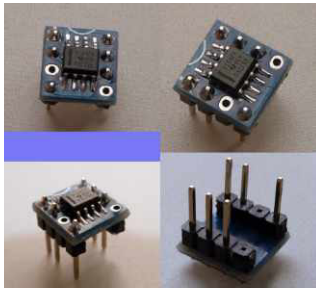
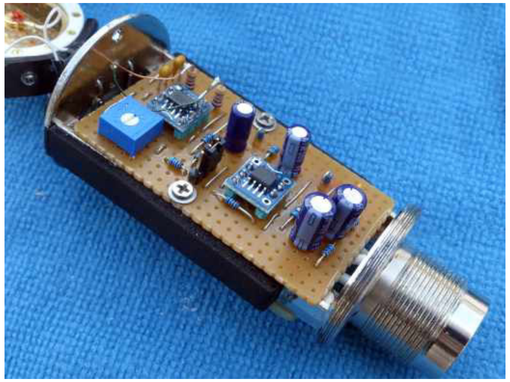
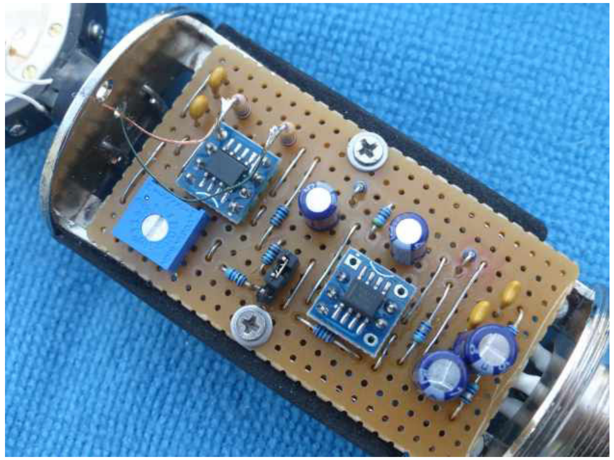
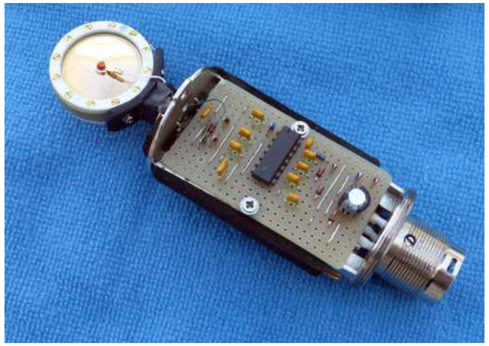
OPIC – Multi Pattern version

- **Impedance Converters with an OPA1642 dual op-amp.**
- **Pattern configuration with an OPA1641 single op-amp.**
- **Stripboard version designed to fit into a BM800 style body**

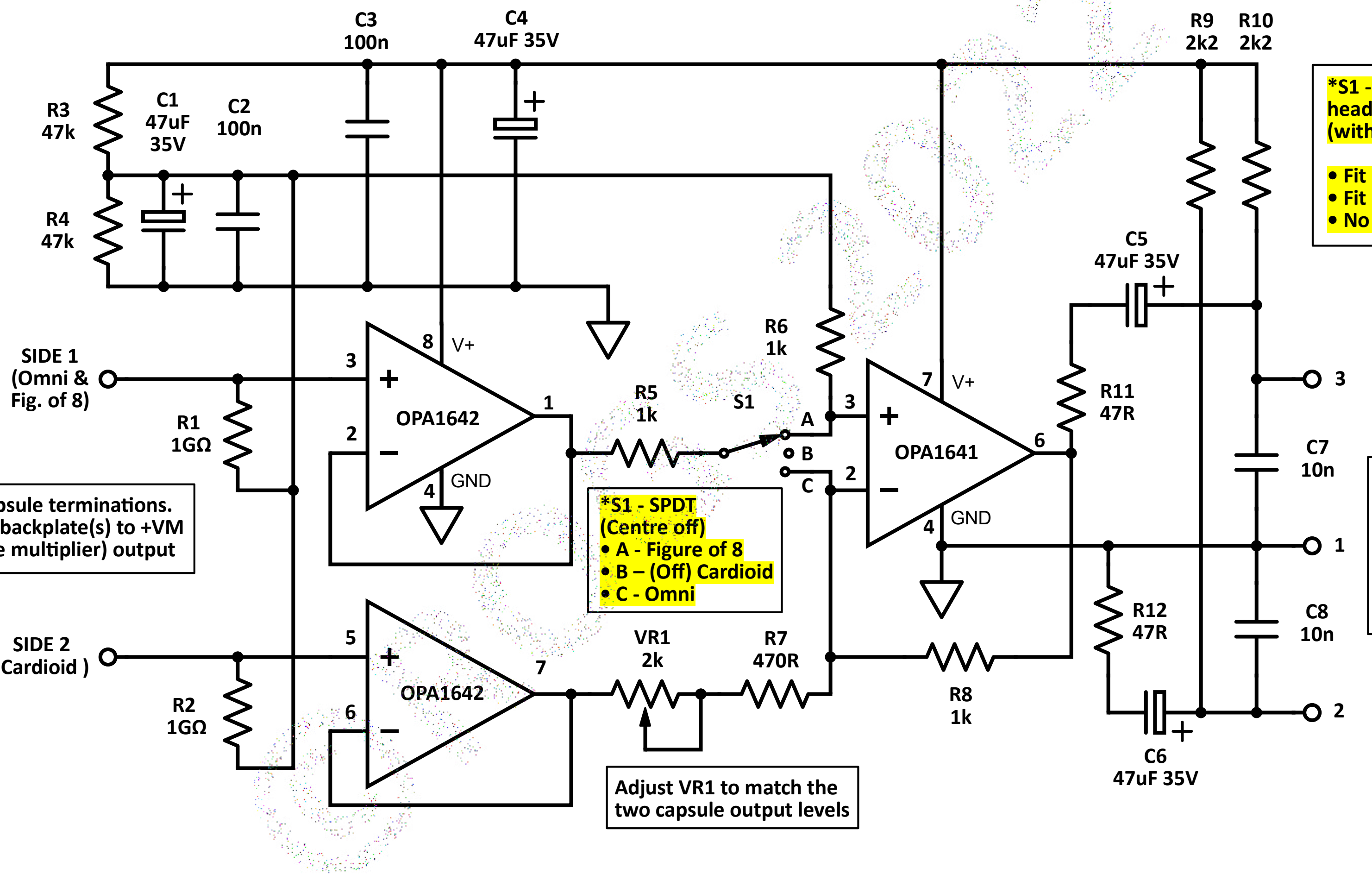








• OPIC MULTI PATTERN MIC - STRIPBOARD SCHEMATIC •



*S1 - Can be 3 way header on stripboard (with R5 connected to B)

- Fit link A-B: Figure of 8
- Fit link B-C: Omni
- No link: Cardioid

LDC capsule terminations. Capsule backplate(s) to +VM (voltage multiplier) output

*S1 - SPDT (Centre off)

- A - Figure of 8
- B – (Off) Cardioid
- C - Omni

Adjust VR1 to match the two capsule output levels

3 PIN XLR (Male)

Note: Pin 3 is used as the active 'hot' pin, as the OPA1641 summing amplifier inverts the signal

OPIC - Multi Pattern Circuit description

Overview:

The circuitry shown in the schematic uses a Texas Instruments OPA1642 dual JFET op-amp as two impedance converters, together with a single channel OPA1641 as a summing amp to create a multi pattern condenser microphone, fitted with a dual sided 34mm LDC mic capsule in a BM800 'donor' body.

A 'single pole double throw' (SPDT) switch - with a third 'centre off' position - allows the mic to be configured as either a Cardioid, Omni or Figure of 8 microphone.*

An OPA1642 dual op-amp is used to provide 2 x impedance converters - one for each side of the capsule.
A second OPA1641 single op-amp is fitted, which may be configured as either a summing amplifier, or a differential input amplifier, depending on the pattern required.
Both types of op-amp have low noise and low quiescent current, making them ideal for this task.
The output of the OPA1641 is used here to provide a 'single sided' audio output, which is balanced passively to help optimise the common mode rejection ratio (CMRR).

Circuit description:

In the OPA1642 each amplifier is configured as a zero gain non-inverting buffer. Each op-amp output is connected directly to its own inverting input to achieve this.

Each amplifier draws around 1.8mA of quiescent current – so c. 3 x 1.8mA in total - and this is provided by the 48v phantom power supply from the mic preamp.
The resistor summing network R9 and R10 - together with the de-coupling capacitors C3 and C4 - allow a smoothed DC supply voltage of around 20v to be presented to pin 8 of the OPA1642, and pin 7 of the OPA1641.
The actual supply voltage is not critical, and the circuitry will automatically adjust the 'half rail' reference to suit the supply voltage.

The op-amp requires a 'dual' DC supply votage, and this is provided by the creation of a 'half rail' voltage of around 10v by the voltage divider R3 and R4, together with the decoupling capacitors C1 and C2.

This 'half rail' voltage is required to bias the op amp, so that the output can swing symmetrically around this reference voltage.
It is fed to the non-inverting inputs of each op-amp in the OPA1642 via R1 and R2, the high value 1GΩ resistors required to bias the purely capacitive mic capsules for effective function.
The bias is also fed to the OPA1641 via R6.

The OPA1642 op-amp outputs (pins 1 and 7) are connected - via series resistors VR1 and R7 - to the inverting input of the OPA1641, and via R5 to either the inverting or non-inverting input of the OPA1641, depending on the required pattern.

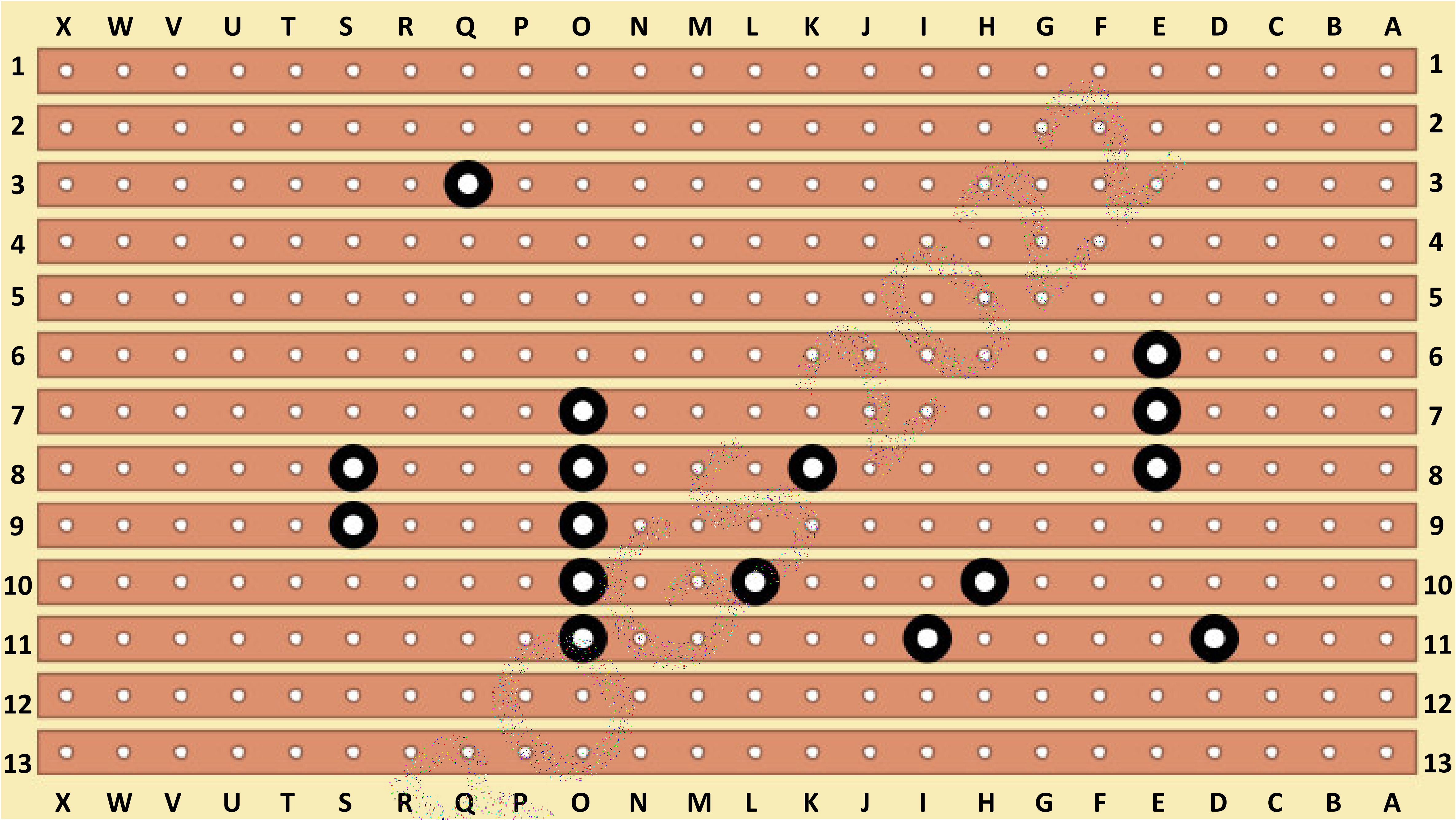
VR1 is included to allow the output amplitude from each side of the capsule to be 'matched'. The outputs should be the same, but some capsules can have significantly output levels from each side of the capsule, and a simple adjustment can be useful to correct this.
The output of the OPA1641 - pin 6 - is fed via R11 and C5 to pin 3 of the XLR connector. Normally pin 2 is used as the 'hot' signal connection, but the configuration of the OPA1641 will invert the signal, so pin 3 is used in this case.

R12 and C6 provide an equivalent 'passively balanced' output to the 'cold' pin 2 of the XLR connector. There is no audio on this pin, the above components are fitted to help maintain a high CMRR, which can be important, especially when the mic is connected to a preamp via a long cable run.
C5 and C6 are required to isolate the DC 'half rail' voltage on the op-amp output from the XLR outputs.
C7 and C8 are included to decouple any stray RF interference which may be present to ground.

*Note that the single pole pattern selector switch is replaced with a simple 3 way header on this prototype stripboard version.

- Link A-B is fitted for the 'Figure of 8' configuration.
- Link B-C is fitted for the 'Omni' configuration.
- No link id fitted for the 'Cardioid' configuration.

•• Viewed from COPPER TRACK SIDE ••



OPIC Multi Pattern - stripboard

•• TRACK CUTS VIEWED FROM COPPER SIDE ••

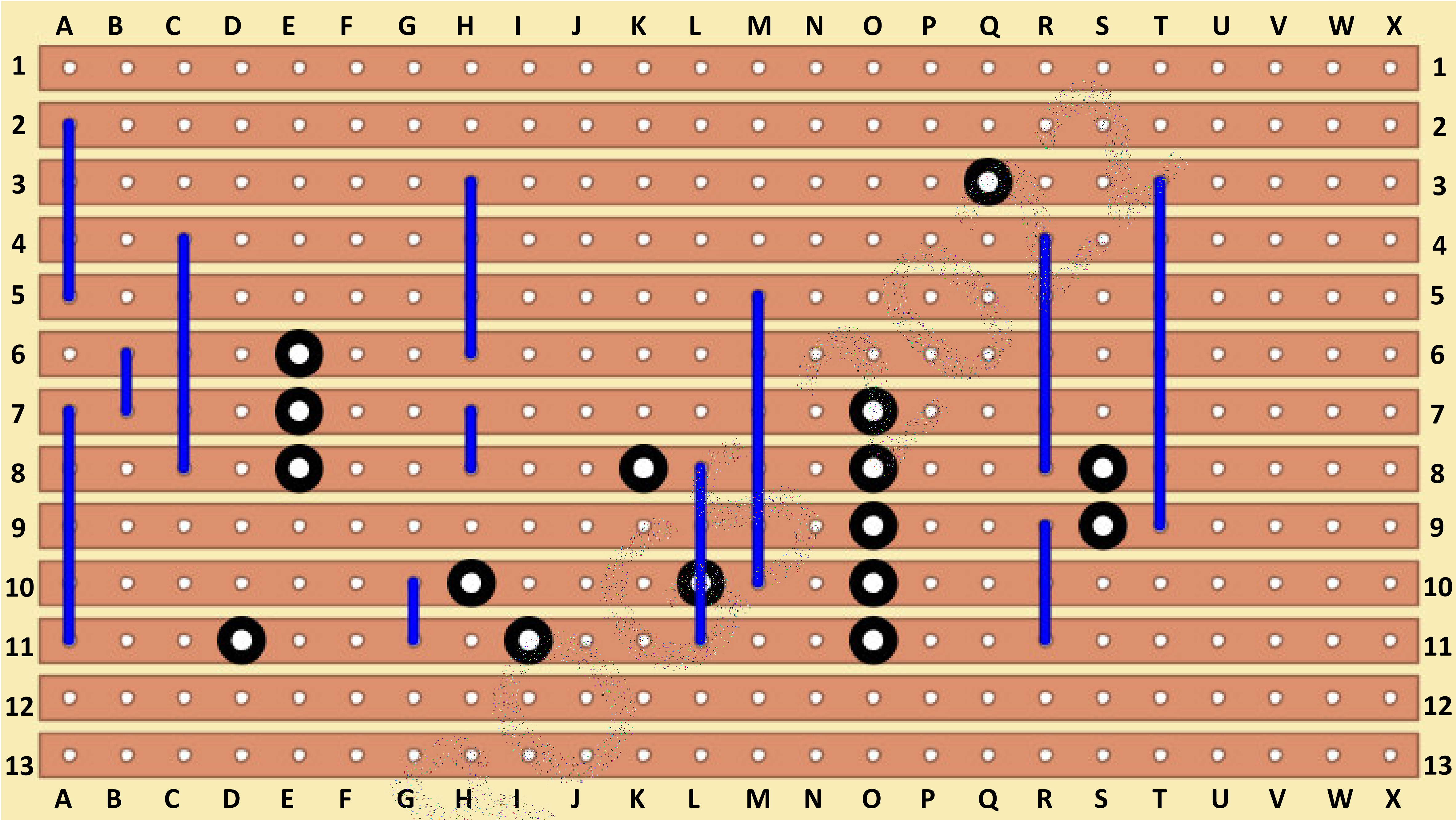
'Spin off' copper with a stripboard track cutter (or drill bit)..

• ensure each 'spin off ' cuts the track completely •

Cut the copper tracks at the following 16 locations:

- D11
- E6
- E7
- E8
- H10
- I 11
- K8
- L10
- O7
- O8
- O9
- O10
- O11
- Q3
- S8
- S9

•• TRACK CUTS AND WIRE LINKS VIEWED FROM COMPONENT SIDE ••



<u>OPIC Multi - stripboard</u>

•• TRACK CUTS AND WIRE LINKS VIEWED FROM COMPONENT SIDE ••

Make links from 0.56swg (or equivalent) tinned copper wire, and fit to the locations shown in blue above

Fit wire links to the 12 locations listed below:

- A (2,5)
- A (7,11)
- B (6,7)
- C (4,8)
- G (10,11)
- H (3,6)
- H (7,8)
- L (8,11)
- M (5,10)
- R (4,8)
- R (9,11)
- T (3,9)

Mic Capsule: 2 x centre terminal connections
* See note below

IC1 SOIC to DIP Adaptors

REMOVE PINS FROM HEADERS :

IC1- PINS 3 & 5

IC2 - PINS 1,5 & 8

NOTE IC Orientations

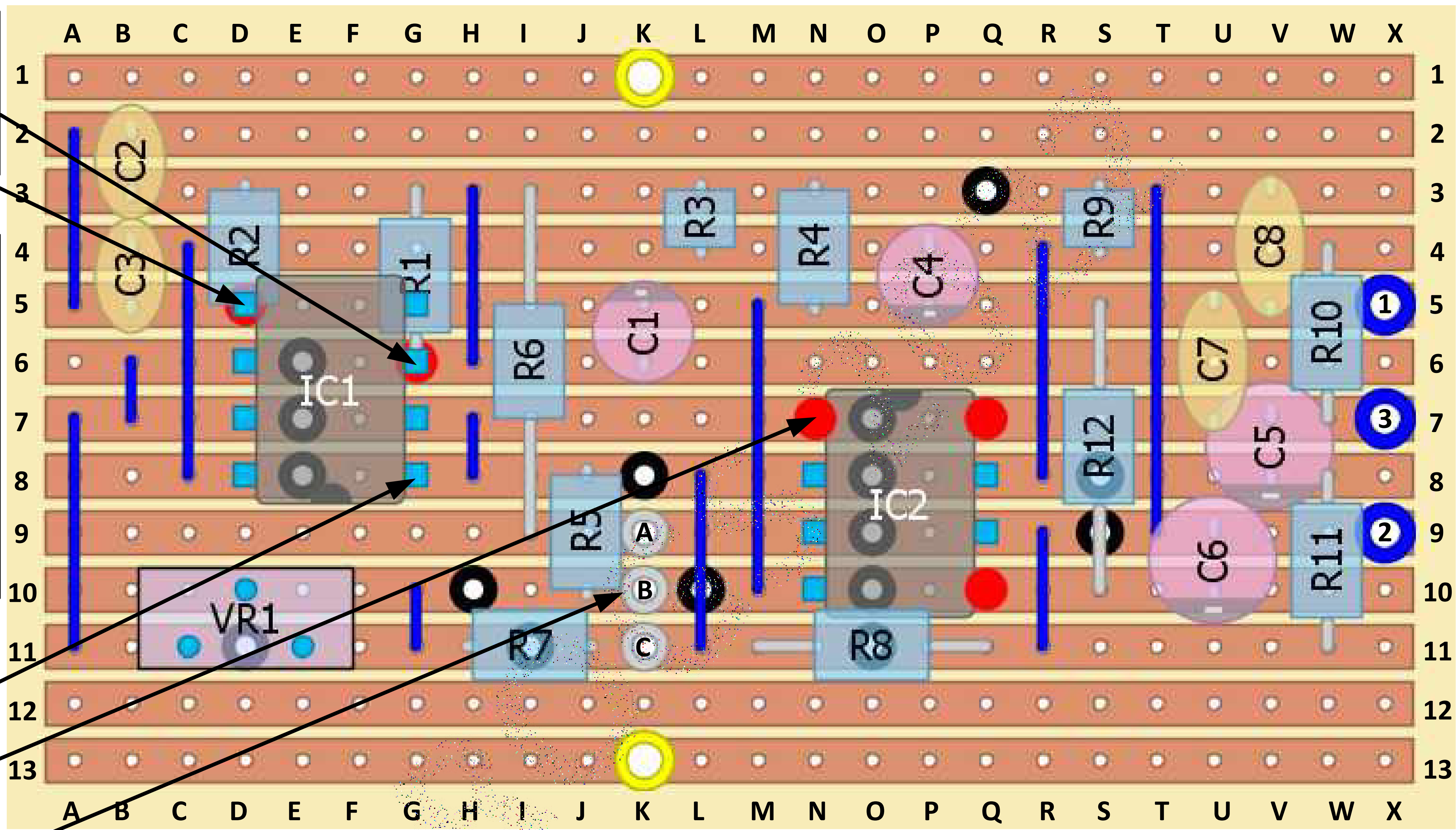
IC1 Pin 1 - G8

IC2 Pin 1 - N7

Terminals A,B and C are 3 way header pins:
• Fit link A-B for Fig of 8

• Fit link B-C for Omni

•No link for Cardioid



3 pin XLR (Male)

OPIC Multi – stripboard

Complete stripboard component layout

•• VIEWED FROM COMPONENT SIDE ••

K1 and K13 are PCB mounting holes

* The capsule centre (or 'edge') terminals are connected to IC1 pin 3 and pin 5 via R1 and R2 wire leads ,which are terminated in the empty DIL adaptor pins 3 and 5 locations.

• R1 to the omni/fig of 8 side of the capsule
• R2 to the cardioid side
• (Backplate is connected to Voltage Multiplier +V output)

Fit the components to the locations listed below:

- C1 47uF 35v (K6+, K5)
- C2 100nF (B2, B3)
- C3 100nF (B4, B5)
- C4 47uF 35v (P4+, P5)
- C5 47uF 35v (V7+, V8)
- C6 47uF 35v (U9+, U10)
- C7 10nF (V6, V8)
- C8 10nF (V3, V5)
- **C2,3,7 & C8 are X7R mlc**

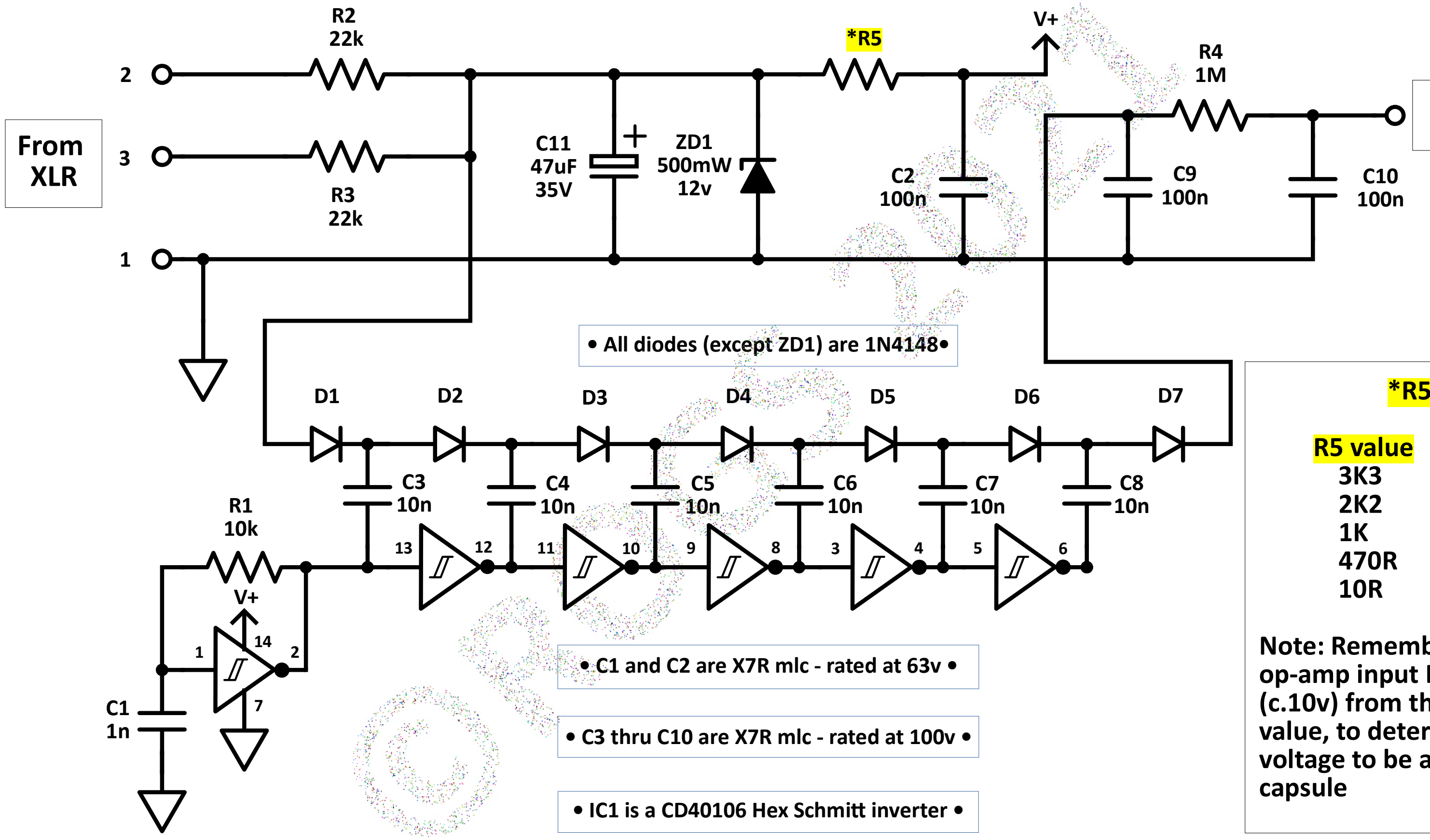
All resistors (except R1&R2) are MF12 - 1/8th watt MF
- R1 1GΩ 1/4w 10% (G3, G6)
- R2 1GΩ 1/4w 10% (D3, D5)
- R3 47k (L3, L4)
- R4 47k (N3, N5)
- R5 1k (J8, J10)
- R6 1k (I3, I9)
- R7 470R (H11, J11)

- R8 1k (M11, Q11)
- R9 2k2 (S3,S4)
- R10 2k2 (W4, W7)
- R11 47R (W8, W11)
- R12 47R (S5, S10)
- VR1 2k (C11, D10, E11)
- IC1 OPA1642
- IC2 OPA1641

(via SOIC to DIL adaptors)
- **A,B,C** are 3 way header

OPIC.VM SCHEMATIC
(DC VOLTAGE MULTIPLIER)

• All resistors are 0.125 w (metal film) •



• All diodes (except ZD1) are 1N4148•

• C1 and C2 are X7R mlc - rated at 63v •

• C3 thru C10 are X7R mlc - rated at 100v •

• IC1 is a CD40106 Hex Schmitt inverter •

*R5 options

R5 value	DC out
3K3	60v
2K2	65v
1K	70v
470R	75v
10R	80v

Note: Remember to subtract the op-amp input DC bias voltage (c.10v) from the selected DC out value, to determine the actual voltage to be applied across the capsule

OPIC VM (Voltage Multiplier) - Circuit description

Overview:

The circuitry shown in the schematic is designed to provide a high voltage DC output - between 60v and 80v - to be applied as the polarisation voltage required by a conventional condenser microphone capsule. (Note that this facility is not required for electret capsules, which are pre-polarised as part of their manufacturing process)

This particular circuit is based on the concepts presented in a 1983 ETI magazine article by Rory Holmes. You can find a copy of the original article here:

https://gyraf.dk/schematics/Voltage_multipliers_with_CMOS_gates.pdf

Circuit description:

In this schematic, an oscillator running at c.125KHz is formed by R1, C1 and pins 1 and 2 of the CMOS 40106 Hex inverter IC.
All 6 inverters – including the ocillator - are connected serially, with each output connected to the following input. Each in/out junction is further connected to one terminal of a 10nF capacitor, the second terminal of which is connected to a diode 'chain' formed by a series of 1N4148 diodes, D1 to D7.
This arrangement will permit the DC supply to the IC to be 'multiplied' so that the voltage at the cathode of D7 is within the range 60v to 80v DC, depending on which value of R5 has been fitted.
More details of the overall system concept are explained in the article linked to above.

The output DC from D7 cathode is decoupled by C9, and then further filtered by the low pass filter formed by R4 and C10. Note that the final DC output has a high impedance because of the value of R4, but as the load is only the mic capsule – which is essentially just a capacitor – there is very little drop in output voltage from the DC value measured at the cathode of D7, with respect to gnd.
However, you will observe a drop in DC value if you attempt to measure the value at the R4 - C10 junction with a conventional DMM, which is likely to have an impedance of around 10MΩ.

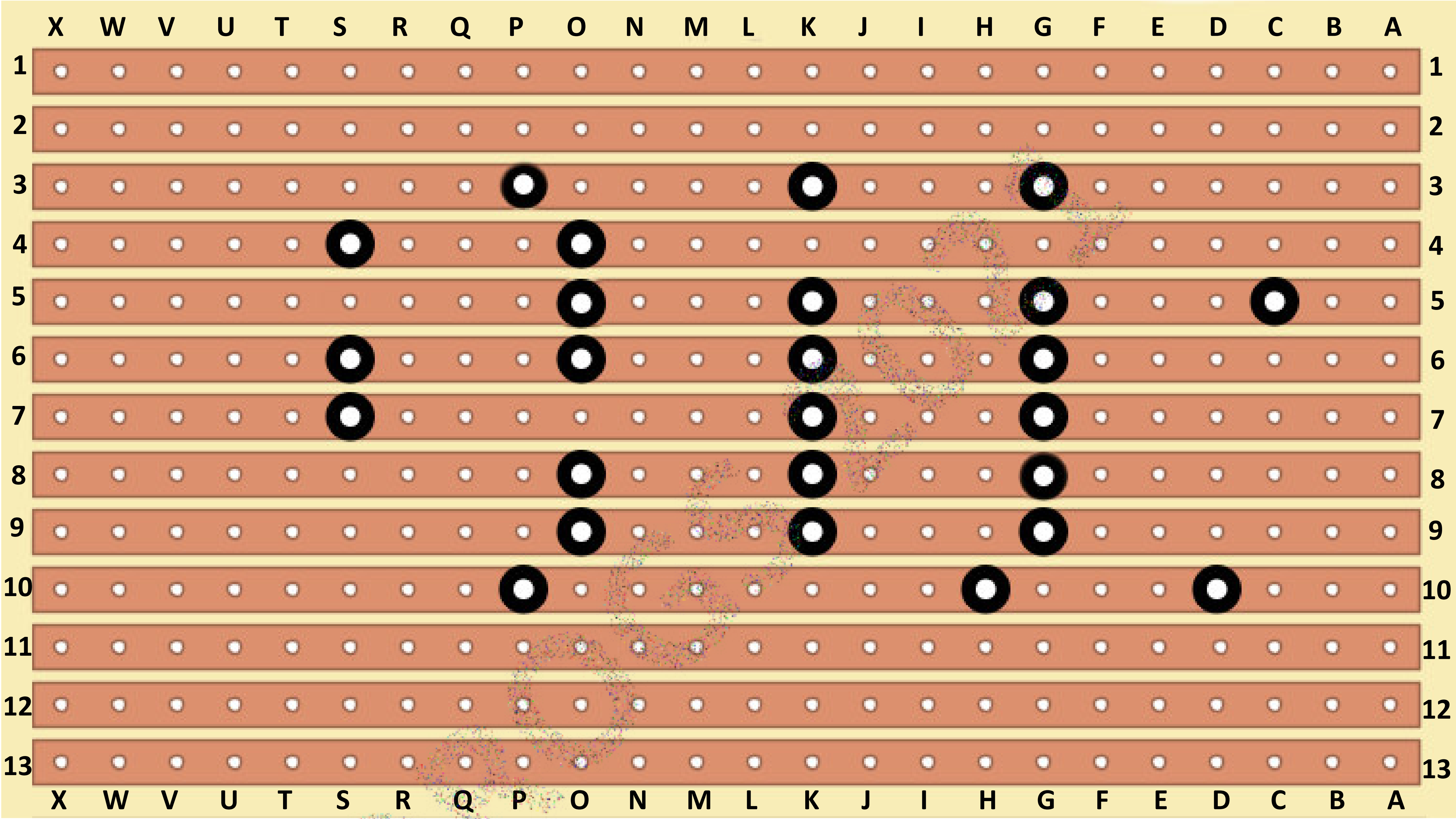
The circuit is powered by 48v phantom power. Feed resistors R2 and R3 take the phantom power voltage from both terminals of the balanced XLR plug. The Zener diode ZD1 will set the voltage at the junction of the 2 feed resistors to 12v. In total around 1.5mA is drawn from the phantom power supply – around 1mA for the 40106 and around 500uA by the zener diode.

The exact value of the DC supply to the inverter IC will depend on the value of R5 selected. The table on the schematic shows the values of R5 required to provide the desired output.
The actual DC supply voltage to the inverter I.C. will vary between 9 and 12v, depending on the value of R5 selected.

It should be noted that the latter few stages of the multiplier can develop up to 80v DC across the 10nF capacitors in the multiplier 'chain', and this is also true of C9 and C10.
It is recommended that all the capacitors C3 thru C10 are rated at 100v - rather than the more common 63v - to simplify things.

Remember to subtract the value of the OPA1641 op-amp 'half rail' input DC bias (c.10v) from the DC multiplier output voltage, when calculating the actual DC voltage being applied across the capsule.

Viewed from COPPER TRACK SIDE



OPIC.VM - stripboard

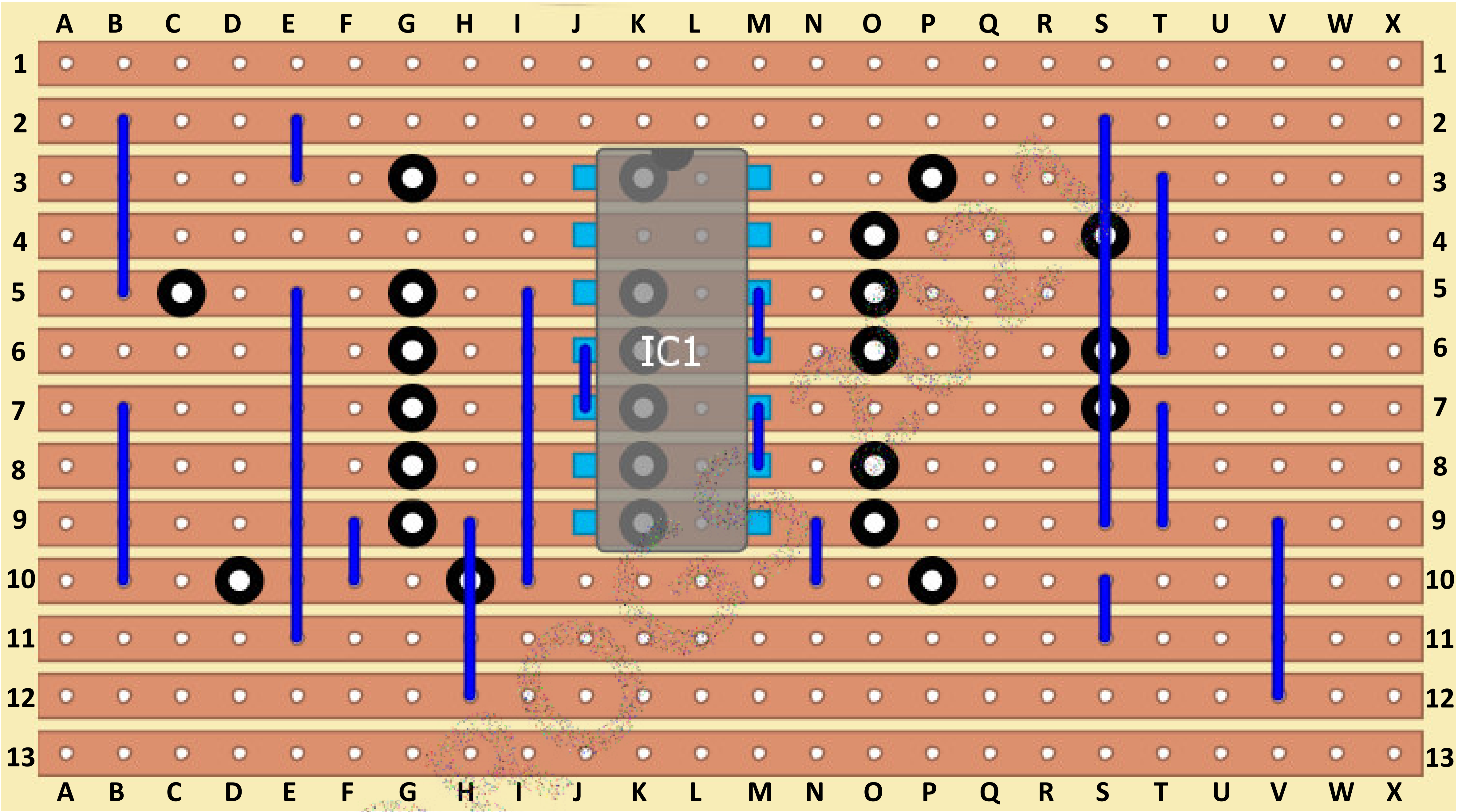
•• TRACK CUTS VIEWED FROM COPPER SIDE ••

'Spin off' copper with a stripboard track cutter (or drill bit)

• ensure each 'spin off ' cuts the track completely •

'Spin off' the copper track at the following 25 locations:

- C5
- D10
- G3
- G5
- G6
- G7
- G8
- G9
- H10
- K3
- K5
- K6
- K7
- K8
- K9
- O4
- O5
- O6
- O8
- O9
- P3
- P10
- S4
- S6
- S7



OPIC.VM stripboard

•• TRACK CUTS AND WIRE LINKS VIEWED FROM COMPONENT SIDE ••

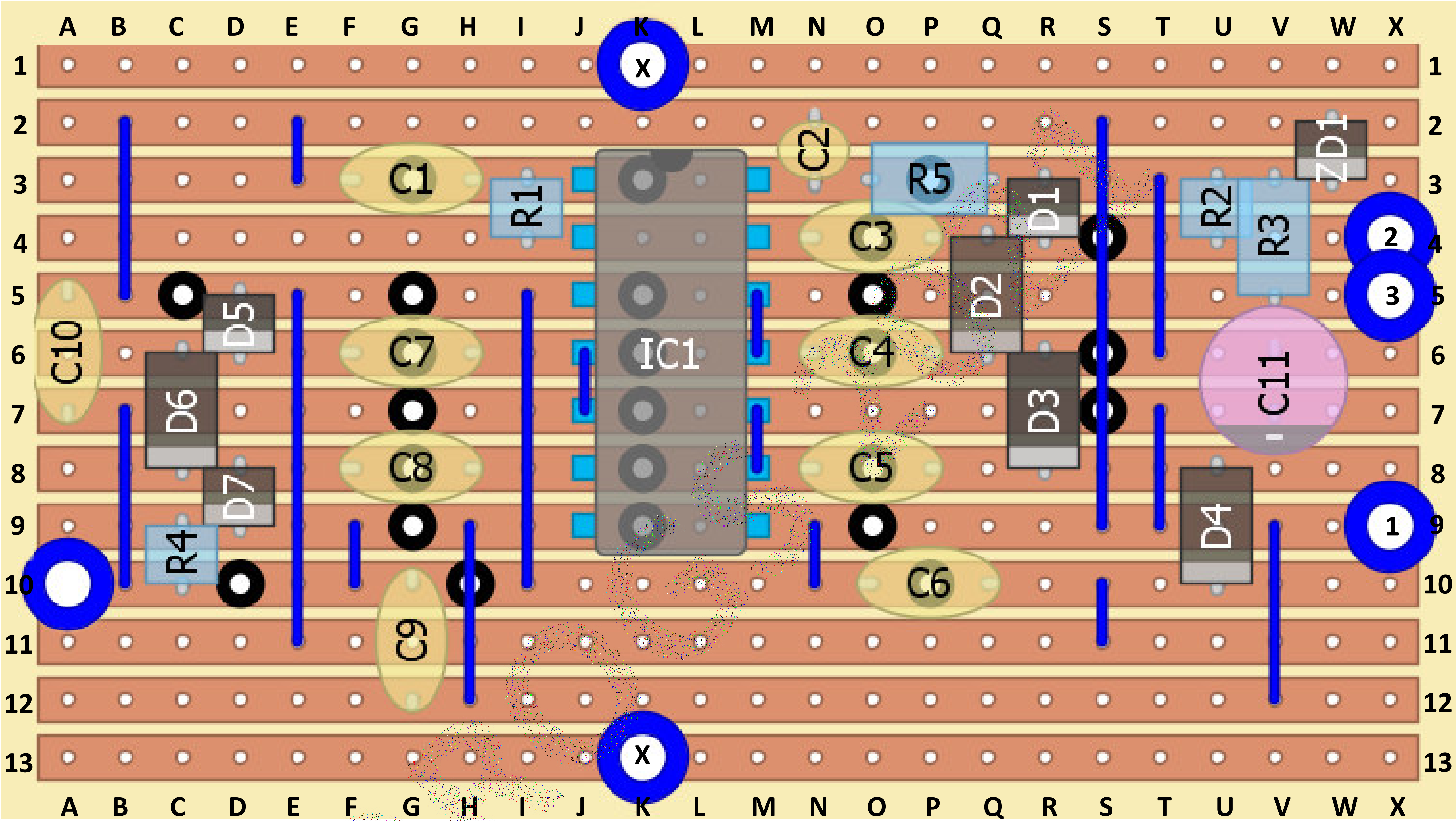
Make links from 0.56swg (or equivalent) tinned copper wire, and fit to the locations shown in blue above

Fit wire links to the 16 locations listed below:

- B (2, 5)
- B (7,10)
- E (2,3)
- E (5,11)
- F (9,10)
- H (9,12)
- I (5,10)
- J (6,7)*
- M (5,6)*
- M (7,8)*
- N (9,10)
- S (2,9)
- S (10,11)
- T (3,6)
- T (7,9)
- V (9,12)

*** these 3 'links' are solder bridges on the IC pins**

OPIC.VM - Complete stripboard component layout •• VIEWED FROM COMPONENT SIDE ••



From XLR

From XLR

60 - 80v DC to mic capsule (LDC only)

(See notes below for voltage selection options)

- For 80v out - R5 is 10R
- For 75v out - R5 is 470R
- For 70v out - R5 is 1k
- For 65v out - R5 is 2k2
- For 60v out - R5 is 3k3

K1 and K13 ('X') are stripboard mounting hole locations

Fit the components to the locations listed below:

- C1 1nF mlc (F3,H3)
- C2 100nF mlc (N2,N3)
- C3 10nF mlc (N4,P4)
- C4 10nF mlc (N6,P6)
- C5 10nF mlc (N8,P8)
- C6 10nF mlc (O10,Q10)
- C7 10nF mlc (F6,H6)
- C8 10nF mlc (F8,H8)
- C9 100nF mlc (G10, G12)
- C10 100nF mlc (A5, A7)
- C11 47uF 35v elec (V6+,V7)

Resistors are 1/8w metal film

- R1 10k (I3, I4)
- R2 22k (U3, U4)
- R3 22k (V3, V5)
- R4 1M (C9, C10)
- R5 (SOT - see notes) (O3,Q3)

- **Diodes D1-D7 are 1N4148 (anode location 1st)**
- D1 (R3,4) • D2(Q4,6)
- D3 (R6,8) • D4 (U8,10)
- D5 (D5,6) • D6 (C6,8)
- D7 (D8,9
- ZD1 12v 500mW zener (W2,3)
- IC1 40106 **(Pin1 - J3)**

- **n.b. C3 thru C10 (mlc) capacitors are 100V X7R**