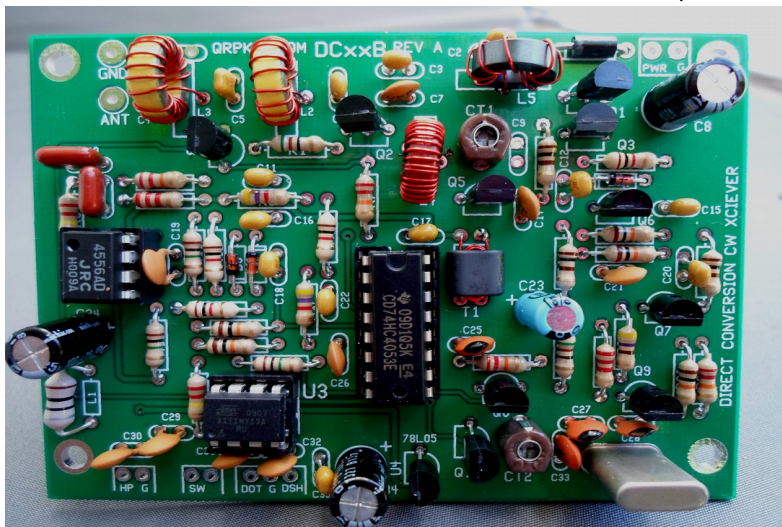


The DCxxB family of transceivers

High performance Direct Conversion transceivers for 40, 30 and 20 meters.



**A KD1JV “Melt Solder” design
Distributed by Pacific Antenna
www.qrpkits.com**

**Join Yahoo's DC40 kits group for support from other builders and information and modifications. Be sure to include your call and real name with your request.
[Http://groups.yahoo.com/group/dc40kits](http://groups.yahoo.com/group/dc40kits)**

Overview:

The DCxx is a moderately complex rig which yields excellent performance. The receiver features an unique analog switching mixer. Unlike other DC receivers which use an active mixer, this passive mixer provides nearly complete immunity to AM SWBC interference and can be run on an AC supply with little or no hum pickup. Minimum detectable signal (MDS) is about 0.3 uV and one stage of audio band pass filtering gives the receiver some selectivity.

The transmitter puts out a respectable 2 to 3 watts (depending on band) with 13.8 volts. The transmitter frequency is automatically shifted about 600 Hz to provide the proper T/R offset.

The rig also includes a simple Iambic keyer.

Note: This manual is for the DcxxB_RevA boards only. Earlier versions will find the correct manual here:
<http://qrpkits.com/manuals.html>

Tips and info for first time builders:

Installing parts:

You can insert several parts at a time onto the board. Parts should be pressed flush to the top of the board. The exception is the transistors, which should stand off the board by about 1/8", due to their three legged nature. Once you insert the part, kink one of the leads over slightly to keep it from falling out of the board when you flip the board over to solder. Once you solder a part in place, clip the lead nearly flush to the board. Clip at the top of the little fillet of solder which forms around the lead.

Finding the right part.

A picture at the bottom of the parts list on the previous page can be used to help identify some of the parts. The parts not shown should be obvious or deduced by the process of elimination. The numbers identifying the Monolithic caps (mostly yellow in color) can be hard to read. The use of a magnifying glass can help you to see them. In addition to the part value of the capacitor, there are a number of other letters and numbers printed on the part. Simply look for the three number group which matches the value your looking for, 331 for 330 pF, 104 for .1 uF 681 for the 680 pF cap and so on.

IC pin 1.

The outline on the board for the ICs has a "V" notch on one end. This indicates the pin 1 end of the IC. If a socket is used, there is also a notch on one end of the socket. This end goes over the V notch outline on the board. Finally, pin 1 of the IC is marked with a round dimple or dot. This end of the IC will go towards the notch on the socket or "V" on the outline.

Soldering

There are two important things which need to be done to ensure the successful operation of a kit. One is getting the right part into the proper place on the board. The second is good soldering. To insure a good connection, the soldering iron should touch both the component lead and the circuit board pad its to be soldered too. Heat the connection for just a second, then put the solder to the iron/pad/lead junction. Allow just enough solder to flow to fill the hole and wick around the lead. Go easy on the solder, you don't need a whole lot. If you use a thin solder like 0.02" instead of the more common 0.032" type, you have better control of the amount of solder used. For parts which connect to the ground plane, you may have to heat the connection a little longer.

Coils and Transformers

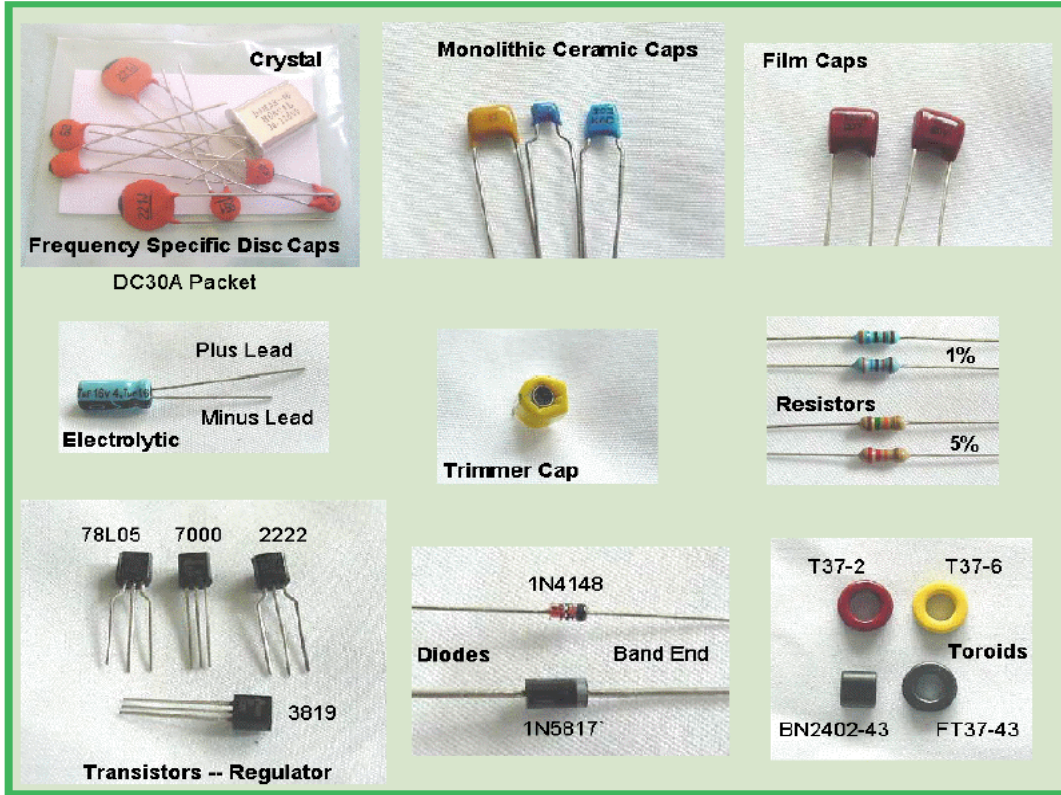
You may find it convenient to wind and prepare all the coils and transformers before you start inserting parts. That way you don't need to stop and possibly loose concentration to wind them for instillation See page 5 for specific band details.

Tinning the magnet wire:

The magnet wire ends should be tined before trying to solder the wire to the board. The insulation of the wire can be soldered through if enough heat is used. Put a little blob of solder on the tip of your iron and rub this against the side of the wire until the insulation melts. It will take a few seconds. Trying to solder through the wire insulation once the wire is inserted into the board generally does not work, as the board connection pad wicks away too much heat. When putting the wire into the board, be sure not to pull the wire too far down into the hole, past the point at which you tined the wire.

Examples of Component Types

Note variations in shape, size and color of similar component types. Some component leads will need to be reshaped to fit the holes in the PCB.



Parts list:

QTY	VALUE	TYPE	QTY	Value	type
2	51 ohms (GRN/BRN/BLK/GLD)	RESISTOR 5%, 1/4W	2	47 pfd (47)	CAP, NPO DISK
3	100 ohms (BRN/BLK/BRN/GLD)	RESISTOR 5%, 1/4W	2	470 pfd (471)	CAP, DISK
1	470 ohms (YEL/VOL/BRN/GLD)	RESISTOR 5%, 1/4W	7	1000 pfd (102)	CAP, DISK
4	1 K (BRN/BLK/RED/GLD)	RESISTOR 5%, 1/4W	2	0.01 ufd (103)	CAP, FILM
2	2.2 K (RED/RED/RED/GLD)	RESISTOR 5%, 1/4W	11	0.1 ufd (104)	CAP, MONO
2	4.7 K (YEL/VOL/RED/GOLD)	RESISTOR 5%, 1/4W	1	4.7 ufd/16V	CAP, ALUM ELECTROLYTIC
5	10 K (BRN/BLK/ORG/GLD)	RESISTOR 5%, 1/4W	3	100 ufd/16V	CAP, ALUM ELECTROLYTIC
4	22 K (RED/RED/ORG/GLD)	RESISTOR 5%, 1/4W	2	60 pfd BROWN	TRIMMER CAPS
2	220 K (RED/RED/YEL/GLD)	RESISTOR 5%, 1/4W			
3	1 MEG (BRN/BLK/GRN/GLD)	RESISTOR 5%, 1/4W			
			1	NJM4556AD	8 PIN DIP, OP AMP
1	10 uhy (BRN/BLK/BLK/SILVER)	RF CHOKE	1	74HC4053	16 PIN DIP, ANALOG
1	T37-2 (RED TOROID)		1	ATTINY13A	8 PIN DIP, programmed keyer
1	FT37-43 (BLACK FERITE)		1	LM78L05	TO-92, +5 REGULATOR
1	BN43-2402 BINOCULAR CORE		3	2N3904	TO-92, NPN
2	STEREO JACKS		4	2N7000	TO-92, MOSFET
1	NO PUSH BUTTON SWITCH		1	2N3819	TO-92, N JFET
1	PC BOARD		3	BS170	TO-92 MOSFET
1	6 feet #28 enamel magnet WIRE		3	1N4148	SS DIODE
2	8 PIN DIP SOCKETS		1	1N5817	Shottky Rectifier DIODE
1	16 PIN DIP SOCKET		1	BAND SPECIFIC	PARTS BAG

QTY	Band Specific parts
	20 meters
1	14.060 MHz xtal
1	22 pfd NPO disk
1	33 pfd NPO disk
1	47 p NPO disk
2	150 p (151) C0G
1	330 p (331) C0G
2	T37-6 yellow toroid

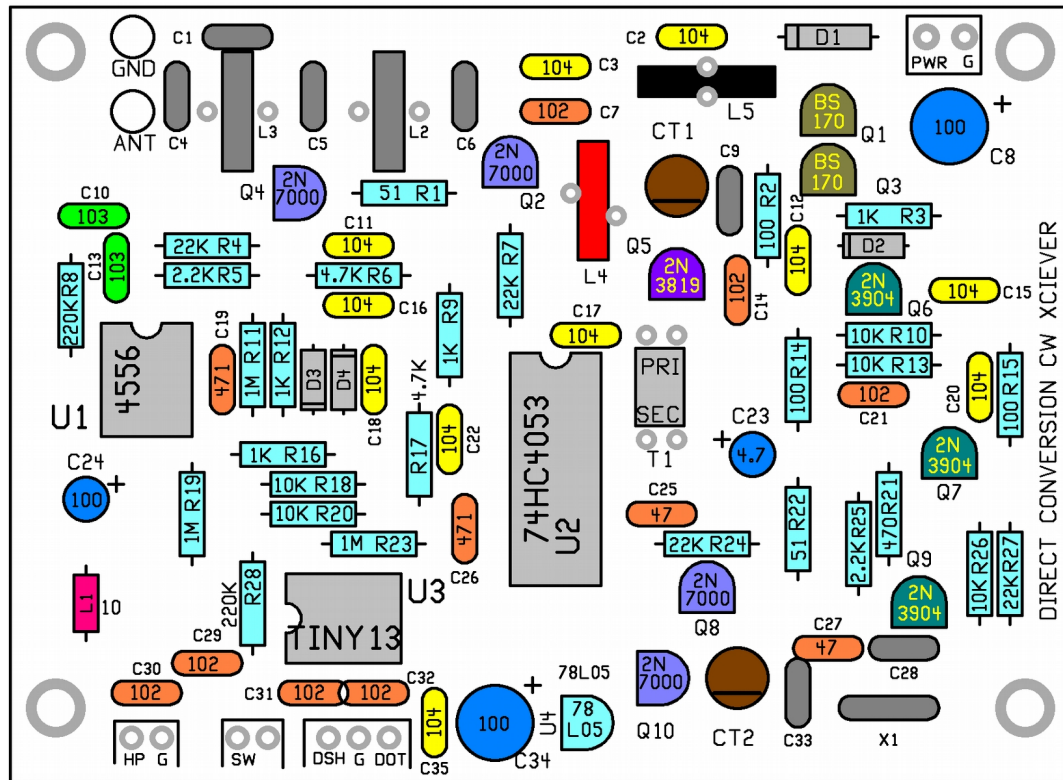
QTY	Band Specific parts
	30 meters
1	10.106 MHz xtal
3	47 pfd NPO disk
2	220 p (221) C0G
1	560 p (561) C0G
2	T37-2 red toroid

QTY	Band Specific parts
	40 meters
1	7.0400 MHz xtal
2	47 pfd NPO disk
1	68 p NPO disk
2	330 p (331) C0G
1	680 p (681) C0G
2	T37-2 red toroid

Assembly:

Most of the parts will be installed on the board before any testing is done. The parts location diagram for the board is shown below. This page should be printed out for easy reference while building. Experienced builders should be able to build up most of the board using just this diagram.

Parts are highlighted in different colors to make them easier to locate and find similar part types or values. Parts with Band specific values are highlighted in light gray. All the other parts have their value shown inside the part outline where there is enough room for the number. In a few cases the value or part number will be next to the part outline.



Group 1: Resistors

The resistors are installed first. Part designations are, in general, numbered starting at the upper left corner of the board and then zig-zag left to right down to the bottom of the board. Parts are listed in the table in that order. 51 ohm and 1 Meg resistors can easily be mixed up, as the colors codes are the same, but in opposite order, so be careful to look at these closely.

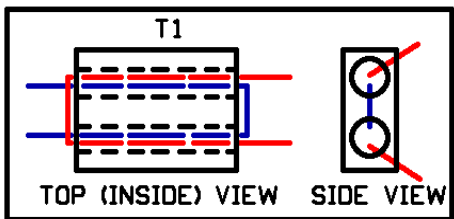
√	Part #	value	markings		√	PART#	VALUE	MARKINGS
	R1	51 ohms	GRN/BRN/BLK			R15	100 ohms	BRN/BLK/BRN
	R2	100 ohms	BRN/BLK/BRN			R16	1 K	BRN/BLK/RED
	R3	1 K	BRN/BLK/RED			R17	4.7 K	YEL/VOL/RED
	R4	22 K	RED/RED/ORG			R18	10 K	BRN/BLK/ORG
	R5	2.2 K	RED/RED/RED/			R19	1 MEG	BRN/BLK/GRN
	R6	4.7 K	YEL/VOL/RED			R20	10 K	BRN/BLK/ORG
	R7	22 K	RED/RED/ORG			R21	470 ohms	YEL/VOL/BRN
	R8	220 K	RED/RED/YEL			R22	51 ohms	GRN/BRN/BLK
	R9	1 K	BRN/BLK/RED			R23	1 MEG	BRN/BLK/GRN
	R10	10 K	BRN/BLK/ORG			R24	22 K	RED/RED/ORG
	R11	1 MEG	BRN/BLK/GRN			R25	2.2 K	RED/RED/RED
	R12	1 K	BRN/BLK/RED			R26	10 K	BRN/BLK/ORG
	R13	10 K	BRN/BLK/ORG			R27	22 K	RED/RED/ORG
	R14	100 ohms	BRN/BLK/BRN			R28	220 K	RED/RED/YEL

Diodes and inductor:

To complete this group, now install the four diodes and molded inductor. Be sure to observe proper polarity of the diodes. There is a black band towards one end of the diode. This band should face the line shown on the diode outline in the placement diagram.

- D1, 1N5817 black body diode.
- D2,3,4 – 1N4148 glass body diodes
- L1, 10 uHy molded inductor, looks like a resistor. Color code Brown/Black/Black/Gold. Form the leads to more closely fit the hole spacing.

Now install T1.



This transformer is wound on a small BN-2402-43 binocular core. This is the black core with two holes in the side of it. One turn is a complete pass through both holes, as shown in the diagram. The secondary is a single turn (1.5"), one "hairpin" passed through both holes. Insert this wire first. You might want to mark the secondary end with a dot of nail polish. Then wind the primary, 5 turns (6"), starting from the other side of the core from which the secondary exits. Only one turn is shown in the diagram for clarity. Try to keep the wire snug to the inside of the holes, or it might be hard to get all the turns in. However, be careful not to scrape

the wire along the outside edge of the holes, or it might damage the insulation on the wire. Be sure to tin the wire ends before attempting to solder the wire to the pads in the board.

Group 2: Small capacitors:

Sort the caps into groups of same value. Install all of one value at a time. The table is organized by value, starting with the smallest values first.

√	location	value	markings		√	location	value	markings
	C25	47 pfd	47 (DISK, BRN)			C2	0.1 ufd	104 (MONO, YEL)
	C27	47 pfd	47 DISK, BRN)			C3	0.1 ufd	104 (MONO, YEL)
						C11	0.1 ufd	104 (MONO, YEL)
	C19	470 pfd	471 (DISK, BRN)			C12	0.1 ufd	104 (MONO, YEL)
	C26	470 pfd	471 (DISK, BRN)			C15	0.1 ufd	104 (MONO, YEL)
						C16	0.1 ufd	104 (MONO, YEL)
	C7	0.001 ufd	102 (DISK, BRN)			C17	0.1 ufd	104 (MONO, YEL)
	C14	0.001 ufd	102 (DISK, BRN)			C18	0.1 ufd	104 (MONO, YEL)
	C21	0.001 ufd	102 (DISK, BRN)			C20	0.1 ufd	104 (MONO, YEL)
	C29	0.001 ufd	102 (DISK, BRN)			C22	0.1 ufd	104 (MONO, YEL)
	C30	0.001 ufd	102 (DISK, BRN)			C35	0.1 ufd	104 (MONO, YEL)
	C31	0.001 ufd	102 (DISK, BRN)					
	C32	0.001 ufd	102 (DISK, BRN)			C1	Band specific	See band table
						C4	Band specific	See band table
	C10	0.01 ufd	103 (FILM, GRN)			C5	Band specific	See band table
	C13	0.01 ufd	103 (FILM, GRN)			C6	Band specific	See band table
						C9	Band specific	See band table
						C28	Band specific	See band table
						C33	Band specific	See band table

Band table: specific capacitor values.

Capacitors	40 meters	30 meters	20 meters	TYPE
C9	47 p	Not Used	Not Used	Disk
C33	Not Used	47 p	47 p	Disk
C28	47 p	47 p	22 p	Disk
C1	68 p	47 p	33 p	Disk
C4	330 p (331)	220 p (221)	150 p (151)	C0G
C5	680 p (681)	560 p (561)	330 p (331)	C0G
C6	330 p (331)	220 p (221)	150 p (151)	C0G

Miscellaneous parts:

CT1 and CT2: These are the small trimmer capacitors. Note one side is flat. This side is installed facing towards the line drawn on the part outline. This insures the adjustment screw inside the cap is at ground.

IC sockets: Install the two 8 pins sockets for U1 and U3 and 16 pin socket for U2. Before you solder any of the socket leads to the board, make sure they are all sticking out of the holes in the board. If one of the leads bends over under the socket while you install it, it will be difficult to remove the socket after you start soldering leads to fix

it. DO NOT install the IC's into the sockets yet!
Semiconductors in TO-92 package:

Be sure to correctly identify each part by reading the number printed on the flat side of the package. A magnifying glass might be of help reading the numbers. Check for wisps of lead plating which might scrape off the leads as they are pushed into the holes in the board. These can cause shorts.

- Q1, Q3: Do not install yet. Will install after initial tests are done.
- Q2, Q4, Q8, Q10 – 2N7000 mosfets
- Q6, Q7, Q9 – 2N3904 NPN bi-polar transistors
- Q5 – 2N3819 N-JFET
- U4 – 78L05 +5 volt regulator
- X1: Install the crystal (frequency is band dependent)

Electrolytic capacitors:

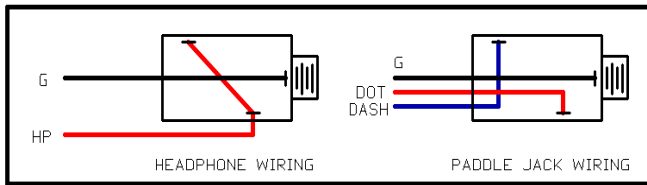
These must be installed with the correct polarity. C8 in particular can heat up and explode if installed backwards, as it is across the main DC supply input. The positive (+) lead is always the long lead. The negative (-) lead is marked by a stripe on the body of the capacitor can. Make sure the plus end of the cap goes towards the hole labeled with the (+).

- C8, C24, C34 – 100 ufd/16V
- C23 – 4.7 ufd/16V
- L5: wind 8 turns of magnet wire (6”) on the black FT37-43 core.
- L4, L2, L3: Wind and install L4, L2 and L3. See band chart for proper number of turns. Be sure to count the number of turns properly. Each time the wire passes through the center of the core, it is counted as a turn. If you wind an extra turn (which is a common mistake), the power output will be reduced. Wire length includes 1” pig tails. Wind wire snug to core. Sloppy, loose winding will result in poor performance. Space turns as evenly as possible around core.

<i>40 meters</i>	<i>wire</i>	<i>core</i>	<i>turns</i>	<i>Wire length</i>
L4	#28 Red	T37-2 (red)	35 turns	19.5"
L3	#28 Red	T37-2 (red)	22 turns	13"
L2	#28 Red	T37-2 (red)	18 turns	11"
30 meters				
L4	#28 Red	T37-2 (red)	30 turns	17"
L3	#28 Red	T37-2 (red)	16 turns	10"
L2	#28 Red	T37-2 (red)	14 turns	9"
20 meters				
L4	#28 Red	T37-2 (red)	27 turns	15"
L3	#28 Red	T37-6 (yellow)	16 turns	10"
L2	#28 Red	T37-6 (yellow)	15 turns	9.5"

This completes the assembly of the board, with the exception of Q1 and Q3, which will be installed shortly after testing.

Testing:



- First, wire up the headphone jack, the paddle jack and the keyer control switch.
- Connect power leads to the board.
- Connect power leads to a 12 volt to 13.8 volt power source.

- Apply power to board.
- Verify +5 volts between pins 8 and 4 of U3
- Check for crystal oscillator operation with station receiver or frequency counter. A frequency counter can be connected to pins 10 or 11 of U2. When using a receiver, place a "clip lead" antenna near the board and tune around the crystal frequency for the band the board is built for.

- Remove power from the board.
- Install U1, the 4556 dual op amp.
- Install U2, the 74HC4053 analog switch
- Install U3, the TINY13 keyer chip.

- Plug in headphones and paddle to jacks.
- Apply power to the board.

You should now be able to hear the keyer side tone when operating the paddle.

Setting T/R offset:

- Connect a test lead antenna to your "big rig" and select the band for which this kit is being built for.
- Tune the receiver to crystal frequency.
- Place the test lead antenna near the board.
- Apply power to the DCxx rig.
- Tune the receiver around a little until you hear the boards crystal oscillator.
- Click and hold closed the keyer control switch until you hear the letter "T" in the headphones. The keyer is now in Tune mode.
- Tapping the DASH paddle will put the rig into transmit mode. It will remain so until you tap the DOT paddle. You can continue to toggle back and forth between transmit and receive using the DOT and DASH paddles. To exit tune mode, click the switch again. You can also use straight key mode, by keeping the Dash paddle closed when you apply power to the board. The Dot paddle will now key the rig on and off.

- Now you can set the CT2 trimmer for the proper T/R oscillator shift.
- Tap the Dash paddle to put the board into transmit mode find and note the frequency of the oscillator.
- Tap the DOT paddle return to receive mode and adjust the CT2 trimmer so the oscillator is about 600 Hz higher in frequency than it was when in transmit mode.
- You can also make this adjustment with a frequency counter if you have one. R21 is a good place to connect the counter.

Final Tests.

Your new rig is now just about ready to use. All we need to do now is peak the receiver trimmer, install Q1 and Q3 and check for transmitter power output.

For peaking the receiver trimmer (CT1) on 30 or 40 you can probably just connect an antenna up and peak the trimmer for best band noise or signal if someone is transmitting near the crystal frequency. On 20, you will probably need to generate a signal using your big rig, transmitting into a dummy load. In this case, you just need to use a piece of wire or clip lead for an antenna on the DC rig and place it near the dummy load. Don't plug in a paddle yet, so you don't accidentally transmit!

For testing the transmitter, you should have a dummy load and watt meter which is reasonably accurate at the 1 watt level. Alternately, you could use a 'Scope if it has enough band width or use a simple diode detector and volt meter.

- Remove power from the board and install Q1 and Q3.
- Connect up an antenna jack if not already done, plug in headphones, paddle and power leads.
- Turn on power to the rig. Put the keyer into "Tune Mode", using the keyer control switch. This will allow you to toggle the transmitter on and off. Toggle the transmitter on and see if how much power out you get. The amount of power will depend a lot on supply voltage and the band.
- With 13.8 volts, 3 W or more is typical on 40, 2.5 W or more on 30 and about 2 W on 20.
- Below 13 volts, the power output will drop off quickly.
- The way the turns are spaced on L2 and L3 can also make a significant difference in the amount of power output, as minor changes in the inductance can affect the matching and power transfer. The L2 coil has the most effect on power output. On 40 or 30 the turns will want to be spaced as evenly as possible. On 20 you'll probably get a little more power with some of the L2 turns shifted close together.

Trouble shooting guide:

The most common reason a kit does not work right is due to soldering issues. Therefore, the first thing to look for if something doesn't work is the solder connections. Look for solder splashes which might be shorting two pads together which shouldn't be connected and for solder which might have stuck just to a lead and didn't flow into the circuit board pad. Connections to the ground plane need extra heat, so look closely to these connections to make sure the solder flowed into the hole. Its also possible to have solder on the circuit board pad, but it didn't flow around the lead.

The second most common error is miss-placed parts. You may have miss read a resistor color code, or put it in the wrong spot. The same goes with capacitors. So, if your soldering looks good, double check the parts placement.

Having an actual bad part is rare. It is possible to damage them though. The 2N7000 can be damaged by static due to improper handling and ICs can be damaged if they are installed backwards.

Some DC voltage levels are shown on the schematic. Note that the DC voltage across R25, the crystal oscillator emitter resistor measures a lot higher than the base voltage, because of the way the DVM responds to the superimposed AC RF voltage.

Low Audio

The Dcxx audio output is adequate for most headphones, especially the higher impedance types. If you are experiencing low audio, try a different headset. Those with the highest sensitivity ratings are best. If you still find the volume too low, you can add a simple audio amplifier. Amplified speakers for MP3 players are now common and inexpensive.

Chirp:

Since the voltage to the crystal oscillator is not regulated on the board, the frequency of the oscillator can change if the supply voltage changes. Therefore, the use of a regulated power supply is recommended. If running the rig on batteries, be careful not to run the batteries too low.

Making contacts with a fixed frequency, Direct Conversion rig.

Making contacts with this type of rig can be a challenge, but its not impossible. In fact, it can be a lot of fun and satisfying. Just remember, its easier to have stations come to you. The reason for this is because the receiver will hear stations on both sidebands, you don't know which side band your hearing them on. Also, although the audio band pass filter adds some selectivity, its hard to tell how close to your operating frequency they really are, especially if the station is pretty strong. You could be hearing them well, but your transmitting too far from their operating frequency for them to hear you. That being said, it can pay to try and answer a CQ you hear anyway, especially if they are signing QRP or QRPP. Then you pretty much know they are on 7.040 and some operators actually use RIT to tune around a little for answering stations. Or they could be using one of these rigs or a Rock Mite.

It also helps to carefully pick the time of day and day of the week to operate this rig. You want to pick a time of day and day of the week when the band isn't overly active. Contest weekends and early evening prime time are out. Good times are Sunday afternoon or evening, mornings, afternoons and late evenings during the week.

Keyer operation:

The momentary switch is used to access the keyer functions. Clicking and holding closed the switch for various lengths of time access these functions. There are five possible functions which are selected using the "Function" Switch. These are:

1. Send message
2. Set code speed
3. Enter and exit Tune Mode
4. Enter store message mode

Sending messages: (A message must be stored before this function will work)

After a short, quick click of the function switch, tap the Dot paddle to send message 1 or tap the Dash paddle to send message 2. Once a message has started to be sent, it can be paused, stopped or set to beacon mode. Note: only message 1 can be used for beacons.

Pause: Close and hold the Dash paddle.

Stop: Close and hold the Dot paddle.

NOTE: these actions will occur after a character currently being sent has finished sending.

Beacon mode:

- Click and hold the function button as Message 1 is being sent.
- The letter "B" will sound from the side tone when the mode is activated. There is a fixed 3 second pause between repeating the message.
- Closing either paddle during the pause will terminate beacon mode.
- In addition, message Pause and Stop can be used during the sending of the message.

Change code speed:

A short, quick click of the switch enters change code speed mode. There is a short pause to see if you want to send a message, then letter "S" will be sounded by the side tone.

- Closing the Dash paddle will increase the code speed, a dot will sound each time the speed is incremented by 1 wpm.
- Closing the Dot paddle will decrease the code speed. Again, a dot will sound each time the speed is decremented by 1 wpm.

- At the upper and lower speed limits, a double dot (I) will sound.
- The change code speed mode will automatically exit after the paddles have been released for about 1 second.

Tune mode:

Tune mode is used when you want to key the transmitter continuously to say adjust an antenna tuner or make a power output measurement. To enter Tune mode:

- Click and hold closed the function switch until the letter “T” is sounded by the side tone (about 1 second)
- To key the transmitter on, tap the Dash paddle closed.
- To turn the transmitter off, tap the Dot paddle closed.
- Repeat as needed.
- To exit Tune mode and return to normal operation, click the Function switch.

Entering Messages:

- Click and hold the function switch closed until the letter “M” is sounded by the side tone, about 1 second after the tune mode annunciation of “T”.
- A message of up to 29 characters (including word spaces) may now be entered via the paddle. If you exceed the maximum character limit, “EM” will sound and you will have to start again, making the message shorter. If you have a 2X3 call, you won't be able to quite fit a 3x3 CQ into the memory.
- “Ideal” timing of 7 dot times for character space and 21 dot times for word spacing is used to determine the completion of a character or word space. To insure a word space is inserted, it is best to pause slightly longer than they would otherwise between words.
- Click the Function switch when you are finished entering the message. The message will repeat so you can check for timing errors. If you need to re-enter the message, click the Function button and “EM” will sound.
- If the message was entered correctly, tap the Dot paddle to store the message in location 1 or the Dash paddle to store in location 2. “MS” (message stored) will sound and normal operation will resume.

Straight key mode:

If a mono plug is in the paddle jack at power up, the keyer will go into straight key mode. In this mode, there is no need for the function switch, so it is disabled. This function allows using an external contest keyer if desired.

How it works:

Receiver:

Signals from the antenna first travel through the transmitters low pass filter. It then passes through a T/R QSK switch comprised a 2N7000 mosfet. During receive, Q2 is turned on. This allows the signal to pass into the link coupling into the front end tuned circuit. During transmit, Q2 is turned off, isolating the transmit signal from the receiver. Q4 is used as an inverter to control the voltage on the gate of Q2, as the control signal from the keyer chip needs to be inverted.

The tuned input circuit is connected to a j-fet amplifier to isolate the mixer from the antenna and to provide some gain. The output of the amplifier is then coupled into the mixer using a transformer wound on a small balun core. The mixer is an analog multiplexer. The analog switches in the multiplexer connect the output load resistor across the secondary of the input tuned circuit at the LO frequency rate. On each half cycle, the phase of the input signal across the load resistor is switched. This produces the mixing of the LO signal and input signal, producing an audio beat note at the load resistor. The switches are biased to ½ the supply to improve the mixers' dynamic range and eliminates AM SWBC interference.

A high gain, differential input audio amplifier is connected to the mixers' load resistor. This stage provides most of the gain for the receiver. A pair of back to back diodes across the amplifiers feedback resistor limits the

peak to peak output of the amplifier to offer some hearing protection from strong signals. These diodes also reduce clicks created by switching transits when switching from receive to transmit and back again.

The output of the first high gain audio stage is then routed through another analog switch for audio muting during transmit. The signal then goes into an audio band pass filter stage. This filter has a Q of 8. However, since only a single stage of filtering is provided, the filter isn't as narrow as a Q of 8 would imply when strong signals are present. The output of this filter drives the headphones. A 10 uhy inductor and the .001 cap across the output helps keep RF, which might be picked up by the headphone leads, out of the amplifier. The NJM4456 op amp used has a high current output, so has no trouble driving headphones.

Oscillator and transmitter.

A classic Colpits crystal oscillator provides the Local Oscillator. During receive, Q10 is turned off, which allows CT2 to shift the oscillator frequency. During transmit, Q10 is turned on, which effectively shorts out CT2. CT2 is used to set the receive frequency about 600 Hz higher than the transmit frequency, providing proper T/R offset. When going from receive to transmit, the keyer chip will first mute the receiver and shift the oscillator frequency before enabling the transmitter output. When going from transmit to receive, the transmitter is first turned off, then after a delay of about 5 ms, the receiver is un-muted and the oscillator frequency shifted.

Q7 buffers the crystal oscillator output, which then drives the mixer and the remaining transmitter circuits. During transmit, Q6 is turned on by the keyer chip via Q8. R14 and R22, in combination with C23 form an R/C time constant which causes the output of Q6 to ramp on and off in about 5 ms. This provides wave shaping to the output signal, as to eliminate key clicks.

The output of Q6 in turn drives the PA stage, two BS170 MOSFETs in parallel. Capacitor C1 tunes the L3 coil to the second harmonic, which forms a trap. This ensures the spurious output of the transmitter is well below required FCC limits. It also improves PA efficiency and power output.

