OPERATION AND INSTALLATION MANUAL

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ORIGINATOR:	**R.J HARDIE**			
ENGINEER:				
PRODUCTION:	**R.J HARDIE**			
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TECHNICAL SUPPORT	
Address	Sonavision Limited Unit 12 Energy Development Centre Aberdeen Science and Energy Park Bridge of Don Aberdeen AB23 8GD Scotland
Telephone	+44 (0)1224 707737
Fax	+44 (0)1224 827290
Email	info@sonavision.co.uk
Website	www.sonavision.co.uk

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3. On completion of any warranty work, Sonavision Limited will return the equipment, freight prepaid.
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SAFETY AND ENVIRONMENTAL STATEMENT

1. Lethal voltages are exposed within the control unit when the top cover is removed. The unit should always be disconnected from the mains supply before removing or operating any internal components.
2. The unit should be earthed at all times.
3. The unit contains electrostatically sensitive devices (ESSD). Appropriate static protection should be used when handling subassemblies.

RELATED DOCUMENTS

Document Number	Document Title

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SAFETY CONSIDERATIONS

In-Service Safety Considerations

The sonar unit operates from low voltage DC electrical supplies and will not normally present a shock hazard to users if a fault occurs. Underwater, if divers are present, they should be advised not to come into contact with the unit with power applied. The metal parts of the sonar housing are electrically isolated from the internal power supplies.

The sonar unit is designed as a pressure vessel to withstand external hydrostatic pressure. If a failure of any of the sealing mechanisms should occur at depth then, as the unit is brought to the surface an internal pressure may be present. Great care must be taken under these circumstances since there is a slight possibility that the end cap may be pushed out of the housing with some force. If the sonar unit fails during service at depth then this situation must be considered.

The hood contains a hydraulic oil for compensation and water proofing purposes. In the event of damage to the hood or its sealing mechanism then oil leaks may occur. If this situation arises, keep the unit away from naked flame, dispose of any materials which may become contaminated with oil and wash thoroughly in the event of skin contact.

Disposal Safety Considerations

The sonar unit does not contain battery powered components.

The unit should not be disposed of by fire. There is a risk of explosion due to the air trapped within the pressure housing.
The oil filling in the hood should be drained and disposed in a safe and environmentally friendly manner

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Section 1.0 INTRODUCTION AND SPECIFICATION

1.1 INTRODUCTION

The 2392 MERCURY SONAR UNITS form a range of miniature sonars with operating depths from 300 metres (acetal housing) to 6000 metres (stainless steel / titanium housings). The sonar head is capable of a full 360° continuous rotation.

The operating frequency is continuously variable over a range of 600kHz to 1200kHz. The unit requires to be supplied with nominally 24vdc power and communicates to the surface control unit over two wires using RS485 half duplex communication or over four wires using RS485 full duplex communication. In addition, the unit can communicate using RS232 format, generally for fiber optic communications interfaces to ROV systems or short cable lengths.

1.2 SPECIFICATION

The subsea unit is a one atmosphere pressure vessel containing all the electronic modules. A piezo-electric composite transducer is located at the upper end and rotates on the shaft of a miniature stepper motor. The transducer, stepper motor, head position sensor and slipring are all immersed in oil within the transducer hood which provides compensation over the full range of depths.

Acoustic Parameters

Operating Frequency: 600kHz to 1200kHz fully tune-able

Transducer Beamwidth (nominal):

Horizontal: 2.0° at 600kHz,1.0° at 1200kHz
Vertical: 42° at 600kHz, 21° at 1200kHz

Source Level (nominal at 24vdc supply):

900kHz 200db re 1µPa at 1 m
600 & 1200kHz 198db re 1µPa at 1 m
(Note that source level varies with supply voltage)

Pulse Length: 100µs

Bandwidth: 10kHz

Depth Rating: 300 metres (Acetal Housing)

Temperature:

Operating: 0°C to +30°C
Storage: -20°C to +50°C

Power Supply Voltage: +20V to +32V d.c.

Weight:

In Air:	1.1kg (Acetal Housing)
In Water:	0.4kg (Acetal Housting)
Size:	140 (L) x 79 (Dia.) mm (excluding connector)
Housing Material: (300m unit)	Stainless Steel End Cap Polyurethane Hood Acetal Body
Sonar Connector:	6-way Right Angle Impulse Bulkhead Plug LPMBH-6-MP
Communication:	RS485 Half Duplex (two wire) RS422 Full Duplex (four wire) RS232 (two wire & ground)
Communication Rate:	Downlink 57600 Baud Uplink 57600 Baud

1.3 GENERAL ARRANGEMENT

The unit consists of three main modules:

- The End Cap
- The Chassis
- The Housing

The end cap contains the piezo-electric transducer, the slipring assembly and the stepper motor. All of these components are within the polyurethane hood and the cavity is oil filled to protect the components from sea water and provide depth compensation. The end cap contains glass / metal seal assemblies which allow transfer of the electrical signals from the end cap components into the dry housing containing the electronic assemblies.

The chassis is a machined component, which holds a total of four printed circuit cards for controlling and processing the sonar data.

The printed cards are identified as follows:

- TX / RX Board
- TX / PA Board
- CPU Board
- PSU Board

The TX / RX board contains all the low level signal processing for the sonar transmit and receive functions. The board is controlled by the CPU board and interfaces to the TX / PA board.

The TX / PA board contains the power supply and power output circuits for driving the transducer transmitting function.

The CPU board controls all the communication with the surface control unit and the control for the transmit and receive functions. The circuit contains a powerful DSP controller which processes both analogue and digital signals as required. In addition, The board contains the output driver components for the stepper motor.

The PSU board provides all power supplies required by the electronic modules via DC/DC converters. These units accept a single DC input in the range 20 to 32 vdc and generates several power supplies for the electronic circuits on the other boards. The unit is protected against reverse supply protection and an automatically resetting fuse is incorporated into the supply line to the system to reduce the possibility of damage due to other circuit faults.

The PSU board also contains the telemetry driver circuits which interface to the surface control unit. Three types of communications protocol are provided for a variety of situations. These can all be selected by jumpers on the board.

RS485 2 Wire - Most suitable for long umbilical cables with a single screened twisted pair for sonar data.

RS485 4 Wire - Suitable for long cables where two screened twisted pairs are available or for certain types of data multiplexers built into larger ROV's. These are usually based on Fiber Optic Technology.

RS232 3 Wire (RXD, TXD & GND) - Suited for systems with built in data telemetry systems which require RS232 protocol. This protocol is not suitable for driving long cables but may be used in test installations with cable lengths limited to a few tens of metres.

The line drivers and receivers are optically isolated from the rest of the sonar electronics to reduce the possibility of interference and ground loops. A high value bleed resistor links the supply for the communications and the sonar electronics to reduce the possibility of static voltage build up on the telemetry lines.

The Housing is a pressure vessel which attaches to the end cap and seals the electronics at one atmosphere against water ingress. It is fitted with an IMPULSE 6 pin male connector for interface to the vehicle electronics.

The housing is secured to the end cap by a pair of seal screws which locate onto studs on the internal chassis. The seal screws have piston seal O rings to maintain water sealing.

Section 2.0 SYSTEM INSTALLATION

2.1 INTRODUCTION

Section 2.3 details how installation of the sonar unit should be carried out assuming the sonar unit is to be installed on an ROV, with power being supplied locally to the sonar unit and communication being connected via an umbilical. This is the conventional mode of operation for this unit. Alternatively, power can be supplied from the surface control unit through a multi-conductor umbilical cable. In this case, ensure that voltage drop in the power conductors is kept to an absolute minimum (2vdc maximum recommended).

2.2 PACKING / UNPACKING

- The unpacking procedure is as follows:
- Remove each unit from its carrying case.
- Check that the contents of each case conforms to the packing note.
- Notify the manufacturer of discrepancies and/or transit damage.
- Retain the carrying case for future shipment.

2.3 INSTALLATION

2392 Sonar Unit

To install the sonar unit on to an ROV, proceed as follows:

a) Remove the sonar unit from the carrying case and inspect for transit damage, retain the carrying case for future shipment.

b) Using the test cable and power supply (if provided), connect the sonar unit to the surface unit or PC and test. If all is satisfactory proceed with c.

c) Fit the unit to the ROV using a suitable and robust clamp, such that the scribed line (or indent) on the sonar transducer end cap is orientated to forward or the connector exits to the rear. It is also advisable that a head guard is fitted around the hood to avoid damage to the transducer when the ROV hits an obstruction. This is best achieved by using a wire cage construction (using 5mm stainless steel bar) set vertically around the sonar hood.

d) Ensure the cable whip is terminated to the supply dc power and communication in either half duplex or full duplex mode according to the factory setting of the unit. Connection details for the 6 way connector are shown in TABLE 1.

e) Check and clean the sonar unit mating area of the connector then lightly grease with silicon grease, (Dow Corning MS4 silicon compound or equivalent) the face of the cable whip connector.

f) Mate the connector and ensure the retention clip is over the sonar unit connector and located in its groove.

g) Connect the Surface Control Unit or PC at the surface end according to the manual (if a Sonavision surface unit) and test the operation of the sonar unit. Should the sonar unit not function correctly when installed on the vehicle remove the unit and test again with the test cable and power supply. If the sonar unit then works correctly there is probably an installation problem that should be investigated.

h) If using a PC, communications can be either using RS232 or RS485. RS232 communications plug directly into the PC COM port. RS485 communications plug into a PC COM port via an RS232/RS485 converter. Refer to TABLE 2 and TABLE 3 for signal connection details.

In the event of problems suspected in the installation, investigate correct polarity / voltage of the subsea power supply and correct polarity of the telemetry conductors.

2.4 ROUTINE MAINTENANCE

a. Wash with fresh water after each recovery to remove sea water, mud, silt and any other contaminants.

b. Inspect the condition of the hood and mating connector and cabling at regular intervals for oil leaks and / or signs of damage.

3.1 TABLES

TABLE 1

Wiring details – Sonar 6-way Impulse Connector LPMBH-6-MP (fitted as standard to the sonar unit)

PIN	RS485 (two wire mode)	RS485 (four wire mode)	RS232	CABLE WHIP COLOURS
5	0v	0V	0v	Blue
2	+24v	+24v	+24v	White
4	RS485 TX/RX-	Rx-	RXD	Green
3	RS485 TX/RX+	Rx+	COM	Red
1		Tx+		Black
6		Tx-	TXD	Brown

TABLE 2

RS232 System wiring – signal connections only. Use this data to check end to end on an ROV to see that all signal connections are correctly made through the umbilical and interconnects.

PC COM Port Pin No.	Signal Name	Sonar Conn. Pin No
	N/C	1
	+V Supply	2
5	GND (RS232)	3
3	RXD	4
	0V	5
2	TXD	6

1.1.1 TABLE 3

RS485 System wiring (2 wire) using RS232 / RS485 converter – signal connections only. Use this data to check end to end on an ROV to see that all signal connections are correctly made through the umbilical and interconnects.

RS485 System Wiring (2 wire)		
232/485 Converter Pin No.	Signal Name	Sonar Conn. Pin No
	N/C	1

	+V Supply	2
3	RS485 TX/RX+	3
2	RS485 TX/RX-	4
	0V	5
	N/C	6

4.0 SERVICE PROCEDURES

4.1 ASSEMBLY AND DIS-ASSEMBLY

The MERCURY SONAR can be dismantled by experienced service personnel. The following approach should be followed for disassembly and re-assembly:

1. Removal of Housing

Unscrew the two seal screws on the rear connector end of the unit but do no remove at this stage.

Grasp the housing and using a screwdriver, press gently on the seal screw to partially push the end cap out of the housing.

Whilst holding the housing, gently pull the end cap from the housing. Do not allow the end cap to break free in an uncontrolled manner otherwise the internal interconnection loom may be damaged.

Remove the connector on the PSU PCB (the board with two large DC/DC converters) to separate the housing and end cap assembly.

2. Removal of the Electronic Chassis

Remove the four pan head PCB retaining screws on the PSU PCB and the TX/PA PCB. Remove the PCB's carefully by pulling away from the boards underneath to disconnect the inter-board mating connectors.

Remove the two wiring looms to the end cap terminating in connectors on the CPU board by carefully extracting the connectors from their sockets on the board.

Remove the wiring loom to the end cap terminating in a connector on the TX / RX board by carefully extracting the connector from its socket on the board.

Remove the two M3 socket head cap screws which hold the chassis onto the end cap. Ease the chassis away from the end cap avoiding straining the wiring looms onto the end cap.

3. Disassembly of the Hood / End Cap

The hood covers and protects the components in the upper end of the end cap.

The hood can be removed by carefully releasing the hood clip with a pair of fine nose pliers at the tensioning point. This will allow the hood and clip to be withdrawn from the end cap. Before starting this procedure it is advisable to have a container to catch the oil which is within the hood.

The transducer, slipring wires and magnet for the head position sensor are fitted a the TRANSDUCER PCB which is held on the shaft of the motor by means of an M3 socket head set screw. This can be loosened and the

assembly removed from the motor shaft. TAKE GREAT CARE NOT to damage the slipring wires.

The SLIPRING PCB is held onto the end cap by means of three pan head screws and this PCB can be removed by extracting these screws. Under the PCB are two connectors which mate with the wiring looms onto the end cap glass / metal seals. The connectors can be disconnected by carefully pulling out the wiring looms and then the board can be removed.

4. Re-assembly of the Hood and End Cap

Re-assembly is a reversal of the disassembly procedure but take note of the following:

a. Always use a screw sealing compound such as Loctite 242 on all screws to avoid their working loose in use.

b. When replacing the TRANSDUCER PCB, fit to the shaft such that approximately a gap of 0.5 to 0.75mm gap is available between the top of HS1 and the magnet. Also check that the head rotates freely without fouling any other part.

c. Check that the slipring wires make contact with the sliprings and travel evenly over the surface as the head rotates. Ensure that they do not slip off the slipring tracks during rotation. To check for correct flexing of the wires, the slipring contact point should be approximately 7mm above the TRANSDUCER PCB before fitting to the motor shaft. If necessary, adjust to suit.

d. Tighten the TRANSDUCER PCB assembly to the shaft using the M3 socket set screw. Do not over-tighten to avoid stripping the threads and make sure that the screw contacts the flat on the shaft normal to its surface.

e. Fit the hood and hood clip. The hood clip is tensioned using a pair of pincers on the tensioning loop. Tighten as tightly as possible without damaging the clip to avoid oil leaks.

f. Remove the seal screw from the internal face of the end cap and support the assembly hood down avoiding compressing the curvature of the hood.

g. Oil filling is best carried out in a vacuum chamber. If one is available, place the end cap assembly under approximately 20mm of oil in a container and place in a vacuum chamber. Pull a vacuum of at least 100mBar and leave until air bubble cease to exit the seal screw hole. Release the vacuum slowly and then repeat the process. It is important that all air is removed from the hood to avoid collapse of the hood at depth and / or poor acoustic performance.

h. If a vacuum chamber is not available, oil filling can be carried out by using a syringe to inject oil into the seal screw hole. In this case, it is more difficult to remove all air from the hood and repeated attempts to fill and then wait for air to rise to the surface should be carried out.

i. Once the hood is full of oil, replace the seal screw tightly and wash off excess oil from the assembly using methylated spirits or a similar solvent. Do not use aggressive solvents such as acetone or trichloroethylene.

5. Replacement of the electronic chassis

Replacement is simply a reversal of the disassembly instructions, ensuring that all screws are sealed and connectors and wires are correctly inserted, routed and undamaged.

6. Re-assembly of the Housing

The housing replacement is a reversal of the disassembly instructions. Carefully clean the end cap O ring and check and clean the seal screw O rings. Lightly smear with Silicone Grease before installation.

Inspect the O ring surfaces on the mating halves to ensure there are no scratches or other damage which could cause the O rings to leak.

Re-connect the housing wiring loom to the PSU PCB connector. The connector is polarised to assist in inserting the correct way round.

The housing is intended to be fitted so that the wires from the housing connector lie along the PSU PCB and should have been routed during manufacture in that way. Avoid allowing the wires to bunch up in the base of the housing whilst inserting the electronic assembly.

When the wires are correctly routed, push the end cap into the housing, after checking the O rings, and press home carefully without distorting the hood.

Locate the chassis studs through the two holes in the housing and centralise. Insert the seal screws and tighten gently to draw the end cap fully into the housing. DO NOT OVERTIGHTEN

4.2 COMMUNICATIONS INTERFACE

INTRODUCTION

The MERCURY sonar is provided with the means to operate using one of three modes of communications with the surface control unit.

The available protocols are:

RS485 2 wire (half duplex)
RS485 4 wire (full duplex)
RS232 3 wire

The user can change the format of the communications by changing links within the sonar unit.

The data rate (baud rate) for the sonar units is set in manufacture and cannot be changed by the user. The standard data rate is 57600 baud to maintain compatibility throughout the range. Other data rates can be provided as options if specified at time of order or if the sonar is returned to Sonavision for modification.

DESCRIPTION OF THE OPTIONS

RS485 2 WIRE COMMUNICATIONS

RS485 2 wire is the conventional communications protocol for small to medium size ROV's which have screened twisted pairs available for optional equipment. A single twisted pair is used for both directions of communication and therefore transmit and receive are interleaved. RS485 is generally accepted as being capable of at least 1000 metre operation over a reasonable quality twisted pair. If a high quality (generally large conductor cross-sectional area coupled with high quality insulation) twisted pair is used then greater distances are achievable.

RS485 communications requires that the cable be correctly terminated at each end. Link 6 & & when fitted, terminate the sonar end of the line with 120 ohm resistors. This is acceptable for most types of screened twisted pair cable.

Ultimately, maximum transmission distance depends upon signal loss in the cable versus noise in the system (providing the lines are correctly terminated to minimise reflections). A correctly terminated screen around the twisted pair, whilst not essential for operation, will improve signal to noise ratio and therefore quality of data communications. Note that the screen must be carefully terminated to a good ground point, generally at one end of the cable only.

RS485 4 WIRE COMMUNICATIONS

RS485 4 wire communication is available, but is rarely used since performance improvements are minimal. Occasionally, this format is used with an ROV fitted with optical fiber multiplexer units.

RS232 COMMUNICATIONS

RS232 communications is a new feature in the MERCURY sonar. It allows the sonar to be directly connected to a COM port on a PC without any interface box or hardware. This truly provides the concept of a "SONAR on a DISK". RS232 communications are severely limited in their transmission distance and, depending on the type of cable used, the maximum can be as little as a few tens of metres.

The main reason for the introduction of this option is to allow easy interface to optical fiber multiplexers in larger vehicles whilst providing the client with the option of using a stand-alone PC instead of a dedicated sonar control unit.

There are limitations in the COM port specifications of some PC's (particularly Laptops) and the data rate of the MERCURY is set at 57600 baud unless otherwise specified to maintain compatibility with different PC formats.

For long distance communications (i.e. ROV's with long umbilical using screened twisted pair conductors for the sonar) and when using a simple PC as the surface unit, an optional RS485 / RS232 converter can be supplied. The sonar is set for RS485 communications and the data converter plugs

directly into the PC COM port. Two wire twisted pair data connection is then made between the sonar and the data converter.

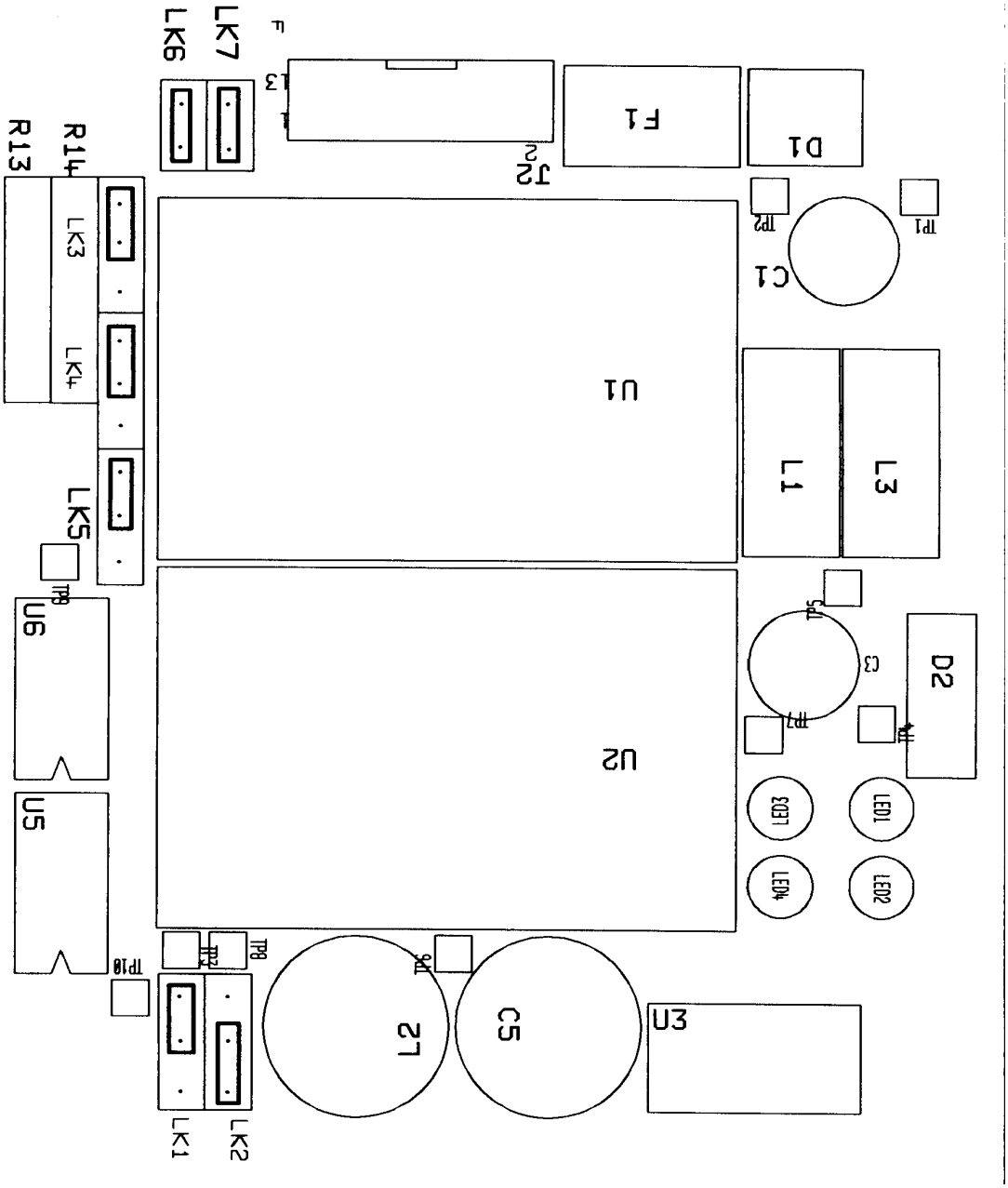
CHANGING THE COMMUNICATIONS PROTOCOL

Changing the protocol requires that the sonar unit is opened to gain access to the printed circuit boards. This is carried out by following the procedures in section 4.1 of this manual. This should only be attempted by an experienced person since poor workmanship which leads to failure of the sonar unit will not be covered by the manufacturers warranty.

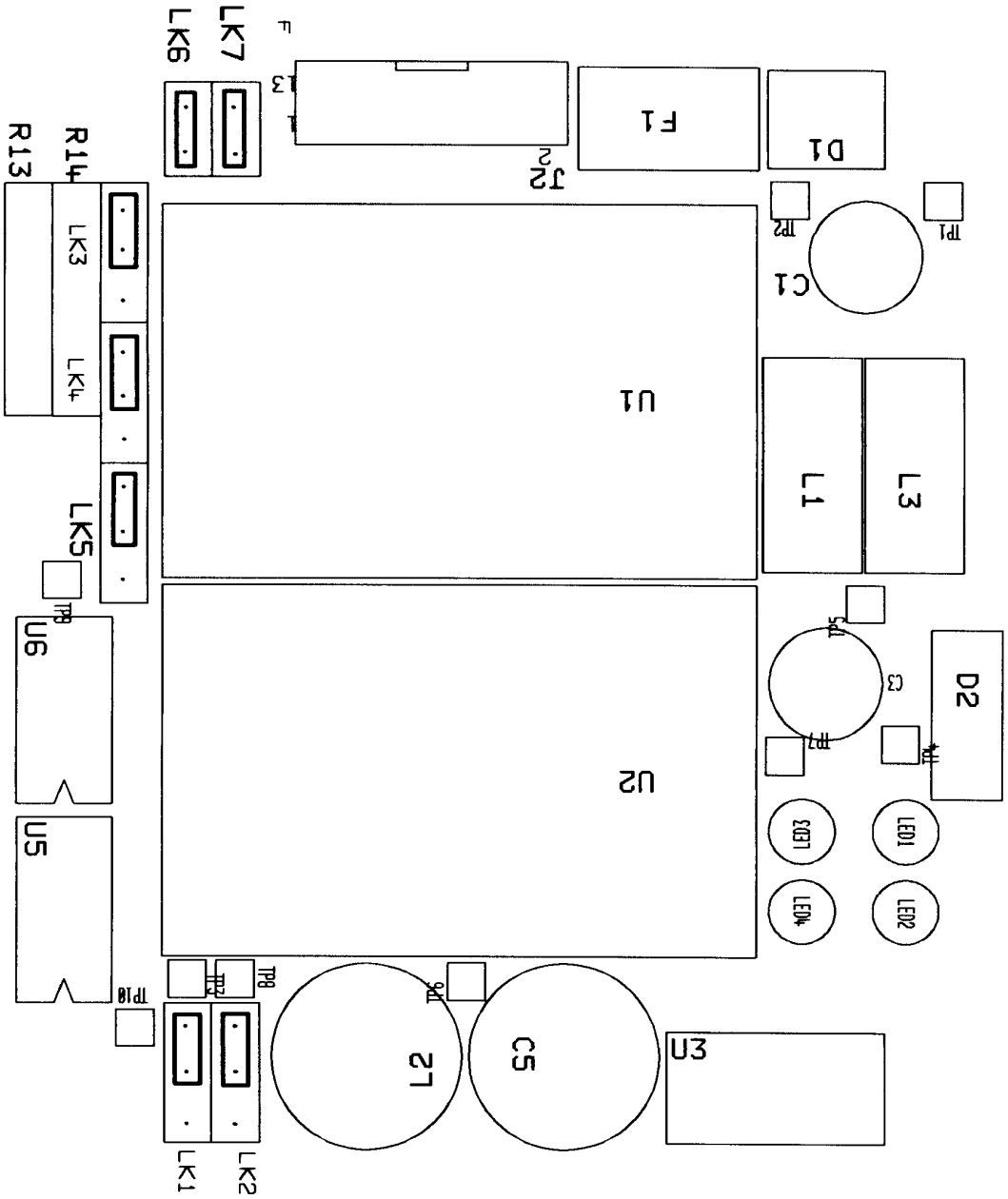
The links which require changing are on the PSU board. This is the outer board to which the connector on the housing mates. It also has two large electronic modules in the centre which are easily recognizable.

The following diagrams show how links 1 to 7 should be set for the three different communications protocols.

LK1--LK7 POSITIONS FOR RS485-- 2 WIRE

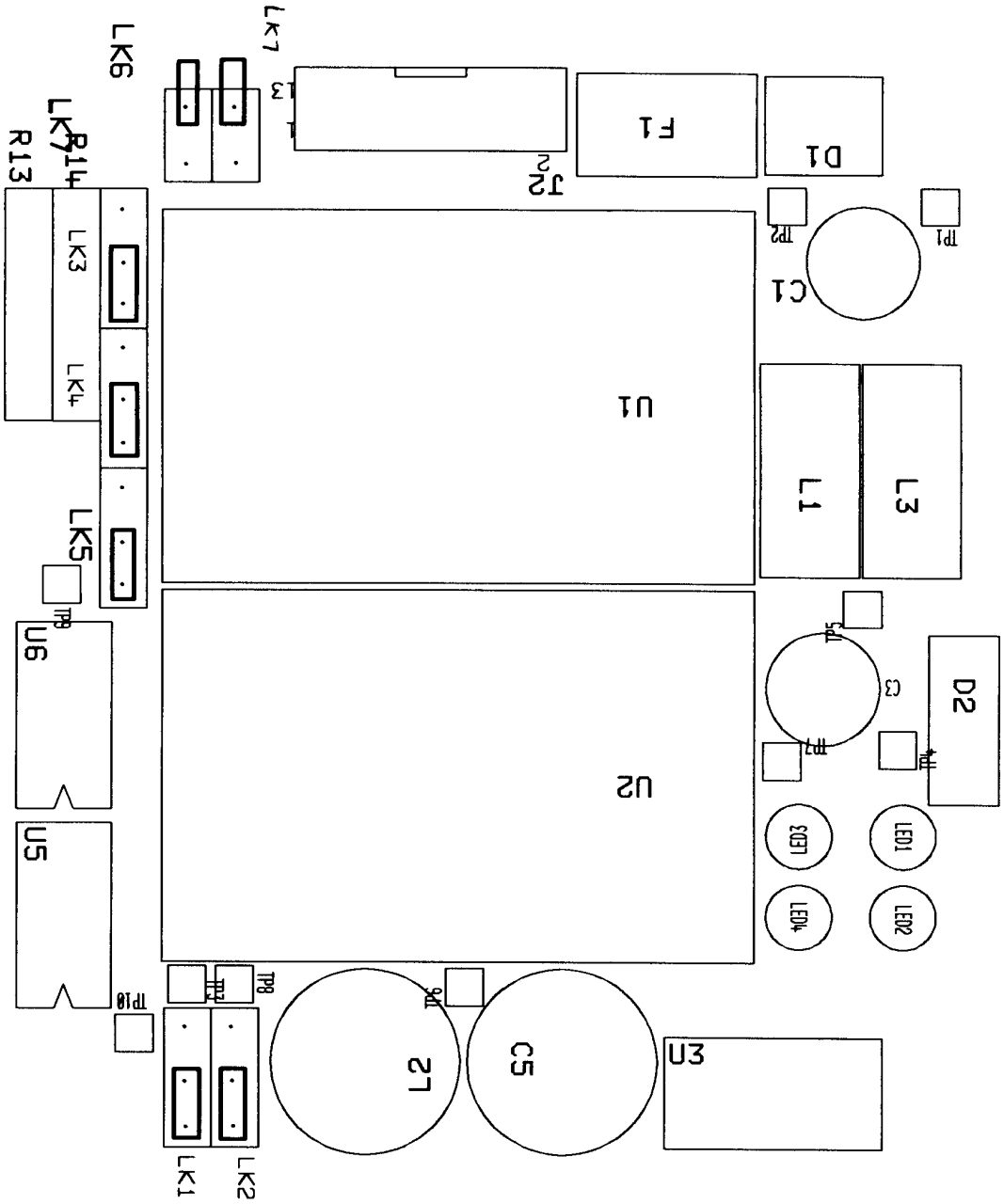


LK1-- LK7 POSITIONS FOR RS485--4 WIRE



LK1-- LK7 POSITIONS FOR RS232

(LK6 . LK7 ARE OPEN)



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