Tool Code: PRT016

Document: MN-PRT016-J

Ultrawire™ Temperature Tool

PLATINUM RESISTANCE THERMOMETER Temperature Tool

PRT016: Ultrawire™ $1^{11}/_{16}$″, Fast Response

Operational & Maintenance Manual

Date:	12 October 1998
Author:	Robert Holding, Judith Lyon
Revised:	Ferry van der Vorst, August 2006
Approved:	Robert Holding

Tel. +44(0)1252 862 200 http://www.sondex.com
Fax. +44(0)1252 862 349 email: support@sondex.com

Created August 23, 2006

C o n t e n t s

0 ABOUT THIS MANUAL

0.1 MANUAL HISTORY

Date	Issue	Description	Auth	Chk	App
12/10/98	F	The manual has been updated to contain specific references and drawings for each tool variant.	JL		RLH
15/12/00	G	Manual reformatted to use new template, drawings and spares kits updated.	JL		RLH
03/05/02	H	Ultrawire electronics added.	SA	DMO	RLH
01/03/05	I	Updated as per ECR1486, 2168 & 2289.	SA	FV	RLH
23/08/06	J	General Updates. Also include updates as per ECR2904, 3141, 3920, 3962.	FV	FV	RLH

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:

Address: Unit 1, Saxony Way,
Blackbushe Business Park,
Yateley, Hampshire,
GU46 6AB
United Kingdom
Telephone: +44(0)1252 862 200
Fax +44(0)1252 862 349
Email: support@sondex.com

0.4 FEEDBACK

Please help us improve future issues of this manual by sending your comments or corrections to Documentation-UK@sondex.com, 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.

Documents from external sources (i.e. MSDS), supplied with/referenced in this manual, are considered the latest version at time of manual issue. However, the document can be altered by the external source without prior notice to Sondex.

1 EQUIPMENT

The Sondex Platinum Resistance Temperature Tools measure the borehole fluid temperature. The PRT016 operates as part of a Ultrawire™ toolstring and can operate as both wireline and memory depending on the system controller, such as an XTU. The power is also supplied by the system controller.

The sensor of the tool is a platinum resistance wire housed in an Inconel® needle. The device is fast reacting, accurate, stable and repeatable.

The line conductor passes through the tool from upper to lower heads.

PRT016

1.1 PURPOSE

To provide a continuous borehole fluid temperature log. This can aid identification of fluid origin and points of inflow.

1.2 APPLICATIONS

- Production and Injection Log interpretation.
- Location of Fluid Movement behind pipe or casing.
- Location of fluid entry, gas leaks and injection zones.
- Cement top determination.

1.3 SPECIFICATION

Parameter	Specification	Remarks
Temperature (max.)	177°C (350ºF)	
Pressure (max)	15,000psi (103.4MPa)	
Diameter	$1^{11}/_{16}$″ (43mm)	
Length	12.5″ (317.5mm)	
Measure point	$1^{3}/_{4}$″ (44.5mm)	
Weight in air	5.2lbs (2.35kgs)	
Operating voltages:		
Nominal:	+18V DC	
Functional:	+13V to +23V DC	
Absolute Max:	+24V DC	
Current consumption at 18V	20mA	
Resolution:	0.0035ºC (0.0063ºF)	For 1 sec acquisition time.
Acquisition time (typical)	1 sec	
Accuracy	±0.5°C	
Linearity	0.15% of full scale	For 2 point cal only. Better for multipoint.
Response time	0.5 secs	
End threads (top/bottom)	$1^{3}/_{16}$″ UNF (female/male)	
End connectors (top/bottom)	4mm single connector (pin/socket)	

2 SAFETY

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.

Warning! The temperature probe is a thin, sharp-ended tube, which could cause injury if improperly handled. Protective bars are fitted to the fluid slot.

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*.

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.

3 THEORY OF OPERATION

3.1 BLOCK DIAGRAM

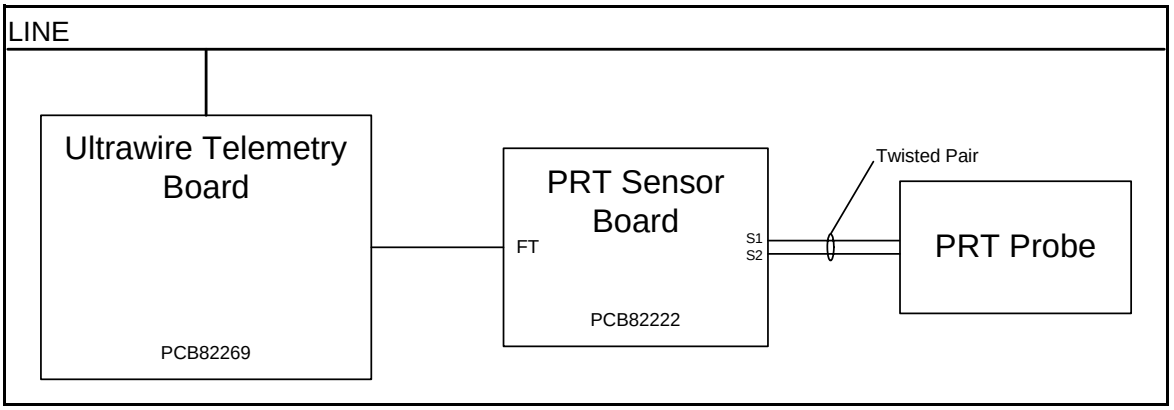


Figure 3.1 PRT016 Block Diagram

3.2 DESCRIPTION

See *Section 6 Electrical Description* for more detail.

3.2.1 TEMPERATURE MEASUREMENT

The Platinum Resistance Thermometer Tool measures downhole temperatures by measuring the resistance of a fast responding platinum resistance element. The probe is contained in a thin, pressure tight Inconel® needle, protruding into an open slot through which borehole fluid can flow.

The resistance of the platinum wire, used in the probe, varies roughly 38% for 100°C of temperature change.

The resistance is nominally 100Ω at 0°C. Sensors are made to a DIN standard and are interchangeable without recalibration.

The probe resistance is included as a key component in a frequency oscillator circuit. The circuit elements are chosen so that at 0°C the sensor frequency is close to 100Hz and increases linearly at approximately 4.5Hz/°C. This frequency is multiplied by 64 to achieve the desired sensor resolution. This 0-64kHz frequency is encoded prior to transmission on the Ultrawire™ toolbus wire.

The Sensor Oscillator circuit linearises the temperature response of the platinum resistance wire. The output frequency depends only on the sensor temperature. Changes in circuit board temperature have negligible effect on the measurement.

An exact calibration of each tool against a secondary platinum resistance standard accurate to 0.5°C or better is provided with each tool.

Although essentially linear, a multipoint calibration is supplied and recommended.

3.2.2 ELECTRONICS

For Ultrawire™ tools, the controller (e.g. XTU or UMT) supplies +18V DC to the through line. The voltage is then reduced to 12V and then further regulated to 5V.

The PRT016 tool operates on a Ultrawire™ toolbus. The Ultrawire™ controller (e.g. XTU or UMT) controls all the tools in the toolstring. Whenever data is requested by the controller the individual tools reply with the required information. The data is then collated by the controller for either wireline or memory operation.

4 OPERATING PROCEDURE

4.1 PRE-LOGGING CHECKS

See also *Section 7 Extended Checks*.

4.1.1 MECHANICAL

Ref: General Assembly *09522*

1 Clean and grease upper and lower O-ring seals. Replace O-rings (item 9, 09522) if damaged.

4.1.2 ELECTRICAL

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

3 Using a multimeter, measure the upper to lower pin resistance. Should be less than 0.5Ω.

4 Using a multimeter, measure the pin (+ve probe) to housing (-ve probe) resistance. Should be between 3 - 4MΩ depending on the meter.

4.1.3 OPERATING

The PRT016 must be electrically connected to a toolstring controller (e.g. UMT or XTU) and to a data acquisition logging system (e.g. MEMLOG or MIDAS).

5 The measured frequency should produce the expected temperature; using the tool's calibration vary the probe temperature and check for noise and stuck (flat) readings.

4.2 CALIBRATION

Calibration data is supplied with each tool and remains valid for the life of the tool. Recalibration is normally not required unless very precise measurements are to be made.

If the tool reads incorrectly, look for faults before recalibrating.

Be extremely wary of making wellsite recalibrations. Any attempt at wellsite calibration is generally likely to be less accurate than that provided with the tool.

For shop calibration see *Section 7.1.4 Calibration*.

4.3 CONNECTING TO TOOLSTRING

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

The PRT tools may be inserted into the toolstring in any location. The tool does not require any centralising although centering the sensor away from the casing is desirable.

An Ultrawire™ Bullnose Terminator (BUL006) or a suitable Ultrawire™ bottom end flowmeter must be fitted to the lower end of the toolstring. Toolstrings without an Ultrawire™ terminator fitted are likely to suffer from data loss.

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 and speed not to exceed 150ft/min.	Surface tension not to exceed 80% of tension when tool stationary and speed not to exceed 150ft/min.
>400 clear open hole	Surface tension not to exceed 130% of tension when tool stationary and speed not to exceed 150ft/min.	Surface tension not to exceed 70% of tension when tool stationary and 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, if a detailed log is required. Note that the sensor response time is 0.5 seconds (in flowing water). High logging speeds have the effect of averaging the temperature over a larger section of the flow. The fast response tool therefore minimises this effect and higher than conventional logging speeds for a detailed log can be used.	

[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

The tool should be cleaned before the toolstring is disassembled.

Ensure that well fluid does not reach the electrical connectors. Disassemble in a horizontal position wherever possible.

Refit thread protectors.

4.6 TRANSPORT, HANDLING & STORAGE

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

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

5 MECHANICAL DESCRIPTION

5.1 DESCRIPTION

Ref:	Sensor Section	*07039*
	Electronics Section	*10505*

The PRT016 is comprised of two main parts, which remain screwed together unless access to the probe is required.

The platinum resistance wire is positioned at the tip of the sensor probe assembly (item 2, 07039). This consists of a low mass Inconel® pressure housing filled with a heat conducting compound. This provides thermal isolation from the tool body and reduces the response time to borehole fluid temperature changes.

The two interchangeable wires from the sensor, together with the through wire to the lower head connector, pass to the electronics through the lower end (item 2, 10505). The electronics section contains 2 circuit boards.

The principal elements of the two sections are as follows:

Electronics Section

- Pressure Housing.
- PSU/Driver and Telemetry circuit board.
- Sensor Oscillator circuit board.
- Upper End fitted with monoconductor Pressure Isolation Head Assembly.
- Lower End with hole for through wiring to Sensor Section.

Sensor Section

- Sensor Body.
- Sensor Probe Assembly.
- Lower Head Connector Assembly.

5.2 DISASSEMBLY

Ref:	General Assembly	*09522*
	Sensor Section	*07039*
	Electronics Section	*10505*

5.2.1 ELECTRONIC SECTION ACCESS

1 Unscrew housing (item 1, 09522) from sensor body (item 3, 09522). The electronics section internal chassis remains fixed to the sensor body by screws (3x item 4, 10505).

Warning! DO NOT remove these screws yet since wires connect the 2 sections.

2 Remove screws (4x item 5, 10505) and remove the top cover (item 3, 10505).

Note: The bottom cover (item 3, 10505) is an integral part of the chassis and should not be removed, particularly if the top part of the Cover is removed.

5.2.2 SEPARATION & DISASSEMBLY OF SENSOR SECTION

Gain access to the electronics section as described above.

Note: The sensor probe **should not** be removed, unless known to be faulty, as it is very difficult to reseal the assembly adequately. Do not pull on the sensor wires as the platinum sensor is very delicate.

3 Unsolder the following 3 wires connecting the electronic and sensor sections.

- 2x Temperature sensor wires.
- 1x through line, yellow & black screen.

4 Screw the grub screws (3x item 4, 10505) **inwards** to release the electronics chassis lower end (item 2, 10505) from the sensor body (item 1, 07039).

5 The sensor probe (item 2, 07039) may be removed for replacement if faulty.

6 Remove circlip (item 7, 09522) and extract the lower head connector assembly (item 6, 09522). It is not necessary to remove the anti-rotation pin (item 8, 09522).

7 The lower head connector assembly can then be further disassembled to replace damaged parts.

5.3 REASSEMBLY

Ref:	General Assembly	*09522*
	Sensor Section	*07039*
	Electronics Section	*10505*

This is the reverse of *Section 5.2 Disassembly* with the following notes:

5.3.1 SENSOR SECTION

1 Inspect the following components for damage and replace if necessary:

- Circlip (item 7, 09522).
- Lower head connector assembly (item 6, 09522).

2 Ensure the lower connector assembly seats correctly against anti-rotation spirol pin (item 8, 09522). Check and grease O-ring (item 12, 09522).

3 Take care not to damage the 3 wires to the electronics section.

4 Clean and grease the pressure seal surfaces at both ends of the sensor body. Replace O-rings (items 9 & 11, 09522). Ensure that the inside of the sensor body is free from debris.

5.3.2 ELECTRONICS SECTION

5 Inspect the banana pin on the end of the pressure isolation head assembly (item 1, 10505) for damage and replace if necessary. See *Section 5.4*.

6 Clean pressure seal surfaces at both ends of pessure housing. Ensure housing is free from debris. Clean and grease O-ring (item 10, 09522).

7 Remember to screw out grub screws (3x item 4, 10505) to engage sensor body. Loctite® 242 (or other suitable compound) may be used to secure these, if vibration causes them to become loose.

5.4 UPPER HEAD PRESSURE ISOLATION ASSEMBLY

See the pressure isolation head manual, *MN-PIH* for disassembly and maintenance instructions of this sub assembly.

6 ELECTRICAL DESCRIPTION

Ref.: Wiring Diagram *WD-80123*

6.1 TELEMETRY CIRCUIT BOARD

Ref.: Circuit Diagram for PCB82267 *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.

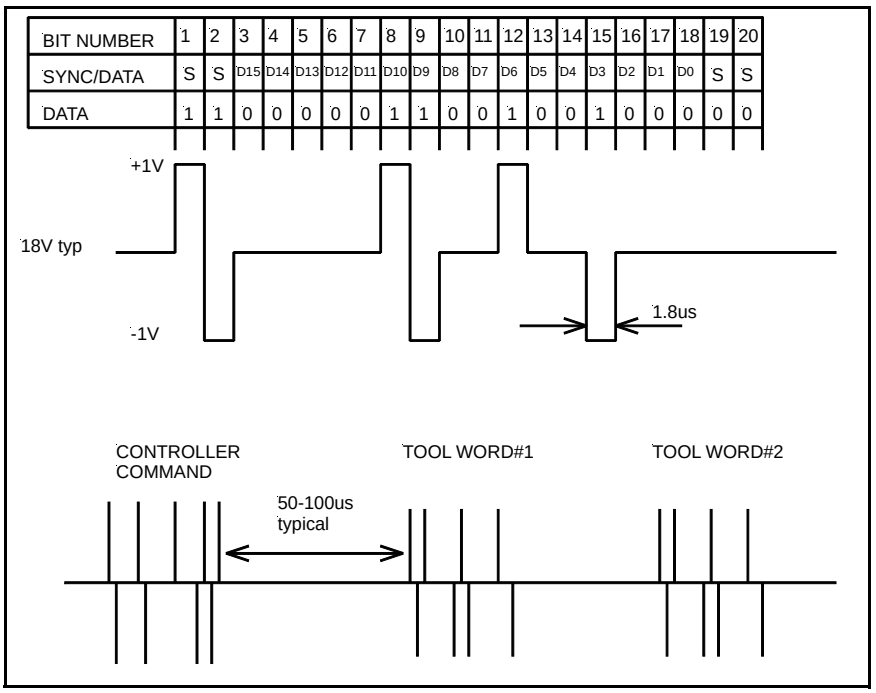


Figure 6.1 Ultrawire™ Signal Shape example

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 SENSOR OSCILLATOR CIRCUIT BOARD

Ref.: Circuit Diagram *CD82222*

The circuit essentially consists of an integrator and comparator to form an oscillator. Current passing through the platinum resistance sensor generates the voltage to be integrated on S1. The output frequency is thus linearly related to the sensor resistance. The sensitivity of the Resistance Wire decreases slightly with temperature and this is linearised by R11.

R11, R12 and C3 provides DC feedback to ensure a symmetrical waveform over the temperature range.

Sensitivity is adjusted by R8 and offset adjusted by R6 & R7.

If the output of U3 (pin 6) is high (Vs), then S2 will be at about 100mV below Vs/2. Current flowing through R20 generates a voltage on S1 relative to S2 proportional to the probe resistance. This is integrated by U5 to produce a descending ramp (pin 6 U5). This is input to comparator U4a with R19 providing a positive offset. When pin 5 U4a reaches S1, the comparator switches, the current flowing in the probe is reversed and the integrator ramps in the positive direction.

Inverter U4b generates a small square wave of opposite polarity on S2. This therefore reduces the voltage on S1 to be integrated and thus provides an adjustable offset. Note that this must not be so large as to reverse the polarity of the signal on S1, otherwise the circuit will not oscillate. R6 and R7 are adjusted to set the FT1 frequency to 100Hz at 0°C.

R8 is selected to set the sensitivity to 4.5Hz/°C.

R11 introduces a small step into the signal on U5 pin 6 proportional to the amplitude on S1. This produces an overall increasing frequency sensitivity to input amplitude, which compensates for the probe's slight temperature non-linearity.

U1 and U2 allow for the FT1 frequency to be multiplied by 8 or 64, selected by LK1, and output on FT. This increases the resolution in terms of counts per °C. R2 is selected for the required frequency range.

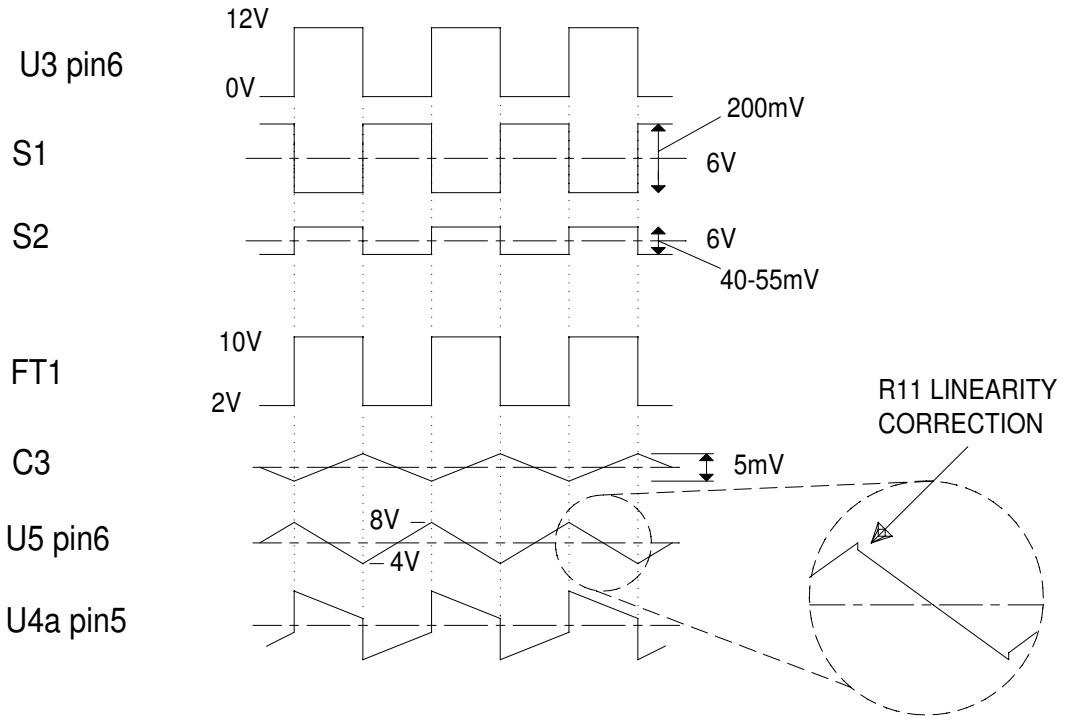


Figure 6.2 Sensor Oscillator Timing

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

Ref.: Electronics Section *10505*

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*.
- Check any connectors for cleanliness and loose/bent pins before replacing.

4 Check all fixings for tightness.

5 Check grub screws (3x item 4) are tight.

7.1.3 ELECTRICAL

1 Check through line resistance and tool current, see *Section 4.1.2*.

2 Check tool current 20mA at 18V.

3 Connect to Logging System and check for correct data. Apply some gentle vibration and rotation to expose potential failure.

4 With an oscilloscope, check line 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 a Ultrawire terminator at the bottom of the tool-string (e.g. Ultrawire bullnose terminator (BUL006) or a suitable Ultrawire bottom end flowmeter).

7.1.4 CALIBRATION

Large calibration adjustments should not be required unless there have been component changes on the Sensor Oscillator board. The calibration supplied with the tool should remain valid for the life-time of the tool under normal conditions.

The Sensor Probe Assembly contains a platinum resistance sensor type Pt100 which conforms to DIN and BS standards for such devices. A section of this standard for the Pt100 is shown below; DIN 43760:1980 and BS1904:1984.

Temp (°C)	Resistance (Ω)	Slope (Ω/°C)	Temp (°C)	Resistance (Ω)	Slope (Ω/°C)
0	100.00	0.390	110	142.29	0.377
10	103.90	0.389	120	146.06	0.376
20	107.79	0.388	130	149.82	0.376
30	111.67	0.387	140	153.58	0.373
40	115.54	0.386	150	157.31	0.373
50	119.40	0.384	160	161.04	0.372
60	123.24	0.383	170	164.76	0.370
70	127.07	0.382	180	168.46	0.370
80	130.89	0.381	190	172.16	0.368
90	134.70	0.380	200	175.84	0.367
100	138.50	0.379			

Figure 7.1 Sensor Probe Resistance: Temperature Chart

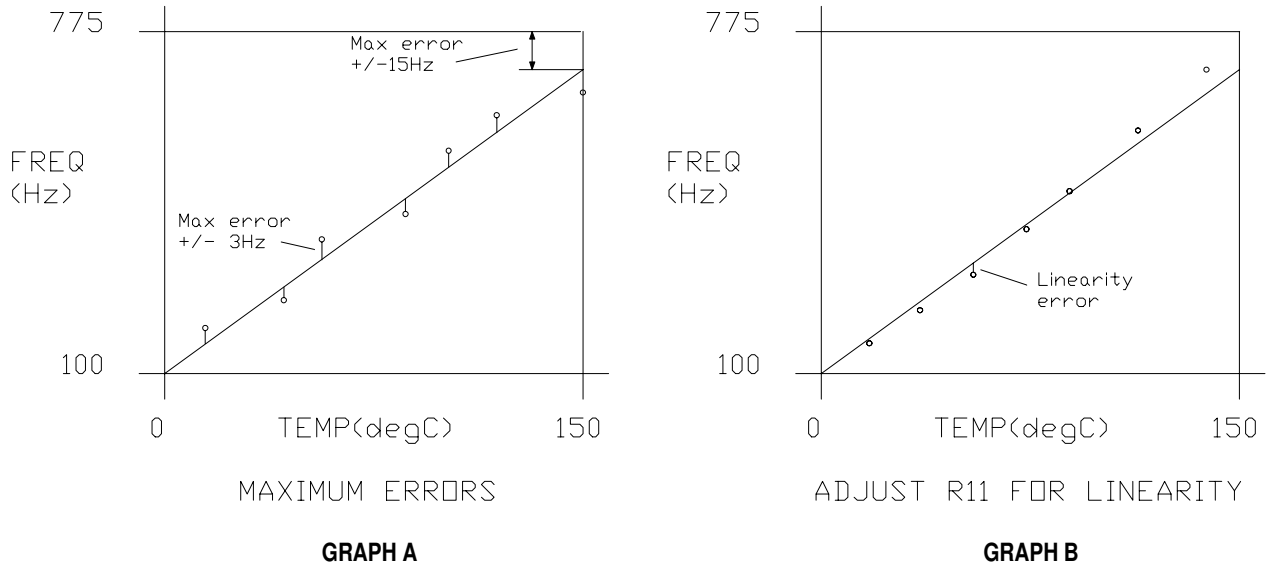


Figure 7.2 Temperature Calibration for FT1

The electronics may be calibrated at temperature with precision resistors or with the actual Sensor Probe at known temperatures. Both are valid. The following procedure assumes that the latter method is used. It must be pointed out that using the Probe itself requires that its temperature must be very accurately known. This can be extremely difficult. Using precision resistors in place of the Sensor Probe is highly accurate, but does not check the Probe.

Full accuracy of calibration requires that the electronics of the PRT tool is within 10°C of the Sensor Probe temperature.

Equipment required:

- Oven or heated oil bath.
- Calibrated temperature reference probe.
- If air oven, a copper thermal coupling is required between PRT probe and reference probe.
- Data aquisition system (e.g. MEMLOG or MIDAS) to measure output frequency. Alternatively a frequency counter may be used.

Procedure:

Collect temperature vs frequency data at approx 20°C intervals. Allow readings to stabilise for at least 5 minutes before recording. Do this while heating and cooling to identify hysterisis errors.

Desired response:

Nominally a straight line for FT1 passing through (0°C, 100Hz) and (150°C, 775Hz). Precise slope and offset is not critical. On PCB82222 circuit board, R8 adjusts slope and R6/7 offset.

Random errors (*Figure 7.2* - Graph A) are usually due to poor calibration method or less likely a tool fault.

Non linearity (*Figure 7.2* - Graph B) is not a problem if a multipoint calibration is used. It does result in error if a 2 point calibration is used. Non linearity is adjusted by R11 on PCB82222 circuit board.

7.1.5 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**.

7.1.6 HEAT TESTING ABOVE 150°C

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

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

7.2 EXTRAORDINARY MAINTENANCE

Ref: General Assembly *09522*

See also *Section 4.1 Pre-Logging Checks.*

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

- 2x item 9
- 2x item 11

No other special maintenance is required.

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	Disconnect wires to isolate fault to: • Upper head isolation assembly. • 82269 circuit board. • 82222 circuit board. • Line wire. Apply Line Signal or 18V direct to PCB82269 line connection. Fault find or replace PCB82269. Upper Head, sensor line wire and lower connector may be tested to 250V relative to chassis to check for electrical leak. **Line connection to PCB82269 must be disconnected**. Resistance should exceeed 100MΩ.
Little or no current	On PCB82269, check LINE = 18V, 12V, 5V and 0V. Fault find or replace PCB.
No telemetry counts	On PCB82269, check LINE = 18V, 12V, 5V and 0V. Fault find or replace PCB.
No telemetry reply	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.
No output from PCB82222 Sensor Board	Check probe resistance (108Ω at 20°C). Not shorted to 0V (chassis). On PCB82222, Junction of R13/16 at Vs/2. On PCB82222, U5 pin 6 ramp 4-8V. On PCB82222, U3 pin 6 switches to within 30mV of voltage rails. Use resistor in place of probe to simulate temperature (*Figure 7.1*).

APPENDIX A EQUIPMENT & RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	PRT016	Ultrawire™ PL Temperature Tool	1	Fast Response Tool.

A.1 ANCILLARY EQUIPMENT

Calibration Fixtures (not normally required)

Item	Part No	Description	Qty	Remarks
1		A thermostat controlled oven or fluid bath	1	
2		Thermometer calibrated to an accuracy better than that required of the PRT	1	
3		Resistance box	1	Optional

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-ring & threads	AR	5oz. pot
3	LOR101L	Grease for O-ring & threads	AR	12oz. pot

A.3 RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	*KITB-PRT1 11/16*	Basic Spares Kit	1	To support 1 run in hole.
2	*KITR-PRT1 11/16*	Recommended Spares Kit	1	To support 25 runs in hole.

Note: Spares kits suitable for remote logging operation can be supplied upon request.

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
91050	-		NGH	PD	DJF
			Date: 14/01/2002	Date: 14/01/2002	Date: 14/01/2002

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

CHANGE HISTORY					RELATED DOCUMENTS		
Iss	*Date*	*Remarks*	*Chkd*	*Appr*	*# Documents*	*Issue*	*Notes*
-	14/01/2002	Initial Release	PD	DJF			

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	91005	-	Spanner Open Ended 42mmx38mm		2	ea	
002	91019	-	Spanner C 50mm 35mm		1	ea	
003	10038	A	Spanner Box 3/8 x 5/16 Modified		2	ea	
004	91028	-	Spanner 3/8x5/16		1	ea	
005	91027	-	Spanner Single Open End 18mm		1	ea	
006	91029	-	Key Hex Metric		1	ea	
007	91030	-	Punch Pin Parallel set		1	ea	
008	00615	A	Assy Spanner PKJ		1	ea	
009	91293	PT1	Screwdriver Parallel tip (3 0 x 75)		1	ea	
010	91105	-	Toolroll With SX Badge Large Black		1	ea	
011	91104	-	Screwdriver Parallel tip (5 5 x 200)		1	ea	
012	91103	-	Pliers Circlip 812 Chrome/Van		1	ea	
013	91102	-	Pliers Mini Flat Nose 5 Inch		1	ea	
014	10037	A	Bar Tommy		2	ea	
015	10051	A	Kemlon tool Sondex - 4BA Hex Socket		1	ea	
016	91280	-	Hammer, 4oz ball pein		1	ea	
017	91130	-	Pin C Spanner 35-50mm		1	ea	

(AR = As Required)

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
KITB-PRT1 11/16	A		SA	RLH	RLH
			Date: 17/02/2005	Date: 17/02/2005	Date: 17/02/2005

Description:
Kit, Spares, Basic, PRT(1 11/16)

CHANGE HISTORY					RELATED DOCUMENTS		
Iss	*Date*	*Remarks*	*Chkd*	*Appr*	*# Documents*	*Issue*	*Notes*
A	17/02/2005	Inital release.	RLH	RLH			

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	99124	-	O Ring Viton 90 Type 124		2	ea	
002	99211	-	O Ring Viton 90 Type 211		2	ea	

(AR = As Required)

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
KITR-PRT1 11/16	B		AJB	RLH	RLH
			Date: 01/05/2001	Date: 01/05/2001	Date: 01/05/2001

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

CHANGE HISTORY

Iss	*Date*	*Remarks*	*Chkd*	*Appr*
B	03/05/2002	Added items 3 - 5	RLH	RLH

RELATED DOCUMENTS

#	*Documents*	*Issue*	*Notes*

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	99124	-	O Ring Viton 90 Type 124		50	ea	
002	99211	-	O Ring Viton 90 Type 211		50	ea	
003	01028	C	Assy, Banana Pin (4mm)		1	ea	
004	01029	-	Screw, Csk Hd(Slotted), M3 x 06mm Lg, St/Steel		2	ea	
005	95211	-	O Ring Viton 75 Type 211		5	ea	

(AR = As Required)

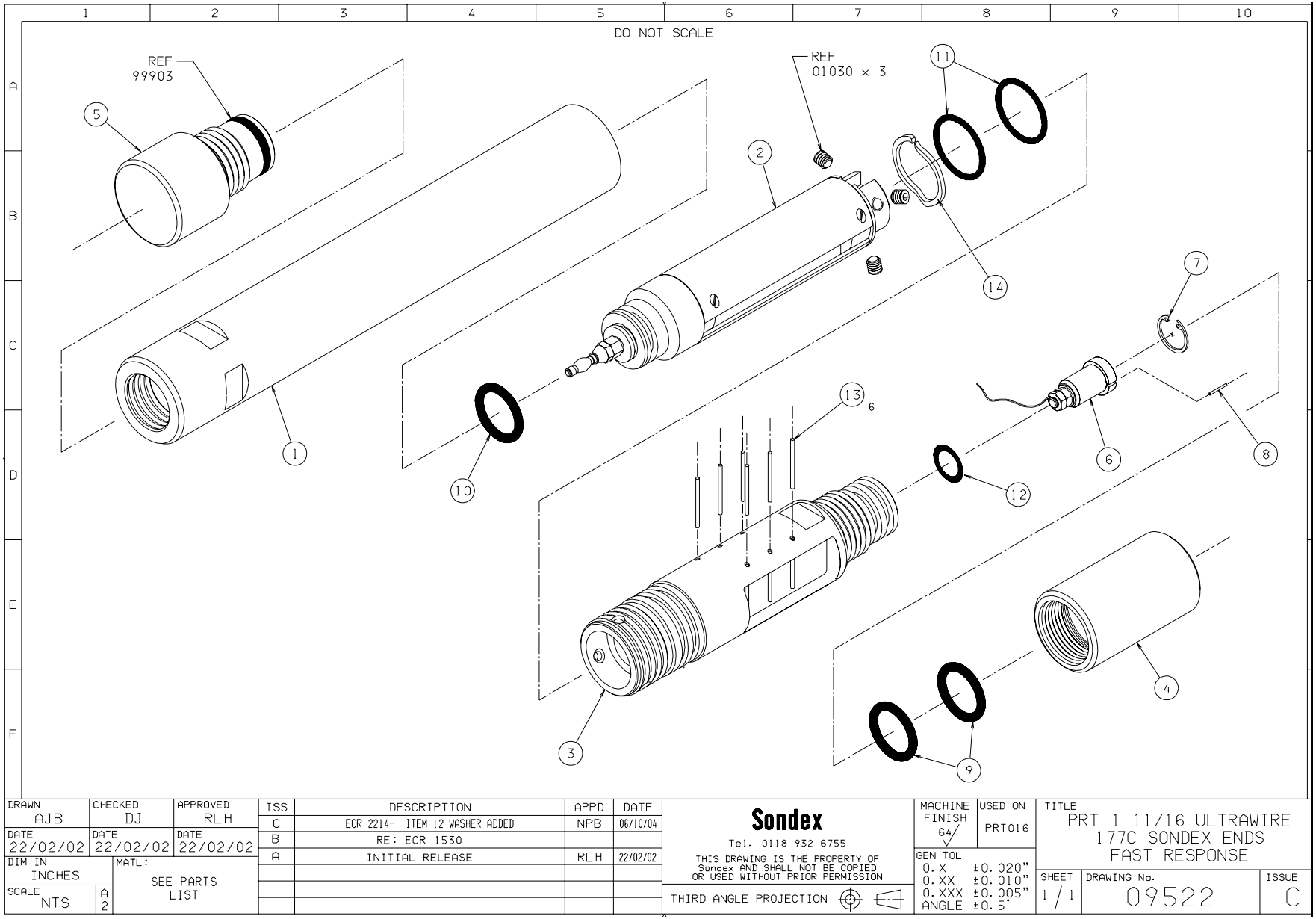
APPENDIX B DRAWINGS & PARTS LISTS

B.1 MECHANICAL DRAWINGS

Description	Drawing	Parts List
PRT016 General Assembly	*09522-C*	*09522-D*
Sensor Section	*07039-D*	*07039-D*
Electronics Section	*10505-D*	*10505-D*
Temperature Probe Assembly	*00364-A*	*00364-A*

B.2 ELECTRICAL DIAGRAMS

Description	Type	Drawing
General Assembly	Wiring Diagram	*WD-80123-G*
Telemetry Board (PCB82269) - 2 sheets	Circuit Diagram	*CD-82261-F00x*
Sensor Oscillator Board	Circuit Diagram	*CD-82222-B01*



DRAWN AJB	CHECKED DJ	APPROVED RLH	ISS	DESCRIPTION	APPD	DATE	**Sondex**	MACHINE FINISH 64	USED ON PRT016	TITLE PRT 1 11/16 ULTRAWIRE 177C SONDEX ENDS FAST RESPONSE	
DATE 22/02/02	DATE 22/02/02	DATE 22/02/02	C	ECR 2214- ITEM 12 WASHER ADDED	NPB	06/10/04	Tel. 0118 932 6755	GEN TOL			
DIM IN INCHES	MATL: SEE PARTS LIST		B	RE: ECR 1530			THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	0.X ±0.020"	SHEET 1 / 1	DRAWING No. 09522	ISSUE C
SCALE NTS	A2		A	INITIAL RELEASE	RLH	22/02/02	THIRD ANGLE PROJECTION	0.XX ±0.010"			
								0.XXX ±0.005"			
								ANGLE ±0.5°			

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
09522	D		AJB	DJ	RH
			Date: 22/02/2002	Date: 22/02/2002	Date: 22/02/2002

Description:
PRT 1 11/16 Ultra Wire (177C) Sondex Fast Response

CHANGE HISTORY

Iss	*Date*	*Remarks*	*Chkd*	*Appr*
A	22/02/2002	Initial release		
B	--/--/--			
C	06/10/2004	ECR 2214 - ITEM 14 WASHER ADDED	NPB	NPB
D	09/11/2004	ECR2289.WD,AI,AR added.80123 was Iss E.Items 15 to 19 added	SA	RH

RELATED DOCUMENTS

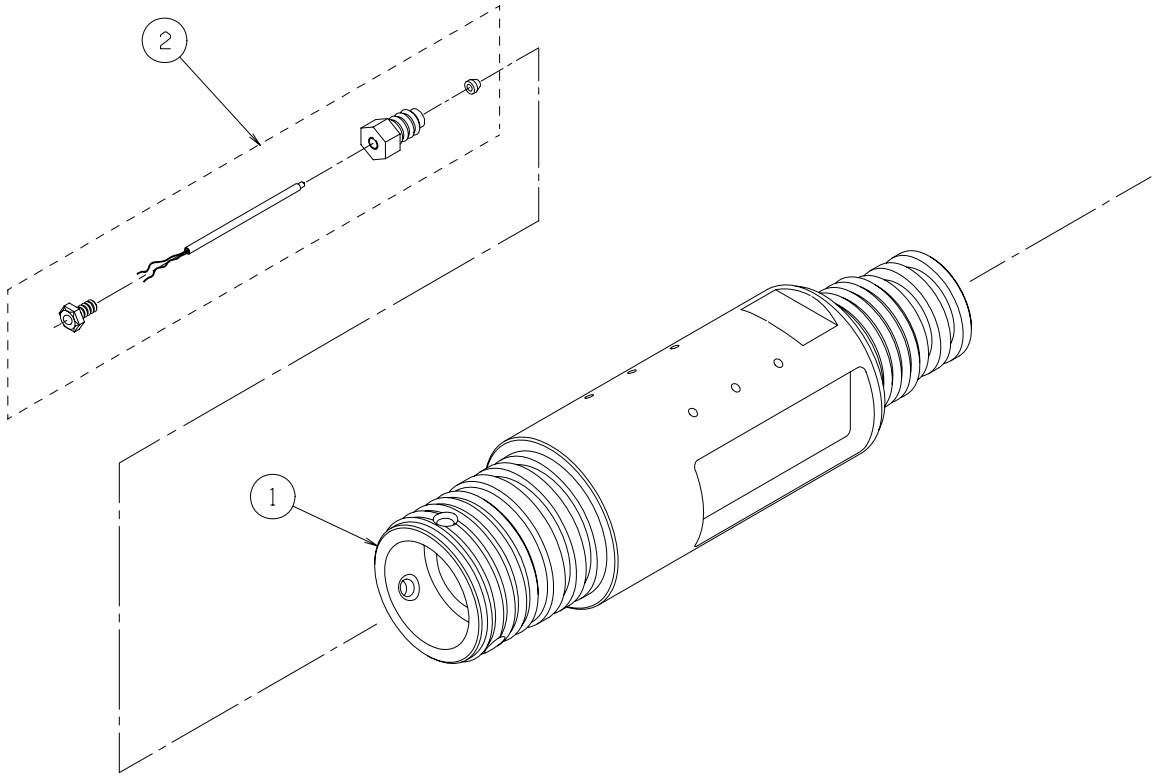
#	*Documents*	*Issue*	*Notes*
01	AD 09522	C	Assembly Drawing
02	AI 09522	PT1	Assembly Instructions
03	AR 09522	PT1	Assembly Record
04	WD 09522	A	Wiring Diagram
05	TP 09522	B	Test Procedure
06	TR 09522	B	Test Results
07	CS 09396	C	Calibration Sheet

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	01020-1	C	Housing Pressure 1 11/16, 1 Module		1	ea	
002	80123	G	Assy Electronic Cartridge PRT Ultrawire		1	ea	
003	07039	D	Assy 1 11/16 PRT High Sensitiivty SX		1	ea	
004	01019	E	Thread Protector, Female, Standard (Lower End)		1	ea	
005	01018	C	Thread Protector, Male, Std, Upper (with O'Ring See 10148)		1	ea	
006	10057	D	Assy Connector Lower SX Sealing Type		1	ea	
007	01047	-	Circlip, Internal, 5/8, St/Steel		1	ea	
008	93019	-	Pin Spirol 1mm x 8mm LG MCK SS		1	ea	
009	99211	-	O Ring Viton 90 Type 211		2	ea	
010	95211	-	O Ring Viton 75 Type 211		1	ea	
011	99124	-	O Ring Viton 90 Type 124		2	ea	
012	95112	-	O Ring Viton 75 Type 112		1	ea	
013	93110	-	Pin Spirol 2mm x 24mm LG MCK SS		6	ea	
014	91552	-	Wavy Washer, 3 Waves, Overlapped, 0100, St/Steel		1	ea	
015	W001-00104	-	Wire, PTFE, Type A, 300V 6A, 200C	7/0.2 Yellow		(AR)	
016	W005-0178B	-	Cable, Coax, RG178B/U 50R, Brown, PTFE Insulated	7/0.1mm		(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	A006-099CA	-	Solder Wire, 331 O.W/Sol., Alloy Sn99.3/Cu0.7, Core#66(3.3%)	Sldr Wire 99C Aqueous		(AR)	

(AR = As Required)

DO NOT SCALE



DRAWN	CHECKED	APPROVED
AJB	NGH	DJF
DATE 20/05/97	DATE 31/07/97	DATE 29/08/97

DIM IN INCHES | MATL: SEE PARTS LIST

SCALE 1:1 | A3

ISS	DESCRIPTION	APPD	DATE
D	RE: ECR 1530	DJF	24/08/04
C	PROBE & GLAND NOW ASSYS (PVR289)	RJ	12/04/00
B	TEMP PROBE NOW SHOWN AS ASSEMBLY	AJB	02-11-98

Sondex
Tel. 0118 932 6755

THIRD ANGLE PROJECTION

USED ON: PRT 10 11

MACHINE FINISH 63

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

TITLE: ASSY ϕ1 11/16" PRT HIGH SENSITIVITY SONDEX END

SHEET 1/2 | DRAWING No. 07039 | ISSUE D

SONDEX FM No: F0023

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
07039	D		AJB	NGH	DJF
			Date: 20/05/1997	Date: 31/07/1997	Date: 29/08/1997

Description:
Assy 1 11/16 PRT High Sensitiivty SX

CHANGE HISTORY

Iss	*Date*	*Remarks*	*Chkd*	*Appr*
A	20/05/1997	Initial Issue		
C	12/04/2000	Item 4 Up-Iss,(PVR 289). Probe Assy Modified	AJB	
D	24/08/2004	Re. ECR:1530	GJS	DJF

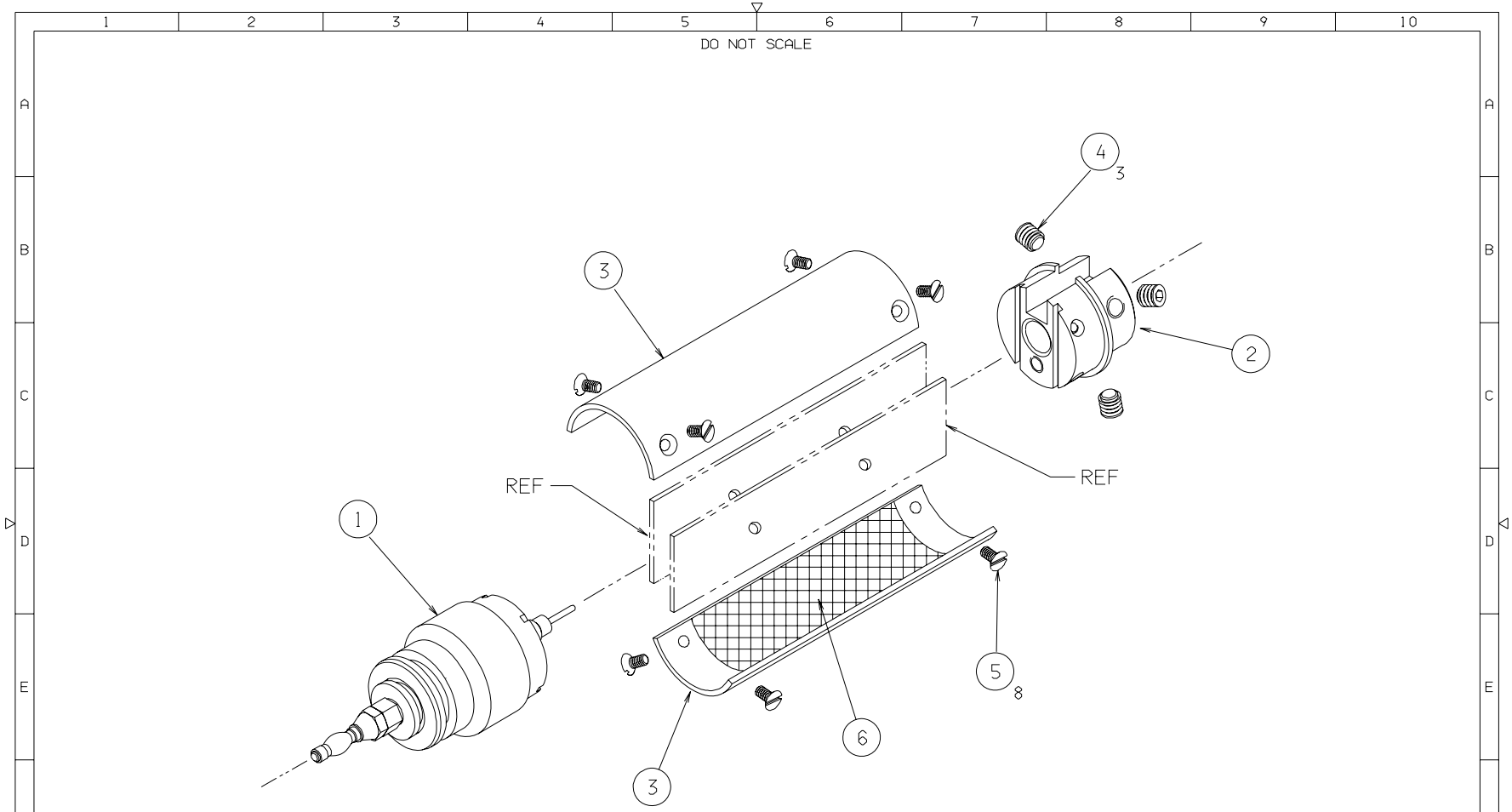
RELATED DOCUMENTS

#	*Documents*	*Issue*	*Notes*
1	AI-07015	A	Fast Response Assy Instructions
2	PS009	A	Pressure Testing General
3	AI-07039	PT1	Assembly Instructions
4	AR-07039	PT1	Assembly Record

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	00355	B	Body Thermometer Probe High Sensitivity 1 11/16 (07039-PRT)		1	ea	
002	00364	A	Sub Assy Temperature Probe & Fittings		1	ea	

(AR = As Required)



DRAWN TLS	CHECKED AJB	APPROVED DJF	ISS	DESCRIPTION	APPD	DATE	**Sondex** Tel. 0118 932 6755 THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	USED ON COM	TITLE ASSY ELECTRONICS 1 MODULE SONDEX ISOLATION WIRED CONNECTION MEMORY		
DATE 10/01/91	DATE 03/05/96	DATE 10/05/96	D	RE: ECR 1526, 1530 & 1531	DJF	04/06/03					
DIM IN INCHES	MATL: SEE DETAIL DRAWINGS		C	COMPONENTS RATIONALISED	DJF	10-05-96		MACHINE FINISH 63	GEN TOL 0.X ±0.020" 0.XX ±0.010" 0.XXX ±0.005" ANGLE ±0.5°	SHEET 1/1	DRAWING No. 10505
SCALE NTS	A3		B	PRESSURE ISOLATION HEAD UPGRADED	JB	22/03/95					ISSUE D
			A	INITIAL RELEASE			THIRD ANGLE PROJECTION				

SONDEX FM No: F0023

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
10505	D		TLS	AJB	DJF
			Date: 10/01/1991	Date: 03/05/1996	Date: 10/05/1996

Description:
Assy, Chassis, 1 Module, Memory, SX (Mechanical)

CHANGE HISTORY

Iss	*Date*	*Remarks*	*Chkd*	*Appr*
C	--/--/--			
D	04/06/2003	Re: ECR1526	GJS	DJF

RELATED DOCUMENTS

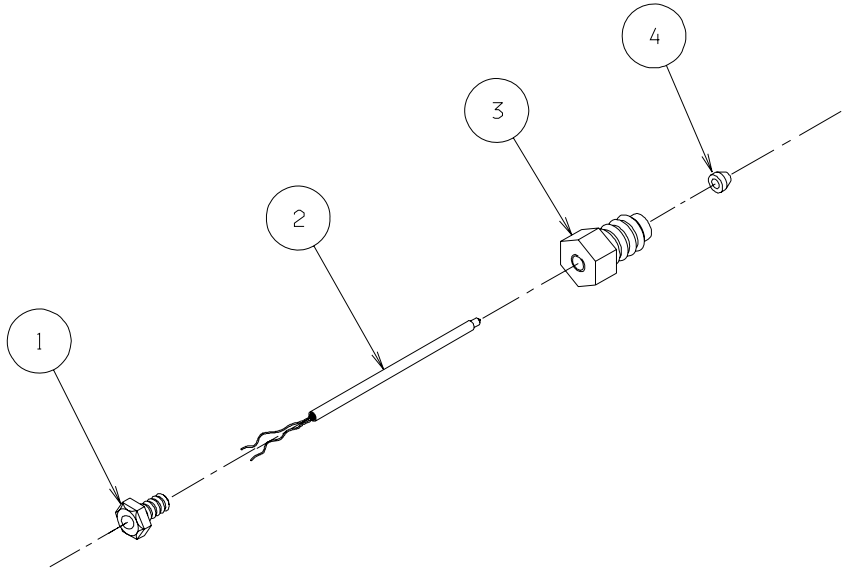
#	*Documents*	*Issue*	*Notes*
01	AD10505	D	Assembly Drawing
02	PL10505	D	Parts List
03	AI10505	PT1	Assembly Instructions
04	AR10505	PT1	Assembly Record

PARTS LIST

Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	10537	G	Assy, Upper Electronics Bulkhead, Memory, SX (Isolation)		1	ea	
002	01006	G	Bulkhead, Electronics, Lower, Standard (Non-Lemo)		1	ea	
003	01015	D	Halfshells, Chassis & Cover, Electronics, 1 Module		1	pr	
004	01030	A	Screw, Grub Skt Hd, M6 x 6mm Long, St/Steel		3	ea	
005	01029	A	Screw, Csk Hd(Slotted), M3 x 06mm Lg, St/Steel		8	ea	
006	T004-008AP	-	Tape Tygaflor 208AP/03T 80mm x 30M	Tygaflor Tape		(AR)	

(AR = As Required)

DO NOT SCALE



DRAWN IH	CHECKED AJB	APPROVED AJB	ISS	DESCRIPTION	APPD	DATE	**Sondex**	MACHINE FINISH 63	USED ON PRT	TITLE SUB ASSY TEMPERATURE PROBE & FITTINGS	
DATE 8/3/00	DATE 27/03/00	DATE 27/03/00	A	INITIAL RELEASE	AJB	27/03/00	Tel. 0118 932 6755				
DIM IN INCHES	MATL: SEE PARTS LIST						THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	GEN TOL 0.X ±0.020" 0.XX ±0.010" 0.XXX ±0.005" ANGLE ±0.5°		SHEET 1/1	DRAWING No. 00364 ISSUE A
SCALE NTS	A4						THIRD ANGLE PROJECTION				

PARTS LISTING

Part:	Issue:		Drawn:	Checked:	Approved:
00364	A		IH	AJB	AJB
			Date: 08/03/2000	Date: 21/03/2000	Date: 21/03/2000

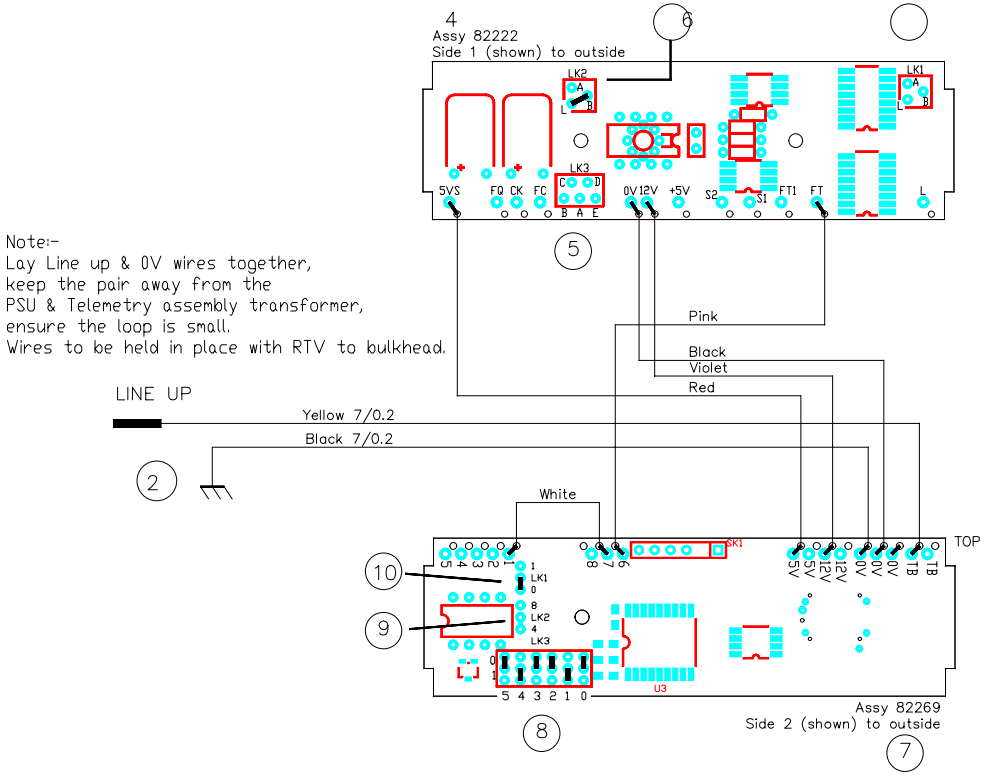
Description:
Sub Assy Temperature Probe & Fittings

CHANGE HISTORY					RELATED DOCUMENTS		
Iss	*Date*	*Remarks*	*Chkd*	*Appr*	*# Documents*	*Issue*	*Notes*
A	08/03/2000	Initial issue	AJB	AJB			

PARTS LIST

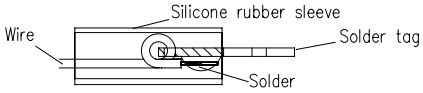
Item	*Part No.*	*Issue*	*Description*	*Component Value*	*Qty*	*Units*	*Remarks*
001	00351	B	Screw Retaining PRT Probe		1	ea	
002	00363	A	Assy Fast Response Temperature Probe		1	ea	
003	00354	A	GlandMOD		1	ea	
004	91052	-	Sleeve Taper Seal Connection		1	ea	

(AR = As Required)

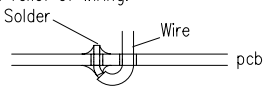


NOTES:

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



3. Strain relief of wiring.



4. Assy 82222
   LK2 – Fit Link L – B
5. Assy 82222
   LK3 – No Links Fitted
6. Assy 82222
   LK1
   Fit Link L – A for FT = 8 x FT1
   Fit Link L – B for FT = 64 x FT1
7. Assy 82269 is Assy 82261
   Programmed SON076
8. Assy 82269
   Set LK3 address
   PRT = 18 as shown
9. Assy 82269
   LK2 is tracked to 1 (5V = 4MHz clock) on PCB
10. Assy 82269
    Fit Link LK1 – 0 (0V)

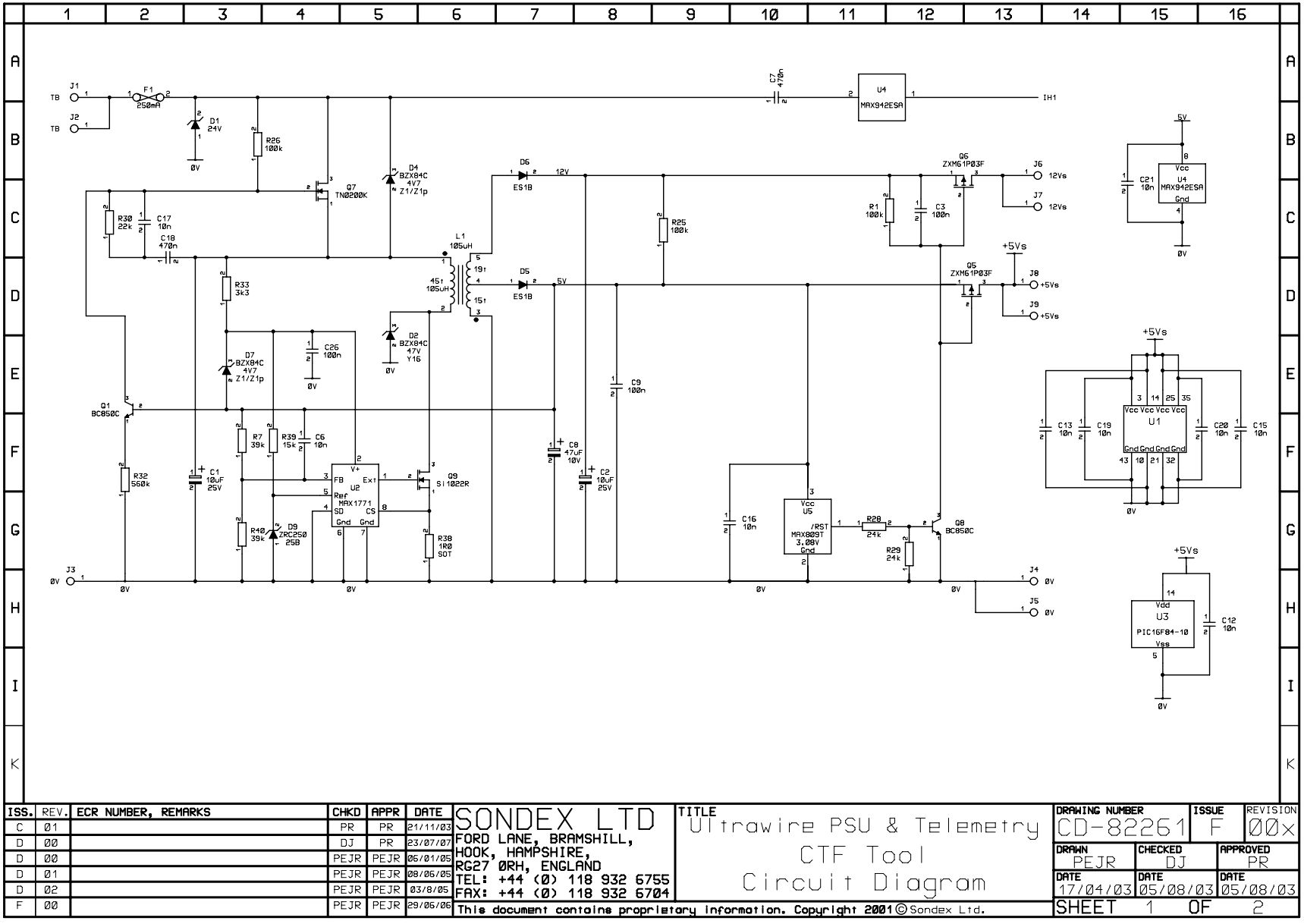
ISS	REV	DATE	CHANGES	CHKD	APPD
D		10.9.04	ECR2168 Link Details clarified	(RH)	(RH)
E		10.9.04	ECR1692 Assy 82269 was 82224	(PR)	(PR)
F		9.11.04	ECR2289 Wires to PRT Probe & Line Down removed	(SA)	(RH)
G		18/07/06	ECR3962 Note added	VH	RH

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

TITLE:
WIRING DIAGRAM
Tool Electronics
Ultrawire PRT

DRAWN	CHECKED	APPROVED
R Holding	D.Jackson	(RH)
DATE 3 Dec 01	DATE 22/2/02	DATE 22/2/02

DRAWING No. WD 80123 | ISSUE G | REVISION



ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE
C	01		PR	PR	21/11/03
D	00		DJ	PR	23/07/07
D	00		PEJR	PEJR	05/01/05
D	01		PEJR	PEJR	08/06/05
D	02		PEJR	PEJR	03/8/05
F	00		PEJR	PEJR	29/06/06

SONDEX LTD
FORD LANE, BRAMSHILL,
HOOK, HAMPSHIRE,
RG27 0RH, ENGLAND
TEL: +44 (0) 118 932 6755
FAX: +44 (0) 118 932 6704

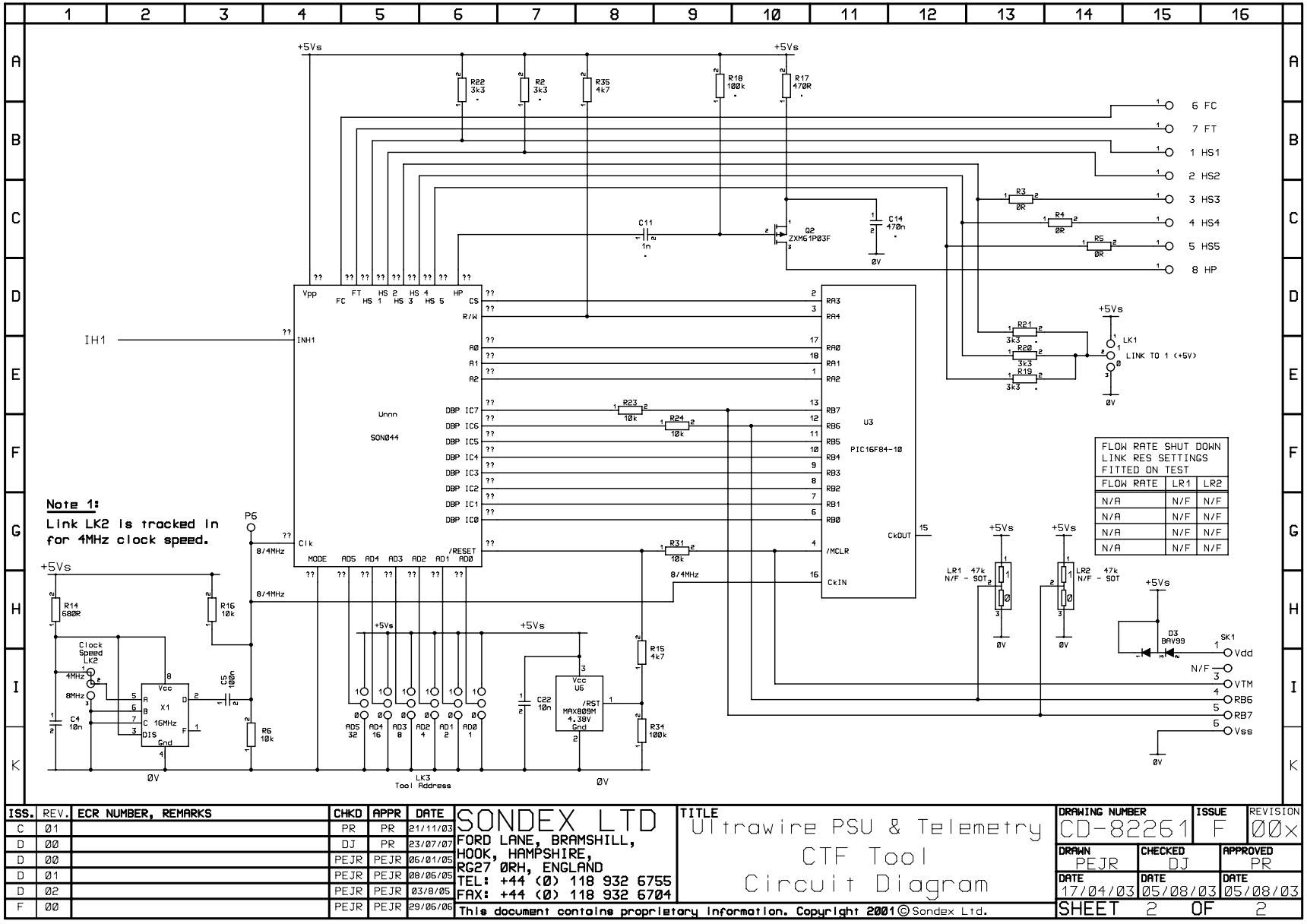
TITLE
Ultrawire PSU & Telemetry
CTF Tool
Circuit Diagram

This document contains proprietary information. Copyright 2001© Sondex Ltd.

DRAWING NUMBER	ISSUE	REVISION
CD-82261	F	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
C	01		PR	PR	21/11/03
D	00		DJ	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

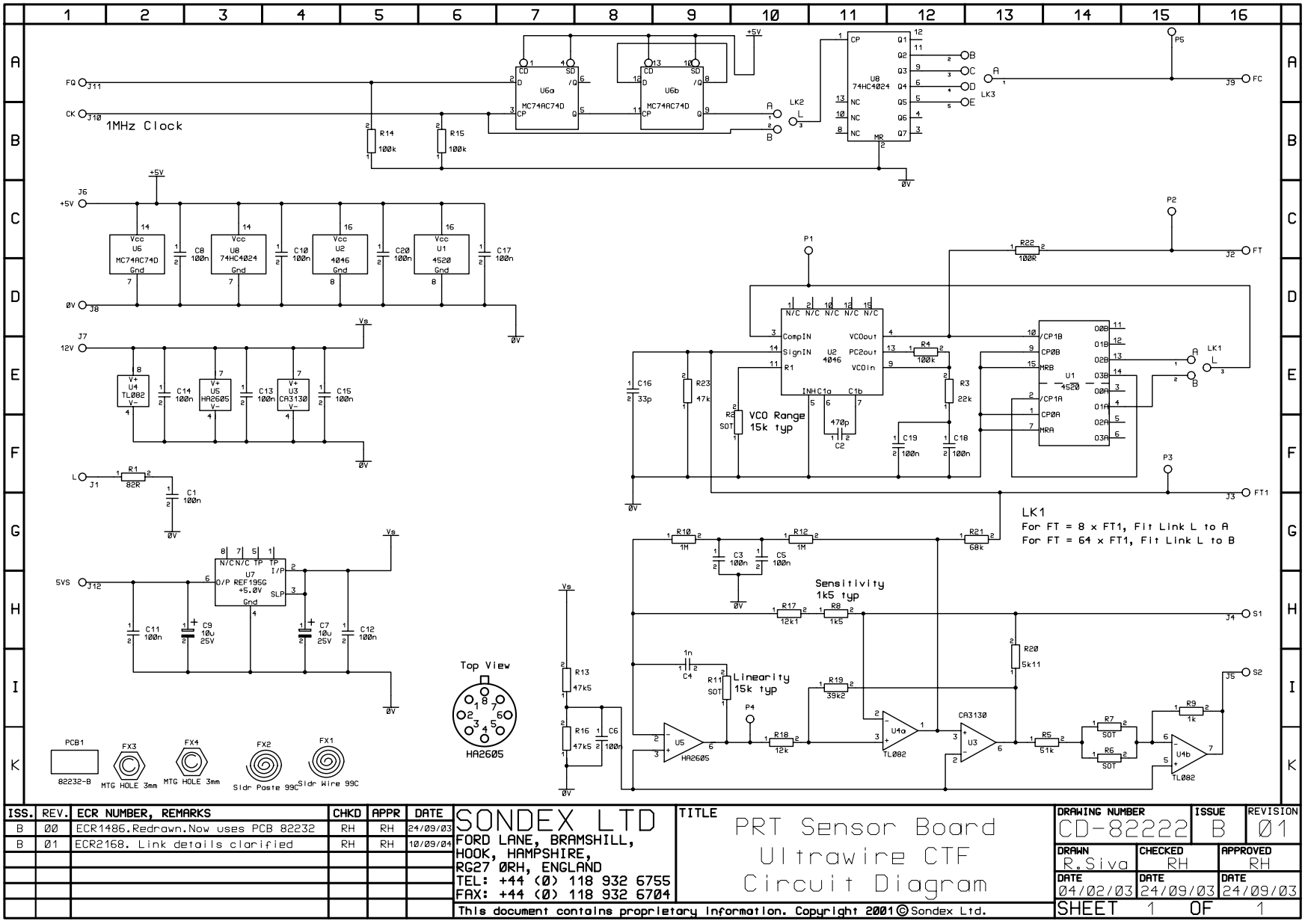
SONDEX LTD
FORD LANE, BRAMSHILL,
HOOK, HAMPSHIRE,
RG27 0RH, ENGLAND
TEL: +44 (0) 118 932 6755
FAX: +44 (0) 118 932 6704

TITLE
Ultrawire PSU & Telemetry
CTF Tool
Circuit Diagram

DRAWING NUMBER	ISSUE	REVISION
CD-82261	F	00x

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

SHEET 2 OF 2



ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE
B	00	ECR1486. Redrawn. Now uses PCB 82232	RH	RH	24/09/03
B	01	ECR2168. Link details clarified	RH	RH	10/09/04