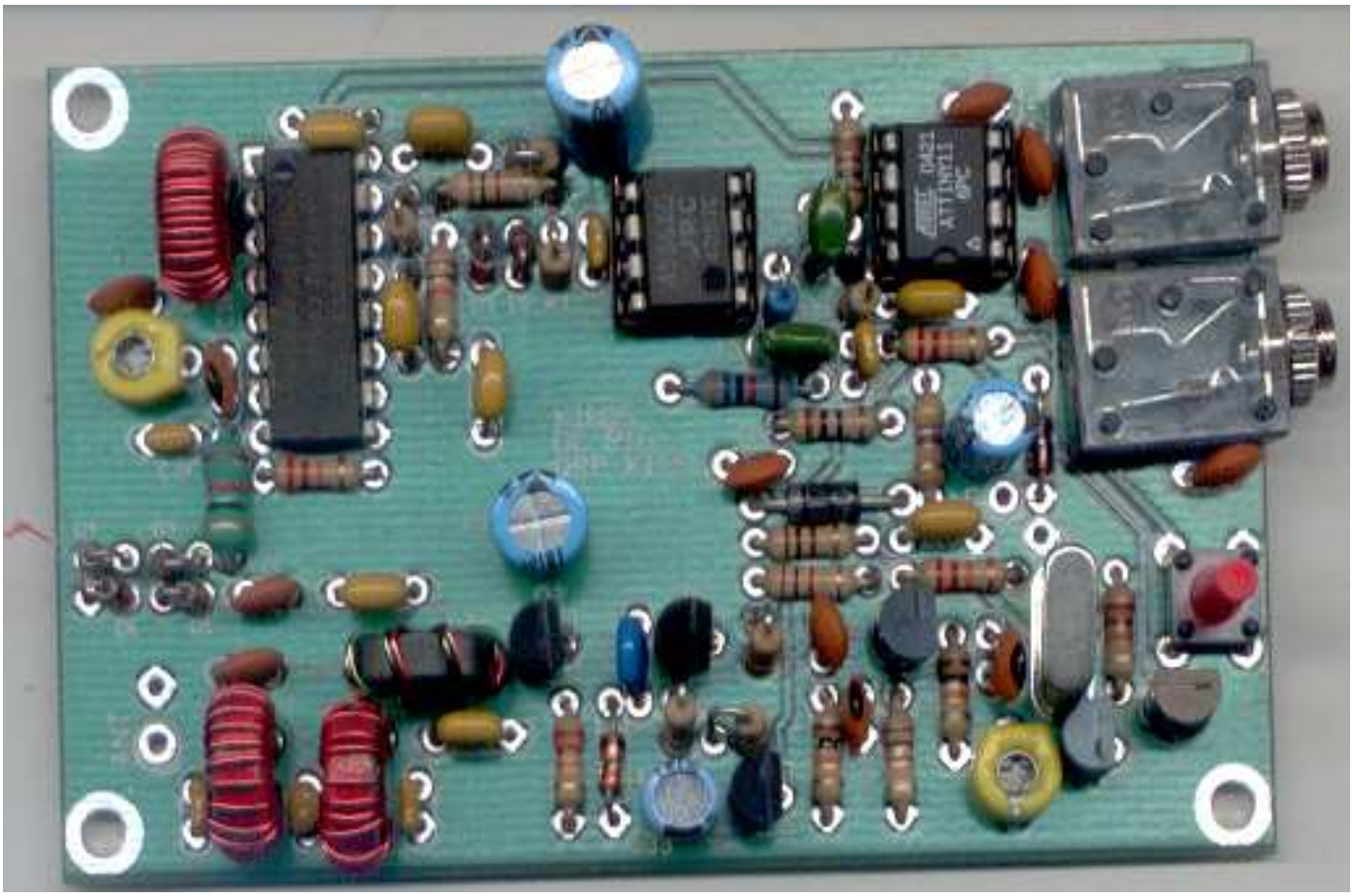
The DC40

A high performance Direct Conversion 40M transceiver.



A KD1JV “Melt Solder” design
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The DC40

A Direct Conversion, fixed frequency Transceiver.

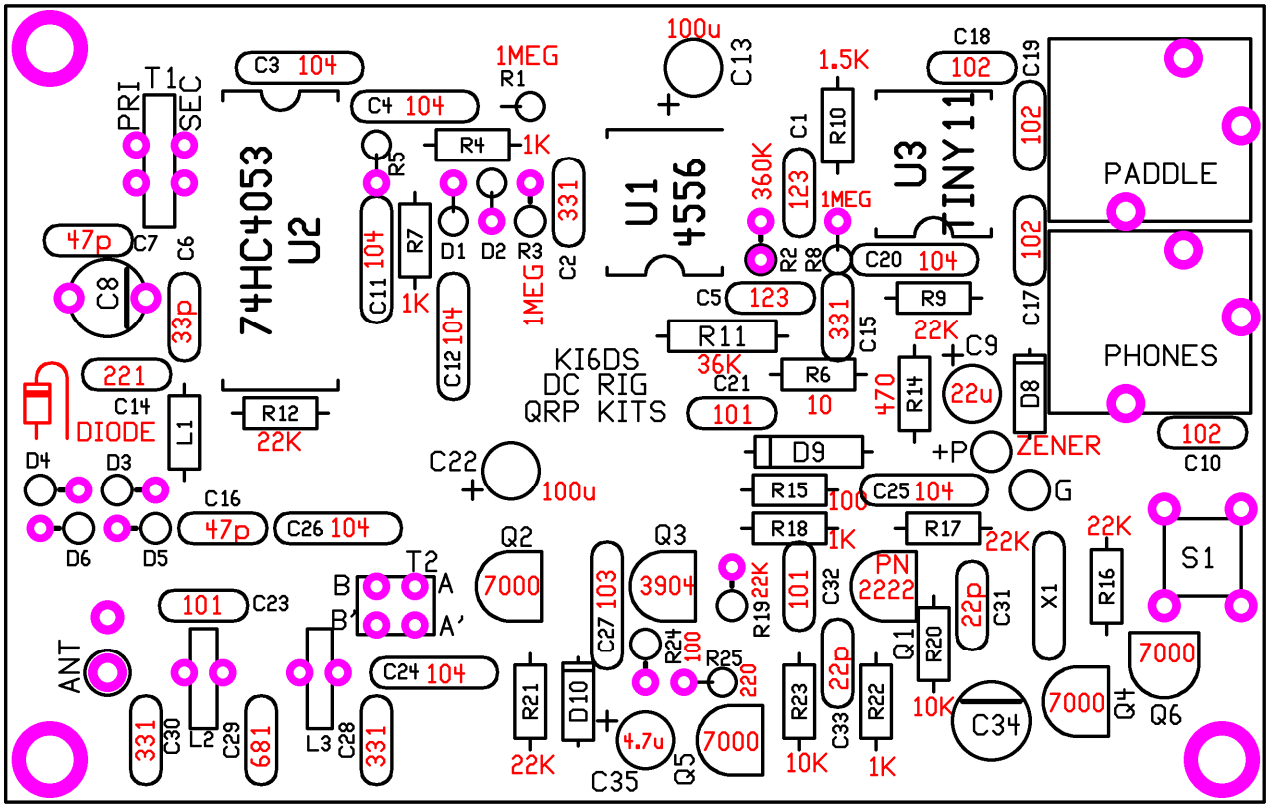
The DC40 is a moderately complex rig, which yields excellent performance, yet is small enough to fit into an Altoids tin. The receiver features nearly complete immunity to AM SWBC interference and can be run on an AC supply without hum pickup or AM BC interference common to most DC receiver designs. One stage of audio band pass filtering gives the receiver some selectivity. The transmitter puts out a respectable 750 mw of power, with a 12V supply and over 1 watt with 13.8 volts. The transmitter frequency is automatically shifted up about 600 Hz to provide the proper T/R offset. The rig also includes a simple keyer chip.

Assembly:

Assembly of the board will be done in several groups. You can test most of these stages when finished, or move onto the next group and test everything at once. If a group fails to pass the smoke test, see the trouble shooting section located after the assembly instructions.

If you plan on installing the board into an Altoids tin, trim off the corner of the board next to the paddle jack before you install the jack. You may also want to mark where the mounting holes and where the phone jacks will be in the tin before installing any parts.

The parts location diagram for the whole board is shown below. Component values are marked in red. Experienced builders should be able to build up most of the board using just this diagram.

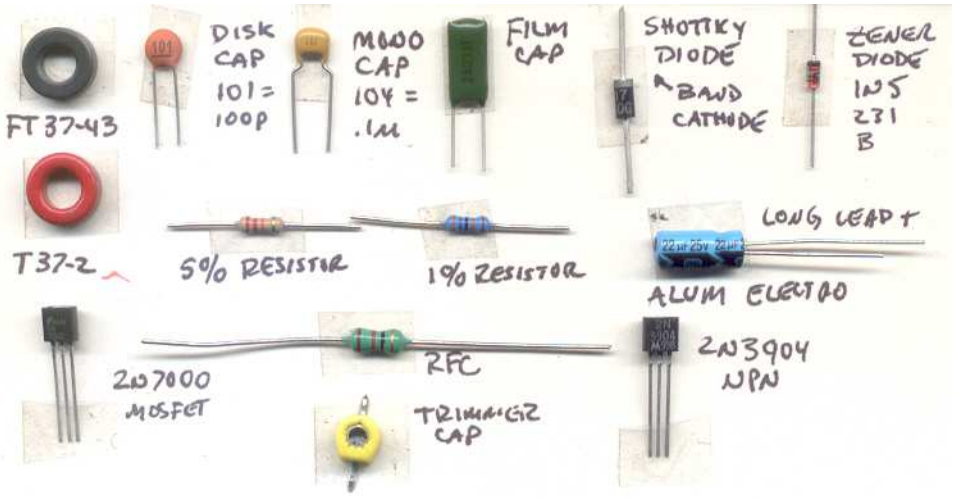


Note that Q1 and Q3 may be either 2N3904 or PN2222A

Parts list

RESISTOR	*VALUE*	*TYPE*	*Caps*	*Value*	*type*
R1	1 meg	5% 1/4w CF	C1	.012 uF	FILM
R2	360 K	1.00%	C2	330 p	DISC or mono
R3	1 meg		C3	.1 uF	.2LS MONO
R4	1 K		C4	.1 uF	MONO
R5	1 K		C5	.012 uF	FILM
R6	10 OHMS		C6	33 p	DISC
R7	1 K		C7	47 p	DISC
R8	1 MEG		C8	40 p	TRIMMER
R9	22 K		C9	22 uF / 16V	ALUM
R10	1.5 K		C10	.001 uF	DISC
R11	36 K	1.00%	C11	.1 uF	MONO
R12	22 K		C12	.1 uF	MONO
R13	Skipped	Not used	C13	100 uF/16V	ALUM
R14	470 OHMS		C14	220 p	DISC or mono
R15	100 OHMS		C15	330 p	DISC or mono
R16	22 K		C16	47 p	DISC
R17	22 K		C17	.001 uF	DISC
R18	1 K		C18	.001 uF	DISC
R19	22 K		C19	.001 uF	DISC
R20	10 K		C20	.1 uF	MONO
R21	22 K		C21	100 p	DISC
R22	1 K OHMS		C22	100 uF/16V	ALUM
R23	10 K OHMS		C23	100 p	DISC
R24	100 OHMS		C24	.1 uF	MONO
R25	220 OHMS		C25	.1 uF	MONO
			C26	.1 uF	MONO
			C27	.01 uF	.2LS

			C28	330 p	DISCor mono
			C29	680 p	DISC or mono
			C30	330 p	DISC or mono
			C31	22 p	DISC /NPO
			C32	100 p	DISC
L1	12uHy	RFC	C33	22 p	DISC /NPO
L2/3	T37-2	Red	C34	40p	TRIMMER
T1	T37-2	Red	C35	4.7uF/16V	ALUM
T2	FT37-43	Black			
			SEMI'S		
X1	7. 040 MHz		U1	NJM4556AD	High current opamp
SWITCH	6mm TACT	14mm shaft	U2	74HC4053	Analog multiplex
JACKS	PC mount stereo		U3	ATTINY11	MPU
PC Board			Q1/3	2N3904 or PN2222A	NPN
Red and Green	Magnet wire		Q2/4/5/6	2N7000	MOSFET
			D1/2/3/4	1N4148 or 1N914A	Small signal
D7 skipped	Not used		D8	1N5231B	5.1V
			D9	1N5718	Schottky power
			D5/6/10	1N4148 or 1N914A	Small signal



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.

The .1 uF caps used in the kit have formed leads, so these will not sit quite flush to the board. Several of the disk caps have lead spacing larger than the pads on the board. These leads you can reform with your pliers so they will sit flush to the board.

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 and 681 for the 680 pF cap.

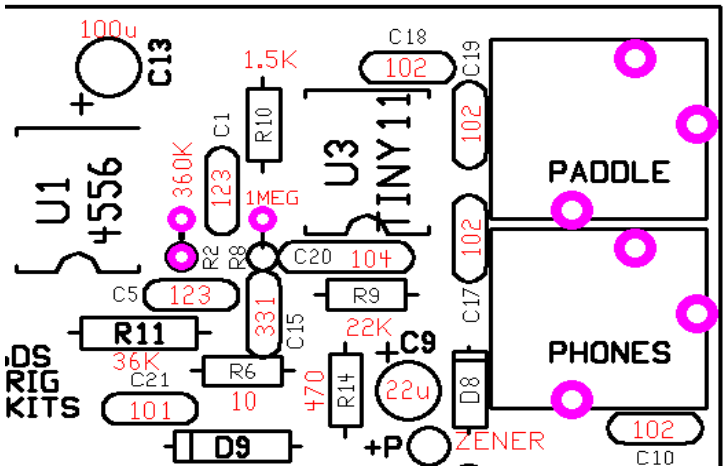
IC pin 1.

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 it is to be soldered to. 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.

Group 1: Power, Audio and Keyer stages.



Part #	value	markings	√
R10	1.5K	BRN/GRN/RED	
R9	22K	RED/RED/ORG	
R14	470 Ohm	YEL/VOL/BRN	
R6	10 Ohm	BRN/BLK/BLK	
R11	36K, 1%	ORG/BLU/BLK/ RED	
R2	360K, 1%	ORG/BLU/BLK/ ORG	
R8	1MEG	BRN/BLK/GRN	
D8	1N5231	ZENER	
D9	1N5718	Schottky	
C18	.001u	102 DISC	
C19	.001u	102 DISC	
C17	.001u	102 DISC	
C10	.001u	102 DISC	
C20	.1u	104 mono	
C15	330p	331 DISC or (mono)	
C1	.012u	123 film	
C5	.012u	123 film	
C21	100p	101 DISC	
C9	22u/16V	22/16 Alum	
C13	100u/16	100/16 Alum	
U1/3	socket	8 pin	
paddle	jack	stereo	
phone	jack	stereo	

NOTES:

Be sure to correctly identify the Zener, D8. It looks like the other glass diodes, but is loose in the parts bag. The 1N4148 diodes are taped together.

R2 and R11 are 1% resistors, so have four color bands for the value, instead of three for the 5% resistors. They also have a blue body color, instead of tan.

C9, C13 The long lead is +, neg lead side marked with black strip on body of cap.

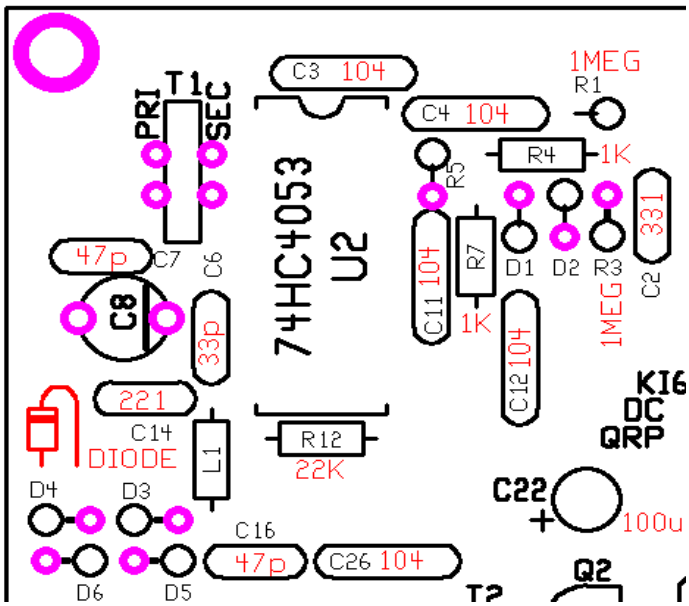
Do not install the ICs into the sockets until after the initial smoke test.

Smoke Test:

Connect the positive lead of a 12V power source to the hole marked “+P”. Connect the negative lead to the hole marked “G”. It is a good idea to use the wire that will be used for final hookup here. Access to the power pads is difficult after all parts are installed. Apply power to the board. Using a voltmeter, verify there is about 5 volts between pins 4 (ground) and pin 8 (+V) on U3. If this tests good, remove power and insert U3, the ATTINY11 keyer chip and U1, the 4456 op amp. Insert a pair of headphones into the phones jack, and a paddle or straight key into the paddle jack. Restore power to the board. Using the paddle or straight key, you should hear the side tone in the

headphones. If you don't hear the side tone, check to see if there is about 5 volts on pins 1,2,3,5,6 and 7 on the op amp U1. Pin 4 is ground, 0 volts, and pin 8 is supply, about 12V.

Group 2: Receiver front end:



NOTES:

C8: the flat side of the trimmer goes towards the line on the outline.

Diodes D1-5 These parts are installed vertically. Note the diagram in red above, showing the way the cathode lead (the end marked with a black band) is bent over and installed into the hole opposite the one marked with a circle.

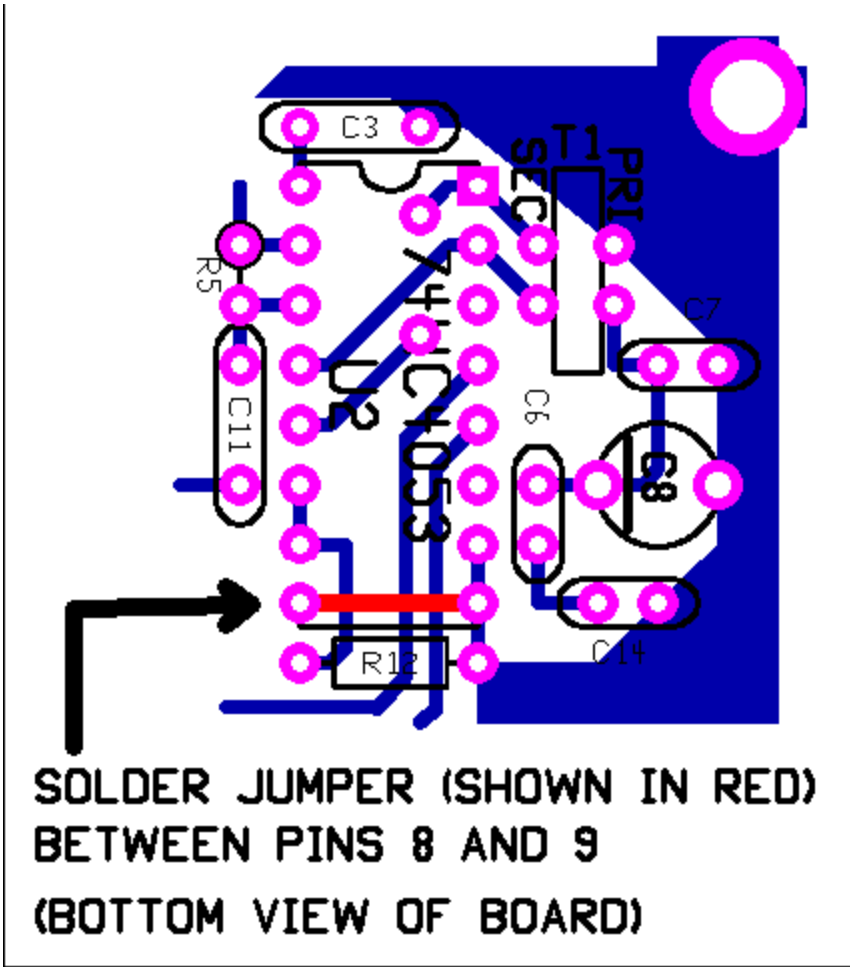
T1: Wind 32 turns of the red magnet wire on the red core (T37-2). This is the primary. Wind 8 turns of the green magnet wire in the space between the start and finish of the primary winding. You can over lap these turns if there isn't enough room to make a single layer.

location	*value*	*markings*	√
R1	1 MEG	BRN/BLK/GRN	
R3	1 MEG	BRN/BLK/GRN	
R4	1K	BRN/BLK/RED	
R5, R7	1K	BRN/BLK/RED	
R12	22K	RED/RED/ORG	
L1	12uHy	BRN/RED/BLK	
C2	330p	331 DISC	
C3	.1u	104 mono	
C4	.1u	104 mono	
C11	.1u	104 mono	
C12	.1u	104 mono	
C26	.1u	104 mono	
C7	47p	47 DISC	
C16	33p	33 DISC	
C14	220p	221 DISC	
C16	47p	47 DISC	
C8	40p	Yellow trimmer	
C22	100u/16V	Alum Electro	
D1/6	1N4148	See notes	
T1	32T / 8T	See notes	
U2		74HC4053	

Trim back the leads to about 1/8” and tin. Tinning can be done with a **HOT** soldering iron, it helps to have a blob of solder on the tip when you do this. Or, you can burn the insulation off with a lighter or match and clean with some fine grit emery cloth. Insert the two red wire leads into the holes labeled “PRI” on the diagram (the two holes to the left) and the two green wires into the holes labeled “SEC” (the holes on the right). Note that one of the green and red wires will have to cross over the outside of the core, so that both red and both green wires are on the same side of the core.

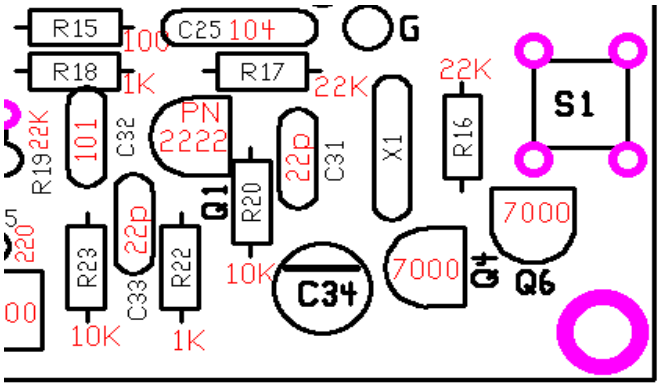
U2: A socket is not used with this IC, solder directly to board.

Missing ground fix:
Pin 9 of U2 was mistakenly left floating on the final board layout. This pin needs to be grounded in order for the mixer to work. After U2 is soldered onto the board, simply use a resistor or diode lead clipping and solder between pin 9 and pin 8 of U2. See below:



Smoke test: There is no test for this group, move onto the next group.

Group 3: Oscillator:



location	*value*	*markings*	√
R15	100 ohm	BRN/BLK/BRN	
R18	1K	BRN/BLK/RED	
R22	1K	BRN/BLK/RED	
R20	10K	BRN/BLK/ORG	
R23	10K	BRN/BLK/ORG	
R16	22K	RED/RED/ORG	
R17	22K	RED/RED/ORG	
C31	22p	22 DISC	
C33	22p	22 DISC	
C32	100p	101 DISC	
C25	.1u	104 mono	
C34	40p	Yellow trimmer	
Q1	PN2222 A	NPN	
Q4	2N7000	mosfet	
Q6	2N7000	mosfet	
X1	7.040M	Crystal	
S1	TACT	PB SWITCH	

NOTE:
Q4/Q6 are mosfets and can be damaged by static. Those who live in dry areas and prone to static problems need to take precautions before handling. This can simply be to touch a large metal object to discharge yourself.

C34: The flat side of the trimmer goes towards line on layout diagram.

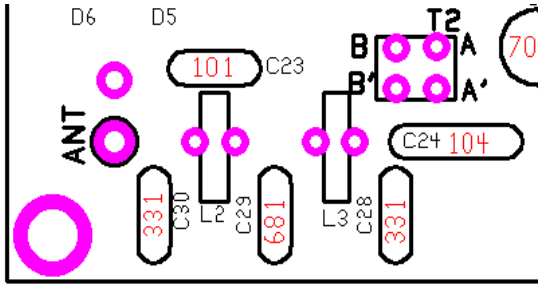
S1: You may want to mount the switch on the bottom of the board. If you are going to mount the rig into an Altoids tin, you won't have to open the lid to access the switch. If you mount the rig into some other kind of enclosure, mounting the switch on the bottom may be the only practical way of accessing it.

Smoke Test:

Connect a test lead antenna to a rig which tunes 40M. Tune the receiver to 7.039000 MHz. Place the test lead antenna near the board. Apply power. Tune the receiver around a little until you hear the boards crystal oscillator. Remove power and connect a paddle or straight key to the paddle jack and a pair of headphones to the phones jack. Re-apply power to the board. If your using a paddle, click the S1 switch and you should hear the letter “S” in the headphones. This is the keyer speed adjust. Shortly after you hear the “S”, you should hear an “I”. This indicates the speed adjust mode has been exited. Now click and hold closed the switch until you hear the letter “T”. The keyer is now in Tune mode. Tapping the DOT paddle will put the rig into transmit mode. It will remain so until you tap the DASH 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.

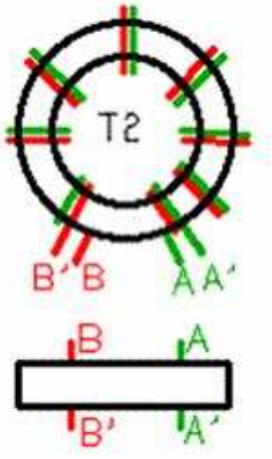
Now you can set the C34 trimmer for the proper T/R offset. Put the keyer back in Tune mode, so you can toggle the oscillator between the receive and transmit frequencies. With the board in receive mode, determine the frequency of the oscillator, either with a frequency counter or with your station receiver. Toggle the board into transmit mode and adjust the C34 trimmer so the oscillator is now 600 Hz higher in frequency than it was when in receive mode.

Group 4: Low pass filter



location	*value*	*markings*	√
C23	100p	101 DISC	
C30	330p	331 DISC	
C29	680p	681 DISC	
C28	330p	331 DISC	
C24	.1uF	104 mono	
T2	Black core	See notes	
L2, 1.3uH	18 turns	Red T37-2 core	
L3, 1.0uH	16 turns	Red T37-2 core	

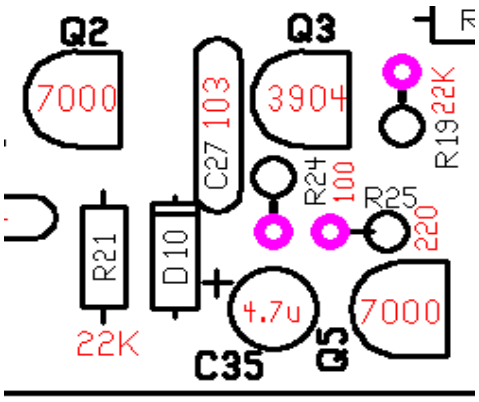
When winding the toroid cores, remember that one pass of wire through the center of the core is one turn. Also try to keep the wire snug to the outside of the core. The picture below shows 8 windings, you will only wind 6.



T2 is a bifilar wound transformer. This simply means we wind two wires on the core. Two colors of wire are used to help identify which is which. You can twist the wires together, or simply lay them side by side as you wind the turns. **Wind 6 turns** of the wire pair. When you are done, there will be a red/green pair at the start and finish of the windings. Reverse the red and green wires on one side of the core, so that both ends of the red and green wires are opposite each other on the core, as shown in the bottom diagram. Now trim back the leads and tin them. Insert the wires into the board, with the red wires in the B holes and the green wires in the A holes, then solder into place.

Smoke Test.
The receiver section is now complete. You can connect an antenna (or some wire) to the antenna pad and see if you can hear any stations or your station transmitter (using a dummy load, of course) Note: You may hear some noise “whoosh” by. This is from the oscillator in the keyer chip. The chip uses an R/C clock which is temperature sensitive and so wanders around a little.

Group 5: Transmitter driver and PA



location	*value*	*markings*	√
R21	22K	RED/RED/ORG	
R19	22K	RED/RED/ORG	
R24	100 ohm	BRN/BLK/BRN	
R25	220 ohm	RED/RED/BRN	
C27	.01uF	103 (blue)	
D10	1N4148 or 1N914A		
Q3	2N3904	NPN	
Q2	2N7000		
Q5	2N7000		
C35	4.7u/16V	4.7/16	

NOTE: Q3 maybe supplied as a PN2222A

Smoke Test:

All the parts should now be on the board.

If you have been testing along the way, the only thing left is to see it the transmitter section is putting out power. If at all possible, connect up a QRP power meter and dummy load to the rig. Apply power to the rig and put the keyer into tune mode. Tap the Dash paddle to turn the transmitter on and see how much power is being produced. Depending on the supply voltage your using, power out should be between 700 mw and 1.2 watts. Power output can vary depending on how the wire on the low pass output filter cores (L2 + L3) are spaced. Try moving the wire around the core to make the turns closer together or farther apart and see how this affects the power out. However, if your powering the rig with a 13.8V supply, don't exceed about 1 watt out, or the PA FET will start to get hot!

If you pass this test, time to hook up the antenna and try to make some contacts! Good luck!

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 flows into the hole. It’s also possible to have solder on the circuit board pad, but it didn't flow around the lead.

The second most common error is mis-placed parts. You may have mis-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.

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. They could be on your transmit frequency of 7.040000 or down at 7.038800. 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 three keyer functions, speed, tune mode and iambic A/B selection. Clicking and holding closed the switch for various lengths of time will access these functions.

Changing code speed.

Keying speed can be selected from about 7 to 30 wpm, in 1 wpm steps.
Momentarily click the switch closed until the letter “S” is heard. Tapping the Dash paddle increases the speed and tapping the Dot paddle decreases speed. A dot will sound at each code step. The letter “I” will sound when the upper or lower speed limit is reached. Code speed mode will automatically exit if neither paddle is closed for about 1 second.

Tune mode.

This mode allows you to toggle the transmitter on and off, using the paddles. This frees up both hands to fiddle with an antenna tuner. To access Tune mode, click and hold closed the switch until the letter “T” sounds. Tapping the Dash paddle will toggle the transmitter on and tapping the Dot paddle will toggle it off. To exit tune mode, click the switch again.

Iambic A/B mode.

The keyer used iambic B mode as default. This can be changed to A mode by clicking and holding closed the switch until the letter “A” sounds (about 2 seconds). This change isn't remembered by the keyer chip, so has to be changed each time power is cycled. In either A ir B mode, holding closed both paddle will produce alternating dots and dashes. In B mode, an extra dot or dash is added to the end of the string, provided the paddles are not released before the end of the inter element space.

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.

How it works:

Receiver:

Signals from the antenna first travel through the transmitters low pass filter. It then enters a series tuned circuit comprised of L1 and C14 and is resonate at 7 MHz. During transmit, a pair of back to back diodes limits the amplitude of the signal at the junction of L1 and C14 to about 1.2 volts peak to peak. This protects the mixer from damaging voltages. A capacitive matching divider couples the output of the series L/C network into the parallel tuned receiver input circuit.

The tuned input circuit then couples the signal into the receiver mixer, through a secondary turn on the 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. 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. Note that there is no bias voltage on the analog switches. Biasing the switches to ½ the supply voltage would improve the mixers' dynamic range, but was found to be not necessary. Any signal strong enough to overload the mixer without bias, would “blow your ears off”.

A high gain, differential input audio amplifier is connected to the mixer’s 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 though another analog switch, again without bias, for audio muting during transmit. The signal then goes into an audio bandpass 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 ohm resistor helps keeping the amplifier stable when driving the relatively low impedance of headphones 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.

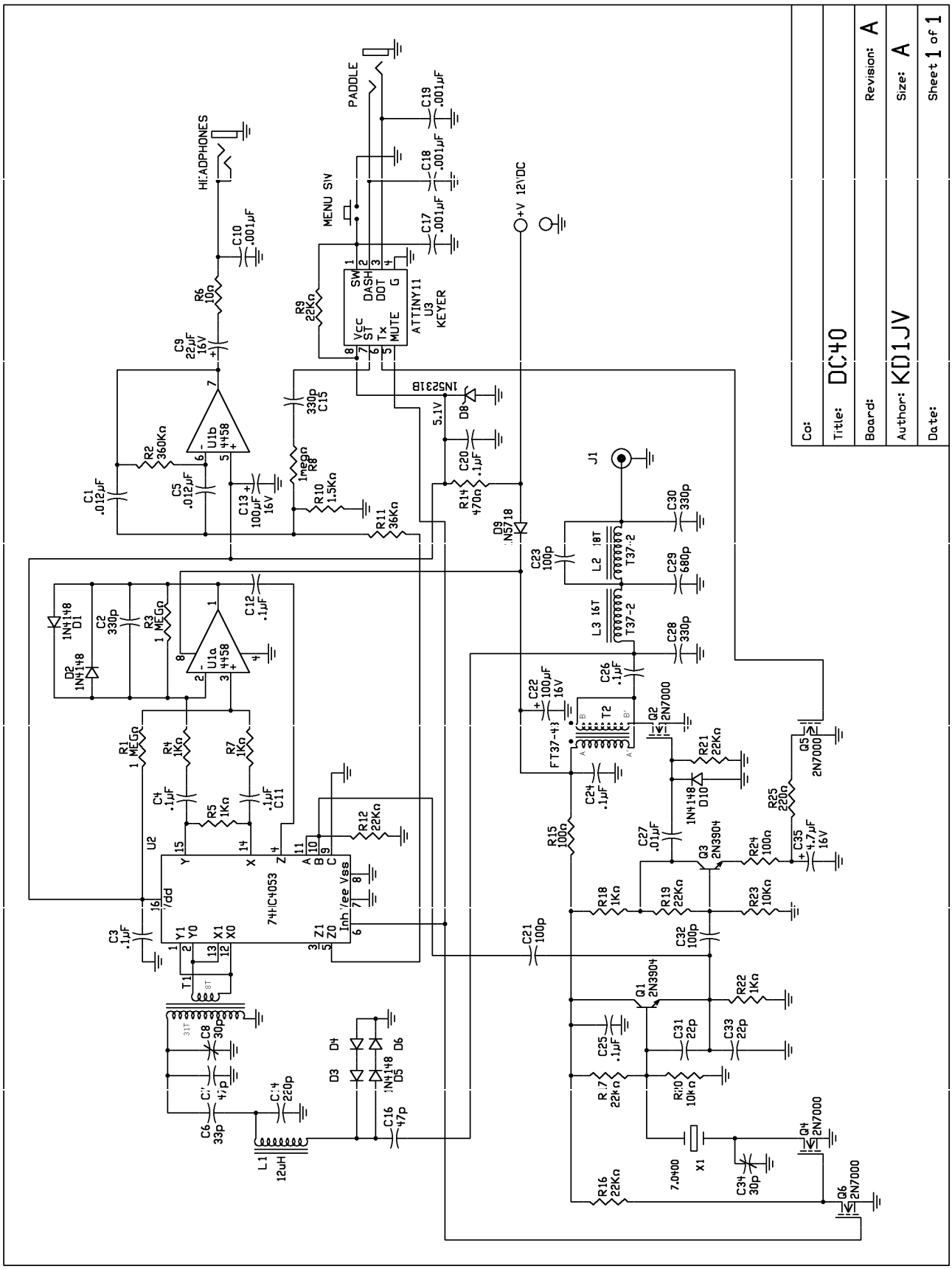
Oscillator and transmitter.

A classic Colpitts crystal oscillator provides the Local Oscillator. During receive, Q4 is turned on, which disables any effect C34 has on the oscillator frequency. During transmit, Q4 is turned off, allowing C34 to increase the oscillator frequency. C34 is used to set the transmit frequency about 600 Hz higher than the receive 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.

Q3 buffers and amplifies the LO output signal in order to drive the PA. This stage is turned on an off by the keyer chip, with the help of Q5. R23 and R25, in combination with C35 form an R/C time constant which causes the output of Q3 to ramp on and off in about 5 ms. This provides wave shaping to the output signal, to eliminate key clicks.

The output of Q3 in turn drives the PA stage, a 2N7000 MOSFET. Diode D10 across the gate acts to double the drive voltage by charging the coupling cap, C27 on negative cycles. This ensures there is enough drive voltage to turn Q2 reasonably well on. The output of the PA, Q2 is coupled to the low pass filter through a bifilar wound transformer. This provides some impedance matching and increase power output and efficiency. Capacitor C23 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.

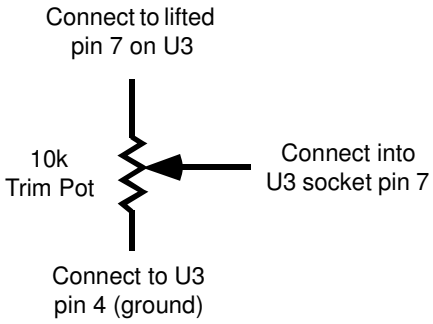
A simple 5.1 volt zener diode is used to supply the required voltage for the keyer chip and Mixer. It also is used as a bias voltage on the audio amplifier op amp.

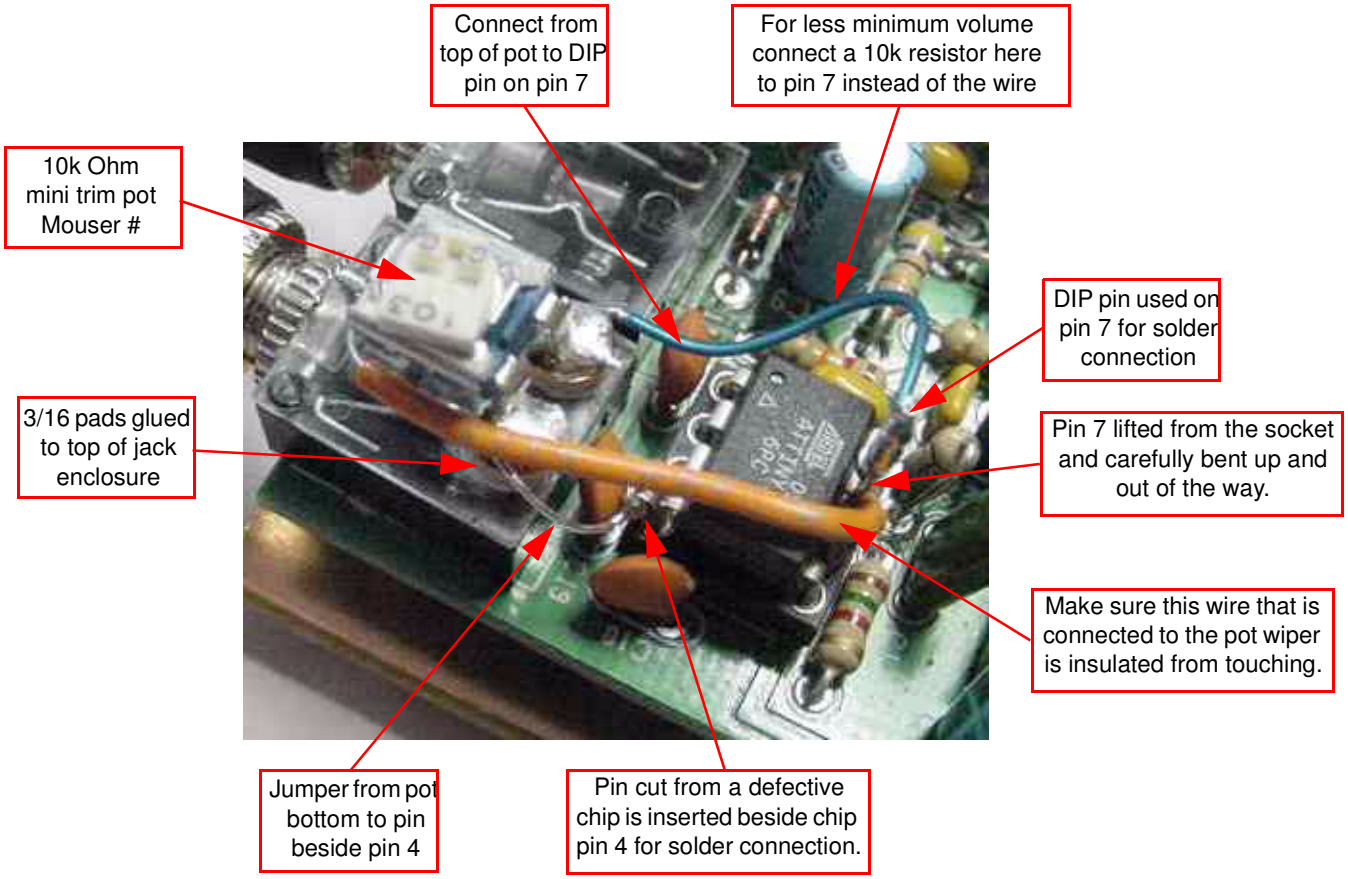

Co:
Title: DC40
Board:
Revision: A
Author: KD1JV
Size: A
Date:
Sheet 1 of 1
HEADPHONES
PADDLE
MENU SW
+V 12VDC
ATTINY11
U3
KEYER
SW
DASH
DOT
G
VCC
ST
Tx
MUTE
U1a
U1b
4458
74HC4053
FT37-43
T37-2
T1
T2
J1
X1
7.0400
1N5231B
1N4148
2N7000
2N3904

DC40 sidetone volume, when used with an audio amplifier is more than adequate for comfortable listening. This paper describes a simple modification that provides a useful sidetone volume control.

The modification does not require any changes in the way of cuts and jumpers or any soldering directly to the keyer chip.

You can do the mod many ways. The pot resistance value is not critical but should be 10k Ohms or greater.





DC40 with Simple VXO Modification

Chuck Carpenter, W5USJ 26 Feb '06

My DC40 is now fitted with a simple VXO consisting of a trimmer in series with the crystal. The trimmer is about 8 to 50 pF (Mouser 24AA084). With a 7030 crystal, the total tuning range is 7028.9 to 7033.9 kHz. However the output power, observed on my FS meter, drops off at the lower capacitance range. Power out stayed constant to about 7031 kHz, about 3/4 of the tuning range. Tuning is not linear and changes at a faster rate as you tune toward minimum capacitance. Figure 1 shows An L-shaped support fashioned from a piece of PCB. Any good 1/16 thick insulator would do. Manhattan pads are used to mount the VXO parts.

I used a 6/32 screw to thread-form the corner holes and mounted the L support with a 3/8 spacer and a 1 in 6/32 screw. Don't use thread cutting screws. They will remove the copper from the plated through hole. Three 3/16 Manhattan pads can be super- glued to the support spaced center to center about the same as the crystal and trimmer lead spacing (.2 in). One near the outside board edge will be the common side. That side is also the crystal common side on the board - Figures 2 and 3.

DIP pins are soldered to the two inside pads for a crystal socket. You could leave 3 pins in the plastic and cut off the middle one. Leads from the board DIP pins are soldered to the two outside pads. I used clipped-off component leads.The capacitor is soldered from the middle pad to the outside ground pad. The rotor on the capacitor should be soldered to the ground side to minimize tool effects.

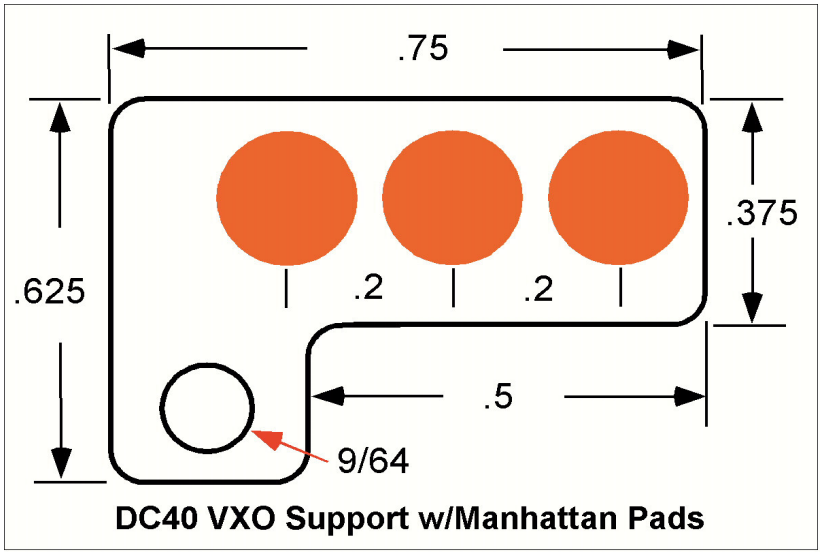


Figure 1. Suggested VXO support using PCB or other insulator

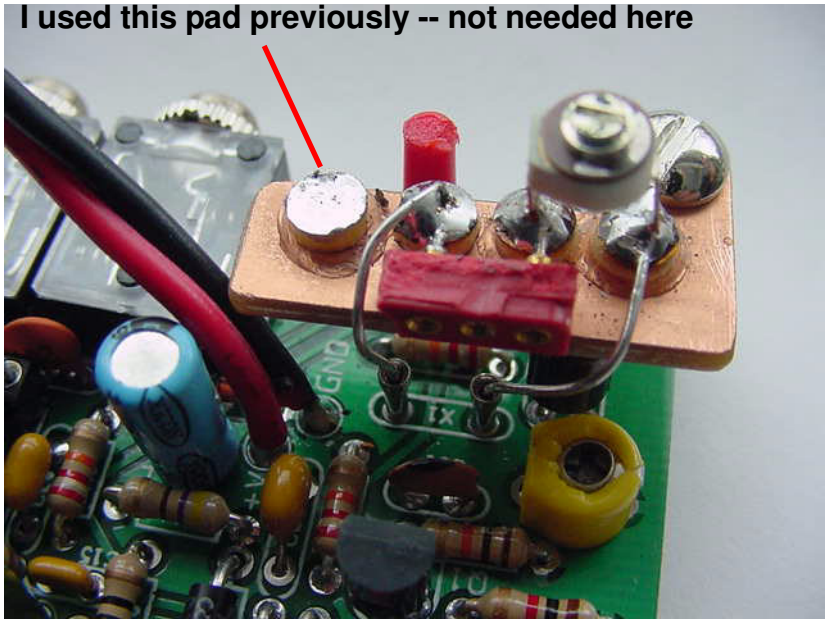


Figure 2. Note use of DIP pins at X1 used as a crystal socket. Also the 3-pin section of DIP pins used on the VXO Supprot.

Keeping within the range where the power output stays constant, the offset, as close as I can measure, is 547 to 686 Hz.

That's with the offset trimmer set to maximum. Less trimmer capacitance puts the offset too far off the filter CF.

That difference in offset and filter CF shouldn't be much of a problem. The audio filter is not too sharp.

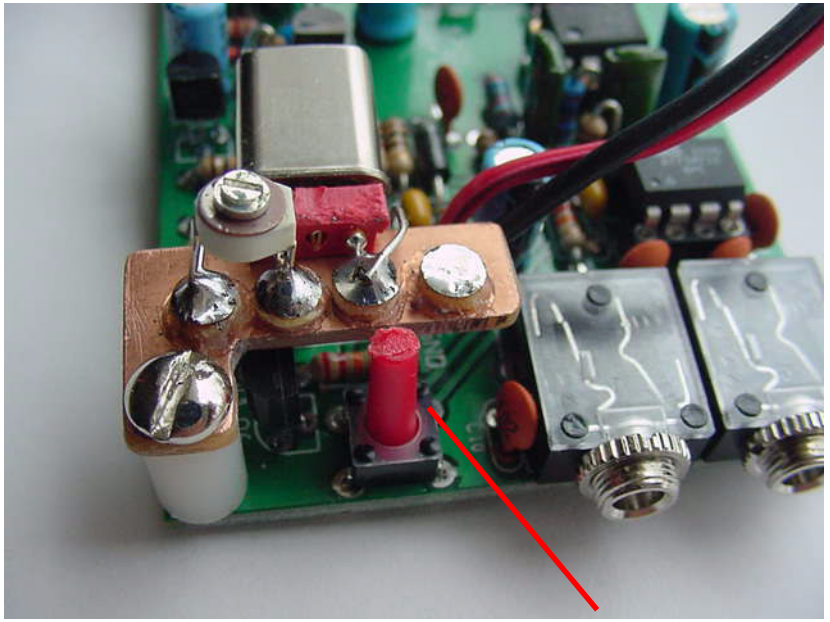
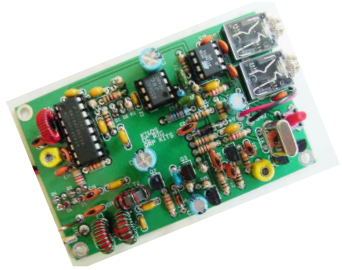


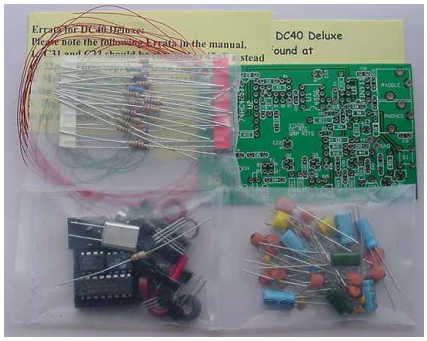
Figure 3. Mounting View. (Singed button not supplied in kit -- results of hooking up power leads after all parts were installed.)

DC40 Deluxe Transceiver



A new 40 meter transceiver from KD1JV and Hendricks QRP Kits.
Features and functions include:

- High immunity to SWBCI interference
- Keyer with iambic mode or straight key mode and sidetone.
- Muting and T/R control
- Tune mode simulating keydown.
- Audio filter centered on 600Hz
- Power output 750mW to 1 Watt



DC40 Kit Contents

Unpacking and Inventory

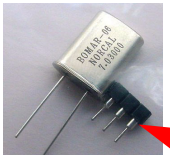
Packaging for the DC40 includes an over-pack for the groups of components. Resistors and capacitors are in individual packs as are the remaining parts. Lengths of wire in two colors for winding toroids are provided. Inventory the parts and check them off on the parts list.

Plan ahead before starting your assembly to allow experimenting later. Install DIP/SIP pins and sockets at key component locations. Experiment with different parts in the PA stage. You may want to add an audio amplifier and so on.

It's a pretty good idea to stuff the board and perform the tests in the sequence outlined in the manual. The functions included in group 1 provide controls for the rest of the sections. If something gets messed up in group 1 all the rest of the groups may not function correctly.

Continue with the remaining assembly groups as described in the DC40 manual.

Note: Initial shipments of kits did not include the SIP crystal socket and 7030 crystal. Contact Hendricks QRP Kits, http;//www.qrpkits.com

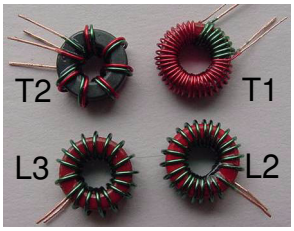


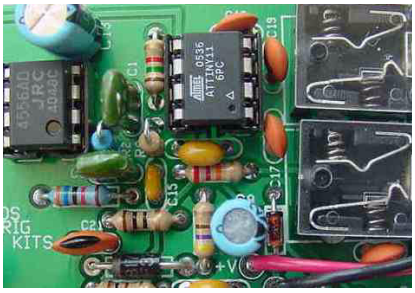
Snip off the middle pin

Winding the Transformers and Coils

Having said that you should stuff the board in the sequence described, I deviated a little.

Toroid winding is described at each point in the manual where the coils are installed. My preference is to prepare all the toroids at the beginning of the assembly process. That way you don't need to stop and start while installing a group of components. Power output testing produced the most power using about 1.2uH for L3 (18t) and 1.7/2.0 for L2 (20/21t).





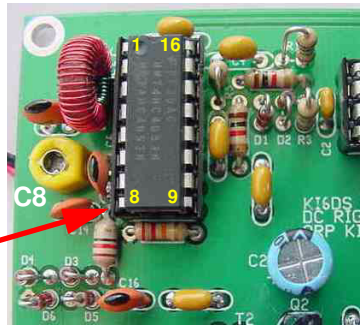
Group 1 Assembly

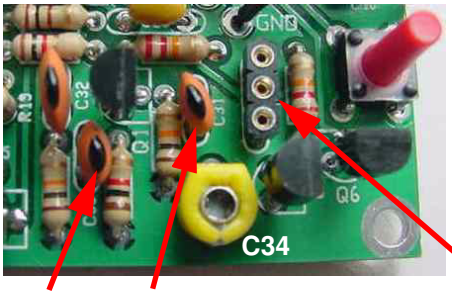
Parts installed here provide the supply voltage and controls for operation of the DC40. In addition to iambic keying, the unique keyer chip (U3) controls muting and T/R functions.

This is probably the most important section of the DC40. If supply voltages are not correct and the muting and T/R functions don't work, the other sections of the rig may not operate. Be sure to perform the smoke test for this group as described in the manual.

Group 2 Assembly

This is the business end of the DC40 receiver. Incoming signals from your antenna are mixed with the oscillator signal. The result is audio fed to the filter stage. The initial shipment of boards were found to have pin 9 of U2 ungrounded. Be sure to solder a jumper from pin 8 to pin 9 as shown in the small picture. A length of clipped component lead does the job. One of the features of the DC40 receiver is immunity to SWBCI. On-the-air use has been positive with no evidence of interference. The mixer is a logic switch called a multiplexer. If there is enough signal input from the antenna and LO to operate the logic circuits, that's all that matters. There will be audio to the audio amp U1a.





C33 and C31 should be 47pF

Group 3 Assembly

After the parts in this group are installed you are ready to check the crystal oscillator and set the 600Hz transmit offset. The procedures to do these operations are described in the manual. Get as close to 600Hz as you can to match the 600Hz audio filter. My FT-847 has a 25Hz filter so a zero beat to the DC40 oscillator will put it fairly close. It will be slightly different between the 7040 and 7030 crystals. If you plan to use both, then average the offset between the two frequencies. You won't be off the filter center frequency enough to make a whole lot of difference.

Note use of SIP (or DIP) pins as a crystal socket

Group 4 Assembly

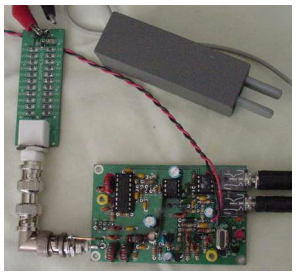
This group includes the Q2 PA output transformer and the parts for the low pass filter. Once these parts are in place, you can test for received signals. After you apply power for this smoke test, you can peak C8 for maximum signal. In the absence of a signal this may be just a peak in the background noise.

Group 5 Assembly

Once you get these parts installed, you're ready for the final smoke test. Anything that my be wrong here has the potential for damaged parts. Carefully check everything again before you apply power. Be sure to follow the instructions in the manual.

Don't be too anxious to do the final test drive. Blowing something now would spoil all the fun.

Power Up and Testing

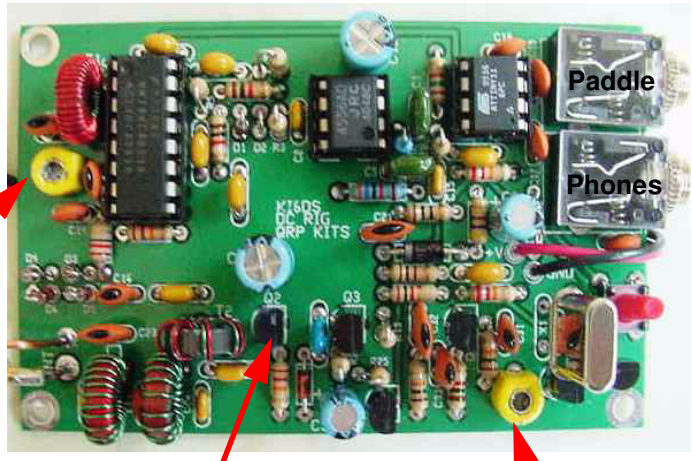


The test setup here includes the NorCal surface mount technology dummy load and the Elecraft XG-1 signal generator. The XG-1 provides a standard S9 50uV signal and a 1uV signal. In the absence of noise, the 1uV signal provided a low level for final peaking of C8.

A BNC jack is connected to the DC40 antenna terminals. To keep it in the picture, an angle adapter is used to connect the DL Power measurements with the NorCal DL used the peak detector output (V_{pk}). Calculations were made using the equation:

$$P_o = ((V_{pk} \times .707) + .15)^2 / R_L$$

My dummy load R measured 49 Ohms. The value .15 is the voltage drop for the schottky diode used in the dummy load peak detector. After adjusting the inductance of L3 and L2, the power output was consistently over 1 Watt.



Peak for max signal strength

You may want a heatsink here.

Adjust for ~600 Hz offset

Final Thoughts

This was a fun little rig to build, test and operate. My usual build process is to start someplace in the middle and work out. Putting this one together in predetermined groups was an interesting change. It worked out quite well, in fact, being able to test and measure things along the way.

Probably the most frequent complaint about the DC40 is the low audio level. Some folks with reduced hearing may have difficulty. A simple LM386 audio amplifier easily takes care of this little deficit.

Making Qs with the DC40 is about what you'd expect from low power and limited frequency agility. The reports are all good so far with no complaints. All in all, another winner in the stable of fun and inexpensive QRP transceivers.