The iBall Instruments Bloodhound™

Description & Operation Manual

Release 12
Fourth Generation Bloodhound™ System
External Code Software Load 175+
Internal Code Software Load 20+

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FOR TROUBLESHOOTING TIPS SEE APPENDIX G

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The iBall Instruments Bloodhound™

Description & Operation Manual – Table of Contents

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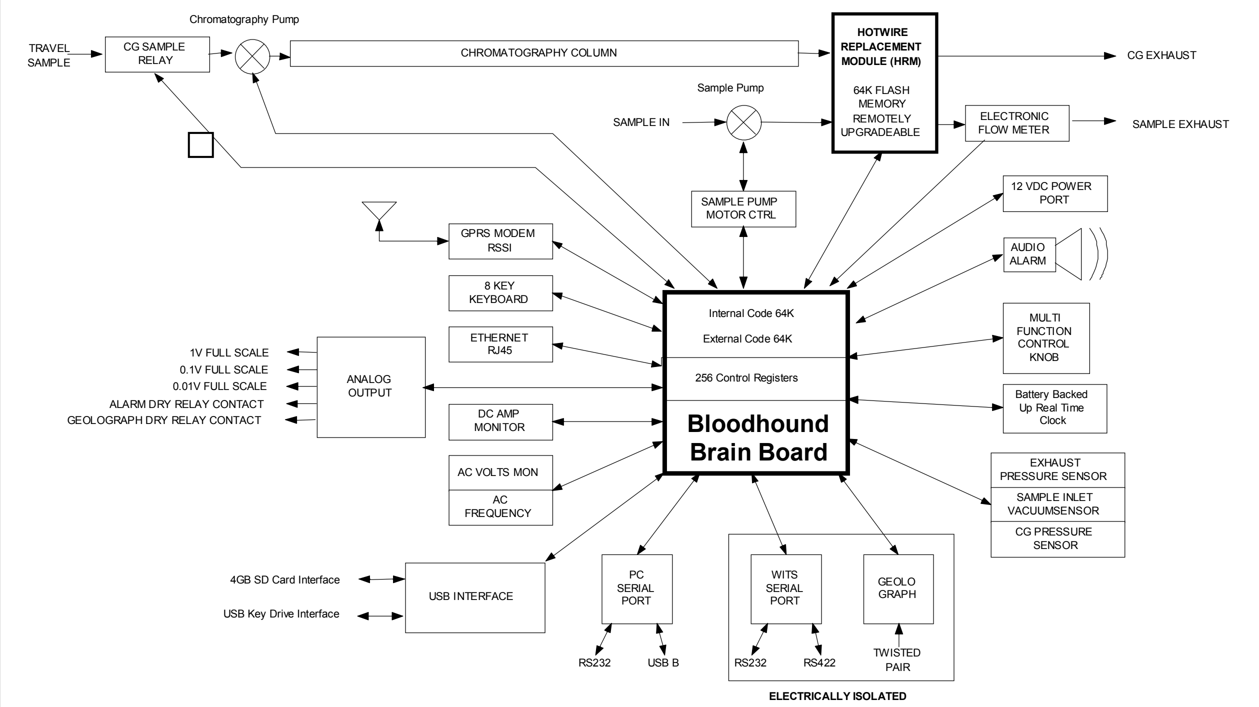
1. OVERVIEW – IBALL INSTRUMENTS BLOODHOUND™

The Bloodhound™ Gas Detection and Chromatograph system was developed using digital signal processing techniques and the very latest in non-dispersive infrared and chemical sensor gas detection. Couple that with multiple integrated WITS interfaces, filtered and positive pressure inner case cooling, DC power support, external analog signal relay contacts, a robust power system, and battery backup makes this system unique in the industry. Further, this new product integrates GPRS (General Packet Radio Service) wireless technology and Ethernet connectivity to provide real-time monitoring and charting via the Internet anywhere in the world.

FIGURE 1 - BLOODHOUND FUNCTIONAL OVERVIEW



The Bloodhound™ is composed of non-dispersive infrared detectors, a proprietary chromatograph, medical grade vacuum pumps, an aircraft grade flow meter, an uninterruptible power system, DC power input/output, WITS (Wellsite Information Transfer Specification) communication, Ethernet connectivity, a wireless data modem and the proprietary digital signal processing system Brain Board housed in a rugged Pelican case.

The Bloodhound™ wireless gas detection equipment has the capability to detect from 0 to 10,000 gas units. This translates as 0 to 100% typical naturally-occurring hydrocarbon gas mixtures. 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 the 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 eight (8) minutes depending on the customer controlled temperature setting; the lower the temperature the longer the time. Typically, chromatograph readings are available in 3.5 to 8 minutes depending on the degree of separation desired by the customer.

Further, the Bloodhound™ has the ability to detect from 0 to 500 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.

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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.

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 filtering protects against particulate contamination from outside sources.

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

All components within the equipment are designed to be easy to access and replace. With the removal of four panel screws, all aspects of the internal mechanisms and pneumatics are easily adjusted or replaced. The 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 GPRS service 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. All aspects of the equipment can be adjusted or monitored remotely. Firmware upgrades can be accomplished through the serial port or through the USB port, or remotely through the GPRS modem or Ethernet.

All detection systems are equipped with a USB connection port that permits the use of industry standard USB 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 within a Microsoft ™ Database structure (Microsoft ™ Access software is not required)
4. If the wireless GPRS service is active or the Ethernet connection is live, the data is also transmitted over the Internet to iBall Instrument's Data Center for storage and Internet display.

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

For example, if the data on the personal computer is inadvertently deleted, it can be restored from the USB memory stick or downloaded from the internal SD card. Or, if the USB memory stick is not available, it can be downloaded in the field and restored from the Internet Database Servers at iBall's Data Center. It should be noted that a host personal computer is not required to use this equipment.

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

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

The Bloodhound™ uses fourth 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.

Currently most gas detection systems deployed in the exploration industry utilize either a hot-wire or a hot-wire/Thermal Conductivity Detector (TCD) system. An overview of these detector technologies is provided in Appendix A.

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A. How the Bloodhound™ Uses the New Infrared Detectors

The following is a patent-pending method in which an infrared detector output is used to emulate the output of a hot-wire or catalytic bead /TCD 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 in order to locate the point to where 100% of injected methane is detected as raw natural gas, which is usually mostly methane.

Today's infrared detectors have been shown to react to hydrocarbon based gases from zero to 100% in concentration without 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 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.

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. A goal of the present invention is to emulate the output of a hot-wire /TCD system to assure consistency of information obtained during the drilling process.


FIGURE 2 – HRM03

B. Gas Detection Subsystem HRM03

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 "HRM03". This module allows the system to be highly flexible and easily repaired when in the field. All calibration parameters are stored on the HRM modules in non-volatile memory. This allows the module to be pre-calibrated and placed on a shelf and forgotten about until replaced as a whole in the field. All without the hassle and down-time associated with replacing hot-wire or catalyst bead technology based systems. This patent-pending module allows for the system as a whole to detect hydrocarbon based 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 HRM03 module is the e2v infrared detectors. The HRM03 modifies the output characteristics of the detectors using a patent-pending digital signal processing technique to very closely mimic the output characteristics of a properly operational older hot-wire system in fit form and function without any of the constant headaches associated with hot-wire systems. It is not uncommon to operate a Bloodhound™ system for more than 6 months without the need for calibration. And when checked, usually only needs a tweak. Attached to the HRM03 module is an electronic flow meter that monitors the gas flow out of the system. The data from the flow meter is given to the Brain Board and the Brain Board then adjusts the amount of power to the sample motor to constantly adjust the flow rate no matter what vacuum load is on the sample line. In addition, the HRM03 has an integrated column oven controller that controls the temperature of the chromatograph column.

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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 outputs, communicates and controls the Ethernet module, communicates and controls the GPRS 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. 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 Radio Shack or other battery supply store. The Bloodhound™ uses a sealed rechargeable battery from Power Sonic PS-1250 F1. This battery is kept charged by the Bloodhound™ system. When the incoming AC power fails, this battery will keep the Bloodhound™ running for greater than two hours when new. This time is reduced as the battery ages. It is recommended to change the battery every year for maintenance. At a minimum, It should be changed at least every two years. If the battery has an internal short or if there is a failure in the charge circuit, the 7.5 amp fuse may open. This fuse is a standard 7.5 amp ATO type automotive fuse found in any automotive store.

Found on the base plate of the Bloodhound™ is a DC protection circuit board. This board will monitor the DC power coming in or going out of the Bloodhound™. The circuitry arrests sparks, surges, and overloads as well as high frequency noise. This board has a type 3 ATO base 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 extractor). The amperage is displayed on the front panel of the Bloodhound™.

E. External Communication Subsystem

The Bloodhound™ advancements include the ability for independent operation in the field. There have been many dog house installations. This is where the unit is hooked up in the dog house next to the drilling deck and monitored and logged off site. This is done with the use of either a GPRS modem or a direct connection to the rig's Ethernet system using the Ethernet connection. The GPRS modem uses the same system as a cellular telephone. 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. In addition, it allows technicians to remotely diagnose, adjust, reprogram, or maintain the instrument.

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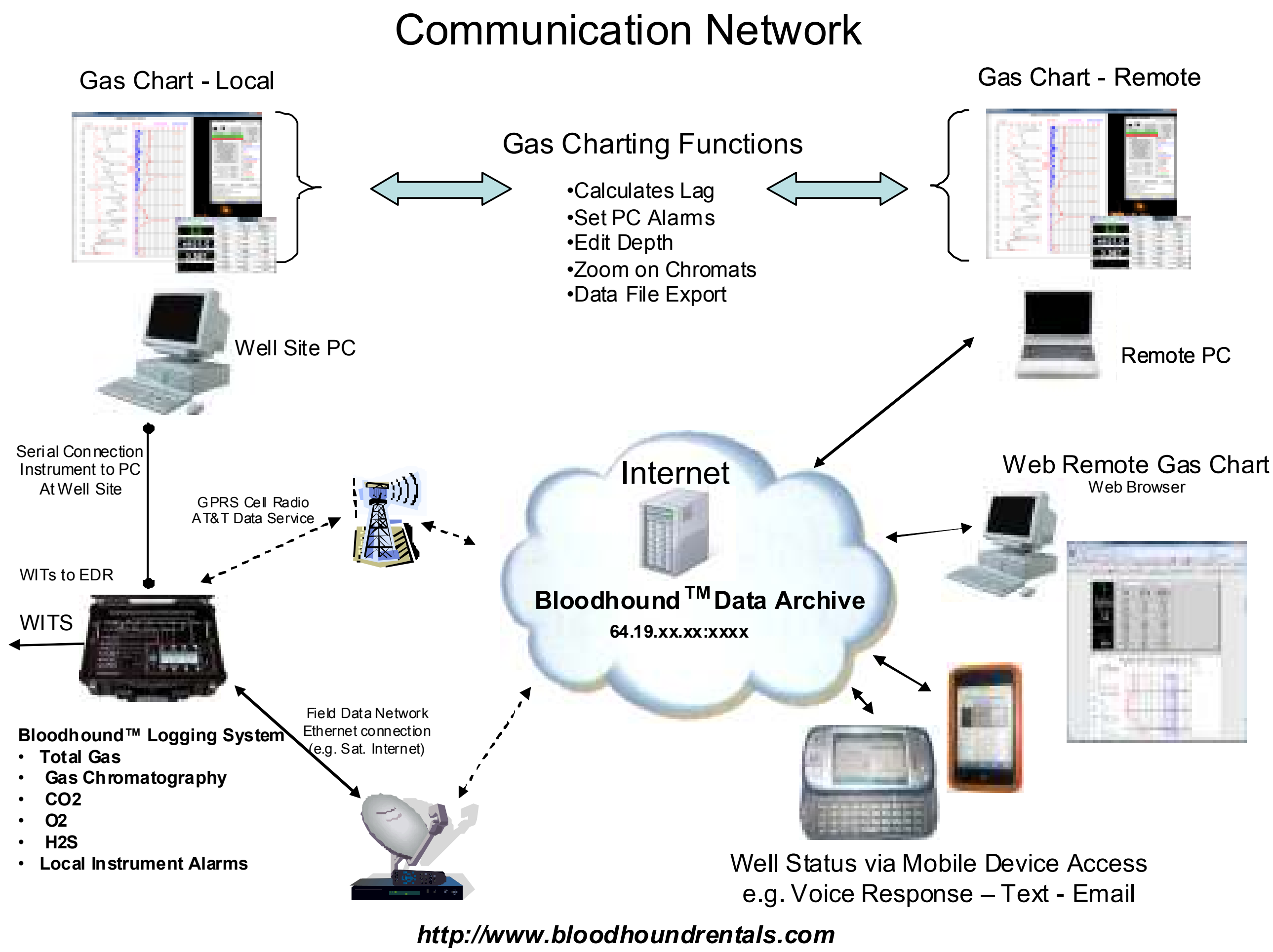

FIGURE 3 – COMMUNICATION NETWORK

The Ethernet connection is identical except the connection is made through the rigs satellite internet service. The GPRS modem has a 1 watt radio output, and with the optional 3 watt booster and 3 dB gain antenna, can reach just about any site in the United States. As a comparison, all hand held cellular phones have around 0.75 of a watt and a low dB antenna. Over the last 2 years we have yet to find a spot that was not available via GPRS cellular radio. Many times, the Bloodhound™ has a Received Signal Strength Indication (RSSI) of 75% where the operator has no cellular connection at all. Further, if needed, a satellite communications dish can be set up and the Bloodhound™ can use the internet connection that it offers.

F. Pneumatic Subsystem

With the advances of the HRM03 infrared detector system, the Bloodhound™ pneumatic system has the advantage of being greatly simplified. The HRM03 infrared detection of gas units will not significantly change with flow rate changes, sample temperature, or pressure differences. Therefore, the Bloodhound™ does not need pressure regulators, flow-smoothing devices, large pumps, or distribution manifolds.

As shown in the figure on the next page, starting with the ¼" sample inlet hose barb, the inlet goes directly to a simple ¼" barbed fuel filter held in place by 2" x ¼" ID rubber tubing pieces. The filter part number we use is G1/4 from Luberfiner. It is a general purpose fuel filter with a 10 micron paper/mesh construction. This filter serves multiple purposes. It filters any particulate matter that may accumulate and/or flake off in the sample line during the drilling process. It allows gases and water vapor to pass through, but will stop any fluid mud that makes its way to the equipment.

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

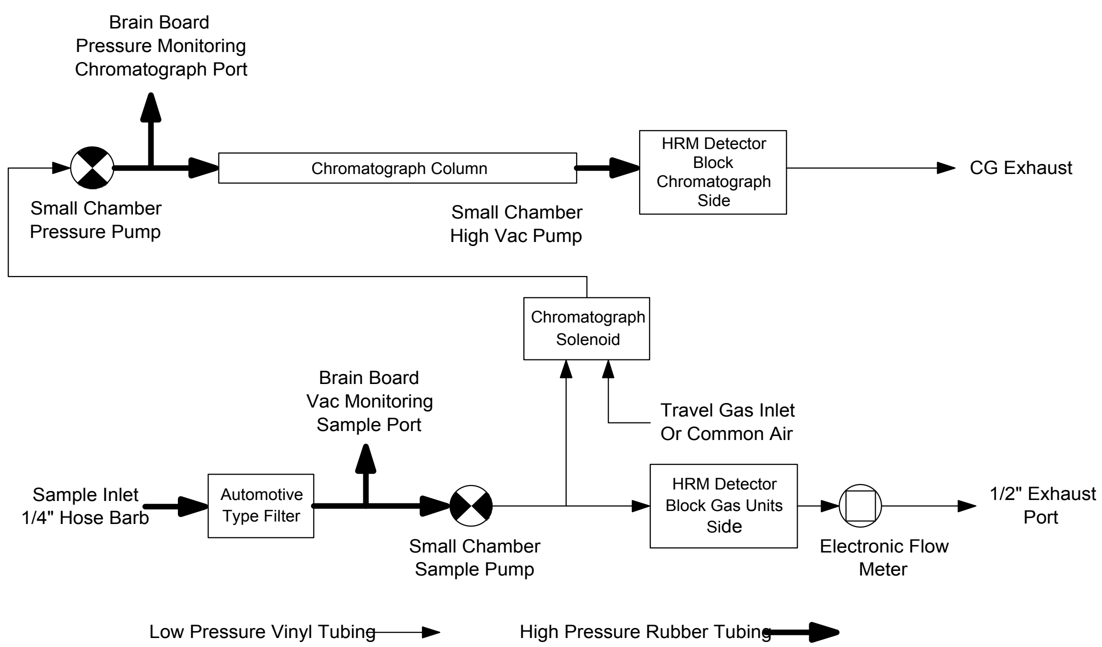

FIGURE 4 – Bloodhound™ Sample and Chromatograph Pneumatic System

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2. DESCRIPTION OF OPERATION

Figure 5 is a reaction and calibration curve chart showing the reactions of the infrared sensor to different gases, and the proposed low range and high range calibration levels.

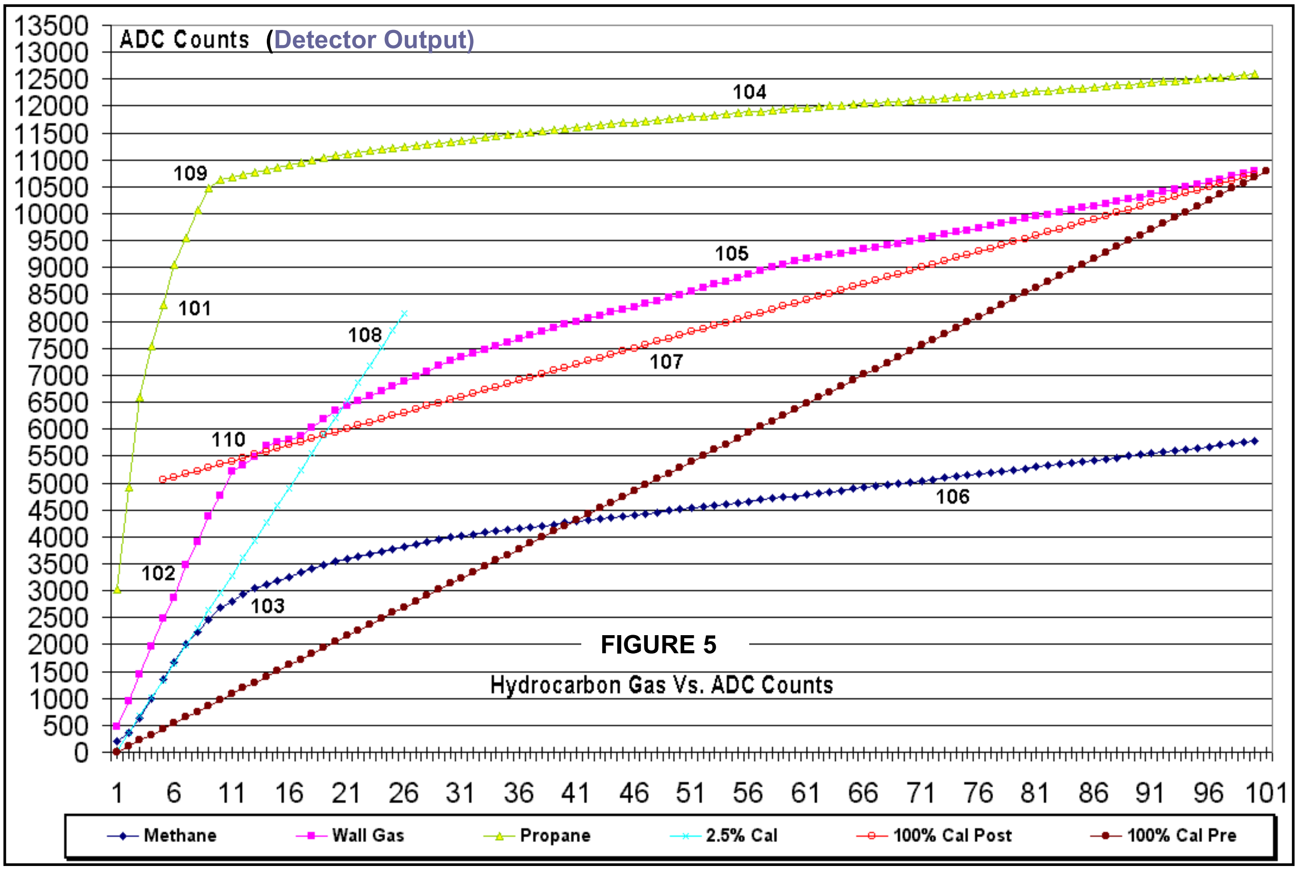

FIGURE 5

Hydrocarbon Gas Vs. ADC Counts

Upon study of the output characteristics of different hydrocarbon gases from 0 to 100% in concentration, it was determined that the infrared detector output has roughly two linear regions but with different overall reactivity.

It can be easily seen that the output of methane (curve 103-106), propane (101-104) and wall gas (102_105) (processed natural gas found in most homes and businesses) all show a similar dual linear region output characteristic, but with different overall absolute reactivities to the gases.

Generally one linear region is between zero and 8 percent of the gas under test (curve segments 101, 102 and 103. A second general linear region is between 12 and 100 percent of the gas under test (segments 104, 105 and 106. Between the two linear regions, there is a -reactionary knee- to the gas under test (see 109, 110 and 111.

Treating these three infrared detection regions separately, a new reactionary calibration system can be implemented based on the reaction of the gases being detected.

A simple linear calibration can be used with the low region using the calibration points of zero and 1% or 2.5% methane (segment 108). Low readings of these gases in the drilling fluid during the drilling process usually indicate a very high percentage of methane and low percentage of anything else. This is the same calibration method currently used on hot-wire systems.

A simple linear calibration can also be used in the high region using the calibration points of zero and 100% wall gas (segment 107). This is much the same calibration method currently used as the high range calibration of TCD systems.

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The third region would be the infrared detector's knee cross-over point at 109, 110 and 111. This is the area between the low range calibration and the high range calibration. The knee cross-over point is that point in which the detector leaves the low range calibration and enters the high range calibration.

Figure 6 (next page) is a functional block diagram showing the logic flow that determines which calibration curve is used at which time.

The system takes a reading from the infrared detector (see box labeled 400) and branches to either the high range or low range function at box 401.

If the system is operating in the low range function, the system then converts the output of the infrared detectors into a percentage of gas using the low range calibration (box 402).

After converting it into a percentage of gas, the system monitors and stores the reactionary profile of the gas over time for later adjustment of the upper calibration scale at 403.

The system then displays the output percentage of gas to the user at 404.

If the system senses a percentage of low range gas to be greater than 5% at box 405, the system uses stored information found in box 403 to correct the high range calibration scale at 406. The system then switches to the high range calibration and outputs at 406. The system then takes another reading (box 400) and finds that it is in the high range of operation at 401. After converting the infrared output to a new high range percentage of gas at 407, it then outputs the data to the system for display at 408.

It then monitors the amount of gas and looks to see if the percentage is less than 5% at 409. If so, the system switches back to the low range calibration at 410 and then takes another sample at 400.

The low range activity and knee cross-over point is closely monitored and tracked over time which builds up a reactionary profile at 403. When enough gas enters the system as to cause the system to exit the low range calibration at 405 (above 5 to 8%), the knee cross-over point monitors and tracks the ADC (analog digital counts) where the low range exits, and then re-assigns the low point of the high range calibration to the ADC count of the low range exit point plus a correction factor based on the generated reactionary profile at 406.

A second modified correction factor, also based on the reactionary profile, is also added to the ADC high range high point calibration assignment for better accuracy at 406.

With this low range (402), high range (407), knee cross-over point (403) triple mode method, the amount of hydrocarbon gases detected is shown to be well within 5% of any hot-wire/TCD system today, and when placed side by side with any other system, nearly duplicate final outputs are seen, but with the infrared system giving better overall character performance on the high end.

Furthermore, an additional percentage control system - called the attenuation adjustment - allows the user to make final adjustments to the overall output of the system based on his or her experience and knowledge of gas levels historically seen in the specific area or field. Adjusting the electronic attenuation downwards has the same final output effect as adding air to the sample inlet (air diluting the sample). In addition, the attenuation adjustment can be used to adjust the output gas level upwards if desired.

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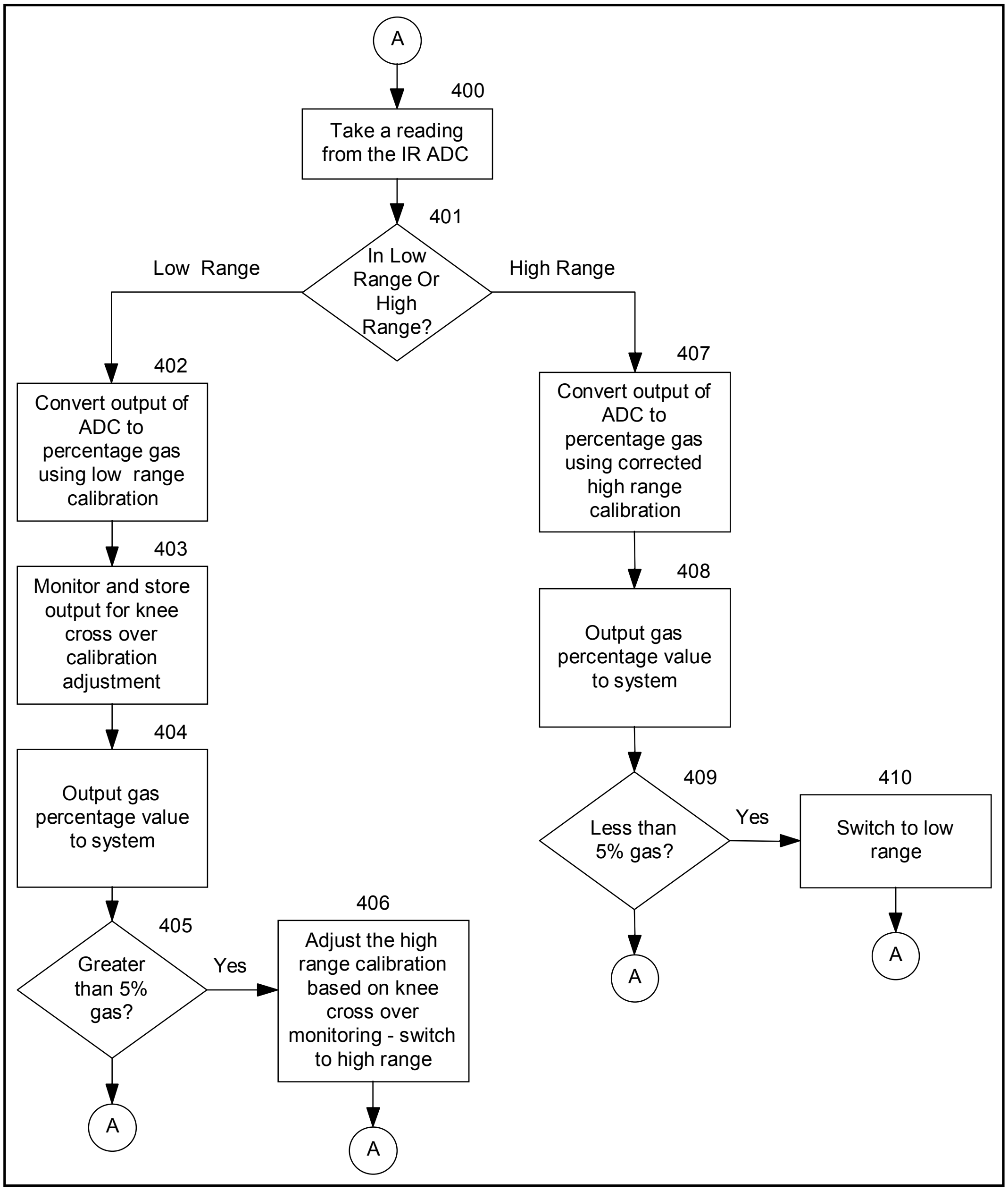

FIGURE 6 – GAS DETECTION SYSTEM FUNCTIONAL BLOCK DIAGRAM

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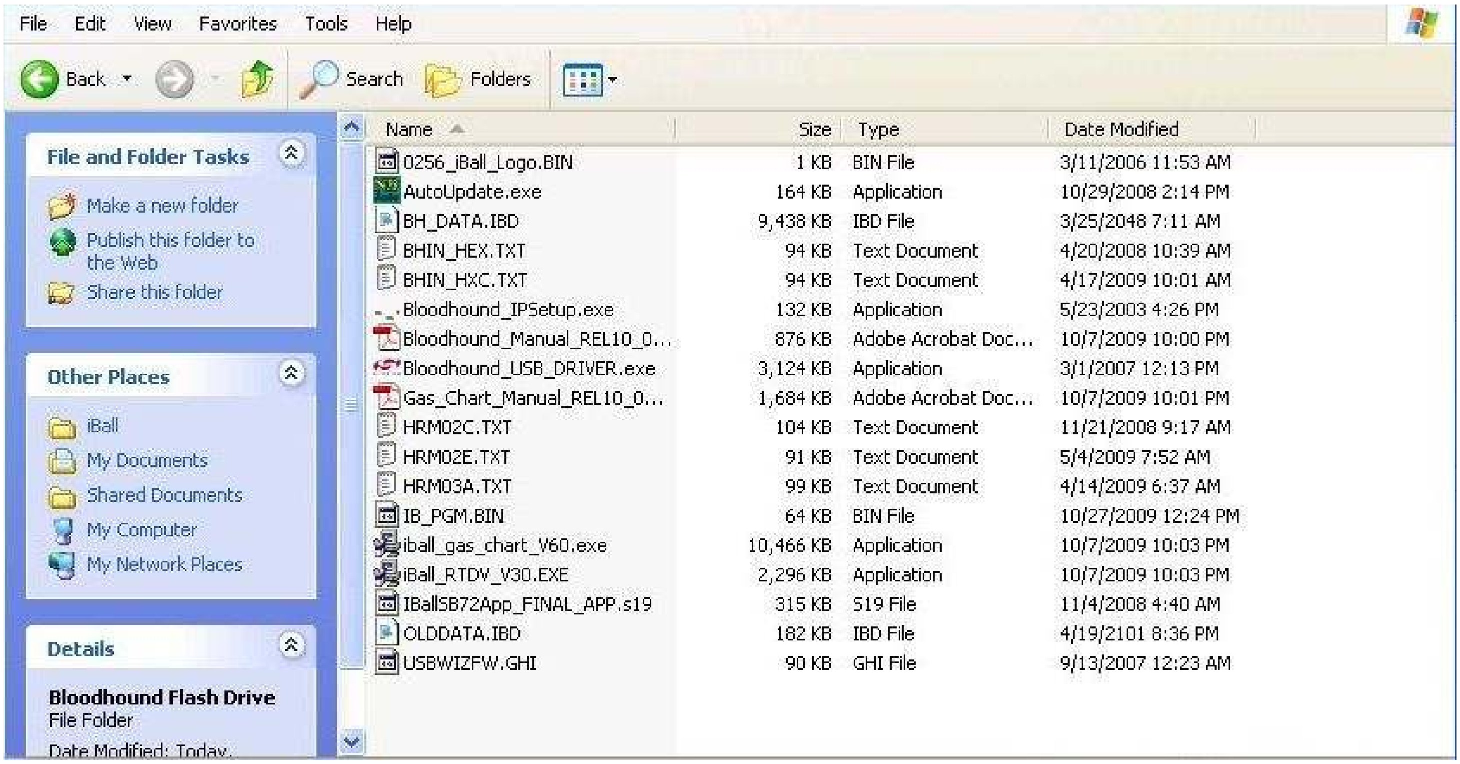
Bloodhound Flash Drive Contents

The following image represents the files found on the flash drive installed in the “top” USB port on the Bloodhound.



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3. CONNECTIONS ON THE BLOODHOUND™

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

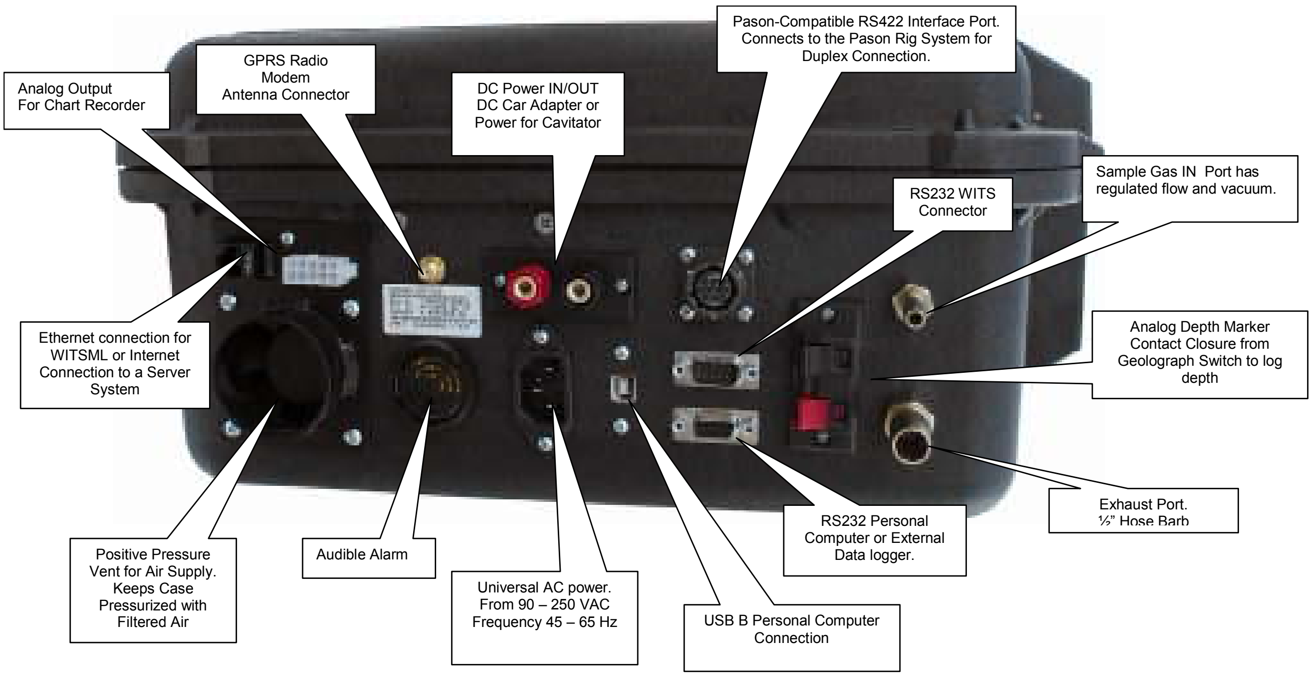

FIGURE 7 – CONNECTIONS ON THE BLOODHOUND™

FIGURE 8 – AIR FILTER

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™ 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 damage to the system over time. The Bloodhound™ uses internal positive pressure to keep dust, dirt and debris out of the 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. The filter used is a common Dust Buster filter part number VF100 that can be found at any hardware store or Wal-Mart. Exhaust out of the Bloodhound™ can be found on the bottom of the case. Do not block the exhaust hole. If the Bloodhound™ alarms due to high temperature, unblocking the cooling ports (or replacing a clogged air filter) 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 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.

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B. Ethernet Connectivity

Above the air inlet there is a RJ45 Ethernet connector. This connector is to hook into a Ethernet network and operates using DHCP (Dynamic Host Configuration Protocol) services, which are the most common type of network to date. After a successful DHCP inquiry and setup, the IP (Internet Protocol) address will show on the lower right hand of the LCD screen. Using a software tool, the Ethernet can easily be set up for a static IP address as well (see below). After the Bloodhound™ has established a DHCP or static network connection, an Ethernet mode of connection can be established to the Bloodhound™ in one of two ways.

1> The Bloodhound™ is listening for an incoming TCP (Transmission Control Protocol) connection on the assigned IP address and port 23. The HyperTerminal computer application can establish a connection in this mode. Hyper Terminal is a program that is supplied with the Windows operating system. The Gas Chart Program can also use this Ethernet connection.

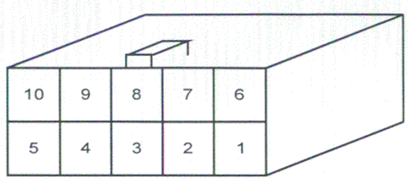
2> The Bloodhound™ will also constantly try to connect outbound via TCP to the Internet Database Servers at the iBall Data Center, using a pre programmed address and port.

3> An incoming Ethernet and outgoing Ethernet connection is possible at the same time.

Ideally, if the user is at a drilling site that has Ethernet connectivity such as a satellite connection, this is a good 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 also allows for technicians to remotely diagnose, adjust, reprogram, or maintain the instrument.

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

To setup the Bloodhound™ with a static IP address, first connect your Bloodhound™ to the local LAN. On the USB key there is a program called Bloodhound_IP_Setup.exe. After running this on a computer that is also connected to the LAN, you should see in the right panel, a Netburner number. Highlight this and click on launch webpage. From the webpage, at the top, click on static instead of DHCP and include the IP address.



Looking at front of connector on side of bloodhound

Pin-out of Bloodhound analog output port

```
Pin 1  10 milli Volt = 10,000 Gas Units Output
Pin 2  100 milli Volt = 10,000 Gas Unis Output
Pin 3  1 Volt = 10,000 Gas Units Output
Pin 4  No connection
Pin 5  Electrical Ground
Pin 6  Geolograph dry relay contact A
Pin 7  Geolograph dry relay contact B
Pin 8  Alarm dry relay contact A
Pin 9  Alarm dry relay contact B
Pin 10 No connection
```

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

FIGURE 9 – ANALOG OUTPUT CONNECTOR

C. Analog and Relay Outputs

Next to the RJ45 connector there is a 10 pin white latching connector (see adjacent figure). This connector allows for analog output of the gas units as well as an open relay contact for depth marking and an open relay contact for alarms.

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

D. GPRS Cellular Radio Connection

On the side of the case there is an antenna connection for the wireless GPRS (General Radio Packet Service) internet connectivity. This allows the Bloodhound™ to connect to the iBall Data Center for transmission of real time data and also allows technicians to diagnose, adjust, reprogram, or maintain the equipment. In order for the GPRS modem to operate, there a configuration procedure that must be implemented:

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

2> The Bloodhound™ has to set up the GPRS modem according to the subscription service.

After an activated SIM card is inserted into the GPRS modem, setting Register 55 to the correct value and then setting Register 123 will tell the Bloodhound™ to set up the GPRS modem to the user's subscription carrier. (See detailed descriptions of Register 55 and Register 123 settings in Appendix B.) A discussion of methods of setting registers is included in Section 9 of this document.

To set up the Bloodhound™ system for a subscription carrier, first set Register 55 to the appropriate number from the list below.

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

After setting register 55, set Register 123 to 1. This will tell the Bloodhound™ that you have set Register 55, and that it is to take the selection and set up the modem for the user's cellular carrier. (After the Bloodhound™ is finished configuring the GPRS modem, it will then reset Register 123 back to 0.) The user can then monitor the connection using the lower right hand corner of the LCD screen. It is important to watch for the RSSI, CN and NC messages. The RSSI stands for Received Signal Strength Indicator and goes from 0 to 100%. When using the GPRS modem, **CN** indicates a current connection to the server and **NC** indicates no connection.

Additional carrier setup information is provided in Appendix D.

E. Audible Alarm

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

Low Flow	High Flow	Blocked Sample Line	High Temperature
Low Temperature	Chromatograph Pump	High Gas Units	Noisy Geolograph Switch
Overhaul	HRM Fault	Power Supply Voltage	High DC Amperage
In Shutdown Mode	High H2S	Blocked Exhaust	

Appendix D describes the Bloodhound™ alarms and alarm settings in more detail.

F. DC Power Port

The DC power port allows the user to either power the Bloodhound™ from an external DC source, or to 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, make sure to connect with correct polarity. Otherwise a fuse in the automotive system will open. If running a DC Cavitator system, the amps can be monitored from the LCD panel or remotely through the Internet. As an added feature, and with the correct adapter, this 12 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.

G. 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 48 – 64 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.

H. 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 Driver first. It can be found at www.iballinstruments.com/ftp. This driver configures the connection to the Bloodhound™ exactly as if it was a serial port. Normally, the USB driver puts the serial connection on COM 3 but not always. This is a common USB to Serial adapter driver. When connected through the USB driver, the Serial parameters are still 115200 Baud,

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8 data bits, 1 stop bit, and no parity (8N1). The Bloodhound™ charting software will scan all available serial ports and find the Bloodhound™. Therefore, knowing which serial port number is not an issue when using the charting software.

I. 10 Pin Pason RS 422 Serial WITS Connector

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. Additional information about this Bloodhound™/Pason connection is provided in Appendix E.

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.

J. 9 Pin Male WITS Interface

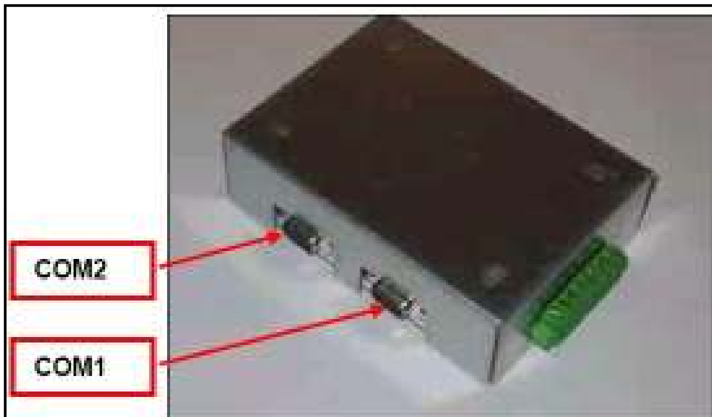

FIGURE 10 – Communication Ports on the Device Extender

If the drilling rig has a TOTCO, EPOCH or other drilling system, then the communications to the drilling computer will come from a different source. 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 an EPOCH system, the WITS data comes from a box called a Device Extender (see adjacent figure). The Device Extender allows for depth pulses, pump pulses, and on bottom marking. It also has serial ports for WITS data. Connect the Bloodhound 9 pin male WITS connector through a null modem cable to this EPOCH system, COM 1. Almost all drilling rigs that have computer monitoring systems have a WITS serial interface of some kind.

K. 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.

L. 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.

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M. 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).

N. Sample Gas Exhaust

The exhaust is a ½" hose barb connection. This larger size exhaust hose keeps the system from developing back pressure, or getting plugged with ice during cold weather. Do not plug the exhaust line or use ¼" hose, because back pressure will increase and the system may 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 then the case bottom, water can not exit the exhaust and will eventually flow back into the system causing damage. This water damage is in no way covered under warranty.

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4. KNOB OPERATION AND CONTROL

On the front panel of the Bloodhound™ Gas Detection System, there is a knob marked "Attenuation" (or "Adjust"). This patent-pending 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)
COLUMN TEMP – set chromatograph temperature
GAS UNITS ZERO – set gas units zero
GAS UNITS LOW SPAN – set gas units low span
GAS UNITS HIGH SPAN – set gas units high span
CO2 ZERO – set CO_2 zero
CO2 SPAN – set CO_2 span
O2 SPAN – set O_2 span
H2S ZERO – set H_2S zero
H2S SPAN – set H_2S span
HRM OEMSETUP – sets pans, zeros, and readjusts the chromatograph to zero
START CG CAL CYCLE – starts calibration cycle
POWER DOWN – turns off 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."

Notes on the knob function: Be patient and get a feel for the knob adjustment. Some functions have the knob sensitive to adjustment, and others will seem sluggish. Further, if the user does not change the knob, the adjustment function will time out after 60 seconds and the Bloodhound™ will return to normal operations.

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, turn the knob left and right to adjust the attenuation to the desired level. The adjustment level can be selected from 1 to 200 percent.

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 build up 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 can not be saturated or damaged with 100% 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

NOTE: Iball Instruments recommends that Attenuation be set to 100 in normal operations. To best mimic the output of older hot-wire systems, the Attenuation should be set at around 30%.

B. 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), and NC4 (normal-butane). (See the Bloodhound™ Chromatograph section of this manual for a more detailed discussion.) Each chromatograph column has an ideal working temperature, typically between 140 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, especially for C1 and C2. **Do not set the column temperature over 190 degrees F.**

C. Gas Units Zero, Low Span and High Span

When adjusting the Gas Units Zero, disconnect the inlet hose and allow the Bloodhound™ to stabilize in air.

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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 1.0% or 2.5% methane gas 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. However, the user is not limited to these low level gases for calibration. Just inject the sample gas of choice for the duration of the adjustment and adjust the Gas Units span to show the correct gas units.

When adjusting the Gas Units High Span, user must inject 100% methane (or wall gas) for the duration of the adjustment. Adjust the instrument to read as close to 8,000 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.

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 EC410 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 trade off 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%.

"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 30, normal damping, and a 10 second burst from a lighter that has ¾" a flame would be about 150 to 300 gas units, depending on how the user holds their fingers around the lighter.

F. Oxygen and Carbon Dioxide Quick Check

The O_2 and CO_2 detectors in room air read about 21% O_2 and 0.2% 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.

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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

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

Low Range Calibration Gas - 1% Methane

J197120LA		METHANE 1.00%	Balance: Air
	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%

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

Carbon Dioxide Calibration Gas - 5% CO2 CALIBRATION GAS

		CARBON DIOXIDE 5.00%
J10135VA		Balance: Air
	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 module to standard factory specifications. 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 and then this function would be used. On a brand new HRM module, the HRM should run for 24 hours to allow the H2S, O2 and VQ500 to stabilize, then it should be used twice in a row.

The downside is that if this command is used during a well in use, it will zero all the sensors to the current gas levels. So, the worst case is that if a logger uses it incorrectly, he should then allow the Bloodhound™ to sample clear air for an hour or so then use it again.

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.

I. Start CG Calibration Cycle

This knob command starts the chromatograph calibration cycle. This cycle automatically sets the time windows within which the five gas component peaks will appear. See the Bloodhound™ Chromatograph section of this manual for a description of how to calibrate the chromatograph.

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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.

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

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5. Front Panel Computer Control (Brain Board)

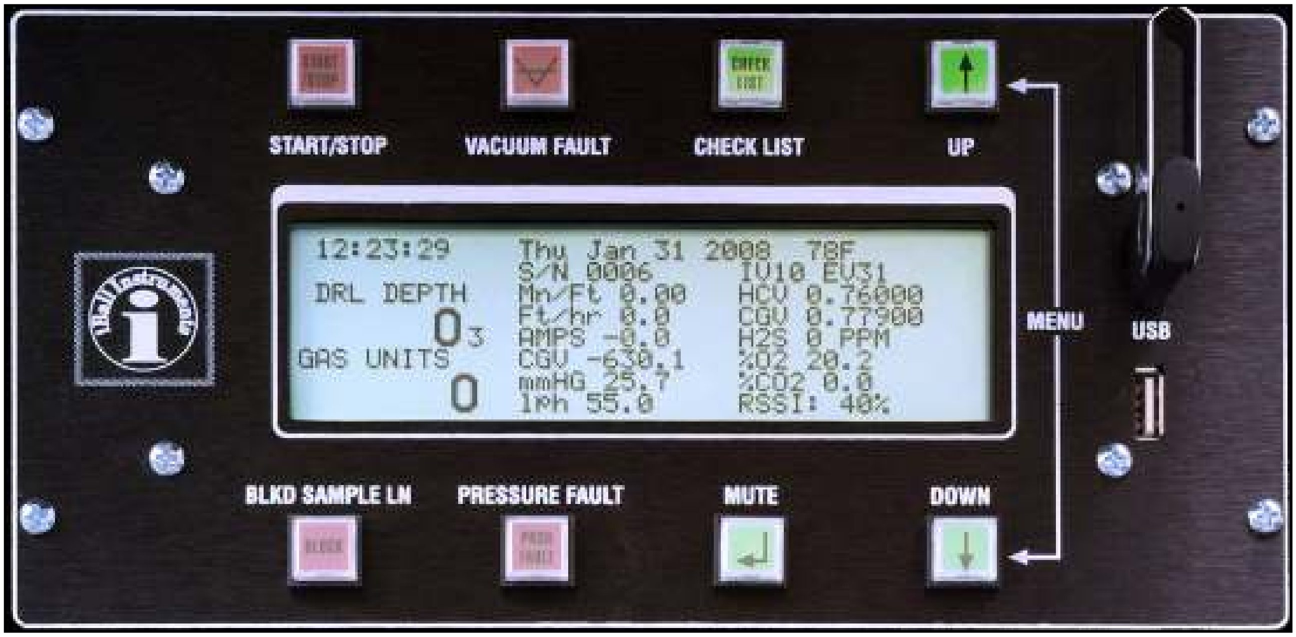

FIGURE 11 – FRONT PANEL COMPUTER CONTROL (BRAIN BOARD)

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.

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 – use to choose the selection shown. Pressing when no selection is shown cycles among MUTE 600 (seconds) / ALARM OFF / ALARM ON, as shown in the lower right of the display. This button does not actually turn off the alarms, 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.

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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.

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 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 –200 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)
- GPRS modem connection indicator
- Chromatograph count down timer (CGT)
- Digital attenuation level (%DA)
- Mute status, "Alarm On", "Alarm Off", or "Mute xxx"
- WITS good or No WITS
- If WITS data is present, it will then display bit depth "Bit xxxx.x"
- If there is a present Ethernet connection it will display "ETHERNET xx"
- If the MainLog program is running and is talking to the Bloodhound, "MAINLOG" will appear.

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 check or change a register setting

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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 give a call 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 Radio Shack or other electronics outlet.

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. 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, and a spreadsheet summarizing the register functions is included in an Appendix B.

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. 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.

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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.

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 Ports and Data Storage

Two industry standard USB ports can be found on the front panel of the Bloodhound™ computer. At this time only the top port is used. This USB port allows the use of external USB memory sticks to be used as secondary mass storage of the data collected. Any USB memory stick can be used; however, it is recommended that the short versions 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 OLDFILE.IBD and a new BH_DATA.IBD is started. Changing back to the old or last job number will not restore/rename the old IBD file but will destroy the last record, OLDFILE.IBD too. Internally there is a 2 gigabyte or 4 gigabyte SD flash storage card that is the primary point of storage. The job data files found on this card can be extracted or deleted through external commands using the serial port that is explained later in this document. The data can also be transferred to the USB 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. A complete parts list of parts and vendors can be found elsewhere in this document. 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 – HRM03 / Electronic Flow Meter Replacement

To replace the HRM03 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 HRM03 module and disconnect the four electrical cables
- Remove the two nylon locking nuts that hold the assembly in place using a 7/16" wrench

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- Pull upward on the HRM03 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 pumps from Hargraves. A spare pump is located in the Bloodhound™ case on top of the power supply, attached with Velcro tape. To replace a malfunctioning pump, remove the bad pump from the Velco and disconnect the power cable and the hoses. Remove the spare pump from the Velco and attach the power cable and the hoses to the spare pump. Attach the spare pump to the Velco where the bad pump was.

Hargraves has a web site at http://www.hargravesfluidics.com/ If you need a replacement pump, we recommend that you order a couple and keep them on hand in case of a pump failure. You can call or order them on line and have them delivered to your door. The part number for the pump from Hargraves is H085-11 BTC series, single head pump. On average, you might expect to replace a pump or two if your Bloodhound™ is used more than 250 days per year.

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.

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" 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" 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. A new column should be run for 12 to 24 hours at 150 degrees with its tubing disconnected from the HRM module, to allow for residual acetone in the column to dissipate.

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7. THE BLOODHOUND™ CHROMATOGRAPH SYSTEM

The theory and application of the Bloodhound chromatograph system is provided in Appendix E.

A. Control of the Bloodhound™ Chromatograph System

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

Register 15

Register 15 is the number in minutes between injection of samples. Typically it is set to 5 or 8. 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.

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 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 150 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 190 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 up 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 part mixture consisting of equal parts of methane, ethane, propane, iso-butane, and normal butane. These gases are typically supplied as a 5-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 a tank of 5-part calibration gas to the Bloodhound™ sample port and open the regulator slightly, so as to keep the sample vacuum reading steady. After calibration gas has flowed into the Bloodhound™ for at least 1 minute, connect the ½" hose from the bag to the exhaust port and let the bag begin to fill. After a minute or two, turn off the calibration gas and very quickly switch the sample port to the ¼" hose from the bag. The calibration gas is now being recirculated from the exhaust port, through the bag, and into the sample port.

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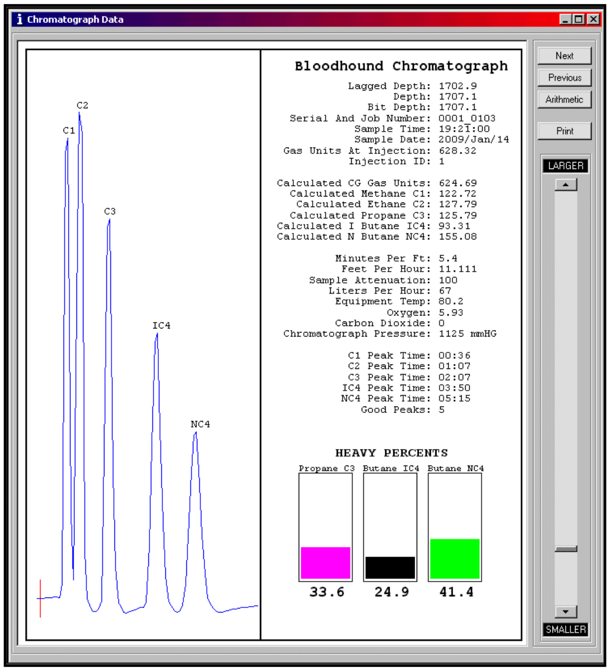


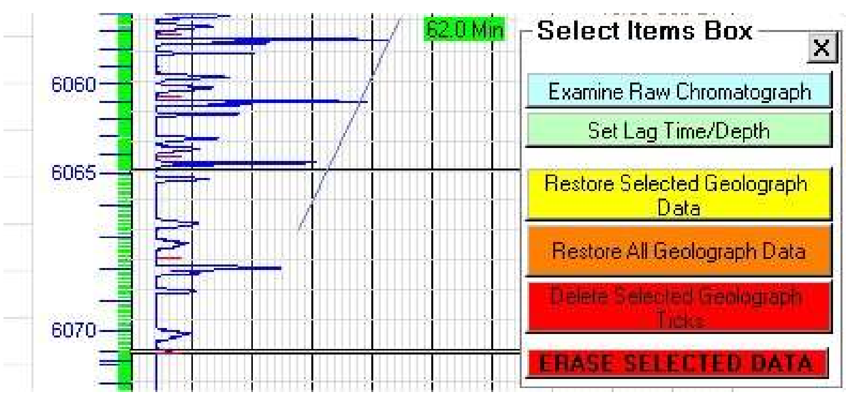
Monitor the chromatograph output using the gas charting software. The output should look something like the adjacent figure. Adjust the column temperature until the desired performance of the chromatograph is achieved. Keep in mind that natural gas is mostly methane. If you increase the column temperature too much, the C1 and C2 peaks will merge when raw natural gas is present.

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.

FIGURE 12 – CHROMATOGRAPH OUTPUT EXAMPLE

To adjust peak time, page 19 of the User Manual for Gas Charting Program. Here is a copy of that page:



Select Items Box

Double left clicking on the gas 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 geolograph tick 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.

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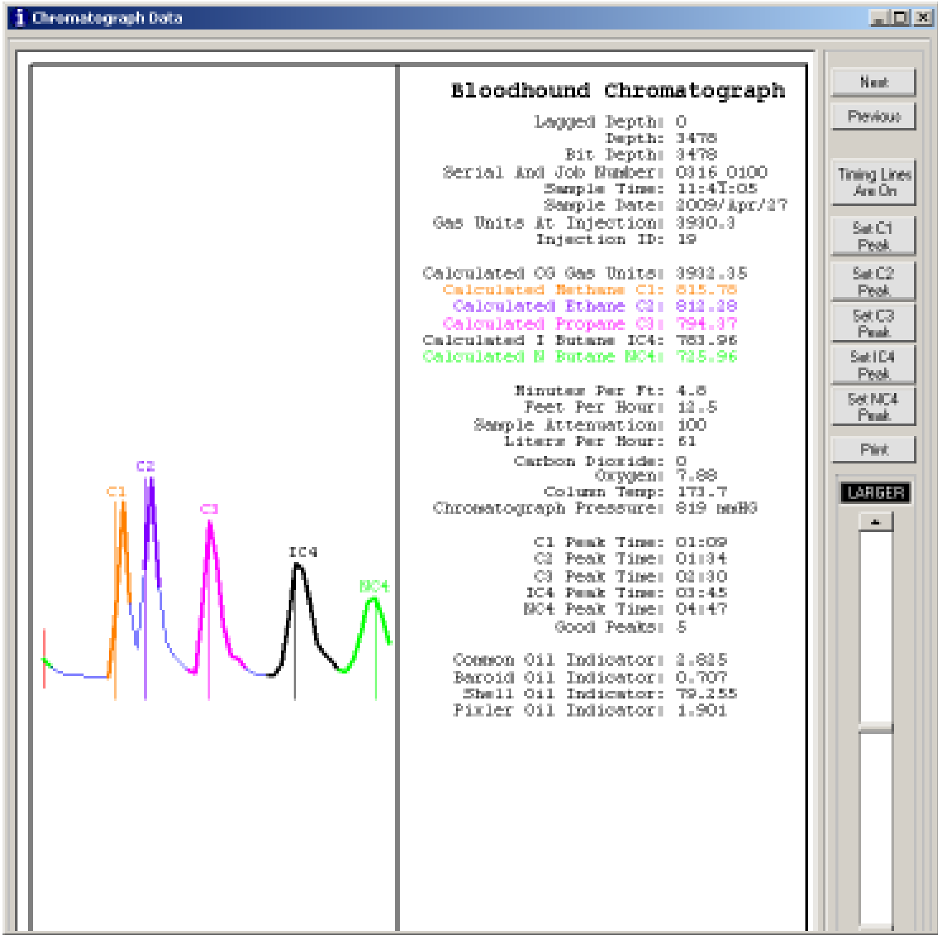

Chromatograph Data Window

Examine Raw Chromatograph This button allows the user to see a close-up view of the selected chromatograph output. Left clicking and holding on the chromatogram will allow the user to adjust the trace up and down on the display window. If the trace is too large or too small, the user can adjust the over all visual size in the Program and Equipment Setup Screen, under the Chromatograph Tab. When the user is satisfied with the display, a print can be made of the chromatogram.

The peak search times are shown as heavy-colored overlays on the chromatograph curve. Each time-window is centered on its associated vertical line. The width of the time windows is controlled by Bloodhound™ registers 61 through 65.

The data for the particular chromatogram is available to the right of the chromatogram. If a particular peak timing is off, or is incorrectly labeled, then all the user has to do is click on the Set Cx peak, place the cross hairs over the correct peak, and DOUBLE CLICK on the peak to set the new timing window for that component.

To see the previous separation, hit the Previous button. To see the next separation, hit the Next button.

Calibrating or adjusting the flow rate:

If you want to calibrate the flow rate, get a flow meter.
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 knob clockwise to increase the flow rate. Adjust to 1LPM or so using the external flow meter.
wait 30 seconds, then hit enter on the console connection and the Bloodhound will lock in this new flow rate.

To just manually up the flow rate set register 10 to a pump power number from 1 - 199. This will set the sample pump motor power level. The Bloodhound will not be able to automatically adjust the flow rate. This would be like setting the knob on a flow meter to adjust the overall flow rate.

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8. COMMAND LINE INTERFACE

The Bloodhound™ is 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 the side, front, or back of your computer. 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.iballinstruments.com

After connecting to the Bloodhound™, if there are serial packets coming out of the instrument, pressing the [ENTER] key will temporally suspend the transmissions of the packets for 60 seconds. This is to preclude interference with the command structure. When no more commands are coming in, the data packets will automatically start being sent again.

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

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 typing, you must enter the command
```
ECHO ON[ENTER]
```

The commands available are:

SETREG	READREG	VER	UPLOAD	REBOOT
STATUS	CALIBRATE	SETTIME		SERIALNUM
ECHO	LINK		GEOHIT	SETDEPTH
CGTEMP	CGSAMPLE	MUTE	?	
	SETUP MODEM	SETPACKETNUM	HOBBS	SETJOBNUM
SHUTDOWN	COPY	TRANSFER	WRITEETIME	

SETREG
All functions of the Bloodhound™ are controlled using register settings. Registers are small points of non volatile memory that hold information critical to the operation of the Bloodhound™. The registers are described in Appendix B. The register command 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 – 255. The rest are used for non volatile storage and should not be modified unless directed by a representative.

To set a register to a different value type in the command:
```
Setreg 5 0[ENTER]
Register 5 is 0
```

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

READREG
To read a register from the Bloodhound™, enter the command READREG followed by the register number to read. Register numbers are from 0 to 32767 and the register values range from 0 to 255.
To read a register enter the following command:
```
readreg 5
```

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```
Register 5 is 1
```

VER

This command returns the version of the software load.
To check the software version load enter the following command:

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

UPLOAD

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

REBOOT

This command performs a hardware reboot on the Bloodhound™. This has the same affect as powering off the unit and then powering back up.

STATUS

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

CALIBRATE

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

```
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 both the sensors for the sample vacuum and the chromatograph pressure, first disconnect the chromatograph pressure and sample vacuum lines from the sensors on the Brain Board. Then enter the CALIBRATE VAC command. After a few seconds, hit the [ENTER] key to return to normal operations. After calibration, the vacuum level will be set between -6 and -8 mmHg before connecting the lines. It will not show zero. This is to compensate for tubing length. Reconnect the chromatograph pressure and sample vacuum lines to the correct sensors on the Brain Board.

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 1 liters per minute (LPM). Since the Bloodhound is drawing a vacuum, connect the tubing to the top of the flow meter. Close the flow regulator knob so that a vacuum is shown on the Bloodhound to be about –30 to –40 mmHg. This simulates a long piece of sample tubing. Then enter the CALIBRATE FLOW[ENTER]. The flow meter should drop to zero. Turn the knob on the face of the Bloodhound clockwise until 1LPH is shown. Wait 20 seconds for the flow to stabilize and then hit [ENTER].

NOTE: Wait at least 20 seconds for the flow to enter before hitting [ENTER]

SETTIME

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

```
Settime [ENTER]
```

The Bloodhound™ will respond with the following string;

```
To set the time, use command SETTIME ???? VALUE
Use HOURS, MINUTES, SECONDS, DAY, DATE, MONTH, YEAR
```

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```
Use only up to 2 digits in all fields
Example: SETTIME HOURS 18

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

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

```
SETTIME HOURS 14
```

The Bloodhound™ will respond with the new date

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

NOTE: Please use the 24 hour time format

SERIALNUM

Serial number is displayed on data stream header.

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

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

And the new serial number will be displayed.

ECHO

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

```
ECHO ON [ENTER]
```

To turn the echo off, just enter the command:

```
ECHO OFF [ENTER]
```

LINK

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

Valid link commands are:

```
Link GPS[ENTER]
Link USB[ENTER]
Link MODEM[ENTER]
Link WITS[ENTER]
Link PC[ENTER]
Link HRM[ENTER]
Link ETHERNET[ENTER]
```

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

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

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

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

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

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

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

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 190 degrees F. There is a thermal fuse set at 240 degrees F. Temperature is in degrees F.

```
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]
```

WRITEETIME

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

WRITEETIME C1 70

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

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

```
MUTE 0[ENTER]
```
Will turn on the alarm tone if an alarm is present

```
MUTE 5[ENTER]
```
Will mute the Bloodhound for 5 minutes

```
MUTE 1000[ENTER]
```
Will turn off the Bloodhound alarm.

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

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

```
?[ENTER]
Bloodhound 4
```

SETUP MODEM

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

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

Then, set register 55 to the number from the chart above using the SET REGISTER command.
You can then monitor the connection using the lower right hand corner of the LCD screen. Some notes that are important to watch for is RSSI, CN and NC. The RSSI stands for Received Signal Strength Indicator and ranges from 0 to 100%. The higher the RSSI number the better the connection to the cellular network and to the Bloodhound servers. When using the GPRS modem, **CN** indicates a current connection to the server and **NC** indicates no connection

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

```
SETPACKETNUM[ENTER]
Packet number is: 187889

SETPACKETNUM 100[ENTER]
Packet number is: 100
```

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

```
HOBBS[ENTER]
Run Time: 20359 minutes

HOBBS 500 SET[ENTER]
Run Time: 500 minutes
```

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

To view the job number just enter the command

```
SETJOBNUM[ENTER]
JOB NUMBER IS: 106
```

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

```
SETJOBNUM 1223[ENTER]
```

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```
JOB NUMBER IS: 1223
```

And the job number will be set.

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

```
SHUTDOWN
Unit entering shutdown mode

SHUTDOWN
Unit exiting shutdown mode
```

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

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

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

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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 over 255 registers that hold a number 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. An explanation of the Bloodhound™ registers can be found in Appendix B.

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.

The active registers are listed in Appendix B. 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 menu, through the serial port, or remotely through the wireless connection.

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

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

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10. 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:

```
*0001_0103,2009/01/15,07:48:30,1843.6,186.76,20.16,0.00,29,76.8,5.400,11.111,59,15,13.3,4.095,1.248,92,0.650
510,0.380,0.00,0 ,30,0,115.5,60,-0.0,82.1,1126,3293370,0.53,0.28,1.48,136.62,47.74,7,148.3,C88,
```

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". Earlier versions of firmware do not include a checksum item. If new monitored items are added to the comma delineated list, the checksum will always be the last item on the list.

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

If the packet starts with a "*" then it is the main Bloodhound™ data packet.
If the packet starts with a "^" then it is a WITS or WITSHL data packet information.
If the packet starts with a "@" then it is a Bloodhound™ minimum data only packet.
If the packet starts with "!!" then it is a Mainlog data only packet.

David Fuller's Mainlog is a software package that is compatible with the Bloodhound™ system. If you wish to use Mainlog with the Bloodhound™, please contact David Fuller at www.mainlog.com for the latest download of the charting/logging program.

The descriptions of the data packets are as follows.

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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	8 Bit Checksum	Byte	0 – 255

NOTES:

1> The packet number always increments by one as packets are sent. Packet numbers will roll over if greater then 4 billion, or if greater than 2 billion and the job number is changed.

2> Chromatograph test number will roll over at 65536

3> If the last comma delineated item is the simple checksum, it will always have a C preceding the ASCII 8 bit number.

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.

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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)***
High Flow Rate	5	Reg 50: factory setting 200 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) Set to 0 to disable
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) Set to 0 to disable
HRM Warming Up	13	
Unit In Shutdown Mode	14	No register settings
Geolograph Switch Noise	15	Reg 33: factory setting 180 spikes Set to 0 to disable
CG Low Pressure	16	Reg 54: factory setting 70 (means 700 mmHg) Set to 0 to disable
High H2S Reading	17	Reg 56: factory setting 50 Can set from 0 to 200 Set to 0 to disable alarm. To disable data stream set reg 41 to 0.
Exhaust Blocked (high ex prs)	18	Set to 50 mmHg - No register setting

B. WITS Data Fields Packet

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

WITS Packet Example:

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

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

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

0108 Bit Depth
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

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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

C. Bloodhound™ Data Sent Out to Wellsite EDR via WITS

The Bloodhound™ is set up to send a packet out to the wellsite EDR via WITS every 6 seconds. 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 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 (ditto)
1214 – C3 (ditto)
1215 – iC4 (ditto)
1216 – nC4 (ditto)
1222 – CO_2
1225 – O_2
0141 – H_2S
0139 – Lag Calc

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

&&
01400.0000
12120.00
12130.00
12140.00
12150.00
12160.00
12220.00
122520.92

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01410.00
01390.0
!!

D. 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

E. Mainlog Packet System

David Fuller has been working closely with iBall Instruments to make his software compatible with the Bloodhound™ system. We have devised a packet system that would satisfy his system. To start the Mainlog compatibility mode the user or program sends the correct string. Every time the user or program sends this string the Bloodhound™ will return the Mainlog packet. On the lower right hand corner of the Bloodhound™ the system will scroll through and show a tag of “MAINLOG xx” where the xx is a count down timer. If the timer reaches zero, the Bloodhound™ will come out of the Mainlog mode and resume normal operations. If a port (such as the PC port) is in Mainlog mode, the other ports are not affected. This means that the GPRS and Ethernet packets are as normal while the PC port operates with Mainlog.

To start the Mainlog mode send

```
MLSTART[ENTER]
```

and the following packet will be sent every time the string is seen.

```
&&
01081844.2
01101844.2
01160.0
01200.00
01210.0
01230.0
01240.0
01250.0
01280.0
```

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```
0140186.29
12120.53
12130.28
12141.48
1215136.37
121647.65
12220.00
122520.15
08210.0
08240.00
010192
!!
```

Note: While in the Mainlog mode, after every point of data there is a carriage return and line feed.

The packet structure is identical to the WITS data system of data. 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. For more information please read the WITS information data system in this manual.

For setting up the Bloodhound™with a computer running Mainlog, see Appendix I.

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11. 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

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- 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,
```

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APPENDIX A

OVERVIEW OF
DETECTOR TECHNOLOGIES

Hot-Wire Technology

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

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

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

The heated wire's electrical resistance increases with the wire's temperature, which limits electrical current flowing through the circuit. When sample gas with hydrocarbons flows past the very hot-wire, the wire burns the hydrocarbons, creating more heat and thereby increasing the wire's resistance, which in turn tells the electronics that there are burning hydrocarbons present. The resulting decrease in current flow causes a gauge or other read-out to indicate an increase in the concentration of combustible gases.

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

Further, when high levels of hydrocarbons were burned on the heated wire, carbon deposits would build up on the wire, which could permanently change the zero point and the sensitivity of the heated wire.

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

Pellistors (Catalyst Bead)

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

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

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

Hot-Wire and Pellister Systems

Old hot-wire and catalytic bead systems generally have a linear reaction to hydrocarbon gases up to and around 3%. At higher concentrations there is usually carbonizing and damage done to the sensor itself. A Thermal Coefficient Detector (TCD) usually has a general linear reaction to hydrocarbon gases up to and around 100% but has very little response to hydrocarbon gases in air under 5%.

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In virtually all older gas detector systems, the designer had the choice of utilizing a hot-wire detector with the ability dilute the gas being sampled with air when large gas percentages are detected. Alternatively, many systems incorporate the ability to electrically switch off the hot-wire and continue monitoring with a TCD in the presence of larger percentages of hydrocarbon gases. Both systems have a real potential of causing irreparable damage to the hot-wire system due to excessive hydrocarbon gases around the detector in the case of the switch-timing being incorrect or faulty.

The linear reaction of hot-wire detectors and thermal coefficient detectors are dissimilar with diverse gases and have a median reaction with raw general non-refined natural gas such as that found extracted from the drilling fluids at a natural gas or oil drilling rig.

Infrared Detectors

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

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

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

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

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

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APPENDIX B

BLOODHOUND™ REGISTER INFORMATION AND SETTINGS

The Bloodhound™ (BH) register settings enable the unit to be flexible as well as powerful in operations. Registers are small points of information held in non-volatile memory locations that dictate how the BH operates. There are 255 registers that hold a number from 0 to 255. All operational settings are made through register values one way or another. Do not set register values unless you know what the results will be. Incorrect register settings may cause the BH to have undesired results, become unstable or even unusable.

THERE ARE 2 WAYS TO CHECK REGISTER VALUES AND 3 WAYS TO CHANGE REGISTER VALUES.

1. ON THE BLOODHOUND™: 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 line, and use up/down keys to scroll to register of interest. Registers 1 through 6 and 8 are not available in this way.

2. GASCHART SOFTWARE ON A COMPUTER DIRECTLY CONNECTED TO 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. To read a register, type READREG RN (where RN 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 BH. To set a register, type SETREG RN ## (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 BH.

3. CONNECTION TO THE BLOODHOUND FROM THE IBALLREMOTE WEBSITE: THIS IS FOR LEVEL ZERO USERS ONLY, AND WILL NOT BE DESCRIBED HERE.

REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
1	Stay in internal code.			85	This register tells the BH to stay in internal program code or jump to external program code. Internal program code is a boot loader program that allows the upload of new program code into the system. VALUE = 85 ok to go to external code. VALUE (anything else) stay in internal code.
2	External program verification.			85	This register tells the BH if there is a valid program code installed into the unit. If this register is not set to 85 then the unit will remain in internal code. VALUE = 85 valid program in external flash. VALUE (anything else) not valid program in flash.
3	RESET COUNTER				see over time if there has been an abnormal ys in internal code because there is something
4	External code version.				This register holds the external firmware code version.
5	Absolute number of resets high byte				Register 5 and 6 work together to make an unsigned integer which is the absolute number of resets from the very first power up.

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
6	Absolute number of resets low byte				Register 5 and 6 work together to make an unsigned integer which is the absolute number of resets from the very first power up.
7	UNUSED			0	
8	First time power up register setup			85	If this register is not 85 then a routine is called that will set the registers to factory levels. This register tells the BH if it has ever been booted before. On a first time startup, the BH sets all 255 registers to a factory default and then sets Register 8 to 85.
9	UNUSED			0	
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 is register is not zero then the BH takes this number and forces the sample gas pump to stay at this power level, typically 170 is a good number to start with. If this register is set to 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)		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			1	If this register is not 0 then the BH will send gas readings to the WITS interface after a good connection is made to the WITS interface using the null packet. 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.
13	Packet Timer	SEC		6	If this register is not 0 then the BH will spit out information through the serial port at the set seconds per packet. To see hi resolution chromat, set to 2 or 3. Be sure to set back to 6, or MDB will be HUGE!
14	Modem aware			1	If not 0 the unit will check for a modem connected to the modem port. If 0 the BH will not check for or even power up the modem.
15	GC INJECT TIMING	MIN	5-12	8	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.

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
16	Data Record Timing	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				100	
18	GC MAX INJECT TIME	SEC		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.
19				0	
20				0	
21				1	
22	GAS READING DAMPING (low range)		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 to which the change over 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.
23	UNUSED			0	
24	UNUSED			85	
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. Pason expects gas in % and that is why the 100 divisor is used. Totco/ Rigwatch expects gas to be in “Gas Units 0-10,000” which is why it needs to be set to 1 in their case.
27	Last time clean power down flag			1	If the last time it powered down was clean this register will be zero. A clean power down is where the power plug is pulled and the power off button was hit. If the unit is going through a reset, then this will be a 1.

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
28	LO & HI gas detector independence		0 OR 1	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 where ever it is at on the gas level concentration. This usually shows up as abnormally large high range gas units. The BH 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		120	This is the number of minutes before power down when the AC power is lost.
30	GAS READING ATTENUATION	%	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.
31	Reset vacuum zero point			0	If this register is set to something other than 0, the BH will reset the zero point in memory for the vacuum Point and then set this register back to zero
32	Feet per geolograph closer	FT		1	This is the number of feet incremented per geolograph contact closure.
33	Geolograph noise spike count alarm level			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.
34	Foot tick chirp	milli-seconds		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.
35				0	
36	HIGH GAS RANGE ATTENUATION			30	Same as register 30 but for the high range. Is additive to register 30. Output = (adjusted low range + (corrected and adjusted high range x (reg36/100))) x (reg 30/100)
37	High Amps Alarm on 12V Cavitator terminals	Note: 60-sec average		5	Set to 0 to disable alarm.
38				20	
39	Low Amps Alarm		0-1	1	0 = off, 1 = activate alarm

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
40	BH casing fan		0-1	1	0 = off, 1 = on
41	H2S sensor Defeat		0-1	1	0 = no data - off, 1 = on (firmware >= 170). Every time the Bloodhound power is cycled this register is reset to 0 to default to the "off" position. If Register 41 = 255 the H2S sensor will remain on after a power cycle of the Bloodhound.
42	O2 Sensor Defeat		0-1	1	If this register is set to 0 then the O2 sensor 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.
43	CO2 Sensor Defeat		0-1	1	If this register is set to 0 then the CO2 sensor is effectively off and will read zero, 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
44				0	
45	ALARM MUTE TIMER	MIN	1-25	10	Mute timer in minutes. NOTE: not to exceed 25. This is the number of seconds that the mute key will mute the alarm tone.
46	High internal temp level			120	High internal temp level usually set to 120 deg F
47	low internal temp level			35	low internal temp level usually set to 35 deg F
48				54	
49				176	
50	High sample flow alarm setting	LPH		200	Manual says "Normally set to 90"
51	Low sample flow alarm setting	LPH		20	Manual says "Normally set to 40"
52	High Vacuum level alarm setting	mmHg		200	200 means -200 mmHg
53	High gas units alarm level			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. Set to 0 to turn off. Factory set at 22 (2200 gas units)
54	Chromatograph low pressure alarm setting	mmHg		70	When the chromatograph pressure falls below 10 times this level an alarm is set. Set to 0 to disable. (70 = 700 mmHg)
55	GPRS MODEM CARRIER SELECTION			1	1 - Cingular/New ATT system (default, most popular); 2 - Old ATT system "PROXY"; 3 - Old ATT system "INTERNET"; 4 - Old ATT system "PUBLIC"; 5 - T-Mobile; 6 - Cellular One NOTE: After setting register 55, set register 123 to 1
56	H2S alarm level in parts per million	PPM	0-200	50	0 = off. IF the H2S is above this level then the alarm will sound. The alarm is off, not the sensor. Go to Reg 41 to shut off the sensor.
57	External alarm relay control.		0 or 1	0	If this register = 0 then the alarm relay will close on all alarms. If this register = 1 then the alarm relay will close on just the H2S alarm. This does not effect the normal alarms.

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
58	GC AVERAGING TO ELIM NOISE FLOOR		1-35	1	
59	debug messages control			0	This will send debug messages over the given port: 0 = debug messages off; 1 = PC PORT; 2 = WITS PORT; 3 = MODEM PORT; 4 = SB72 PORT; 5 = off; 6 = HRM PORT
60				0	
61	C1 timing window before and after peak time			6	C1 timing window before and after peak time (vert line)
62	C2 timing window before and after peak time			6	C2 timing window before and after peak time (vert line)
63	C3 timing window before and after peak time			25	C3 timing window before and after peak time (vert line)
64	IC4 timing window before and after peak time			35	IC4 timing window before and after peak time (vert line)
65	NC4 timing window before and after peak time			40	NC4 timing window before and after peak time (vert line)
66	Chromatograph noise floor window			20 (opt. value is 5)	This is the size, in hundreds of microvolts, of the noise window for the chromatograph. Typically 20 (= 2000 microvolts = 2 millivolts) on the HRM03
67	WITS data sending mode			0	0 = Send with Pason WITS handshake (note: zero DOES work with Rigwatch & TOTCO) 1 = Send with no handshake (only for special clients who want no handshake)
68	WITS C values sending format			0	0 = Send as Gas Units 1 = Send as PPM
69					
70	MODBUS		0-1	0	0 = pc port is normal, 1 = MODBUS is active on pc port, no serial port is available to connect to BH.
71	Slave address for	ZZ-NC-485	0-1	0	0 = no search, 1 = look for MODBUS zz-nc-485
72	Slave address for	MFC10	0-1	0	0 = no search, 1 = look for MODBUS MFC10
73					
74					
75	MODBUS serial port speed		0-1-2	0	0 = 115200, 1 = 19200, 2 = 9600
76	MODBUS serial port parity		0-1	0	0 = 8 data byte-no parity-1 stop bit, 1 = 8 data byte-even parity-1 stop bit.
77					
78					
79					
80					
81					
82					
83					
84					

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95	External code 8 bit checksum				This is the external code checksum
96	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
97	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
98	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
99	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
100	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
101	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
102	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
103	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
104	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
105	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
106	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
107	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
108	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
109	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
110	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
111	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
112	Serial number up to 15 ASCII characters				Register 96 - 112 inclusive
113					
114	Modem IP Address				The 4 address spaces for the IP that the modem is to connect to.
115	Modem IP Address				The 4 address spaces for the IP that the modem is to connect to.
116	Modem IP Address				The 4 address spaces for the IP that the modem is to connect to.

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REG.	FUNCTION	Units	Range	Factory Setting	COMMENT
117	Modem IP Address				The 4 address spaces for the IP that the modem is to connect to.
118	High byte TCP Connection port to host computer				(REGISTER118 * 256) + REGISTER119 = "Data Port" number
119	Low byte TCP Connection port to host computer				(REGISTER118 * 256) + REGISTER119 = "Data Port" number
120	Internal code version				
121					
122					
123	Configure GPRS Modem		0 OR 1	0	After setting register 55, or installing a new modem, set register 123 to 1. After the BH is finished configuring the GPRS modem for both the GPRS network and the correct server IP and Port, it will then reset register 123 back to 0.
124					
125					
126					
127					
128					
129					
130					
131					
132					
133					
134					
135					
136					
137					
138					
139					
140	Low byte of the job number				
141	High byte of the job number				
142					
143					
144					
145					
146					
147					
148					
149					
150					

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APPENDIX C

Bloodhound Cellular Carrier Setup (Register 55)

When using the GPRS modem option to communicate to the server, the modem has to be told what carrier it is to use so that it can set it up correctly.

1 - Cingular/New ATT system (default)
```
AT+CGDCONT=1,"IP","ISP.CINGULAR","",0,0              -- Cingular
AT%CGPCO=1,"ISP@CINGULARGPRS.COM,CINGULAR1",0        -- Cingular (login / password)
```

2 - Old ATT system "PROXY"
```
AT+CGDCONT=1,"IP","PROXY","",0,0                     -- AT&T connection
at%cgpco=1,",",0                                     -- AT&T connection (login / password)
```

3 - Old ATT system "INTERNET"
```
AT+CGDCONT=1,"IP","INTERNET",,0,0                    -- AT&T connection
at%cgpco=1,",",0                                     -- AT&T connection (login / password)
```

4 - Old ATT system "PUBLIC"
```
AT+CGDCONT=1,"IP","PUBLIC",,0,0                      -- AT&T connection
at%cgpco=1,",",0                                     -- AT&T connection (login / password)
```

5 - T-Mobile
```
at+cgdcont=1,"IP","internet2.voicestream.com",,0,0   -- T-Mobile ??
at%cgpco=1,",",0                                     -- T-Mobile ?? (login / password)
```

6 - Cellular one
```
AT+CGDCONT=1,"IP","CELLULAR1","",0,0                 -- Cellular one
at%cgpco=1,",",0                                     -- Cellular one (login / password)
```

7 - Old Cingular
```
AT+CGDCONT=1,"IP","WAP.CINGULAR","",0,0              -- Cingular
AT%CGPCO=1,"ISP@CINGULARGPRS.COM,CINGULAR1",0        -- Cingular (login / password)
```

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APPENDIX D

POSSIBLE ALARM MESSAGES FROM BLOODHOUND™

Condition	Alarm Number	Bloodhound™ Register Setting
No Alarm	0	
Blocked Sample Line	2	Reg 52: factory setting 200 (means –200 mmHg)
Detector Voltage High	3	No register setting - Automatic from HRM
Detector Voltage Low	4	No register setting - Automatic from HRM
High Flow Rate	5	Reg 50: factory setting 200 LPH
Low Flow Rate	6	Reg 51: factory setting 20 LPH
Low Power Voltage	7	Set at 11.1 VDC No register setting
High Amps going out to 12V Cavitator terminals (60 second average)	9	Reg 37: factory setting 5 Set to 0 to disable
High Temperature inside Case	10	Reg 46: factory setting 120 degrees F
Low Temperature inside Case	11	Reg 47: factory setting 35 degrees F
High Gas Units	12	Reg 53: factory setting 22 (means 2200 units) Set to 0 to disable
HRM Warming Up	13	
Unit In Shutdown Mode	14	No register settings
Geolograph Switch Noise	15	Reg 33: factory setting 180 spikes Set to 0 to disable
CG Low Pressure	16	Reg 54: factory setting 70 (means 700 mmHg) Set to 0 to disable
High H2S Reading	17	Reg 56: factory setting 50 Can set from 0 to 200 Set to 0 to disable
Exhaust Blocked (high ex prs)	18	Set to 50 mmHg - No register setting
Note: If Pri and Sec Volts = 0.010		Instrument has been flooded - return to iBall

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APPENDIX E

THE iBALL INSTRUMENTS 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 megabaud 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

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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 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.

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APPENDIX F

The Bloodhound™ Chromatograph Design
Theory and Application

A bit of terminology first:

The Elution Time is the time it takes for a single gas to peak while going through a CG column out of a mix of gases.

The Solution Time is the time it takes for all of gases in the entire mix of gases to go through the CG column.

The C1 (methane) - C2 (ethane) separation is always the most challenging. Complaints of losing the ethane separation are common, and there are only two ways to improve this separation. One is to decrease your pressure (flow rate) so that it takes more time for a solution. The C1-C2 peaks will be farther apart. The problem is also that the total solution time will also lengthen. Because raw natural gas is almost all methane, and since ethane has such a problematic separation through the column, the key is to use a more efficient column to have a better separation between the two. A more efficient column would make the methane spike less fat at the base and the peak taller. This also means that the methane spike would contain a higher percentage of methane vs. travel gas at the apex.

There are number of good books on the subject, but a couple of the most useful ones that are recommended are:
Basic Gas Chromatography, Harold M McNair – ISBN 0-471-17261-8
The Essence of Chromatography Colin F Poole. – ISBN 0-444-50199-1
Both are good but the second one is heavy on the liquid chromatography.

Over 99% of all gas chromatography today is implemented via a temperature-controlled or temperature-programmable capillary tube column system. By far these systems can be the fastest in solution times. Depending on the detector used, a solution can be resolved in less than two minutes. This includes separations of hydrogen, oxygen, nitrogen, water vapor, CO_2 and all the other gases commonly found in a sample. The problem is that these columns are highly fragile and usually are built on a glass or ceramic substrate and have an outer diameter of under 0.125" and can easily be hundreds of feet in length. A good jolt can easily destroy a $1,500.00 column. Another problem is that they almost always have to use a mobile phase of hydrogen or helium. Furthermore, the detectors must be extremely sensitive, which usually means they are fragile, as the injected sample must be anywhere from $1/10^{th}$ to $1/100^{th}$ of what is currently used in traditionally packed columns. A large number of the detectors are flame ionization detectors (FID), which means that there may be another bottle of gas required. These facts influenced the decision to use a packed column in the Bloodhound.

A packed column appears to be the only practical method to deliver a rugged and portable gas chromatograph system. Our research was directed to the design and production of a premier packed column that would fit into the portable Bloodhound case yet still be comparable to or better than most natural gas chromatograph systems.

A 6' 0.250" OD column will provide a 5 minute solution at around 20 to 40 PSI based on a plethora of other variables with the goal of providing the best C1-C2 separation possible.

The most important of the variables are:
- Mobile phase
- Pressure
- Temperature
- Column length
- Packing material
- Detector
- Injection time
- Injection quality
- Contaminants

The following is an overview of each one of these variables and its effects on the solution and perhaps additional knowledge as to how the Bloodhound system operates and balances these issues.

MOBILE PHASE
The mobile phase is the travel gas or the air that is injected into the column at a constant pressure and flow rate. In the systems that we build, this is also known as wet atmosphere. All common air contains some moisture. On a

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humid day there is more. In the desert there is less. Dry atmosphere is common air that has been chemically or mechanically had the water vapor removed. When wet atmosphere is compressed above its new dew point, water will condense into the lines. Water is considered to be a contaminant in gas chromatography. Water is usually not a problem at the pressures at which we run, usually below 30 psi. Above that it could start to be a problem because of the amount of potential condensed liquid water. This water is usually disastrous to capillary columns. A new and very nice product out today is a membrane water separator. If you have high column pressures and want to use dry atmosphere as a travel gas, then you can get a compressor, and a membrane drier and have almost all the water removed which makes for a nice cheap travel gas. The Bloodhound system employs minimal pressure and keeps the column temperature much higher than ambient, and the line length minimal, so that the water stays in a vapor state and should not affect the detector.

PRESSURE

As the pressure of the column goes up, the flow rate of the travel gas will increase. It is not so much the pressure on the column, but the increase of travel gas or "mobile phase" flow rate through the column that will speed up the solution time. If the flow rate of the column is decreased, the solution time is longer but more defined with better and higher isolated peaks. This is a gain of column efficiency. If the flow rate is increased, the solution time is shorter and the peaks come closer together. Also, the base of the peaks get fatter and actually start to merge beyond a given point. This results in a loss of column efficiency. The other problem with higher column pressure is water. If the system uses "wet" atmosphere as the travel gas, a higher pressure will encourage liquid water to form and be forced through the column. Many packed columns are adversely affected by this water contaminant. The Bloodhound™ system uses a fixed pressure pump operating at the lowest amount of pressure as possible and a fixed flow rate through the column. Because the task of measuring and controlling the physical pressure and flow rate of the column is a difficult mechanical task, the Bloodhound™ system digitally controls the temperature of the column to adjust the solution and elution times.

TEMPERATURE

The temperature of the column affects the solution time. Column temperature vs. solution time is a non-linear relationship. As the temperature of the column goes up, the time it takes for the complete solution decreases. This also causes a loss of column efficiency (peak separation). As the temperature of the column goes down, the time it takes for a complete solution to go through goes up. This is a gain of column efficiency. The flow rate is affected but not to a very large extent and to an inverse effect. The Bloodhound™ system controls and maintains the column temperature to control the solution time. This column temperature adjustment is now in the hands of the operator or remotely adjustable. Also, a higher than ambient column temperature helps keep any water contaminant in a gaseous state.

COLUMN LENGTH

The length of the packed column also has an effect on the solution time and quality. As a general rule, the longer the column, the better quality, higher efficiency, and more (higher) isolated peaks will be returned. The cost is time. Since a longer column will be more efficient at separating and heightening the peaks, it will also take longer to do it. But in the mudlogging world, a minimal solution time is demanded. Because of this, the pressure or temperature must also be increased to compensate for the longer column length and solution time. This increase in pressure (flow) or temperature will decrease the solution time and the efficiency of the column. Therefore, gaining length to increase efficiency is counteracted with an increase in pressure or temperature to shorten the solution time, thereby decreasing efficiency. This becomes a vicious circle. Generally, there is an overall slight gain in elution efficiency in this trade off. The maximum practical column length, with no holds barred, is 18 feet of 1/4" ID nylon tubing at 110 to 120 psi using dry atmosphere at 130 degrees F. In such a system you can have about a 1 to 2 minute solution or less. Better if you use a pure travel gas such as hydrogen, helium or even nitrogen. Since the Bloodhound™ system needs a minimal solution time and maxim C1-C2 separation and still fit into the case for portability, a column length of 6' is used. Adjustments can be made with the column ID size too where a larger ID tubing will result in a slightly lower efficiency but with less over all pressure needed with an increase of packing material amount.

PACKING MATERIAL

The Bloodhound™ uses a proprietary engineered product known as AZVO™ for the column packing material. Most mudlogging systems use a very good mix of hexadecane and 60-80 Chromasorb P-AW. We believe that AZVO™ has better water immunity and also has a slightly smaller particle size which generally means more surface area presented to the gases that need to be separated. It packs slightly tighter and needs a little more pressure with everything else being the same. A tighter packing means a little more efficient column but requires a little more pressure too.

DETECTOR

The perfect detector can react to anything, emits no noise on the trace, and thus can have an incredible amount of gain so that it can detect even the slightest amount of gas out side of the travel gas. As important as the detector

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itself is the housing it is in. A large chamber area around the detector will allow the separated gases a chance to dilute or even remix, thus destroying the desired elution. Because of this, the smallest physical chamber area around the detector is always desired. In order to have a proper C1-C2 separation, you have to minimize the size of the detector chamber. Furthermore, for all the same reasons, capillary tubing, which is tiny thin tubing, should be used to transfer the gases from the exit of the column to the detector if the exit of the column is not already attached to the chamber.

A TCD or Thermal Coefficient Detector is used where there is a high difference in the thermal coefficient in the gases being detected and the travel gas. This detector works on the principal of wicking heat off the surface of the detector. Different gases will wick off more heat than others. This difference in sensor heat is ultimately translated into a voltage change. Because every gas has a different thermal coefficient, this is also known as a universal detector. This is an effective and good sensor to use when using hydrogen or helium as a travel gas. This is because hydrogen and helium have a high wicking coefficient. When one of the other gases comes out of the column, the detector heats up rapidly and then cools rapidly. This is not an effective sensor when using atmosphere as a travel gas. This is because air has a close thermal coefficient to the gases under sample. Small amounts of gas will simply not cause enough of a temperature change on the face of the sensor.

A hot-wire is more commonly used in mudlogging systems. This is a special wire that is heated by electrical current. As a gas flows past the wire, it heats up and the resistance changes. This is ultimately changed into a voltage change which is detected. The drawback to a hot-wire system is that if too much gas is given to the wire, it will carbonize and start to decay and lose its sensitivity. Because raw natural gas is almost all methane, and if you have a highly efficient column with minimal travel gas, and your are going through a pay zone, the methane spike coming out of your column could be close to 25% or more of pure methane. This much methane on a hot-wire system, even if brief, will quickly destroy a hot-wire detector, especially if there is an injection every 5 minutes or so. Care must be taken when using a hot-wire detector as to not over-range the physical limitations of it or damage will ensue.

A flame ionization detector (FID) is an ion detector. The source of these ions is almost always a small hydrogen-air flame. The flame burns at such a temperature as to ionize most organic compounds, this produces positively charged ions and electrons. In order to detect these ions, two electrodes are used to provide a potential difference. Usually, the positive electrode is also the nozzle head where the flame is produced. The negative electrode is positioned above and in the flame itself. New systems have the positive and negative pins within the flame with the nozzle floating. The ions are attracted to the negative electrode and upon hitting the pin, induce a current. This current is measured with a high-impedance high gain ammeter. The current measured is mostly proportional of the reduced carbon atoms in the flame. The benefits of the FID is that it can be a highly sensitive detector but the drawbacks are rather large in that there has to be a large bottle of fuel gas if it is not the travel gas itself such as hydrogen. There are hydrogen generators available but are usually expensive and require a source of distilled water. Then there is that whole open flame around combustible gases thing.

Infrared (IR) detector. Infrared detectors are very nice and are currently being used in the Bloodhound™ system. In the IR detector there is an infrared source that illuminates a volume of gas that has diffused into the measurement chamber. The gas absorbs certain of the infrared wavelengths as the light passes through it while others pass through completely un-attenuated. The amount of absorption is related to the concentration of the gas. The difference of the absorption is measured by a set of optical detectors and subsequent electronics. The change in intensity of the absorbed light is measured relative to the intensity of light at a non-absorbed wavelength. The Bloodhound™ microprocessor computes and reports the gas concentration from the absorption.

Earlier versions of the Bloodhound™ gas chromatograph used infrared detectors. The current versions of Bloodhound™ chromatograph use a combination of TCD (thermal conductivity detector) and a special hot-wire known as a pellistor. If the percentage of gas goes above a safe level for the operation of the pellister, the pellister is switched off and the TCD is left on to continue to operate at the higher gas levels. As the gas level drops, the pellister is switched back on and resumes detection thereby eliminating any damage to the pellister.

INJECTION TIME

The injection time is simply the amount of sample gas that is injected into the chromatograph column. A larger amount injected will have more gas to be separated and will usually have larger bases and higher peaks. A smaller injection time will have less gas to separate and will have more narrow and shorter peaks. This is the other problem with the C1-C2 separation. Because raw natural gas is mostly methane, the wide methane base starts to merge with the ethane elution. If too much sample gas is injected into the column, the gases will actually start to take the place of the travel gas and the separations will start to combine. This is known as column saturation. When the injections are too small, there may not be enough gas to trigger the detector. Because raw natural gas is mostly methane, and if a large amount of sample gas is injected, many hot-wire systems will start to quickly decay because

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the methane spike will be huge compared to the trace gases that follow. Many loggers increase the injection time to try to increase the trace gas observations while forgetting the amount of methane they are carbonizing the hot-wire with. By carbonizing the hot-wire, they make it less sensitive; another viscous circle.

The Bloodhound™ system takes into account the total gas units that are detected and automatically adjusts the injection time to keep the amount of injection normalized so as to preclude over-ranging the detectors or saturate the column. This helps ensure the maximum performance out of the ever changing volume of gases to be analyzed.

INJECTION QUALITY
The quality of the injection is important as well. If for instance the sample to be injected is air diluted, the sample trace gases may be too diluted for the detector. The Bloodhound™ does not have any air dilution system so it does not become a factor in the quality of the injection.

CONTAMINANTS
Contaminants are anything that is in the sample or travel gas that is undesired. Basically the major things that degrade the column efficiency or detector sensitivity are water from the air, and oxygen.

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APPENDIX G

Running MainLog on an Attached Computer

Overview:
This information is to help the operator of the Bloodhound system to set up a computer to utilize David Fuller's MainLog program.

Dual Mode Use
The iBall Instruments Gas Charting program is unable to talk to the Bloodhound over the USB serial port at the same time that the MainLog program is being used. The serial port connected to the Bloodhound can only serve one program at a time, never both.

MainLog can only communicate to the Bloodhound over a serial connection. In order to use MainLog at the same time as the iBall Instruments Gas Charting Software, the iBall Instruments Gas Charting Software must communicate with the Bloodhound over the integrated Ethernet port while MainLog program talks to the Bloodhound over the serial USB or 9 pin Serial port.

Additional detail on how to set up the iBall Instruments Gas Charting Software utilizing the Ethernet port can be found on Page 3 of this document.

Setting Up The Computer To Use Main Log
To enable the serial USB connection between the computer and the Bloodhound, the user must load the serial USB driver program.

Note: *It is imperative that the* ***Bloodhound USB serial driver be loaded into the computer to be used before plugging in the Bloodhound USB serial cable to the computer.*** *If the USB serial cable is already connected, remove the USB cable and then install the serial port drivers.*

The serial port drivers can be found at www.iballinst.com/ftp/usbkey or the USB key installed into the front panel of the Bloodhound, or on the MainLog setup CD.

After loading the serial USB driver software, connect the USB cable to the computer.

Note: If the iBall Instruments Gas Charting Program is installed and running, the user must exit out of the program in order for MainLog to function over the USB serial port. This is because by default, the gas charting program will search the serial ports and connect to the Bloodhound. This will make the serial port unavailable to MainLog.

To use MainLog over the USB serial connection, the program will need to know what serial port the computer has assigned to the USB serial connection. The user may already know what serial port number the Bloodhound is on. If not, here is the procedure to establish what serial port has been assigned.

- Find "My Computer" Icon on desktop or "My Computer" in the Start Menu
- Right click on "My Computer" Icon to bring up "Properties"
- Click on Tab that reads "Hardware"
- Click on button reading "Device Manager"
- Scroll down to "Com Ports"
- Double click on "Com Ports"
- Look for "CP2101" and record the Com Port number that appears

This is the number that must be entered into the MainLog program.

Note: if the Com Port assigned to CP2101 is great than "9" then the CP2101 driver must be re-assigned to a number within the range of Com Ports 1 through 9. The procedure for reassignment is found on Page 3 of this document.

Setting Up MainLog Software to Use the Bloodhound

Start the MainLog Program

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Options:
Drilling
NOTE: This puts MainLog into the “drilling” or “active logging mode.” It will also activate and make visible new menu items if the copy of Mainlog is currently registered and active.

Setup
Gas Monitor Setup
Under type of instrument: Select “iBall Bloodhound WITS”
Set Wits com to the port previously identified and assigned to CP2101
Driver
Set the “Gas Com port” to something other than the WITS-iBall port This is not used with the iBall system.
Setup
Lines and Scales
OPTIONS (If available)
Check on “Use WITS Gas”
Check on “Use WITS Depth”
Select “Save and Close”

View
Check WITS GAS MONITOR ON

Enter Data
Lag Time
Use 15 minutes (or) the current lag time at present depth. This will start the current calculations for a given lag.

Setting Up iBall Gas Charting Program while using the Bloodhound with Main Log

Connect an Ethernet cable to the same local switch or hub that the computer is connected to.
After MainLog is running, start the iBall Instruments Gas Chart program.

Look on the front of the Bloodhound panel. Locate the LCD and observe the scrolling information on the lower right hand corner. An IP and PORT address will scroll by and appear i.e. 192.168.1.100:23. This is the IP and PORT number that the Bloodhound has been assigned to by the Gateway or Router.

Start the Gas Chart Program
When the Gas Chart Program is running and chart appears on the screen
Right click on the chart to bring up the “Gas Chart Control Box.”
Click on “Setup”
Click on “Bloodhound Tab”
Enter the Local IP PORT number obtained from the Bloodhound Display into the Local Ethernet or Internet Settings box
Check the box labeled “Use Ethernet Instead Of Serial Connection”

The Gas Chart program will now connect to the Bloodhound using the Ethernet connection

Note: If the computer is equipped with two video ports, iBall Gas Chart and MainLog can be viewed simultaneously, otherwise the user will have to minimize one program to view the other.

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APPENDIX H

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	Unblock the cooling air intake (on end) or exhaust (on bottom) or replace clogged air filter
Need to set static IP address on Ethernet connection	First connect your Bloodhound to the local LAN. On the USB key there is a program called Bloodhound_IP_Setup.exe. After running this on a computer that is also connected to the LAN, you should see in the right panel, a Netburner number. Highlight this and click on launch webpage. From the webpage, at the top, click on static instead of DHCP and include the IP address.
BH not connecting to internet	Internal BH Netburner card must be set to 115200 baud, and not have the same IP setting as the external NetburnerEX (if present)
Need to set up GPRS (cell) data service	In order for the GPRS modem to operate, there a configuration procedure that must be implemented: 1. An operational SIM (Subscriber ID Module) card must be inserted into the GPRS modem correctly. (The SIM card must have GPRS connectivity activated through the subscription service.); 2. The Bloodhound has to set up the GPRS modem according to the subscription service. After an activated SIM card is inserted into the GPRS modem, setting Register 55 to the correct value and then setting Register 123 will tell the Bloodhound to set up the GPRS modem to the user’s subscription carrier. (See detailed descriptions of Register 55 and Register 123 settings in Manual Appendix B.) A discussion of methods of setting registers is included in Manual Section 9. To set up the Bloodhound system for a subscription carrier, first set Register 55 to the appropriate number from the list below. 1 - Cingular/New ATT system (default, most popular); 2 - Old ATT system "PROXY"; 3 - Old ATT system "INTERNET"; 4 - Old ATT system "PUBLIC"; 5 - T-Mobile; 6 - Cellular One. After setting register 55, set Register 123 to 1. This will tell the Bloodhound that you have set Register 55, and that it is to take the selection and set up the modem for the user’s cellular carrier. (After the Bloodhound is finished configuring the GPRS modem, it will then reset Register 123 back to 0.) The user can then monitor the connection using the lower right hand corner of the LCD screen. It is important to watch for the RSSI, CN and NC messages. The RSSI stands for Received Signal Strength Indicator and goes from 0 to 100%. When using the GPRS modem, CN indicates a current connection to the server and NC indicates no connection**.** ***VERY IMPORTANT!*** Check the registry settings at 114 through 117 for the proper IP address and 118 and 119 for the proper port numbers associated with that Bloodhound serial number.
GPRS connection issues	If the Bloodhound LCD says “MODEM NONE” there is a physical fault that keeps the brain board from talking to the modem. This could be as easy as a loose cable or an actual hardware fault with the modem or brain board. Normally it should say “MODEM NC xxx” or MODEM CN xxx”. NC means there is no connection to the iBall Data Center Server and CN means connected to the iBall Data Center Server. The RSSI is the signal strength of the closest tower, which is not necessarily the right carrier. Therefore, if the RSSI says 50%, it will not guarantee a good connection, but it does indicate that the GPRS modem is operational. 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

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GPRS connection issues (con't)	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 can not hear the tower. This includes small laptop GPRS 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.** Open the Bloodhound case. Watch the modem (upper left) for a few minutes in the Bloodhound. The lights should shut off when the NC timer reaches close to zero. If the modem does not power down and then back up, it can not reestablish a fresh connection to the tower. If the modem does not power down and then back up, there is a physical fault with the brain board, and it needs repair. On the modem there is a green light. If the light keeps blinking and never goes solid, then the modem is unable to sync to a tower for communications. You most likely have an antenna problem. Remove the SIM card, place it into a cell phone and see if there is connectivity or GPRS data, or make a phone call if it has a voice subscription. This will also have the effect of reseating the SIM card when it is reinstalled back into the modem. Replace the SIM card with a known good one and test. On rare occasion, these go bad too. Keep in mind that the modem is set up for a specific carrier. Placing an ATT SIM card

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	into a modem that was configured for CELLULAR ONE will not work. Most Bloodhound hardware modem failures can be traced to an electrical storm or local lightning strike event.
Gas Chart running on adjacent computer cannot find Bloodhound through USB serial cord connection	To enable the serial USB connection between the computer and the Bloodhound, the user must load the serial USB driver program. **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 serial port driver. The driver can be found at www.iballinst.com/ftp/usbkey 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, then start the Gas Chart program. The program will search the serial ports and connect to the Bloodhound. If this is not successful, check in the computer's Control Panel / Add or Remove Programs list for SILICON LABORATORIES CP210x DRIVERS and remove all instances of them. Then, with the BH USB cord disconnected, run the the driver install program from the BH flash drive. After the driver install, plug in the BH USB cord and start Gas Chart. The program will search the serial ports and connect to the Bloodhound. If still not successful, check what comm port the BH has been assigned to, as follows: (For Windows XP computers) • Right click on "Start" in the lower left corner of the screen. This will open a small Options Menu • Left click on "Explore." This will open the Start Menu • Right click on "My Computer" in the Start Menu. This will open a small Options Menu • Right click on "Properties" • Left Click on Tab that reads "Hardware" • Left Click on button reading "Device Manager" • Scroll down to "Comm Ports" • Double click on "Comm Ports" • Look for "CP2101" and record the Comm Port number that appears. Note: if the Comm Port assigned to CP2101 is great than "20" then the CP2101 driver must be re-assigned to a number within the range of Com Ports 1 through 9. The procedure for reassignment follows: **Re-assigning the Bloodhound connection Com Port:** (For Windows XP computers) • Right click on "Start" in the lower left corner of the screen. This will open a small Options Menu • Left click on "Explore." This will open the Start Menu • Right click on "My Computer" in the Start Menu. This will open a small Options Menu • Right click on "Properties" • Left Click on Tab that reads "Hardware" • Left Click on button reading "Device Manager" • Scroll down to "Comm Ports" • Double click on "Comm Ports" • Right Click on "CP2101" if the Comm Port assigned is greater than 20 • Click on "Properties" • Click on "Port Settings Tab" • Click on "Advanced Button" at bottom • From the Advanced Settings for Comm X Window • At the bottom in the Comm Port Number field, click the Down Arrow • Select a Comm Port between 5 and 20, then click "OK" Note: Select a Comm Port in this field that that you know is not assigned to another USB

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	device, even if the Comm Port is marked as “in-use.”
Gas Chart running on adjacent computer cannot find Bloodhound through Ethernet Connection	Connect an Ethernet cable from the BH to a 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. The router can be connected to the internet or not, it doesn't matter. Look on the front of the Bloodhound panel. Locate the LCD and observe the scrolling information on the lower right hand corner. An IP and PORT address will scroll by and appear i.e. 192.168.1.100:23. This is the IP and PORT number that the Bloodhound has been assigned to by the Gateway or Router. Start the Gas Chart Program. When the Gas Chart Program is running and chart appears on the screen, right click on the chart to bring up the “Gas Chart Control Box.” Click on “Setup” then Click on “Bloodhound” tab. Enter the Local IP PORT number obtained from the Bloodhound Display into the Local Ethernet or Internet Settings box, and Check the box labeled “Use Ethernet Instead Of Serial Connection.” The Gas Chart program will now connect to the Bloodhound using the Ethernet connection.
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	Check Register 67. 0 = Communicate to WITS with the Pason handshake (note: zero DOES work with Rigwatch & TOTCO). 1 = Send with no handshake.
Not getting WITS info into BH on drillsite with Autodrill EDR	For Autodrill, external NetburnerEX serial port 0 has to be set to 9600 baud 8N1
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 100. 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. i.e., 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.
Want C1, C2 etc. values to go out to WITS as PPM.	Set Register 68 to 1. 0 = Send as Gas Units; 1 = Send as PPM
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

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	protect the Bloodhound system from this induced voltage, but it can not 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 unsuccessful	When 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.
Oxgen sensor drifts	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. 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 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%. “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 change over 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 where ever it is at

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	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 = 30.
USB memory stick not working	Plug it into the Bloodhound upper USB port only; the lower port is not active. When inserting a USB memory stick, it may take up to 60 seconds for the Bloodhound to recognize it.
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	**Most likely cause is some kind of Antenna (Bloodhound, cell phone, wireless router, etc.) too close to BH. Move antennas as far as possible from the BH.** Noise can be induced through Pason Cable or Power cable or Antenna cable or a combination of these, or through the BH case. Remove each cable until noise gone. Also try connecting Cavitator power neg (black screw terminal) to rig chassis ground, making chassis common to rig chassis ground. If noise still present, re-attach cables and wrap unit in tin foil, leave fan openings open. If still noisy, rent vehicle and run Bloodhound from rented vehicle away from platform.

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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 are 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. If the pump motor is bad, as the power increases, the motor does not turn, the vac and flow are low, and when the power reaches 200, it cycles back down to 0 and tries again. This can be tested momentarily by connecting a clean piece of tubing to the inlet port and blowing into it. If the flow meter shows a flow briefly, then the motor is not running. If the pump is bad, there would be no vacuum on the inlet port and the vacuum and flow would be low or missing. If the flowmeter is bad, you would see the vacuum build up and then suddenly drop as the percent motor increased and then dropped to cycle again. To overcome a bad flowmeter, set Register 10 to something like 80. This will set the pump to a static power setting and bypass the flow meter. This allows the Bloodhound to finish the job. When Register 10 is set to a motor power percent number (1 to 199), the sample motor is on a constant setting and the flowmeter may change but the power to the motor will not. In addition, the flow rate alarms are defeated. Since flow rate does not effect the sensors, this setting is ok for finishing a job. If the vacuum sensor is bad, you would see good flow and percent motor but an odd vacuum. This can be tested by placing a finger over the inlet. If the vacuum suddenly increases the sensor is ok, if not then the vacuum sensor is bad. One interesting thing is when there is a lot of water built up in the line you will see the flow/vac/power cycle up and down as the water allows for air to burp in the line.

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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 (Drierite or equivalent), connect it to the sample intake port to pre-dry the air entering the instrument. Write down the current Chromatograph Column temperature and set the Chromatograph Column temperature to 190 degrees. This will help dry out the column. After an hour running under these conditions, reset the Column temperature to what it was before and 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.

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