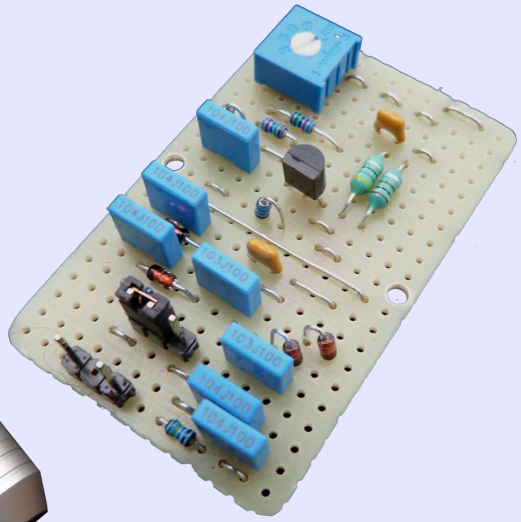
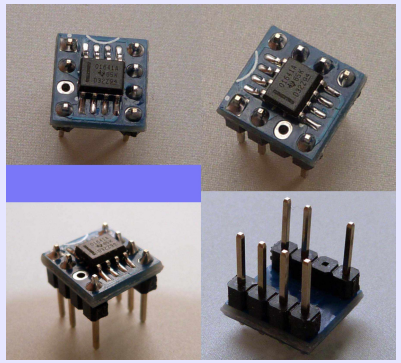
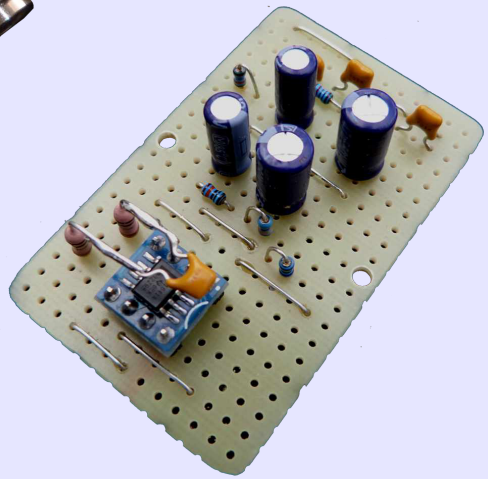
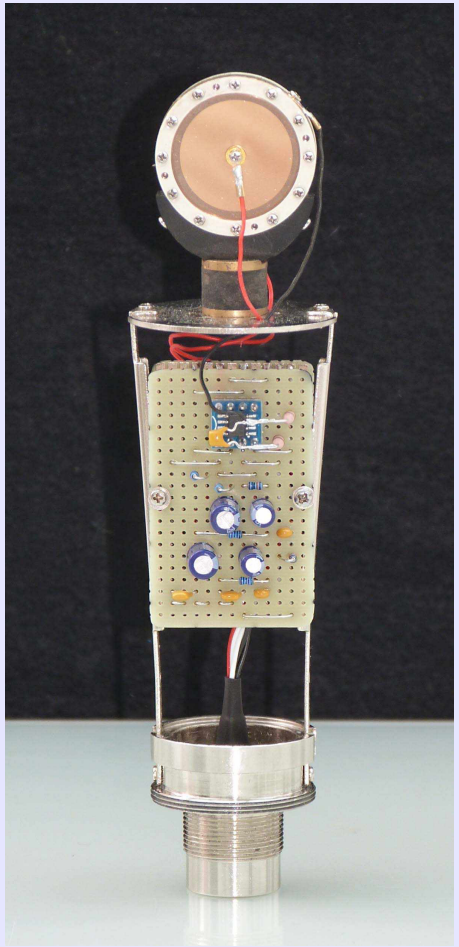
• OPIC 45: Op-amp Impedance Converter - with Adjustable Dual Output Voltage Multiplier •

- *Multi-pattern Version for Dual Sided LDC capsules*
- *Updated strip boards – simplified construction*
- *Designed to fit into a U87 or BM800 style body*

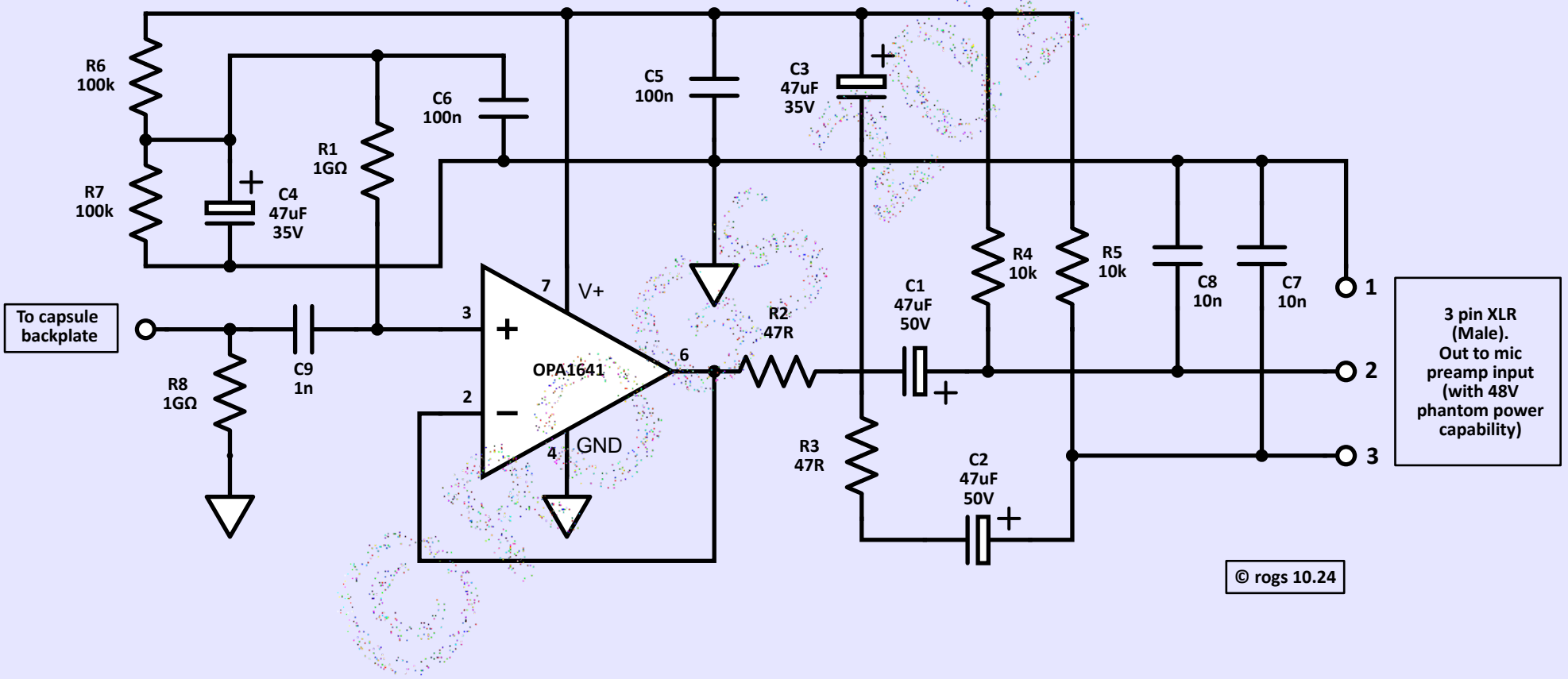








• OPIC.45 – For multi-pattern use with dual polarity VM •



OPIC.45

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 OPA1641 op-amp offers low noise, low quiescent current and very low distortion, making it ideal for this task.

The op-amp is used here to provide a single sided audio output, which is impedance balanced passively, to help optimise the common mode rejection ratio (CMRR) when used with a balanced input microphone pre-amplifier, which has 48v phantom power.

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 feed resistors R4 and R5 - together with the de-coupling capacitors C3 and C5 - will allow a smoothed supply voltage of around 22v to be presented to pin 7 of the op-amp.

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.

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

This 'half rail' voltage is required to bias the op-amp, so that the output can swing symmetrically around this reference voltage.

This half rail voltage is fed to the non-inverting input of the op-amp via R1, a high value 1GΩ resistor used as part of the very high input impedance circuitry required for this type of capsule.

A second 1GΩ resistor - R8 - together with the coupling capacitor C9 allows the microphone capsule to be referenced to ground, rather than the half rail voltage at the amplifier input.
This will allow for a dual polarisation voltage of equal positive and negative values to be applied across each side of the capsule.

The LDC capsule used with this circuit is double sided, to allow for multi pattern options, each side of the capsule being supplied with either a positive or negative DC voltage.
This voltage is normally generated from a separate dual DC voltage multiplier, fitted within the microphone.
(see OPIC.45 project notes for details of the dual DC voltage multiplier)

Both sides of the 48v phantom power are used to supply the op-amp, via R4 and R5. Each leg provides around 1mA of current to the op-amp.

The op-amp audio output (pin 6) is connected via R2 and C1 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 C2 provide a 'passively balanced' output to pin 3 (cold) of the XLR connector, to match the impedance of the active audio output on pin 2 (There is no audio output to pin 3).
This helps to maintain the Common Mode Rejection Ratio (CMRR) of the balanced output.

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

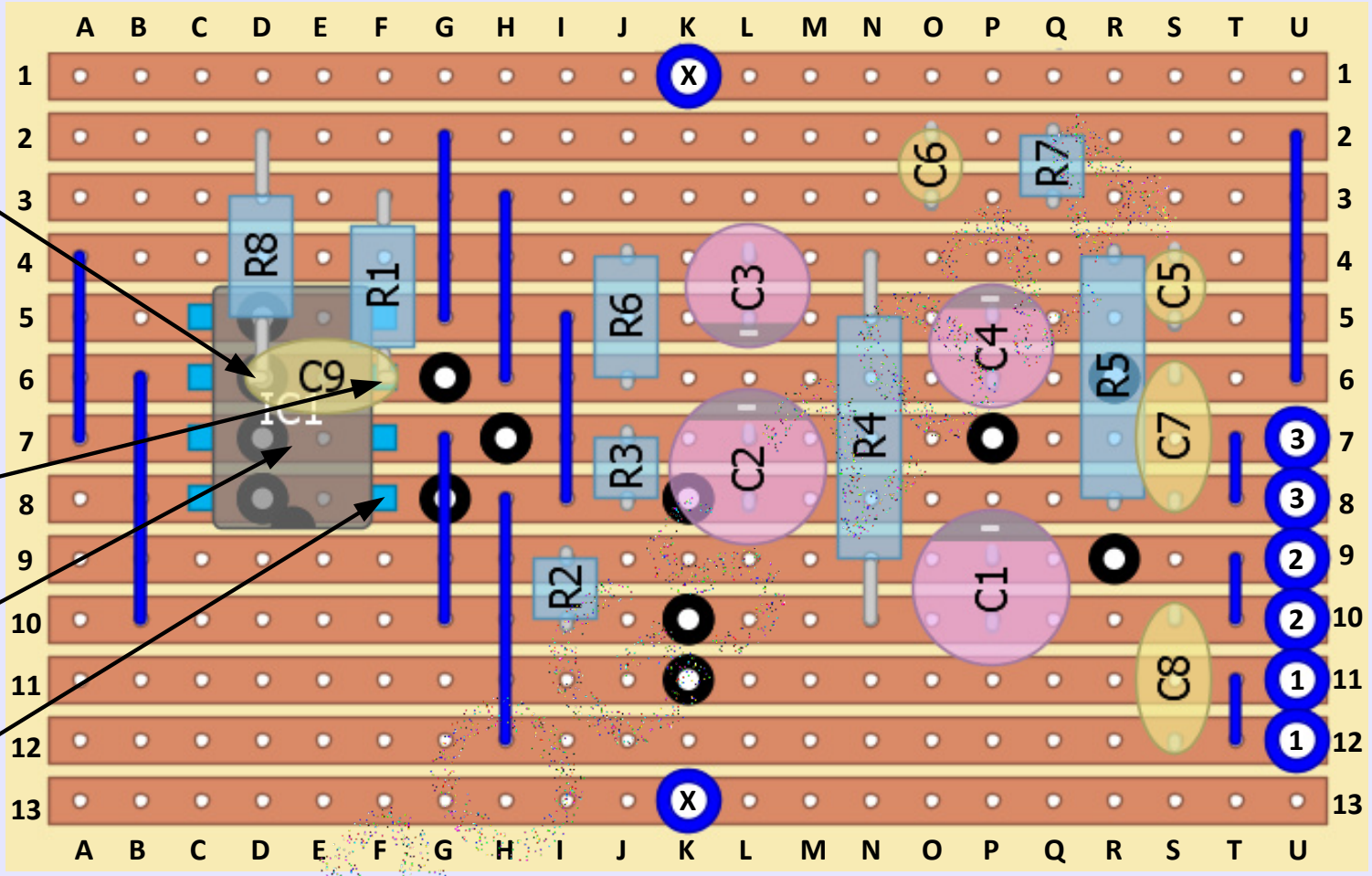
Mic Capsule: Backplate terminal connection to R8/C9 junction (above op-amp).

• R1: connect to adaptor pin 3.

• C9: solder to R1 leg (above op-amp).

• IC1: SOIC to DIP Adaptor. DO NOT CONNECT PIN 3 TO THE STRIPBOARD

NOTE IC1 Orientation : Pin 1 to F8



Connections 1,2 and 3 are out to 3 pin XLR

(Connections are 'double padded' for easier termination)

OPIC.45 – stripboard

Complete stripboard component layout

•• VIEWED FROM COMPONENT SIDE ••

- K1 and K13 (marked 'X') are mounting holes
- 11 x TCW links (marked as blue lines)
- 13 x 'spin off' track cuts (marked as black and white dots)

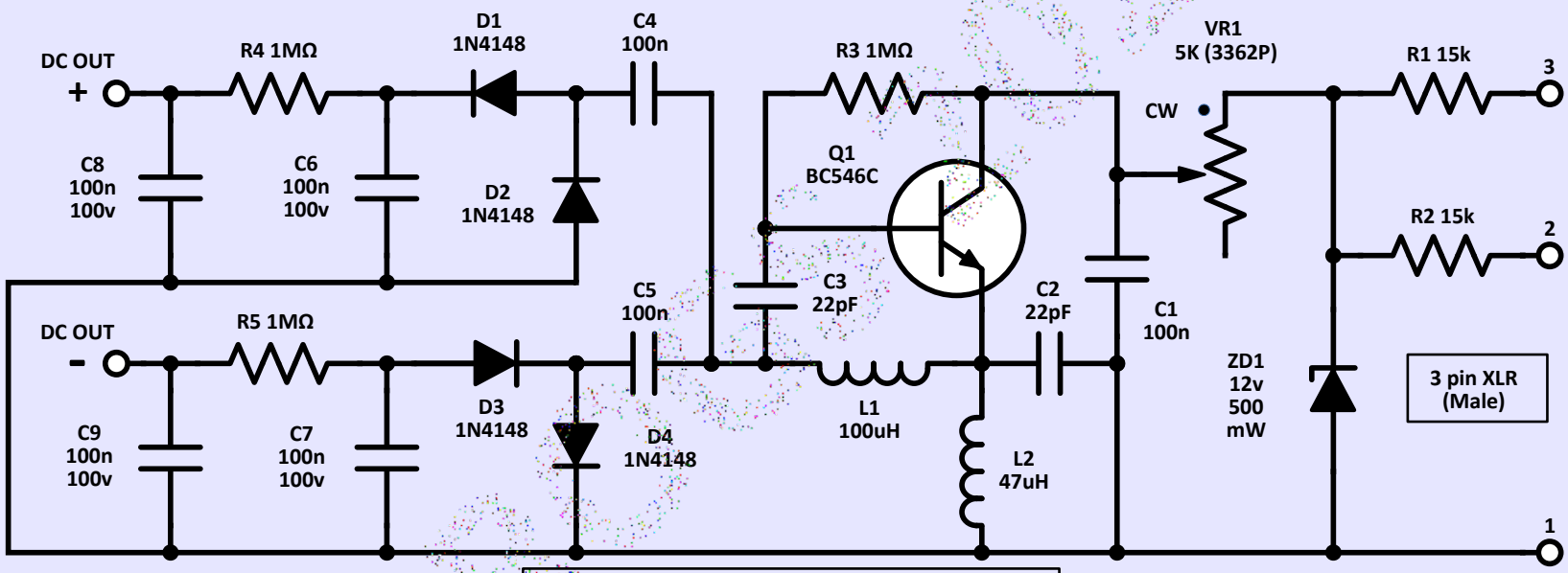
Components:

- C1, C2 47uF 50V
- C3, C4 47uF 35V
- C5, C6 100n X7R mlc
- C7, C8 10n X7R mlc
- C9 1n X7R mlc

All resistors (except R1,R8) are MF12 1/8th watt metal film

- R1 & R8 1GΩ (10%) (RGP0207CHK1G0 or similar)
- R2, R3 47R
- R4, R5 10k
- R6, R7 100k
- IC1 OPA1641 (via adaptor) (Pin1 to F8)

• OPIC 45: HARTLEY OSCILLATOR ADJUSTABLE DUAL VOLTAGE MULTIPLIER •



Typical results with component values shown:

- **Output voltages: c. ±55v to ±95v**
  (Adjust using VR1 - max volts clockwise (CW))
- **Oscillator frequency: c. 2MHz**
- **Current: c. 2.5mA**

OPIC.45 - Adjustable Dual Voltage Multiplier

Overview:

The circuitry shown in this schematic is designed to provide dual polarity high voltage DC outputs - adjustable between ±55v and ±95v - to be applied as the opposite polarisation voltages required by each membrane of a dual sided conventional large diameter condenser microphone capsule.

This will enable 3 alternative response patterns - Omni, Figure of 8 or Cardioid - to be selected for the microphone.

DC power to the circuitry is supplied from the 48v phantom power of the connected mic pre-amp. About 2.5mA will be drawn by this circuit.

Circuit description:

This particular circuit is based on a Hartley oscillator, the output of which is coupled to 2 x voltage doubling circuits, one of which provides a positive output voltage, the second a negative one.

There are a number of alternative possible configurations for a Hartley oscillator. The one chosen for this project follows the format used by Schoeps, in their famous 'CMC5' microphone schematic.

There are many online technical items on Hartley oscillators. The notes here:

https://learnabout-electronics.org/Oscillators/osc21.php

provide some interesting insights, particularly regarding mutual coupling of the inductors, which can play an important role in the layout of the oscillator components.

In this schematic, a Hartley oscillator running at c.2MHz is formed by the components connected to Q1. The amplitude of the oscillator output, which is taken from the junction of L1 and C3, will be a sine wave that will vary in amplitude between c.55v and 95v (p-p), depending on the position of VR1.

Notice the positions of the 2 inductors L1 and L2 on the stripboard. Although not critical, it is recommended that the inductors are laid with the same orientation, in adjacent 0.1" stripboard rows. That should provide for an appropriate level of mutual inductive coupling between the inductors, for reliable oscillator operation.

The oscillator output is fed - via C4 - to the junction of D1 anode and D2 cathode. D1 and D2 - in conjunction with C4 and C6 - form a voltage doubling circuit, which will produce a rectified DC output of between +55v and +95v at D1 cathode.
R4 and C8 act as a low pass filter, to allow a smoothed DC voltage to be present at the junction of those two components. This DC output is connected to one membrane of the capsule.

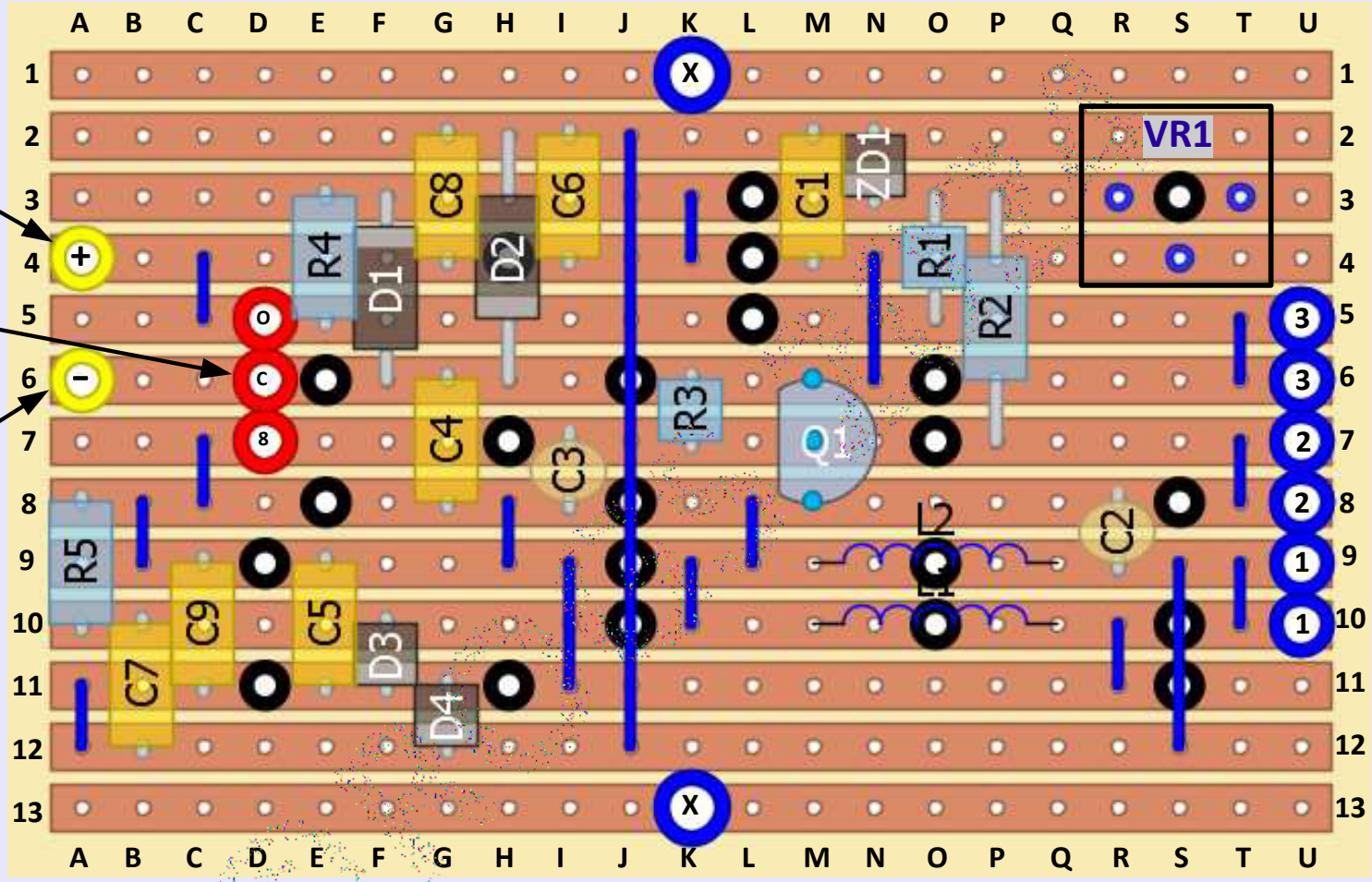
The oscillator output is also fed - via C5 - to the junction of D3 cathode and D4 anode. The same voltage doubling process takes place, using C5 and C7, but this time creating a negative DC output, because of the reverse orientations of D3 and D4.
In this case R5 and C9 act as the low pass filter. The negative DC output is connected to the other membrane of the capsule.

Note that capacitors C6,7,8 & 9 need to be rated at 100v rather than the more common 63v type that can apply to other capacitors in this circuit.

R1 and R2 will feed both legs of the 48 v phantom power from the mic pre-amp to the cathode of ZD1. The regulated 12v DC supply from this point is fed - via the adjustable resistor VR1 - to the collector of Q1.
C1 serves to decouple this supply.
The variable DC available at this point will determine the amplitude of the oscillator output, and the value of the final DC outputs as a result.

To determine the actual value of DC being supplied to the output, it is recommended that DMM measurements are taken from either D1 cathode or D3 anode, and not from the actual output terminations themselves. This will minimise the effect the impedance of the DMM has on the observed voltage readings.

OPIC.45: Hartley Oscillator Adjustable Dual Voltage Multiplier - Stripboard Layout •• VIEWED FROM COMPONENT SIDE ••



DC to capsule (front side)

Pattern Select Links
- O-C = Omni
- C-8 = Fig of 8
- No Link = Cardioid

DC to capsule (rear side)

Connections 1,2 and 3 are out to 3 pin XLR

(Connections are 'double padded' for easier termination)

- K1 and K13 ('X') are mounting holes
- 16 x TCW wire links - TCW25 or similar (marked as blue lines on schematic)
- 22 x track cuts – 'spin off' with track cutter or drill bit (marked as black & white dots on schematic)
- *Do not forget track cut under D2 (H4)*

Components:

Semiconductors:
- Q1: BC546
- D1,2,3 & 4: 1N4148
- ZD1: 12v 500mW Zener Diode

Inductors (Bourns 78F or similar):
- L1: 100uH
- L2: 47uH

Capacitors:
- C1,4,5,6,7,8 & 9: 100nF 100v PET box cap (0.2")
- C2,C3: 22pF ceramic (0.1")

Resistors (all 1/8w metal film):
- R1 & 2: 15k
- R3,4 & 5: 1M
- VR1: 5K (Bourns type 3362P or 3386P)