



ILS022

Document: MN-ILS022-C

In-Line Spinner Flowmeter

IN-LINE SPINNER FLOWMETER

1¹¹/₁₆" X 2¹/₈", ULTRAWIRE™

Operational & Maintenance Manual

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Created: October 3, 2006

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0 ABOUT THIS MANUAL

0.1 MANUAL HISTORY

Date	Issue	Description	Auth	Chk	App
23/01/02	A	First Issue for Ultrawire™ tools.	RH/DO	SA	RLH
23/02/05	B	Drawing & Parts List updates.	FV	SA	RLH
03/10/06	C	ECR2784, 2904, 3141, 3284, 3285, 1387, 3920, 3962.	FV	RLH	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:

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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 in-line spinner (ILS) flowmeter is a very short flowmeter with an electrical through connection. When run in combination with a fullbore flowmeter, the ILS allows for production profiling in tubing and casing within one logging run. The ILS may also be used as a backup flowmeter, especially for horizontal well logging where the fullbore spinner may get damaged by debris in the well.

The tool is very durable and particular attention has been paid to the protection of the spinner unit. The ILS performs in all well orientations from vertical to horizontal.

1.1 OPERATING PRINCIPLE

The spinner is mounted by precision roller bearings and rotation detection is through zero drag Hall effect devices, giving very low threshold and optimising low flow measurement. At high flow rates, the flowmeter is similarly reliable due to the precision bearings employed in the assembly. The symmetrical spinner provides identical measurement of up and down flow, with directional information.

1.2 APPLICATIONS

- Production profiling in tubing across sliding side doors.
- Tubing leak detection.
- Back up spinner in horizontal wells.
- Logging inside sand screens / slotted liners.

1.3 INTERFACING & TOOL COMBINATIONS

- Run centralised at any location in toolstring.
- Simultaneous operation with other PL tools.
- 1³/₁₆" UN 12 tpi Sondex, GO or other heads.



Figure 1.1 ILS

1.4 SPECIFICATIONS

1.4.1 ELECTRONICS

Parameter	Specification	Remarks
Operating voltage:		
- Nominal	+18V DC	
- Range	+13 to +23V DC	
- Absolute maximum	+24V DC	
Current consumption @ 18V	10mA	

1.4.2 MECHANICAL

Parameter	Specification	Remarks
Output	10 pulses/revolution with flow indication	
Max. pressure	15,000 psi (103.4MPa)	
Max. temperature	350°F (177°C)	
Make up length	17.3" (439mm)	
Shipping length	21.1" (536mm)	Incl. thread protectors.
Measure point	4.3" (109.2mm)	
Tool diameter	2 ¹ / ₈ " (54mm)	
Tubing diameter	Min. ¹ / ₈ " greater than tool OD	
Weight	Approx 10.6lbs (4.8kg)	
Materials	Corrosion resistant throughout	
Apparent treshold	Approx. 12ft/min	
Max. fluid velocity	>3,000ft/min	
Max working pull	5,600lbs	

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.



Liquid O-ring

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



High Temperature Grease

A High Temperature Grease (Castrol Spheroil L-EP2 or Castrol LMX) is used to fill the tool during maintenance. Contact with skin or eyes can be harmful. For more details refer to the Material Safety Data Sheet for Castrol Spheroil L-EP2 or Castrol LMX respectively.



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

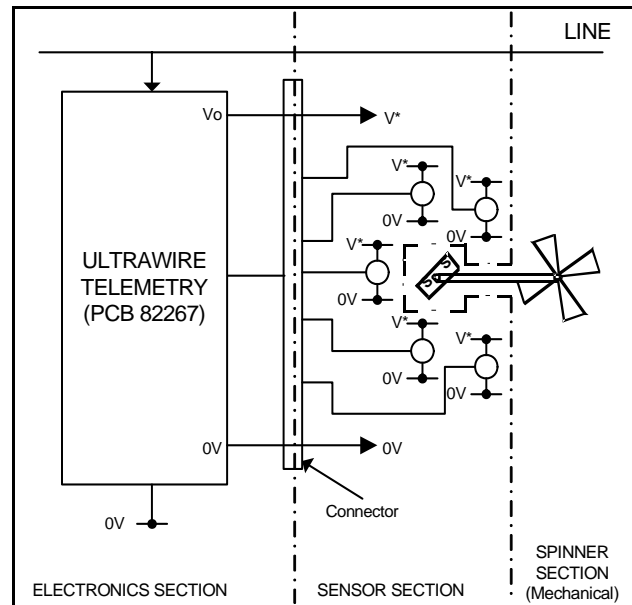


Figure 3.1 Block Diagram

3.2 DESCRIPTION

3.2.1 MECHANICAL

The in-line spinner (ILS) flowmeter has a fixed diameter and spinner. The impeller rotates continuously and is supported by precision roller bearings at each end. The spinner is fully protected within the shroud of the spinner body.

A magnet at the top end of the spinner shaft rotates inside the oil filled sensor assembly. The field of the rotating magnet is sensed by Hall effect switches, placed outside a cylindrical non-magnetic pressure barrier, which is placed around the magnet. The Hall effect switches are integrated circuits whose output is switched to ground when the magnet field passes a certain threshold thus creating a pulse each time a magnet passes it. The 2 pole magnet and 5 Hall effect switches produce 10 pulses per revolution. The operating sequence of the Hall effect switches is used to determine flow direction.

3.2.2 ELECTRICAL

Tool power and Ultrawire™ telemetry are present on the top single connector pin.

The Hall effect devices are not powered continuously due to their high current consumption. The FPGA Logic uses the status of the switches to determine the pulse frequency and rotation direction. Every cycle of the pulse frequency is stored in the FPGA logic and is read out over the Ultrawire™ toolbus in response to requests from the telemetry controller, e.g. XTU.

Link options determine the tool address. Various commands are supported in the protocol.

3.3 CALIBRATION THEORY

3.3.1 SPINNER ROTATION

The rotational velocity of the spinner is measured to provide the flow velocity.

The rotation frequency of a real spinner is given by [Equation 3.1](#) below. This assumes that the friction (i.e. around the bearings) has no viscous component and that the viscous effect is to slow fluid moving along the blade face. This equation only applies to a rotating spinner; it does not apply to a stationary spinner in a very slow flow:

$$f = aV - \left(\frac{b}{\rho}\right)V - c\sqrt{\frac{V\mu}{\rho}} \quad \text{Equation 3.1}$$

where:

- f is the frequency of rotation of the spinner cps (Hz).
- V is the fluid velocity.
- a is a constant depending on blade pitch.
- b is a constant depending on ratio of friction to blade moment of inertia.
- c is a constant depending on the skin friction of fluids moving over the blade surface.
- ρ is fluid density.
- μ is fluid viscosity.

Neglecting friction and inertia terms:

$$f = aV \quad \text{Equation 3.2}$$

3.3.2 FLUID VELOCITY DETERMINATION

The operating procedure in the well allows the flowmeter to be calibrated by recording several passes at different logging speeds. Plots of logging speed versus tool reading enable the apparent fluid velocity (V_{app}) to be determined.

A small ILS spinner in its shroud will rotate slower than the true fluid velocity and spinner pitch would suggest due to bearing friction and the slowing of the fluid as it passes through the tool. These effects are taken into account by calibrating the tool using multiple logging speed passes.

The more linear the tool response, the more accurate the velocity determination. Non-linearity of [Equation 3.1](#), for example bearing friction and viscosity, can be accounted for in the plots. The plots also compensate for the alteration to flow velocity due to the insertion of the toolstring. Sondex flowmeters are linear over their full operating range under normal well conditions.

In fluid velocities much higher than possible cable velocity calibration rates, an ILS should be used to maintain accuracy of fluid velocity determination.

3.3.3 TOTAL FLOWRATE DETERMINATION

The velocity of fluids is largest at the centre of the pipe and varies to zero at the pipe wall. For the most part, spinner flowmeters read fluid velocity close to that of the centre. The true average fluid velocity (V_t) is therefore somewhat less than that indicated by the spinner flowmeter (V_{app}) and requires correction. This correction factor is a function of the spinner blade diameter with respect to the pipe inside diameter and the Reynolds number of the flow.

Typical approximate correction, necessary to determine true average flow velocity (V_t) in turbulent flow from the velocity measured by the spinner, is:

$$V_t = V_{app} \times 0.85 \quad \text{Equation 3.3}$$

Total flowrate can be directly calculated by multiplying the flowrate (in ft/min) by the casing internal cross-sectional area (in inches). The following converts directly to barrels per day (bpd).*

$$\text{Total Flowrate} = 1.4 \times V_t \times (\text{casingID})^2 \quad \text{Equation 3.4}$$

3.3.4 TYPICAL APPROXIMATE SPINNER ROTATION RATES

Note: The figures shown in the table below are to be used to derive the **approximate** spinner rotation rate for a given fluid velocity, or to derive the **approximate** fluid velocity for a given spinner response. Accurate fluid flowrate can only be derived by multipass calibration of the spinner in the flow downhole.

Spinner Type	Design pitch inch/revolution	Flow loop slope rps/fpm	Nominal Slope	
			fpm/rps	rps/fpm
ILS	7		35.0	0.029

*. For a more detailed discussion, see "Cased-hole Log Analysis and Reservoir Performance Monitoring", R.M. Bateman, 1984. (ISBN 90-277-1922-5).

4 OPERATING PROCEDURE

4.1 PRE-LOGGING CHECKS

4.1.1 MECHANICAL

Ref.: Spinner/Sensor Assembly Drawing 05015

- 1 Fit new bearings in the spinner shaft assembly. See [Section 5.2.2.3 Bearings](#).
- 2 Oil fill the sensor assembly housing.

Note: This is essential before logging to ensure bearing lubrication. The choice of oil depends on the expected operating temperature. A low viscosity oil ensures minimum drag but if too low it will leak out too quickly.

- Below 20°C: use WD-40®.*
 - Above 20°C: use a very light lubricating oil or kerosene with a little oil dissolved in it.
 - Above 100°C: a very light engine oil may be used.
- i. Unscrew socket head screw (item 13).
 - ii. Holding the hole uppermost pour the lubricant into the hole until the cavity is full and leaking out around the bearings.
 - iii. Replace the socket head screw (item 13).

Note: Gravity and thermal expansion will assist the lubricant to flow around the bearings while logging until it is exhausted.

- 3 Check the spinner rotates freely in both directions when in a gentle airflow.
- 4 Check that the spinner does not stop suddenly, which would indicate the presence of dirt in one of the bearings and consequently an unacceptably poor threshold to flow.
- 5 With the tool horizontal, check that the spinner is balanced.

Note: Each part of the rotating assembly is separately balanced, but small amounts of overall imbalance can be corrected by rotating the spinner around the shaft. Final balancing is best achieved by filing the tip of the 'heaviest' spinner blade.

- 6 Check the axis of rotation does not move, which would indicate a bent shaft.
- 7 Clean and grease upper and lower O-ring seals. Replace O-rings if damaged.
- 8 Ensure that upper and lower electrical connectors are clean, dry and undamaged.

*. Do not use WD-40® as a lubricant in applications above 20°C, or before storing the tool as it will leave a thin film on the bearings.

4.1.2 ELECTRICAL

- 1 Using a Multimeter, measure upper to lower pin resistance. The resistance should be less than 0.5Ω .
- 2 Using a Multimeter, measure pin (+ve probe) to housing (-ve probe) resistance on all connected pins. The resistance should be $3-4M\Omega$, depending on the meter.

4.1.3 OPERATING

The flowmeter must be electrically connected to a toolstring controller, e.g. XTU, and to a data acquisition or logging system, e.g. MEMLOG or MIDAS.

- 1 No counts should be observed if the spinner is not rotating.
- 2 Counts should occur at the rate of 10 per revolution when rotating.

Check both *forward* and *reverse* direction of rotation and make sure decoding by the data acquisition system is correct.

4.2 CALIBRATION

Calibration data is not supplied with the tool as it is best performed in the well. Calibration is a standard procedure for flowmeters of this type. There is little variation between Sondex tools of the same type.

Log data must be obtained over several passes in both up and down directions at different speeds during every logging operation. More than one set of data should be collected, for example before and after a survey. This enables a cross plot of spinner rps against speed to be made at any depth. From this the apparent flow velocity (V_{app}) can be determined.

Calibration data may be transferred to other logging runs, but this is not recommended since the response curve of [Equation 3.1](#) may have altered due to a change in fluid properties of bearing friction.

Plots must be made of tool reading against cable (tool) velocity.

Note: The diagram on the next page is a general crossplot for different spinners and should only be used as an example.

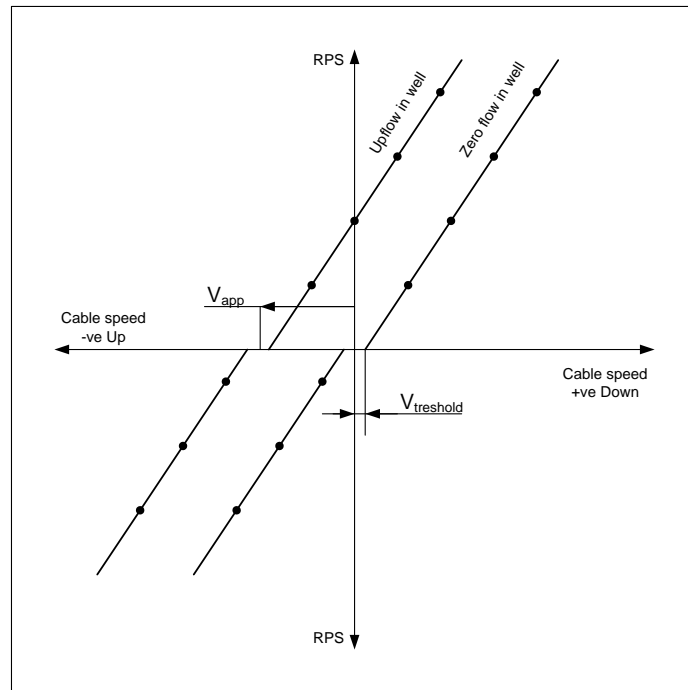


Figure 4.1 Flowmeter Fluid Velocity Response

Note: Sensitivity to flow in one direction or the other may be reduced by the shielding effect of the toolstring above or below the spinner.

Flow in the well shifts the zero rotation point along the cable velocity axis by the apparent average flow in the centre of the well V_{app} . Note that no calibration, other than this crossplot, is needed.

See [Section 3.3.3 Total Flowrate Determination](#).

4.3 CONNECTING TO TOOLSTRING

ILS flowmeters can be placed anywhere in the toolstring.

Centralisers are desirable above and below to have the spinner measuring at the centre of the flowing stream.

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.	

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

Recommended speed: as required for tool calibration. Typically 30, 60, 90 and 120ft/min or 30, 50, 70, 90, 110ft/min. See [Section 4.2 Calibration](#) for instructions.

4.5 POST LOGGING DISASSEMBLY

Ref.: Spinner/Sensor Assembly Drawing *05015*

Clean the tool before the toolstring is disassembled.

Ensure that well fluid does not reach the upper electrical connector.

Refit upper thread protector.

Flush the bearings. Flushing of the bearings with a solvent should be carried out as a *minimum requirement after logging*. Flushing can be carried out prior to checking the tool function.

However, **Sondex recommends that bearings are replaced before the next logging job**. It can not be worth compromising the quality of a survey for the sake of carrying out the easy task of replacing a pair of inexpensive bearings.

- 1 Remove the socket screw (item 13) and O-ring (item 20).
- 2 Pour a suitable solvent (e.g. petrol or kerosene) through the M6 hole into the bearing housing to flush out any well fluid.
- 3 Ensure that the spinner rotates freely. If not, the bearings will need replacing before the next logging job (see *Section 5.2.2.3 Bearings*).
- 4 Allow solvent to evaporate and lubricate bearings with a light oil (do not use WD-40®) or complete the oil filling procedure (see operation 2 of *Section 4.1 Pre-Logging Checks*).

4.6 TRANSPORT, HANDLING & STORAGE

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

Bearings should be lubricated.

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

5 MECHANICAL DESCRIPTION

5.1 DESCRIPTION

Electronics Section:

- Pressure housing.
- Flowmeter circuit board.
- Pressure tight upper head fitted with monoconductor pin.
- Lower end fitted with 8-pin internal connector.

Spinner/Sensor Section:

- Sensor body containing sensor assembly and 8-pin internal connector.
- Spinner bearing housing.
- Spinner assembly comprising spinner, shaft, magnet assembly and bearings.
- Shroud assembly with integral bypass.

Two magnets at the top end of the spinner shaft rotate inside the oil filled sensor assembly. Oil leaks out during logging to lubricate the bearings. Outside this chamber (at atmospheric pressure), 5 Hall effect switches detect the magnets' rotation.

5.2 DISASSEMBLY

5.2.1 ELECTRONICS SECTION

Ref.: ILS General Assembly *09462*
Electronics Chassis *10504*

- 1 Unscrew the pressure housing (item 2, 09462) from the spinner/sensor body (item 4, 09462).

Note: Once the pressure housing (item 2, 09462) is removed from the spinner/sensor body (item 4, 09462), all O-rings, shown on the general assembly drawing, can be replaced without further disassembly.

- 2 To access to the electronics boards, remove screws (4x item 6, 10504) and remove large upper cover (item 3, 10504) of the electronics cartridge (item 3, 09462).

Note: The lower cover of the electronics cartridge (item 3, 09462) is an integral part of the chassis and should not be removed, particularly if the large upper cover (item 3, 10504) is removed.

- 3 To remove the electronics cartridge (item 3, 09462), screw in the grub screws (3x item 4, 10504) and pull the electronics cartridge (item 3, 09462) away from the spinner/sensor body.



Caution!

Do not force the screws in too far and do not rotate the electronics cartridge in relation to the spinner/sensor body, otherwise the 8-pin connector may be damaged.

- 4 Refer to *MN-PIH* to service the pressure isolation head.

5.2.2 SPINNER/SENSOR SECTION

Ref.: Spinner/Sensor Assembly 05015

Note: Remove the electronics section as described in [Section 5.2.1 Electronics Section](#).

5.2.2.1 Sensor Assembly

Note: The sensor is very delicate and should not be removed unless a fault is suspected.

- 1 Remove the lower connector assembly (item 26) by removing the circlip (item 18) and carefully withdrawing the connector assembly.

Note: Take care not to break the wiring when withdrawing the connector assembly.

- 2 Unscrew nut with line wire attached.
- 3 Unsolder the through wire and attach a 'fishing' wire of approx 12" (4.5cm) long to simplify reassembly.
- 4 Screw in the grub screws (2x p/n 04034), which lock the sensor assembly (item 27) to the spinner body (item 1), and withdraw the assembly and through wire.

Note: Withdraw the assembly and through wire by levering it out gradually in a controlled manner, i.e. with a screwdriver. **DO NOT ROTATE IT.** Carefully feed the fishing wire through as the sensor assembly is withdrawn. Separate the fishing wire from the feedthrough wire when the junction appears, and secure the ends of the wire.

5.2.2.2 Spinner & Shaft Assembly

Note: It is not required to remove the sensor assembly prior to disassemble the spinner & shaft assembly.

- 1 Remove the spirol pin (item 17), securing the cover window (item 2) to the spinner body shroud (item 1) and remove the cover window (item 2).
- 2 Remove the spinner (item 6):
 - i. Prevent the spinner shaft (item 5) from turning.
 - ii. Release the spinner (item 6) by gently pushing it upwards and rotate it by a $\frac{1}{4}$ turn.
 - iii. The small compression spring (item 8) above the top end of the spinner should push the spinner down.
 - iv. Pull the spinner down and off the shaft.
 - v. Loosen the grub screws (3x item 14), securing the bearing spacer (item 3), until the shaft (item 5) and bearing assembly will slide inside the bearing housing of the main body (item 1).
 - vi. Push it upwards until the assembly stops moving freely and the assembly protrudes approximately 5mm from the bearing housing.

Note: Be careful if the movement has become tight. Avoid bending or breaking the shaft or its end.

- vii. Turn the spinner inside the shroud until its axis is across the tool, and remove the spinner through the open window in the shroud.
- 3 Slide the shaft assembly (items 7, 4, 24, 3, 24, 5 & 8) downwards until it is clear of the spinner body. It may now be removed from the bottom or the window of the shroud.

5.2.2.3 Bearings

- 1 Remove the shaft assembly from the tool body as described in [Section 5.2.2.2](#).
- 2 Hold the shaft in a soft jawed vice.
- 3 Locate the locking spring (item 7), locking the magnet holder (item 4) to the shaft (item 5) and with a sharp pointed instrument raise the end of the locking spring at the magnet holder end of the spring.
- 4 Unscrew the magnet holder (item 4) from the shaft (item 5).
- 5 Pull the upper bearing (item 24), bearing spacer (item 3), and lower bearing (item 24) from the shaft. These can be quite tight - avoid bending or breaking the shaft.

5.3 REASSEMBLY

5.3.1 SPINNER/SENSOR SECTION

Ref.: Spinner/Sensor Assembly 05015

5.3.1.1 Bearings

- 1 Check the shaft (item 5), magnet holder (item 4), bearings (item 24) and locking spring (item 7) and replace if necessary.
- 2 Hold the shaft in a soft jawed vice.
- 3 Fit the upper bearing (item 24), bearing spacer (item 3), and lower bearing (item 24) over the shaft (item 5).

Note: Lubricate the bearings with a light oil (not a silicone oil, like WD-40[®], as this tends to leave a tacky film on the bearings once dry).

- 4 Screw the magnet holder (item 4) onto the shaft (item 5).

Note: When the magnet holder has been screwed on, an end float of about 0.2" (0.5mm) should exist to allow for thermal expansion of the body relative to the main shaft. If not, the bearings may stick at high temperature under end load and may be permanently damaged.

- 5 Refit the locking spring (item 7) to lock the the magnet holder (item 4) to the shaft (item 5).

Note: There is no need to open up the lock spring when screwing the magnet holder onto the shaft as it opens automatically when screwing on.

- 6 Refit the shaft assembly into the tool body as described in [Section 5.3.1.2](#).

5.3.1.2 Spinner & Shaft Assembly

- 1 Inspect the spinner (item 6) and the locking spring (item 8) for damage and replace if necessary.
- 2 Place the locking spring (item 8) on the shaft (item 5).
- 3 Slide the shaft assembly (items 7, 4, 24, 3, 24, 5 & 8) into the spinner body via the bottom or the window of the shroud.
- 4 Completely remove one of the three grub screws (item 14), which retain the bearing spacer (item 3).
- 5 Fit the spinner (item 6) onto the shaft:
 - i. Push the shaft assembly upwards until the assembly stops moving freely and the assembly protrudes approximately 5mm from the bearing housing.
 - ii. Turn the spinner until its axis is across the tool, and fit the spinner through the open window in the shroud.
 - iii. Slide the upper end* of the spinner onto the shaft and rotate the spinner until it slides up and compresses the locking spring (item 8).
 - iv. Rotate the spinner $\frac{1}{4}$ turn and release it. The spring will push the spinner down a little; locking it onto the shaft.
 - v. Push the shaft assembly downwards until the assembly can move freely.
 - vi. Refit and tighten the three screws (item 14) to retain the bearing spacer (item 3).

Note: When sliding the shaft into place after positioning the spinner, check that the reduced diameter section of the bearing spacer (item 3) is directly under the hole for the grub screw (item 14). The lower bearing is positioned about 1mm inside the housing when the shaft is correctly installed.

- 6 Refit the cover window (item 2) to the spinner body shroud (item 1) and secure with the spirol pin (item 17).
- 7 Perform the spinner checks from [Section 4.1.1](#) to ensure the spinner is fitted correctly.

5.3.1.3 Sensor Assembly

- 1 If previously removed, attach a 'fishing' wire of approx 12" (4.5cm) long to simplify reassembly.
- 2 Rethread the through wire through the bypass tube.

Note: Take care not to damage the through wire when re-threading through bypass tube.

- 3 Refit the sensor assembly (item 27) to the spinner body (item 1).



Caution!

Do not rotate sensor assembly when re-fitting. If the sensor does not fit easily and the grub screws (p/n 04034) line up, the line wire might be trapped. Pull sensor out and investigate.

*. The lower end of the spinner is identified by the pin across the hole at its end.

- 4 Solder through wire to hole in modified the modified nut and clean off flux.
- 5 The 2 nuts must be screwed tight against each other. Two spanners are required for tightening ($3/8$ " and $5/16$ " AF).
- 6 Align with pin (item 16) and refit lower connector assembly (item 26). Secure with circlip (item 18).
- 7 The O-rings (2x p/n 99124 & 2x 99211) can be refitted if required. Apply Liquid O-ring to the O-ring groove and the O-ring before fitting.

5.3.2 ELECTRONICS SECTION

Ref.: ILS General Assembly *09462*
Electronics Chassis *10504*
Flowmeter Electronics Assembly *80286*

- 1 Clean the pressure seal surfaces at both ends of the Pressure Housing. Ensure housing is free from debris.
- 2 Slide the electronics cartridge (item 3, 09462) on to the spinner/sensor assembly (item 4, 09462), aligning the holes for the grub screws.



Caution!

Do not rotate the electronics cartridge in relation to the spinner/sensor body, otherwise the 8-pin connector may be damaged.

- 3 Adjust the connector (item 4, 80286) by temporarily loosening the 2x M4 grub screws on the electronics assembly (item 3, 09462).
- 4 Screw out three grub screws (item 4, 10504) to engage the cartridge. Use Loctite[®] 242 to secure the grub screws.
- 5 Refit O-ring (item 5) if required. Apply Liquid O-ring to the O-ring groove and the O-ring before fitting.
- 6 Slide the pressure housing (item 2, 09462) over the electronics cartridge (item 3, 09462) and screw on tight to the spinner/sensor assembly (item 1, 09462).

6 ELECTRICAL DESCRIPTION

6.1 TELEMETRY CIRCUIT BOARD

Ref.: Ultrawire™ Circuit Diagram (PCB 82267) 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.

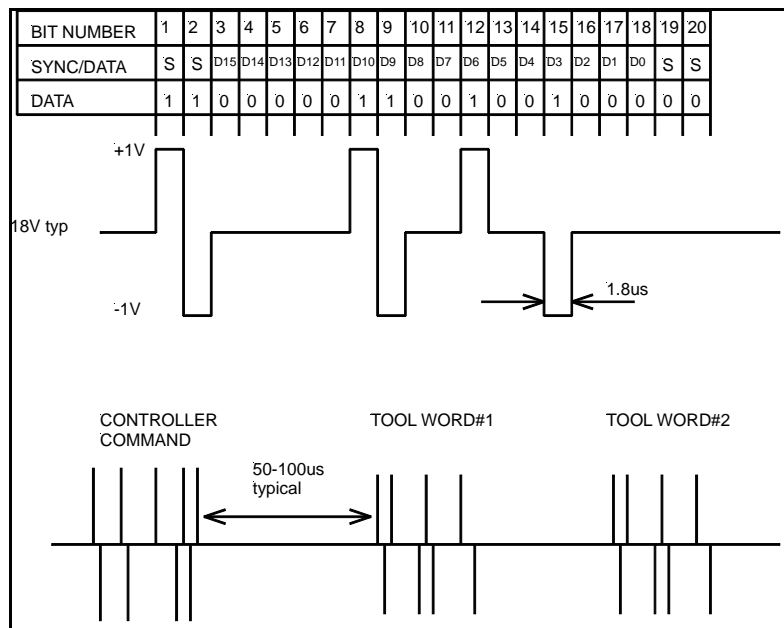
Control is implemented by a PIC microcontroller in conjunction with FPGA logic. The code in the PIC differs according to the tool.

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 18Vd.c. (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, see below a typical tool response.



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 a.c. 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 FLOW SENSOR

This comprises 5 Hall effect sensors arranged in a semicircle inside the spinner pressure housing. Two magnets, the other side of a pressure barrier, rotate with the spinner shaft. This results in 10 pulses per revolution.

To reduce power consumption, the sensors are powered with 5V for 7µs every 250µs. If a south pole of a magnet is close to a Hall sensor, its output will be 0V at the end of the 7µs settling time when the electronics takes the sample.

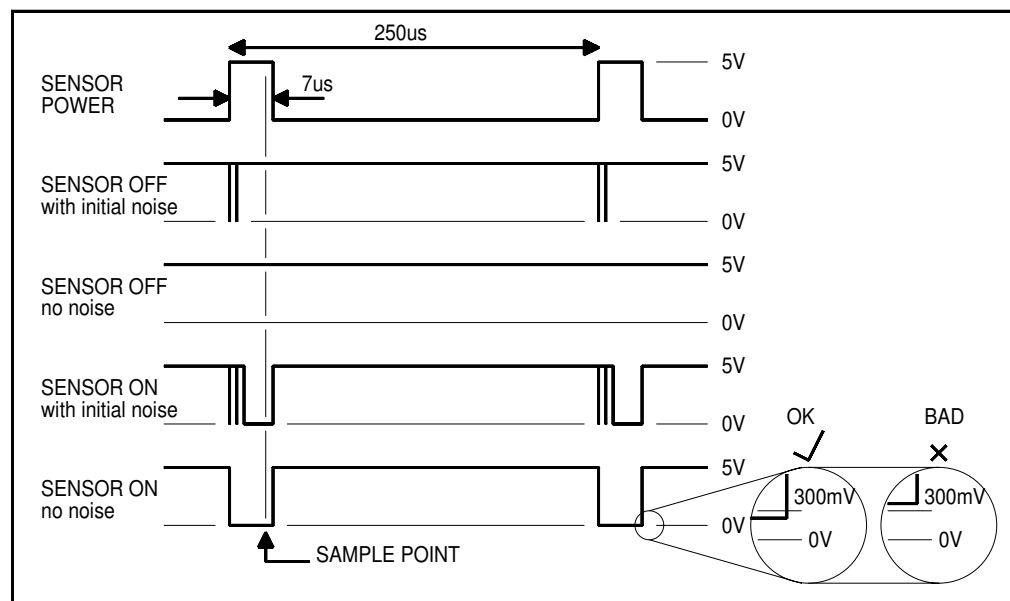


Figure 6.1 Flow Sensor

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.

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

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

Note that some threads are internal, which can cause grease to 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 for grease are not suitable for use on O-rings. Silicone grease may be used on O-rings, but must be kept clear of threads, especially stainless steel to stainless steel.

Cavities, e.g. spring housings, should be filled with a suitable heavy high melting point grease. like Castrol Spheerol L-EP2 or Castrol LMX.



Caution!

The use of certain greases, which contain volatile content, (e.g. some types of Lubriplate) can cause electrical failure due to production of corrosive gasses inside the tool when burned off.

7.1.2 MECHANICAL

Ref.: Electronics Chassis
Spinner/Sensor Assembly

10504
05015

- 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 reassembly.
 - 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 connectors for cleanliness and loose/bent pins before replacing.
- 5 Check 3 grub screws (item 4, 10504) are tight.
- 6 Check pin (item 17, 05015) for damage and corrosion.
- 7 Change bearings and check for free rotation just before next job.
- 8 Check for recessed, damaged or loose magnets (item 4, 05015).
- 9 Check spinner shaft (item 5, 05015) float of 0.5mm. Too little and the shaft may jam. Too much and the sensor may lose counts and direction.
- 10 Check for excessive cracks in sensor body fins (item 1, 05015).
- 11 Check for damage to bypass tube soldered into one of the Sensor Body fins.
- 12 Check for excessive bending of the sensor body. This is easier to see when other tools are attached.

7.1.3 ELECTRICAL

- 1 Using a Multimeter, measure upper to lower pin resistance. The resistance should be less than 0.5Ω .
- 2 Using a Multimeter, measure pin (+ve probe) to housing (-ve probe) resistance. The resistance should be $3-4M\Omega$, depending on the meter.
- 3 Tool current 10mA @ 18V.

7.1.4 OPERATIONAL

- 1 Connect to Logging System and check for correct data. Apply some gentle vibration, rotation and invert tool to expose potential failure. Check for 10 pulses per revolution (2 per sensor), and direction indication OK. Fault causes are:
 - Damaged magnets.
 - Incorrectly fitted magnet holder.
 - Excessive shaft float (see [Section 7.1.2](#) step 9 above).
 - Faulty sensor.

Note: Three of the five sensors are used for direction so a failure on one of the other two would only cause pulses per rev to drop to 8.

- 2 With an oscilloscope, check line telemetry from tool for +1V and -1V, $2\mu\text{s}$ pulses. Make sure to check tool pulses not those from the controller which occur first, see [Section 6.1](#). Pulses should have no ringing, if ringing, also attach bottom tool (CFT, other bottom flowmeter or toolstring terminator).
- 3 Check sensor output on pins 1-5 on 82267 circuit, see [Section 6.2](#). When ON, sensor output at the sample point should be between 0 and 300mV.

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 which 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.

If 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 tool should not be kept at temperature for more than 1 hour.

7.2 EXTRAORDINARY MAINTENANCE

7.2.1 OIL FILLING

Ref.: Spinner/Sensor Assembly 05015

Oil fill the sensor assembly housing as follows.

Note: This is essential before logging to ensure bearing lubrication. The choice of oil depends on the expected operating temperature. A low viscosity oil ensures minimum drag but if too low it will leak out too quickly.

- Below 20°C: use WD-40®.*
- Above 20°C: use a very light lubricating oil or kerosene with a little oil dissolved in it.
- Above 100°C: a very light engine oil may be used.

- 1 Unscrew socket head screw (item 13).
- 2 Holding the hole uppermost pour the lubricant into the hole until the cavity is full and leaking out around the bearings.
- 3 Replace the socket head screw (item 13).

Gravity and thermal expansion will assist the lubricant to flow around the bearings while logging until it is exhausted.

*. Do not use WD-40® as a lubricant in applications above 20°C, or before storing the tool as it will leave a thin film on the bearings.

7.2.2 FLUSHING

Ref.: Spinner/Sensor Assembly 05015

Flush the bearings. Flushing of the bearings with a solvent should be carried out as a *minimum requirement after logging*. Flushing can be carried out prior to checking the tool function.

However, **Sondex recommends that bearings are replaced before the next logging job**. It can not be worth compromising the quality of a survey for the sake of carrying out the easy task of replacing a pair of inexpensive bearings.

- 1 Remove the socket screw (item 13) and O-ring (item 20).
- 2 Pour a suitable solvent (e.g. petrol or kerosene) through the M6 hole into the bearing housing to flush out any well fluid.
- 3 Ensure that the spinner rotates freely. If not, the bearings will need replacing before the next logging job (see [Section 5.2.2.3](#)).
- 4 Allow solvent to evaporate and lubricate bearings with a light oil (do not use WD-40[®]) or complete the oil filling procedure (see operation 2 of [Section 7.2.1](#)).

7.2.3 O-RING EXCHANGE

Ref.: ILS General Assembly 09462
Spinner/Sensor Assembly 05015

Clean and grease upper O-ring seals. If the tool experiences H₂S gas or temperatures above 150°C, the following O-rings must be replaced:

- 1x item 5, 09462.
- 2x item 21, 05015.
- 2x item 22, 05015.
- 1x item 20, 05015.

For information on maintenance of the electronics section, see [Section 4.1](#).

To check whether the tool experienced H₂S gas or temperatures above 150°C, check for discolouration of the split nut (item 18, 05015), which is made of Aluminium Bronze.

Sondex recommends replacement of O-rings whenever the tool is disassembled.

7.3 TROUBLESHOOTING

Ref.: Spinner/Sensor Assembly 05015

Refer to [Section 5.2](#) where necessary.

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

7.3.1 MECHANICAL

<p>Damaged O-rings.</p>	<p>Visually inspect O-rings. Check that the O-rings are clean and greased. Replace the O-rings if the following occurs:</p> <ul style="list-style-type: none"> • Cracks or tears in the O-rings. • The O-rings will have an excessive size when taken out of the hole (due to moisture intake). • The tool experienced temperatures in excess of 150°C. • The Sensor Section in the tool changed colour from bronze to black, meaning the tool experienced contact with H₂S gas.
<p>Damaged Magnets.</p>	<p>Visually inspect the magnets and replace when necessary if:</p> <ul style="list-style-type: none"> • Data is spiked. • Irregular count rate or missed counts are noticed. • Magnets are damaged (e.g. chipped).
<p>Spinner does not rotate smoothly or does not rotate at all. If the spinner is unbalanced</p>	<ul style="list-style-type: none"> • Ensure the bearings are clean and not damaged. Replace if necessary. • If the spinner does not appear to be balanced. Replace or contact Sondex for alternative options. • Ensure the shaft is not bent. Replace if necessary.

7.3.2 ELECTRICAL

<p>Initial inspection</p>	<p>Check for:</p> <ul style="list-style-type: none"> • 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. <p>Check all fixings are tight.</p>
<p>Excessive Current</p>	<p>Unplug electronics and disconnect wires to isolate fault to:</p> <ul style="list-style-type: none"> • Upper head isolation assembly. • Sensor. • PCB82267. <p>Apply Line signal or 18V direct to PCB82267 Line connection.</p> <p>Fault find or replace PCB82267 circuit.</p> <p>Upper head, sensor line wire and Sensor body lower connector may be tested to 250V relative to chassis to check for electrical leak (LINE connection to PCB82267 circuit must be disconnected). Resistance should exceed 100MΩ.</p> <p>Upper head may be dissassembled to locate fault.</p>
<p>Little or no Current</p>	<p>Check 18V Line voltage on PCB82267 and 0V wire connects to chassis.</p> <p>Fault find or replace PCB82267 circuit.</p>
<p>No telemetry reply</p>	<p>Check 0V, 5V and 12V on PCB82267.</p> <p>Check P6 for 4MHz >3V clock. Replace X1 if faulty. Reduce R14 value if clock <3V amplitude.</p> <p>Check Line for +1V and -1V, 2μs pulses from Controller and similar pulses from tool. Pulses should have no ringing. If ringing, fit bottom tool, e.g. CFB, CTF or Ultrawire™ Bullnose (BUL006) below the tool. Logic pulses should be present on PCB82267 U1 pin 1.</p> <p>If no tool response words on Line, fault find or replace PCB82267 circuit.</p>
<p>Incorrect Flow/direction data</p>	<p>Check power and 0V to sensor and check outputs, see Section 7.1.3 step 5.</p> <p>Remove Window (item 2, 05015) and check for 10 pulses per revolution (2 per sensor), see Section 7.1.3 step 3.</p> <p>Check shaft float, see Section 7.1.2 step 9.</p> <p>The sensor (item 27, 05015) has no user serviceable parts, replace if faulty.</p>

APPENDIX A EQUIPMENT & RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	ILS022	Inline Spinner, 1 ¹¹ / ₁₆ " x 2 ¹ / ₈ ",	1	Ultrawire™

A.1 ANCILLARY EQUIPMENT

Item	Part No	Description	Qty	Remarks
None Required.				

A.2 MAINTENANCE EQUIPMENT

Item	Part No	Description	Qty	Remarks
1	91050	Toolkit for 1 ¹¹ / ₁₆ " tools	1	
2	04053	Flushing Kit Assembly	1	Part of Basic Spares Kit.
3	LOR101/	Grease for O-rings and threads	1	5oz. pot.
4	LOR101L	Grease for O-rings and threads	AR	16oz. pot.

A.3 RECOMMENDED SPARES

Item	Part No	Description	Qty	Remarks
1	KITB-ILS	Basic Spares Kit.	1	To support 1 run in hole.
2	KITR-ILS2 1/8	Recommended Spares Kit.	1	To support 25 runs in hole.
3	KITRem-PIH, SX	Remote Spares Kit for Pressure Isolation Head.	AR	See Pressure Isolation Head Manual <i>MN-PIH</i>

All spares kits, mentioned in this section, can be supplied upon request. However, Sondex recommends the purchase of these kits to properly support your logging tools from job to job. Contact Sondex and quote the part number of the spares kit for additional information or when ordering the spares kit.

As a guidance:

- A Basic Spares Kit mainly contains essential maintenance equipment, O-rings and parts, which are likely to need replacing on a run-by-run basis (including spare parts for the initial tool run) or parts that can be lost easily (like grub screws).
- A Recommended Spares Kit has got a multitude of the same parts as a Basic Spares Kit, supplemented by parts that might need replacement at a lower frequency, i.e. 5 runs and/or 25 runs.
- Spares Kits, suitable for remote logging operations, can be supplied upon request.

Note that the information above is a guidance only and Sondex reserves the right to change the contents of the Spares Kits as required.

PARTS LISTING					
Part:	Issue:		Drawn:	Checked:	Approved:
91050	-		NGH	PD	DJF
Description:			Date:	Date:	Date:
Tool Kit for all 1 11/16 Tools SX and GO			14/01/2002	14/01/2002	14/01/2002

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)

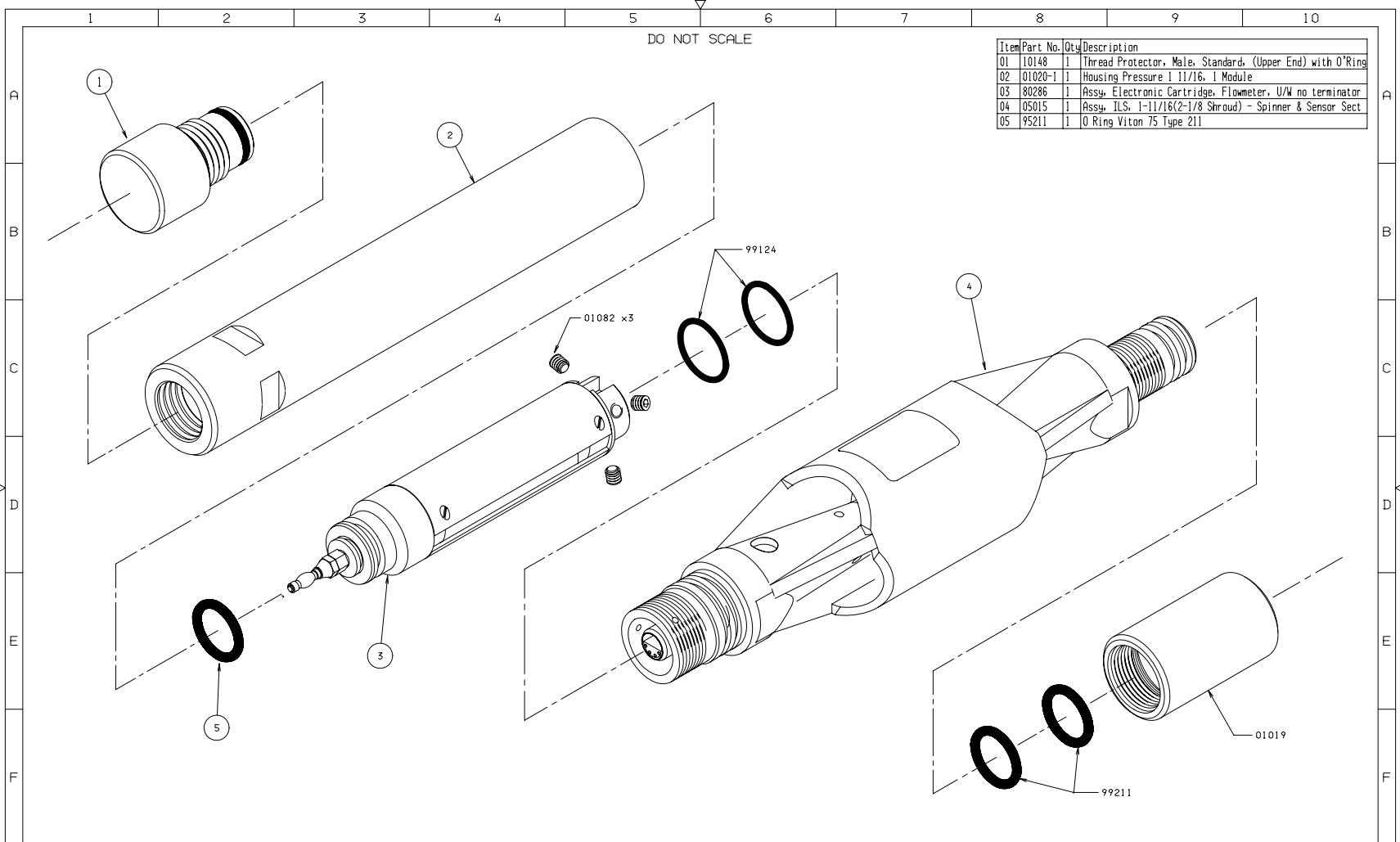
APPENDIX B DRAWINGS & PARTS LISTS

B.1 MECHANICAL DRAWINGS

Description	Drawing	Parts List
ILS022 General Assembly	<i>09462-B</i>	See Drawing.
Spinner/Sensor Assembly	<i>05015-F</i>	<i>05015-F</i>
Flowmeter Electronics Assembly	<i>80286-C</i>	See Drawing.
Electronics Assembly	<i>10504-F</i>	See Drawing.

B.2 ELECTRICAL DIAGRAMS

Description	Type	Drawing
Flowmeter Electronics Assembly (Ultrawire™)	Wiring Diagram	<i>WD-80286-C</i>
Ultrawire™ PSU/Telemetry Board (PCB82267)	Circuit Diagram	<i>CD-82261-F00x</i>



Item	Part No.	Qty	Description
01	10148	1	Thread Protector, Male, Standard, (Upper End) with O'Ring
02	01020-1	1	Housing Pressure 1 11/16, 1 Module
03	80286	1	Assy. Electronic Cartridge, Flowmeter, U/W no terminator
04	05015	1	Assy. ILS, 1-11/16(2-1/8 Shroud) - Spinner & Sensor Sect
05	95211	1	O Ring Viton 75 Type 211

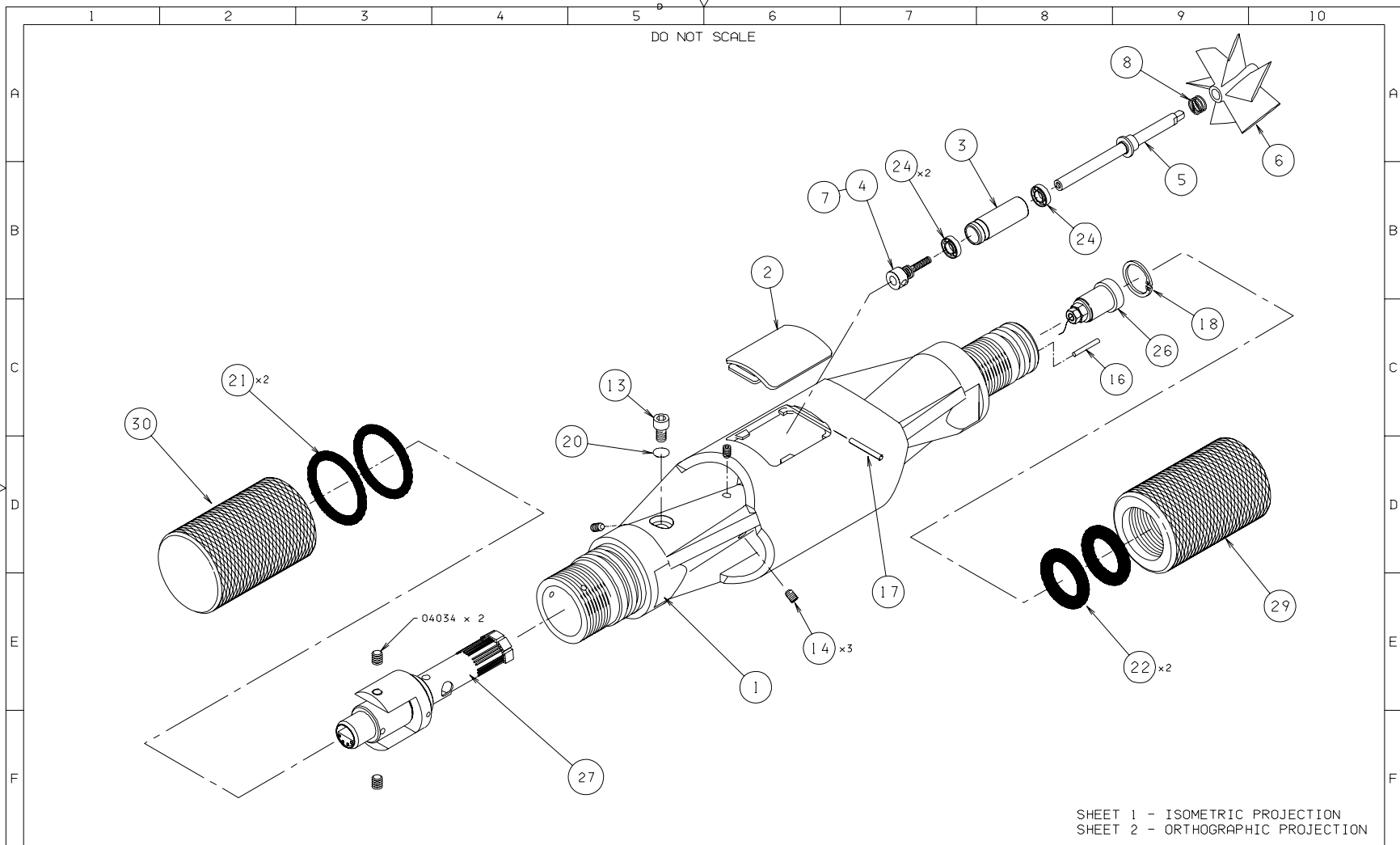
DRAWN NGH	CHECKED DJF	APPROVED DJF	ISS B	DESCRIPTION ECR 3285 REFERS - P/L ADDED	APPD JC	DATE 24/11/05	Sondex Tel. 0118 932 6755 THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	MACHINE FINISH 64	USED ON ILS022	TITLE ASSY IN-LINE SPINNER 1-11/16"(2-1/8" SHROUD) ULTRAWIRE - SX
DATE 03/08/01	DATE 29/09/01	DATE 29/09/01	A	INITIAL RELEASE	DJF	29/09/01		GEN TOL 0. X ±0.020" 0. XX ±0.010" 0. XXX ±0.005" ANGLE ±0.5°	SHEET 1/1	DRAWING No. 09462
DIM IN INCHES		MATERIAL: SEE DETAIL DRAWINGS		THIRD ANGLE PROJECTION						

SONDEX FM No: F0022

In-Line Spinner Flowmeter

ILS022

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SHEET 1 - ISOMETRIC PROJECTION
SHEET 2 - ORTHOGRAPHIC PROJECTION

DRAWN AJB	CHECKED DJF	APPROVED DJF	ISS F	DESCRIPTION REFER ECR382, PVR335	APPD AJB	DATE 15/03/00	Sondex Tel. 0118 932 6755 THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION	USED ON ILS	TITLE DIA 2 1/8" IN-LINE SPINNER SPINNER AND TRANSDUCER SECTION
DATE 10-06-94	DATE 10-06-94	DATE 10-06-94	E	ITEM 1 WAS 04821 NOW 04884	AJB	22-10-97		MACHINE FINISH 63/	GEN TOL 0. X +0.020" 0. XX +0.010" 0. XXX +0.005" ANGLE ±0.5°
DIM IN INCHES		MATL: SEE PARTS LIST	D	SEE C/R 210	DJF	19-09-97	THIRD ANGLE PROJECTION	DRAWING No. 05015	
SCALE 1:1	A 3		C	ITEM 27 REMOVED	AJB	26/9/95		ISSUE F	
			B	ITEM 11 REMOVED, ITEM 27 CHANGED	DJF	21/12/94			

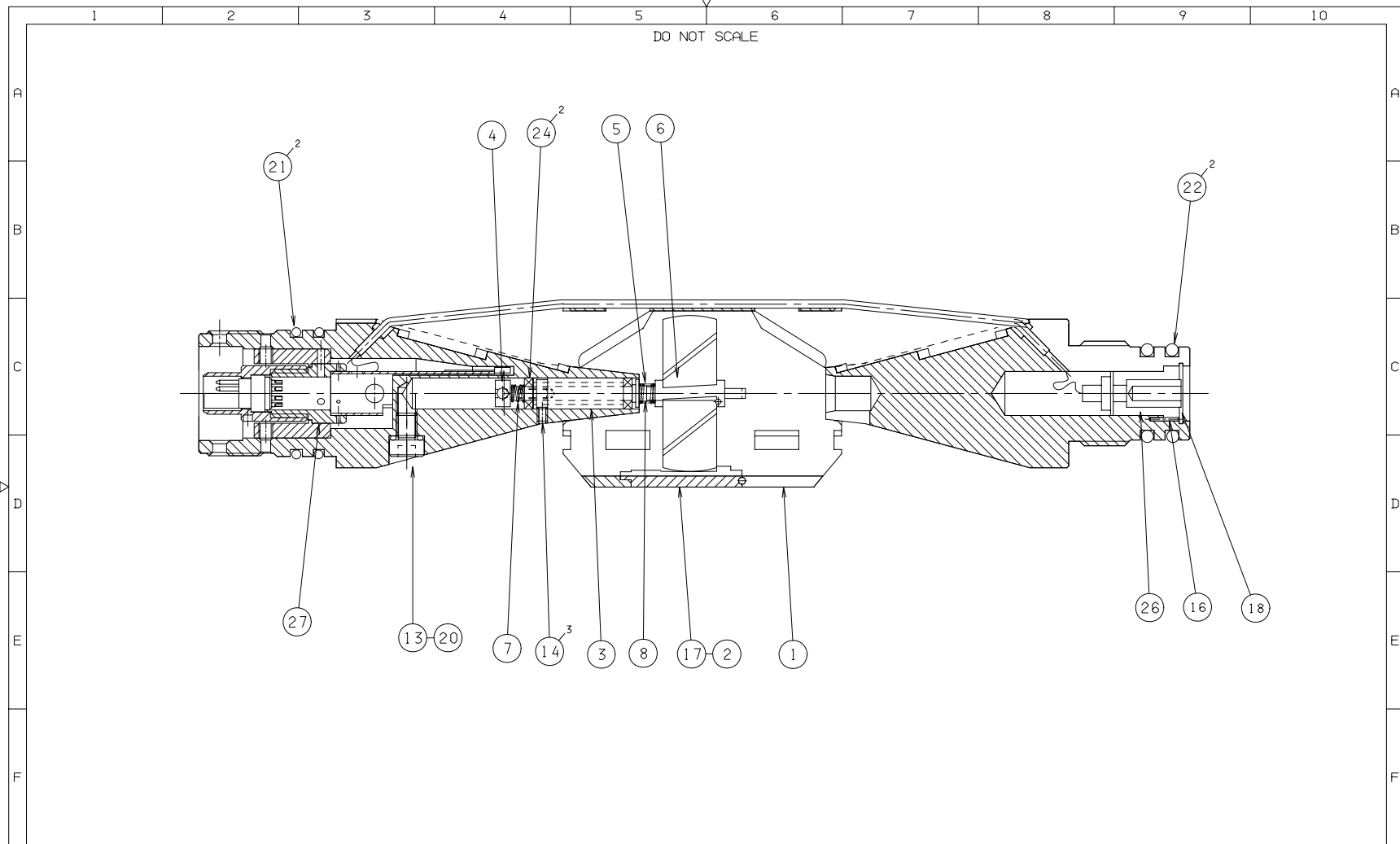
SONDEX FM No: F0023

In-Line Spinner Flowmeter

ILS022

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B-3



ISS	DESCRIPTION	APPD	DATE	<p style="text-align: center;">Sondex</p> <p style="text-align: center;">Tel. 0118 932 6755</p> <p style="text-align: center;">THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION</p> <p style="text-align: center;">THIRD ANGLE PROJECTION</p>	USED ON	ILS		TITLE	
F	REFER ECR382, PVR335	AJB	15/03/00			MACHINE FINISH	GEN TOL	SHEET	DRAWING No.
E	ITEM 1 WAS 04821 NOW 04884	AJB	22-10-97		63/	0. X ±0.020"	2/2	05015	F
D	SEE C/R 210	DJF	19-09-97			0. XX ±0.010"			
C	ITEM 27 REMOVED	AJB	26/9/95			0. XXX ±0.005"			
B	ITEM 11 REMOVED, ITEM 27 CHANGED	DJF	21/12/94		ANGLE ±0.5°				
DRAWN	CHECKED	APPROVED							
AJB	DJF	DJF							
DATE	DATE	DATE							
10-06-94	10-06-94	10-06-94							
DIM IN	MATL:								
INCHES	SEE PARTS LIST								
SCALE	A								
1:1	3								

In-Line Spinner Flowmeter

ILS022

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In-Line Spinner Flowmeter

ILS022

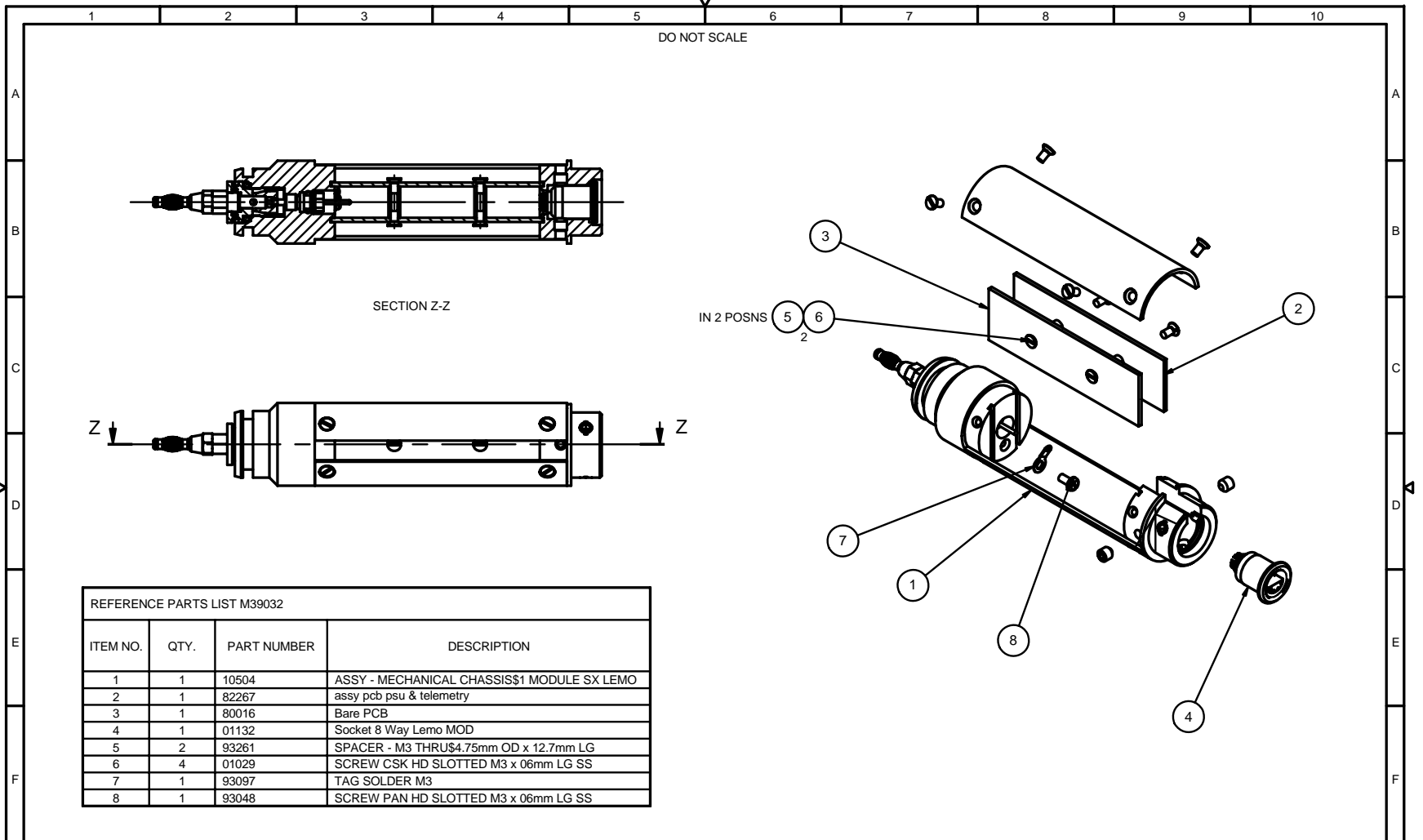
APPENDIX B. Drawings & Parts Lists

PARTS LISTING					
Part:	Issue:		Drawn:	Checked:	Approved:
05015	F		AJB	DJF	DJF
Description:			Date:	Date:	Date:
Assy, ILS, 1-11/16(2-1/8 Shroud) - Spinner & Sensor Sect			10/06/1994	10/06/1994	10/06/1994

CHANGE HISTORY					RELATED DOCUMENTS		
Iss	Date	Remarks	Chkd	Appr	# Documents	Issue	Notes
F	15/03/2000	Refer ECR382, PVR344	NGH	AJB			

PARTS LIST							
Item	Part No.	Issue	Description	Component Value	Qty	Units	Remarks
001	04884	D	Assembly Body 2 1/8 ILS		1	ea	
002	04818	C	Window Cover 2 1/8		1	ea	
003	04811	A	Spacer Bearings		1	ea	
004	04812	C	Assy Magnet Holder		1	ea	
005	04889	D	Shaft Spinner, ILS		1	ea	
006	08005	B	Spinner Quick Release 2 1/8 ILS		1	ea	
007	04820	C	Spring Compression		1	ea	
008	91076	-	Spring Compression St/St 0.210(OD) x 0.313(FL) 12.7lb/in		1	ea	
009							
010							
011							
012							
013	00714	B	Plug Filler		1	ea	
014	01037	-	Screw, Grub Skt Hd, M3 x 4mm Lg, St/Steel		3	ea	
015							
016	93019	-	Pin Spirol 1mm x 8mm LG MCK SS		1	ea	
017	93006	-	Pin Spirol 2mm x 10mm LG MCK SS		1	ea	
018	01047	-	Circlip, Internal, 5/8, St/Steel		1	ea	
019							
020	99009	-	O Ring Viton 90 Type 009		1	ea	
021	99124	-	O Ring Viton 90 Type 124		2	ea	
022	99211	-	O Ring Viton 90 Type 211		2	ea	
023							
024	01155	-	Bearing Ball, Radial 9mm OD		2	ea	
025							
026	01073	B	Assy, Lower Connector, SX		1	ea	
027	04828	D	Assy Sensor ILS		1	ea	
028							
029	01019	E	Thread Protector, Female, Standard (Lower End)		1	ea	
030	10117	B	Protector Thread Housing Connector Female		1	ea	

(AR = As Required)



REFERENCE PARTS LIST M39032			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10504	ASSY - MECHANICAL CHASSIS\$1 MODULE SX LEMO
2	1	82267	assy pcb psu & telemetry
3	1	80016	Bare PCB
4	1	01132	Socket 8 Way Lemo MOD
5	2	93261	SPACER - M3 THRU\$4.75mm OD x 12.7mm LG
6	4	01029	SCREW CSK HD SLOTTED M3 x 06mm LG SS
7	1	93097	TAG SOLDER M3
8	1	93048	SCREW PAN HD SLOTTED M3 x 06mm LG SS

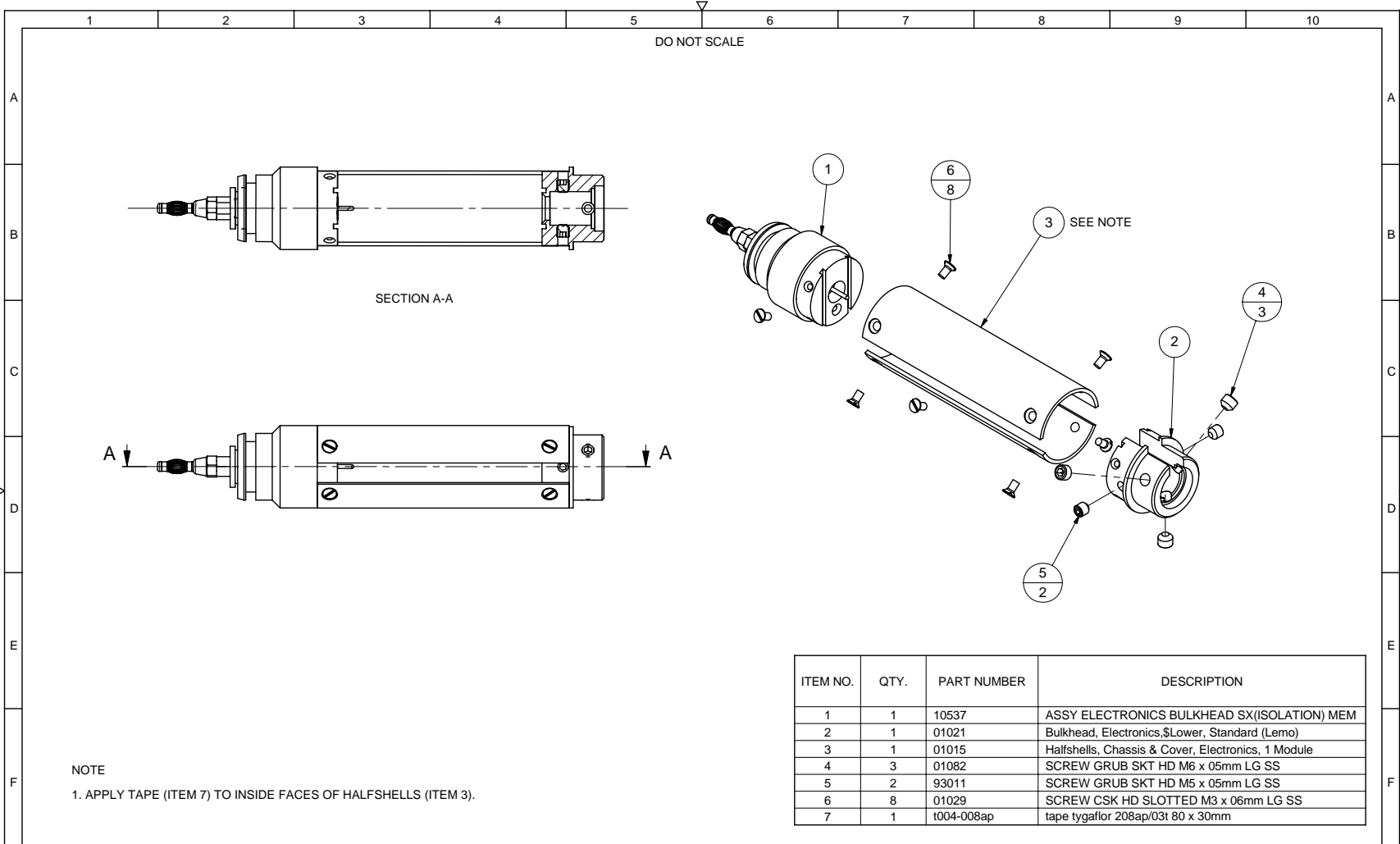
DRAWN: NGH	CHECKED: GHT	APPD: NPB	ISS	DESCRIPTION	APPD	DATE	Sondex Tel. 0118 932 6755 <small>THIS DRAWING IS THE PROPERTY OF Sondex AND SHALL NOT BE COPIED OR USED WITHOUT PRIOR PERMISSION</small>	MACHINE FINISH	USED ON	TITLE	SHEET	DRAWING No.	ISSUE	S
DATE: 16/06/05	DATE: 07/07/05	DATE: 30/11/05	C	ERC'S 3284 & 85	NPB	30/11/05		64	ILS	ASSY ELECTRONICS ILS SONDEX UW				
DIM IN INCHES	MATERIAL: SEE DETAIL DRAWINGS						THIRD ANGLE PROJECTION	GEN TOL						
SCALE 1:1	A	HEAT TREATMENT/CONDITION: NOT APPLICABLE						0.X 0.020" 0.XX 0.010" 0.XXX 0.005" ANGLE ±0.5°						

SONDEX FM No: F0022

In-Line Spinner Flowmeter

ILS022

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DRAWN: GC	CHECKED: GHT	APPD: NGH	ISS	DESCRIPTION	APPD	DATE	MACHINE FINISH	USED ON	TITLE
DATE: 07/07/05	DATE: 07/07/05	DATE: 13/06/06	F	REDRAWN FROM HELIX	NGH	13/06/06	64/	COM	ASSY - MECHANICAL CHASSIS 1 MODULE SX LEMO
DIM IN INCHES	MATL: SEE DETAIL DRAWINGS						GEN TOL		SHEET
SCALE 1:1	A	HEAT TREATMENT/CONDITION: NOT APPLICABLE					0.X 0.020* 0.XX 0.010* 0.XXX 0.005* ANGLE ±0.5°		1/1
THIRD ANGLE PROJECTION								DRAWING No.	ISSUE
								AD 10504	F
									S
									W

In-Line Spinner Flowmeter

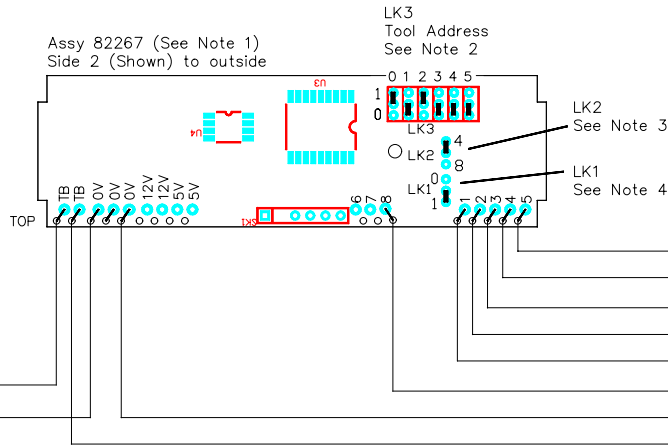
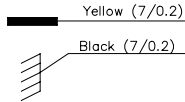
ILS022

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B-7

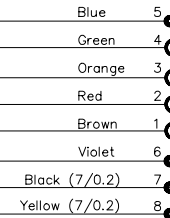
Note:-
Lay Line up & 0V wires together, keep the pair away from the PSU & Telemetry assembly transformer, ensure the loop is small. Wires to be held in place with RTV to bulkhead.

LINE UP

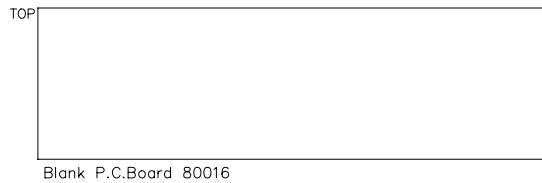


NOTES:

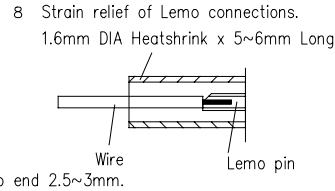
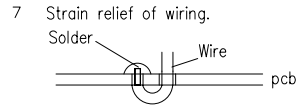
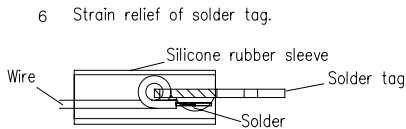
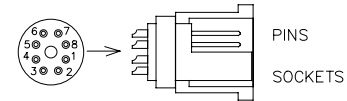
- 1 Wires PTFE 7/0.12 unless otherwise stated.
- 2 82267 is a programmed 82261 using bare board 82260
- 3 82267 Assy. Set LK3 address.
DBT = 05 as shown.
ILS = 07
- 4 82265 Assy. Link LK2 is tracked to 4 on PCB
- 5 82265 Assy. Link LK1 to 1 (5V).



Ensure Yellow & Black wires to Lemo are run together and kept away from Assy 82267 Transformer



8 WAY LEMO HOUSING
VIEW ON
SOLDER FACE

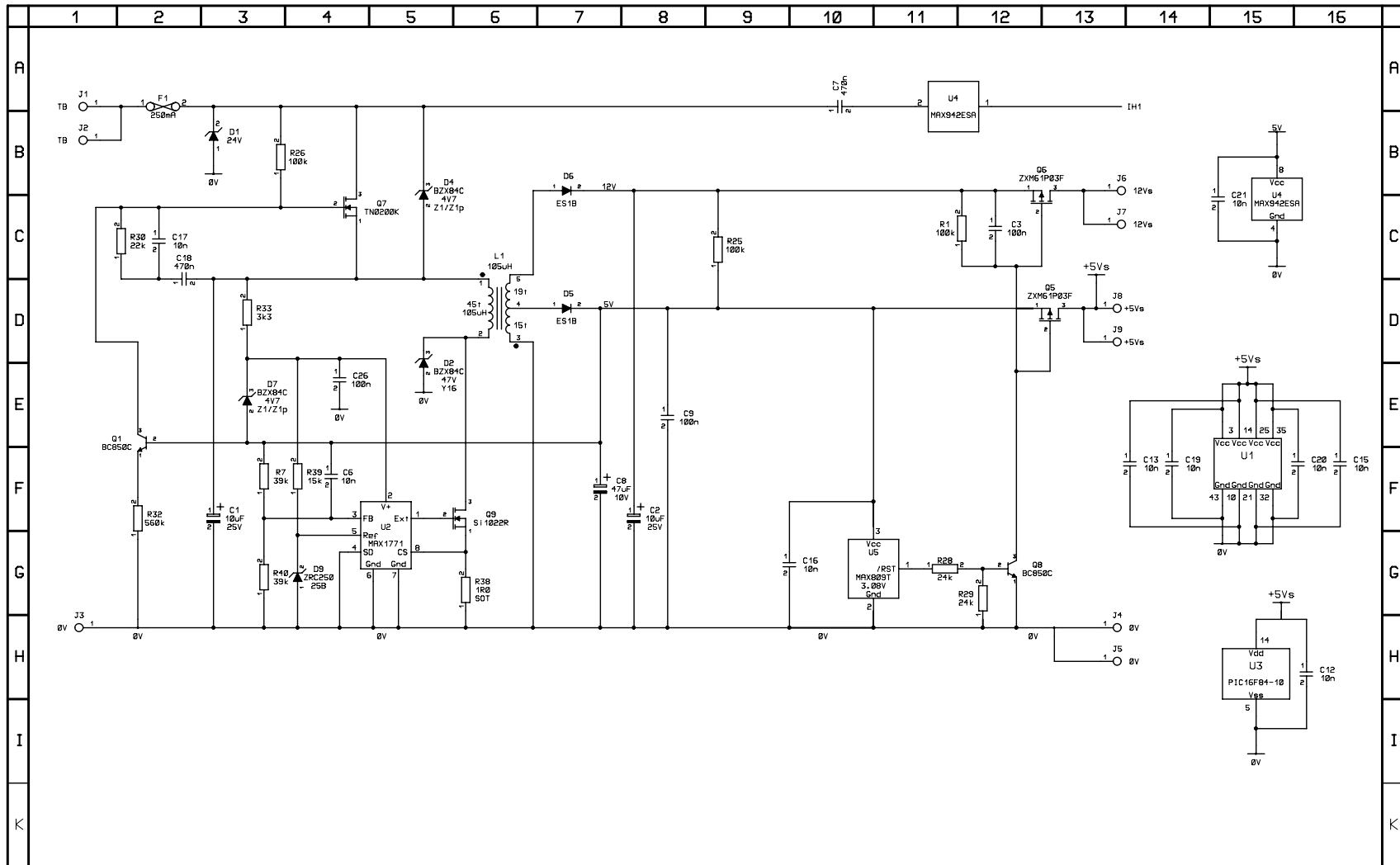


ISS	REV	DATE	CHANGES	CHKD	APPD
B		15.6.04	ECR1688. Redrawn. 82267 was 82223	(PR)	(PR)
C		25/07/06	ECR3962 & ECR3980 Notes added	VH	RH

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

TITLE:
WIRING DIAGRAM
Tool Electronics
Ultrawire Flowmeter

DRAWN R Holding	CHECKED	APPROVED (RH)
DATE 12 Nov 00	DATE	DATE 16/11/01
DRAWING No. WD 80286	ISSUE C	REVISION

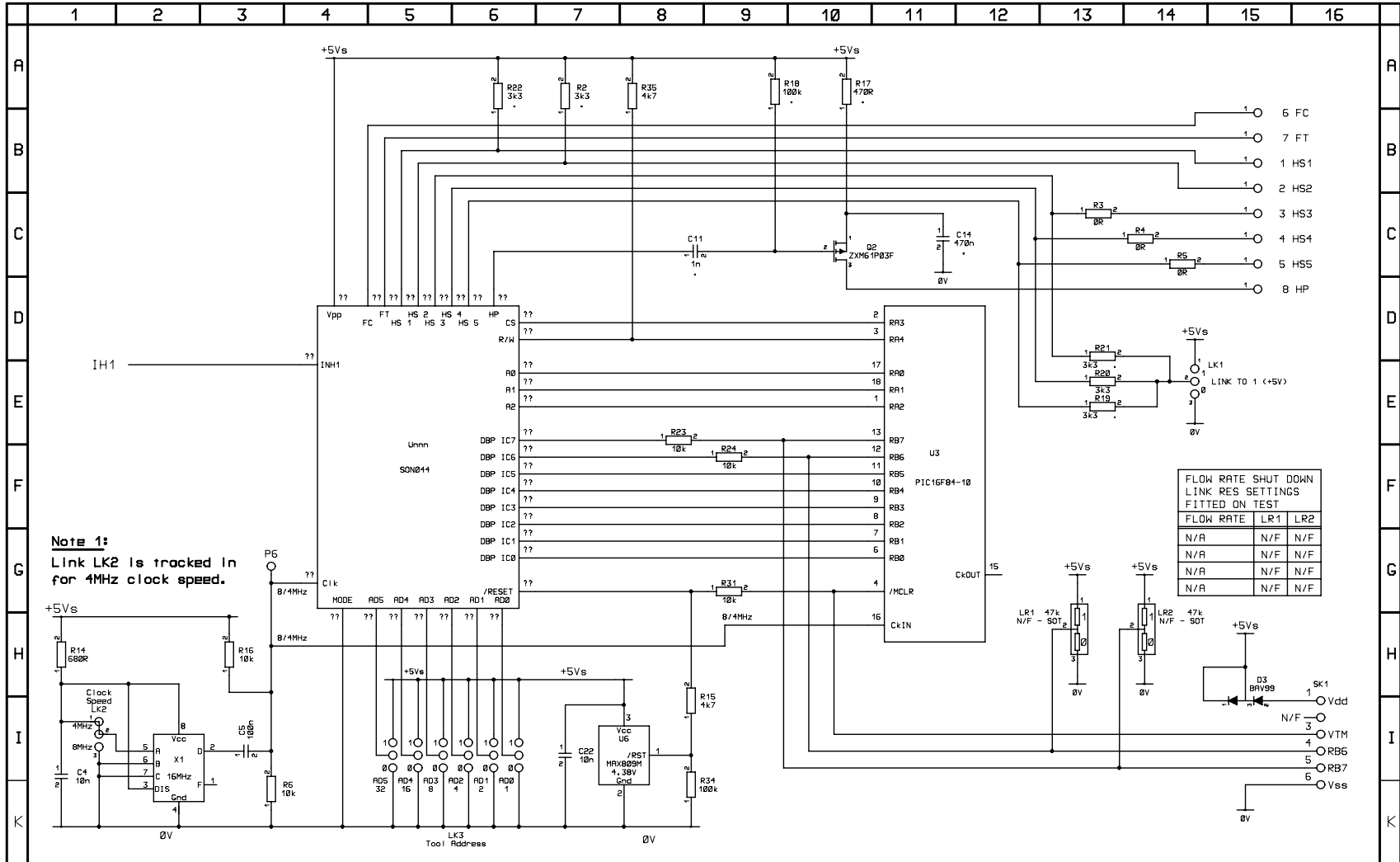


ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE	TITLE	DRAWING NUMBER	ISSUE	REVISION
C	01		PR	PR	21/11/03	SONDEX LTD FORD LANE, BRAMSHILL, HOOK, HAMPSHIRE, RG27 0RH, ENGLAND TEL: +44 (0) 118 932 6755 FAX: +44 (0) 118 932 6704 This document contains proprietary information. Copyright 2001 © Sondex Ltd.	CD-82261	F	00x
D	00		DJ	PR	23/07/07				
D	00		PEJR	PEJR	06/01/05				
D	01		PEJR	PEJR	08/05/05				
D	02		PEJR	PEJR	03/8/05				
F	00		PEJR	PEJR	29/06/06				
							Ultrawine PSU & Telemetry CTF Tool Circuit Diagram		
							DRAWN: PEJR CHECKED: DJ DATE: 17/04/03	APPROVED: PR DATE: 05/08/03	DATE: 05/08/03
							SHEET 1	OF 2	

In-Line Spinner Flowmeter

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I LS022



Note 1:
Link LK2 is tracked in for 4MHz clock speed.

ISS.	REV.	ECR NUMBER, REMARKS	CHKD	APPR	DATE	TITLE	DRAWING NUMBER	ISSUE	REVISION
C	01		PR	PR	21/11/03	SONDEX LTD FORD LANE, BRAMSHILL, HOOK, HAMPSHIRE, RG27 0RH, ENGLAND TEL: +44 (0) 118 932 6755 FAX: +44 (0) 118 932 6704 This document contains proprietary information. Copyright 2001 © Sondex Ltd.	CD-82261	F	00x
D	00		DJ	PR	23/07/07		DRAWN	CHECKED	APPROVED
D	00		PEJR	PEJR	05/01/05		PEJR	DJ	PR
D	01		PEJR	PEJR	08/05/05		DATE	DATE	DATE
D	02		PEJR	PEJR	03/08/05		17/04/03	05/08/03	05/08/03
F	00		PEJR	PEJR	29/05/06		SHEET	2	OF

In-Line Spinner Flowmeter