

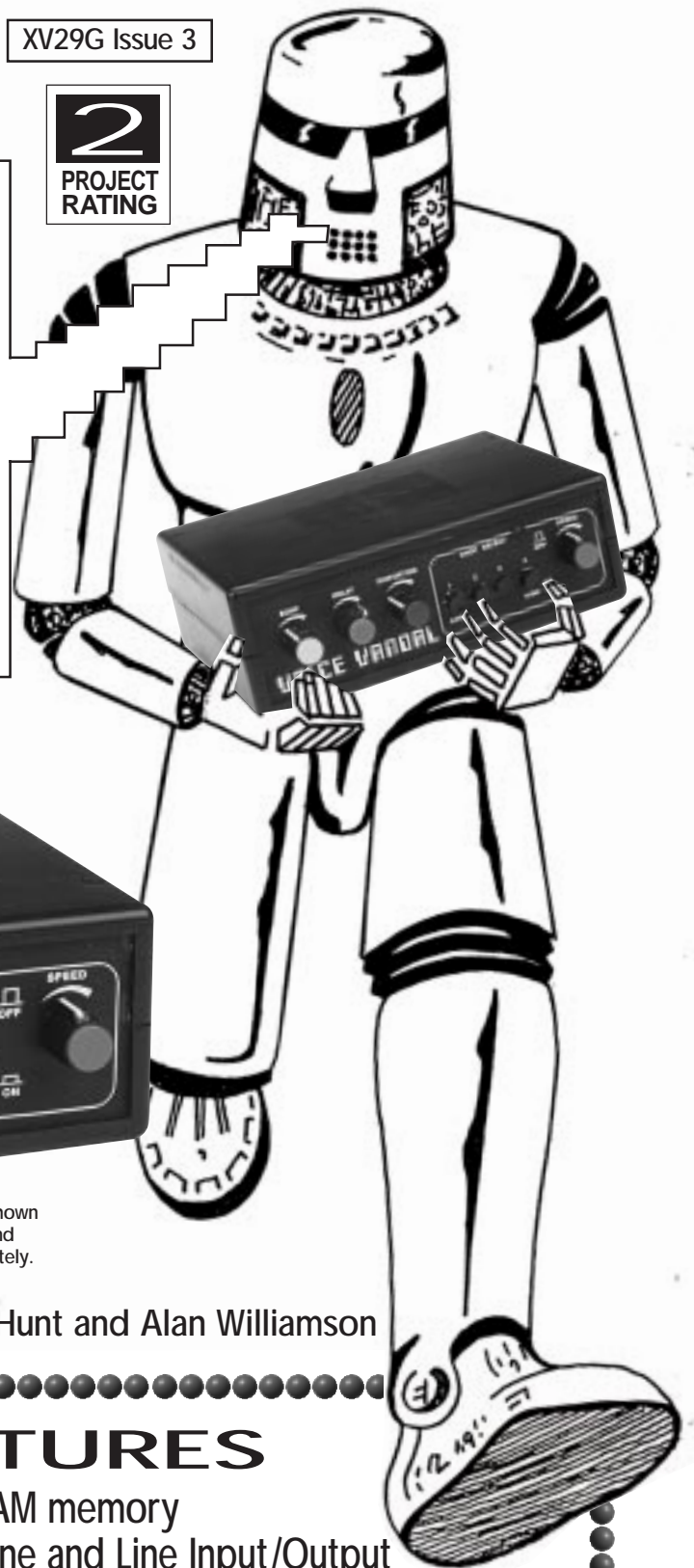
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PROJECT
RATING

"Here is a project to enthrall fans of film and TV 'characters' that appeared in series of Dr Who, Metal Mickey, Red Dwarf and others featuring distorted voices. You too can now imitate the Daleks, Chewbakka, et al, without straining your voice, by building the

VOICE VANDAL



Please note that the box shown is not included in the kit and must be purchased separately.



Design by Alan Williamson, Text by Maurice Hunt and Alan Williamson

DESCRIBED here is an audio signal distortion unit, that will take the audio signal from a microphone and/or line input, and by means of digital sound processing, selective clipping and storage and feedback of 'sound bites', will alter the original sound, by a widely adjustable level, ranging from a subtle change in pitch to a barely recognisable, completely altered form, and with the option of echo repetition of the resultant noise.

This will be a boon for anyone requiring a wide spectrum of special sound effects from one inexpensive, versatile unit, either for 'serious' use in productions, etc., or just for laughs.

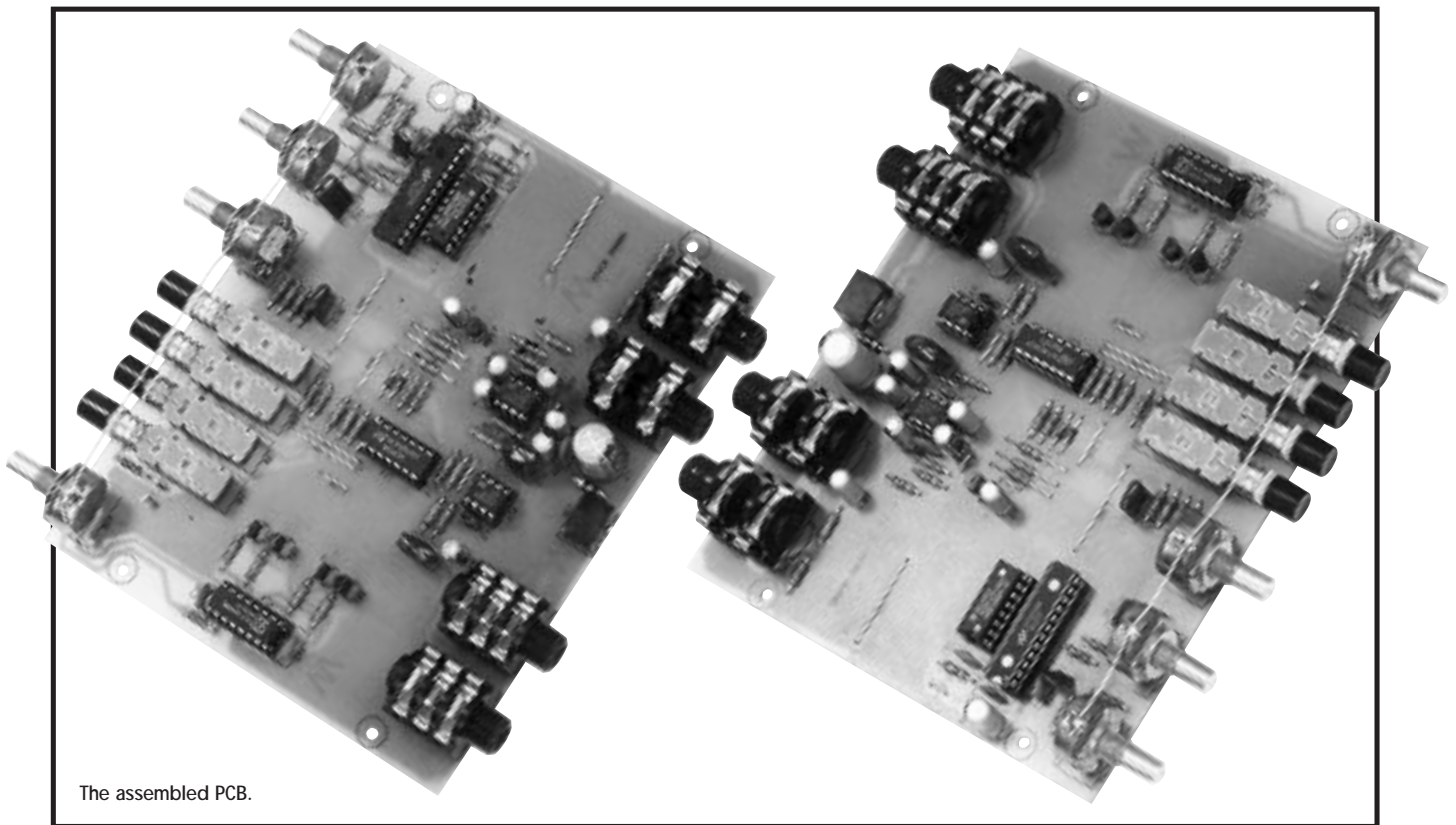
With both microphone and line inputs/outputs, the unit also enables simple mixing of signals from more than one source, so that, for example, soundtracks from films, music albums, etc., could be altered to suit your requirements. This provides scope for much amusement – just imagine what you could do to 'improve' that awful album or

FEATURES

- * 256K DRAM memory
- * Microphone and Line Input/Output
- * Digital Audio Signal Delay Processor
- * Low Current Consumption * Easy to Build/Use

APPLICATIONS

- * Echo generator * Party entertainment/general amusement
- * Sound effects for models/toys * DJ/Public Address systems
- * Sound effects for dramatics or film use * Simple mixer



The assembled PCB.

video that you would not readily admit to paying good money for, or why not liven up the next party political broadcast with some wacky distortion of the speaker's ramblings!

The output signal of the unit, via microphone and line outputs, can be fed into a suitable audio amplifier for immediate listening, or into the input of a tape recorder, etc., to allow replaying of your audio creativity.

Circuit Description

The full block diagram of the Voice Vandal is given in Figure 1, with the circuit diagram shown by Figure 2. Studying these should assist in following the circuit description, or with fault-finding if necessary, in the completed unit.

The heart of the circuit is IC5, a Holtek HT-8955A, which is a dedicated Voice Echo chip, or CMOS digital audio signal delay processor. This is an LSI device containing preamplifier, system and time-delay oscillators, DRAM interface, 10-bit A/D and D/A converters and control logic, A/D converter correction comparator, shift register, timebase generator, row/column multiplexer, address counter, and, last but not least, a DRAM size selector section.

Working in conjunction with an external 256K DRAM (IC6), this provides a continuously adjustable delay time of up to several seconds, and operates in the following manner: resistors R27 and R28 set the gain of the built-in input op amp at -2.13 , the output of which is fed to the A/D converter correction comparator and also the output amplifier, IC1b.

The comparator supplies the A/D converter, whereupon the digital output is fed serially, after a short delay (determined by RV4) into the shift register, which then presents a parallel 'word' to the D/A converter; the resulting analogue signal output from pin 4 is then fed back into the input op amp via C20, R29 and RV3, which

produces the 'echo' effect, the level of echo being controlled by RV3.

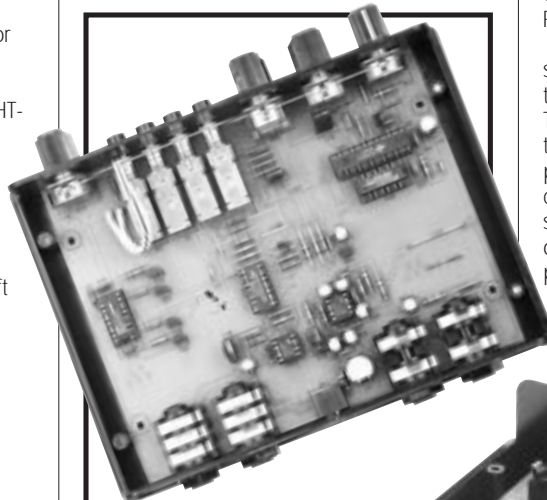
The final mixed signal is taken from pin 3, and is buffered and amplified by IC1b, whose gain is equal to $R37/R38 + 1$, in this case, a gain of 3-13.

IC1a and associated components form a 'half supply generator', whereby resistors R1 and R2 produce the voltage reference for IC1a, whilst capacitors C3 to C6 symmetrically decouple the input and output of IC1a to the supply rails. Capacitors C9 and C10 provide AC coupling of the input signals

to the inverting amplifier, IC2a, the gain of which is set by resistors R3 to R5, according to the formula, $G = -R5/R3$ (or R4); gains of -1 or -10 , respectively.

Diodes D2 and D3 clip the output waveform of IC2a, to produce a signal rich in harmonics (akin to a fuzz box). This signal is then applied to the inputs of IC3, a quad CMOS analogue switch. The signal is then 'chopped' by turning the four solid-state switches on and off with the aid of TR1 to TR4, controlled by IC4, a 14-stage divider and oscillator, the rate of switching being determined by the timing components, RV1, R15 and C12.

The 'chopped' waveforms are then selected via the latch switches, S1 to S4, the signals being recombined via R20 to R23. The reconstituted signal is then passed on to the 'distortion' control, dual-ganged mixing potentiometer RV2, and the 'clipped and chopped' signal combines with the direct signal from IC2a via R25 and R26; the ratio of mixing is dependent on the wiper position of RV2.



PCB mounted in the casing.



Voice Vandal

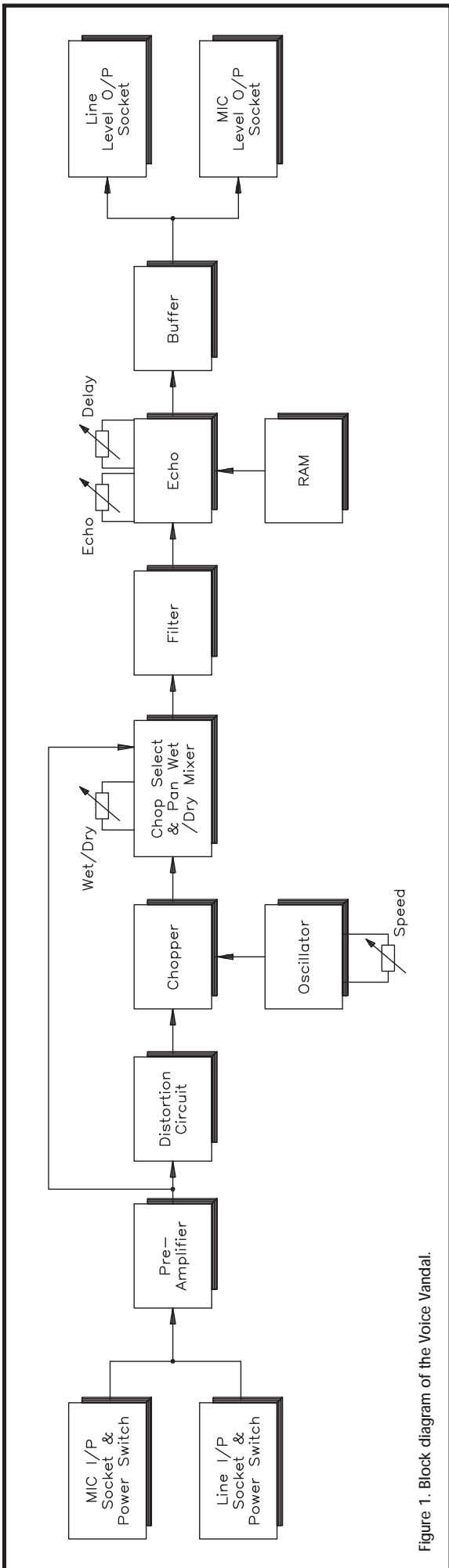


Figure 1. Block diagram of the Voice Vandal.

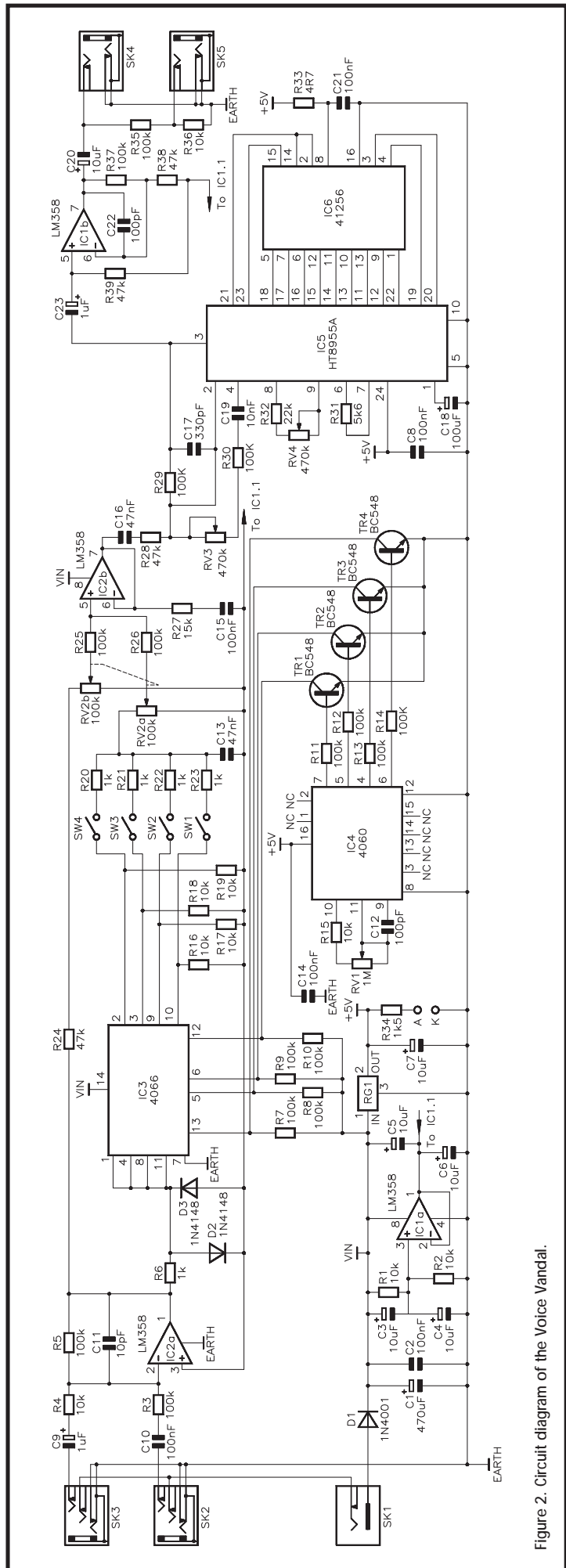


Figure 2. Circuit diagram of the Voice Vandal.

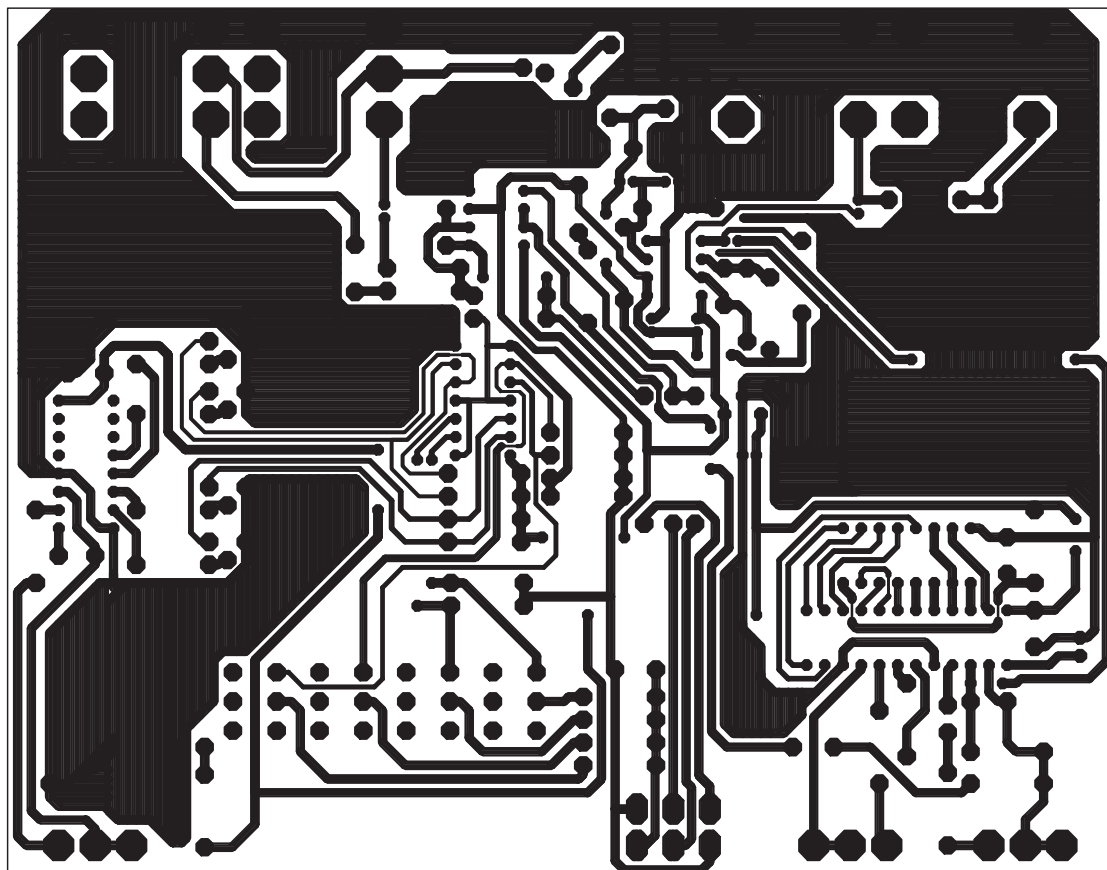
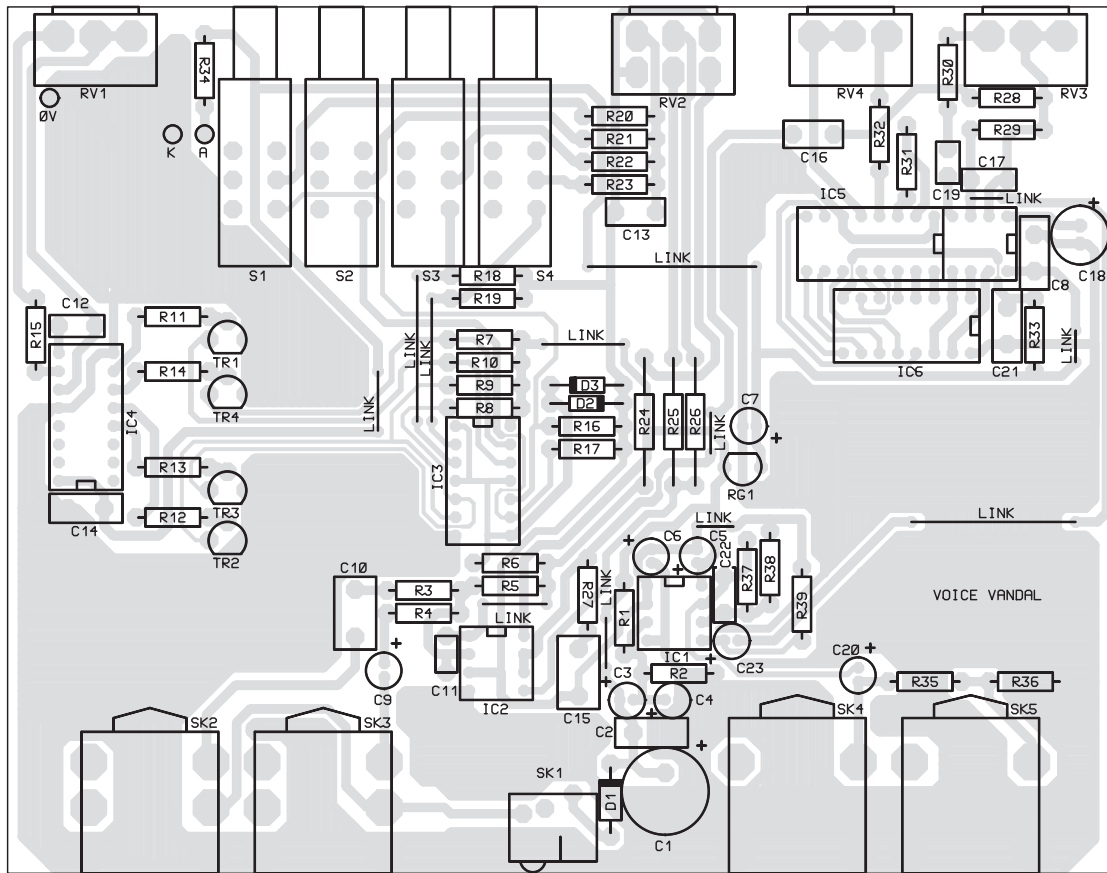


Figure 3. PCB legend and track.

There are several filters within the circuit, a combination of high- and low-pass types, to produce an overall band-pass response of approximately 100Hz to 3kHz between -3dB points. The low-pass filters consist of C13 in conjunction with the combined impedance of the resistive mixer network, C15 and R27, and C17 and R29, whilst the high-pass filter is effected by C16 and R28, on the output of IC2b. The input filters formed by C9 and R4, or C10 and R3, and C11 and R5, reduce the out-of-band gain of IC2a.

RG1 is a 5V regulator that supplies power to IC5 and IC6, which are 5V devices, and it also provides a constant supply voltage to IC4, preventing oscillator drift that would otherwise result from supply variations. The remaining circuitry is happy to operate at the applied power supply voltage, which may be between 8V and 18V DC. The relatively high lower voltage limit is the reason why a 9V battery is not used as a power supply, as a slight drop in battery strength would prevent the unit working properly. An LED, LD1, gives visual confirmation of supply connection.

Construction

PCB Assembly

This is fairly straightforward: refer to the Parts List, circuit diagram of Figure 2, and PCB legend and track of Figure 3. Begin with the

Specification

DC power supply voltage: Single-rail supply via power socket, 8 to 18V DC, LED indication of supply
 Supply current (typical): 19mA
 PCB dimensions: 155 × 120mm
 Case dimensions: 175 × 130 × 58mm
 Functions: Echo, Delay, Distortion, Chopping level and speed adjustment
 DRAM memory: 256K (262,144 × 1 bits)

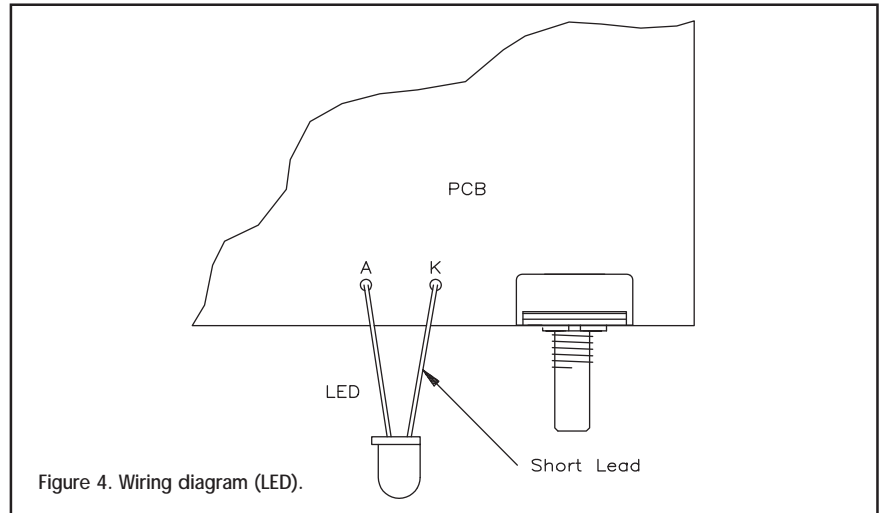


Figure 4. Wiring diagram (LED).

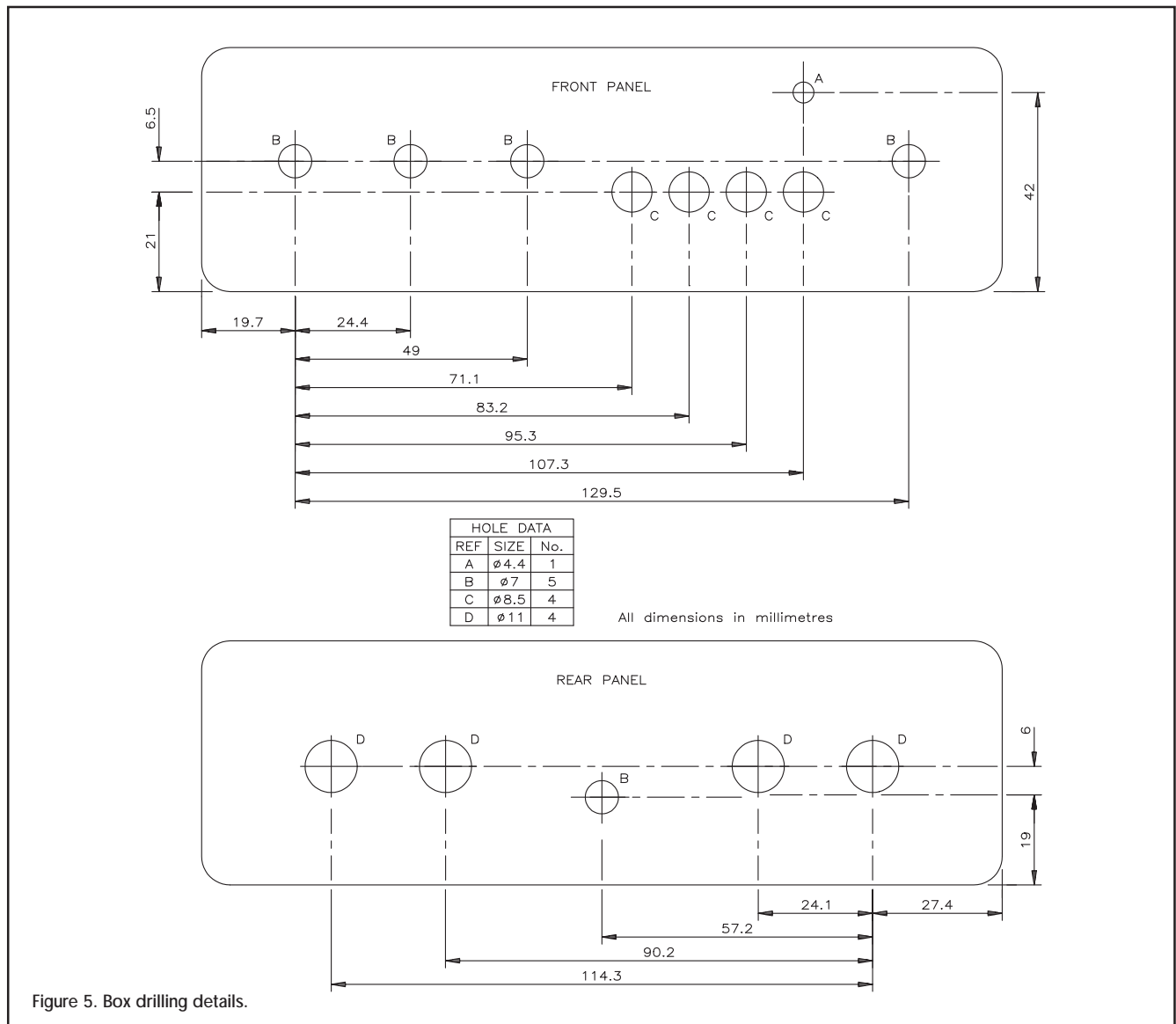


Figure 5. Box drilling details.

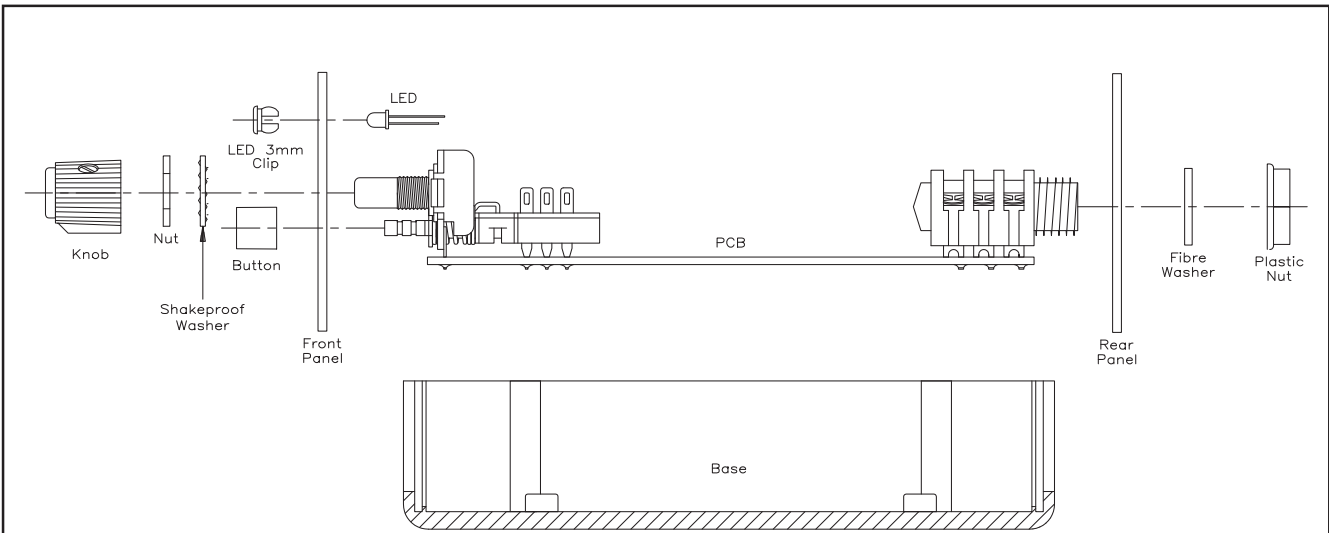


Figure 6. Exploded Assembly.

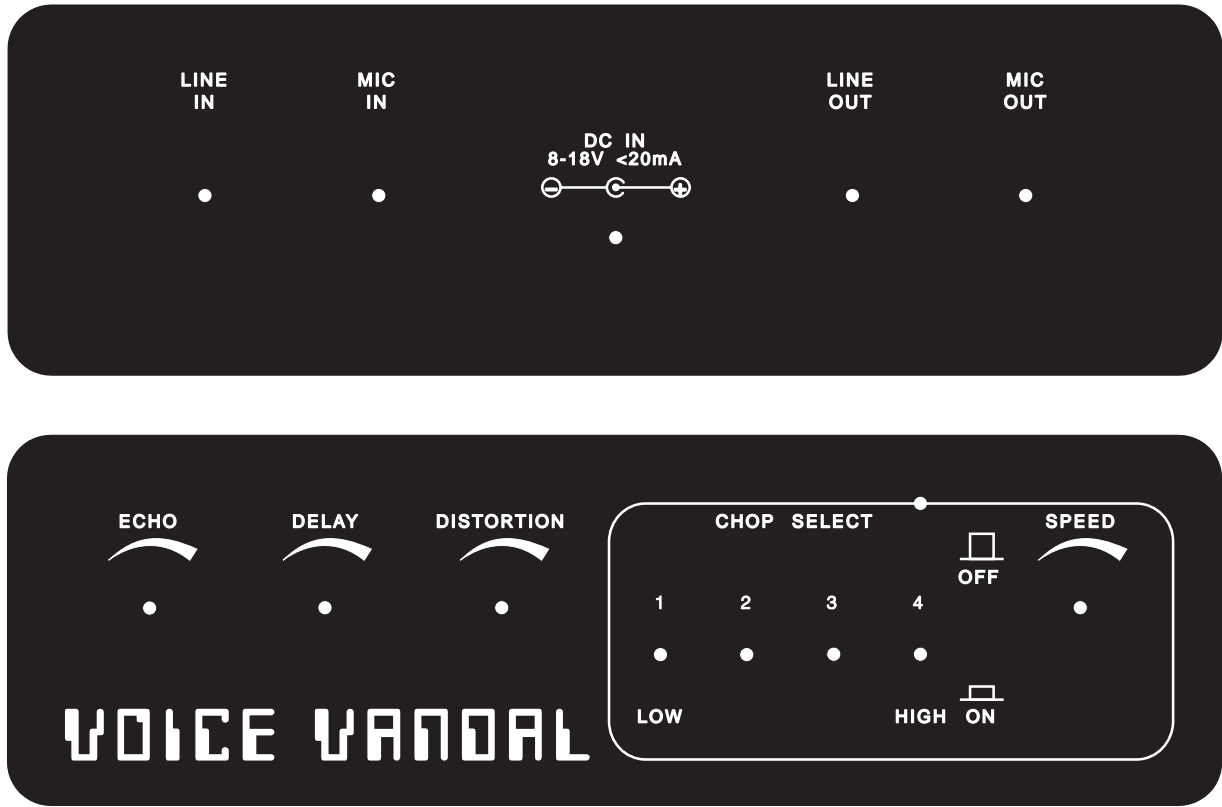


Figure 7. Voice Vandal front and rear panel labels.

smallest components, working up in size to the largest.

If you are new to project construction, please refer also to the Constructor's Guide (XH79L) for hints and tips on soldering and assembly techniques.

22swg tinned copper wire should be used for the long links, whilst component lead offcuts can be used for the shorter wire links.

Insert the PCB pins from the track side, there being three required: one for the potentiometer casing earth link – use a length of 22swg tinned copper wire (approximately 16cm) soldered to, and spanning the uppermost part of the potentiometer's metal bodies (once the

potentiometers have first had their spindles cut to the right length – 9mm, for the knobs supplied in the kit – and then soldered in place on the PCB), prior to joining the PCB pin – and two pins to which are attached the short interconnecting cables to the LED, see Figure 4 – twin core bell ('Zip') wire, approximately 5cm long is suitable here. Take care to correctly orientate polarised devices, such as electrolytic capacitors, diodes, transistors 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. When the PCB has been fully built up, clean all the flux off using a suitable solvent.

Case Assembly

Refer to Figure 5 for the box drilling details, noting that the recommended box has slide-out front and rear panels to enable easier drilling. With the holes drilled and chamfered to remove burrs, the front and rear panel labels can be applied, and the marked hole positions punched through with a pointed instrument, being careful not to damage the labels. The LED bezel can then be fixed into its aperture in the front panel, a simple push-fit. Before fitting the front panel, ensure that the holes drilled for the push switches allow them to operate without sticking.

Next, secure the front panel with the potentiometer nuts, then secure the rear

panel with the jack socket nuts, ensuring the panels are the correct way up!

This sub-assembly should then slide into the lower box section along the panel tracks. Ensure that the LED is connected and mounted in the front panel correctly, and then slide the upper section (lid) of the box onto the exposed half of the panels. Four screws, supplied with the box, are used to secure the sections of the box. A look at Figure 6, showing the exploded view of the unit, will assist in this process.

The only remaining assembly job is to affix the knobs onto the potentiometer spindles, by means of the grub screws, in the colour order of your own preference.

Testing

Except for connecting the unit up with a microphone input and output to an audio amplifier and seeing if wild voice distortions can be produced, the only testing that can be readily carried out, having connected a suitable power supply via the power socket, is to plug in a connecting lead terminated in a 1/4in. mono plug, to either the line or microphone input sockets, and ensure that the LED lights when the plug is pushed

home, indicating that the unit is on (the LED should extinguish with input leads removed).

A multimeter can be used to check that the voltage regulator, RG1, is providing a stable 5V supply to IC4 to IC6, and that the other ICs are receiving the supply voltage (i.e. between 8V and 18V DC) at their supply pins.

An oscilloscope, or earpiece, could be used to confirm that IC4 is providing

oscillatory signals, with differing frequencies at its divider outputs.

Other than these tests, check for any components getting warm or smoking hot, a fair indication that all is not well!

Operation

The operation of the device is straightforward, connect a microphone and/or line source via the appropriate input sockets, via leads terminated in 1/4in. mono jack plugs, and connect the appropriate output to an audio amplifier, tape recorder, etc., via leads having 1/4in. mono jack plugs. With the power supply connected, speaking into the microphone or providing other audio input (!) and trying out different settings of the potentiometers and combinations of the control switches, should result in some very alternative output sounds being produced!

The variety of sound effects obtainable from the unit is too wide to describe here, so it is up to you to experiment and make your own notes, if you wish, on how to produce certain sound effects.

Alternatively, just twiddle the knobs and make noises as you see fit!



The rear of the completed unit.

VOICE VANDAL PARTS LIST

RESISTORS: All 0.6W 1% Metal Film

| | | | | | |
|------------------|-----------------------------------|----|---------|-------|--|
| R1,2,4,15-19,36 | 10k | 9 | (M10K) | SK4,5 | |
| R3,5,7-14,25,26, | | | | S1-4 | |
| 29,30,35,37 | 100k | 16 | (M100K) | | |
| R6,20-23 | 1k | 5 | (M1K) | | |
| R24,28,38,39 | 47k | 4 | (M47K) | | |
| R27 | 15k | 1 | (M15K) | | |
| R31 | 5k6 | 1 | (M5K6) | | |
| R32 | 22k | 1 | (M22K) | | |
| R33 | 4.7 | 1 | (M4R7) | | |
| R34 | 1k5 | 1 | (M1K5) | | |
| RV1 | 1M Miniature Linear Potentiometer | 1 | (JM76H) | | |
| RV2 | 100k Miniature Dual Linear Pot | 1 | (JM82D) | | |
| RV3,4 | 470k Miniature Linear Pot | 2 | (JM75S) | | |

CAPACITORS

| | | | | | |
|------------|-------------------------------|---|---------|--|--|
| C1 | 470µF 35V Electrolytic Radial | 1 | (FF16S) | | |
| C2,8,14,21 | 100nF 50V Ceramic Disc | 4 | (BX03D) | | |
| C3-7,20 | 10µF 50V Electrolytic Radial | 6 | (FF04E) | | |
| C9,23 | 1µF 100V Electrolytic Radial | 2 | (FF01B) | | |
| C10,15 | 100nF Mylar Film | 2 | (WW21X) | | |
| C11 | 10pF Ceramic Disc | 1 | (WX44X) | | |
| C12,22 | 100pF Ceramic Disc | 2 | (WX56L) | | |
| C13,16 | 47nF Mylar Film | 2 | (WW20W) | | |
| C17 | 330pF Ceramic Disc | 1 | (WX62S) | | |
| C18 | 100µF 25V Electrolytic Radial | 1 | (FF11M) | | |
| C19 | 10nF Mylar Film | 1 | (WW18U) | | |

SEMICONDUCTORS

| | | | | | |
|-------|-----------------------------------|---|---------|--|--|
| D1 | 1N4001 | 1 | (QL73Q) | | |
| D2,3 | 1N4148 | 2 | (QL80B) | | |
| TR1-4 | BC548 | 4 | (QB73Q) | | |
| RG1 | LM78L05ACZ 5V Voltage Regulator | 1 | (QL26D) | | |
| LD1 | Low Current Miniature 3mm Red LED | 1 | (CZ28F) | | |
| IC1,2 | LM358N | 2 | (UJ34M) | | |
| IC3 | HCF4066BEY | 1 | (QX23A) | | |
| IC4 | HCF4060BEY | 1 | (QW40T) | | |
| IC5 | HT8955A Voice Echo IC | 1 | (AE14Q) | | |
| IC6 | 41256 100ns 256K DRAM | 1 | (QY74R) | | |

MISCELLANEOUS

| | | | | | |
|-------|-------------------------------|---|---------|--|--|
| SK1 | PCB 2.5mm DC Power Socket | 1 | (FK06G) | | |
| SK2,3 | Stereo PCB 1/4in. Jack Socket | 2 | (FJ05F) | | |

| | | |
|------------------------------------|----------|----------|
| Mono PCB 1/4in. Jack Socket | 2 | (FJ00A) |
| Latchswitch 2-Pole | 4 | (FH67X) |
| Single-ended PCB Pin 1mm (0.04in.) | 3 | (FL24B)★ |
| DIL Socket 8-pin | 3 | (BL17T) |
| DIL Socket 14-pin | 1 | (BL18U) |
| DIL Socket 16-pin | 3 | (BL19V) |
| Zip Wire | 1 length | (XR39N)★ |
| Tinned Copper Wire | | |
| 0.71mm 22swg | 1 length | (BL14Q)★ |
| Front and Rear Panel Labels | 1 | (KP83E) |
| PCB | 1 | (GJ09K) |
| Instruction Leaflet | 1 | (XV29G) |
| Constructors' Guide | 1 | (XH79L) |

OPTIONAL (Not in Kit)

| | | |
|---|-------|---------|
| ABS Plastic Instrument Case | 1 | (KC61R) |
| Small Black Latchswitch Button | 4 | (KU75S) |
| LED Clip 3mm | 1 | (YY39N) |
| Knob RN15 Blue | 1 | (FD65V) |
| Knob RN15 Green | 1 | (FD66W) |
| Knob RN15 Red | 1 | (FD67X) |
| Knob RN15 Yellow | 1 | (FD68Y) |
| Square Stick-on Feet | 1 Pkt | (FD75S) |
| AC Adaptor Regulated | 1 | (YB23A) |
| Low-Cost Dynamic Microphone | 1 | (ZA31J) |
| 1/4in. Stereo Plug to 3.5mm Mono Socket Adaptor | 1 | (YW34M) |

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 LT82D (Voice Vandal)

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.

PCB Order As GJ09K
Front and Rear Panel Labels Order As KP83E



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