



## VN2000 Flow Meters

### Modbus Registers

#### INTRODUCTION

The VN2000 transmitter has the option of including Modbus RTU EIA-485 communications. The connection is unterminated and operates at 9600, 14400, 19200 baud, 8 bit, no parity, 1 stop bit. The Modbus RTU slave address defaults to 1 and can be changed in the parameter settings. Enter the "S" menu to access the Modbus address.

All the data retrieval for the meter is done via the "Read Holding Registers" Command (command ID 00003).

#### REGISTER DEFINITION

All Registers are 16 bit unsigned integers. Some parameters' readings are stored in two registers and are noted as such.

##### **Register 40002, 40003 (Address 0001, 0002): Totalizer**

The flow totalizer is a 32-bit unsigned integer with big endian order. Units are in register 40006 (without time base).

Register 40002 contains the high order 16-bit position of the 32-bit Totalizer.

##### **Register 40004 (Address 0003): Flow Rate (Integer Part)**

The Flow Rate is often a number represented as a number in decimal format (values to the right of the decimal point). This is especially true for pipes with small diameters. Two registers are used to represent the flow rate (Register 40004 and Register 40005). Register 40004 is used to show the integral part of the flow rate and Register 40005 is used to show the decimal part of the flow rate. For example, if the Flow Rate is 123.456, then the value 123 will be returned in Register 40004 and the value 456 will be returned in Register 40005.

As mentioned above, this is adequate when the flow rate is not large. This method is limited to flow rates under 65536. An alternate representation is available and is implemented using Register 40009 and Register 40010.

##### **Register 40005 (Address 0004): Flow Rate (Decimal Part)**

Register 40005 contains the decimal portion of the flow rate. See the discussion on Register 40004 (above) for the interpretation and use of this register.



**Badger Meter**

**Register 40006 (Address 0005): Units**

Register 40006 encodes the units currently selected on the meter. The encoding includes whether Metric, English or Actual (for gas applications) units have been chosen, the engineering units selected and the time base for the flow calculations.

Binary	Decimal	Units					Time Base
		Liquid	Steam	Gas	Gas Actual	BTU	
0000000000000000	0	Pounds (LB)	Pounds (LB)	Pounds (LB)	—	—	Second
0000000000000001	1	Tons (TON)	Tons (TON)	Tons (TON)	—	—	Second
0000000000000010	2	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	—	—	Second
0000000000000011	3	U.S. Gallons (GAL)	U.S. Gallons (GAL)	U.S. Gallons (GAL)	—	—	Second
0000000000000100	4	Kilograms (KG)	Kilograms (KG)	Kilograms (KG)	—	—	Second
0000000000000101	5	Metric Tons (TNN)	Metric Tons (TNN)	Metric Tons (TNN)	—	—	Second
0000000000000110	6	Cubic Meters (M <sup>3</sup> )	Cubic Meters (M <sup>3</sup> )	NaturalCubicMeters(Nm <sup>3</sup> )	—	—	Second
0000000000000111	7	Liters (LTR)	Liters (LTR)	Natural Liters (Nlt)	—	—	Second
0000000000001000	8	—	—	—	Pounds (LB)	—	Second
0000000000001001	9	—	—	—	Tons (TON)	—	Second
0000000000001010	10	—	—	—	Actual Cubic Feet (Acf)	—	Second
0000000000001011	11	—	—	—	U.S. Gallons (GAL)	—	Second
0000000000001100	12	—	—	—	Kilograms (KG)	—	Second
0000000000001101	13	—	—	—	Metric Tons (TNN)	—	Second
0000000000001110	14	—	—	—	ActualCubicMeters(Am <sup>3</sup> )	—	Second
0000000000001111	15	—	—	—	Actual Liters (Alt)	—	Second
0000000000100000	16	Oil Barrels (BBL)	—	—	—	—	Second
0000000100000000	256	Pounds (LB)	Pounds (LB)	Pounds (LB)	—	—	Minute
0000000100000001	257	Tons (TON)	Tons (TON)	Tons (TON)	—	—	Minute
0000000100000010	258	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	—	—	Minute
0000000100000011	259	U.S. Gallons (GAL)	U.S. Gallons (GAL)	U.S. Gallons (GAL)	—	—	Minute
0000000100000100	260	Kilograms (KG)	Kilograms (KG)	Kilograms (KG)	—	—	Minute
0000000100000101	261	Metric Tons (TNN)	Metric Tons (TNN)	Metric Tons (TNN)	—	—	Minute
0000000100000110	262	Cubic Meters (M <sup>3</sup> )	Cubic Meters (M <sup>3</sup> )	NaturalCubicMeters(Nm <sup>3</sup> )	—	—	Minute
0000000100000111	263	Liters (LTR)	Liters (LTR)	Natural Liters (Nlt)	—	—	Minute
0000000100001000	264	—	—	—	Pounds (LB)	—	Minute
0000000100001001	265	—	—	—	Tons (TON)	—	Minute
0000000100001010	266	—	—	—	Actual Cubic Feet (Acf)	—	Minute
0000000100001011	267	—	—	—	U.S. Gallons (GAL)	—	Minute
0000000100001100	268	—	—	—	Kilograms (KG)	—	Minute
0000000100001101	269	—	—	—	Metric Tons (TNN)	—	Minute
0000000100001110	270	—	—	—	ActualCubicMeters(Am <sup>3</sup> )	—	Minute
0000000100001111	271	—	—	—	Actual Liters (Alt)	—	Minute
0000000100010000	272	Oil Barrels (BBL)	—	—	—	—	Minute
0000001000000000	512	Pounds (LB)	Pounds (LB)	Pounds (LB)	—	BTU	Hour
0000001000000001	513	Tons (TON)	Tons (TON)	Tons (TON)	—	KiloBTU	Hour
0000001000000010	514	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	—	—	Hour
0000001000000011	515	U.S. Gallons (GAL)	U.S. Gallons (GAL)	U.S. Gallons (GAL)	—	—	Hour
0000001000000100	516	Kilograms (KG)	Kilograms (KG)	Kilograms (KG)	—	—	Hour
0000001000000101	517	Metric Tons (TNN)	Metric Tons (TNN)	Metric Tons (TNN)	—	—	Hour
0000001000000110	518	Cubic Meters (M <sup>3</sup> )	Cubic Meters (M <sup>3</sup> )	NaturalCubicMeters(Nm <sup>3</sup> )	—	—	Hour
0000001000000111	519	Liters (LTR)	Liters (LTR)	Natural Liters (Nlt)	—	—	Hour
0000001000001000	520	—	—	—	Pounds (LB)	—	Hour
0000001000001001	521	—	—	—	Tons (TON)	—	Hour
0000001000001010	522	—	—	—	Actual Cubic Feet (Acf)	—	Hour
0000001000001011	523	—	—	—	U.S. Gallons (GAL)	—	Hour
0000001000001100	524	—	—	—	Kilograms (KG)	—	Hour
0000001000001101	525	—	—	—	Metric Tons (TNN)	—	Hour
0000001000001110	526	—	—	—	ActualCubicMeters(Am <sup>3</sup> )	—	Hour
0000001000001111	527	—	—	—	Actual Liters (Alt)	—	Hour
0000000200010000	528	Oil Barrels (BBL)	—	—	—	—	Hour
0000001100000000	768	Pounds (LB)	Pounds (LB)	Pounds (LB)	—	—	Day
0000001100000001	769	Tons (TON)	Tons (TON)	Tons (TON)	—	—	Day
0000001100000010	770	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	Cubic Feet (FT <sup>3</sup> )	—	—	Day
0000001100000011	771	U.S. Gallons (GAL)	U.S. Gallons (GAL)	U.S. Gallons (GAL)	—	—	Day
0000001100000100	772	Kilograms (KG)	Kilograms (KG)	Kilograms (KG)	—	—	Day
0000001100000101	773	Metric Tons (TNN)	Metric Tons (TNN)	Metric Tons (TNN)	—	—	Day
0000001100000110	774	Cubic Meters (M <sup>3</sup> )	Cubic Meters (M <sup>3</sup> )	NaturalCubicMeters(Nm <sup>3</sup> )	—	—	Day
0000001100000111	775	Liters (LTR)	Liters (LTR)	Natural Liters (Nlt)	—	—	Day
0000001100001000	776	—	—	—	Pounds (LB)	—	Day
0000001100001001	777	—	—	—	Tons (TON)	—	Day
0000001100001010	778	—	—	—	Actual Cubic Feet (Acf)	—	Day
0000001100001011	779	—	—	—	U.S. Gallons (GAL)	—	Day
0000001100001100	780	—	—	—	Kilograms (KG)	—	Day
0000001100001101	781	—	—	—	Metric Tons (TNN)	—	Day
0000001100001110	782	—	—	—	ActualCubicMeters(Am <sup>3</sup> )	—	Day
0000001100001111	783	—	—	—	Actual Liters (Alt)	—	Day
0000000300010000	784	Oil Barrels (BBL)	—	—	—	—	Day

**Register 40007 (Address 0006): Temperature**

Register 40007 reports the temperature used in the flow rate determination. This temperature is always returned in Fahrenheit and is returned with a value that is 10 times the temperature value. Therefore, a value of 1234 represents a temperature of 123.4 degrees Fahrenheit.

For BTU/energy meters (where two temperatures are used), this value is the Source Temperature.

The register value will not be a live reading for meters that do not have an RTD temperature or are overwritten. For Gas and BTU/energy meters, if the temperature is overridden with a manual temperature override, this register returns the value set in the manual temperature override. For steam meters, if the temperature sensor is overwritten with a manual pressure input, the register value will be invalid.

**Register 40008 (Address 0007): Pressure (non-BTU/energy applications)**

Register 40008 reports the pressure used in the flow rate determination. The pressure is always returned in PSIG and is returned with a value that is 10 times the pressure value. Therefore, a value of 1234 represents a pressure of 123.4 PSIG.

The register value will not be a live reading for meters that do not have a pressure input. For steam meters, if the temperature is overridden with a manual pressure input, this register returns the value set in the manual pressure override. Similarly, for gas applications, if the pressure sensor is overridden with a manual pressure override, the register returns the value set in the manual pressure override.

**Register 40008 (Address 0007): Return Temperature (BTU/energy applications)**

For BTU/energy applications, Register 40008 reports the return temperature used in the flow rate determination. The temperature is always returned in Fahrenheit and is returned with a value that is 10 times the temperature value. Therefore, a value of 1234 represents a temperature of 123.4 degrees Fahrenheit.

If the temperature is overridden with a manual temperature override, this register returns the value set in the manual temperature override.

**Register 40009, 400010 (Address 0008, 0009): Flow Rate (High Flow)**

The flow rate (high flows) is a 32-bit unsigned integer with big endian order. Register 40009 and Register 400010 provide an alternate for obtaining the Flow Rate (versus Register 40004 and Register 40005). Register 40004 and Register 40005 work best with small diameter pipes with lower flow rates. Register 40009 and Register 400010 are intended to be used when the flow rates are higher. Flow rates up to 4,200,000 can be accommodated with this approach.

Register 400010 contains the lower 16 bits of this value.

**Register 400011, 400012 (Address 00010, 00011): Gallons Per Minute (BTU/energy applications only)**

Register 400011 and Register 400012 provide the flow in Gallons per Minute. These registers are only valid in BTU/energy applications. This value is not the Gallon/Minute rate but is 1000 times Gallon/Minute rate. That is, if the resultant 32-bit value is 123456789, then the Gallon/Minute rate is 123456.789.

Register 40011 contains the high order 16-bit position. Register 400012 contains the lower 16 bits of this value.

## TROUBLESHOOTING

Symptoms	Possible Causes	Recommended Action
No communication	Transmit and receive are wired incorrectly.	Check the network wiring from the meter.
	Baud rate does not match master.	Check the baud rate of the master and ensure the baud rate of the meter matches the master. The master is often a PLC or BAS.
	Parity and stop bits do not match the master.	The meter is set to no parity and 1 stop bit. Check that the settings are compatible with the master.
	Slave address is not unique. Another device is on the network with the same address.	Check the addresses of the other devices on the network. Check that the slave address is not 1.
	Cable is not terminated properly.	For Modbus RTU on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors.
	Cable or chain longer than 4000 feet.	For Modbus RTU on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Intermittent communication	Cable is not properly shielded.	Communication cables must have shielding to protect the quality of the communication signals from electro-magnetic interference (EMI). Check that the cable has a shield.  Typically, one end of the shield drain is connected to a clean ground to dissipate EMI and prevent ground loops. However, depending on the ground quality, cable length and type of interference, other methods can be employed.
	Cable routed near power cables such as variable frequency drives.	Cables carrying high currents cause a high degree of electro-magnetic interference that can interfere with the quality of the communication signals. Route signal cables away from power cables.
	Cable is not terminated properly.	For Modbus RTU on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors.
	Cable or chain longer than 4000 feet.	For Modbus RTU on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Unable to read specific parameters	Incorrect endian and data type/format.	In Modbus RTU, long integers and string character registers may have the word order (endian) swapped.  Check the data type and endian of the master and verify that the register in the meter matches the master. If it does not, select a different register.
Unable to write specific parameters	All registers are read only.	—

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