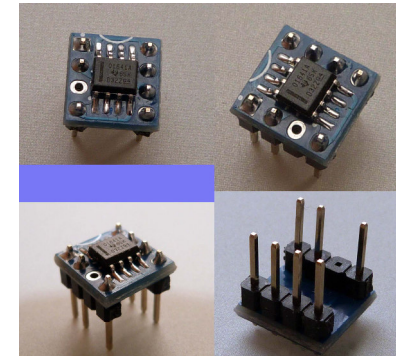
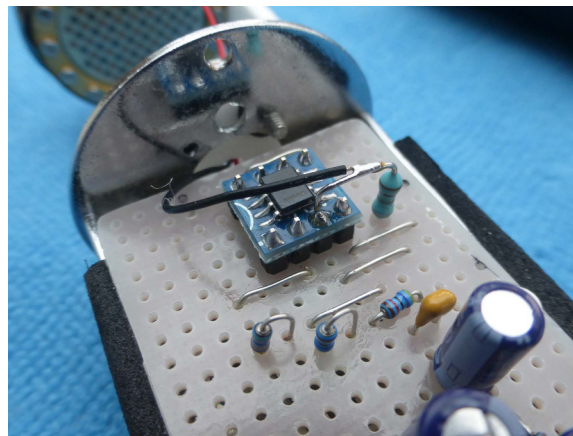
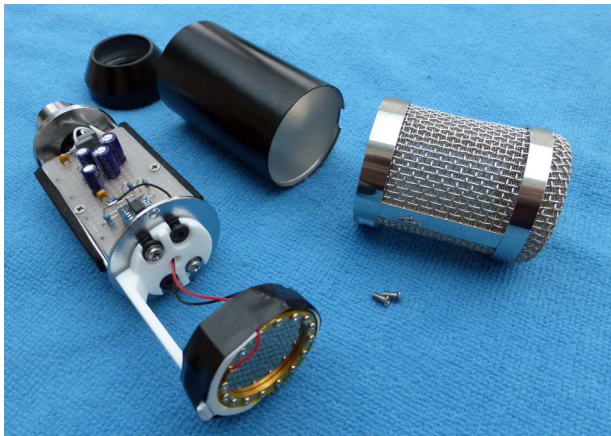
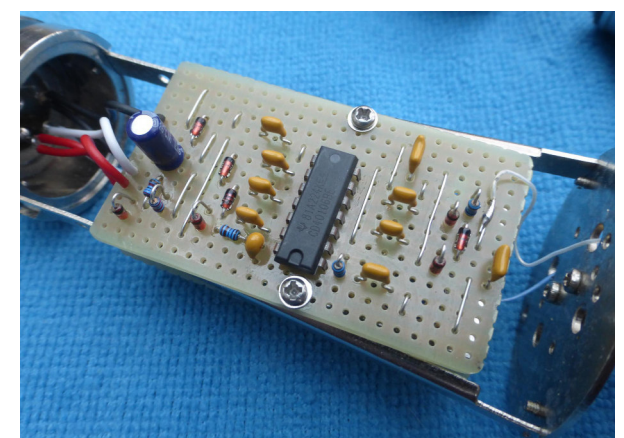
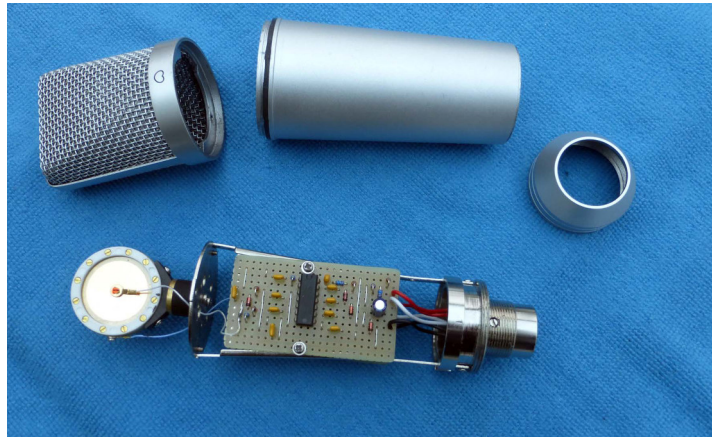
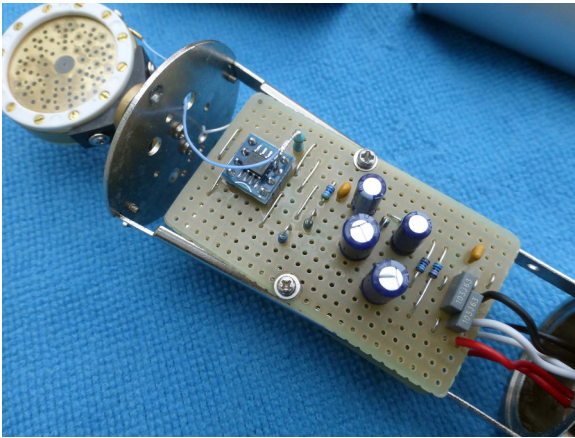


OPIC.41 – Impedance Converter and Voltage Multiplier

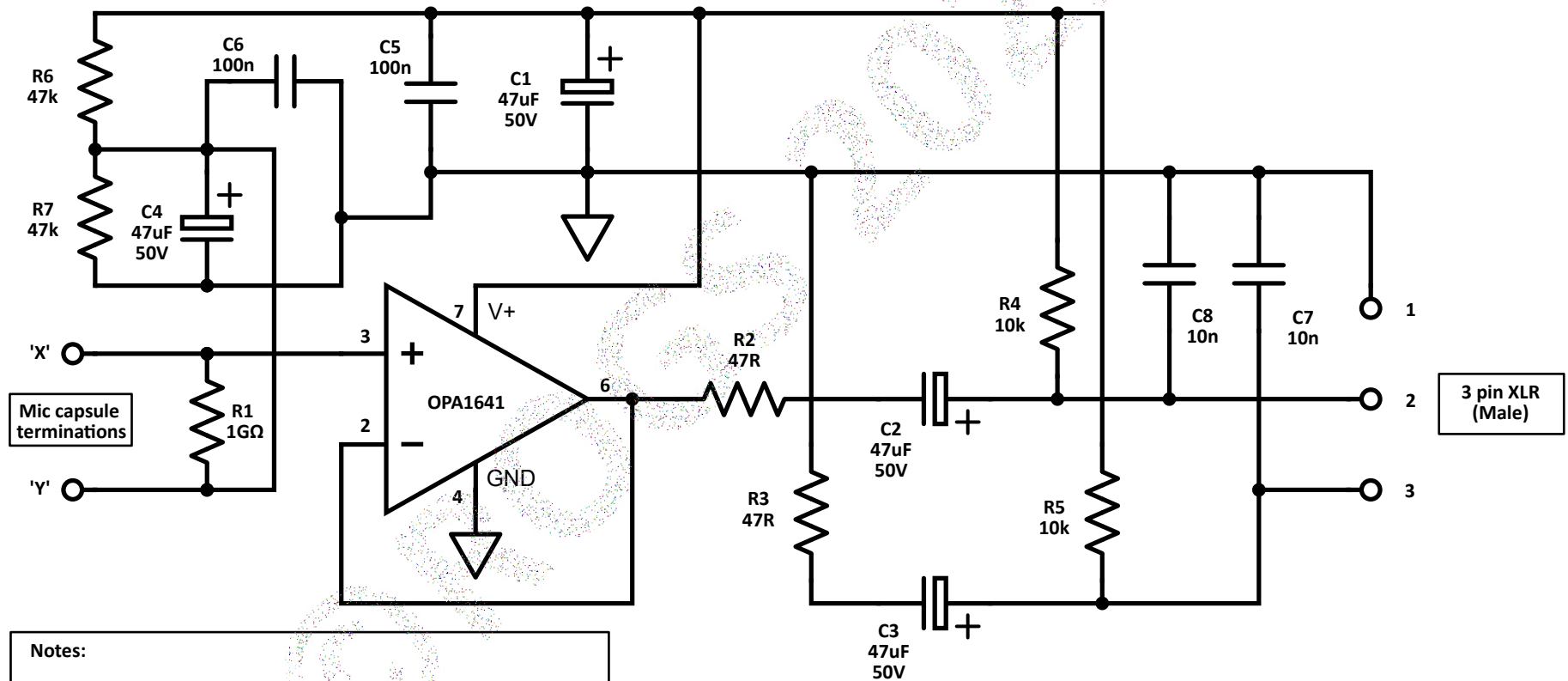
Stripboard version for LDC capsule

Designed to fit into a BM800 or Neumann 'style' body



© rogs 01.22

• Op Amp Impedance Converter (OPIC.41) STRIPBOARD SCHEMATIC •



Notes:

- The 'X' connection is made to one of the capsule terminations – select the one appropriate for the desired microphone polarity.
- The 'Y' connection is not used in this configuration
- For the second capsule connection – see the VM schematic.

OPIC.41 Circuit description

Overview:

The circuitry shown in the schematic uses a Texas Instruments OPA1641 JFET op-amp as an impedance converter for a condenser microphone capsule.

This is a simple alternative to the more conventional use of a discrete JFET device for the task.

The TI OPA164* series of op-amps offer both low noise and low quiescent current, making them ideal for this task.

A single OPA1641 op amp is used here to provide a single sided audio output, which is balanced passively to optimise the common mode rejection ratio (CMRR).

For a fully differential output balanced version, the OPA1642 dual op-amp can be used. This is the option selected by US based mic builder Jules Ryckebusch for his 'OPA Alice' project, and it does provide an extra 6dB of output signal - but at the expense of extra current drain, and a marginally worse signal/noise ratio.

Both options are valid – the single sided version is used here.

Circuit description:

The OPA1641 is configured as a zero gain non-inverting buffer. The op-amp output is connected directly to the inverting input to achieve this.

The amplifier draws around 1.8mA of quiescent current, and this is provided by the 48v phantom power supply from the mic preamp. The resistor summing network R4 and R5 - together with the decoupling capacitors C1 and C5 – will allow a smoothed supply voltage of around 22v to be presented to pin 7 of the op-amp.

The actual supply voltage is not critical, as the circuitry will automatically adjust the half rail reference to suit the supply voltage.

The op-amp requires a 'dual' voltage supply, and this is provided by the creation of a 'half rail' voltage of around 11v by the voltage divider R6 and R7, together with the decoupling capacitors C4 and C6.

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 input of the op-amp via R1, the high value 1G Ω resistor required to bias the purely capacitive capsule for effective function.

The LDC capsule used in this version requires an externally generated polarising DC voltage. (See the 'VM' schematic description for more details.)

The 'X' input connection on the schematic is connected to one capsule termination, the other being connected to the output of the VM voltage multiplier. The polarity of the microphone will not depend on which capsule lead is connected to which termination.

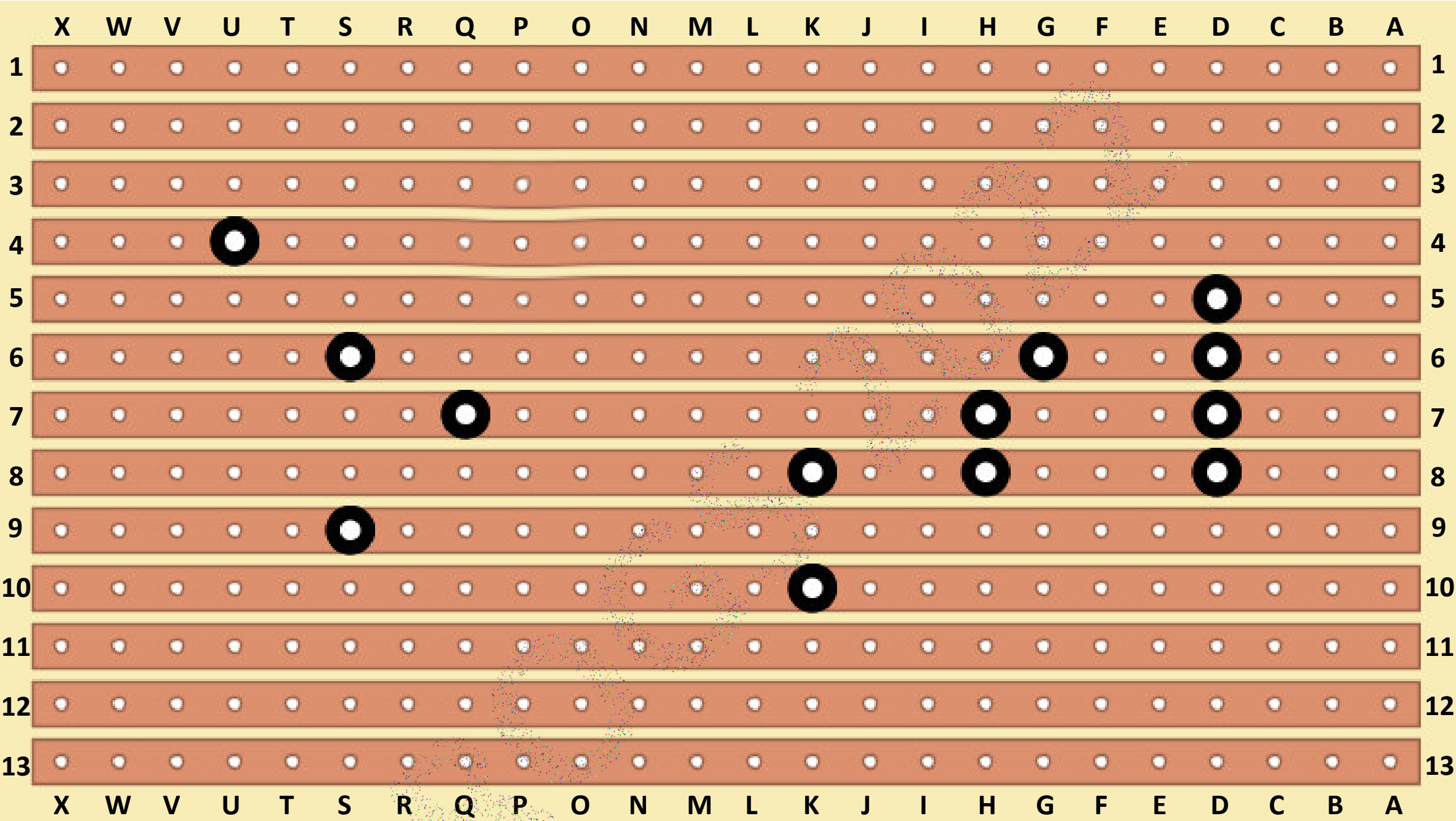
The preferred option often seems to be to connect the backplate termination to the VM high voltage output, and the centre termination to the 'X' input, but the polarity of the signal is not affected with a reversed connection. It is important to remember that the 'X' input is biased at positive 'half rail' (c.11v), and that value needs to be added to the calculated VM value to determine the actual polarisation voltage applied to the capsule.

The op amp output (pin 6) is connected via R2 and C2 to pin 2 (hot) of the XLR connector. C2 is required to isolate the DC 'half rail' voltage present on the output of the op-amp from the XLR output.

R3 and C3 provide an equivalent 'passively balanced' output to pin 3 (cold) of the XLR connector. There is no audio on this pin, R3 and C3 are fitted to improve CMRR, which can be important when the mic is connected to the preamp via a long cable run.

C7 and C8 are included to decouple any stray RF interference which may be present.

•• Viewed from COPPER TRACK SIDE ••



OPIC.41 - stripboard

•• TRACK CUTS VIEWED FROM COPPER SIDE ••

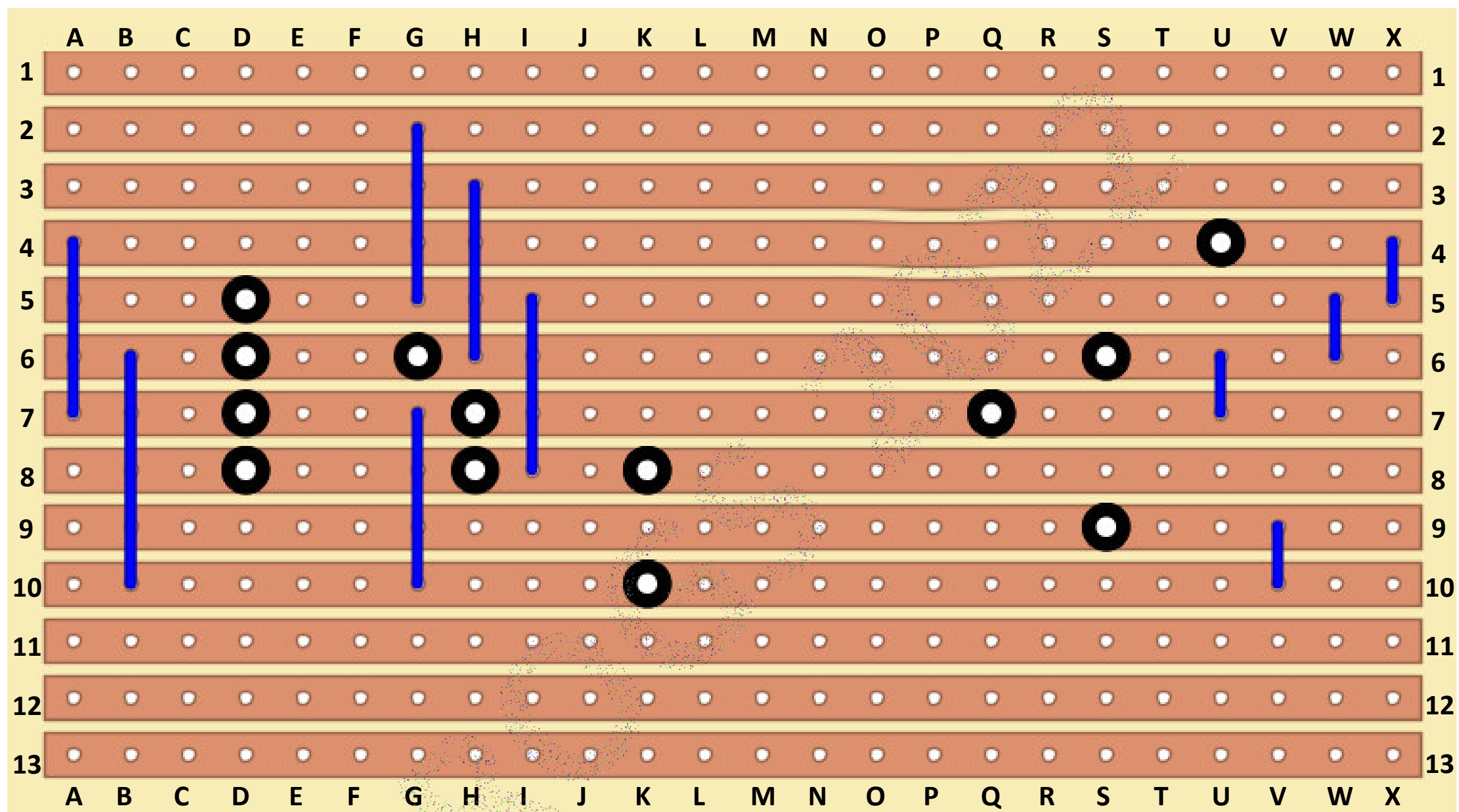
‘Spin off’ copper with a stripboard track cutter (or drill bit)..

• ensure each ‘spin off’ cuts the track completely •

‘Spin off’ the copper track at the following 13 locations:

- D5
- D6
- D7
- D8
- G6
- H7
- H8
- K8
- K10
- Q7
- S6
- S9
- U4

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



OPIC.41 - 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

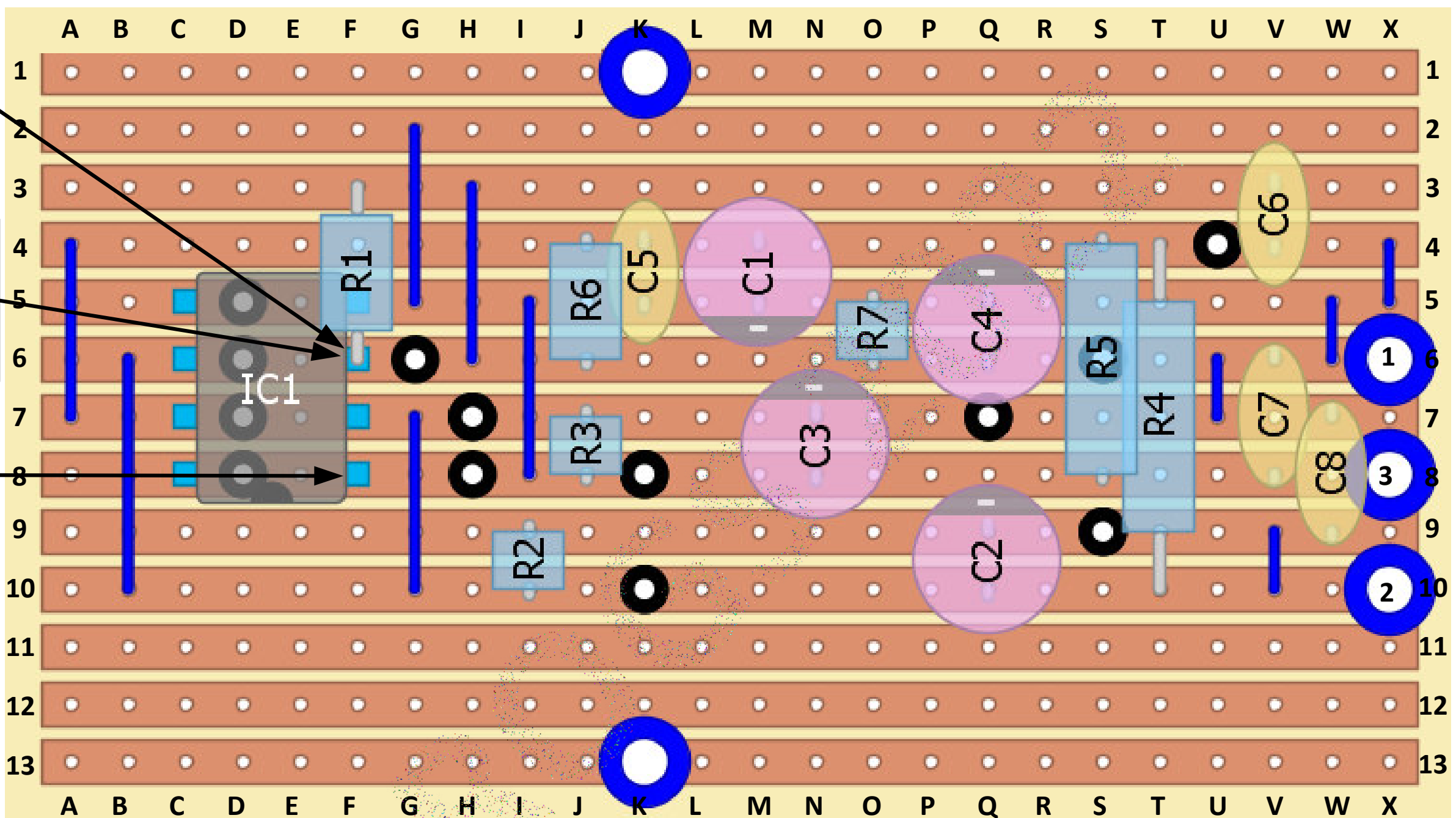
Fit wire links to the 10 locations listed below:

- A (4,7)
- B (6,10)
- G (2,5)
- G (7,10)
- H (3,6)
- I (5,8)
- U (6,7)
- V (9,10)
- W (5,6)
- X (4,5)

Mic Capsule:
Centre
terminal
connection
to IC1 pin3
and R1)

IC1 SOIC to
DIP Adaptor :
**DO NOT
CONNECT
PIN 3 TO
STRIPBOARD**

NOTE IC1
Orientation:
Pin 1 to F8



3 pin
XLR
(Male)

OPIC.41 – stripboard

Complete stripboard component layout

•• **VIEWED FROM COMPONENT SIDE** ••

K1 and K13 are PCB mounting holes

© rogs 1.22

Fit the components to the locations listed below:

- C1 47uF 50V (M4+, M5)
- C2 47uF 50V (Q10+, Q9)
- C3 47uF 50V (M8+, M7)
- C4 47uF 50V (Q6+, Q5)
- C5 100n mlc (K4, K5)
- C6 100n mlc (V3, V4)
- C7 10n mlc (V6, V8)
- C8 10n mlc (W7, W9)
- C5-C8 are X7R 63V mlc

All resistors (except R1)
are MF12 1/8th watt MF

- R1 1GΩ (10%) (F3, F6)

- R2 47R (I9, I10)
- R3 47R (J7, J8)

- R4 10k (T4, T10)
- R5 10k (S4, S8)
- R6 47k (J4, J6)
- R7 47k (O5, O6)

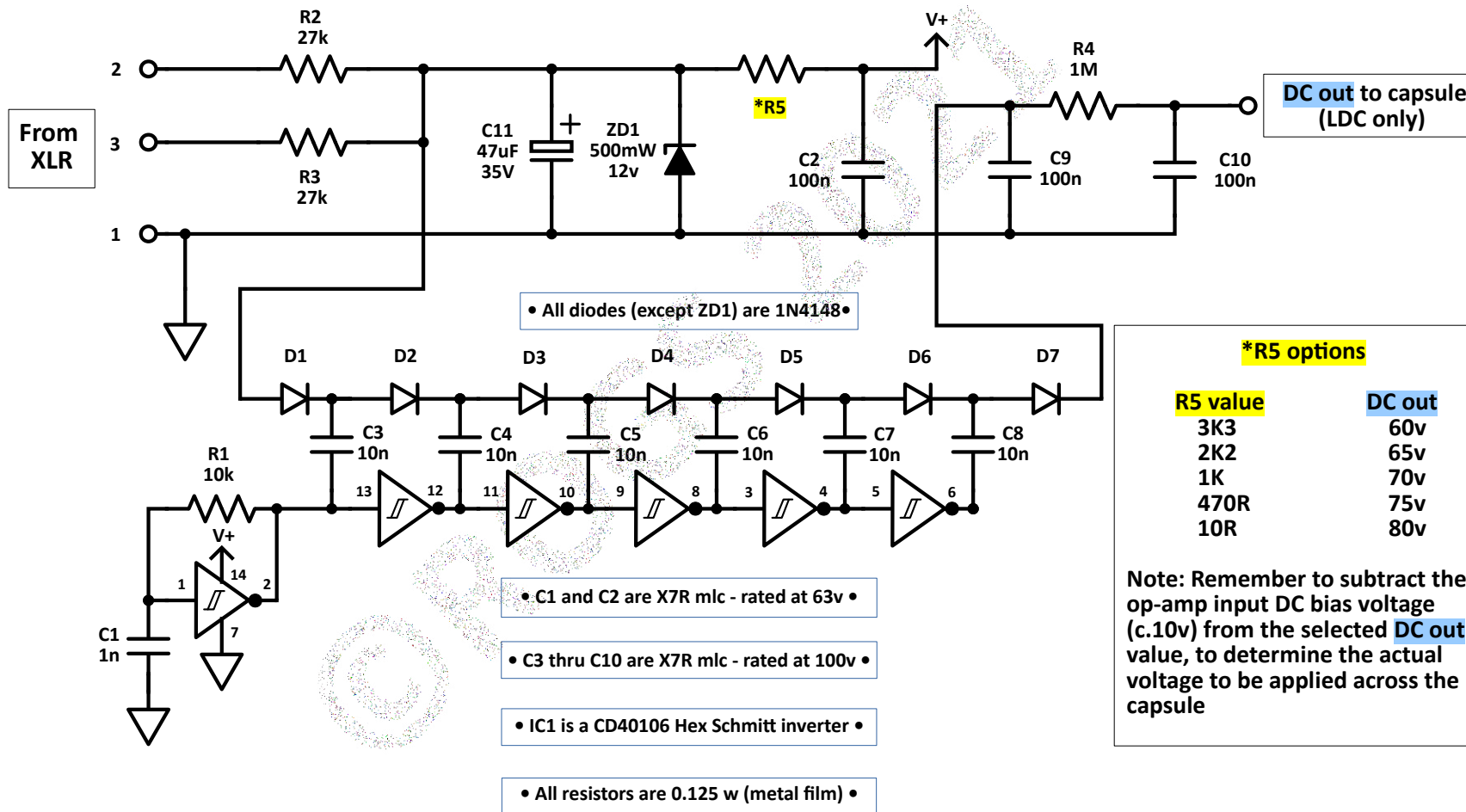
- IC1 OPA1641
(via adaptor)
(Pin1 - F8)

OPIC.VM SCHEMATIC (DC VOLTAGE MULTIPLIER)

Details of a more recent, simpler, fully adjustable Voltage Multiplier - which may be used as an alternative in this project - can be found here:

<https://www.jp137.com/lts/OPIC.Adjustable.Voltage.Multiplier.pdf>

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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 oscillator - 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.

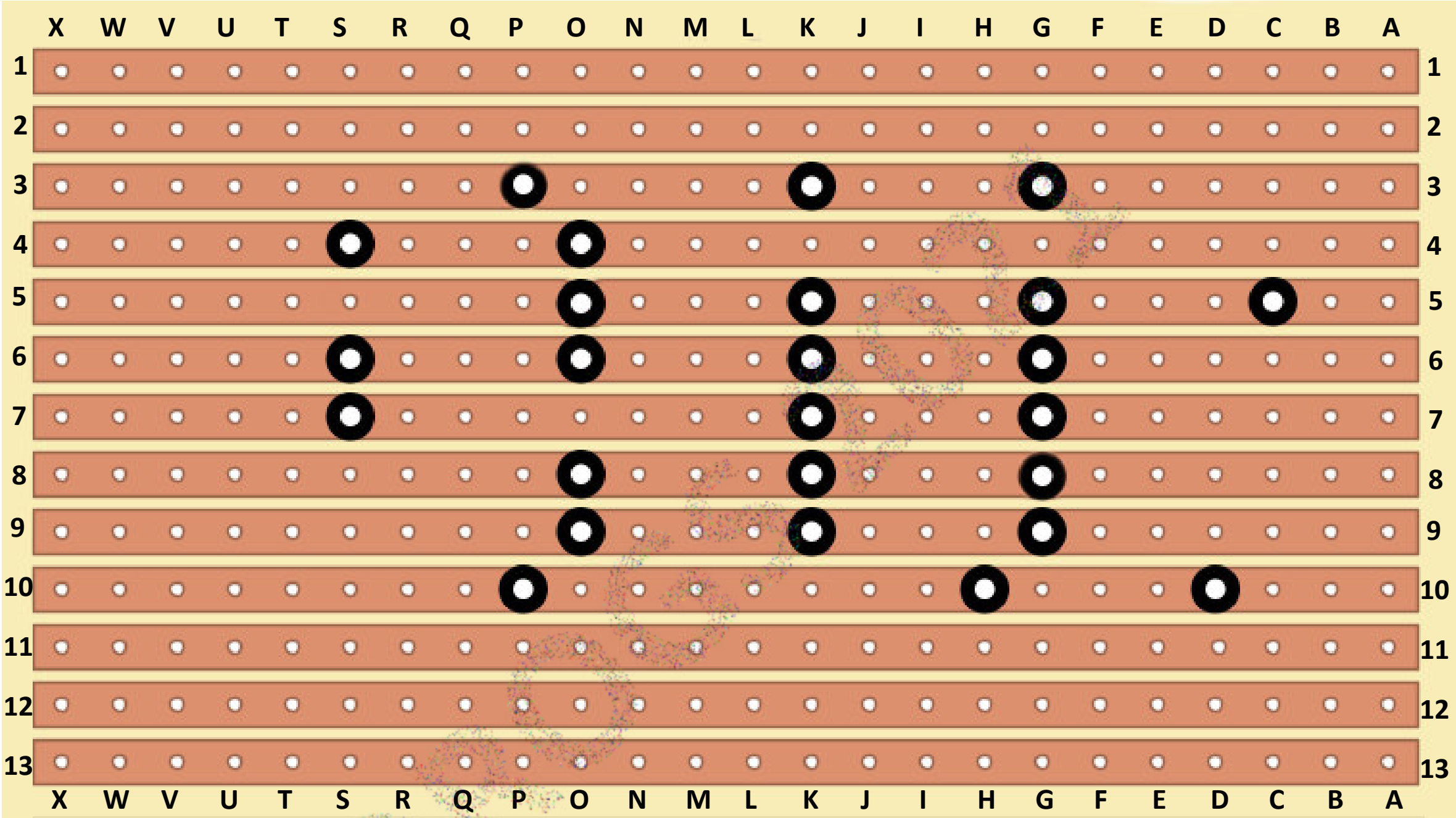
The actual DC supply voltage to the inverter I.C. will vary between 9 and 12v, depending on the value of R5 selected.

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

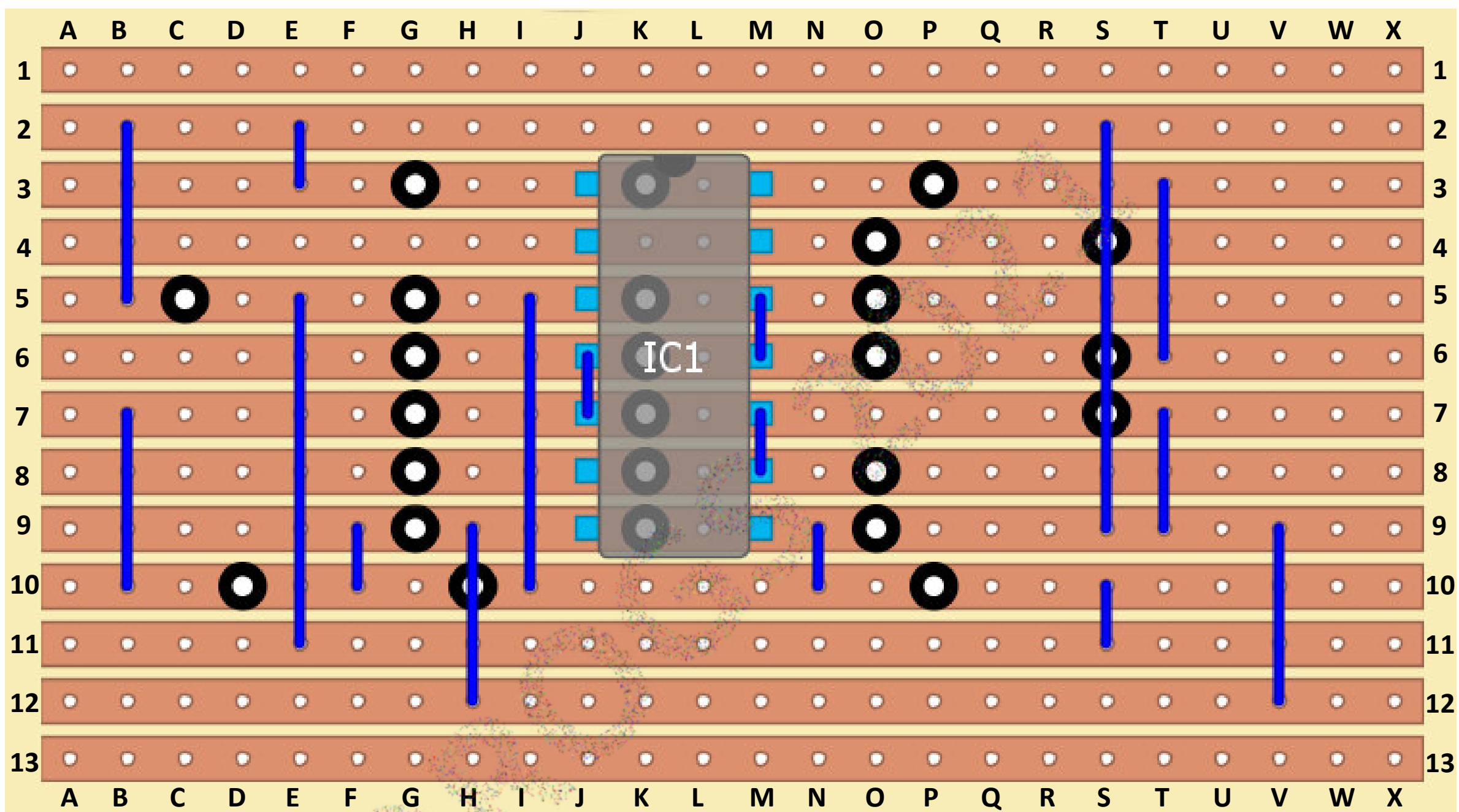
•• TRACK CUTS VIEWED FROM COPPER SIDE ••

‘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 | • G7 | • K5 | • O4 | • P3 |
| • D10 | • G8 | • K6 | • O5 | • P10 |
| • G3 | • G9 | • K7 | • O6 | • S4 |
| • G5 | • H10 | • K8 | • O8 | • S6 |
| • G6 | • K3 | • K9 | • O9 | • 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

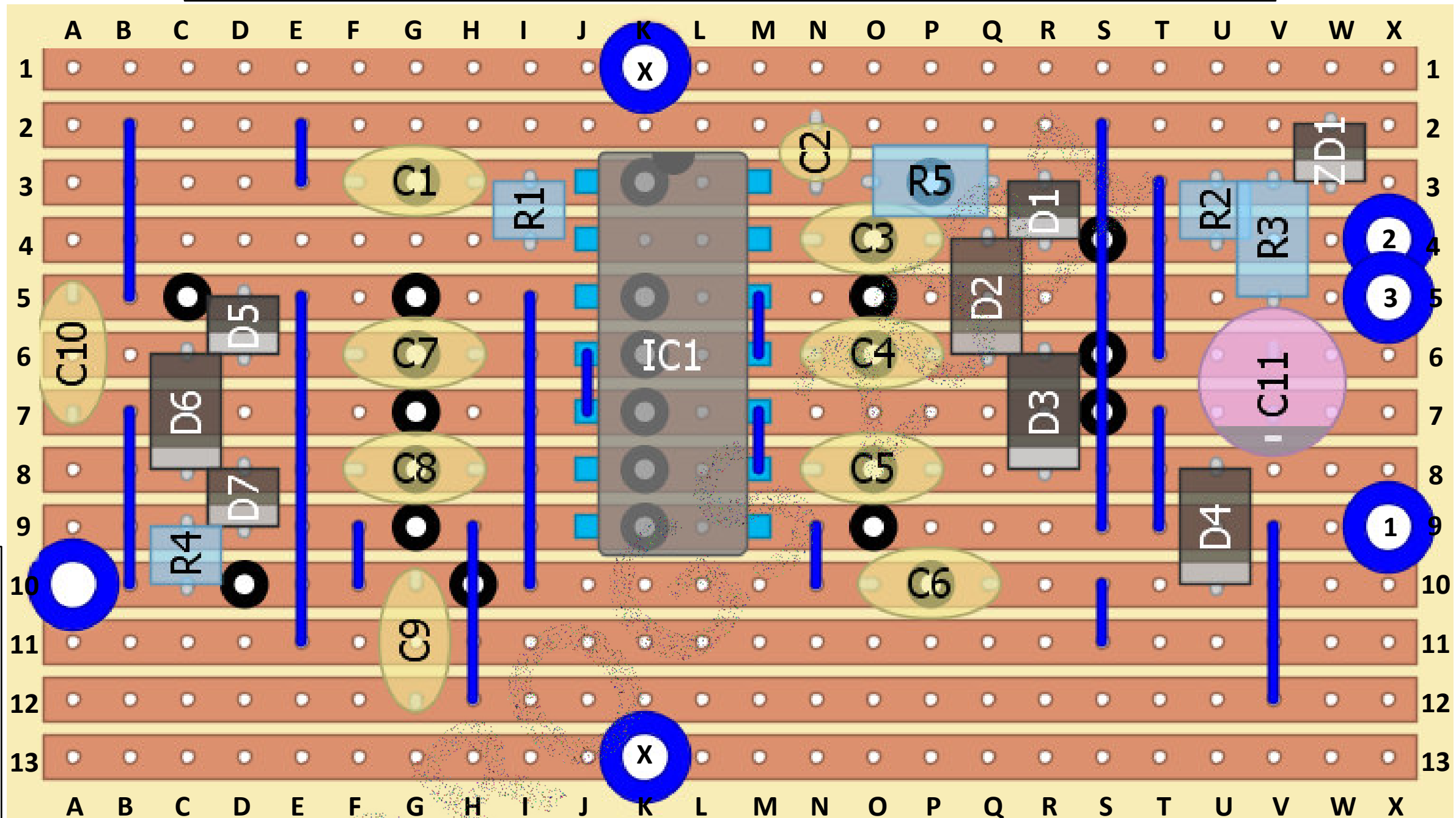
© rogs 12.21

Fit wire links to the 16 locations listed below:

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

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

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



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

© rogs 12.21

Fit the components to the locations listed below:

- | | | |
|-------------------------|--------------------------------------|------------------------------|
| • C1 1nF mlc (F3,H3) | • C9 100nF mlc (G10, G12) | • Diodes D1-D7 are 1N4148 |
| • C2 100nF mlc (N2,N3) | • C10 100nF mlc (A5, A7) | (anode location 1st) |
| • C3 10nF mlc (N4,P4) | • C11 47uF 35v elec (V6+,V7) | • D1 (R3,4) • D2(Q4,6) |
| • C4 10nF mlc (N6,P6) | Resistors are 1/8w metal film | • D3 (R6,8) • D4 (U8,10) |
| • C5 10nF mlc (N8,P8) | • R1 10k (I3, I4) | • D5 (D5,6) • D6 (C6,8) |
| • C6 10nF mlc (O10,Q10) | • R2 27k (U3, U4) | • D7 (D8,9) |
| • C7 10nF mlc (F6,H6) | • R3 27k (V3, V5) | • ZD1 12v 500mW zener (W2,3) |
| • C8 10nF mlc (F8,H8) | • R4 1M (C9, C10) | |
| | • R5 (SOT - see notes) (O3,Q3) | • IC1 40106 (Pin1 - J3) |

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