100mA
Max Pulse Current Capability: 200mA
Operating Temperature Range: -55°C (131°F) to 85°C (185°F)

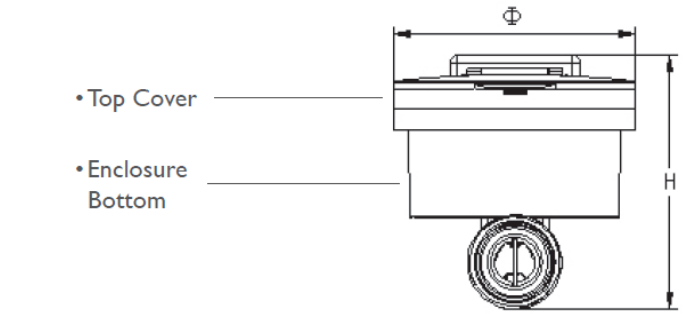
2.4. Product Measurement Method

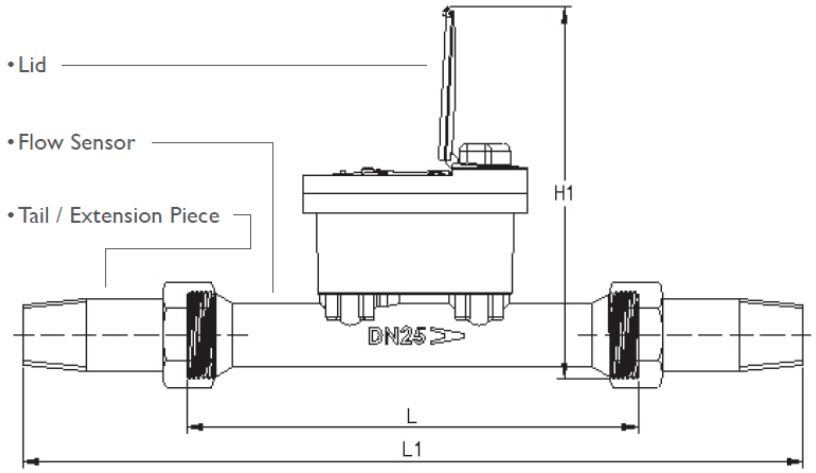
The measurement principal is based on ultrasonic transit time technology. The sensors, located in the meter's body, send and receive the ultrasonic signal. The transit-time difference is processed by a strong signal processing signal in order to display the flow velocity and the volume.

The ultrasonic water meter is a battery-powered precision flow meter designed for bidirectional flow measurement of water. The water meter can be used for a wide range of applications.

2.5. Specifications

Size		Flowrate					Dimensions					Pressure Loss	Weight	Pipe Joint (BSP)	
mm	in	Q3	Q4	Q2	Q1	Qs	L	L1	H	H1	ϕ			Sensor	Ext. Piece
		m^3/h	m^3/h	l/h	l/h	l/h	mm	mm	mm	mm	mm	bar	kg		
15	½	2.5	3.125	16	10	3	165	261	102	167	108	0.48	0.8	G ¾ B	R ½
20	¾	4	5	25.6	16	4	195	301	107	172	108	0.27	0.95	G 1 B	R ¾
25	1	6.3	7.875	40.32	25.2	5	225	347	112	177	108	0.23	1.2	G 1 ¼ B	R1
32	1 ¼	10	12.5	64	40	6	260	386	121	186	108	0.38	1.4	G 1 ½ B	R 1 ¼
40	1 ½	16	20	102.4	60	8	245	366	132	197	108	0.42	1.6	G 2 B	R 1 ½





Notes:

- ***Default pipe joint is BSP threading.***
- ***NPT threading is available upon request.***
- ***L is flow sensor length. L1 is the total length of flow sensor plus extension pieces.***
- ***Weight includes extension piece. It may vary. Please contact us for exact measure.***
- ***1m^3/h is about 4.4GPM.***
- ***Dimension H, Φ1 and Φ2 are for reference only. Please contact us for exact measure.***

Approvals

OIML R49, ISO 4064, NSF61-G, MID B

Electrical Data

Power Supply:	Battery, 3.6V, Lithium
Replacement Interval:	>10 years at tBAT<30°C (86°F) based on one remote reading per day.
Power Consumption:	<0.1W
Backup Power Supply:	Internal SuperCap
Communication Interface:	M-Bus (default). Optional: RF 433MHz or RF 868MHz wMBus*, RF 470MHz long range, Encoder or Modbus
CE approval:	EN61326-1:2006
Electromagnetic Class:	E2

Accuracy / MPE (Maximum Permissible Error)

MPE according to ISO 4064: 2005 or OIML R49
±2 in the range Q2 ≤ Q < Q4; ±5 in the range Q1 ≤ Q ≤ Q2 [for T ≤ 30ºC (85ºF)]
±3 in the range Q2 ≤ Q < Q4; ±5 in the range Q1 ≤ Q ≤ Q2 [for T > 30ºC (85ºF)]
Dynamic Range: 250 (For others please contact SpireMT)

Mechanical Data

Metrological Class:	2 (according to ISO 4064: 2005 or OIML R49)
Environmental Class:	B / C
Environmental Temp:	0 ~ 60°C (32 ~ 140°F)
Permissible Flow Temp:	0.1 ~ 60°C (35 ~ 140°F) for long term and up to 85°C (185°F) for <24 hours.
Enclosure Protection:	IP68
Integrator Detachable:	No
Pressure:	PN16

Pressure Loss

The pressure loss of a flow sensor is proportional to the square on the flow: $\Delta p = k \times Q2$
Here Δp is pressure loss, Q is volume flow rate and k is the coefficient.
The DN15 (½") meter has k=0.067 and Δp less than 0.48bar at Q3.
The DN20 (.") meter has k=0.019 and Δp less than 0.27bar at Q3
The DN25 (1") meter has k=0.006 and Δp less than 0.23bar at Q3.
The pressure loss for all sizes meet the ISO 4064: 2005, OIML R49 standards.

3. Operation

3.1. Built-in Battery

The instrument operates from the built-in Lithium battery, which is long-lasting… up to 10 years of operating time. For more details about the battery please refer to the battery specifications section 2.3. If your 280W-R is connected to an outside power source, such as M-Bus, the meter will not use the battery but instead draw power directly from the M-Bus.
Due to transport regulations, the battery might be deactivated by an insulating strip, which must be removed completely in order to activate the meter. If a replacement battery is needed, please contact your representative or Spire Metering. If the meter needs to be sent by air freight, then the battery will be removed prior to shipping.
For safety precautions, the batteries should not be opened, come into contact with water, or be exposed to temperatures above 80 °C (176°F). Batteries should be disposed of at proper collection centers.

3.2. Power On

First, make sure to activate the battery and that the display will turn on. If the meter LCD is on, the meter is active already and no further action is needed. Generally, there should be no error messages, and the water meter will cycle between the total volume and the flow rate.
The flow measurement program will always operate in the background of the user interface. This means that the flow measurement will keep running regardless of any user window browsing or viewing.
Once it is turned on, the 280W-R will keep on running until its battery runs out. There is no need to turn off the device when not in use; the display will turn off by itself to save the battery.

3.3. Menu Windows

The user interface of this 280W-R water meter has several windows displays that can be viewed. The water meter calculates the results and updates the display constantly. The menus are displayed in loop-fashion. The following values can be displayed:

- Total Volume (m^3)
- Flow rate (m^3/h)
- Serial number (ID)

These are the top layer (A1-layer) of the menu display structure. On the second layer (A2-layer) of this structure, more information can be seen. To go from the A1-layer to the A2-layer, the user will need factory software tool change the LCD display. On the A2-layer, the following menus are displayed:

- Total Volume with High Resolution (5 decimals)
- The current time
- The error code
- Factory data 1
- Factory data2, followed by meter size
- Meter size

- Factory data3
- Factory data4
- Flow rate (m^3/h)

Note: Factory Data 4 and Factory Data 5 are the calibration coefficients for Q1 (normal flow rate), Q2 (0.2 times normal flow rate), Q3 (0.1 times normal flow rate), and Q4 (minimum flow rate).
Example: If Menu Factory Data 4 shows 626C 63CE, then the coefficient for Q1 is626C (Hex) or 25196 (Dec), and the coefficient for Q2 is 63CE (Hex) or 25550 (Dec). Similarly, this applies to Factory Data 5.

4. Installation

4.1. Installation Directions

The water meter body should be completely full at all times for proper flow measurements. When this is not the case, it will show a loss of signal and the meter will not measure. The signal will be restored as soon as the pipe is full again.

FLOW DIRECTION: The 280W-R is a one directional water meter. Note the indicating arrow for forward flow. Even though the meter can measure the reverse flow, however, the accuracy for reverse flow measurement is not guaranteed.

Spire Metering recommends keeping the lid closed in case of direct sunlight exposure. However, no direct damage will occur while the lid is open temporarily.

Do not expose the meter to excessive vibration. To prevent this from occurring, support the connection pipe spools on both ends of the water meter.

To avoid measuring errors and malfunctioning of the flow meter due to air or an empty pipe, please observe the following precautions:

• Installation of the flow meter should be at the lowest point of the system, if possible, since air will be built at the highest point of a system.

• If possible, maintain positive back pressure in meter outlet piping.

• In order to avoid cavitation, always install control valves downstream of the flow meter and never install the flow meter on a pump suction side.

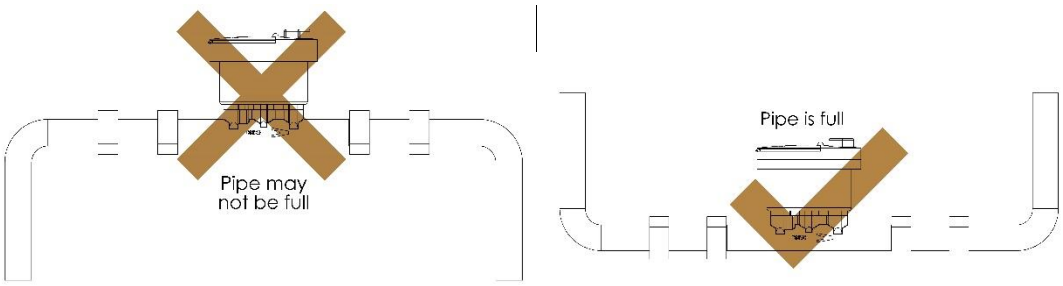
4.2. Site Selection:

Find a suitable location for connecting the flow cell (the “tube” part of the device where water flows through) to the pipeline.

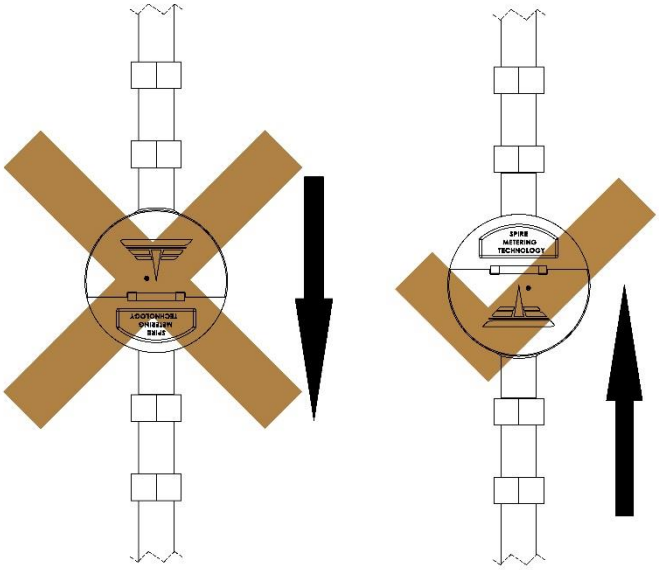
- Do not install the meter within 0.5m of an AC power line or a high-frequency radiation source.
- It is highly recommended to have a 5D straight pipe run upstream and 2D straight pipe run downstream, where D stands for pipe diameter.
- When two or more water meters are installed closely, make sure they are distanced by 5D or more.
- Do not install where back flow or pressure fluctuations may occur. An alternative is to install a non-return valve to prevent the backflow. We do offer easy-to-install insertion non-return valve. Please consult sales@spiremt.com for more information.
- When using a wrench, hold the metal part of the sensor.
- When connecting to a pipe line, use an O-ring for the sealing. Make sure the O-ring is centered at the joining point. Otherwise, it could generate flow disturbance, thus degrade the meter accuracy
- The meter sensor can be installed vertically or horizontally: When it is installed vertically, make sure the flow goes upward When it is installed horizontally, the flow-cell should be installed in a way so that the display faces upward and the two ultrasonic transducers on the horizontal plane.

4.3. Installation Position and Location:

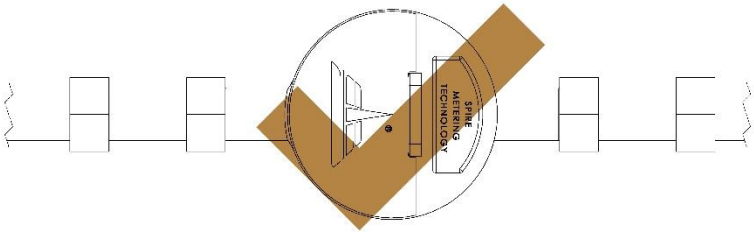
Please refer to the following diagrams for correct installation and handling.



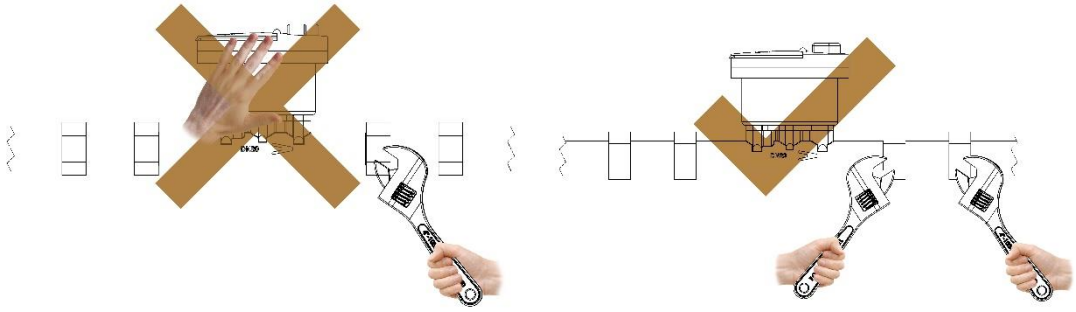
Correct installation of meter on U-configuration



For proper and accurate reading, flow should go against gravity



Sensor can be on the side after installation



Handle the metal of the meter during installation

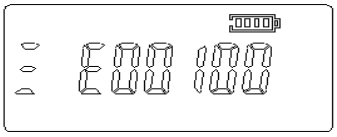
4.4. Operations Check

- After the installation is complete, the air in the pipe has to be purged out completely.
- Make sure the pressure in the system is normal.
- Use meter only under the specified operating conditions. Make sure flow rate range is proper for the pipe.
- Important: The pipe must be full of liquids during operation!

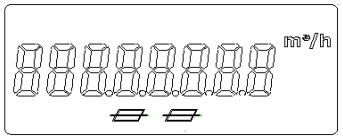
5. Troubleshooting

5.1. Powers-On Errors

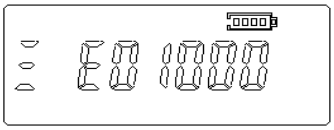
When powered on, the 280W-R meter automatically starts the self-diagnosis process to see if there are any hardware or software problems. If a problem is identified, an error message will be displayed. The following are the possible error messages, the corresponding causes, and their solutions:



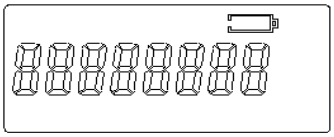
If this error is displayed, it means there is no water flowing through the water meter. Check the pipe's water supply and try to get it so that the pipe is full of water.



If this error is displayed, it means that the flow is reversed.



If this error is displayed, it means that the signal is abnormal.



If this error is displayed, it means that means the battery is low.

5.2. Other Problems and Solutions

Q1: Why does the instrument display 0.0000 flow rate while the liquid in the pipe is actually flowing?
A1: There might not be enough water in the pipe. Try to get it so that water flow through the flow cell is almost full. Additionally, check the installation to see if it is in a desirable location.

Q2: The displayed flow rate is much lower or much higher than the actual flow rate in the pipe under normal working conditions. Why?
A2: The flow cell and meter might have been installed incorrectly. Check the connection.
The amount of straight pipe run upstream and downstream may be too small. This can cause the data reading to be inaccurate.

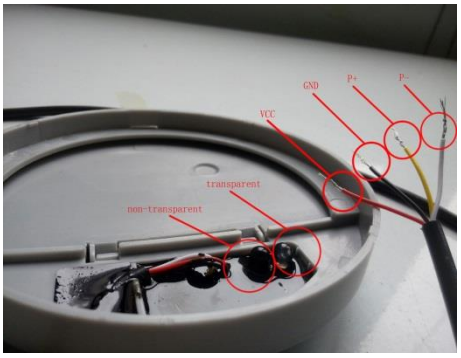
When the meter sensor is installed vertically, make sure the water flow goes upward. When it is installed horizontally, make sure the ultrasonic transducers of the flow cell are on the side instead of the top or bottom, as this may skew results.

6. Interface/Communication

The 280W-R will have one of the many options output pre-selected when placing the order. This section will describe each output:
Pulse Output (see section 6.1)
Mbus output (see section 6.2)
Modbus/Bacnet/RS485 output (see section 6.3)
4-20mA output (see section 6.4).
Wireless output (see section 6.5)

6.1. Pulse Output

This opto-isolated digital output is an open Collector type pulse. The allowable voltage range for the pulse is 5-24 VDC. The input impedance (Rx) is set at the factory to be 11 KOHM. Consult the instrument representative or Spire Metering if you are uncertain as to the proper diagram interpretation and wires details:



Pulse wires output

The table below shows all the details about the pulse parameters by size:

Pulse Parameters	Range	Default value(<DN125)	Default value(<DN250)	Default value(<DN500)	Note
Update time	8s~3600s	60s	60s	60s	
Pulse width	20ms~1000ms	50ms	50ms	50ms	Low pulse, duty ratio is 50%
Pulse interval	100ms~1000ms	100ms	100ms	100ms	It means the minimal time interval between two pulses
Pulse volume	1 10 100 1000 10000 100000 (L)	1000	100	10	Pulses per 100m³. Such as: 1000 means 100L per pulse.

6.2. M-Bus/BACnet Output

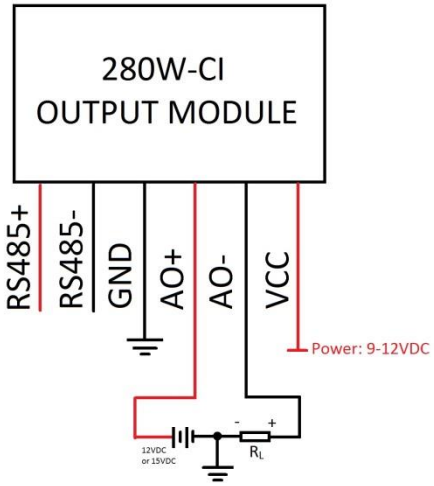
The M-Bus uses two wire cables which are going from the M-Bus Master / Repeater to each

M-Bus device (bus structure). The M-Bus is polarity independent and needs no line termination resistors at the end of the cables.
Any cable type may be used as long as the cable is suitable for 42 V / 500 mA. Shielding is not necessary and not recommended since the capacity of the cable should be minimized.
In most cases a standard telephone cable is used which is a twisted-pair wire with a diameter of 0.8 mm each (2 x 0.8 mm). This type of cable should be used for the main wiring. For the wiring to the meters from the main wiring (last 1 … 5 m to the meter) a cable with smaller diameter may be used.
The M-Bus system is an European instrument “bus” standard designed for domestic metering devices, such as water meters, heat/water meters, gas meters, etc., to communicate with data centers. The “bus” simply uses two non-polarized wires to achieve a variety of options for reliable meter reading, remote diagnosis, remote control, incremental pricing, time-based pricing, batch service, prepaid billing, and more. This ‘bus’ system is both simple and economical to wire and implement.
A typical M-Bus AMR system consists of a number of M-Bus utility meters, several M-Bus concentrators, a GSM/GPRS/LTE Data Transmitter Unit (DTU) for each M-Bus concentrator, and a data center. The M-Bus Concentrator communicates with the data center computer through a GSM/GPRS network. The data center first issues a meter reading command and sends it to the network. The DTU receives the command and forwards it to the M-Bus concentrator. Then, the concentrator either replies to the command with requested data or passes the command to its submeters transparently.
Please note that you may not need the DTU unit if you can connect the M-Bus concentrator(s) to your computer directly. Alternatively, you may connect the concentrator(s) to your computer through TCP-IP network by using Ethernet-232 adapters. Similarly, you may connect the concentrator(s) to your BACnet or MODBUS network by using proper adapters.
The 280C Concentrators are used for an AMR system to facilitate the communication between the data center and the M-Bus utility meters of the AMR system. These concentrators support up to 280 meters 280W-R. A wireless M-Bus concentrator is also available, where the M-Bus concentrator is affixed with a GSM/GPRS/LTE data transmitter unit (DTU).

6.3. Analog Output 4-20mA

The current pulse output is passive 4-20 mA. 4 mA is always “0” (zero) flow and the 20 mA is factory programmable at the max flow rate of the meter.

Below is the diagram showing the wiring details:



4-20mA output diagram

6.4. Modbus Output

The 280W-R meter is equipped with MODBUS serial communications to volume rate data, volume data in a variety of engineering units. You select the engineering units you wish to use by mapping to the appropriate registers.
This document provides a suggested list of registers to use.

MODBUS REGISTER FORMAT AND NETWORKING INFORMATION
MODBUS RS485, 2-wire (half-duplex) serial output is master/Slave communication architecture. The 280W meter is the slave.

With the MODBUS module option, the 280W-R supports standard MODBUS protocol:

- Baud Rate: 9600 bps
- Checksum: None
- Data bit: 8 bits
- Stop bit: 1 bit

1. All registers are 16 bit MODBUS Holding Registers.
2. MODBUS Holding Registers are used in 4 different ways.
   - As an Analog Value: In some cases these values are scaled by multiplying the register contents by a fixed multiplier.
   - As a status or mode indicator where the register value can be “1” or “2”...etc.
   - As a control register where the host can write a value.
3. Registers 40001 through 4038 are described below in the registers table.

MODBUS REGISTER TABLE

Register Address	# reg.	Variable Name	Data Type	Notes
0001-0002	2	Flow Rate	LONG	*
0003-0003	1	Flow Rate Unit	INTEGER	*
0004-0005	2	reserved	LONG	*
0006-0006	1	reserved	INTEGER	*
0007-0008	2	Flow Total	LONG	*
0009-0009	1	Flow Total Unit	INTEGER	*
0010-0011	2	reserved	LONG	*
0012-0012	1	reserved	INTEGER	*
0013-0014	2	reserved	LONG	*
0015-0015	1	reserved	INTEGER	*
0016-0017	2	Temperature	LONG	x0.01degC
0018-0019	2	reserved	LONG	x0.01degC
0020-0020	1	State	INTEGER	
0021-0022	2	Working Time	LONG	Unsigned. second
0023-0024	2	Clock	BCD	Writable. 3bytes BCD for second, minute and hour. Low on left
0025-0026	2	Date	BCD	Writable. 4bytes BCD for day, month and year. Low on left
0027-0027	1	4-20mA output current value	INTEGER	x0.01mA
0028-0029	2	Flowrate/Energy rate at 4mA	LONG	Unit similar to (0003)
0030-0031	2	Flowrate/Energy rate at 20mA	LONG	Unit similar to (0006)
0032-0032	1	Size	LONG	mm (saved in flash)
0033-0034	2	SN#	BCD	High on left
0035-0035	1	MODBUS ADDR	INTEGER	Writable (saved in flash)
0036-0036	1	Meter Type	INTEGER	BIT0=0:water meter BIT0=1:heat meter (saved in flash)
0037-0037	1	Comm Mode Select	INTEGER	Writable.

				0 - 9600/MODBUS （Default）; 1- 2400/Mbus**
0038-0038	1	Firmware Version	INTEGER	Hex

Notes:
***Unit code:**
32 – Litre/H; 2C – Cubic Meter;
29 – Litre; 35 – Cubic Meter/H.

Data Format:

For LONG data, it has 32bits. Thus, two registers are used to store a LONG. The first register (lower address) is for the lower 16bits of the data. The second register (higher address) is for the higher 16bits of the data.

** Use factory software to change the communication protocol. If you set the Communication Mode to 1, and set the duration to 6556, then the meter will switch to M-Bus protocol. Resetting the external power will switch the mode back to MODBUS protocol.

6.5. Wireless Output

The 280W-R has could be remotely monitored with its robust and reliable wireless module. This module can be RF (for short distances, less than 2K feet), GPRS, GSM or LTE. Each water meter will be accessible as long as GSM/GPRS/LTE network is available.
All the data can be monitored and analyzed using our software.

For details on the wireless interface, please consult with our tech support department by phone at +1 978-263-7100 or by email at support@spiremt.com.