DB4020

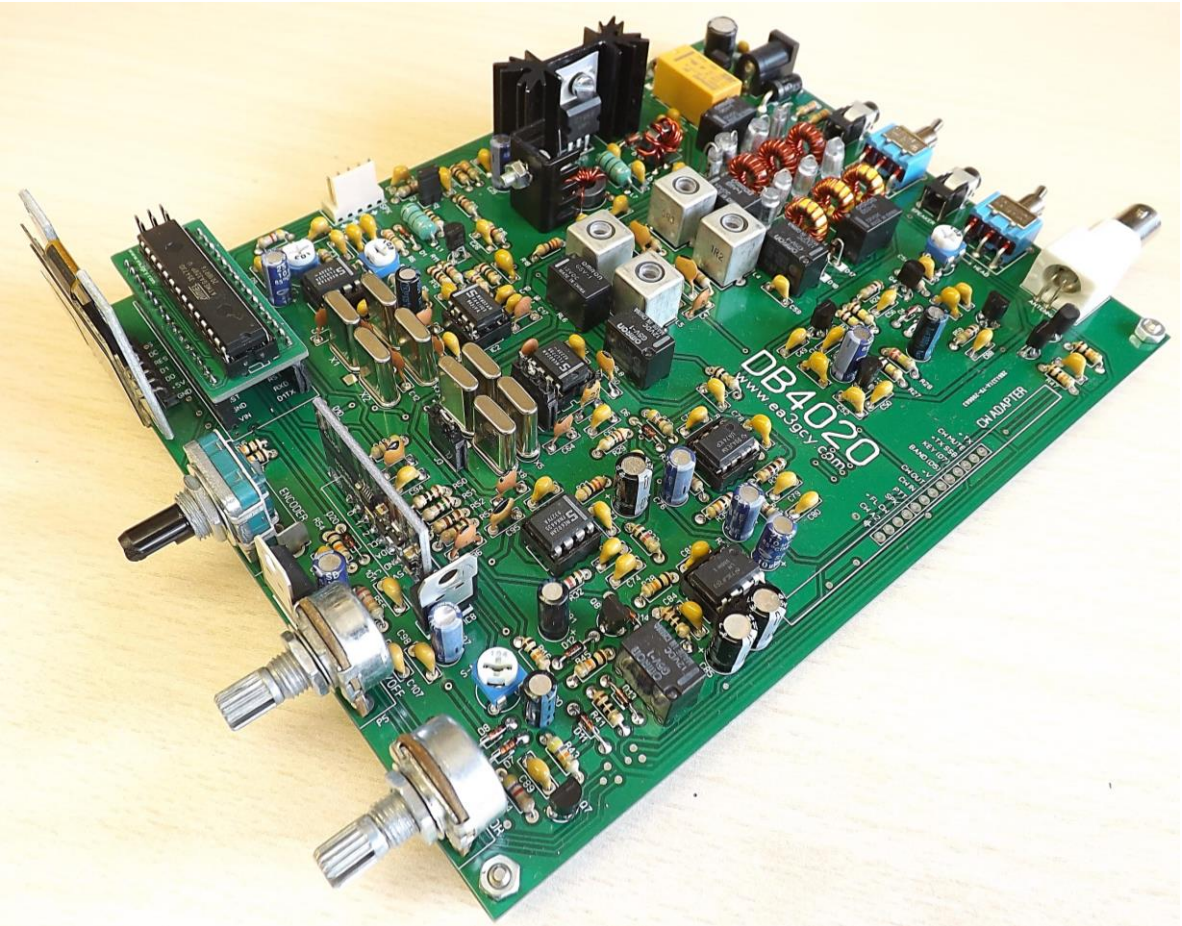
Dual Band 40&20m QRP SSB transceiver KIT

Assembly manual

Last update December 1, 2022

ea3gcy@gmail.com

Latest updates and news in: **www.ea3gcy.com**



Thank you for building the ***DB4020*** Dual Band 40&20M SSB Transceiver kit

Have fun assembling it and enjoy QRP! 73 Javier Solans, ea3gcy

INTRODUCTION

The *DB4020* is a design based on the NE602 integrated circuit used as a receiving SSB mixer and demodulator and SSB generator and transmission mixer.
Band and TX / RX switching, audio mute etc. they are controlled by an Arduino Nano.
The Local Oscillator and BFO are generated by a SI-5351 module that is governed by the Arduino Nano.
Frequency and other performance data is displayed on a 1.3 "OLED screen
The *DB4020* includes functions like Audio Mute, six frequency steps in two ranges, S-Meter and RIT.
There are only three controls: Tuning, Volume and RF attenuator.
In addition to tuning, all the functions of the controller are carried out by means of the rotary encoder with push button (no more keys or push buttons).
The *DB4020* is a single-board design in which all the elements are included.
CW mode is possible by means of a CW Interface module and a pluggable narrow IF filter optional.
The *DB4020* kit uses through-hole components, you can assemble it to your home, without special soldering irons or any professional measuring set.
A quality soldering iron for electronics and good solder and a cutter pliers is all you need.

Note: a good experience on radio assembly is required.
It shouldn't be your first transceiver to build.

There are only three controls: volume and tuning, which are sufficient for enjoying the pleasure of QRP!

SPECIFICATIONS

GENERAL:

Frequency coverage:

- 40m 7.0 – 7.3 MHz
- 20m 14.0 – 14.5 MHz

Note: You can tune a few hundred kHz below and above the bands, but downgrading the characteristics (SW broadcasting can be heard).

Tuning steps on two ranges: 10Hz-100Hz-1kHz and 10kHz-100kHz-1MHz.
Modes: LSB on 40m, USB on 20m (CW optional).
RIT function: without frequency limit
Power requirements: 12 – 14VDC, 1 - 2A transmit, 0.1 – 0.4A receive.
Antenna impedance: 50 ohms nominal.
Controls: Tuning-pushbutton. Volume. RF attenuator.
Board dimensions: 180 x 140 mm.
Weight: (no enclosure): 0.28 kg.

TRANSMITTER:

Emisión: SSB (CW optional).
RF output: 8W on 40m, 3.5W on 20m (13.8V).
2nd harmonic output: -45dBc or better below the fundamental frequency.
Other spurious signals: -50dBc or better below the fundamental frequency.
Carrier suppression: better than -40dBc.
T/R switching: Relays.
Microphone type: Electret condenser (capsule included).

RECEIVER:

Type: Superheterodyne. Balanced mixers.
Sensitivity: 0.2uV minimum discernible signal.
Selectivity: 4-pole crystal ladder filter, 2.4KHz nominal bandwidth (optional narrow CW Filter).
IF frequency: 4.915MHz.
AGC: acts on the receive path according to the received audio.
Audio output: 250mW, 4-8 ohms.

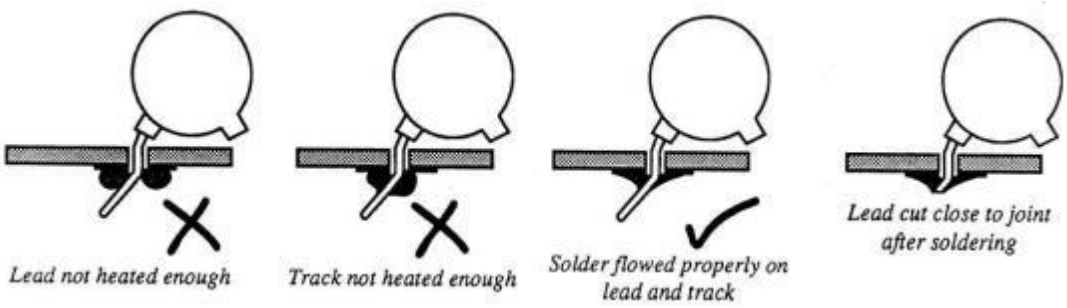
PLEASE READ ALL ASSEMBLY INSTRUCTIONS COMPLETELY AT LEAST ONCE BEFORE YOU BEGIN.

TIPS FOR BUILDERS WITH LITTLE EXPERIENCE

Tools required:
- Fine-tip soldering iron of about 30W, small wire cutters for cutting component leads, wire strippers, long-nose pliers, needle-nose pliers, X-Acto knife, screwdriver for M3 screws, alignment tool for adjusting IF transformers.
- You will need a good light and a magnifying glass to see the fine print on the components and other assembly details.

Instruments required:
- Multimeter, frequency counter or HF receiver, RF power meter, dummy load of about 10W - 50ohms, RF signal generator (desirable but not essential).

Soldering:
There are two essential things to keep in mind to ensure the proper functioning of a kit. The first is to put the component into its proper place on the circuit board, the second is good soldering.



To solder properly, you must use a high-quality solder for electronics and the correct type of soldering iron. Use a small soldering iron that has a fine, pointed tip. The soldering iron should be about 30 watts (if it is not thermostatically controlled). Use only solder intended for electronic soldering; NEVER use extra flux. You should hold the hot soldering iron in contact with both the circuit board and the component lead for about two seconds to heat them up. Then, keeping the soldering iron in place, touch the solder at the junction of the component lead and circuit board trace and wait about two seconds or so until the solder flows between the lead and the trace to form a good joint. Now remove the soldering iron. The soldering iron should have been in contact with the joint for a total time of about 4 seconds. After soldering each joint, you should clean the soldering tip, removing any excess solder. This prevents mixing in old solder and residues from previous soldering operations.

Finding the correct component:
IC's
The component outline for the IC printed on the circuit board has a "U" shaped notch on one end, indicating the end at which pin 1 of the IC is located. There is a similar notch on one end of the IC socket that should be oriented over the "U" printed on the circuit board. Finally, pin 1 of the IC is also marked with a small dimple or dot; this end of the IC should be oriented towards the notch in the IC socket or the "U" of the component outline.

Diodes
Be careful to observe the correct polarity of the diodes. There is a dark-colored band towards one end of the diode. This band should be oriented towards the line printed on the component outline of the circuit board.

Electrolytic capacitors:
These must be placed with the correct polarity. The positive lead (+) is always the long lead. The negative terminal (-) is the short lead and is marked by a stripe on the body of the capacitor. Make sure that the positive lead of the capacitor goes through the hole marked with a "+" on the circuit board.

Toroids:
You may find it convenient to wind and prepare all the toroids before beginning to mount the components. That way you won't have to stop and possibly lose concentration while winding them.
This is the part of the construction that some consider to be the most difficult. I personally find it to be one of the easiest stages, and it can even be relaxing. Look for the most appropriate moment to do it, and most importantly, take your time. The drawings, photos and instructions in the manual will illustrate and make the process easier.

LIST OF COMPONENTS BY VALUE/QUANTITY

Resistor list				
Qty	Value	Checked	Ref.	Identified
2	1Ω		R39, R58	brown-black-gold
3	10Ω		R40,R41,R50	brown-black-black
7	22Ω		R6,R8,R18,R29,R31,R60,R61	red-red-black
6	100Ω		R10,R12,R13,R15,R37,R52	brown-black-brown
2	150Ω		R51,R53	brown-green-brown
2	330Ω		R17, R20	orange-orange-brown
5	470Ω		R1,R7,R30,R42,R49	yellow-violet-brown
7	1K		R11,R14,R22,R24,R32,R33,R59	brown-black-red
2	1K5		R19, R44	brown-green-red
3	4K7		R5, R9, R21	yellow-violet-red
11	10K		R4, R34, R35, R38, R45, R46, R47, R48, R54, R56, R57	brown-black-orange
1	22K		R55	red-red-orange
2	47K		R2, R3	yellow-violet-orange
5	100K		R23, R25, R26, R27, R43	brown-black-yellow
1	220K		R36	red-red-yellow
1	1M		R28	brown-black-green
3	10K		P1, P2, P4 adjustable trimmer	103
1	100K		P6 adjustable trimmer	104
1	1K		P3 potentiometer 1K	B1K
1	10K		P5 potentiometer 10K	B10K
1	Encoder		Rotary Encoder PEC16-2015F	--

Capacitors list				
Qty	Value	Checked	Ref.	Identified
8	1n		C2,C5,C18,C20,C21,C22,C55,C78	102 or 0.001
3	10n		C27,C30,C81	103 or 0.01
43	100n		C6,C8,C9,C15,C16,C19,C23,C24,C28,C29,C31,C32,C33, C34,C49,C50,C52,C53,C54,C56,C58,C59,C61,C63,C69,C70 C72,C73,C74,C75,C79,C80,C84,C86,C88,C89,C92,C94,C98, C99,C100,C101,C107	104 or 0.1
2	470n		C1,C3	474 or 0.47
1	1p5		C96	1P5 or 1.5
2	8p2		C44,C47	8P2 or 8.2
1	15p		C93	15P or 15J
2	22p		C60, C111	22P or 22J
7	33p		C10,C11,C12,C13,C14,C64,C68	33P or 33J
5	82p		C43,C45,C46,C48,C95	82P or 82J
2	220p		C17,C62	n22 or 221 or 220
2	180p		C39,C42 Polystyrene	180
2	270p		C35,C38 Polystyrene	270
2	390p		C40,C41 Polystyrene	390
2	680p		C36,C37 Polystyrene	680
1	1uf		C4 (elect.)	1uf
1	2u2f		C57 (elect.)	2.2uF
1	4u7f		C90 (elect.)	4.7uf
6	10uf		C7, C25, C51, C82, C97, C102 (elect.)	10uf
1	22uf		C91 (elect.)	22uf
3	100uf		C71, C76, C85 (elect.)	100uf
2	470uF		C77, C83	470uF
1	1000uf		C87 (elect.)	1000uf

Semiconductor list				
Qty	**Type**	**Checked**	**Ref.**	**Identified**
Transistors				
1	P2222		Q1	2222
1	BD135 / C2314 / NTE295		Q2	BD135 / C2314 / NTE295
1	2SC1969 / 2078		Q3	2SC1969 / 2078
5	BC547		Q4, Q7, Q8, Q9, Q11	BC547
2	2N7000		Q5,Q6	2N7000
1	BC557/8		Q10	BC558 or BC558
Integrated circuits				
4	NE602SG		IC1,IC2,IC4,IC5	NE602 or SA602
1	LM386		IC7	LM386
1	UA741		IC6	741
1	78L05		IC3	78L05
1	7805		IC9	7805
1	7809		IC8	7809
1	SI5351		IC10	SI5351
1	DISPLAY OLED 1.3”		IC11	--
1	ATMEGA328P module		IC12	--
Diodes				
15	1N4148		D4,D5,D7,D8,D9,D10,D11,D12,D13,D14,D15, D16, D17,D18,D20	4148
2	Zener 6V2		D1,D6	6V2
1	Zener 1W 47V		D3	47V
1	1N4001/7		D2	4001 or 4007
1	BY255		D19	BY255

Inductor/RF Transformer/Crystal/Relay list				
Qty	**Value**	**Checked**	**Ref.**	**Identified**
2	1u2H		L4,L5	1u2 or 1R2
2	5u3H		L2,L3	5u3 or 5R3
2	100uH		L1,L7	brown black brown
3	T37-2		L9, L10, L11	Red toroid
3	T37-6		L12, L13, L14	Yellow toroid
2	FT37-43		L6, L8	Black toroid
8	4.915MHz.		4.915MHz crystals	4.915 or 4.91
1	12VDPDT Relay		RL1	Huigang HRS2H 12V
7	OMRON G5V-1 12V		RL2,RL3,RL4,RL5,RL6,RL7,RL8	Omron G5V-1 12V

Connectors and Hardware				
Qty	**Value**	**Checked**	**Ref.**	**Identified**
1	BNC socket		BNC PCB socket	--
2	Jack socket		Stereo PCB Jack 3.5mm socket	--
1	Supply socket		Power supply PCB Jack 2.1mm socket	--
2	Switch		SPDT PCB switch toggle	--
2	Female pins		15 pins female sockets strip	--
2	Male pins		15 pins male (to ATMEGA328P module)	--
1	Male pins		5 pin male strippolarized socket	--
6	8 pin IC sockets		8 pins IC sockets	--
1	28 pin IC sockets		28 ìns IC socket (to ATMEGA328P module)	--
11	Male pins strip		4 + 3 + 2 + 2 nopolarizedstrip pins	--
2	45° strip pins		7 pin 45° bent strip (to SI5351 and OLED modules)	--

4	Jumper		Jumpers to J1, J2 and J3, J4 (IF Rx filter jumpers).	--
1	Heatsink		Heatsink to Q3	--
1	Heatsink		Heatsink to Q2	--
2	Mica insulator		Mica insulator to Q2 and Q3	--
1	Plastic washer		Plastic through isolator washer to Q3 screw	--
2	M3x10 screw		10mm M3x10 screw to Q3 and Q2	--
4	M3x4 screws		4mm M3x4 screws	--
6	M3 nuts		M3 nuts	--
2	M3 washer		Metal M3 washer to Q2 and Q3	--
4	M3 spacers		Hex 5mm M3 spacers	--
217	217 cms.		217 cms. 0,5mm enamelled wire	--
1	Microphone		Electret Microphone Capsule	--
1	PCB		DB4020 PCB (printedcircuitboard)	DB4020

LIST OF INDIVIDUAL COMPONENTS

Resistors						
Checked		Ref.	Value	Ident./Comment	Circuit section	Located
		R1	470 Ω	yellow-violet-brown	Microphone input	N-2
		R2	47K	yellow-violet-orange	SSB gen balance	M-2/3
		R3	47K	yellow-violet-orange	SSB gen balance	M-4
		R4	10K	brown-black-orange	Mic supply	N-1
		R5	4K7	yellow-violet-red	Mic. Supply	N-1
		R6	22 Ω	red-red-black	IC1 supply	L-2/3
		R7	470 Ω	yellow-violet-brown	IC1 and IC2 supply	K-1
		R8	22 Ω	red-red-black	IC2 supply	M-4
		R9	4K7	yellow-violet-red	Pre-driver	L-4/5
		R10	100 Ω	brown-black-brown	Pre-driver	K-4/5
		R11	1K	brown-black-red	Pre-driver	L-4
		R12	100 Ω	brown-black-brown	Pre-driver	L-4
		R13	100 Ω	brown-black-brown	Pre-driver	K-2
		R14	1K	brown-black-red	Driver	J-2
		R15	100 Ω	brown-black-brown	Driver	J-1/2
		R16	NO used		Driver	J-3/4
		R17	330 Ω	orange-orange-brown	Driver	J-1/2
		R18	22 Ω	red-red-black	Driver	J-4/5
		R19	1K5	brown-green-red	Output Amp bias	H-3
		R20	330 Ω	orange-orange-brown	Output Amp	G/H-2
		R21	4K7	yellow-violet-red	BPF	H-5
		R22	1K	brow-black-red	BPF	H-7
		R23	100K	brown-black-yellow	AGC	D-10
		R24	1K	brown-black-red	AGC	E-10
		R25	100K	brown-black-yellow	AGC	F-10
		R26	100K	brown-black-yellow	AGC	F-10
		R27	100K	brown-black-yellow	AGC	F-11
		R28	1M	brown-black-green	AGC	F-11
		R29	22 Ω	red-red-black	IC4 supply	L-9
		R30	470 Ω	yellow-violet-brown	IC4 and IC5 supply	K-9/10
		R31	22 Ω	red-red-black	IC5 supply	M-10
		R32	1K	brown-black-red	SSB Dem	N-11
		R33	1K	brown-black-red	Audio preamp	M-11
		R34	10K	brown-black-orange	Audio preamp	K-11
		R35	10K	brown-black-orange	Audio preamp	K-11
		R36	220K	red-red-yellow	Audio preamp	J-11
		R37	100 Ω	brown-black-brown	IC6 supply	J-11/12
		R38	10K	brown-black-orange	Audio Amp	M-12
		R39	1 Ω	brown-black-gold	Audio Amp	L-13
		R40	10 Ω	brown-black-black	Audio Amp	N-13
		R41	10 Ω	brown-black-black	Audio Amp	O-13
		R42	470	yellow-violet-brown	S-Meter	K-12
		R43	100K	brown-black-yellow	S-Meter	P-13
		R44	1K5	brown-green-red	S-Meter	Q-13
		R45	10K	brown-black-orange	Mute	O-12
		R46	10K	brown-black-orange	Mute	P-12
		R47	10K	brown-black-orange	Band switch	D-13/14
		R48	10K	brown-black-orange	Band switch	C-13/14
		R49	470 Ω	yellow-violet-brown	VFO input	O-7
		R50	10 Ω	brown-black-black	BFO input	O-8
		R51	150 Ω	brown-green-brown	BFO input	O-8/9
		R52	100 Ω	brown-black-brown	BFO input	O-9
		R53	150 Ω	brown-green-brown	BFO imput	O-9
		R54	10K	brown-black-orange	Arduino nano	Q-8

		R55	22K	red-red-orange	Arduino nano	Q-9
		R56	10K	brown-black-orange	Rotary encoder	Q-5
		R57	10K	brown-black-orange	Rotary encoder	Q-6
		R58	1 Ω	brown-black-gold	Tx SSB supply	I-9/10
		R59	1K	brown-black-red	CW Tx Mute	D-12
		R60	22 Ω	red-red-black	Headphones Att.	A-5
		R61	22 Ω	red-red-black	Headphones Att.	A-4
		P1	10K	adjustable resistor 103	Mic gain	N-2
		P2	10K	adjustable resistor 103	DSB balance	M-3
		P3	1K	Potentiometer B1K	RX atennuator	R-12/13
		P4	10K	adjustable resistor 103	AGC gain	C-10
		P5	10K	Potentiometer B10K	Volume	R-10/11
		P6	100K	adjustable resistor 104	S-Meter	P-12
		Encoder	--	Rotary Encoder PEC16-4015F	VFO Tune	R-7

Capacitors

Checked		Ref.	Value	Ident./Comment	Circuit section	Located
		C1	470n	474 or 0.4	Microphone input	M-1
		C2	1n	102 or 0.001	Microphone input	M-2
		C3	470n	474 or 0.4	Microphone input	M-2
		C4	1uF	1uF electrolytic	SSB balance	M-4
		C5	1n	102 or 0.001	Microphone supply	L-2
		C6	100n	104 or 0.1	Microphone supply	O-2
		C7	10uF	10uF electrolytic	Microphone supply	O-2
		C8	100n	104 or 0.1	IC1 supply	M-4
		C9	100n	104 or 0.1	IC1 an d IC2 supply	K-1
		C10	33p	33 or 33J	IF xtal filter	O-4
		C11	33p	33 or 33J	IF xtal filter	N-4
		C12	33p	33 or 33J	IF xtal filter	N-6
		C13	33p	33 or 33J	IF xtal filter	M-6
		C14	33p	33 or 33J	IF xtal filter	M-5
		C15	100n	104 or 0.1	TX mix	M-6
		C16	100n	104 or 0.1	IC2 supply	K-5
		C17	220p	n22 or 222 or 221	TX mix	K-6
		C18	1n	102 or 0.001	Pre driver	L-5
		C19	100n	104 or 0.1	Pre driver	K-5
		C20	1n	102 or 0.001	Pre driver	K-4
		C21	1n	102 or 0.001	Driver	G/H-10
		C22	1n	102 or 0.001	Driver	F-5
		C23	100n	104 or 0.1	Driver	J-1
		C24	100n	104 or 0.1	Driver supply	I-1
		C25	10uF	10uF electrolytic	Driver supply	I-2
		C26	NO used		Driver	K-3
		C27	10n	103 or 0.01	Driver	I-4
		C28	100n	104 or 0.1	Output Amp	G/F-3
		C29	100n	104 or 0.1	Output Amp bias	G/F-4
		C30	10n	103 or 0.01	Output Amp	G-1/2
		C31	100n	104 or 0.1	Output Amp	F-4/5
		C32	100n	104 or 0.1	Rx Ant path	D-3
		C33	100n	104 or 0.1	Output Amp supply	E-3
		C34	100n	104 or 0.1	Output Amp supply	H-4
		C35	270p	Polystyrene 270J	40m LPF	C-5
		C36	680p	Polystyrene 680J	40m LPF	D-5
		C37	680p	Polystyrene 680J	40m LPF	D/E-5
		C38	270p	Polystyrene 270J	40m LPF	E-5
		C39	180p	Polystyrene 180J	20m LPF	C-7
		C40	390p	Polystyrene 390J	20m LPF	D-7
		C41	390p	Polystyrene 390J	20m LPF	D/E-7
		C42	180p	Polystyrene 180J	20m LPF	E-7
		C43	82p	82	40m BPF	H-5
		C44	8p2	8p2	40m BPF	H-6
		C45	82p	82	40m BPF	H-5

		C46	82p	82	20m BPF	H-7
		C47	8p2	8p2	20m BPF	H-8
		C48	82p	82	20m BPF	H/I-7
		C49	100n	104 or 0.1	AGC	G-10
		C50	100n	104 or 0.1	AGC supply	G-12
		C51	10uF	10uF electrolytic	AGC supply	G-10/11
		C52	100n	104 or 0.1	AGC supply	H-11
		C53	100n	104 or 0.1	AGC	C-11
		C54	100n	104 or 0.1	AGC	C-10
		C55	1n	102 or 0.001	AGC	D-11
		C56	100n	104 or 0.1	AGC	E-10
		C57	2u2F	2.2uF electrolytic	AGC	E-11
		C58	100n	104 or 0.1	AGC	G-10
		C59	100n	104 or 0.1	AGC	G-8/9
		C60	22p	22	RX Mix	K-8
		C61	100n	104 or 0.1	RX Mix	K-7
		C62	220p	n22 or 222 or 221	RX Mix	L-7
		C63	100n	104 or 0.1	IC4 supply	L-9
		C64	33p	33	IF xtal filter	M-9
		C65	33p	SMD pre-soldered on bottom	IF xtal filter	(M-7)
		C66	33p	SMD pre-soldered on bottom	IF xtal filter	(N-7)
		C67	33p	SMD pre-soldered on bottom	IF xtal filter	(N-8)
		C68	33p	33	IX xtal filter	N-8
		C69	100n	104 or 0.1	SSB Dem	N-9
		C70	100n	104 or 0.1	IC4 and IC5 supply	L-10
		C71	100uF	100uF electrolytic	IC4 and IC5 supply	L/M-10
		C72	100n	104 or 0.1	IC4 and IC5 supply	J-10
		C73	100n	104 or 0.1	IC5 supply	M-10
		C74	100n	104 or 0.1	Audio preamp	M-11/12
		C75	100n	104 or 0.1	Audio preamp	M-11
		C76	100uF	100uF electrolytic	Audio preamp	L-11
		C77	470uF	470uF electrolytic	Audio preamp	K-12
		C78	1n	102 or 0.001	Audio preamp	J-11
		C79	100n	104 or 0.1	S-Meter path	J-12
		C80	100n	104 or 0.1	Audio Amp path	J-12
		C81	10n	103 or 0.01	Audio Amp	L-12
		C82	10uF	10 uFelectrolytic	Audio Amp	K-13
		C83	470uF	470uF electrolytic	Audio Amp	L-14
		C84	100n	104 or 0.1	Audio Amp	M-13
		C85	100uF	100uF electrolytic	Audio Amp out	M-14
		C86	100n	104 or 0.1	Power supply	A-2
		C87	1000uF	1000uF electrolytic	Power supply	B-1
		C88	100n	104 or 0.1	CW Mute	D-12
		C89	100n	104 or 0.1	S-Meter	Q-13
		C90	4u7F	4.7uF electrolytic	S-Meter	P-12/13
		C91	22uF	22uF electrolytic	Mute	O-11/12
		C92	100n	104 or 0.1	Band switch	C-14
		C93	15p	15	VFO input	O-7
		C94	100n	104 or 0.1	BFO input	O-8
		C95	82p	82	RX BFO path	N/O-9
		C96	1p5	1p5	TX BFO path	O-9
		C97	10uF	10uF electrolytic	Arduino nano	Q-11
		C98	100n	104 or 0.1	Arduino nano	Q-11
		C99	100n	104 or 0.1	Arduino nano	Q-8
		C100	100n	104 or 0.1	Si5351	J-9/10
		C101	100n	104 or 0.1	SI5351	Q-9
		C102	10uF	10uF electrolytic	Arduino nano	R-9
		C103	100n	SMD pre-soldered on bottom	Arduino nano	(R-3)
		C104	100n	SMD pre-soldered on bottom	Arduino nano	(R-6)
		C105	100n	SMD pre-soldered on bottom	Arduino nano	(R-7)
		C106	100n	SMD pre-soldered on bottom	Arduino nano	(Q-2)
		C107	100n	104 or 0.1	Arduino nano	Q-11/12
		C108	100n	SMD pre-soldered on bottom	Arduino nano	(P-5)

		C109	100n	SMD pre-soldered on bottom	Arduino nano	(Q-1/2)
		C110	100n	SMD pre-soldered on bottom	Arduino nano	(Q-1/2)
		C111	22p	22 or 22J		L-8/9

Crystals						
Checked		**Ref.**	**Frequency**	**Ident./Comment**	**Circuit section**	**Located**
		X1	4.915 MHz	4.915 or 4.91	TX IF xtal filter	O-4
		X2	4.915 MHz	4.915 or 4.91	TX IF xtal filter	O-6
		X3	4.915 MHz	4.915 or 4.91	TX IF xtal filter	N-6
		X4	4.915 MHz	4.915 or 4.91	TX IF xtal filter	N-4
		X5	4.915 MHz	4.915 or 4.91	RX IF xtal filter	M-8
		X6	4.915 MHz	4.915 or 4.91	RX IF xtal filter	M-7
		X7	4.915 MHz	4.915 or 4.91	RX IF xtal filter	N-7
		X8	4.915 MHz	4.915 or 4.91	RX IF xtal filter	N-9

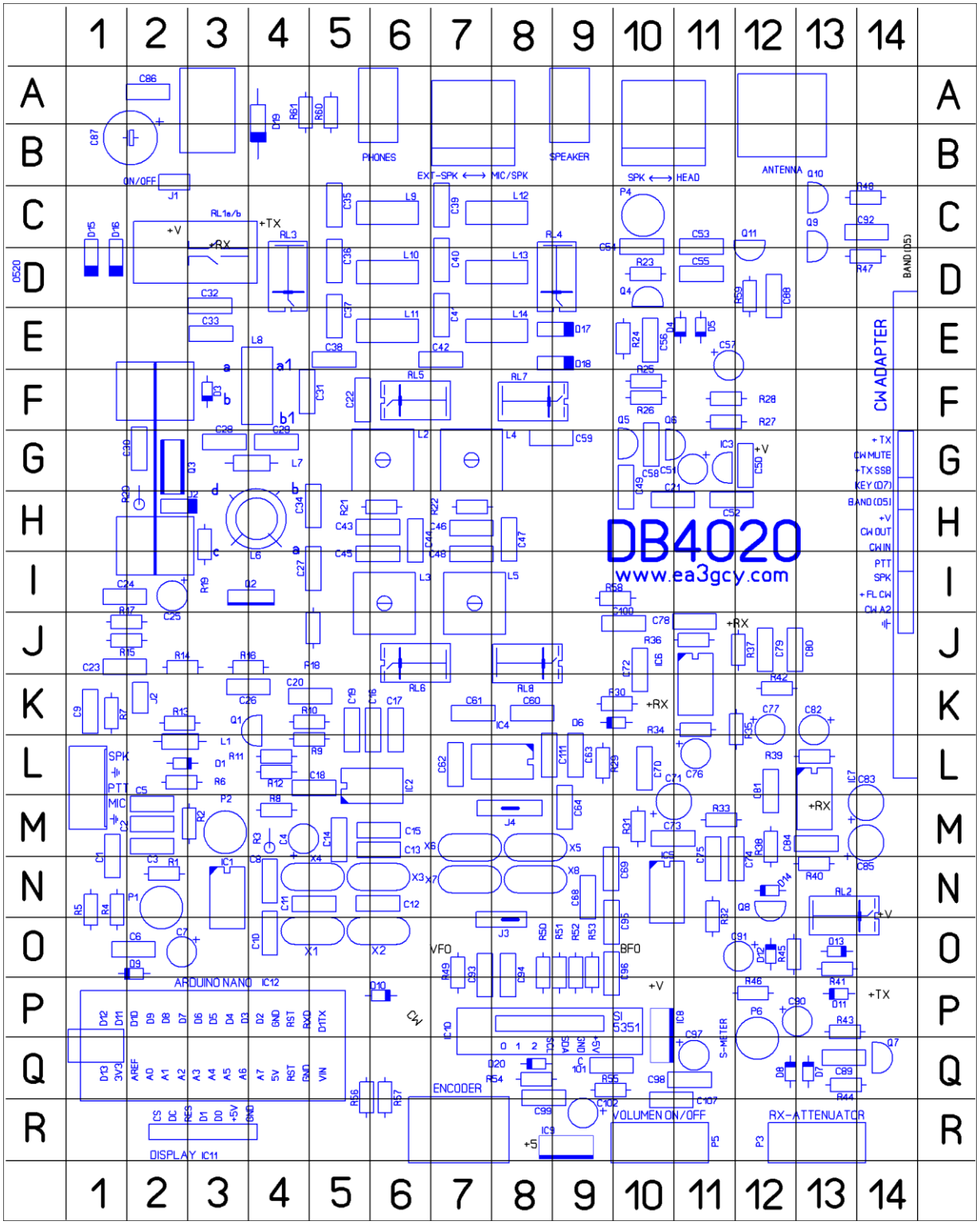
Semiconductors						
Checked		**Ref.**	**Type**	**Ident./Comment**	**Circuitsection**	**Located**
		Transistors				
		Q1	P2222	2222	Pre driver	K-3
		Q2	BD135 / C2314 / NTE295	BD135 / C2314 / NTE295	Driver	I-3/4
		Q3	2SC1969 / 2078	2SC1969 / 2078	PA output TX amp	G-2
		Q4	BC547	BC547	AGC	D-10
		Q5	2N7000	2N7000	AGC	G-10
		Q6	2N7000	2N7000	AGC	G-10
		Q7	BC547	BC547	S-Meter	Q-14
		Q8	BC547	BC547	Mute	N-12
		Q9	BC547	BC547	Band switch	C-13
		Q10	BC557/8	BC557 or BC558	Band switch	B-13
		Q11	BC547	BC547	CW Mute	C-12
		IC's				
		IC1	NE602	NE602 or SA602	SSB Gen	N-3
		IC2	NE602	NE602 or SA602	TX Mix	L-5/6
		IC3	78L05	78L05	AGC supply	G-11
		IC4	NE602	NE602 or SA602	RX Mix	L-7/8
		IC5	NE602	NE602 or SA602	SSB Dem	N-10
		IC6	UA741	741	Audio premp	J/K-11
		IC7	LM386	LM386	Audio Amp	L/M-13
		IC8	7809	7809	Arduino supply	P-10
		IC9	7805	7805	Arduino supply	R-9
		IC10	SI5351 Module	SI5351	SI5351	R-8/9
		IC11	DISPLAY OLED	1.3” display	Display	R2/3
		IC12	ATMEGA328P module	ATMEGA328P	uC processor	P/Q-1/5

		Diodes				
		D1	6V2	6.2V Zener diode	IC1 and IC2 supply	L-2
		D2	1N4001/7	1N400 or 1N4407	Output Amp bias	H-2
		D3	1W47V	47V Zener diode	Output Amp	F-3
		D4	1N4148	4148	AGC	E-10/11
		D5	1N4148	4148	AGC	E-11
		D6	6V2	6.2V Zener diode	IC4 and IC5 supply	K-9/10
		D7	1N4148	4148	S-Meter	Q-13
		D8	1N4148	4148	S-Meter	Q-12
		D9	1N4148	4148	RIT path	O-1/2
		D10	1N4148	4148	Mute	P-5/6
		D11	1N4148	4148	Mute	P-13

		D12	1N4148	4148	Mute	O-12
		D13	1N4148	4148	Relay RL2	O-13
		D14	1N4148	4148	Mute	N-12
		D15	1N4148	4148	PTT path	C/D-1
		D16	1N4148	4148	Relay RL1	C/D-1
		D17	1N4148	4148	Relays 3,4, 5, 6	E-8/9
		D18	1N4148	4148	Relays 7, 8	E-8/9
		D19	BY255	BY255	Power supply protect	A-4
		D20	1N4148	4148	Arduino nano	Q-9

Inductors/RF Transformers/Relay						
Checked		**Ref.**	**Value/Type**	**Ident./Comment**	**Circuit section**	**Located**
		L1	100uH	brown black brown	Pre-driver	L-2/3
		L2	5u3H	5u3 or 5R3	40m BPF	G-6
		L3	5u3H	5u3 or 5R3	40m BPF	I-6
		L4	1u2H	1u2 or 1R2	20m BPF	G-7
		L5	1u2H	1u2 or 1R2	20m BPF	I-7
		L6	FT37-43	Black toroid	Driver output	H-3
		L7	100uH	brown black brown	Output amp bias	G-4
		L8	FT37-43	Black toroid	Output amp out	F-3/4
		L9	T37-2	Red toroid	40m LPF	C-6
		L10	T37-2	Red toroid	40m LPF	D-6
		L11	T37-2	Red toroid	40m LPF	E-6
		L12	T37-6	Yellow toroid	20m LPF	C-8
		L13	T37-6	Yellow toroid	20m LPF	D-8
		L14	T37-6	Yellow toroid	20m LPF	E-8
		Relés				
		RL1	RL1a/b	Huigang HRS2H 12V	Power/ant. relay	C/D-3
		RL2	RL2	Omron G5V-1 12V	Mute	N-13
		RL3	RL3	Omron G5V-1 12V	Band switch	D-4
		RL4	RL4	Omron G5V-1 12V	Band switch	D-8/9
		RL5	RL5	Omron G5V-1 12V	Band switch	F-6
		RL6	RL6	Omron G5V-1 12V	Band switch	J-5
		RL7	RL7	Omron G5V-1 12V	TX / RX path	F-8
		RL8	RL8	Omron G5V-1 12V	TX / RX path	J-8

252-QUADRANT COMPONENT LAYOUT MAP



ASSEMBLY

You can use the “individual parts list” or the “value/quantity parts list.” Using the “value/quantity parts list” is the quickest way to mount components since all the circuit board components of the same value or type can be placed one after the other. However, you will need the “individual parts list” to know how each component is identified and its location on the circuit board. Depending on your personal experience, you may prefer the individual parts list and feel more confident using it.

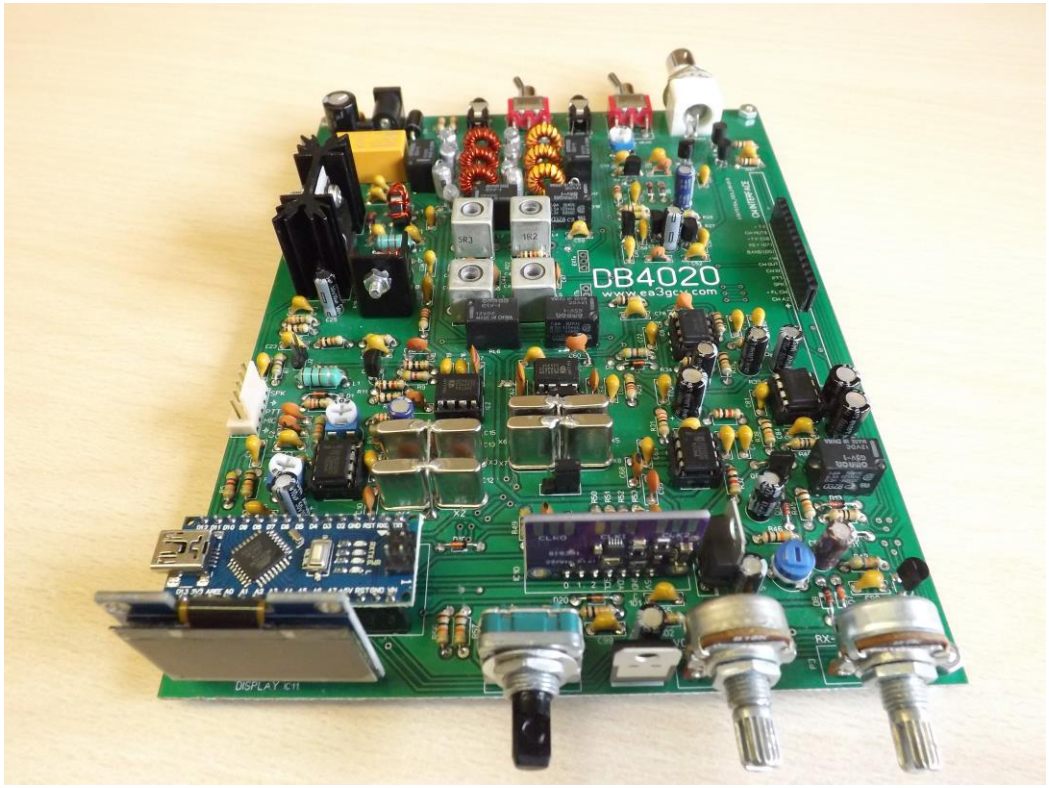
The 252-quadrant component layout map makes it very easy to find the location for all the components. After mounting each component, it can be marked off in the “checked” column.

It is highly recommended that an inventory be taken of all the components to make sure that everything can be located and is ready for assembly. Each builder may have his/her own method of organizing the components. One suggested method is to use a block of Styrofoam packing material and poke the components into it. The components can be sorted by type, value and size (ohms, micro-farads etc.).

RECOMMENDED ASSEMBLY SEQUENCE

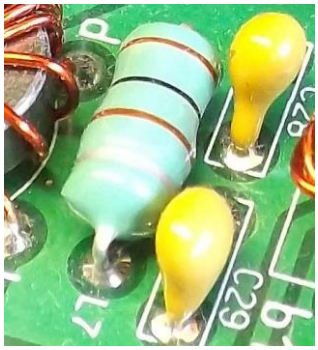
⇨ Resistors

The resistors are installed first. Mount all resistors and trimmers P1, P2, P4 and P6
P3 and P5 are the RF attenuator and volume potentiometers respectively; which should not be installed yet.
Refer to the parts list, and select the first resistor, R1. Bend the leads as close to the component body as possible (otherwise, they will not fit well into the holes), and place them into the appropriate holes according to the component outline printed on the circuit board. Be careful to avoid confusing the resistors with the axial inductors which are a bit thicker.
All of the resistors have a light-colored body and a gold band on one end. Inserting the resistor leads into the holes, push down on the body of the component so that it rests flat on the board, hold it in place, and then slightly bend the leads to keep the resistor in place. Then turn the board over and solder the leads to the printed circuit trace. Make sure that the resistor body lies flat on the board so that its leads are as short as possible. Please read the notes about soldering, as poor soldering is the most common cause for a kit failing to work for the first time. After soldering the component leads, cut off the excess length as close to the joint as possible. Mount the next resistor in the parts list in the same manner and continue until all the resistors are mounted.
The values which are in decade increments can be easily confused, such as 470, 4K7 and 47K, so be sure to verify the colors before soldering the component in place! If you are in doubt, use a multimeter to check the resistance value.



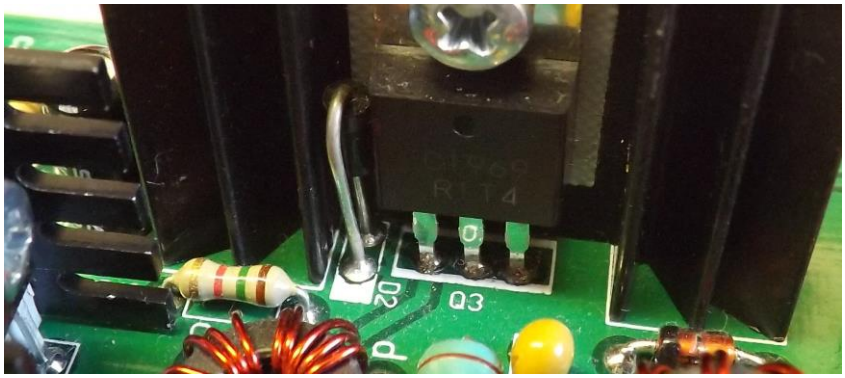
⇨ Axial Inductors

These components look like thick-bodied resistors and the body is colored blue or green. In their interior there is a small coil wound on a ferrite core. There are two axial inductors L1 and L7, refer to the parts list to select the correct component for each location. Mount the inductors in their respective locations, as identified on the circuit board, in the same manner as you did with the resistors.



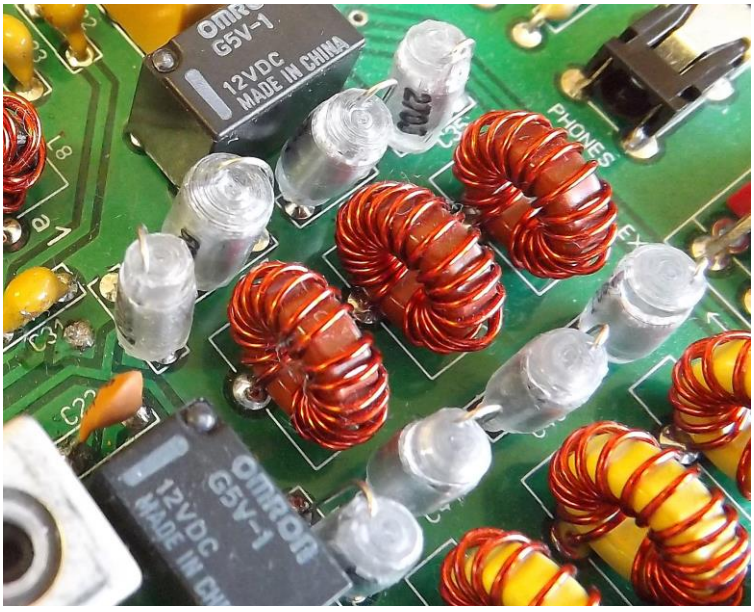
⇨ Diodes

Next mount the diodes, being careful to place them with the correct orientation. There is a dark-colored band on one end of each diode that corresponds to the component outline on the circuit board. There are 15 1N4148 diodes; they are normally orange in color with a black band and they have the type “4148” printed on the body. Note that some diodes are mounted in a vertical position.
D1 and D6 are Zener diodes, similar in size to 1N4148 but are marked 6V2.
D2 is a 1N4001 or 1N4007 diode; it is mounted vertically to the side of Q3. It should be at the same height as Q3 as shown in the image.
D3 is also a Zener diode (thicker than the others); it is marked 47V.
Diode D19 is a BY255, black, much thicker than the others.



⇨ Capacitors

There are ceramic, polystyrene (Styroflex) and electrolytic capacitors. They all have their value printed on the body. Refer to the “identified” column in the parts list.
When you mount them, make sure to leave the leads as short as possible.
C35 through C42 are polystyrene capacitors; these are axial capacitors, but they must be mounted in a vertical position (see image).
The values which are in decade increments can be easily confused, such as 100n and 10n, so be sure to verify the numbers of their value before soldering them in place!
The electrolytic capacitors must be placed with the correct orientation: the LONG LEAD goes in the hole labeled “+” and the SHORT LEAD is "-", indicated by a band containing "-" signs on the side of the capacitor.

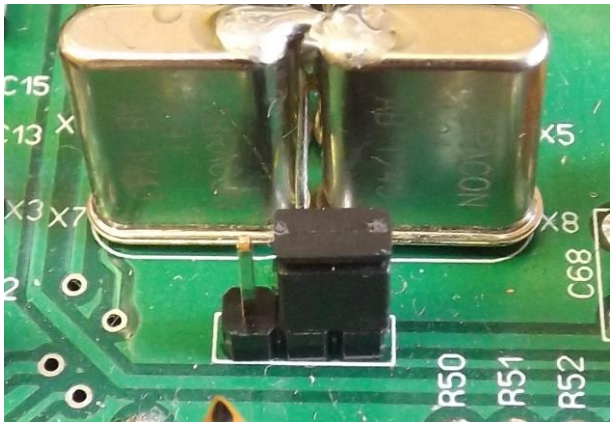


⇨ Pin headers and jumpers

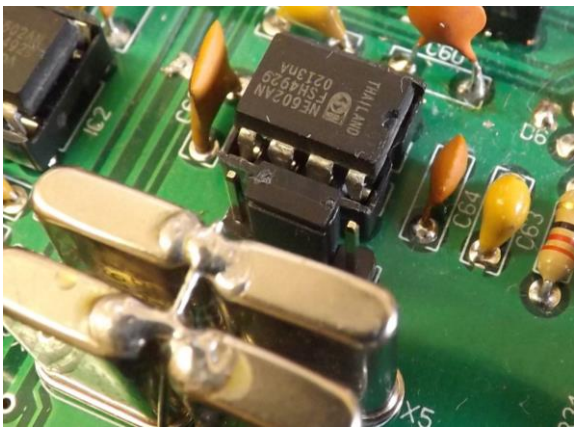
Place and solder the 5-pin header corresponding to the microphone and speaker.
Place and solder the pin headers “J1” and “J2”
Place and solder 4 pins strip on RX IF crystal filter input (if you don't use the CW filter.
Place and solder 3 pins strip on RX IF crystal filter output (if you don't use the CW filter).
Place and solder 2 x female 15 pin strips for the Arduino UNO.
Turn the board over and use one hand to insert and hold the header in place, using a “jumper” placed on the header while you solder the pins to avoid burning your fingers. Use your other hand to hold the soldering iron and move the board towards the solder to solder the headers in place. If you have someone available to help you, it will be much easier!

Place jumpers on the terminals:

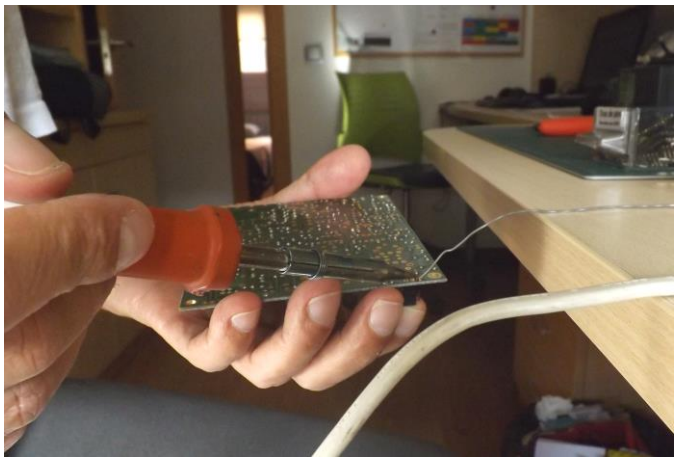
- “**J1**” if you do not use an ON/OFF switch.
- “**J2**” if you do not use the optional CW module.
- “**RX IF Filter jumpers”** if you no use the optional CW Interface and filter (see images)

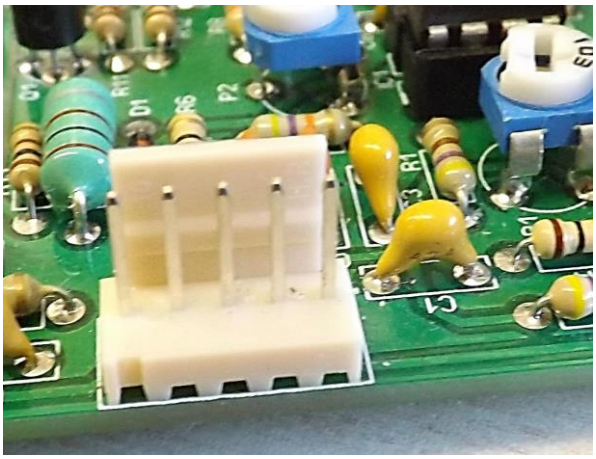


Jumper on RX IF crystal filter input



Jumper on RX IF crystal filter output





⇨ Transistors

All of the transistors have their type printed on the component body. Place them according to the corresponding component outline printed on the circuit board.

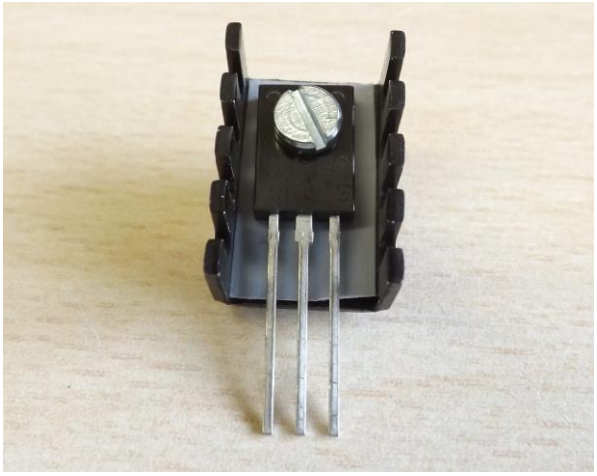
Be very careful not to confuse the types. Although their body is the same but they are different transistors. Use a suitable magnifying glass to read the marked references printed on them.

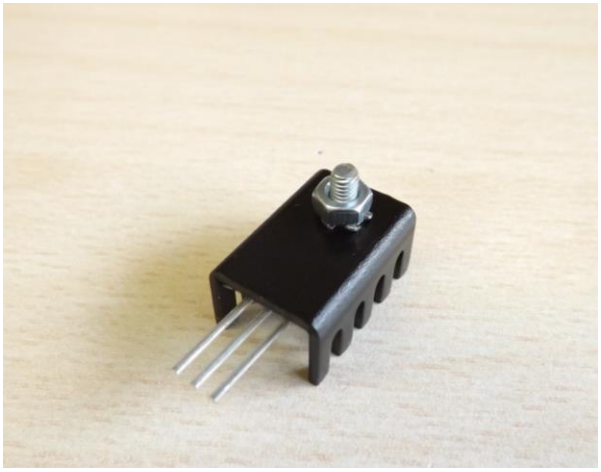
Prepare Q2 and Q3, but do not place them yet. It is better to do it after placing L6 and L8.

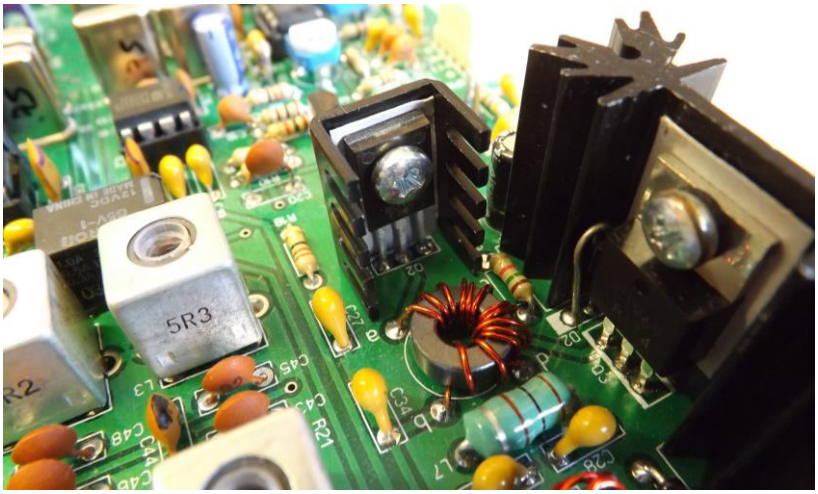
Q2 BD135

Mount Q2 onto the heatsink as shown in the image.

Use a mica insulator sheet that you will find in the kit and trim it 1-2mm so that it seats well within the heatsink.



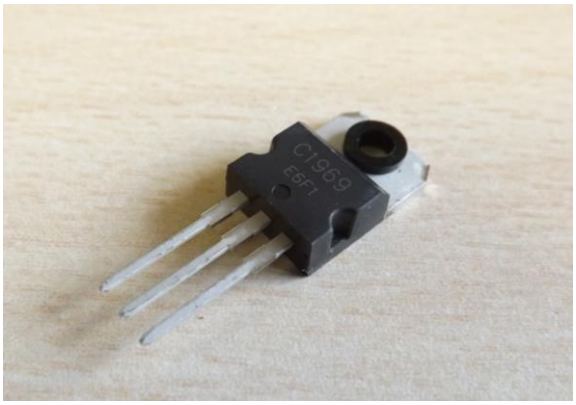


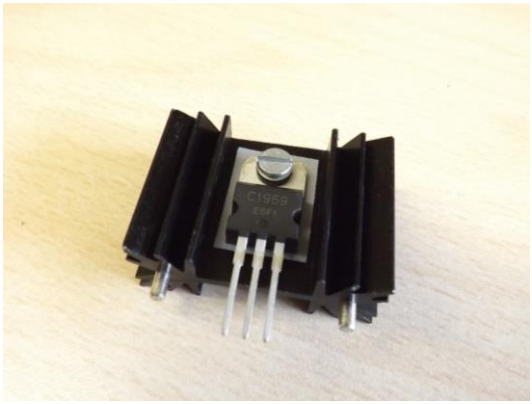


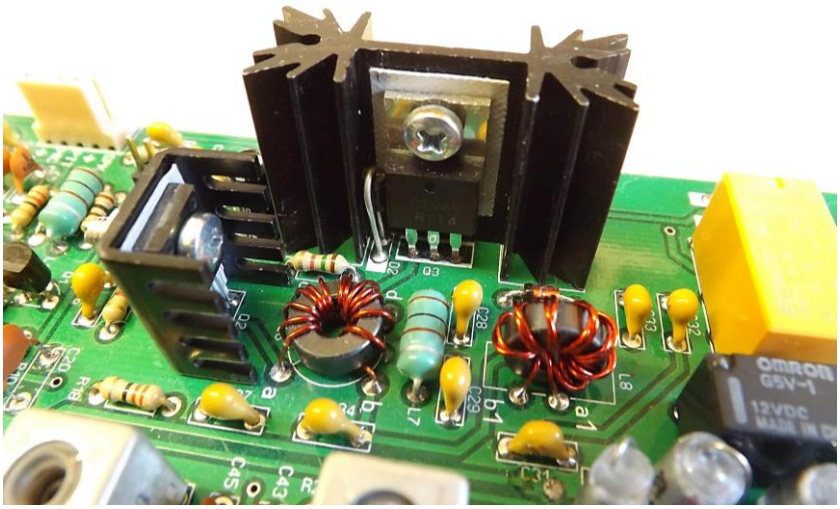
Q3 2SC1969

Mount Q3 (TX power amplifier) onto the heatsink as shown in the image. This transistor is placed with a mica insulator sheet and also a heatsink insulator bushing that insulates the screw from the transistor body.

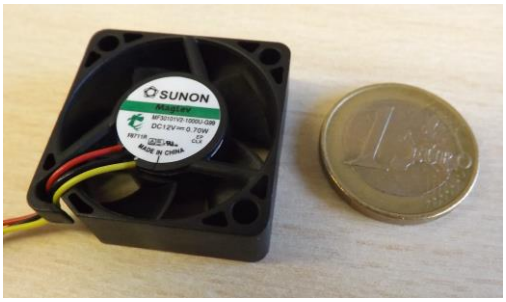
This is an important task; it should be done exactly as shown in the images.







If you plan to work at maximum power and for long periods of time (at base station) it may be advisable to increase the cooling surface. You can add some system to increase the temperature dissipation, for example by an auxiliary metal surface, a mini-fan or other similar system.



⇨ Integrated Circuits

The component outline for the IC on the circuit board has a “U” shaped notch on one end, indicating the end at which pin 1 of the IC is located. There is a similar notch on one end of the sockets. This should be oriented over the "U" notch outline on the circuit board. Finally, pin 1 of the IC is marked with a small dimple or dot; this end of the IC should be oriented towards the notch in the IC socket or the "U" on the component outline.

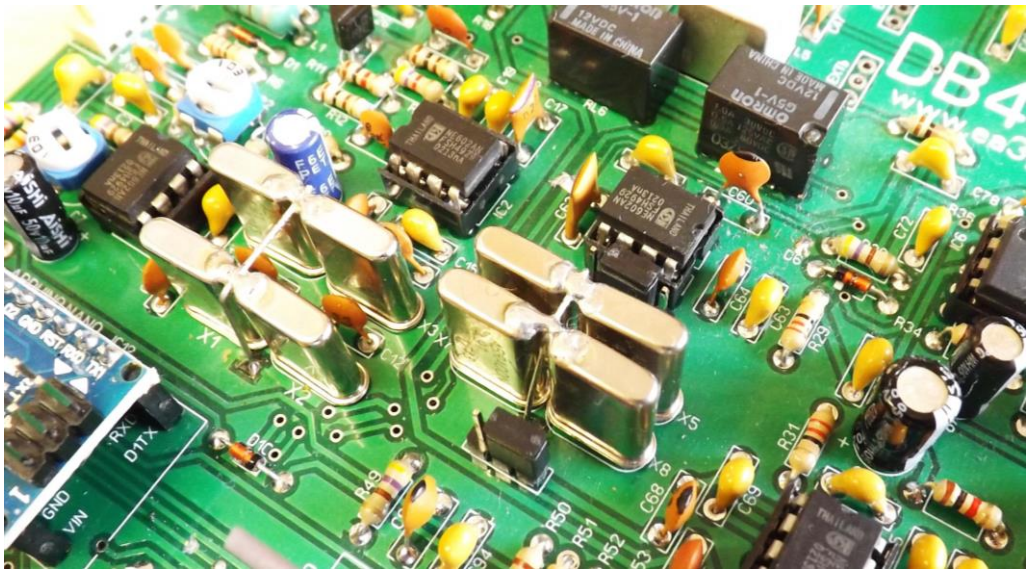
Mount the sockets for IC1, IC2, IC4, IC5, IC6 and IC7 in the locations printed on the circuit board. Make sure that the sockets lie flat against the circuit board. Next, insert IC1, IC2, IC4, IC5, IC6 and IC7 into their respective sockets.

Install IC3, IC9 and IC8. These are regulatory integrated circuits. Be careful not to confuse IC3 (78L05) with IC9 (7805).

IMPORTANT: Make sure that the IC's are fully inserted into their sockets. A poor contact between the socket and IC can cause malfunction of the kit.

⇨ Crystals

Install **X1** through **X8**.
X1, X2, X3 and X4 are part of the IF receiver filter, and X5, X6, X7 and X8 are the IF transmitter filter. These crystals have been hand-picked (they have handwritten numbers on them) and have the same resonant frequency, in order to obtain the best filter quality.
The crystal housing should not touch the board; place them slightly separated from the board, at a distance of 0.5mm.



Note: *With a scrap piece of wire left, you can solder the crystals housings to GND.*

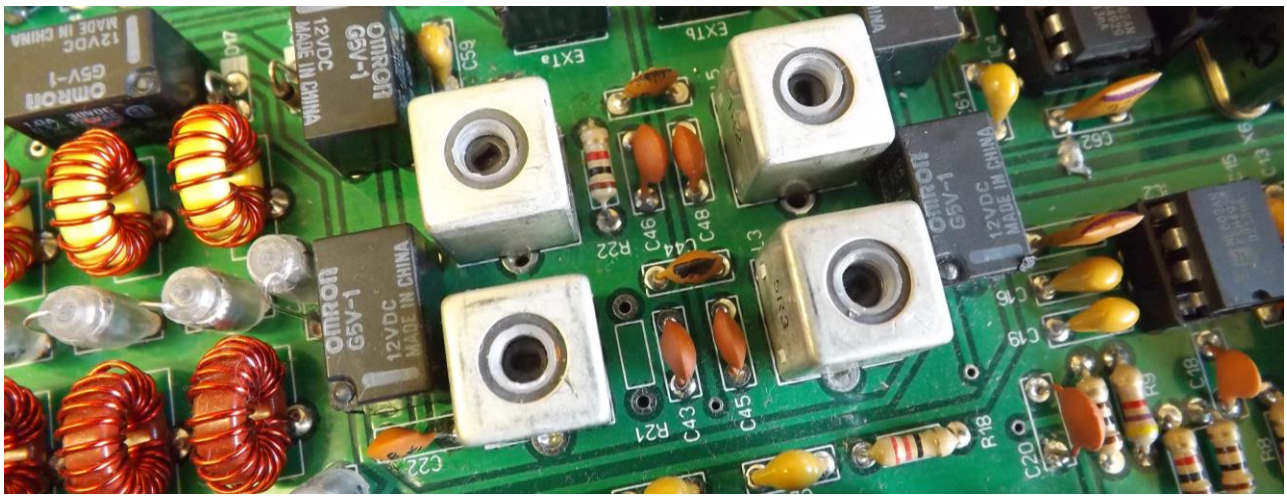
⇨ Relays

Install relays RL1 to RL8. They can only be placed in one position.

Make sure that the body of the relay lies flat against the circuit board.

⇨ Shielded coils (cans)

L2, and L3 are shielded coils equivalent to Toko KANK3334, marked as **5u3H or 5R3**.
L4, and L5 are shielded coils equivalent to Toko KANK3335, marked as **1u2H or 1R2**.
They are RF transformers for the bandpass filters. Make sure that they lie flat against the circuit board.
In order to solder the tabs of the shield, you will need to hold the soldering iron a little longer on the joint.



⇨ 40m LPF Toroids L9, L10 and L11

These are the 40m low-pass filter toroids.

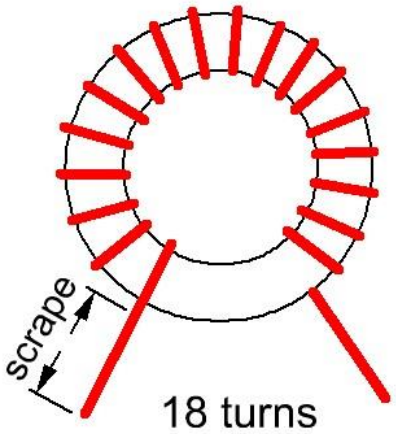
- **L9 and L11** are identical and are wound with **18 turns**.
- **L10** is wound with **20 turns**.

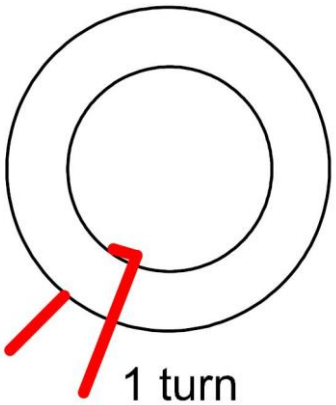
They use T37-2 (red toroids 9.5mm/0.375in outer diameter).
Cut about 26cm (10.3”) of 0.5mm diameter enameled wire and wind the **L9 and L11** toroids with eighteen (18) turns. Spread the turns evenly around the toroid and wind them tightly so that they follow the contour of the toroid and are as tight against the toroid as possible. The turns should be evenly distributed around the circumference of the toroid.
Leave pigtails of about 10mm (0.40”). Scrape off the enamel with a knife from the ends of the wire, in order to solder the toroid onto the board.

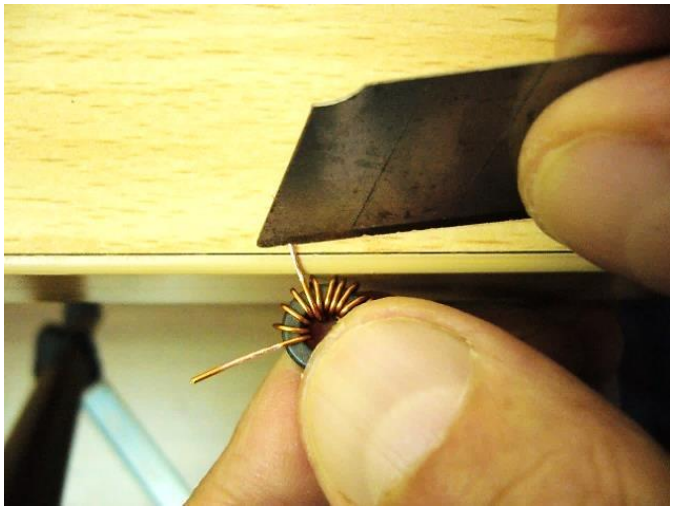
For **L10** cut about 28cm (11”) of 0.5mm diameter enameled wire and wind twenty (20) turns.
Mount and solder the three toroids in place.

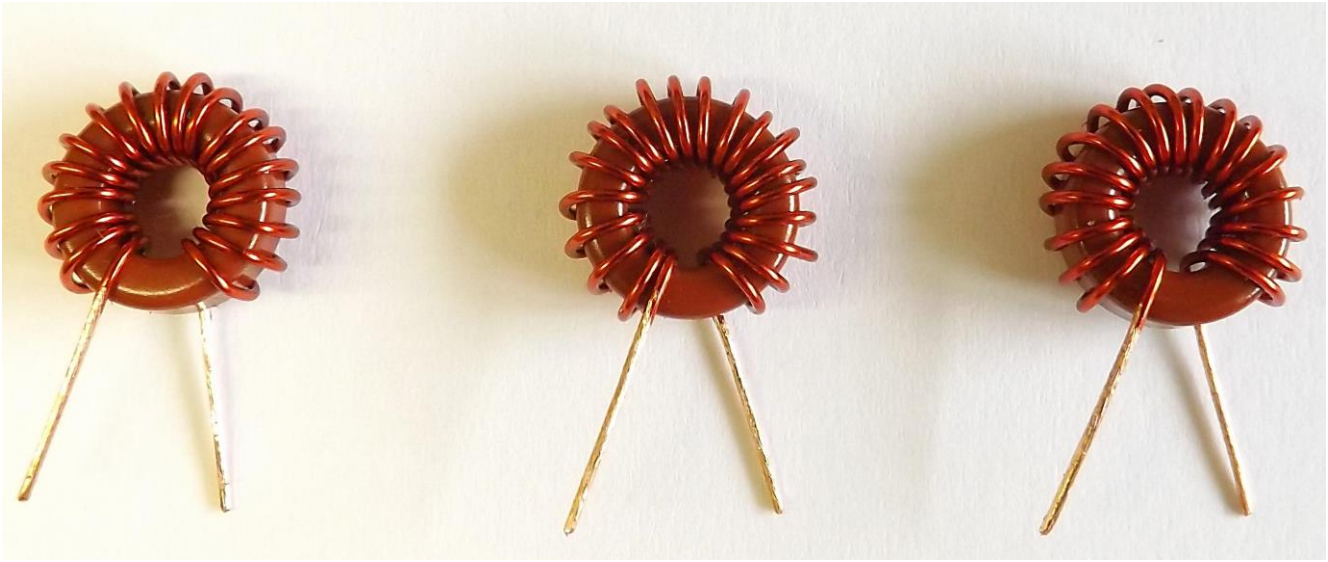
Counting the turns: Count one turn for each pass of the wire through the center of the toroid.

Important: Wind the toroid exactly as shown in the images. One turn more or less will affect the operation and the output power.









L9 (18 turns) L10 (20 turns) L11 (18 turns)

⇨ 20m LPF Toroids L12, L13 and L14

These are the 20m low-pass filter toroids.

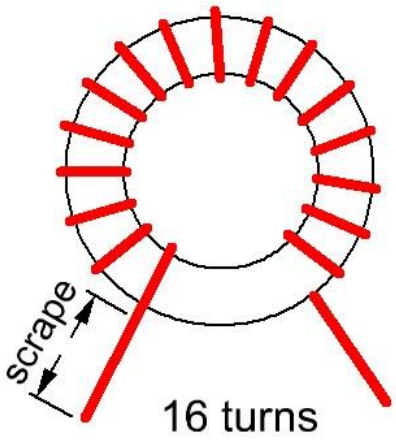
- **L12 and L14** are identical and are wound with **15 turns**.
- **L13** is wound with **16 turns**.
- They use T37-6 (yellow toroids 9.5mm/0.375in outer diameter).

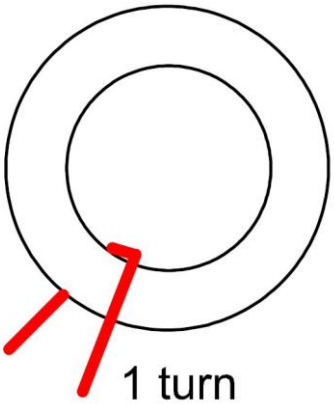
Cut about 24cm (9.2”) of 0.5mm diameter enameled wire and wind the **L12 and L14** toroids with fifteen (15) turns. Spread the turns evenly around the toroid and wind them tightly so that they follow the contour of the toroid and are as tight against the toroid as possible. The turns should be evenly distributed around the circumference of the toroid.

Leave pigtails of about 10mm (0.70”). Scrape off the enamel with a knife from the ends of the wire, in order to solder the toroid onto the board.

For **L13** cut about 25cm (9.5”) of 0.5mm diameter enameled wire and wind sixteen (16) turns.

Mount and solder the three toroids in place.





L12 (15 turns) L13 (16 turns) L14 (15 turns)

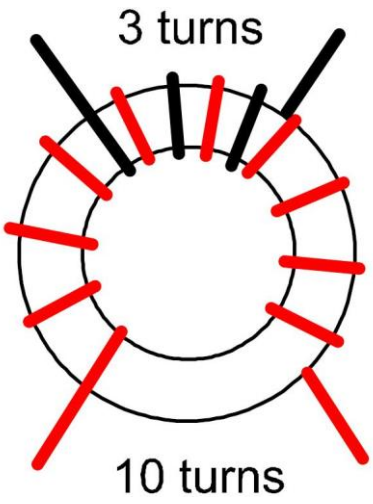
⇨ L6 Toroid Transformer

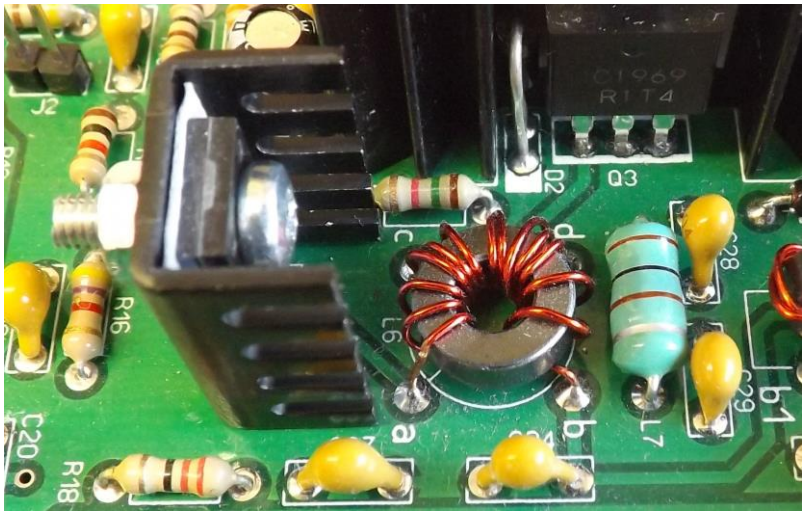
L6 is an impedance matching transformer. An FT37-43 (black toroid 9.5mm/0.375in outer diameter) is used. It has a 10-turn primary and a 3-turn secondary.

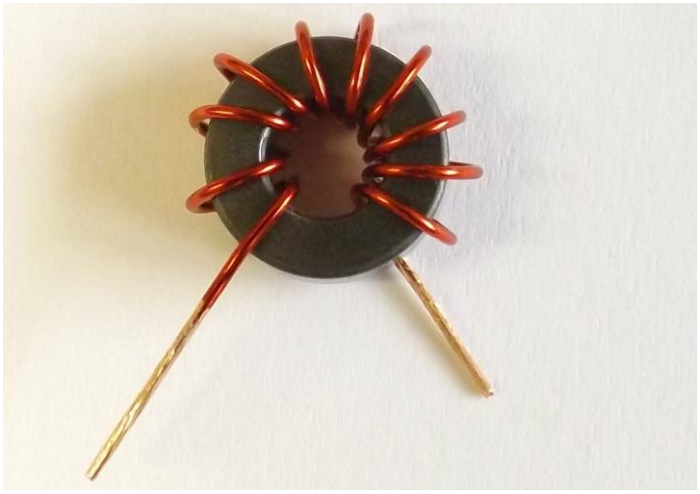
- Take 17cm (7.5”) of 0.5mm diameter enameled wire and wind ten (10) turns on a black FT37-43 toroidal core. Spread the turns evenly around the entire toroid and wind them tightly so that they follow the contour of the toroid and are as tight against the toroid as possible. The turns should be evenly distributed around the circumference of the toroid. Leave pigtails of 10-20mm (0.70”).
- Now take about 8 cm (3.5”) of 0.5mm diameter enameled wire and wind three (3) turns on the other side of the toroid, spacing the turns over the previous winding. Leave pigtails of 10-20mm (0.70”).
- Before inserting them on the circuit board, use a knife or sandpaper to scrape off the enamel from the pigtails of the windings. Solder them in place.
- The 3-turn winding faces towards the output transistor Q3 and the 10-turn winding towards C27 and C34.

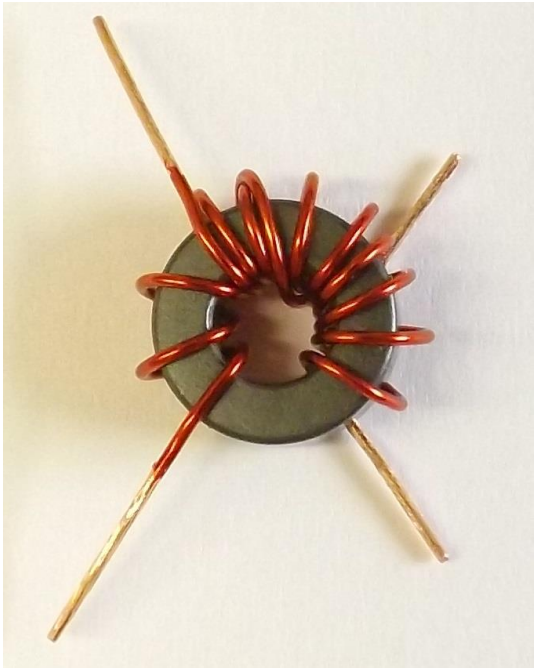
Counting the turns: Count one turn for every pass of the wire through the center of the toroid.

Note: If you need to, you can remove the Q2 heatsink or use small tweezers to help you insert the toroid into place.







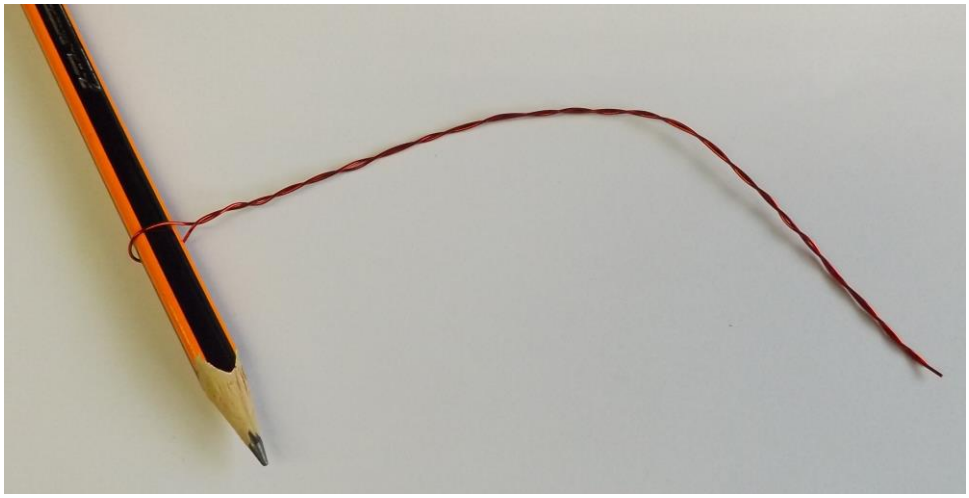


IMPORTANT: Wind the toroid exactly as shown in the images. You must pay attention to number of turns as well as to the direction of the winding.

⇨ L8 Toroid transformer

L8 is an impedance matching transformer with a bifilar winding. An FT37-43 (black toroid with 9.5mm/0.375in outer diameter) is used. It has 8 + 8 turns.

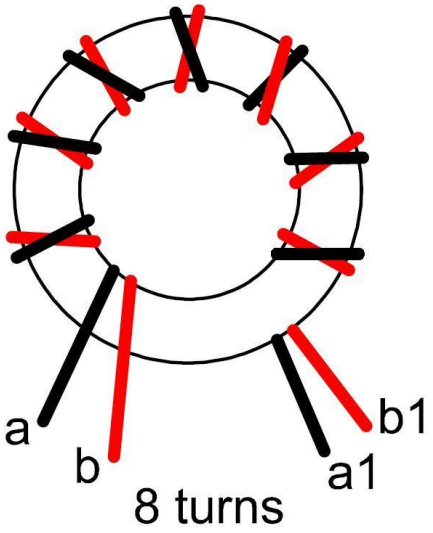
- Cut a 31-32cm (12”) long piece of 0.5mm diameter enameled wire.
- Bend the wire in half.
- Twist it so that there are two twists per cm.

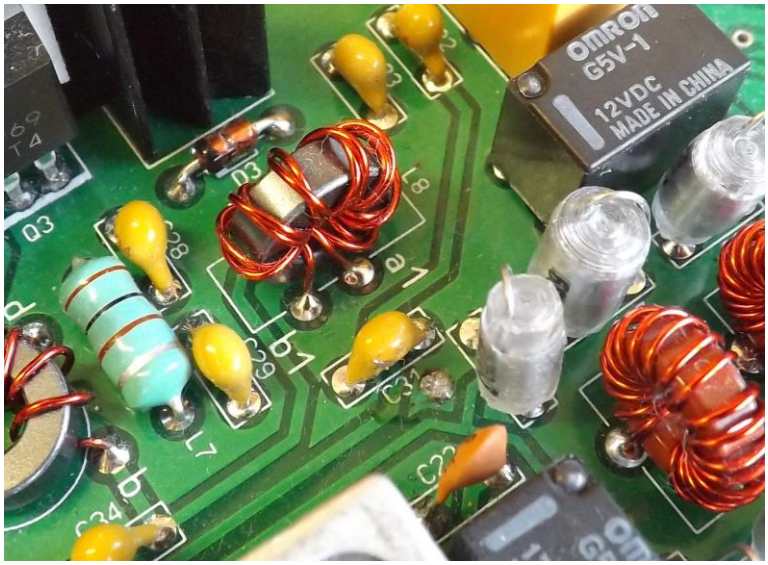


16cm (32cm bent in half)

- Before beginning to wind, leave 15-20mm of wire, measured from the end of the wires to the outer edge of the toroid. Now wind eight (8) turns on the toroid. Remember: Count one turn for each pass of the wire through the center of the toroid.
- Spread the turns evenly around the toroid.

- Cut the ends and separate the two windings.
- Use a sharp knife to scrape the enamel off the ends that will be soldered. The ends of the coils that we have made need to be prepared in this manner before soldering them into the board.
- Using a multimeter in its ohm or continuity function, locate and mark the ends, identifying them as “a” - “a1” and “b” - “b1”.
- Mount the toroid into the appropriate holes as marked on the circuit board.





Note: For greater clarity, the drawing shows one black wire and one red wire. In reality, both wires are of the same color. You can mark the "a" -"a1" with a marker pen.

⇨ Rotary Encoder, P5 volume potentiometer P3 Rx attenuator potentiometer, external connections Jacks and Switches

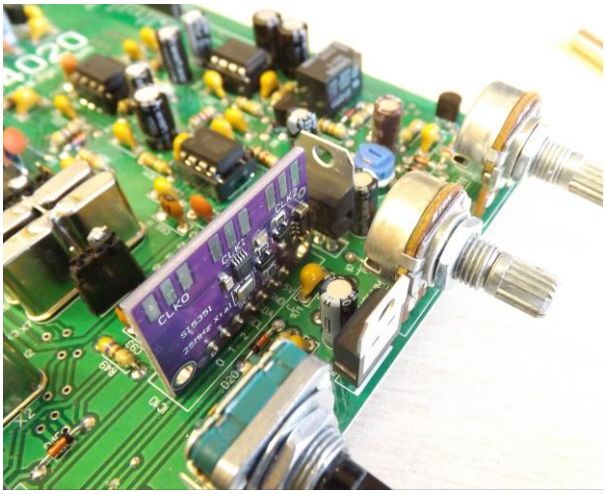
You may prefer to install the jacks, connectors, switches outside the board. Then see the section "WIRING AND CONNECTIONS"

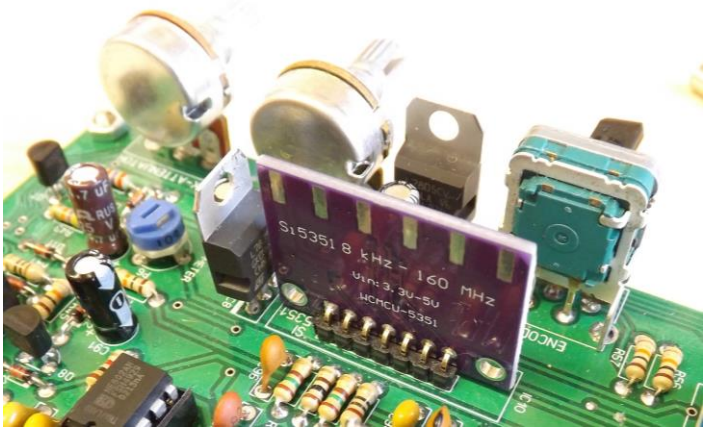
Now mount and solder the Rotary Encoder, the P2 volume potentiometer (marked B10K) and the P4 Rx attenuator potentiometer (marked B1K) in their respective positions. Mount and solder the antenna and power jacks, phones and speaker jacks, and the SPK-HEAD, EXT-SPK/MIX-SPK switches.

Before mounting the external connection jacks, you should cut the protrusions located at the bottom of these jacks; otherwise you will not be able to solder them in the correct position. See the image.

IC10 SI5351

The IC10 is a module that incorporates the SI-5351 frequency generator
Solder the elbow 7-pin strip and solder the module onto the board.
Make sure that the module is vertically with the board as shown in the images.



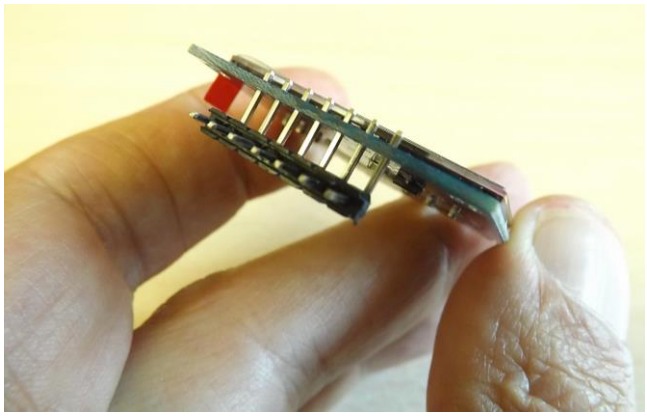


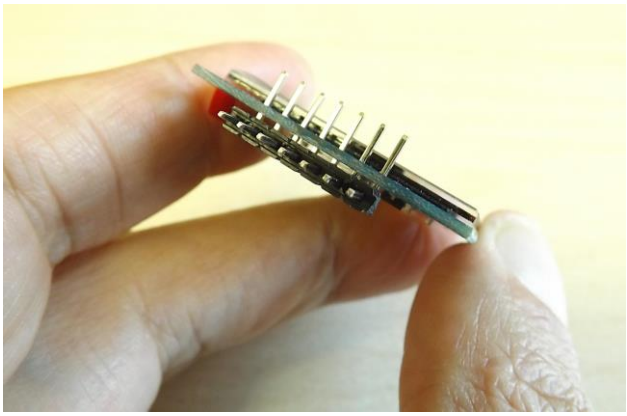
IC11 OLED 1.3” display

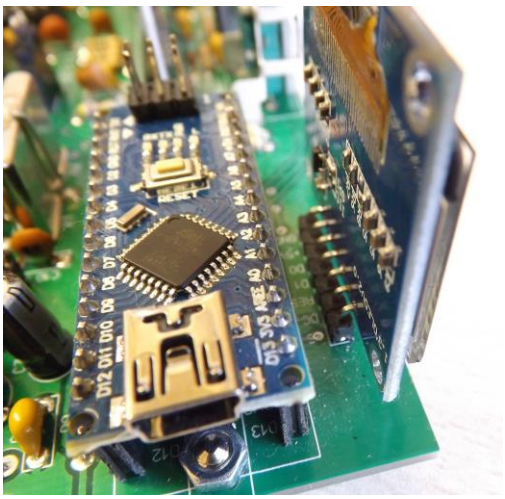
This is the display for the *DB4020*. It may be best not to place it to the end.

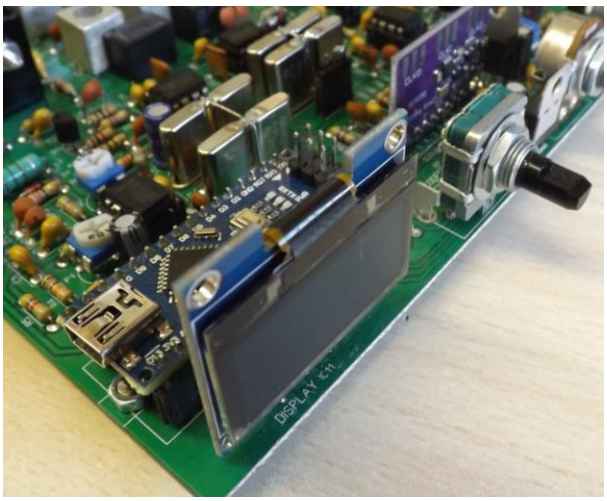
Before placing it, you must think and be sure how to install the DB4020 in your enclosure.

The OLED display use a strip of 7 pins at right angles to solder the module onto the board.
When solder, you can adjust the distance a little to match the front panel of the enclosure





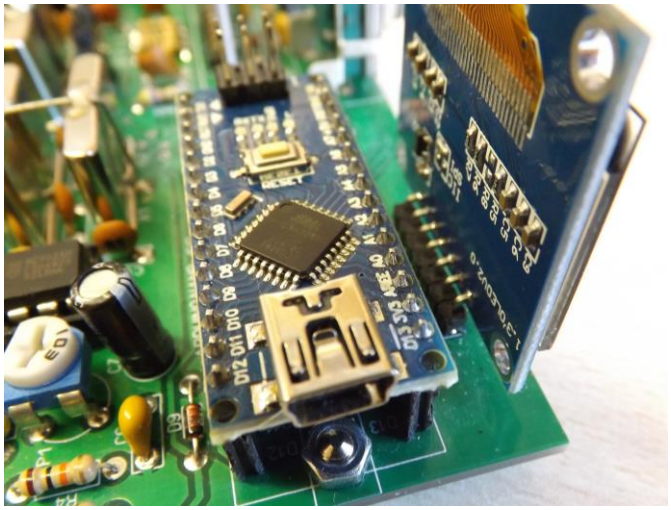


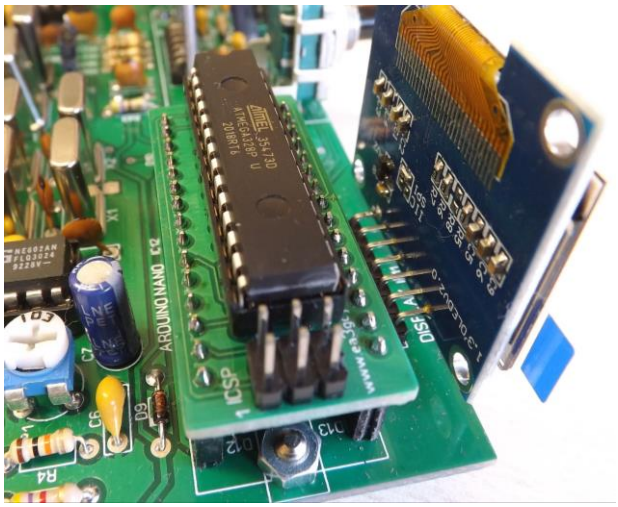


You may prefer to install the OLED display, encoder and potentiometers outside the board. Then see the section "WIRING AND CONNECTIONS"

IC12 ATMEGA328P module (Arduino NANO compatible)

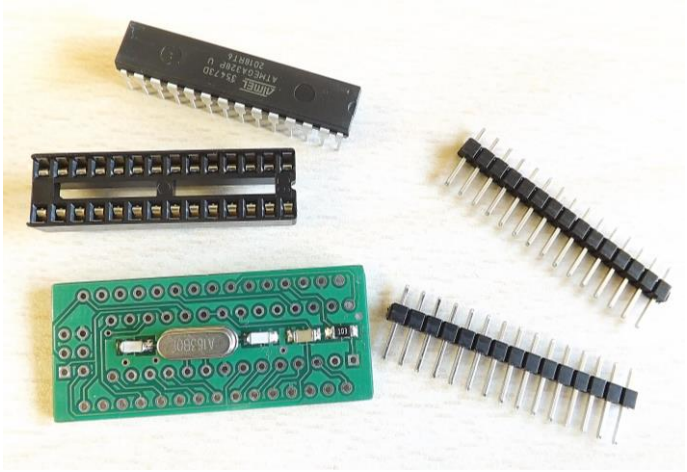
Install the two 15-pin female strips on DB4020 board to ATMEGA328P or Ardino NANO module as shown in the image.

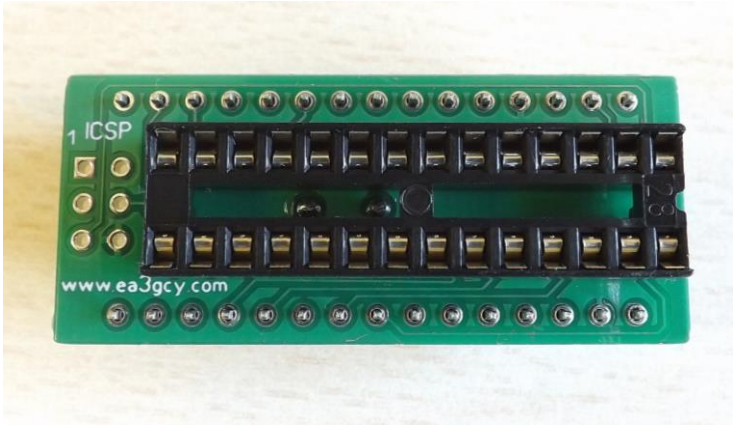


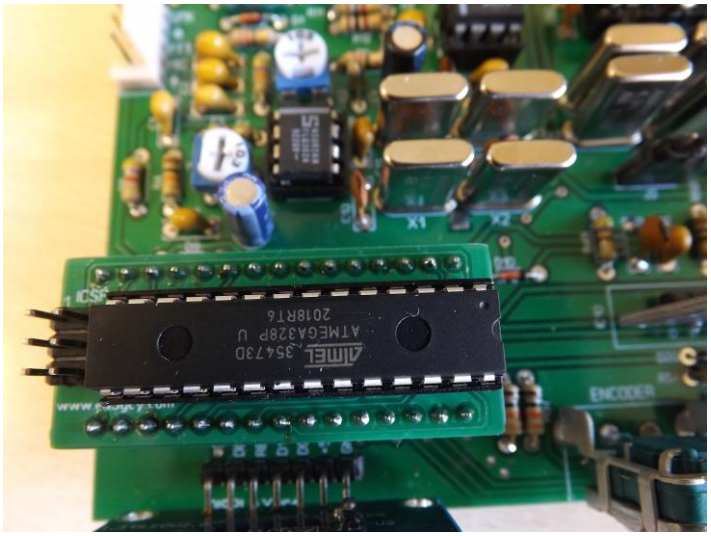


To assemble the ATMEGA328P module follow the following order:

- Solder the 29-pin socket. You must make sure to place it in the correct direction according to the silhouette printed on the board.
- Solder the two 15-pin male strips. Make sure that they are vertical.
- Insert the ATMEGA328P chip into the socket. Make sure that you are heading in the right direction.
- Insert the module on DB40020 board its correct position (see pictures).







SETTINGS AND TESTS

⇨ First checks

- Adjust P2 (carrier suppression) and P5 (volume potentiometer) to mid-position.
- Adjust P1 (mic gain) to minimum position (counterclockwise).
- Adjust P6 and P4 nearly to maximum.
- Plug a speaker into the "SPEAKER" jack or headphones into the "PHONES" jack.

IMPORTANT: Use a good quality speaker unit. A bad speaker will spoil the quality of the reception.

- DO NOT yet connect a microphone.
- Apply power (remember J1 jumper plugged).
- The screen should light up and show the main menu. See “DB4020 User manual”.
- Turn the volume to maximum; you should hear a light background noise.

If everything is okay, you may continue.
If something is not right, you will need to examine it.

⇨ Adjustment of the passband, L2, L3, L4 and L5

For this adjustment you will need an “alignment” tool suitable for this type of coils; if you use a screwdriver, you risk breaking the core of the coil.
Tune to any frequency in the 40m band (see the section using the DB4020).
With an antenna connected to the transceiver, alternately adjust L2 and L3 until obtaining the maximum noise level in the speaker. Now, try to tune in a stable signal within the band and readjust L2 and L3 alternately until you hear it at the highest possible level.
Tune to any frequency in the 20m band (see the section using the DB4020).

With an antenna connected to the transceiver, alternately adjust L4 and L5 until obtaining the maximum noise level in the speaker. Now, try to tune in a stable signal within the band and readjust L4 and L5 alternately until you hear it at the highest possible level.

If you have access to an RF signal generator, begin injecting a signal of about 5-10uV within the frequency coverage of the receiver and tune it in. Reduce the level of the RF signal generator to the minimum that is still audible with a loudspeaker or headphones, and alternately adjust the coils until obtaining the maximum reception level.

Remember: All transmission tests must be done with a 50 ohm load connected to the transmitter output.

⇨ Transmitter

Important note: The passaband coils L2, L3, L4 and L5 work for both receive and transmit.
You must adjust the transmission until you get the maximum power

Connect a power meter with a 50 ohm load to the antenna jack.
Adjust P1 (mic gain) to mid-position. Connect an electret condenser microphone to the microphone input, put the transceiver in TX (PTT terminal to "GND") and speak or whistle loudly into the microphone. The power meter will display the power output level. Adjust L2-L3 (40m) and L4-L5 (20m) until obtaining the maximum. You can expect 6-8W on 40m and about 3-4W on 20m
You can now increase the P1 setting for the power of your choice. Depending on the sensitivity of the microphone, you can adjust the P1 to the maximum.
For microphone wiring see "DB4020 Microphone" on "ANNEXES" section.

⇨ Adjustment of Balanced modulator (carrier suppression)

Adjust P1 (mic gain) to minimum (counterclockwise). Adjust P2 to mid-position.
Apply power. Now, activate the PTT pin of the mic and monitor the transmitter output with an oscilloscope (with a 50 ohm load connected). Adjust P2 to obtain the minimum level possible of residual carrier signal

If you don't have access to an oscilloscope, you may listen to the transmitted signal on a SSB/CW receiver; adjust P2 until you hear the least possible amount of carrier signal. Keep in mind that with a receiver so close, you will ALWAYS hear a weak residual signal.
When you finish adjusting, remember to raise P1 (mic gain) again.

The ideal position will always be very close to mid-position.

⇨ Adjustment of P6 S-Meter level

You can use another receiver to compare.
Tune in a stable signal and adjust P6 until the display shows the proper signal level.

Normally P6 will be adjusted to mid-position.

Note: The displayed signal level is for guidance only. They are not precise levels. It is not a calibrated circuit.

⇨ Adjustment of P4 AGC

We recommend that you set P4 to maximum.

However, you can decrease and eliminate the action of the AGC by lowering the level of P4.
This AGC circuit will help you receive more comfortably, but if you receive very strong signals (local or high power stations) you should attenuate the signals with the "RX ATTENUATOR" P3 potentiometer.

⇨ Adjusting the "IF LSB", "IF USB", "Calibrate Xtal" and "Calibrate Volts"

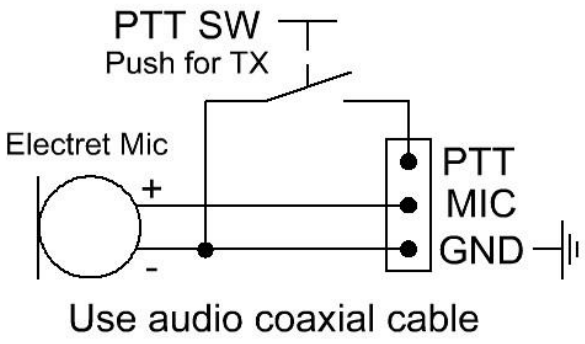
VERY IMPORTANT: See "SETTINGS" section on:

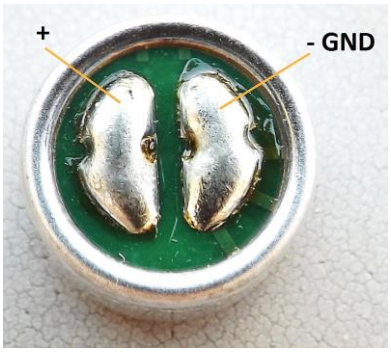
Download "DB4020 User Manual" on www.qrphamradiokits.com

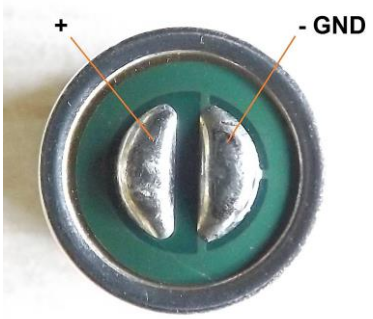
ANNEXES

⇨ Microphone for DB4020.

The DB4020 need a condenser electret microphone. An “electret” capsule included on kit, this capsule works very well and you can assemble your own microphone.
The wiring is very simple:







Note about electret capsules:
The connections of all capsules have polarity “+” and “-“. The “-“ it is joined to capsule housing.
You can build your own handheld microphone with the micro electret capsule included in the kit and a pushbutton for PTT:

“Home made” microphone

Multimedia microphones and other microphone capsules.

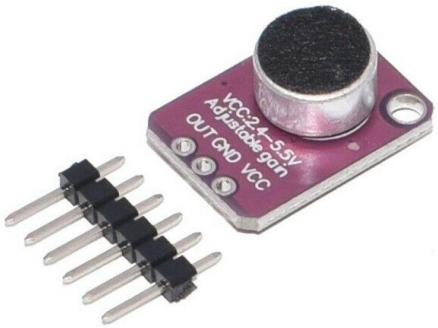
Multimedia microphones are not very sensitive because they are designed for high audio gain systems (sound cards for computers or similar devices). You will have to use some model of processor or pre-amplifier, but be careful not to saturate the transmitter input.

Adjust the microphone signal to the optimum level

If your microphone does not have enough output, you will not be able to get the maximum power from the transmitter, however too much signal will saturate the transmitter input and decrease the output power.

Be careful not to get distortion or feedback in the transmitter.

You can also find inexpensive pre-amplified microphone modules online. For example those that incorporate the MAX4466 chip.



NOTES:

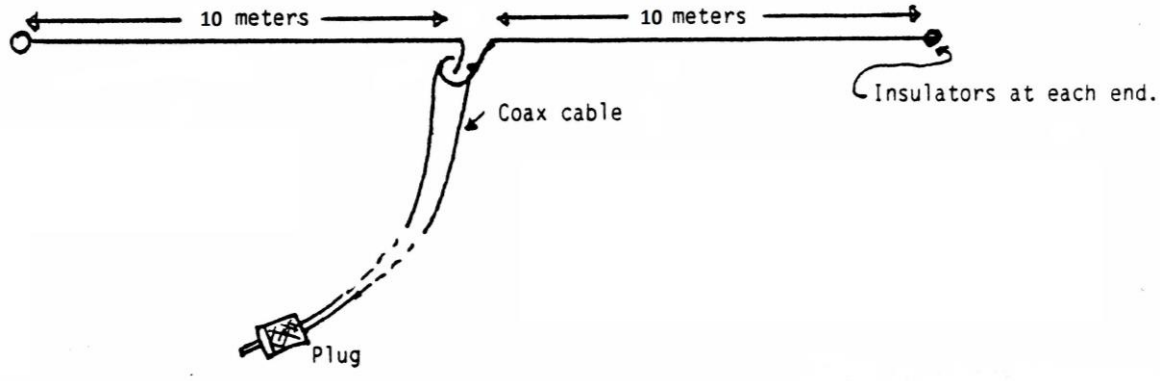
- Install the module in the microphone receptacle. Do not install it inside the equipment, as the mic cable can pick up RF signal and produce feedback in transmission.
- If you use Chinese microphones for walkie-talkie (“baofeng” or similar), you must replace the capsule with one of more sensitivity. You can use the capsule included in the kit.

⇨ CW Interface and CW IF narrow Filter option.

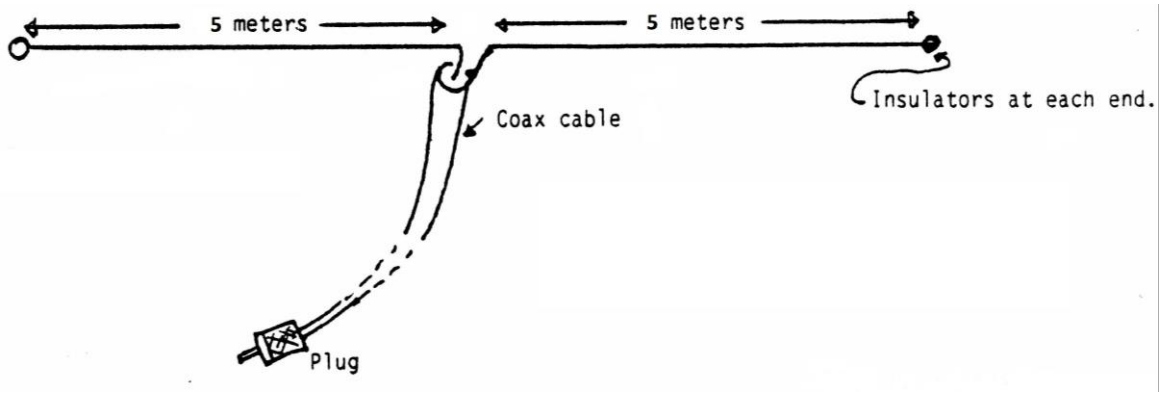
The *DB4020* board and the Arduino controller are prepared for a *CW Interface module* and a *narrow IF Filter board*. This is an optional kit that you can buy separately.

⇨ 40 and 20 meters Antennas.

To obtain a good performance of the DB4020 it is essential to use a specific antenna for the 7Mhz and 14MHz band. You can use a ham radio antennas from factory. Or you can build your own dipoles antennas for very little money and that will give you very good results. You must build a dipole for each band.



40 m dipole antenna



20 m dipole antenna

For the antenna "arms" you can use any cable strong enough to hold the weight of the coaxial cable hanging. Install the antenna in the highest and clearest position possible.

Very interesting multi-band option are the end fed dipoles that allows working in several bands with a 49: 1 transformer. Look "EndFed antenna" on Google.

⇨ AGC Decay time.

The CAG decay can be lowered if you think the recovery time is too slow. It should decrease R28 and C57. Try R28 at 220K and C57 at 1uF.

This modification is not usually necessary. Although it will depend on your listening habits.

⇨ *DB40320* User Manual.

The *DB4020* transceiver is easy to use.
There is a User Manual where all the functions of the transceiver are explained.
The Arduino module is already programmed at the factory. There are a few initial frequency settings that will help get you up and running**.**

However, for each assembly some re-adjustments must be made in the display settings menu.

Please, download the "DB4020 User Manual" from the website:
www.qrphamradiokits.com

⇨ Adjusting the reference oscillator "Calibrate Xtal", voltmeter "Calibrate Volts" and "IF Frequency"

See "CALIBRATE XTAL", "CALIBRATE VOLTS" and "IF FREQUENCY"sections on DB4020 User Manual.

IF YOUR KIT DOES NOT WORK AFTER COMPLETING ASSEMBLY

Don't worry, it is not uncommon that a kit doesn't work on the first try; stay calm, as in most cases they are minor problems with a simple fix.
Most faults are due to poorly soldered connections or improperly placed components, incorrectly wound toroids, etc.; it is very rare for one of the supplied components to be defective.
Before taking any measurements with test equipment, check all the connections and carefully inspect your soldering, looking for cold joints, short circuits between traces, sockets not making good contact, or components mounted in the wrong place.
If your kit does not work after final assembly, please follow these steps in order:

- Double-check every step in the assembly manual, the solder connections, and correct component placement.
- If you have access to instrumentation, take measurements and follow the signal path of the circuits to diagnose what is happening and why.
- Request another ham experienced with kits or a radio technician to check your work. Someone taking a fresh look may find things that you overlooked.
-If you decide that technical assistance is needed, you are welcome to send an email to ea3gcy@gmail.com. As a last resource, you may send the kit in for repair; however, I will have to charge for any repairs done, although I will try to keep the cost as moderate as possible (see the “FAQ” page of the EA3GCY kits website).

LIMITED WARRANTY

Please read carefully BEFORE building your kit

All electronic components and hardware supplied with the kit are under warranty in case of any manufacturing defect for the period of one year after purchase. The warranty does not include the transmitter final amplifier transistor.

The original purchaser has the option of examining the kit and manual for 10 days. If, within this period, the buyer decides not to build the kit, he/she may return the entire unassembled kit at their own expense for the shipping expenses. The shipping expenses and sales commissions (i.e. bank, EBay, and PayPal commissions) included in the purchase price will not be returned.
Please, BEFORE returning a product, request instructions by email at: ea3gcy@gmail.com

Javier Solans, EA3GCY, warrants this device to function according to the specifications, provided that it is assembled and adjusted as described in this documentation, and used correctly according to all provided instructions.

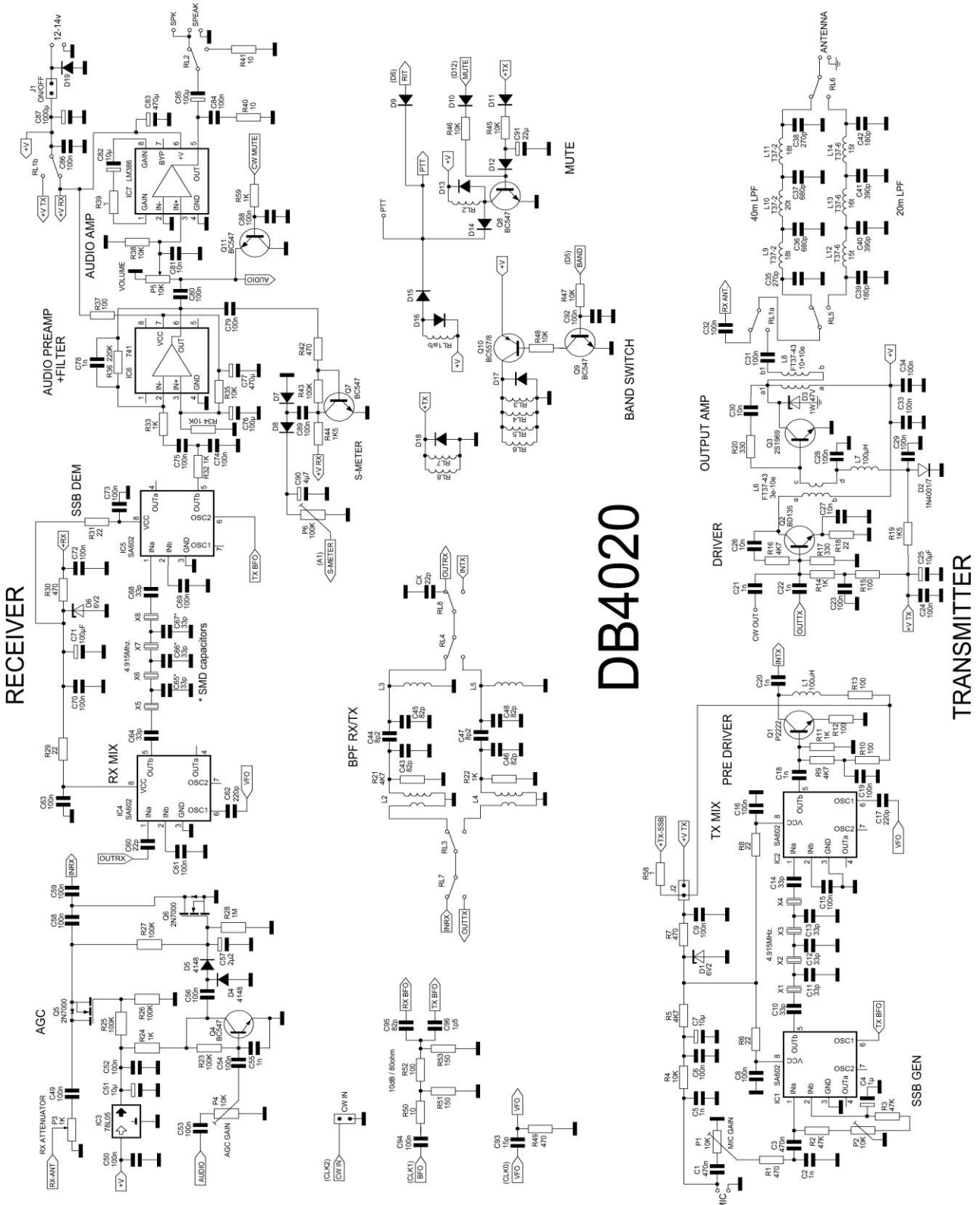
It is your responsibility to follow all the instructions in the manual, to identify all the components correctly, and to use good workmanship and proper tools and instruments in the construction and adjustment of this kit.

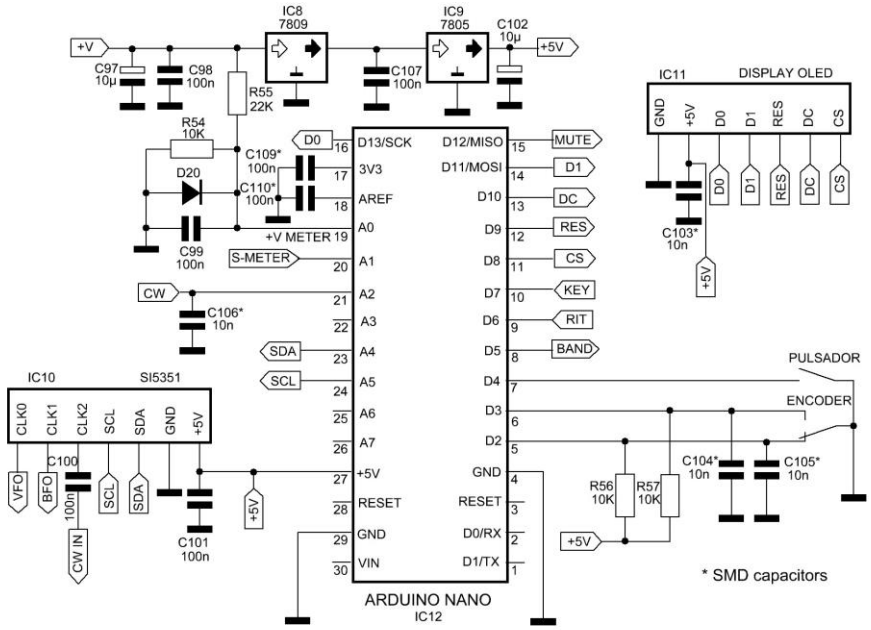
REMEMBER: This kit will not work as a commercially manufactured product; however, it can often give similar results. Do not expect great performance, BUT YOU ARE SURE TO HAVE LOTS OF FUN!

If you believe that there is a missing kit component, please do a thorough inventory of all parts using the parts list in the manual. Check all bags, envelopes and boxes carefully. If needed, you may email me and I will replace any component that you are missing. Even if you can find the exact part locally, please let me know so that we are aware of the problem to help other customers.
I can also supply any part that you have lost, damaged or broken accidently.
If you find any errors in this manual or would like to make a comment, please do not hesitate to contact me at ea3gcy@gmail.com

THANK YOU for building the ***DB4020*** Transceiver kit.
Enjoy QRP!
73 Javier Solans, EA3GCY

SCHEMATICS


DB4020
RECEIVER
TRANSMITTER
BAND SWITCH
MUTE
BPF RX/TX
AUDIO AMP
AUDIO PREAMP +FILTER
SSB DEM
RX MIX
AGC
S-METER
* SMD capacitors
OUTPUT AMP
DRIVER
PRE DRIVER
TX MIX
SSB GEN
40m LPF
20m LPF
ANTENNA
RX ATTENUATOR
AGC GAIN
MIC GAIN
VOLUME
12-14v
SPK
SPEAK
PTT
MIC
CW IN
CW OUT
4.915MHz.



Note: If you want to have the diagrams with more graphic quality, you can request the file in JPG or GIF format at: www.ea3gcy.com

WIRING AND CONNECTIONS

- The DB4020 only requires wiring of the microphone, PTT and speaker internal to the microphone (if using a speaker-mic) or a speaker installed inside the transceiver enclosure. You can use an external speaker cabinet connected to the rear "SPEAKER" jack socket.
- The DB4020 circuit board incorporates the power, antenna, headphone, and external speaker and headphone jacks, the “external speaker-mic/speaker” switch and “speaker/headphones” switch.
- Optionally, you can connect an ON/OFF switch instead of jumper J1.

It is highly recommended that suits a metal box for all items that are installed on the board. If you use a plastic box, then shield with conductive paint or conductive tape (aluminum or copper may be suitable).

⇨ *Wire the elements off the board*.

It is highly recommended that you adapt a metal box to suit the elements that are installed on the board. However, you can wire the elements off the board with the following considerations in mind:

Rear panel elements.
You may prefer to install the jacks, connectors, switches outside the enclosure. This is not critical, you can wire them. But if the cable to the antenna connector is longer than 1-2cm, then use thin 50ohm coaxial cable (RG174 or equivalent).

Front panel elements.
OLED display, encoder and potentiometers.
This is more critical. The cables to the OLED display and to the rotary encoder should be as short as possible. You can add spurious noises to the reception.
Potentiometer wiring is not as critical.

The DB4020 is protected against possible polarity reversal faults by means of diode D19

If your power supply is short-circuit protected or is equipped with a fuse at the output, perfect; if not, build or purchase a cable with a built-in series 2.5 or 3A fuse.
If you make a mistake with the polarity, then the fuse will blow.