DSP-10 Assembly Manual

D R A F T – August 28, 2000

TABLE OF CONTENTS

INTRODUCTION

The DSP-10 is a two-meter ham-radio transceiver design by Bob Larkin, W7PUA, using a DSP processor for the IF and audio. Details of the DSP-10 were published in QST magazine for September, October and November of 1999. The DSP-10 can be used for very weak signals communications and has special features for use with microwave transverters.

This assembly manual is a draft document. It is an attempt to bring together all the documentation on parts purchase, assembly, testing and troubleshooting the DSP-10 into one comprehensive and cohesive manual. Comments, corrections, and suggestions are highly encouraged. Please send email to n7hpr@tapr.org and/or post to the DSP-10 list (subscription information below).

DSP-10 information can be found on the DSP-10 Project web page at http://www.proaxis.com/~boblark/dsp10.htm. Updates to this assembly manual can be found at the above URL.

All aspects of the DSP-10 project are discussed and information distributed on the dsp-10@qth.net email reflector. You can send an email to the reflector after you subscribe and it will then be sent to all subscribers of the list. This will give a way for all those interested in the project to share their questions, answers and experiences, quickly and informally. If you want to get this email news on the DSP-10 project, send an email:

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If there are any problems, go to http://www.qth.net and you can read more and fill out a form. After you subscribe, you will receive full information on using the reflector.

ACKNOWLEDGEMENTS

Bob Larkin, W7PUA – Designer and author of the DSP-10.
Rich Kellner W5RXP – Created parts list from QST articles and assembly notes of Bob Larkin W7PUA.
Steven Bible, N7HPR – Combined parts list, assembly notes, testing and troubleshooting into this assembly manual.

PARTS LIST

The parts list is organized by quantity and part type. Verify that all parts are present by checking in the space [ ] provided as you locate the part in the list. You may wish to take this opportunity to sort the parts into a compartmented container such as an egg carton or muffin tin as you inventory them. This will aid you in kit building.

Suppliers shown in the parts listing are typically one of several vendors carrying the same part.

Legend
AM = Amidon
DK = Digi-key Catalog
IX = International Crystal
MC = Mini-Circuits
ME = Mouser Electronics Catalog
NE = Newark Electronics
DC = DC Electronics, Phoenix AZ

Resistors
NOTE: Do not remove the chip resistors from the paper sheet they are taped to until you are ready to solder them to the PCB.

1/8W 5% Thick Film Chip Resistor 1206 Size

	Qty	Value	Supplier	Designator
[ ]	1	2.2 Ω	ME 263-2.2	R10
[ ]	2	2.7 Ω	ME 263-2.7	R42, R43
[ ]	3	22 Ω	ME 263-22	R11, R111, R112
[ ]	2	47 Ω	ME 263-47	R60, R121
[ ]	1	68 Ω	ME 263-68	R62
[ ]	9	100 Ω	ME 263-100	R20, R22, R44, R45, R50, R59, R67, R110, R150
[ ]	1	220 Ω	ME 263-220	R123
[ ]	10	330 Ω	ME 263-330	R1, R2, R3, R5, R6, R7, R61, R64, R113, R114
[ ]	11	470 Ω	ME 263-470	R28, R58, R63, R68, R107, R109, R136, R140, R144, R148, R149
[ ]	3	680 Ω	ME 263-680	R4, R12, R65
[ ]	6	1K Ω	ME 263-1K	R9, R19, R25, R101, R102, R103
[ ]	2	1.8K Ω	ME 263-1.8K	R51, R52
[ ]	3	2.2K Ω	ME 263-2.2K	R55, R56, R57
[ ]	1	2.7K Ω	ME 263-2.7K	R14
[ ]	3	3.3K Ω	ME 263-3.3K	R8, R17, R29
[ ]	3	4.7K Ω	ME 263-4.7K	R108, R119, R120
[ ]	1	5.6K Ω	ME 263-5.6K	R18
[ ]	2	6.8K Ω	ME 263-6.8K	R15, R16
[ ]	25	10K Ω	ME 263-10K	R13, R21, R26, R27, R30, R31, R33, R34, R37, R38, R104, R122, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R139, R147, R151
[ ]	1	22K Ω	ME 263-22K	R143
[ ]	4	33K Ω	ME 263-33K	R46, R105, R138, R145
[ ]	5	47K Ω	ME 263-47K	R35, R36, R48, R49, R54
[ ]	2	75K Ω	ME 263-75K	R137, R142
[ ]	11	100K Ω	ME 263-100K	R23, R24, R39, R40, R41, R47, R53, R66, R106, R146, R152
[ ]	1	180K Ω	ME 263-100K	R141
[ ]	1	1M Ω	ME 263-1M	R135

Variable Resistor

	Qty	Value	Supplier	Designator
[ ]	1	10K Ω (103)	DK 3329H-103	R124 (Bourns 3329H)

Capacitors

NOTE: Do not remove the chip capacitors from the paper sheet they are taped to until you are ready to solder them to the PCB.

Chip Capacitor, 1206 Size

	Qty	Value	Supplier	Designator
[ ]	3	0.5 pF	DK PCC0R5CCT	C16, C19, C21
[ ]	2	1 pF	DK PCC010CCT	C3, C18
[ ]	2	2.7 pF	DK PCC2R7CCT	C14, C23
[ ]	1	3.3 pF	DK PCC3R3CCT	C119
[ ]	2	6.8 pF	DK PCC6R8CCT	C125, C146
[ ]	3	8.2 pF	DK PCC8R2CCT	C15, C22, C52
[ ]	6	10 pF	DK PCC100CCT	C26, C28, C68, C109, C117, C141
[ ]	5	12 pF	DK PCC120CCT	C2, C4, C17, C20, C27
[ ]	8	15 pF	DK PCC150CCT	C25, C29, C50, C51, C53, C96, C97, C98
[ ]	4	22 pF	DK PCC220CCT	C72, C108, C143, C144
[ ]	1	33 pF	DK PCC330CCT	C6
[ ]	10	47 pF	DK PCC470CCT	C1, C5, C63, C64, C65, C75, C114, C115, C116, C118
[ ]	1	100 pF	DK PCC101CCT	C70
[ ]	1	220 pF	DK PCC221BCT	C71
[ ]	2	0.001 pF	ME 140-CC501N102J	C62, C113

Chip Capacitor 0805 Size

	Qty	Value	Supplier	Designator
[ ]	23	0.01 µF	ME 140-CC501Z103M	C7, C8, C10, C12, C13, C34, C40, C42, C44, C46, C47, C48, C49, C57, C79, C81, C85, C86, C120, C123, C137, C138, C142
[ ]	21	0.22 µF	ME 140-CC502Z224M	C32, C33, C36, C38, C56, C58, C67, C76, C77, C83, C87, C88, C91, C92, C94, C107, C121, C122, C126, C134, C140
[ ]	14	470 µF	DK PCC471BNCT	C9, C11, C41, C43, C45, C73, C74, C78, C80, C93, C124, C127, C135, C136

Disc-Ceramic Capacitor

	Qty	Value	Supplier	Designator
[ ]	2	0.01 µF	ME 140-100Z5-103Z	C201, C202

Film Capacitor, Panasonic V-Series

	Qty	Value	Supplier	Designator
[ ]	1	0.0047 µF (472)	DK PS1472J	C111
[ ]	1	0.01 µF (103)	DK P4713	C61
[ ]	1	0.015 µF (153)	DK P4715	C95
[ ]	1	0.033 µF (333)	DK P4719	C60
[ ]	1	0.068 µF (683)	DK P4723	C112
[ ]	2	0.1 µF (104)	DK P4725	C30, C31

Capacitor, Electrolytic, Surface Mount (Panasonic HB Series)

	Qty	Value	Supplier	Designator

[ ]	4	2.2 µF 50V	ME 555-50V2.2	C35, C39, C59, C139
[ ]	1	10 µF 16V	ME 555-16V10	C133
[ ]	16	47 µF 16V	ME 555-16V47	C37, C54, C55, C66, C82, C84, C89, C90, C101, C103, C104, C105, C106, C131, C132, C145

Capacitor, Electrolytic, Axial-lead

	Qty	Value	Supplier	Designator
[ ]	1	470 µF 25V	ME 140-XAL25V470	C102

Capacitor, Electrolytic, Radial-lead

	Qty	Value	Supplier	Designator
[ ]	2	47 µF, 25V	ME 140-XRL16V47	C220, C221
[ ]	1	2.2 µF, 16V	ME 140-XRL50V2.2	C222

Capacitor, Variable

	Qty	Value	Supplier	Designator
[ ]	1	1.8-6 µF	ME 24AA070	C69 (Red Paint)
[ ]	1	2.8-12.5 µF	ME 24AA071	C110 (No Paint)

Capacitor, Feedthrough

	Qty	Value	Supplier	Designator
[ ]	17	1500 pf	NE 19F687	C203 through C219 (?? 2200 pf ??)

Capacitor, Other

	Qty	Value	Supplier	Designator
[X]	1	0.04 pF		C24 “Gimmick” wire capacitor. See construction notes)

Inductor, Ferrite SMT Bead, 1206 Size

	Qty	Value	Supplier	Designator
[ ]	12	600 Ω at 100 MHz	DK 240-1019-1	L16, L17, L26, L27, L28, L29, L30, L31, L106, L107, L108, L109

Inductor, Chip

	Qty	Value	Supplier	Designator
[ ]	3	39 nH (39NM)	DK TKS1008CT	L3, L19, L104
[ ]	1	100nH (R10M)	DK TKS1013CT	L18
[ ]	6	0.33 µH (R33M)	DK TKS1019CT	L4, L5, L6, L7, L14, L15
[ ]	1	2.2 µH (2R2K)	DK TKS1029CT	L22
[ ]	1	10 µH (100)	DK TKS1037CT	L20

Inductor

	Qty	Value	Supplier	Designator
[ ]	1	47 µH	DK TK4444	L101

Toroid Core

	Qty	Value	Supplier	Designator
[ ]	4	T25-17 (Blue and Yellow)	AM T25-17	L23, L24, L25, L103
[ ]	1	T37-6	AM T37-6	L21

(Yellow and Black)

Ferrite Cores

	Qty	Value	Supplier	Designator
[ ]	11	FT-23-43	AM FT23-43	L32 (10 are for EMI suppression. See construction notes.)

Inductor, Variable

	Qty	Value	Supplier	Designator
[ ]	7	100 nH 0.1 µH	DK TK1402 Toko BTKENS-T1044Z	L1, L2, L8, L9, L10, L11, L102
[ ]	2	2.2 µH	DK TK1413 (Toko TKANS-9447HM)	L12, L13

Diodes, Axial-Lead

	Qty	Value	Supplier	Designator
[ ]	1	1N5401	DK 1N5401CT	D101
[ ]	1	SR105		(See Construction Notes)

Diodes, Surface Mount SOT23

	Qty	Value	Supplier	Designator
[ ]	6	BAR74	DK BAR74ZXCT	D4, D5, D6, D105, D111, D112
[ ]	4	BAV74	DK BAV74ZXCT	D107, D108, D109, D110
[ ]	2	HSMP-3804	NE 83F5593	D1, D2
[ ]	4	FMMV2101	DK FMMV2101CT	D104, D113, D114, D115
[ ]	1	FMMV2103	FMMV2103CT	D3

Diode, Light Emitting

	Qty	Value	Supplier	Designator
[ ]	1	T1 Amber	DK 160-1079	D102
[ ]	1	T1 Red	DK 160-1078	D103

Transistors, TO-39

	Qty	Value	Supplier	Designator
[ ]	1	2N5109	ME 610-2N5109	Q2

Transistors, Surface Mount SOT23

	Qty	Value	Supplier	Designator
[ ]	4	FMMT3904	DK FMMT3904CT	Q1, Q5, Q103, Q104
[ ]	3	FMMT3906	DK FMMT3906CT	Q3, Q6, Q102

MOSFET, N-Channel, TO-92 Case

	Qty	Value	Supplier	Designator
[ ]	2	J310	DC J310	Q4, Q101

MOSFET, P-Channel, TO-92 Case

	Qty	Value	Supplier	Designator
[ ]	2	ZVP2106A	DK ZVP2106A	Q105, Q106

Integrated Circuits, Surface Mount

	Qty	Value	Suppliers	Designator
[ ]	1	MM74HC14M	DK MM74HC14M	U110
[ ]	2	MM74HC595	DK MM74HC595M	U107, U108
[ ]	2	CD4066BCM	DK CD4066BCM	U11, U12
[ ]	1	LM833	DK LM833M	U10

[ ]	1	LMX1501A	DK LMX1501AM	U104
[ ]	1	MC145170	NE MC145170D2	U7
[ ]	1	LM358M	DK LM358M	U109
[ ]	1	OP27GU	DK OPA27GU	U6

Integrated Circuit, DIP

	Qty	Value	Supplier	Designator
[ ]	1	LM1877N-9	DK LM1877N-9	U14

MMIC Amplifiers

	Qty	Value	Supplier	Designator
[ ]	2	MAR-3SM	MC MAR-3SM	U2, U9 Substitutions: MSA-0386 or MSA-0304
[ ]	2	MAR-4SM	MC MAR-4SM	U5, U106 Substitution: MSA-0486
[ ]	4	MAR-6SM	MC MAR-6SM	U1, U4, U8, U105 Substitution: MSA-0686

Mixers

	Qty	Value	Supplier	Designator
[ ]	2	TUF-1	MC TUF-1	U3, U15

Voltage Regulators, TO-92 Case

	Qty	Value	Supplier	Designator
[ ]	2	LM78L05ACZA	DK LM78L05ACZ	U13, U103

Voltage Regulators, TO-220 Case

	Qty	Value	Supplier	Designator
[ ]	1	LM2937ET-10	DK LM2937ET-10	U101
[ ]	1	LM7805CTB	ME 511-L7805ACV	U102
[ ]	1	LM7809	ME 511-L7809ACV	U201
[ ]	1	LM7809	ME 511-L7809ACV	U201 (?)

Crystals

	Qty	Value	Supplier	Designator
[ ]	1	10 MHz	IX 433463	X101
[ ]	4	19.66 MHz	DK SE3437	X1, X2, X3, X4

Filters

	Qty	Value	Supplier	Designator
[ ]	18	470 pF pi filter	DK P9806CT	F1, F2, F3, F4, F5, F101, F102, F103, F105, F106, F108, F109, F110, F111, F112, F113, F114, F115

Fuse and Fuse Clips

	Qty	Value	Supplier	Designator
[ ]	1	1A	DK F948	FS1 (fuse)
[ ]	2		DK F058	FS1 (fuse clips)

Headers

	Qty	Value	Supplier	Designator
[ ]	6	2 Pin	DK WM4200	P1, P2, P3, P6, P7, P103
[ ]	2	3 Pin	DK WM4201	P105, P106
[ ]	1	4 Pin	DK WM4202	P4
[ ]	1	5 Pin	DK WM4203	P102
[ ]	2	8 Pin	DK WM4206	P5, P108

[ ]	1	12 Pin	DK WM4210	P101

Connector Body

	Qty	Value	Supplier	Designator
[ ]	4	2 Pin	DK WM2011	J1, J2, J3, J103
[ ]	3	3-Pin	DK WM2012	J105, J106, J106_ALT
[ ]	1	4 Pin	DK WM2013	J4
[ ]	1	5 Pin	DK WM2014	J102
[ ]	2	8 Pin	DK WM2017	J5, J108
[ ]	1	12 Pin	DK WM2021	J101

Crimp Terminals

	Qty	Value	Supplier	Designator
[ ]	47		DK WM2200	

Connectors, Various

	Qty	Value	Supplier	Designator
[ ]	1	DB9 Female	RS 276-1538	J201
[ ]	1	5-Pin DIN	RS 274-005	J202
[ ]	1	1/8” Phono Jack Mono	RS 274-251	J203
[ ]	1	1/8” Phone Jack Stereo	RS 274-249	J204
[ ]	3	RCA Phono Jack	RS 274-346	J206, J212, J213
[ ]	1	8-Pin DIN Jack	DK CP-1280	J208
[ ]	1	BNC Bulkhead Female Jack	RS 278-105	J211
[ ]	1	Conn 5.5/2.1	RS 274-1563	P205

Miscellaneous

	Qty	Value	Supplier	Designator
[ ]				22 AWG or 24 AWG Insulated Hookup Wire
[ ]				32 AWG Magnet Wire, Enamel Covered
[ ]				26 AWG Magnet Wire, Enamel Covered
[ ]			Mashell Electric	PC Board
[ ]	1		NE 66F3812	Analog Devices EZ-Kit Lite
[ ]			RS 21-1172	Microphone
[ ]		Hammond 1590F	ME 546-1590F	Case
[ ]	4		DK J243	Spacers
[ ]	3		RS 276-1499	Double-sided PC Board Material

CONSTRUCTION NOTES

The main pc board uses mostly surface mount parts. This can be the subject of some worry at first. Once the techniques are learned most people find that the assembly is easier than using through-hole parts.

The following tools are a must:

* A quality soldering iron with a 1/16 inch tip
* Stainless steel tweezers with a bend near the tip
* Solder flux in either a squeeze bottle or felt tip pen
* 1/32 inch flux core 60% tin (Sn) solder
* Cleaning solvent for the flux being used
* Reading glasses or magnifiers, if they seem to help
* Solder Wick or equivalent, 1/16 inch wide
* Wet sponge for cleaning your soldering iron
* Stainless steel pick with a right angle bend near the tip.

To attach a component, first place some flux on all the pads being used on the board. Pick up the component with the tweezers and solder one end or pin down without adding any solder. Make sure that the component is in position and down against the PC board. Next solder the remaining end or pins using the smallest possible amount of solder. Now go back and add a very small amount of solder to the first end or pin. After the board or some portion is complete, go back and clean the flux away and carefully inspect the connections.

The solder should not bulge up on the component ends and ideally will form a concave fillet. If you spent too much time making a connection it will not be shiny. If so, add more flux and re-flow the connection. If the solder bulges excessively, remove some with the Solder Wick.

If you must remove a component, first use Solder Wick to remove as much solder as possible. For two-ended components such as resistors, move the soldering iron between the two ends (or use two soldering irons if you have them) until the component comes up. Shake it free from the surface tension of the solder onto a newspaper. In the case of multi-pin components such as integrated circuits, it is very important that the solder is first removed completely. It will then be possible to lift the component starting from one corner with a sharp pick while applying heat along the one side with the soldering iron.

It is important that the iron be clean and have a shiny coating of solder. A good quality plated soldering-iron tip is most helpful.

Relative to through-hole components there are the advantages that all work is done from one side and that no component leads need to be trimmed. The biggest disadvantage of the surface mount is that not all components, particularly ceramic capacitors, have their values marked and so greater care is needed to avoid mistakes.

The PC board has a lot of parts on it. If you are not sure about soldering on the surface mount boards, start with a scrap piece of practice board and some extra low cost parts. Look at N4UAU's articles in April, May, June and July 1999 QST on surface mount construction. Start out slowly and you will be pleasantly surprised how well it will turn out!

UNSOLDERING: Oops, it is not the right part!! What to do: Put liquid flux on the surface-mount parts before working on them. Then remove the extra solder with Solder-Wick or similar braid. Next heat both ends of the part at the same time, which can be done with one iron, but is easier with two, if you have them. The surface tension of the solder will cause the part to cling to the soldering iron, when it is ready to come free. Knock it free into a paper towel. Apply more solder flux, whenever it seems like the heat is not transferring to the pads and the part. NEVER PRY THE PARTS UP. Prying is how the pads on the PC board disappear!

REUSE: SMT resistors and inductors tend to be OK after being carefully removed. Ceramic caps are questionable. They can develop microscopic cracks that are very difficult or impossible to see. The best practice is to use new ceramic caps. Likewise these cracks are the reason to NEVER PUSH on the chip caps during installation. All of this is not to suggest that these parts are particularly delicate, but rather that some precautions are needed!

PART INSTALLATION ORDER: Get the little low chip parts in, and inspected, before placing the bigger ones. This gives you the maximum working room. There are two pages of color copies that come with the PCB from W7SLB that show the location of all the common parts (like 0.01 uF chip caps, or 10K chip resistors.) Do all of these "in-color" parts first and then recheck that they are in the right spots. This helps to prevent mistakes with the chip caps that are not marked.

When you put down the common chip caps, you will notice that, most likely, each value has a "different" look. After they are on the board is a really good time to check things carefully, as the situation is still pretty much observable. When you get to putting the caps like 10pf NPO and 15pf NPO, they will look very much alike. So go carefully through those values.

SOLDERING IRONS: W7LHL bought a Xytronic JS1258 (Jameco 116572) soldering iron and reports good success with it. He says the cord is stiffer than he would prefer, but the iron works well on the small surface-mount parts. He uses a XY1, Semi-Chisel 1/32-inch tip (Jameco 35078). The big feature of the iron is that it costs about $20 and the tips are $4.

Kester 22 AWG 63/37 No-Clean Solder
Solder Wick, No-Clean Flux
Kester Flux-Pen #951, No-Clean Flux

CONSTRUCTION

Wires

In order to not require a multi-layer PC board, there are wires on the back of the board. These are marked on the back with a silk-screen legend (rev C only) with designators W1, W2, etc.

NOTE: The instructions for soldering the coax cables to the bottom of the PC board assume that there is no solder mask on that side. In their enthusiasm to do a good job, the board maker for the boards sold by W7SLB added a bottom mask. This is not a problem, but it may be necessary to scrape some mask away where the braid of the coax is soldered to the ground plane. This can be done with the blade of a knife.

Install the following coaxial cables:
[ ] W13 3-1/8" long between C78 and U15-1 (19.68 MHz LO to mixer)
[ ] W24 4" long between C127 and U3 (126 MHz LO to mixer)
[ ] W29 1-3/4" long between R150 and U7-1 (10 MHz ref sig to 126 MHz PLL)

Install the following wire jumper:
[ ] W12 U7-4 to R60 (19.68MHz to PLL IC)

[ ] Glue to ground plane with a dab of RTV.

The remaining 25 are hookup wire and any wire will do; 22 AWG or 24 AWG is probably the easiest to work with.

Install the following wire jumpers:
[ ] W1 P101-1 to Fuse (+13.6VDC)
[ ] W2 P108-8 to L107 (+5 to external control)
[ ] W3 U110-8 to F111 (PLL Lock Out)
[ ] W4 U108-1 to R130 (Transmit Control)
[ ] W5 U108-2 to R133 (Receive Control)
[ ] W6 F1 to D107, D108 (R_ATT1 Pin diode current)
[ ] W7 F2 to D109, D110 (R_ATT2 Pin Diode Current)
[ ] W8 F5 to Q106-1 (+10 Receive)
[ ] W9 U12 to Q106-1 (+10 Receive)
[ ] W10 R102 to Q105-1 (+10 Transmit to Red LED)
[ ] W11 R50 to L29 (+10 Transmit to U6)
[ ] W14 U11-1 to Q5E (15 kHz transmit i-f)
[ ] W15 C40 to P5-4 (DAC1 for transmit i-f)
[ ] W16 L17 to R4 (+10 Transmit to Diode T/R)
[ ] W17 L17 to R12 (+10 Transmit to Diode Ant T/R)
[ ] W18 L17 to Q105-1 (+10 Transmit)
[ ] W19 L108 to +5 Dist (+5 feed to distribution point)
[ ] W20 D112 to U102 (+5)
[ ] W21 D111 to U102 (+5)
[ ] W22 U11-3 to C85 (Left Audio)
[ ] W23 R57 to F109 (SER_CLK to U7, MC145170)
[ ] W25 U11-4 to P5-4 (DAC_1 Left Audio)
[ ] W26 F108 to R55 (SER_DAT to MC145170)

NOTE: On the backside of the board, one end of W27 is not marked on the silk-screen. It is shown on the drawing of the wires. The missing marking is the ungrounded pad, half way between W26 and W23, in the U7 area.

[ ] W27 F114 to R56 (SER_EN2 to MC145170)
[ ] W28 P5-6 to C86 (Right Audio)

Resistors

Solder the following 1/8W 5% Size 1206 Thick Film Chip Resistors. Verify resistance value with an ohmmeter. Dimensions are referenced to the lower left corner of the board (by the fuse clips for FS1.) The first number is to the right and the second number is up. Dimensions listed in inches and mm.

[ ] R10 2.2 Ω (1.7 x 4.7 inch) (43.2 x 119.1 mm)

[ ] R42 2.7 Ω (3.4 x 0.9 inch) (86.4 x 22.2 mm)
[ ] R43 2.7 Ω (3.4 x 1.5 inch) (86.0 x 38.4 mm)

[ ] R11 22 Ω (1.9 x 4.7 inch) (48.6 x 119.1 mm)
[ ] R111 22 Ω (4.8 x 3.0 inch) (121.0 x 75.9 mm)
[ ] R112 22 Ω (5.0 x 2.3 inch) (127.6 x 57.8 mm)

[ ] R60 47 Ω (6.0 x 1.9 inch) (152.4 x 48.3 mm)
[ ] R121 47 Ω (2.2 x 1.7 inch) (55.6 x 43.5 mm)

[ ] R62 68 Ω (6.4 x 1.8 inch) (161.6 x 45.7 mm)

[ ] R20 100 Ω (4.4 x 4.3 inch) (110.8 x 110.2 mm)
[ ] R22 100 Ω (3.9 x 4.5 inch) (98.4 x 113.3 mm)
[ ] R44 100 Ω (5.0 x 1.8 inch) (126.4 x 44.5 mm)
[ ] R45 100 Ω (5.0 x 1.9 inch) (126.4 x 47.0 mm)
[ ] R50 100 Ω (5.2 x 1.1 inch) (133.0 x 27.3 mm)
[ ] R59 100 Ω (5.8 x 1.2 inch) (147.3 x 31.1 mm)
[ ] R67 100 Ω (2.8 x 1.9 inch) (72.1 x 47.9 mm)
[ ] R110 100 Ω (4.6 x 2.4 inch) (117.5 x 61.3 mm)
[ ] R150 100 Ω (3.8 x 2.8 inch) (97.2 x 70.5 mm)

[ ] R123 220 Ω (1.5 x 1.4 inch) (37.1 x 35.2 mm)

[ ] R1 330 Ω (1.4 x 6.0 inch) (34.9 x 153.3 mm)
[ ] R2 330 Ω (1.6 x 6.0 inch) (40.0 x 153.3 mm)
[ ] R3 330 Ω (1.8 x 6.1 inch) (45.1 x 154.0 mm)
[ ] R5 330 Ω (2.4 x 4.2 inch) (61.0 x 107.3 mm)
[ ] R6 330 Ω (2.1 x 4.2 inch) (52.1 x 106.7 mm)
[ ] R7 330 Ω (2.1 x 4.3 inch) (52.1 x 109.0 mm)
[ ] R61 330 Ω (6.1 x 1.7 inch) (155.2 x 43.2 mm)
[ ] R64 330 Ω (6.1 x 2.2 inch) (155.2 x 55.6 mm)
[ ] R113 330 Ω (5.1 x 2.7 inch) (129.8 x 68.9 mm)
[ ] R114 330 Ω (5.5 x 3.2 inch) (140.6 x 81.3 mm)

[ ] R28 470 Ω (2.2 x 1.4 inch) (55.6 x 35.9 mm)
[ ] R58 470 Ω (5.7 x 1.1 inch) (144.2 x 26.7 mm)
[ ] R63 470 Ω (6.1 x 2.3 inch) (155.2 x 58.1 mm)
[ ] R68 470 Ω (2.4 x 4.1 inch) (61.0 x 105.1 mm)
[ ] R107 470 Ω (2.7 x 2.2 inch) (69.5 x 55.6 mm)
[ ] R109 470 Ω (2.7 x 2.4 inch) (69.5 x 60.6 mm)
[ ] R136 470 Ω (1.1 x 2.3 inch) (28.9 x 58.7 mm)
[ ] R140 470 Ω (2.1 x 2.9 inch) (53.3 x 72.7 mm)
[ ] R144 470 Ω (2.1 x 3.2 inch) (53.3 x 81.6 mm)
[ ] R148 470 Ω (5.6 x 3.2 inch) (142.9 x 81.3 mm)
[ ] R149 470 Ω (5.4 x 3.3 inch) (137.8 x 82.9 mm)

[ ] R4 680 Ω (1.5 x 5.0 inch) (36.8 x 127.6 mm)

NOTE: The silkscreen for R12 is hard to see on the PCB. It is located next to C81. Verify placement using the parts layout figure.

[ ] R12 680 Ω (0.7 x 4.7 inch) (18.1 x 119.1 mm)
[ ] R65 680 Ω (1.2 x 6.0 inch) (29.9 x 153.3 mm)

[ ] R9 1K Ω (1.7 x 4.5 inch) (43.5 x 114.6 mm)
[ ] R19 1K Ω (4.1 x 4.4 inch) (104.4 x 112.7 mm)
[ ] R25 1K Ω (1.9 x 1.2 inch) (48.6 x 29.5 mm)
[ ] R101 1K Ω (0.5 x 0.8 inch) (12.7 x 20.6 mm)
[ ] R102 1K Ω (0.8 x 0.8 inch) (20.3 x 20.6 mm)
[ ] R103 1K Ω (3.5 x 2.9 inch) (88.9 x 73.0 mm)

[ ] R51 1.8K Ω (5.2 x 0.9 inch) (133.0 x 22.2 mm)
[ ] R52 1.8K Ω (5.2 x 0.8 inch) (133.0 x 19.7 mm)

[ ] R55 2.2K Ω (4.7 x 1.5 inch) (118.1 x 36.8 mm)
[ ] R56 2.2K Ω (4.7 x 1.3 inch) (118.1 x 31.8 mm)
[ ] R57 2.2K Ω (4.7 x 1.1 inch) (118.1 x 26.7 mm)

[ ] R14 2.7K Ω (5.0 x 5.0 inch) (126.4 x 126.0 mm)

[ ] R8 3.3K Ω (1.7 x 4.4 inch) (42.9 x 110.8 mm)
[ ] R17 3.3K Ω (4.7 x 4.8 inch) (120.3 x 121.0 mm)
[ ] R29 3.3K Ω (2.2 x 1.2 inch) (56.2 x 29.5 mm)

[ ] R108 4.7K Ω (2.7 x 2.3 inch) (69.5 x 58.1 mm)
[ ] R119 4.7K Ω (2.2 x 1.5 inch) (55.6 x 38.4 mm)
[ ] R120 4.7K Ω (2.2 x 1.6 inch) (55.6 x 41.0 mm)

[ ] R18 5.6K Ω (4.3 x 4.9 inch) (109.0 x 124.8 mm)

[ ] R15 6.8K Ω (5.0 x 4.9 inch) (126.4 x 123.5 mm)
[ ] R16 6.8K Ω (4.7 x 4.9 inch) (120.3 x 123.5 mm)

[ ] R13 10K Ω (5.9 x 4.4 inch) (149.5 x 111.8 mm)
[ ] R21 10K Ω (4.3 x 4.8 inch) (108.9 x 121.6 mm)
[ ] R26 10K Ω (1.9 x 0.8 inch) (47.9 x 21.0 mm)
[ ] R27 10K Ω (2.2 x 0.8 inch) (56.5 x 19.7 mm)
[ ] R30 10K Ω (2.3 x 3.5 inch) (58.1 x 89.8 mm)
[ ] R31 10K Ω (2.3 x 3.6 inch) (58.1 x 92.4 mm)
[ ] R33 10K Ω (5.2 x 4.3 inch) (132.7 x 109.5 mm)
[ ] R34 10K Ω (5.6 x 4.6 inch) (142.9 x 117.5 mm)
[ ] R37 10K Ω (4.0 x 0.7 inch) (100.6 x 16.5 mm)
[ ] R38 10K Ω (3.9 x 1.6 inch) (99.1 x 40.0 mm)
[ ] R104 10K Ω (2.9 x 2.5 inch) (74.3 x 64.4 mm)
[ ] R122 10K Ω (1.5 x 1.3 inch) (37.1 x 32.7 mm)
[ ] R125 10K Ω (1.1 x 2.2 inch) (28.9 x 55.6 mm)
[ ] R126 10K Ω (1.0 x 1.9 inch) (26.0 x 47.6 mm)
[ ] R127 10K Ω (1.8 x 2.0 inch) (46.4 x 49.8 mm)

[ ] R128 10K Ω (1.8 x 2.1 inch) (46.4 x 52.4 mm)
[ ] R129 10K Ω (5.2 x 0.4 inch) (131.1 x 10.2 mm)
[ ] R130 10K Ω (4.4 x 0.4 inch) (111.4 x 10.8 mm)
[ ] R131 10K Ω (4.4 x 0.3 inch) (111.4 x 7.9 mm)
[ ] R132 10K Ω (5.2 x 0.1 inch) (131.1 x 2.5 mm)
[ ] R133 10K Ω (4.4 x 0.2 inch) (111.4 x 5.1 mm)
[ ] R134 10K Ω (4.4 x 0.1 inch) (111.4 x 2.2 mm)
[ ] R139 10K Ω (2.1 x 2.8 inch) (53.3 x 70.5 mm)
[ ] R147 10K Ω (2.2 x 2.4 inch) (56.5 x 61.0 mm)
[ ] R151 10K Ω (1.7 x 1.1 inch) (42.9 x 27.3 mm)

[ ] R143 22K Ω (2.1 x 3.1 inch) (53.3 x 79.4 mm)

[ ] R46 33K Ω (4.7 x 1.7 inch) (120.3 x 41.9 mm)
[ ] R105 33K Ω (3.2 x 2.4 inch) (81.6 x 61.0 mm)
[ ] R138 33K Ω (2.1 x 2.7 inch) (53.3 x 68.3 mm)
[ ] R145 33K Ω (3.1 x 2.4 inch) (77.8 x 60.6 mm)

[ ] R35 47K Ω (4.3 x 0.7 inch) (108.0 x 18.4 mm)
[ ] R36 47K Ω (4.3 x 1.5 inch) (108.0 x 39.0 mm)
[ ] R48 47K Ω (5.0 x 1.0 inch) (126.0 x 26.3 mm)
[ ] R49 47K Ω (5.0 x 1.0 inch) (126.0 x 24.1 mm)
[ ] R54 47K Ω (5.9 x 0.9 inch) (149.9 x 23.2 mm)

[ ] R137 75K Ω (2.1 x 2.6 inch) (53.3 x 66.0 mm)
[ ] R142 75K Ω (2.1 x 3.0 inch) (53.3 x 77.1 mm)

[ ] R23 100K Ω (4.4 x 4.4 inch) (110.8 x 112.7 mm)
[ ] R24 100K Ω (4.5 x 4.6 inch) (114.6 x 117.1 mm)
[ ] R39 100K Ω (4.3 x 0.9 inch) (108.0 x 21.6 mm)
[ ] R40 100K Ω (4.0 x 0.8 inch) (100.6 x 20.0 mm)
[ ] R41 100K Ω (4.0 x 1.5 inch) (99.1 x 37.1 mm)
[ ] R47 100K Ω (4.7 x 1.8 inch) (120.3 x 46.7 mm)
[ ] R53 100K Ω (5.9 x 0.8 inch) (149.9 x 20.6 mm)
[ ] R66 100K Ω (4.3 x 1.4 inch) (108.0 x 36.2 mm)
[ ] R106 100K Ω (4.2 x 2.5 inch) (106.4 x 62.9 mm)
[ ] R146 100K Ω (2.2 x 2.2 inch) (55.9 x 54.6 mm)
[ ] R152 100K Ω (4.1 x 2.9 inch) (104.4 x 74.0 mm)

[ ] R141 180K Ω (2.1 x 3.0 inch) (53.3 x 74.9 mm)

[ ] R135 1M Ω (1.0 x 2.5 inch) (25.4 x 64.4 mm)

Capacitors

Dimensions are referenced to the lower left corner of the board (by the fuse clips for FS1.) The first number is to the right and the second number is up. Dimensions listed in inches and mm.

Chip Capacitors, 1206 Size

[ ] C16 0.5 pF (2.3 x 5.5 inch) (58.1 x 138.7 mm)
[ ] C19 0.5 pF (2.6 x 5.5 inch) (65.7 x 139.4 mm)
[ ] C21 0.5 pF (2.9 x 5.5 inch) (74.0 x 140.6 mm)

[ ] C3 1.0 pF (0.1 x 5.6 inch) (3.5 x 143.2 mm)

[ ] C18 1.0 pF (2.6 x 5.3 inch) (65.7 x 134.3 mm)

[ ] C14 2.7 pF (1.9 x 5.5 inch) (47.6 x 138.7 mm)
[ ] C23 2.7 pF (3.6 x 5.6 inch) (91.4 x 143.2 mm)

[ ] C119 3.3 pF (4.8 x 2.6 inch) (120.7 x 65.4 mm)

[ ] C125 6.8 pF (4.9 x 2.3 inch) (124.1 x 59.4 mm)
[ ] C146 6.8 pF (3.3 x 2.3 inch) (84.8 x 59.1 mm)

[ ] C15 8.2 pF (2.1 x 5.5 inch) (53.0 x 138.7 mm)
[ ] C22 8.2 pF (3.1 x 5.5 inch) (78.4 x 139.4 mm)
[ ] C52 8.2 pF (1.1 x 4.4 inch) (26.7 x 110.5 mm)

[ ] C26 10 pF (4.9 x 5.5 inch) (124.8 x 138.7 mm)
[ ] C28 10 pF (5.4 x 5.5 inch) (136.5 x 138.7 mm)
[ ] C68 10 pF (5.6 x 1.4 inch) (141.9 x 36.5 mm)
[ ] C109 10 pF (3.9 x 3.3 inch) (98.4 x 82.9 mm)
[ ] C117 10 pF (4.4 x 2.7 inch) (110.5 x 69.2 mm)
[ ] C141 10 pF (4.3 x 2.9 inch) (109.9 x 74.0 mm)

[ ] C2 12 pF (0.3 x 5.2 inch) (7.0 x 131.1 mm)
[ ] C4 12 pF (0.7 x 5.7 inch) (17.8 x 144.2 mm)
[ ] C17 12pF (2.4 x 5.3 inch) (61.6 x 134.3 mm)
[ ] C20 12 pF (2.7 x 5.5 inch) (68.6 x 139.4 mm)
[ ] C27 12 pF (5.2 x 5.5 inch) (130.5 x 138.7 mm)

[ ] C25 15 pF (4.6 x 5.5 inch) (115.6 x 138.7 mm)
[ ] C29 15 pF (5.7 x 5.5 inch) (145.7 x 138.7 mm)

NOTE: C50 is a 1206 part on 0805 pads. This is tight. The part covers almost the entire pad, leaving little room for inspection. The solder connection is still practical, with care. Use a magnifying glass to carefully inspect the connections to be sure that you see solder flow on the ends of the capacitor.

[ ] C50 15 pF (1.2 x 4.3 inch) (30.5 x 109.9 mm)
[ ] C51 15 pF (1.1 x 4.6 inch) (28.2 x 117.5 mm)
[ ] C53 15 pF (1.0 x 4.6 inch) (24.4 x 117.5 mm)
[ ] C96 15 pF (1.7 x 5.2 inch) (43.8 x 132.1 mm)
[ ] C97 15 pF (4.6 x 5.5 inch) (117.8 x 138.7 mm)
[ ] C98 15 pF (5.8 x 5.5 inch) (148.0 x 138.7 mm)

[ ] C72 22 pF (6.2 x 1.4 inch) (159.1 x 35.9 mm)
[ ] C108 22 pF (3.5 x 3.0 inch) (88.9 x 75.6 mm)
[ ] C143 22 pF (5.5 x 2.6 inch) (139.4 x 66.3 mm)
[ ] C144 22 pF (5.6 x 2.6 inch) (141.6 x 66.3 mm)

[ ] C6 33 pF (1.075 x 5.550 inch) (27.31 x 140.97 mm)

[ ] C1 47 pF (0.5 x 5.2 inch) (12.4 x 131.1 mm)
[ ] C5 47 pF (0.7 x 5.9 inch) (18.7 x 149.2 mm)
[ ] C63 47 pF (4.7 x 1.6 inch) (118.1 x 39.4 mm)
[ ] C64 47 pF (4.7 x 1.4 inch) (118.1 x 34.3 mm)
[ ] C65 47 pF (4.7 x 1.2 inch) (118.1 x 29.2 mm)
[ ] C75 47 pF (6.0 x 1.8 inch) (152.4 x 45.7 mm)
[ ] C114 47 pF (3.8 x 2.3 inch) (97.5 x 59.4 mm)
[ ] C115 47 pF (3.8 x 2.5 inch) (97.5 x 62.2 mm)

[ ] C116 47 pF (3.8 x 2.6 inch) (97.5 x 65.1 mm)
[ ] C118 47 pF (4.4 x 2.5 inch) (110.5 x 64.1 mm)

[ ] C70 100 pF (5.7 x 1.4 inch) (144.8 x 36.5 mm)

[ ] C71 220 pF (5.8 x 1.4 inch) (147.3 x 36.5 mm)

[ ] C62 0.001 pF (6.1 x 1.1 inch) (155.6 x 26.7 mm)
[ ] C113 0.001 pF (4.2 x 2.4 inch) (107.0 x 60.6 mm)

Chip Capacitor, 0805 Size

Previous instructions incorrectly state that ALL chip caps can be 0805 or 1206 size. Two values, 470 pF and 0.01 uF should be only 0805. This makes the 0.01 part from Mouser, listed in rev 4.1 above incorrect. Examples of 0805 parts for these two values are:

470 pF	Digi-Key PCC471BNCT	Mouser 140-CC501B471K
0.01 uF	Digi-Key PCC103BNCT	Mouser 140-CC501Z103M

The pads for the surface mount capacitors will take 1206 size parts. They are closely enough spaced to also take 0805 size parts. So, wherever you see either a 1206 or a 0805 cap listed, either size can be used based on what you have, or can find.

[ ] C7 0.01 uF (1.0 inch x 5.9 inch) (24.1 x 149.9 mm)
[ ] C8 0.01 uF (1.2 x 5.9 inch) (31.1 x 149.5 mm)
[ ] C10 0.01 uF (1.5 x 5.9 inch) (36.8 x 149.9 mm)
[ ] C12 0.01 uF (1.7 x 5.8 inch) (42.2 x 147.3 mm)
[ ] C13 0.01 uF (1.6 x 5.0 inch) (40.0 x 126.0 mm)
[ ] C34 0.01 uF (1206 Size Pad) (5.9 x 4.6 inch) (149.5 x 116.8 mm)
[ ] C40 0.01 uF (2.2 x 0.9 inch) (56.5 x 21.9 mm)
[ ] C42 0.01 uF (2.5 x 4.4 inch) (62.9 x 110.5 mm)
[ ] C44 0.01 uF (1.7 x 4.2 inch) (44.1 x 107.0 mm)
[ ] C46 0.01 uF (2.6 x 4.1 inch) (65.4 x 104.1 mm)
[ ] C47 0.01 uF (1.5 x 4.2 inch) (37.1 x 106.1 mm)
[ ] C48 0.01 uF (1.2 x 4.2 inch) (29.5 x 106.1 mm)
[ ] C49 0.01 uF (1.7 x 4.6 inch) (42.6 x 116.8 mm)
[ ] C57 0.01 uF (4.7 x 1.8 inch) (119.7 x 44.5 mm)
[ ] C79 0.01 uF (0.9 x 5.1 inch) (21.9 x 128.6 mm)
[ ] C81 0.01 uF (0.6 x 4.6 inch) (15.5 x 117.1 mm)
[ ] C85 0.01 uF (4.2 x 0.6 inch) (107.6 x 16.2 mm)
[ ] C86 0.01 uF (4.3 x 1.7 inch) (108.0 x 41.9 mm)
[ ] C120 0.01 uF (4.5 x 2.5 inch) (114.6 x 62.2 mm)
[ ] C123 0.01 uF (5.1 x 2.4 inch) (128.9 x 61.0 mm)
[ ] C137 0.01 uF (1.8 x 3.4 inch) (44.5 x 87.3 mm)
[ ] C138 0.01 uF (1.6 x 2.6 inch) (40.3 x 65.7 mm)
[ ] C142 0.01 uF (1.6 x 2.4 inch) (39.4 x 60.0 mm)

[ ] C32 0.22 uF (1206 Size Pad) (5.3 x 5.0 inch) (133.4 x 126.0 mm)
[ ] C33 0.22 uF (1206 Size Pad) (5.3 x 4.9 inch) (133.4 x 123.2 mm)
[ ] C36 0.22 uF (1206 Size Pad) (4.1 x 4.3 inch) (104.4 x 110.2 mm)
[ ] C38 0.22 uF (1206 Size Pad) (3.9 x 4.6 inch) (98.4 x 115.9 mm)
[ ] C56 0.22 uF (1206 Size Pad) (5.0 x 1.6 inch) (126.4 x 41.3 mm)
[ ] C58 0.22 uF (1206 Size Pad) (5.2 x 1.0 inch) (133.0 x 24.8 mm)
[ ] C67 0.22 uF (1206 Size Pad) (5.7 x 1.9 inch) (144.2 x 47.0 mm)
[ ] C76 0.22 uF (1206 Size Pad) (6.1 x 1.6 inch) (154.0 x 40.6 mm)
[ ] C77 0.22 uF (1206 Size Pad) (6.1 x 2.1 inch) (154.0 x 53.0 mm)
[ ] C83 0.22 uF (1206 Size Pad) (3.4 x 1.3 inch) (86.0 x 33.0 mm)
[ ] C87 0.22 uF (1206 Size Pad) (4.3 x 0.5 inch) (108.0 x 13.6 mm)

[ ] C88 0.22 uF (1206 Size Pad) (3.9 x 1.7 inch) (98.7 x 43.2 mm)
[ ] C91 0.22 uF (1206 Size Pad) (3.4 x 0.8 inch) (86.4 x 19.4 mm)
[ ] C92 0.22 uF (1206 Size Pad) (3.4 x 1.4 inch) (86.0 x 35.6 mm)
[ ] C94 0.22 uF (1206 Size Pad) (5.9 x 1.2 inch) (150.8 x 31.1 mm)
[ ] C107 0.22 uF (1206 Size Pad) (3.3 x 2.6 inch) (82.9 x 65.7 mm)
[ ] C121 0.22 uF (1206 Size Pad) (4.8 x 2.8 inch) (121.9 x 71.8 mm)
[ ] C122 0.22 uF (1206 Size Pad) (5.1 x 2.9 inch) (128.9 x 74.0 mm)
[ ] C126 0.22 uF (1206 Size Pad) (5.5 x 3.1 inch) (139.1 x 77.5 mm)
[ ] C134 0.22 uF (1206 Size Pad) (1.5 x 1.2 inch) (37.1 x 30.2 mm)
[ ] C140 0.22 uF (3.1 x 2.3 inch) (77.5 x 58.4 mm)

[ ] C9 470 uF (1.137 x 5.687 inch) (28.88 x 144.45 mm)
[ ] C11 470 uF (1.500 x 5.500 inch) (38.10 x 139.70 mm)
[ ] C41 470 uF (1.800 x 5.012 inch) (45.72 x 127.30 mm)
[ ] C43 470 uF (2.162 x 4.512 inch) (54.91 x 114.60 mm)
[ ] C45 470 uF (1.837 x 4.600 inch) (46.66 x 116.84 mm)
[ ] C73 470 uF (6.175 x 1.900 inch) (156.85 x 48.26 mm)
[ ] C74 470 uF (6.362 x 1.900 inch) (161.59 x 48.26 mm)
[ ] C78 470 uF (6.362 x 2.287 inch) (161.59 x 58.09 mm)
[ ] C80 470 uF (0.125 x 4.425 inch) (3.18 x 112.40 mm)
[ ] C93 470 uF (6.087 x 5.450 inch) (154.61 x 138.43 mm)
[ ] C124 470 uF (1206 Size Pad) (5.225 x 2.637 inch) (132.72 x 66.98 mm)
[ ] C127 470 uF (1206 Size Pad) (5.650 x 2.762 inch) (143.51 x 70.15 mm)
[ ] C135 470 uF (1.112 x 2.100 inch) (28.24 x 53.34 mm)
[ ] C136 470 uF (1.8 x 2.2 inch) (45.7 x 54.6 mm)

Capacitor, Other

[ ] C24 0.04 pF “gimmick” capacitor. Constructed from a 0.2-inch length of #24 tinned wire spaced 0.05-inch above the adjacent PC-board pad. (2.4 x 5.6 inch) (61.3 x 141.3 mm)

Inductors

Ferrite SMT Bead, 1206 Size
[ ] L16 (1.5 x 4.3 inch) (37.8 x 108.3 mm)
[ ] L17 (2.6 x 4.2 inch) (66.0 x 106.4 mm)
[ ] L26 (3.4 x 1.2 inch) (86.0 x 30.5 mm)
[ ] L27 (5.9 x 4.5 inch) (149.5 x 114.3 mm)
[ ] L28 (5.5 x 1.9 inch) (138.7 x 47.0 mm)
[ ] L29 (5.9 x 1.7 inch) (149.9 x 43.2 mm)
[ ] L30 (5.9 x 2.2 inch) (149.9 x 55.9 mm)
[ ] L31 (6.1 x 5.3 inch) (155.6 x 134.0 mm)
[ ] L106 (3.3 x 2.8 inch) (82.6 x 70.2 mm)
[ ] L107 (1.4 x 2.6 inch) (35.6 x 65.4 mm)
[ ] L108 (2.0 x 3.4 inch) (51.1 x 86.0 mm)
[ ] L109 (1.5 x 2.5 inch) (39.0 x 62.2 mm)

Chip Inductors
[ ] L3 39 nH (39NM) (1.1 x 5.8 inch) (27.6 x 148.3 mm)
[ ] L19 39 nH (39NM) (1.1 x 4.5 inch) (26.7 x 113.3 mm)
[ ] L104 39 nH (39NM) (5.5 x 2.9 inch) (140.6 x 73.7 mm)

[ ] L18 100 nH (R10M) (1.3 x 4.2 inch) (33.3 x 107.6 mm)

[ ] L4 0.33 µH (R33M) (1.5 x 5.8 inch) (38.1 x 146.4 mm)

[ ] L5 0.33 µH (R33M) (1.7 x 5.6 inch) (41.9 x 142.9 mm)
[ ] L6 0.33 µH (R33M) (1.6 x 5.1 inch) (41.0 x 129.0 mm)
[ ] L7 0.33 µH (R33M) (1.5 x 5.4 inch) (38.1 x 136.8 mm)
[ ] L14 0.33 µH (R33M) (2.3 x 4.3 inch) (59.1 x 110.2 mm)
[ ] L15 0.33 µH (R33M) (1.9 x 4.3 inch) (47.6 x 108.3 mm)

[ ] L22 2.2 µH (2R2K) (6.0 x 1.4 inch) (151.4 x 36.5 mm)

[ ] L20 10 µH (100) (5.9 x 1.1 inch) (150.2 x 26.7 mm)

Diodes, Surface Mount

[ ] D4 BAR74 (4.9 x 4.7 inch) (125.4 x 118.4 mm)
[ ] D5 BAR74 (2.3 x 1.2 inch) (57.8 x 31.4 mm)
[ ] D6 BAR74 (2.1 x 1.2 inch) (53.0 x 31.4 mm)
[ ] D105 BAR74 (1.1 x 2.7 inch) (27.9 x 67.3 mm)
[ ] D111 BAR74 (1.2 x 2.0 inch) (29.9 x 51.7 mm)
[ ] D112 BAR74 (1.8 x 2.3 inch) (44.8 x 59.1 mm)

[ ] D107 BAV74 (2.2 x 2.7 inch) (56.5 x 68.3 mm)
[ ] D108 BAV74 (2.2 x 2.9 inch) (56.5 x 72.7 mm)
[ ] D109 BAV74 (2.2 x 3.1 inch) (56.5 x 77.1 mm)
[ ] D110 BAV74 (2.2 x 3.2 inch) (56.5 x 81.6 mm)

[ ] D1 HSMP-3804 (1.7 x 5.5 inch) (41.9 x 138.4 mm)
[ ] D2 HSMP-3804 (0.3 x 4.7 inch) (7.6 x 119.1 mm)

[ ] D104 FMMV2101 (4.1 x 2.8 inch) (104.4 x 71.4 mm)
[ ] D113 FMMV2101 (4.0 x 2.6 inch) (101.9 x 65.7 mm)
[ ] D114 FMMV2101 (4.3 x 2.8 inch) (108.3 x 71.4 mm)
[ ] D115 FMMV2101 (4.2 x 2.6 inch) (106.4 x 65.7 mm)

[ ] D3 FMMV2103 (5.6 x 1.3 inch) (141.6 x 31.8 mm)

Transistors, Surface Mount

[ ] Q1 FMMT3904 (5.0 x 4.5 inch) (126.7 x 114.3 mm)
[ ] Q5 FMMT3904 (2.3 x 1.1 inch) (57.2 x 27.3 mm)
[ ] Q103 FMMT3904 (4.7 x 0.3 inch) (119.1 x 7.9 mm)
[ ] Q104 FMMT3904 (4.7 x 0.2 inch) (119.1 x 3.8 mm)

[ ] Q3 FMMT3906 (4.6 x 1.8 inch) (116.5 x 45.4 mm)
[ ] Q6 FMMT3906 (2.1 x 1.1 inch) (53.0 x 27.3 mm)
[ ] Q102 FMMT3906 (2.1 x 2.2 inch) (54.3 x 56.8 mm)

MMIC Amplifiers

The input lead on the MSA or MAR RF IC's is pin 1 and is marked by a 45 degree cut. Mount these against the PC board with the leads bent down fairly close to the case.

The MAR/MSA amplifier IC's are sometimes shown on the part layout without the cut lead. In all cases, though, the dot on the layout drawing is at the input, or slant-cut lead side.

NOTE: The MSA-0304 package has a different marking system than the MSA-0386 or MAR-3SM. The MSA-0304 has a bump on the package next to pin 3. There is no slant cut on the leads as shown above.

[ ] U2 MSA0386 or MSA-0304 or MAR-3SM (1.3 x 5.6 inch) (33.3 x 142.2 mm)
[ ] U9 MSA0386 or MSA-0304 or MAR-3SM (6.3 x 2.1 inch) (160.7 x 53.3 mm)

[ ] U5 MSA0486 or MAR-4SM (2.0 x 4.5 inch) (50.5 x 113.7 mm)
[ ] U106 MSA0486 or MAR-4SM (5.4 x 2.8 inch) (136.2 x 70.2 mm)

[ ] U1 MSA0686 or MAR-6SM (0.9 x 5.7 inch) (23.5 x 144.5 mm)
[ ] U4 MSA0686 or MAR-6SM (2.3 x 4.5 inch) (59.4 x 115.2 mm)
[ ] U8 MSA0686 or MAR-6SM (6.3 x 1.6 inch) (160.7 x 40.6 mm)
[ ] U105 MSA0686 or MAR-6SM (5.0 x 2.6 inch) (126.7 x 65.4 mm)

Integrated Circuits, Surface Mount

[ ] U110 MM74HC14M (1.4 x 2.3 inch) (34.9 x 58.4 mm)

[ ] U107 MM74HC595 (1.8 x 2.7 inch) (44.5 x 67.3 mm)
[ ] U108 MM74HC595 (1.7 x 3.6 inch) (42.21 x 90.8 mm)

[ ] U11 CD4066BCM (5.6 x 4.4 inch) (141.6 x 111.4 mm)
[ ] U12 CD4066BCM (4.0 x 4.8 inch) (99.7 x 121.9 mm)

[ ] U10 LM833 (4.3 x 4.6 inch) (108.9 x 116.5 mm)

[ ] U104 LMX1501A (3.4 x 2.8 inch) (87.0 x 69.9 mm)

[ ] U7 MC145170 (4.9 x 1.5 inch) (123.2 x 38.4 mm)

[ ] U109 LM358M (1.7 x 1.4 inch) (42.6 x 35.6 mm)

[ ] U6 OP27GU (5.5 x 0.9 inch) (138.4 x 22.9 mm)

Integrated Circuits, Through Hole Mount

NOTE: It takes a bit of soldering iron heat to solder the 6 grounds in the middle of U14. These are the heat-sink pins for the IC.

[ ] U14 LM1877N-9 (3.7 x 1.0 inch) (94.0 x 25.4 mm)

(Tall Surface Mount Components)

Surface Mount Electrolytic Capacitor
Electrolytic capacitors are polarized. The positive lead goes towards the pad marked with a "+". The negative lead is marked with a black line. The shape of the base of the electrolytic capacitor should match the silk screen on the PCB.

[ ] C35 2.2 uF (5.2 x 4.5 inch) (131.5 x 114.3 mm)
[ ] C39 2.2 uF (1.9 x 1.0 inch) (48.6 x 26.3 mm)
[ ] C59 2.2 uF (5.0 x 0.7) (127.6 x 18.7 mm)
[ ] C139 2.2 uF (1.2 x 2.4) (29.5 x 61.6 mm)

[ ] C133 10 uF (1.2 x 1.4) (30.8 x 34.9 mm)

[ ] C37 47 uF (4.7 x 4.5) (119.4 x 113.3 mm)

[ ] C54 47 uF (3.1 x 1.7) (77.5 x 44.1 mm)
[ ] C55 47 uF (3.6 x 1.7) (91.7 x 44.1 mm)
[ ] C66 47 uF (5.2 x 1.8) (132.4 x 44.5 mm)
[ ] C82 47 uF (2.0 x 3.6) (49.8 x 91.1 mm)
[ ] C84 47 uF (3.7 x 0.7) (94.0 x 18.7 mm)
[ ] C89 47 uF (3.0 x 0.9) (76.8 x 23.2 mm)
[ ] C90 47 uF (3.0 x 1.2) (76.8 x 30.5mm)

NOTE: C101 is a surface mount electrolytic with pads that are too small. Scrape the solder mask off of the ground trace, clear back to the ground via, (removing the letter 'C' in C101) and there is enough room to mount the part.

[ ] C101 47 uF (1.1 x 0.6 inch) (28.0 x 14.9 mm)
[ ] C103 47 uF (2.7 x 0.6 inch) (68.0 x 15.2 mm)
[ ] C104 47 uF (3.9 x 0.3 inch) (99.4 x 7.3 mm)
[ ] C105 47 uF (2.7 x 3.1 inch) (68.3 x 79.7 mm)
[ ] C106 47 uF (3.2 x 3.1 inch) (82.2 x 78.1 mm)
[ ] C131 47 uF (1.6 x 1.7 inch) (40.6 x 41.9 mm)
[ ] C132 47 uF (1.9 x 1.7 inch) (48.3 x 41.9 mm)
[ ] C145 47 uF (5.0 x 3.2 inch) (125.7 x 80.3 mm)

Variable Capacitor

C69 and C110 are small ceramic variables. The markings show a flat side. As they are shown, the screwdriver will be on the "hot" side of the capacitor. This works, but is annoying when adjusting. If you install them in the reverse of the markings, the screwdriver will be grounded when they are being adjusted. Hint: If you look at the backside of the capacitor, the grounded side is clear.

[ ] C69 1.8 - 6 uF (Red Paint) (5.2 x 1.5 inch) (133.0 x 37.8 mm)

!! C110 is close to X101 !!
[ ] C110 2.8 – 12.5 uF (No Paint) (3.6 x 3.3 inch) (92.4 x 82.9 mm)

Variable Resistor

R124 may not line up with the pads and the silk-screen marking, depending on which version of the 3329 pot you have. If so, bend the center wire so that it lines up better, and push the part away from C131. There is plenty of room and it all works out fine if you don't try to push the pot down too far. Short leads help to make the pot mechanically stable, but are of no concern electrically.

[ ] R124 10K Ω (1.3 x 1.6 inch) (33.0 x 39.7 mm)

(Through-Hole Components)

Filters

The Pi filters, FIL1, FIL2, etc., have three leads coming out the bottom. The center lead is ground. The pads on the PC board have a through-hole for the center lead. The two side leads should be bent at right angles and cut short to fit the square "SMT" pads. When you look at the board you will see the arrangement.

The 18 filters, like F1, F2,... should have their outside leads bent at right angles and the leads cut short. They will then fit the pads. It is important that the center grounded lead be down against the board for low inductance.

[ ] F1 470 pF (1.0 x 4.9 inch) (25.7 x 125.4 mm)
[ ] F2 470 pF (1.8 x 5.7 inch) (45.1 x 145.7 mm)

[ ] F3 470 pF (1.1 x 1.0 inch) (27.3 x 25.7 mm)
[ ] F4 470 pF (1.1 x 1.1 inch) (27.3 x 28.6 mm)
[ ] F5 470 pF (0.9 x 6.0 inch) (22.5 x 153.3 mm)
[ ] F101 470 pF (0.4 x 0.4 inch) (11.1 x 8.9 mm)
[ ] F102 470 pF (2.7 x 2.7 inch) (68.2 x 69.5 mm)
[ ] F103 470 pF (5.2 x 3.0 inch) (131.8 x 77.1 mm)
[ ] F105 470 pF (0.8 x 1.2 inch) (20.3 x 31.1 mm)
[ ] F106 470 pF (0.8 x 1.3 inch) (20.3 x 33.7 mm)
[ ] F108 470 pF (1.2 x 3.1 inch) (29.2 x 77.8 mm)
[ ] F109 470 pF (1.2 x 3.2 inch) (29.2 x 80.0 mm)
[ ] F110 470 pF (1.2 x 3.0 inch) (29.2 x 75.6 mm)
[ ] F111 470 pF (1.2 x 3.2 inch) (29.2 x 82.2 mm)
[ ] F112 470 pF (1.2 x 2.9 inch) (29.2 x 73.3 mm)
[ ] F113 470 pF (1.2 x 2.8 inch) (29.2 x 71.1 mm)
[ ] F114 470 pF (0.5 x 2.2 inch) (12.7 x 54.6 mm)
[ ] F115 470 pF (0.8 x 2.7 inch) (20.3 x 68.9 mm)

Film Capacitor

[ ] C111 0.0047 uF (472) (3.1 x 2.6 inch) (78.7 x 66.3 mm)

NOTE: As shown on both the part layout and the QST schematic, C61 is a film type capacitor. There are also ceramic chips of the same 0.01 uF value, but they are not interchangeable.

[ ] C61 0.01 uF (103) (6.0 x 0.7 inch) (153.3 x 17.8 mm)

[ ] C95 0.015 uF (153) (5.8 x 5.0 inch) (147.3 x 125.7 mm)

[ ] C60 0.033 uF (333) (4.8 x 0.9 inch) (121.6 x 22.5 mm)

NOTE: C112 leads may be too narrow the mounting holes. Bend them to suit. These do not need to be extremely short.

[ ] C112 0.068 uF (683) (2.9 x 2.7 inch) (74.3 x 68.6 mm)

[ ] C30 0.1 uF (104) (6.3 x 5.0 inch) (160.0 x 125.7 mm)
[ ] C31 0.1 uF (104) (5.5 x 5.0 inch) (139.7 x 125.7 mm)

Axial-Lead Capacitor

[ ] C102 470 uF, 25V (1.6 x 0.2 inch) (40.6 x 4.8 mm)

Inductor

L101 has no preferred direction for insertion.

[ ] L101 47 µH (1.7 x 0.6 inch) (43.5 x 14.0 mm)

Transistors and FETs

[ ] Q2 2N5109 (1.4 x 4.6 inch) (35.2 x 117.8 mm)

The leads of the two JFET's Q4 and Q101 should be reasonably short. The bottom of the package should sit about 1/8-inch (3 mm) above the board.

[ ] Q4 J310 (5.6 x 1.8 inch) (143.2 x 44.8 mm)
[ ] Q101 J310 (4.6 x 2.8 inch) (117.8 x 71.8 mm)

SILK-SCREEN MARKINGS: silk-screen errors: Q105 and Q106 from Zetex do not have the same shape as the outline shown, which is a conventional TO-92. The flat side of the TO-92 has the markings, and the marked side of the Zetex package goes the same direction. In other words, if you look from the edge of the board, you should be able to read the markings on Q105 and Q106.

The MOSFET's Q105, Q106 do not require particularly short leads and should be pushed down until the bottom of the packages are about 3/16-inch (5 mm) above the board.

[ ] Q105 ZVP2106A (4.8 x 0.5 inch) (121.9 x 11.4)
[ ] Q106 ZVP2106A (4.8 x 0.2 inch) (121.9 x 4.1 mm)

Diodes

[ ] D101 1N5401 (1.4 x 0.1 inch) (35.6 x 2.5 mm)

[ ] "no designator" SR105

Light Emitting Diodes

[ ] D102 Amber (0.5 x 0.7 inch) (12.7 x 16.5 mm)

[ ] D103 Red (0.8 x 0.7 inch) (20.3 x 16.5 mm)

Voltage Regulators
IMPORTANT!! 78L05 SILK SCREEN MARKINGS: The silk-screen legend is backwards for the 78L05 regulators, U13 and U103. The flat sides of both TO-92 packages should be towards the top of the board. There is no problem in installing the parts, of course. The sketch of the package included with the board is correct.

The voltage regulators, U13 and U103 do not require particularly short leads and should be pushed down until the bottom of the packages are about 3/16-inch (5 mm) above the board.

[ ] U13 LM78L05ACZA (3.3 x 1.9 inch) (82.6 x 47.0 mm)
[ ] U103 LM78L05ACZA (2.9 x 3.3 inch) (72.7 x 82.6 mm)

The two TO-220 voltage regulators, U101 and U102, mount under the board. They can be mounted to the box with a 6-32 screw, #6 washer, lock washer and nut. Bend the leads right where they change size.

[ ] U101 LM2937ET-10 (3.1 x 0.4 inch) (79.7 x 10.2 mm)

[ ] U102 LM7805CTB (3.6 x 0.4 inch) (91.1 x 10.2 mm)

Crystals
The 19.665 MHz crystals are soldered to the surface mount pads. Their case is soldered to the ground strip towards the edge of the board, as shown in the part layout. The symbols on the part layout make it appear that there is a chip resistor across the leads of the crystals. This, of course, is not the case.

[ ] X1 19.6608 MHz (4.8 x 5.6 inch) (121.9 x 142.9 mm)
[ ] X2 19.6608 MHz (5.0 x 5.6 inch) (127.6 x 142.9 mm)

[ ] X3 19.6608 MHz (5.3 x 5.6 inch) (133.4 x 142.9 mm)
[ ] X4 19.6608 MHz (5.5 x 5.6 inch) (139.1 x 142.9 mm)

The required capacitors for C108 and C109 on the 10 MHz oscillator may vary some depending on the crystal. There is some room in the area of these caps if more are needed in parallel. Also, be sure that a plug in jumper connects pins 1 and 2 of P106 for the crystal oscillator option. If an external reference is used it should go to P106, pin 2, with the ground to pin 3.

[ ] X101 10 MHz (3.5 x 3.1 inch) (89.5 x 79.4 mm)

Mixers

The two TUF-1 mixers are mounted through the board by their pins. There is a dot in the silk screen (Rev C) showing pin 1 (blue glass.) As an additional check, the grounded pin of the mixer (no glass at all) goes to the ground plane on the back of the board. Check the pins carefully, as the mixer is tough to get out of the board if it is backwards.

The mixers should sit a few thousandths of an inch above the board to be fully safe from shorts. A tiny piece of Scotch tape at each end may help.

[ ] U3 TUF-1 (3.8 x 5.9 inch) (97.5 x 148.9 mm)
[ ] U15 TUF-1 (6.3 x 5.5 inch) (160.3 x 139.7 mm)

Variable Inductor

There are two types of slug-tuned coils with nominal inductances of 0.1 µH (100 nH) and 2.2 µH. Be careful to not get these mixed up. These 10K series Toko parts do not have their values on them, but they are marked with their part number.

TOKO TKANS-9447HM

[ ] L12 2.2 µH (4.3 x 5.7 inch) (108.6 x 144.2 mm)
[ ] L13 2.2 µH (5.7 x 5.7 inch) (145.7 x 144.2 mm)

TOKO TKENS-T1044

The 10K Toko coils are really hard to get out from the PC board if they are in the wrong place. Check twice, then solder.

[ ] L1 0.1 µH (100 nH) (0.3 x 5.3 inch) (7.0 x 134.6 mm)
[ ] L2 0.1 µH (100 nH) (0.3 x 5.7 inch) (7.0 x 145.4 mm)
[ ] L8 0.1 µH (100 nH) (2.0 x 5.7 inch) (49.8 x 144.8 mm)
[ ] L9 0.1 µH (100 nH) (2.2 x 5.3 inch) (56.8 x 134.6 mm)
[ ] L10 0.1 µH (100 nH) (2.5 x 5.7 inch) (64.1 x 144.8 mm)
[ ] L11 0.1 µH (100 nH) (3.1 x 5.7 inch) (78.4 x 144.8 mm)
[ ] L102 0.1 µH (100 nH) (4.3 x 3.0 inch) (109.2 x 77.1 mm)

Toroid Cores

Estimate the amount of wire needed and cut off a little extra. Feed the wire through the center the same number of times as there are turns. The turns can be in either direction. Line the turns up reasonably close together. If you have the polyurethane covering it is easy to remove with a soldering iron or with a a solvent (an example is Belden's Beldsol wire). Otherwise, carefully remove the enamel with a sharp knife.

CAUTION: The toroid cores are brittle. Wind carefully. Do not pull the wire to tight.

0.36 µH – 17 turns with #26 enameled wire on a T-25-17 (Blue and Yellow) toroid core

[ ] L23 (0.4 x 5.0 inch) (9.0 x 126.4 mm)
[ ] L24 (0.3 x 4.5 inch) (7.00 x 113.7 mm)
[ ] L25 (0.3 x 4.2 inch) (6.7 x 107.0 mm)
[ ] L103 (4.5 x 2.6 inch) (115.2 x 66.7 mm)

0.5 µH – 12 turns of #26 enameled wire on a T-37-6 (Yellow and Black) toroid core. Adjust inductance by moving the turns.

[ ] L21 (5.4 x 1.3 inch) (138.1 x 33.3 mm)

Ferrite Cores
L32 is wound with #32 wire and the core is about 1/4 inch in diameter. In order that this core not behave as an antenna at 15 kHz it needs to be small and the magnetic field needs to be concentrated in the core (no air gaps.) This is achieved with this coil design, but it does take a few minutes to wind. Try to keep the turns in line around the toroid. But, don't worry if the turns sometimes overlap or get looped under the prior turn. It will not affect the functionality.

330 µH – 52 turns of #32 enameled wire on an Amidon F-22-43 toroid core.

[ ] L32 (5.7 x 4.8 inch) (144.8 x 121.0 mm)

Fuse Holder and Fuse
CAUTION: Do NOT have a fuse in the holder clips when you solder them!

[ ] FS1 (0.8 x0.1 inch) (20.0 x 1.9 mm)

Headers

2-Pin
[ ] P1 (0.1 x 4.2 inch) (2.8 x 106.4 mm)
[ ] P2 (0.1 x 4.6 inch) (2.8 x 115.2 mm)
[ ] P3 (0.9 x 4.4 inch) (21.6 x 111.1 mm)

P6 and P7: These are not used at present (marked ALC and VLF.) They go to the Right (Q), unused ADC input for transmit and receive.

[ ] P6 (3.7 x 4.7 inch) (92.7 x 118.4 mm)
[ ] P7 (3.6 x 5.0 inch) (92.7 x 125.7 mm)
[ ] P103 (0.1 x 1.0 inch) (2.5 x 25.4 mm)

3-Pin
[ ] P105 (0.1 x 0.6 inch) (2.5 x 15.2 mm)

INTERFERENCE: The corner of P106 may need to share space with C109. Just let P106 sit high enough to clear the capacitor, which needs to be installed first.

[ ] P106 (3.9 x 3.1 inch) (98.7 x 79.4 mm)

4-Pin
[ ] P4 (0.4 x 1.0 inch) (10.8 x 25.4 mm)

5-Pin
[ ] P102 (0.1 x 1.3 inch) (2.5 x 33.0 mm)

8-Pin
[ ] P5 (2.4 x 3.9 inch) (61.0 x 99.1 mm)
[ ]P108 (1.4 x 3.8 inch) (34.3 x 95.9 mm)

12-Pin
[ ] P101 (0.2 x 3.3 inch) (5.1 x 82.6 mm)

POWER-UP AND INITIAL TESTING

For transceiver main-board alignment and basic troubleshooting, you need a voltmeter. A signal generator covering 144-148 MHz is helpful, but on-the-air signals are an adequate substitute and their use is assumed in the following steps.

[ ] First, apply +11 V to the main boards without using the DSP board. At 11 V, it is not necessary to heat sink the voltage regulators, so the board can be tested outside the box.

[ ] At this point, current consumption should be around 350 mA.

If everything is operating properly, your checks should show the nominal voltages given in the following table.

	Component ID and Pin Number	Function	V_{avg}
[ ]	U101 pin 1	10-V regulator input	11.0 V
[ ]	U101 pin 3	10-V regulator output	10.0 V
[ ]	U102 pin 3	Main 5 V regulator	5.0 V
[ ]	U103 pin 3	First synthesizer regulator	5.0 V
[ ]	U14 pins 2 and 13	Audio outputs	5.5 V
[ ]	U1 pin 3	First RF amp	3.5 V
[ ]	U2 pin 3	Second RF amp	4.7 V
[ ]	R110	Source of Q101 VCO	0.23 V
[ ]	U105 pin 3	VCO buffer	3.5 V
[ ]	U106 pin 3	VCO buffer	4.6 V
[ ]	R59	Source of Q4 VCO	0.91 V
[ ]	U8 pin 3	VCO buffer	2.8 V
[ ]	U9 pin 3	VCO buffer	3.6 V

All dc voltages must be proper before further testing is possible. If they are not right, find out why.

[ ] Next, mount the main board in the die-cast box and fasten the two regulator heat sinks to the box.

[ ] Connect the EZ-Kit box wiring, but leave the EZ-Kit box separate from the main box so that it can be moved out of the way of the main board.

[ ] Connect the transceiver serial connection to the PC's serial port using the 9-pin cable supplied with the EZ-Kit.

[ ] Now both the main board and the EZ-Kit can be powered via the power connector.

[ ] With power applied, load and run the EZ-Kit program UHF3.EXE as was done earlier.

[ ] Next, execute the PC program UHFA.EXE that initializes all the parameters for the DSP program, including programming the synthesizers.

[ ] The amber POWER LED, D102, should be lit,

[ ] But the red TRANSMIT LED, D103, should be off.

Confirm the voltage readings at the following points:

	Component ID and Pin Number	Function	V_{avg}
[ ]	Q106 pin 1	10 V receive	9.7 V
[ ]	U10A pin 3	IF amplifier	6.0 V
[ ]	U109B pin 6	Transmit IF driver	2.4 V

[ ] Be sure that the RF gain is at 100 (press CTRL-F8 on the PC keyboard) and confirm the following voltages:

	Component ID and Pin Number	Function	V_{avg}
[ ]	D2-A1	Antenna TR diode	0.73 V
[ ]	D1-A1	RF Filter TR diode	0.73 V

[ ] Measure the 19.68 MHz synthesizer tuning voltage at the U6 pin 6 side of R54 (Figure 8). Set this to about 4 V using C69. If it is not possible to set the voltage to that level, adjust the turns on the VCO coil, L21. Pushing the turns together raises the tuning voltage.

[ ] After you are sure that L21 is at its proper setting, use a small dab of RTV sealant to hold the windings in places and secure the coil to the board.

[ ] Set the MODE to CW and set the Operating Frequency to 147.000 MHz.

[ ] Adjust the 126 to 128 MHz VCO coil, L102, until the tuning voltage measured at the junction of R104 and R105 is about 3.5 V.

[ ] Ensure that a jumper is in place between pins 1 and 2 of P106, or that an external reference signal is being fed to P106 pins 2 and 3.

[ ] Attach an antenna and see if you can receive a local repeater signal, with the transceiver in CW mode. If so, adjust the reference oscillator frequency with C110 until the carrier pitch is about 600 Hz with the repeater frequency on the display.

[ ] If it is not possible to get on frequency adjusting C110, change the value of C109.

As you obtain more accurate frequency references than a local repeater, it will be necessary to repeat this adjustment.

[ ] Next, peak crystal filter coils L12 and L13 for maximum signal. The signal level indication can be helpful for these adjustments. Select a repeater frequency as close as possible to 147 MHz and peak the RF filter coils L1, L2, L8, L9, L10 and L11 at that frequency.

[ ] Now, center the MIKE GAIN.

That completes all adjustments.

[ ] Connect a dummy load to the antenna connector (a 51 ohm, ¼ W resistor is adequate) and press the Home key to put the transceiver into transmit. With the key up, you should measure the following voltages:

	Component ID and Pin Number	Function	V_{avg}
[ ]	D1-A2	RF Filter TR diode	0.73V
[ ]	U4 pin 3	1st transmit amplifier	3.6 V
[ ]	U5 pin 3	2nd transmit amplifier	4.6 V
[ ]	Q2 emitter	Power amplifier emitter	1.2 V
[ ]	Q2 base	Power amplifier base	1.9 V

[ ] While holding down the CW key (right hand ALT key), measure the transceiver's output power. It should be at least 20 mW at full power setting. Figure 12 shows a circuit that can be used to measure the power output if a power meter is not available.

BOX FOR DSP: The box size in the drawing furnished with the PC Board from Mashell Electric is snug around the DSP board. This can be problematic when taking the board in and out. If you keep to the 3.6 inch inside dimension shown on the drawing, you must use nuts no bigger than 3/16 across. Alternatively, the ground contact to the cover can come from finger stock, as shown on the cover of Nov 1999 QST.

Otherwise, to use the hardware store type of 1/4-inch brass nuts, you should increase the box width by 0.1 to 0.2 inches. This extra size should be arranged to not cause the box to overhang the main board any extra. Doing so would put P5 and P108 under the box. There is some extra room on the other side, overhanging the voltage regulators, U101 and U102. Thanks to W7LHL for pointing this out.

Also, do not mount any nuts on the ends of the box, but only as shown in the drawing. Four or five ground points will keep things quiet at 2-meters.

For reference purposes, the mounting centers on the EZ-KIT Lite are 5.20x3.20 inches.

Before mounting the EZ-Kit board, you must, of course, remove the rubber "Bumpon" feet. If you are careful, these can be reused on the bottom of the main die-cast box.

SPACERS: A sketch of the board mounting, that I used, is included with the PC Board. This uses 8 round, metal spacers, 0.187 inches long, Such as (Johnson Component) Digi-Key J166, and four threaded metal round spacers, 1.000 inches long, such as (Johnson Components) Digi-Key J243. These are all 0.25 inches in diameter.

It is tricky to get the EZ-Kit board in, unless one glues the spacers to either the bottom of the board, or to the bottom of the inner enclosure. RTV works fine for this. Alternatively, "male/female" spacers can be used under the EZ-Kit board, if they can be found.

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ADDENDUM FOR REV 4.3 - 27 Oct 99, RSL

EZ-KIT HEAT: The way the EZ-Kit comes, the 7805 voltage regulator runs a little warmer than you like to touch, but not burning hot. This is probably within specs, but it is pretty toasty. When you put the board in a sealed box, the regulator gets warmer yet. I have not heard of any failures due to this heat. To be safe though, I took a piece of copper, 0.25x2 inches, drilled a 0.140 hole in it and fastened it to the regulator with 6-32 hardware. This cools the regulator quite a bit. Be careful that you do not end up with the heat sink strip too high, or the box cover will hit it. The tab is grounded, so it is not an electrical hazard.

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ADDENDUM FOR REV 4.4 - 10 Nov 99, RSL

MICROPHONE CONNECTIONS: I must have put the microphone connections for J202 onto paper late at night. If you want to use the Radio Shack 21-1172 microphone, the correct connections are:

J202, Pin 1 Ground to J102-2 & Box
J202, Pin 2 NC
J202, Pin 3 PTT to J102-4
J202, Pin 4 Mike audio to J102-1
J202, Pin 5 NC
The Radio Shack microphone does not need power, so the +5 is unused.

Also, be sure to notice the non-sequential numbering system of the Circular DIN connectors.

STANDOFFS: Hunting around in my junk box, I came across some of the little 4-40 male/female standoffs that are used to mount 'D Connectors' to a panel. These are 0.187 inches on the spacer and quite ideal for mounting the EZ-Kit box down to the 1-inch standoffs. This avoids any gluing or soldering of the spacers to keep them from moving around.

EZ-KIT BOX: I drilled two 1/4-inch holes in the cover for the EZ-Kit box to line up with the Red LED and the Reset Switch. This is not required for operation of the transceiver, but it is handy when getting things working. You need to reset the DSP board before reloading the DSP program. And if it doesn't work, you always wonder if the DSP was really reset. The Red LED blinks when the board is reset, waiting for a program download. These two holes allow these items to be dealt with.

EZ-KIT: Your DSP may come with R28 missing. If so, you need not remove it!!

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ADDENDUM FOR REV 4.5 - 4 Dec 99, RSL

BOX GROUND: The grounding of the EZ-Kit is not shown on the schematics. You do not get automatic grounds from the mounting posts with this board. It is a multilayer board and so has good low-inductance ground paths once the path is on the board. Between the DSP box and the EZ-Kit it is desirable to have at least one good short ground. One way to accomplish this is with a short lead from either (or both) P3-1 or P3-50 to the adjacent box wall. I used #20 wire for this and have had no problems.

CORRECTION: It is listed elsewhere, but a reminder here that the wire from J101-11 goes to EZ-Kit P2-32 and J101-12 goes to P3-31.

LEFT/RIGHT: I think I have it correct now. For the 1/8-inch stereo plugs, the convention seems to be that the ring is "Left" and the tip is "Right". If your speakers seem to be wrong (I don't know how you can tell) switch their positions (or the wires). If someone thinks this is wrong, please let me (W7PUA) know!

SCHEMATIC: Sheet 2 of the schematic that comes with the board says that the U104 synthesizer has 2 kHz steps. It has 5 kHz steps. No wiring change is involved.

TEST PADS: There are several places on the board where test points have been brought to small square pads. In one case, next to pin 15 of U104, it looks like there should be a surface mount part. Note that there are no lines on the silkscreen pattern and no part goes there! Those pads are used to probe the phase detector inputs on U104.