- Interfaces with up to four electric, gas or water meters having a dry contact pulse output.
- Pulse count capacity is 2,147,483,648. Pulse counts are saved periodically.
- A multiplier allows pulses to accumulate in units dispensed by the meter. Accumulated pulse counts or units dispensed can be initialized to match the meter reading during installation.
- Real-time data and configuration information is exchanged using the Modbus open communication standard over an **isolated three wire RS485 interface**.
- Housed in a compact DIN Rail mount enclosure.
- Wiring is done via removable terminal blocks.
- **Operates from 12 VDC, 24VDC, 48VDC and 24VAC power supply rails. Power input is not polarity sensitive**

DESCRIPTION

The Model 2220 is a Quad channel pulse meter interface with integrated Modbus communication capability. Modbus is a very popular open communication standard that is available on many third party controllers, data acquisition systems and man-machine interfaces. The Model 2220 is self-contained. It contains the Quad dry contact switch inputs, processor, power supply and an isolated RS485 communication interface.

NOTE	This PDF datasheet has attachments. To access them, it may be necessary to use an actual Adobe Reader. since some readers built into internet browsers do not allow access to attachments.

Dry Contact Inputs

The Model 2220 has four dry contact inputs. There is an internal 5K Ohm pull up resistor on each input which will supply at most 0.75 mA contact current.

The dry contacts can be a mechanical relay, solid state relay or a pull to ground NPN type output. Up to 1K Ohm total contact and wiring resistance is tolerated.

Power Supply

The Model 2220 features an exceptionally flexible switching power supply. It allows the Model 2220 to be easily integrated into building automation, industrial automation, telecommunication and remote telemetry type systems. It operates from 12 VDC, 24 VDC, 48 VDC and 24 VAC power supply rails with a design margin better than +/-25% to allow for installation variations. A main advantage of the on board power supply is low power consumption. The unit draws less than 10 mA at 24 VDC. This makes it ideal for low cost battery backup systems if one is desired.

The power supply is well protected against overvoltage spikes via solid state transient voltage suppressors. It is additionally protected against over current conditions via fuses on both voltage input lines. On board thermal fuses do not have to be replaced. They will simply recover when the fault condition is corrected. Input voltage is polarity insensitive.

RS485 Communication

The physical communication interface is implemented using an isolated half duplex RS485 transceiver. The RS485 lines are isolated from the voltage input lines, Connection to the RS485 network is via 3 wires consisting of a RS485A, RS485B and an RS485 common. For maximum protection, each wire is internally fused and has additional external clamps relative to the other two communication lines.

The RS485 receiver on the Model 2220 has high input impedance and is fault tolerant. It requires no additional pull up or pull down resistors for proper operation and allows up to 128 devices to be connected on the bus.

As with all RS485 communications, termination using a 120 Ohm resistor at each end of the bus is a requirement. Termination resistors must be placed between the RS485A and RS485B lines.

Finally, while communication may be successful on a test bench or short bus wires, connecting the third wire, RS485C is also a requirement for proper operation as it establishes a reference point for the RS485A/B signals. Note, the RS485 wiring is polarity sensitive.

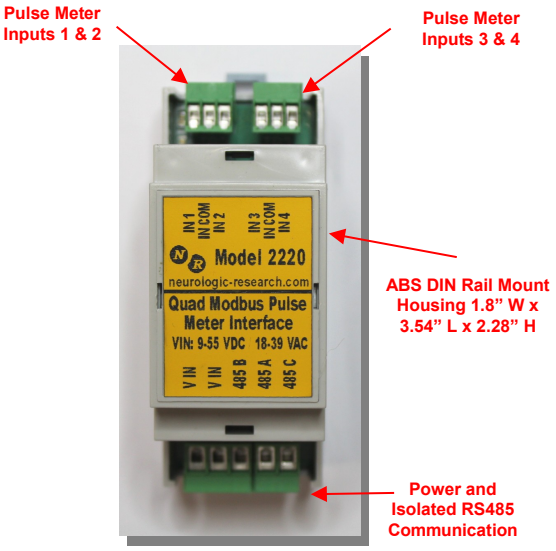
Wiring

The Model 2220 is supplied in a compact DIN Rail mount enclosure with three pluggable terminal groups. The tables below define the connection and the terminal block groups used.

PULSE METER INPUTS 1 & 2 (TOP LEFT)	
IN 1	One side of dry contact 1. If NPN is used, this is the positive input.
IN COM	Other side of dry contact inputs 1 and 2.
IN 2	One side of dry contact 2. If NPN is used, this is the positive input.

PULSE METER INPUTS 3 & 4 (TOP RIGHT)	
IN 3	One side of dry contact 3. If NPN is used, this is the positive input.
IN COM	Other side of dry contact inputs 3 and 4.
IN 4	One side of dry contact 4. If NPN is used, this is the positive input.

POWER & RS485 COMMUNICATION (BOTTOM)	
Vin / Vin	Polarity insensitive power supply connection
485A	Connect to positive or A side of 485 communication network. RS485 communication is polarity sensitie.
485B	Connect to negative or B side of 485 communication network. RS485 communication is polarity sensitie.
485C	Common reference for RS485 communication.



Features / Dimensions

How the Pulse/Units Accumulator Works

Each input has a configurable filter to prevent glitches from being counted. Glitches are mostly caused by relay type outputs which normally exhibit a contact bounce. The filter can be setup to insure that each of the open/close states are maintained for a minimum number of milliseconds before being recognized. Filter values can be modified using Modbus registers. The value of the filter ranges from 5 to 255 milliseconds. For the maximum input frequency of about 100 Hz, a filter value must be no larger than 5. This means that the Model 2220 firmware will not recognize a closed or open state unless it is maintained for at least 5 milliseconds. A value of 250 by contrast will filter out any pulses that are shorter than 250 milliseconds or a maximum of around 2 Hz. Please note that meters with solid state outputs do not exhibit a contact bounce. The open to closed state transition is what is actually counted.

The internal pulse accumulator has a count capacity of 2,147,483,648. It is a signed 4-byte integer value and can be read via two consecutive Modbus Input Registers. When the maximum value is reached it will reset to zero and continue counting. However, for most practical applications this will likely not happen often. A meter that outputs 100 pulses per minute continuously would take over 40 years to roll over. The count is saved every 10 to 15 seconds and will be restored on power up. A Modbus Input register, 30004 = Restarts, can be read. It indicates the number of times the power was cycled or if the unit has reset for any reason. If tracked by the host computer, it will indicate power has been lost.

Power meters output a pulse each time amount of energy has been dispensed usually in watt-hours or kilo-watt-hours. Gas and water meters output a pulse when a particular amount of volume has been dispensed. Usually this is in gallons or liters. The Model 2220 allows a Units Per Pulse constant to be entered. This constant is multiplied by the Total Count accumulated and it results in the Units Dispensed to be calculated. The Units Per Pulse constant is entered as a floating point value for maximum flexibility. The Units Dispensed is also formatted as a floating point value and can be read via a Modbus Input Register

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Initialization of Accumulated Count or Units Dispensed

During installation it maybe desirable to start the Total Count or Units Dispensed at a particular value to match an existing meter reading.

To initialize the total count, a negative value must first be written into the Count Start holding register. This is followed by a zero or positive value. The second value will be saved and used as the starting point for the Total Count.

Assuming that a correct Units Per Pulse has been entered. The Units Dispensed can also be initialized in the same fashion. First enter a negative value into the Units Dispensed Start holding register followed by a zero or positive value. The Model 2220 will divide this value by the Units per Pulse and calculate a new Total Count to start at.

This procedure is necessary. Many Modbus hosts will update the value of a Modbus holding register periodically. This would then cause the total count to periodically reset. However using this mechanism provides an orderly reset of the Total Count.

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MODBUS COMMUNICATIONS IMPLEMENTATION

The Model 2220 implements the Modbus RTU or non-ASCII version of the protocol. Note, this section assumes the reader has a working knowledge of the Modbus protocol

All data is communicated via either 16-bit registers or single bit registers. The16-bit registers are transmitted with the most significant byte followed by the least significant byte. This is per Modbus standard.

Input Registers are read only 16-bit registers used to return real-time data. Holding Registers are read/write 16-bit registers. They are used to read and write data from or to a Modbus device. In the Model 2220, a Holding Register can be either volatile or non-volatile. Non-volatile Holding Registers are used for configuration data and retained across a power cycle.

Input Status registers are single bit read only values that can be on or off. Coil Registers are also single bit registers that can be read or written.

The following Modbus Functions are implemented:

- Read Coil – Modbus Function code 1
- Read Input Status – Modbus Function code 2
- Read Holding Registers – Modbus Function code 3
- Read Input Registers – Modbus Function code 4
- Write 1 Coil – Modbus Function code 5
- Write 1 Holding Register – Modbus Function code 6
- Diagnostics Loop Back only - Modbus Function code 8
- Write Multiple Coils – Modbus Function code 15
- Write Multiple Holding Registers - Modbus Function code 16

Modes of Operation and Setting up Communication Parameters

To communicate with the Model 2220 or any RS485 Modbus device you need to know its Modbus address, baud rate, and parity settings. There are no jumpers or dip switches to change.

When the unit is first powered up, it goes into a Setup Mode. While in Setup Mode, it will communicate via Modbus address 255, a baud rate of 19200, no parity and 1 stop bits. If it does get a request using these Setup Parameters, it will stay in Setup Mode until no communication is seen for 5 seconds. It will then recall its Modbus address, baud rate, and parity settings from non-volatile memory and use those until power is interrupted again. This allows any unit's configuration to be read and written without first knowing its communication parameters.

The factory default configuration is Modbus address 240, even parity and 19200 baud rate. This address and communication parameters can also be used immediately after receiving the unit from the factory. If there is only one unit on the RS485 bus, no further communication setup is needed. Note, that while successfully communicating with the Model 2220 using a particular set of communication settings, it will **NOT** use the modified parameters until communication using the previous parameters is terminated for at least 5 seconds. This allows the configuration process to complete in an orderly fashion. When the host device switches to the new parameters, the Model 2220 will start answering.

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NOTE	**A "No Parity" setting is supported only with one stop bit but NOT two**

Coils (Function Code 1, 5 and 15)

Modbus Coils are read/write single bit registers.
They are specified using a 0xxxx Modbus addressing designation.

Modbus Address Designator	Register Address (Decimal)	Description
00001-00008	0-7	Reserved

Input Status (Function Code 2)

Modbus Input Status Registers are read only 16 bit registers. They are specified using a 1xxxx Modbus addressing designation.

Modbus Address Designator	Register Address (Decimal)	Description
10001	0	**Dry Contact 1 Input** A 1 indicates dry contact switch is closed
10002	1	**Dry Contact 2 Input** A 1 indicates dry contact switch is closed
10003	2	**Dry Contact 3 Input** A 1 indicates dry contact switch is closed
10004	3	**Dry Contact 4 Input** A 1 indicates dry contact switch is closed
10005-10008	4-7	Reserved

Input Registers (Function Code 4)

The following Input Registers are implemented. These registers are read only. They are specified using a 3xxxx Modbus addressing designator.

NOTE	The firmware only allocates 64 byte transmit and receive communication buffers. This limits the number of registers that can be read with a single read to around 25.

Modbus Address Designator	Register Address	Description
30001	0	**Firmware ID** 0x2220 to identify firmware as Model 2220. In Hex
30002	1	**Firmware Version** 0x0100 for version 1.00 in hex. MSB is major and LSB minor version.
30003	2	Reserved
30004	3	**Restarts**. Number of times the unit was power cycled or reset
30005	4	Reserved
30006-30007	5-6	**Count Total 1**. Signed 32 bit integer occupying two registers
30008-30009	7-8	**Count Total 2**. Signed 32 bit integer occupying two registers
30010-30011	9-10	**Count Total 3** Signed 32 bit integer occupying two registers
30012-30013	11-12	**Count Total 4** Signed 32 bit integer occupying two registers
30014-30021	13-20	Reserved
30022-30023	21-22	**Units Dispensed Total 1**. IEE754 float occupying two registers
30024-30025	23-24	**Units Dispensed Total 2**. IEE754 float occupying two registers
30026-30027	25-26	**Units Dispensed Total 3** IEE754 float occupying two registers
30028-30029	27-28	**Units Dispensed Total 4** IEE754 float occupying two registers
30030-30053	29-52	Reserved

Holding Registers (Function Code 3, 6, 16)

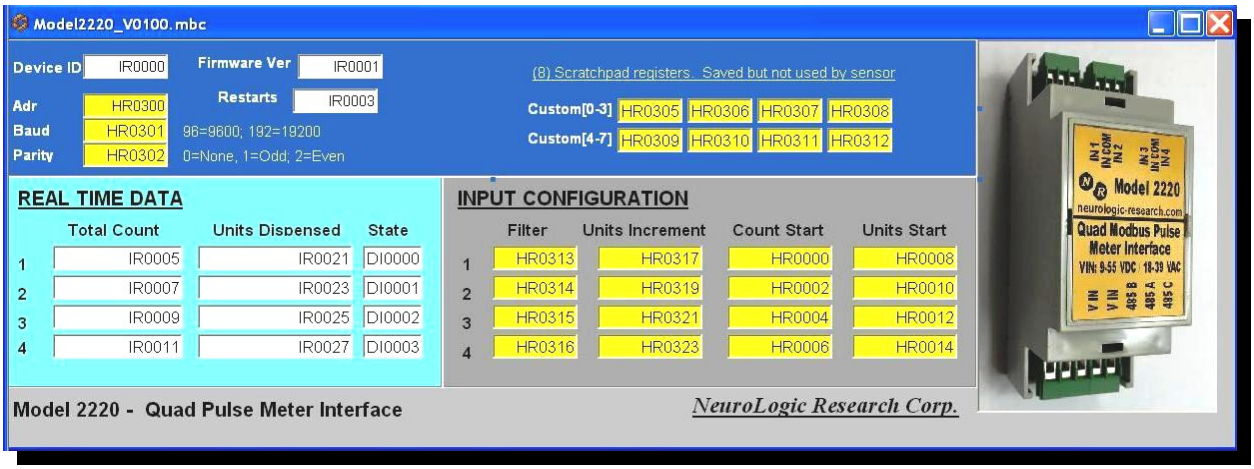
The following volatile Holding Registers are implemented. These can be read and written by the host computer and are normally accessed using 4xxxx addressing designator.

Modbus Address Designator	Register Address (Decimal)	Description
40001-40002	0-1	**Count Start 1**. Signed 32 bit integer occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count.
40003-40004	2-3	**Count Start 2**. Signed 32 bit integer occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40005-40006	4-5	**Count Start 3** Signed 32 bit integer occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40007-40008	6-7	**Count Start 4** Signed 32 bit integer occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40009-40010	8-9	**Units Dispensed Start 1**. IEE754 float occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40011-40012	10-11	**Units Dispensed Start 2**. IEE754 float occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40013-40014	12-13	**Units Dispensed Start 3** IEE754 float occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count
40015-40016	14-15	**Units Dispensed Start 4** IEE754 float occupying two registers. **Must first write a negative number followed by desired value.** Prevents updates by host from restarting the count

Non-Volatile Holding Registers (Function Code 3, 6, 16)

Unlike Modbus Holding Registers defined in the previous section, the following registers are used for configuration and saved to on board non-volatile memory.

Modbus Address Designator	Register Address (Decimal)	Description
40301	0300	**Modbus Address**. Valid values are 1 to 255. Factory Default is 240, While in Setup Mode address is 255.
40302	0301	**Baud Rate**. 12=1200, 24=2400, 48=4800, 96=9600, 192=19200. Factory default is 19200 which is also used in Setup Mode.
40303	0302	**Parity**. 0=None, 1=Odd, 2=Even. Default is Even Parity. While in Setup Mode no parity is used with 1 stop bit. **Note, currently, no parity with two stop bits are not supported**..
40304	0303	Reserved
40305	0304	Reserved
40306-40313	0305-0312	**Scratchpad Registers**. Eight registers saved and restored but not used by firmware.. Can be used by customer for any purpose to identify the device or its location.
40314	0313	**Filter Value 1**. 5-255 are valid. Number of milliseconds input must be maintained without change to be recognized. Value of 5 is the default value which allows for a pulse frequency up to 100 Hz.
40315	0314	**Filter Value 2**. Same as Filter Value 1 but for input 2.
40316	0315	**Filter Value 3** Same as Filter Value 1 but for input 3
40317	0316	**Filter Value 4** Same as Filter Value 1 but for input 4
40318-40319	0317-0318	**Units Dispensed Per Pulse 1**. IEE754 float occupying two registers
40320-40321	0319-0320	**Units Dispensed Per Pulse 2**. IEE754 float occupying two registers
40322-40323	0321-0322	**Units Dispensed Per Pulse 3** IEE754 float occupying two registers
40324-40325	0323-0324	**Units Dispensed Per Pulse 4** IEE754 float occupying two registers



Using the Modbus Reader Utility

The Modbus Reader is a free third party utility available for the Windows operating system. It allows a dialog box to be defined to read and write data from and to a Modbus device. The dialog box layout, register addresses, display format and Modbus requests are all defined in a Modbus Configuration file with a ".mbc" extension. The Modbus Reader utility uses this file to communicate with the Modbus device. While the Modbus Reader utility is free, the utility to create the configuration file is not.

The Model2220_vx.mbc file is attached to this PDF file. It can be used to immediately test the Model 2220, and exercise its function or to bench configure it before installing in the field. It also allows the user to implement only the portion of the interface that is needed for the project at hand.

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While the Modbus Reader utility uses the specification in the ".mbc" file to communicate to the Modbus device, it still needs to know a few configuration parameters to function on different computers. The serial communication port, Modbus address, baud rate, parity and timeout need to be specified. The Model 2220 configuration screen is shown above. It is very useful in quickly visualizing all the Modbus registers, their type and addresses.

Fields shown in yellow can be modified by the user by double clicking on them. "HR" designates Holding Registers. "IR" designates Input Registers. "DI" designates a single bit Input Status Registers.

- Install Modbus Reader application on a computer with Windows Operating system
- Make sure your system has a USB to RS485 communication adapter installed and that your system recognizes it. At the factory we use an FTDI chip based USB to serial device but there are others.
- Use File->Open menu to load the Model 2220_vxx.mbc file
- Use the Mode menu and make sure "Master" is selected
- Use Ctl-I or the Mode->Master Setting menu to set the Slave address to 255 and Response timeout to 100 milliseconds
- Use the Connection Menu to select the serial communication port
- Use Ctl-P or the Connection->Comm Parameters to set the Baud Rate to 19200, no parity, 1 stop bits
- Use the F2 key or Connection->Connect menu to start communication
- Cycle the power on the connected Model 2220 or simply unplug the bottom removable terminal block and plug back in..

SPECIFICATIONS

Inputs

Inputs	4
Input Types	Dry Conact or NPN
Input Protection	Input is protected from -15 to 50 V peak to peak
Contact Resistance Tolerated	1000 Ohm maximum. Includes contact resistance and wires
Pullup Type	5000 Ohms to 3.3V
Minimum pulse width detected.	5 millisecond +/- 3%
Minimum pulse period	10 millisecond. +/- 3%
Pulse Accumulator Size	2,147,483,648

Electronics

Operating Environment	-40 to 85 C
Input Voltage Operating	9 to 55 VDC or 18 to 39 VAC at 0.25W maximum.
Input Voltage Maximum	65 VDC / 45 VAC. Please note at this voltage the unit will start to draw more current and may trip the internal thermal fuses but will not be damaged. Normal operation resumes when voltage returns to operating range.
Input Power Protection	Input power is fused and transient voltage protected. (Fuses do not need to be replaced)
Communication Transceiver Type	Fail safe RS485 transceiver with high input impedance allowing up to 128 devices on a wire trunk. Baud rates of 1200-19200 are supported. NOTE, no parity is only supported with 1 stop bit.
Communication Line Protection	Each communication line is fused with additional transient voltage clamps on all lines relative to each other.

Dimension and Materials

External Dimension	36 mm (1.8”) W x 90 mm (3.54”) L x 58 mm (2.28”) H
Enclosure Type	DIN rail mount to 35 mm rail
Enclosure Material	Grey frame retardant Noryl UL94 V0

Ordering Information

2220	Quad Modbus Pulse Meter Interface

Modbus is a trademark of Schneider Electric.