PROJECT

# Simple 4-to-1 AUDIO MIXER

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**Text by Alan Williamson and Maurice Hunt**

***The Simple 4-to-1 Audio Mixer is a functionally basic yet very useful unit that can accept up to four audio inputs and mix (combine) them into one output, with unity voltage gain (zero amplification), for feeding into an audio amplifier, tape recorder, or PA system.***

**The completed unit.**

The mixer is ideal for gigging bands who wish to easily mix the outputs from four instruments so that the resulting combined signal can be boosted via a single amplifier. The mixer also has uses in PA systems, allowing music to be combined with speech, or even for use at karaoke sessions, enabling wannabe pop singers to sing along to the backing track. The unit could additionally be used for sound recording, allowing up to four tracks/samples to be combined into one.

**PROJECT RATING** 1

**Kit Available**
Order as 95133
Price £24.99

The unit will operate from either an internal battery or an external DC supply, and indicators are incorporated to show Power On, Low Battery and Signal Overload (clipping). The kit is simple to construct, and comes complete with pre-punched, silk-screen printed front and rear panels for easy construction and a professional appearance. The specified casing, being of extruded aluminium construction, makes the completed Mixer unit extremely durable – perfect for on-stage use.

## Circuit Description

The circuit diagram of the project is shown in Figure 1. This type of mixer is known as an Inverting Summing Amplifier, which sums the input currents; it is also known as a Virtual Earth Mixer, because the inverting input is never too far away (voltage wise) from the non-inverting input, which can be treated as earth/ground with a symmetrical dual rail (+/0/–) power supply.

The mixing itself is achieved passively by the resistors R1-R4; the op-amp IC1b merely prevents the junction point (mixed end) of the resistors floating around because it has a virtual input impedance of 0Ω. Resistor R5 provides 100% feedback to cancel the input currents from the input resistors, maintaining the virtual earth input.

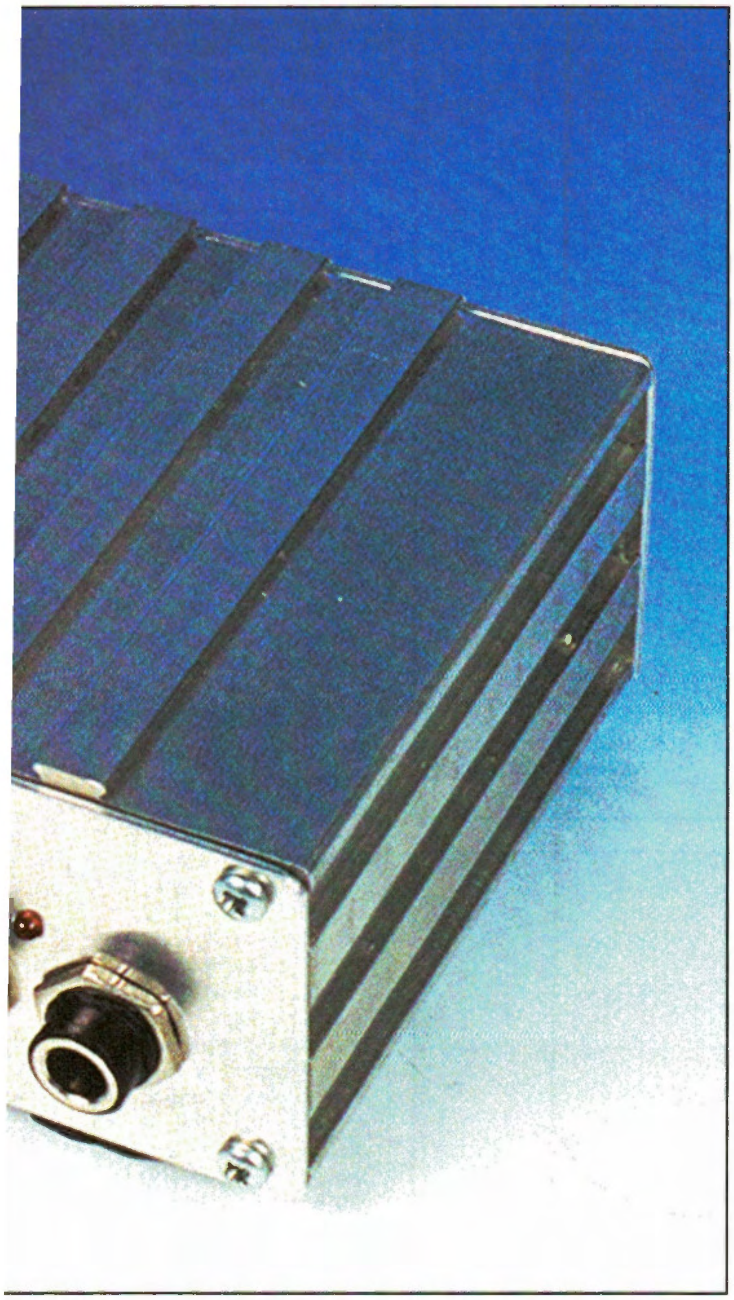
Power for the circuit can be derived from either an external DC supply via SK1 (preferably regulated) or an internal PP3 battery. Inserting a ¼in. jack plug into the 'OUTPUT' socket (SK5) will close the switch contacts, completing the supply circuit.

**FEATURES**

- Overload, power on and low battery indicators
- Pre-punched, silk-screen printed front and rear panels
- Battery or external PSU operation
- Compact and rugged construction

**APPLICATIONS**

- Gigging bands
- PA systems
- Karaoke systems



Diode D1 is normally reverse biased across the supply rails, which prevents accidental reverse polarity connections from the external PSU or battery, by clamping the reverse potential to –1V.

This is preferable to a series connected diode, where battery voltage is at a premium – maximum use of the battery must be made because they are not cheap, and the circuit cannot afford the 1V loss (with a near-exhausted battery potential of +7V) and maintain maximum signal headroom at 4V Pk-to-Pk.

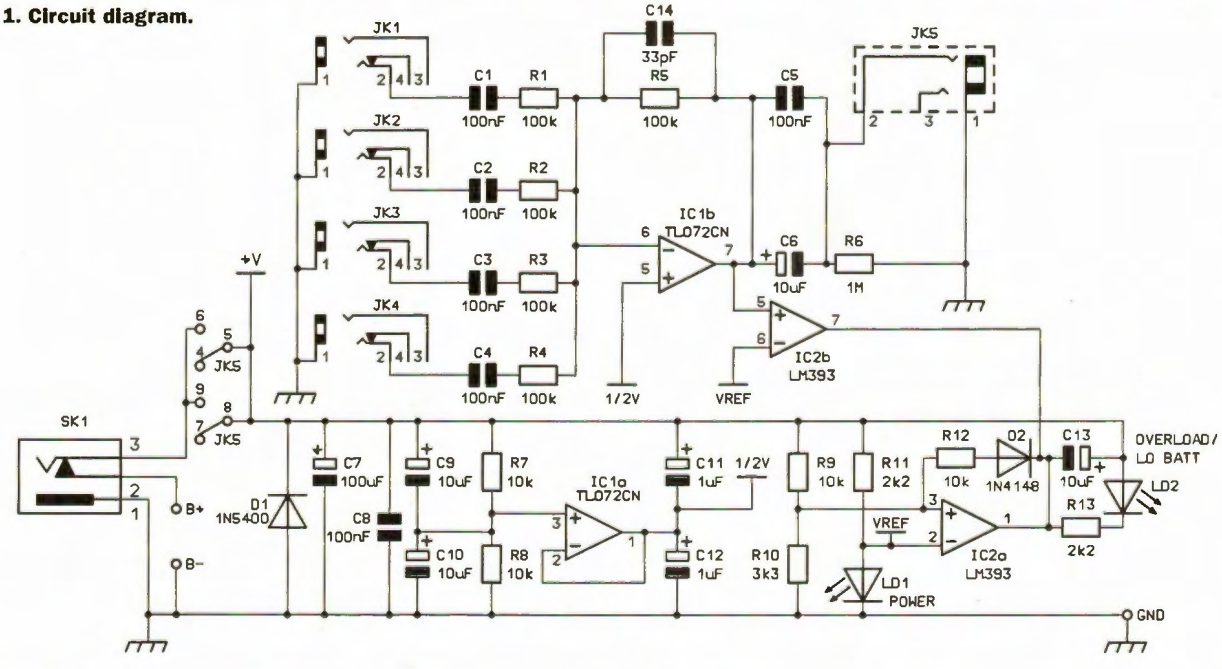
Capacitor C7 provides the main supply decoupling and C8 the high frequency decoupling. The potential divider resistors R7 & R8 form a half supply reference, symmetrically decoupled by the capacitors C9 & C10. The noise free reference is then buffered by IC1a used to generate the low impedance half supply reference ½V; the output of the op-amp is also symmetrically decoupled by C11 & C12 to improve (current) transient behaviour.

IC2 is a dual comparator, half of which is used as a low supply voltage detector; the LED LD1 not only serves as a Power On indicator, but also as a voltage reference for the (–) inverting input of the comparator. The (+) non-inverting input of the comparator is connected to a potential divider, formed by R9 & R10. When the supply voltage drops to approximately +7V, the (+) non-inverting input potential will be below the potential at the (–) inverting input. This will switch ON the comparator output, illuminating LD2 (LD2 also has a dual function, but more on this later); R12 & D2 now come in to play, which are effectively in parallel with R10, reducing the potential even further at the (+) non-inverting input of the comparator. LD1 will only extinguish when the supply voltage is raised above (approximately) +7·5V.

## SPECIFICATION

| | |
|---|---|
| Supply Voltage: | 7-15V DC (9V DC nominal); internal PP3 battery or external DC PSU |
| Current consumption: | 8·6mA @ 9V (1kΩ load); <25mA @ 15V |
| Input impedance: | ≈ 100kΩ |
| Output impedance: | ≈ 200Ω |
| Bandwidth: | 20Hz – 130kHz |
| Distortion: | <0·01% within audio bandwidth |
| PCB dimensions: | 101 × 82mm |
| Boxed unit dimensions (WHD): | 108 × 50 × 93mm |

**Figure 1. Circuit diagram.**



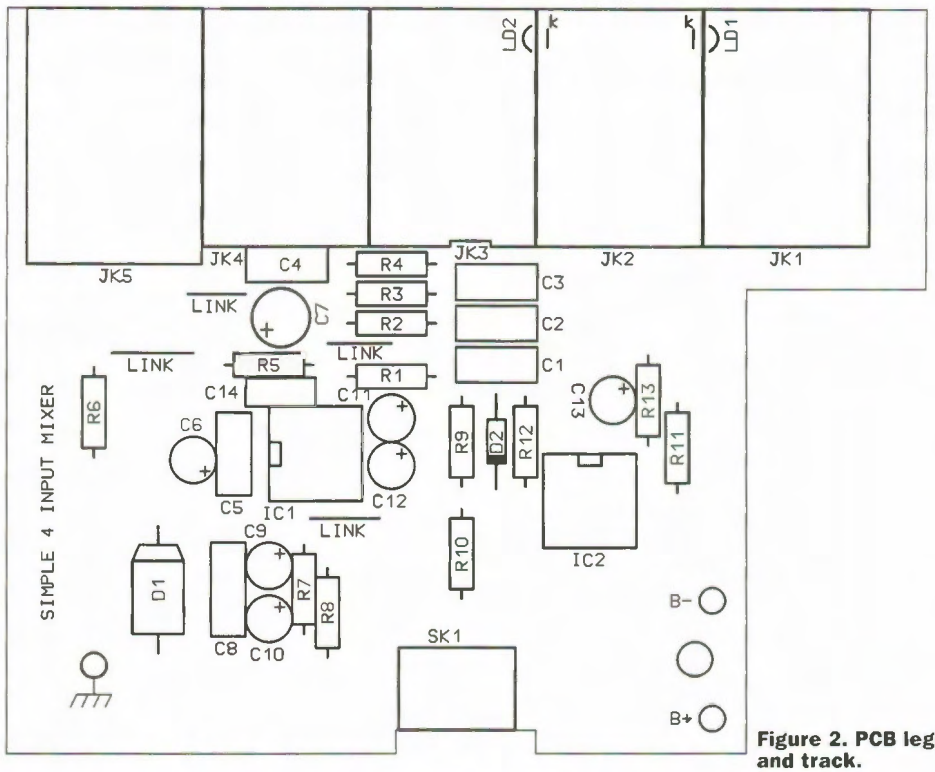



**Figure 2. PCB legend and track.**

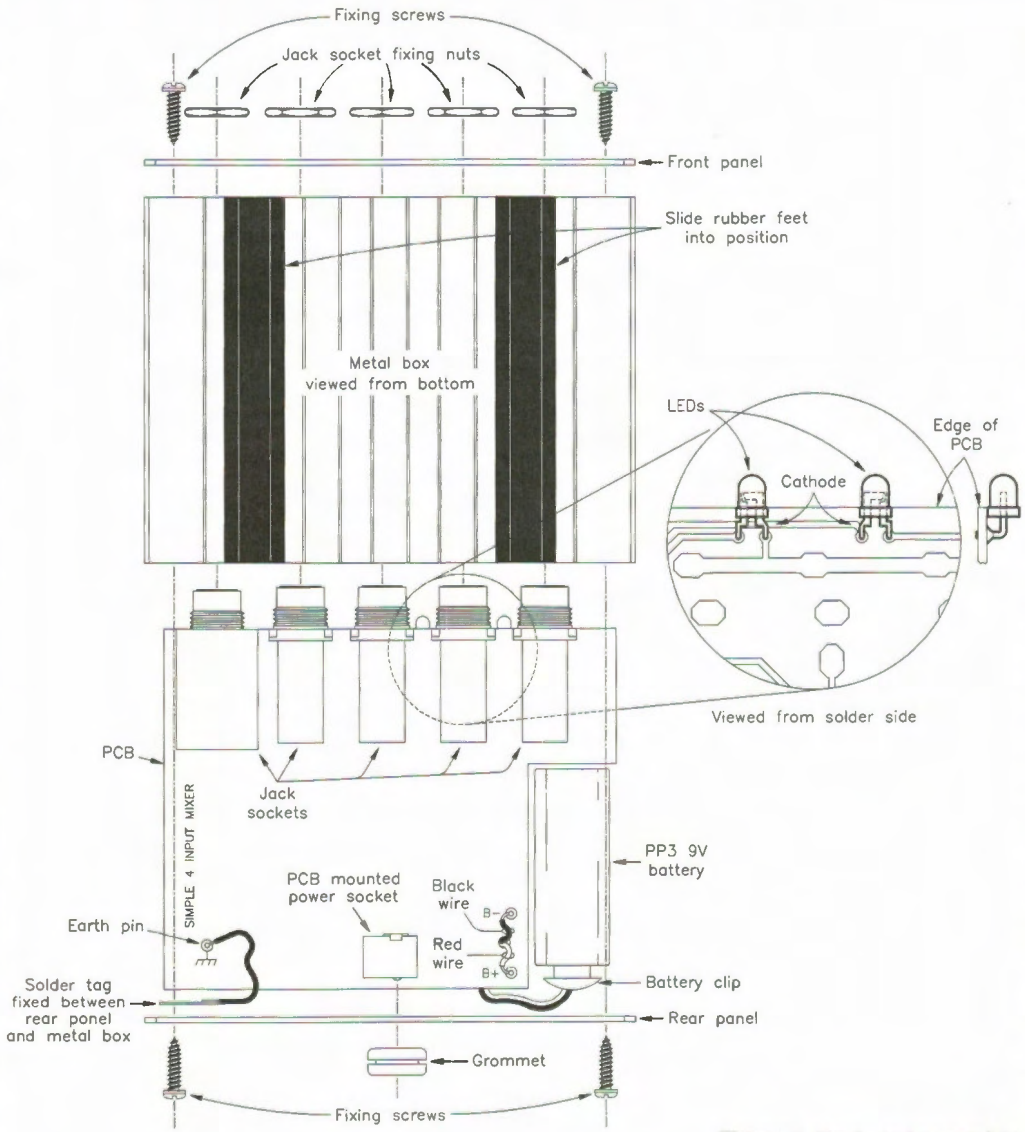



**Figure 3. Exploded assembly.**

The second half of IC2 forms a simple 'overload' or 'clipping' detector; the comparator compares the output signal from the mixer to the reference voltage (VRef) across LD1. Should the signal come within 1·8V to the ground rail, the comparator output will switch ON, illuminating LD2. However, the duration of the clipping may be very short and may not be 'seen'; adding the capacitor C13 effectively stretches the 'clip pulse' and solves the problem. The LED illuminates just before the onset of clipping, giving advance warning to reduce the input signal(s) or increase the supply voltage (up to 15V maximum), thus preventing avoidable distortion.

## PCB Construction

If you are a newcomer to electronic project building, please read the Constructors' Guide supplied with the kit for hints on soldering techniques, component identification and other information, before starting the assembly process.

Refer to the PCB legend and track diagram, shown in Figure 2. Construction is fairly straightforward, hence the low project rating. Begin with the smallest components first, working up in size to the largest. Ensure that the DIL holders are fitted so that their end notches align with those on the printed legend. Be careful to correctly orientate the polarised devices, i.e. electrolytic capacitors, diodes, LEDs and ICs; the ICs should be inserted into their sockets last of all.

Thoroughly check your work for misplaced components, solder whiskers, bridges and dry joints. Finally, clean all excess flux off the PCB using a suitable solvent.

## Case Assembly

Pre-punched front and rear panels are provided in the kit, which are silk-screen printed with the legend.

A rubber grommet (supplied) MUST be used to shroud the external power supply socket entrance hole on the rear panel, to prevent the outer ('+') terminal of the socket from shorting out on the metal casing. The positive outer terminal is used to comply

with the power supply socket standard that is used on most modern electronic music equipment/pedals.

Note that a length of moulded rubber strip is supplied in the kit, which is cut to size and can then be slid into grooves on the underside of the box to provide anti-slip/anti-rattle feet. This should be done BEFORE fitting the front and rear panels. Apply a sparing amount of rubberised adhesive (e.g. Bostik), not supplied, to the underside of the strips to permanently attach them, but ensure that the glue is fully dry before using the unit.

Before finally fitting the module into the enclosure, double-check EVERYTHING. Fit the front panel to the PCB, slide the PCB into the box, attach the battery, and fit the rear panel, not forgetting to fit the grounding wire under one fixing screw as shown in Figure 3, the exploded assembly diagram.

## Testing

The best way to test the unit is to use it! However, if you have a variable power supply, a signal generator and an oscilloscope, it is worthwhile bench testing it before taking it to a gig.

Refer to Figure 4, showing the typical application wiring diagram for the project.

Set the PSU to +9V and current limit at 0·5A, then connect to the external power socket, SK1 (NOTE, the centre pin of the connector is (–) negative); both LEDs should be extinguished. Insert a jack plug into the 'Output' socket, the 'Power On' LED (LD1) should illuminate; reduce the supply voltage until the 'Low Batt/Clipping' LED (LD2) illuminates, which should be at approximately +7V.

Apply a 4V Pk-to-Pk signal (or if you prefer, a 1·414Vrms or +3dBV) to any input (try them all) and monitor the output; the signal should be just on the edge of clipping.

Slowly increase the supply voltage to +9V, LD1 should extinguish at approximately +7·5V; there should also be a little more signal headroom. If you have a second signal generator, try mixing two different frequency and amplitude signals together.

Please note that the Mixer inverts the input signal(s).

The Simple 4-to-1 Audio Mixer has now been fully tested and is ready for use. Two Mixer units can be used if a stereo mixing system is required, and the specified casings can be interlocked. ELECTRONICS

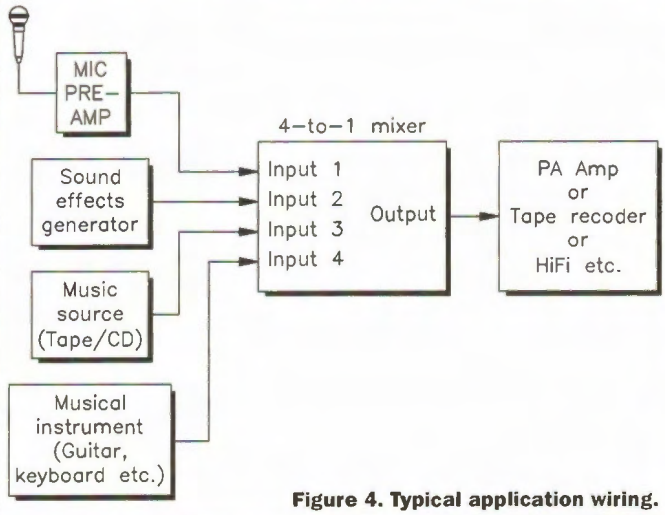
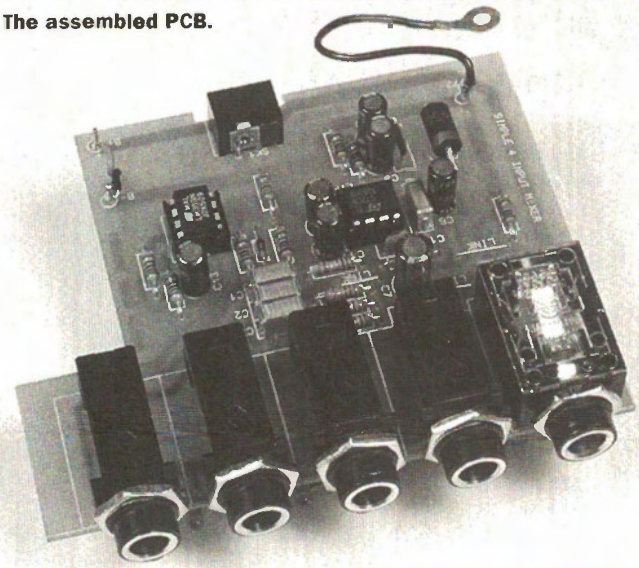



**Figure 4. Typical application wiring.**

**The assembled PCB.**



## PROJECT PARTS LIST

**RESISTORS: All 0·6W 1% Metal Film**

| | | | |
|---|---|---|---|
| R1-5 | 100k | 5 | (M100K) |
| R6 | 1M | 1 | (M1M) |
| R7-9,12 | 10k | 4 | (M10K) |
| R10 | 3k3 | 1 | (M3K3) |
| R11,13 | 2k2 | 2 | (M2K2) |

**CAPACITORS**

| | | | |
|---|---|---|---|
| C1-5 | 100nF Polyester Layer | 5 | (WW41U) |
| C6,9,10,13 | 10µF 63V Radial Electrolytic | 4 | (AT77J) |
| C7 | 100µF 16V Radial Electrolytic | 1 | (AT40T) |
| C8 | 100nF 16V Ceramic Disc | 1 | (YR75S) |
| C11,12 | 1µF 63V Radial Electrolytic | 2 | (AT74R) |
| C14 | 33pF Ceramic Disc | 1 | (WX50E) |

**SEMICONDUCTORS**

| | | | |
|---|---|---|---|
| D1 | 1N5400 | 1 | (QL81C) |
| D2 | 1N4148 | 1 | (QL80B) |
| LD1,2 | Miniature Red Low Current (2mA) LED | 2 | (CZ28F) |
| IC1 | TL072CN | 1 | (RA68Y) |
| IC2 | LM393N | 1 | (UH30H) |

**MISCELLANEOUS**

| | | | |
|---|---|---|---|
| JK1-4 | PCB-mounting ¼in. Switched Mono Jack Socket | 4 | (CX89W) |
| JK5 | PCB-mounting ¼in. Switched Stereo Jack Socket | 1 | (FJ87U) |
| SK1 | PCB-mounting Power Socket | 1 | (RK37S) |
| | 8-pin DIL Socket | 2 | (BL17T) |
| | Aluminium Box Type CCN80 | 1 | (YN50E) |
| | PP3 Clip | 1 | (HF28F) |
| | 1mm PCB Pin | 1 Pkt | (FL24B) |
| | 6·4mm Standard Grommet | 1 Pkt | (JX65V) |
| | M3 Solder Tag | 1 Pkt | (LR64U) |
| | Rubber Foot | 1m | (XR93B) |
| | 7/0·2mm Green Hook-up Wire | 1 Pkt | (BL03D) |
| | PCB | 1 | (95134) |
| | Front Panel | 1 | (95135) |
| | Rear Panel | 1 | (95186) |
| | Instruction Leaflet | 1 | (XZ26D) |
| | Constructors' Guide | 1 | (XH79L) |

**OPTIONAL**

| | | | |
|---|---|---|---|
| | PP3 Battery | 1 | (JY49D) |
| | 9V Regulator | 1 | (BZ84F) |

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 95133 (Simple 4-to-1 Audio Mixer) Price £24.99**

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.

Simple 4-to-1 Audio Mixer PCB **Order As 95134 Price £3.49**

Simple 4-to-1 Audio Mixer Front Panel **Order As 95135 Price £2.69**

Simple 4-to-1 Audio Mixer Rear Panel **Order As 95186 Price £1.99**