

# MOAS II Construction

Version 1.01

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## ***Tools Required***

Soldering iron (preferably controlled heat)

Needle nose pliers

Diagonal cutting pliers

## ***Parts Installation***

All parts except for the pluggable block connectors are installed on the top of the board.

Use regular 60/40 or 63/37 rosin core solder.

The holes are plated-through. Use enough solder to fill the hole and to produce a fillet. Don't use so much solder that it bridges. Note: The military used to recommend using the minimum amount of solder. Then they discovered that connections with minimum solder are more likely to crack. Don't skimp on the solder. It is recommended that you keep a wet sponge near your iron to keep the iron clean while soldering. Keep your iron clean.

There is nothing magical about the component installation below. You can install the parts in just about any order. It will be easiest if you install the smaller and lighter parts before the bigger and heavier ones.

When installing each component you can solder one lead of each part and check and adjust placement if necessary before soldering the other lead. If you have experience building equipment with printed circuit boards you know how to do this.

For multi-lead parts solder one or two pins and make sure the component is seated against the board before soldering the other pins. Once you solder the remaining pins it will be impossible to adjust it.

If you solder a part in the wrong location it is often easier to remove the part by breaking it and then taking each piece out separately.

Pre-form the leads prior to installing them so that there is no tension on the lead where it enters the component. After installing each of the below lines of components clip any excess leads before going to the next line.

Some parts are susceptible to ESD. Use of a wrist strap and normal ESD precautions are recommended.

Part numbers depend on where they are on the schematic, not where they are on the PC board. Parts numbered 1-99 are on the first page of the schematic, 100-199 are on the second page etc.

Save a few of the resistor leads you clipped. You will need them as jumpers.

- Get a copy of the parts list, inventory list, and the silkscreen from the [http://www.k1xm.org/Antenna\\_Switch/MOAS\\_II/](http://www.k1xm.org/Antenna_Switch/MOAS_II/) website. Use the parts list to check component values.
- Inventory all parts.

The first parts to install are the resistors. These can be installed in either direction but it is good practice to install them all facing the same direction, usually with the gold or silver band on the right or bottom.

If you have trouble reading the color codes check them with an ohmmeter.

The color code for each resistor can be found on the inventory sheet and here in instructions. There are three color bands that represent the value and a fourth which represents the tolerance. The fourth band will be gold or silver.

All of the resistors are 1/4 watt.

The first group of resistors is along the front of the board behind the LEDs..

- Install R13 1.5K $\Omega$  (Brown-Green-Red)
- Install R101, R102 1K $\Omega$  (Brown-Black-Red)

These resistors are near the front left of the board behind the RCA connectors and diodes.

- Install R1-R12 1K $\Omega$  (Brown-Black-Red)

This resistor is near the right side next to the fuse.

- Install R14 0 $\Omega$ . You can use a wire jumper or a lead from a resistor.

All of the resistors are now installed. Check the board for solder bridges and cold solder joints.

The direction matters with the diodes. Match the bar on the diode with the bar on the PC board. The diode part number is on each diode.

These diodes are to the right of U3, the TO-220 voltage regulator.

- Install D1, D2 (1N4007)

These diodes are near the front left of the board between the resistors and the RCA connectors.

- Install D3-D14 (1N4007)

The capacitors are next. The electrolytic capacitors must be installed in the correct direction. The part number stamped on each capacitor for identification purposes can be found on the inventory list and here in the instructions.

These capacitors are near the front of the board to the right of U3.

- Install C1, C4 .1 $\mu$ f
- Install C2 22 $\mu$ f
- Install C3, 220 $\mu$ f

- Install C5, 10uf

These capacitors are near U1, the microprocessor.

- Install C6, .1μf
- Install C7, C8 22pf

These capacitors are near the right side of U2, the surface-mounted IC.

- Install C9, C10 .1μf

This capacitor is to the left of U101.

- Install C101 .1μf

These capacitors are at the front of the board on the right side between the RCA connectors.

- Install C102-C107 .1uf

These capacitors are used in the output circuits. How many you need depends on how many outputs you are installing. There is no harm in installing more capacitors than you need, and you might do this if you are planning to eventually increase the number of outputs.

- Install C201-C213 .1μf
- If you have sixteen or more outputs install C214-C226 .1μf
- If you have twenty four or more outputs install C301-C313 .1μf
- If you have thirty two or more outputs install C314-C326 .1μf
- If you have forty or more outputs install C401-C413 .1μf
- If you have forty eight or more outputs install C414-C426 .1μf
- If you have fifty six or more outputs install C501-C513 .1μf
- If you have sixty four outputs install C514-C526 .1μf

These capacitors are at the front of the board on the left side between the RCA connectors. They are the large 1KV caps.

- Install C11-C16 .01μf 1KV

The crystal is to the right of U1. Be careful not to overheat it.

- Install X1

Check the board for solder bridges and for cold or unsoldered connections. Verify that the electrolytic capacitors are installed in the correct direction.

Match the notch on the IC socket with the notch drawn on the PC board. Note that for some ICs, including U1 the notch is towards the front of the board and for others, including U3, the notch is towards the rear of the board.

- Install IC sockets at U1, and U101

If you have some high side outputs and some low side you must decide which groups of outputs will be which.

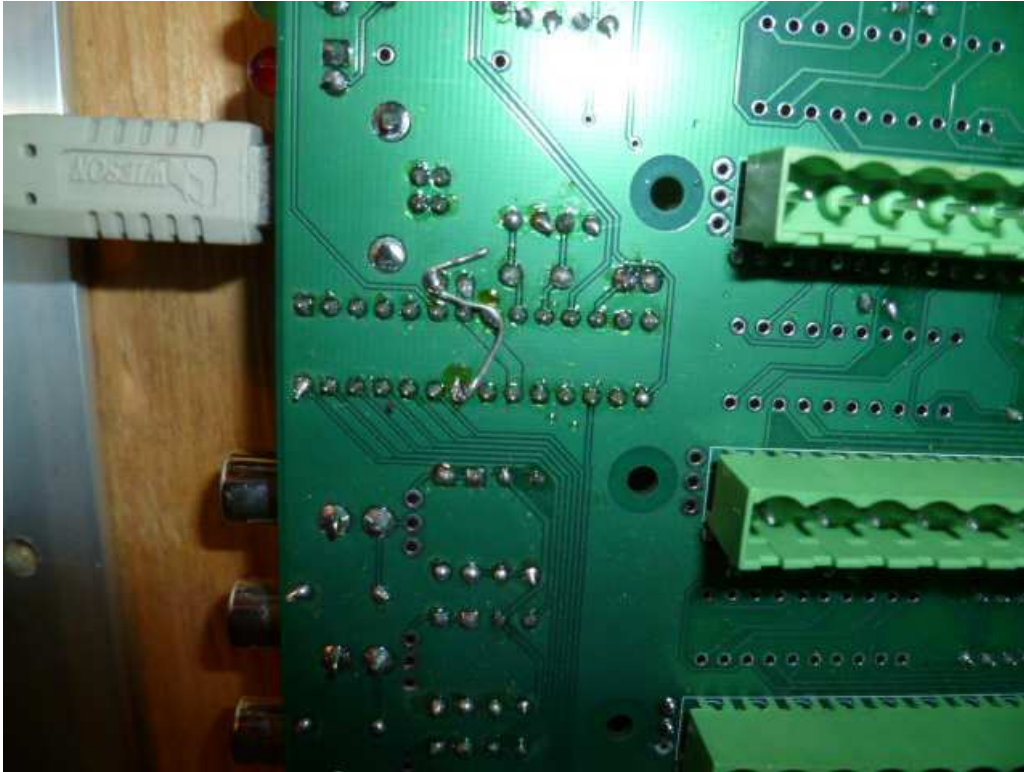
- If outputs 0-7 will be high side install a socket at U201. If they will be low side install a socket at U202.
- If you have sixteen or more outputs then if outputs 8-15 will be high side install a socket at U203. If they will be low side install a socket at U204.
- If you have twenty four or more outputs then if outputs 16-23 will be high side install a socket at U301. If they will be low side install a socket at U302
- If you have thirty two or more outputs then if outputs 24-31 will be high side install a socket at U303. If they will be low side install a socket at U304.
- If you have forty or more outputs then if outputs 32-39 will be high side install a socket at U401. If they will be low side install a socket at U402
- If you have forty eight or more outputs then if outputs 40-47 will be high side install a socket at U303. If they will be low side install a socket at U304.
- If you have fifty six or more outputs then if outputs 48-55 will be high side install a socket at U501. If they will be low side install a socket at U502
- If you have sixty four outputs then if outputs 56-63 will be high side install a socket at U503. If they will be low side install a socket at U504.

Check your work for solder bridges, especially between the IC socket pins, and for cold solder joints.

Each output connector has ten pins. The outputs are on pins 2-9. Pins 1 and 10 can be connected to either the power supply or to ground by installing jumpers. Most commonly they will both be connected to ground for high side outputs and to +12V for low side outputs but this is up to the builder. Connect the center hole to one of the outside holes. Use cut off resistor leads as jumper wires.

- Install jumpers JP201 and JP202.
- If you have sixteen or more outputs install jumpers JP203 and JP204
- If you have twenty four or more outputs install jumpers JP301 and JP302
- If you have thirty two or more outputs install jumpers JP303 and JP304
- If you have forty or more outputs install jumpers JP401 and JP402
- If you have forty eight or more outputs install jumpers JP403 and JP404
- If you have fifty six or more outputs install jumpers JP501 and JP502
- If you have sixty four outputs install jumpers JP503 and JP504

The first production boards are missing two traces. It is necessary to add a jumper from U1 pin 8 and U1 pin 22 to ground. This photo shows a jumper added to the bottom of the board. Make sure it does not short to any other parts.



- Ground U1 pins 8 and 22 if needed

The MOAS II board can connect to six radios. If you plan to use three or fewer radios you can set jumpers so that two RCA connectors connect to each amplifier keying line. These jumpers are located near the front of the board to the left of U1 behind the RCA connectors. Connect the center hole to the left hole if you will have three or fewer radios and to the right hole if you will have more than three radios.

- Install jumpers JP2, JP3, JP4.

Bend the leads of the TO-220 voltage regulator, U3 so that the leads go through the holes and the screw hole lines up with the hole on the board. Try not to make the bend too sharp.

- Mount U3 on board. It is not necessary to secure it to the board but if you want to use a 4x40 bolt, lockwasher, and nut. Solder the three leads.

The fuse holder is made up of two identical pieces. Make sure you orient them properly – the notches go away from each other to hold the fuse.

Also note that the fuse holder pieces get quite hot when soldered. Let them cool for a moment before continuing to work on the board.

- Install Fuse Holder halves F1

Make sure that the connectors and LEDs are positioned properly. They should be mounted flush on the board and be square-on to the front of the board. Solder one or two leads and check for position before soldering the rest.

- Install red LED D15
- Install green LEDs D101, D102
- Install USB connector J2
- Install white RCA connectors J3-J8
- Install black RCA connectors J101-J106

The power connector is made up of four pieces. Slide the red and black plastic pieces together with the red piece on the left as you look at it from the front. The black piece should be closest to the right edge of the board when you install it. Insert the two metal parts and make certain they click into place and are secure.

- Install PowerPole™ connector J1

The pluggable block connectors are installed on the bottom of the board.

- Install J201.
- If you have sixteen or more outputs J202
- If you have twenty four or more outputs install J301
- If you have thirty two or more outputs install J302
- If you have forty or more outputs install jumpers J401
- If you have forty eight or more outputs install jumpers J402
- If you have fifty six or more outputs install jumpers J501
- If you have sixty four outputs install jumpers J502

Check the board for solder bridges, especially around the connectors, for cold or unsoldered connections, and for pieces of solder or component lead clippings which may have become wedged under or between parts.

R15 is not used. JP1 and JP5 are empty. Check that all resistors and diodes are present and that there are no other places where components are not installed except where there are unused outputs.

All components are now soldered to the board.

## ***Preliminary Checks***

These are a few tests before completing assembly. A good place to connect to for ground is the tab of U3.

- Install the fuse F1 in the socket
- Measure the resistance between either side of the fuse and ground. The resistance should be at least 1K ohms. It may start lower and go up as the capacitors charge. There is a diode in this path so meter polarity matters. Connect the ground lead of the meter to ground on the board. .
- Measure the resistance between U3 pin 3 and ground. It should be at least 1K ohms when the capacitors have charged.
- Measure the resistance between U3 pin 1 and U3 pin 3. It should be at least 1K ohms. If it reads lower reverse the meter leads and measure it again.

- Connect a 12 volt power supply to J1
- Measure the voltage between either side of the fuse and ground and verify that it is between 10 and 15 volts.
- The red LED should glow.
- Watch the fuse and the board for signs of failure – the fuse should not glow and there should be no noise or smoke.
- Check that U2 and U3 are not warm or hot. Be careful because if one of these parts does get hot it can burn your finger.
- Measure the voltage between U3 pin 3 and ground. It should be between 4.8 and 5.2 volts.
- Disconnect the power supply.

## ***IC Installation***

The pins of the ICs will need to be bent to fit in the sockets. The easy way to do this is to put the chip upside down on a flat surface and then rotate it 90 degrees so that it bends all of the pins on one side. Then rotate it the other way to bend the pins on the other side.

The pins must line up with the IC socket before you press the chip down into the socket.

Make sure the notch in the chip matches the notch in the socket and the board. Some parts face left and others face right.

- Install U1 ATMEGA328P-PU
- Install U101 TPIC6A596NE
- Install U201 MIC5891YN or U202 TPIC6A596NE
- If you have sixteen or more outputs install U203 MIC5891YN or U204 TPIC6A596NE
- If you have twenty four or more outputs install U301 MIC5891YN or U302 TPIC6A596NE
- If you have thirty two or more outputs install U303 MIC5891YN or U304 TPIC6A596NE
- If you have forty or more outputs install U401 MIC5891YN or U402 TPIC6A596NE
- If you have forty eight or more outputs install U403 MIC5891YN or U404 TPIC6A596NE
- If you have fifty six or more outputs install U501 MIC5891YN or U502 TPIC6A596NE
- If you have sixty four outputs install U503 MIC5891YN or U504 TPIC6A596NE

Check carefully for pins which are not in the sockets. Particularly look for pins which have been bent under the IC.

## ***Microprocessor Test***

If something gets hot disconnect power immediately.

- Connect a 12 volt power supply to J1
- The red LED and one green LED should illuminate
- Connect a USB cable between J2 and a computer. You may get a message about a driver being installed. If you get a message that a driver is needed it can be obtained from <http://www.ftdichip.com/Drivers/VCP.htm>.

- Run device manager. Depending on the version of Windows you can start it by right-clicking on Computer or My Computer and selecting Manager or by running it as a control panel. You should find a USB Serial Port. If you double-click on it a properties dialog will appear. It will show that the name of the manufacturer is FTDI. If the you want to change the serial port number select the Port Settings tab, then click Advanced.
- Install the MOAS software.
- Run the MOAS II Switch Utility program.
- Selectt Switch->COM Port and set the COM port to the number shown by device manager
- Select Switch->Connect. You should see a message which has the firmware version of the MOAS II.
- Select Switch->Operate.
- Select Switch->Status. You should see six lines, one for each radio. All TX, RX, and Alternate antennas will be antenna 64.
- In the TX Row, change station 1 to 1. The green LED that was illuminated should go out, and the other LED should illuminate.You should see a line saying that station 1 TX antenna is now 1(fast).
- Shutdown the MOAS II switch utility. Or play with it a bit if you prefer – the only command to avoid is switch->firmware which updates the firmware in the MOAS II.

Congratulations! You have assembled a MOAS II!