Vortex Flow Meters

# 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 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 400010.

### 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.

## 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 |
|---|---|---|---|---|---|---|---|
| | | Liquid | Steam | Gas | Gas Actual | BTU | Base |
| 0000 0000 0000 0000 | 0 | Pounds (LB) | Pounds (LB) | Pounds (LB) | — | — | Second |
| 0000 0000 0000 0001 | 1 | Tons (TON) | Tons (TON) | Tons (TON) | — | — | Second |
| 0000 0000 0000 0010 | 2 | Cubic Feet (CFT) | Cubic Feet (CFT) | Cubic Feet (CFT) | — | — | Second |
| 0000 0000 0000 0011 | 3 | U.S. Gallons (GAL) | U.S. Gallons (GAL) | U.S. Gallons (GAL) | — | — | Second |
| 0000 0000 0000 0100 | 4 | Kilograms (KG) | Kilograms (KG) | Kilograms (KG) | — | — | Second |
| 0000 0000 0000 0101 | 5 | Metric Tons (TNN) | Metric Tons (TNN) | Metric Tons (TNN) | — | — | Second |
| 0000 0000 0000 0110 | 6 | Cubic Meters (CUM) | Cubic Meters (CUM) | Natural Cubic Meters ($Nm^3$) | — | — | Second |
| 0000 0000 0000 0111 | 7 | Liters (LTR) | Liters (LTR) | Natural Liters (Nlt) | — | — | Second |
| 0000 0000 0000 1000 | 8 | — | — | — | Pounds (LB) | — | Second |
| 0000 0000 0000 1001 | 9 | — | — | — | Tons (TON) | — | Second |
| 0000 0000 0000 1010 | 10 | — | — | — | Actual Cubic Feet (Acf) | — | Second |
| 0000 0000 0000 1011 | 11 | — | — | — | U.S. Gallons (GAL) | — | Second |
| 0000 0000 0000 1100 | 12 | — | — | — | Kilograms (KG) | — | Second |
| 0000 0000 0000 1101 | 13 | — | — | — | Metric Tons (TNN) | — | Second |
| 0000 0000 0000 1110 | 14 | — | — | — | Actual Cubic Meters ($Am^3$) | — | Second |
| 0000 0000 0000 1111 | 15 | — | — | — | Actual Liters (Alt) | — | Second |
| 0000 0001 0000 0000 | 256 | Pounds (LB) | Pounds (LB) | Pounds (LB) | — | — | Minute |
| 0000 0001 0000 0001 | 257 | Tons (TON) | Tons (TON) | Tons (TON) | — | — | Minute |
| 0000 0001 0000 0010 | 258 | Cubic Feet (CFT) | Cubic Feet (CFT) | Cubic Feet (CFT) | — | — | Minute |
| 0000 0001 0000 0011 | 259 | U.S. Gallons (GAL) | U.S. Gallons (GAL) | U.S. Gallons (GAL) | — | — | Minute |
| 0000 0001 0000 0100 | 260 | Kilograms (KG) | Kilograms (KG) | Kilograms (KG) | — | — | Minute |
| 0000 0001 0000 0101 | 261 | Metric Tons (TNN) | Metric Tons (TNN) | Metric Tons (TNN) | — | — | Minute |
| 0000 0001 0000 0110 | 262 | Cubic Meters (CUM) | Cubic Meters (CUM) | Natural Cubic Meters ($Nm^3$) | — | — | Minute |
| 0000 0001 0000 0111 | 263 | Liters (LTR) | Liters (LTR) | Natural Liters (Nlt) | — | — | Minute |
| 0000 0001 0000 1000 | 264 | — | — | — | Pounds (LB) | — | Minute |
| 0000 0001 0000 1001 | 265 | — | — | — | Tons (TON) | — | Minute |
| 0000 0001 0000 1010 | 266 | — | — | — | Actual Cubic Feet (Acf) | — | Minute |
| 0000 0001 0000 1011 | 267 | — | — | — | U.S. Gallons (GAL) | — | Minute |
| 0000 0001 0000 1100 | 268 | — | — | — | Kilograms (KG) | — | Minute |
| 0000 0001 0000 1101 | 269 | — | — | — | Metric Tons (TNN) | — | Minute |
| 0000 0001 0000 1110 | 270 | — | — | — | Actual Cubic Meters ($Am^3$) | — | Minute |
| 0000 0001 0000 1111 | 271 | — | — | — | Actual Liters (Alt) | — | Minute |
| 0000 0010 0000 0000 | 512 | Pounds (LB) | Pounds (LB) | Pounds (LB) | — | BTU | Hour |
| 0000 0010 0000 0001 | 513 | Tons (TON) | Tons (TON) | Tons (TON) | — | KiloBTU | Hour |
| 0000 0010 0000 0010 | 514 | Cubic Feet (CFT) | Cubic Feet (CFT) | Cubic Feet (CFT) | — | — | Hour |
| 0000 0010 0000 0011 | 515 | U.S. Gallons (GAL) | U.S. Gallons (GAL) | U.S. Gallons (GAL) | — | — | Hour |
| 0000 0010 0000 0100 | 516 | Kilograms (KG) | Kilograms (KG) | Kilograms (KG) | — | — | Hour |
| 0000 0010 0000 0101 | 517 | Metric Tons (TNN) | Metric Tons (TNN) | Metric Tons (TNN) | — | — | Hour |
| 0000 0010 0000 0110 | 518 | Cubic Meters (CUM) | Cubic Meters (CUM) | Natural Cubic Meters ($Nm^3$) | — | — | Hour |
| 0000 0010 0000 0111 | 519 | Liters (LTR) | Liters (LTR) | Natural Liters (Nlt) | — | — | Hour |
| 0000 0010 0000 1000 | 520 | — | — | — | Pounds (LB) | — | Hour |
| 0000 0010 0000 1001 | 521 | — | — | — | Tons (TON) | — | Hour |
| 0000 0010 0000 1010 | 522 | — | — | — | Actual Cubic Feet (Acf) | — | Hour |
| 0000 0010 0000 1011 | 523 | — | — | — | U.S. Gallons (GAL) | — | Hour |
| 0000 0010 0000 1100 | 524 | — | — | — | Kilograms (KG) | — | Hour |
| 0000 0010 0000 1101 | 525 | — | — | — | Metric Tons (TNN) | — | Hour |
| 0000 0010 0000 1110 | 526 | — | — | — | Actual Cubic Meters ($Am^3$) | — | Hour |
| 0000 0010 0000 1111 | 527 | — | — | — | Actual Liters (Alt) | — | Hour |
| 0000 0011 0000 0000 | 768 | Pounds (LB) | Pounds (LB) | Pounds (LB) | — | — | Day |
| 0000 0011 0000 0001 | 769 | Tons (TON) | Tons (TON) | Tons (TON) | — | — | Day |
| 0000 0011 0000 0010 | 770 | Cubic Feet (CFT) | Cubic Feet (CFT) | Cubic Feet (CFT) | — | — | Day |
| 0000 0011 0000 0011 | 771 | U.S. Gallons (GAL) | U.S. Gallons (GAL) | U.S. Gallons (GAL) | — | — | Day |
| 0000 0011 0000 0100 | 772 | Kilograms (KG) | Kilograms (KG) | Kilograms (KG) | — | — | Day |
| 0000 0011 0000 0101 | 773 | Metric Tons (TNN) | Metric Tons (TNN) | Metric Tons (TNN) | — | — | Day |
| 0000 0011 0000 0110 | 774 | Cubic Meters (CUM) | Cubic Meters (CUM) | Natural Cubic Meters ($Nm^3$) | — | — | Day |
| 0000 0011 0000 0111 | 775 | Liters (LTR) | Liters (LTR) | Natural Liters (Nlt) | — | — | Day |
| 0000 0011 0000 1000 | 776 | — | — | — | Pounds (LB) | — | Day |
| 0000 0011 0000 1001 | 777 | — | — | — | Tons (TON) | — | Day |
| 0000 0011 0000 1010 | 778 | — | — | — | Actual Cubic Feet (Acf) | — | Day |
| 0000 0011 0000 1011 | 779 | — | — | — | U.S. Gallons (GAL) | — | Day |
| 0000 0011 0000 1100 | 780 | — | — | — | Kilograms (KG) | — | Day |
| 0000 0011 0000 1101 | 781 | — | — | — | Metric Tons (TNN) | — | Day |
| 0000 0011 0000 1110 | 782 | — | — | — | Actual Cubic Meters ($Am^3$) | — | Day |
| 0000 0011 0000 1111 | 783 | — | — | — | Actual Liters (Alt) | — | 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.<br>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.<br>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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