A Guide to Operating, Troubleshooting and Repair of the MFJ-9200 QRP Radio

by

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KL7KN

Foreword from the author:

These are the new "golden years" of ham radio, with newly licensed operators swelling the ranks daily. One thing I have noticed is that a significant number of these new hams have no background in radio/electronics. Thanks to the Internet and many sites that provide a focus on passing the Amateur Radio Service FCC tests, these new hams have a license but no *real* knowledge of how the technology works.

I don't say this like it's a bad thing, because *it is not*. What it *does* mean is that a large number of folks entering this hobby have no clue on how to perform basic troubleshooting of on repair of the radios they use in enjoying the hobby. To be honest, some of the newer radios on the market, especially handheld V/UHF rigs are, frankly, disposable. It has become, quite literally, less expensive to purchase a replacement radio than to attempt repairs via a commercial shop where shop rates can reach $100/hour.

On the other end of this equation, is the MFJ-9200 QRP Transceiver.

This radio is an *excellent* little HF rig and offers quite a lot to the portable operator. It is, to me, the ultimate in a Plug and Play rig. Add power, a resonant antenna, a set of cans, a key and you have a working *multi-band* HF station. Set the frequency, and you're on the air. Unfortunately, in my research prior to purchasing this radio, I discovered that neither the Chinese manufacturer or the Seller has made technical data for the rig publicly available.

This situation is a common issue with many radios imported to North America. Repair of the unit becomes problematic for a new or inexperienced operator and even experienced hams need at least some technical data and a parts list prior to attempting a repair.

I wrote this manual with the view of the new ham trying to fix what are the most likely problems with a dead radio, quite literally, on the kitchen table with very minimal equipment. The Manual covers the most common items that might need repair in the lifetime of the rig. I later added a modified Operations manual, hopefully one a bit easier to understand.

I hope you enjoy this Guide and welcome any suggestions to improve this Guide for everyone enjoying the MFJ-9200. Many of the *troubleshooting* tips and tricks will work with any of the newer solid state HF rigs, like the HB-1Bx.

I've sent many copies of this manual out to the amateur community as requested. To my surprise, Steve Weber (*Yes*, that Steve Weber, KD1JV) asked for a copy. Long story short, I shipped him a working -9200 and he was kind enough to draw up a full schematic for the unit and kindly allowed me to include it. Thanks Steve! I'm certain many will remember your support to the QRP community.

Another happy side effect to sending out many copies of the manual is the feedback I receive from other hams. This manual is the fourth version and as I obtain more data, updates will follow.

August 25, 2017

Don//KL7KN

Anchorage, Alaska.

08/23/2017 Happy Face – the rig is listed again and is back in stock with the folks at MFJ.

About the Author:

Mr. Koehler first tested for and received his FCC Commercial Radiotelephone license with a RADAR endorsement in 1977. He received his Amateur Radio Service license on the next test cycle. This was back when FCC employees had to give the test.

After spending 22+ years in the US Air Force as a Master Technician working on radio/electronics, maintaining a wide variety of communications equipment to the component level, Mr. Koehler retired from the military. He then went on to spend another 10 years working with telecommunication equipment as a technician, technical writer, quality manager and finally, a supervising manager.

He now works part-time as a technical writer for a local Corporation in the IT field. His published works include many articles in "73" Magazine, Site (later, Above Ground Level) Magazine and multiple other industry periodicals. He was also a Contributing Editor for Mobile Radio Technology magazine for a number of years.

He has a Bachelor of Science degree from the University of the State of New York, with multiple Associate degrees, to include an Associate of Science in Communications Technology.

In addition to HAM radio, he enjoys shortwave listening, sailing, hiking, camping and just being outdoors in Alaska. A prolific fiction writer, he has ten full length novels currently on the market under a pseudonym. (see www.worldofthechernyi.com)

Steve *"Melt Solder"* Weber, KD1JV, who provided the attached schematic, is well known for his QRP designs. See more of his work at **kd1jv.qrpradio.com**.

To retain the fidelity of the original drawing by Steve, I send that as a separate .PDF file with just the schematic. This will allow you to 'zoom in' as need to see details.

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Table of Contents

A schematic for MFJ-9200 is sent separately as a .pdf file to allow full screen viewing.

This Guide is focused on the new amateur population providing simplified:

- Diagrams of important systems and sub-systems.
- Troubleshooting and maintenance steps that may be taken with minimal test equipment. I explain how to use the listed test equipment and how to build some of your own.
- A *limited* parts listing for those items *most likely* to need replacement at some point in the life of the radio set. I'll explain *how* to replace those parts and hopefully allow you to get your rig up and running.
- I also provide at least one source (available at the time of this writing) and common part numbers to source the parts for yourself in the future.

Please note the list of parts; part numbers and parts source were current at the time this was written.

MFJ-9200 Operating Instructions – modified.

In reading many of the E-mails sent to me with regard to my original Technical Manual, it has become apparent that some form of simplified Operating instruction should have been included. While MFJ's on-line Operating Instruction is adequate, it may be confusing to a new ham. I found a very well done manual for the HB-1A on-line written up by K9MA, Scott Ellington. I asked for and received his kind permission to edit his basic layout (format) over to -9200 specifics for use in this manual section. Photos used with permission.

***Warning*:** Before attempting to operate your MFJ-9200 on air, *read through the entire manual*. Failing to adhere to prescribed setup and operating recommendations could result in permanent damage to your radio!

Initial power up

After connecting a known good antenna or dummy load, key, headphones and then the power supply, turn the radio on. After the initial splash screen shows the installed Band Module, the -9200 LCD panel displays:

Operating Mode (CW/USB/LSB)

(M) Memory number or **(V) VFO** this setting is based on last use.

Supply Voltage (xx.x VDC) displays alternatively with the Mode.

Receiver Incremental Tuning (*RIT*) status and amount of offset is provided just after the displayed frequency – with a dash or up/down arrow (↑ ↓) .

VFO Tuning Steps:

The VFO tuning steps are set by pressing down on the **Tune** control. Press briefly to change between 100 HZ and 1 KHz. (Observe location of flashing digit)

For 100 KHz increments, press and hold **Tune** for several seconds. (Observe location of flashing digit)

RIT Steps: 10-Hz default

VFO Memories: 8 *per band*

VFO Display: LCD, switched backlight

VFO Display Frequency Resolution:

100-Hz, 10-Hz with RIT activated.

Operating Modes:

Transmit - A1 (CW) **only**, Receive - A1, A3J (LSB or USB) Am is possible with careful tuning.

CW Offset: ~700 Hz

T/R Switching: Fully QSK capable

External Power Supply

Any 9 to 14.8 V DC power supply or battery may be connected to the radios coaxial power jack, **provided that any internal battery is disconnected.** Reverse-polarity protection at the main DC input and the internal J2 power header is provided. There is **no** internal battery charger. *No* internal battery was ever offered. I also recommend against an operator installing an internal battery. (See battery section for more)

Antenna

Any well-matched (50 Ohm) antenna may be connected to the ANT jack BNC connector. An external antenna tuner is required for antennas which are not resonant at the selected frequency. The radio does **not** provide for any adjustments other than audio volume and VFO. High SWR *will* damage the radio. Use care when tuning any antenna.

Headphones

A stereo headset can be connected to the PHONE jack. Impedance should be 8-32 Ohms. A *stereo* connector ***must*** be used. A MONO headphone plug will SHORT the output! Alternatively, you may use a mini stereo amplified speaker. While 8-32 ohms is recommended, a 4 ohm stereo speaker will work – just barely.

NOTE: As noted in *Basic Repair and Maintenance* of the radio, under the *Tuning Band Modules*, if you have access to the speaker leads, you may, with a sensitive multi-meter on the AC setting, tune your band modules! If you choose to use an amplified speaker for tuning, bypass the amplifier and connect to the speaker itself.

Key/Paddle

If using a stereo plug for a **straight key**, both ring and sleeve must be connected together for use. A monaural plug may also be used with a straight key.

TIP. Connects to DOT paddle or straight key

RING. Connects to DASH paddle or straight key ground

SLEEVE. Connects to paddle or straight key ground

3.5mm stereo plug

Key Operation

When power is applied with a paddle connected or **no** key is present, the letter "A" will be heard in the headphones upon power up. The letter "M" is heard if a straight key is connected.

Mem/VFO Button

Pressing this button alternates the display between Memory mode (**M**) and VFO (**V**)mode. The display will show M-# or V-#. # represents the numbers 1 thru 8.

In **M**emory mode, the Tune knob is used to change memory locations.

In **V**FO Mode, the Tune knob is used to change the frequency.

Pressing and then holding the **Mem/VFO** key for more than two seconds will display **SAVE** \ and the current frequency and mode will be stored in the memory # location displayed.

Band Error: If no filter module has been installed, the display will flash [**BAND-???]** to alert you that a module must be installed for the radio to operate.

Transmit Error: If the transmitter is keyed while the VFO is tuned outside the amateur band, the top line of the display / flashes [**TX ERROR**] and transmission is blocked.

TIP - Setting the radio to an out of band frequency will allow the operator to practice sending with a new key or set of paddles. This is also a good time to set keyer speed.

RIT/MODE Button

RIT Mode:

Press this button briefly to enter or exit the RIT function. A dash (==) will be displayed to the right of the frequency.

In the RIT mode, the Tuning knob controls the offset of the received frequency from the transmit frequency. The transmit frequency setting is unchanged. The dash (==) indicates that the received frequency is the same as the transmit frequency (zero offset).

NOTE – Remember that the normal offset of ~750 Hz is always present.

Turning the **Tune** knob clockwise ***raises*** the received frequency, as indicated by the up arrow (↑).

Turning the Tune knob counter-clockwise ***lowers*** the receive frequency, as indicated by down arrow (↓).

In each case, *the displayed frequency is the received frequency* – the transmitter frequency is not changed. After exiting the RIT mode, the receiver offset returns to zero.

CW/USB/LSB Mode Changes:

To change mode, press and hold RIT/MOD for two seconds. Press and hold RIT/MOD for two seconds for each change in Mode.

Changing the Frequency Tuning Steps

The VFO tuning steps are set by pressing down on the Tune control. These steps are in 100 Hz, 1 KHz, and 100 KHz increments for the amateur bands. Outside of the North American amateur bands, VFO tuning remains the same. RIT tuning can ***only*** be set in 10 Hz increments.

CW Keyer

Changing Speed:

Press and hold **Call** button for approximately one second, until the letter "S" is heard, then release. Within FIVE seconds, press the DOT paddle to increase the keyer speed, or the DASH to decrease. When done, press Call briefly to exit. The letter "E" is heard. The 9200 **does not give any indication of speed setting in WPM**, you can hear the change in speed, adjust to your comfort level in receiving.

Entering Your Callsign:

Press and hold **Call** button until the letter "S" is heard, continue to hold **Call** until you hear the letter "I", then release the button.

Send your callsign with the paddle as usual. When complete, press **Call** briefly to exit. (The letter "E" will be heard.) Otherwise, automatic exit will occur after 8 seconds.

Automatic CQ

Press **Call** button briefly to send "CQ CQ CQ DE (your callsign three times) PSE K" To *cancel* the CQ, press and hold **Call** button for 1 second. It is not possible to eliminate the PSE – the text is embedded in the chip program. I often suggest an external keyer for both convenience and memory based messages. This is the same chip/programming found in the HB1B, -B and the CRK-10A (by BA6BF) radios.

Test Carrier:

If a straight key is connected, simply close the key to transmit.

Depress and hold **CALL** until you hear the letter **T** (which follows **S** and **I** in order). When you hear **T**, release the **CALL** button and press the *DASH* paddle to initiate a continuous carrier. Press the *DOT* paddle to turn it off. To escape from *Transmit Carrier* mode, *tap* the **CALL** button. The letter **E** will confirm your exit.

The *Test Carrier* function allows you to lock the key down when using paddles to take SWR readings or make tuner adjustments. **Use this function with caution, as high SWR will damage Q10, the PA transistor.** I strongly recommend using a series of **DOTS** to set/check any tuner adjustments.

ATT button

Attenuator:

Pressing the ATT key invokes the receiver attenuator (ATT) on or off. This provides an overly generous amount of loss (~20dB) and is of minimal use to the operator. The ATT serves to replace an RF gain control.

I'm sorting out how to reduce this, but it will require changing out one (or more) SMD resistors.

1.0 How to Use this Guide:

As you examine the Table of Contents, you will see the radio set broken down into several basic sub-systems. Each of these sub-systems must work properly for the whole to perform. The order of the sub-systems is specific by design. Each section builds on the one before.

Please, READ the radio overview and the *entire* Concept of Operations sections before you attempt *any* of the troubleshooting steps. A basic understanding of each of the sub-systems is essential to be able to perform the troubleshooting steps that follow. Most sub-system sections will have either a portion of the schematic or block diagram as part of the description.

Test points used in troubleshooting are identified in a linked illustration. A photo really is worth a thousand words, or nearly so... These photos are linked in the text for testing/repair to save space and reduce confusion. The images included may be *zoomed* (CTRL and +) to 400% or more and still be readable. To return to the test step, use the Back button on your reader.

The troubleshooting steps are not in with the sub-system description, again, to avoid any possible confusion. Each of the troubleshooting steps builds on the prior step. In other words, you must ensure the DC power system is operating properly before you can tackle an issue, say, with the transmitter.

The information in this guide was obtained by direct observation and measurements on a working 9200 with a Series B board. **Older radios, those with an A series board, may or may not work with the manual directions** as I did not have access to a unit to confirm.

This guide is based on the 9200-B board version. The software displays 08-2011 on power up with both the VFO/Mem and Mode/RIT buttons held down.. This manual will lay out troubleshooting steps, explain how to perform specific repair actions and suggest others.

Finally, if you cannot resolve a problem with your radio, you can open an on-line trouble ticket with MFJ Enterprises and request a quote for repair. Ensure you document what steps you have taken and the results – then put that information in the trouble ticket.

Good luck!

73s // Don // KL7KN

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2.0 Warnings page

This radio contains Electro-Static Sensitive Devices (**ESD**). Use an appropriate conductive/grounded work surface when preforming repairs.

If you will be soldering anything on this radio, use of an ESD –safe rated soldering iron with proper grounding is a must.

Use a personal ESD grounding device for yourself before beginning work on the radio.

Perform soldering only in a well-ventilated area!

ALWAYS wear eye protection when soldering! The eyes you save will be your own.

DO NOT key the radio without connection to an antenna, dummy load or into a high SWR load – *you will damage the transmitter*. If using an external tuner, avoid extended key down times when making adjustments.

While the DC input is diode protected, use a fuse – 2 amp – inline on the DC input cable.

If using the internal DC header (J2) to power the radio via internal batteries, use a polarized plug. Insulate any battery used internally to avoid shorting vital components. Secure any internal batteries to prevent movement which could damage the radio.

Do Not attempt to use the external DC supply to charge user installed internal battery packs. Damage to the unit may result.

When installing band modules, check to ensure the header pins line up correctly and are fully seated ***before*** installing rear cover and applying power to the unit. (See Band module section for more.) After transport, check Band Module is fully seated before use.

Before any power on tests are made, ensure you have a set of phones and a dummy load attached to the radio or main board **before** applying power.

I STRONGLY suggest that operators remove the DC supply and antenna connections when the radio is not in active use.

Remove any user installed internal batteries prior to the radio being stored.

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Recommended tools & test equipment:

You will need some *minimum test equipment* to perform any troubleshooting on the MFJ-9200 radio set. These are:

Multimeter. Sometimes called a V-O-M for a Volt, Ohm, Milliammeter. You may also see these called a DMM, for Digital MultiMeter. This unit will be used to measure voltage at several points within the radio set. I've made measurements listed with both a VOM and DDM. Any differences because of the meter type are identified.

The meter used must be a *quality* unit, with a listed input impedance of *at least* 20K ohms/volt, with 1M ohm/volt preferred. A quality DDM may be found new at a cost of under $50 USD and can be used for other tasks, such as checking fuses or confirming power is present at a connector.

- Test leads for your meter should have a sharp point to allow measurement at a specific pin on a small SMD device without shorting across to any other pin.
- The test leads should have a way to clip at least one lead to the chassis ground.
- The test leads should be color coded, usually red and black, to indicate polarity.

Resistive Dummy Load. Used to terminate the transmitter chain, this will both prevent damage from transmitting into an unterminated connecter and allow a way to determine output power. If you don't have one, look at the end of the maintenance section. I'll show you how to build a dummy load for a few dollars.

Wattmeter *and* Dummy load. A nice kit is available from Pacific Antennas and Kits for under $20. This allows use of you DMM to read power out. (See www.qrpkits.com). At some point, as an active Amateur operator, you will need to have some kind of working watt meter.

Signal tracer or Oscilloscope. I've been building or repairing radios since 1970 and I still don't have one at home for shack use. What to do? I use a small (portable) general coverage receiver, specifically an ATS-909. Most tests with the radio are just to see if a signal is present or not. In newer digital radios, generally something either works or it doesn't. If I can hear something on the radio, I can keep going.

Signal Generator. While nice to have, there are alternatives for a new ham:
A low-cost antenna analyzer, such as the MFJ 207, can serve as a signal source.
There are multiple "DDS kits" to be found on line that may be used as a basic signal generator. One such kit is the N3ZI kit – http://www.pongrance.com/super-dds.html - about $80 USD. The QRPGuys (www.qrpguys.com) have some nice test gar as well.
If you have another HF rig, feed it into a dummy load at low power, and then use it as a signal source.
Used commercial equipment may be found from time to time, but maintenance, manuals and ongoing calibration can be problematic for the amateur radio operator.
Finally, a wire antenna can provide a small, broadband signal for use in very basic troubleshooting.

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Hand tools:

Screwdrivers (small and very small). Since the -9200 is tiny, your screwdrivers are going to be typically called a "Jeweler's screwdriver set" or the like. The only two internal adjustments available are very small. You will need to pick up a non-metallic set as well to tune the RF cans on a couple of the Band Modules.

Small needle nosed pliers. The kind with a wire cutter are nice to have.

Adjustable wrench (spanner). It is used to remove the BNC connector from the chassis, remove the PA transistor screw mount and internal standoffs.

Non-metallic tuning tools, both 1/8 Hex head and small screwdriver type.

An ESD- safe soldering iron and ESD-safe work surface.

> -An ESD-safe soldering iron will be marked as such and on low-cost units is distinguished by a 3 prong AC connector. If you plan on attempting your own repairs as a matter of course, investing in a better grade unit, often called a soldering "station", is a worthwhile investment.
>
> -I use a roll-up ESD safe pad to work on. This pad has a snap connection for my wrist-strap so I and the work surface stay at the same potential. You may be tempted to skip this expense, please don't. Cost is only about $30 USD for a nice unit.

Solder pump and soldering wick. You will need these to be able to remove any installed active devices. I have a spring powered solder pump that is nice for fast work. Wicking works as well, it's just not as fast.

> Solder pump – an under $4 USD example is from New Egg. They call it a "Solder Sucker Desoldering Pump Vacuum Soldering Iron 19cm Repairing Tool". Wow.
>
> Solder wicking may be found on-line at Mouser Electronics or DigiKey. Get the Static Dissipative (SD) rated wicking. It's sold by the roll. Get a couple...

Magnifying lenses – you *will* need them. A headband unit with dual lenses allows working hands-free. Pick whatever will work for you, but you will need to be able to clearly see the pins on an installed SMD IC to check the supply voltage, if nothing else.

Safety glasses for soldering! No joke, get 'em, wear 'em! *Save your eyesight...*

For testing, a 50 ohm dummy load may be made with a pair of 100 ohm, 2 watt composite resistors in parallel and a BNC panel mount. BNC male to male adapter allows use on this radio.

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Basic radio overview

The MFJ-9200 is a miniature, single-conversion transceiver that operates on six of the Internationally allocated high frequency bands within the Amateur Radio Service. The unit is all digital. The VFO control provides for tuning in 100kHz, 1KHz and .1KHz increments. The RIT function permits receiver tuning in 10 Hz increments.

In addition to manual tuning via the rotary encoder, eight memories *per band* are provided to store frequency/mode. Changing between stored Memory and the VFO is by a pushbutton. Changing between bands is done by swapping out a compact Band Module.

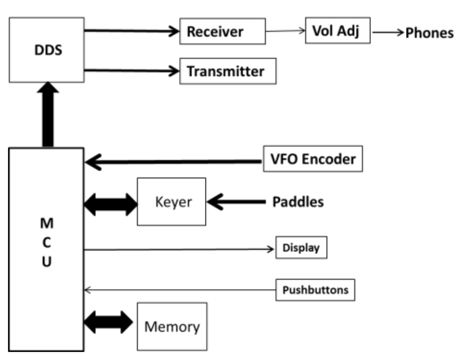
Placement of the operator controls clearly puts this radio in the class generally known as *Trail Friendly*. The high-contrast digital display is large enough to easily read in bright sunlight and it has a backlight for viewing at night. The backlight may be turned off for a *significant* saving in current draw on receive.

The receiver is single conversion, with a crystal ladder filter to reduce noise and adjacent signal interference. The filter may be set for narrow (CW) and wide (USB/LSB). This bandwidth change is controlled by a simple pushbutton. Receiver performance is impressive, with Minimum Discernable Signal (MDS) levels of 0.1 to 0.2 microvolts (-127 dBm @ 50 ohms) typical.

The transmitter is a classic Master Oscillator/Power Amplifier (MOPA) type fed directly by the DDS system. The transmitted signal passes through several filters to reduce harmonic content in the output. The transmitter final amplifier, a robust 2SC2078 transistor, is protected from high VSWR by a Zener diode. The antenna is attached via a BNC connector mounted on top of the unit.

The internal keyer supports iambic keying via a set of operator-supplied paddles. Use of a straight key is supported as well. (See operation manual for more). A keyer memory allows automated calling of CQ at the push of a button. It is **<u>not</u>** possible to reverse the Dot/Dash sense, you must rewire the plug to swap paddle sides.

Operating on a DC input between 8 and 15 Volts DC, the radio transmits with a nominal power of five watts output with 12 DCV applied. The power input and an internal DC feed (J2) are both protected against reverse polarity. External power supplies must be able to provide up to 2 amperes of current with no AC ripple. A simple battery pack made up of eight "AA" batteries provides ample power.



More detail is provided in the sub-system descriptions that follow.

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3.2 DC power busses and protection:

The MFJ-9200 uses several voltages to operate. One power buss is unregulated. The applied DC voltage, either from the external or internal source, will be measured on this buss. This buss feeds the PA section. So higher voltage means more power out and lower voltage lowers the power out. 5 watt output is easily obtained at 12.8VDC.

DO NOT exceed the 14.8 VDC limit on DC input power.

3.3 DC Voltage regulation:

The two additional power busses present are regulated. One buss is regulated for +5 Volts DC and the other is regulated for +6 Volts DC.

Regulation for the DC busses is provided by a solid state regulator device, a 78Lxx SMD. These three lead devices are robust and provide excellent regulation as power varies in situations with marginal batteries, such as on extended transmit.

A potentiometer, labeled as "VR" is used to make an adjustment and is found on the main board. This sets the displayed voltage on the main display. (See Illustration)

3.4 DDS VFO sub-system

The Direct Digital Synthesis (DDS) sub-system the MFJ-9200 is based the popular Analog Devices AD9834 chip. The AD9834 is a 75 MHz low power, DDS device capable of producing high performance sine wave outputs, using the installed 60MHz oscillator as its clock source. The DDS output is determined by the MCU per the encoder settings. With the clock source provided, the DDS chip has an output resolution *under 1 Hz.*

The accuracy and stability of the entire radio is dependent on this clock oscillator. The HOSONIC made unit installed has a claimed 50ppm stability. "Better" units are available (20ppm, for example) but the one used seems to be well within amateur limits. If you were to zero-beat the radio with WWV, for example, you would be hard pressed to even hear a 100 to 300 cycle note if off-frequency. Use of an oscilloscope and a highly accurate signal generator would be required to determine what, if any, difference in the VFO setting and the actual output frequency exists.

Output of the DDS system ranges from a low of 3.5 MHz to a high of 21.45 MHz. The output of the system is buffered to eliminate loading of the DDS system.

On **transmit**; the DDS system output frequency is identical to the displayed VFO value. On **receive**; the DDS output frequency is plus or minus 4.9152 MHz (band dependent) from the displayed VFO value. This off-set matches the first conversion scheme to allow the crystal filter to function.

The AD9834 is controlled via a 3 line serial interface from the PIC controller (MCU). I don't have a way to read the embedded MCU code, and if I did, I still wouldn't put the code in this manual. Since the code is mature (8/2011) this normally wouldn't be required in ordinary circumstances. I am unaware of any method to purchase a replacement MCU from the manufacturer.

Frequency chart for DDS system for selected frequencies

Band & test freq	Transmit setting	Receive setting	**DDS output**
80 meters 4.0 MHz	4.000 MHz		4.000 MHz
		4.000 MHz	8.9152 MHz
40 Meters 7.100 MHz	7.100 MHz		7.100 MHz
		7.100 MHz	12.0152
30 Meters 10.100 MHz	10.100		10.100 MHz
		10.100	5.0848 MHz
20 Meters 14.100 MHz	14.100		14.100 MHz
		14.100	9.1848 MHz
17 Meters 18.100 MHz	18.100		18.100 MHz
		18.100	13.1848 MHz
15 Meters 21.100 MHz	21.000		21.100 MHz
		21.000	16.1848 MHz

NOTE – BFO oscillator is crystal-controlled to 4.9152 MHz.

NOTE – Center frequency of crystal filter is nominally 4.9152 MHz.

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3.5 Band Module diagram and header pin-outs

(See Illustrations – Band Module)

I cover the band module in order for an operator to understand how it fits into the overall system. You *must* have a Band Module installed for the radio to work. There are no user-serviceable parts as the capacitors are, as far as I can see, unmarked. If a module faults, a replacement is available from MFJ Enterprises or their dealers for under$30 USD. BTW, the Band Modules are manufactured right here in the USA by MFJ.

I arbitrarily numbered the header pins on the band module 1 to 8, left to right for convenience. The schematic provided doesn't number these pins, so these numbers are as good as anything else. Just remember, the sockets on the main board will be numbered in the opposite sense. (1 to 8 right to left – see Illustrations.)

The Band Modules **all** have the same MFJ part number and the board layout is identical. Only the installed components – L1, L2 and related capacitors and resistors are different. All silk-screened markings are identical as well.

As I examined the modules, I was looking for something that might be used to cue the MCU as to what module is installed, thus to bring up the DDS/VFO with the correct band settings. I had initially thought that three of the pins in the eight pin header might be grounded or not to present a digital number from zero to seven.

As it turns out, I was overthinking the issue. Pin 1 of the band module runs to ground through a resistor labeled R1. Each band module has a different value of R1. Tracing this pin back out into the board, it runs through what I take to be a resistive voltage divider network which then leads to the MCU. Pretty slick.

This is diagramed on the next page.

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8 pin header

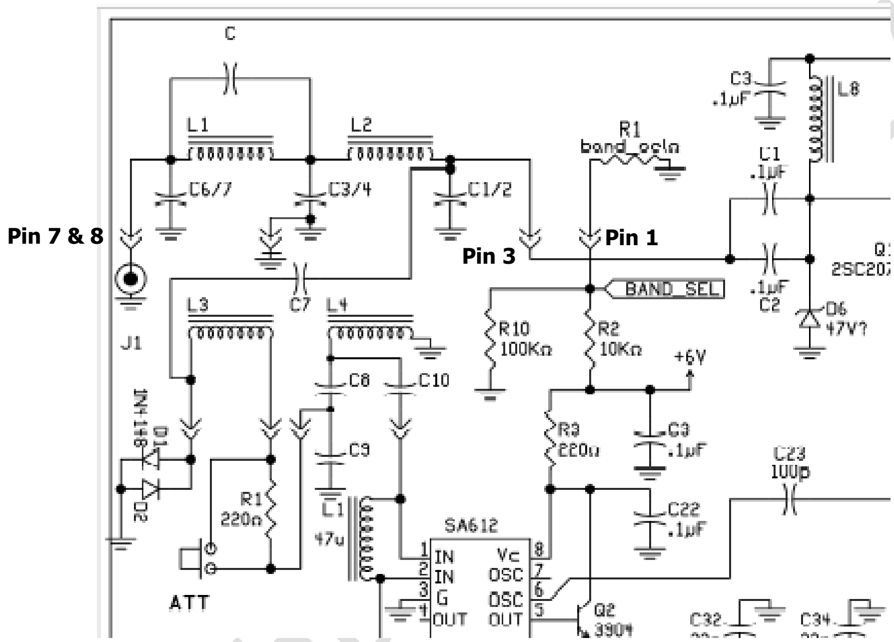
Pin 1 ➡ R1 ➡ Ground.

Pin 2 ➡ Ground.

Pin 3 ➡ C1, C2, L1, L2 ➡ C6, C7, Pin 7 & 8. ➡ To antenna

Pin 4, 5, 6 ➡ Ground.

Note – Pin 7 & 8 are tied together and feed to the BNC connector center conductor solder pad labeled **ANT**.



The RF power from Q10 enters the Band Module via L8 and C2 to Pin 3 of the header. After passing through the filter of C3, C4, C5, C6, C7, L1 and L2, it leaves the header at Pins 7 and 8 going to the ANT pad, the BNC connector and on to the antenna.

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6 pin header

Pin 1 ➡ Q2 switching transistor, then to first mixer. Feeds in to T1 on BM
NOTE – The socket for this pin on the main board will be used as a Test Point later.

Pin 2 ➡ Ground.

Pin 3 ➡ C3 then also feeds into T1.

Pin 4 ➡ Ground.

Pin 5 ➡ T2.

Pin 6 ⬅ T2 (to board D1 & D2).

The receive signal enters the band module at pin 3 of the 8 pin header. The signal travels through C8 before connecting to the socket for pin 6 of the 6 pin header. Pin 6 is on the trace that leads into T2. Pin 6 also feeds out to D1 and D2 on the main board, which is part of the T/R muting circuit. This allows QSK operation.

After going through T2, the signal is present at pin 5. Pin 5 feeds out to the main board attenuator circuit. (See Illustrations – Attenuator R1 @ 221)

The RX signal leaves the Band Module going through C3, C11 before going out pin 1 to Q2, a switching transistor. From there, it goes to the first of two SA612 mixers.

Between C3 and C11, a trace leads to T1 making it part of the circuit. I assume the circuit is grounded inside the can where the connection isn't visible. Pins 2 and 4 are grounded.

T1 and T2 are adjusted for best (loudest) receive signal at a frequency you choose.

Band	R1 Label	R1 Value
80	101	100
40	222	2.2K
30	472	4.7K
20	103	10K
17	223	22K
15	473	47K

NOTE – How to read SMD resistor values. The first two numbers denote significant digits. The third digit is the multiplier, that is, the- power of ten which the two digits are multiplied. Basically, the third digit is how many zeros to add. Resistances of less than 10 ohms don't have a multiplier. Instead, the letter 'R' is used to indicate the position of the decimal point.

3-digit code example:
220 = 22 × 10^0 (1) = 22 ohm – <u>not</u> 220 ohms
471 = 47 × 10^1 (10) = 470 ohms
102 = 10 × 10^2 (100) = 1000Ω or 1k ohm

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3.6 Receiver

- Signal path.

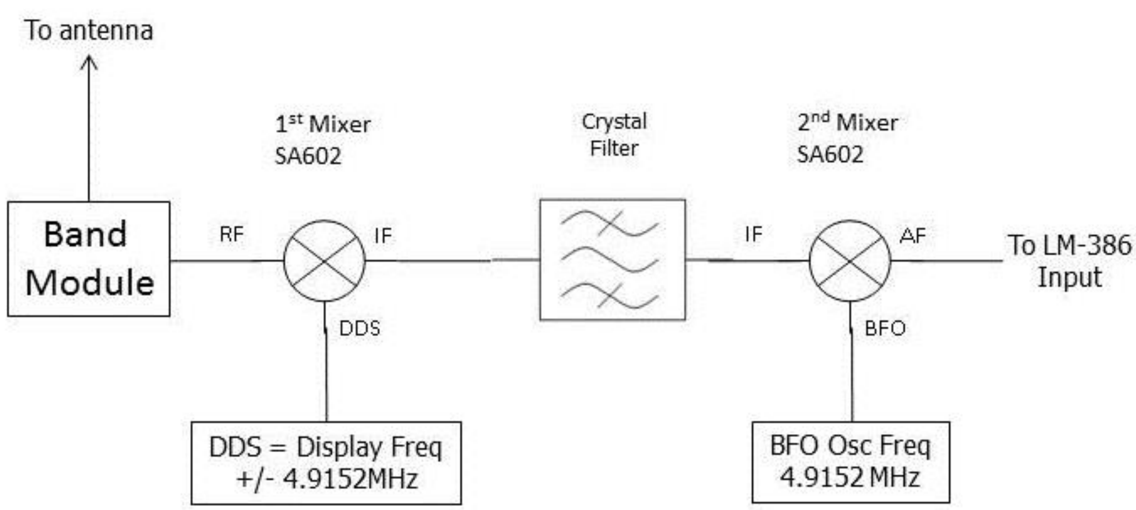
The desired signal leaves the antenna and enters the radio via the BNC connector. The signal then enters the installed Band Module.

The Band Module acts as a bandpass filter, utilizing several capacitors & both T1 and T2. RF energy outside of the passband defined by T1 and T2 is severely attenuated. This is why there is the need to peak the two coils on the Band Module and is so important for receiver performance.

Leaving the Band Module, the signal enters the first of two SA602A mixers. There, the incoming RF is mixed with the signal from the DDS sub-system. The output of the SA612 now contains the two original signals (RF and DDS) ***plus*** the sum and difference of the two signals. This is the *Intermediate Frequency* or IF. This complex output feeds through a buffer amplified Q2 into the ladder filter, a matched set of four crystals. The crystals in the filter are marked as 4.9152 MHz.

The ladder filter, acting as a high-Q, series resonant circuit, then feeds the signal into the second SA612 mixer. This filtered signal (IF) is mixed with the output from the BFO sub-system. The BFO oscillator is crystal controlled at ~4.9152 MHz. Again, the output of the second mixer has both original signals ***plus*** the sum and difference of the mixer input. One of those output products is the recovered audio (AF) or CW note from the signal that entered at the beginning. This goes to the LM386 audio amplifier, through the Volume Control potentiometer and on to the Phone output jack.

This double mixer scheme, with crystal filter, is seen in many other MFJ QRP radios and is vastly superior to the simple Direct Conversion (DC) receivers of an earlier age. This circuit architecture allows filtering of unwanted noise and out of band signals, such as shortwave broadcasters. It is also inherently a low-noise system.



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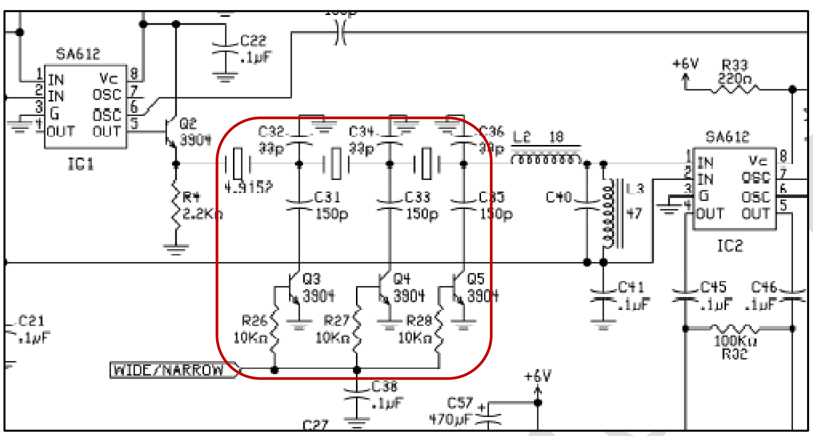
Discussion on receiver and filtering scheme:

The DDS system, **in receive**, feeds the first mixer a signal that is **offset** from the desired (displayed) frequency by the value of the ladder filter crystals +/- 4.9152 MHz. The DDS signal and the received signal are mixed in the SA612.

Since the crystals in the ladder filter act as a narrow passband filter, only the desired signal (4.915 MHz and the intelligence it carries) is found at the output.

The crystals act as a series resonant circuit and are much smaller the equivalent capacitor, coil and resistor of such a complex circuit. The Q or bandwidth of the ladder filter is changed by use of a set of 'shunt' or swamping capacitors.



You see shunt caps to the right of the crystals on the main board with several switching transistors (Q3, Q4, Q5). The bandwidth is changed by these capacitors as the transistors are switched by the MCU when selecting CW or USB/LSB.

Why does this matter? In the test equipment section, I stated I use a portable general coverage radio, an ATS 909 to be exact, as a signal tracer. With the BFO active in my portable, the DDS, BFO and mixer products can be heard as a tone on the radio. Since the portable radio is fairly accurate, I can quickly see if the DDS system is working and on frequency, the filter has an output and the BFO system is working and on frequency by setting the radio to listen for the expected signal.

The DDS sub-system has a Chart of frequencies for the DDS chip in both transmit and receive states. This data is also used in the troubleshooting section.

For the receiver to work correctly, the BFO must be set properly to maximize the receiver performance. If the BFO is off-frequency, the product of the second mixer may be not be heard. The BFO is adjustable because the DDS source may be slightly off from the displayed value.

Attempt adjustment the BFO **only** if troubleshooting steps call for an adjustment. Follow detailed adjustment steps ***exactly***. Randomly tweaking things in an effort to repair a problem will just lead to...more problems. *Leave it alone!*

See adjust VC for more on this aspect of the BFO.

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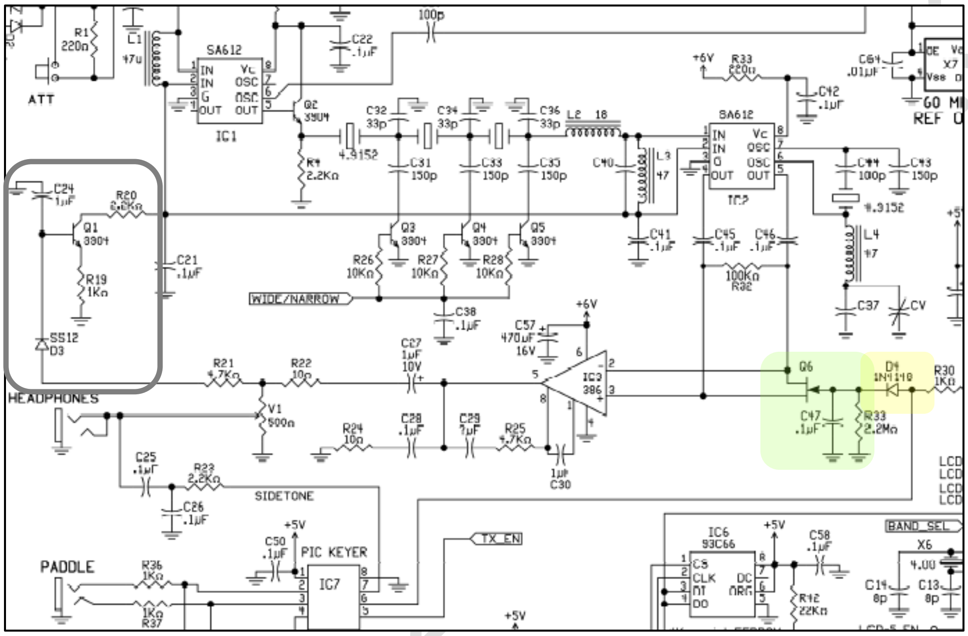
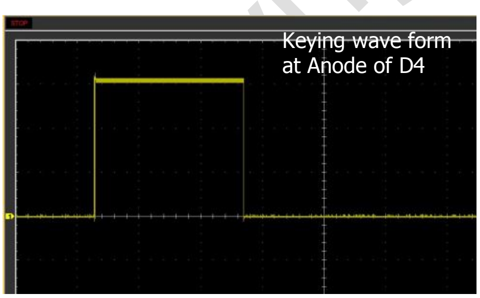
3.6.3 Audio switching, muting and side-tone:

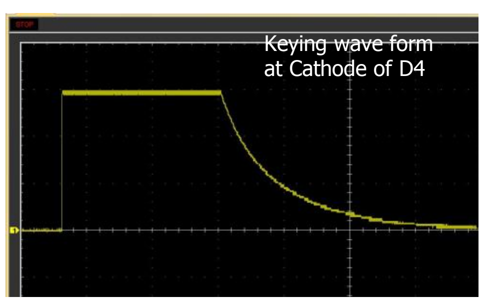
Unlike many of the contemporary QRP radios on the market, **the -9200 does <u>not</u> use relays for band-switching, muting or side-tone**. It is also one of the few that offers a real AGC function. Automatic Gain Control or AGC is what keeps your ears from being blasted by strong stations as you tune across the band.

For the operator this is an important distinction. Electromechanical devices, such as relays, are a prime failure point on many radios. Let's look at how the 9200 performs essential T/R muting, provides side-tone and AGC while avoiding the need for relays.



When the radio is keyed, the keyer chip, IC7, Pin 6 changes state. Since Pin 7 is connected to the anode of D4, the state change is also seen at the Emitter of Q6, a unijunction transistor. Q6 acts as a switch, cutting off the audio feed to IC2, the LM386 audio amplifier. While switched, the RC combination of C47/R33 charge up to the same potential as the cathode of D4. What does this look like?





These images provided by and used with permission of Robbie, G0GUH.

When the key goes up, IC7, Pin 6 changes state again, and the voltage drops. The RC time constant of C47/R33 allows a gentle drop (sloped line) and thus, the audio does not pop upon T/R switching. *Wicked cool stuff.*

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At the same time, when IC7 (the keyer) is active, Pin 7 feeds a tone to the audio path leading to the headphone jack. This means side-tone is not adjustable for either pitch or volume. The LM-386 has no output and so you hear the side-tone.

If you will now look at IC3 (the LM386) – Pin 5. This Pin is connected to the Cathode of D3 via a couple of resistors and a capacitor. The Anode of D3 is connected, in turn, to the base of Q1. Note that Q1 is a 2N3904, an amplifier, not a switching transistor like Q6.

The collector of Q1 is tied to IC1 (the SA612) , Pin 2 – this is the first mixer. This chain forms an *AGC loop*.

As the audio comes from the LM386, it is rectified by D3 and fed to Q1. This in turn changes the input to the first mixer, providing a fairly robust AGC action for the receiver. As the audio voltage varies, the input to IC1, Pin 2 changes at the same rate.

R20 and C21 provide an RC time constant to keep the AGC from 'pumping' the input on all but the strongest stations. This loop benefits from the crystal filter just ahead of the second mixer. The filter reduces any effect of strong stations just a few KHz away from the desired station also causing the AGC to 'pump' the input to the first mixer.

Thus, with a few components, and a bit of clever engineering, receiver system AGC, T/R switching and audio muting is provided without the need to resort to relays. This allows QSK (fast T/R switching) and a pop-free audio feed with at least some AGC for strong stations.

I have to say, there is a lot to love about this rig….

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3.7 Transmitter

<u>Signal path and SWR protection for final amplifier.</u>

As mentioned earlier, the transmitter is a simple MOPA type. The signal from the DDS sub-system is fed to Q7, Q8, then Q9, before going into the input side of T1 (8 turns). The output side of T1, the smaller link coil, feeds Q10 the 2SC2078. The signal is amplified by transistor Q10, passed through the Band Module for filtering before going to the BNC connector.

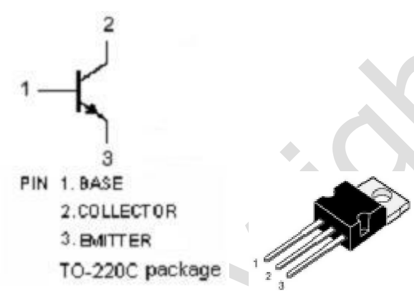
T1 is the large toroidal transformer next to Q10 and is used to link the transistor base to the incoming DDS RF. L8 is a fixed inductor and is mounted on the face of the main circuit board. Note that Q10 is supplied by the unregulated supply. As the supply voltage drops, so will the power output.

I would note that the HB-1B MK 3 now uses this same setup.

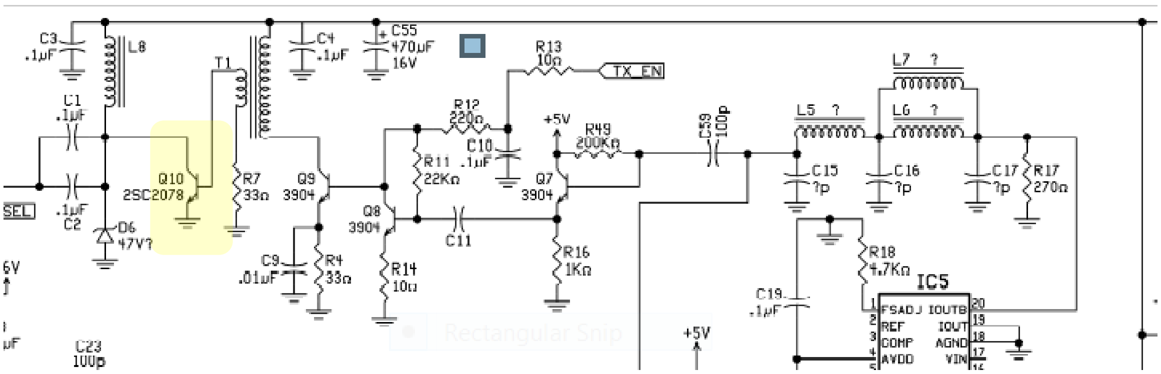
All capacitors and inductors in the transmitter are fixed. There are <u>**no**</u> adjustments possible by the operator nor are any needed. If you don't have a resonant antenna, then some kind of matching unit is *required*. A mismatched antenna produces high Voltage, Standing Wave Ratio (VSWR).

These 'mismatch voltages' can cause failure of the final by exceeding the Base/Collector or Emitter/Collector breakdown voltage rating. In an effort to protect the final transistor, a Zener diode, rated at 43 Volts, is installed. Once the voltage present at the emitter exceeds the 43 volt level, the Zener diode will start to conduct, *hopefully* saving Q10. I've called out a 36 volt Zener as a replacement. It might save you from replacing Q10 again...

Any time you are testing, always have a 50 ohm dummy load connected to the BNC connector or between the ANT pad and ground.



The TO-220 case for Q10 has a standard pin-out. The 2SC2078 is a common device.



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4. Troubleshooting Basic Radio Problems:

4.1. Radio does not function (seems to be dead)

Reminder – Click link to view relevant illustration.

Confirm by: Attach power, headphones and dummy load. Confirm – no sound in headphones, display remains blank, backlight on display does not function.

Test Steps/Results/Action:

If in-line fuse on DC supply cable blows repeatedly, **STOP**. An internal short will cause the in-line fuse will blow repeatedly.

If the SWR protection diode, C-55, or Q10 are shorted, the DC supply is grounded.

Quick Check 1: Disconnect power cable; attach an ohm meter in place of the power supply/battery. That is to say, connect the meter to the power leads, then the power lead to radio.
When the power switch is activated, the ohm meter should read *around* 36K ohms.

NOTE - If the reading is above 36K then *drops*, it is an indication that C-55 is charging.

- If meter indicates **an open** (zero on a VOM or 1. on most DMM), *reverse* the ohm meter leads as the reverse polarity protection diode is blocking your reading .
- ~36K ohms is indicated, go to 1).
- Short (zero) indicated, go to Quick Check 2.

Quick Check 2 - Check SWR protection diode first. Then check Q10 then C-55 for short.

1) Check DC supply:

Remove DC feed connector and measure voltage and polarity present at connector:
-DC supply may be below 8 volts.
-DC supply may be not be present (cable/connector broken).
-DC supply at connector may have wrong polarity (must be + center/- on exterior).

Action: Correct issue with DC supply, if found.

If DC feed voltage is correct - Remove rear cover.

2) Find J1. Check for supply voltage at rear of jack. Supply voltage present?
Yes? Continue.
No? Fault. See Action item 1.

NOTE – The operator supplied connector and installed jack may not fully match due to manufacturer tolerance mismatch. Wiggle the connector to see if voltage appears. If supply voltage does appear, replace supply connector.

3) Find power switch Check for supply voltage at center pins. Voltage present?
Yes? Continue.
No? Fault. See Action item 2.

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4) Find TEST POINT +5VDC. Check +5 VDC . Is 5 VDC +/- 5% found?
Yes? Continue.
No? Fault See Action item 3.

5) Find TEST POINT +6VDC. Check +6 VDC . Is 6VDC found?
Yes? End of test. All DC supplies test as operational.
No? Fault. See Action item 4.

Action items:
(1) Supply voltage not present at J1. Possible fix, replace J1.

(2) Supply voltage not present. Possible fix, test/replace diode D5.

(3) +5VDC not present at Test Point. Possible fix, replace 78L05.

(4) +6VDC not present at Test Point. Possible fix, replace 78L06.

Final Action: If the above steps fail to correct problem, open a trouble ticket with MFJ, request quote for repair. Document steps taken and result for inclusion in trouble ticket.

4.2. No received signal is heard:

Confirm by: Attach known good: Power, headphones and dummy load or known good antenna. Attach adjustable signal source to dummy load. There may be no sound in headphones. Volume control moves easily. Display operates normally indicating a Band Module is installed, backlight on display functions.

Test Steps/Results/Action:
1) Remove back cover. Ensure Band Module is installed correctly. If so, trade out Band Module. This is an unlikely fix, but a simple first check.

Action: If different Band Module restores operation, inspect/replace suspect Band Module.

2) If changing the Band Module makes no difference, remove installed Band Module.
-Find the 6 pin header on the main board. Take an unconnected test lead and touch header socket marked as PIN 1. Is noise heard?
Yes? Continue.
No? Additional testing required. See Action item 2.

3) Find LM386 (IC3). Carefully touch the test lead to PIN 2. (The circuit board trace from this pin leads to top of Q8). Is noise like a 60 Hz hum heard?
Yes? Continue.
No? Additional testing required. See Action item 3.

4) Find pins feeding the Phones Jack.
On Ohmmeter, select lowest value for Ohms, measure between the Tip and Sleeve/Ring and Sleeve. Is a popping noise heard in headphones?
No? See Action item 4.
Yes? All receiver subsystems appear functional. See Action item 5. See Action item 6.

Action items:

(2) Path from first mixer to audio output appears functional.
See Test DDS.

(3) Path to audio output appears functional.
See Test First mixer. See Test Second mixer. See Test BFO.

(4) Phone Jack may be inoperative. Possible fix –Replace the Phone jack.

(5) The SWR protection diode may be shorted. See Test SWR protection diode.

(6) The Band Module may be defective. See Bypass Band Module.

Action: If these steps fail to correct problem, open a trouble ticket with MFJ, request quote for repair.

If Phones jack was replaced, restart checks at top of this tree.

4.3. No RF output

Confirm by: Attach known good: Power, headphones and dummy load. There may be sound in headphones. Display operates normally indicating a Band Module is installed, backlight on display functions. Signals are heard with antenna attached.

Set VFO to listed test frequency (example – 10.100MHz). When keyed into the dummy load, no apparent signal is transmitted or watt meter indicates no output or very low output. Sidetone maybe audible in headphones when keyed with either a straight key or a set of paddles.

Alternatively, set tracer/radio to test frequency as above. A very loud tone should be heard when -9200 is keyed. A very weak or no tone indicates a possible fault.

Test Steps/Results/Action:

1) Confirm DC power is correct at supply. Measure between 8VDC and 15VDC.
Is supply voltage between 8 and 15VDC ?
Yes? – Continue.
No? – Fault. Correct supply voltage before any more testing.

2) Confirm DC supply voltage is present at each pin of L8. (Two pins between C2 and C3 on main circuit board). Is supply voltage is present on both pins?
Yes? – Continue.
No? – Fault. L8 appears to be open. Replace L8.

3) Test DDS to confirm output frequency is correct. Is DDS on correct frequency?
Yes? – Continue.
No? – Fault. Contact MFJ Enterprises for a repair quote.

4) Remove dummy load, headphones and power. Remove back cover. Ensure Band Module is installed correctly. If so, trade out Band Module. This is an unlikely fix, but a simple check.

If different Band Module restores operation, inspect/replace suspect Band Module. It is possible, though unlikely, that the receiver will work, but there is some fault in the transmit filter section. Examine L1 and L2 closely for a broken lead.

5) If changing the Band Module makes no difference. Test SWR protection diode to see if it is defective. If receiver is working, this is very unlikely, but it is possible that the diode conducts when unit transmits.

Alternatively, if using dummy load, remove SWR protection diode. If it is faulted, transmit power should be seen on wattmeter.

Note - This diode normally has supply voltage present at anode at all times radio is on.

6) Check that Q10 has power.

-Remove main circuit board from chassis.

-Attach power, headphones and using a pair of test leads, connect 51 ohm resistor between the ANT pad and ground.

-Using voltmeter, confirm supply voltage is present on Pin 2 (center pin) of Q10 as seen from front of main circuit board. Is supply voltage present?
Yes? – Continue.
No? – Additional testing required. See Test Q10.

7) Check that C55 (470 uF electrolytic capacitor) is not shorted. This is only possible from front of main circuit board. If shorted, replace.

After all checks are performed and results are normal, additional troubleshooting will require advanced test equipment. Contact MFJ Enterprises for a repair quote.

4.4. No or low audio output

Confirm by: Attach known good: Power, headphones and dummy load. There may be some sound in headphones. Display operates normally indicating a Band Module is installed, backlight on display functions. Signals *may* be heard with antenna attached.

Test Steps/Results/Action:

1) No audio. Check audio path using steps from Chapter 4.2

2) If some audio is heard, but at a low volume, no matter where the volume control is set. Use one test lead to bypass the volume control.

-Find the three pins nearest R21. These are found below and to the left of the crystal filter. A trace goes from R21 to the leftmost pin. The center pin leads to J4 (Phones) on the front of the main board.

-Short between these two leads, this will bypass the potentiometer.

-Volume should be 'loud'. Did audio output increase?
Yes? – Fault. Replace potentiometer.
No? – Contact MFJ Enterprises for a repair quote of the LM-386.

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4.5. Radio doesn't key or keys erratically

Confirm by: Attach known good: Power, headphones and dummy load. There may be sound in headphones. Display operates normally indicating a Band Module is installed, backlight on display functions. Insert key plug, press key or paddle. Radio doesn't transmit or transmits erratically.

Test Steps/Results/Action:

1) No transmit. Using VOM, confirm that a short develops on Tip to Sleeve on key plug when key is pressed. If using paddles, check both Tip and Ring to Sleeve for a short when paddle contact closes.

-Did VOM indicate a short when key/paddle contact closed?
Yes – Continue testing.
No – Fault. Assuming key or paddle contacts are clean, check, then replace or repair cable.

2) Erratic transmit (drops out with key pressed)
Remove DC power, headphones. Remove back cover. Find J3, key jack. Locate R36 and R37. The trace leads back to IC 7, pins 2 and 3. See Illustration.
IC-7 is the keyer chip. Connect **dummy load**, headphones and power. Grounding either pin 2 **or** pin 3 at J3 should cause the radio to transmit. Using test lead, short between Tip or Ring and ground at J3. Radio should transmit.

-Did radio transmit when pin 2 or 3 is grounded at key jack?
Yes – Fault. J3 may be loose or have bad contacts internally. Replace J3.
No – Fault. Contact MFJ for repair quote.

4.6. Display is dead, displays "funny characters" or has no backlight

Confirm when radio is powered up that boot screen displays, then current frequency displays. If display does not show correct information (numbers), it may have faulted.
Or - Backlight doesn't light when B/L button pushed.

1) Check DC supply. If OK, continue.
2) Check voltages on display.

-Pin 2 to ground should have +5 VDC.
-Confirm ground is present.
Is +5VDC found on correct pin?
No? If +5VDC test good and no voltage found on pins 2. Fault. See Action item 1.
Yes? If +5VDC test good and voltage is found on pins 2. Fault. See Action item 1.

Continue to next page

3) Backlight button feeds +5VDc to Pin 15 of display. Check voltages on display.

- When B/L button is depressed, button should remain depressed.
Does button stay 'down' when pressed?
Yes? – Continue.
No? – Fault. See Action item 2.

-When B/L button is depressed, button remains depressed and + 5VDC is seen on pin 15.
Does +5VDC appear on pin 15?
Yes? – Fault. See Action time 1.
No? – Fault with button. See Action item 2.

Action:
1) Replace display. **CAUTION** – several pins on the display lead *directly* to MCU. **Use of ESD safe soldering iron required.**
Alternatively - Contact MFJ Enterprises for a repair quote.

2) Replace pushbutton. P/N and mfg are unknown. Contact MFJ Enterprises for a replacement part quote.

4.7. Radio is off frequency (display doesn't match measured output signal)

Confirm by: Attach known good: Power, headphones and dummy load. There may be sound in headphones. Display operates normally indicating a Band Module is installed, backlight on display functions. Signals may be heard with antenna attached.

Set VFO to listed test frequency (example – 10.100MHz). When keyed into the dummy load, no apparent signal is transmitted, tracer/radio hears no signal. Tuning tracer/radio to a different frequency may yield a tone, indicating Transmitter is off frequency. Sidetone audible in headphones when keyed with either a straight key or a set of paddles.

Alternatively, set tracer/radio to test frequency as above. A very loud tone should be heard when -9200 is keyed. A very weak or no tone indicates a possible fault.

Check receive by setting signal source to listed test frequency using tracer/radio as confirmation. Ensure RIT is not active. A loud tone should be heard.

1) Check DDS subsystem. If DDS shows as good in testing for receive, but off frequency for transmit, the MCU is faulted. The same is true for the opposite symptom, good frequency on transmit, off frequency on receive.

Does receiver or transmitter appear to be off frequency?
Receiver – Check that the RIT is not active. RIT not active? See Action item 1.
Transmitter – Transmitter off frequency? Yes – See Action item 1.

Action:

1) Contact MFJ Enterprises for a quote for repair.

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Testing specific radio sub-systems:

Test DDS

Test Steps/Results/Action:

1) Remove back cover. Attach power, headphones and dummy load. Using this Chart, set VFO as shown for Band Module installed. Set signal tracer/radio to DDS output listed in chart below.

- Place the tracer/radio input lead over the DDS chip. Is a tone heard at listed setting?
    - No. See Action item 1.
    - Yes? End of test, DDS system appears to be functional.

-If possible, set tracer/radio to 60 MHz. Is a tone heard?
    - No. See Action item 1.
    - Yes? End of test, DDS system Master Clock source appears to be functional.

(1) This test indicates the DDS system is inoperative.
Action: Open a trouble ticket with MFJ, request quote for repair. Repair of the DDS system/Master Clock Oscillator requires additional (and expensive) tools and techniques, putting any repair beyond the scope of this manual.

Band & test freq	**VFO displays:**	DDS output
80 meters 4.0 MHz	4.000 MHz	8.9152 MHz
40 Meters 7.100 MHz	7.100 MHz	12.0152MHz
30 Meters 10.100 MHz	10.100 MHz	5.0848 MHz
20 Meters 14.100 MHz	14.100 MHz	9.1848 MHz
17 Meters 18.100 MHz	18.100 MHz	13.1848 MHz
15 Meters 21.100 MHz	21.000 Mhz	16.1848 MHz

Adjust +5 Volt supply:

- VR adjustment for +5 VDC buss: (board may be in chassis or out)

Step 1) Ground negative lead (com or black) of meter to board by clipping to ground point.

Step 2) Attach dummy load, phones and DC supply. With back cover removed and the unit face down, locate TEST POINT for +5VDC.

Step 3) Using positive (+ or red) lead from your meter, measure voltage at TEST POINT +5VDC. If voltage is +5 VDC +/- 5% (this is 0.25 volts or 4.75 to 5.25) no adjustment is required. If the voltage is off by more than 5%, adjust **VR** until +5 VDC is obtained.

Step 4) Remove power and reassemble radio.

NOTE – adjustment of control VR required a small Phillips head screwdriver.
NOTE – the +6VDC buss is not adjustable.

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Test First mixer

Test Steps/Results/Action:

NOTE – with a Band Module installed, access to the first mixer is not possible.

1) Remove back cover. Attach power, headphones, dummy load and antenna/signal source. Set signal source to 10.100 MHz. Set signal tracer/radio to 4.8152 MHz.

(Use listed test settings for other bands from Chart above.)

- Place the tracer/radio input lead on the right side of L2 which is the small blue square to the right of the crystal filter marked as 180J. Is a tone heard at listed setting? (See Illustration.)

NOTE – A loud 1 KHz tone will be heard due to the 4.9152 MHz BFO oscillator. As you adjust the signal source, a second, weaker, tone will be heard. This second tone is the output of the first mixer after passing through the filter. This second tone will vary in frequency as you adjust the signal source. The louder (BFO) tone will not change regardless of signal source setting.

-No second tone is heard. See item A.
-Yes, second tone heard. End Test: First mixer appears to be functional.

(A) This test indicates the first mixer is inoperative. If mixing is not occurring, no mixing product (4.913 MHz signal) will be present. Possible fix: Replace SA612 chip.

Action: Open a trouble ticket with MFJ, request quote for repair if you choose not to replace chip.

Test Second mixer // Test Audio path:

Test Steps/Results/Action

1) Ensure First mixer has passed test above.

2) Find LM386 (IC3).

-Carefully touch the test lead to PIN 2. (The circuit board trace from this pin leads to top of Q8). (See Illustration) Is noise like a 60 Hz hum heard?

-A noticeable 60HZ hum is heard in phones. Yes. See item A. End of test.

(A) If the First mixer is good and the audio path is good, this indicates a fault in the second mixer. If mixing is not occurring, no mixing product (audio) will be present. Possible fix: Replace SA612 chip.

Action: Open a trouble ticket with MFJ, request quote for repair if you choose not to replace chip.

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Test BFO oscillator

Test Steps/Results/Action:

1) Remove back cover. Attach power, headphones and dummy load. Set signal tracer/radio to 4.9152 MHz.

- Place the input lead over adjustment **VC,** this is near the bottom of the crystal filer. Is a loud tone heard at listed setting?
No. See item A.
Yes? End Test: BFO oscillator appears to be functional.

(A) This test indicates the Beat Frequency Oscillator is inoperative. Possible fix: Replace second mixer SA612 chip. The crystal is unlikely to be bad.

Action: Open a trouble ticket with MFJ, request quote for repair if you choose not to replace chip.

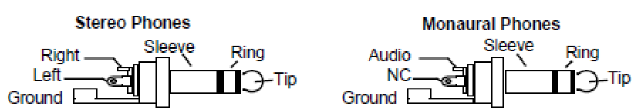
Adjust VC to 'center' the BFO to filter pass band:

This adjustment is performed *only* when the receiver has demonstrated very low sensitivity. Caution must be exercised as the 'wrong' sideband may be peaked.

You really need an accurate RF signal source, an accurate AF signal source and an O'scope to correctly set the BFO. This is beyond the stated scope of this manual.

If you adjust **Vc** in an attempt to peak the received signal in the filter passband, you may peak to the undesired sideband.

Note - To measure the audio output, you will need an AC voltmeter that can read 0 to 1 volt, AC. Output of the radio at full volume is about 0.25VAC into an 8 ohm reactive load - a speaker. Audio is obtained with a cable connecting TIP to Sleeve or RING to Sleeve as seen in Operations Manual.



1) With the audio output fed into a speaker, attach the AC voltmeter across the leads feeding the speaker. With audio present, you should measure up to 0.25 VAC.

2) Set the VFO to one of the listed test frequencies, for example, 10.100 MHz.

3) Using your signal source, (adjust for a 700 Hz tone for best results), peak the voltmeter reading. You will see at least two peaks.

4) Using a non-metallic tool, adjust **Vc** for peak. Note direction you move the adjustment.

5) Attach an antenna and seek a SSB signal. If you can tune a signal with clarity, you are on the correct sideband.

Return to ToC

6) If you cannot tune a SSB signal with clarity, repeat Steps 3 and 4, this time, move the adjustment in opposite direction. Repeat Step 5.

Results: If tuned correctly, Minimum Detectable Signal (MDS) of 0.1 to 0.2 microvolts are measured.

Normally, this is set at the factory owing to the need for precision test equipment. If you are unable to obtain a MDS of 0.2 uV, contact MFJ for a repair quote.

Test SWR protection diode:
If the SWR diode is shorted, the DC supply is grounded. The in-line fuse will blow repeatedly. *You do have an in-line fuse for your power cable, yes*?

1) With power supplied, check anode of diode to see if supply voltage is present. See illustration.

Results: If shorted, replace the diode. Since this is a Zener diode, you can only check for the supply voltage with the test equipment called out. If the diode is open, it will have no effect on the transmitter, but damage from high VSWR is now very possible.

Bypass Band Module for RX path:
If the Band Module is defective, both receive and transmit are affected. However, a fault in a Band Module is very unlikely. Given that the Module is made entirely of passive devices, that is, coils, capacitors and a resistor, the most likely fault is a soldered connection gone bad or header pin issue related to rough handling.

You will need a short double-ended test lead – one with alligator clips at each end as shown in illustration. A 4.7K ohm resistor (1/8 watt), a set of pins and a known good signal source are required.

To bypass the Band Module on the main circuit board, ***in receive only***:

1) Remove knurled screws, remove back cover. Remove Band Module.

2) Attach headphones and dummy load. Set signal source connected to dummy load to the same frequency as shown on VFO display. Use your tracer/radio to confirm signal source is on the correct frequency. In this example, set VFO and signal source to 10.100 MHz.

3) With power removed, insert the leads of a 1/8 watt, 4.7K ohm resistor into the 8 pin header socket for pins 1 and 2.
On power up, the VFO display will indicate a 30 Meter Band Module is installed. Set VFO to 10.100.
NOTE – for other bands, see the Chart for resistor value.

4) Using the test lead, and a set of pins – jumper between [the 8 pin header] pin 7 or 8 and [the 6 pin header], pin 1. See Illustration.

Result: You should hear a tone in your headset. Removing the jumper should kill the signal.

If the Module is faulted – contact MFJ Enterprises for the appropriate replacement.

Testing Q10 with Ohm meter

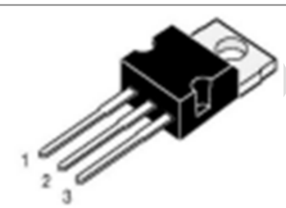
Transistors act like diodes when checked with an VOM set to lowest range (1 X). By swapping the leads, you should see a major change in the ohms measured. Once the transistor has been removed from the main circuit board, confirm Q10 status with this test.

1 is **B**ase, 2 is **C**ollector and 3 is the **E**mitter.

So, for the first column - Positive lead on meter (Red) is the first letter - **B**

Negative lead of meter (Black) goes on the second letter - **E**. (Red on lead 1, black on lead 3).

Then swap the meter leads – Red is now on lead 3...Black lead on 1 See chart below.



Ohms Test for Q10

B to E	E to B	B to C	C to B	C to E	E to C
Low	High	Low	High	High	High

Low = 1 to 10 ohms..

High = Many ohms to infinite.

If you fail to obtain these reading, Q10 is likely faulted. Replace Q10.

Return to ToC

Basic Maintenance and Repair of the radio:

Common steps for every Task.

Return to Main ToC

Basic Maintenance and Repair of the radio Tasks

Task preparation – a common set of steps for every Task:

- *Read the entire Task* in advance to ensure you understand what is required, that you have the correct items (parts and tools) and space on hand to perform the Task.
- Clear work area and set up ESD-safe work surface.
- Set out required tools (and solder, pump, etc)
- If required by the Task, plug in ESD-safe soldering iron to begin heating to operating temperature.
- Don safety glasses.

Return to Basic Maintenance ToC

TASK 1 – Tuning Band Modules for best performance.

Required by:
Task performed to ensure radio sensitivity is at maximum possible at selected frequency.

Tools required:

- Non-metallic miniature screwdriver or non-metallic hex head tuning tool, as appropriate.
- Voltmeter, AC. 0 to 1 or 0 to 3 VAC range, 0 to 1 VAC preferred.

Begin Task:
Step 1: Determine *preferred* operating frequency for the Band Module installed.

NOTE – For the 30 Meter band and module, the common QRP calling frequency is 10.106 MHz, for 20 Meters it is 14.060 MHz. Peaking the Band Module for a preferred frequency ensures best possible sensitivity for operation. If you will use the -9200 primarily on an established net, then use that net frequency for this Task. The turning is fairly broadband

Step 2: Remove back cover. Attach 8 ohm speaker, power and dummy load. Feed signal source to radio via the dummy load.

Step 3: With the speaker attached, connect AC voltmeter leads *across* the speaker terminals.

CAUTION – **DO NOT** use the voltmeter as the only audio load, damage to audio sub-system may result.

Step 4: Turn on radio, set VFO to desired frequency. Turn up volume until the voltmeter indicates something.

Step 5: Adjust slugs in T1 and T2 for maximum (peak) indicated voltage. See Illustration for location of T1 and T2. The radio will produce about 0.25 VAC into an 8 ohm load.

NOTE - The adjustments affect one another, take your time. After adjustment of either slug produces no increase in measured voltage, turn off radio.

Step 6: Repeat as necessary for each Band Module.

Step 7: Replace back cover.

END OF TASK

Return to Basic Maintenance ToC

TASK 2 – Remove main circuit board from chassis:

Required by:
Task performed to gain access to front of main circuit board for replacement of devices or parts.

Tools required:

- Adjustable spanner.
- Screwdriver, Phillips head. One small, one medium.
- Safety glasses.
- Soldering iron (ESD-safe).
- Solder pump or solder wicking.
- Small container to hold parts as removed.

Begin Task:

Step 1: Using the small Phillips head screwdriver, loosen VFO knob setscrew found on the side of the knob. **DO NOT** remove the setscrew, only loosen enough to remove knob. Remove knob. Place knob in container.

Step 2: Using fingers, gently remove the volume control knob by pulling straight up. Place knob in container.

Step 3: Turn unit over on face and remove two knurled screws. Set the screws in the container. Remove back cover. Set cover aside, out of the way.

Step 4: Remove installed Band Module. Place in container.

Step 5: Using soldering iron and pump/wicking, remove solder bridge between main circuit board pad labeled **ANT** and center conductor of BNC Connector. **DO NOT** unsolder the washer/ring under the BNC connector retaining nut. (see Illustration)

Step 6: Using adjustable spanner, carefully remove the BNC connector retaining nut. Remove BNC connector by pulling it away from chassis. Use care not to disturb tabbed washer that is soldered to main circuit board. Replace retaining nut & star washer on BNC connector and place in container.

Step 7: Using medium Phillips head screwdriver and adjustable spanner, remove mounting screw & nut holding Q10 power transistor to chassis. (see Illustration).

NOTE – *Carefully* remove stepped insulating washer and thermal insulator (both are white) and place in container. Screw nut onto mounting screw and place in container.

Step 8: Using adjustable spanner, remove hex-shaped support posts on each side of main circuit board. Set these posts in container. (see Illustration)

Step 9: Carefully remove main circuit board by pulling up. You may need to rock the board slightly to clear the Phone/Key jacks. Don't be in a hurry here; the board will come out with *little* real force required. Set the chassis with the cover removed in Step 3.

END OF TASK

Return to Basic Maintenance ToC

Task 3 – Install main circuit board back into chassis

Installing main circuit board is nearly the opposite of removing the board.

Step 1: Carefully insert main circuit board in chassis, tilted at slight angle to clear both the encoder/Volume pot and the Phone/Key connectors.

You may need to rock the board slightly to clear the Phone/Key jacks. Don't be in a hurry here; the board will go in with *little* force required. Loosely install both the Hex shaped support posts. (see Illustration)

Step 2: Using medium Phillips head screwdriver and adjustable spanner, mount screw & nut holding Q10 power transistor to chassis. *Ensure the heat conducting insulator is evenly behind the Q10 mounting tab.* Inset screw and insulated step washer in chassis. Add nut and tighten the screw, but to not tighten firmly. (see Illustration)

CAUTION – both the step washer (insulator) and heat conducting insulator are required, otherwise, the power supply is shorted to ground.

Step 3: Install BNC connector by inserting it into the chassis. Use care not to disturb tabbed washer that is soldered to main circuit board. Replace retaining nut & star washer on BNC connector. The star washer goes behind the tabbed washer.

Tighten BNC connector nut carefully with adjustable spanner. The center conductor of BNC should almost touch ANT pad on main circuit board.

Step 4: Carefully tighten down screw holding the stepped washer on Q10. Carefully tighten down the Hex shaped support posts. DO NOT over-tighten either of these – damage to board may occur.

Step 5: Build a solder bridge between center conductor of BNC and the ANT pad.

Check your work for solder bridges/splatter that might short out the DC supply, etc.

Step 6: Install Band Module. Replace back cover.

END OF TASK

Return to Basic Maintenance ToC

Task 4 – Minimum checks before power up after maintenance

1) Ensure no solder bridges exist. Remove any small bits of wire or solder that might be loose on either side of the main circuit board. A small brush may be used to clean with. Use a bright light and magnifying glass to examine area where you performed any soldering task.

2) The Q10 screw should be tight, with the white stepped washer in place to insulate the screw. The white insulating heat transfer sheet MUST be in place and appear symmetrical on all sides of the heat sink for Q10. Without these items (washer and sheet) Q10 will ground out the DC supply.

3) The Hex-shaped stand-offs should both be in place and snugly fit. CAUTION - Apply too much pressure and you *will* damage the main circuit board.

4) Attached dummy load, headphones and power cable.

(see illustration)

Task 5 – Replacement of DC feed protection diode

1) Using solder wicking and soldering iron, remove the installed diode, if open. If shorted, this diode has no practical effect on the operation of the radio. Only the loss of reverse polarity protection is the issue.

2) Solder in replacement. Inspect area for solder bridges or splatter.

3) Recommend cleaning the area after soldering with 91% iso-alcohol to remove any residual flux. .

4) Re-install main circuit board back into chassis per Task 3 above.

NOTE - Use of the listed diode is important. Any Schottky Rectifier rated at for least 20 V and 1.0 Amp will work. The reason for a Schottky diode is the low voltage drop found on these type of devices. Any quality rectifier, even one with axial leads may be pressed into service. Common power diode will work as the cost of the voltage lost across the device.

Return to Basic Maintenance ToC

Task 6 – Replacement of Q10 (transmitter final)

1) Ensure you purchased the correct transistor. Most are plainly marked.

2) Remove main board from chassis as defined in Task 2 above.

3) Carefully note the size of any gap under Q10 and the main circuit board. This is essential when replacing the main circuit board – the hole in Q10's heat sink must line up with the hole in the chassis.

4) Using solder pump or wicking - heat, then clear solder on all three tabs of the transistor. Once cleared, the transistor should be easy to remove. You may have to reheat the area – use caution not to damage the board.

5) With Q10 off of the main circuit board, test transistor as shown.

6) Trim leads on replacement transistor to match the length of the leads on transistor removed from main circuit board. You may need to trim the sides of the replacement – see photo.

7) Carefully solder replacement Q10 onto main circuit board. Examine are to ensure there are no solder bridges between circuit pads.

HINT - If you worry about overheating the replacement Q10, clip a piece of *damp* paper toweling around the transistor while heat is applied to act as an additional heat sink.

Initial Test –

-Using a pair of clip test leads, attach a 1 watt, 51 ohm resistor between the ANT pad and a grounding point.

-Tune tracer/radio to a listed test frequency (example – 10.100 MHz)

-*Briefly* key transmitter. A very loud tone should be heard. This confirms Q10 operational. If a wattmeter is available, confirm at least 5 watts output @ 12.8VDC

8) Re-install main circuit board back in chassis per Task 3 above.

Return to Basic Maintenance ToC

TASK 7 - Replacement of DDS encoder

1) Ensure you purchased the correct encoder..

2) Remove main board from chassis as defined in Task 2 above.

3) Using soldering wick and ESD-safe soldering iron, unsolder encoder. Remove the encoder from the board. Using this, confirm lead spacing of replacement matches item removed.

NOTE - A solder pump is recommended for removing solder from mounting tabs.

4) Solder in new encoder. Examine your work to ensure no solder bridges are present between pins.

5) Connect power, phones and dummy load. Confirm encoder changes the VFO per Operations manual. Remove cables.

6) Re-install main circuit board back into chassis per Task 3 above.

Return to Basic Maintenance ToC

TASK 8 - Replacement of display screen

1) Ensure you purchased the correct display. The logic (driver) for the screen is embedded in the display module.

2) Remove main board from chassis as defined in Task 2 above.

3) Using soldering wick and ESD-safe soldering iron, unsolder display pins from module. Remove the display module.

4) Solder in new display. Use ESD handling practices with display module.

CAUTION! Several of the display module pins lead *directly* to MCU. Use of ESD-safe iron will help prevent damage to MCU.

5) Examine your work to ensure no solder bridges are present between pins. Clean under display module to ensure no loose solder splatter is present.

6) Connect power, phones and dummy load. Confirm Display changes as set by VFO per Operations manual. Remove cables.

7) Re-install main circuit board back into chassis per Task 3 above.

Return to Basic Maintenance ToC

TASK 9 - Replacement of Volume potentiometer

1) Ensure you purchased the correct potentiometer (1K ohm).

2) Remove main board from chassis as defined in Task 2 above.

3) Using soldering wick and ESD-safe soldering iron, unsolder all potentiometer pins. Remove the potentiometer from the board. Using this, confirm lead spacing of replacement matches item removed.

NOTE - A solder pump is recommended for removing solder from mounting tabs.

4) Solder in new potentiometer. Examine your work to ensure no solder bridges are present between pins.

5) Connect power, phones and dummy load. Confirm potentiometer changes the volume. Remove cables.

6) Re-install main circuit board back into chassis per Task 3 above.

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Data for system components

Item / Label	Nomenclature	Description
DDS encoder w/switch	Encoder, rotary, mechanical (confirm shaft length)	(Bourns) Mouser P/N 652-PEC11R-4215F-S24
Display	Display, 8 character, 2 lines, 5 VDC	CORE Electronics SKU- LCD 11122 Basic 8x2 Character LCD Black on Green 5V /////// MIDAS P/N MC20805B6W-FPTLW LCD, 2X8, FSTN, WHITE LED B/L 5V (MIDAS)
Volume control	rotary potentiometer 1K liner taper	Mouser P/N 688-RK09D1130C2P
5 volt buss regulator78L05	Voltage regulator +5 VDC SOT89 pkg	78L05 Newark P/N 77C1856
6 volt buss regulator 78L06	Voltage regulator +6 VDC SOT-89 pkg	78L06 Newark P/N 37X9027
IC 1, IC 2 Mixer	double balanced mixer & oscillator, SMT type SA612A	SA612A Newark P/N 26M2818 (SA602 is a suitable substitute
IC 3 Audio amplifier	amplifier, audio, 8 pin, SMT type, DIP LM386	LM386 Newark P/N 41K5099
IC 4 MCU	32-Bit Microcontroller IC, 48K memory, 74 MHz clock speed	PIC16F73-1/60 (Microchip brand) Newark P/N 86W6451
IC 5 DDS	Direct Digital Synthesis	AD9834 Newark P/N 28M4203
IC 6 VFO scratch pad memory	4K EEPROM 93C66A	93C66A (Microchip brand) Newark P/N 61H6598
IC 7 Keyer (must be programmed)	CMOS Flash-based 8-bit microcontroller 12F629	12F629 (Microchip brand) Newark P/N 61K3433
D 6 Zener diode, SWR protect	Schottky Rectifier, 36 V, SMD Vendor	Mouser P/N **771-BZX84J-B36,115** Nexperia P/N **BZX84J-B36,115**
D3	Surface Mount Schottky Barrier Rectifier	SS12, diode Multicomp brand Newark P.N 90R9168
Q1, Q2, Q3, Q4, Q5, Q7, Q8 Switching transistor –multiple	.1Amg (1AM) NPN Silicon Epitaxial Planar Transistor Switching, TO-23 SMT type 2N3904	Taitron P/N MMBT3904
Q6	marked 7KXNF (7K) Transistor 2N7002K	Fairchild Semiconductor Mouser P/N 512-2N7002K
Q9	marked t1P (1P) 2N2222/2N2222A SOT-23	Mouser P/N 512-MMBT2222A
Q 10 Transmitter PA	RF power transistor, NPN TO-	2SC2078

	220 pkg	Futurlec P/N2SC2078
Item / Label	Nomenclature	Description
J1, DC input jack	2.1 mm coaxial, PC mount	DC-9 P/N FC68146) CLIFF brand
J2, internal battery header	2-Pin, 2.54mm spacing, polarized	CuteDigi – SKU POL_CON_254_2_J11
Jack – Phone	3.5MM PC horizontal mount Jack, stereo, non-threaded bushing	Switchcraft P/N 35RAPC2BHN2
Jack – Key	3.5MM PC horizontal mount Jack, stereo, non-threaded bushing	Switchcraft P/N 35RAPC2BHN2
Crystal, filter, ladder	4.9152 MHZ (matched) 4 each	Digikey P/N X084-ND **ECS P/N** ECS-49-20-1
Crystal, 2nd mixer BFO	4.183 MHz (front of board)	
DDS source clock	Oscillator, DIP package	HOSONIC brand HSC-33B**/**D726 60 MHz, 5 DC

THE MCU (PIC Controller) Keyer and VFO Memory chips require programming code that *I do not have access to* – the parts are included in the listing above, but must be programmed prior to replacement.

Additional parts identification Band Modules

L1	**L2**	**Band**	**R1** value marked	Takes Pin 1 to ground
14 turns	13 turns	**80**	473	
11	12	**40**	223	
11	12	**30**	103	
7	9	**20**	472	
7	9	**17**	222	
7	9	**15**	101	

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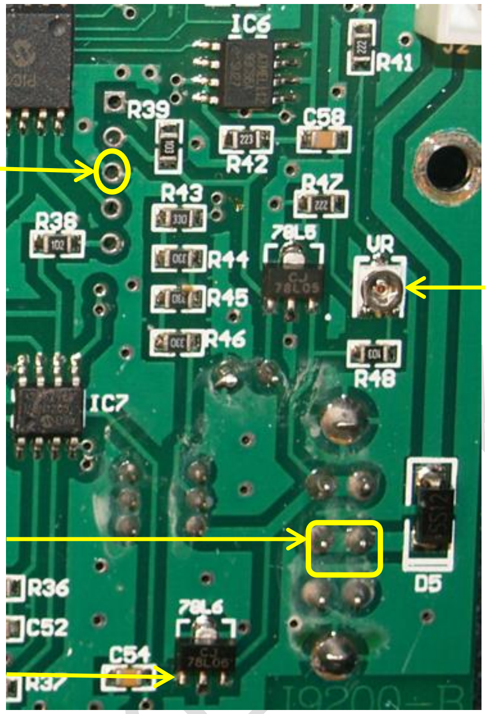
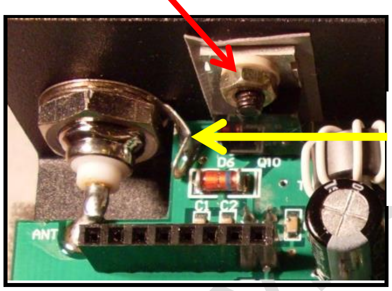
Illustrations

DC Power Test Points, adjustment and protection



Q10 mounting nut.



Ground to the tab <u>under</u> BNC connector nut.

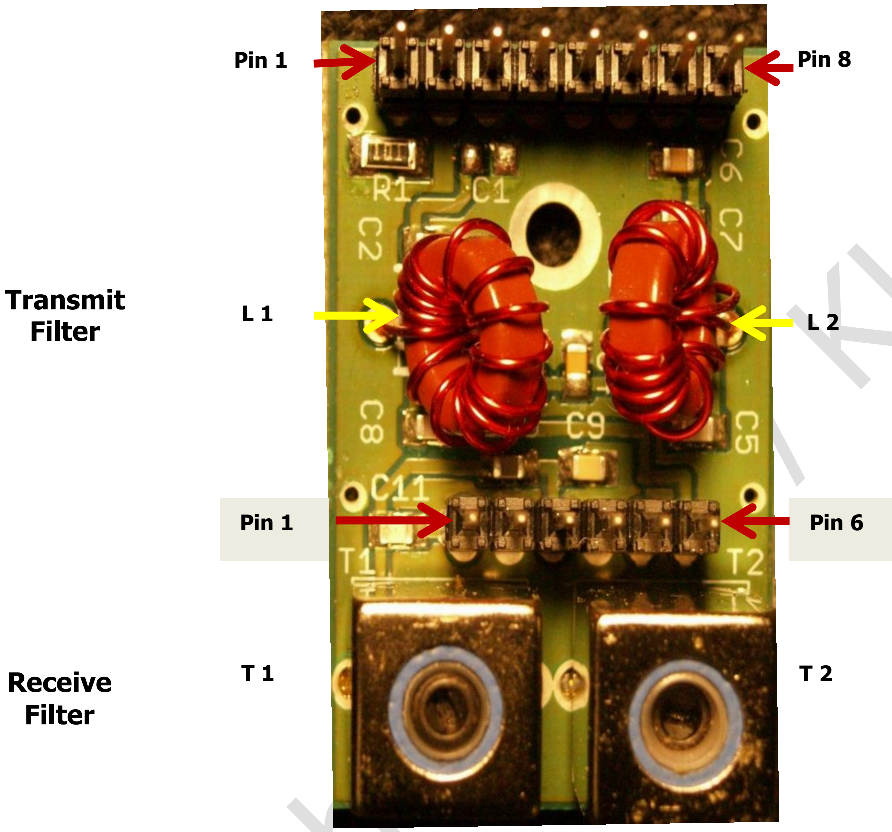
Test Point
Rear of J1

[*Return to DC Test Steps*]

[*Return to ToC*]

Illustrations

Band Module, top
80 Meter



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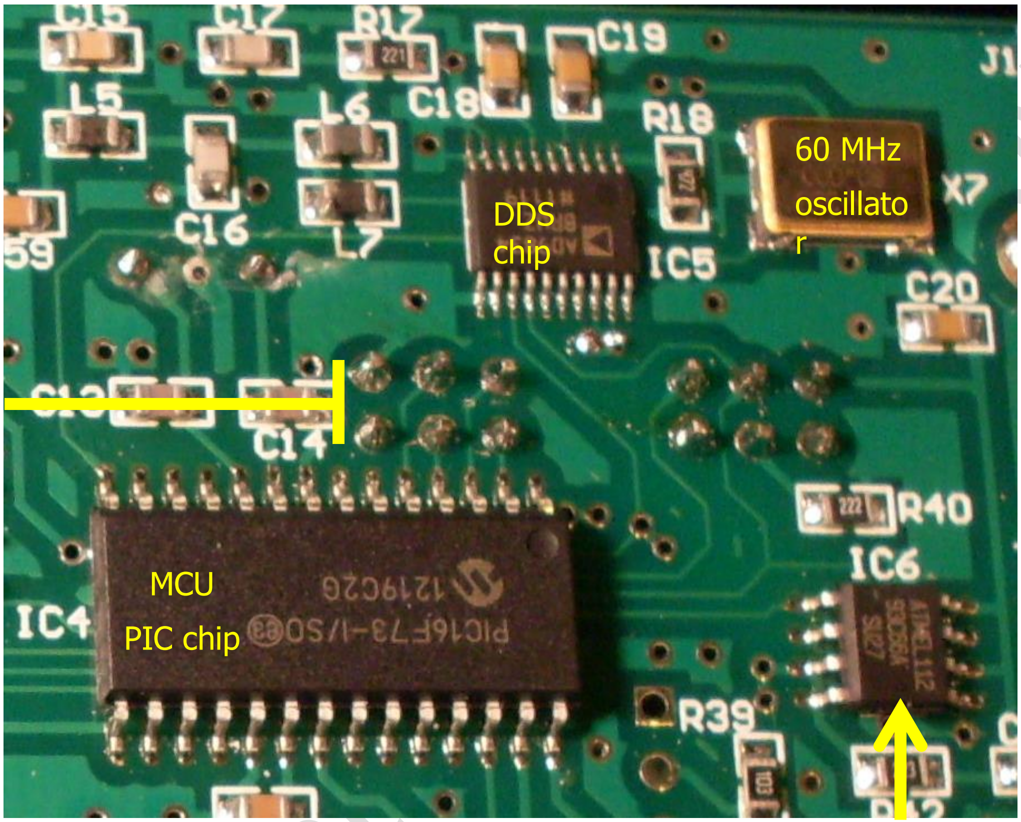
Illustrations

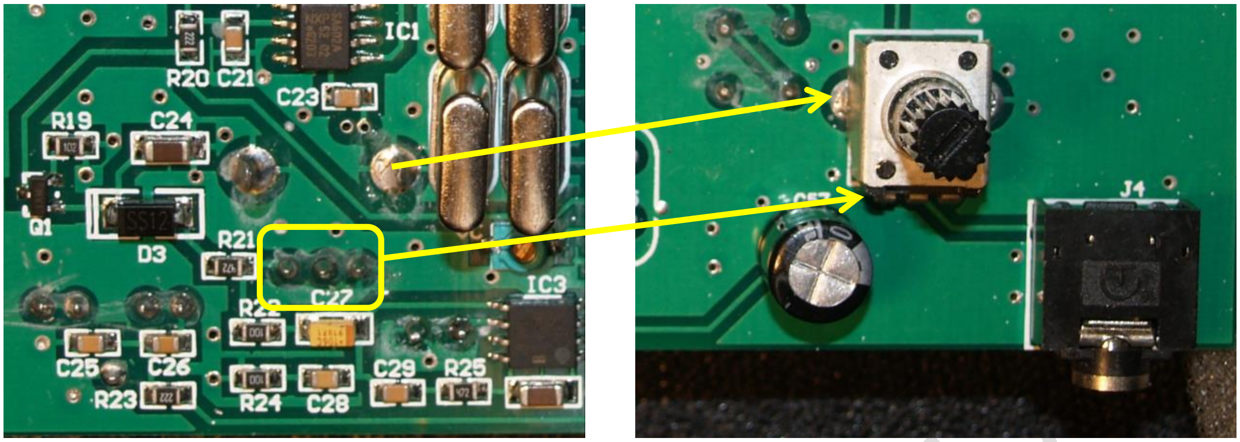
DDS / VFO sub-system



VFO
memory
chip

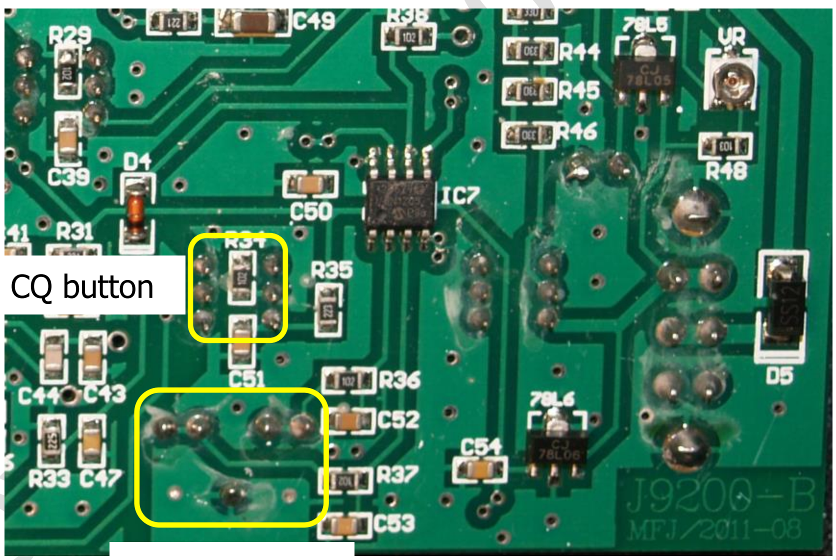
These 12 pins
(to the right of the T)
feed the digital display

[Return to ToC](#)



Volume Control pins – Center pin feeds J4 (Phones)

Keying system



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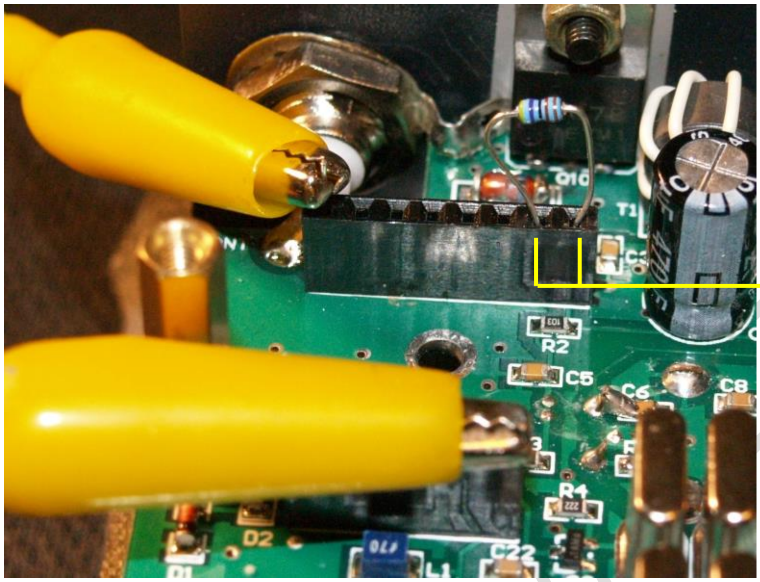
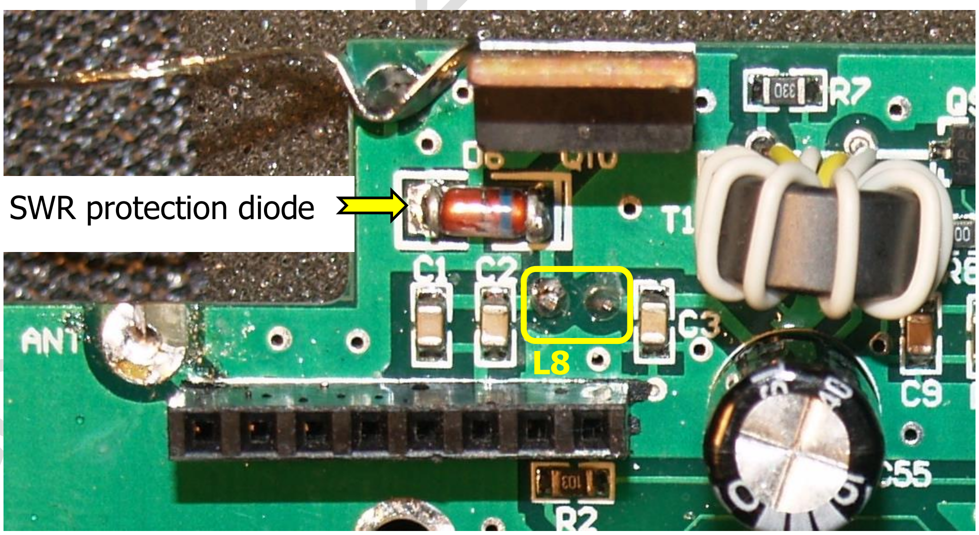
Band Module Bypass



L8 test point for supply voltage.



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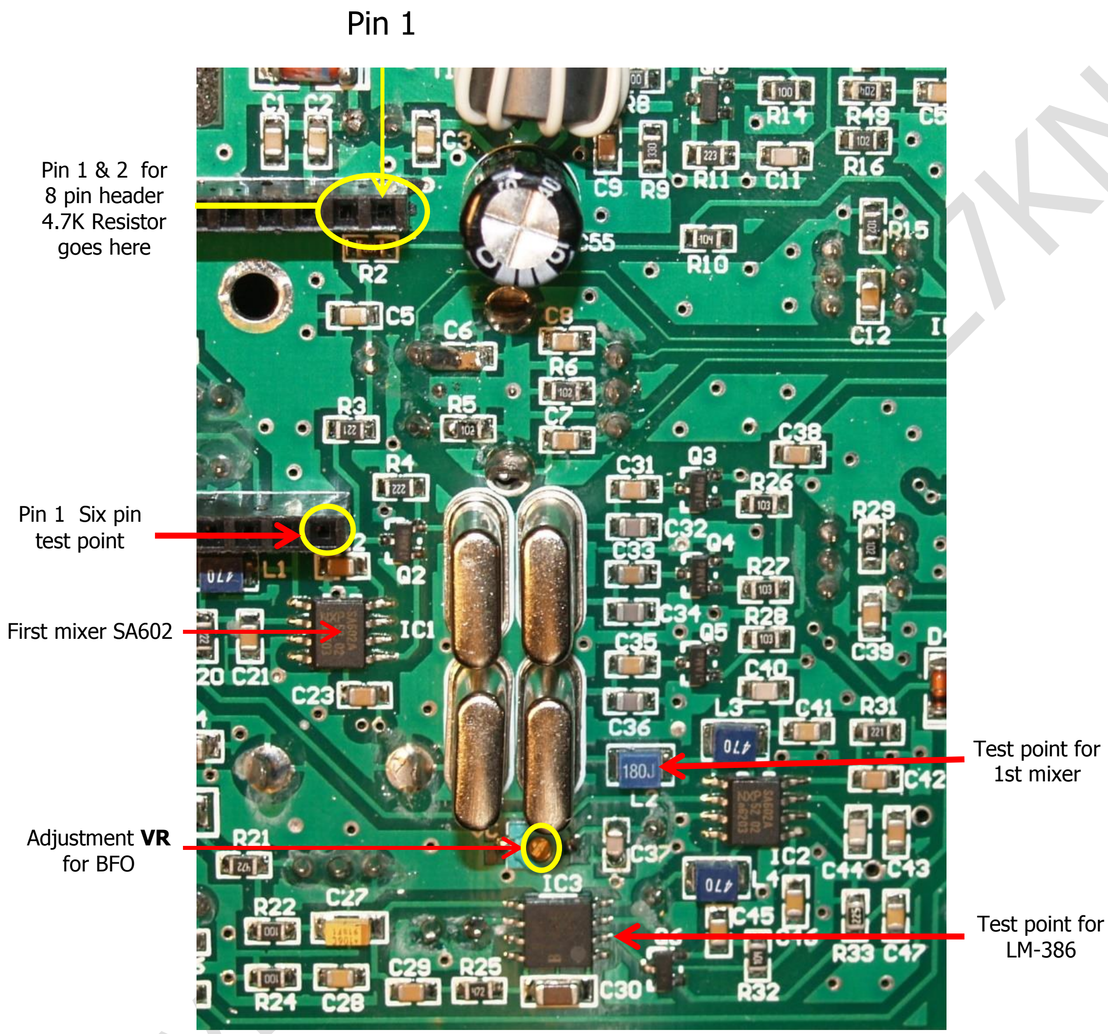
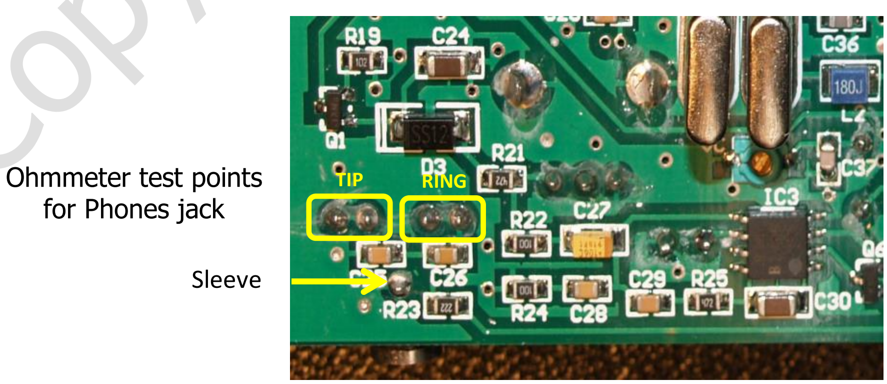
Illustrations

Main Receiver components & signal path





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Illustrations

Digital Display Screen 8 Characters x 2 Lines

Pin 1 – Signal ground for data

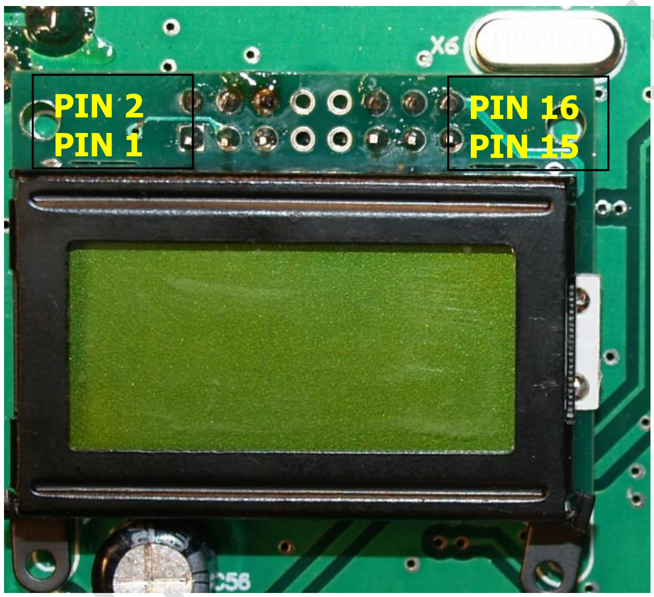
Pin 2 - + power for embedded logic

Pin 3 – Contrast adj

Pin 11-14 – data buss lines

Pin 15 – LED +5 line (backlight)

Pin 16 – LED - line

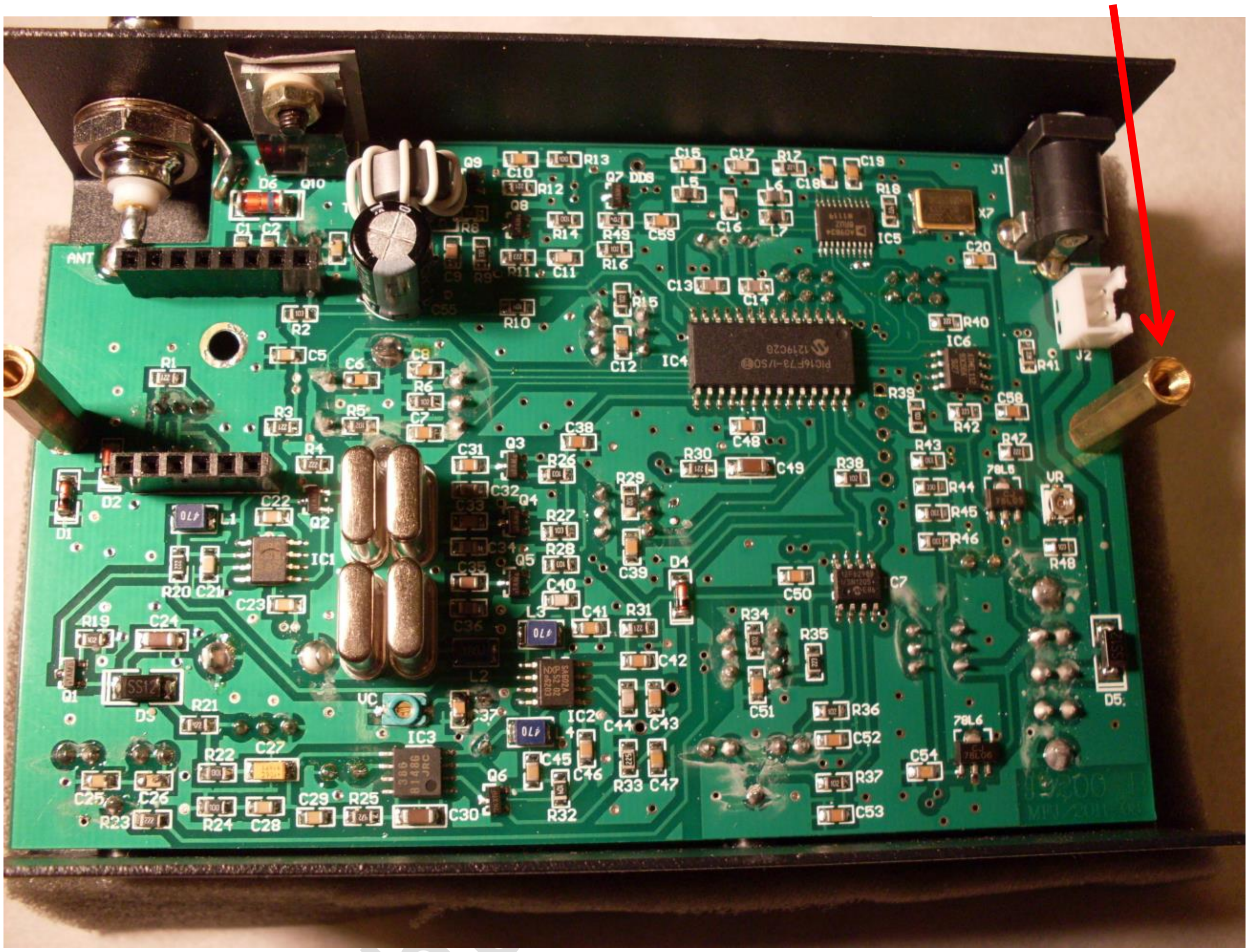


Main Board, back view of Display pins.

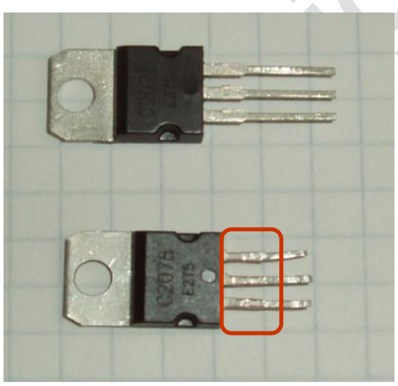
NOTE – Four of the data pins connect **directly** to the MCU – ESD techniques apply!

Return to Display test.

These standoffs must be removed for main board to be removed.



Steve, M0SHM, sent these photos showing how he had to mod (slightly) the pins on a new 2SC2078 to fit it to his rig. He was kind enough to share these photos and allow use here.



Trim leads of Q10 as needed, use a fine file and take your time.

Hints, Tips, Kinks

Recommended items not supplied with radio set.

These are items I've added to my 'kit' to carry with the radio all the time. When operating outside of the shack, I make notes in my log about items I wished I brought along or needed. Here are some of those noted items:

- Adapter BNC male to BNC male. I use this with my home-made dummy load.
- Adapter BNC Female to SO239. MFJ-7708 (P/N 610-2008). May allow you to use someone else's existing antenna system.
- Cable, jumper, BNC to BNC. To connect to an external antenna tuner. You may need an adapter BNC Female to PL-259, depending on the tuner.
- Jameco P/N GSE 231015: Cable ASM RG58/U 15 Foot BNC to BNC 50 Ohm M-M.
- Adaptor, BNC To Dual binding posts MFJ-7704 (P/N 610-2106). Allows you put up a makeshift antenna.

KK6FVP uses these cleverly modified adapters for an antenna feed. Hook up your wire to the post for a dipole and hoist into a tree. The split rings carry the weight of the wire, saving wear on the binding post. Use a BNC to BNC cable and the adapter isn't required.

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Return to ToC

Thoughts on building a portable DC power system

An easy place to start is with a MFJ-5513 - power cable, 2.1mm,-open end, 3 ft (MFJ P/N 620-8321). This will fit the -9200 and allow you enough cable to park your battery pack someplace convenient. Like, inside your parka to keep the batteries warm in inclement weather.

ALWAYS put in-line fuses on any power cable. Use at least a 1.5 ampere fuse for this cable.

Add a "Holder, battery, "AA", for either 8 or 10 cells. I use both, but if I'm going out where there is no power for a charger, the 8 cell holder is my first choice. It allows use of NiMH rechargeable batteries for a 9.6 volt source or "AA" primary cells, for a 12VDC+ power source. The -9200 is happy with anything over 8 volts, so all you see is somewhat reduced power out with the NiMH cells.

A 10 cell holder gives me a full 12VDC+ with the rechargeable cells, but would provide over 15 volts with primary "AA" cells – ***not good***. So – I have both...an eight cell holder for either type and a ten cell holder when I know I can recharge my NIMH cells on the road. The cell holders are just a couple of dollars. A rubber band on the outside to keep the cells in place and you're ready to travel.

For extreme cold weather, *Lithium-Iron* 1.5 volt "AA" cells are now available at reasonable prices. There are also Lithium primary cells at 3.6 VDC @ 2.4 aH that will work in a 3 or 4 cell holder – price is a major consideration here as the cells cost up to 3 dollars - per cell. If *weight* is your primary consideration, these are worth a look.

I bought my cell holders on line because the output of the pack is a polarized connector – one that looks just like the top of a 9 volt battery. That was by design. *I cannot stress enough to USE A POLARIZED battery connector.*

A single 9 volt battery will power the -9200 long enough for a few contacts or some extended listening to shortwave stations. I see this as maximum flexibility.

A connector for the power cable is easily had. Take a dead 9V battery and peel off the foil on the outside. You discover a set of very small 1.5 volt batteries and a ready-made for your cell holder connector. Solder this connector to your power cable, put some insulating tape over the soldered connections and you're in business.

With this setup I can run primary cells, rechargeable cells or to save weight on a hike, just carry a couple of 9 volt batteries for a few quick QSO's. All with the same, polarized, power cable.

The 9200 has an internal power connector - a header, really. If you find an appropriate *polarized* 2 pin connector, there is room for two or three paralleled 9 volt batteries inside the radio. This may appeal to you, if so, ensure you both insulate the batteries and secure them so the Band Module doesn't get bashed.

Finally, a thought about LiPO batteries. The AA sized 14500 series are 3.7 VDC at almost 2.4 aH capacity – that's no typo. 2.4 amp hours. So, a 3 cell (11.1 VDC) or a 4 cell (14.8VDC) battery pack with that amount of power density has some appeal. Keep in mind LiPO cells require *exquisite care* in charging and use. These cells should *always* be monitored while under charge. Read more about these cells and related hazards elsewhere or on line.

Alternatively, if you are already using Anderson Power Pole DC connectors, there is the MFJ-5513M power cord with the Power Pole connectors. Simply carry what you already have. ***Ensure you add an in-line fuse***.

I've been asked why I seem to be such a fan of AA batteries for powering this rig. Simple, AA batteries are just about universally available *world-wide*.

For example, I was working an oil spill clean-up project in the Komi Republic, part of the old Soviet Union. This was in 1995, just after the old Soviet fell apart. Despite being in an isolated town, quite literally at the end of the railroad line on the Arctic Circle, I never had any issues finding fresh AA batteries for my shortwave set. I've been a fan ever since.

The genesis of the MFJ-9200:

When I first made the decision to purchase the 9200, I was struck, as are many, by the similarity of this radio to the You Kits HB-1x series of radios. There is a good reason for that. The MFJ-9200 is a clone of a clone of the HB-1A.

A variant of the HB-1A was offered. Several foreign (Non- North American) web sites started chatting about an "HS-1A" radio kit. I first saw this on a site where the entry was dated 8/2011. It talked of BD4RG's upcoming HS-1A CW transceiver.

I found further info and some images on a Japanese web site that tied the HB-1A and the HS-1A directly together – the HS stood, it was said, for ***S****ingle* band. The HS-1A was offered as an even lower cost single band transceiver. Band modules would provide the needed filtering. Now very interested, I dug around even more.

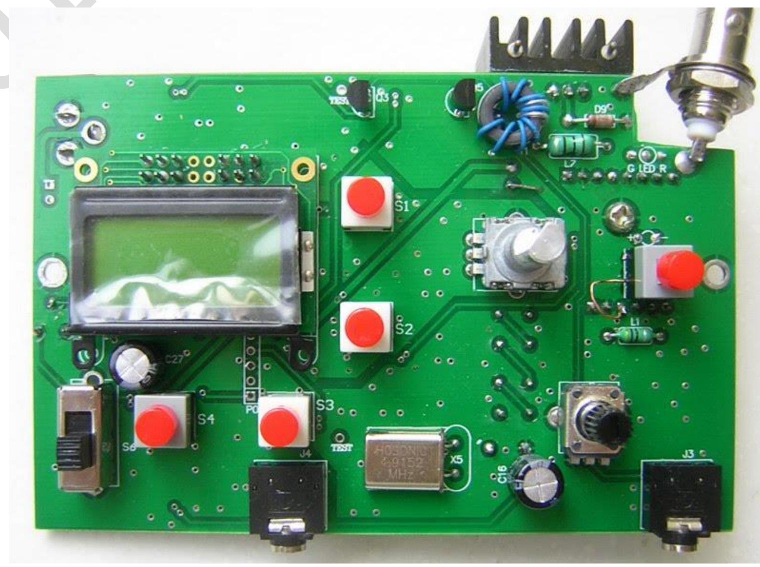
I found some nice, high definition images of the HS-1A and compared it to the original MFJ-9200. You can see the resemblance with little effort. The software splash screen on the "B" board version of 9200 comes up as 8/2011.

On these *early* "A" board version of the 9200, the splash screen, first seen at power on, displays HS-1A. The original 9200 (the A model) fared badly.

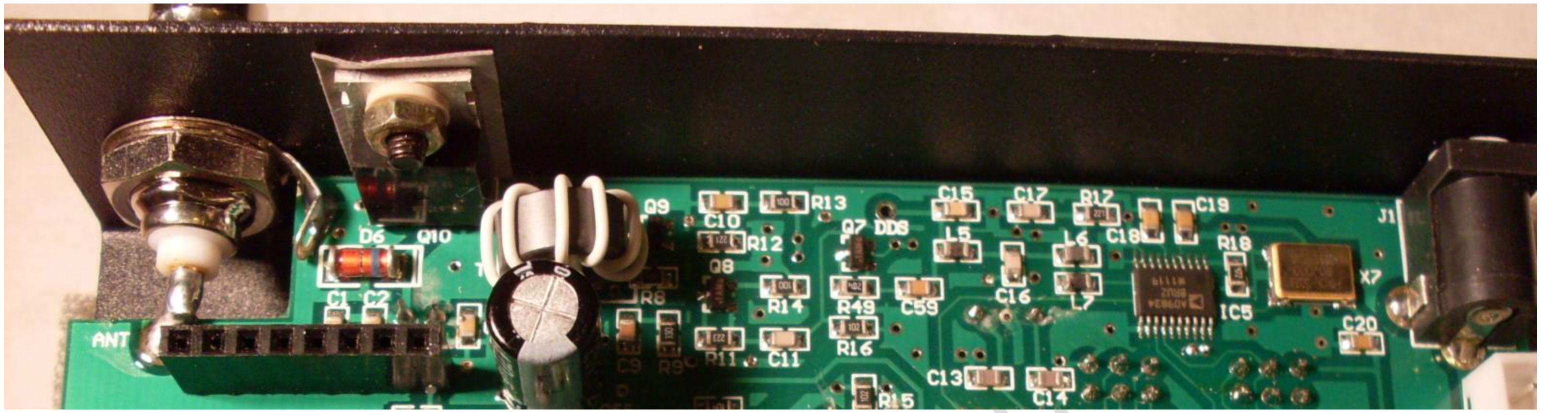
Reviews were *uncomplimentary* and complained of poor sensitivity and very low audio. Birdies were also a complaint. IOW, the receiver was a dud. The next 9200, the B model seems to have solved most of the issues seen in early reviews. I have people still send me emails that often complain of birdies, but it seems less often than before.

Once sorted out, the 9200 is a very nice radio with a hot (.1 to .2 uV for MDS) receiver and a solid transmitter. In addition, I see the newest HB-1B, the MKIII uses the same PA setup as the 9200. Here are the photos that layout the evolution of the 9200.

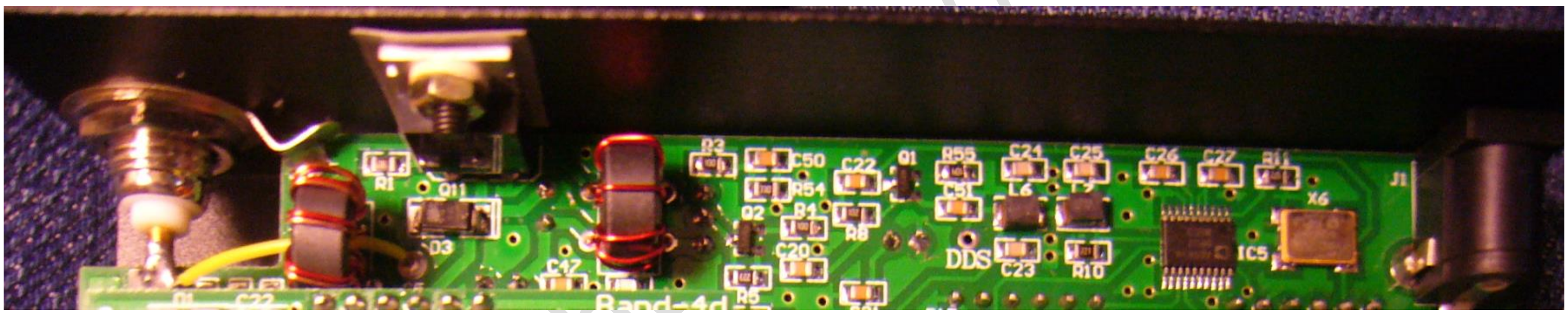
HS-1A and HB-1A side and side. Larger shot of the HS-1A splash screen on an "A" model 9200 (Thanks to Steve, K7EW)

HS-1A main board – rear and front. D-9, the SWR diode is on the face of the board and is an axial version. The broadband transformer (T-1) feeding Q-10 is also found on the front of the board.



9200 B Model PA section.



HB-1B MK III PA section – both use the same 2SC2078. Much cleaner that the earlier HB-1Bxx series.

To be completely honest, the build quality of the HB-1Bx is better than the 9200. No hand soldered parts as seen on the 9200. The 9200 is still, however, relay free.