iBall Instruments
Enhanced Bloodhound
Description & Operation Manual

External Code Software Load 65 and Over
**Internal Code Software Load 23 and Over**
Release 22

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1. OVERVIEW – IBALL INSTRUMENTS BLOODHOUND

The Bloodhound Gas Detection and Chromatograph system was developed using digital signal processing techniques and the very latest in infrared and chemical sensor gas detection. Couple that with multiple integrated WITS interfaces, filtered and positive pressure inner case cooling, DC power support, a robust power system, and battery backup makes this system unique in the industry. Further, this new product integrates cellular wireless technology, Ethernet connectivity with an embedded Ethernet switch to provide real-time monitoring and charting via the Internet anywhere in the world.

BLOODHOUND FUNCTIONAL OVERVIEW
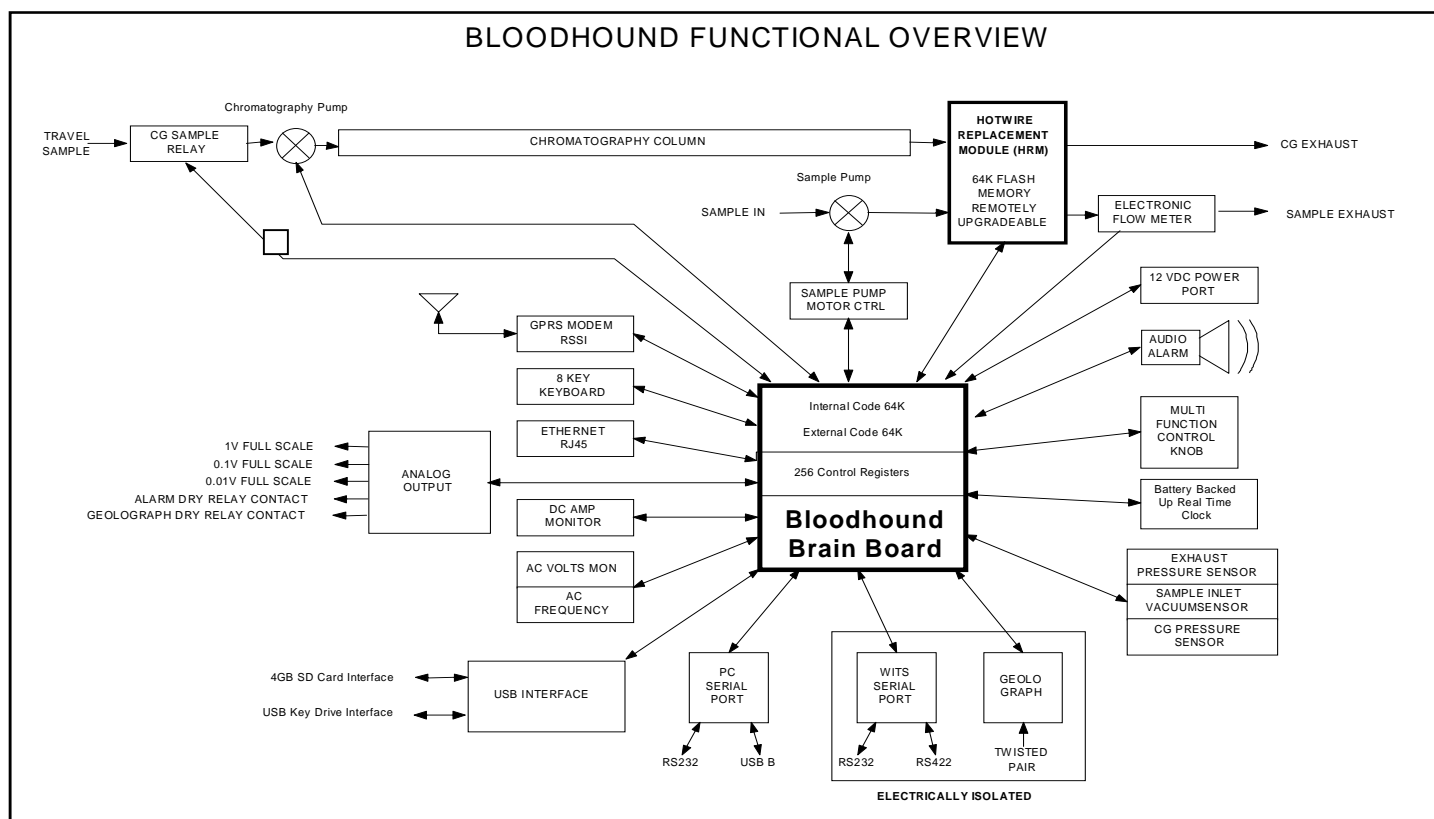
The Bloodhound is composed of an infrared detector, a proprietary chromatograph system, medical grade 10,000 hour brushless vacuum pumps, an aircraft grade flow meter, an uninterruptible power system, DC power input/output port, WITS (Wellsite Information Transfer Specification) communication, Ethernet connectivity, a cellular wireless data modem and the proprietary digital signal processing system Brain Board and housed in a rugged plastic Pelican case.

The Bloodhound wireless gas detection equipment has the capability to detect from 0 to 10,000 gas units. This translates as 0-100% typical naturally occurring hydrocarbon gas mixtures in air. Calibration is performed using National Institute of Standards and Technology (NIST) traceable calibration gases.

Lab calibration points include 0%, 2.5%, and 100% pure methane. Complete immunity to saturation or damage in the presence of high concentrations of both light and heavy hydrocarbon gases precludes the necessity of constant re-calibration or zero referencing.

The briefcase-sized design also has the ability to pull a sample apart using our proprietary temperature – controlled and integrated gas chromatograph. This chromatograph has been shown to pull the samples apart in about five (5) to thirteen (13) minutes depending on the customer-controlled temperature setting; the lower

the temperature the longer the time to complete the injection results. Typically, chromatograph readings are available in 6 to 14 minutes depending on the degree of separation desired by the customer.

The Chromatograph can separate Methane, Ethane, Propane, Iso Butane, Normal Butane, Iso Pentane and Normal Pentane.

On request the Bloodhound has the ability to detect from 0-1000 parts per million of H_2S (hydrogen sulfide) within the extracted sample gases. Detection of even greater amounts is possible on a non-linear scale.

This Bloodhound contains its own universal power supply that can accept 90 to 280 volts AC input with a frequency tolerance of 48 to 65 hertz (Hz). It is lightning, surge, and power spike hardened. If rig power fails, the Bloodhound has its own internal battery system to keep it alive for two hours depending on the health and age of the battery.

The revolutionary integrated computer control system allows the Bloodhound to monitor and control all vacuum levels and flow rates using internal powerful state-of-the art flow meters, vacuum pumps and pressure sensors.

Internal 1 micron filtering protects against particulate contamination from outside sources coming in from the sample line.

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

All components within the equipment are designed to be easy to access or replace. With the removal of four panel screws, all aspects of the internal mechanisms and pneumatics are easily adjusted or removed. The 10,000-hour brushless medical grade pumps are mounted using industrial Velcro for vibration damping and easy replacement.

The Geolograph switch and WITS interfaces are electrically isolated for safety and have adjustable timing sensitivity and de-bounce control.

If the cellular wireless modem is active, or the integrated Ethernet connection has connectivity, remote monitoring of the equipment is available and troubleshooting and/or firmware upgrades can be accomplished remotely. Almost all aspects of the equipment can be adjusted or monitored remotely if connected to the internet. Firmware upgrades or enhancements can be accomplished through the serial port or through the USB port, or remotely through the cellular wireless modem or Ethernet connections.

All gas detection systems are equipped with a USB connection port that permits the use of industry standard USB memory stick of up to 4 gigabytes of accessible storage space. Primary storage is provided through 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 four (4) locations.

1. Locally, within a removable USB memory stick

2. Locally, within an internal SD flash card

3. At the connected computer. As the personal computer pulls in the real-time data from the Bloodhound equipment, via an EIA-232 (formerly RS-232), or from the USB connection, it is stored locally on the hard drive in a Microsoft Access relational database format using the Gas Charting software (Microsoft Access is not required).

4. If the cellular wireless modem service is active or the Ethernet connection is active, the data is also transmitted over the Internet to iBall Instrument's Data Server Center (iballremote.com) for storage and Internet display to you or your customers.

5. Data can also be collected using a remote secondary copy of Gas Chart connected via Ethernet connectivity routing to a specific Bloodhound unit number.

This innovation brings a new level of data redundancy to the entire system. For example, if the data on the connected personal computer is inadvertently deleted or damaged, it can be restored from the USB memory stick or downloaded from the internal SD card. Or, if the USB memory stick is not available, it can be downloaded and restored from the iBall Instrument's Data Server Center if unit is online.

> **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. Typical storage size is about 500 Kilobytes of information a day. The collected Bloodhound data is primarily stored on this SD card. In addition, there should always be a compatible USB memory stick installed in the Bloodhound USB front panel, the Bloodhound attempts to also place data onto the memory stick, after it detects it.

It should be noted that a host personal computer running the Gas Charting software is not required to use the gas detection equipment on a site that is monitored only but recommended.

Further, the Bloodhound always operates in full range. No more data loss due to not having the correct settings on the instruments. There are no settings to make or dilution valves to adjust. The Bloodhound Gas Detection System uses the most advanced Infrared sensor for the best accuracy and longevity.

All connections to the equipment are made on the side of the case and all access controls are environmentally protected within the case or can be locked on the hard Pelican case to prevent tampering.

The Bloodhound uses fifth generation high-speed Infrared sensors for hydrocarbon detection as well as new advanced custom materials used in the high-density packed chromatograph column for better separation of sampled gases.

The equipment is set up to monitor and sense Methane and like type hydrocarbon-based gasses, Oxygen, Hydrogen Sulfide, and Carbon Dioxide.

2. BLOODHOUND DETECTION SYSTEM

A. Infrared Detector System

Currently most gas detection systems deployed in the exploration industry utilize either a hot-wire or a hot-wire/TCD system. These types of hydrocarbon detection systems have been in operation for many decades and are still in widespread use today. A simple linear calibration was easily possible both mechanically and electrically.

An industry standard calibration technique calls for injecting a known percentage of methane gas, typically 1%, into a hot-wire system. Because a hot-wire system is generally linear over its usable range, a known linear scale for the hot-wire can be calculated using zero and a single point of calibration. A third point of calibration is sometimes employed to calibrate the high-end scale utilizing 100% methane. This second point of calibration is generally used on TCD type detectors to locate the point to where 100% of injected methane is detected as raw natural gas, which is usually mostly methane.

Generally, a system is deployed to allow the hot-wire and TCD to operate together and hand off the detection duties as the concentrations change from low ranges to high ranges. Sometimes the system utilizes a type of air dilution to keep the hot-wire from saturating and causing damage to the burning sensor if the concentration gets above 5% in air.

Today's infrared detectors have been shown to react to hydrocarbon-based gases from zero to 100% in concentration without air dilution. This feature garnered great interest within the petroleum geological community as the benefits of infrared over the traditional hot-wire systems became obvious.

When the same hot-wire calibration technique was used to calibrate an infrared detector, problems were quickly discovered because the overall output of the infrared detector is not linear. This linear calibration of a non-linear output had the effect of reporting extremely high percentages of gas when the true amount of gas was much less.

Other techniques were used such as a multiple point calibration. This method employed the storage of multiple points of calibration in a calibration look-up table. This technique utilized the raw output of the detector, and a processor was used to locate the closest value in the table and report the stored output percentage. This method fails in practice because the raw output values of the detector can vary widely based on the types or mix of gases being detected, thereby invalidating the look up multi-point table and also causing false high readings.

Until recently, there was no known method that would easily or better predict the output of the infrared detector for use in the raw natural gas detection in the drilling fluid. The current Bloodhound system can emulate the output of a hot-wire /TCD system to assure consistency of information obtained during the drilling process.

B. Gas Detection Subsystem, the HRM

The Bloodhound detects the gases using an independent gas detection module known as the Hot-wire Replacement Module, third generation or otherwise known as the "HRM". 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 a non-volatile memory. This allows the module to be pre-calibrated and stored until replaced as a whole in the field or as a service item. This is done without the hassle and down-time associated with replacing hot-wire or catalyst bead technology-based systems. This module allows for the system to detect hydrocarbon-based gases, CO_2, O_2, and H_2S. It also has a second detector channel for detecting gases coming from the chromatograph column. The greatest innovation of the HRM module is the infrared detector. The HRM modifies the output characteristics of the detectors and uses 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 many months without the need for calibration. And when checked, usually only needs a tweak.

Attached to the HRM module is an electronic flow meter that monitors the gas flow through 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. In addition, the HRM has an integrated column oven controller that accurately controls the temperature of the chromatograph column.

C. Brain Board Subsystem

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 Geolograph inputs, controls the analog and relay output, communicates, and controls the Ethernet module, communicates, and controls the cellular wireless modem, switches the alarm, controls the chromatograph, 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.

D. Power Supply Subsystem

The power supply in the Bloodhound is an isolated switching power supply. The AC power that is supplied is first converted into very high voltage direct current (DC). The incoming voltage and frequency is not important, as long as there is enough to keep the DC voltage high enough. Generally, between 85 and 240 VAC and between 45 and 65 cycles. This permits the Bloodhound to operate with wildly fluctuating voltage and frequencies that are very common when running on rig power. The high voltage DC output of the power supply is inverted to alternating current (AC) and fed to a high frequency transformer, then rectified to generate a smooth and regulated 13.5 DC voltage that is used by the Bloodhound to maintain the backup battery and operate the system.

The internal battery is a common household 12 volt 5-amp hour burglar alarm battery found at local battery supply store. This battery is kept charged by the Bloodhound system. When the incoming AC power fails, this battery will keep the Bloodhound running for around two hours when in like new condition. This time is reduced as the battery ages. It is recommended to change the battery every year for maintenance. If the battery has an internal short or if there is a failure in the charge circuit, the 7.5-amp fuse on the Brain Board 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 to the Cavitator. The circuitry arrests sparks, surges, and overloads as well as high frequency noise. This board has a type 3 ATO base automatic reset circuit breaker.

This breaker will open when the load becomes excessive and will remain open until the load is removed. After cooling for a couple minutes, the breaker will 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 amperage (such as to the Cavitator). The amperage is displayed on the front panel of the Bloodhound and is sent out as part of the normal data packet to the server system.

E. External Communication Subsystem

The Bloodhound advancements include the ability for independent operation in the field. There have been many installations on the drilling platform that are unattended. This is where the unit is hooked up in the service platform next to the drilling deck and monitored and logged off site.

This is done with the use of either a cellular wireless modem or a direct connection to the rig's Ethernet system using the Ethernet connection. The cellular wireless modem uses the same system as a cellular telephone to communicate to the Internet. This system allows the Bloodhound to directly connect to the internet and communicate to the Bloodhound Data Center Servers. Connection to these servers allow for persons having the user-selected password to log in and monitor the well remotely or download information. In addition, it allows technicians to remotely diagnose, adjust, reprogram, or maintain the instrument.

The Ethernet connection is identical except the connection is made through the rigs supplied satellite internet service. The cellular wireless modem has up to 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.

F. Pneumatic System

With the advances of the HRM infrared detector system, the Bloodhound pneumatic system has the advantage of being greatly simplified. The HRM infrared detection of gas units will not significantly change with flow rate changes, or sample temperature. Therefore, the Bloodhound does not need pressure regulators, large pumps, or distribution manifolds.

The sample line should be conditioned before entering the Bloodhound system. This conditioning should always try to remove any condensate or other liquids from the sample line before it is drawn into the Bloodhound system. Right before the 1/4" inlet, the user should use a pre-filter of around 10-15 microns.
The pre-filter part number we use is G1/4 from Luberfiner or similar type fuel filter. 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 allows gases and water vapor to pass through but will stop any fluid mud that makes its way to the equipment.

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

As shown in the figures on the next page, starting with the ¼" sample inlet hose barb, the inlet goes directly to an internal 1-micron medical grade sample filter. The sample then progresses to the sample pump where it is then put through the flow meter and then the HRM detector block (**Water Detector has been removed in many rental units**).

NOTE: The 1/2" exhaust must have a MINIMUM 1/2" exhaust tubing run from the Bloodhound to the external of the Logging Trailer or other housing. Straight tubing run out and down, no longer than 10' to 12' and should not taper into smaller 3/8" tubing.
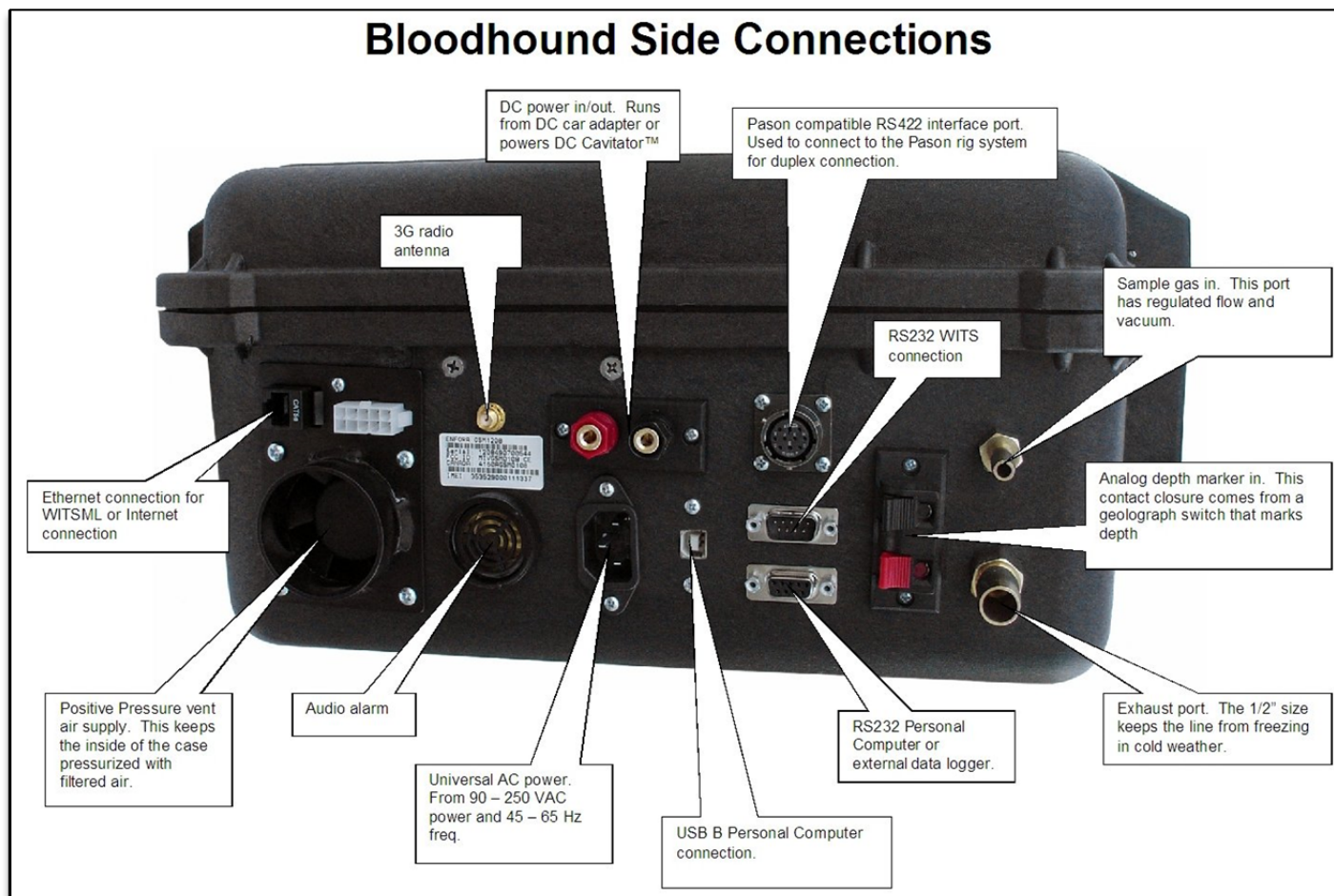
If the exhaust is not run correctly or if there is ANY back pressure, the Bloodhound will not operate correctly and will malfunction. This equipment is sensitive to all back pressure on the exhaust.

3. CONNECTIONS TO THE BLOODHOUND SYSTEM

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

A. Cooling Vent

On the side of the case is a large 1.9" filtered positive pressure cooling air intake. This allows for the

Bloodhound Side Connections

DC power in/out. Runs from DC car adapter or powers DC Cavitator™

Pason compatible RS422 interface port. Used to connect to the Pason rig system for duplex connection.

3G radio antenna

Sample gas in. This port has regulated flow and vacuum.

RS232 WITS connection

Ethernet connection for WITSML or Internet connection

Analog depth marker in. This contact closure comes from a geolograph switch that marks depth

Positive Pressure vent air supply. This keeps the inside of the case pressurized with filtered air.

Audio alarm

RS232 Personal Computer or external data logger.

Exhaust port. The 1/2" size keeps the line from freezing in cold weather.

Universal AC power. From 90 – 250 VAC power and 45 – 65 Hz freq.

USB B Personal Computer connection.

Bloodhound to regulate internal temperatures on hot days, allows for the air to be filtered, and for a source of positive pressure. If the filter is not used, dirt and debris can enter into the case of the Bloodhound causing contamination and damage to the system over time.

The Bloodhound uses internal positive pressure through this filter to keep dust, dirt and debris out of the inside case and system. Always use an air filter on the Bloodhound system for years of trouble-free operation. If the Bloodhound needs to use a filtered source from an outside duct, such as an air conditioning system, the size of the vent is the same as a 1 1/2" PVC tubing fitting and has a good friction fit. This allows for easy plumbing of outside filtered sources. Blocking of this vent is not recommended and can cause the Bloodhound to issue a high temperature alarm. The filter used is a common Dust Buster filter part number VF100 that can be found online. The exhaust of the Bloodhound can be found on the bottom of the case. Do not block the exhaust hole on the bottom. If the Bloodhound alarms due to high temperature, unblocking the cooling ports will quickly bring the temperature down.

NOTE: If operating the Bloodhound for any significant time without the air filter, dust and dirt will accumulate within the Bloodhound case and onto the electronic printed circuit boards. This dust and dirt can be somewhat conductive and can cause erratic behavior within the system. In extreme cases of weather change, humidity can accumulate and cause the dust to become a fine mud and adhere to the surface of the printed circuit boards. Any significant dust and dirt within the Bloodhound case found during repair or replacement means that the unit was run for a length of time without this critical filter and will void the warranty or incur additional charges for cleaning.

B. Ethernet Connectivity

Above the air inlet there is one RJ45 Ethernet connector. This port hooks into a multi-port Ethernet network internally and operates using DHCP (Dynamic Host Configuration Protocol) services, which is the most common type of network to date. After the Bloodhound has a successful DHCP inquiry and setup, the IP (Internet Protocol) address will scroll by on the lower right-hand side of the LCD screen.

Once an IP address has been assigned to the Bloodhound connection, the Bloodhound will listen for an incoming TCP (Transmission Control Protocol) connection on the assigned IP address and port 23. The iBall Instruments Gas Chart Program can also use this Ethernet connection to connect to the Bloodhound once it is entered in the Gas Charting software. This IP number can be found on the lower right-hand side of the LCD as it scrolls.

The best type of connection is if the user is at a drilling site that has Ethernet connectivity, such as a satellite connection. This is the best way for the Bloodhound system to connect to the Internet Database Servers at the iBall Data Center. Connection to iBall's Data Center allows for transmission of real time data to any internet-connected computer, and allows for technicians to remotely diagnose, adjust, reprogram, or maintain the instrument.

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 the user that there is a good connection to the iBall Server System.

C. Cellular Wireless Radio Connection

On the side of the case there is a SMA antenna connection for the wireless Cellular wireless modem that provides internet connectivity when the local rig cannot supply one. This allows the Bloodhound to connect to the iBall Data Center for transmission of real time data and allows remote technicians to diagnose, adjust, reprogram, or maintain the equipment. For the cellular wireless modem to operate the antenna has to be attached to the SMA antenna connector.

The user can monitor the connection of the cellular wireless modem by viewing the lower right-hand corner of the LCD screen. It is important to watch for the RSSI messages. The RSSI stands for Received Signal Strength Indicator and goes from 0-100% when searching for a signal. Once it connects you will have an RSSI strength based on the location.

802.11 Wireless connection. If the cellular wireless modem is being utilized for connection to the Internet, the Bloodhound will also supply a local 802.11 WiFi Connection for laptops, computers, or other wireless capable devices. (See laminated instructions in Bloodhound pouch for SSID and Password information).
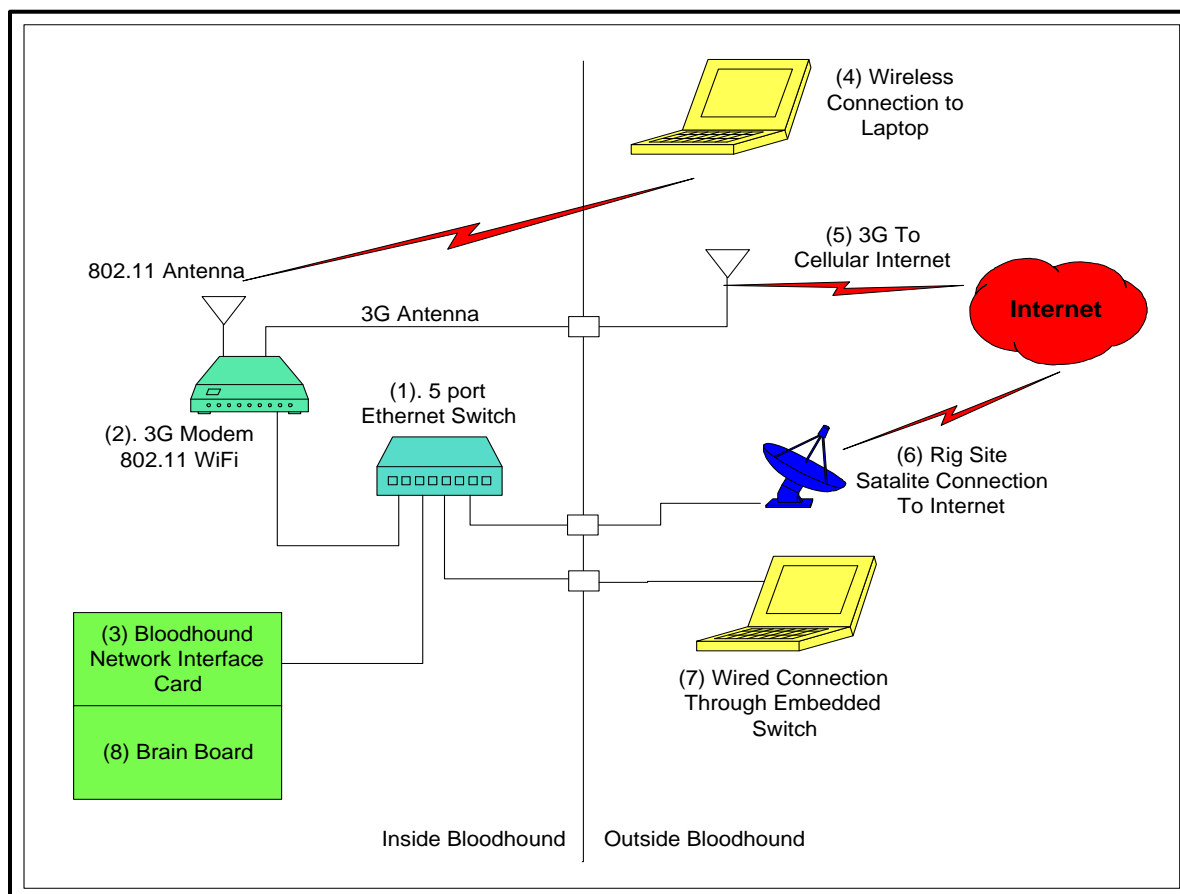
The connectivity of the Enhanced Bloodhound is expanded with the use of an internal 5 port Ethernet Switch, and an internal intelligent cellular wireless modem.

Please reference the above drawing.

> (1) 5 port 1Gb Ethernet Switch
>
> (2) GPRS/EDGE Cellular modem system complete with its own operating system. This modem acts as a Gateway, Firewall, DNS server, DHCP server, port forwarding device and 802.11 transceiver WiFi system.
>
> (3) The Bloodhound NIC (SB72 Network Interface Card)
>
> (4) Wireless internet connection to a local laptop or other 802.11 WiFi enabled device such as smart phones, tablets, and iPads.
>
> (5) 4G and up connectivity to the Internet through the Cellular System
>
> (6) Local Rig supplied Ethernet cable for Internet accessibility

(7) A wired connection to the Bloodhound switch that can access either the on-board Cellular internet connection (2) or the wired rig supplied Ethernet Connection (6).

(8) The Brain Board that controls all aspects of the connections and connection type.

The Networking connection to the Bloodhound system can basically take one of two forms. Either the primary Networking connection is through the internal cellular wireless modem, or the primary Networking connection is through a Rig Supplied Ethernet cable.

It cannot do both at the same time and if both are connected at the same time (i.e., External Ethernet and Cellular Modem) then the Bloodhound will eventually choose one and start using it. It may not produce the results that the user is expecting.

- To choose the cellular modem, disconnect the rig supplied Ethernet cable and attach the external cellular antenna.

- To choose the rig supplied Ethernet cable, disconnect the cellular antenna and connect the rig supplied Ethernet cable.

If the primary networking connection is through the internal cellular wireless modem, then the 802.11 WiFi is enabled for wireless devices and services. External devices connected to the 1Gb Ethernet switch connection will be able to access the Internet through the cellular wireless modem.

If the primary networking connection is through a rig Supplied Ethernet cable connection such as a satellite connection, Then the cellular wireless modem must not have the external antenna connected. By not connecting the external cellular antenna, the modem will automatically power down and allow for external connections to take over. When the internal cellular modem is powered down all 802.11 WiFi connections will terminate.

The Bloodhound SB72 network interface card (NIC) will utilize either connection type that is available to the Internet.

If the user is switching from one type of connection to the other, please allow up to 15-30 minutes for the system to automatically reset itself up to the new connection type. You will know the Bloodhound has a successful connection to the Internet when the message ETHERNET xx shows in the lower right-hand corner of the LCD.

D. Audible Alarm

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

02 Blocked Sample Line	03 High Sensor Volts	04 Low Sensor Volts	05 High Flow Rate
06 Low Flow Rate	07 Low Line Voltage	08 High Line Voltage	09 High DC Amps
10 High Temperature	11 Low Case Temp	12 High Gas Units	13 HRM Warmup
14 Unit In Shutdown	15 Geolograph Noise	16 CG Pressure Low	17 High H2S
18 High Exhaust Prs	19 Low DC Amps	20 Service Required	

E. DC Power Port

The DC power port allows the user to either power the Bloodhound from an external DC source, or power an external Cavitator extractor 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, or other 12VDC lead acid battery, make sure to connect with correct polarity. Otherwise, a fuse in the automotive system will open.

If running a DC Cavitator extractor system, the amps can be monitored from the LCD panel or remotely through the Internet Gas Chart and/or Iballremote.com. As an added feature, and with the correct adapter, this 12 volt DC power port can run just about any automotive appliance such as cell phone chargers. Output current is limited to 10 amperes by an internal fuse.

F. AC Power Port

Below the DC port is the universal AC power input. This AC input can handle from 90 – 260 volts AC and from 45 – 65 hertz (Hz) without any problems. Overseas operation on 240 volts, 50 Hz is as normal as 120 volts, 60Hz. It is configured to use a standard computer power cable.

G. Personal Computer Connector (USB B-Type Connector)

Next to the AC power port is the USB B-type connector used to connect the Bloodhound to a Personal Computer. If planning to use the USB B connector to connect to a PC, you must load the USB to Serial device driver first and only once per PC. It can be found at www.iballinst.com\downloads (downloading Gas Chart will also download the USB Driver. Both Gas Chart and USB Driver will need to be installed after download). This driver configures the USB computer connection to the Bloodhound 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. This USB serial driver is also found on the USB key drive on the faceplate of the Bloodhound.

NOTE: Do not connect the Bloodhound to a USB hub. Plug directly into USB port on PC.

H. 10 Pin Pason RS 422 Serial WITS Connector

To communicate to the Pason Electronic Drilling Recorder (EDR) system without the hassle of any external hardware, iBall has incorporated a Pason RS422 connection interface into the Bloodhound. This allows for direct connection to the Pason EDR system to obtain duplex WITS communication. Generally, no user intervention is necessary on the Bloodhound to access the Pason WITS information when using this connection. After connecting the 10-pin round military type cabling to the Bloodhound from the Pason EDR system, the Bloodhound automatically establishes communication to the Pason system and starts acquiring and sending WITS data.

NOTE: On sites with a Pason EDR system, just because the Pason cable can fit into a connector found on the site does not mean that the connection will work. Pason advises to always connect the Bloodhound to the "Toolpush" Connection Panel on the outside of the Rig Manager's trailer, or, if that is not present, then to the "Toolpush" Computer itself via one of the cables attached to it. (In the event that Pason does not have somewhere to mount the "Toolpush" Connection Panel, they leave cables extending outside of the Rig Manager's trailer with the RS422 connectors accessible. In that case, they are simply cable ends, so are not labeled.) Always connecting to the "Toolpush" Connection Panel or the "Toolpush" Computer will ensure that the proper connection is made and the TPC will not require any configuration change to receive WITS.

I. 9 Pin Male WITS Interface

If the drilling rig has a Totco, Pason, RigWatch or other like drilling system, then the communications to the drilling computer will come from a different source. For example, if connecting to a Totco system, A Totco technician must come to the drilling site and hook up a secondary computer. This computer talks to the rig and makes available the WITS information through a 9-pin null modem cable to the Bloodhound's 9 pin WITS port. If connecting to a Pason EDR the workstation has serial ports for WITS data. Connect the Bloodhound 9 pin male WITS connector through a null modem cable to this Pason system. Almost all drilling rigs that have computer monitoring systems have a WITS serial interface of some kind.

If the connection to the Bloodhound 9 pin male WITS interface is made from the male 9 pin serial port of an external computer, then a **null modem Female to Female** cable will be mandatory.

J. 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 described 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 Gas Chart software will scan all available serial ports and find the Bloodhound, so knowing the serial port number is not an issue when using the charting software.

If connecting this the 9-pin female connector from the Bloodhound to a 9-pin male serial port on an external computer, then a standard 9 pin male to 9 pin female cable will be mandatory.

K. Geolograph Switch Input

The red and black spring terminal clamps are for the Geolograph switch input. On rigs that are not WITS or WITSML (Wellsite Information Transfer Standard Markup Language) compliant, the most common method to transmit drilling foot changes is with a switch connected in some manner to the mechanical Geolograph. As more rigs become WITS and WITSML compliant, this should be less common.

L. Sample Gas Inlet

The smaller ¼" hose barb connection on the side is for the sample gas in. Right before this connector, there should always be a line filter and a water catch canister (dropout jar).

NOTE: Do not allow liquids to enter into the Bloodhound through this sample gas inlet port.

M. Sample Gas Exhaust

The exhaust is a ½" hose barb connection. This larger size exhaust hose keeps the system from developing exhaust back pressure or getting plugged with ice during cold weather. Do not plug the exhaust line or reduce the internal diameter of the exhaust to anything less than 1/2". This is because any back pressure will increase, and the system will not operate correctly.

NOTE: Under no circumstances is the exhaust line, at any point, to 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 than the case bottom exhaust port then water cannot exit the exhaust and will eventually flow back into the system causing damage. Water damage is in no way covered under warranty and is an additional charge on rental items.

4. KNOB OPERATION AND CONTROL

On the front panel of the Bloodhound Gas Detection System, there is a function knob. This function knob is used to access 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 functions.

The selections of knob functions are:

GAS UNITS ATTEN	set attenuation (Register 30), default is 100%
COLUMN TEMP	set chromatograph temperature
GAS UNITS ZERO	set gas units zero
GAS UNITS LOW SPAN	set gas units low span
CO2 ZERO	set CO_2 zero
CO2 SPAN	set CO_2 span
HRM OEMSETUP	sets spans, zeros, and readjusts the Chromat to zero
O2 SPAN	set O_2 span

H2S ZERO	set H_2S zero
H2S SPAN	set H_2S span
GAS UNITS HIGH SPAN	set gas units high span
START CG CAL CYCLE	starts calibration cycle
POWER DOWN	power cycles the Bloodhound

After Rotating the knob until the desired function is seen, press the green Enter/Mute key. This tells the Bloodhound that you wish to access 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 exit at any time, either press any of the red buttons, or just wait 60 seconds for the selection to "time-out."

NOTE: 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.

A. Gas Units Attenuation

The attenuation setting adjusts the gas readings down or up from 1 percent of the "normal" (that is, non-adjusted) reading to 200 percent of the "normal" reading. To adjust the attenuation, rotate the knob to find Gas Units Atten and select Enter/Mute, then turn the knob left or right to adjust the attenuation to the desired level. The adjust level can be selected from 1 to 200 percent. Attenuation adjustments can also be made with a register.

The reason for providing this adjustment is to allow the Bloodhound to generate gas readings similar to older technologies, such as hot-wire or catalyst bead systems. In most hot-wire or catalyst bead systems, when high levels of hydrocarbon-based gases enter the detector, the system experiences problems immediately reacting to the high gas levels, causing carbon buildup and other damage. This causes the system to become inaccurate or to drift. In order to keep this damage to a minimum, 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 gas units based on experience, mud weight or any other parameter. Because the infrared detector system cannot be saturated or damaged with 100% raw natural gas and can instantly monitor high levels of hydrocarbon-based gases, physical air dilution of the sample gas is simply not needed. However, this adjustment was still requested as an operational parameter. Further, the ability to not only cut, but also amplify the sample gas readings, gives new flexibility to the mud logging community

B. Chromatograph Column Temperature

The Bloodhound's internal chromatograph periodically takes a small portion of the sample gas flowing through the Bloodhound and separates the hydrocarbon component gases C1 (methane), C2 (ethane), C3 (propane), IC4 (iso-butane), NC4 (normal-butane), IC5 (Iso-pentane), and NC5 (Normal-pentane). (See the Bloodhound Chromatograph section of this manual for a more detailed discussion.)

Each chromatograph column has an ideal working temperature, typically between 120 and 190 degrees F. For a given column, a higher temperature will cause the components to move through the column faster, but at the price of poorer peak separation. **Do not set the column temperature over 220 degrees F.**

C. Gas Units Zero, Low Span and High Span

When adjusting the Gas Units Zero, disconnect the inlet hose (never adjust with line on) and allow the Bloodhound to stabilize in air.

When adjusting the Gas Units Low Span and High Span, please be sure that the correct gas is injected. When adjusting the Gas Units Low Span, you will have to inject 2.5% methane gas in air for the duration of the adjustment.

NOTE: In the Bloodhound system 1% methane is 100 Gas Units and 2.5% methane is 250 Gas Units. We recommend that the Bloodhound system is calibrated using 2.5% methane in air.

When adjusting the Gas Units High Span, user <u>must</u> inject 100% methane (or wall gas) for the duration of the adjustment. Adjust the instrument to read as close to 8,000 (or as the user prefers) as possible while in calibration mode. The reading will change after exiting the calibration mode.

D. CO2, O2, and H2S Zero and Span

When selecting a CO_2, O_2, or H_2S zero or span setting, it is as simple as injecting clean air or a known sample gas and adjusting the output to match the gas injected. Note that there is no O_2 zero adjustment. O_2 zero adjustment is automatically performed when 100% Methane or wall gas is injected.

NOTE: If adjusting the zero and span on a particular gas, **always adjust the zero first, then the span**. Adjusting the span first and then zero will throw off the span adjustment.

Oxygen Sensor Notes

This sensor was included as a differential monitor as to the amount of methane in the sample. If user observes 5% of methane, then the O_2 should change about 1% no matter where it is presently.

The O_2 is an electrochemical sensor does not have a sacrificial element so it should exhibit a long life.
However, because of its construction, the O_2 sensor is highly sensitive to any exhaust back pressure. If the user desires the O_2 sensor to work correctly, the Bloodhound must have a 1/2" exhaust line or it will fail rather quickly. Prolonged exposure to back pressure will cause irreparable damage to the sensor and will necessitate replacement.

The sensor is constructed using sandwiched layers of chemicals. The reactive chemical is an acid between two electrochemical layers. As oxygen is presented, a reaction between the acid and the electrochemical layers is made and a voltage difference is seen on the electrical bias. The tradeoff is that it is very sensitive to pressure changes because any pressure changes push or pull the acid onto one of the electrochemical layers and a reaction is made as well.

Furthermore, it has cross reactivity to other chemicals that may be encountered in the drilling process. One of the most reactive is acetylene which may be generated using carbide for a lag check. Acetylene may knock the sensor out for up to 20 minutes. Because of these cross reactions, it is not immune to drift and should be adjusted to 21% periodically to air. To do this just disconnect the sample line for a few of minutes and adjust to 21%.

NOTE: "Fuming" mud which is emitting gases other than normally seen may cause the O_2 to appear to drift as well, when in reality it is reacting to the loss of O_2 that the fumes have replaced. Keep in mind where the sample is being taken from.

E. Gas Units Quick Check

If the user would like to do a quick check on the gas units output, the easiest way is to use a small hand held cigarette lighter. Place the lighter up to the ¼" 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 100, normal damping, and a 10 second burst from a lighter that has ¾" a flame would be about 1000 to 2000 gas units, depending on how the user holds their fingers around the lighter.

NOTE: Lighter tests will only show total gas results. To test for Butane, you will have to perform a chromat lighter test. Tech support can assist if that is desired.

F. Oxygen and Carbon Dioxide Quick Check

The O_2 and CO_2 detectors in room air read about 21% O_2 and 0.01% CO_2. To check the detectors, take a 2 liter or 1 gallon plastic bag and remove the air from it by squeezing it. Then take a deep breath and hold it for 3 to 5 seconds. The longer you hold it the more O_2 is removed and replaced with CO_2. After that, breathe into the bag until it has about 2 liters into it. Human expiratory gases are about 17-19% O_2 and 2-5% CO_2. The readings on the Bloodhound should reflect somewhere around these numbers. You should at least see them change.

G. Recommended Calibration Gases

We recommend the following gases and supplier company to be used with the Bloodhound system. Each bottle should last more than a year with regular calibrations. A regulator that is compatible with and will fit all tanks described below: **Model 620-SSC10.**

MESA Specialty Gas & Equipment a Division of MESA International Technologies, Inc.
2427 South Anne Street, Santa Ana, CA 92704
Toll-Free: (866) 470-MESA (6372) Tel: (714) 434-7102; Fax (714) 434-8006
http://www.mesagas.com/

Following are the part numbers and descriptions.

High Range Calibration Gas – 99+ % Methane:

S1971   METHANE 99.0% MIN PURITY
                        CYLINDER: 58L
                        VALVE CGA: C-10
                        CONTENTS: 58 LITERS
                        PRESSURE: 1000 PSI
                        SHELF LIFE: NO LIMIT

NOTE: Wall gas (also known as city or house gas) can be used for the high range calibration. This is the fuel that is piped to houses and business for cooking and heating. It is natural gas that has been refined to remove moisture and most of the butane and propane, leaving mostly methane. Because the high range only needs a very high methane concentration to generate a set point, and because the unit automatically adjusts the upper range limit of the calibration based on the gas reactivity, a pure high range calibration gas is not necessary.

Low Range Calibration Gas - 2.5% Methane in Air

J197150LA   METHANE 2.50%
                                        AIR BALANCE
                        GRADE: CERTIFIED
                        CYLINDER: 103L
                        VALVE CGA: C-10
                        CONTENTS: 103 LITERS
                        PRESSURE: 1000 PSI
                        SHELF LIFE: 3 YEARS

Chromatograph Calibration Gas - EQUAL 5 PART MIXTURE

08/01/08-1   METHANE 0.75%
                                        ETHANE 0.75%
                                        PROPANE 0.75%
                                        BUTANE 0.75%

ISOBUTANE 0.75%
                              BALANCE: NITROGEN
            GRADE: CERTIFIED
            CYLINDER: 103L
            VALVE CGA: C-10
            CONTENTS: 103 LITERS
            PRESSURE: 1000 PSI
            SHELF LIFE: 3 YEARS

Chromatograph Calibration Gas - EQUAL 7 PART MIXTURE

MASA REF 112840   METHANE 1.00%
192013-15   ETHANE 1.00%
                              PROPANE 1.00%
                              BUTANE 1.00%
                              ISOBUTANE 1.00%
                              PENTANE 1.00%
                              ISOPENTANE 1.00%
                              BALANCE: NITROGEN
            GRADE: CERTIFIED
            CYLINDER: 108-110 LTR Steel 50" x 15"
            VALVE CGA: 510 Brass
            CONTENTS: 65 CF LITERS
            PRESSURE: 255 PSI
            SHELF LIFE: 3 YEARS

Carbon Dioxide Calibration Gas - 5% CO2 CALIBRATION GAS

                              CARBON DIOXIDE 5.00%
J10135VA   AIR BALANCE
            GRADE: CERTIFIED
            CYLINDER: 103L
            VALVE CGA: C-10
            CONTENTS: 103 LITERS
            PRESSURE: 1000 PSI
            SHELF LIFE: 3 YEARS

Hydrogen Sulfide Calibration Gas - 100PPM H2S GAS

                              HYDROGEN SULFIDE 100 PPM
Z1053100PN   BALANCE: NITROGEN
            GRADE: CERTIFIED
            CYLINDER: A58L
            VALVE CGA: C-10
            CONTENTS: 58 LITERS
            PRESSURE: 500 PSI
            SHELF LIFE: 1 YEAR

H. HRM OEM SETUP

This knob command is a powerful function that will set the HRM sensor module to standard factory specifications (last known good configuration). When this function is used it will zero the gas reading and the H2S reading, set the O_2 span, and readjust the CG to zero and such. In order for this function to operate

correctly, the Bloodhound should breathe fresh air for about an hour (ideally but can be done sooner with the help of Tech Support), be up to temperature, and then this function would be used.

When this function is used, it will appear that all the readings on the Bloodhound will freeze, because the HRM is not talking to the Brain Board while in this process of OEM setup. Process takes only about 2 minutes is usually performed with Tech Support.

I. Start CG Calibration Cycle

This knob command starts the chromatograph calibration cycle. This cycle automatically sets the time window within which the five or seven gas component peaks will appear. See the Bloodhound Chromatograph section of this manual for a description of how to calibrate the chromatograph. This is usually never required in field.

J. Power Down

This knob command is a secondary method of turning off the Bloodhound. Using this method, first disconnect the unit from power (it will continue to run on the internal battery). Then select "POWER DOWN" and press the MUTE/ENTER button. If unit has a bad battery, it will go down immediately when AC power is disconnected. If you do not pull AC power before selected "POWER DOWN" the Bloodhound will only power cycle.

NOTE: The primary way to turn off the Bloodhound is to disconnect the unit from power, then press the red START/STOP button.

5. Front Panel Computer Control (Brain Board)

A. Buttons

On the front panel of the Bloodhound computer are eight (8) buttons that can also light up. The labeled buttons light up when there is a VACUUM FAULT, PRESSURE FAULT, or BLOCKED SAMPLE LINE.

Only five (5) of the buttons are active for user input.

1. START/STOP – when pressed after the power cord is unplugged, this red button will cause the Bloodhound to power down. Also used to exit menu or knob operations.
2. RED – any red button will cause the Bloodhound to "back-out" of any pending menu operation and go back to normal operation.
3. MUTE/ENTER – used to choose the selection shown. Pressing when no selection is shown toggles between 3 Mute modes, MUTE 600 (seconds) / Audible ALARM OFF / Audible ALARM ON, as shown in the lower right of the display. This button does not actually turn off the alarm codes, but just mutes the sounder.
4. UP – press at the same time as DOWN to display the menu. Then use to move up in the menu list.
5. DOWN – press at the same time as UP to display the menu. Then use to move down in the menu list.

B. Display

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 temperatures are displayed for both the internal temperature on the circuit board and for the HRM module. Keep in mind that these are the internal temperatures of the equipment and not the outside ambient temperature. Internal temperatures within the Bloodhound generally run about 10 degrees Fahrenheit higher than outside the case.

The second line is reserved for any alarm messages such as "Blocked Sample Line."   If there are no alarms to show, 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 of 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 Penetration in feet per hour, followed by the voltage from the chromatograph sensing element.

The fifth line displays the extractor DC amps pulled from the Bloodhound. Amperage over 6 amps may indicate that the extractor needs replacement. To the right of the amps, is the hydrogen sulfide content in parts per million if H2S sensor is turned ON otherwise OFF is displayed.

The sixth line shows the gas units title, followed by a display of the chromatograph pressure. Chromatograph pressure is generally around 800 to 1200 millimeters of mercury (mmHg) depending on the chromatograph column and the prevailing atmospheric pressure. If the Brain Board senses a low chromatograph pressure, an alarm will sound to alert to notify the user to a possible chromatograph problem.

The seventh line shows the gas units, followed by the sample vacuum level used to draw in the sample gases from the extractor. System vacuum is generally between –5 and –450 mmHg. Excessive vacuum will trigger the system to alert the user to a vacuum problem or blockage of 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, as follows:

- USB and SD storage card operational status
- Received Signal Strength Indicator (RSSI)
- Modem connection indicator
- Chromatograph count down timer (CGT)
- Mute status, "Alarm On", "Alarm Off", or "Mute xxx"
- WITS OK 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" and IP Address with port
- If the MainLog program is running and is talking to the Bloodhound, "MAINLOG" will appear.
- HOBBS hour maintenance meter
- DT USE (xMB)

MUTE
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 (600 seconds). 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 sounder 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 menu. To select an item on the menu display, 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.

- SET TIME/DATE - to set the time and/or date
- TRANSFER LAS DATA TO USB KEY - to transfer LAS data to the USB memory stick
- REGISTER SETUP - to read or set a register setting
- SET DEPTH COUNTER - to set the depth counter
- SET JOB NUMBER - to set the job number

- SET GAS UNITS ALARM LEVEL - to set the gas units alarm level
- TRANSFER JOB DATA TO USB KEY - to transfer stored data from the internal SD memory to the USB memory stick

When setting any function, the up arrow, down arrow, and enter key 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 press any red key to return to normal operating view.

C. Menu Selections

SET TIME/DATE
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 watch battery on the brain board that keeps the RTC alive. This battery also allows for storage of 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 call Tech Support to correct some of the lost non-critical data. If you lose 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 many local stores or online (Energizer ECR1220 3v Lithium, replaces CR1222).

TRANSFER LAS DATA TO USB KEY
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 memory stick installed in the Bloodhound 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
The Bloodhound register settings enable the unit to be flexible as well as powerful in operations. Registers are small bits of information held in non-volatile memory locations that dictate how the Bloodhound operates. There are 255 registers that each hold a number from 0 to 255 not all of the registers are open to field user operations. 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
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
The job number is very important to the Bloodhound system in two ways. The job number tells the Bloodhound what job number to place into the data packet specific for each unit. 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 memory stick. Usually, the job number is the last item to be changed upon rig up of the Bloodhound

system at a well site. A new job number on the unit should go hand in hand with a new Gas Chart database if using the software.

> **NOTE:** You can set a job number from 0000 to 9999.

SET GAS UNITS ALARM LEVEL
The Bloodhound has the ability to set off an alarm if a preset gas units 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. The default is 2200.

TRANSFER JOB DATA TO USB KEY
The Bloodhound stores all job data to the internal SD storage media every 6 seconds. Typical data storage size is about 500 kilobytes of information per day. The collected Bloodhound data is primarily stored on this card. If a user has a compatible USB memory stick installed in the Bloodhound 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.

D. USB Port and Data Storage

One USB port on the front panel of the Bloodhound computer allows the use of external USB memory sticks to be used as secondary mass storage of the data collected. All Bloodhounds are shipped with a USB stick installed. Any USB memory stick can be used; however, it is recommended that the short versions (low profile) be used to permit the case to be closed during operations. When inserting a USB memory stick, it may take up to 60 seconds for the Bloodhound to recognize it. All data is stored and organized on the memory stick 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 OLD_DATA.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, OLD_DATA.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 memory stick from the SD card using the menu option.

6. SERVICE AND REPAIR OF THE 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. The Bloodhound system can be broken down into 5 subsystems. Each subsystem can be exchanged for a new system when it is upgraded or repaired.

A. Gas Detection System – HRM / Electronic Flow Meter Replacement

To replace the HRM module or the electronic flow meter, first disconnect electrical power to the Bloodhound and then turn the unit off by selecting "POWER DOWN." After that, remove the four panel screws that hold the top cover in place and pull up on the panel about 4 inches and then move the panel towards your person and stand the cover up in place. This will expose the inner workings of the Bloodhound system.

- Find the HRM module and disconnect the four electrical cables
- Remove the two nylon locking nuts that hold the assembly in place using a 7/16" wrench
- Pull upward on the HRM module until it clears the mounting bolts.
- Remove the tubing that is attached in three places, noting 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 and/or flow meter and assembly is the reversal of removal.

B. Sample and Chromatograph Pumps

The sample pump and chromatograph pumps are high performance medical grade brushless pumps from Parker. The sample pump and chromatograph pumps are a special-order item from Parker and can be ordered from iBall Instruments. The pumps are a brushless medical grade pump system. The chromatograph pump is a two-wire pump and the sample pump is a three wire pump. They are not interchangeable.

Each brushless pump has a service life of a minimum of 10,000 hours. This translates to over 416 days of nonstop use. Or more than a year of service per pump.

C. Chromatograph Sample Solenoid

The chromatograph sample solenoid is an Ingersoll Rand part number P251SS-012-D-G. The part is readily available from Grainger. You can easily call or visit their web site at www.grainger.com and you can have them delivered to your door. Keep in mind that there is an adjustment on the bottom of the solenoid. on occasion the solenoid is not adjusted correctly from the factory. If this adjustment is not correct the solenoid will not transfer the gases correctly. The solenoid is adjusted correctly when there is no cross flow or leakage between the open and closed positions and a proper amount is injected per sample.

NOTE: User will have to transfer the electrical connector and the plastic fittings from the old solenoid to the new one.

D. Tubing

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

The thick black rubber tubing is automotive grade high vacuum/pressure Goodyear tubing part number 65113. It is available from Auto Zone or just about any other auto parts store. This tubing has excellent temperature, characteristics and resists kinking on hard corners. This dark black tubing is shown in the pneumatic diagram as a heavy dark black line. It is used immediately following the particulate filter, through a plastic T, and then goes to the inlet side of the sample pump and the sample line vacuum monitor port on the Brain Board. It is also used to connect the Chromatograph pump inlet to the chromatograph column and through another T connector to the chromatograph monitor port on the Brain Board.

The second type of tubing is a common 1/8" ID clear PVC tubing that can be found in just about any hardware store and can be bought for a few cents per ft. A benefit of the clear line is that it useful to observe if any contaminants or liquids have entered the system.

E. Chromatograph Column

The chromatograph column fits snuggly in the case at the upper right-hand side. It can be replaced in a matter of minutes by disconnecting one electrical cable and the input and exhaust tubing. Take care to pull the tubing straight off the connectors, because side pressure can cause the connectors to break.

F. Calibrating or adjusting the flow rate

If you want to calibrate the flow rate, get a flow meter. The best one to calibrate with is a clear plastic flowrater. It should be labeled 0 - 5 LPM. Omega Part number FL-2039.

From a console connection to the Bloodhound type in "calibrate flow" and enter.

This will put the Bloodhound into a calibration mode that will allow you to adjust the flow.

Rotate the black knob on the face of the Bloodhound clockwise to increase the flow rate. Adjust to 1LPM on the plastic flowrator using the external flow meter.

Wait until the process times out. At that time the Bloodhounds internal electronic flow meter will have been calibrated.

To manually adjust the flow rate of the Bloodhound, set register 10 to a pump power number from 1 – 200. This will set the sample pump percent motor power level and at the same time override the Bloodhounds flowmeter. The Bloodhound will not be able to automatically adjust the flow rate when register 10 is set to anything other than 0.

NOTE: The value you set in register 10 should be double the expected pump power (i.e. to set the pump at 75% you would set register 10 to 150)

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7. THE BLOODHOUND CHROMATOGRAPH SYSTEM

A. Control of the Bloodhound Chromatograph System

The control of the Bloodhound chromatograph system is through 2 registers and the control knob.

Register 15

Register 15 is the number in minutes between injection of samples. Typically all Enhanced Series Bloodhounds can be set to 5, 8, or 13 minutes. Changing the number of minutes that the chromatograph will run before it begins a new run will adjust the expected results (6 minutes will stop at C3, 8 minutes will stop at C4, 13 minutes will stop at C5). When this time expires, the Bloodhound will start another chromatograph injection and cycle. Setting the column temperature to a higher level will allow for the separations to transfer through the column at a faster pace which will allow the user to reduce this injection timing but may lose the C1-C2 separation.

NOTE: The number of minutes can be seen on the LCD screen at bottom right labeled CGT followed by a number representing the minutes in seconds as a countdown.

Register 18

Register 18 is the maximum number of seconds to inject the sample into the chromatograph column. Typically set to 5 and should not be set greater than 10. This timer is automatically adjusted on the fly by the Brain Board in order to keep from saturating the column with sample gas and causing distortions in the separations.

Column Temperature

When turning the control knob, one of the options displayed is column temperature. Typically, the temperature is set to around 120 to 190 degrees F. The user has the ability to adjust this temperature to compensate for the degradation of the column over time or to adjust the performance characteristics of the chromatograph system. **Do not set the column temperature over 220 degrees F.** Internally there is a thermal fuse that is preset to operate at 240 degrees F. The closer the user sets the column temperature to this level, the more likely this fuse will open and the column will become useless because it will not be able to hold temperature. If the thermal fuse opens, the protective insulation must be peeled off and the thermal fuse replaced. The thermal fuse is provided to keep the column from overheating in case of a controller failure.

NOTE: If the user changes the column temperature, it is highly recommended that chromatograph be calibrated as the Bloodhound employs a slope peak detector and peak timing for high accuracy. Changing the temperature changes the elution time of the gasses and therefore changes both of these sampled characteristics.

B. Calibration of the Bloodhound Chromatograph System

If the temperature of the column is changed to a higher or lower temperature, the user must recalibrate the Bloodhound chromatograph system in order to maintain accuracy. To calibrate the Bloodhound chromatograph system the user will need a recirculation bag and a tank of calibration gas. The calibration gas is a 5- or 7-part mixture consisting of equal parts of methane, ethane, propane, iso-butane, normal butane, iso-pentane and normal pentane. These gases are typically supplied as a 5- or 7-part mixture containing 1% of each with the remainder nitrogen.

To prepare to calibrate the chromatograph, make recirculation bag, which is a Ziploc bag with two (2) pieces of clear PVC tubing taped into the lower corners. This type of bag allows for the calibration gas to continuously recirculate through the Bloodhound system for calibration and testing. To construct a recirculation bag, obtain a 1-gallon Ziploc bag and cut off the two bottom corners. Obtain 2 pieces of clear PVC tubing from a hardware supply house. One piece of clear PVC tubing 1/2" ID and the other 1/4" ID. Tape these pieces of tubing into the corners of the bag, and (temporarily} put tape on the end of the ¼" tube. Squeeze air out of the bag.

Connect the regulator from a tank of 5- or 7-part calibration gas bottle to the Ziploc baggie and fill the baggie with the 5 or 7 part calibration gas and then move to the Bloodhound.

Attach the calibration gas bag 1/4" ID hose to the 1/4" Bloodhound inlet connector hose for at least 30 seconds then connect the ½" ID hose from the bag to the 1/2" exhaust port. The calibration gas is now being recirculated from the exhaust port, through the bag, and into the sample port in a closed loop system. This technique conserves calibration gas.

Monitor the chromatograph output using the gas charting software. The output should look something like the CG output picture on page 24. Adjust the column temperature until the desired performance of the chromatograph is achieved. Keep in mind that natural gas is mostly methane. If you increase the column temperature too much, the C1 and C2 peaks will merge when raw natural gas is present. Set the injection timing to capture the 5- or 7-part calibration gas peaks.

The Bloodhound can be calibrated using 5 part or 7 part calibration gas. The parts must be at least 0.75% in a nitrogen balance. If the Bloodhound sees 5 peaks, it will calibrate using 5 parts. If the Bloodhound sees 7 peaks, it will be calibrated for 7 parts. The following picture is for 7 part calibration gas.
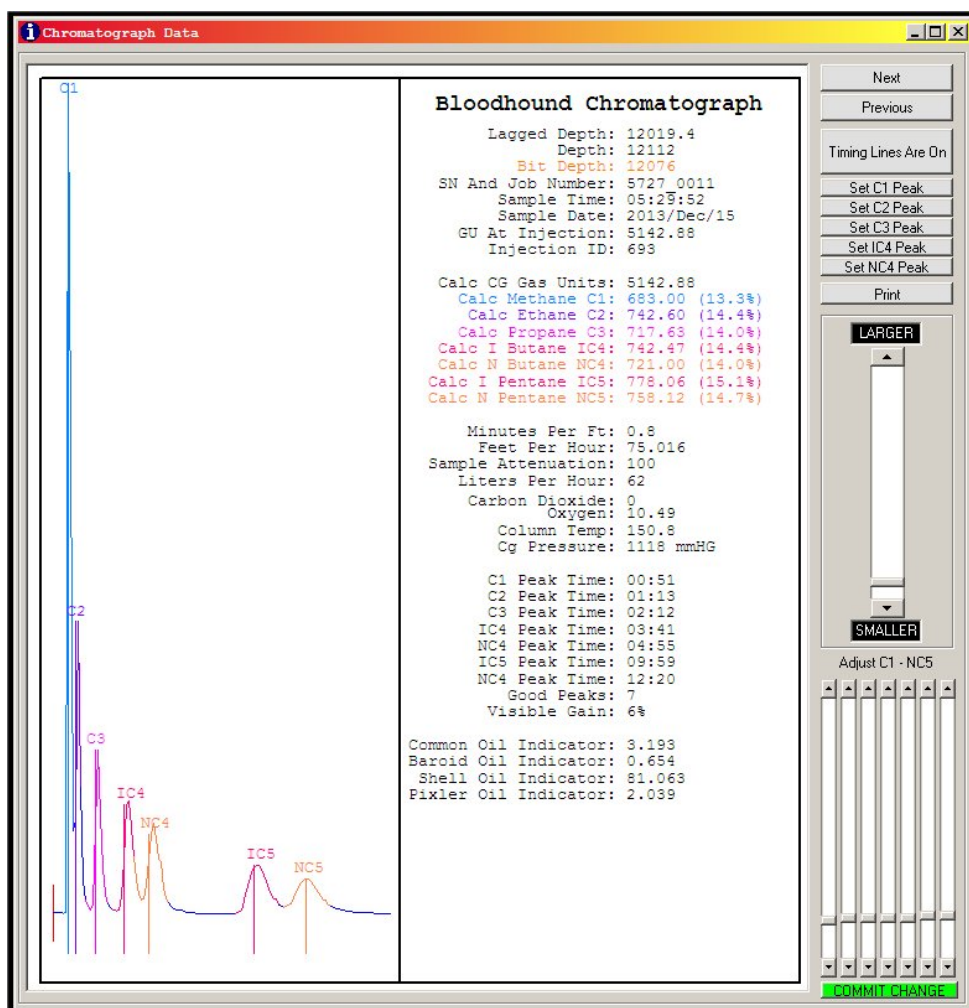

Example of C1-C5 setup.

When the output of the chromatograph is as desired, start the automatic calibration cycle by adjusting the knob until "START CG CALIBRATION CYCLE" is seen and press the MUTE/ENTER button. A countdown will begin on the display showing how long it will be until gases from the previous chromatograph cycle clear out, so that

the calibration cycle can start. When the calibration cycle is complete, the unit will be calibrated and the 5 part gases will show equal gas units using the gas charting program.

Leave the bag connected for additional cycles if you wish to check the calibration.

C. Viewing Chromatograph Output

Double left clicking on the right side of the chart will bring up a select tool that changes color and is "stuck" to the tip of the cursor. Also at the tip of the cursor is a green information box that displays the time in minutes. If the cursor goes to the left of the depth marks, the green information box displays the depth. This is useful in selecting a range of feet or minutes of data. By double clicking on a second point on the Gas Chart, you have just selected a range of data, and the Select Items Box will appear.
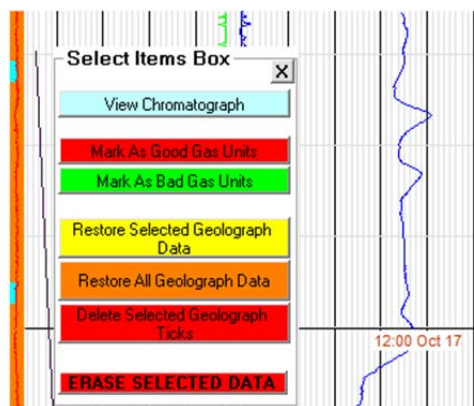
View Chromatograph button allows the user to see a close-up view of the selected chromatograph output (see picture of Chromatograph Data window above). Left clicking and holding on the chromatogram will allow the user to adjust the trace up and down on the display window. When the user is satisfied with the display, a print can be made of the chromatogram.

The peak timing lines are shown as heavy-colored overlays on the chromatograph curve. Each time-window is centered on its associated vertical line.

The data for the particular chromatogram is available to the right of the chromatogram (see Chromatograph Data window picture above). If any peak timing is off, or incorrectly labeled, then all the user must do is click on the Set Cx Peak button, place the cross hairs over the correct peak, and DOUBLE CLICK on the peak to set the new timing window for that component.

To view other chromat injections, hit the Previous and Next buttons.

8. COMMAND LINE INTERFACE

The Bloodhound can be controlled, calibrated, programmed, and set up using a command line interface. To interface with the Bloodhound, connect to the USB B-type connector on the side of the Bloodhound to an available USB A-type connector on your computer (do not connect the Bloodhound to a USB hub). Alternately, you can also use a PC DB9 Male to DB9 Female serial cable from an available male DB9 serial port of user's computer to the Female DB9 found on the side of the Bloodhound.

NOTE: If a USB cable is used to connect the Bloodhound to a PC, the USB driver must be loaded first. This driver can be found on the USB key supplied with the unit or can be found at www.iballinst.com/downloads. When you install the latest version of Gas Chart the USB Driver automatically downloads with it. The install file is located in the same directory location at the default data directory DB_CUE.

To communicate directly to the Bloodhound, you can send commands from the Gas Charting software, Real Time Data Viewer, and directly on the Bloodhound using the control knob or buttons.

Commands sent to the Bloodhound must be in the following format:

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 are typing, you must enter the command

The commands available are:

SETREG	READREG	VER	HOBBS	REBOOT
STATUS	CALIBRATE	SETTIME	WRITEETIME	SETJOBNUM
ECHO	LINK	SETPACKETNUM	GEOHIT	SETDEPTH
CGTEMP	CGSAMPLE	MUTE	?	SHUTDOWN

SETREG
All functions of the Bloodhound are controlled using register settings. Registers are small points of nonvolatile memory that hold information critical to the operation of the Bloodhound. The register command to change a register value starts with the SETREG command followed with the register number to be changed and then lastly with the value to be stored. Register numbers are from 0 to 32767 and the register values range from 0 to 255. The common registers used are from 0 to 255 with many not listed or used for nonvolatile storage and should not be modified unless directed by a representative.

To set a register to a different value type in the command:
Setreg 10 0[ENTER]

Bloodhound Response:
Register 10 is 0

The Bloodhound will respond with a report of what the registers new contents are in the Real Time Data Window in the raw text box at bottom (yellow text). It is good practice to read a register before setting it. Once you change the value you can then read it again to confirm the change went into effect.

READREG
To read a register from the Bloodhound, enter the command readreg followed by the register number to read.

To read a register enter the following command:
Readreg 10 [ENTER]

Bloodhound Response:
Register 10 is 0

The results of the READREG command will be shown on the Real Time Data window in the raw text at bottom (yellow text).

VER
This command returns the version of the software load.

To check the software version load enter the following command:
Ver [ENTER]

Bloodhound Response:
iBall Firmware V68
Boot Loader V24

REBOOT
This command performs a soft reboot on the Bloodhound.

Reboot [ENTER]

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.

Status [ENTER]

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

CALIBRATE 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 sensors for the sample vacuum, chromatograph pressure, and the Exhaust pressure sensor, first shutdown the sample pump and the chromatograph pump by using the SHUTDOWN command.   Once pressure has bled off the Chromat pump then you can enter the CALIBRATE VAC command and press [ENTER]. After a few seconds, hit the [ENTER] key again to return to normal operations. To bring both pumps back up enter the SHUTDOWN command again. After calibration, the vacuum level will be somewhere between -6 and up.   It will not show zero. This is to compensate for tubing length.

NOTE: Before running the CALIBRATE VAC command first try to power down the Bloodhound with the poly flow line off the Bloodhound. This is an easy way to calibrate the vac sensor in most cases. Pull poly line off before the power down and leave off for a few to breathe open air. Take note of the vac reading and then put poly line back on.

To calibrate the flow, connect a clear plastic flow meter to the sample port. The flow meter should be able to read between 0 and 5 liters per minute (LPM). Since the Bloodhound is drawing a vacuum, connect the tubing to the top of the flow meter. 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 on the plastic flow meter. Wait for the function to time out and the calibration will be set.

SETTIME
To remotely set the time or date you can, enter the commands as described below or you can use the menu on the LCD of the Bloodhound.

Settime [ENTER]

The Bloodhound will respond with the following string;

Current time is: Sun 2022 Apr 02 09:36:12

The available values for the SETTIME command are as follows:

HOURS, MINUTES, SECONDS, DAY, DATE, MONTH, YEAR

Only 2 digits allowed for all values

The following is an example of setting the hours.

Settime hours 14

The Bloodhound will respond with the new date

Current time is: Sun 2022 Apr 02 14:36:12

NOTE: Please use the 24-hour time format

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 inside the Bloodhound.

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 cellular wireless 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.

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

GEOHIT [ENTER]

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

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

Setdepth [ENTER]
DRL DEPTH IS: 2813.00

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

Setdepth 2800 [ENTER]
DRL DEPTH IS: 2800.00

CGTEMP
This command will allow the user to set the column temperature remotely or through the console. To use just enter the command with the desired temperature to run the column at.

NOTE: Do not generally run the column over 220 degrees F. There is a thermal fuse set at 240 degrees F. Each column has been calibrated at its own temperature and each one will vary. To see the temp it was calibrated at a Chromatograph printout is sent with each unit in the pouch. It is uncommon to have to change chromatograph temps in the field.

CGTEMP 150 [ENTER]

CGSAMPLE
This is also a troubleshooting command. When issuing this command, the Bloodhound will automatically restart a chromatograph cycle no matter where it is in the chromatograph timing. This command is used to help calibrate and troubleshoot the chromatograph.

CGASMPLE [ENTER]

WRITETIME

This command is used to individually set the timing of the CG center point (peak), in seconds.

Writetime C1 70 [ENTER]

This example would set the peak timing for C1 to 70 seconds

MUTE
The mute command will allow the remote user to silence, turn off, or turn on 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.

? Command

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

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]
Pkt 187889

SETPACKETNUM 100 SET [ENTER]
Pkt 100

HOBBS
This is an internal timer that keeps track of the number of hours that the unit has been running since first power up and since it was last serviced. HOBBS USE shows the user how many hours since it was last serviced, HOBBS shows total number of hours in operation since build.

HOBBS [ENTER]

HOBBS USE: 968 Hours
HOBBS: 1118 Hours

NOTE: When a HOBBS meter hits 4000 hours the Bloodhound will give an Unknown Alarm. The 4000-hour threshold is a known preventative maintenance window. Tech Support will be able to roll the meter back to finish the well. At 5000 hours the Bloodhound will go into shutdown mode.

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 iballremote.com 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 the USB memory stick and copies the last well to OLD_DATA.IBD.

To view the job number, you can look on the display of the Bloodhound or open Real Time Data window at the top you will see the unit number followed by current job number (59XX_0200)

SETJOBNUM [ENTER]
JOB NUMBER IS: 106

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

SETJOBNUM 1223 SET [ENTER]
JOB NUMBER IS: 1223

And the job number will be set. Verify on LCD display of Bloodhound or in Real Time Data Window.

NOTE: Job numbers can be set from 0000 to 9999.

SHUTDOWN

Entering this command will make the Bloodhound enter a shutdown mode. What this does is shut down the Total gas sample pump and the Chromatograph pump. This command is used when the Bloodhound is not being used in the field and troubleshooting. 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 enter and exit the shutdown mode, just enter the command again.

SHUTDOWN [ENTER]
Unit entering shutdown mode

SHUTDOWN [ENTER]
Unit exiting shutdown mode

9. 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 bits of information held in non-volatile memory locations that dictate how the Bloodhound operates. There are 255 registers that hold a number value from 0 to 255. All operational settings are made through register values. 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.

NOTE: To effectively set up and operate the Bloodhound, the registers must be set correctly. Failure to do so will cause undetermined results. Do not set register values unless you know what the results will be. Incorrect register settings may cause the Bloodhound to have undesired results or become unstable or even unusable. 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 settings and changes can be made through the LCD menu on the Bloodhound, via the Gas Charting software, or via Real Time Data Utility.

A. WAYS TO MODIFY REGISTERS

1. **On the bloodhound LCD menu:** Pressing the Up and Down Arrow keys at the same time will bring up a 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 check and/or adjust a register setting select the REGISTER SETUP menu option and press Enter/Mute button., Press up/down keys to scroll to register of interest (registers 1 through 6 and 8 are not available in this way). Once on the desired register, press Enter/Mute to move to value, press up/down to desired value and press Enter/Mute to set that value. LCD will timeout after 30 seconds and go back to main screen or you can press Start/Stop.

2. **Gas Chart software on a computer directly connected to the Bloodhound:** Right click on the chart to bring up the CONTROL PANEL.

   Click on REAL TIME DATA to bring up the real time data window and move it out of the way.

   On the CONTROL PANEL, click the SETUP BUTTON, then on BLOODHOUND tab.

   To read a register, type READREG ## (where ## is the register number) in the SEND BLOODHOUND COMMAND window and click on the SEND button.

The result of the query will appear at the bottom of the REAL TIME DATA window, in the communications stream from the Bloodhound.

To set a register, type SETREG ## (where ## is the number to put in the register) in the SEND BLOODHOUND COMMAND window and click on the SEND button.

The result of the change will appear at the bottom of the REAL TIME DATA window, in the communications stream from the Bloodhound.

10. REGSITER LIST

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
9	Total Gas Calibration Mode	Binary Switch	0=Standard Mode 1=Enhanced Mode	1	This register will put Bloodhound in standard or enhanced mode and should be used in conjunction with register 36 (Any other explanation you want to add?)
10	SUCTION PUMP MANUAL SETTING (Flow meter override)		0-199	0	This register is used to set the pump to a static level in case the electronic flow meter fails. If this register is not zero, then the BH takes this number and forces the sample gas pump to stay at this power level. Register value should be double the desired pump speed. (ex. To set sample pump to 75% set register 10 to 150) If this register is set to 0 then the BH uses feedback from the electronic flow meter to regulate the speed of the suction pump.
11	Flow meter regulated flow rate	Liters per Hour (LPH)	1-255	60	Sets the flow in LPH, that the BH will regulate to. The BH takes readings from the electronic flow meter and regulates its sample gas pump and flow rate. If this register is set to 255, the sample gas motor is turned all the way on.
12	Gas readings out to WITS	Binary Switch	0=Off 1=On	1	If this register is 1 then the BH will send gas readings to the WITS interface after a good connection is made to the WITS interface. If this register is 0 the BH will NOT send any gas readings out the WITS interface but will continue sending the null packet to keep the connection going.
15	Chromat Injection Timing	MIN	5-13	13	Number of minutes chromat runs before collecting a new sample and starting over. When this time expires, the BH will start another chromatograph injection and cycle. Setting the column temperature to a higher level will allow for the separations to transfer through the column at a faster pace which will allow the user to reduce this injection timing but may lose the C1 C2 separation. 13 stops at C5 8 stops at C4 6 stops at C3
16	Data Record Timing Or Cooling Fan?	SEC		6	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.
17	Timed Geolograph Foot Increment	MIN	0=Off 1-255=Minutes between ticks	0	This can be used in a situation where there is no WITS interface or Geolograph switch and there is a need to tick a foot at a timed interval (in minutes) rather than with footage. A depth record can be generated and consequently an LAS file can be generated that shows gas data over time rather than depth. NOTE: This will not roll the depth counter.
18	Chromat Injection Duration	SEC	1-10	5	Maximum number of seconds to inject the sample into the chromatograph column. Typically set to 5 and should not be set greater than 10. This timer is automatically adjusted on the fly in order to keep from saturating the column with sample gas and causing distortions in the separations.

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
22	GAS READING DAMPING (low range)	Arbitrary	1-120	5	This register sets the low range damping number. This is the number of samples that is used in order to slow or speed up the response curve of the gas units output. This also changes the points in which the "changeover" between the low range and high range occurs. A larger number will give an overall smaller absolute number on the high range. A smaller number will give an overall larger number on the high range. Setting this register higher will make the output more sluggish. Setting it lower will allow for a faster response. Not the same as averaging.
25	GEOLOGRAPH DEBOUNCE TIMER	SEC	1-120+	10	The Geolograph 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.
26	WITS OUTPUT GAS UNITS DIVISOR		Either 1 or 100	100	When sending total gas out to an EDR via WITS, this will be the divisor for the gas units value. (i.e., a setting of 100 outputs gas units ÷ 100 and a setting of 1 outputs gas units ÷ 1). Do not set to 0. This can be set to whatever the WITS system is using.
27	Last time clean power down flag	Binary Indicator	0=clean 1=not clean	1	If the last time it powered down was clean this register will be 0. A clean power down is where the power plug is pulled and the power off button was hit to finish the normal power down cycle. A clean power down can also be logged with the Bloodhound is shutdown via knob function. If the register is set to 1, the prior power down was not intended like in the case of lost rig power.
28	Low and High gas detector independence	Binary Switch	0=Joined Ranges 1=Independent ranges	0	IR independence register. This register sets up the way the high range and low range interact. If this register is set to 0 then the IR ranges 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. This attaches the high point of the low range calibration to the low point of the high range calibration to help calculate the new response curve. If this register is 1 then the IR sensors 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 wherever it is at on the gas level concentration. This usually shows up as abnormally large high range gas units. The Bloodhound enters this mode and cancels the dampening when in calibration mode. Setting this register to 1 will basically show the calibration points when the calibration gas is injected.
29	Power down timer	MIN	1-120	120	This is the number of minutes before power down is initiated when running on battery after the AC power was lost.
30	Total Gas Attenuation	Percent	1-200	100	This is a percentage of the calibrated output - It has the same effect as air dilution. 100 = 100% output, 50 = 50% output, and so on.
32	Feet Logged per Geolograph Tick	Feet	1-20	1	This is the number of feet incremented per Geolograph contact closure.
33	Geolograph noise spike count alarm level	Incidents	0=Disabled 1-255=Number of spikes before alarm	180	If there are noise spikes on the Geolograph line and the spike count is greater than this number, then the Bloodhound will alarm with a noisy Geolograph alarm. If set to 0 this alarm is disabled.

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
34	Geolograph foot tick chirp duration	milli-seconds	0=Disabled 1-255=Number of ms to hold alarm	0	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.
36	High Gas Range Attenuation	Arbitrary	1=200	30=Standar Mode 80=Enhanced Mode	Same as register 30 but it only impacts the high range scale. This is additive to the value stored in register 30. Output = ((adjusted low range) + (corrected and adjusted high range) x (reg36/100))) x (reg 30/100) When using register 9 to set the mode, when reg 9 is 1 then reg 36 must be 80, when reg 9 is 0 then reg 36 must be 0.
37	High Amps Alarm on 12V Cavitator terminals	Amperage	0=Disabled 1-12=Amps over	5	This is the threshold over which amperage draw on the DC port should raise an alarm condition. If set to 1 thru 12 this will set the amps over which the alarm should be raised. Set to 0 to disable alarm. 60 second average
39	Low Amps Alarm	Binary Switch	0=Off 1=On	1	This is the threshold under which amperage draw should raise alarm.
41	H2S sensor Defeat	Ternary	0=Off 1=On 255=Always on	0	This will turn on or off the H2s sensor. Default is Off. If set to 1 (on) every time the Bloodhound power is cycled this register is reset to 0 to default to the "off" position. If Register 41 is set to255 the H2S sensor will remain on after a power cycle of the Bloodhound.
42	O2 Sensor Defeat	Binary Switch	0=Off 1=On	1	If this register is set to 0 then the O2sensor is effectively off and will read zero. Also, the LCD screen will show OFF instead of a percent number and the WITS packet 1225 will not be sent out the WITS interface. The Off setting will persist through power down events.
43	CO2 Sensor Defeat	Binary Switch	0=Off 1=On	1	If this register is set to 0 then the CO2 sensor is effectively off and will read 0, also the LCD screen will show OFF instead of a percent number and the WITS packet 1222 will not be sent out the WITS interface The Off setting will persist through power down events.
45	Alarm Mute Duration	MIN	1-25	10	This value represents the number of minutes the audible portion of an alarm on the Bloodhound will remain silent after pressing the MUTE button on the faceplate. This does not remove the alarm condition, just the audible part of the alarm. Alarm conditions will continue to be shown on the LCD display, web servers, and attached Gas Chart/RTDV software. NOTE: not to exceed 25.
46	High Case Temp Alarm Threshold	Degrees/F	10-120	120	This is the threshold above which an alarm will be raised indicating an internal case temperature that is potentially too high for the Bloodhound to operate optimally and without potential damage.
47	Low Case Temp Alarm Threshold	Degrees/F	10-120	35	Threshold for a case temperature below what the Bloodhound can operate optimally at.

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
50	High sample flow alarm threshold	LPH	0=alarm off 1-200=Flow rate	90	When the sample flow rate on the Bloodhounds internal electronic flow meter exceeds the value set in this register, an alarm condition will be raised indicating the sample is flowing too quickly for the Bloodhound to operate at an optimal level.
51	Low sample flow alarm threshold	LPH	0=alarm off 1-200 Flow rate	20	When the sample flow rate on the Bloodhounds internal electronic flow meter drops below the value set in this register, an alarm condition will be raised indicating the sample flow is flowing too slow.
52	High Sample Vacuum alarm threshold	-mmHg	0= alarm off 1-255 vacuum rate	200	When the vacuum sensor on the Bloodhound exceeds the value set in this register, a "Blocked Sample Line" alarm condition is raised. It is displayed on the LCD display, web server, and Gas Chart/RTDV software.
53	High gas units alarm threshold	Units/100	0=alarm off 1-100=gas units	22	High gas units alarm level / 100. This is the gas units alarm level divided by 100. So, if this is set to 10 then the alarm level is 1000 gas units. Default is set at 22 (2200 gas units).
54	Chromatograph low pressure alarm threshold	+mmHg	0= alarm off 1-255=pressure value /10	70	When the pressure in the chromatograph column (measured internally by a pressure sensor) falls below 10 times the value set in this register, a "Low CG Pressure" alarm condition is raised. Example: (70 = 700 mmHg)
55	Cellular Wireless Modem On/Off	Binary Switch	0=off 1-on	1	When you set this register value to 0, the Bloodhound will power down the internal modem. When register value is 1 the internal modem will be powered on.
56	Max H2S alarm threshold	PPM	0=alarm off 1-255=alarm ppm	50	If the H2S ppm current sensor reading exceeds the value set in this register an alarm will sound. This sensor is divided by 10, thus 50 = 500 ppm. 1 = 10 ppm alarm levels. NOTE: This register only affects the alarm threshold not the sensor. Go to Reg 41 to shut off the sensor.
57	External alarm / audible alarm On/Off switch	Binary Switch	0=On 1=Off	0	The register value controls external relay connected alarms. If set to 0, then audible alarms will be turned on for ALL alarm conditions. IF set to 1, then audible alarms will be turned off for ALL alarm conditions EXCEPT any H2S related alarm conditions.
58	Chromatograph Averaging To Eliminate Noise Floor	Arbitrary	1-35=Amt of dampening	1	If there is noise in the chromatograph sensor, the value set in this register is used to apply dampening to the origin of the curve to eliminate noise.

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
59	Debug Message Level Switch	Switch	0=debug off 1-6=debug on for various ports	0	Setting the value in this register to 0 will turn debug messages off. Setting the value to 1-6 will send debug messages over a corresponding selected port as follows: 1=PC port. This is the serial port on the PC 2=WITS port. This is the null modem port on the EDR. 3=Modem port. This is the COM port on the other end of the modem at the designated IP/Network port. 4=SB72 port. This is the Bloodhounds Ethernet port. 5=Unused currently. Same as 0 which is off. 6=HRM port. This is the internal COM port on the Bloodhounds HRM board. NOTE: To view data on these ports you need to use a system level analysis tool like HyperTerminal or similar.
61	C1 timing window before and after peak time	Seconds	1-255=seconds	6	Regarding chromatograph peaks and elution timing, this is the number of seconds before and after the "picked peak time" during which the Bloodhound will search for the real peak an establish a volume under the parabola (peak) that will be used to create a model of the gas mix in each injection. This will be a colored vertical line.
62	C2 timing window before and after peak time	Seconds	1-251-255=seconds 5	6	Regarding chromatograph peaks and elution timing, this is the number of seconds before and after the "picked peak time" during which the Bloodhound will search for the real peak an establish a volume under the parabola (peak) that will be used to create a model of the gas mix in each injection. This will be a colored vertical line.
63	C3 timing window before and after peak time	Seconds	1-2551-255=seconds	25	Regarding chromatograph peaks and elution timing, this is the number of seconds before and after the "picked peak time" during which the Bloodhound will search for the real peak an establish a volume under the parabola (peak) that will be used to create a model of the gas mix in each injection. This will be a colored vertical line.
64	IC4 timing window before and after peak time	Seconds	1-251-255=seconds 5	35	Regarding chromatograph peaks and elution timing, this is the number of seconds before and after the "picked peak time" during which the Bloodhound will search for the real peak an establish a volume under the parabola (peak) that will be used to create a model of the gas mix in each injection. This will be a colored vertical line.
65	NC4 timing window before and after peak time	Seconds	1-2551-255=seconds	40	Regarding chromatograph peaks and elution timing, this is the number of seconds before and after the "picked peak time" during which the Bloodhound will search for the real peak an establish a volume under the parabola (peak) that will be used to create a model of the gas mix in each injection. This will be a colored vertical line.
66	Chromatograph Noise Floor Level	Microvolt X100	1-30=microvolts	20 (opt. value is 5)	When looking at the Chromatograph data each peak represents a component gas. All peaks rise from an origin on that chart. The value set in this register can be thought of as an invisible line that hovers over the origin so that the natural variation or jaggedness at the origin is not falsely interpreted as a peak by the Bloodhound.
67	WITS Output Handshake Mode	Binary Switch	0=synchronous 1=Asynchronous	0	The value in this register switches the output on the Null modem port between synchronous mode (waits for a question and replies with gas data) or Asynchronous mode (sends gas data every few seconds without being asked). 0 = Send with Pason WITS handshake 1 = Send with no handshake (only for special clients who want no handshake) NOTE: (0 does work with Rigwatch & TOTCO)

REG.	FUNCTION	Units	Range	Factory Setting	DESCRIPTION
68	WITS C Value Format Switch	Binary Switch	0=units 1=ppm	0	This register value switches component gas data modes as they are sent out to an attached WITS EDR. If set at 0 the gas data will be sent in units as viewed on the Bloodhounds LCD. If set to 1, gas data will be sent as PPM.
77	No Chromatograph Run When Pumps Are Off	Binary Switch	0=on 1=off	0	Chromatograph injections will be suspended when pumps are off.
81	WiFi SSID	Binary Switch	0=Off 1=On	1	This register value controls the status of the internal cellular modems WiFi connectivity. Setting the value to 0 will disable the Bloodhounds Wifi SSID (BHXXXX). Setting the value to 1 will enable. NOTE: This applies only to the Wifi capability. Ethernet connectivity is still available.
83	Mainlog/Chevron Packet Send Switch	Binary Switch	0=Mainlog 1=Chevron	0	If running Mainlog this is used in conjunction with register 84. If this register value is set to 0, WITS to serial port will be sent all in one group as Mainlog requires. If this register value is set to 1, WITS will be grouped into standard packets for Chevron.
84	WITS Out on USB port	Binary Switch	0=gas chart 1=mainlog	0	The value in this register switches the type of data that is sent out of the Bloodhounds USB port. If set to 0, normal packet data will be sent that Gas Chart expect. If set to 1, it will send a raw WITS feed instead which Mainlog mandates.
88	WITS Out Debug	Binary Switch	0=off 1=on	0	This register can turn on and show the WITS channels and values that the Bloodhound is sending out in Real Time Data Window. NOTE: A reboot or power down of the Bloodhound will turn debug off.
150	SB72 Network Card Power Switch	Binary Switch	0=off 1=on	1	The value in the register will power on or off the Bloodhounds internal network card (SB72).
151	WITS Output Channel Shift	1000 x additive	0-8=1000 x wits	0	The value in this register is multiplied by 1000 and added to the wits channels sent from the Bloodhound to the wits system over the Null Modem connection. This is used when there is more than one gas detector on site and conflicts arise when both try to use the same industry standard gas channels. Example: Normally gas channels are sent on 0140, 0139, 1212, 1213, 1214 etc. Setting the value to 2 would send them as 2140, 2139, 3212, 3213, 3214 etc.

11. DATA INFORMATION, STORAGE AND TRANSMISSION

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. The packet is broken into fields that are separated by commas. An example of the main data packet that is transmitted is as follows:

```
*5727_0011,2013/12/15,10:14:44,12404.6,3703.08,13.52,0.00,100,93.7,0.746,80.393,6
0,-18,13.2,4.095,1.725,711,0.7114322,0.382,0.00,12
,21,100,121.5,60,0.0,97.4,1124,2688658,409.47,515.28,531.41,589.42,517.47,-
8,151.3,12313.1,1070,612.84,529.03,C205,
```

A Bloodhound Minimum Data Packet is always sent internally to the SD card and the USB memory stick, if installed, for storage.

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 capitol C before the ASCII number such as "C91". 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 "^" then it is a WITS data packet information.
If the packet starts with a "@" then it is a Bloodhound minimum data only packet.

The descriptions of the data packets are as follows.

A. 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 99999.9
5	Gas Units	Float	Gas units 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	Chromatograph Test #	UInt	0 to 65536
18	Chromatograph VDC	Float	0.00000 to 8.2000 VDC
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	Chromatograph Press	Float	1500.0 to –1500.00 mmHg
29	Packet number	ULong	0 to 4,000,000,000
30	C1 Gas Units	Float	0.00 to 10000.00
31	C2 Gas Units	Float	0.00 to 10000.00
32	C3 Gas Units	Float	0.00 to 10000.00
33	IC4 Gas Units	Float	0.00 to 10000.00
34	NC4 Gas Units	Float	0.00 to 10000.00
35	Exhaust Pressure	Float	-200 to +800 (mmHg)
36	Column Temperature	Float	0.00 to 500.00
37	Lag Depth	Float	0 - 40000.0
38	HOBBS use in hours	Long	0 - 2,000,000,000
39	Iso Pentane	Float	0.00 - 10000.00
40	Normal Pentane	Float	0.00 - 10000.00
41	8 Bit Checksum	Byte	0 – 255

NOTES: The packet number always increments by one (1) 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. Chromatograph test number will roll over at 65536. The last comma delineated item is the simple checksum, it will always have a C preceding the ASCII 8 bit number.

12. Bloodhound ERROR Number Codes In the Error Field

In the Bloodhound packet, one of the fields is for error (condition) number codes. This number(s) represents the current condition or conditions and notification of instance that needs to take place such as a blocked sample line. Below is a table that shows the currently transmitted conditions and the corresponding error (condition) code number. More than one condition can be present, and if so, are separated by a space.

Condition	Code	Associated Bloodhound Register Setting
No Alarm	0	
Blocked Sample Line	2	Reg 52: factory setting 200 (means –200 mmHg)
Detector High Voltage	3	No register setting - Automatic from HRM
Detector Voltage Low	4	No register setting - Automatic from HRM *(if Primary & Secondary voltage = 0.010 detector is inoperable due to flooding or internal connection issues)*
High Flow Rate	5	Reg 50: factory setting 90 LPH
Low Flow Rate	6	Reg 51: factory setting 20 LPH
Low Power Voltage	7	Set at 11.1 VDC No register setting (AC power lost)
High Amps at Cavitator Conn.	9	Reg 37: factory setting 5 (60-sec average)
High Temperature in Case	10	Reg 46: factory setting 120 degrees F
Low Temperature in Case	11	Reg 47: factory setting 35 degrees F
High Gas Units	12	Reg 53: factory setting 22 (means 2200 units)
HRM Warming Up	13	Unit is warming up
Unit In Shutdown Mode	14	No register settings
Geolograph Switch Noise	15	Reg 33: factory setting 180 spikes
CG Low Pressure	16	Reg 54: factory setting 70 (means 700 mmHg)
High H2S Reading	17	Reg 56: factory setting 50
Exhaust Blocked (high ex prs)	18	Set to 50 mmHg - No register setting
Low DC port amps	19	If the Cavitator is disconnected
Service is required	20	The Bloodhound will require service
Flooded	21	The water detector has detected water in the inlet (if water detector is installed in unit)
Flood override	22	Water has entered the system and service technicians have overridden the warning
Overhaul	255	Permanent electronics failure, service required

13. 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_0107,2008/04/20,13:11:13,189092,01082000.4,01102000.4,0112294.1,01130.0,01
15303.9,01177.9,011911.7,012069.3,01213301.7,0122-
0.2,0123110.8,012477.6,012596.0,0126669.0,0127-3.0,012840.0,
0130396.7,0137213292.0,014011.0,0142584285.1,01436334.5,0144206959.0,01450.0,0150
584285.1,
```

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 Data Types are as follows:

0108 Bit Depth	0110 Hole Depth	0111 True Vert Depth
0112 Block Height	0113 On Bottom ROP F/H	0114 Hook Load
0115 Hook Load	0116 Weight On Bit	0117 Weight On Bit
0118 Rotary Torque	0119 Rotary Torque	0120 Rotary RPM
0121 Standpipe Pressure	0122 Casing Pressure	0123 Pump 1 Strokes Per Min
0124 Pump 2 Strokes Per Min	0125 Pump 3 Strokes Per Min	0126 Total Mud Volume
0127 PVTTotal Mud Gain/Loss	0128 Flow	0130 Total Pump Output
0137 Total Strokes Sum	0139 WITS Lag Calc	0140 WITS Gas
0141 H2S	0142 TotalPumpDisplacement	0143 Pump 1 Total Strokes
0144 Pump 2 Total Strokes	0145 Pump 3 Total Strokes	0150 TotalPumpDisplacement
0408 Bit Depth	0410 Hole Depth	0414 Standpipe Pressure
0713 Inclination	0715 Azimuth	0716 Magnetic Toolface
0717 Gravity Toolface	0722 Toolface Threshold	0813 Resistivity 1 Lag Calc
0816 Resistivity 1	0817 Resistivity 2 Lag Calc	0820 Resistivity 2
0821 Gamma Lag Calc	0824 Gamma	0829 Porosity 1 Lag Calc
0831 Porosity 1	0832 Porosity 2 Lag Calc	0834 Porosity 2
0839 FormationDenLagCalc	0841 Formation Density	0913 Downhole Pressure
1108 Hole Depth	1110 Total Mud Volume	1111 Total Mud Volume
1115 Mud Tank Volume 1	1116 Mud Tank Volume 2	1117 Mud Tank Volume 3
1118 Mud Tank Volume 4	1119 Mud Tank Volume 5	1120 Mud Tank Volume 6
1121 Mud Tank Volume 7	1122 Mud Tank Volume 8	1129 Trip Tank Mud Volume
1212 Methane C1	1213 Ethane C2	1214 Propane C3
1215 Iso Butane IC4	1216 Normal Butane NC4	1217 Iso Pentane IC5
1218 Normal Pentane NC5	1219 Neo Pentane NC5	1220 Iso Hexane IC6
1221 Normal Hexane NC6	1222 Carbon Dioxide CO2	1223 Acetylene

1225 Oxygen O2	1226 Gas Specific Gravity	1705 Cement Date
1706 Cement Time	1712 Cement Pump Pressure	1716 Cement Slurry Rate
1719 Slurry Density	1724 Event Number	1728 Cement Stage Volume
1734 Cement Water Rate	1735 Annulus Pressure	1736 Nitrogen Rate
1815 Nitrogen Pressure In	1816 UBD Flow Pressure	1817 UBD Flow Temp
1818 Down Hole Pressure 1	1819 Down Hole Temp	1820 Condensate Out
1821 Hydrocarbon Flow	1826 H2S	1827 Nitrogen Volume In
1828 Total Gas Return	1829 Nitrogen Volume Out	1830 Water Out
1831 Water Nozzle	1984 System Info	6310 Magnetic Toolface
6311 Gravity Toolface	6339 Magnetic Toolface	6340 Gravity Toolface

A. Bloodhound Data Sent Out to Electronic Drilling Recorder (EDR) via WITS

The Bloodhound is set up to send a packet out to the EDR via WITS every 6 seconds. This is done through either the 9-pin male serial connector at 9600 baud (8N1) or through the Pason 10 pin military style connector.

If Register 67 is zero, a Pason Handshake is sent. If Register 12 is not zero then the Bloodhound will attempt to send total gas to the WITS interface after a good connection is made to the WITS interface using the null packet. If Register 12 is zero, the Bloodhound will not send the gas readings out the WITS interface - all it will do is send the null packet to keep the connection going.

The packets the Bloodhound sends out to WITS, in order, are:

0140 –Total Gas (if Register 12 is not zero). The Total Gas value sent is divided by the number in Register 26.
1212 – C1   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1213 – C2   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1214 – C3   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1215 – iC4   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1216 – nC4   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1217 – IC5   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1218 – NC5   if Register 68 is 0, sent as Gas Units. If Register 68 is 1, sent as parts per million (PPM).
1222 – CO_2
1225 – O_2
1826 – H_2S
0138 – Lag Strokes (if PC connected)
0139 – Lag Depth (If PC connected)

Following is a sample transmission from the Bloodhound out to WITS:

```
&&
01400.0000
12120.00
12130.00
12140.00
12150.00
12160.00
12170.00
12180.00
12220.00
122520.92
18260.00
0138280
013914832
!!
```

B. The Bloodhound rs422 Pason interface specifications overview

In order to communicate to the Pason Electronic Drilling Recorder (EDR) system without the hassle of any external hardware, iBall has incorporated a Pason RS422 connection interface into the Bloodhound. This allows for direct connection to the Pason EDR system to obtain duplex WITS communication.

Generally, no user intervention is necessary on the Bloodhound to access the Pason WITS information when using this connection. After connecting the 10-pin round military type cabling to the Bloodhound from the Pason EDR system, the Bloodhound automatically establishes communicates to the Pason system and starts acquiring and sending WITS data.

NOTE: On sites with a Pason EDR system, just because the Pason cable can fit into a connector found on the site does not mean that the connection will work. Pason advises to always connect the Bloodhound to the Toolpush Connection Panel on the outside of the Rig Manager's trailer, or, if that is not present, then to the Toolpush Computer itself via one of the cables attached to it. (In the event that Pason does not have somewhere to mount the Toolpush Connection Panel, they leave cables extending outside of the Rig Manager's trailer with the RS422 connectors accessible. In that case, they are simply cable ends, so are not labelled.) Always connecting to the Toolpush Connection Panel or the Toolpush Computer will ensure that the proper connection is made and the TPC will not require any configuration change to receive WITS.

Communication Hardware

The Bloodhound system has integrated an improved and electrically isolated RS-422 interface that directly connects to the Pason EDR system utilizing the common Pason 10 pin interface cabling system.

Improvements include the addition of input current limiting resistors, over/under voltage protection diodes, isolated grounding, and a 500-volt electrical isolation barrier between the external interface and the internal electronics.

Communication Specifics

American national standard ANSI/TIA/EIA-422-B (formerly RS-422) and its international equivalent ITU-T Recommendation V.11 (also known as X.27), are technical standards that specify the "electrical characteristics of the balanced voltage digital interface circuit". It provides for data transmission, using balanced or differential signaling, with unidirectional/non-reversible, generally resistively balanced and terminated transmission lines, point to point, or multi-drop communication systems. In contrast to EIA-485 (which is multi-point instead of multi-drop), EIA-422/V.11 does not allow multiple drivers but only multiple receivers. Pason only uses the interface as a point-to-point wiring system between a central communications hub and a distal communications device.

The current title of the ANSI standard is "TIA-422 Electrical Characteristics of Balanced Voltage Differential Interface Circuits" and is now in revision B, published in May 1994, and was reaffirmed by the Telecommunications Industry Association in 2005.

Several key advantages offered by this standard include a differential receiver, a differential driver, and with correct load balancing, data rates as high as 10 mega baud at 12 meters (40 ft). Several key disadvantages with the Pason implementation of the RS-422 interface is, high cost of the physical cabling, the absence of any electrical isolation between nodes and the central communications point, inducted noise accumulated from parallel high voltage power lines, and the physical damage to the cabling caused by heavy equipment and common rig ground traffic.

EIA-422 (RS-422) only specifies the electrical signaling characteristics of a single balanced signal. Protocols and pin assignments are defined in other specifications. The mechanical connections for this interface are specified by EIA-530 (DB-25 connector) or EIA-449 (DC-37 connector), however common minimal devices exist which have 4 screw-posts to implement the transmit and receive pair only.

When used in relation to communications wiring, RS-422 wiring refers to cable made of 2 sets of twisted pair, often with each pair being shielded, and a ground wire. While a double pair cable such as common telephone

cabling may be practical for many RS-422 applications, the RS-422 specification only defines one signal path and does not assign any function to it.

The Pason RS-422 interface for external devices uses a 10-pin round military connector with 4 pins and 4 conductors called out and a common ground pin between the proximal and distal connections. Electrical isolation is not present at the proximal end but is expected to have minimal over, under and electrical spike protection only and is not hardened to current proposed lightning electrical models. This probably is the reason behind the high number of electrical interface failures and dead ports after lightning strike scenarios.

Using the common and specified 0-5VDC bi-directional electrical methods, the maximum practical cable length is 1200 meters with no minimal length. With proper cable twist and shielding, maximum data rates are 10 Mbit/s at 12 m or 100 kbit/s at 1200 meters. Even though EIA-422 and EIA-485 share the same electrical interface hardware, the EIA-422 communications standard cannot implement a truly multi-point communications network, however one driver can be connected to up to ten receivers when the load is properly balanced. This is due to the fact that the communications protocol for EIA-485 contains device addresses where the protocol for EIA-422 does not.

A common use of EIA-422 is for RS-232 extenders. Pason, in effect, uses the EIA-422 interface, as a RS-232 serial device extender for all devices wishing to utilize the WITS information system.

According to Pason EDR Version 3.0+, when Pason RS-422 WITS interface is connected to distal equipment the proximal Pason equipment is generally set to AUTO. In this mode, the distal equipment is required to set up the communications baud rate, and serial data parameters to the Pason WITS system using the required WITS null packet.

This is done by the distal equipment (Bloodhound) sending the WITS packet 0111 as a null:

> **NOTE**: The WITS packet 0111 sent as a null is known as a null packet.
> Example:
> **&&[CR]**
> **0111-9999[CR]**
> **!![CR]**
> Where [CR] is a carriage return ASCII character

This packet is sent repeatedly to the proximal Pason system. When this occurs, and the distal equipment is connected to an EDR port that has not been damaged from a prior lightning event, the cabling is intact and connected at both ends, and there is no inducted noise due to close proximity high voltage power lines, the proximal port is supposed to change from AUTO to the baud rate, bit count, parity, and stop bits at which the distal equipment is transmitting.

At that time the distal equipment can maintain the connection to the proximal Pason system by changing from a null packet to general WITS packet information such as gas units or lag information. If the distal equipment does not want to send the proximal Pason system WITS information, the distal system can maintain the connection and reception of WITS information by continuing to send the null packet.

Currently, the Bloodhound system expects to communicate to the Pason EDR system at 9600 baud, 8 data bits, 1 stop bit with no parity. This can be changed remotely by IBall Instruments technicians.

C. 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 memory stick.

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	Gas Units	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	CG Test Number	Uint	0 – 65536
12	CG Volts	Float	0 – 8.2000
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

14. EXPLANATION OF FILES GENERATED BY THE BLOODHOUND

A. BH_LAS.LAS File

The Bloodhound generates an LAS file that is stored locally in the internal SD card and to the external USB memory stick if compatible and inserted. If there is not a USB memory stick 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 and the same depth drilled more than once, the depth will show up more than once.

The LAS data is saved as a comma-delimited text file. In order, the data items are:
- Drill depth **(NOT LAGGED)**
- Drill rate min/ft
- Gas units
- C1
- C2
- C3
- IC4
- NC4
- Gas units
- Gamma
- O_2
- CO_2
- H_2S
- Inclination
- Azimuth
- Year / Month / Date
- Hours : Minutes : Seconds

Example of LAS data for two feet:

```
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.

B. BH_DATA.IBD File

The second data file that can be downloaded from the Bloodhound equipment is the .IBD (iBall Data) file. It is a comma-delimited file that contains a packet of data from every 6 seconds of operation, rather from each foot.

In order, the data items are:
- @ Symbol to show the start of the packet
- Year / Month / Date
- Hours : Minutes : Seconds
- Packet number
- Drill depth **(NOT LAGGED)**
- Bit depth
- Gas units
- O_2
- CO_2
- Drill rate minutes per foot
- Chromatograph test number
- chromatograph voltage
- H_2S ppm
- Gamma
- Total strokes per minute
- Weight on bit
- Rotary RPM
- Pipe Pressure
- Inclination
- Azimuth

Example for two packets (6 seconds apart):

```
@,080419,095224,187005,2001.6,2001.6,2.47,20.98,0.68,2.367,1,0.859,0,300.3,276,8,
69,3302,210,65,
@,080419,095230,187006,2001.6,2001.6,2.86,20.97,0.66,2.367,1,0.859,0,300.3,276,8,
69,3302,210,65,
```

12. BLOODHOUND TROUBLESHOOTING TIPS

Problem	Troubleshooting Tip
How do I turn off the alarm horn?	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 (600 seconds). **Pressing the Enter/Mute key a second time defeats the audible alarm and the rolling display at the bottom right of the Bloodhound display screen will show ALARM OFF.** Pressing the Enter/Mute key a third time will display "ALARM ON". Hitting the Enter/Mute key does not turn off any alarms but rather mutes the horn for a given amount of time. **If ALARM OFF is selected, the horn will not sound.**
High Temperature Alarm triggered	It is important to bring Case and HRM temperatures down as quickly as possible. First pull off cooling air intake filter (on connection side of BH). Inspect this filter for dirt. If dirty replace filter after cool down of unit. Second try to prop up BH case to allow good air flow through bottom exhaust fan. Be sure not to block exhaust fan when propping up unit. Wait for a few minutes to see if temps start to fall. Open lid if closed. Be sure not to run unit without air intake filter.
BH not connecting to internet using Ethernet Connection	Ensure you have a good Ethernet cable. Connect Ethernet cable from side of BH to an external Rig Router open RJ45 port. Look for lights on both ends at each port. Wait for an IP address to show on BH's LCD display in data that cycles around at the bottom. The IP address displayed should be one that is pulled from the Rig network. If you do not get an IP address, try a different Ethernet cable and/or router port. You could also try to power cycle the Rig Router and maybe even the BH. Test to ensure other devices, outside of the BH can get internet access using the same Rig Router. If yes, then call iBall tech support for further troubleshooting steps.
BH not connecting to internet using Cellular Modem Connection	For the cellular wireless modem to operate for internet access an operational SIM (Subscriber ID Module) card must be inserted into the modem. All rental units will have an active SIM installed upon arrival. Owned units active SIMs is entirely up to owner. The modem is powered on and ready to use by default. In the pouch of each rental BH are 2 antennas to use for connectivity. Plug one into the antenna port on side of the BH and place other end as high up on trailer and outside of trailer as possible to get best signal. Once connected the BHs cellular wireless modem will search the area for a received signal strength indicator (RSSI). The display of the BH and RTDV will show RSSI. If unit bounces from 0% to 100% that means it is still searching. Wait for a few minutes to see if it eventually finds connectivity. It could be that you are in a dead signal location. In that case you will not connect to internet. The SIM works similar to a cellular phone (no bars…no service). Move the antenna a foot over. This has fixed many connection problems. Move the antenna higher. A higher antenna will reach out further. A change in one foot of height can increase the distance it can travel over a mile. A small move from the top of the trailer to the top of the AC compressor may do the trick. If there is more than one radio antenna in the area, move them as far apart as physically possible. At least 6 feet of separation is good, but 12 feet would be ideal. If the antennas are too close together, one or both may not operate or be intermittent. That is because they are screaming into each other's ears and cannot hear the tower. This includes small laptop antennas and 802.11 (WI-FI) antennas. All cellular equipment has automatic power reduction systems. If a similar close-by system is screaming in its ear, it will reduce its own power as much as possible (thinking it is close to a tower) and will therefore fail to connect to the tower. Ground Plane: Make sure that the antenna has a good ground plane. This can be any grounded metal plate that the antenna is connected to. This actually helps in setting up the standing wave that the antenna generates and has the effect of boosting the signal. If the user has a magnetic mount antenna, a 12" x 12" steel plate should be used; the larger the better. The aluminum rooftops of trailers provide a good ground

	plane, but some form of ferrous (iron-containing) material is required to stabilize the magnetic base. An empty metal wire spool will work wonders. Placing the antenna on a fiberglass rooftop is not helpful. Running the antenna out a window is perfectly fine, until the window is slammed/closed onto the cable. This will crush the outer shield into/through the dielectric insulation and result in the center conductor shorting out the antenna or affecting its transmission ability. The antenna cables are thin and cheaply constructed. The shorting of the coax can burn out a booster amplifier as well, doubling the problem. A rule of thumb is this "if the antenna cable must be run through a window, it must be held in place, not forced in place. This coax should be handled and installed as if it were a glass fiber. Check for an antenna grounding fault. If the antenna cable goes through the trailer wall, check for a ground fault. To do this, disconnect the antenna from the Bloodhound and place an AC voltmeter between the antenna ground and the Bloodhound antenna ground. There should be very little voltage difference. If there is any real voltage difference between the two, a grounding fault exists and must be repaired. Ideally, the ground of the antenna should be at the same potential as the Bloodhound antenna ground. Excessive AC voltage will cause damage to the modem and/or the brain board. Typically, if the user can talk on a cell phone when looking at the Bloodhound, a booster will not be required. If equipped with a booster, remove or change out the booster. This will eliminate the booster as a possible problem. Add a 3-watt booster in the antenna path. This can stretch the distance to over 25 miles with a good 3db gain omni-directional antenna. A Yagi antenna can improve transmission and reception greater than 25 miles. **A booster should NEVER be powered up without an antenna connected, otherwise damage <u>will</u> result to the booster. Replace the antenna and adapter and/or booster.** Most Bloodhound hardware modem failures can be traced to an electrical storm or local lightning strike event. There are different colored unit number labels on each BH (i.e., white/yellow). If the label is white that identifies the cellular SIM as a Verizon provider. If yellow, it is an ATT sim. Most of the units are Verizon. Be careful not to pinch, crimp, flatten, cut etc. the antenna cable, doing so will damage antenna and not allow connectivity. If you suspect damage, try the 2nd backup antenna. Sometimes if connectivity is lost simply disconnecting antenna from BH, waiting 2-3 minutes, and connecting again will force modem to search for signal again. Another step to take may be to power cycle the cellular wireless modem internal to the BH. Register 55 will turn on/off the modem as needed. Register 55 is set to 1 (on) by default and will arrive on with all rentals. Setting register 55 to 0 (off) and then back again to 1 (on) will power cycle the modem. Then try to connect antenna again. If still no connectivity call iBall tech support.
Gas Chart cannot connect to Bloodhound through USB serial cord connection	To enable the serial USB connection between the computer running Gas Chart and the Bloodhound, the user must load the serial USB driver program for the first time when connecting to a BH. **It is imperative that the USB serial driver be loaded into the computer before plugging in the USB serial cable to the Bloodhound.** If the USB serial cable is already connected, remove the USB cable and then install the USB/serial port driver. The driver is automatically download with each Gas Chart download and it stored in the default iBall folder (C:/Program Files/iBall/USB_DRIVER, could also be Program Files (X86)). It can also be found on our Website (www.iballinst.com in the downloads section), or on the USB key installed in the front

	panel of the Bloodhound. After loading the serial USB driver software, connect the USB cable to the computer (this will finish the driver installation by recognizing the BH device and assigning a software port), then start the Gas Chart program. The program will search the serial ports and connect to the Bloodhound if Gas Chart is looking to the Serial/USB port to verify, click on the Setup button in the Control Box, go to the Bloodhound tab and make sure Use Serial/USB is selected.
Gas Chart cannot connect Bloodhound through ethernet connection	Connect an Ethernet cable from the BH to a rig router that can assign an IP Address, or to a switch or hub behind a router that can assign an IP Address. Connect an Ethernet cable from the local computer to the same device. Look on the front of the Bloodhound panel. Locate the LCD and observe the scrolling information on the lower right-hand corner. An IP: PORT address will scroll by and appear (i.e. 192.168.1.100:23 or 10.1.2.0:23 as example only). This is the IP and PORT number (separated by a :) that the Bloodhound has been assigned to by the Gateway or Router. Start the Gas Chart Program. When the Gas Chart Program is running from the Control Box select the Setup button. In Program and Equipment Setup, go to the Bloodhound tab. In the Local Ethernet or Internet Connection Settings section (bottom half of screen) select Use Ethernet option. To the right you will see 2 boxes to enter information. If you have obtained a local network IP: PORT as described above enter that information in the larger box below the Look UP IP/DNS button ONLY. You do not need to enter in the unit number above it and you do not need to click the Look Up IP/DNS button when entering a local address. REMOVE the info currently in the larger box and replace it with your IP: PORT info (ex. 192.168.3.100:23). Close the setup box and wait for connection green lights on BH and WITS. Alternatively, if there is no rig network IP: PORT, AND you are running Mainlog you will need to connect the BH to the internet using the antenna and then select Use Ethernet on the Bloodhound tab while ONLY typing in the unit number in the small box to the left of the Look Up IP/DNS button. Once you enter current BH unit number then click the bottom for connectivity.
Pason blue cable connector not working	Just because the Pason cable can fit into a connector found on the site does not mean that the connection will work. Pason advises to always connect the Bloodhound to the Toolpush Connection Panel on the outside of the Rig Manager's trailer, or, if that is not present, then to the Toolpush Computer itself via one of the cables attached to it. (In the event that Pason does not have somewhere to mount the Toolpush Connection Panel, they leave cables extending outside of the Rig Manager's trailer with the RS422 connectors accessible. In that case, they are simply cable ends, so are not labeled)
Not receiving data from WITS	The BH is ready to send and receive WITS information as long as there is a good physical connection (i.e., Null modem cable connection by itself or with a converter) from the BH to the EDR. Once that is in place then you must configure the WITS OUT information on the EDR and save that configuration. The BH does have a register that sets a communication handshake (see register list above). Usually, the default works in almost all cases. If after both steps above are complete and still no WITS communication, you could try to reboot both the EDR workstation and the BH. Also, if you have toolpush connection options AND a 9pin port on back of EDR workstation be sure to try them both. If still no wits call tech support to do some internal checks.

Total Gas readings not going out to WITS	Check Register 12. If this register is 0 the BH will not send the Total Gas out the WITS interface. If this register is not 0 then the BH will attempt to send total gas to the WITS interface.
Pason Total Gas reading is 100 times higher than Bloodhound says	Set Register 26 to desired setting. See register list above. When sending total gas out to a WITS system, Register 26 will be the divisor for the gas units. i.e., 100 = gas units / 100. Or 1 = gas units / 1. Do not set this register to 0. The Pason system has a tendency to report gas units 100x the value received from the instrument. The BH can be set by this register to send total gas as it it setup.
Want C1, C2 etc. values to go out to WITS as PPM.	Refer to register list above. This setting will be on register 68.
Geolograph hookup not working right	This is due to an electrical or mechanical problem which may need adjustments to remove. Register 25 is the debounce register. Adjusting it will eliminate the multiple bouncing of the microswitch within reason. There are two sources as to excess depth counts. **Mechanical Contact Bounce:** when the arm of the Geolograph contacts or releases the switch, the switch moves into the open or closed mode. When it does, the contacts bounce on and off inside the switch itself. Register 25 will eliminate these multiple strikes if even set to 1 second, because contact bounce lasts only milliseconds. **Mechanical Switch Bounce:** if the mechanical Geolograph arm is constantly bouncing up and down due to wind, chatter, or a faulty or loose mechanism, it can cause multiple hits on the microswitch. Register 25 can be set to a higher number, such as 60 seconds or more, to counter this problem. Another way to counter this problem is to use a depth wheel from US Geosupply with one of our corrective PC boards in it. This device connects to the Geolograph cable and counts depth in only one direction. **Electrical Induced Noise:** when the Geolograph cable is placed over large power lines, especially when in the same power conduit running under roadways, a single twisted pair cable will have induced noise on it. Sometimes this noise can reach as high as 80 volts AC. The Bloodhound system uses an electrically isolated Geolograph input in order to protect the Bloodhound system from this induced voltage, but it cannot cancel the noise on the Geolograph line. In this case the Bloodhound will usually give a noisy Geolograph alarm. **Electrical Ground Potential Noise:** when the trailer holding the Bloodhound is at a great ground potential relative to the drilling rig, an induced DC reference can be generated on the Geolograph line. In both cases, to eliminate the noise, try the following steps: • If you are not running CAT 5E cable for the Geolograph, go get some. • Run CAT 5E Network Cable. This cable has a high twist to it which helps eliminate the induced noise. • Run CAT 5E Shielded Network Cable. This cable has an additional conductive shield that helps eliminate induced noise. • There are 8 conductors in CAT 5E. You are probably using 2 for the Geolograph cable. Strip back the other 6 and the shield wire, if it has a shield, tie them all together and connect them to the black 12VDC screw terminal power lead on the same side of the Bloodhound. This will reference the Geolograph line to the Bloodhound ground reference and eliminate the noise. Do not connect the far end of the 6 cables and or shield wire to anything. (If you do so, you do not have a shield, you just have another ground line and that will not help you.) • If you are using a 2-conductor wire, strip back and tie a small piece of wire from the black Geolograph terminal to the black 12VDC power lead. At least you will have a common ground reference in the case of induced noise.
Span adjustment	When adjusting the zero and span on a particular gas, **always adjust the zero first,**

unsuccessful	**then the span**. Adjusting the span first and then zero will throw off the span adjustment.
Oxygen sensor drifts	This sensor was included as a differential monitor as to the amount of methane in the sample. If user observes 5% (500gu) of methane, then the O_2 should change about 1% no matter where it is presently. It is very sensitive to back pressure and is sensitive to chemicals that may be encountered in the drilling process. One of the most reactive is acetylene which may be generated using carbide for a lag check. Acetylene may knock the oxygen sensor out for up to 30 minutes. Because of these cross reactions, it is not immune to drift and should be adjusted to 21% periodically to air. To do this just disconnect the sample line for a few of minutes and adjust to 21%. "Fuming" mud which is emitting gases other than normally seen may cause the O2 to appear to drift as well, when in reality it is reacting to the loss of O_2 that the fumes have replaced. Keep in mind where the sample is being taken from.
High Range Gas reads too high	There are four (4) registers that affect the way the high range automatically adjusts itself. In adjusting these registers, the user can mimic any type of system currently in use. REGISTER 22 – Low Range Gas Reading Damping This register sets the low range damping number. This is the number of samples that is used in order to slow or speed up the response curve of the gas units output. This also changes the points to which the changeover between the low range and high range occurs. A larger number will give an overall smaller absolute number on the high range. A smaller number will give an overall larger number on the high range. 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 between 5 and 120, maximum is 120. Factory setting is 5. REGISTER 28 - IR Independence Register This register sets up the way the high range and low range interact. If this register is set to zero, then the IR ranges are not independent and are joined. This means when the gas level reaches the end of the low range it goes to the high range IR sensor, but it calculates out the high range sensor level at the low-level point. This attaches the high point of the low range calibration to the low point of the high range calibration to help calculate the new response curve. Normally 0. If this register is 1 then the IR sensors are independent from each other. This means when the gas level reaches the end of the low range it jumps to the high range wherever it is at on the gas level concentration. This usually shows up as abnormally large high range gas units. The Bloodhound enters this mode (and cancels damping) when in calibration mode. Setting this register to 1 will show the calibration points when the calibration gas is injected. Normally 0. REGISTER 30 – Attenuation This is the Attenuation described in detail above. This is a percentage of the calibrated output - it has the same effect as air dilution. 50 = 50% output, 100 = 100% output, up to 200 %. Factory setting is 100. A setting of about 30 may result in a similar output to old hot wire instruments. REGISTER 36 – Hi Range Attenuation Same as Register 30, but for the high range only. Is additive to register 30. Factory setting = 80 for enhanced mode.
USB memory stick not working	Plug it into the Bloodhound upper USB port only; the lower port is not active. Many BHs only have one USB port. When inserting a USB memory stick, it may take up to 60 seconds for the Bloodhound to recognize it. If you try to list and read it on your PC and it needs to be formatted, try to do that. If it still won't allow you to read or write to it, it needs to be replaced. You can purchase a low profile one and ask for reimbursement

	or you can ask tech support to send another to you. Getting a working USB stick in the faceplate is important for data recovery.
Can see peaks on the chromatogram, but they are not being quantified (especially at low Total Gas levels)	Try setting Register 66 (factory setting is 20) down to 10 or 5.
Total Gas Reading is Noisy	Noise can be induced through usually 1 of 3 things. Antenna, outside electrical interference (microwave, cell phones, routers, air conditioners, fans, refrigerator), or bad/loose connectors internal to the BH. You will need to go through a process of elimination and give the BH time to correct. It is not instantaneous. Once you have eliminated outside possible interference and it is still noisy, try to disconnect the antenna and see if after a few minutes it starts to calm down. If still noise call Tech support to check internal connectors.

Sample Flow Rate Troubleshooting	There are three items on the Real Time Data screen of Gas Chart that tell the user about the flow properties. These 3 things have a relational operation to each other.

Vac - tells the user how much vacuum is being pulled on the sample line. If it is a high negative number then there is a high vacuum, if it is a very low negative number then there is no draw on the line. If above -200 the Bloodhound will turn the sample motor off (see % motor power) until the occlusion in the line is cleared. The pump has the ability to pull up to -600 mmHg on the line but is programmed to not let it get that high because if there is not a good flow in the line at -200 mmHG then something is blocking the line, so it is limited to -200.

Percent Motor Power - This tells the user how much energy the Bloodhound is giving the sample motor. A higher number means a higher voltage is being sent to the sample motor. Typically, if below 100, there should not be any problems; if above 100 the motor may be going out or there is an occlusion building in the line. 200% (12 volts DC) is maximum. If allowed to build up to 200, the motor % power will cycle back to 0 % power to give the motor a rest and cool off as it starts to build again. Sometimes this will allow the motor to restart if it is marginal. Generally, a higher power will draw a higher vacuum on the line and a higher flow rate (LPH). A lower power will reduce the vacuum and flow rate.

LPH (liters per hour) flow - The flowmeter in the unit monitors the flow through the system. The Bloodhound will change the motor power up and down until a flow rate of 55 to 645 LPH is obtained. If the line starts to get plugged up, the power to the motor is increased to maintain the flow. This results in a higher vacuum. If the line is disconnected from the Bloodhound the vacuum will drop to almost zero, and the flow rate will increase until the motor power is once again adjusted to compensate for the pressure change.

Always pull the poly flow line off the inlet of the BH when troubleshooting Vac/Flow Rate issues. Let the BH settle while breathing air. If LPH, Vac, and motor are stable on air note the settings. Use a butane lighter to bump test the BH right at the inlet. If unit is in enhanced mode a test for approx. 10 seconds should yield anywhere between 1000 and 2000 gas units with right in the middle of that being ideal. With the settings noted and a good gas test put line back on and note the changes to the settings. If you are unable to get a similar gas test back from the trap that you just did at the BH then you need to inspect and test the line. You can estimate a vac range by using the formula of -14 per 100 feet of ¼" poly and -7 per 100 feet of 3/8" poly. You would start with your open-air vac and add the length of your line, and plus or minus -5 on the end of that result. (Ex. 200' of ¼" poly with an open-air vac of -20 would give an expected vac range of -43 to -53 (-20 +-28 +/- 5)). |
| Sucked Water Into Instrument | If Pri and Sec Volts = 0.010, instrument has been flooded - return to iBall, or try:

Note: There is no guarantee this procedure will work, so start working on your Plan B now. Turn off the instrument and disconnect the sample tubing from the instrument. Remove 4 screws holding instrument cover and lift cover towards you. Replace sample line filter located inside left front of instrument with a new filter. Replace cover and power up instrument. Set Register 10 to 199. This runs the sample pump at full power, which may help dry out the instrument's internals. If you have a drying tube (Dririte or equivalent), connect it to the sample intake port to pre-dry the air entering the instrument.   After an hour or more running under these conditions, set Register 10 to 0, which sets the sample pump to automatic operation. Zero the Total Gas reading and test the instrument with test gas or a butane lighter. |