



iBall Instruments Internet Enabled Real Time Gas Detection Equipment

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# The iBall Instruments *Bloodhound PUP* **Environmental And Hazardous Monitor** Description & Operations Manual

Release 1  
Fourth Generation Bloodhound System  
External Code Software Load 112+  
Internal Code Software Load 20+



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## Overview - iBall Instruments *Bloodhound*<sup>TM</sup>

During the last two decades there has been little innovation in the technology applied to the process of gas detection employed during the drilling process. iBall Instruments LLC. has developed the Bloodhound gas detection system using digital processing techniques and the very latest in non-dispersive infrared and chemical sensor gas detection. Couple that with multiple integrated WITS interfaces, filtered and positive pressure inner case cooling, DC power support, external analog signals, relay contacts, robust power system, and battery backup makes this system unique in the field. Further, this new product integrates GPRS wireless technology and Ethernet connectivity to provide real-time monitoring and charting via the Internet anywhere in the world.

The *Bloodhound*<sup>TM</sup> is composed of non-dispersive infrared detectors, electrochemical hazardous gas detectors, medical grade vacuum pumps, aircraft quality flow meters, an uninterruptible power system, DC power I/O, WITS communication, Ethernet connectivity, a wireless data modem and the iBall Instruments digital processing system Brain Board housed in a rugged a Pelican case.

The iBall Instruments *Bloodhound*<sup>TM</sup> wireless gas detection equipment has the capability to detect from 0 to 100% methane or other combustible gasses. Calibration is performed using National Institute of Standards and Technology (NIST) traceable calibration gasses.

Calibration points can include, 0, 2.5%, and 100% pure methane or other combustible hydrocarbon gas. Complete immunity to saturation in the presence high concentrations of both light and heavy hydrocarbon gasses precludes the necessity of constant re-calibration or zero referencing.

Further, the iBall Instruments *Bloodhound*<sup>TM</sup> has the ability to detect from 0 to 500 parts per million of Hydrogen Sulfide within the extracted sample gases. Detection of even greater amounts is possible on a non-linear scale. Other hazardous gas detectors are available.

This iBall *Bloodhound*<sup>TM</sup> contains its own universal power supply that can accept 90 to 280 VAC input with a frequency tolerance of 48 to 65 Hz. It is lightning, surge, and power spike hardened. If AC power fails, the *Bloodhound*<sup>TM</sup> has its own internal battery system to keep it alive for over 2 hours.

The revolutionary integrated computer control system allows the iBall Instruments *Bloodhound*<sup>TM</sup> to monitor and control all vacuum levels and flow rates using internal powerful state of the art flow meters, vacuum pumps and pressure sensors. Particulate contamination from outside sources is eliminated using internal filtering.

Ease of use is assured with only 4 buttons and one knob to learn. Alarms are automatic and easy to read and usually easy to correct.

All components within the equipment are designed to be easy to get to and replace. With the removal of 4 panel screws all aspects of the internal mechanisms and pneumatics are easily adjusted or replaced. The medical grade pump is mounted using industrial Velcro for vibration damping and easy replacement.

The event switch, RS232 and RS422/485 interfaces are electrically isolated for safety and has adjustable timing sensitivity.

If the GPRS modem is installed, or through the integrated Ethernet connection, remote monitoring of the equipment is available and troubleshooting and/or firmware upgrades can be accomplished remotely. All aspects of the equipment can be adjusted or monitored remotely. Firmware upgrades can be done through the serial port, through the USB port, or remotely through the GPRS modem or Ethernet.

All detection systems are equipped with a USB connection port that permits the use of industry standard USB storage keys of up to 4 Gigabytes of accessible storage space. Primary storage is an internal 2 Gigabyte SD flash card. This is the same card used in popular camera equipment today.

The data that this equipment generates is extremely important, so the real time data is simultaneously stored in three (3) locations.

- Locally, within a removable USB storage thumb drive and SD flash card.
- At the connected computer. As the personal computer pulls in the real time serial from the iBall Instruments *Bloodhound*<sup>TM</sup> equipment, via an EIA-232 (formerly RS-232) or from the USB B connection, it is stored locally in the hard drive within a data Microsoft<sup>TM</sup> Data Base structure.
- If the GPRS modem is connected, it is also transmitted wirelessly over the Internet to the iBall Instruments Central Data Center for storage and Internet display.

This level of innovation brings a new level of data redundancy to the entire system.

For example, if the data on the personal computer is inadvertently deleted, it can be restored from the USB memory stick or downloaded from the internal SD card.

Or, if the USB stick is not available, it can be downloaded in the field and restored from the Internet Data Base Servers at the iBall Instruments Data Center. It should be noted that a host personal computer is not required to use this equipment.

Further, The iBall Instruments *Bloodhound*<sup>TM</sup> always operates in full range. No more data losses due to not having the correct settings on the instruments. There are no settings to make or dilution valves to adjust. Further, the iBall Instruments Gas Detection System uses the most advanced Infra Red hydrocarbon detection sensors for the best accuracy and longevity.

All connections to the equipment are made on the side of the case and all controls are environmentally protected within the case.

### **Overview - Hot Wire**

The hot wire technology developed with the idea of actually burning the sample gas as it enters the testing chamber. This is achieved by heating Nichrome or platinum wire with an electric current that is suspended in the testing chamber. This heated wire is much like the glowing filaments in a toaster.

Nichrome is a brand name for a non-magnetic alloy of nickel and chromium. A common alloy is 80% nickel and 20% chromium. It is silvery-gray in color, is corrosion resistant, and has a high melting point of around 1400 °C. Because of its relatively high resistivity and resistance to oxidation at high temperatures, it is a very good substance to use as a source of heat.

Typically, there are two heated wire elements in a system. One is in normal air and the other is exposed to the sample gas. The electronic hardware uses the normal air element as a reference and the other as the active element.

The heated wire's electrical resistance increases with the wire's temperature, which limits electrical current flowing through the circuit. When sample gas with hydrocarbons flows past the very hot wire, the wire burns the hydrocarbons, creating more heat and thereby increasing the wire's resistance, which in turn tells the electronics that there are burning hydrocarbons present. In principal, this deflection in current flow moves a gauge or needle movement.

Some of the common problems with hot wire technology were when running these wire elements at such high temperatures, it was found that significant evaporation or degradation of the wire element was taking place. This produced a reduction in the useable wire diameter and a subsequent change in the resistance. This change in wire characteristics produced a significant level of zero drift and a lifetime of as short as several days.

Further, when high levels of hydrocarbons were burned on the heated wire, carbon deposits would attach to the wire causing carbonization that could permanently change the zero or sensitivity of the heated wire.

Newer chemical changes and alloy modifications have helped the hot wire technology stay alive in the ability for the heated elements to have a longer life span. Most of the changes finally evolved into pellistor or catalyst bead technologies.

### **Overview – Pellistors (Catalyst Bead)**

In the early 1960s a catalytic sensor, known as a pellistor was developed, which had a much-improved lifetime and reduced zero drift. This work involved replacing the limited catalytic activity of the Nichrome or platinum wire by a much greater activity of a finely divided high catalytic type layering system.

Multiple layers are laid down on a ceramic bead that contained a platinum wire coil acting again as the heater. In this design, the catalytic layer only needed to be heated to 500 °C. These changes vastly reduced the degree of evaporation and degradation of the platinum wire coil. These changes improved the stability and accuracy as well as reducing the amount of power required to run the sensor. Further, this allowed sensors to be fitted into portable battery-powered equipment having a more acceptable battery lifetime. This type of pellistor design is still used today.

Unfortunately, pellistor based sensors are susceptible to significant unseen sources of failure and drift. These sources are known as catalyst poisoning, carbonization, and flame arrestor plugging, any of which prevent or skew the sensing of gas under test. In fact, a compromised pellistor could be a problem for hours as the only way to detect a failure is to periodically check the calibration with a known gas sample.

### **Overview of Infrared Detectors**

The benefits to infrared detection are many. The very fact that the absence of undetectable failure or drift modes is one of the best characteristic benefits of infrared gas detectors. This alone provides a very significant advantage over catalytic beads or hot wire technology. Once again, any and all failure modes are obvious and instantly signaled so that repair can be initiated immediately.

All infrared gas sensors have and use variations on the basic split detector measurement system. In this system, there is an infrared emitter that illuminates a volume of gas that has been introduced into the measurement chamber. The sample gas absorbs some of the infrared wavelengths as the light passes through. The amount of absorption is related to the concentration of the target gas.

This amount of absorption is detected by a set of optical sensors. The change in intensity of the absorbed light is measured relative to the intensity of light at a non-absorbed wavelength.

The electronics generates a value of gas concentration based on the level of absorption.

Failure modes become quickly evident. When there is no target gas present, the output of the reference and active detectors are balanced. When there is target gas present, there is a predictable change in the output from the active sensor because the gas is absorbing the infrared emissions. A typical fault condition for the signal levels is encountered in the case of dirty optics or a weak and failing infrared source. This would indicate the need to perform routine maintenance. Even so, the instrument continues to faithfully measure gas concentration up until the situation degrades to an untenably low signal level. If a sensor or infrared source fails, it becomes immediately obvious to the system due to lack of output. Further, infrared sensors also have a much longer life span with much greater stability over time and little drift. In addition they are not 'poisoned' by the presence of other substances and are highly selective in respect of the target gas type being detected. In this case hydrocarbon based gasses as compared to carbon dioxide.

## Connections On The iBall Instruments *Bloodhound*<sup>TM</sup>

All outside connections are made to the external surfaces of the case to allow for the case to be closed when in operation.

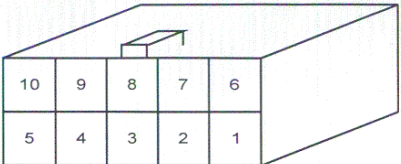
### Ethernet Connectivity

On top of the cooling inlet there is a RJ45 Ethernet connector. This connector is to hook into a Ethernet network and operates using DHCP services which are the most common type of network to date. After a successful DHCP inquiry and setup, the IP address will show on the lower right hand of the LCD screen. Using a software tool, the Ethernet can easily be set up for a Static IP address as well. After the Bloodhound has established a DHCP or Static network connection, an Ethernet mode of connection can be established to the Bloodhound in one of two ways.

- 1> The Bloodhound is listening for an incoming TCP connection on the assigned IP address and port 23. HyperTerminal can establish a connection in this mode. Hyper Terminal is a program that is supplied with the Windows operating system. The iBall Instruments Gas Chart Program (Version 10) can also use this Ethernet connection.
- 2> The Bloodhound will constantly try to connect outbound via TCP to a remote server using a pre programmed address and port.
- 3> An incoming and outgoing connection can not both be maintained at this time.

Ideally, if you are at a drilling site that has Ethernet connectivity through a satellite connection or such, this is a good way for the Bloodhound system to connect back to the Bloodhound servers. Connecting to the Bloodhound servers to allows for transmission of real time data and also allows for iBall Instruments technicians to adjust, reprogram, or maintain the equipment.

Set up of the Ethernet connection parameters can be easily done using a software tool. The set up of the Ethernet port and the software tools to do so is not covered in this manual but is supplied at [www.iballinstruments.com](http://www.iballinstruments.com). When there is a successful connection to the Bloodhound and the Bloodhound has received its first command from the server or software, the lower right hand corner of the LCD will display ETHERNET and a connection timer. This is to show a good connection to the server or software. Future expansion of the Ethernet port will allow for direct communication to rig data using WITSML and also multiple simultaneous inbound and outbound connections as well as a local web page showing all current data as a chart.



Looking at front of connector on side of bloodhound

Pin-out of Bloodhound analog output port	
Pin 1	10 milli Volt = 10,000 Gas Units Output
Pin 2	100 milli Volt = 10,000 Gas Units Output
Pin 3	1 Volt = 10,000 Gas Units Output
Pin 4	No connection
Pin 5	Electrical Ground
Pin 6	Geolograph dry relay contact A
Pin 7	Geolograph dry relay contact B
Pin 8	Alarm dry relay contact A
Pin 9	Alarm dry relay contact B
Pin 10	No connection

Use Molex Pin number 39-00-0047-C  
Use Molex housing part number 39-01-2100  
Use Molex pin extractor tool 11-03-0044

### Analog And Relay Outputs

Beside the RJ45 Ethernet connector there is a 10 pin white latching connector. This connector allows for analog output of the methane percent as well as an open relay contact for depth marking and an open relay contact for alarms.

When the Bloodhound detects a foot change the depth relay will close a normally open relay contact for 500 milliseconds. Also, when the unit goes into alarm, the alarm relay contact will close for the duration of the alarm.

### GPRS Cellular Radio Connection

On the side of the case there is an antenna connection for the wireless GPRS internet connectivity. This allows the *Bloodhound*<sup>TM</sup> to connect to remote servers to allow for transmission of real time data and also allows for iBall Instruments technicians to adjust, reprogram, or maintain the equipment. In order for the GPRS modem to operate there has to be some basics set up.

- 1> An operational SIM (Subscriber ID Module) card must be inserted into the GPRS modem correctly. And the SIM card has to have GPRS connectivity activated through the subscription service.

2> The Bloodhound has to set the GPRS modem up according to the subscription service. After an activated SIM card is inserted into the internal GPRS modem, Setting Register 55 to the correct value and then setting Register 123 will tell the Bloodhound to set the GPRS modem up to your subscription carrier. To set up the Bloodhound system for a subscription carrier, please select a number from the chart below.

- 1 - Cingular/New ATT system (default, most popular)
- 2 - Old ATT system "PROXY"
- 3 - Old ATT system "INTERNET"
- 4 - Old ATT system "PUBLIC"
- 5 - T-Mobile
- 6 - Cellular one

Then, set register 55 to the number from the chart above.

After setting register 55, set register 123 to 1. This will tell the Bloodhound that you have set register 55 and that it is to take the selection and set up the modem for your cellular carrier. After the Bloodhound is finished configuring the GPRS modem, it will then reset register 123 back to 0. You can then monitor the connection using the lower right hand corner of the LCD screen. Some notes that are important to watch for is RSSI, CN and NC. The RSSI stands for Received Signal Strength Indicator and goes from 0 to 100%. The higher the number the better the connection to the cellular network and to the Bloodhound servers. When using the GPRS modem, CN indicates a current connection to the server and NC indicates no connection.

#### **Audible Alarm**

Below the GPRS radio modem, there is an audible alarm module. The alarm will sound when the Bloodhound detects a problem with the system or one of the parameters it is monitoring. Alarm parameters are:

Low Flow	High Flow	Blocked Sample Line	High Temperature
Low Temperature	High H2S	High Methane	Noisy Event Sw
Overhaul	HRM Fault	Power Supply Voltage	High DC Amperage
In Shutdown Mode	Dangerous Condition		

The external relay contact will also close for the duration of the alarm.

#### **DC Power Port**

The DC power port allows the user to either power the Bloodhound from an external DC source or the DC power port will power an external DC system from the internal power supply. The DC port has overload, spike, sag and transient protection built in. If powering the Bloodhound system from a DC power port from an automobile, make sure it has the correct polarity. Otherwise a fuse in the automotive system will open. If running a DC system, the amps can be monitored from the LCD panel or remotely through the Internet. As an added feature, and with the correct adapter, this 12 VDC power port can run just about any automotive appliance such as cell phone chargers .

#### **AC Power Port**

Below the DC port is the universal AC power input. This AC input can handle from 90 – 260 VAC and from 48 – 64 HZ without any problems. Overseas operation on 240 50 HZ is as normal as 120 60HZ. It is configured to use a standard computer power cable.

#### **PC Laptop Connector – USB B**

Beside the AC power port, is the USB B connector used to connect the Bloodhound to a Personal Computer. If using the USB B connector to connect to a PC, please load the USB to Serial driver first. It can be found at [www.iballinstruments.com](http://www.iballinstruments.com). This driver configures the connection to the Bloodhound exactly as if it was a serial port. Normally, the USB driver puts the serial connection on COM 3 but not always. This is a common USB to Serial adapter driver. When connected through the USB driver, the Serial parameters are still 115200 Baud, 8 data bits, 1 stop bit, and no parity (8N1). The Bloodhound charting software will scan all available serial ports and find the Bloodhound so knowing which serial port number is not an issue when using the charting software (Version 10).

### **10 Pin RS 422 RS485 Serial Connector**

In order to communicate to industrial systems without any external hardware, iBall Instruments has incorporated a RS422 connection system into the Bloodhound. This allows for direct connection to the systems data.

### **9 Pin Female Serial PC Port**

The 9 pin female serial port allows for connections to the host computer system. This connector shares a common communication bus as the USB B connector found above. If the user is using the USB B connector to connect to a PC, then serial data will still come out of this connector, but the Bloodhound will not be able to hear data coming in from this port. This makes this port a handy output to a data logger when using the USB B connector to go to a PC. The Serial parameters are 115200 Baud, 8 data bits, 1 stop bit, and no parity (8N1). The Bloodhound charting software will scan all available serial ports and find the Bloodhound, so knowing the serial port number is not longer an issue when using the charting software (Version 10).

### **Event Switch Input**

The red and black spring terminal clamps are for the event switch input. On rigs that are not WITS or WITSML compliant, the most common method to transmit drilling foot changes is with a switch connected in some manner to the mechanical event.

### **Sample Gas Inlet**

The smaller 1/4" hose barb connection on the side is for the sample gas in. This is where the Bloodhound gets its sample from. Right before this connector, there should always be a line filter and a water catch canister or bubble jar if coming from a wet environment.

### **Sample Gas Exhaust**

The exhaust is a 1/2" hose barb connection. A large exhaust hose keeps the system from having a plugged exhaust line during cold weather. Do not plug the exhaust line because back pressure will build up and the system may not operate correctly.

<p><b>NOTE:</b> Under no circumstances is the exhaust line, at any point, be physically higher than the bloodhound case bottom. Under normal operations, water and water vapor is expelled from the exhaust. If the exhaust line is higher then the case bottom, water can not exit the exhaust and will eventually flow back into the system causing damage. This water damage is in no way covered under warranty.</p>
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## Control And Operation Of The iBall Instruments *Bloodhound*<sup>™</sup>

On the front panel of the iBall Instruments Gas Detection System, there is only one knob marked Attenuation. This patent pending function knob is used to adjust many features of the Bloodhound system. When first turning the knob, the LCD screen switches to ask the user to select a knob function. Keep rotating the knob to select from one of the adjustment functions. The selection of knob functions are:

- Attenuation Adjustment (Primary Function)
- Methane Zero Adjust
- Methane Low Span Adjust
- Methane High Span Adjust
- CO2 Zero Adjust
- CO2 Span Adjust
- O2 Zero Adjust
- O2 Span Adjust
- H2S Zero Adjust
- H2S Span Adjust



After Rotating the knob until the desired adjustment function is seen, hit the Green Enter/Mute key. This tells the Bloodhound that you wish to adjust the selected function and the LCD will then instruct you further.

After adjusting the instrument to the desired level, press the Enter/Mute key again. The settings are saved and the Bloodhound resumes normal operations. To adjust the attenuation, turn the knob left and right to adjust the attenuation to the desired level. The adjustment level can be selected from 1 to 200 percent.

In most hot wire or catalyst bead systems today, when high levels of hydrocarbon based gasses enter the detector, either hot wire or catalyst bead, the system experienced problems displaying and reacting to the high gas levels causing carbon build up or damage. This caused the system to possibly become inaccurate or to drift. In order to keep this damage from happening, air dilution was introduced to “cut” or air dilute the sample. This had the desired effect of minimizing the damage to the system and to also allow for final adjustment to the methane percent based on experience, mud weight or any other parameter. Since the infra red detector system can not be saturated or damaged with 100% natural gas, and can instantly monitor high levels of hydrocarbon based gasses, physical air dilution of the sample gas is simply not needed, but the adjustment and function was still requested as an operational parameter. Further, with the ability to not only cut but also amplify the sample gas readings, gives new flexibility to the mud logging community.

NOTE: iBall Instruments recommends that in normal operations, and to best mimic the output of older hot wire systems, the attenuation be set at around 30%.

### **Methane Percent Adjustments**

When adjusting the Methane percent, please be sure that you are injecting the correct gas.

When adjusting the Methane percent Zero, disconnect the inlet hose and allow the Bloodhound to stabilize in air. When adjusting the Methane percent Low Span, you will have to inject 1.0% or 2.5% methane sample gas for the duration of the adjustment.

When adjusting the Methane Percent High Span, you must inject 100% methane for the duration of the adjustment.

### **CO2, O2, and H2S Zero and Span Adjustments**

When selecting a CO2, O2, or H2S zero or span adjustment, it is as simple as injecting air or the sample gas and adjusting the output to match the sample gas injected.

Notes on the knob function: Be patient and get a feel for the knob adjustment. Some functions have the knob sensitive to adjustment, and others will seem sluggish. Further, if the user does not change the knob, the adjustment function will time out after 60 seconds and the Bloodhound will return to normal operations. When adjusting O2 zero, please remember to inject a sample gas that has no oxygen and not common air. This can be just about anything with no oxygen our preference is 100% nitrogen gas. If adjusting a zero and span on a particular gas, always adjust the zero first, and then the span. Adjusting the span first and then zero will throw off the span adjustment 100% of the time.

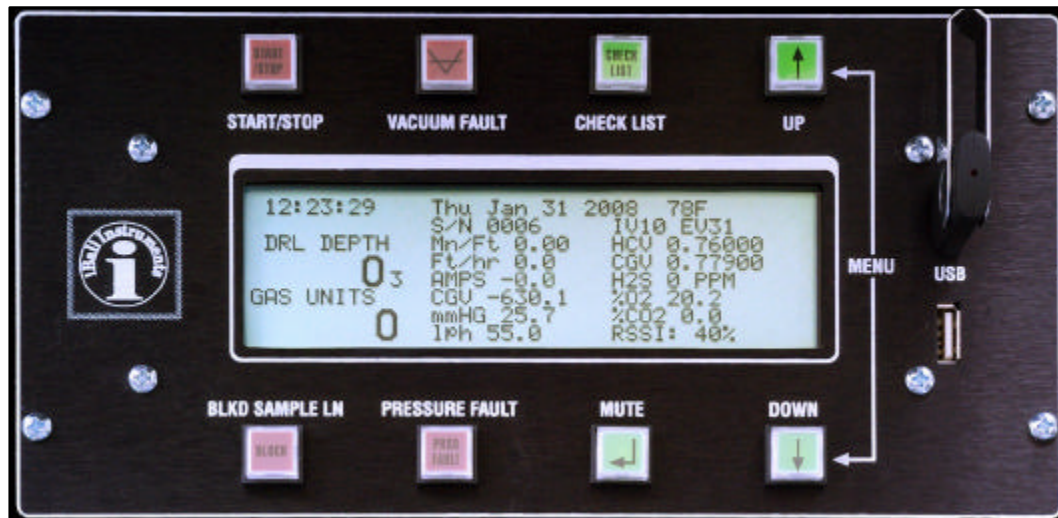
### Methane Percent Quick Check

If the user would like to do a quick check on the Methane percent output, the easiest way is to use a small hand held cigarette lighter. Place the lighter up to the 1/4" sample port and press the lever to allow gas to escape. Do not strike the lighter. This will inject butane into the system. Doing this for 10 seconds will give a good spike reading on the Bloodhound. The output amount of the spike will vary depending on the attenuation settings, the damping settings, and the actual amount of butane injected. A typical spike with attenuation at 30, normal dampening, and a 10 second burst from a lighter that has a 3/4" flame would be about 1.5 to 3.0% of Methane depending on how you hold your fingers around the lighter.

### Oxygen And Carbon Dioxide Quick Check

The Oxygen and CO2 detectors in room air read about 21% Oxygen and 0.2% CO2. To check the detectors, take a 2 liter or 1 gallon plastic bag plastic bag and remove the air from it by squeezing it. After that, take a deep breath and hold it for 3-5 seconds. The longer you hold it the more Oxygen is used up. After that breathe into the bag until it has about 2 liters into it. Human expiratory gasses are about 17-19% Oxygen and 2-5% CO2. The readings on the Bloodhound should reflect somewhere around these numbers. You should at least see them change.

### Front Panel Computer Control (Brain Board)



On the front panel of the Bloodhound computer, the user needs only to know a few control buttons.

When in the normal mode of operation, the LCD display shows many points of information.

On the top line, the current time, day, date, and internal equipment temperature is displayed for both the internal temperature and for the temperature of the HRM module being used. Keep in mind that this is the internal temperature of the equipment and not outside ambient temperature. Internal temperature within the Bloodhound generally runs about 10 degrees Fahrenheit higher.

The second line is reserved for any alarm messages such as "Blocked Sample Line". If there are no alarms to be serviced, the line will display the current job number, serial number, Internal software version number and external software version numbers. If you call technical support, these pieces of information may be asked from you.

The third line displays the Drill Depth title, the Rate Of Penetration (ROP) in Minutes Per Foot and the voltage of the primary sensing element. The voltage number represents how much of the detected gas the instrument sees. The higher the number, the more gas it will see. If the number is zero or low, an alarm will sound and the error will show.

The fourth line displays the Drill Depth in large numbers followed by the Rate Of drilling Penetration in Feet per hour.

The fifth line displays the extractor DC amps pulled from the Cavitator extractor system. A high amperage such as 5-6 amps indicates that the extractor may need replacement. To the right of the amps, is the Hydrogen sulfide content in Parts Per Million.

The Seventh line shows the Methane percent, followed by the sample vacuum level used to draw in the sample gasses from the extractor. System Vacuum is generally between -5 to -200 mmHg. Excessive vacuum will trigger the system to alert the user to a vacuum problem or an occlusion in the sample line. The Bloodhound has enough suction power to easily pull sample through a 1000+ ft of 1/4" OD tubing. To the right of the sample vacuum, is percent carbon dioxide.

The eighth line holds the current sample flow rate in Liters per hour followed by a scrolling screen that will display general technical and current operational parameters.

These eighth line parameters are :

USB and SD storage card operational status

Received Signal Strength Indicator (RSSI)

GPRS modem connection indicator

Digital attenuation level (%DA)

Mute status, "Alarm On", "Alarm Off", or "Mute xxx"

WITS good or No WITS

If WITS data is present, it will then display bit depth "Bit xxxx.x"

If there is a present Ethernet connection it will display "ETHERNET xx"

If the MainLog program is running and is talking to the Bloodhound, "MAINLOG" will appear too.

If there is an alarm condition, the Brain Board will display the problem. This alarm is accompanied with an audible alarm tone. To mute the alarm tone, press the Enter/Mute key. This will place the alarm in a muted state for ten (10) minutes. Pressing it a second time defeats the audible alarm and the display will show ALARM OFF. Pressing it a third time will display "ALARM ON". Hitting the Enter/Mute key does not turn off any alarms but rather mutes the alarm tones for a given amount of time. If ALARM OFF is selected, the Bloodhound will not make an audible tone.

Pressing the Up and Down Arrow keys at the same time will bring up a very simple menu. To select an Item on the menu display, just press the Up or Down key. This will move the highlight bar up and down. After the desired selection is highlighted, press the Enter/Mute key. This will bring up the selected function for adjustment.

To set the time select the SET TIME/DATE line.

To set the Metric values on/off select the METRIC VALUES ON/OFF line.

To adjust a register setting select the REGISTER SETUP line.

To set the depth counter select the SET DEPTH COUNTER.

To set the job number, select the SET JOB NUMBER line and follow the instructions.

To set the Methane percent alarm level select the SET METHANE PERCENT ALARM LEVEL.

To transfer stored data from the internal SD card select TRANSFER JOB DATA TO USB KEY.

When setting any function, the up arrow, down arrow, and enter key are all that are used to manipulate the data. When making large changes to numbers just press and hold the up or down arrow key. The numbers will start to scroll slow, fast, faster, and then very fast. This is handy when setting the depth from 2000 to 8000 or such. After the new value has been set, just hit the Enter/Mute key to store the new changes and return to the normal operational screen.

To cancel a selection, just hit a red key to return to normal operating view.

### **SET TIME/DATE Menu Selection**

This allows the user to set the current time and date. The Bloodhound has an integrated Real Time Clock RTC, that will keep the current time and date even when the power is turned off to the bloodhound. There is a small 10mm watch battery on the brain board that keeps the time and date RTC alive. This battery also allows for storage some other non volatile and non critical information such as depth, HOBBS timer, and packet counter. If you remove the watch battery for more than a couple of minutes, prepare to give iBall Instruments a call to correct some of the lost non critical data. If you loose time frequently on power down, it is time to replace it. This battery is expected to last about 5 years. The part number is on the battery and a replacement can be found at Radio Shack or other electronics outlet.

### **TRANSFER LAS DATA TO USB KEY Menu Selection**

The Bloodhound stores LAS job data to the internal SD storage media. This SD card can be found on the Brain board. It is a common camera type storage card and can be picked up just about any electronics store. The Bloodhound comes with a 2 Gigabyte storage card but it can use just about any sized one. The collected Bloodhound LAS data is primarily stored on this SD card. If a user has a compatible USB key installed in the Bloodhound USB front panel, the Bloodhound attempts to also place the LAS data onto the USB key after it detects it. This menu selection allows the user to walk up to the Bloodhound, insert a USB key, and download the current job LAS data into the USB key. This key can then be taken to a PC where it can be loaded into a mud logging program or opened with Microsoft Excel for editing.

### **REGISTER SETUP Menu Selection**

The *Bloodhound™* register settings enable the unit to be flexible as well as powerful in operations. Registers are small points of information held in non volatile critical memory locations that dictate how the Bloodhound operates. There are 255 registers that hold a number from 0 to 255. All operational settings are made through register values one way or another. Do not set register values unless you know what the results will be. Incorrect register settings may cause the Bloodhound to have undesired results, become unstable or even unusable. On the other hand, the register settings can allow the user to fine tune the operations of the Bloodhound for optimum performance. This all depends on how knowledgeable the user is of the registers and their settings. A very good explanation of the Bloodhound registers can be found later in this document.

### **SET DEPTH COUNTER Menu Selection**

This menu item allows the user to quickly set a starting depth for the drilling process. To set the depth from its current number, just press and hold the up or down key. The numbers will start to scroll slow, fast, faster, and then very fast. This is handy when making a large number change. After the new value has been set, just hit the Enter/Mute key to store the new changes and return to the normal operational screen.

### **SET JOB NUMBER Menu Selection**

The job number is very important to the Bloodhound system in 2 ways. The job number tells the bloodhound what job number to place into the data packet. Generated packets are sent to the charting software and the remote server system. This tells the server system into what file to place the data. If the job number changes, the remote server software will start a new chart and file. Also when changing the job number, the Bloodhound knows to start a new BH\_DATA.IBD file on the SD storage card and if inserted, the USB disk drive. Usually the job number is the last to be changed on a rig up of the Bloodhound system at a well site.

### **SET METHANE PERCENT ALARM LEVEL Menu Selection**

When in the drilling process, sometimes high Methane percent will come from the extractor. When this happens the Blood hound has the ability to set off an alarm if a preset Methane percent level has been passed. This allows the mud logger to either identify the zone or to warn of a possible dangerous situation. Set this value to zero to defeat the alarm.

### **TRANSFER JOB DATA TO USB KEY Menu Selection**

The Bloodhound stores all job data to the internal SD storage media every 6 seconds. This SD card can be found on the Brain board. It is a common camera type storage card and can be picked up just about any electronics store. The Bloodhound comes with a 2 Gigabyte storage card but it can use just about any sized one. Typical storage size is about 500 Kilobytes of information a day. The collected Bloodhound data is

primarily stored on this SD card. If a user has a compatible USB key installed in the Bloodhound USB front panel, the Bloodhound attempts to also place data onto the USB key after it detects it. This menu selection allows the user to walk up to the Bloodhound, insert a USB key, and download the current job data into the USB key. This key can then be taken to a PC where it can be loaded into the gas charting software version 10 or above.

### **USB Ports And Data Storage**

Two industry standard USB ports can be found on the front panel of the *Bloodhound™* computer. At this time only the top port is used. This USB port allows the use of external thumb drives to be used as secondary mass storage of the data collected. Just any thumb drive can be used, however it is recommended that the smaller or short versions be used exclusively to permit the case to be closed during operations. When inserting a USB drive, it may take up to 60 seconds for the Bloodhound to recognize, and initialize the USB drive. All data is stored and organized on the thumb drive and SD card in the root directly under the file name BH\_DATA.IBD. When starting or changing to a new job number, this file is renamed to OLDFILE.IBD and a new BH\_DATA.IBD is started. Changing back to the old or last job number will not restore/rename the old IBD file but will destroy the last record, OLDFILE.IBD too. Internally there is a 2 Gigabyte or 4 Gigabyte SD flash storage card that is the primary point of storage. The job data files found on this card can be extracted or deleted through external commands using the serial port that is explained later in this document. The data can also be transferred to the USB key from the SD card using the menu option.

### **Service And Repair Of The iBall Instruments *Bloodhound™***

The design of the Bloodhound was conceived with modularity, serviceability, reliability, and portability as paramount. Off the shelf common parts were selected to allow the user to service the Bloodhound with readily available parts from local vendors. A complete parts list of parts and vendors can be found elsewhere in this document. The Bloodhound system can be broken down into 5 sub systems. Each sub system can be exchanged for a new system when it is upgraded or repaired.

### **Gas Detection Sub System**

The Bloodhound detects the gasses using an independent gas detection module known as the Hot wire Replacement Module, second generation or otherwise known as the "HRM02". This module allows the system to be highly flexible and easily repaired when in the field. All calibration parameters are stored on the HRM modules in non volatile memory. This allows the module to be pre-calibrated and placed on a shelf and forgotten about until replaced as a whole in the field. All without the hassle and down time associated with replacing hot wire or catalyst bead technology based systems. This patent pending module allows for the system as a whole to detect hydrocarbon based gasses, CO<sub>2</sub>, O<sub>2</sub>, and H<sub>2</sub>S. Further, it has the ability to utilize the exciting new infra red detector modules from e2v. The greatest innovation of the HRM02 module is the e2v Infra red detectors. The HRM02 modifies the output characteristics of the detectors using a patent pending digital signal processing technique to very closely mimic the output characteristics of a properly operational older hot wire system in fit form and function without any of the constant headaches associated with hot wire systems. It is not uncommon to operate a Bloodhound system for more than 6 months without the need for calibration. And when checked, usually only needs a tweak. Attached to the HRM02 module is a modified electronic flow meter that monitors the gas flow out of the system. The data from the flow meter is given to the Brain Board and the Brain Board then adjusts the amount of power to the sample motor to constantly adjust the flow rate no matter what vacuum load is on the sample line. Attached to this document is a second document that details the HRM02.

### **Gas Detection System – HRM02 / Electronic Flow Meter Replacement**

To replace the HRM02 module or electronic flow meter disconnect the power to the Bloodhound and turn the unit off by hitting the upper left red key. After that, remove the 4 panel screws that hold the top cover in place and pull up on the panel about 4 inches and then move the panel to words your person and stand the cover up in place. This will expose the inner workings of the Bloodhound system.

- Find the HRM02 module and disconnect the data ribbon cable and the power cable.
- Remove the two nylon locking nuts that hold the assembly in place using a 7/16" wrench
- Remove the top RFI shield that has the iBall logo.
- Pull upward on the HRM02 module until it clears the mounting bolts.

- Remove the clear PVC tubing that is attached in 4 places note which tubing goes where. If the tubing is attached back in the wrong place, the unit will not operate correctly. There is a flow diagram elsewhere in this document.
- Disconnect the electrical cabling coming from electronic flow meter to the Brain Board at the Brain Board end. This is a 4 pin locking connector. This locking connector has a small tab on one side that must be pressed in order for the connector to come loose from the Brain Board. Do not force.
- Replace the module or flow meter and assembly is the reversal of removal.

### **Pneumatic Sub System**

With the advances of the HRM02 infra red detector system, the Bloodhound pneumatic system has the advantage of being greatly simplified. The HRM02 infra red detection of Methane will not significantly change with flow rate changes, sample temperature, or pressure differences. Therefore, the Bloodhound pneumatics are straight through without the need for pressure regulators, flow smoothing devices, large pumps, or distribution manifolds. Below you will find the complete flow diagram of the Bloodhound system showing all the pneumatic components.

### **Pneumatic System Description**

Starting with the 1/4" sample inlet hose barb, the inlet goes directly to a simple 1/4" barbed fuel filter held in place by 2" 1/4" ID rubber tubing pieces. The filter part number we use is G1/4 from Luberfiner. It is a general purpose fuel filter with a 10 micron paper/mesh construction. This filter serves multiple purposes. It filters any particulate matter that may accumulate and/or flake off in the sample line during the drilling process. It also allows samples gasses and water vapor to pass through. It will also stop any fluidic mud that happens to make its way to the equipment.

NOTE: Never operate the Bloodhound system without - at the very least - this particulate filter in place. Running the system without any filtering will eventually contaminate the sample pump valves with particulate contaminate and cause the pump to fail prematurely. Running the Bloodhound system without an in line filter will void the warranty. It is very highly recommended that this same filter also be used as a last point filter right before entry of the sample gasses into the Bloodhound and also at the Cavitator extractor.

The sample pumps are a high performance medical grade vacuum pump from Hargraves. They have a web site at <http://www.hargravesfluidics.com/> If you need a replacement pump, we recommend that you order a couple and keep on hand in case of a pump failure. You can call or order them on line and have them delivered to your door. On average, you might expect to replace a pump or two if your Bloodhound is used more than 250 days per year.

The part numbers for the pumps at Hargraves are:

- Sample pump part number: C103E-12

NOTE: You will have to transfer the electrical connector from the old pump to the new one.

There are two types of tubing in the Bloodhound system. A thick black rubberized tubing and a small 1/8" clear PVC vinyl tubing.

The thick black rubber tubing is automotive grade high vacuum good year tubing part number 65113. You can get it from Auto Zone or just about any other auto parts store. This tubing has excellent temperature, wear, and resists kinking on hard corners. This dark black tubing is shown in the pneumatic diagram as a large dark black line. It is used right after the particulate filter, through a vacuum T, and goes to the inlet side of the sample pump and the sample line vacuum monitor port on the Brain Board.

The second type of tubing is a very common 1/8" clear PVC tubing that can be found in just about any hardware store and can be bought for only a few cents per ft. A feature of the clear line is that it useful to see if any contaminates or if liquid water has entered the system.

### **Power System Description**

The power supply in the Bloodhound is an isolated switching power supply. The AC power that is supplied is first turned into very high voltage DC. Since the first step is to turn it into DC power, the incoming voltage, and frequency is not important, as long as there is enough there to keep the DC voltage high enough. This allows the Bloodhound to operate with wild voltage and frequency fluctuations that is very common when running on

rig power. From that high voltage DC the power supply then uses a high frequency transformer to generate smooth and regulated low voltage 13.5 DC that the Bloodhound uses to maintain the backup battery and operate the unit.

The internal battery is a common house hold 12 volt 5 amp hour burglar alarm battery found at Radio Shack or other battery supply store. We use the sealed rechargeable Battery from Power Sonic PS-1250 F1. This battery is kept charged by the Bloodhound system. When the main AC power fails, this battery will keep the Bloodhound running for over 2 hours when new. A little less as it ages. We recommend changing the battery every year for maintenance. Do change it out at least every 2 years. If the battery has an internal short or if there is a failure in the charge circuit, the 7.5 amp fuse may open. This fuse is a standard 7.5 amp ATO type automotive fuse found in any automotive store.

Found on the base plate of the Bloodhound is a DC protection circuit board. This board will monitor the DC power coming in or going out of the Bloodhound. The circuitry arrests sparks, surges, and overloads as well as high frequency noise. This board also has a type 3 ATO base circuit breaker. This breaker will open when the load becomes too much and will remain open until the load is removed. After cooling for a couple minutes, the breaker will then close and apply power to the external load. This board also holds a load resistor that allows the Bloodhound to monitor the incoming or outgoing amps. These amps can be seen on the front panel of the Bloodhound.

### **Control, Analog And Communication System Description**

The Brain Board assembly controls all aspects of the Bloodhound system. It sends power and communicates to the HRM module, Communicates to the WITS interfaces and event inputs, controls the analog and relay out, communicates and controls the Ethernet module, communicates and controls the GPRS modem, switches the alarm, monitors the vacuums, sample flow rate, watches for buttons to be pressed, and dozens of other functions. Truly the heart of the system, it is easily replaced as an assembly, and by design is robust and rugged.

### **External Communication System Description**

The Bloodhound advancements include the ability for independent operation out in the field. There have been many dog house installations. This is where the unit is hooked up in the dog house next to the drilling deck and monitored and logged off site. This is done with the use of either a GPRS modem or a direct connection to the rigs Ethernet system using the Ethernet connection. The GPRS modem uses the same system as a cellular telephone. This system allows for the Bloodhound to directly connect to the internet and lastly communicate to the Bloodhound servers. These servers allow for anyone to log in and monitor the well remotely. The Ethernet connection is identical except the connection is made through the rigs satellite internet service. The GPRS modem has a 1 watt radio output, and with the optional 3 watt booster and 3 dB gain antenna, can reach just about any site in the United States. As a comparison, all hand held cellular phones have around 0.75 of a watt and a low dB antenna. Over the last 2 years we have yet to find a spot that was not available via GPRS cellular radio. Many times, the Bloodhound has a RSSI of 75% where the operator has no cellular connection at all. Further, if needed, a satellite communications dish can be set up and the Bloodhound can use the internet connection that it offers.

### **Explanation Of The BH\_LAS.LAS File Generated By The Bloodhound**

The Bloodhound generates a LAS file that is stored locally in the internal SD card and to the external USB drive if compatible and inserted. If there is not a USB drive inserted, the data will be stored only on the internal SD card. A LAS record is stored every time a foot is drilled. This allows the operator to walk up to the bloodhound and insert a USB key and download the LAS data. If the bit is pulled out and the same depth drilled more than once, the depth will show up more than once.

The data is saved as a comma delimited text file and the columns are called out as:

- Drill depth
- Drill rate min/ft
- Methane Percent
- C1
- C2
- C3
- IC4
- NC4
- Methane Percent
- Gamma
- O2
- CO2
- H2S
- INCLINATION
- AZIMUTH
- Year / Month / Date
- Hours : Minutes : Seconds

Example:

```
2000,3.292,38.73,1.8,3.5,6.2,8.5,9.1,38.73,0.0,0.0,0.95,0,0.0,0.0,08/04/19,09:47:59,  
2001,2.367,49.42,2.1,2.7,5.3,8.4,9.0,49.42,300.3,20.7,0.90,0,210.0,65.0,08/04/19,09:50:26,
```

This information is easily imported into any logging program that allows for import of LAS data.

### **Explanation Of The BH\_DATA.IBD File Generated By The Bloodhound**

The second data file that can be downloaded from the Bloodhound equipment is the .IBD file. It too is a comma delimited file that contains data from every 6 seconds of operation. The packet is broken down into

- @ symbol to show the start of the packet.
- Year / Month / Date
- Hours : Minutes : Seconds
- Packet number
- Drill depth
- Bit depth
- Methane Percent
- O2
- CO2
- Drill rate minutes per foot
- H2S ppm
- Gamma
- Total strokes per minute
- Weight on bit
- Rotary RPM
- Pipe Pressure
- INCLINATION
- AZIMUTH

Example:

```
@,080419,095224,187005,2001.6,2001.6,2.47,20.98,0.68,0,0,0.859,0,300.3,276,8,69,3302,210,65,  
@,080419,095230,187006,2001.6,2001.6,2.47,20.98,0.68,0,0,0.859,0,300.3,276,8,69,3302,210,65,
```

## Command Line Interface

The Bloodhound is controlled calibrated, programmed, and set up using a command line interface. To interface with the Bloodhound, connect a common PC DB9 Male to DB9 Female serial cable from an available male DB9 serial port of your computer to the Female DB9 found on the side of the Bloodhound. Or connect to the USB B connector on the side of the Bloodhound to an available USB A connector on the side, front, or back of your computer.

NOTE: If you are using a USB cable from the Bloodhound to the PC, please load the USB driver first. This driver can be found on the USB key supplied with the or found on our web site at [www.iballinstruments.com](http://www.iballinstruments.com)

After connecting to the Bloodhound, if there is serial packets coming out of the Bloodhound, hitting the [ENTER] key will temporarily suspend the transmissions of the packets for 60 seconds. This is to keep from interfering with the command structure. If no more commands are coming in, the data packets will automatically start being sent again.

To communicate directly to the Bloodhound, Open HyperTerminal and select the communications port that is connected to the Bloodhound. The communications parameters are 115200 baud, 8 data bits, no parity, and 1 stop bit. (8N1). All ASCII characters that are entered are internally converted to upper case so all commands are not case sensitive. This is true for both the 9 pin serial cable and the USB B connection. If using version 10 of the gas charting software to communicate to the Bloodhound, the serial port number will automatically be found and used.

The commands that are sent to the Bloodhound are in the format as follows.

COMMAND MODIFIER 1 MODIFIER 2 [ENTER]

An example is:

ECHO ON[ENTER]

By default, the command line interface echo is off. To view what you typing, you must enter the command

ECHO ON[ENTER]

The commands available are:

SETREG	READREG	VER	UPLOAD	REBOOT
STATUS	CALIBRATE	SETTIME	SONALERT	SERIALNUM
ECHO	LINK	CONTRAST	GEOHIT	SETDEPTH
MOTOR	CGSAMPLE	MUTE	?	CGETIME
CHARTTEST	SETUP MODEM	SETPACKETNUM	HOBBS	SETJOBNUM
SHUTDOWN	COPY	TRANSFER		

### SETREG

All functions of the Bloodhound is controlled using register settings. Registers are small points of non volatile memory that hold information critical to the operation of the Bloodhound. The individual registers are called out elsewhere in this document. The register command starts with the SETREG command followed with the register number to be changed and then lastly with the register value. Register numbers are from 0 to 32767 and the register values range from 0 to 255. The common registers used are from 0 – 255. The rest are used for non volatile storage and should not be modified unless directed by a an iBall Instruments representative. To set a register to a different value type in the command:

```
> Setreg 5 0[ENTER]
Register 5 is 0
>
```

The Bloodhound will respond with a report of what the registers new contents are.

### READREG

To read a register from the Bloodhound, enter the command READREG followed by the register number to read. Register numbers are from 0 to 32767 and the register values range from 0 to 255.

To read a register enter the following command:

```
>readreg 5  
Register 5 is 1  
>
```

## VER

This command returns the version of the software load.

To check the software version load enter the following command:

```
>ver [ENTER]  
iBall Firmware V61  
Boot Loader V17  
>
```

## UPLOAD

Entering this command will force the Bloodhound to enter the internal code program. When running the internal code the bloodhound is able to upload data to the external program code. More information is available about the internal program code or otherwise known as the boot strap or loader program.

## REBOOT

This command performs a hardware reboot on the Bloodhound. This has the same effect as powering off and then back on the Bloodhound.

## STATUS

This starts the packet transmissions in the Bloodhound. If the registers are set up to do so, then the data packets begin to be sent out the various communications port. The data packets are described elsewhere in this document.

## CALIBRATE

The calibrate command allows the user to set a calibration point for the vacuum, flow, and amperage settings. The valid calibration modes are:

```
CALIBRAE AMPS[ENTER]  
CALIBRATE VAC[ENTER]  
CALIBRATE FLOW[ENTER]
```

To calibrate the amperage settings, disconnect any devices that are currently connected to the DC power port on the side of the Bloodhound. After that enter CALIBRATE AMPS command. After a couple of seconds hit the [ENTER] key and the new zero amps will be stored.

To calibrate the vacuum port for the sample vacuum, remove the inlet line and enter the CALIBRATE VAC command. After 20 seconds, hit the [ENTER] key to return to normal operations. Reconnect the sample line. After calibration the vacuum level will be set between -6 and -8 mmHg. It will not show zero. This is to compensate for tubing length.

To calibrate the flow, connect a clear plastic flow meter to the sample port. The flow meter should be between 0 and 1 LPM and show a maximum of 1LPM. Since the Bloodhound is drawing a vacuum, connect the tubing to the top of the flow meter. Close the flow regulator knob so that a vacuum is shown on the Bloodhound to be about -30 to -40 mmHg. This simulates a long piece of sample tubing. Then enter the CALIBRATE FLOW[ENTER]. The flow meter should drop to zero. Turn the knob on the face of the Bloodhound clockwise until 1LPH is shown. Wait 20 seconds for the flow to stabilize and then hit [ENTER].

<b>NOTE:</b> Wait at least 20 seconds for the flow to enter before hitting [ENTER]
--

## SETTIME

To remotely set the time or set the time through the serial port, enter the command

```
>Settime [ENTER]
```

The Bloodhound will respond with the following string;

```
To set the time, use command SETTIME ???? VALUE
Use HOURS, MINUTES, SECONDS, DAY, DATE, MONTH, YEAR
Use only up to 2 digits in all fields
Example: SETTIME HOURS 18
```

```
Current time is: Sun 2008 Apr 02 09:36:12
>
```

All the user has to do after that is enter the information in ASCII form. The following is an example of setting the hours.

```
>SETTIME HOURS 14
```

The Bloodhound will respond with the new date

```
Current time is: Sun 2008 Apr 02 14:36:12
>
```

<b>NOTE: Please use the 24 hour time format</b>
---

## SONALERT

This command momentarily sounds the sonalert (alarm).

## SERIALNUM

To view or change the serial number of the Bloodhound, enter this command. By entering the command

```
>Serialnum[ENTER]
The serial number is: 0214
>
```

And the serial number will be displayed.

To change the serial number use the post term 'set':

```
>Serialnum 0219 set[ENTER]
The NEW serial number is: 0219
>
```

And the new serial number will be displayed.

## ECHO

This command turns the echo on and off to the unit. The unit boots up with echo off as the default. Echo is the return of the characters that you have typed through the return serial path and also all error messages.

The echo can be turned on by entering the command:

```
ECHO ON [ENTER]
```

To turn the echo off, just enter the command:

```
ECHO OFF [ENTER]
```

## LINK

Within the Bloodhound, there are multiple serial ports that connect to multiple optional modules. These optional modules are all controlled serially from the Bloodhound computer. When the user wants to directly connect the PC serial port to one of the serially controlled modules, or one module to another, the LINK command is used. Simply put, the link command links the communications port that you are using to any one of the other optional serial modules.

Valid link commands are:

```
> Link GPS[ENTER]
> Link USB[ENTER]
> Link MODEM[ENTER]
```

```
> Link WITS[ENTER]
> Link PC[ENTER]
> Link HRM[ENTER]
> Link ETHERNET[ENTER]
```

For example, this allows the user to link from a remote location using the GPRS modem to the WITS serial port to see if WITS data is operating correctly or to the HRM module to modify some of the operating parameters.

The details of the communications to these modules are beyond the scope of this document.

### CONTRAST

This sets the contrast of the Bloodhound. As the Bloodhound ages, it may be necessary to slightly adjust the contrast. A normal contrast setting is 14000. To set the contrast darker, select a higher number such as 15000, for a lighter contrast select a lower number.

```
CONTRAST 145000[ENTER]
```

### GEOHIT

When this command is entered, it is the same as momentarily shorting out the event contacts. This will increase the foot depth the same as if the event contact switch was hit.

```
>GEOHIT[ENTER]
```

The event depth will increase one foot. This allows the remote technician to help diagnose a switch problem.

### SETDEPTH

This command will return or set the current depth on the Bloodhound.  
To receive the current depth of the event counter just enter:

```
>Setdepth[ENTER]
DRILL DEPTH IS: 2813
```

To set the depth counter, enter the command followed by the new depth.

```
>Setdepth 2800[ENTER]
DRILL DEPTH IS: 2800
```

The pumps within the Bloodhound are automatically controlled by the Bloodhound computer to keep flow rates and pressures constant. Changing the pump speeds using this command is only temporary. After a few minutes the Bloodhound will regain control of the pump motors and adjust them accordingly. To override the automatic control of the pump motors, you must first set the appropriate register settings.

The command structure for the motor command is

```
MOTOR MotorNum MotorSpeed[ENTER]
```

To manually set the speed of the total gas detector pump to half power enter the following command:

```
>MOTOR 1 128[ENTER]
```

### MUTE

The mute command will allow the remote user to silence or turn off the local alarm tone generator.  
To set the mute for a number of minutes, just add the modifier.

```
MUTE 0[ENTER]
```

Will turn on the alarm tone if an alarm is present.

```
MUTE 5[ENTER]
```

Will mute the Bloodhound for 5 minutes

MUTE 1000[ENTER]

Will turn off the Bloodhound alarm.

NOTE: If there is no present alarm, the tone will not be sounding, even if set to 0. Setting MUTE to a number greater than 1000 has no effect.

?

Sending a question mark [enter] to the console will return the string BLOODHOUND and the model number 4. This allows for the charting software or any other software to check to see if there is a Bloodhound connected to that port.

?[ENTER]

BLOODHOUND 4

### CHARTTEST

This command will output a full sweep triangle wave output to the analog port. Every time the level goes to zero, the depth relay will actuate giving a foot tick. This is handy when setting up an old chart recorder to the analog output.

>CHARTTEST[ENTER]

Full sweep chart recorder analog output test, hit Enter to stop

### SETUP MODEM

This command is used to set up the modem for other carrier systems. The user must first select a carrier from the list below and set register 55 to that number. Setting Register 55 to the correct value and then giving the Bloodhound the SETUP MODEM command will tell the Bloodhound to set the GPRS modem up to your subscription carrier.

- 1 - Cingular/New ATT system (default, most popular)
- 2 - Old ATT system "PROXY"
- 3 - Old ATT system "INTERNET"
- 4 - Old ATT system "PUBLIC"
- 5 - T-Mobile
- 6 - Cellular one

Then, set register 55 to the number from the chart above. Using the SET REGISTER command.

You can then monitor the connection using the lower right hand corner of the LCD screen. Some notes that are important to watch for is RSSI, CN and NC. The RSSI stands for Received Signal Strength Indicator and goes from 0 to 100%. The higher the number the better the connection to the cellular network and to the Bloodhound servers. When using the GPRS modem, CN indicates a current connection to the server and NC indicates no connection.

### SETPACKETNUM

This command will allow the user to view or set a specific packet number starting point. Most packets that come out of the Bloodhound have a sequential packet number. This allows the software to monitor and keep track of the packets in sequential order as well as look for missing packets. If changing the bloodhound out mid job, due to system failure or other reason, it may be necessary to set the packet number so that duplicate packet numbers are not sent. If the packet number is over 2,000,000,000, the number will be reset to zero on the next job number change.

>SETPACKETNUM[ENTER]

Packet number is: 187889

>SETPACKETNUM 100[ENTER]

Packet number is: 100

## HOBBS

This is an internal timer that keeps track of the number of minutes that the unit has been running since power up. You are able to reset and set the HOBBS value to also keep track of a job time if desired. To find the number of hours that it has been running, divide the number by 60.

```
HOBBS[ENTER]
```

```
Run Time: 20359 minutes
```

```
HOBBS 500 SET[ENTER]
```

```
Run Time: 500 minutes
```

## SETJOBNUM

The job number is very important to the Bloodhound system in 2 ways. The job number tells the bloodhound what job number to place into the data packet. Generated packets are sent to the charting software and the remote server system. This tells the server system into what file to place the data. If the job number changes, the remote server software will start a new chart and file. Also when changing the job number, the Bloodhound knows to start a new BH\_DATA.IBD file on the SD storage card and if inserted, the USB disk drive. Usually the job number is the last to be changed on a rig up of the Bloodhound system at a well site.

To view the job number just enter the command

```
SETJOBNUM[ENTER]
```

```
JOB NUMBER IS: 106
```

To set the job number to a value, enter the value

```
SETJOBNUM 1223[ENTER]
```

```
JOB NUMBER IS: 1223
```

And the job number will be set.

## SHUTDOWN

Entering this command will make the Bloodhound enter a shutdown mode. What this does is shut down the pumps and the DC power port. This command is used when the Bloodhound is not being used in the field. It allows the Bloodhound to operate normally except without using the pumps. This can make the pumps last longer if the unit is not going to be operational for a long period of time or if the sample line is occluded. To exit the shutdown mode, just enter the command again.

```
>SHUTDOWN
```

```
Unit entering shutdown mode
```

```
>
```

```
>SHUTDOWN
```

```
Unit exiting shutdown mode
```

```
>
```

## COPY

This command allows the user to walk up to the Bloodhound, insert a USB key, and download the current job data into the USB key with a console command. This key can then be taken to a PC where it can be loaded into the gas charting software version 10 or above.

## TRANSFER

This command allows the console user to start a transfer of job data from the internal SD card to the attached PC. This command is used to transfer the job data from the Bloodhound to the PC through the attached cable. The charting software then appends this data to the current data base and sorts it according to packet number.

NOTE: The Bloodhound stores all job data to the internal SD storage media every 6 seconds. This SD card can be found on the Brain board. It is a common camera type storage card and can be picked up just about any electronics store. The Bloodhound comes with a 2 Gigabyte storage card but it can use just about any sized one. Typical storage size is about 500 Kilobytes of information a day. The collected Bloodhound data is primarily stored on this SD card. If a user has a compatible USB key installed in the Bloodhound USB front panel, the Bloodhound attempts to also place data onto the USB key after it detects it.

### Register Settings And Modes Of Operation

The *Bloodhound™* register settings enable the unit to be flexible as well as powerful in operations. Registers are small points of information held in non volatile critical memory locations that dictate how the Bloodhound operates. There are over 255 registers that hold a number from 0 to 255. All operational settings are made through register values one way or another. Do not set register values unless you know what the results will be. Incorrect register settings may cause the Bloodhound to have undesired results, become unstable or even unusable. On the other hand, the register settings can allow the user to fine tune the operations of the Bloodhound for optimum performance. This all depends on how knowledgeable the user is of the registers and their settings. A very good explanation of the Bloodhound registers can be found later in this document.

Register settings and changes can be made through the menu, through the serial port, or remotely through the wireless connection.

Some of the settings that are available for modification include but are not limited to:

- Flow meter override. In case the flow meter fails, the pumps can be placed in a static mode of operation and will not rely on the feedback of the flow meters for operation. This will allow the unit to continue operations until the flow meter can be replaced.
- Flow meter settings. The flow rate can be adjusted from 0 to 120 LPM or the sample pump can be turned full on.
- Data output. The data that is sent out the data ports can be configured in a packet form or human readable.
- Data output timer. A timer register can be set to determine the number of seconds between data packets sent out or refreshed.
- The unit can be configured to defeat or utilize the internal wireless connection.
- Seconds between data stores to the USB drive
- Amperage (Current) settings
- Primary / Secondary sensing element selection
- Zero knob override
- Switch de bounce variables - Event sensitivity
- Dampening variables. If the output of the detectors requires smoothing, the unit can increase the dampening of internal values
- Infrared independence. The *Bloodhound™* can monitor the dual Infrared detectors and determine if either of them is faulty providing a method of redundancy
- Flow meter calibration and K factor
- Mute timer settings
- High and low alarm levels
- IP and PORT addresses
- WITS and WITSHL settings
- Baud rate settings
- Job numbers

### Registers and Register Settings

The *Bloodhound™* operation is dictated by the setting of registers. In the *Bloodhound™* there are over 255 registers. Most are not used and are reserved for future expansion or for non volatile storage.

NOTE: To effectively set up and operate the *Bloodhound™*, the registers must be set correctly. Failure to do so will cause undetermined results.

The active registers are listed below. Unlisted registers are not used and should not be changed from the default setting by the user because they could become active in later loads of software. Registers that are not listed should not be changed.

REGISTER 0  
Unused.

REGISTER1  
Stay in internal code.

This register tells the Bloodhound to stay in internal program code or jump to external program code. Internal program code is a boot loader program that allows the upload of new program code into the system.

VALUE = 85 ok to go to external code  
VALUE (anything else) stay in internal code

REGISTER2  
External program verification.

This register tells the Bloodhound if there is a valid program code installed into the unit. If this register is not set to 85 then the unit will remain in internal code.

VALUE = 85 valid program in external flash  
VALUE (anything else) not valid program in flash

REGISTER3  
RESET COUNTER

This register keeps track of the number of resets that the Bloodhound has done. It is a useful tool to see over time if there has been an abnormal number of resets within a given amount of time. If there are 10 resets in a row, the Bloodhound stays in internal code because there is something wrong.

This register is cleared in the external code

REGISTER4  
External code version.

This register holds the external firmware code version.

REGISTER5 Absolute number of resets high byte

REGISTER6 Absolute number of resets low byte

Register 5 and 6 work together to make an unsigned integer which is the absolute number of resets from the very first power up.

REGISTER7  
Unused.

REGISTER8  
First time power up register setup

If this register is not 85 then a routine is called that will set the registers to factory levels. This register tells the Bloodhound if it has ever been booted before. On a first time startup, the Bloodhound sets all 255 registers to a factory default and then sets itself to 85.

REGISTER9  
Unused.

REGISTER10  
Flow meter override.

If this register is not zero then the Bloodhound takes this number and forces the sample gas pump to stay at this power level, typically 170 is a good number to start with.

If this register is set to zero then the Bloodhound uses feedback from the electronic flow meter to regulate the speed of the hot wire pump.

Normally set to 0 or sample gas pump self regulation.

This register is used to set the pump to a static level in case the electronic flow meter fails.

REGISTER11

#### Flow meter regulated flow rate

This register sets the flow in liters per hour LPH, that the Bloodhound will regulate to. The Bloodhound takes readings from the electronic flow meter and regulates its own sample gas pump and flow rate. If this register is set to 255, the sample gas motor is turned all the way on.

Normally set to 60 or self regulating at 60 LPH.

#### REGISTER12

Unused.

#### REGISTER13

Packet Timer in seconds

If this register is not zero then the Bloodhound will spit out information through the serial port at register 13 seconds per packet.

Usually set to 6 or 6 seconds between packets.

#### REGISTER14

Modem aware

If not zero the unit will check for a modem connected to the modem port.

If zero, the Bloodhound will not check for or even power up the modem.

#### REGISTER16

Number of seconds between data records sent to USB and SD card.

This is the number of seconds between storing the data packet to the USB key storage device. If the USB drive is not inserted or if there is a problem with the USB drive then there will be no data stored in the USB. The data is always sent to the SD card for storage.

Usually set to 6

#### REGISTER22

Dampening number

This register sets the low range dampening number. Normally set to 25 and a maximum of 120 with a minimum of 1. Setting this register higher will make the output more sluggish. Setting it lower will allow for a faster response. Not the same as averaging.

Normally set to 25.

#### REGISTER23

Unused.

#### REGISTER24

Unused.

#### REGISTER25

Debounce timer in seconds

The event switch input can sometimes be noisy or needs a debounce in seconds. This register sets up the number in seconds that the switch has to be at rest before another contact will be counted.

Usually set to 20 seconds or 20.

#### REGISTER26

When sending total gas out to a wits system, this will be the divisor for the methane percent.

ie  $100 = \text{methane percent} / 100$

ie  $1 = \text{Methane percent} / 1$

do not set this register to 0

The Pason system has a tendency to report Methane percent 100x the normal value.

#### REGISTER27

Last time power down flag

If the last time it powered down was clean this register will be zero. A clean power down is where the power plug is pulled and the power off button was hit. If the unit is going through a reset, then this will be a 1.

#### REGISTER28

IR independence register

This register sets up the way the high range and the low range inputs interact. If this register is set to zero then the IR sensors are not independent and are joined. This means when the gas level reaches the end of the low range it then goes to the high range IR sensor, but it calculates out the high range sensor level at the low level point.

If this register is not zero, then the IR sensor inputs are independent from each other. This means when the gas level reaches the end of the low range then it jumps to the high range where ever it is at on the gas level concentration

Normally set to 0

#### REGISTER29

Power down timer in minutes

This is the number of minutes before power down when the AC power is lost.

Normally set to 120.

#### REGISTER30

Digital attenuation

Some operators want to have artificially low or high total Methane percent. This register allows for the Methane percent to be digitally adjusted as if there was an element of air dilution or gain. This entered value is a percentage of the calibrated output and it has the same effect as air dilution or gain.

150 = 150% output.

100 = 100% output

50 = 50% output

and so on to 10%

Normally set to 30

#### REGISTER31

Reset vacuum zero point

If this register is set to something other than 0 the iBall will reset the zero point in memory for the vacuum Point and then set this register back to zero

#### REGISTER32

Depth per hit register

This is the number of feet incremented per event contact closure.

Normally set to 1

#### REGISTER33

Event noise alarm level

If there are noise spikes on the event line and the spike count is greater than this number then the bloodhound will alarm with a noisy event alarm. If set to 0 this alarm is disabled

Normally 0

#### REGISTER34

Foot tick chirp

This register sets the time in milliseconds that the sonalert will chirp when a foot is drilled. The larger the number the longer and louder the chirp

Normally 0

#### REGISTER39 High byte

Unused.

#### REGISTER40 Low Byte

Unused.

#### REGISTER41

Unused.

#### REGISTER45

Register 45:Mute timer in minutes

NOTE: not to exceed 25.

This is the number of seconds that the mute key will mute the alarm tone

Normally set to 5 minutes or 5.

REGISTER46

High internal temp level usually set to 120 deg F

Normally set to 120

REGISTER47

low internal temp level usually set to 35 deg F

Normally set to 35

REGISTER50

High LPM level

Normally set to 90

REGISTER51

Low LPM level

Normally set to 40

REGISTER52

High Vacuum level typically 200 (-200)

Normally set to 200

REGISTER95

External code 8 bit checksum

This is the external code checksum

REGISTER96

Register 96 - 112 inclusive

Serial number up to 15 ASCII characters

REGISTER114

REGISTER115

REGISTER116

REGISTER117

The 4 address spaces for the IP that the modem is to connect to.

REGISTER118 High byte

REGISTER119 Low byte

TCP Connection port to host computer

Normally 00, 23

REGISTER120

Internal code version

REGISTER140

Low byte of the job number

REGISTER141

High byte of the job number

### Data Information And Storage

All information within the *Bloodhound™* is stored or transmitted as a common text-based string or file. If a new job number is entered through the computer panel or set remotely, the *Bloodhound™* will rename the old file and start a new file for the data to be stored under.

The data that is transmitted to the Internet or via the serial port by the *Bloodhound™* is in simple ASCII human readable packet form.

A packet is always sent to the SD card and the USB key, if installed, for storage. The packet is broken into fields that are separated by commas. An example of the main data packet that is transmitted is as follows.

```
*0001_0101,2008/11/01,07:11:01,2142.3,2.40,21.06,0.00,30,79.0,0.000,0.000,18,10,13.3,0.479,0.380,0,0.684,0.379,0.00,6,32,0,117.3,60,0.0,82.6,-592,2146741,0.00,0.00,0.00,0.00,0.00,0,C91,
```

The *Bloodhound™* will send other packets of information based on internal activity. If the user has other equipment connected to the Bloodhound and is only interested in gas detection information then it should be configured to ignore all other packets.

The simple checksum is the 8 bit rollover sum of all the ASCII characters starting with and including the '\*' and ending with and including the ';' preceding the checksum delineated item.

The Checksum delineated item will always have a preceding capital C before the ASCII number such as "C91".

Earlier versions of firmware do not include a checksum item.

If new monitored items are added to the comma delineated list, the checksum will always be the last item on the list.

All other packets that are generated from the Bloodhound start with other symbols and also end with a carriage return and line feed.

If the packet starts with a "\*" then it is the main Bloodhound data packet.

If the packet starts with a "A" then it is a WITS or WITSHL data packet information.

If the packet starts with a "@" then it is a Bloodhound minimum data only packet.

If the packet starts with "MLS" then it is a Mainlog data only packet.

David Fullers Mainlog is a software package that is compatible with the Bloodhound system. If you wish to use Mainlog with the Bloodhound, please contact David Fuller at [www.mainlog.com](http://www.mainlog.com) for the latest download of the charting/logging program.

The descriptions of the data packets are as follows.

### Main Bloodhound Packet

The main data packet starts with an asterisk followed by the data fields separated by commas, and then the packet is ended with a carriage return and line feed. All data output is ASCII text and can be seen using a terminal program such as HyperTerminal. This packet is used by the gas charting software.

The Bloodhound packet fields are broken down in the following chart.

Field	Description	Type	Value / Range
1	Header, holds SN/Job #	String	Serial Number Underscore Job Number
2	Date	String	YYYY/MM/DD Year Month Day separated by a "/"
3	Time	String	HH:MM:SS 24 hour Minute Second separated by a ":"
4	Drill Depth	Float	Depth in feet up to 99500.0
5	Methane percent	Float	Methane percent from 0 to 10000.0
6	O2 Percent	Float	0.0 to 100.0
7	CO2 Percent	Float	0.0 to 100.0
8	Attenuation	Float	0.0 to 200
9	Internal Temp	Float	-120.0 to +200.0
10	Drill Rate Min/Ft	Float	0.0 to 500.0
11	Drill Rate Ft/Hour	Float	0.0 to 1000.0
12	Sample Flow Rate	Float	0.0 to 400. LPH
13	Sample Vac Pressure	Float	+120.0 to -800.00 mmHg
14	Power Supply Volts	Float	0.0 to 24.0 VDC
15	Pri Methane DET VDC	Float	0.00000 to 4.09600 VDC
16	Sec Methane DET VDC	Float	0.00000 to 4.09600 VDC
17	unused		0
18	unused		0
19	H2S DET VDC	Float	0.00000 to 4.40000 VDC
20	H2S PPM	Float	0.00 to 500.00
21	ERROR NUM	String	Error number (s) separated by spaces
22	Sample Motor % Power	UInt	0 – 200
23	RSSI Percent	UInt	0 – 100
24	AC voltage	Float	0.0 – 300.0
25	AC Freq	Float	0.0 – 200.0 Hz
26	Amps through DC port	Float	-15.0 to 15.0
27	HRM module temp	Float	-40 to 200.0
28	unused		0
29	Packet number	ULong	0 to 4,000,000,000
30	unused		0
31	unused		0
32	unused		0
33	unused		0
34	unused		0
35	Exhaust Pressure	Float	-200 to +800 (mmHg)
35	8 Bit Checksum	Byte	0 – 255

#### NOTES:

- 1> The packet number always increments by one as packets are sent. Packet numbers will roll over if greater than 4 Billion or if greater than 2 billion and the job number is changed.
- 2> If the last comma delineated item is the simple checksum, it will always have a C preceding the ASCII 8 bit number.

## Wits Data Fields Packet

The Bloodhound collects and monitors the WITS data that is available while during the drilling process.

The Bloodhound then collects all WITS data and builds a packet. It then sends the formed packet to the host server. All packets start with common fields and the collected WITS packets are appended to it. The end of the packet is terminated with a carriage return and line feed.

WITS Packet Example:

```
^,0008_0107,2008/04/20,13:11:13,189092,01082000.4,01102000.4,0112294.1,01130.0,0115303.9,01177.9,
011911.7,012069.3,01213301.7,0122-0.2,0123110.8,012477.6,012596.0,0126669.0,0127-3.0,012840.0,
0130396.7,0137213292.0,014011.0,0142584285.1,01436334.5,0144206959.0,01450.0,0150584285.1,
```

1	^	String	Start Packet Character
2	Serial_Job	String	Packet identifier
3	Year/Month/Date	String	Date
4	Hour:Minute:Seconds	String	Time
5	Packet Number	Long	Same as the Main Bloodhound Packet number
6 - X	WITS Packets	String	See WITS Packet Structure Below

The WITS packet structure is formed by a semi fixed string structure. All points of information are separated by commas. Each point starts with 4 characters that represent a field data identifier followed by an ASCII float value. The number "01102000.4" would mean WITS packet type 0110 and the value would be 2000.4. Packet type 0110 is hole depth and 2000.4 would be the depth in feet. The number of packets that are sent depends on the type of system the Bloodhound is connected to and how the system is set up. A list of known WITS data types are as follows:

0108 Bit Depth	0716 Magnetic Toolface	1219 Neo Pentane NC5
0110 Hole Depth	0717 Gravity Toolface	1220 Iso Hexane IC6
0111 True Vert Depth	0722 Toolface Threshold	1221 Normal Hexane NC6
0112 Block Height	0813 Resistivity 1 Lag Calc	1222 Carbon Dioxide CO2
0113 On Bottom ROP F/H	0816 Resistivity 1	1223 Acetylene
0114 Hook Load	0817 Resistivity 2 Lag Calc	1225 Oxygen O2
0115 Hook Load	0820 Resistivity 2	1226 Gas Specific Gravity
0116 Weight On Bit	0821 Gamma Lag Calc	1705 Cement Date
0117 Weight On Bit	0824 Gamma	1706 Cement Time
0118 Rotary Torque	0829 Porosity 1 Lag Calc	1712 Cement Pump Pressure
0119 Rotary Torque	0831 Porosity 1	1716 Cement Slurry Rate
0120 Rotary RPM	0832 Porosity 2 Lag Calc	1719 Slurry Density
0121 Standpipe Pressure	0834 Porosity 2	1724 Event Number
0122 Casing Pressure	0839 FormationDenLagCalc	1728 Cement Stage Volume
0123 Pump 1 Strokes Per Min	0841 Formation Density	1734 Cement Water Rate
0124 Pump 2 Strokes Per Min	0913 Downhole Pressure	1735 Annulus Pressure
0125 Pump 3 Strokes Per Min	1108 Hole Depth	1736 Nitrogen Rate
0126 Total Mud Volume	1110 Total Mud Volume	1815 Nitrogen Pressure In
0127 PVTTotal Mud Gain/Loss	1111 Total Mud Volume	1816 UBD Flow Pressure
0128 Flow	1115 Mud Tank Volume 1	1817 UBD Flow Temp
0130 Total Pump Output	1116 Mud Tank Volume 2	1818 Down Hole Pressure 1
0137 Total Strokes Sum	1117 Mud Tank Volume 3	1819 Down Hole Temp
0139 WITS Lag Calc	1118 Mud Tank Volume 4	1820 Condensate Out
0140 WITS Gas	1119 Mud Tank Volume 5	1821 Hydrocarbon Flow
0141 H2S	1120 Mud Tank Volume 6	1826 H2S
0142 TotalPumpDisplacement	1121 Mud Tank Volume 7	1827 Nitrogen Volume In
0143 Pump 1 Total Strokes	1122 Mud Tank Volume 8	1828 Total Gas Return
0144 Pump 2 Total Strokes	1129 Trip Tank Mud Volume	1829 Nitrogen Volume Out
0145 Pump 3 Total Strokes	1212 Methane C1	1830 Water Out
0150 TotalPumpDisplacement	1213 Ethane C2	1831 Water Nozzle
0408 Bit Depth	1214 Propane C3	1984 System Info
0410 Hole Depth	1215 Iso Butane IC4	6310 Magnetic Toolface
0414 Standpipe Pressure	1216 Normal Butane NC4	6311 Gravity Toolface
0713 Inclination	1217 Iso Pentane IC5	6339 Magnetic Toolface
0715 Azimuth	1218 Normal Pentane NC5	6340 Gravity Toolface

### Bloodhound Minimum Data Packet

The Bloodhound has a second type of data packet. This packet is used to make the storage of data into smaller files so that the files will take less time to transmit. The minimum packet is always the packet stored on the SD card and the USB key.

Bloodhound minimum packet example.

@,080420,111341,187955,2001.6,2001.6,8.09,20.89,0.60,11.347,1809,1.240,0,123.6,46.3,23,12,1004,18,10,

1	The @ character	String	Start of packet character
2	Year/Month/Date	String	Date
3	Hour:Minute:Seconds	String	Time
4	Packet Number	ULong	0 – 4 Billion
5	Drill Depth	Float	0.0 – 60,000.00
6	Bit Depth	Float	0.0 – 60,000.00
7	Methane percent	Float	0.0 – 10,000.00
8	O2 Percent	Float	0.0 – 100.00
9	CO2 Percent	Float	0.0 – 100.00
10	Drill Rate Min/Ft	Float	0.0 – 500.00
11	not used		0
12	not used		0
13	H2S PPM	Float	0 – 1,000,000
14	Gamma	Float	0 – 1,000,000
15	Total Strokes Per Minute	Float	0 – 500
16	Weight On Bit	Float	0 – 1,000,000
17	Rotary RPM	Float	0 – 500
18	Pipe Pressure	Float	0 – 1,000,000
19	Inclination	Float	0 – 360
20	Azimuth	Float	0 – 360

**ERROR Numbers**

In some of the packets, one of the fields is an error number. This number represents the current problem or problems and notification of instance that needs to take place such as an overhaul. Below is a chart that shows all the current error levels and the corresponding error number. More than one error can be present, and if so, are separated by a space.

No Alarm	0
High Sample Line Pressure	1
Blocked Sample Line	2
Detector Voltage High	3
Detector Voltage Low	4
High Flow Rate	5
Low Flow Rate	6
Low Power Voltage	7
High Amps	9
High Temperature	10
Low Temperature	11
High Methane percent	12
HRM Module Warming Up	13
Unit In Shutdown Mode	14
Event Switch Failure	15
not used	16
High H2S	17
Exhaust Blocked (high ex prs)	18
Overhaul	255