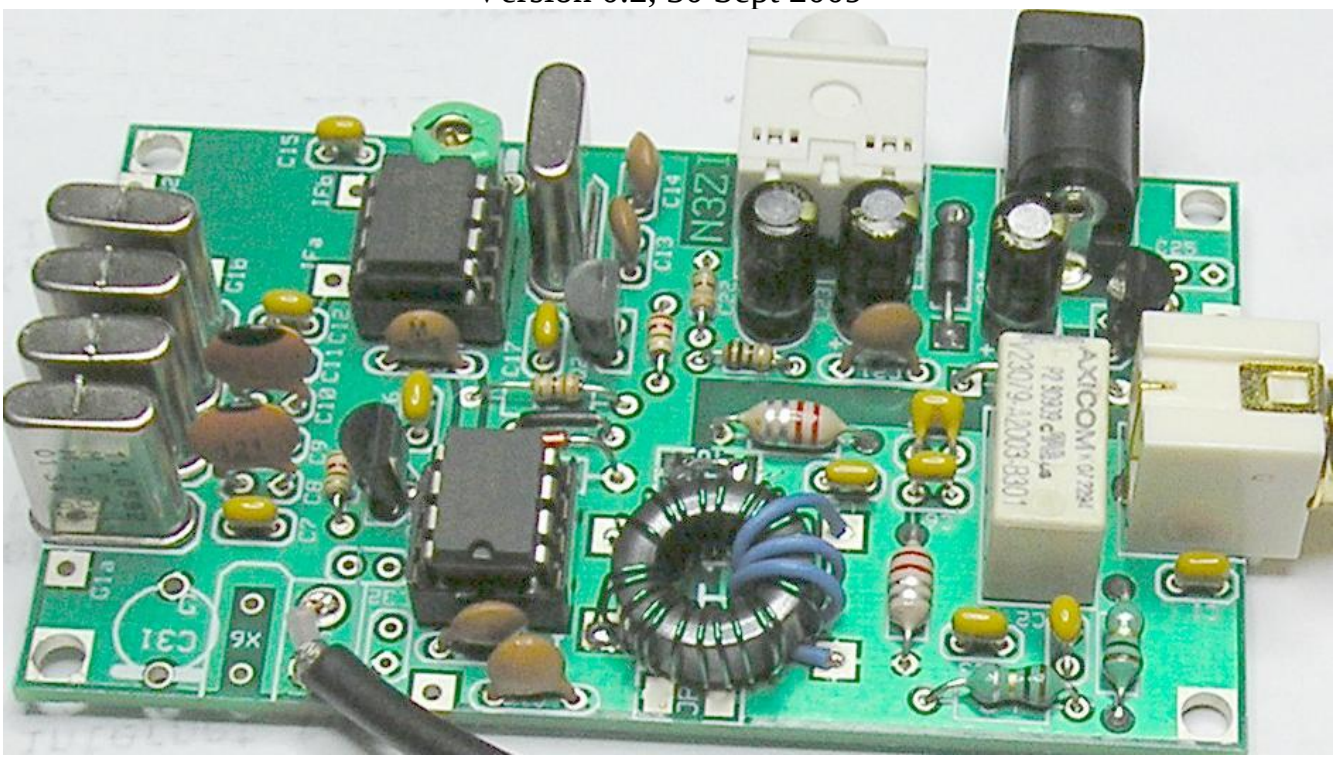
# N3ZI Kits

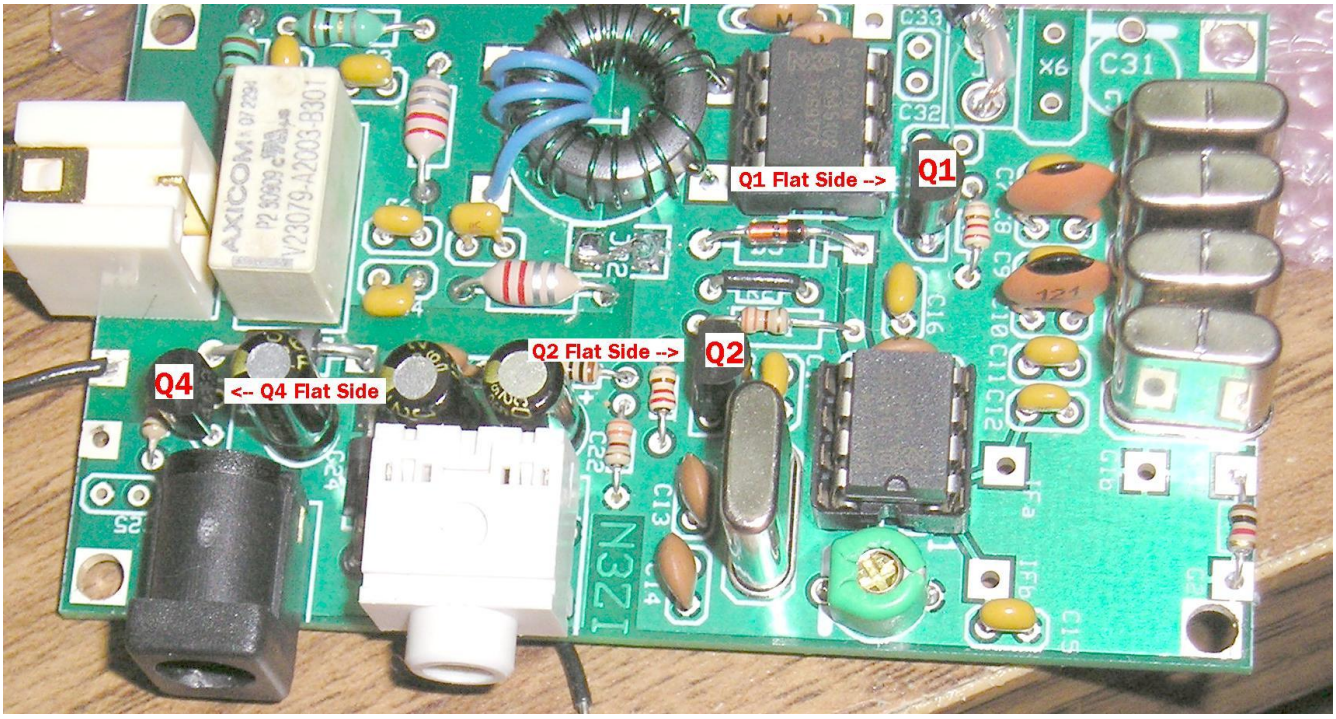
General Coverage Receiver
Assembly & Operations Manual
Version 0.2, 30 Sept 2009




Thank you for purchasing my general coverage receiver kit. You can use the photo above as a guide to assembly. The silk screen on the PCB can also be used as an assembly guide, but there is one error regarding 1, more on that later.

You should also realize the the color and appearance of the parts in your kit may be slightly different from the ones in the photo above, especially with capacitors. Also you can see that the SA612 mixer IC's in the above photo (the 8 pin dips) have sockets. We do not supply sockets in the kit, and recommend that you solder the chips directly in the board.

Many of the parts have are sensitive to their orientation (direction) they are soldered in the board. The silk screen has the proper orientation markings for all parts except Q1 which is shown backwards on the silk screen. You can see the orientation of all the transistors in the photo below. Note that there is no Q3. Q2 and Q4 are marked correctly on the PCB, but Q1 is marked in reverse.




Double check the electrolytic caps before soldering them in, you will release the magic smoke if you power the board up with these in wrong. Normally the + side has a longer lead, and the - side is well marked. Also they may look the same but there are different values, double check them against the parts list.

Also take care with the trimmer cap orientation. Normally we do not think of these as polarity sensitive, but in a way they are. The side that is connected to the adjustment hole goes to ground. So your screwdriver used for adjustment will not cause capacitance change. If you put it in backwards it will still work but you may find it difficult to adjust.

There is one torrid to wind. There are a number of other inductors in the circuit, but in those cases I simply used fixed inductors of standard values so that you did not have to wind them. T1 is on a FT50-43 core (included in your kit) The secondary is wound first and is 22 turns of any smallish magnet wire. Anything from gauge 24 to 32 would work fine, it's not terribly critical. The primary is 3 turns of insulated hookup wire. I generally find that Ethernet cable makes a good source of hookup wire. It's seems to be relatively inexpensive, and available everywhere. Strip it, and cut off what you need. Lots of different colors to pick from. This transformer matches your 50 ohm antenna with the 3000 ohm input impedance of the first mixer.

When you are installing J1, the RCA jack, you find it to be a tight fit. The plastic nibs on the bottom will hang over the edge of the board and you may have to bend the center pin in towards the other pin to get it to fit.

If a power connector is included in your kit, you will have to break off the side pin. Just bend it up and it should break off easily. If you don't have a power connector in your kit, just solder your power wires into the holes for J4.

I recommend that you solder everything in, except the SA612 mixers in the board first. Then power the board up with a regulated 12 to 15 volt power source. And check the voltage on pin 8 of both the SA612's If everything was put together properly you should see something very close to 7.5 volts there. If that's ok, remove power and solder in the mixer chips, carefully noting the orientation (they face in opposite directions).

Note that there are some positions on the PCB for which parts are not normally used. C31, C32, C33, and X6 are used only for the fixed frequency version. C25 is not used.

You will get 5 crystals in your kit. Four 11059 for the crystal filter, and one 11.046 for the BFO. The 4 filter crystals you receive in your kit are a matched set. So if you order more than one kit don't mix up the crystals. Some of them may have a mounting wire attached to the top, just cut that off. You can attach a ground wire from G1a to G1b and across the tops of the 4 filter crystals and solder it to each crystal. I didn't bother with that, but it does improve the blow-by in the filter and reduce spurious signals.

OPERATION:

External connections:

You need to connect a VFO. to J2 If you are using my DDS, it is simplest to use a piece of coax, soldered in both ends. If you want to be able to disconnect them then put a connector on one end. The boards are the same size, and if you stack them, you can probably get away with a twisted pair of wires for the VFO signal. If you are using a different VFO, you will need about 250mV peak to peak. You can also use a crystal instead of a VFO signal. (The crystal goes in to X6, ~47pF caps in C32, C33, and a ~50 or 70pF trimmer in C31. )

You need to connect to a 12-15V power source, well regulated, no AC ripple. You don't need more than 100mA, but wall warts normally have too much ripple. If you hear AC hum in the audio output, that's from your power supply. A battery will also work. You can connect this in using the J4 connection. But you can also use the unmarked pad between C33, C19, and C18. If you have a DDS VFO you can use this connection to wire power from the DDS board, and supply your main power to the DDS board.

You will need to connect something to the audio output. Amplified computer speakers work well. Headphone will work on the low band, but not very well on the high band.

You can also connect it to your computer 's "line in" input.

If you have the 2 band kit, you should connect a twisted pair from the pads next to R8 on the GCRX board, to PC0 on the DDS board. On the GCRX board, the square pad closer to C25 is the ground, the other square pad is the signal. You can also connect this signal to a band switch instead. A high (3 to 10 volts) will select the low band, a low or open circuit will select the high band.

You also need an outside antenna. I use a simple long wire 50 feet long, about 15 feet high, with a tuner to match it to approx 50 ohms. The tuner is not important 7 Mhz and below. But on the higher frequencies, I don't hear much unless the antenna is tuned. For test purposes, you may be able to hear your local AM broadcast stations, with just a short wire in the shack. But keep in mind that computers, and most modern electronics emit a wide range of frequencies that you will also pick up.

JP1 & JP2: Theses jumper connect the receiver ground to the antenna ground. The input section is floating. It's up to you to decide if you want to connect the grounds. It depends on your antenna. But if you are not sure just put the jumper in. In my shack it greatly reduced noise with the jumper installed. Both JP1 and JP2 are the same, you only need to connect one, not both.

Calibration:

It is important to set the BFO. Set it to the low side of the crystal filter. Generally the crystal filter will has a passband from approx 11053.5 to 11056.5. In most cases the BFO should be set to 11053.25 but the exact setting will depend on the exact frequencies of the filter crystals.

If you have no test equipment, use the following procedure. Set the DDS VFO to a IF of -11053.25, set the operating frequency to the strong AM broadcast signal, WWV on 5.0 or 10.0 MHZ is good if you can receive that, but also any of your local AM broadcast stations will work. Adjust the BFO trimmer cap to zero beat the carrier. If you have another receiver, you can simply listed for the BFO signal, and adjust it to be 11053.25

However, this setting will only give you a starting point. You will need to fine tune the BFO. One way is to set the VFO frequency to someplace with with no signal, and listen to the noise. Adjust the BFO so that the noise sounds right, not too many highs and not too many lows. You can also use a PSK31 software to help you observe the frequency spectrum being put out. Digipan and most others have a nice waterfall display that will essentially give you a display of the spectrum You want to spectrum to be from approx 300Hz to 3KHz. There is some degree of personal preference in the exact setting.

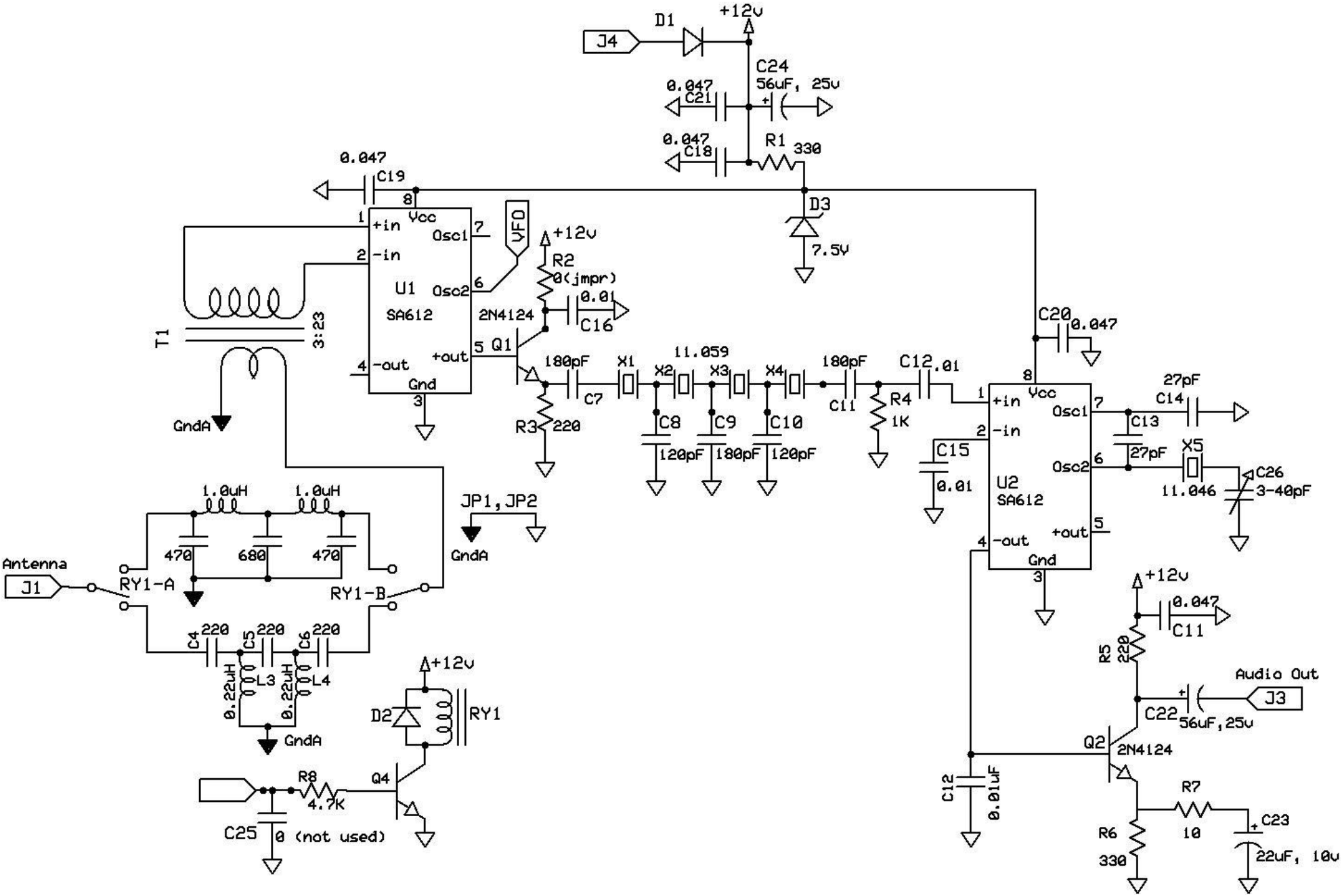
Once the BFO trimmer is tweaked in, you have to change the IF setting in the DDS to match. If you have another receiver with an accurate digital readout, then you can use that to measure the BFO frequency. If not, then use this method: Tune to a strong AM reference station, either WWV on 5 or 10MHz, or an AM broadcast station. Zero beat the carrier this time using the rotary encoder on the DDS. Then note the DDS digital display reading. Calculate how far off the reading is vs/ the expected frequency. i.e. If you zero beat WWV at 10,000.5 then you know you are 0.5KHz high. Now increase the IF setting by exactly that amount. You will have to make this change to the IF setting in all the memories, because each memory can store a different IF. The IF should be negative for operating frequencies below 12 MHz, and should be the same value, but positive for frequencies above 12 MHz.

If you have strong AM broadcast signals in your area, they may overload the receiver. Sometimes you will hear them at unusual frequencies, sometimes you will hear mixed products from them. The easiest thing to do is to build a simple filter to knock them out. Put two 1000pF caps in series, and a 1 or 1.5 uH inductor at the center point to ground . Put this in series with your antenna. This will roll of the low frequency response below 3 MHz. If you have just one strong station that is bothersome, you can design a notch filter just for the one frequency.

Normally you use a negative IF value for reception below 11MHz, and a positive value for above. This gives you LSB for the lower frequencies, and USB for the higher ones, which is the norm. There are some exceptions. 60M is one, here USB is directed by FCC rules. To receive on 60M you will need to set the IF to a positive number. I suggest you set up a special memory for this. If you are using the serial port to set frequencies, you can leave the IF the way it normally is, negative, but just enter the frequencies as negative numbers. Occasionally this is useful for shortwave listening AM signals have both sidebands. Both are the same. Normally, below 11MHz, with a negative IF setting, you will be listening to the LSB. If you enter the operating frequency as a negative number you will get the opposite sideband. If there is interference on one side of the signal you might find this usefull.

N3I Kits, General Coverage Receiver Kit
Parts list (BOM) 2 band version

| Qty | Type | Value | Color Appearance / Marking | Designator on PCB |
|---|---|---|---|---|
| 1 | PCB | PCB | Sept 2009 | Sept 2009 |
| 4 | Capacitor | 0.047uF | Brown, 473 | C18, C19, C20, C21 |
| 4 | Capacitor | 1000pF | Yellow, 102 | C12, C15, C16, C17 |
| 3 | Capacitor | 180pF | Yellow, 181 | C7, C9, C11 |
| 2 | Capacitor | 120pF | Yellow, 121 | C8, C10 |
| 3 | Capacitor | 220pF | Yellow, 221 | C4,C5, C6 |
| 2 | Capacitor | 470pF | Yellow, 471 | C1, C3 |
| 1 | Capacitor | 680pF | Yellow, 681 | C2 |
| 2 | Capacitor | 27pF | Brown, 27 | C13, C14 |
| 1 | Trimmer Cap | 40pF | | C26 |
| 1 | Capacitor, Elec | 22uF/10V | 22uF, 10v | C23 |
| 2 | Capacitor, Elec | 56uF/ 25v | 56uF, 25v | C22,C24 |
| 1 | Crystal | 11.046MHz | 11.04-S | X5 |
| 4 | Crystal | 11.059MHz | 11.0592 MP-1 | X1, X2, X3, X4 |
| 2 | I.C, Mixer | SA612 | SA612 | U1, U2 |
| 2 | Resistor | 220 ohms | Red, Red, Brown | R3, R5 |
| 2 | Resistor | 330 ohms | Orange, Orange Brown | R1, R6 |
| 1 | Resistor | 10 ohms | Brown, Black, Black | R7 |
| 1 | Resistor | 1K ohms | Brown, Black, Red | R4 |
| 1 | Resistor | 4.7K ohms | Yellow, Purple, Red | R8 |
| 2 | FT-50-43 Core | 3T to 23T | Black | T1 |
| 3 | Transistor | 2N4124 | 2N4124 | Q1*, Q2, Q4 |
| 2 | Power Diode | 1N4007 | Black | D1, D2 |
| 1 | Zener Diode | 7.5V | Glass | D3 |
| 2 | Inductor | 1uH | Brown, Black, Gold | L1, L2 |
| 2 | Inductor | 0.22uH | Red, Red, Silver, Silver | L3, L4 |
| 1 | Relay | DPDT | White | RY1 |
| 1 | RCA Jack | RCA Jack | White | J1 |
| 1 | Power Jack | 2.1 mm | Black | J4 |
| 1 | Audio Jack | 3.5 mm | White or Black | J3 |
| | Jumper | (0 Ohms) | | R2 |
| | Not Used | Not Used | | C31, C32,C33, C25, X6 |


J4
D1
+12v
C24
56uF, 25v
0.047
C21
0.047
C18
R1
330
0.047
C19
8
Vcc
1
+in
2
-in
U1
SA612
Osc1
7
Osc2
6
5
Q1
+out
4
-out
Gnd
3
VFD
+12v
R2
0(jmpr)
2N4124
0.01
C16
D3
7.5V
C20
0.047
T1
3:23
GndA
180pF
C7
X1
X2
11.059
X3
X4
180pF
C11
C12
.01
R3
220
C8
120pF
C9
180pF
C10
120pF
R4
1K
8
Vcc
1
+in
2
-in
U2
SA612
Osc1
7
Osc2
6
5
+out
4
-out
Gnd
3
27pF
C14
C13
27pF
X5
11.046
C26
3-40pF
C15
0.01
JP1, JP2
GndA
1.0uH
1.0uH
470
680
470
Antenna
J1
RY1-A
RY1-B
C4
220
C5
220
C6
220
0.22uH
L3
0.22uH
L4
GndA
+12v
D2
RY1
R8
4.7K
Q4
C25
0 (not used)
+12v
0.047
C11
R5
220
Audio Out
J3
C22
56uF, 25v
Q2
2N4124
C12
0.01uF
R7
10
C23
22uF, 10v
R6
330