

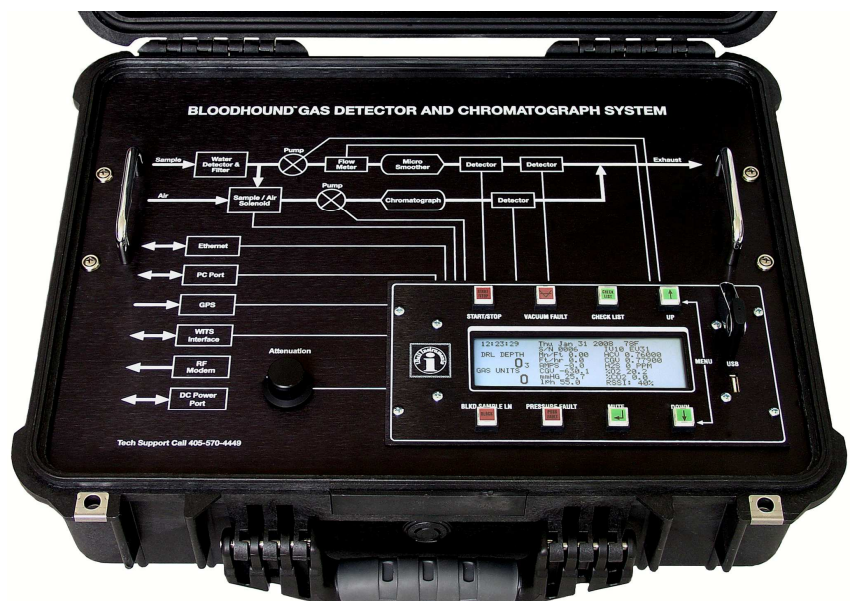


iBall Instruments Internet Enabled Real Time Gas Detection Equipment

## The iBall Instruments Bloodhound™

### Modbus Extension Module Manual

Release 6  
Fourth Generation Bloodhound™ System  
External Code Software Load 180+  
HRM03 Firmware 31+  
With Internal Modbus Hardware Modification



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## Modbus General Overview

“Modbus” was designed as a serial communications protocol that was published by Modicon in 1979. Its original use was to communicate to its programmable logic controllers that it had designed. Since then it has become one of the most popular standard communications protocols in industry between embedded and commercial devices.

Today some of the main reasons for the highly popular use of Modbus over other types of communications protocols are:

1. It is openly published and royalty-free
2. Relatively easy industrial network to deploy
3. It moves raw bits or words without placing many restrictions on vendors

Modbus also allows for communication between many devices connected to the same network.

Modbus is most often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

An example of this system is where a main computer will communicate to a terminal, temperature sensors, humidity sensors, and flow rate sensors all within a single building. And then through the same wired network will control air conditioning motors and ductwork plenums.

Since the popularity of Modbus has grown, different versions of the Modbus protocol exist for serial port, Ethernet, and other types of networks that support the Internet protocol suite. The most popular Modbus devices still communicate over a serial EIA-485 physical layer.

For serial connections, two protocol variants exist, with different representations of numerical data and slightly different protocol details. Of the two, Modbus RTU is a compact, binary representation of the data. The second type is Modbus ASCII which is human readable, and more verbose.

Both of these variants use standard serial communication hardware layers. The RTU format follows the commands/data with a cyclic redundancy check checksum (CRC), while the ASCII format uses a longitudinal redundancy check checksum. Nodes configured for the RTU variant will not communicate with nodes set for ASCII, and the reverse.

For connections over TCP/IP, the more recent variant Modbus/TCP exists. It does not require a checksum calculation because the TCP/IP stack system already has one.

Data model and function calls are identical for all three communication protocols; only the encapsulation layer is different.

Of note is an extended version, Modbus Plus (Modbus+ or MB+), also exists, but remains proprietary to Modicon. It requires a dedicated co-processor to handle fast HDLC-like token rotation. It uses twisted pair at 1 Mbit/s and includes transformer isolation at each node, which makes it transition/edge triggered instead of voltage/level triggered. Special interfaces are required to connect Modbus Plus to a computer, typically a card made for the ISA (SA85), PCI or PCMCIA bus.

## Bloodhound Modbus Hardware Interface



The Bloodhound system uses the Zlinx Modbus I/O module which is available from B & B Electronics. Part number ZZ-NC-485. This module has 2 digital inputs, 2 digital outputs, 2 analog inputs, and 2 analog outputs. In the picture, it is the one on the far left.

The ZZ-NC-485 is set up exactly as coming from the factory except the digital inputs are set up as frequency counters on top of just analog inputs.

The over all setup is:

- 1> RS232 input/output, 115200 baud rate, 8 bits, no parity, 1 stop bit.
- 2> RTU protocol, in Modbus mode.
- 3> Digital inputs are set to frequency counter mode
- 4> Analog inputs are 0-10VDC input
- 5> Digital output is sink mode with internal weak pull up resistor



The Bloodhound system must be modified with a new internal cable, new firmware for the HRM03 module, and new firmware for the Bloodhound Brain board.

HRM03 firmware 31+, Brain Board firmware 180+

When the Bloodhound is modified for the external Modbus module, the normal DB 9 pin female PC interface connector will be replaced with the Modbus DB 9 pin male connector and the new connector will have a Modbus label.

This new Modbus connector will be the bottom of the three connectors.

The Modbus module can be purchased directly from B & B electronics or from us. If it comes from us it will be pre configured for proper operation.

The ZZ-NC-485 module comes with a black serial cable that has a RJ45 on one end and a DB 9 female connector on the other. The RJ45 end connects to the front of the blue Modbus unit. The female DB 9 connector connects to the Modbus interface on the side of the Bloodhound.

Power for the Modbus module must come from a 12VDC source. Connect a power cable from the red (+ positive) and black (- negative) DC power port on the side of the Bloodhound to the positive and negative power terminals on the top of the Modbus module or supply your own 12 VDC power. Connecting the voltage backwards to the Modbus module will permanently damage the module. No damage will occur to the Bloodhound.

When all is powered up and connected, the Modbus module data light will be blinking green, and in the lower right hand side of the Bloodhound LCD screen will scroll by the term MODBUS xx where xx is a count down timer.

If you see both of these indications, the Modbus module is communicating to the Bloodhound system and is ready for connection to the external equipment.

## Bloodhound Modbus Implementation

The Modbus ZZ-NC-485 module has multiple input and output functionality specified by the following list.

Analog IN 1(+) 0 - 10VDC input from Mud Resistivity Meter (in development)  
Analog IN 1(-) Common for Analog IN 1 (+)

Analog IN 2 (+) 0 - 10VDC input – Mud Weight Monitor (in development)  
Analog IN 2 (-) Common for Analog IN 2 (+)

Analog OUT 1 (+) 0 - 10VDC output – Gas Units Out 0 – 10V = 0 – 10, 000 gas units  
Analog OUT 1 (-) Common for Analog OUT 1 (+)

Analog OUT 2 (+) 0 - 10VDC output – Analog Chromatograph Voltage Out x2  
Analog OUT 2 (-) Common for Analog OUT 2 (+)

Digital IN 1 Pump Strokes In – High impedance input – Has Built in weak pull up to 5VDC – Ground this pin to COM to trigger  
Digital IN 2 Off Bottom – High impedance input – Has Built in pull up to 5VDC – Ground this pin to COM to trigger

Digital OUT 1 Open Drain – Closes for 1 second on depth change – When active port will ground this input to COM  
Digital OUT 2 Open Drain – Closes for 1 second on CG Injection – When active port will ground this input to COM

Note: The Analog input and output is limited to 4096 counts (12 bit ADC).

### Analog in 1 – Mud resistivity sensor

This first analog input connects to the Mud Resistivity Meter. The meter sets within the return collection tank (possum belly) before the shaker and is connected to the Cavitator extractor. This sensor will return the mud resistivity and give a good reading on any salt contaminates that would be infused into the oil based on a salt water layer after the oil zone. (Oil / water barrier) (REPORTED AS WITS CHANNEL 3001)

0-10VDC input is reported as 0 Meg ohms to 4095 Meg ohms.

**Output on the wits channel is in Meg Ohms.**

### Analog In 2 – Mud weight in pounds per gallon.

This analog input connects to the mud weight detector. This sensor will detect the mud weight and report the pounds per gallon. (REPORTED AS WITS CHANNEL 3003)

0-10VDC input is reported as 0 – 40 pounds per gallon.

**Output on WITS channel is pounds per gallon.**

### Analog Out 1 – Gas units output

This analog output will send the Bloodhound gas units. 0 – 10VDC will represent 0-10,000 gas units.

### Analog Out 2 – Raw analog chromatograph volts out x2 (doubled)

### Digital In 1 – Pump strokes in

This input is commonly connected to a switch of some type that will close when a pump stroke action takes place. This will count the number of strokes and report a SPM (Strokes per Minute). (REPORTED AS WITS channel 0123)

### Digital In 2 – Off bottom switch

This switch will indicate to the Bloodhound system that the bit is off bottom or the mud pumps are off.

### Digital Output 1 – Depth close change

When the Bloodhound detects a depth change, this open drain output will momentarily short to the common.

### Digital Output 2 – Chromatograph injection

When the Bloodhound makes an injection into the chromatograph, this open drain output will momentarily short to the common.

## Data output from the Modbus Module

The Bloodhound system collects the data from the connected Modbus module. To output and transmit the data it collects, it uses the current Bloodhound WITS data system. More information on the Bloodhound WITS data system and packet structure can be found in the Bloodhound manual.

## Using the Modbus module when external WITS information is NOT available and NOT connected

If the Bloodhound is not connected to an external EDR WITS feed the Bloodhound will generate its own WITS codes and transmit them to the connected computers and over the network. These codes are as follows.

0108 – Bit Depth  
0110 – Hole Depth  
0123 – Pump 1 Strokes per Minute  
3001 – Mud Resistivity in Meg ohms  
3003 – Mud Weight in Pounds per Gallon  
4000 – Modbus Data Flag

These WITS codes are pseudo WITS codes generated by the Bloodhound itself to transmit the accumulated data from the Modbus module. **No actual EDR is connected to the Bloodhound.**

0110 – Hole Depth  
0108 – Bit Depth

Since in reality the hole depth is generated and incremented using the geograph switch, the hole depth is actually the depth recorded by the switch closures on the geograph input on the side of the Bloodhound. The Bit depth is the same as the hole depth EXCEPT when the off bottom switch is activated. When the off bottom switch is activated, the bit depth will be the hole depth minus 10 feet.

0123 – Pump 1 Strokes per Minute  
This will be the strokes per minute of the pump switch closures. This input can be from 0 to 5000 pulses per second.

### 4000 – Modbus Data Flag

**If you see this WITS channel, then this is your only remote way of knowing that the data is coming from the Modbus module and not from an actual EDR WITS feed.**

## Using the Modbus module when external WITS information is available and connected

When using the external Modbus device on a rig that has an EDR and the EDR is connected to the Bloodhound WITS input, then the output from the Modbus module will only inject the following additional information into the WITS data stream.

3001 – Mud Resistivity in Meg ohms  
3003 – Mud Weight in Pounds per Gallon

Only these two WITS channels are added to the current stream of WITS information coming from the current EDR WITS.

If the WITS feed fails, then the Bloodhound will revert to a connection that does not have a wits feed and additional channels will be added. Watch for the WITS channel 4000 to see if an actual wits feed is present and operational.

## **Electrical considerations using the Modbus module**

The ZZ-NC-485 module is not an electrically isolated module.

If you have hundreds of feet of wire stretched out all over the rig and a lightning storm rolls in and hits the tower you may have problems.

If someone shorts a switch lead to a high voltage line, you may have problems.

Some of these electrical problems may transmit through the module and damage the Bloodhound equipment itself and you will have multiple problems.

If you wish to have a level of electrical isolation, there are electrical isolation modules from B & B electronics that will isolate the Modbus Module from the Bloodhound system.

Specifically, these modules will give the Bloodhound a comfortable level of electrical isolation from the outside connections.

B & B Electronics website <http://www.bb-elec.com>

Isolated serial port line extender part numbers

232 OPDR (Good)

232 OPDRI (Best, worth the extra expense)