PROJECT

AUDIO LEAD CHECKER

PROJECT RATING 3

Kit Available
Order as LU26D Price £19.99

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Open any gigging musicians cable-box and you're bound to find a handful of 'questionable' leads – do they or don't they work? Or are they just wired incorrectly?

FEATURES

Easy to build

No setting-up required

Easily and clearly identifies interconnections on most types of audio cable

APPLICATIONS

PA/Sound engineers

Gigging bands

No home or professional studio is complete without one!

The problem is, there are only so many types of connectors, but an almost infinite number of ways to interconnect them! Are those balanced XLR-to-unbalanced jack cables wired correctly? Or are those suspect 5-pin DIN-to-DIN MIDI cables wired 'straight', 'mirrored', or do they just have a broken connection in the cable?

So, much time is spent rummaging through boxes of cables, trying each one out until a working lead is finally found. But what happens once the gig has finished? The lead is thrown back into the box with all its friends, returning you to square one!

Those of us with the time have probably developed labelling techniques that allow us to instantly recognise each type of cable. However, what happens when the label falls or wears off?

Well, help is at hand! The compact and rugged audio lead tester described here has been designed to show interconnections on the majority of audio leads used at anything from a home hi-fi set-up through to live venues. With pairs of phono, 3·5mm & 6·35mm (¼in.) jack, XLR and 5-pin DIN connectors, the wiring of almost any cable can be clearly and easily seen.

Working by sending a signal out on each pin of a connector, routing it through the cable-under-test, and returning it to the unit, the cable interconnections are clearly displayed on two rows of LEDs – one showing the 'sent' pin, and the other the 'return' pin.

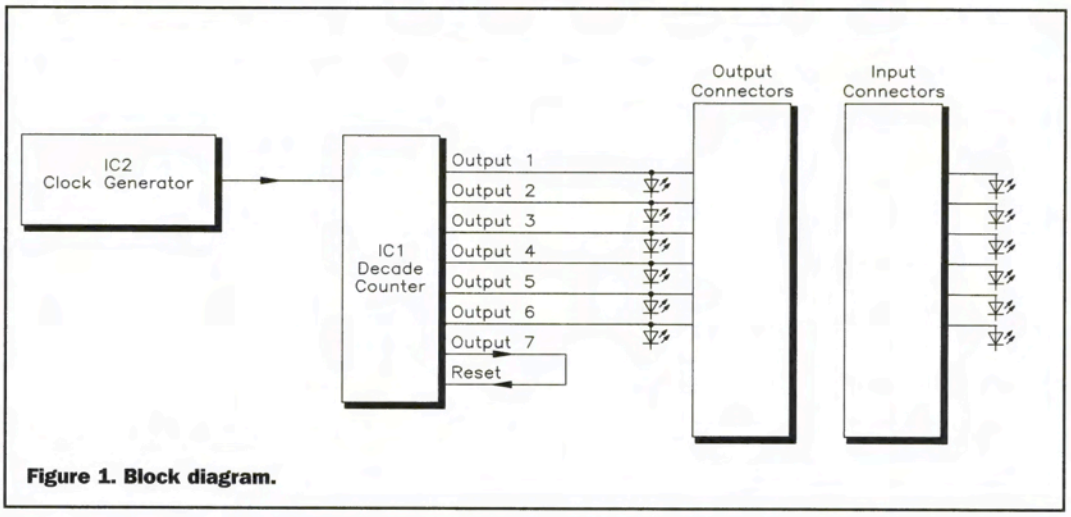


Figure 1. Block diagram.

Circuit Description

Reference to the block diagram shown in Figure 1 and the circuit diagram of Figure 2 will assist with the understanding of the following description of how the circuit works.

The entire circuit is powered from a 9V PP3 battery, with C1 and C2 providing, respectively, low- and high-frequency de-coupling of the supply rail.

IC2, a tried-and-tested 555 multi-vibrator, is configured as an equal mark-space ratio astable oscillator with an output frequency, set by R7 and C3, of approximately 1Hz. This circuit configuration was chosen in preference to the more common 'two resistors and capacitor' astable oscillator for no other reason than it saves on components!

For those who are interested in the calculations; Capacitor C3 charges *and* discharges from/to the output of the 555, pin 3, through R7. This makes the charge and discharge periods exactly the same, $t_{charge/discharge} = 0{\cdot}693 \times C3 \times R7$. The total period of oscillation is therefore twice this, $t_{period} = 1{\cdot}386 \times C3 \times R7$. Using the component values chosen, $t_{period} = 1{\cdot}386 \times 0{\cdot}0000047 \times 120000 = 0{\cdot}78$ seconds, resulting in an operating frequency of $f = 1/t_{period} = 1{\cdot}3$Hz.

The clock output of IC2 is fed into IC1, a decade counter. On each clock pulse the active output is moved along one step

Close-up showing soldering of the PCB inter-connectors CN1 and CN2.

– Output 1 to Output 2, Output 2 to Output 3, etc. However, as Output 7 is linked directly to the RESET input of IC1, when the active output is moved from Output 6 to Output 7, IC1 resets and starts the cycle once again. In addition, the active output of IC1 at power up cannot be guaranteed but, by tying Output 7 to RESET, it can be ensured that wherever IC1 powers up, it will always (eventually) issue itself a RESET.

Outputs 1 to 6 of IC1 are connected to IC3, a Darlington Array. This drives the six LEDs used to indicate which output is active. The outputs of IC1 are also connected, each through a diode and current limit resistor, to the connectors on the right-hand side of the unit – labelled 'OUT'. To minimise both the number of LEDs and the complexity of the project, all input and all output connectors are wired in *parallel*, see Figure 3. So, for example, when Output 5 of IC1 is active, a signal is sent to pin 4 of the 5-pin DIN connector, pin 3 of the XLR connector, *and* the ring of the jack connectors (both 3·5mm and 6·35mm).

The lead under test is plugged between a suitable 'OUT' connector and 'IN' connector. As each of IC1's outputs become active, a signal is sent to the 'OUT' connector, through the cable, and back to the 'IN' connector. Each pin of the 'IN' connectors is wired identically to the 'OUT' connectors, with the return signals being buffered by IC4 (a slightly different variant of the Darlington Array, IC3), before being displayed on LEDs LD7 to LD12. Therefore, plugging in a direct pin-to-pin 5-pin DIN lead will result in LD6 & LD12 illuminating, then LD5 & LD11, LD4 & LD10, LD3 & LD9, LD2 & LD8, and finally LD1 & LD8 before starting all over again at LD6 & LD12.

PCB Construction

The Audio Lead Checker is easy to construct and requires no special tools, setting up or adjustment. The circuit is constructed on a three-part high quality fibreglass PCB which has a printed legend to facilitate component positioning. If you are new to project building, refer to the Constructors' Guide included with the kit for further information on component identification and soldering techniques.

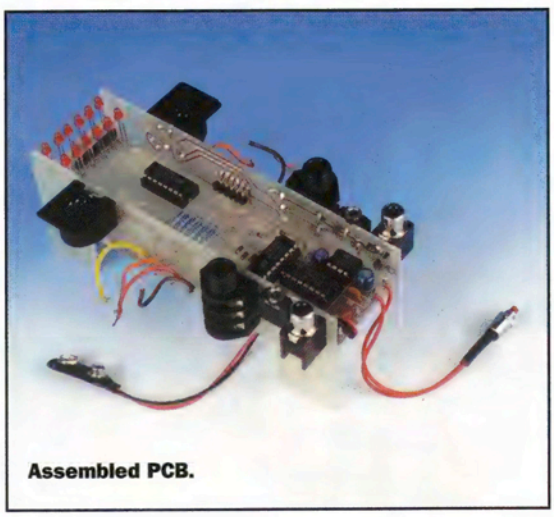
First start by breaking the PCB into its three parts, and sand- or file-flat the snap-off tags; This is especially important along the top edge of the 'Transmit PCB'. Insert and solder the components onto the PCB referring to Figure 4. Start by inserting the twelve PCB pins, and press them into position using a hot soldering iron. When the pins are heated in this way very little pressure is required to push them in place. Once the pins are in position they can be soldered. Now fit the resistors, diodes, capacitors, seven wire links (made from off-cut resistor/diode legs), IC sockets (taking care to match the notch in the end of the socket with the block on the legend), and SIL resistor (matching the pin 1 designator to the outline on the legend). Now fit and solder sockets SK1 to SK8, ensuring that each one is pushed *fully* home before soldering. All component leads should be kept as short as possible and the height of the components above the component side of the PCB must be kept to an absolute minimum to avoid problems when housing the project.

You may now fit the LEDs at a height of 17mm above the PCB (from PCB to top of LED, 12·5mm from PCB to bottom of LED), see Figure 5. The best way to do this is to cut a thin strip of card 12·5mm wide and place it between the legs of the LEDs and the PCB whilst they are soldered in place. Note that the cathode wire, which is the shorter of the two, must correspond with the 'flat' side of the LED symbol printed on the PCB legend Take care not to overheat the LEDs as they can be very easily damaged. Once the LEDs are fitted, and after taking suitable anti-static precautions, the IC's can be inserted into their holders.

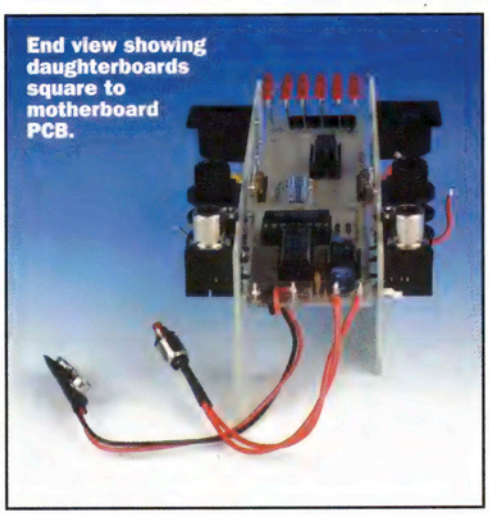
Break off two six-pin sections of right-angled pin-strip and solder them to the 'main' PCB in positions CN1a and CN2a, as shown in Figure 6. Next, align each side PCB at 90° to the main PCB before soldering it in place. (It may be easier to stand the PCBs up on their end for this.) Initially only solder the first and last pins then, after ensuring that the PCBs meet at 90°, solder the remaining pins.

Now thread the PP3 battery clip through the strain-relief hole, and solder it to the PCB pins marked BATT+ and BATT-. Cut the supplied red wire into three equal lengths, using two of the lengths to connect the power switch to the PCB (don't forget to insulate the wires at the switch end with heat-shrink sleeving), see Figure 7.

Now check your work very carefully, ensuring that all solder joints are sound. It is also important that there are no trimmed component leads standing proud by more than 1mm (this is very important of the right-angled connectors CN1 and CN2).



Assembled PCB.



End view showing daughterboards square to motherboard PCB.

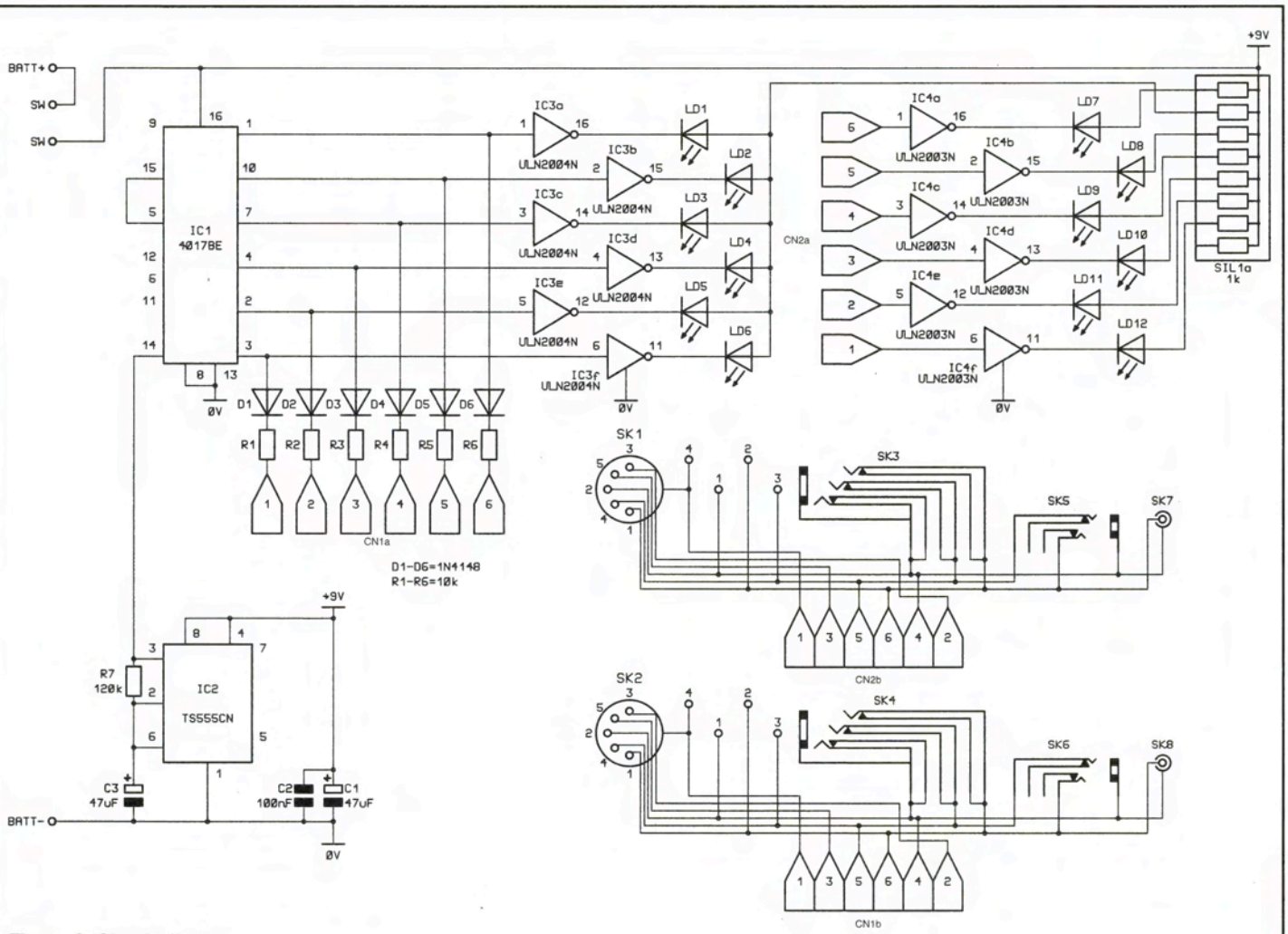


Figure 2. Circuit diagram.

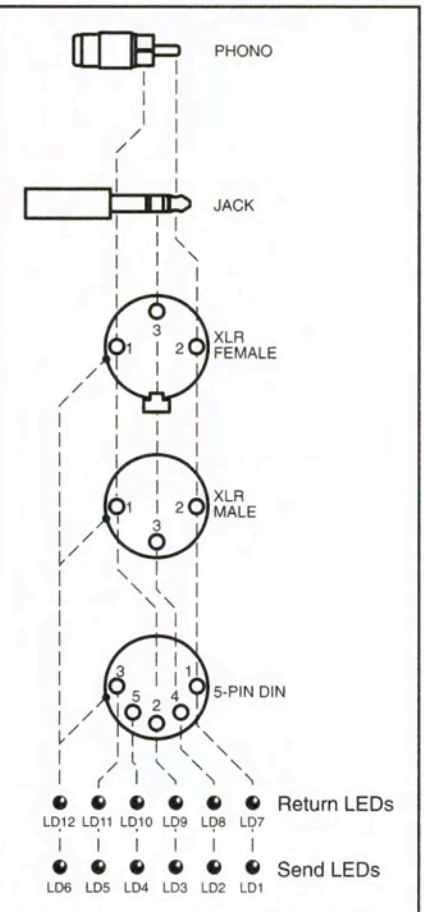


Figure 3. Connector pin-to-LED mapping.

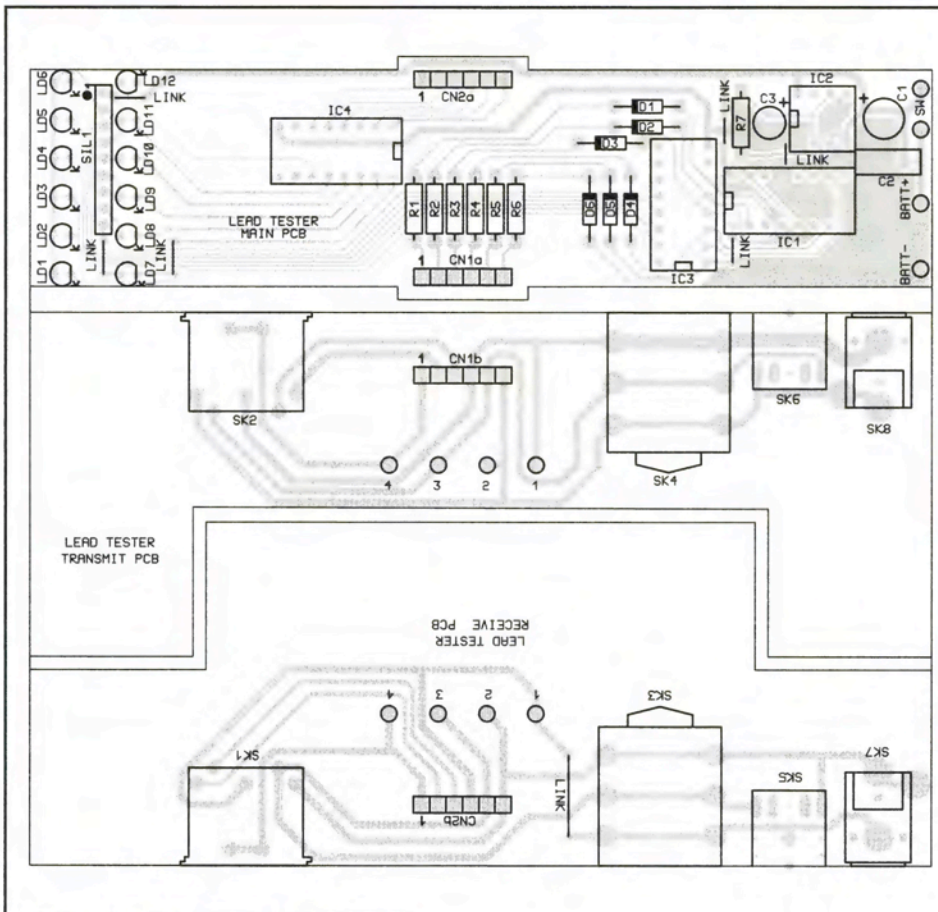


Figure 4. PCB legend and ghost track.

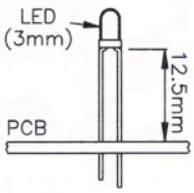


Figure 5. Setting the LED heights.

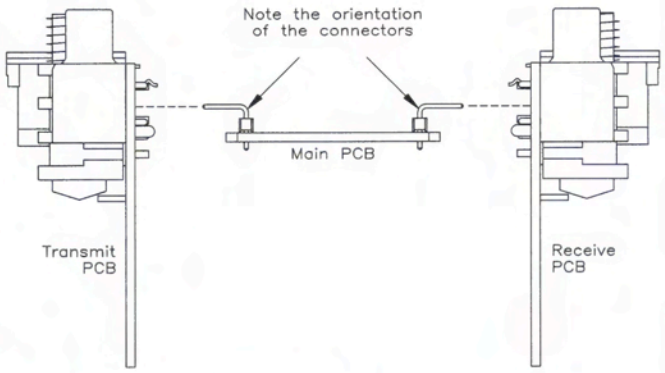


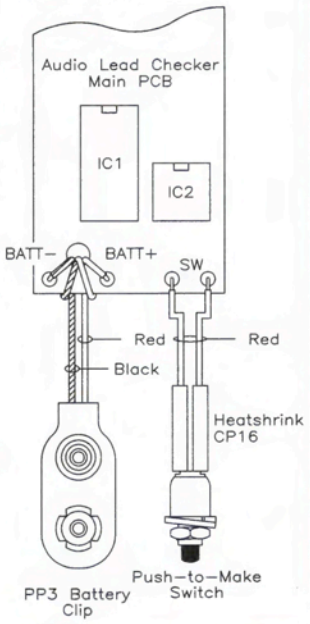
Figure 6. Exploded PCB assembly.

Boxing and Final Assembly

The remaining wire should be cut into equal length strips so that you have two lengths of each colour. Using the following colour convention, solder each wire to the solder tags/buckets on the rear of the XLR connectors: Pin 1 – Brown, Pin 2 – Red, Pin 3 – Orange, Case/Chassis – Yellow.

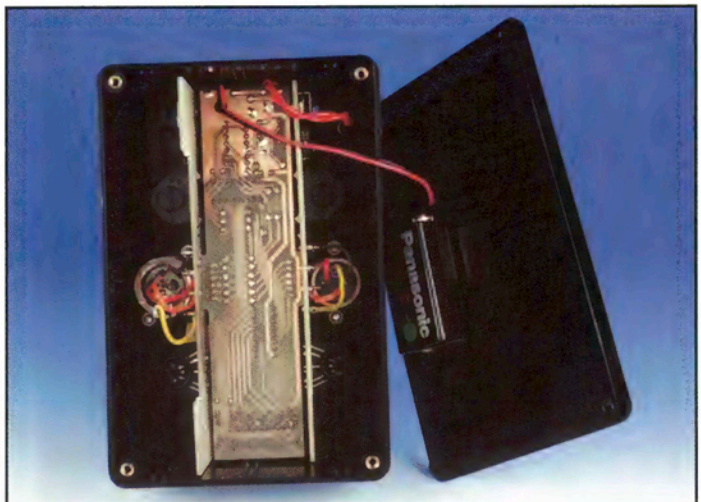
A black plastic ABS box with self-adhesive label is supplied to house the PCB assembly. However, the tray of the box must be drilled in accordance with Figure 8. It may be

Figure 7. Wiring the PP3 battery clip and push-switch.

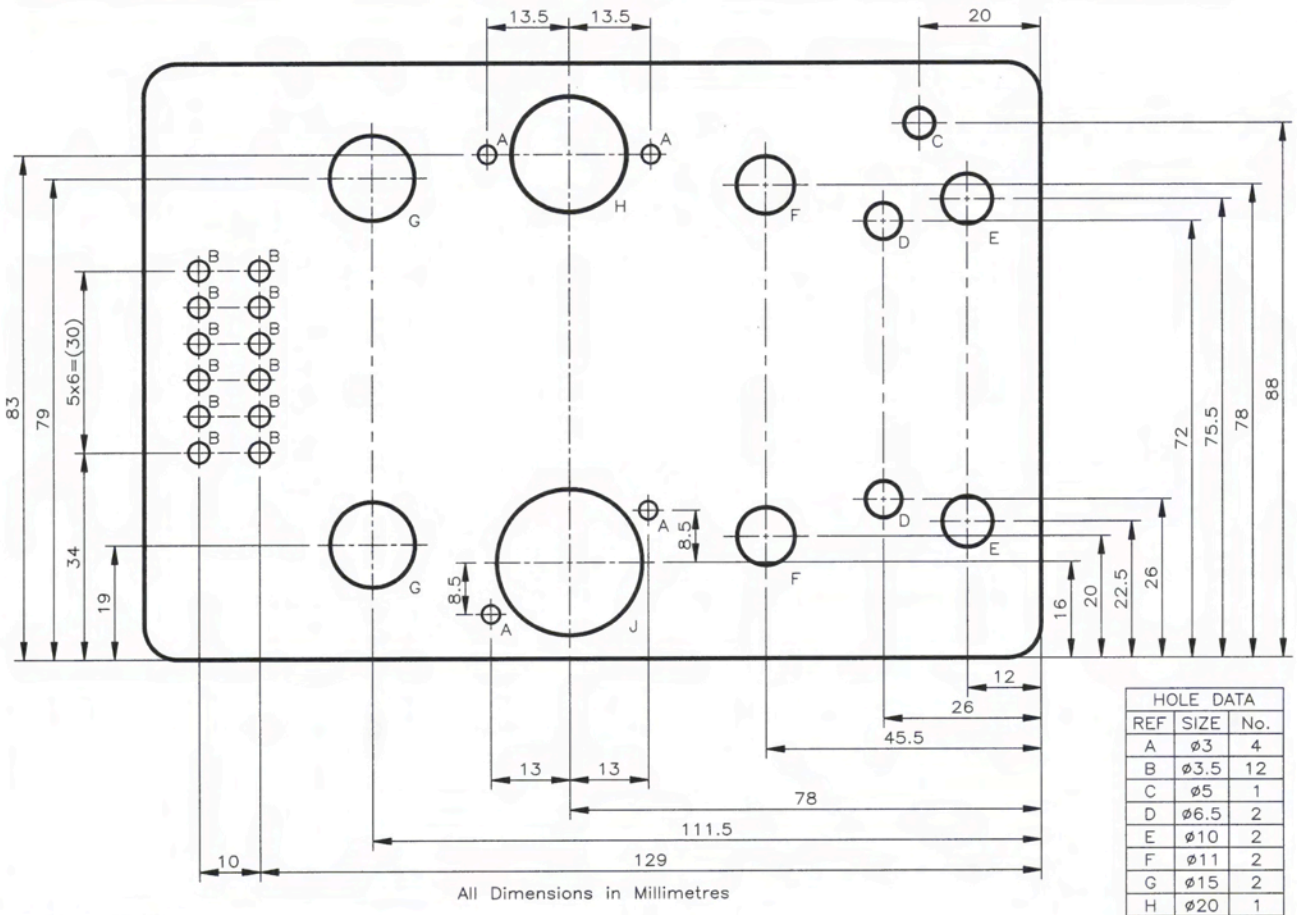


A Testing Time

It is now best to carry out the basic tests on the unit before it is housed, as this will make it easier to identify and rectify any faults. The first test is for any short circuits. Using a multimeter on the ohms range and applying the test probes either way around to the PP3 battery connector, you should read open circuit (>20MΩ). With the positive probe connected to BATT+ and the negative probe to BATT-, pressing the power button should yield a resistance of >1kΩ. If your readings disagree greatly with these, then carefully check your work for misplaced components and bad solder joints.



PCB positioned in box prior to base lid fitment.



HOLE DATA		
REF	SIZE	No.
A	ø3	4
B	ø3.5	12
C	ø5	1
D	ø6.5	2
E	ø10	2
F	ø11	2
G	ø15	2
H	ø20	1
J	ø24	1

Figure 8. Box drilling.

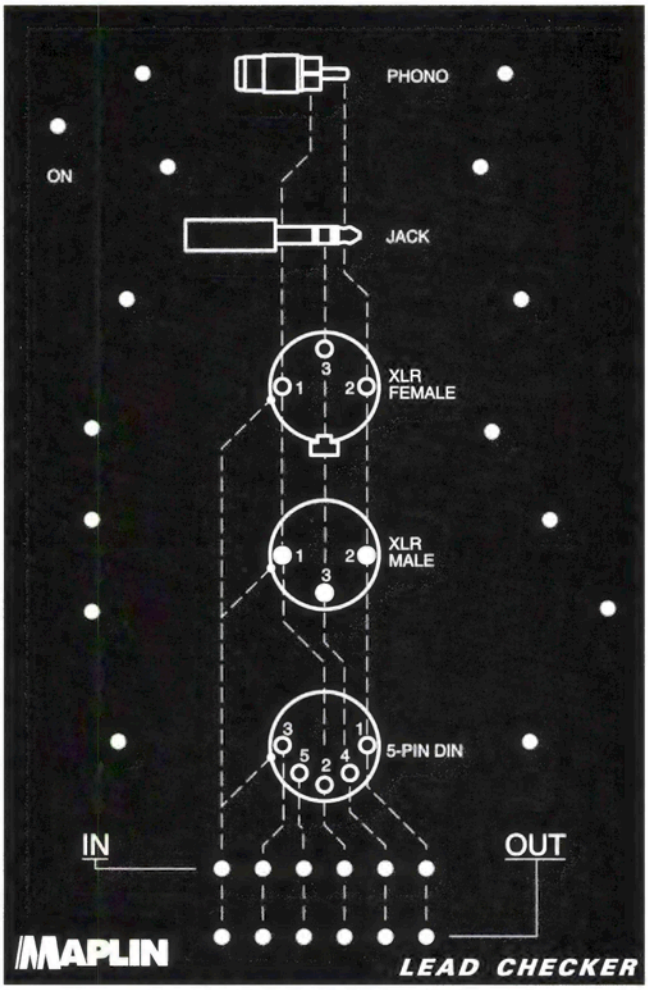


Figure 9. Audio Lead Checker label. (reduced to 90%).

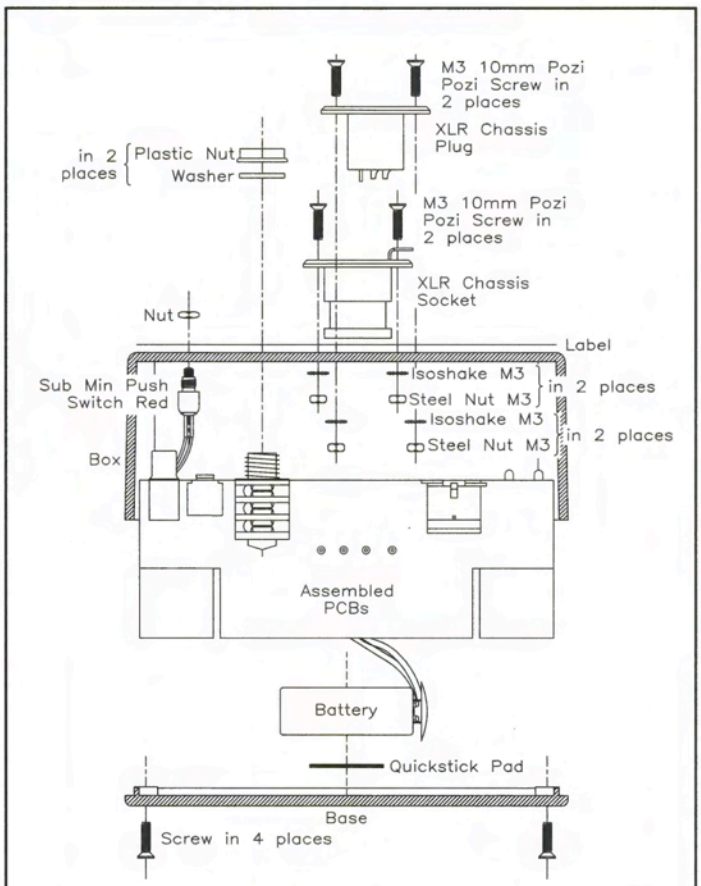
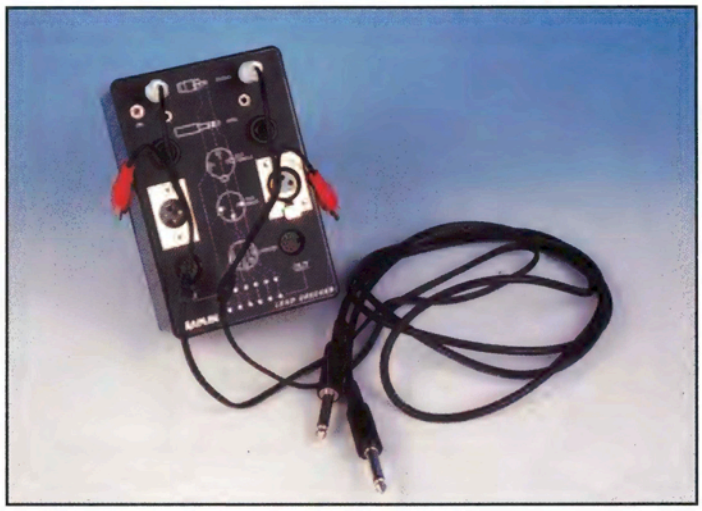


Figure 10. Exploded assembly.



necessary to use small hole punches for the ø20mm and ø24mm hole. Once these two large holes have been made, the XLR connectors can be dropped in place, enabling the positions of their fixing screws to be easily marked and drilled.

Having drilled the box, chamfered the holes to remove any burrs and removed all traces of swarf, apply the self-adhesive label, see Figure 9. The label is pre-punched and will ensure the final appearance is professional even if the holes are slightly irregular.

Using M3 hardware, fit the XLR connectors in place, followed by the push-switch. Now wire the XLR connectors to pins 1 to 4 on the Transmit and Receive PCB's, as shown in Figure 10 and Figure 11. Carefully ease the PCB into the box and fix in place with the 6·35mm Jack socket 'nuts' (omit the fibre washers). Using the supplied 'Quickstick Pad', a PP3 battery (not supplied) should now be affixed to the lid of the box – take care to ensure the battery will not foul the PCB when the box halves are brought together.

If you experience difficulty in placing the PCB in the box, check carefully for tightly trimmed component leads on connectors CN1, CN2, and sockets SK1, SK2, SK7 and SK8.

This completes the assembly and testing of the project.

On The Road

Use of the project couldn't be simpler – connect your 'cable-under-test' between a suitable 'OUT' and 'IN' connector, depress the 'ON' button and read out the connections on the two rows of LED's.
Note that the 5-pin DIN sockets will also accept 3-pin DIN plugs, and that mono jack plugs can be tested in the stereo jack sockets – just remember that the 'ring' and 'sleeve' connections will be connected.

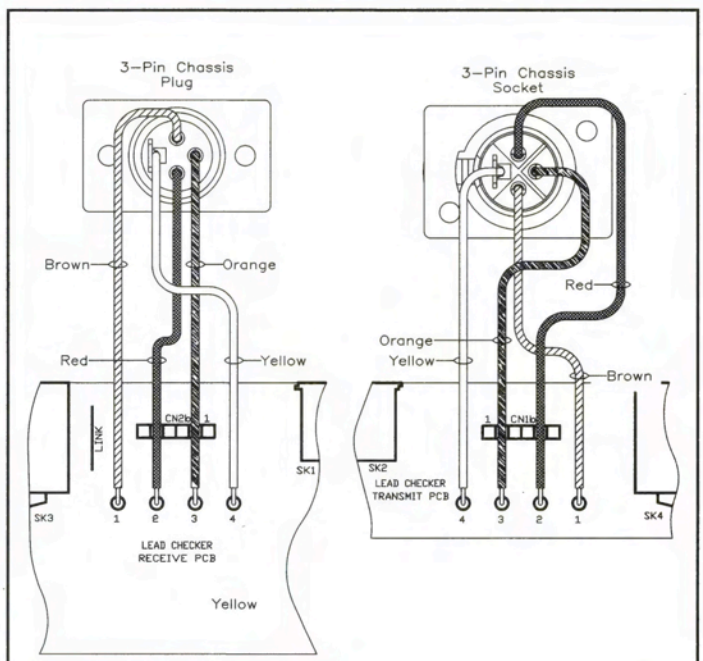


Figure 11. Wiring the XLR connectors.

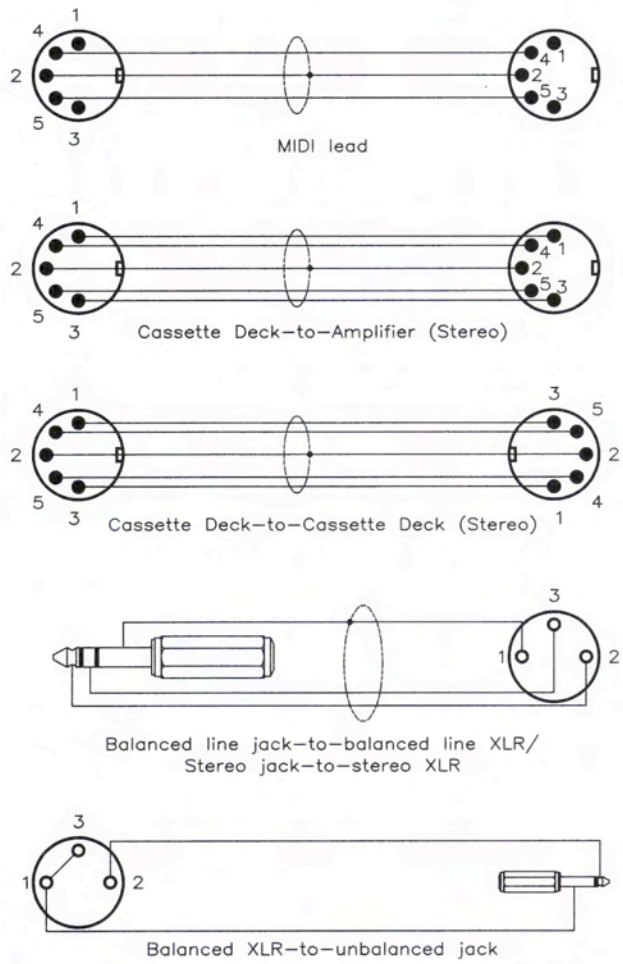


Figure 12. Wiring of common audio leads.

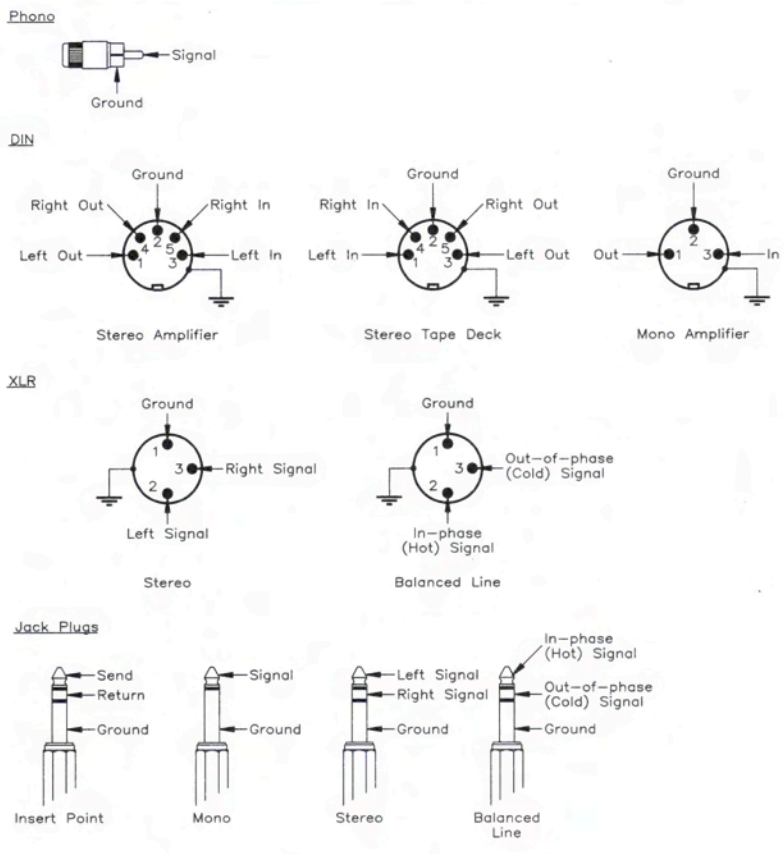


Figure 13. Pin configuration of common audio connectors.

PROJECT PARTS LIST

RESISTORS All 0·6W 1% Metal film (Unless specified)

R1-6	Min Res 10k	6	(M10K)
R7	Min Res 120k	1	(M120K)
SIL1	SIL Resistor 1k	1	(RA27E)

CAPACITORS

C1	GenElect 47uF 16V	1	(AU01B)
C2	Minidisc 0.1uF 16V	1	(YR75S)
C3	GenElect 4.7uF 50V	1	(AU05F)

SEMICONDUCTORS

IC1	HCF4017BEY	1	(QX09K)
IC2	TS555CN	1	(RA76H)
IC3	ULN 2004 A	1	(AD94C)
IC4	ULN 2003 A	1	(AD93B)
LD1-12	Mini LED Red	12	(WL32K)
D1-6	1N4148	6	(QL80B)

MISCELLANEOUS

	16-pin IC Socket	3	(BL19V)
	8-pin IC Socket	1	(BL17T)
	PP3 Battery Clip	1	(HF28F)
	Box MB5	1	(YN40T)
SK1,2	PC DIN Skt 5-pin A	2	(YX91Y)
SK3,4	Stereo PCB 1/4in Skt	2	(FJ05F)
SK5,6	PCB 3.5 Sto Sw Skt	2	(JM20W)
SK7,8	PCB Phono Skt	2	(HF99H)
PL1,2	Pin Strip 1x36 RA	0·5	(JW60Q)
	XLR Chassis Socket	1	(BW90X)
	XLR Chassis Plug	1	(BW92A)
	Pin 2145	10 Pins	(FL24B) ★
	M3 10mm Pozi Screw	4	(LR57M) ★
	Steel Nut M3	4	(JD61R) ★
	Isoshake M3	4	(BF44X) ★
	7/0.2 Wire 10M Brown	10cm	(BL02C) ★
	7/0.2 Wire 10M Red	30cm	(BL07H) ★
	7/0.2 Wire 10M Orange	10cm	(BL05F) ★
	7/0.2 Wire 10M Yellow	10cm	(BL10L) ★
	Heatshrink CP16	10cm	(BF86T) ★
	Quickstick Pads	1	(HB22Y) ★
	Sub Min Push Switch Red	1	(JM47B)
	Audio Lead Check PCB	1	(GJ65V)
	Audio Lead Check Label	1	(KV20W)
	Audio Lead Check Leaflet	1	(XZ20W)
	Constructors Guide	1	(XH79L)

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately. **Order as LU26D (Simple Audio Lead Checker) Price £19.99**

Please Note: Items in the Parts List marked with a ★ are supplied in 'package' quantities (e.g., packet, strip, reel, etc.), see current Maplin Catalogue for full ordering information.

The following new items (which are included in the kit) are also available separately.

Audio Lead Checker PCB **Order As GJ65V Price £6.99**
Audio Lead Checker Label
Order As KV20W Price £6.99