MFJ-415 CW Adapter For 20 Meter SSB Radios

General Description

The MFJ-415 CW adapter expands the coverage of your MFJ-9420 SSB radio to the 20 Meter CW band and permits communication with LSB mode CW radios. Once installed, the MFJ-415 will work with almost any key or keyer outfitted with a 3.5 mm mini plug. Transmitter RF output on CW is typically from 5-8 Watts, and semi-break in keying is provided for operating convenience.

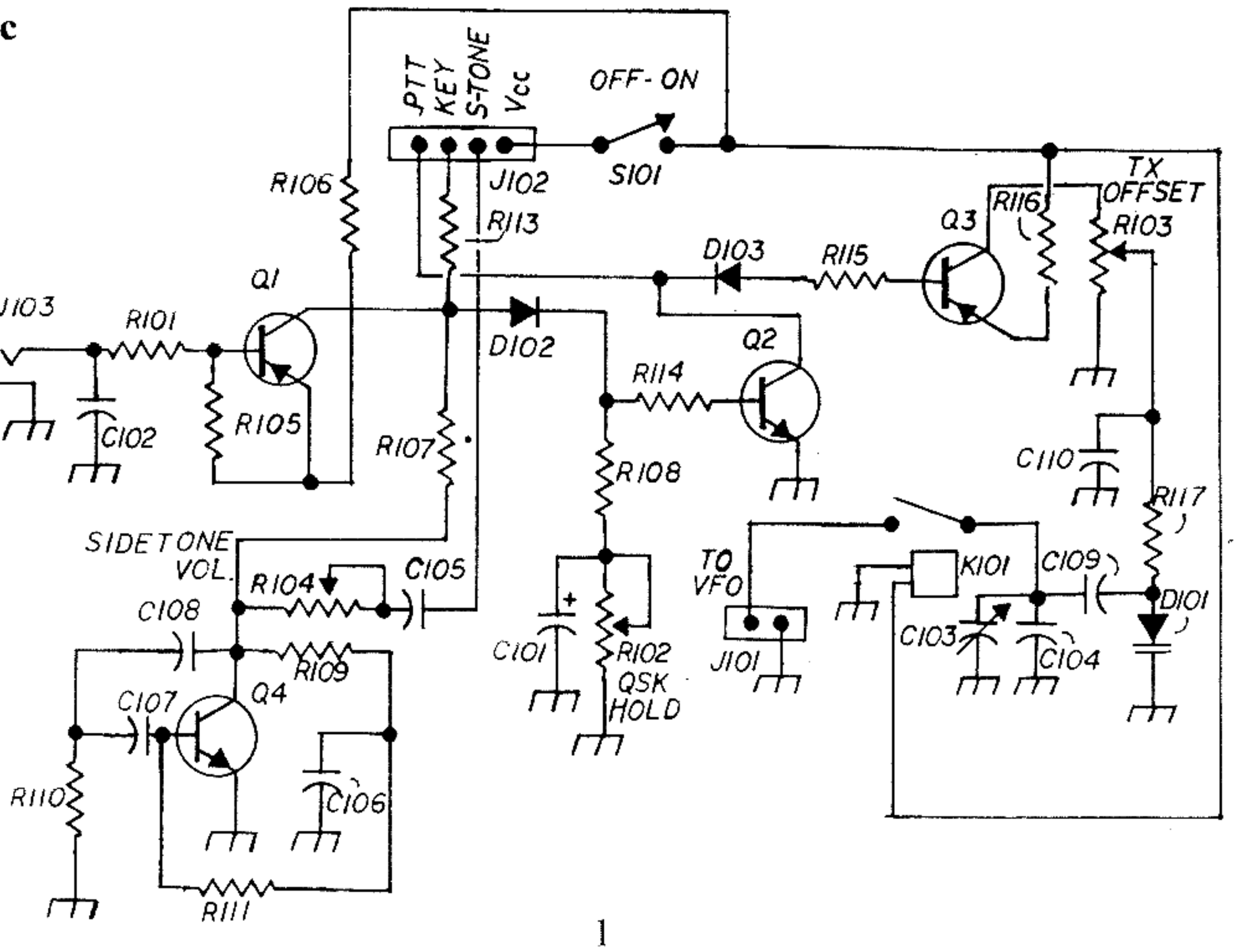
For best performance, use an antenna with a CW band VSWR of 2:1 or less (avoid high SWR antennas). Also, observe sub-band allocations if operating with a General or Advanced license.

The MFJ-415 is a basic unit, and does not offer advanced CW operating features like RIT, CW bandwidth receiver filtering, or full QSK switching. However, it does provides the valuable option of being able to switch modes with the push of a button for enjoyable worldwide CW contacts!

Theory Of Operation

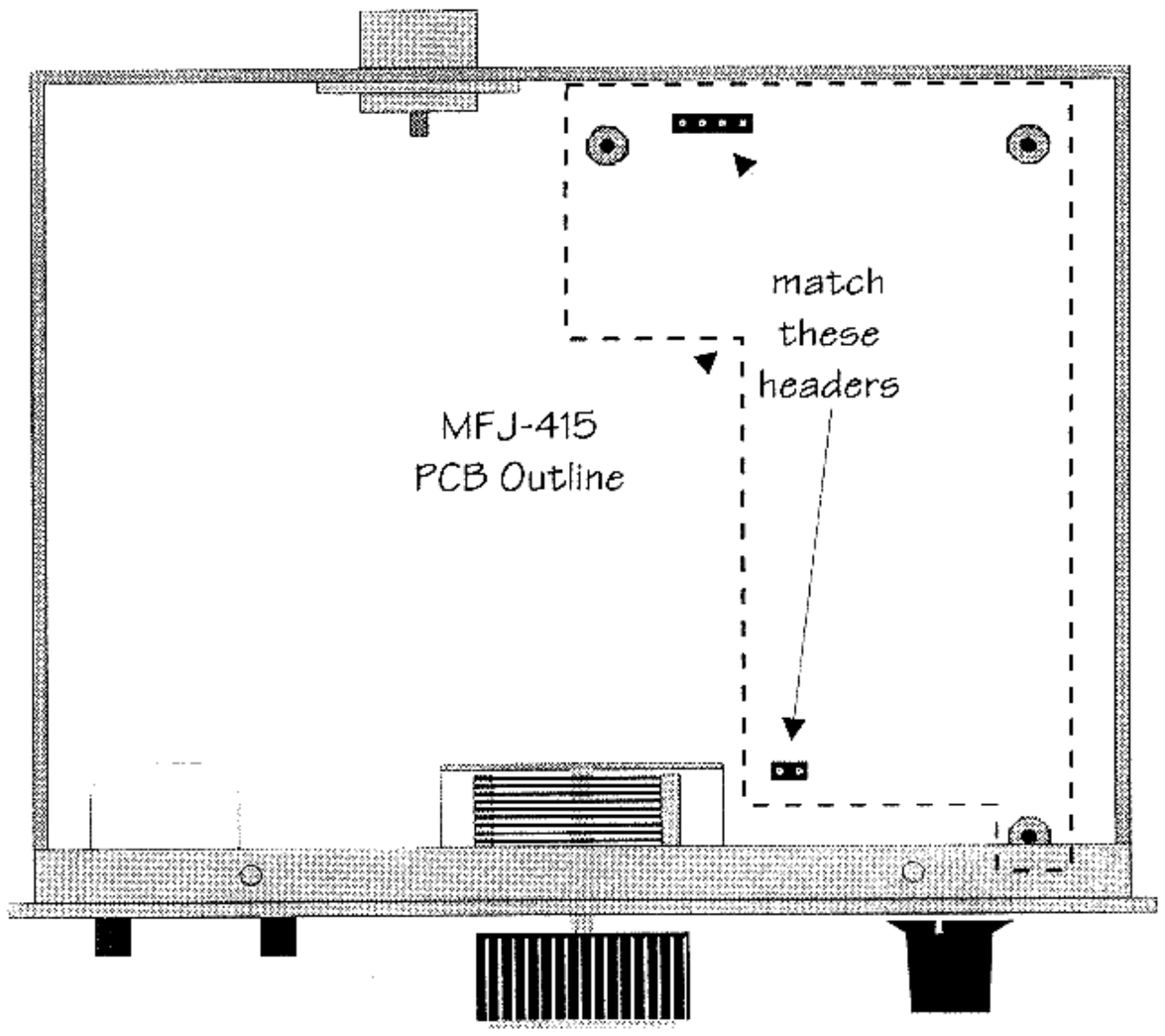
When the adapter is activated via the OFF/ON switch, relay K1 switches added capacitance into the VFO tank shifting frequency coverage down to the CW band. When the key is pressed, DC switch Q1 turns on QSK delay circuit Q2. Q2 then activates the MFJ-9420 PTT line and holds it on for a pre-set period of time (adjustable up to 2 seconds). Q2 also activates Q3, which provides 700 Hz CW offset by reverse biasing a varactor in the VFO tank circuit. DC switch Q1 triggers RF output by biasing on a FET switch in the transceiver's TUNE circuit. Finally, Q1 powers sidetone generator Q4, which injects a 700-800 Hz tone into the receiver audio path. Sidetone is optional, and must be activated by a minor modification on the main transceiver board.

Schematic



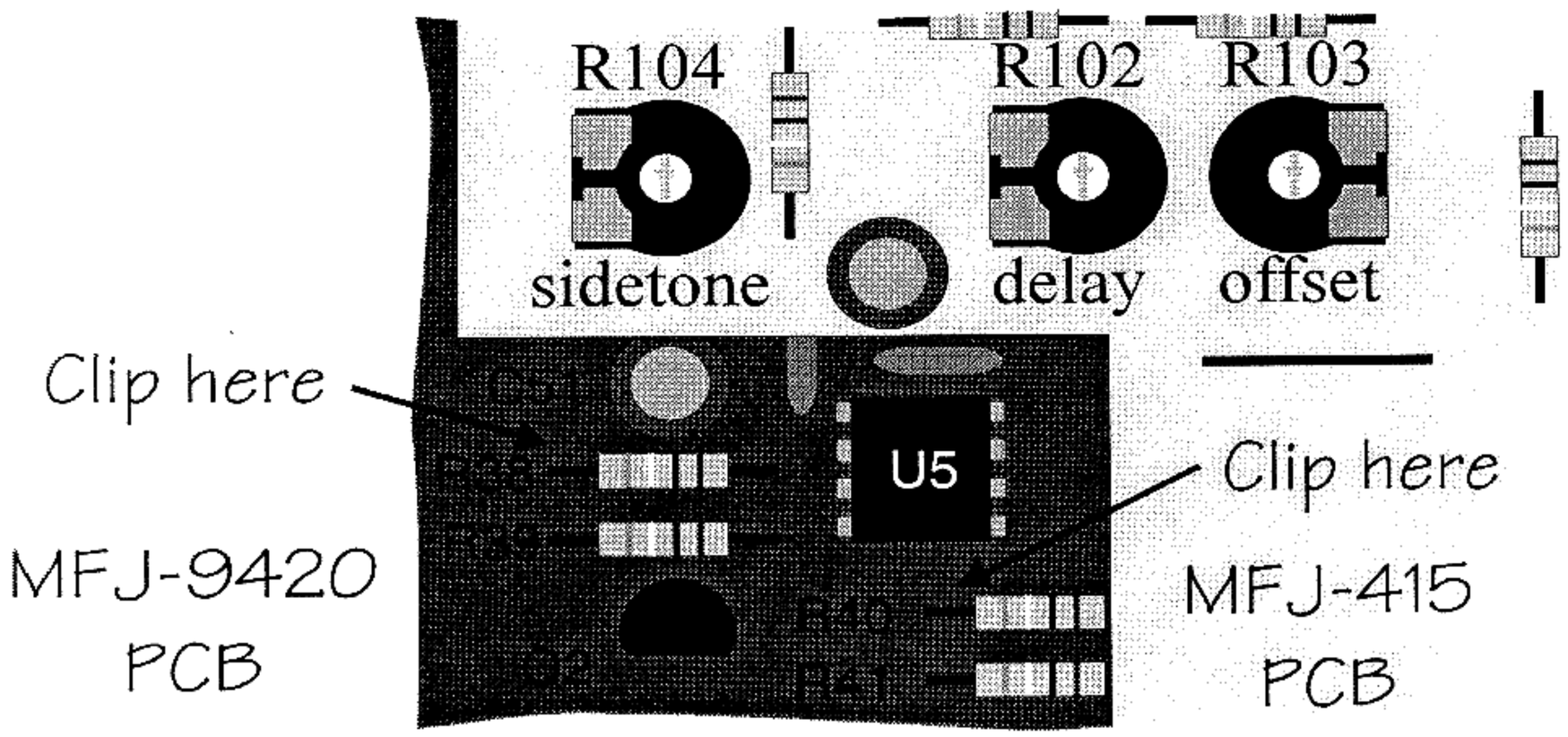
Installation Instructions

1. Remove the MFJ-9420 cover (4 screws on sides, 2 on top).
2. Install the adapter module on the special headers provided on the MFJ-9420's main circuit board. Remove the cap from and engage the pushbutton for better clearance. Insert the 4 pin header in the back first and then the 2 pin header in the front.
3. When the module is correctly installed on its headers, carefully seat the board and secure it in place with #6-32 x 1/4" screws.
4. If you wish to use the MFJ-415 sidetone feature, follow the activation instructions provided below.



Activating The Sidetone

To activate the MFJ-415's sidetone feature, find R38 and R40 on the main pc board. These resistors supply voltage to the radio's AF amplifier "kill" pin during transmit. R38 and R40 are located next to AF amplifier IC U3.



Nip one lead on each, but do not physically remove them from the board; you may wish to tack solder them back into the circuit at a later time. If you prefer to use the sidetone generator built into your keyer or keyboard, do not make this modification.

Adjustments and Calibration

The MFJ-415 CW adapter is pre-adjusted at the factory and should work in your radio with minimal adjustment. Use the alignment procedure outline below for initial set-up or future adjustments.

QSK Delay, Sidetone Level

Set the QSK DELAY R102 and SIDETONE VOLUME R104 trimpots to your personal preference.

SSB VFO Range

If installing the CW module altered your SSB calibration, readjust VFO coil L3. To do this, tune the VFO to mid-band (14.250) and connect a dummy load. Using a counter (or monitoring with a second receiver), press the TUNE switch and adjust L3 with an insulated tuning wand for 14.250 output (make sure the CW adapter is turned OFF when you do this).

CW VFO Range

To calibrate the CW range, set the MFJ-9420 VFO dial to 14.025 on the CW scale. Turn the CW adapter ON and press TUNE. Now, adjust the adapter's CAL trim-cap C103 for 14.025 output as monitored on your counter or monitor receiver.

Offset Adjust

If other stations do not respond to your calls or tend to answer off frequency, the adapter's OFFSET trimpot R103 may need re-adjustment. To reset this control, you'll need a frequency counter or a general coverage receiver.

Method #1 With A Frequency Counter:

Connect a dummy load to the MFJ-9420 and activate the CW adapter. Locate transmit mixer IC U7 and connect the counter probe to pin #6. This enables you to monitor the frequency of the radio's VFO signal (lower 4 MHz range). Key the transmitter and note the VFO frequency shift it should shift UPWARD in frequency by 700 Hz. If it does not move upward by 700 Hz, adjust the OFFSET trimpot until it does.

Method #2 With A General Coverage Receiver:

Connect a dummy load to the MFJ-9420 and activate the CW adapter (transceiver's cover removed). Set the VFO to 14.025 MHz. Connect an antenna probe to the general coverage receiver and place it near TX Mixer U7 in the MFJ-9420. Set your receiver to the USB mode and locate the MFJ-9420 VFO signal slightly below 4.025 MHz. Tune for zero beat. Now, key the MFJ-9420 the VFO signal should shift upward in frequency and produce a continuous 700 Hz tone. If the tone is significantly higher or lower in pitch, adjust the OFFSET trimpot control for 700 Hz (or for your preferred CW pitch).

In Case Of Difficulty

1. Radio does not shift frequency or perform other CW functions with adapter activated.
   [ ] Check headers to make sure all pins are inserted correctly into the adapter board.

2. Stations do not respond to calls or consistently answer your calls off frequency.
   [ ] Check OFFSET adjustment on the MFJ-415 adapter (read the OFFSET ADJUST section above).

3. Stations report hearing a continuous carrier between keyed characters.
   [ ] Transceiver's CARRIER NULL circuit is significantly out of alignment. Remove CW adapter and null out carrier via R36 and T3 as outlined the MFJ-9420 manual.

4. Electronic keyer causes "key-down" condition whenever plugged in.
   [ ] Open circuit switching resistance may be too low for MFJ-415 keying circuit's high Z input. Try a straight key to confirm the MFJ-415 is working properly.
   [ ] Check for plug incompatibility or shorted key line.

5. No CW sidetone.
   [ ] Check SIDETONE LEVEL trimpot setting on MFJ-415.
   [ ] Check R38 and R40 on MFJ-9420 board must be "snipped" before AF Amp will pass sidetone.

Important warning: If your mic's PTT switch does not provide extra contacts which disable the microphone element, you must unplug it from your MFJ-9420 during CW operation!

If this is NOT done, the "live" mic element will pick up and retransmit any noise or stray voice signals in the room along with your CW signal! If you use the recommended MFJ-290 or Radio Shack 21-1172 mics, you can disregard this warning. Both mics disconnect the mic element through the PTT switch and may be left connected to your radio during CW operation.

Technical Assistance

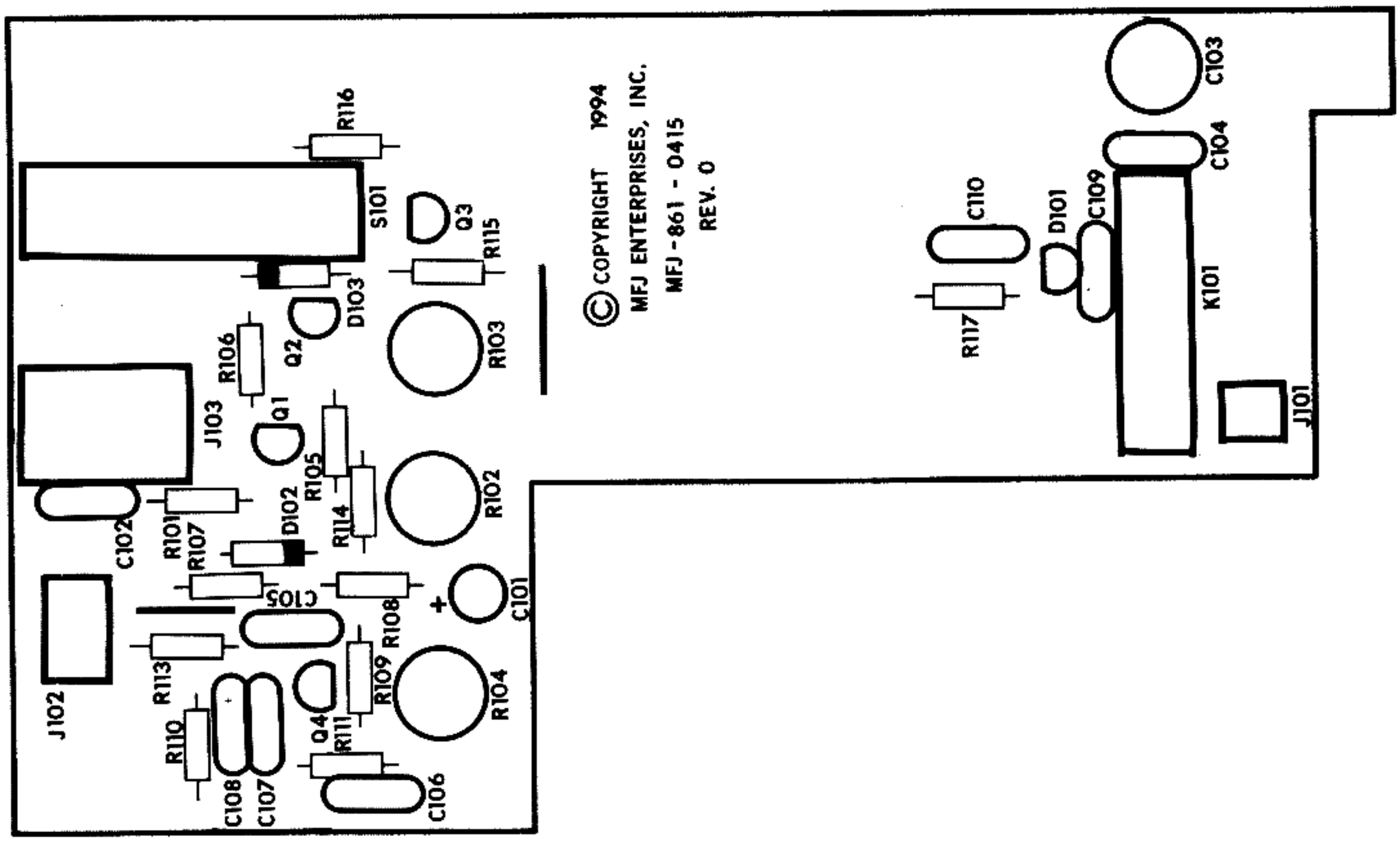
If you have any problem with this unit, first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual, you may call MFJ toll-free at 1-800-647-TECH (8324) or send FAX to 601-323-6551. Outside of the continental U.S.A. call 601-323-5869. You will be best served if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask. Please do not return your unit to the factory without first requesting technical assistance by phone or mail.

You can also send questions to MFJ Enterprises, INC., P.O. Box 494, Mississippi State, MS 39762. Send a complete description of your problem, an explanation of exactly how you are using your unit and a complete description of your station.

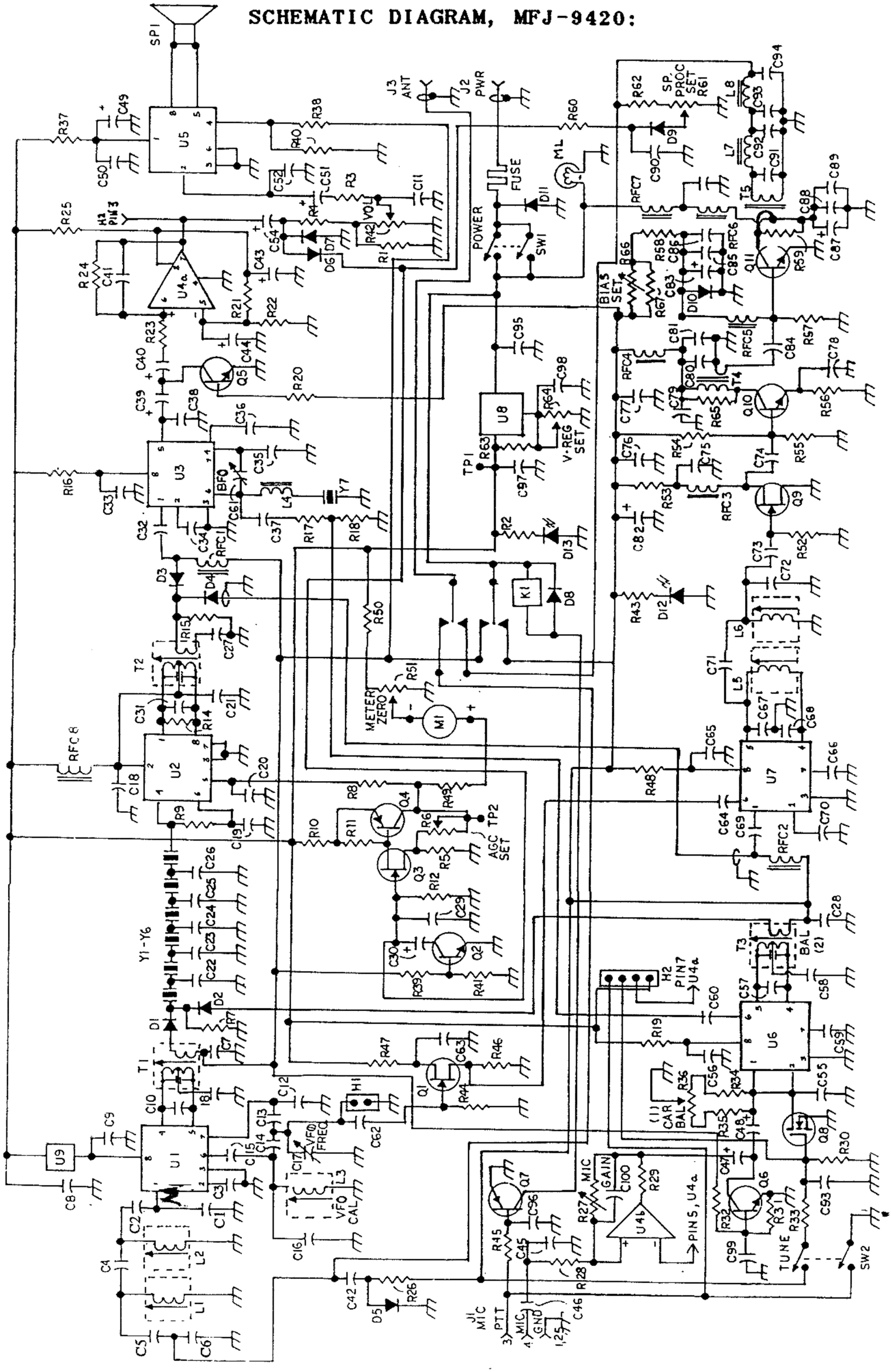
Parts List

Designator	Part Number	Description
C101	203-0013	Capacitor, Electrolytic, Radial, 16v, 22 uF
C102	200-0004	Capacitor, Disc Ceramic, 25/50v, 20%, .01 uF
C103	204-0001	Capacitor, Trimmer, 250v, 3-10 pF
C104	205-0039	Capacitor, Multilayer Cer., .1, 5%, 50v, NPO, 39 pF
C105	200-0005	Capacitor, Disc Ceramic, 50/100v, 20%, .1 uF
C107,C108,C106	205-1133	Capacitor, Multilayer, .1, 50v, 10%, Z5u, .033 uF
C109	200-2004	Capacitor, Disc Ceramic, 1 Kv, 5%, NPO, 4.7 pF
C110	200-2024	Capacitor, Disc Ceramic, 1 Kv, 20%, .001 uF
D101	315-2104	Transistor, Varactor, MV 2104
D102,D103	300-0003	Diode, Switching, DO-35, 10 mw, 75 Piv, 1N4148
J101	612-3002	Connector, Socket, .1, PCB, Bottom Entry, 2 Pos
J102	612-3004	Connector, Socket, .1, PCB, Bottom Entry, 4 Pos
J103	601-5005	Jack, 3.5mm, PCB, Stereo, Closed
K101	408-1011	Relay, Reed, PCB, 1050 Ohm, 12 vDC, SPST
Q1,Q3	305-0002	Transistor, General Purpose, TO-92, PNP, 2N3906
Q2,Q4	305-0001	Transistor, General Purpose, TO-92, NPN, 2N3904
R101,R113	100-4470	Resistor, 1/4 Watt, 5%, Film, 47.0 K
R102	133-5100	Resistor, Trimpot, Sub. Horz., 100 K
R104,R103	132-4100	Resistor, Trimpot, Sub. Vert, 10 K
R105,R117	100-5100	Resistor, 1/4 Watt, 5%, Film, 100 K
R106,R116	100-2100	Resistor, 1/4 Watt, 5%, Film, 100 Ohm
R107	100-3330	Resistor, 1/4 Watt, 5%, Film, 3.3 K
R110,R108	100-3100	Resistor, 1/4 Watt, 5%, Film, 1.0 K
R111,R109	100-4180	Resistor, 1/4 Watt, 5%, Film, 18.0 K
R114	100-4100	Resistor, 1/4 Watt, 5%, Film, 10.0 K
R115	100-3220	Resistor, 1/4 Watt, 5%, Film, 2.2 K

Parts Layout



SCHEMATIC DIAGRAM, MFJ-9420:



MFJ-9420 Parts List

DESIGNATION	DESCRIPTION	MFJ PARTS #	DESIGNATION	DESCRPTION	MFJ PARTS #
C1,5,73	100pF, 50V Multilayer	205-0100	Q8	VN10KM	305-6005
C2	560pF, 50V Multilayer	205-0005	Q9	J310	305-6310
C3,7,11,18,19,20,21,27	.01uF, 25/50V Disc	200-0004	Q10	2N5109	305-0017
C28,29,34,36,38,42,45,52	.01uF, 25/50V Disc	200-0004	Q11	MRF-477	305-5477
C53,55,58,59,63,65,66,70	.01uF, 25/50V Disc	200-0004	R1,2,7,15,16,19,26,43	2.2K ohm, 1/4 Watt	100-3220
C75,76,79,85,88,90,96	.01uF, 25/50V Disc	200-0004	R3,54	4.7K ohm, 1/4 Watt	100-3470
C4,71	4.7pF, 500V Disc	200-1004	R4,8,11,14,20,39,41,45	10K ohm, 1/4 Watt	100-4100
C6	680pF, 50V Multilayer	205-0680	R62	10K ohm, 1/4 Watt	100-4100
C8,9,33,46,50,56,77,78	.1uF, 50/100 Disc	200-0005	R5,23,28,46	1K ohm, 1/4 Watt	100-3100
C81,86,89,95,97,98,99	.1uF, 50/100 Disc	200-0005	R6,36,61,64	1K ohm, Trimpot	133-3100
C10,31,57	220pF, 50V Disc	200-0010	R9,25	330 ohm, 1/4 Watt	100-2330
C12,13,14	560pF, 160V Polysterene	202-0022	R10,13,29,47,63	100 ohm, 1/4 Watt	100-2100
C15,84	.1uF, 50V Multilayer	205-1210	R12	680K ohm, 1/4 Watt	100-5680
C16	27pF, 50V Multilayer	205-0027	R17,24,30,44,52,60	100K ohm, 1/4 Watt	1005100
C17	5-50pF, 750V Air Var	204-5050	R18,50	1.5K ohm, 1/4 Watt	100-3150
C22,26	120pF, 50V Multilayer	205-0120	R21,22,32,33,34,35,38	47K ohm, 1/4 Watt	100-4470
C23,24,25	150pF, 50V Multilayer	205-0150	R27	50K ohm, 1/4 Watt	130-4500
C30	2.2uF, 16V Electrolytic	203-8022	R37,53,57	22 ohm, 1/4 Watt	100-1220
C32,41,60,74,80,100	470pF, 50V Multilayer	205-0470	R40	22K ohm, 1/4 Watt	100-4220
C35	47pF, 50V Multilayer	205-0047	R42	10K ohm, Pot	165-4100
C37,62	22pF, 50V Multilayer	205-0022	R48	3.3K ohm, 1/4 Watt	100-3330
C39,40,47,48,51,54	1uF, 50V Electrolytic	203-0006	R49	5.6K ohm, 1/4 Watt	100-3560
C43,44	47uF, 35V Electrolytic	203-0007	R51	10K ohm, Trimpot	133-4100
C49,83,87	100uF, 16V Electrolytic	203-0003	R55	390 ohm, 1/4 Watt	100-2390
C61	12-100pF, 250V Trimmer	204-0010	R56	10 ohm, 1/4 Watt	100-1100
C64,69	100pF, 50V Disc	200-2013	R58	180 ohm, 1/2 Watt	101-2180
C67,68	180pF, 50V Multilayer	203-8022	R59	150 ohm, 1/4 Watt	100-2150
C72	68pF, 50V Multilayer	205 0068	R60	100K ohm, 1/4 Watt	100-5100
C82	10uF, 35V Electrolytic	203-0012	R65,67	220 ohm, 1/4 Watt	100-2220
C91,92,93,94	220pF, 500V Sm	208-0220	R66	500 ohm, Trimpot	130-2500
D1,2,3,4,5,6,7,8,9	1N4148	300-0003	RFC1,2,3,4	10uH, Inductor	401-0102
D10,11	1N4001	300-1004	RFC5	22uH, Inductor	401-0046
D12	MV5753 Red LED	320-0001	RFC6	4.7uH, Inductor	401-0099
D13	Green LED	320-0002	RFC7	4T, Indutor	11-9015-3
H1	2 Position Header	612-0402	RFC8	100uH, Inductor	401-0030
H2	4 Position Header	612-0404	SW1,2	Switch	504-0022
J1	5 Pin Din Connector	611-1005	T1,2,3	25K:1K Inductor	402-3123
J2	2.1MM Coaxial Jack	601-6021	T4	3:1 Transformer	11-9020-1
K1	12V Relay	408-2042	T5	4:1Transformer	11-9420-1
L1,2,5,6	1.8uH, Red Inductor	402-3402	U1,3,6,7	NE602	311-1602
L3	6.5uH Inductor	402-3406	U2	MC1350P	311-1045
L4	15uH, Inductor	401-0043	U4	LM358	311-0386
L7,8	12T Inductor	11-9020-3	U5	TDA7052AN	311-27052
Q1,3	2N5486	305-6004	U8	LM317T	307-1021
Q2,5,6	2N3904	305-0018	U9	78L05AC	307-0010
Q4,7	2N3906	305-0002	Y1,2,3,4,5,6,7	10MHz Crystals	405-0065