Tool Code: GHT004

Document: MN-GHT004-B

Gas Holdup Tool

GAS HOLDUP TOOL

GHT004: $1^{11}/_{16}$″, Ultrawire™, Sondex ends

Operational & Maintenance Manual

CE

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C o n t e n t s

0 ABOUT THIS MANUAL

0.1 MANUAL HISTORY

Date	Issue	Description	Auth	Chk	App
07/07/04	A	First Issue.	RH/DO	SA	RH
27/02/09	B	ECR: 2390, 2771, 2904, 2837, 2839, 2841, 3141, 3844, 3909, 3912, 3920, 3962, 3982, 4137, 4505, 5641, 5733 & 6193.	RS	RS	(TG)

0.2 UPDATES TO BE USED WITH THIS MANUAL

Consult the CD Directory for the appropriate Manual Updates to be used with this Manual.

0.3 TECHNICAL HELP

For further technical help contact Sondex as follows:

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0.4 FEEDBACK

Please help us improve future issues of this manual by adding your comments or corrections to www.ge-energy.com/oilfield, referencing the document number.

Thank you.

Photographs and sketches are for illustration purposes only. Depending on the tool model that you have, certain features or dimensions may differ from those shown.

1 DESCRIPTION

The Gas Holdup Tool (GHT) operates as part of an Ultrawire™ toolstring and measures the gamma radiation from a radioactive source, contained in the bottom of the tool. Gamma rays from the source are scattered back into the detector by fluids around the tool.

The tool provides a reliable fullbore measurement of gas volume fraction, independent of flow regime or well deviation. The tool response is representative of the entire cross section of the well-bore within the casing and is almost completely independent of salinity, water cut oil/water densities and material outside the casing.

The scintillation type detector is unshielded and accepts radiation from any direction. The short source-detector spacing reduces statistical errors associated with gamma ray detection as a result of Compton Scattering or photoelectron absorption.

The tool is supplied with a shielded carrying case, which alleviates the need for source insertion/removal.

Figure 1.1 GHT

1.1 OPERATING PRINCIPLE

The Gas Holdup Tool measures the gas void fraction in the wellbore around the tool by emitting low energy gamma rays from a small radioactive source inside the tool. When sent out, the gamma rays undergo a variety of interactions with wellbore fluids surrounding the tool, i.e. backscattering, photoelectron absorption and Compton Scattering.

A sodium-iodide scintillation detector in the tool is positioned a short distance away from the source, so it will detect back scattered gamma rays. Less dense fluids, such as gas, produce less backscatter, hence detailed count rate is low in gas and high in water.

1.2 APPLICATIONS

- Multi-phase flow profiling.
- Fluid identification.
- Bubble point determination.
- Gas entry detection.

1.3 INTERFACING & TOOL COMBINATIONS

- Combinable with other UltraWire™ tools.
- Surface read-out or memory mode data acquisition.

1.4 SPECIFICATION

Parameter	Specification	Remarks
Temperature (max)	350°F (177°C)	
Pressure (max)	15,000psi (103.4MPa)	
Diameter	$1^{11}/_{16}$″ (43mm)	
Make-up length	23.5″ (597mm)	
Shipping length	27.3″ (694mm)	
Measure point	4″ (102mm)	Above lower tool joint
Weight in air	7.7lb (3.5kg)	
Operating voltage:		
- Nominal	+18V DC	
- Functional	+13 to +23V DC	
- Absolute max.	+24V DC	
Current consumption at 18V DC	24mA	
Acquisition time	1 sec typical	
Accuracy	±3%	
Resolution	1%	
Vertical resolution	2.5″ (64mm)	
Range	0-100% gas hold-up.	Within 2.9 - 9.9″pipe ID.
End threads (top/bottom)	$1^{3}/_{16}$″ UNF	(female/male)
End connectors (top/bottom)	4mm banana single conductor.	(male/female)
Materials	Corrosion resistant throughout.	
Source	GSR005: Cobalt 57 - 3mCi (57 - 111MBq)	Not supplied with tool.

2 SAFETY

2.1 GENERAL

Warning! **HOT WORK!** Sondex equipment may, under certain circumstances or failure modes, become a potential source of ignition. Using it must therefore be considered "HOT WORK" and appropriate precautionary procedures should be followed when testing at surface in areas where there is a risk of gas leaks or other potentially explosive atmospheres.

2.2 RADIATION HAZARD

Warning! **Radioactive Material**

The lower housing of the Gas Holdup Tool contains a 3 millicurie Cobalt 57 source. Its specification is as follows:

Radioactive element	Cobalt 57
Half Life	271 days (9 months)
Gamma Ray energies	122KeV and 136KeV
Strength	3 millicurie
Radiation Flux	111MBq

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^{1}/_{4}$″ thickness.

2.3 CHEMICAL HAZARD

Warning! The scintillation detector contains Thallium doped Sodium Iodide.
— Thallium is a poison —

Should the detector become cracked or otherwise leak, it must be packed in a sealed, labelled container and disposed of according to local regulations in force. Old detectors, which are no longer in use, must also be disposed of properly.

2.4 HIGH VOLTAGE HAZARD

High voltages (1.6KV) are generated HV PSU assembly and are sufficient to cause unpleasant shocks. Care should be taken not to touch exposed HV components if power is applied when removed from the housing. Test probes should only be moved when the line power is off.

A short circuit may also cause serious damage to the tool.

2.5 PHOTOMULTIPLIER TUBE

Caution! The Photo-Multiplier Tube (PMT) must be kept in total darkness whenever the tool is powered up or the tube will be harmed.

The PMT is a glass vacuum tube device which can be damaged by severe shock particularly when dismantled from the Detector Pressure Housing.

2.6 LUBRICANTS

Liquid O-ring

LOR101 is used for lubricating the tool during maintenance. Contact with skin or eyes can be harmful. For more details see the *Material Safety Data Sheet for Liquid O-ring*.

2.7 ELECTRO STATIC DISCHARGE

Caution! **Electro Static Discharge (ESD)**
All tools with electronic boards that contain solid state circuits (transistors, diodes, semiconductors) may become damaged when contacted with an electrostatic charge.

When handling tools, which contain electronic parts that are ESD sensitive, the following guidelines should be followed to reduce any possible electrostatic charge build-up on the user's body and the electronic parts:

- Always ensure proper ESD precautions are taken when handling electronic parts that are ESD sensitive during maintenance.
- Avoid touching the tool electronics, unless stated otherwise in this manual.

Note that ESD is less likely to affect tools when the housing is fitted.

2.8 RECOMMENDATIONS

The product should be installed, adjusted and serviced by qualified electrical maintenance personnel. Improper installation or operation of the equipment may cause injury to personnel or equipment. Before beginning any installation or commissioning work ensure that electrical power is disconnected and locked out.

NOTE: Installation must meet National Wiring Regulations in accordance with IEC/UL 61010 latest revision.

WARNING 1: The outer casing of the product should be connected to a known good system ground before making any other electrical power connection. This system ground to be maintained until all electrical power connections are disconnected and locked out.

WARNING 2: Units with exposed Electrical Connectors are supplied with protective insulating end caps bearing a warning of High Voltage. These end caps should only be removed when Electrical Power is disconnected and locked out for the purposes of interconnection to other Units. Under no circumstances should equipment be operated with the Electrical Connectors exposed.

WARNING 3: Units with moving parts such as callipers can be activated immediately on application of Electrical Power. A safe area should be established around any such Units before the application of Electrical Power.

WARNING 4: Units with moving parts such as springs can retain significant Potential Energy. Great care should be exercised when removing Closing Rings or handling over tightened assemblies.

WARNING 5: Units containing seals may entrap pressure. Disassembly should only be carried out in accordance with recommended procedures ensuring the release of pressure prior to the disengagement of cap threads.

WARNING 6: If the equipment is not installed, commissioned and used in accordance with the manufacturer's specifications, protection provided may be impaired.

Standard Personal Safety Gear must be worn at all times including but not limited to: Safety glasses, gloves and steel-toed boots.

Equipment exceeding 18Kg in weight should be handled with extreme care. Heavy items should be mechanically lifted. Any installation of equipment over 10Kg to be lifted over 1 metre should be at least a two man lift. Good lifting practice should be exercised at all times including but not limited to:

- **Use of correct personal safety gear.**
- **Lift using legs not back**
- **Not proceeding with a lift in the presence of any doubt of completing the lift safely**
- **Use of mechanical lifting aids wherever possible**
- **Ensuring work area is free of clutter and tripping hazards**

3 THEORY OF OPERATION

3.1 DESCRIPTION

The GHT004 source emits gamma rays, which exit the tool housing into the medium surrounding the tool. They are scattered by the molecules of the medium, losing some energy in the process.The remaining molecules return back into the tool and into the sodium iodide crystal scintillation photomultiplier detector.

The number of molecules around the source depends upon the density of the medium and determines how many gamma rays are scattered back towards the gamma ray detector. All liquids have approximately the same number of molecules per unit volume. The number of molecules per unit volume of gas is significantly lower than that of liquids. Consequently a reduction in the countrate of returning gamma rays is due almost entirely to the increase in the gas fraction in fluids surrounding the tool.

The direct path of gamma rays from the source to the detector crystal is blocked by a tungsten shield.

3.1.1 GAMMA DETECTION

A gamma ray, passing through the sodium iodide crystal, may excite an atom sufficiently to cause a photon of light to be emitted. A photon of light, striking the photo-cathode in the photomultiplier tube (PMT), may emit one or more electrons.

As there is a potential difference of approximately 130V between dynodes in the PMT chain, any electrons emitted will be accelerated onto the next and the collision causes many more electrons to be emitted. These are accelerated onto the third and multiplied as well. The 10-stage multiplication will thus provide in the order of 5^{10} electrons per gamma ray detected, which is a measurable charge pulse.

3.1.2 ELECTRONICS

The HV PSU generates the -1.6kV cathode potential and the voltage taps for the PMT dynodes. The PMT anode output is at ground potential.

The output charge pulse is wired through the HV PSU to the detector electronics, where it is amplified and detected by a comparator.

Gamma detections are stored in FPGA logic and read out over the Ultrawire™ toolbus in response to requests from the telemetry controller, e.g. MPL, XTU or other crossover. Various commands are supported in the protocol.

3.2 STATISTICAL VARIATION

The Cobalt 57 source half-life is only 9 months. There will therefore be a noticeable reduction in countrate through the life of each source.

The nominal maximum countrate of a tool fitted with a new source and in water in the Calibrator Jig should be approximately 40,000 cps.

The creation and journey of a gamma ray from radioactive decay is a probabilistic event. The existence and thus counting of gamma rays is therefore likely to show an instantaneous rate above or below the average. This is the statistical variation associated with the measurement of gamma rays.

The GHT is subject to the normal statistics associated with radioactive decay.

Statistical variation depends on the standard deviation σ. For a normal distribution, the σ is the square root of the number of counts in the sample.

The σ defines a confidence level: 1 x σ defines a 68% level and 2 x σ, 95%.

Example 1: If 10000 raw counts were detected in a 1 second sampling interval, you would be 95% confident that the true long term count rate was in the range 9800 - 10200 counts/sec.

Example 2: If 100 raw counts were detected in a 0.25 second sampling interval, you would be 95% confident that the true long term count rate was in the range 320 - 480 counts/sec.

Example 2 shows a large uncertainty due to the low number of counts in the sampling interval which would occur if logging speed was high. Filtering is required for best results.

4 OPERATING PROCEDURE

4.1 PRE-LOGGING CHECKS

4.1.1 MECHANICAL

Ref.: General Assembly drawing *09600*

1 Clean and grease upper and lower O-ring seals. Replace O-rings if damaged.

2 Ensure that upper and lower electrical connectors are clean, dry and undamaged.

4.1.2 ELECTRICAL

1 Using a Multimeter, measure the upper and lower pin resistance. Reading should be <0.5Ω.

2 Using a Multimeter, measure pin (+ve probe) to housing (-ve probe) resistance. Depending on the meter, the reading should be 3-4MΩ.

4.1.3 OPERATING

The GHT must be electrically connected to a toolstring controller e.g. MPL or XTU, and to a data acquisition or logging system, e.g. MEMLOG or MIDAS. Checks may be made on the GHT in isolation, see *Section 7 Extended Checks*.

3 The prevailing background count with the tool in air and away from any solid material should be observed. Typically it would be on average one or two thousand counts per second.

4.2 CALIBRATION

The calibration jig (p/n 07416) is used to define the water and air countrates in $5^1/_2$″ pipe. These are used in the software calibration process.

The response of the tool is essentially linear between the 100% air (zero density) and 100% water (density 1g/cc). The effect of the surrounding pipe size is shown in the calibration chart. The calibration end points to be used for the calibration can be selected from it.

The wellsite verifier (p/n 07415) is used at the wellsite to ensure that the countrates have not changed and that the tool is still working. It is **NOT** used to adjust the software calibration values. *See Figure 4.1* below.

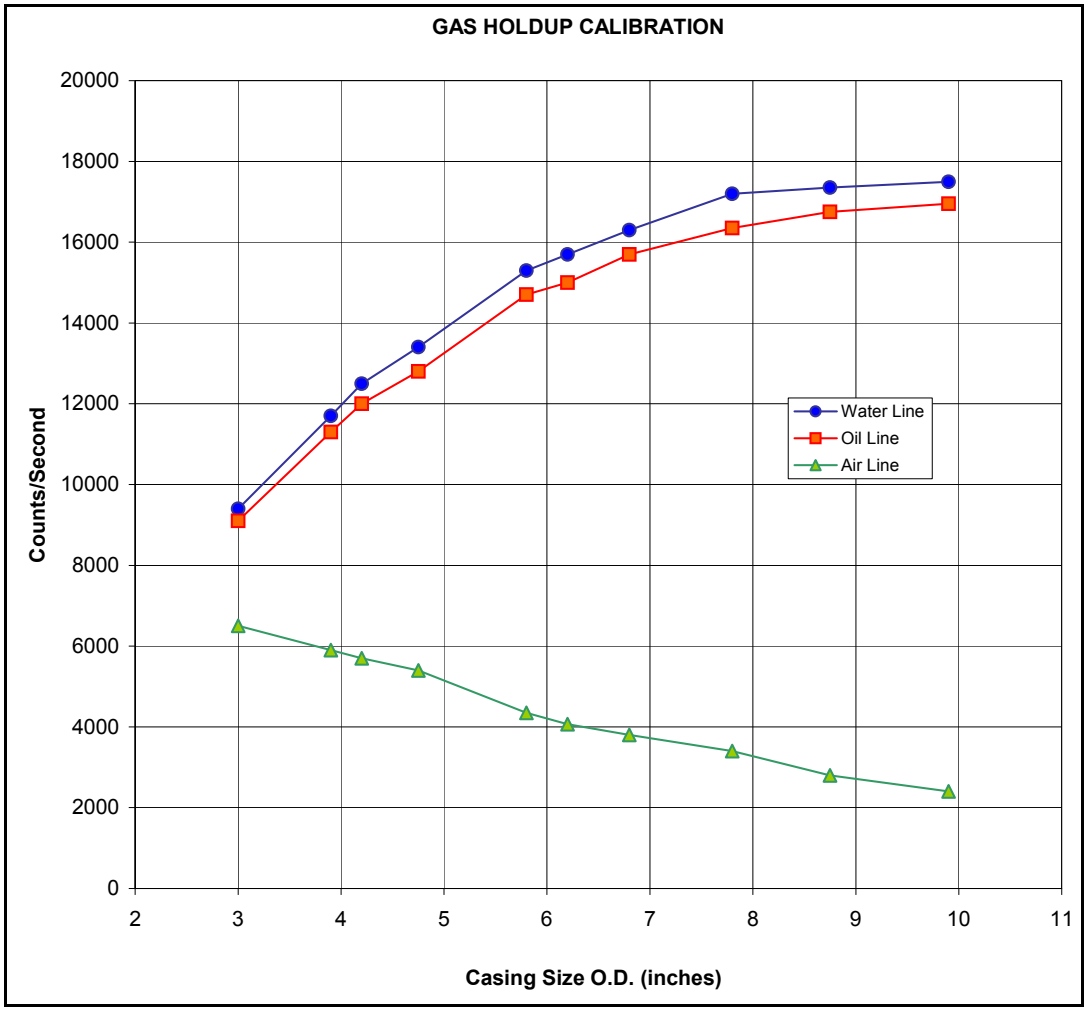


Figure 4.1 Gas Holdup Calibration Chart

4.3 CONNECTING TO TOOLSTRING

Upper and lower tool joint O-rings and seal surfaces should be clean, undamaged and lightly greased.

The GHT can be inserted into the toolstring in any location below the toolstring controller.

Centralisers are desirable above and below, as the tool must be centred away from the casing.

For use in deviated wells, enough centralisers should be used so that they can lift the toolstring from a horizontal surface in air. If length permits, it is preferable to use more standard (25lb ea.) strength centralisers rather than a few strongly (40lb ea.) centred ones.

4.4 LOGGING

The following are guidelines only and must be used in conjunction with local policy and specific well site conditions both downhole and at surface. The table below is appropriate for near vertical wells and must be adjusted accordingly when in deviated wells. Use of a Head Tension Unit is highly recommended.

Note: Do not exceed the calculated safe working load of your selected weakpoint. If in doubt, use a head tension unit, especially in deviated wells where calculation from surface tension is less accurate.

Depth (ft)	Speed Pulling Out of Hole	Speed Running in Hole
In/out of catcher (pressure rig up only)	Dead slow or manual.	
30 to 150	30ft/min	
150 to 400	60ft/min	
>400 clear cased hole	Surface tension not to exceed 120% of tension when tool stationary. Speed not to exceed 150ft/min.	Surface tension should not be less than 80% of tension when tool stationary. Speed not to exceed 150ft/min.
>400 clear open hole	Surface tension not to exceed 130% of tension when tool stationary. Speed not to exceed 150ft/min.	Surface tension should not be less than 70% of tension when tool stationary. Speed not to exceed 150ft/min.
Approaching potential obstacles[a]	30ft/min	
Logging Data	**Do not exceed the above speeds.** Recommended speed is <30ft/min. Higher speeds may introduce unacceptable statistical variation in recorded count rate.	

a. For example: Reduced diameters, gas lift mandrels, fluid levels, valves, tubing shoes, packers, cross overs and other downhole equipment.

4.5 POST LOGGING DISASSEMBLY

Clean the tool before the toolstring is disassembled. Ensure that well fluid does not reach the upper electrical connector.

Disassemble in a horizontal position wherever possible.

Refit upper thread protector.

4.6 TRANSPORT, HANDLING & STORAGE

Store with end threads lightly greased and with water tight thread protectors fitted.

Store in Transport Case (p/n 07414). This is certified for the GHT source, hence it is not necessary to remove the source from the tool.

Do not subject the tool to extreme shock such as dropping or hitting with a hard object.

5 MECHANICAL DESCRIPTION

5.1 DESCRIPTION

The Gas Holdup Tool (GHT) comprises two main units, which remain screwed together unless access to the interior is required.

Electronics Section:

- Pressure housing (steel).
- Telemetry circuit board.
- Detector circuit board.
- Upper head, fitted with mono-conductor pin and pressure isolation seal.
- Lower End with 10-pin 'LEMO' connector socket.

Sensor Section:

- Pressure housing (titanium).
- HV power supply with 10-pin 'LEMO' connector plug.
- Photo-Multiplier/Sodium Iodide crystal assembly.
- Tungsten bulkhead and ring.
- GHT source assembly.
- Lower sub with pressure feed-through and mono-conductor socket.

5.2 DISASSEMBLY

Warning! Important Safety Information. Read *Section 2 Safety* before disassembly.

5.2.1 ELECTRONICS SECTION

Ref.:	General Assembly	*09600*
	Chassis Assembly	*10504*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^{1}/_{4}$″ thickness.

1 Unscrew the pressure housing (item 1, 09600) from the sensor section (item 3, 09600).

Note: The electronics section (item 2, 09600) internal chassis remains fixed to the sensor section (item 3, 09600) by grub screws (3x item 4, 10504).

2 Carefully screw the grub screws (3x item 4, 10504) 2 turns **inwards** and pull the electronics section (item 2, 09600) away from the from the sensor section (item 3, 09600).

3 To access the circuit boards and electronics bulkhead (item 1, 10504), remove screws (4x item 8, 10504) and remove the larger/upper half shell (item 3, 10504).

Note: The smaller/lower half shell (item 3, 10504) is an integral part of the chassis and should not be removed, especially if the upper half shell is already removed.

4 For servicing the electronics bulkhead (item 1, 10504), refer to manual *MN-PIH*.

5.2.2 SENSOR SECTION

5.2.2.1 PMT Assembly Access

Ref.: Sensor Section *07083*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^{1}/_{4}$″ thickness.

1 Gain access to the electronics section, see *Section 5.2.1*.

2 Unscrew lower sub (item 7) from the detector housing (item 1).

Note: To replace the O-ring on the connector (item 3), Remove the circlip (item 5) and extract the assembly from the lower sub (item 7). Refit the connector and replace the circlip.

3 Pull the Photo-Multiplier Tube (PMT) assembly (item 2) out from the housing. It should slide freely.

Note: Take care not to damage the LEMO plug at the top and the wire running down the side.

4 Rest the PMT assembly (item 2) on V-blocks with the lower (source) end shielded in a steel or lead tube.

5.2.2.2 Radioactive Source

Ref.: HV PSU & Photo-Multiplier Tube Assembly *07407*
Radioactive Source Assembly, GHT *07410*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^{1}/_{4}$″ thickness.

1 Remove the PMT assembly as above.

2 Remove screws (4x item 18, 07407) from the detector housing (item 7, 07407) and bulkhead (item 8, 07407).

3 Untape the spare lead wrapped around the detector-crystal sleeve (item 7, 07407).

4 Pull out the lower connector assembly (items 8, 12, 13, 14, etc., 07407).

Further disassembly of the tool is not recommended.

5.3 REASSEMBLY

5.3.1 SENSOR SECTION

5.3.1.1 Radioactive Source

Ref.: HV PSU & Photo-Multiplier Tube Assembly *07407*
Radioactive Source Assembly, GHT *07410*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^1/_4$″ thickness.

1 Check O-ring (item 22, 07407) has not been damaged excessively. Replace if required.

Note: O-ring (item 22, 07407) is used for shock absorption only and does not normally require replacing.

2 Take the source holder (item 1, 07410 - p/n 07408) and fit the source (item 2, 07410) into the holder, using pliers.

3 Lock the source in place with the circlip (item 3, 07410 - p/n 93306) as shown on the drawing.

4 Ensure the source cavity inside detector/crystal sleeve (item 7, 07407) is empty and clean.

5 Use the pliers to insert the source and holder assembly (item 6, 07407) into the cavity as shown on the drawing.

5.3.1.2 PMT Assembly Installation

Ref.: HV PSU & Photo-Multiplier Tube Assembly *07407*
Sensor Section *07083*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^1/_4$″ thickness.

1 With pliers, insert washer (item 10, 07407) and wavy spring (item 19, 07407) after the source holder.

2 Re-insert lower connector assembly (items 8, 12, 13, 14 etc., 07407) noting the orientation of the wire and recess cut in the lower bulkhead (item 8, 07407).

Note: Take care not to damage the wiring.

3 Firmly push the lower connector assembly in and screw the screws (4x item 20, 07407) back in.

Note: This will require some assistance either from another person or by using a frame, vice or jig to hold the tool steady while pushing the connector and inserting the screws.

4 Check O-ring (item 11, 07083) has not been damaged excessively and fit over the lower connector assembly (items 8, 12, 13, 14 etc., 07407). Replace O-ring if required.

Note: O-ring (item 11, 07083) is used for shock absorption only and does not normally require replacing.

5 Replace the detector assembly (item 2, 07083) in the housing (item 1, 07083) and rotate until the LEMO plug is realigned with its original position.

6 Fit new O-rings (items 9 & 10, 07083) on the lower sub (item 7, 07083). Apply Liquid O-ring to the O-rings and O-ring grooves.

Note: To replace the O-ring on the connector (item 3, 07083), Remove the circlip (item 5, 07083) and extract the assembly from the lower sub (item 7, 07083). Refit the connector and replace the circlip.

7 Screw the lower sub (item 7, 07083) into the detector assembly (item 2, 07083).

8 Fit new O-ring (items 8, 07083) on the pressure housing (item 1, 07083). Apply Liquid O-ring to the O-rings and O-ring grooves.

9 Replace the electronics cartridge and screw out the three M6 grub screws to lock it in place. Ensure that the two 10 pin 'LEMO' connectors between the Electronics and Detector mate correctly.

5.3.2 ELECTRONICS SECTION

Ref.: General Assembly *09600*
Chassis Assembly *10504*

Warning! If the source is in the tool, avoid holding the lower end of the tool. Keep your distance from the tool as much as possible and keep the lower end of the tool shielded in a lead or steel tube of more than $^{1}/_{4}$″ thickness.

1 For servicing the electronics bulkhead (item 1, 10504), refer to manual *MN-PIH*.

Note: Ensure the wiring on the electronics bulkhead (item 1, 10504) is not damaged.

2 If removed, refit the larger/upper half shell (item 3, 10504) and secure with screws (4x item 8, 10504).

3 Fit new O-ring on the electronics bulkhead (item 1, 10504). Apply Liquid O-ring to the O-rings and O-ring grooves.

4 Replace the electronics cartridge (item 2, 09600) onto the sensor assembly (item 3, 09600) and screw the grub screws (3x item 4, 10504) 2 turns **outwards**.

Note: Ensure the 'LEMO' connectors on the electronics cartridge (item 2, 09600) and the sensor assembly (item 3, 09600) mate correctly.

5 Clean the pressure housing (item 1, 09600) and screw it onto the sensor section (item 3, 09600).

6 ELECTRICAL DESCRIPTION

6.1 TELEMETRY CIRCUIT BOARD

Ref.: Circuit Diagram (PCB82269) *CD82261*

The Ultrawire™ Tool Telemetry Board is based on a common PCB (82260), which is populated and programmed according to the tool in which it is fitted. The main functional blocks of the circuit are the power supply, the Ultrawire™ interface (together with its drivers and receivers) and the sensor interface.

Control is implemented by a PIC microcontroller in conjunction with FPGA logic. The code in the PIC differs according to the tool.

Communication between the Telemetry Controller and the tool is via the Ultrawire™ toolbus. This is a single pin bus, which carries power to the tool in addition to its telemetry function. The return for both power and signal is via the chassis.

The Ultrawire™ line carries 18V DC (nom). Power is supplied to the SMPS via Q7, which with associated components generates local power rails at 12V and 5V.

The tool is protected by fuse (F1), which in conjunction with diode (D1) gives overvoltage and reverse polarity protection.

The telemetry is modulated onto the line as 1V AMI (alternate mark inversion) pulses at 500kbaud.

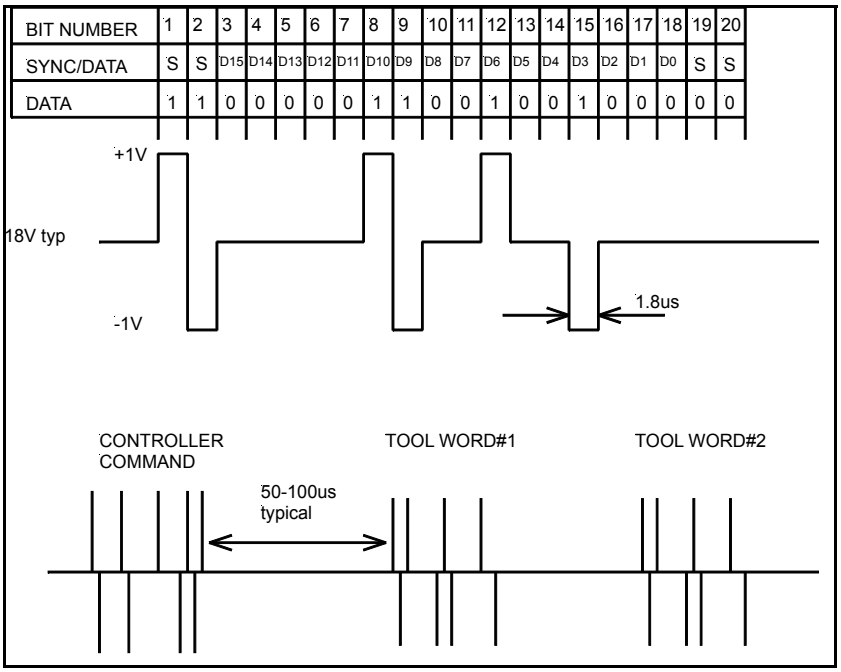


Figure 6.1 Ultrawire™ Signal Shape example

The Ultrawire™ telemetry is a master slave protocol. The controller, which is always the master, sends a command to the tool. This may be a global command (to all tools) or a tool specific command, which contains the address of the target tool. Tool specific commands are acknowledged by the tool; global commands are executed, but do not generate a response.

For rate-meter type tools, count pulses are collected from the sensor on inputs 1 - 7 of the PCB. These are counted in hardware by the FPGA logic, (U1) and accumulated by the PIC (U3).

When the controller is in logging mode, it will periodically send a global sample command to all the tools and then poll each tool individually for data. The sample command causes the latest count to be frozen in a shadow register, and this count is then passed to the controller in response to the data request.

Electrically, the telemetry is AC coupled from the line to the drivers and receivers by capacitor (C7). The received data is removed from the line by a comparator (U4), and passed to the FPGA logic, which validates the address. The command is interpreted by the PIC which if necessary generates the response packet and passes it to the FPGA logic for placement on the line.

6.2 GHT DETECTOR

Ref.: Detector Circuit Diagram *CD81001*

U5, 6 and 7 are not active in the GHT004. R10 should not be fitted. This stops the clock (CK) and reduces the current consumption of these unused parts.

U1/A is a charge amplifier for the photomultiplier pulses.

The pulse gain is set by C2 and the width by R2, R4 and C3.

U1/B provides additional pulse gain with C15 and R14 acting as a high pass filter to sharpen the pulses and reject low frequency noise e.g. from the HV switching power supply in the detector section.

U2 (LT1019-5) is a stable 5V reference used to set the comparitor (U3) detection threshold at approximately 3.8V.

U2 provides a secondary reference which increases with temperature. This is 0.6V at 25°C and 0.8V at 125°C. R2 and R4 give U1/A some DC gain, so the DC voltage on P2 and P3 is approximately 2V. Detector pulses sit on top of this DC at P3 for detection by comparitor (U3). At 25°C, the peak pulse amplitude for Co57 at P3 would be 7-8V. As temperature increases, detector sensitivity drops, however the increasing DC bias from U2 pin 3 partially compensates for this.

7 EXTENDED CHECKS

7.1 PREVENTATIVE MAINTENANCE

7.1.1 GREASE & LUBRICANTS

Sondex recommends the use of “Liquid O-ring type 101” (p/n LOR101) on threads and O-rings, see *APPENDIX A*.

All O-rings and housing threads are assumed to be and must be lightly greased unless specifically indicated differently.

Correct use of grease and lubricants is essential to the maintenance of all Sondex downhole equipment.

Note that some threads are internal such that grease can get inside the tool. Do not use excessive quantities.

Sondex does not recommend Copper loaded greases since some types can cause electrical leaks. Some types are also not suitable for use on O-rings. Silicone grease may be used on O-rings, but must be kept clear of threads especially stainless to stainless.

Warning! The use of certain greases, such as some types of Lubriplate, can cause electrical failure if they have any volatile content, which can burn off producing corrosive gasses inside the tool.

7.1.2 MECHANICAL

1 Remove dirt and old grease from pressure housing threads and O-rings and replace with fresh.

2 Inspect O-rings for damage or ageing/hardening and replace where required.

3 Check for:

- Damaged wires.
- Wires that are loose and likely to be crushed on re-assembly.
- Damaged components.
- Loose screws/nuts/components/connectors.

Note: If RTV or similar compound is used to secure loose components, it must be fully cured before housing is replaced.

- Electrical components shorting to chassis.
- Heat or chemical damage (discoloured components).
- Incorrect thread grease or excessive quantity, see *Section 7.1.1*.

4 Check Line wire on outside of detector.

5 Check upper and lower O-ring (item 27, 07407) is fitted.

6 Check connectors for cleanliness and loose/bent pins before replacing.

7 Check all fixings for tightness. Check 3 grub screws (item 4, 10504) are tight.

7.1.3 ELECTRICAL

1 Using a Multimeter, measure the upper and lower pin resistance. Reading should be <0.5Ω.

2 Using a Multimeter, measure pin (+ve probe) to housing (-ve probe) resistance. Depending on the meter, the reading should be 3-4MΩ.

3 Tool current 24mA @ 18V.

4 Connect to Logging System and check for correct data. Should agree with previous test. Apply some gentle vibration, rotation and invert tool to expose potential failure.

5 With an oscilloscope, check line telemetry from tool for +1V and -1V, 2μs pulses. Make sure to check tool pulses, not those from the controller which occur first, *See Figure 6.1*.

Pulses should have no ringing, if ringing, also attach bottom tool (CTF, other bottom flowmeter or toolstring terminator).

7.1.4 AGEING OF ELECTRONICS

At 150°C, significant electronic ageing failures are expected after 4000hrs typical use, hence PCB replacement should be considered at this point. Every additional 10°C halves the time. Also accelerated by vibration and corrosive gas inside the chassis. Visual inspection and logging previous history is recommended, but is unlikely to predict premature failure.

Tools that may be suspected of reliability problems due to age or unusual log response may be heated to 120°C, which would not normally age the electronics, and then subjected to moderate vibration. A moderately hard blow from a wooden hammer is recommended. **DO NOT USE METAL HAMMERS**.

7.1.5 HEAT TESTING ABOVE 150°C

This is not generally recommended since it shortens tool life expectancy.

Heat testing may be required for contractual reasons, tool out of use for a long period or job with unusually high well temperature. The test should be carried out only slightly above expected well temperature and the tool should not be kept at temperature for more than 1 hour.

7.2 EXTRAORDINARY MAINTENANCE

7.2.1 O-RING REPLACEMENT

Ref.:

	General Assembly	*09600*
	Sensor Section	*07083*
	HV PSU & Photomultiplier Assembly	*07407*

If the tool experiences H_2S, gas or temperatures above 150°C, the following O-rings must be replaced:

- 2x item 8, 07083
- 2x item 9, 07083
- 2x item 10, 07083
- 1x O-ring on the electronics bulkhead (item 2, 09600)

It is recommended to replace the O-rings, mentioned above, when the tool is disassembled/ reassembled for repair purposes.

Note: O-rings (item 22 & 23, 07407) are used for shock absorption only and do normally not require replacement, unless damaged excessively. It is not recommended to try to replace the O-ring between the HV PSU and the Photomultiplier.

7.2.2 DETECTOR SENSITIVITY/CALIBRATION CHECK

The GHT detector, which includes the HV PSU, PMT and Crystal, leaves Sondex with a known sensitivity for that particular tool. Any failing or ageing of any of these 3 components reduces the sensitivity. The PMT ageing and dynode circuit leakage have the most effect. Heat also reduces sensitivity. Loss of sensitivity may be obvious from previous logs.

1 With the source fitted, monitor P3 on PCB81001. This is set to give a 7-8V pulse at room temperature. There will be a small number of larger and smaller pulses. If the pulse is low at room temperature, sensitivity has dropped and downhole counts may be lower than expected. Unless logging at low temperature, preventative action is required. See *Section 7.3 Troubleshooting*.

2 Check calibration, see *Section 7.3 Troubleshooting*. Count rate should be within 1% of previous check, subject to ageing of the CO_{57} source. The source has a 9 month half life.

7.2.3 DETECTOR REPLACEMENT, ADJUSTMENT & TEMPERATURE COMPENSATION

The detector (p/n 85170) is matched to the detector PCB81001. On PCB81001, R4 and C2 are adjusted to set the amplifier pulse height and R12 for the detection threshold. Replacing the Detector and/or changing R4/C2 will require the count rate temperature drift to be checked.

Replacing the HV PSU (p/n 00873) only, does not normally affect the calibration or temperature drift.

R12 is adjusted to achieve lowest temperature drift.

7.3 TROUBLESHOOTING

Refer to *Section 5.2 Disassembly* and *APPENDIX B Drawings & Parts Lists* where necessary.

An oscilloscope, multimeter and other basic test equipment will be required.

Initial inspection	Check for: • Damaged wires. • Damaged components. • Electrical components shorting to chassis. • Heat or chemical damage (discoloured components). • Incorrect thread grease or excessive quantity, see *Section 7.1.1*. Also check all fixings are tight.
Excessive current	Unplug detector and disconnect wires to isolate fault to: • Upper head isolation assembly. • Detector, see 'High current detector' below. • Line wire through Detector, lower pressure feedthrough and connector. • PCB82269 (drawing 82261). • PCB 81001 (detector disconnected). Apply Line Signal or 18V direct to PCB82269 line connection. Fault find or replace PCB82269 circuit. Upper Head, detector line wire and lower connector may be tested to 250V relative to chassis to check for electrical leak. Line connection to PCB82269 circuit must be disconnected. Resistance should exceed 100MΩ. Upper head, detector line wire and lower pressure feedthrough and connector may be disassembled to locate fault. **The lower socket is part of the source and should not be disassembled.**

Warning! **The PMT must only be powered in complete darkness.**

High current detector	Separate HV PSU (part no 00873) from PMT. HV PSU takes 5mA approx., attaching PMT. Check HV PSU and PMT base for wire damage. High current PMT: Ensure PMT base PCB is clean and dry. High current HV PSU: Check for shorts and wire damage. Check for broken transformer core. Otherwise HV PSU and PMT are not user serviceable, replace complete if faulty.
Little or no current	On PCB 82269 check LINE = 18V, V+ = 12V and Vc = 5V and 0V wire connects to chassis. Fault find or replace PCB 82269.

No telemetry counts	On PCB82269, check LINE = 18V, 12V, 5V and 0V. Fault find or replace PCB. On PCB82269, check P6 for 4MHz clock. Replace X1 if faulty. Reduce R14 value if clock <3V amplitude. Check line for +1V and -1V, 2μs pulses from the controller and similar pulses from the tool. Logic pulses should be present on PCB82269 P2 - 5 and temperature frequency on pin 7 (FT). If no tool response words on the Line, fault find or replace PCB82269.
Low counts	See *Section 7.2.2*. See 'Low current detector'. See 'High current detector'. Replace PMT/Crystal detector; this assembly is not field repairable.

Warning! **The PMT must only be powered in complete darkness.**

Low current detector	12V detector current is typically 5mA. The 1.6kV output is not normally measured directly since a 1:100 HV probe must be used. The PMT base must be completely clean and dry. Probes of a lower resistance will not measure correctly.

APPENDIX A EQUIPMENT & RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	GHT004	Gas Holdup tool, $1^{11}/_{16}$″, Ultrawire™	1	
2	GSR005	Source	1	Not supplied with tool.

A.1 ANCILLARY EQUIPMENT

Item	Part No	Description	Qty	Remarks
1	07414	Transport Case/Radiation Shield.	1	Supplied with tool.
2	07415	Wellsite Verifier.	1	Not supplied with tool.
3	07416	Calibration Fixture.	1	Not supplied with tool.

A.2 MAINTENANCE EQUIPMENT

Item	Part No	Description	Qty	Remarks
1	*91050*	Hand Tool Kit for all $1^{11}/_{16}$″ tools.	1	
2	LOR101	Grease for O-rings and threads.	1	5oz pot.
3	LOR101L	Grease for O-rings and threads.	AR	16oz pot.

A.3 RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	*KITR-GHT*	Recommended Spares Kit.	1	Supports 25 runs in hole.
2	KITRem-PIH,SX	Spares Kit for Pressure Isolation Head.	1	See *MN-PIH.*

PARTS LISTING

Part	*Issue*
91050	C

Description

Tool Kit for all 1 11/16 Tools SX and GO

PARTS LIST

Item	*Part No*	*Description*	*Qty*	*Units*	*Remarks*
0001	91005	Spanner Open Ended 42mmx38mm	2	EA	
0002	91019	Spanner C 50mm 35mm	2	EA	
0003	10038	Spanner Box 3/8 x 5/16 Modified	2	EA	
0004	91028	Spanner O/E 3/8x5/16	1	EA	
0005	93876	Spanner Single Open End 18mm	1	EA	
0006	91029	Key, Hex Metric (Set)	1	EA	
0007	91030	Punch Pin Parallel set	1	EA	
0008	00615	Assy Spanner PKJ	1	EA	
0009	91293	Screwdriver Parallel tip (3 0 x 75)	1	EA	
0010	91105	Toolroll With SX Badge Large Black	1	EA	
0011	91104	Screwdriver Parallel tip (5 5 x 200)	1	EA	
0012	91103	Pliers Circlip 812 Chrome/Van	1	EA	
0013	91102	Pliers Mini Flat Nose 5 Inch	1	EA	
0014	10037	Bar Tommy	2	EA	
0015	10051	Kemlon tool Sondex - 4BA Hex Socket	1	EA	
0016	91280	Hammer, 4oz ball pein	1	EA	
0017	91130	Pin C Spanner 35-50mm	1	EA	
0018	91822	Medium Flat Blade Screwdriver, 5mm	1	EA	
0019	91255	T15 Torx driver, Sandvik Belzer 8915	2	EA	

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
KITR-GHT	A		RLH	NGH	NGH
			Date: 03/02/2004	Date: 20/10/2008	Date: 20/10/2008

Description:
Kit, Spares, Recommended(25Run), GHT 1 11/16

CHANGE HISTORY					RELATED DOCUMENTS		
Iss	*Date*	*Remarks*	*Chkd*	*Appr*	*# Documents*	*Issue*	*Notes*
A	20/10/2008	Initial Release	NGH	NGH			

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	99211	-	O-ring 211 Viton 90		50	ea	
002	99124	-	O-ring 124 Viton 90		50	ea	
003	99217	-	O-ring 217 Viton 90		50	ea	
004	95211	-	O-ring 211 Viton 75		5	ea	
005	99008	-	O-ring 008 Viton 90		5	ea	
006	99901	-	O-ring 310 Silicone 60		10	ea	
007	95020	-	O-ring 020 Viton 75		2	ea	
008	93128	-	Screw Csk Hd Sltd M2.5x06mmLG SS-A2 (DIN 963)		4	ea	

(AR = As Required)

APPENDIX B DRAWINGS & PARTS LISTS

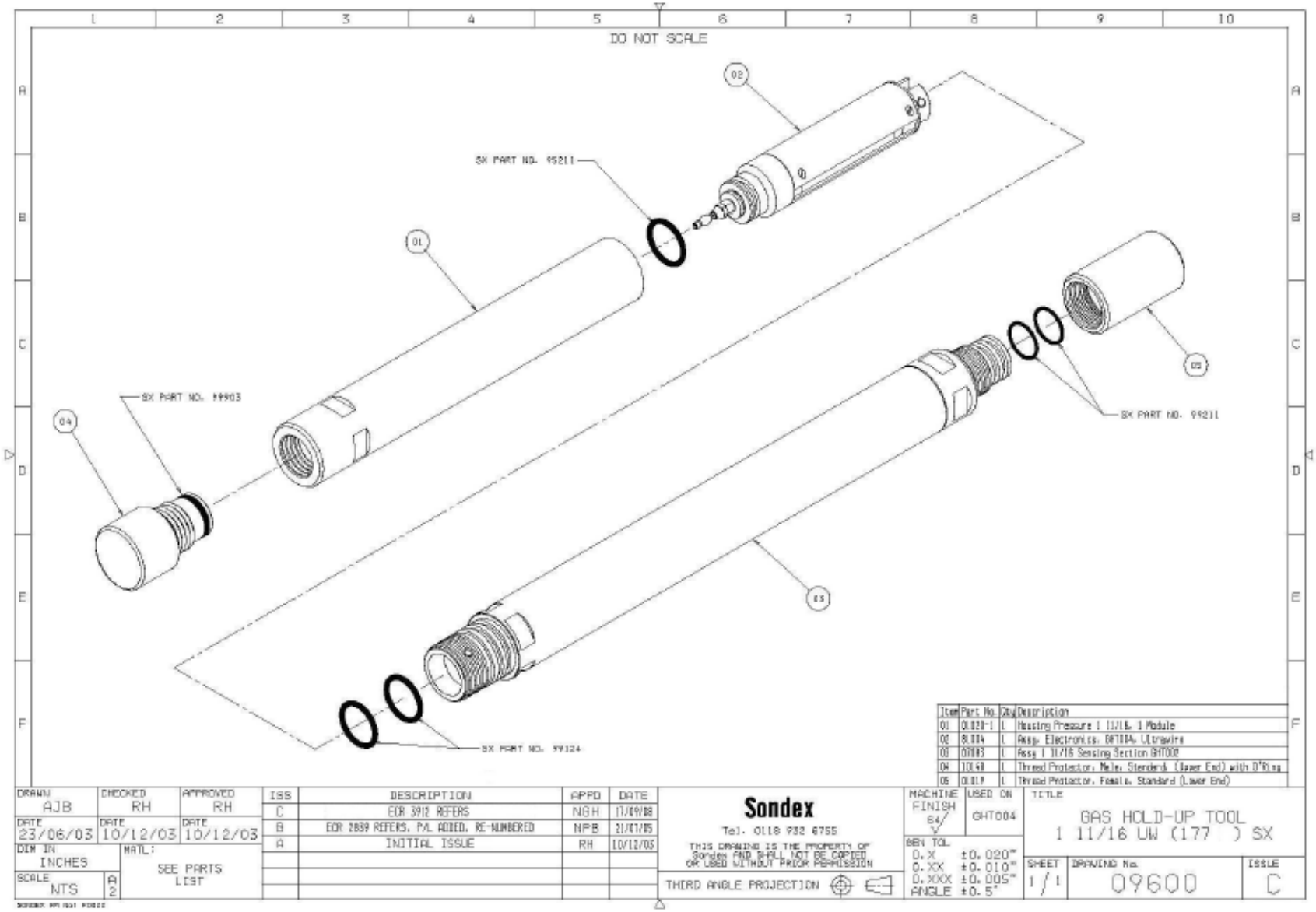
B.1 MECHANICAL DRAWINGS

Description	Drawing	Parts List
General Assembly, $1^{11}/_{16}$″, Ultrawire™	*09600-C*	See drawing
Sensing Section Assembly	*07083-E*	See drawing
Electronics Assembly[a]		*81004-C*
HV-PSU Photomultiplier Assembly - 2 sheets	*07407-F*	See drawing
Chassis Assembly	*10504-F*	See drawing
Radioactive Source Assembly[b]	*07410-A*	*07410-A*

a. The Electronics Assembly (p/n 81004) is a Parts List only.
b. No Parts List available.

B.2 ELECTRICAL DIAGRAMS

Description	Type	Drawing
Electronics Assembly	Wiring Diagram	*WD-81004-D*
Detector	Circuit Diagram	*CD-81001-F*
PSU/Ultrawire™ Telemetry (PCB82269) - 2 sheets	Circuit Diagram	*CD-82261-H00x*



Item	Part No.	Qty	Description
01	01.020-1	1	Housing Pressure 1 11/16, 1 Module
02	01.034	1	Assy. Electronics, GHT004, Ultrawire
03	07003	1	Assy 1 11/16 Sensing Section GHT004
04	10.040	1	Thread Protector, Male, Standard (Lower End) with O'Ring
05	01.019	1	Thread Protector, Female, Standard (Lower End)

ISS	DESCRIPTION	APPD	DATE
C	ECR 3912 REFERS	NGH	17/09/08
B	ECR 2839 REFERS. P.L ADDED. RE-NUMBERED	NPB	21/07/05
A	INITIAL ISSUE	RH	10/12/05

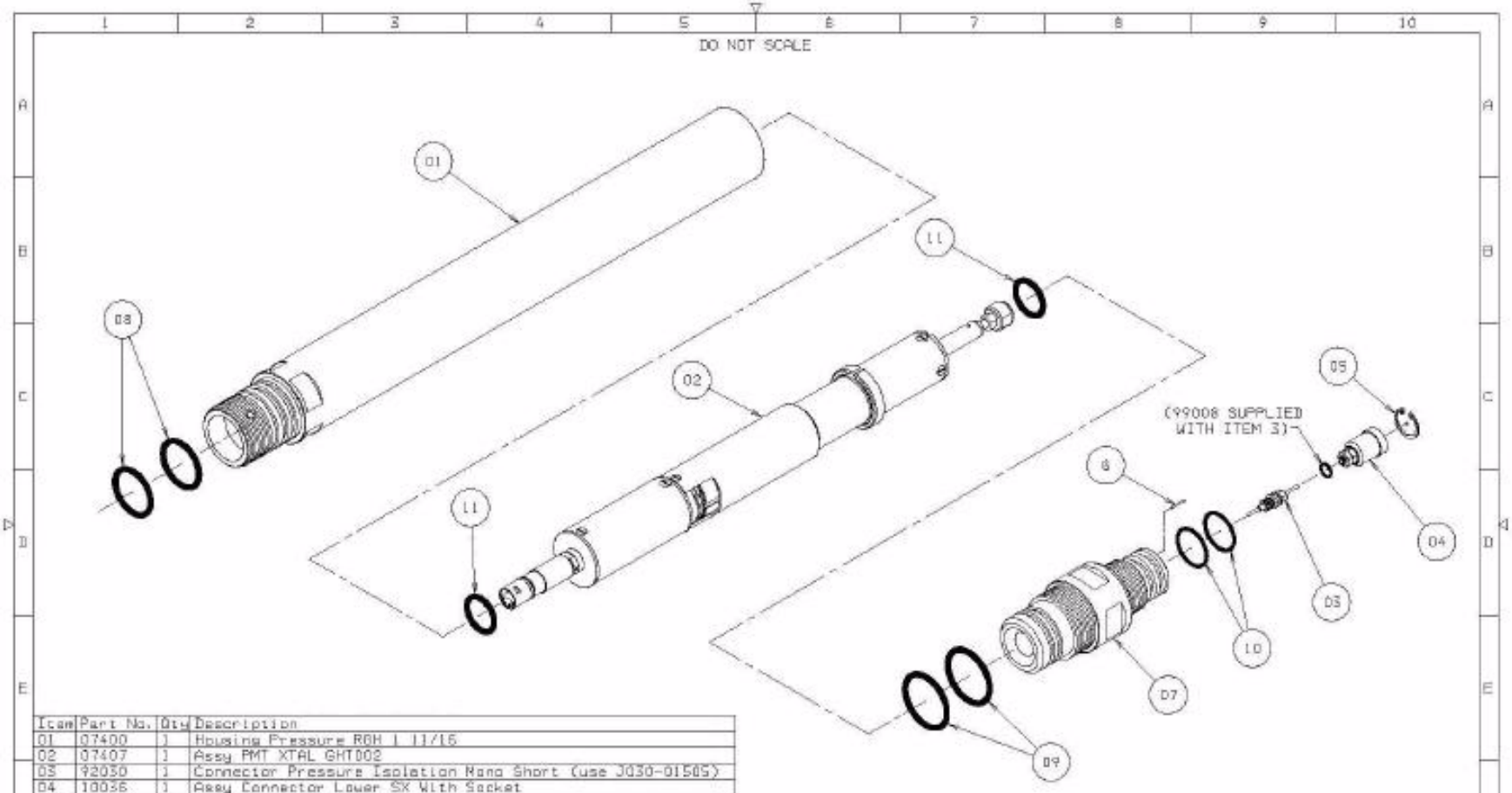
DRAWN AJB | CHECKED RH | APPROVED RH
DATE 23/06/03 | DATE 10/12/03 | DATE 10/12/03
DIM IN INCHES | MATL: SEE PARTS LIST
SCALE NTS | A2

Sondex
Tel. 0118 932 6755
THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION
THIRD ANGLE PROJECTION

MACHINE FINISH 64
USED ON GHT004
GEN TOL
0.X ±0.020"
0.XX ±0.010"
0.XXX ±0.005"
ANGLE ±0.5°

TITLE
GAS HOLD-UP TOOL
1 11/16 UW (177) SX

SHEET 1/1 | DRAWING No. 09600 | ISSUE C



Item	Part No.	Qty	Description
01	07400	1	Housing Pressure RGH 1 11/16
02	07407	1	Assy PMT XTAL GHT002
03	92030	1	Connector Pressure Isolation Nano Short (use J030-01505)
04	10036	1	Assy Connector Lower SX With Socket
05	01047	1	Circlip, Internal, 5/8, St/Steel
06	93019	1	Pin, Spirol, 1mm x 8mm Lg, SS
07	07401	1	Sub Lower RGH 1 11/16
08	99124	2	O Ring Viton 90 Type 124
09	99217	2	O Ring Viton 90 Type 217
10	99211	2	O Ring Viton 90 Type 211
11	99901	2	O Ring 31D Silicon

DRAWN	CHECKED	APPROVED
JDR	AJB	DJF
DATE 13-10-98	DATE 30-11-98	DATE 19-01-99
DIM IN INCHES	MATL: SEE DETAIL DRAWINGS	
SCALE N.T.S.	A3	

ISS	DESCRIPTION	APPD	DATE
E	ECRs 5441 & 5912 REFER	NGH	17/09/08
D	ECR 3844 ITEM 11 WAS 95008	GC	15/06/06
C	ECR 2859 REF P/L ADDED. ITEMS RE-NUMBERED	NPB	21/07/05
B	DRG CORRECTION (ITEM 6 WAS LISTED AS ITEM 5)	AJB	25-01-99

Sondex
GEOPHYSICAL EQUIPMENT
Tel- 0118 932 6755

THIRD ANGLE PROJECTION

USED ON 09093 09600

MACHINE FINISH 63

GEN TOL
0.X ±0.020"
0.XX ±0.010"
0.XXX ±0.005"
ANGLE ±0.5°

TITLE ASSY SENSING SECTION GAS-HOLD-UP TOOL DIA 1 11/16"

DRAWING No. 07083

ISSUE E

SONDEX FM No: F0023

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
81004	C		DJ	RH	RH
			Date: 24/06/2003	Date: 10/12/2003	Date: 10/12/2003

Description: Assy, Electronics, GHT004, Ultrawire

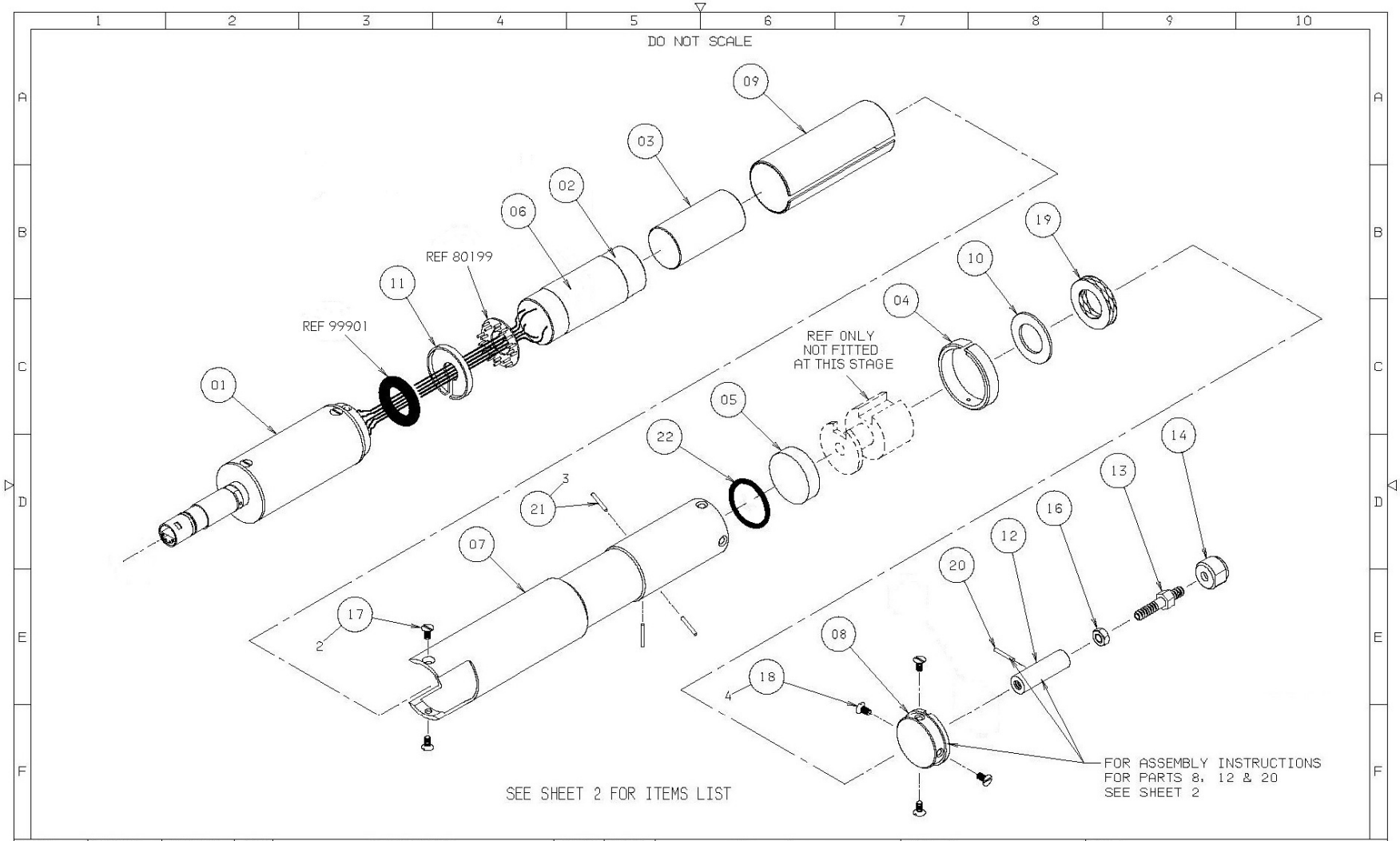
CHANGE HISTORY				
Iss	*Date*	*Remarks*	*Chkd*	*Appr*
B	13/09/2004	ECR1692. Wd81004 was Iss A. Assy 82269 was 82224	PR	PR
C	26/07/2006	ECR3962 & ECR3982 Refers	BET	VH

RELATED DOCUMENTS		
# Documents	*Issue*	*Notes*
01 10504	C	Assembly Drawing (Chassis)
02		SEE ITEMS

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	10504	E	Assy, Chassis, 1 Module, Memory, SX, Lemo (Mechanical)		1	ea	
002	10049	A	Plug 10 way Lemo modified		1	ea	
003	81001	F	PCB ASSY Gas Holdup Detector ***(Fit as Item 10 on Assy Drawing 10504)***		1	ea	
004	82269	C	Assy, PCB, PSU & Telemetry, UW Single Ratemeter, Programmed ***(Fit as Item 9 on Assy Drawing 10504)***		1	ea	
005	01029	-	Screw Csk Hd(Slotted) M3 x 06mm LG SS		2	ea	
006	93261	A	Spacer Round M3 Thru 4.75mm OD x 12.7mm LG BNP		1	ea	
007	93097	-	Tag Solder M3		2	ea	
008	93048	-	Screw Pan Hd Sltd M3x06mmLG SS-A2 (DIN 85)		1	ea	
009	93028	-	Washer Lock Serrated M3 SS (DIN 6798 Form I) ***(Fit Washer between solder tag & bulkhead)***		1	ea	
010	W001-00104	-	Wire, PTFE, Type A, 300V, 6A, 200C	7/0.2 Yellow		(AR)	
011	W001-00200	-	Wire, PTFE, Type A, 300V, 3A, 200C	7/0.12 Black		(AR)	
012	W001-00202	-	Wire, PTFE, Type A, 300V, 3A, 200C	7/0.12 Red		(AR)	
013	W001-00208	-	Wire, PTFE, Type A, 300V, 3A, 200C	7/0.12 Grey		(AR)	
014	W001-00209	-	Wire, PTFE, Type A, 300V, 3A, 200C	7/0.12 White		(AR)	
015	W005-0178B	-	Cable, Coax, RG178B/U 50R, Brown, PTFE Insulated	7/0.1mm		(AR)	
016	A012-00000	-	Sleeving, Silicone Rubber, Class H, 180C, Wall 0.5mm	1mm ID Black		(AR)	
017	A011-003m2	-	Heatshrink Sleeving, Polyvinylidene Fluoride, +175C	3.2mm Dia		(AR)	
018	A006-0099C	-	Solder Wire, Alloy Sn99.3/Cu0.7, High Activity Rosin 309	Sldr Wire 99C Rosin		(AR)	
019	95211	-	O-ring 211 Viton 75		1	ea	
020	W001-00100	-	Wire, PTFE, Type A, 300V, 6A, 200C	7/0.2 Black		(AR)	
801	WD-81004	D	Wiring Diagram			(AR)	
802	AI-81004	PT1	Assembly Instruction			(AR)	
803	AR-81004	PT1	Assembly Record			(AR)	

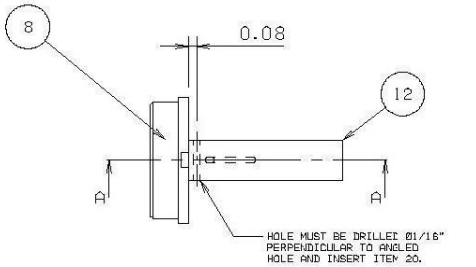
(AR = As Required)

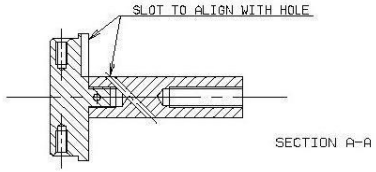


DRAWN JDR	CHECKED AJB	APPROVED DJF	ISS	DESCRIPTION	APPD	DATE	Sondex GEOPHYSICAL EQUIPMENT Tel. 0118 932 6755	USED ON 07083	TITLE ASSY HV PSU PMT/XTAL GAS HOLD UP TOOL
DATE 14/01/98	DATE 01/12/98	DATE 19/01/98	F	ECR 3056 REFERS	IH	05/11/08			
DIM IN INCHES	MATL: SEE DETAIL DRAWINGS		E	ECR 3912 REFERS	IH	17/09/08			
SCALE N. T. S.	A3		D	ITEM 23 AT REF F10 CHANNGED TO 20 ECR2837	GT	01/08/05	THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	MACHINE FINISH 63	GEN TOL 0.X ±0.020" 0.XX ±0.010" 0.XXX ±0.005" ANGLE ±0.5°
			C	ECR'S 2839 & 2841 REFER, SHT 2 ADDED	NPB	21/0 /05			
			B	PT22 & 23 NOW 1 OFF, PT27 NOW 3 OFF	AJB	08/03/00			
			A	INITIAL RELEASE	DJF	19/01/98	THIRD ANGLE PROJECTION		SHEET 1/2 · DRAWING No. AD-07407 · ISSUE F

SONDEX FM No: F0023

DO NOT SCALE





Item	Part No.	Qty	Description
01	00873	1	Assy, Low Powered HV PSU
02	94143	1	Photomultiplier, High Temp, Ruggedised
03	07413	1	Crystal, scintillation (HES 3 30521)
04	07403	1	Shield Outer Source Detector Housing
05	07404	1	Shield Inner Source Detector Housing
06	94167	A/R	Mu Metal Sheet 0.015 thick
07	07402	1	Housing Source Detector Assy
08	07405	1	Bulkhead Lower Source Detector Assy
09	07406	1	Sleeve Peek Source Detector Assy
10	07409	1	Spacer Source GHT002
11	07411	1	DISC
12	07441	1	Insulator XTAL
13	00857	1	Assy Connector Female Adjustable with Socket
14	00856	1	Insulator Centraliser
15			
16	01026	1	Half-Nut, Hex, 10-32UNF, St/Steel
17	01029	2	Screw, Csk Hd(Slotted), M3 x 06mm Lg, St/Steel
18	93128	4	Screw Csk Hd Slotted M2 5x06mm Lg SS
19	91155	1	Spring Spirawave Crest to Crest 6 Coils
20	01042	1	Pin, Spirol, 1/16 x 3/8 Lg, SS
21	93235	3	Pin Spirol 1/16 x 3/8 Long St/Steel, Heavy Duty
22	95020	1	O Ring Viton 75 Type 020
23			

NOTES

1. REMOVE ALL BURRS AND SHARP EDGES

DRAWN	CHECKED	APPROVED
JDR	AJB	DJF
DATE 14/01/98	DATE 01/12/98	DATE 19/01/98
DIM IN INCHES	MATL: SEE DETAIL DRAWINGS	
SCALE N.T.S.	A3	

ISS	DESCRIPTION	APPD	DATE
F	ECR 3056 REFERS	IH	05/11/08
E	ECR 3912 REFERS	IH	17/09/08
D	ITEM 23 AT REF F10 CHANNGED TO 20 ECR2837	GT	01/08/05
C	ECR's 2839 & 2841 REFER, SHT 2 ADDED	NPB	21/07/05
B	PT22 & 23 NOW 1 OFF, PT27 NOW 3 OFF	AJB	08/03/00
A	INITIAL RELEASE	DJF	19/01/98

Sondex
Tel. 0118 932 6755

THIRD ANGLE PROJECTION

USED ON 07083

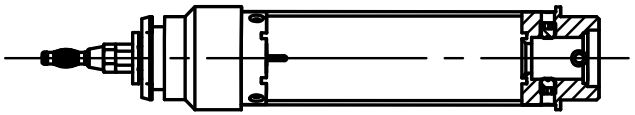
MACHINE FINISH 63

GEN TOL
0.X ±0.020"
0.XX ±0.010"
0.XXX ±0.005"
ANGLE ±0.5°

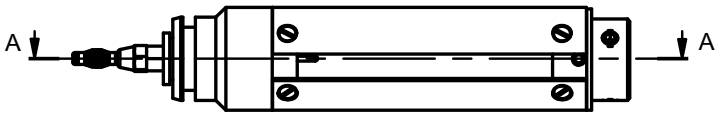
TITLE: ASSY HV PSU PMT/XTAL GAS HOLD UP TOOL

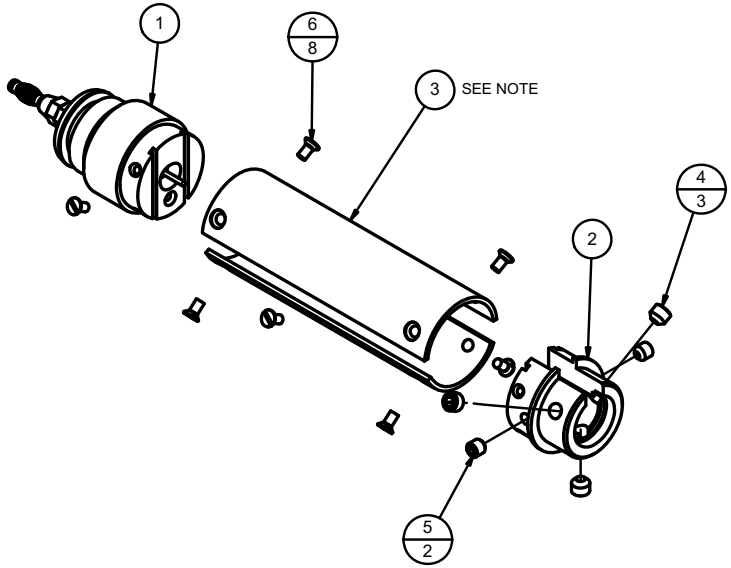
SHEET 2/2 | DRAWING No. AD-07407 | ISSUE F

DO NOT SCALE



SECTION A-A





ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10537	ASSY ELECTRONICS BULKHEAD SX(ISOLATION) MEM
2	1	01021	Bulkhead, Electronics,$Lower, Standard (Lemo)
3	1	01015	Halfshells, Chassis & Cover, Electronics, 1 Module
4	3	01082	SCREW GRUB SKT HD M6 x 05mm LG SS
5	2	93011	SCREW GRUB SKT HD M5 x 05mm LG SS
6	8	01029	SCREW CSK HD SLOTTED M3 x 06mm LG SS
7	1	t004-008ap	tape tygaflor 208ap/03t 80 x 30mm

NOTE

1. APPLY TAPE (ITEM 7) TO INSIDE FACES OF HALFSHELLS (ITEM 3).

DRAWN: GC	CHECKED: GHT	APP'D: NGH
DATE: 07/07/05	DATE: 07/07/05	DATE: 13/06/06
DIM IN: INCHES	MATL: SEE DETAIL DRAWINGS	
SCALE: 1:1	A2	HEAT TREATMENT/CONDITION: NOT APPLICABLE

ISS	DESCRIPTION	APPD	DATE
F	REDRAWN FROM HELIX	NGH	13/06/06

Sondex
Tel. 0118 932 6755

THIRD ANGLE PROJECTION

MACHINE FINISH 64 | USED ON: COM

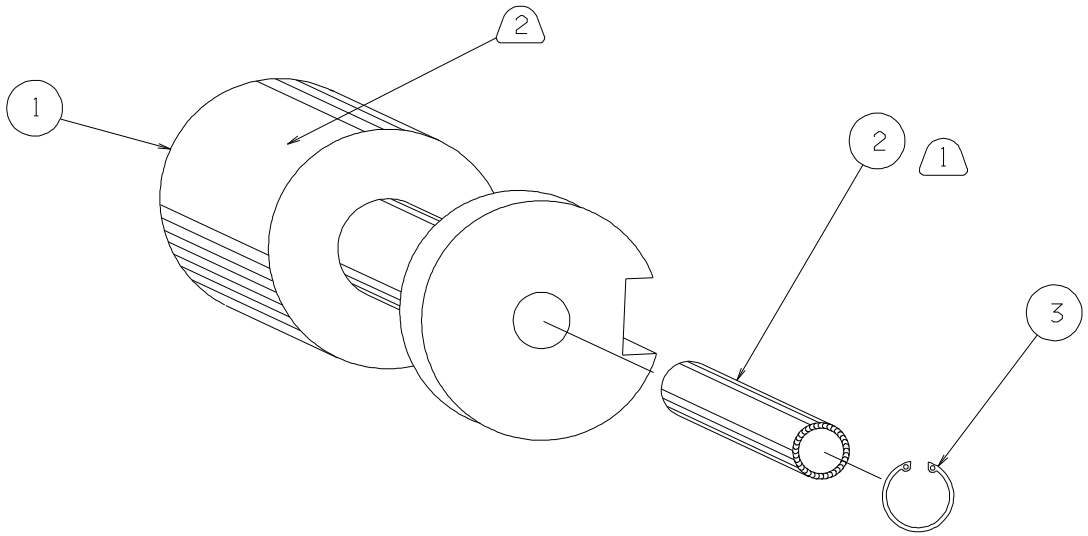
GEN TOL
0.X 0.020"
0.XX 0.010"
0.XXX 0.005"
ANGLE ±0.5°

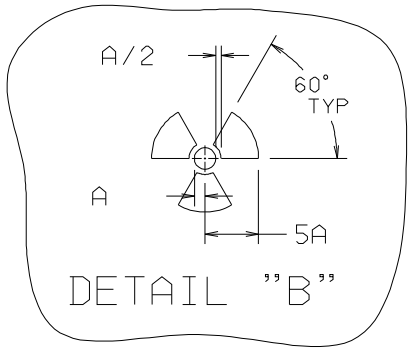
TITLE: ASSY - MECHANICAL CHASSIS 1 MODULE SX LEMO

SHEET 1/1 | DRAWING No. AD 10504 | ISSUE F | SW

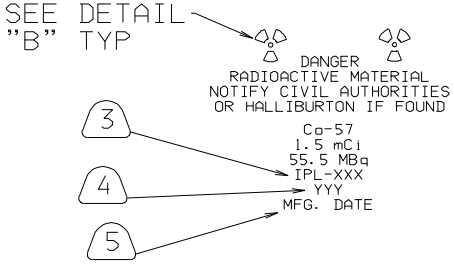
SONDEX FM No: F0022

DO NOT SCALE





VIEW A



NOTE:

1. INSTALL SOURCE WITH WELDED END AGAINST SNAP RING.
2. STENCIL PART AS SHOWN IN VIEW A
3. IPL-XXX = SOURCE SERIAL NUMBER
4. YYY = SOURCE MODEL NUMBER
5. MFG. DATE FORMAT = DAY, MONTH, YEAR.

DRAWN	CHECKED	APPROVED
AJB	NGH	DJF
DATE 11-09-98	DATE 22-01-99	DATE 19-01-99
DIM IN INCHES	MATL: N/A	
SCALE 2:1	A3	

ISS	DESCRIPTION	APPD	DATE

Sondex
GEOPHYSICAL EQUIPMENT
Tel. 0118 932 6755

THIRD ANGLE PROJECTION

USED ON: GHT 02

MACHINE FINISH: 63

GEN TOL
0.X ±0.020"
0.XX ±0.010"
0.XXX ±0.005"
ANGLE ±0.5°

TITLE: ASSY RADIOACTIVE SOURCE GAS HOLDUP TOOL

DRAWING No. 07410

ISSUE: A

SONDEX FM No: F0023

PARTS LISTING

TITLE:	Used On:	Drawn:	Checked:	Approved:
Assy Radioactive Source **Gas Holdup Tool**	GHT02	AJB	NGH	DJF
		Date: 11-Sep-98	Date: 22-Jan-99	Date: 19-Jan-99

CHANGE HISTORY

Issue:	Date:	Remarks:	Chk'd:	App'd:

RELEVANT DRAWINGS

Drawing No:	Issue:	Description:

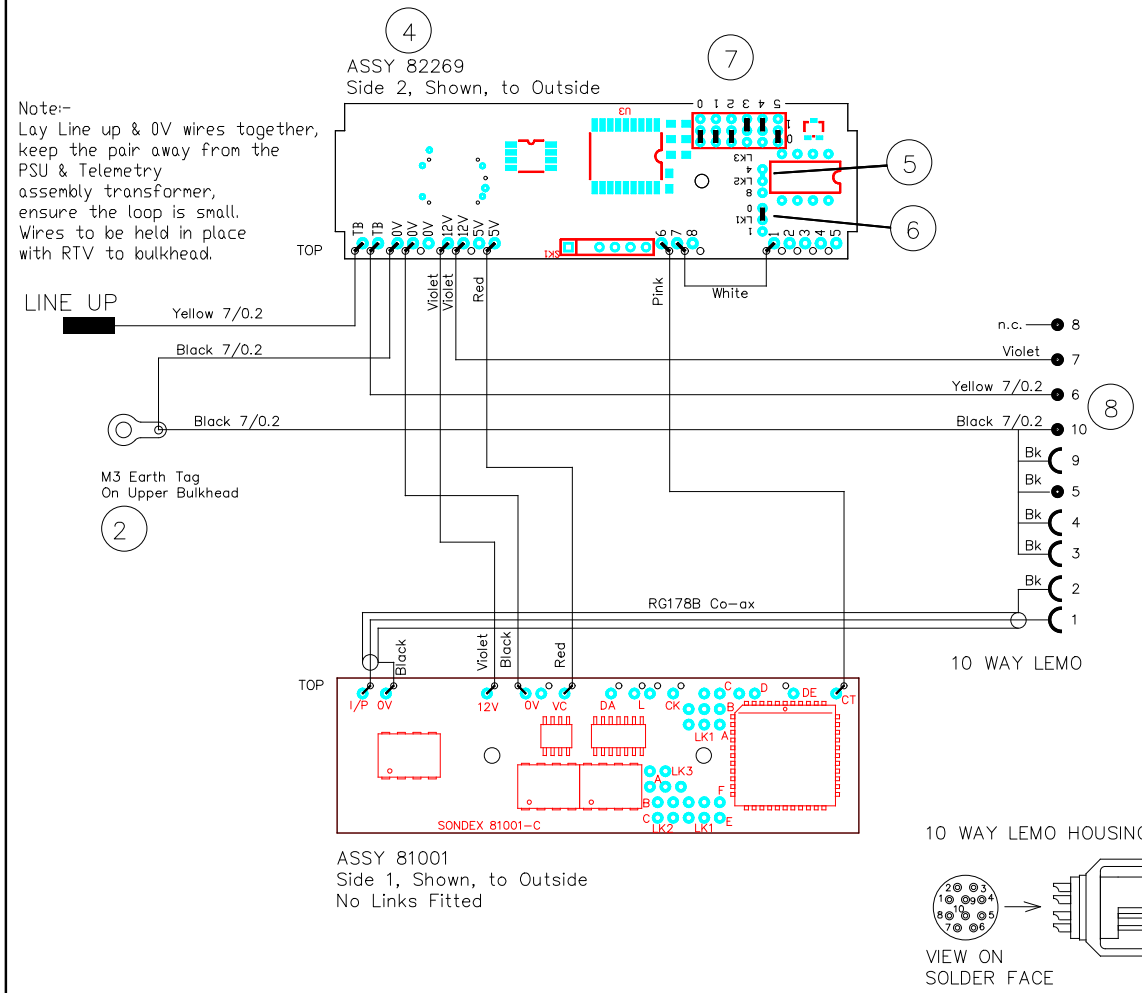
PARTS LIST

Item	Part No.	Issue	Description	Qty	Remarks
1	07408	A	Holder, Source (HES 3.26513)	1	
2	-	-	Source - Cobalt 57-1.5 Mci (HES .40575)	1	Customer supply
3	93306	-	Circlip, Internal Dia 1/4" St/Steel	1	
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					

SONDEX
Ford Lane, Bramshill, Hook, Hants, RG27 0RH.
Tel: ++44 0118 932 6755 Fax: ++44 0118 932 6704

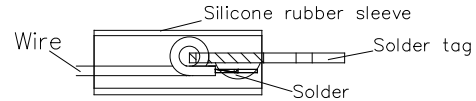
DRAWING No:
PL07410A.GHT

Page 1 of 1
Printed on 25/01/99

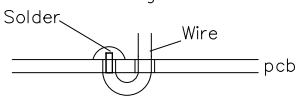


NOTES:

1. Wires PTFE 7/0.12 unless otherwise stated.
2. Strain relief of solder tag.



3. Strain relief of wiring.



4. Assy 82269 is Assy 82261 programmed with SON076
5. On Assy 82269, Link LK2 tracked to 4 on PCB
6. On Assy 82269, Fit Link LK1 – 0 (0V)
7. On Assy 82269, Fit Links LK3 to Address 24 as shown
8. Ensure Yellow & Black wires to Lemo are run together and kept away from Assy 82269 Transformer

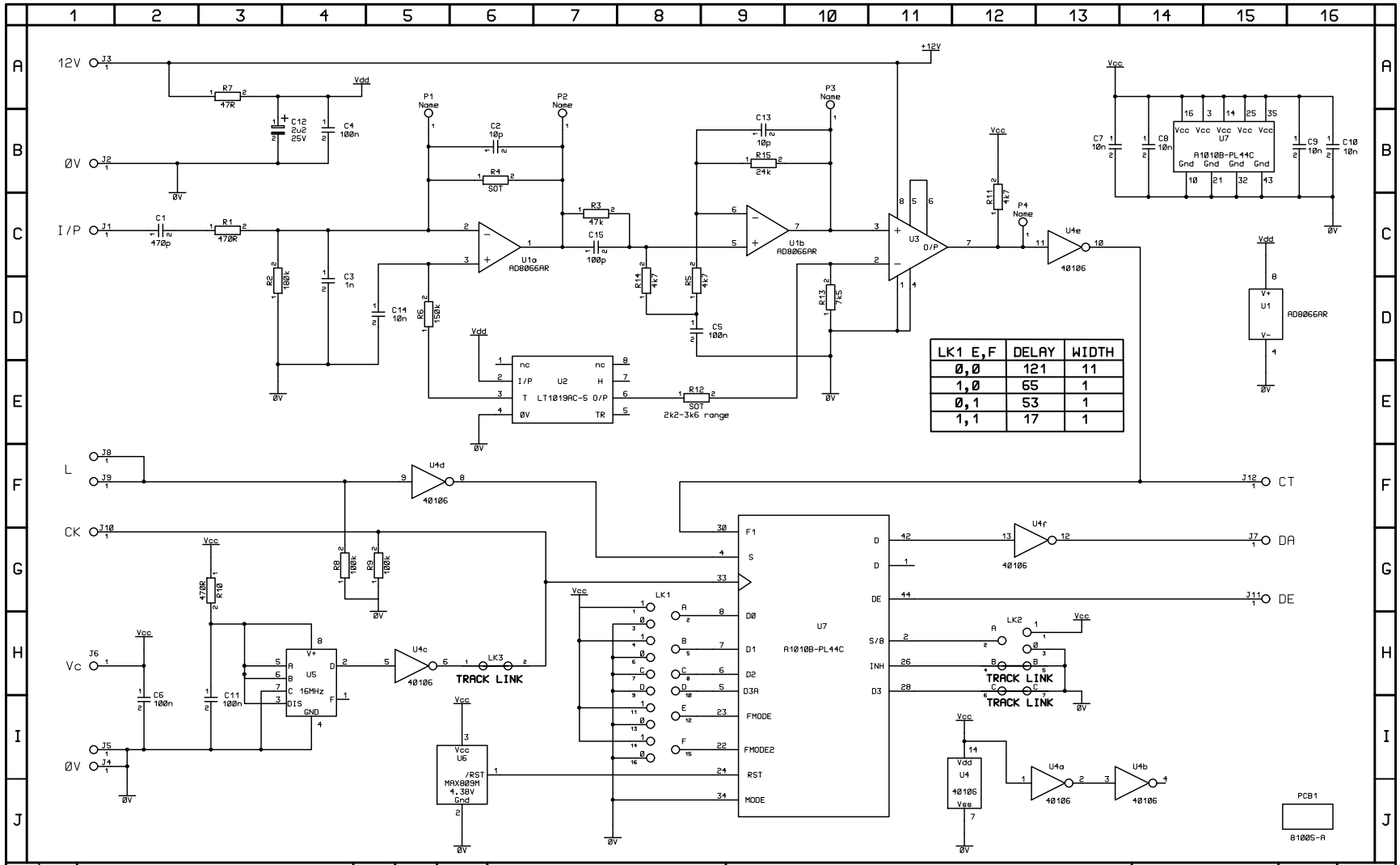
ISS	REV	DATE	CHANGES	CHKD	APPD
A		10.12.03	Initial release	(RH)	(RH)
B		13.9.04	ECR1692. Assy 82269 was 82224	(PR)	(PR)
C		20/06/06	ECR3909 Typo Error 82269 was 82229	MCP	BET
D		18/07/06	ECR3962 & ECR3982 Notes added	VH	RH

SONDEX
FORD LANE, BRAMSHILL,
HOOK RG27 0RH,
ENGLAND.
tel 44 118 9326755 fax 9326704

TITLE:
WIRING DIAGRAM
TOOL ELECTRONICS
U/W GAS HOLDUP

DRAWN	CHECKED	APPROVED
D.Jackson	(RH)	(RH)
DATE 2/6/3	DATE 10/12/03	DATE 10/12/03

DRAWING No. WD 81004 | ISSUE D | REVISION



LK1 E,F	DELAY	WIDTH
0,0	121	11
1,0	65	1
0,1	53	1
1,1	17	1

ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE
E	00	ECR2199 U1 was LM6152BCN	RH	RH	08/09/05
F		ECR5733 U1 was LM6152	VH	RH	09/09/08

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FORD LANE, BRAMSHILL,
HOOK, HAMPSHIRE,
RG27 0RH, ENGLAND
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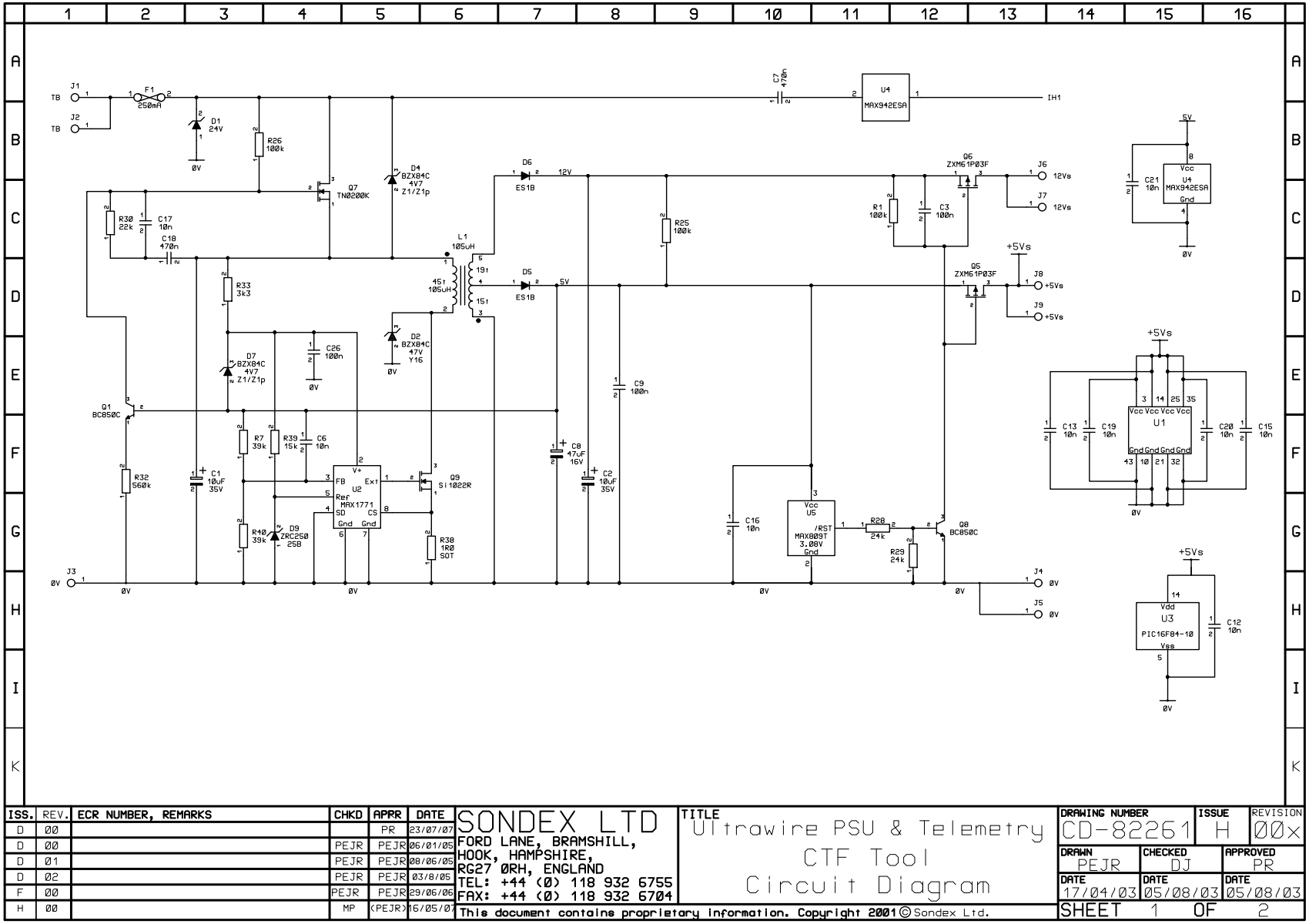
FAX: +44 (0) 118 932 6704

TITLE
Gas Hold Up Detector
Circuit Diagram

DRAWING NUMBER	ISSUE	REVISION
CD-81001	F	

DRAWN	CHECKED	APPROVED
DJ	RH	RH
DATE 15/9/04	DATE 08/09/05	DATE 08/09/05

SHEET 1 OF 1



ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE
D	00			PR	23/07/07
D	00		PEJR	PEJR	06/01/05
D	01		PEJR	PEJR	08/06/05
D	02		PEJR	PEJR	03/8/05
F	00		PEJR	PEJR	29/06/06
H	00		MP	(PEJR)	16/05/07

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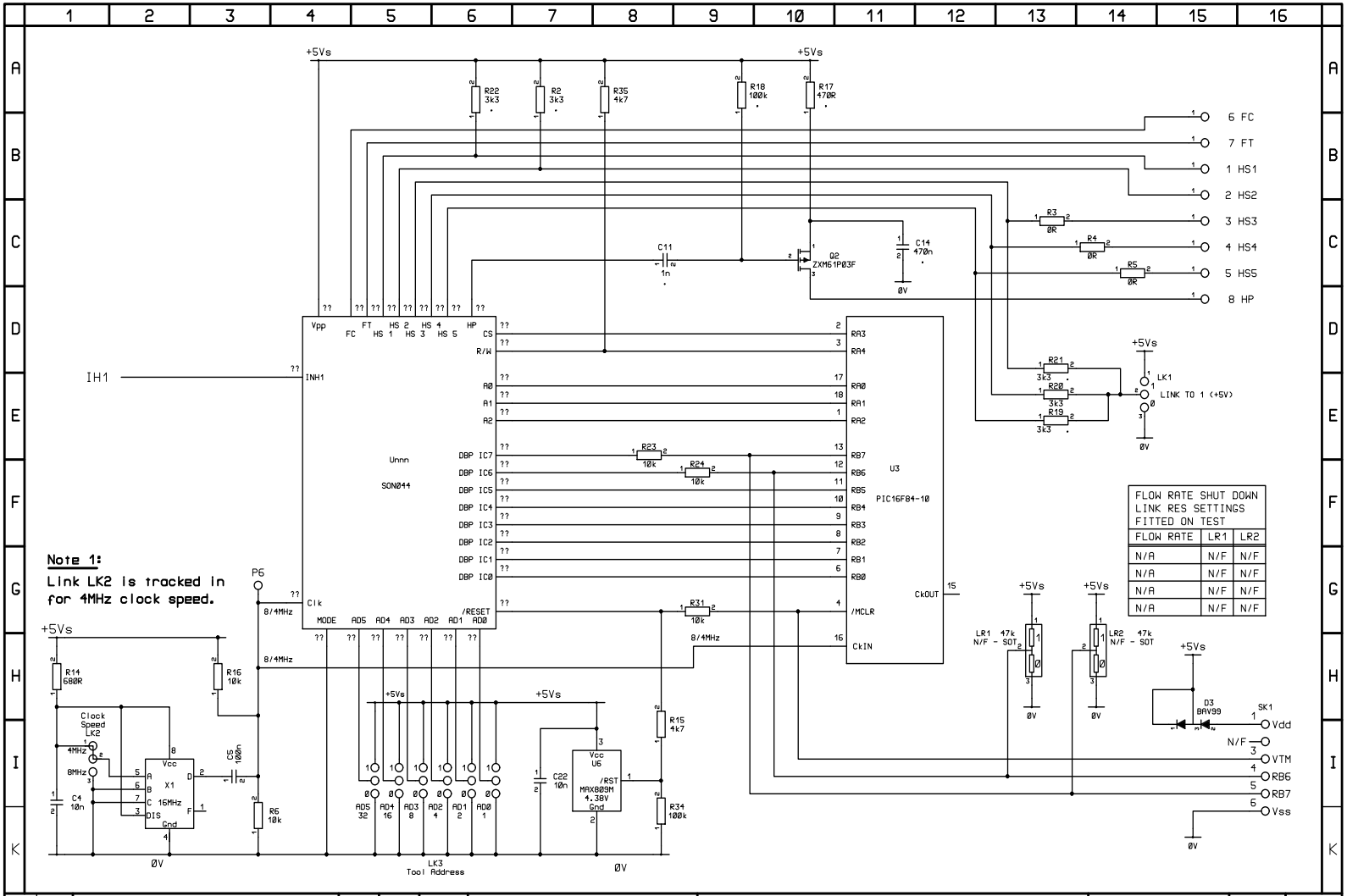
TITLE
Ultrawire PSU & Telemetry
CTF Tool
Circuit Diagram

DRAWING NUMBER	ISSUE	REVISION
CD-82261	H	00x

DRAWN	CHECKED	APPROVED
PEJR	DJ	PR
DATE 17/04/03	DATE 05/08/03	DATE 05/08/03

SHEET 1 OF 2



ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE
D	00			PR	23/07/07
D	00		PEJR	PEJR	06/01/05
D	01		PEJR	PEJR	08/06/05
D	02		PEJR	PEJR	03/8/05
F	00		PEJR	PEJR	29/06/06
H	00		MP	(PEJR)	16/05/07

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HOOK, HAMPSHIRE,
RG27 0RH, ENGLAND
TEL: +44 (0) 118 932 6755
FAX: +44 (0) 118 932 6704

TITLE: Ultrawire PSU & Telemetry CTF Tool Circuit Diagram

DRAWING NUMBER	ISSUE	REVISION
CD-82261	H	00x

DRAWN	CHECKED	APPROVED
PEJR	DJ	PR
DATE 17/04/03	DATE 05/08/03	DATE 05/08/03

SHEET 2 OF 2