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## **METCON-2 Assembly Manual**

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**1. INTRODUCTION**

(MORE NEEDED)

### **ACKNOWLEDGEMENTS**

The Tucson Amateur Packet Radio (TAPR) METCON-2 Kit was made possible by the

pioneering efforts of Paul Newland, AD7I, and the active participation of a number of TAPR members. TAPR wishes to acknowledge their contribution to this effort.

Individuals:

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Keith Justice, ??????, beta tester  
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Joe Borovitz, WA5VMS, parts liason, beta tester  
John Koster, W9DDD, board layout and production, alpha tester

## 2. PARTS LIST

This parts list is organized by quantity and part type. Please verify that all parts are present, checking the space  provided as you locate and verify it against this list. You may wish to take this opportunity to sort the parts into a compartmented container, such as an egg carton, muffin tin, or other container as you inventory them. This will aid you in building.

**Base Configuration:** The following parts are required for the base configuration of the METCON-2.

### Resistors

1/4 watt, 5% carbon film:

<input type="checkbox"/>	1	R24	100 ohm	(brown-black-brown-gold)
<input type="checkbox"/>	1	R33	470ohm	(yellow-violet-brown-gold)
<input type="checkbox"/>	2	R23, R31	1k	(brown-black-red-gold)
<input type="checkbox"/>	8	R3, R4, R10, R11, R20, R21, R22, R28	10k	(brown-black-orange-gold)
<input type="checkbox"/>	14	R2, R7, R9, R12, R13, R14, R14, R15, R16, R17, R18, R19, R25, R27	100k	(brown-black-yellow-gold)
<input type="checkbox"/>	5	R1, R8, R26, R29, R32	470k	(yellow-violet-yellow-gold)
<input type="checkbox"/>	1	R5	1M	(brown-black-green-gold)
<input type="checkbox"/>	1	R6	2.2M	(red-red-green-gold)

10-pin Single Inline Package (SIP) Resistor Packs:

1 RS1 2.2k 9r SIP (770-101-2.2K-ND or 2201)

### **Capacitors**

Capacitors may be marked in various ways. The typical markings are given but may vary. Find all that match the typical markings given and the remaining ones, if any, should become apparent by elimination.

#### **Capacitors, Ceramic, Monolithic**

8 C16, C17, C18, C19 33pF/10 (330)  
C20, C21, C22, C23

13 C1, C2, C4, C5, C6, 0.1uF/16v/Z5U (104)  
C7, C8, C9, C10, C11,  
C12, C14, C31

#### **Capacitors, Electrolytic, Radial Lead**

8 C23, C24, C25, C26, C27 1uF/25  
C28, C29, C30

1 C32 10uF/16

1 C3 470uF/25

#### **Capacitors, Tantalum, Radial Lead**

2 C13, C33 1uF/16/tant

### **Integrated Circuits**

Integrated Circuits come from various manufacturers and may have differing prefixes and/or suffixes. For example, if the part is listed as a 74LS00, it may be marked SN74LS00N or MC74LS00P or DM74LS00N or F74LS00P or some other variation. The key is that the sequence 74LS00 appears in the part number. A four-digit number, such as 8834, indicates the year and week of manufacture and should not be confused with the part number.

**NOTE:** Do not handle the ICs at this time! Carefully remove the black foam carrier with ICs from the bag and verify the ICs against this list. Then return the foam with the ICs to the bag. Do not touch the ICs!

3 IC1, IC2, IC3 74HC14  
 1 IC4 74HC151  
 2 IC5, IC6 MAX232  
 1 IC7 75176  
 2 IC8 LM358

### **Transistors**

<input type="checkbox"/>	2	Q1, Q2	2N3904	TO-92
<input type="checkbox"/>	1	Q3	2N3906	TO-92

### **Diodes**

<input type="checkbox"/>	1	D1	1N4002	
<input type="checkbox"/>	8	D2, D3, D4, D5, D6 C7, D8, D9	1N4148	
<input type="checkbox"/>	1	DS1	RED LED	

### **Inductor**

<input type="checkbox"/>	1	L1	100uH	5800-101
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### **Relay**

<input type="checkbox"/>	1	K1	G6HK-2DC12	
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### **Jack**

<input type="checkbox"/>	1	J1	2.1mm coax power jack	
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### **Sockets and Connectors**

<input type="checkbox"/>	2	SK7, SK8	8p DIP socket
<input type="checkbox"/>	3	SK1, SK2 SK3	14p DIP socket
<input type="checkbox"/>	1	SK4, SK5, SK6	16p DIP socket

<input type="checkbox"/>	11	H1, H2, H3, H4, H6, H7, H11, H13, H14, H15, H16	2 pin header
<input type="checkbox"/>	2	H8, H12	3 pin header
<input type="checkbox"/>	1	H5	50 pin (2x25) header
<input type="checkbox"/>	2	H9, H10	10 pin (2x5) header

### **Terminal Blocks**

Assemble these as you check them off.

<input type="checkbox"/>	1	TB1	2 posn. screw terminal block
<input type="checkbox"/>	2	TB2, TB6	4 posn. screw terminal block (make from 2 – 2 posn. TB)
<input type="checkbox"/>	2	TB3, TB4	10 posn. screw terminal block (make from 5 – 2 posn. TB)
<input type="checkbox"/>	2	TB5, TB8	9 posn. screw terminal block (make from 3 – 3 posn. TB)
<input type="checkbox"/>	1	TB7	3 posn. screw terminal block

### **Miscellaneous**

<input type="checkbox"/>	1	PC Board, METCON-2
<input type="checkbox"/>	1	Assembly Manual (This Document)
<input type="checkbox"/>	4	shunts

## **4. CONSTRUCTION**

Check the PC Board and verify that the exposed, tinned pads are clean and shiny. If

they are not, scrub the board LIGHTLY with a household cleanser (such as "AJAX" or "COMET") and rinse with clean water, then dry with a clean soft towel. If you feel it is necessary to clean the board, be careful that you don't scrub off the solder mask, which is typically green in color.

PC Board clean

Refer to the layout diagram in Figure 1 for clarification of parts placement. Figure 1 is also attached as a full size diagram at the end of the manual.

### **IC Sockets**

**NOTE:** If any socket pins are bent, carefully straighten them with a pair of long-nose pliers before assembly. Some types of IC sockets have crimps in the pins to hold them in place when automatic wave-soldering is performed. These sockets may be tricky to install if you are not familiar with them. If your kit contains these sockets, you may want to straighten the pins before attempting to insert them into the PC board.

When installing IC sockets, double check to ensure that the socket is seated properly against the board with the notch matching the silkscreen. Pin 1 (nearest the socket notch) has a square solder pad. Be sure that all IC socket pins are showing on the solder side of the board. Next, tack-solder two diagonally opposite corners first (such as pins 1 and 8 on a 14-pin socket).

Then solder the remaining pins of that socket before proceeding to the next one. If you find a socket is difficult to install, remove it and double-check for a bent pin.

**NOTE:** Take care now to avoid solder bridges!

Install the following IC sockets.

<input type="checkbox"/> IC7	8p DIP socket
<input type="checkbox"/> IC8	8p DIP socket
<input type="checkbox"/> IC1	14p DIP socket
<input type="checkbox"/> IC2	14p DIP socket
<input type="checkbox"/> IC3	14p DIP socket
<input type="checkbox"/> IC4	16p DIP socket
<input type="checkbox"/> IC5	16p DIP socket
<input type="checkbox"/> IC6	16p DIP socket

Now check your work. All leads should be soldered. There should be no solder bridges (a blob of solder that shorts two adjacent soldered connections) or cold (gray and/or grainy looking) solder connections.

OK so far.

### **Diodes**

Diodes are polarized, with the cathode end being banded. Observe polarity when installing the following diodes. The diode band must match the band shown on the PCB's silk screen. Leads are at a 0.3" spacing.

- D1 1N4002
- D2 1N4148
- D3 1N4148
- D4 1N4148
- D5 1N4148
- D6 1N4148
- D7 1N4148
- D8 1N4148
- D9 1N4148

Solder and clip the leads (18 total)

### **Resistors**

Resistors lie flat on the PC board and have a lead spacing of 0.400". You may wish to use a lead former to preform the resistor leads for neatest appearance.

Save the leads from the resistors. They will be used in a following step.

Install the following 5% resistors:

- R24 100 (brown-black-brown-gold)
- R33 470 (yellow-violet-brown-gold)
- R23 1k (brown-black-red-gold)
- R31 1k (brown-black-red-gold)

**WARNING!** Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

Solder and clip the leads (8 total)

- R3 10k (brown-black-orange-gold)
- R4 10k (brown-black-orange-gold)
- R10 10k (brown-black-orange-gold)
- R11 10k (brown-black-orange-gold)
- R20 10k (brown-black-orange-gold)
- R21 10k (brown-black-orange-gold)
- R22 10k (brown-black-orange-gold)
- R28 10k (brown-black-orange-gold)

**WARNING!** Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

Solder and clip the leads (16 total)

- R2 100k (brown-black-yellow-gold)
- R7 100k (brown-black-yellow-gold)
- R9 100k (brown-black-yellow-gold)
- R12 100k (brown-black-yellow-gold)
- R13 100k (brown-black-yellow-gold)

<input type="checkbox"/> R14	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R15	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R16	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R17	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R18	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R19	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R25	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R27	100k	(brown-black-yellow-gold)
<input type="checkbox"/> R30	100k	(brown-black-yellow-gold)

**WARNING!** Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

Solder and clip the leads (28 total)

<input type="checkbox"/> R1	470k	(yellow-violet-yellow-gold)
<input type="checkbox"/> R8	470k	(yellow-violet-yellow-gold)
<input type="checkbox"/> R26	470k	(yellow-violet-yellow-gold)
<input type="checkbox"/> R29	470k	(yellow-violet-yellow-gold)
<input type="checkbox"/> R32	470k	(yellow-violet-yellow-gold)

**WARNING!** Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

Solder and clip the leads (10 total)

<input type="checkbox"/> R5	1M	(brown-black-green-gold)
<input type="checkbox"/> R6	2.2M	(red-red-green-gold)

**WARNING!** Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

Solder and clip the leads (4 total)

### **Headers**

The male headers will next be installed. The plastic body of the part should rest flush with the top surface of the PC board. The short end of the pins goes into the PC board, the long end sticks up. Install them using the same procedures you used for the IC sockets. Note that the PCB silk-screen has a square to denote pin #1.

**WARNING:** Do not hold these parts with your fingers as they quickly get very hot while soldering in place.

Hint: place one or two of the shunts on the header. You can then hold the header by the

shunt and not get burnt. The longer style shunts with a closed top end work best.

- H1 2 pin header
- H2 2 pin header
- H3 2 pin header
- H4 2 pin header
- H6 2 pin header
- H7 2 pin header
- H11 2 pin header
- H13 2 pin header
- H14 2 pin header
- H15 2 pin header
- H16 2 pin header

Solder the leads (22 total)

- H8 3 pin header
- H12 3 pin header

Solder the leads (6 total)

- H9 10 pin (2x5) header
- H10 10 pin (2x5) header

Solder the leads (20 total)

- H5 50 pin (2x25) header

Solder the leads (50 total)

### **Capacitors**

**NOTE:** All capacitors should be mounted as nearly flush to the board surface as practical without stressing the leads.

- C15 33pF (330)
- C16 33pF
- C17 33pF
- C18 33pF
- C19 33pF
- C20 33pF
- C21 33pF
- C22 33pF

Solder and clip the leads (16 total)

- C1 0.1uF/16v/Z5U (104)
- C2 0.1uF/16v/Z5U
- C4 0.1uF/16v/Z5U
- C5 0.1uF/16v/Z5U



- C6 0.1uF/16v/Z5U
- C7 0.1uF/16v/Z5U
- C8 0.1uF/16v/Z5U
- C9 0.1uF/16v/Z5U
- C10 0.1uF/16v/Z5U
- C11 0.1uF/16v/Z5U
- C12 0.1uF/16v/Z5U
- C14 0.1uF/16v/Z5U
- C31 0.1uF/16v/Z5U

Solder and clip the leads (26 total)

Carefully check the board for solder splashes, solder bridges and cold solder joints.

OK so far.

### **Terminal Block**

Insert the following terminal blocks, assemble now if you didn't earlier.

- TB1 2 posn. screw terminal block
- TB2 4 posn. screw terminal block (make from 2 – 2 posn. TB)
- TB6 4 posn. screw terminal block (make from 2 – 2 posn. TB)
- TB3 10 posn. screw terminal block (make from 5 – 2 posn. TB)
- TB4 10 posn. screw terminal block (make from 5 – 2 posn. TB)
- TB5 9 posn. screw terminal block (make from 3 – 3 posn. TB)
- TB8 9 posn. screw terminal block (make from 3 – 3 posn. TB)
- TB7 3 posn. screw terminal block

Solder the leads (51 total)

**Note:** Solder one pin on each, then check the alignment before soldering all pins.

### **Capacitors**

Install the balance of the capacitors

**NOTE: *The following capacitors are polarized.*** Electrolytic capacitors (tubular metal cans with the leads coming out of one end) have the negative lead marked with a bold black band; tantalum capacitors (teardrop-shaped epoxy-covered blobs) have the positive lead marked with hard-to-read little plus (+) signs.

- C23 10uF/25
- C24 10uF/25
- C25 10uF/25
- C26 10uF/25
- C27 10uF/25

- C28 10uF/25
- C29 10uF/25
- C30 10uF/25
- C32 10uF/25
- C13 1uF/16/tant
- C33 1uF/16/tant
- C3 470uF/25

Solder and clip the leads (24 total)

Now check your work. All leads should be soldered. There should be no solder bridges or cold solder connections.

OK so far.

### **Power Connector**

J1 2.1mm coax power connector

### **LED**

-----need words here

DS1 Red LED

### **Inductor**

-----need words here

L1 100uH

### **Transistors**

-----need words here

- Q1 2N3904
- Q2 2N3904
- Q3 2N3906

### **Test Points**

-----need words here

- GND loop of wire
- +V loop of wire
- +5BB loop of wire
- +5 loop of wire

start up and testing, what jumpers need to be in, what do they each do etc.