ILER-40 MK2

QRP SSB Transceiver Kit

Assembly manual

Version 2, last update: June, 2017

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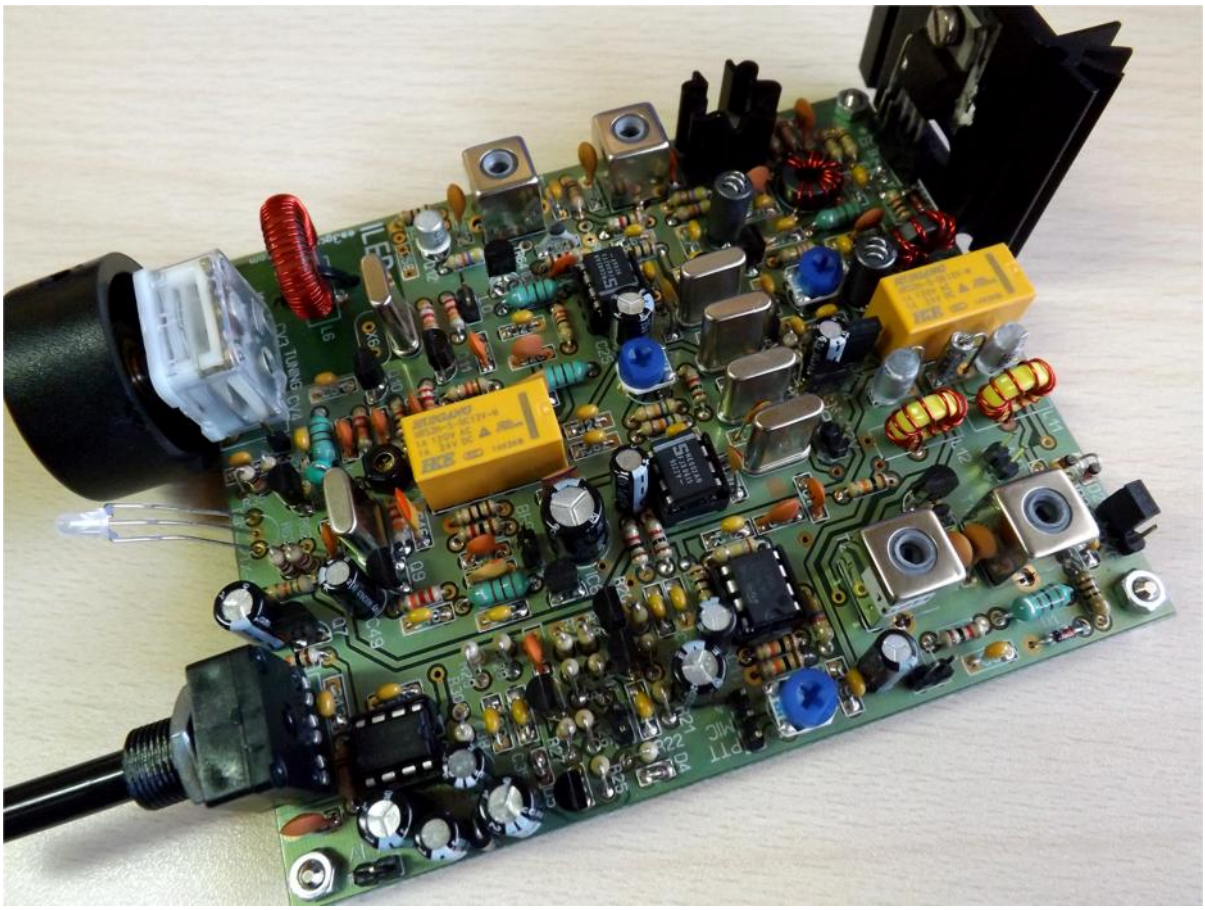
Most recent updates and news at: **www.qsl.net/ea3gcy**



Thanks for constructing the ILER-20 MK2 SSB Transceiver kit

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

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INTRODUCTION

What is the significance of ILER? A little bit history…

The origin of LLEIDA goes back to 5th century B.C. when the Iberian people of the ILERGETAS settled on top of the "Cerro de la Seu Vella" (Hill of the Old See) and founded the city of ILTIRDA. Their most well-known leaders were Indibil and Mandonio, who defended against the Carthaginians and Romans, but were defeated in the year 205 B.C., and thereafter the city was Romanized and renamed ILERDA.

LLEIDA is the current name of this city in the northeast of Spain.

Photo: Seu Vella de Lleida.

ILER-40 MK2

The circuit of the ILER kits is a Spanish redesign of the 80 meter transceiver “Antek” by Andy SP5AHT, published in the magazine “Swiat Radio.” By switching the LO and the BFO between the two NE602’s, each one carries out two different functions determined by TX or RX mode. One NE602 functions as a receive mixer and a DSB generator, and the other NE602 functions as a transmit mixer and a SSB demodulator.

A quartz crystal controlled local oscillator (LO) tunes a segment with a range of 25-100 KHz.

The optional **“ILER-DDS”** kit makes it possible to cover the entire band.

The transmitter has a robust design to withstand and work hard in the field!

The philosophy of this transceiver is:

"Put in just the minimum that it needs to work, and work well!"

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

Acknowledgments
To Andy, SP5AHT, for his important contribution to the world of amateur radio.
To Jon Iza, EA3SN, for his educational articles and contribution to technical data.
To Luis EA3WX, Juan EA3FXF, Jaime EA3HFO, Alfonso EA3BFL and to J. Antonio Beltrán for the help they gave in making this kit a reality, from the first prototype to the current ILER-17.
To “eaqrpclub.com” for keeping the "tinkering" flame burning even during difficult times.

SPECIFICATIONS

GENERAL:
Frequency coverage: VXO that tunes a 30 to 100 KHz segment of the 40M band (recommended 50-60KHz max. to obtain reasonable stability). The range of coverage is selected by means of the value of L6 in the VXO circuit.
Frequency control: Quartz crystal controlled oscillator (VXO).
Option A: a pair of 12.031MHz crystals. (upper limit approx. 7.105MHz)
Option B: one 12.096MHz crystal. (upper limit approx. 7.185MHz)
Variable tuning capacitor (polyvaricon).
Antenna: 50 ohms.
Power supply: 12-14VDC, 35mA in receive (without signal), 1000-1100mA in transmit.
Components: 65 resistors, 83 capacitors, 3 variable resistors, 1 trimmer capacitor, 1 potentiometer (volume), 8 IC’s, 14 transistors, 12 inductors-chokes, 6 RF transformers, 1 variable tuning capacitor, 6 crystals.
Front panel controls: tuning, volume.
Optional controls: RX attenuator potentiometer, RX attenuator switch.
External connections: mic/ptt, speaker jack, antenna, DC input.
Circuit board dimensions: 100x120 mm.

TRANSMITTER:
RF output: 4-5 W (12-14V)
Second harmonic output: -42dB below the fundamental frequency.
Other spurious signals: all signals -50dB or better below the fundamental frequency.
Carrier suppression: better than -45dB.
T/R switching: Relays.
Microphone preamp with bandpass.
Microphone: dynamic, approx. 600 ohms, CB type or similar (not included).

RECEIVER:
Type: Superheterodyne, balanced mixer.
Sensitivity: 0.250uV minimum discernible signal.
Selectivity: 4-pole crystal ladder filter, 2.2 KHz nominal bandwidth.
IF Frequency: 4.915 MHz.
Built-in audio preamp and AGC.
Audio output: 250mW @ 8 Ohms.

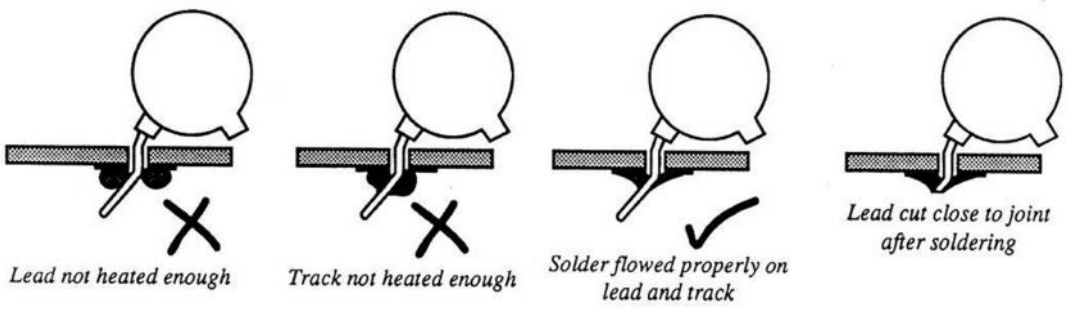
PLEASE READ ALL OF THE ASSEMBLY INSTRUCTIONS COMPLETELY AT LEAST ONCE BEFORE BEGINNING.

TIPS FOR FIRST TIME BUILDERS

Tools required:
- A 15-30w soldering iron with fine tip, 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, oscilloscope (desirable but not essential), frequency counter or HF receiver, RF power meter, dummy load: 5W - 50 Ohms, RF generator (desirable but not essential).

Soldering:
There are two important things which need to be done to insure successful operation of a kit. The first is to put the component into the proper place on the circuit board; the second is good soldering.



To solder properly, you must use a high-quality solder for electronics use and the correct type of iron. Use a small soldering iron with a fine, pointed tip. The soldering iron should be about 15-30 watts (if it is not thermostatically controlled). Use only high-quality electronic type solder. NEVER use any 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 lead and trace and wait about two seconds or so until the solder flows between the terminal and the trace to form a good joint. Now remove the soldering iron. The soldering iron should have been in contact with the work piece 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 black 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.

Coils and transformers:

You may find it convenient to wind and prepare all the coils and transformers 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 and instructions in the manual will illustrate and accompany you in the process.

PARTS LIST SORTED BY VALUE/QUANTITY

Resistor list				
Qty	Value	Checked	Ref.	Identified
5	1		R33, R51, R57, R60, R61	brown-black-gold
1	10		R1	brown-black-black
2	22		R15, R56	red-red-black
4	100		R13, R39, R50, R52	brown-black-brown
1	270		R58	red-violet-brown
2	470		R46, R54	yellow-violet-brown
13	1K		R2, R7, R10, R16, R30, R38, R42, R47, R53, R59, R62, R63	brown-black-red
1	1K2		R45	brown-red-red
1	1K5		R32	brown-green-red
4	4K7		R4, R25, R48, R55	yellow-violet-red
9	10K		R3, R5, R11, R12, R14, R22, R31, R34, R35	brown-black-orange
7	22K		R27, R36, R37, R40, R41, R43, R44	red-red-orange
1	33K		R26	orange-orange-orange
3	47K		R21, R28, R29	yellow-violet-orange
2	56K		R8, R9	green-blue-orange
1	100K		R6	brown-black-yellow
1	150K		R18	brown-green-yellow
1	220K		R20	red-red-yellow
1	270K		R24	red-violet-yellow
2	470K		R17, R19	yellow-violet-yellow
1	1M		R23	brown-black-green
1	1K		P1 RX-gain pot. w/shaft **(optional no included)**	1K lin.
1	10K		P4 Volume control pot. w/shaft	10K
2	5K		P2, P3 ajustable trimmer	502 or 53E
1	500		P5 ajustable trimmer	501 or 52Y

R64 is **1K** (brown-black-red) if **Q14 = 2SC1969** or **3K3** (orange-orange-red) if **Q14 = 2SC2078** (see bag 9)

Capacitor list				
Qty	Value	Checked	Ref.	Identified
35	100n		C1, C2, C3, C9, C12, C14, C15, C22, C23, C24, C28, C29, C31, C32 C33, C39, C43,C44, C48, C50, C51, C56, C59, C60, C64, C65, C67, C70, C71, C72, C73, C75, C77, C78, C82	104 or 0.1
5	10n		C26, C40, C68, C69, C76	103 or 0.01
5	1n		C34, C47, C55, C57, C66	102 or 0.001
1	1n		**C80** Polystyrene	1000
2	470p		**C79, C81** Polystyrene	470
1	330p		C10	n33 or 331
4	220p		C16, C27, **C45, C46**	n22 or 221
2	100p		C52, C53	101
4	82p		**C4, C6, C61, C63**	82P
1	47p		C54	47P
5	33p		**C17, C18, C19, C20, C21**	33P or 33J
1	27p		C7	27P or 27J
1	12p		**C83**	12P or 12J
2	8p2		**C5, C62**	8P2
1	220uf		C36 (elec.)	220uf 25v or 35V
5	100uf		C25, C30, C35, C41, C42 (elec.)	100uf 25V or 35V
6	10uf		C8, C11, C37, C38, C49, C74, (elec.)	10uf 25V or 35V
1	1uf		C13 (elec.)	1uf 25V, 35V or 63V
1	**60p**		**CV1** Murata trimer BFO	Brown
1	160p 70p		CV2+CV3 Polyvaricon dual gang. Tuning. 160p + 70p	

Semiconductors list				
Qty	Type	Checked	Ref.	Identified
Transistors				
11	BC547		Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11	BC547
1	2N2222		Q12	2N2222
1	2N5109		Q13	2N5109
1	**2SC1969/2078**		**Q14 2SC1969 or 2SC2078**, washer + mica spacer	C1969 or C2078
Integrated circuits				
1	LM741		IC1	LM741CN or UA741
2	SA/NE602		IC2, IC3	SA602AN or NE602AN
1	LM386		IC4	LM386N-1
1	78L05		IC8	MC78L05
1	78L06		IC5	MC78L06
2	78L08		IC6, IC7	MC78L08
Diodes				
5	1N4148		D1, D2, D3, D4, D5	4148
2	1N4001(7)		D6, D7	1N4001 or 1N4007
1	47V		D8, Zener 47V 1W	BZX85C47
1	LED		D9, bicolor Led	-

Inductors/RF Transformers list/Crystals/Relays				
Qty	Value	Checked	Ref.	Identified
6	100uH		L1, L2, L3, L5, L7, L9 Axial inductor	brown, black, brown
1	**39uH**		**L4 Axial inductor**	**orange, white, black**
2	VK200		L8, L10	Choque
2	**T37-2**		**L11, L12 LPF toroids**	**9.5 mm diam. Red**
1	T68-2		L6 Toroid. Tuning inductor	18 mm diam. Red
4	**5u3H (3334)**		**T1, T2, T3, T4 coils 5u3H**	**5u3H**
2	FT37-43		T6 toroid 8t+8t ; T5 toroid 10t - 3t	9.5 mm diam. Black
5	**4.915**		**X1, X2, X3, X4, X5 Crystals 4.915MHz.**	**4.915**
2/1	**12.031/ 12.096**		**X6, X7 12.031MHz crystals or X7 12.096MHz X6 none**	**12.031 or 12.096**
2	Relays		RL1, RL2	-

Hardware				
Qty	Value	Checked	Ref.	Identified
5	nuts		hex nuts M3	-
4	spacers		5mm spacer for M3 screw	-
4	screw		5mm M3 screw	-
1	screw		10mm M3 screw	-
2	screw		4mm M2,5 screw (for Polyvaricon)	
1	screw		12mm M2,5 screw (for Polyvaricon)	
1	washer		M3 lock washer	-
29	pins		Mic, 12V, ATT, P1-RXG, ANT, ALT, D7, VXO, BFO, J1, J2, K1, K2, S	-
3	jumper		jumpers for J1, J2 and P1RXG	-
4	IC socket		IC's socket 8 pin	-
1	Shaft Poly.		6mm Shaft Polyvaricon Hardware	-
1	Heatsink		Q14 (Output Amp) Heatsink	-
1	Heatsink		Q13 (Driver) Heatsink small	
110cm	wire		110cm enameled copper wire 0,5mm	-
115cm	wire		100cm enameled copper wire 0,3mm	-
1	ILER MK2 PCB		100mm x 120mm ILER MK2 PCB	-

LIST OF INDIVIDUAL COMPONENTS

Resistors						
Checked		Ref.	Value	Ident./Comment	Circuit section	Located
		R1	10	brown-black-black	RX att.	B-10
		R2	1K	brown-black-red	RX att.	C-10
		R3	10K	brown-black-orange	Mic. Preamp	F-9
		R4	4K7	yellow-violet-red	Mic. Preamp	E-9
		R5	10K	brown-black-orange	Mic. Preamp	F-9
		R6	100K	brown-black-yellow	Mic. Preamp	F-8
		R7	1K	brown-black-red	Mic. Preamp	G-7
		R8	56K	green-blue-orange	DSB gen/RX mix	F-6
		R9	56K	green-blue-orange	DSB gen/RX mix	F-5
		R10	1K	brown-black-red	Carrier ctrl.	E-5
		R11	10K	brown-black-orange	Carrier ctrl.	D-6
		R12	10K	brown-black-orange	Carrier ctrl.	D-5
		R13	100	brown-black-brown	Mic.Preamp	F-8
		R14	10K	brown-black-orange	RX RF mute	D-7/8
		R15	22	red-red-black	Dem/Gen supply	G-3/4
		R16	1K	brown-black-red	AGC input	G-7
		R17	470K	yellow-violet-yellow	Audio AGC-preamp	H-9
		R18	150K	brown-green-yellow	Audio AGC-preamp	H-8
		R19	470K	yellow-violet-yellow	Audio AGC-preamp	G-9
		R20	220K	red-red-yellow	Audio AGC-preamp	G-8
		R21	47K	yellow-violet-orange	Audio AGC-preamp	G-9
		R22	10K	brown-black-orange	Audio AGC-preamp	H-10
		R23	1M	brown-black-green	Audio AGC-preamp	H-9
		R24	270K	red-violet-yellow	Audio AGC-preamp	H-8
		R25	4K7	yellow-violet-red	Audio AGC-preamp	H-10
		R26	33K	orange-orange-orange	Audio AGC-preamp	H-9/10
		R27	22K	red-red-orange	Audio AGC-preamp	I-9/10
		R28	47K	yellow-violet-orange	Audio AGC-preamp	I-8
		R29	47K	yellow-violet-orange	Audio AGC-preamp	J-8
		R30	1K	brown-black-red	Audio Amp mute	J-9
		R31	10K	brown-black-orange	Audio Amp mute	L-7/8
		R32	1K5	brown-green-red	Audio Amp mute	L-6
		R33	1	brown-black-gold	Audio Amp Out.	K/L-9
		R34	10K	brown-black-orange	BFO offset	L-5
		R35	10K	brown-black-orange	BFO offset	L-5
		R36	22K	red-red-orange	BFO	J-7
		R37	22K	red-red-orange	BFO	J-6
		R38	1K	brown-black-red	BFO	I-6/7
		R39	100	brown-black-brown	BFO	I-6
		R40	22K	red-red-orange	VXO	I-3
		R41	22K	red-red-orange	VXO	J-4/5
		R42	1K	brown-black-red	VXO	J-4/5
		R43	22K	red-red-orange	VXO	I-2
		R44	22K	red-red-orange	VXO	I-4
		R45	1K2	brown-red-red	VXO	I-4
		R46	470	yellow-violet-brown	VXO	I-4/5
		R47	1K	brown-black-red	TX Pre-driver	G-2
		R48	4K7	yellow-violet-red	TX Pre-driver	H-2
		R49	--	NO USED	TX Pre-driver	I-1
		R50	100	brown-black-brown	TX Pre-driver	I-1
		R51	1	brown-black-gold	TX Pre-driver	F-1
		R52	100	brown-black-brown	TX Driver	E/F-3
		R53	1K	brown-black-red	TX Driver	E/F-2
		R54	470	yellow-violet-brown	TX Driver	D-2
		R55	4K7	yellow-violet-red	TX Driver	D-2

		R56	22	red-red-black	TX Driver	C-1
		R57	1	brown-black-gold	TX Driver	B-1
		R58	270	(BIAS) red-violet-brown	BIAS TX Out Amp	C-3/4
		R59	1K	brown-black-red	TX Out Amp	A-3
		R60	1	brown-black-gold	TX Out Amp	B-1/2
		R61	1	brown-black-gold	TX Out Amp	A-1/2
		R62	1K	brown-black-red	Bi-color LED	K-6
		R63	1K	brown-black-red	Bi-color LED	L-6
		R64	**1K**	**If Q14 = 2SC1969** brown-black-red	**TX Pre-driver**	**G-2**
			3K3	**If Q14 = 2SC2079** orange-orange-red	**TX Pre-driver**	**G-2**
		R65	**--**	**NO USED**	**TX Pre-driver**	**F-2**
		P1	1K	RX-GAIN Pot. w/shaft optional	Rx-Gain Control	A-9
		P2	5K	502 or 53E trimmer	Mic preamp	F-10
		P3	5K	502 or 53E trimmer	DSB gen / Rx mix	F-5
		P4	10K	VOLUME pot. w/shaft 10K	Audio Amp volume	L-8/9
		P5	500	501 or 52Y trimmer	"Bias" out amp	C-4

Capacitors						
Checked		Ref.	Value	Ident./Comment	**Circuit section**	**Located**
		C1	100n	104 or 0.1	RX input	A-8
		C2	100n	104 or 0.1	RX input	A-8
		C3	100n	104 or 0.1	RX att	C-10
		C4	**82p**	**82P**	**BPF RX**	**C-9**
		C5	**8p2**	**8P2**	**BPF RX**	**C-8**
		C6	**82p**	**82P**	**BPF RX**	**C-9**
		C7	27p	27p or 27J	DSB gen/RX mix	E-7/8
		C8	10uF	10uf 25V or 35V (elec)	Mic preamp	E-10
		C9	100n	104 or 0.1	Mic preamp	E-10
		C10	330p	n33 or 331	Mic preamp	E-8
		C11	10uF	10uf 25V or 35V (elec)	Mic preamp	F-9
		C12	100n	104 or 0.1	Mic preamp	F-8
		C13	1uF	1uF 25V, 35V or 63V (elec)	DSB gen/RX mix	G-6/7
		C14	100n	104 or 0.1	Carrier ctrl.	D-5
		C15	100n	104 or 0.1	DSB gen/RX mix	F-6
		C16	220p	n22 or 221	DSB gen/RX mix	H-6
		C17	**33p**	**33p or 33J**	**FI xtal filter**	**F-7**
		C18	**33p**	**33p or 33J**	**FI xtal filter**	**E-6**
		C19	**33p**	**33p or 33J**	**FI xtal filter**	**E-5**
		C20	**33p**	**33p or 33J**	**FI xtal filter**	**E-4/5**
		C21	**33p**	**33p or 33J**	**FI xtal filter**	**E/F-4**
		C22	100n	104 or 0.1	SSB dem/TX mix	E-3
		C23	100n	104 or 0.1	IC2-IC3 supply	H-3
		C24	100n	104 or 0.1	IC2-IC3 supply	G-5
		C25	100uF	100uF 25V or 35V (elec)	C3 supply	F-4
		C26	10n	103 or 0.01	IC3 supply	H-4
		C27	220p	n22 or 221	SSB dem/TX mix	H-5
		C28	100n	104 or 0.1	Audio AGC-preamp	G-8
		C29	100n	104 or 0.1	Audio AGC-preamp	G-8
		C30	100uF	100uF 25V or 35V (elec)	Audio AGC-preamp	G-9
		C31	100n	104 or 0.1	Audio AGC-preamp	H-9/10
		C32	100n	104 or 0.1	Audio AGC-preamp	I-9
		C33	100n	104 or 0.1	Audio AGC-preamp	I/J-9
		C34	1n	102 or 0.001	Audio AGC-preamp	I-8
		C35	100uF	100uF 25V or 35V (elec)	Audio AGC-preamp	I/J-10
		C36	220uF	220uF 25V or 35V (elec)	VCC supply	H-7
		C37	10uF	10uF 25V or 35V (elec)	Audio Amp out.	J-10
		C38	10uF	10uF 25V or 35V (elec)	Audio Amp out.	J-9
		C39	100n	104 or 0.1	Audio Amp out.	K-8
		C40	10n	103 or 0.01	Audio Amp out.	L-9/10
		C41	100uF	100uf 25V or 35V (elec)	Audio Amp mute	L-7
		C42	100uF	100uF 25V or 35V (elec)	Audio Amp out.	K-10
		C43	100n	104 or 0.1	Audio Amp out.	K-8

		C44	100n	104 or 0.1	BFO offset	L-4
		C45	**220p**	**n22 or 221**	**BFO**	**I-7**
		C46	**220p**	**n22or 221**	**BFO**	**J-6**
		C47	1n	102 or 0.001	BFO	I-7
		C48	100n	104 or 0.1	BFO	J-7
		C49	10uF	10uF 25V or 35V (elec)	BFO/VXO supply	K-7
		C50	100n	104 or 0.1	BFO/VXO supply	I-8
		C51	100n	104 or 0.1	VXO	K-3/4
		C52	100p	n10 or 101	VXO	K-4/5
		C53	100p	n10 or 101	VXO	J-4/5
		C54	47p	47p or 47J	VXO	J-4/5
		C55	1n	102 or 0.001	VXO	H-4
		C56	100n	104 or 0.1	VXO	K-4/5
		C57	1n	102 or 0.001	TX Pre driver input	G-3
		C58	--	NO USED	TX Pre-driver	I-1/2
		C59	100n	104 or 0.1	TX supply	C-5
		C60	100n	104 or 0.1	TX Pre-driver	F-1
		C61	**82p**	**82p or 82J**	TX Pre-driver BPF	**H-1**
		C62	**8p2**	**8p2 or 8.2**	TX Pre-driver BPF	**G-2**
		C63	**82p**	**82p or 82J**	TX Pre-driver BPF	**F-1**
		C64	100n	104 or 0.1	TX Driver	E-3
		C65	100n	104 or 0.1	TX Driver	E/F-2
		C66	1n	102 or 0.001	TX Driver	D-1
		C67	100n	104 or 0.1	BIAS supply	D-4
		C68	10n	103 or 0.01	TX Driver	B-1
		C69	10n	103 or 0.01	TX Driver	C-2
		C70	100n	104 or 0.1	TX Driver supply	C-2/3
		C71	100n	104 or 0.1	TX Driver supply	E-3
		C72	100n	104 or 0.1	BIAS supply	C-3
		C73	100n	104 or 0.1	TX Out Amp supply	C-5
		C74	10uF	10uF 25V or 35V (elec)	TX Out Amp supply	C/D-6
		C75	100n	104 or 0.1	TX Out Amp	B-2/3
		C76	10n	103 or 0.01	TX Out Amp	B-3/4
		C77	100n	104 or 0.1	TX Out Amp supply	B-4
		C78	100n	104 or 0.1	TX Out Amp	A-5
		C79	**470p**	**470 (polystyrene)**	**LPF**	**A-6**
		C80	**1000p**	**1000 (polystyrene)**	**LPF**	**B-6**
		C81	**470p**	**470 (polystyrene)**	**LPF**	**C-6**
		C82	100n	104 or 0.1	PTT	G-6
		C83	**12p**	**12p or 12J**	**Offset BFO**	**K-6**
		CV1	**60p**	**Trimmer (brown)**	**BFO**	**J-5**
		CV2 + CV3		Polyvaricon (tuning control)	VXO Tuning	L-2/3/4

Crystals						
Cheked		**Ref.**	**Frequency**	**Ident./Comment**	**Circuit section**	**Located**
		X1	**4.915MHz**		**I.F.**	**E-7**
		X2	**4.915MHz**		**I.F.**	**E-6**
		X3	**4.915MHz**		**I.F.**	**E-5**
		X4	**4.915MHz**		**I.F.**	**E-4**
		X5	**4.915MHz**		**BFO**	**J/K-6**
		X6	**12.031MHz or none**		**VXO**	**J-3**
		X7	**12.031MHz or 12.096MHz**		**VXO**	**I-3**

Semiconductors						
Cheked		**Ref.**	**Type**	**Ident./Comment**	**Circuit section**	**Located**
		Transistors				
		Q1	BC547	BC547	RX RF mute	C-8
		Q2	BC547	BC547	Carrier switch	D-6
		Q3	BC547	BC547	Audio AGC preamp	H-9
		Q4	BC547	BC547	Audio AGC preamp	H-8

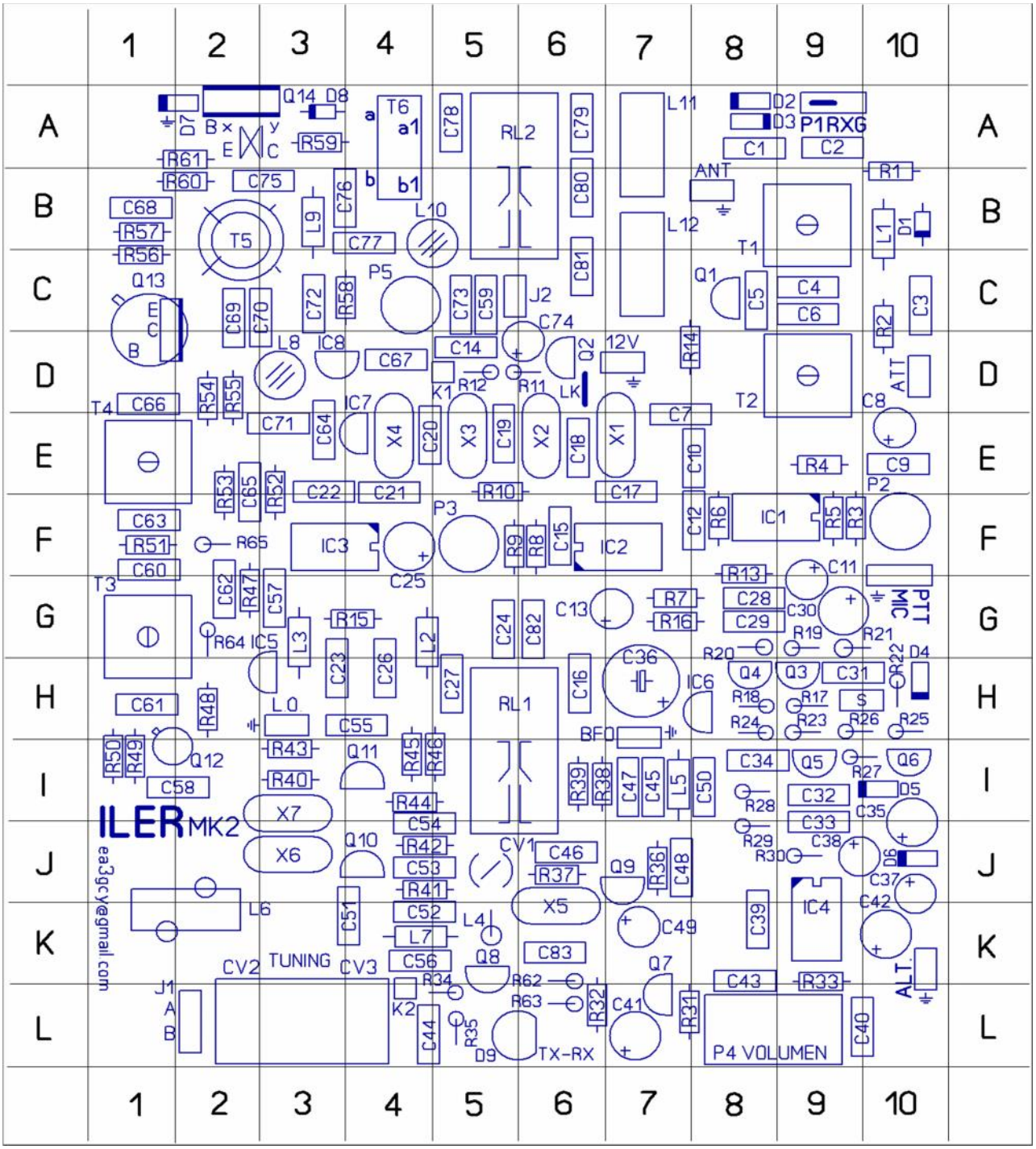
		Q5	BC547	BC547	Audio AGC preamp	I-9
		Q6	BC547	BC547	Audio AGC preamp	I-10
		Q7	BC547	BC547	Audio amp mute	L-7
		Q8	BC547	BC547 (option)	BFO offset switch	K-5
		Q9	BC547	BC547	BFO	J-7
		Q10	BC547	BC547	VXO	J-4
		Q11	BC547	BC547	VXO	I-4
		Q12	2N2222A	2N2222A	TX Pre driver	I-1/2
		Q13	2N5109	2N5109	TX Driver	C/D-1
		Q14	**2SC1969/2078**	**2SC1969 or 2SC2078**	**TX Out Amp**	**A-2/3**
		IC's				
		IC1	LM741	LM741CN or UA741	Mic preamp	F-8/9
		IC2	SA/NE602	SA602AN or NE602AN	DSB gen/Rx mix	F-6/7
		IC3	SA/NE602	SA602AN or NE602AN	SSB Dem/Tx mix	F-3/4
		IC4	LM386	LM386N-1	Audio Amp	J/K-9
		IC5	78L06	MC78L06	Dem/Gen supply	H-3/4
		IC6	78L08	MC78L08	BFO/VXO supply	H-8
		IC7	78L08	MC78L08	bias Driver	E-4
		IC8	78L05	MC78L05	BIAS Output Amp	D-3

		Diodes				
		D1	1N4148	4148	RX Att	B-10
		D2	1N4148	4148	RX RF limiter	A-8
		D3	1N4148	4148	RX RF limiter	A-8
		D4	1N4148	4148	Audio AGC preamp	H-10
		D5	1N4148	4148	Audio AGC preamp	I-10
		D6	1N4007 or 4001	1N4007 (1)	AGC preamp supply	J-10
		D7	1N4007 or 4001	1N4007 (1)	BIAS supply	A-1/2
		D8	Zener 47V 1W	BZX85C47	TX Out Amp	A-3
		D9	Led doble	Bicolor	LED	L-5/6

Inductors/RF Transformers						
Checked		**Ref.**	**Value/Type**	**Ident./Comment**	**Circuit section**	**Located**
		L1	Axial 100uH	brown, black, brown	Rx attenuator	B-10
		L2	Axial 100uH	brown, black, brown	DSB gen/Rx mix	G/H-4
		L3	Axial 100uH	brown, black, brown	SSB Dem/Tx mix	G/H-3
		L4	**Axial 39uH**	**orange, white, black**	**BFO**	**K-5**
		L5	Axial 100uH	brown, black, brown	BFO	I-7
		L6	T68-2	Turns = see text	VXO	J/K-1/2
		L7	Axial 100uH	brown, black, brown	VXO	K-4
		L8	VK200	ferrite wound	Driver	D-3
		L9	Axial 100uH	brown, black, brown	Output Amp	B-3
		L10	VK200	ferrite wound	Output Amp	B/C-4
		L11	**T37-2**	**Turns = see text**	**LPF**	**A-7**
		L12	**T37-2**	**Turns = see text**	**LPF**	**C-7**
		T1	**KANK3334 (5u3H)**	**K3334 or 5u3H**	**BPF Rx**	**B-9**
		T2	**KANK3334 (5u3H)**	**K3334 or 5u3H**	**BPF Rx**	**D-9**
		T3	**KANK3334 (5u3H)**	**K3334 or 5u3H**	**BPF Pre Driver**	**G-1**
		T4	**KANK3334 (5u3H)**	**K3334 or 5u3H**	**BPF Pre Driver**	**E-1**
		T5	FT37-43	toroid 10t 3t see text	Driver	B/C-2
		T6	FT37-43	Toroid 8+8 see text	Output Amp	A/B-4

Note:
The components written in **bold** are different according to the version of ILER that you have chosen (ILER-40, ILER-20 or ILER-17). In the kit, you will find all these components together in a separate bag.

120-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 120-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 is there and ready for assembly. Each constructor 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.).

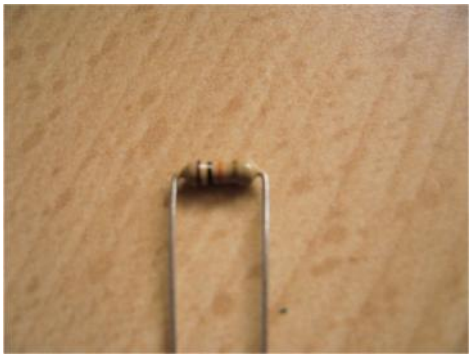
RECOMMENDED ASSEMBLY SEQUENCE

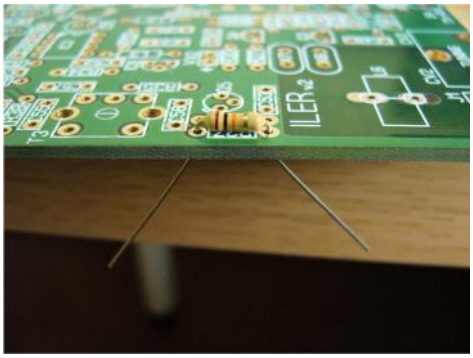
❒ **Resistance and jumper LK**

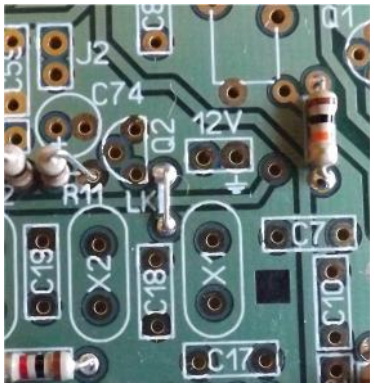
- The resistors are installed first. Mount all the resistors R1 to R65 and trimmers P2, P3 and P5. P4 is the volume potentiometer, which will not be installed yet.

Refer to the parts list, and select the first resistor, R1. Bend the leads as close to the component body as possible, 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 of the ends. 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 hold 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 them, cut the excess length off the component leads 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. Note that some resistors are mounted vertically; bend the leads and insert them as shown in the pictures.
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 resistor value.

- Bend a piece of leftover component lead and insert it into the jumper location marked as **LK** on the circuit board (located between Q2 and the “12V” terminals).





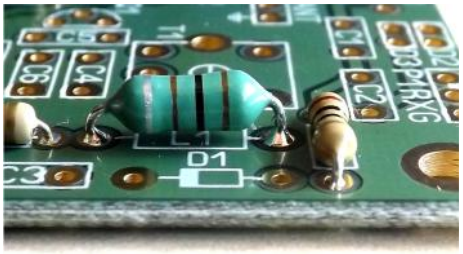


❒ Axial Inductors

L1, L2, L3, L4 L5, L7, L9

These components look like thick-bodied resistors and the body is colored blue or green. In its interior there is a small coil wound on a ferrite core. 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, but leave a separation of 1-1.5mm from the board.

Note: L4 is mounted vertically.



❒ Diodes

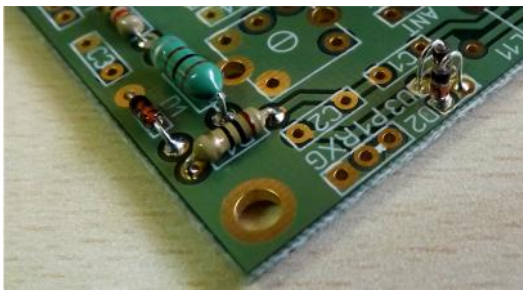
Next mount the diodes, being careful to place them with the correct orientation. There is a band on one end of each diode that corresponds to the component outline on the circuit board.

D1, D2, D3, D4 and D5 are 1N4148; 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.

D8 is similar to the 1N4148 but slightly thicker. It is marked as BZX85C47.

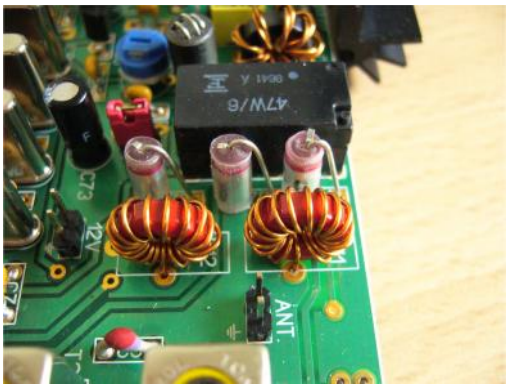
D6 and D7 are 1N4007 diodes; they are black with a gray band. Mount D6 only.

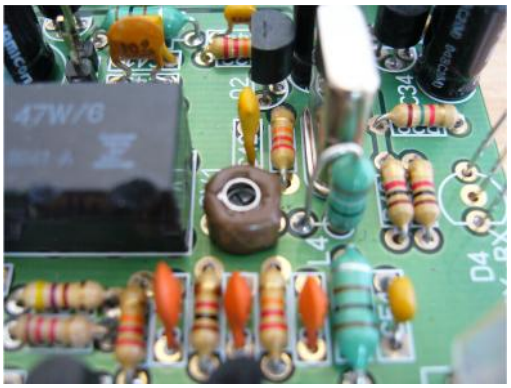
DO NOT MOUNT diode D7 now (“bias” limiter), nor the bi-color LED rx/tx D9.



❒ 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.
C79, C80 and C81 are polystyrene capacitors; these are axial capacitors, but they must be placed in a vertical position.
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.
CV1 is a trimmer capacitor which is black in color. It does not have printed numbers. Place it with the rounded edge closest to the relay.
CV2 + CV3 are the same capacitor; it is a dual-section “Polyvaricon” variable tuning capacitor. DO NOT INSTALL IT yet.



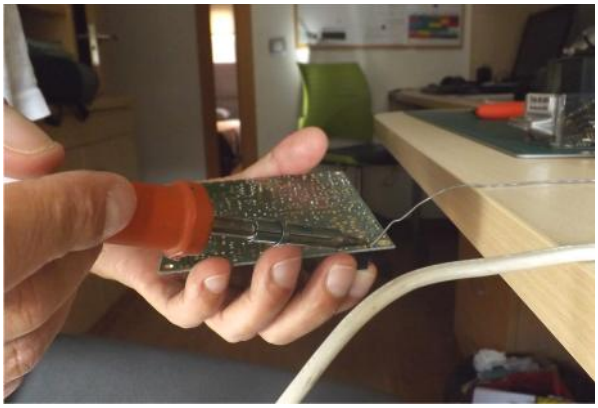


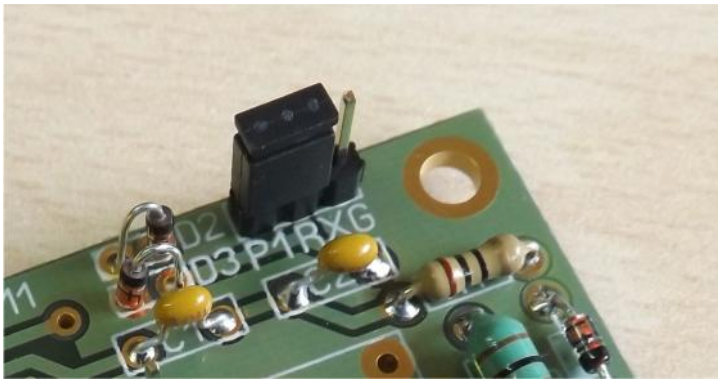
❒ Radial Inductors VK200

L8 and L10 are broadband ferrite RF chokes; they are mounted in a vertical position.
Separate them approximately 0.5 - 1mm above the board to prevent the windings from touching any part of the printed circuit.

❒ Pin "headers"

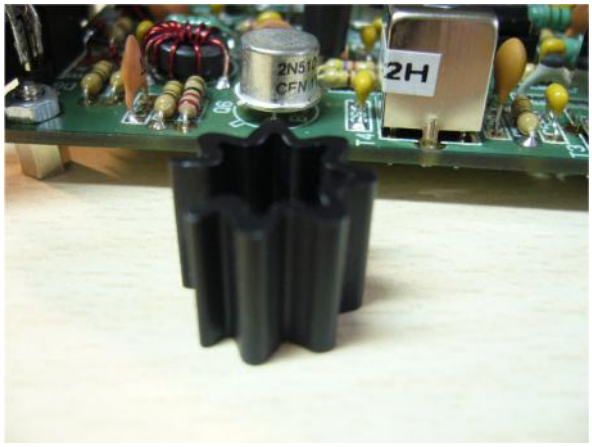
Place and solder the pins in Mic(3), 12V(2), ATT(2), P1-RXG(3), ANT(2), ALT(2), D7(2), VXO(2), BFO(2), J1(3), J2(2), K1(1), K2(1), and S(2).
Place “jumpers” between pins “J2” and “J1-B” and between the active pins of “P1-RXG” (if RX gain potentiometer is not used).
Turn the board over and insert and 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!

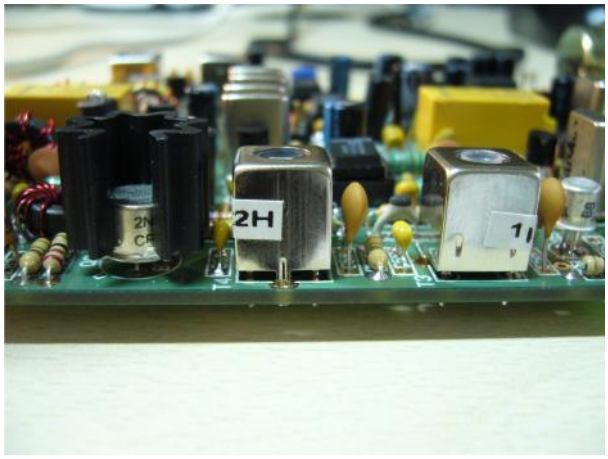




❒ Transistors

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. Transistors Q1 through Q11 are all of the type BC547. Q12 is a 2N2222 and Q13 is a 2N5109; these two transistors have a small tab that must match up with the component outline printed on the circuit board. Mount them with 1.5-2mm separation from the board. Mount the crown-like heatsink, which you will find in the kit’s "hardware" bag, onto Q13.
Do not install Q14 (TX power amplifier) yet.





❒ 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 oriented towards the notch in the IC socket or the "U" on the component outline.

Mount the sockets for IC1, IC2, IC3 and IC4 in the locations printed on the circuit board. Make sure that the sockets lie flat against the circuit board.

Next, insert IC1, IC2, IC3 and IC4 into their respective sockets.

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.

Now, mount the voltage regulators IC5, IC6, IC7 and IC8 in their respective locations according to the markings of the component outline on the circuit board.

❒ Crystals

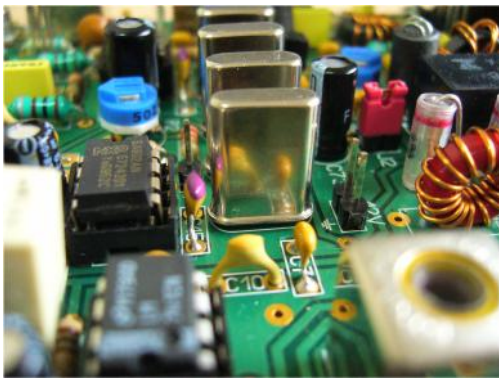
Install X1 through X7.

X1, X2, X3 and X4 are part of the SSB filter, and X5 is the oscillator crystal for the BFO. 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 pair X6 & X7 are the VXO crystals.

The crystal housing should not touch the board; place them slightly separated from the board, at a distance of 0.5-1mm.

The ILER-20 has two options for the VXO crystals X6 and X7; option A uses a pair of 12.031MHz crystals and option B uses one 12.096MHz crystal.

If you use 12.031MHz crystals, you must open the legs carefully to insert in its place. They have an insulating sheet and can touch the board.

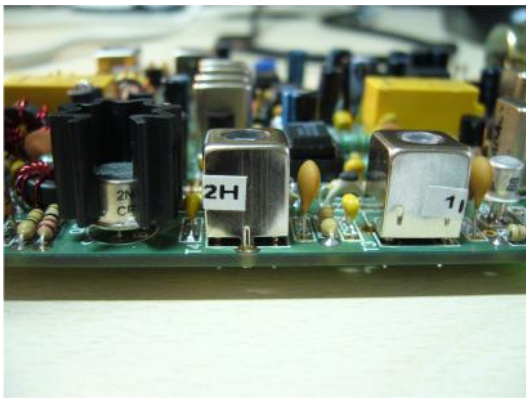


❒ Relays

Install relays RL1 and RL2; they can only be mounted in one position.
Make sure that the body of the relay lies flat against the circuit board.

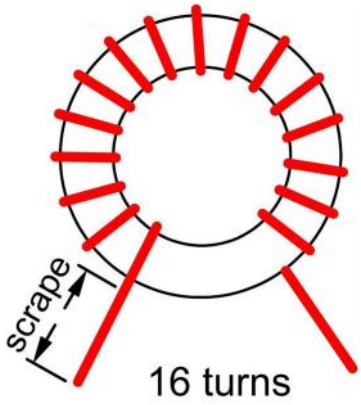
❒ Shielded coils (cans)

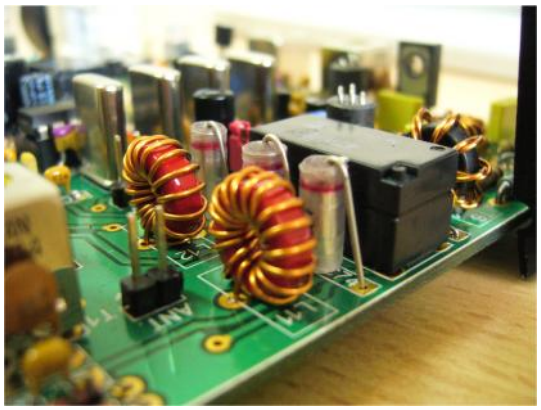
T1, T2, T3 and T4 are shielded coils equivalent to Toko KANK3334, marked as **5u3H**. They are RF transformers for the passband filters. Make sure that they lie flat against the circuit board.
In order to solder the tabs of the shield, you will need to hold the soldering iron a little longer on the joint or use a higher-wattage soldering iron.

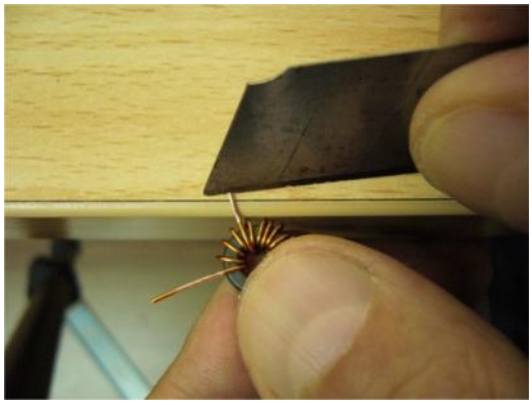


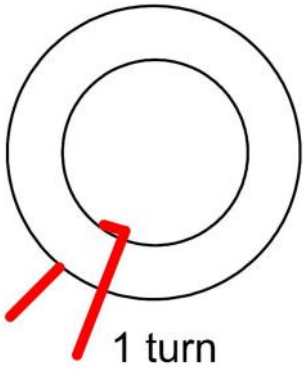
❒ LPF Toroids L11 and L12

L11 and L12 are identical. They use T37-2 cores (red toroid with 9.5mm/0.375in OD).
Cut 25cm (10”) of 0.5mm diameter enameled wire and wind sixteen (16) turns on a red toroidal T37-2 core. Spread the turns evenly around the toroid and wind them tightly so that 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 (0.4”). Scrape off the enamel with a cutter from the ends of the wire, in order to solder the toroid onto the board.
Counting the turns: Count one turn for every time the wire passes through the center of the toroid.
Important: wind the toroid exactly as shown in the pictures.
One turn more or less will affect the operation and the power output.







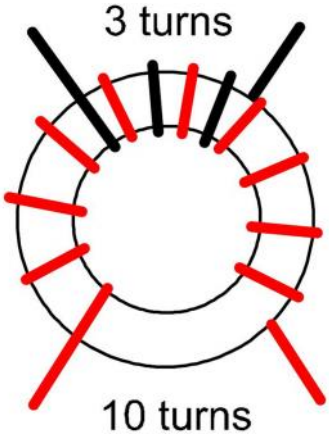


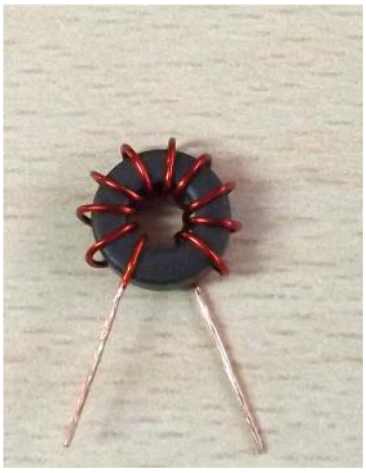
❒ **Toroidal transformer T5**

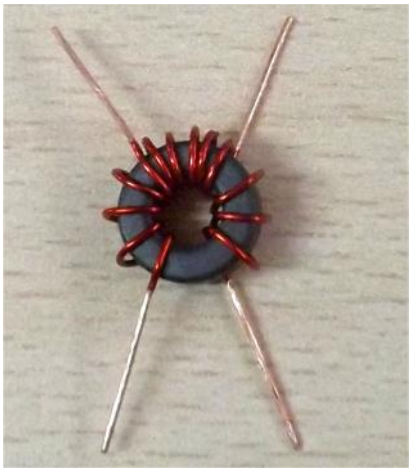
T5 is an impedance matching transformer. A FT37-43 is used (black toroid with 9.5mm/0.375in OD). It has a 10-turn primary and a 3-turn secondary.

- 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 toroid and wind them tightly so that 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 8cm (3.5”) of 0.5mm diameter enameled wire and wind three (3) turns on the other side of the toroid, spacing the turns within the space between the turns of the previous winding. Leave pigtails of 10-20mm (0.70”).
- Before inserting them on the circuit board, use a cutter or sandpaper to scrape off the enamel from the pigtails of the windings. Solder them in place. Mount the toroid with approximately 0.5 - 1mm distance from the board.
- The 3-turn winding is facing towards output transistor Q14 and the 10-turn winding towards C69 - C70.

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







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

❒ Toroidal transformer T6

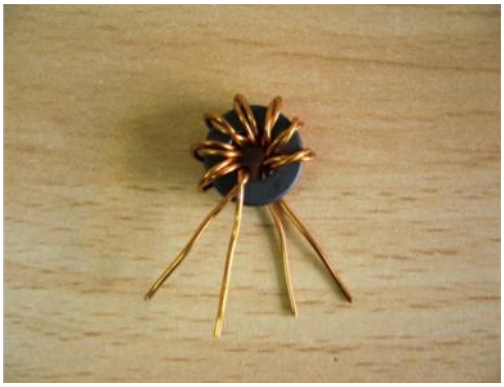
T6 is an impedance matching transformer with a bifilar winding. A FT37-43 is used (black toroid with 9.5mm/0.375in OD). It has 8+8 turns.

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

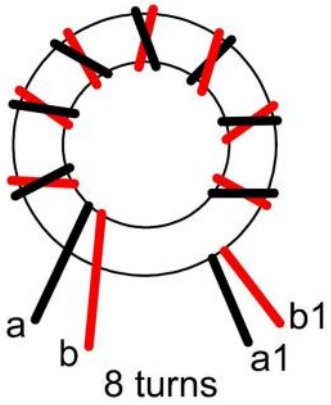
16cm (32 cm bent in half)

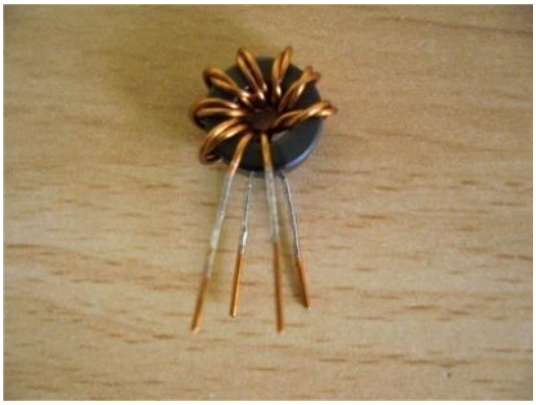
- Before beginning to wind, leave 15-20mm of wire, measured from the end of the wires to the outer edge of the toroid. Now wind eight (8) turns on the toroid. Remember: Count one turn for every time the wire passes through the center of the toroid.

- Spread the turns evenly around the toroid.



- Cut the ends and separate the two windings.
- Use a sharp X-Acto 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.

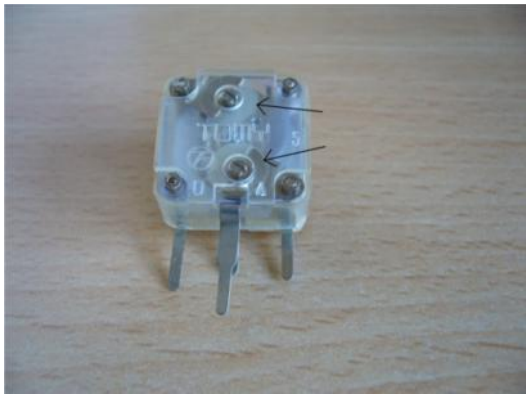
❒ VXO tuning Polyvaricon CV2/CV3

Install the hardware shaft onto the polyvaricon with the 12mm-long, M2.5 screw.
Mount the Polyvaricon with a separation of 2-3mm or more from the board (see picture). This makes it easier to fit the variable cap to the front panel. Please, do not solder it until you are sure of how you are going to mount the board into the box.
You may want to mount the polyvaricon off the board. This may be a good idea and there is no objection to doing it, but use very short and slightly rigid wires. Even small movements may affect the tuning!
This polyvaricon contains two variable tuning capacitor sections. By means of external jumpers J1 A/B, you may select which section you will use; section CV2, which is the one with greater capacitance, is selected by placing jumper “B”; section CV3, which has less capacitance, is selected by placing jumper "A".

CV2 has about 160pF, CV3 has about 70pF.
In the back of the capacitor there are two padders (trimmers) for fine adjustment. The lower one is parallel with CV2 (J1-B) and the top one is parallel with CV3 (J1-A). **Adjusting these trimmers changes the upper limit of band coverage by some 10-20 KHz!** The upper limit adjustment must be done with the polyvaricon at its minimum capacitance (turned completely clockwise).

For the ILER-40, jumper J1 must be placed in position B.

IMPORTANT: When screwing the polyvaricon to the front panel (M2.5 screws of 4mm) take care to not drive the screws in too much, to avoid blocking the internal mechanism of polyvaricon. If needed, add some washers to space the screws out from the panel to avoid this problem.



❒ L6 VXO tuning inductor

A T68-2 is used (red toroid with 18mm/0.690in OD).
Cut about 113cm (44in) of 0.3mm enameled wire.
The number of turns for L6 will depend on the crystal option that you have chosen for the VXO:
- If you use the 12.031MHz crystal pair, then wind fifty-four (54) turns.
- If you use one 12.096MHz crystal, wind fifty-five (55) turns.

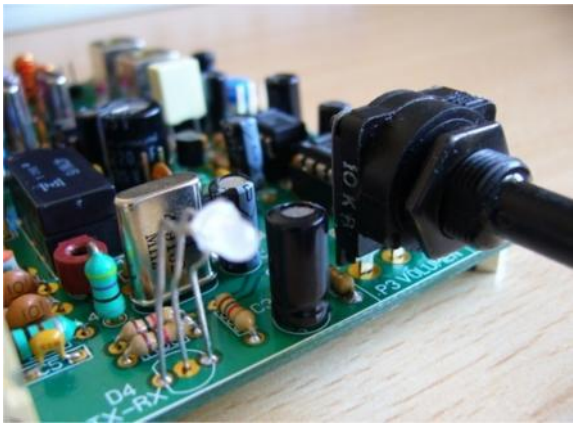
Leave an extra 1.5-2cm pigtail of wire on each end.

L6 can be wound in two stages. Pass half of the wire through the toroid, wind half of the toroid, and then turn the toroid and wind the other half. If you're not sure how many turns you have wound, you can count them easily looking closely through a magnifying glass. The half-turns that only pass through the inside of the toroid also count as a complete turn.

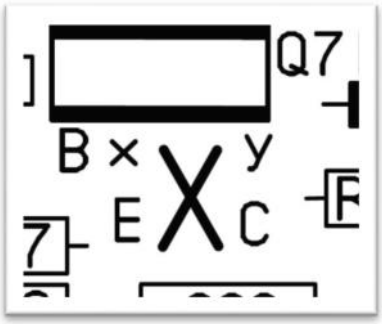
IMPORTANT: DO NOT MOUNT toroid L6 yet. It will be installed later, in the last section for adjustments (see the section "adjustment and testing").

❒ Volume Potentiometer P4 and Tx-Rx LED D9

Install the volume potentiometer P4 and the bi-color LED D9 as shown in the picture.
You may prefer to mount these components on the front panel, off the circuit board. There is no problem in doing this as long as the wires you connect them with are kept short.
Some series of bi-color LED's are fabricated with the leads reversed; in this case you will need to orient the LED opposite to what the circuit board's component outline shows.
It should illuminate in green in Rx and in red in Tx; if it is the contrary, just turn the LED around (the middle lead is always the common).



❒ Jumpers "E-C-x-y", positioning of the Q14 and D7

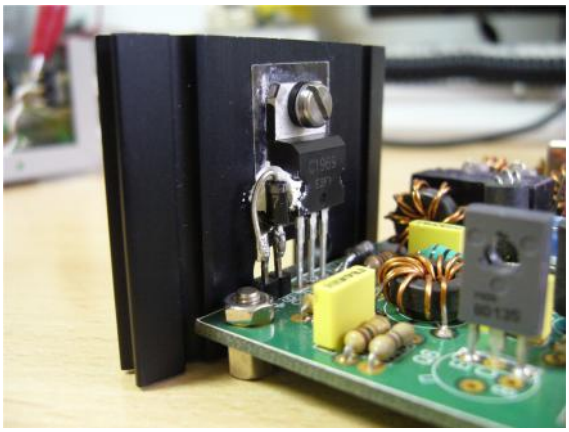


The combination of jumpers “E-x-C-y” allows the use of different types of transistors for Q14. If need be, we can use substitutes with different lead configurations.
The ILER-40 kit uses a 2SC1969 or 2SC2078 for Q14 and **the following the jumpers SHOULD BE INSTALLED: “E-y” and “C-x”.** Cut small pieces of wire to make the connections "E" to "y" and “C” to “x”.
Make sure that the wires do not touch each other.

The case of Q14 should be electrically isolated from the heatsink. Use the plastic washer and the mica sheet provided with the transistor. Fasten it with the 10mm screw, nut and M3 washer. After mounting the transistor to the heatsink, verify with a multimeter that the transistor case does not make contact with the screw or with the heatsink. It is also recommended to apply a dab of thermal grease on both sides of the mica sheet.

Install diode D7 with it touching Q14 and the heatsink so that there is heat transfer among them**.**
The cathode (marked with a white band on the diode) connects to the pin marked with a GND symbol on the circuit board. This diode helps to stabilize the idle current BIAS as the transistor heats up. Pay attention to the following photo to see how the transistor and diode are mounted.

You may drill another hole on the heatsink if that better suits its position in your box. You may also mount the circuit board on the rear part of the box with the heatsink external to the box.



DO NOT operate the transceiver without mounting Q14 to the heatsink.

❒ Terminals “ATT” for enabling the RX attenuator

The header pins labeled “ATT” (located in quadrant D-10) can connect to a simple switch to activate the receive attenuator.
The attenuation level is inversely proportional to the value of R1, which takes a part of the signal from the antenna to ground. As you use the ILER-40, you may decide that you prefer a different level of attenuation; simply replace R1 with the next value above or below that of the current resistance, according to your wish.
The receiver can operate perfectly without using terminals “ATT”; however, it will not be able to reduce the signal of the antenna input to compensate for very strong signals, and consequently it might produce intermodulation distortion due to saturation of IC2.
If you frequently use the ILER-40 at different hours of the day and night, it might prove useful to add a potentiometer for “RF Gain” at the terminals “P1RXG”, with which you can adjust the attenuation level at the RX input according to what is most appropriate for each situation.

❒ Terminals “P1RXG” for connecting a RX attenuator potentiometer (optional)

The header pins P1RXG can connect to a 1K linear potentiometer for adjusting to the most appropriate attenuation level at the moment. This potentiometer is optional and is not included with kit. For connection details, see the corresponding Appendix in the additional documentation.
If not using the P1, remember to place a “jumper” (bridge) among active terminals.

❒ Terminal “K1” for carrier generation

The header pin marked "K1" is located in quadrant D-6.
This terminal is provided for generating a carrier for testing, transmitter adjustments, adjusting antenna couplers, etc. It can also be used to operate the ILER-40 in CW mode (see Appendix in the additional documentation).
Connecting terminal K1 to +V during transmission, unbalances the modulator and a carrier is generated.

❒ Terminal “K2” BFO offset for CW (occasional)

The terminal marked "K2" is located in quadrant L-4.
This terminal is provided to shift the BFO during transmit by several hundreds of Hertz to use the ILER-40 in CW mode. To operate in CW, the K2 terminal stays connected to +V during RX and is disconnected during TX (see Appendix in the additional documentation).

Important:

- Note that to operate in CW mode, the switching of K1 and K2 connections operates opposite each other. For more details, see the corresponding Appendix in the additional documentation.
- **The ILER-40 is not specifically designed for operating in CW.** However, K1 and K2 allow CW operation on an occasional basis, for tests or in case of emergency.

- To operate only in SSB, no connection to K1 or K2 is necessary.
- All of the adjustments mentioned in this manual are for operating in SSB.

ADJUSTMENTS AND TESTS

❒ Preliminary Testing

- Adjust P3 (carrier suppression), P4 (volume potentiometer), and P5 (bias adjustment) to mid-position.
- Adjust P2 (mic gain) to minimum position (counterclockwise).
- Connect a speaker or headphones to the “ALT” pins on the circuit board.

IMPORTANT: Use a high-quality speaker box. A bad speaker will make ineffective the operation of the transceiver.

- DO NOT yet connect a microphone.
- Apply power supply voltage (12-14V) to the “12V” header pins on the circuit board.
- Measure the voltage at the following main points:

Rx-Tx LED illuminated green (some LED’s have the leads reversed; turn it around if it is red in Rx).
8V on any lead of L5 or L7 to ground.
6V on any lead of L2 or L3 to ground.

- Turn the volume to maximum; you should hear a hissing noise in the headphones or speaker.

If everything is okay, you may continue.
If something is not right, you will need to examine it. (see the section, “If your kit does not work after assembly").

❒ Adjustment of the VXO Tuning Inductor L6 and Polyvaricon CV2/CV3

The following work is usually more enjoyable than what it appears at first; it is not “plug & play”. Look for a few hours when you are not in a hurry. Take your time and enjoy yourself!
Solder the pigtails of L6 in place on the circuit board. Leave them a little long (5-6mm) for the moment, so that you can compress or spread the turns. Connect a frequency counter to the “VXO” header. If the input of the frequency counter is low impedance, insert a 470 ohm (or greater) or a small value capacitor (try with 22pF or less) between the frequency counter and the header to reduce the interaction with the VXO.
If you don’t have access to a frequency counter, you may use a high-quality SSB or CW receiver that covers the VXO frequency (12.000MHz) and that has digital frequency readout. Connect to the receiver antenna input a piece of wire with a small loop and place it close to the VXO.
Note: Use of a frequency counter is highly recommended for this adjustment, as the use of a receiver is very cumbersome.
The IF frequency of 4.915MHz is substract to the VXO frequency, for example of 12.010MHz, to obtain the operating frequency of 7.095MHz (VXO crystals option=12.031MHz). Another example would be IF 4.915MHz and VXO 12.065MHz = 7.150MHz (VXO crystal option of 12.098MHz).
Spreading or compressing the turns changes the range of coverage. Compressing the turns increases the inductance, thus increasing the frequency range. If the turns are spread, the inductance and thus the frequency coverage decreases. Spreading or compressing the turns very little achieves a variation of a few Khz.
The polyvaricon contains two variable tuning capacitor sections. J1 selects which section is used. Placing jumper “B” selects the section with more capacitance, CV2 (160pf); placing jumper “A” selects the section with less capacitance, CV3 (70pf).
The following illustrative table uses **J1** with a jumper in **position B** and the **turns on L6** moderately compressed (this is the configuration that I recommend for the ILER-40):

For the ILER-40, jumper J1 should be placed in position B.

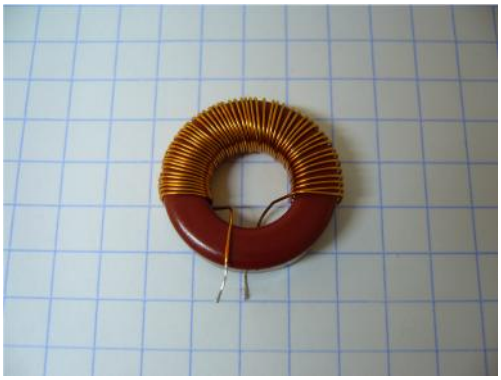
Option X6-X7 = 12.031Mhz.

J1-B T68-2= 54 turns	Maximum		Minimum		
X6-X7 = 12.031Mhz.	MHz	MHz	MHz	MHz	
	VXO	**RF**	**VXO**	**RF**	**Coverage**
	12.020	7.105	11.955	7.040	65Khz

Option X7 = 12.096Mhz.

J1-B T68-2= 55 turns	Maximum		Minimum		
X7 = 12.096Mhz.	MHz	MHz	MHz	MHz	
	VXO	**RF**	**VXO**	**RF**	**Coverage**
	12.085	7.170	12.015	7.100	70Khz

Values are strictly illustrative. They will be influenced by the number of turns on L6, the rear fine tuning trimmer adjustment and the component tolerances.



Upper frequency limit adjustment.

In the back of the polyvaricon there are two padders (trimmers) for fine adjustment. The lower one is parallel with CV2 (J1-B) and the top one is parallel with CV3 (J1-A). In the ILER-40 the lower trimmer is used. **This adjustment allows setting the upper frequency limit within a range of more than 10 KHz!**

Make this adjustment with the polyvaricon at its minimum capacitance (completely clockwise).

In the ILER-40 try locating the padder (trimmer) at its minimum capacitance (completely open) to obtain the highest possible upper limit.

In the case that, even after spreading the turns to the maximum the range is very large, or compressing them the range is very small, you can take off or add a turn to L6. (one more turn = more range; one less turn = less range).

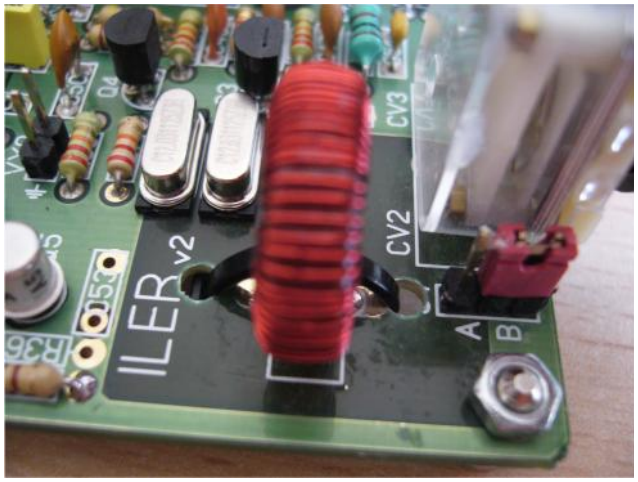
Once you are sure that the VXO range will suit your needs, you will need to secure L6 in position on the board. I suggest two options:

1) Use a little bit of wax or *hot glue* (that doesn't contain water) to secure it in the place. Then you may also use a fine layer of nail polish to fix the turns.

Caution: Some glues, due to their composition, may greatly affect the characteristics of L6, even after curing. You may find that once you have secured inductor L6, the VXO frequency has changed considerably in relation to the adjustments that were made before. They can also absorb more or less humidity, affecting the stability.

2) ***The most effective and cleanest option*** is to use a small plastic tie-wrap, passing it through the holes in the circuit board as showing in the picture.
Once the tie-wrap is fully tightened, you will still be able to move the turns slightly and make slight adjustments before securing them with a little bit of nail polish.

L6 should be well secured; this is *very important, since vibrations may change the VXO frequency, causing frequency "flutter" in the received and transmitted signals.*
IMPORTANT: Prior to permanently securing L6, make all of the transceiver adjustments and checks and confirm that the frequency coverage suits your needs.



I recommend this number of turns and type of toroid for L6. It works well! However, you can modify and experiment with the inductance to try a different coverage. More inductance will increase the coverage but reduce the stability and the VXO may even stop oscillating, and vice versa.

In order to obtain good stability, a maximum coverage of 50-60 KHz is recommended.

In addition, a wide coverage will make tuning difficult, and it will be necessary to add a fine tuning control by using gear reduction on the polyvaricon, a second variable capacitor or a varactor diode.
Do not worry too much about obtaining exact coverage down to the KHz. Is it so important to end up with 60, 59 or 61 KHz?
If you have graphical ability, you can draw a dial on the front panel with a frequency scale to serve as a guide.
In order to put us in other segments of the band different from those specified here, you will need to use VXO crystals with different frequencies.

❒ Adjustment of the BFO/Carrier Oscillator

There are two ways to adjust the BFO oscillator frequency.

- Adjustment without instrumentation:
Turn on the transceiver. Leave it on for about 5 minutes.
You can adjust CV1 while listening to a LSB signal on the 40 meter band. This is a “two-hand” operation; tune the VXO to obtain the best possible intelligibility, and next adjust CV1 to obtaining the best possible audio quality. Repeat these adjustments until obtaining the best possible results.

- Adjustment with instrumentation (requires a frequency counter):
Turn on the transceiver. Leave it on for about 5 minutes. Connect the frequency counter to the “BFO” header. If the input of the frequency counter is low impedance, insert a 470 ohm (or greater) resistor or a small value capacitor (try 22pF or less) between the frequency counter and the header to reduce the interaction with the BFO.
Adjust CV1 for a frequency of 4.913.5 MHz. You may readjust it slightly later if needed.

The total range of the CV1/BFO is approximately 4.912.8 to 4.914.5 MHz. The capacitance of the trimmer goes from maximum to minimum in a ½ turn (180 degrees). If you look inside the adjustment hole, you will see that there is an arrow to one side or other of the travel. When the arrow points to the flat part of trimmer, the capacitance is at minimum.
Note: The BFO adjustment is important for reception, but even more so for transmission, as it substantially influences the modulation quality as well as the output power. The signal may sound too sharp and tinny or very bassy and muffled.

❒ Adjustment of the RX pass band, T1 and T2

Note: For this adjustment you will need an “alignment” tool suitable for this type of coils; if you use a screwdriver, you risk of breaking the core of the coil.
With an antenna connected to the transceiver, alternately adjust T1 and T2 until obtaining the maximum level of noise in the speaker. Now, try to tune in a stable signal within the band and readjust T1 and T2 alternatively until you hear it at the highest possible level.
If you have access to an RF generator, begin injecting a signal of about 1uV within the frequency coverage of receiver and tune it in. Reduce the level of the RF generator to the minimum that is still audible with a loudspeaker or headphones, and alternately adjust T1 and T2 until obtaining the maximum reception level.
Once you have finished all of the adjustments and tests for the ILER-40, you may make a slight readjustment of the reception if you wish.

REMEMBER: All transmission tests should be done with a 50 ohm load connected to the transmitter output. DO NOT OPERATE the transmitter without a heatsink attached to Q14.

❒ Adjustment of the idle current of the TX output transistor Q14

Although this adjustment is not critical, it is important to do it with the transistor cool.
Adjust P2 (mic gain) to minimum position (counterclockwise). Remove jumper J2. Adjust P5 (“BIAS” adjustment) to the center of its range.
Connect a multimeter in its position for measuring current on the 200mA scale in series with the pins of J2. Activate the PTT or put a jumper between the PTT pin and ground; adjust P5 to obtain about 45mA on the meter.
As transistor Q14 is heating up, it is normal for this value to increase.
If you don’t have a meter for measuring milliamperes, adjust P5 to about 75% of its range (going clockwise); this position will be within the correct margin.
After finishing the adjustment, return jumper J2 to its position and readjust P2 (mic gain).

❒ Adjustment of the TX passband, T3 and T4

Note: For this adjustment you will need an “alignment” tool suitable for this type of coils; if you use a screwdriver, you risk of breaking the core of the coil.
Connect a power meter with a 50 ohm load to the antenna jack.
I suggest two options for adjusting the transmitter passband:

1) If you have access to an audio generator, set the mic gain (P2) to half range and injects a signal of around 800-1000Hz. at about 20mV into the mic input; put the transceiver in transmit mode (PTT pin to “GND”) and alternately adjust T3 and T4 until obtaining to the maximum power reading on the power meter.

2) If you don’t have access to instrumentation, connect a wire from header pin “K1” to positive +12V and puts the transceiver in transmit (pin PTT to GND). This will cause the modulator to generate a carrier; alternately adjust T3 and T4 until obtaining the maximum power level possible on the power meter **(you will not obtain the maximum power until connecting the microphone).** After finishing the adjustment, disconnect the wire from pin “K1”.

❒ Adjustment of the Balanced modulator (carrier suppression)

Adjust P2 (mic gain) to minimum (counterclockwise). Adjust P3 to mid-position.
Connect the power supply. Let the transceiver warm up for about 5 minutes.
Now, activate the PTT pin of the mic and monitor the transmitter output with an oscilloscope (with a 50 ohm load connected). Adjust P3 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 P3 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.

IMPORTANT: The ILER-40 mic input is quite sensitive and offers very comfortable operation and good modulation quality. Use of a classic dynamic microphone, such as those used for CB’s, is recommended.
In order to use an electret microphone, a small adaptor circuit will need to be used (see the Appendix in the additional documentation).
The use of amplified microphones is not recommended.
Just as choosing a good speaker is important for reception, be careful with the type of microphone that you use and with the gain adjustment; an unsuitable microphone or excessive gain can ruin the transmission quality.

❒ Adjustment of mic gain P2

Adjustment with instrumentation.
Connect the 50 ohm load and power meter to the antenna jack. Adjust P2 (mic gain) to its mid-position.
Connect the microphone to the mic input and press the PTT to go to transmit. (TX = PTT to “GND”)
Connect an oscilloscope to the antenna jack (along with a 50 ohm load). Adjust the transceiver to see the signal envelope and, speaking loudly into the microphone, adjust P2 just to the point before seeing distortion on the waveform.

If you don't have access to instrumentation, speak or whistle into microphone and adjust P2 so that you obtain the maximum power level of power on the power meter. P2 should be adjusted just to the point at which maximum power is obtained or a little less.

This adjustment will be a little ambiguous, since it depends a lot on the operator's type of voice and way of speaking. Use the "cut and try" method.
It is recommended that you request a fellow operator to critique your modulation.

Note: For very sharp or very bassy voices, you may slightly readjust the BFO to obtain the best level of output power.

IF YOUR KIT DOES NOT WORK AFTER 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 of faults are due to poorly soldered connections or misplaced components; it is very rare to find a faulty component. 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.

To help troubleshoot your transceiver, the following voltage table may be useful. The IC and transistor voltages were measured in receive **(without volume)** and transmit **(without modulation)**. If there is a fault, it is quite likely that one or more of the readings will be very different.

IC Ref.	Type	pin1 Rx	pin1 Tx	pin2 Rx	pin2 Tx	pin3 Rx	pin3 Tx	pin4 Rx	pin4 Tx
IC1	LM741	0	0	0	6.20	0	6.55	0	0
IC2	SA602	1.26	1.26	1.26	1.26	0	0	4.95	4.95
IC3	SA602	1.40	1.40	1.40	1.40	0	0	4.80	4.80
IC4	LM386	1.34	0.42	0	0	0	0	0	0
IC5	78L06	Out.=6V	--	--	--	--	--	--	--
C6	78L08	Out.=8V	---	--	--	--	--	--	--
IC7	78L08	Out.=8V	--	--	--	--	--	--	--
IC8	78L05	Out.=5V	--	--	--	--	--	--	--

IC Ref.	Type	pin5 Rx	pin5 Tx	pin6 Rx	pin6 Tx	pin7 Rx	pin7 Tx	pin8 Rx	pin8 Tx
IC1	LM741	0	0	0	6.25	0	13.2	0	0
IC2	SA602	5	5	5.9	5.9	5.45	5.14	5.95	5.95
IC3	SA602	4.8	4.8	5.9	5.9	5.2	5.2	5.9	5.9
IC4	LM386	6.65	0.4	13.5	0.4	6.80	0.4	1.35	0.4

Transistor Ref.	Type	B Rx	B Tx	E Rx	E Tx	C Rx	C Tx
Q1	BC547	0	0.7	0	0	0	0
Q2	BC547	0	0	0	0	1.28	1.28
Q3	BC547	0.60	0	0.04	0.85	2.20	0
Q4	BC547	0.46	0	0	0	0.04	0.85
Q5	BC547	0.60	0	0	0	3.65	0
Q6	BC547	0	0	0	0	12	0
Q7	BC547	0	0.7	0	0	0	0
Q8	BC547	0	0	0	0	--	--
Q9	BC547	3.85	3.85	4.20	4.20	7.97	7.97
Q10	BC547	3.80	3.80	4.15	4.15	7.97	7.97
Q11	BC547	3.95	3.95	3.80	3.80	7.97	7.97
Q12	2N2222	0	2.30	0	1.70	0	13.4
Q13	2N5190	0	2.25	0	1.60	13.5	13.5
Q14	2SC1969	0	0.68	0	0.03	13.5	13.5

VCC = 13.5V Approximate values of +/-10% can be considered correct.

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.

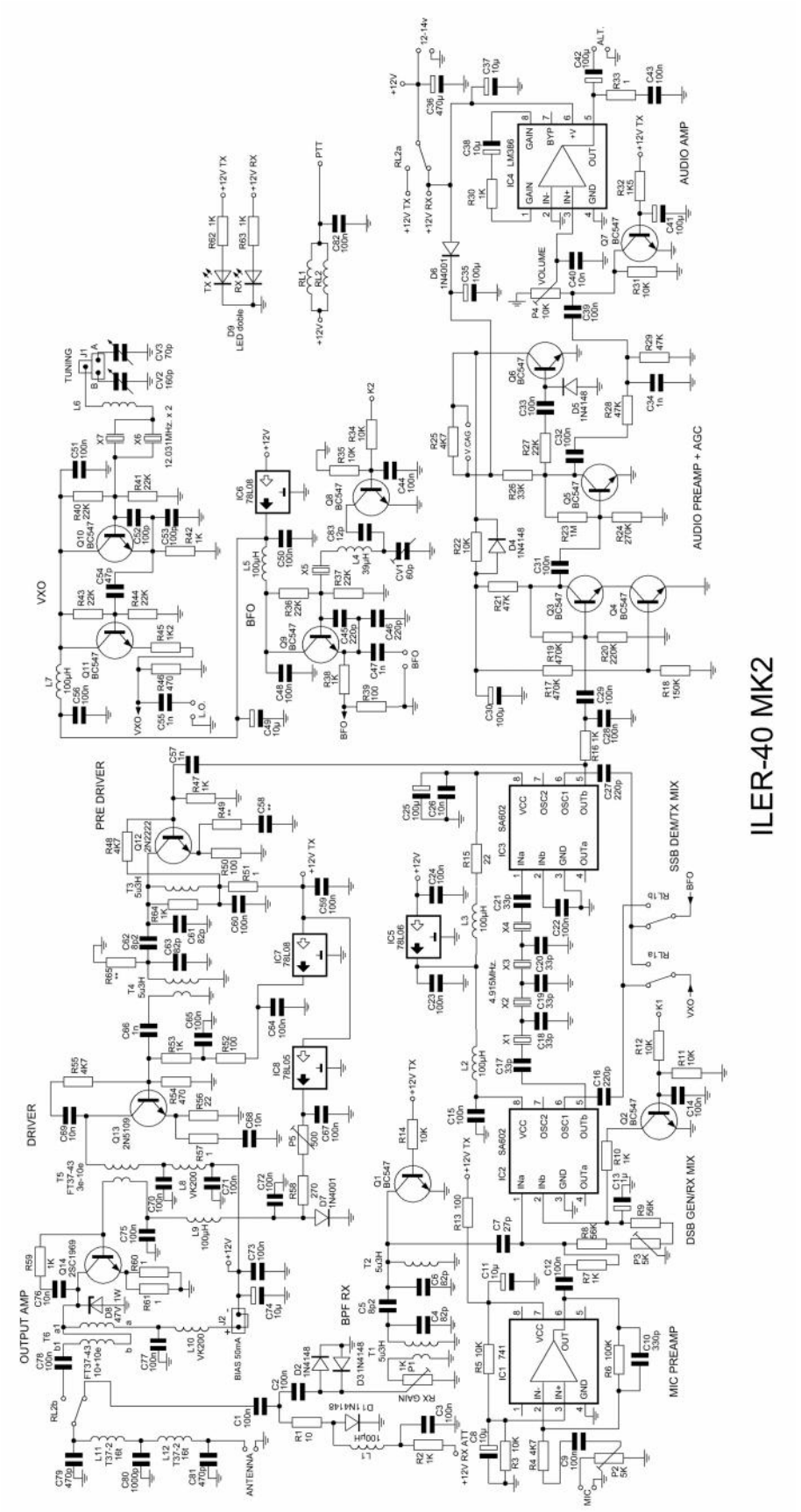
The original purchaser has the option of examining the kit and manual for 10 days. If, within this period, the buyer decides not to build the kit, he/she may return the entire unassembled kit at their own expense for the shipping expenses. The shipping expenses and sales commissions (i.e. bank, Ebay, 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, if can often give similar results. Do not expect great performance, BUT YOU ARE SURE TO HAVE LOTS OF FUN!

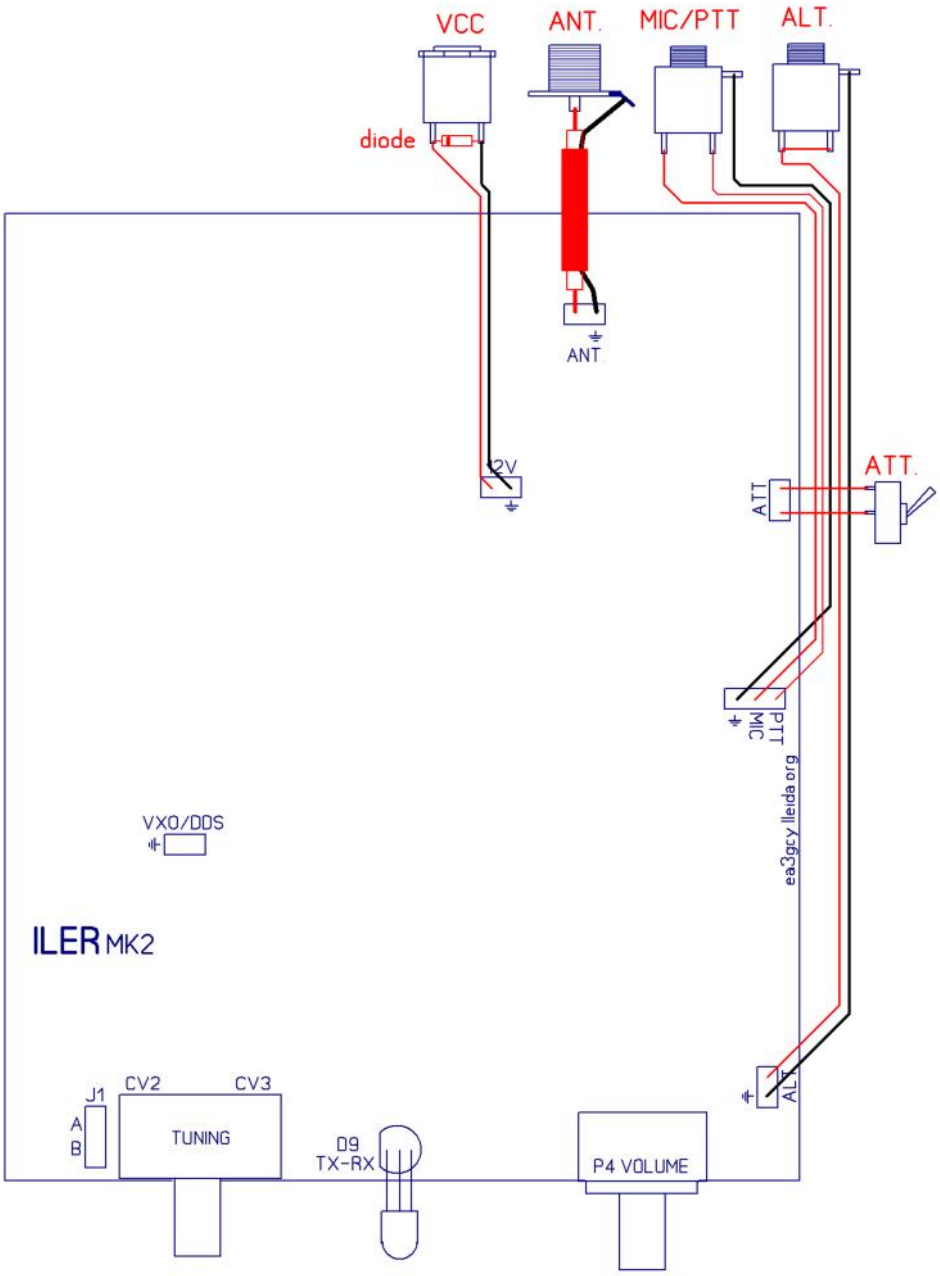
If you believe that there is a missing component for the kit, please do a thorough inventory of all parts using the parts list in the manual. Check all bags, envelopes and boxes carefully. If needed, you may email me and I will replace any component that you are missing. Even if you can find the exact 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 ILER-40 MK2 SSB Transceiver kit.
Enjoy QRP!
73 Javier Solans, EA3GCY

SCHEMATIC


ILER-40 MK2
AUDIO AMP
AUDIO PREAMP + AGC
SSB DEM/TX MIX
DSB GEN/RX MIX
MIC PREAMP
BPF RX
OUTPUT AMP
DRIVER
PRE DRIVER
BFO
VXO
TUNING

WIRING



The ILER-40 wiring is very simple, as long as you remember that:
- For the antenna connection use a thin, RF-rated coaxial cable such as RG-174 or similar.
- If you install the tuning polyvaricon off the circuit board, you should use short and stiff wires, as the mechanical stability is very important.
-A metal box is highly recommended.

The ILER-40 is not protected against reverse polarity!
It is a good idea is to place a diode (i.e. BY255 or larger) in parallel with the power supply input. The cathode (the end of the diode with the printed band) goes to the positive wire. If your power supply has short-circuit protection or has a fuse on its output, fine; otherwise, you will need to build or buy a cable with an in-line fuse in series.