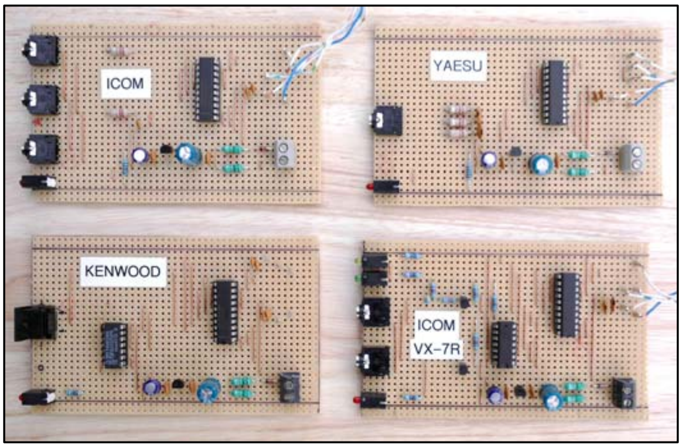
# CATbox a Modular Computer Interface

by Bas Helman G4TIC

## Introduction


CATbox is a modular computer aided transceiver (CAT) interface system comprising four stand-alone matrix board cards. One, or at most two, of these cards can be contained in a Hammond box – the CATbox. The cards are a slide-in fit to enable all the construction work to be completed outside of the box. A constructor can choose to build one to four boards depending on requirements. The Kenwood card is in prototype form and has not been fully tested. A box able to contain two cards was chosen to allow a pair of rigs to be controlled simultaneously. All the cards are powered from an external power supply of between 9 and 15V.

A MAX233 chip and a regulated power supply are common to all the cards. The MAX233 chip solves the problem of converting from the rig's TTL computer interface voltages to those of the RS232 connection on the computer. The MAX233 chip is a line driver/receiver designed for the RS232 interface. The detailed properties of the IC can be downloaded in .pdf format from http://www.maxim-ic.com .

In a previous article, I described computer interfaces for ICOM, TEN-TEC and YAESU rigs which were powered from the RS232 port of a computer. Whilst these designs have proven effective, they do have some inherent weaknesses.

- Some laptops will not provide sufficient power to the circuit from the port
- The circuits were not bypassed for RF
- The designs only allowed one rig to be connected at a time

CATbox is an attempt to overcome some of these weaknesses.
Software for use with these interfaces is available free from the internet and is covered in the final section.

## Overview

The CATbox system comprises the following four cards:

1. ICOM and TEN-TEC HF rigs (up to three machines of one make can be connected)
2. YAESU HF rigs
3. ICOM and TEN-TEC HF and Yaesu VX-7R VHF / UHF Handheld. This card can accommodate two HF rigs by the same manufacturer and, using suitable software, the memories and band coverage of the handheld can be reprogrammed. Other handhelds in the Yaesu range may also work with this interface but have not been tested.
4. KENWOOD HF rigs card is under development

These circuits have been built on matrix board to simplify construction and detailed circuit diagrams, matrix board layouts, component lists and photographs are included to aid occasional or novice constructors.

Whilst every effort is made to ensure accuracy and consistency between circuit diagrams, matrix board layouts and the final photograph, the latter, except in the case of the Kenwood, is taken from a working example and should be referred to in order to resolve any queries.

The only test equipment you should require is a multi-meter to check resistance, voltages and continuity.

The completed project has been tested on an ICOM 7400, Yaesu 817 and a Yaesu VX-7R.

Whilst three of the cards have been tested individually over a number of weeks the possible interactions between pairs of boards has not been fully explored. There are twelve possible permutations given four cards!

## *Matrix Board*

A few tips for those of you unfamiliar with matrix board.

- Mark out the size of board you require
- Score both sides of the board with a craft knife
- Snap to break to length
- Alternatively use a model maker’s saw
- Remove the rough edges with a knife or a file
- Before mounting any components clean the copper tracks with a BrilloPad and dry

The only special tool required for constructing with matrix board is a device for cutting the copper tracks.  In the UK a spot face cutter is available from Maplin's, at a price.  Fortunately, there are convenient and cheaper alternatives.  For example a 3.2mm drill bit set into a piece of dowelling makes a very effective tool.  A soldering iron tip of 2.5mm is ideal for these projects.

## Construction

The cards are built on a piece of matrix board 29 tracks wide and approximately 47 columns long.  The precise length will depend on the projection of the shoulders of the sockets which mate with the end plate of the Hammond box.  Cut the matrix board over-long and temporarily place a socket at one end.  Slide the card into place in the box and mark the required length.  The box used was the Hammond 1455 Series measuring 120mm long by 81mm wide and 46mm high with plastic end plates.  The alternative design with aluminium endplates and a plastic bezel should be avoided to simplify construction.

The usual order of construction is to start with the lowest profile components and work systematically to those of the highest profile. With these circuits it is easier to start by placing sockets and LEDs and then work towards the other end of the board.

Remove any unnecessary plastic location tabs from beneath the sockets and LEDs before you superglue them in place.  Encapsulated LEDs have been used in this project.  However, standard LEDs bent at right angles to be parallel with the board would serve equally well.  The chokes L3, L4 and L5 are customarily 1uH but, in the best amateur tradition, having a box of 2.2uH I used these instead.  Similarly, having some 74HC04's to hand I used these instead of 74LS04's.

For maximum reliability, the chips should be soldered to the matrix board.  However, I have used turned pin sockets to allow easy removal and replacement.

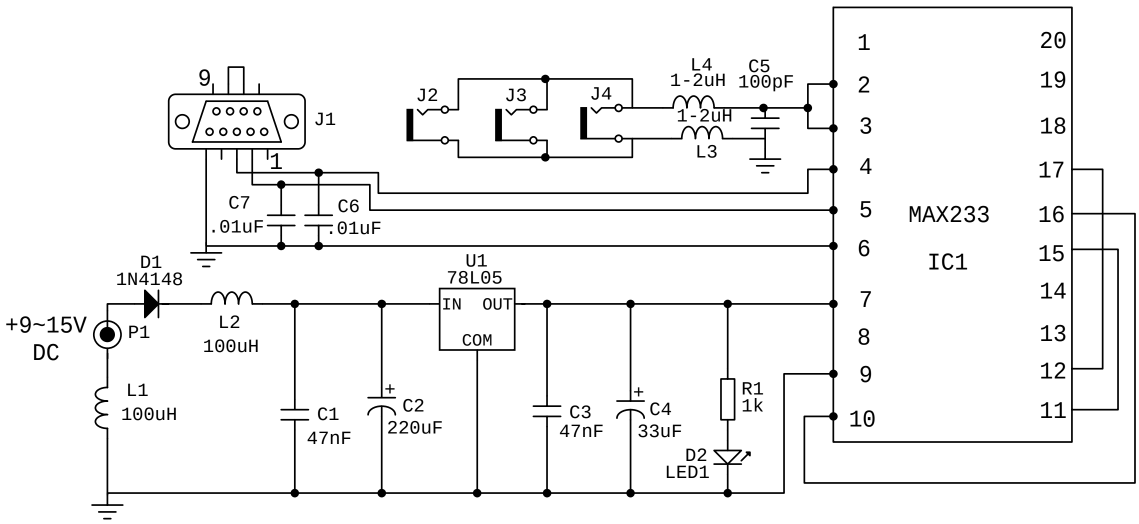
Anyone who believes that life is too short to count holes in matrix board please go to the section on ugly construction at the end of the article.

# Card 1 The ICOM & TEN-TEC Interface

## *Comment*

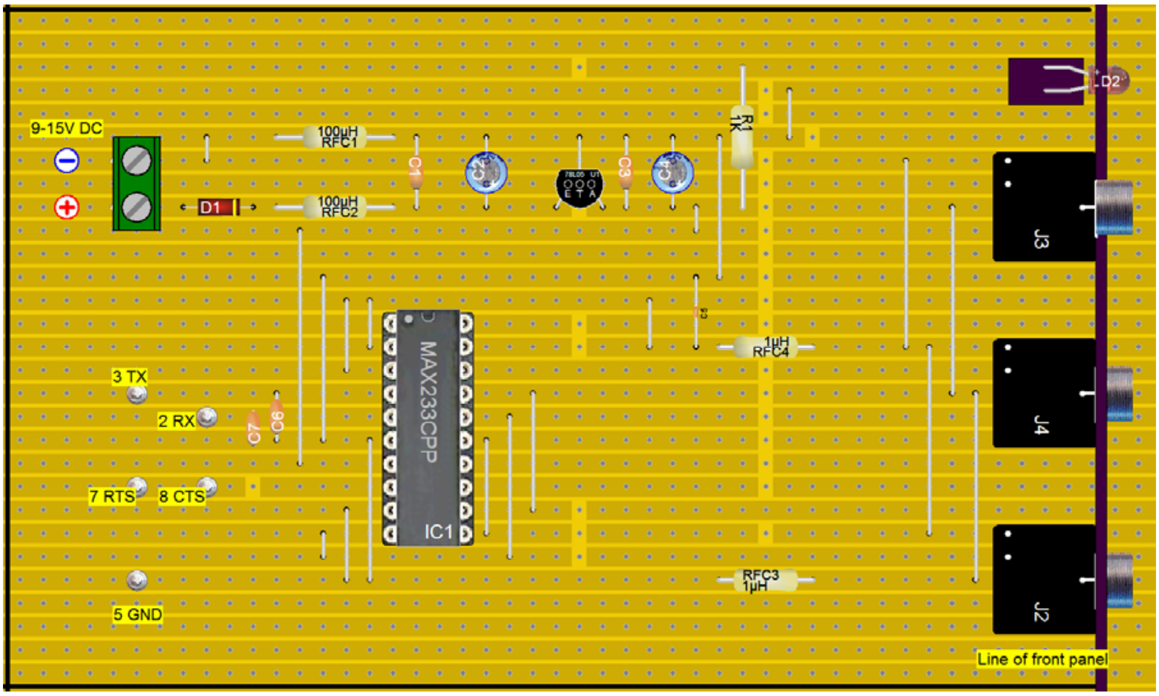
ICOM and Ten-Tec both use a carrier-sense multiple access collision detect (CSMA/CD) bus. More than one rig can be attached to this design.

## Circuit diagram

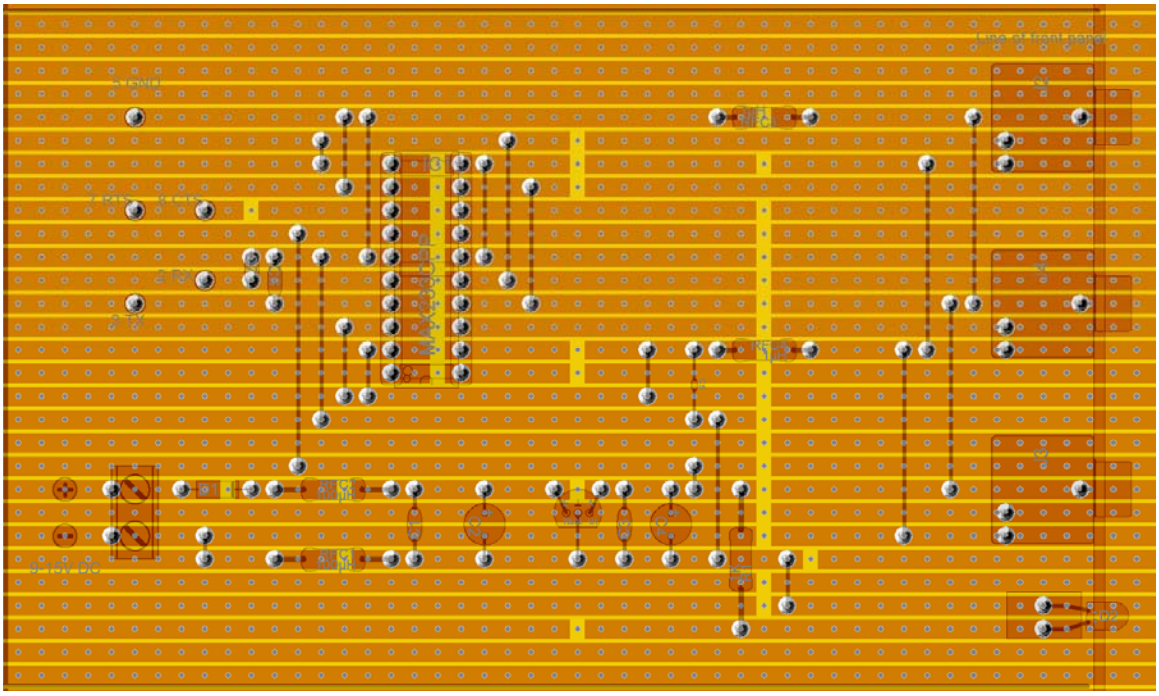


## The Matrix Board Layout

Component side:-



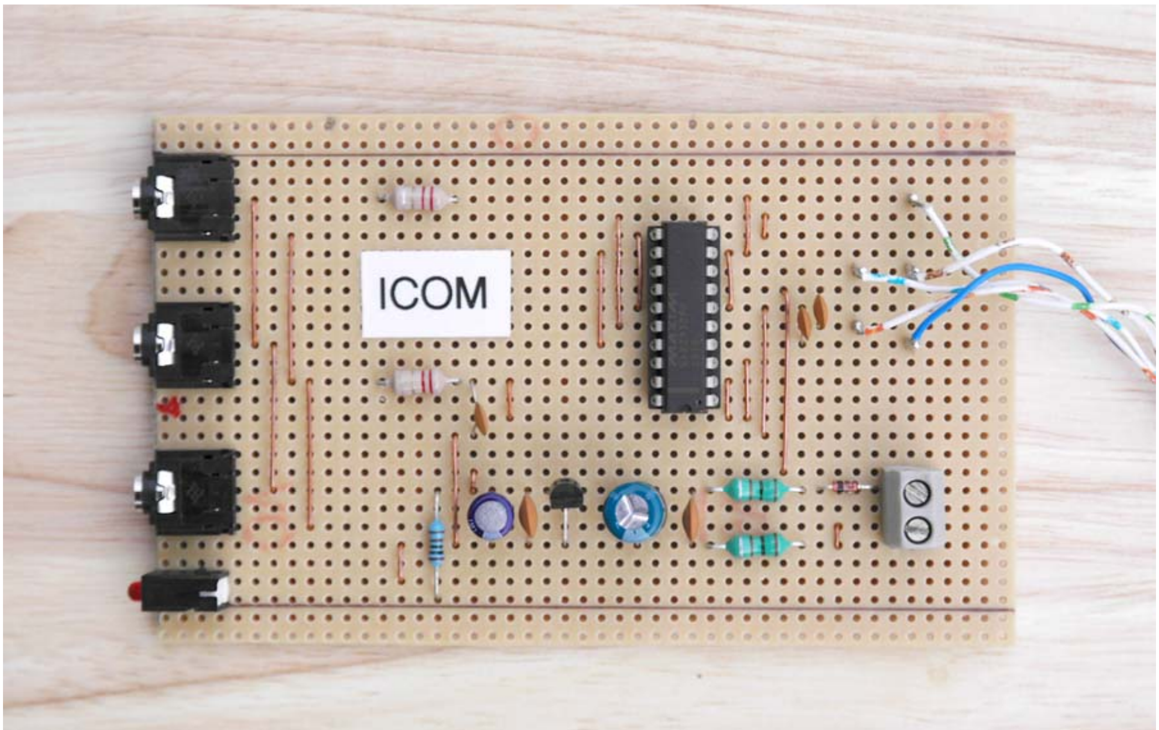

Solder side:-



Component List:-

| | |
|---|---|
| J1 | Screw terminal, double |
| J2 | 3.5mm Mono jack |
| J3 | 3.5mm Mono jack |
| J4 | 3.5mm Mono jack |
| IC1 | DIL20, MAX233CPP |
| SC1 | Socket DIL20 |
| U1 | Voltage regulator, positive 100mA, 78L05 |
| C1 | Ceramic, 47nF |
| C2 | Electrolytic capacitor, 220 µF |
| C3 | Ceramic, 47nF |
| C4 | Electrolytic capacitor, 33µF |
| C5 | Ceramic capacitor, 100pF |
| C6 | Ceramic, 10nF |
| C7 | Ceramic, 10nF |
| R1 | Resistor, 1K |
| D1 | SI-diode, 1N4148 |
| D2 | LED 3mm, red |
| RFC1 | Inductor, 100µH |
| RFC2 | Inductor, 100µH |
| RFC3 | Inductor, 1µH |
| RFC4 | Inductor, 1µH |

***Photograph of completed board.***

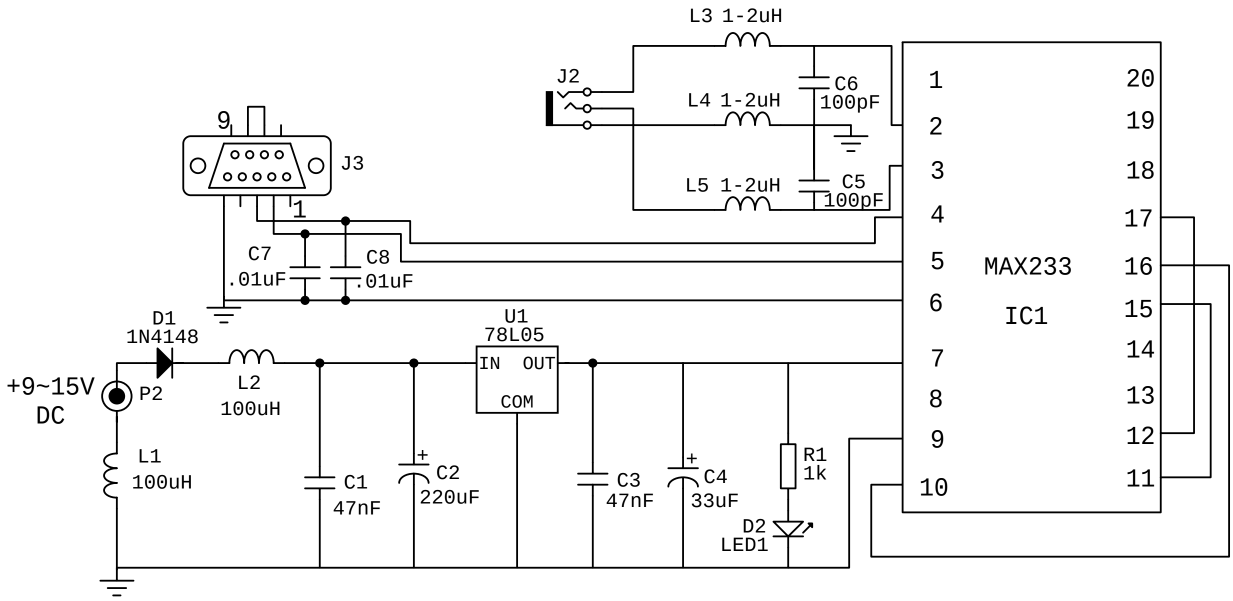


# Card 2 The Yaesu Interface

## *Comment*

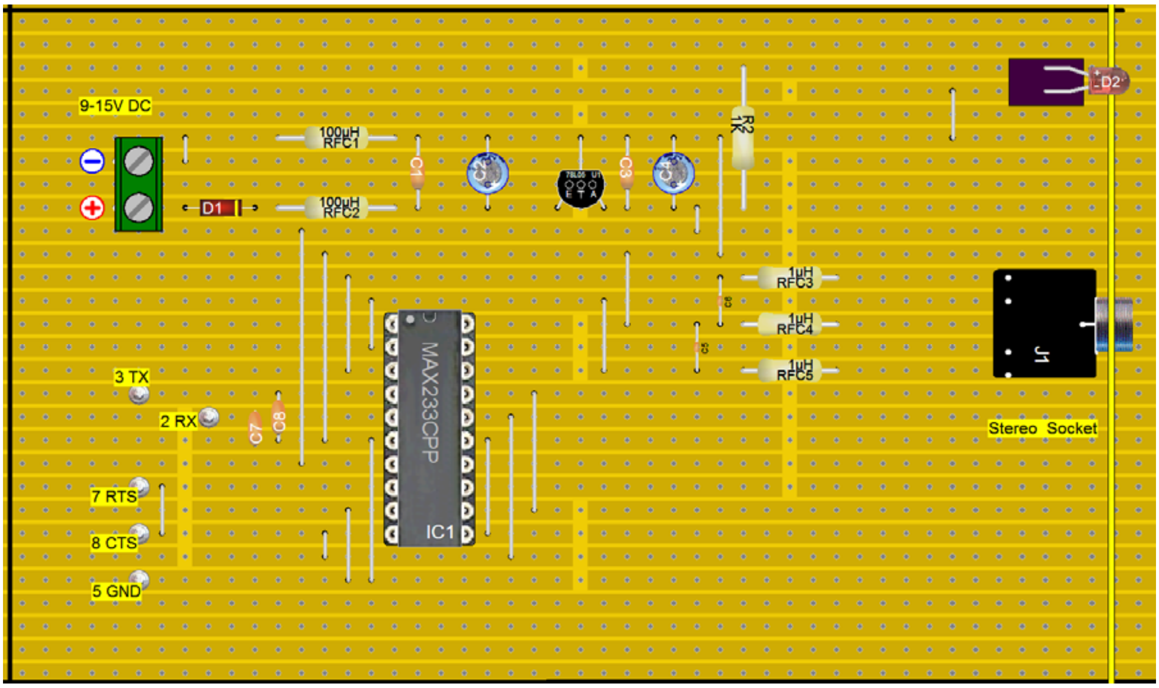
The only difference between this and the ICOM interface is the separation of the RX and TX lines to the rig.

## Circuit diagram

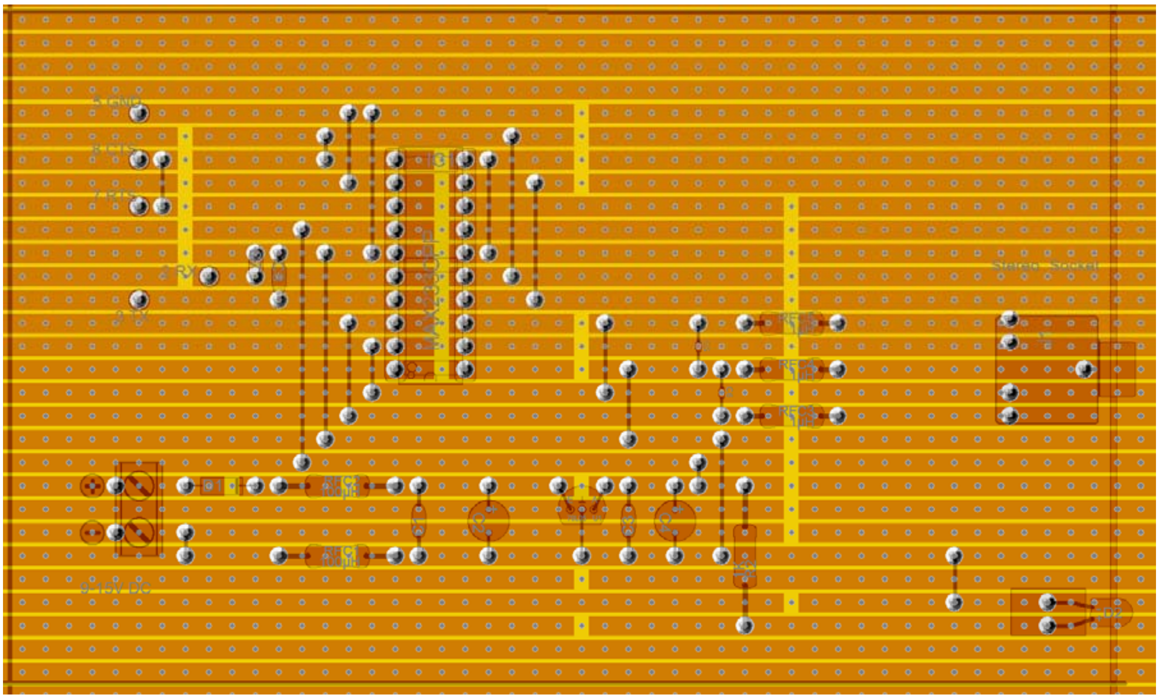


## The Matrix Board Layout

Component side:-



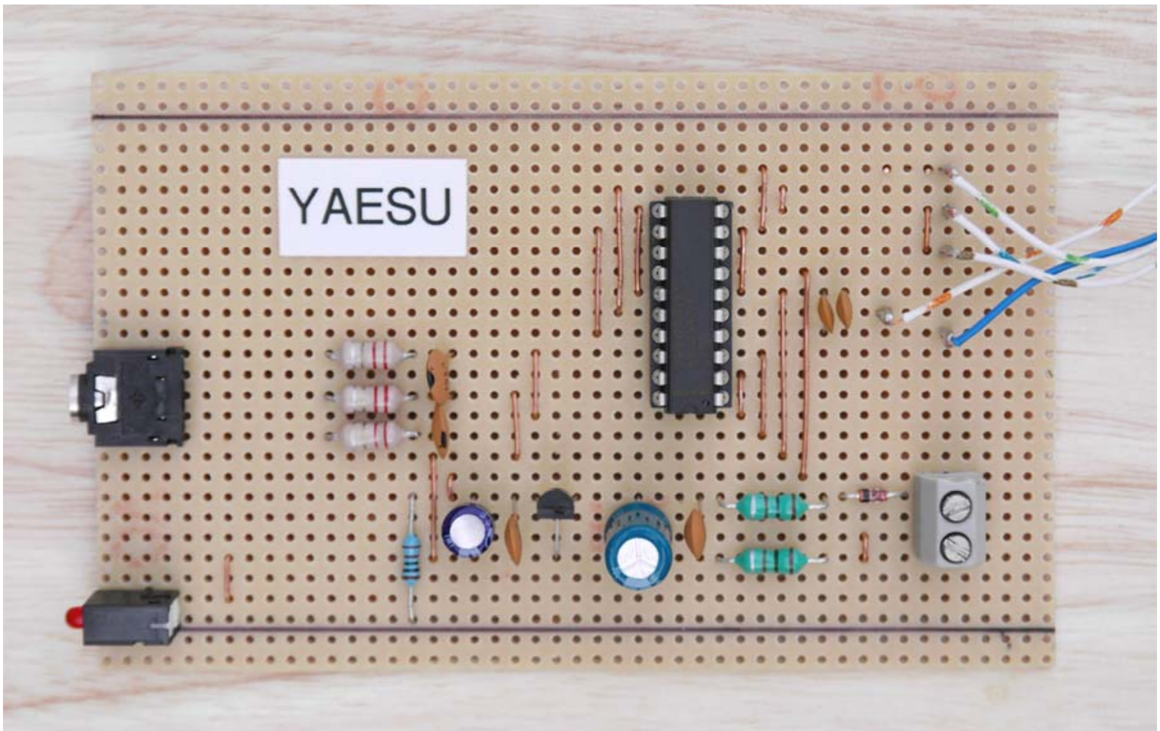

Solder side:-



Component List:-

| | |
|---|---|
| ST1 | Screw terminal, double |
| J1 | 3.5mm Stereo jack |
| IC1 | DIL20, MAX233CPP |
| SC1 | Socket DIL20 |
| U1 | Voltage regulator, positive 100mA, 78L05 |
| C1 | Ceramic, 47nF |
| C2 | Electrolytic capacitor, 220 µF |
| C3 | Ceramic, 47nF |
| C4 | Electrolytic capacitor, 33µF |
| C5 | Ceramic, 100pF |
| C6 | Ceramic, 100pF |
| C7 | Ceramic, .01uF |
| C8 | Ceramic, .01uF |
| R1 | Resistor, 1K |
| D1 | SI-diode, 1N4148 |
| D2 | LED 3mm, red |
| RFC1 | Inductor, 100µH |
| RFC2 | Inductor, 100µH |
| RFC3 | Inductor, 1µH |
| RFC4 | Inductor, 1µH |
| RFC5 | Inductor, 1µH |

***Photograph of completed board.***



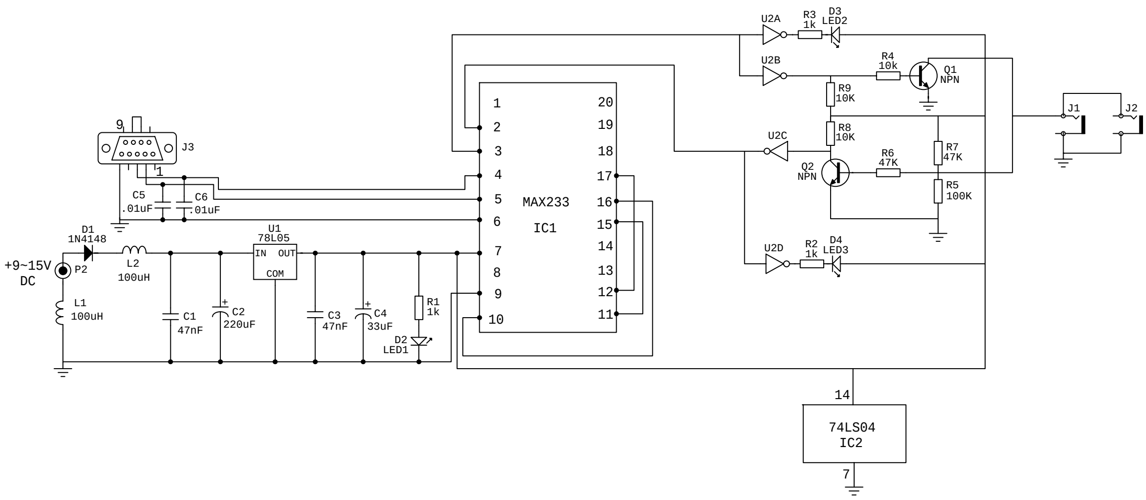
# Card 3   The ICOM, TEN-TEC and Yaesu VX-7R Interface

## *Comment*

Two rigs of the same manufacturer can be attached to this design.  The Yaesu handheld is much more demanding than the HF rigs hence the additional amplification and buffering.

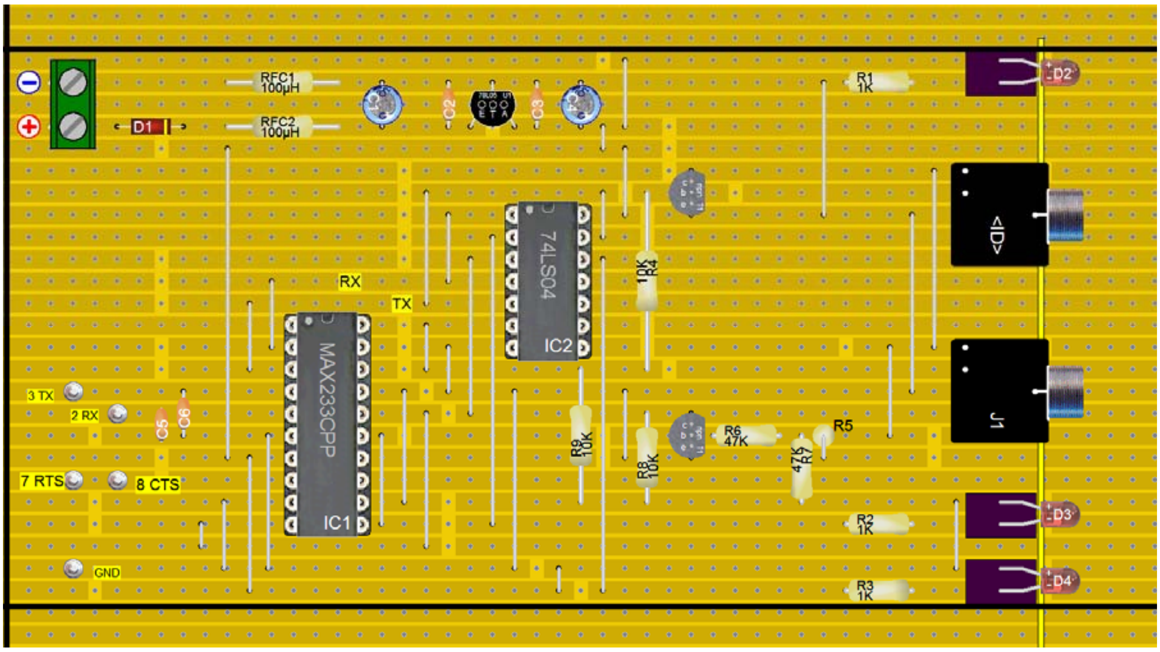
The transistor pinout is illustrated in the photograph.

## Circuit diagram

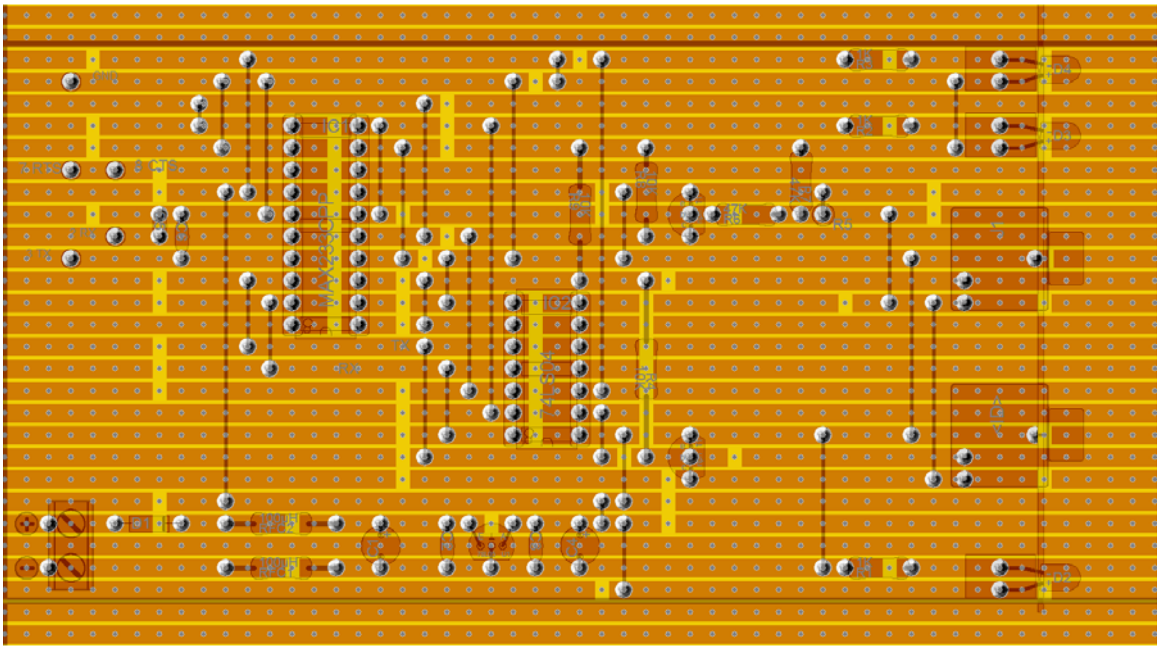


## The Matrix Board Layout

Component side:-



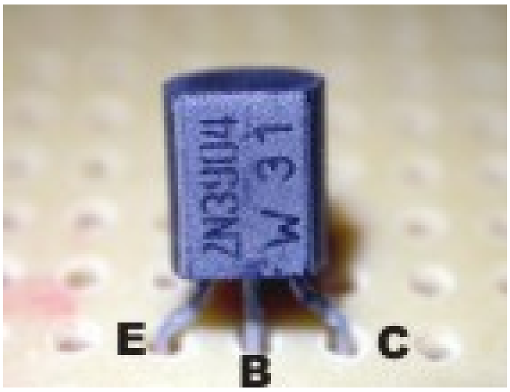

Solder side:-



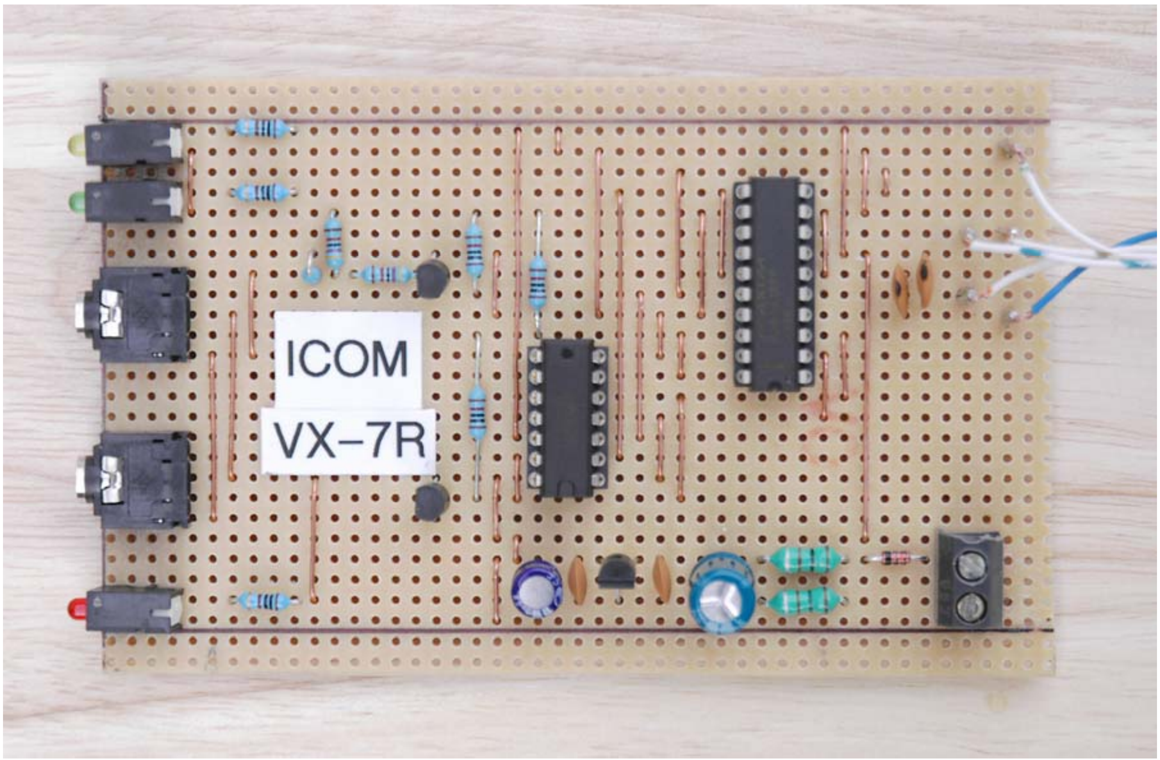
## Component List:-

| | |
|---|---|
| ST1 | Screw terminal, double |
| IC1 | DIL20, MAX233CPP |
| IC2 | DIL14, 74LS04 |
| S U1 | Voltage regulator, positive 100mA, 78L05 |
| C2 | Socket DIL14 |
| SC4 | Socket DIL20 |
| R1 | Resistor, 1K |
| R2 | Resistor, 1K |
| R3 | Resistor, 1K |
| R4 | Resistor, 10K |
| R5 | Resistor, 100K |
| R6 | Resistor, 47K |
| R7 | Resistor, 47K |
| R8 | Resistor, 10K |
| R9 | Resistor, 10K |
| Q1 | TO-92, npn 2N3904 |
| Q2 | TO-92, npn 2N3904 |
| RFC1 | Inductor, 100µH |
| RFC2 | Inductor, 100µH |
| D1 | SI-diode, 1N4148 |
| D2 | LED 3mm, red |
| D3 | LED 3mm, green |
| D4 | LED 3mm, yellow |
| J1 | 3.5mm Stereo jack, PCB |
| C1 | Electrolytic capacitor, 220uF |
| C2 | Ceramic, 0.1uF |
| C3 | Ceramic, 0.1uF |
| C4 | Electrolytic capacitor, 33µF |
| C5 | Ceramic, 0.01uF |
| C6 | Ceramic, 0.01nF |

## 2N3904



***Photograph of completed board.***

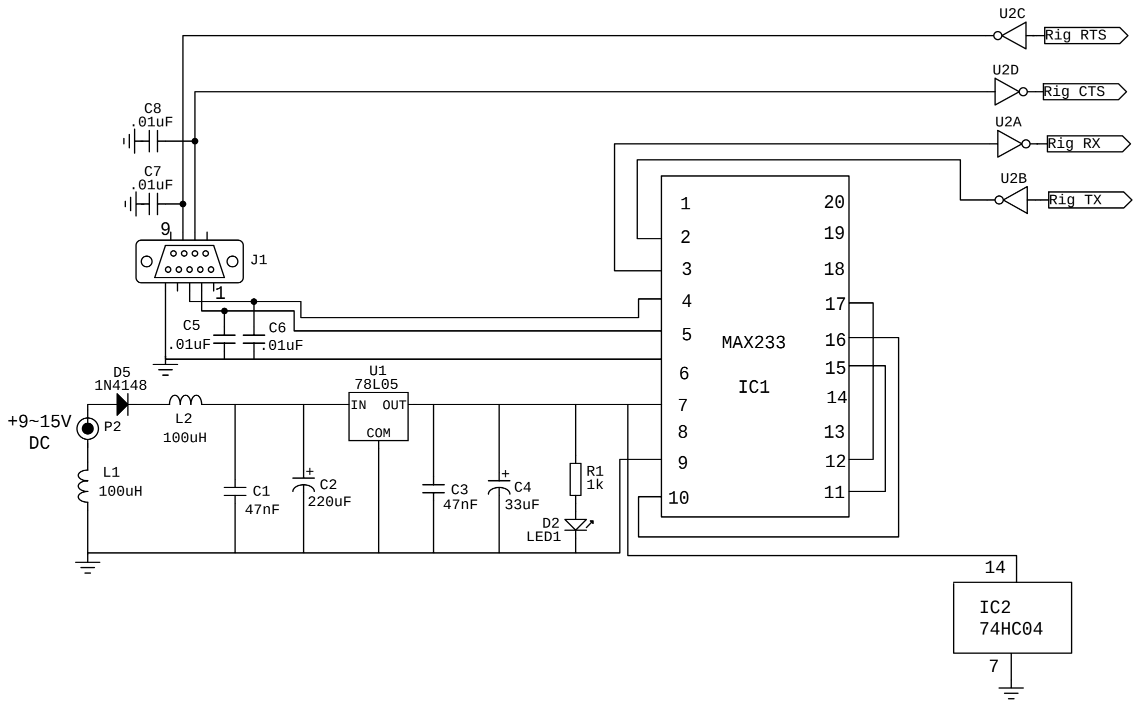


# Card 4 The Kenwood Interface

## *Comment*

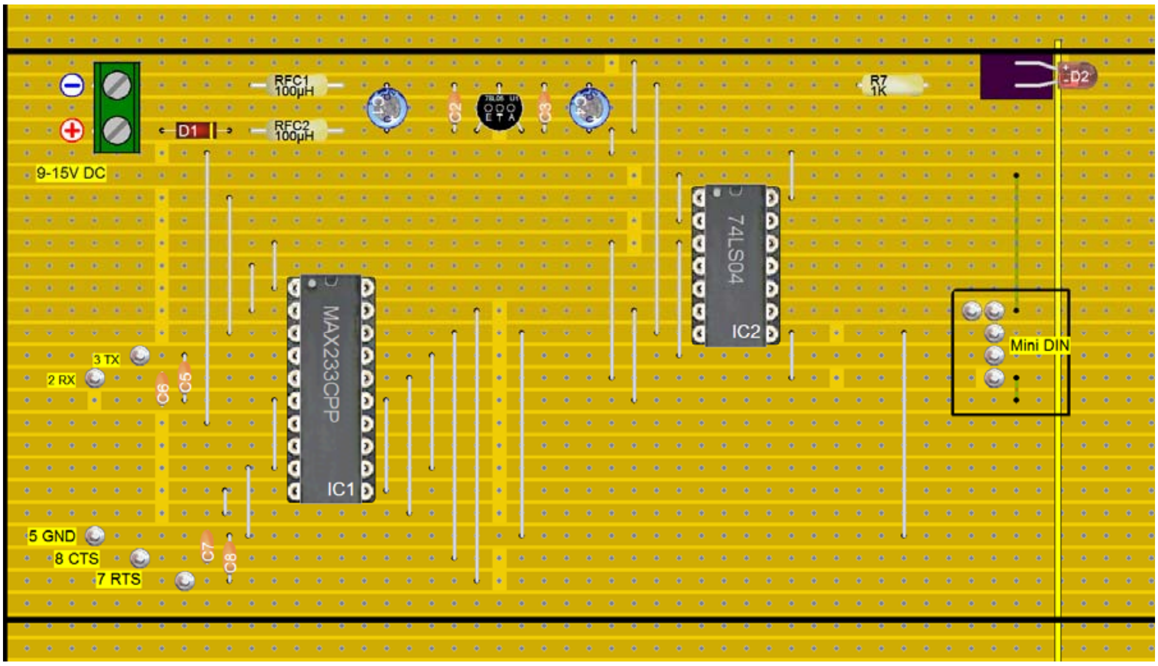
The Kenwood card is at the prototype stage and although a full description is included it has not been fully tested. However, the circuit is known to work. The Kenwood interface differs from the other three in two respects; the logic is 'active low' and RTS and CTS are implemented. The services of a local Kenwood owner are being sought to help with the testing. If anyone is brave enough to build it would they please email me their experiences.

## Circuit diagram



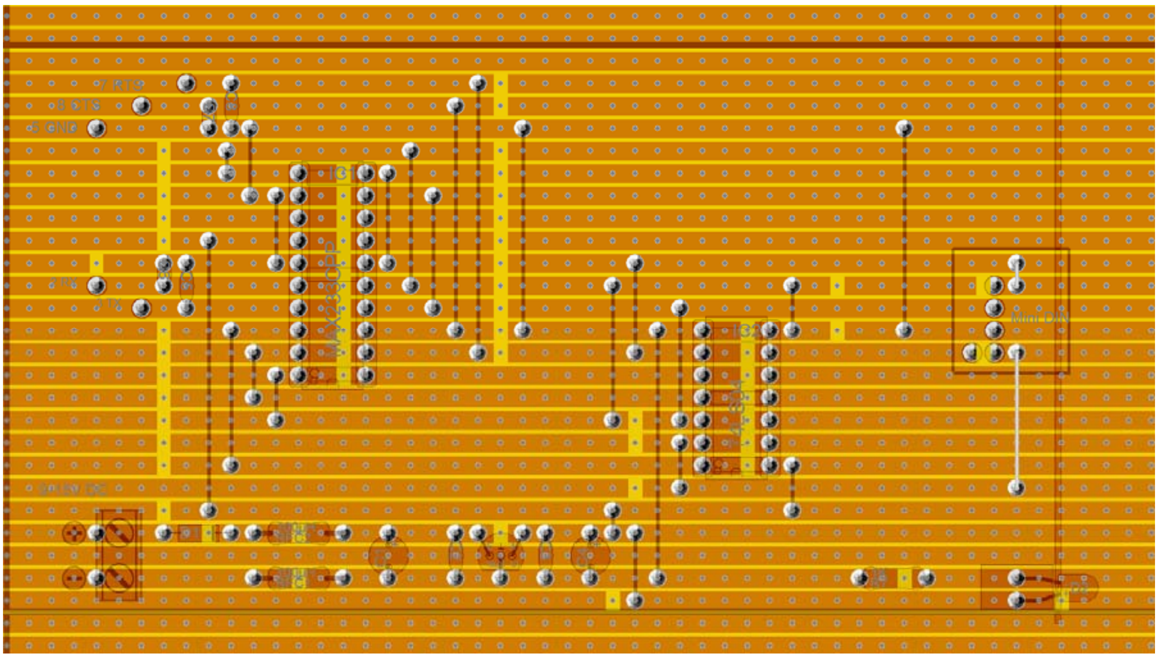
## The Matrix Board Layout

Component side:-




N.B. There are two links on the underside of the board from the mini din plug.

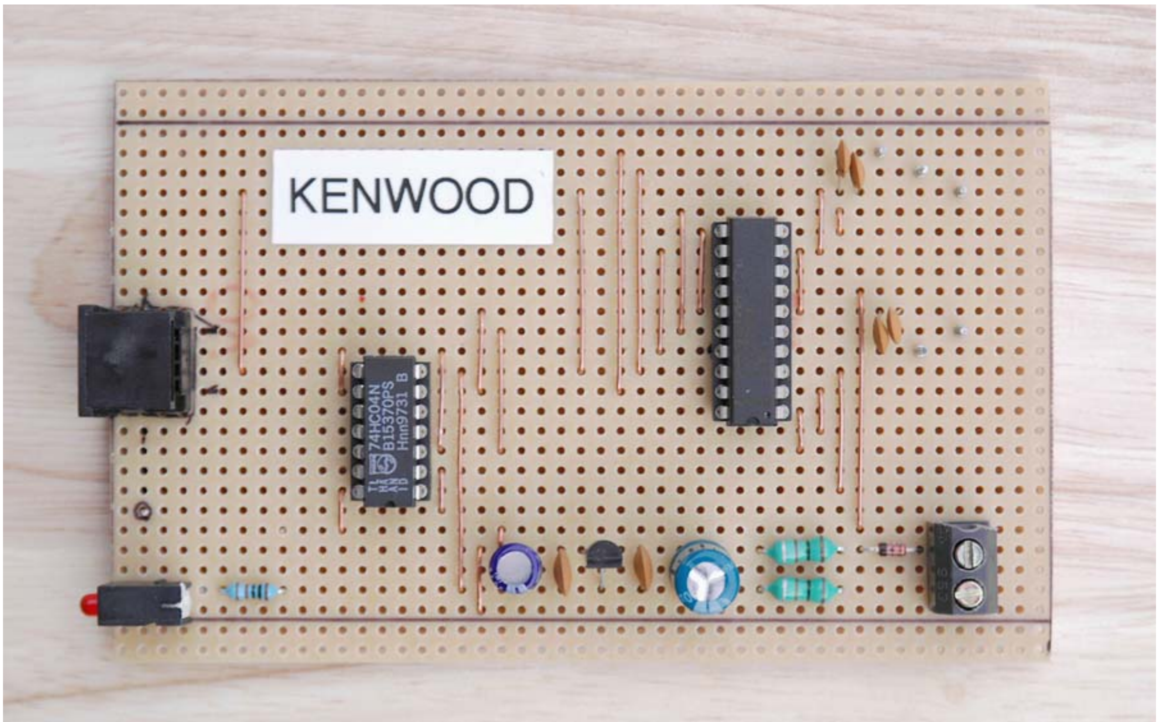
Solder side:-



Component List:-

| | |
|---|---|
| IC1 | DIL20, MAX233CPP |
| IC2 | DIL14, 74LS04 |
| U1 | Voltage regulator, positive 100mA, 78L05 |
| SC1 | Socket DIL14 |
| SC2 | Socket DIL20 |
| RFC1 | Inductor, 100µH |
| RFC2 | Inductor, 100µH |
| D1 | SI-diode, 1N4148 |
| D2 | LED 3mm, red |
| ST1 | Screw terminal, double |
| C1 | Electrolytic capacitor, 220uF |
| C2 | Ceramic, 47nF |
| C3 | Ceramic, 47nF |
| C4 | Electrolytic capacitor, 33µF |
| C5 | Ceramic, 10nF |
| C6 | Ceramic, 10nF |
| C7 | Ceramic, 10nF |
| C8 | Ceramic, 10nF |
| R1 | Resistor, 1K |

***Photograph of completed board.***



## Boxing the Completed Project

The Hammond box used for this project consists of a black anodised aluminium extrusion in a U section with a separate sliding top (bottom) also of aluminium. The sides of the U section include rails to take slide-in circuit boards. The box is closed with thick plastic end plates which are easy to work.

Using this enclosure enables the circuit board to be constructed outside the box and slid into place once completed. Consequently, there are no tricky solder connections to be made within the box itself.

The only obvious problem is the need to drill very precise holes in the end plate to take the sockets and the LEDs which will pass through it. Fortunately, the solution is simple. Once the board has been constructed select the rails which place the socket and LED where required. Now remember your dentist, but not for long, and take an impression.

### *Making an Impression*

Fill the end plate with a slab of Blu-Tack leaving about 2mm gap all-round to ease the fit. Push the end cap into place; it need not go fully home as long as it is square to the body of the box. Insert the circuit board in its slot and slowly force the socket and LED into the Blu-Tack. A couple of mm should be sufficient. Very carefully withdraw the circuit board and make sure it does not drag the Blu-Tack with it – repeat the process for the second board. You should end up with an impression similar to that in the accompanying photograph. Take a fine bit, say1.5mm, and drill a hole at the centre of each of the impressions right through the Blu-Tack and the end plate. Remove the Blu-Tack, enlarge the holes with progressively larger bits, and finish to size with a reamer. Offer up the circuit board once again and you should have a perfect slide-in fit.

The rear endplate of the box is drilled for grommets taking the two data lines and the power line. Plastic sleeved grommets are used for the data lines. These are placed centrally to avoid any projections on the cards.  The power cord is held in place by a gripper-grommet for added security.  In addition, all the grommets are secured in place with a few dabs of superglue.

## *Details of the end plate*

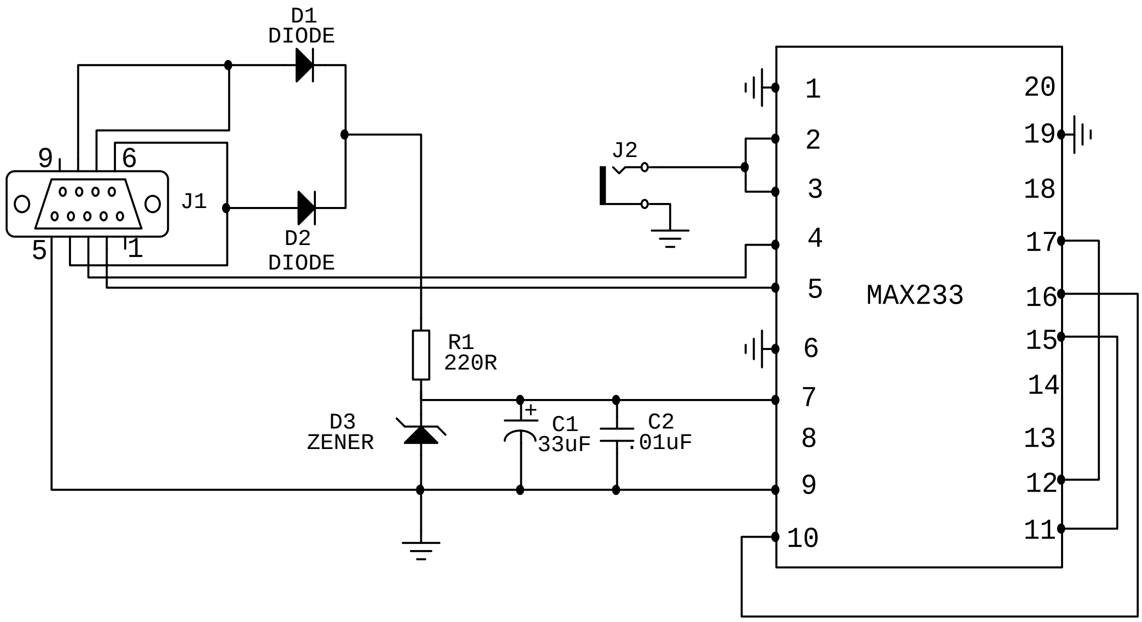

The screw connectors for the 12V supply allow easy interconnections between the two cards. The interconnecting wires are routed through conveniently sited holes in the matrix board from the lower to the upper card.

For ease of testing CAT5 cable was used for the data lines with an RJ45 connector plugged into an RS232 converter. The converter is permanently attached to the computer.  It is for this reason that RTS and CTS connections are shorted at the board rather than in the RS232 socket.

# Ugly Construction

The advantage of matrix board for a constructional article is its reproducibility and ease of diagnosis. Ugly construction is fast, direct and looks a mess but often proves very reliable. To illustrate the process, a self-powered ICOM interface was constructed using the MAX233 chip. The “dead bug” system of construction was used. A saw and a scalpel were employed to separate out sufficient pads on which to solder the various components. The chip was placed upside down on the copper ground plane and the grounded pins and unused inputs were twisted in a loop back to the ground plane where they were soldered in place. Once they were soldered these pins kept the chip located. The rest of the components (just six) and external connections were added to the assembly by point-to-point wiring.

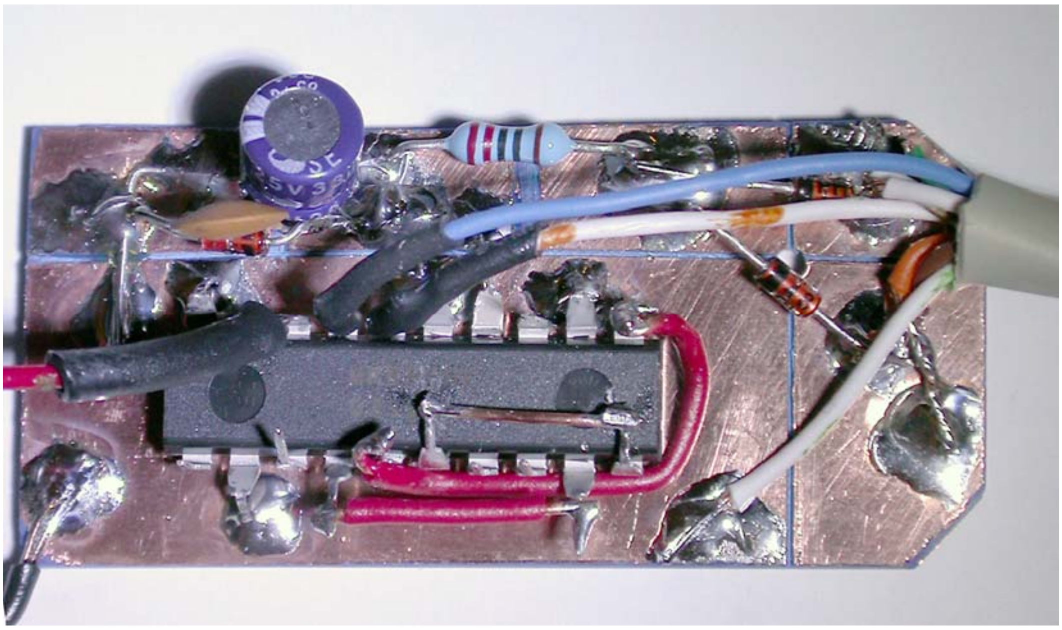
## Self-powered ICOM Interface Circuit Diagram




Component List:-

| | | |
|---|---|---|
| IC1 | MAX233 | |
| C1 | Electrolytic, | 33uF |
| C2 | Ceramic, | .01uF |
| D1 | Diode, | IN4148 |
| D2 | Diode, | IN4148 |
| D3 | Zener, | 5.1V |
| J1 | Connector, | DB9F |
| J2 | Connector, | 3.5mm Mono Jack |
| R1 | Resistor, | 220R |

## *The completed board*



Happily, if surprisingly, it worked first time!  Clearly, it was necessary to find a suitable cover to hide this chaotic construction from critical view.

## *Meet Lucanus electronicus - "Call me Luke!"*

## Software

Simon Brown HB9DRV, assisted by Peter Halpin PH1PH, has written some excellent software for controlling rigs. This started with a program for the FT-817 called *FT-817 Commander* which has been superseded by *Ham Radio Deluxe* available from http://www.kns.ch/sysgem/hb9drv/HamRadioDeluxe.htm. This program allows the control of a wide range of rigs. The base station interfaces illustrated here were tested with Ham Radio Deluxe.

The Yaesu VX-7R interface was tested using Jim Mitchell's *VX-7 Commander* available from http://mywpages.comcast.net/sllewd/vx7rmain.htm.

## Sources

ARRL Handbook
'*Interfacing*' a collection of published interfaces by Peter Halpin PH1PH:-
    http://www.halpin.tomaatnet.nl
Hiroto Fukui JF3RFY:-
    http://hse.dyndns.org/hiroto/RFY_LAB/vx7/e/vx7_8000.htm
http://www.maplin.co.uk
http://groups.yahoo.com/group/ham-radio-deluxe
http://mywebpages.comcast.net/sllewd/vx7rupdates.htm
http://www.hammondmfg.com/1455.htm

## Contact

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