Build and Operation Manual

For the ADX-MINI Version 1.3
Digital Mode HF Transceiver

Document Revision 1.0

March 2, 2023

Acknowledgement: The ADX-MINI is derived from the ADX, and ADX-UNO projects by WB2CBA. More info about the ADX project can be found here:
https://antrak.org.tr/blog/adx-arduino-digital-transceiver

The ADX-MINI is most similar to the ADX-UNO with the following differences:

- The ADX-MINI has the ATmega328 onboard
- It uses a BNC antenna connector
- It uses a different band filter module layout
- It has a change in the PA FET driver circuit
- USB serial communication requires a USB-to-serial adapter

Several changes were made from ADX-MINI version 1.2, including:

- The PA FET driver circuit was changed from AC coupled to direct
- The audio input comparator bias was changed to ~2.5V
- Jumper J6 (PA disconnect) was removed
- The DTR signal was added to serial adapter connector J5

It is recommended for builders of the ADX-MINI to also download the ADX-UNO manual which can be found here:
https://github.com/WB2CBA/ADX-UnO-V1.3

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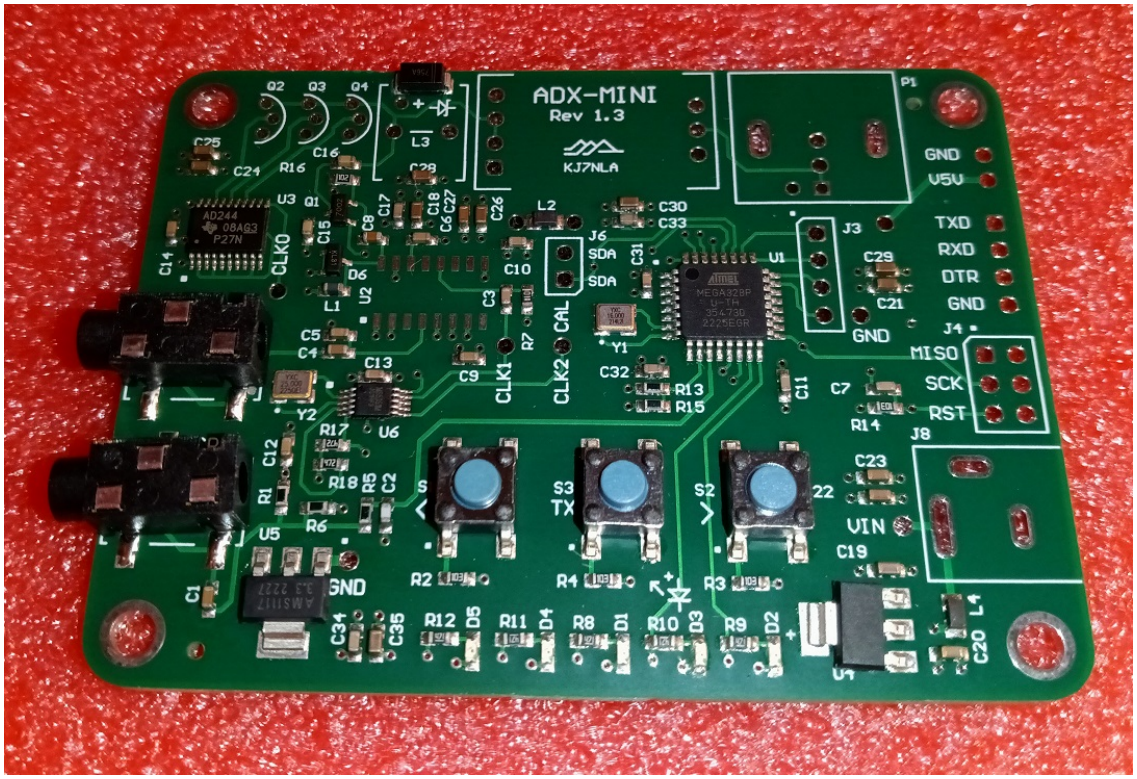
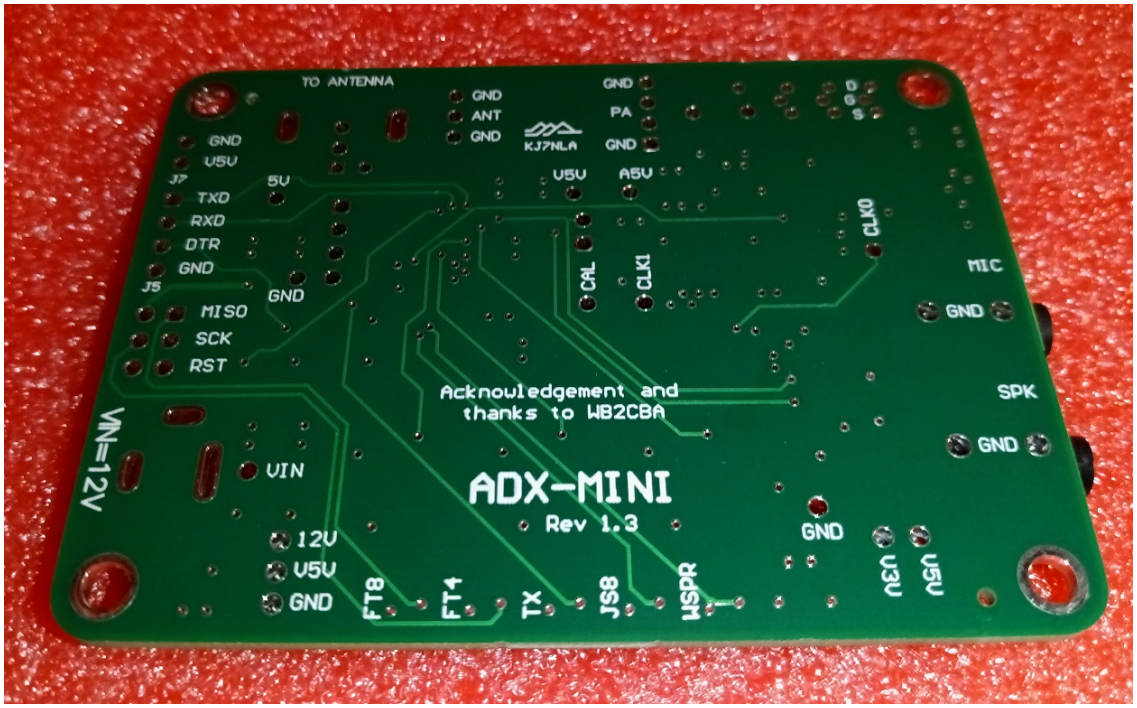
Building the ADX-MINI

Here's what it looks like when it arrives from JLCPCB





Adding the CD2003 Receiver

The CD2003GB receiver chip is not stocked by JLCPCB and must be added by hand. It is in an SOP-16 package, so it is possible to add this part with a fine-tipped soldering iron and fine (.015” diameter) solder.

First put a small amount of solder on one corner and use tweezers to align the chip and tack the corner pin. Once this is done, tack the opposite corner and then solder all the remaining pins. Use a magnifying glass to inspect your solder joints at re-touch as needed.

Winding the L3 Inductor Toroid

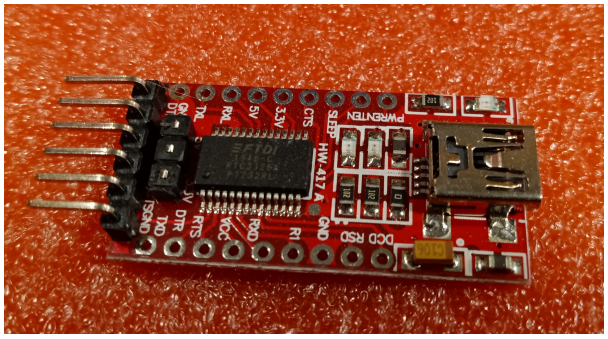
L3 is an FT37-43 with 20 turns (approximately 11 inches) of 24 AWG wire.

Adding the through-hole parts

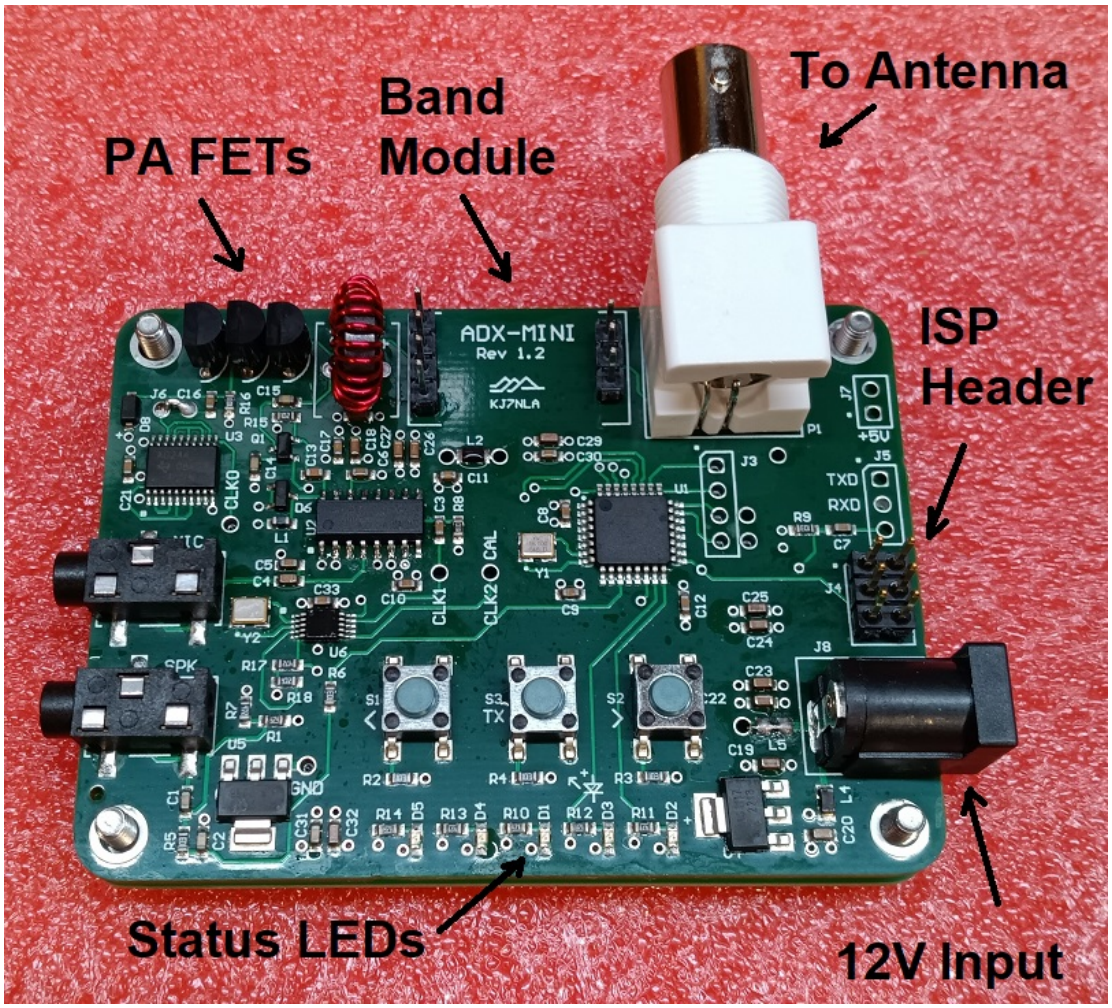
The required through-hole parts include

1) L3 inductor
2) J6 jumper
3) LPF band module pins
4) BNC antenna connector
5) ISP connector
6) 12V power connector
7) J5 and J7 serial port (optional)

Note: The serial port on the ADX-MINI is currently only used for debug purposes. A serial-to-USB adapter is required. Make sure the adapter is configured for 5V operation.



After installing the required parts, the board should look like this:



Programming the AtMega328

Your ADX-MINI should already be programmed with the latest ADX-MINI firmware. But if you want to upload new firmware, you will need to use an ISP programmer. I'm not going to cover the detailed steps required for programming (search YouTube for Arduino ISP programmer)

Si5351 Calibration

Your ADX-MINI should already be calibrated, but here are the steps to run or check calibration:

1) Connect a scope or frequency counter to the CLK2/CAL testpoint
2) Power OFF and press and hold the ">" switch and then power ON
3) After the LEDs flash, release the switch
4) Now you are in calibration mode and the "<" and ">" switches can be used to adjust the CLK2/CAL frequency to exactly 1 MHz
5) Press the TX switch to save the calibration results and exit calibration mode.

Wind Toroid L2

The ADX-MINI main board has one toroid that needs to be wound. It is 20 turns on an FT37-43 with approximately 10.5 inches of 24 AWG wire.

Install the PA FETs

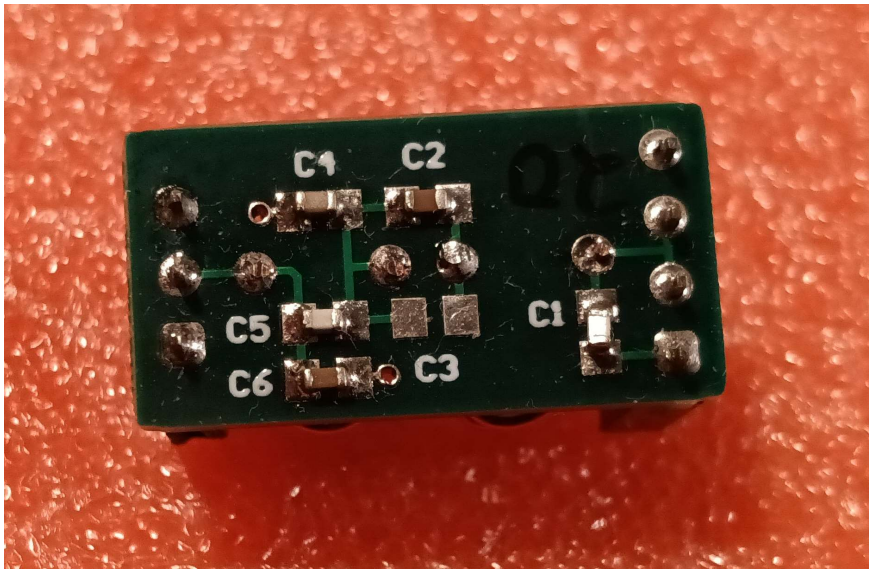
Install the 3 BS170 PA FETs

Add Optional Connectors

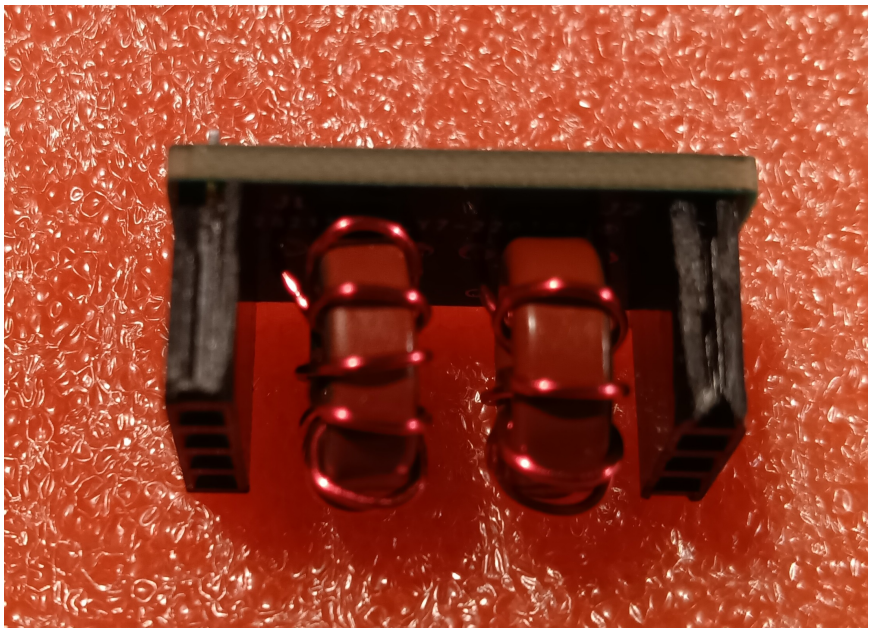
J5 is optional. It is only needed if you want to use the serial port. The primary purpose of the serial port is for debugging new firmware.

Building the Band Modules

The appendix contains per-band capacitor values. I use a fine-tip soldering iron to install the caps, but other method (e.g. solder paste and IR reflow) are possible.

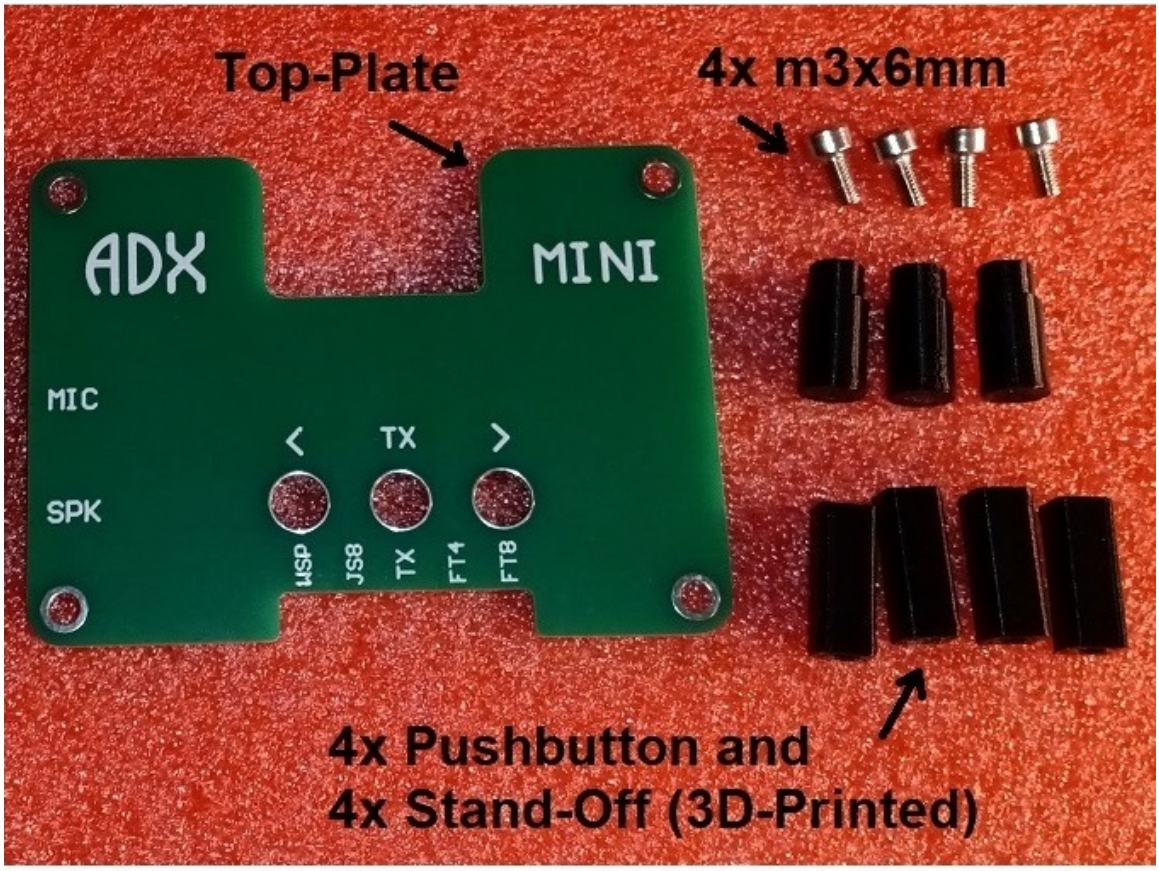


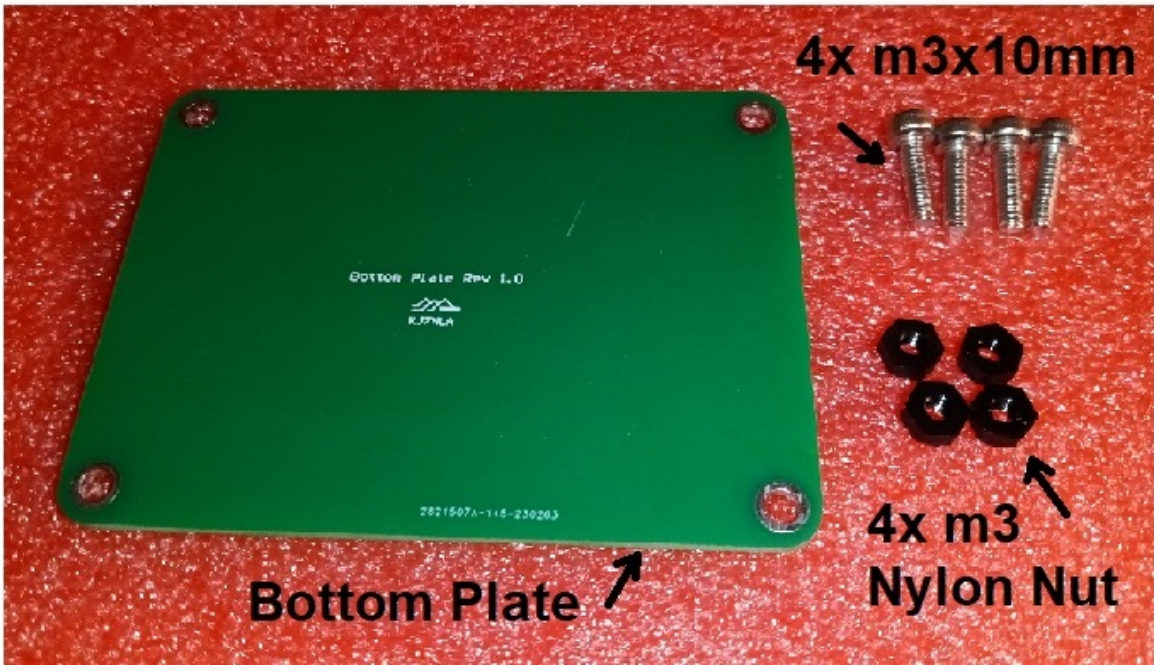
The appendix also contains per-band toroid winding information. Use 24 Ga. Magnet wire.



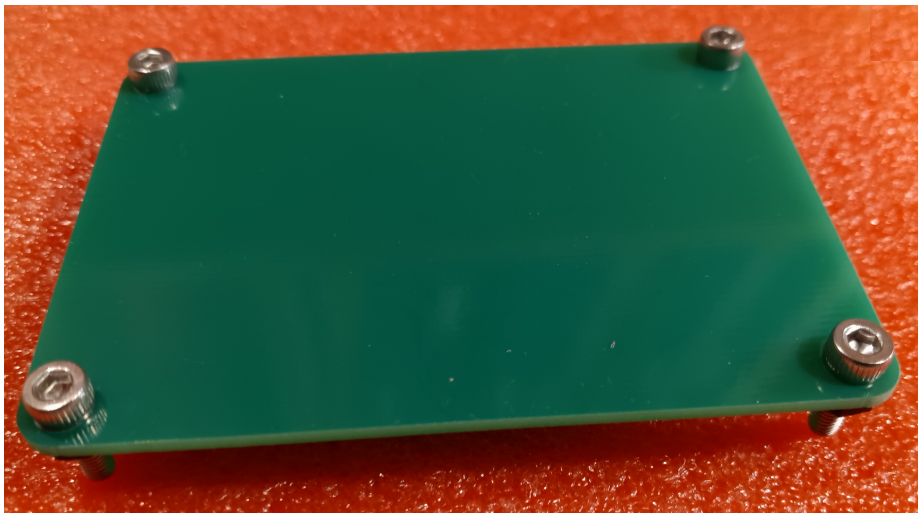
Putting It All Together

The ADX-MINI uses top and bottom PCBs to create an open style case.





Step 1: insert four m3x10mm screws through the bottom plate and secure with four m3 nylon nuts.



Step 2: Place the ADX-MINI main board over the four m3 screws and secure with the four stand-offs.

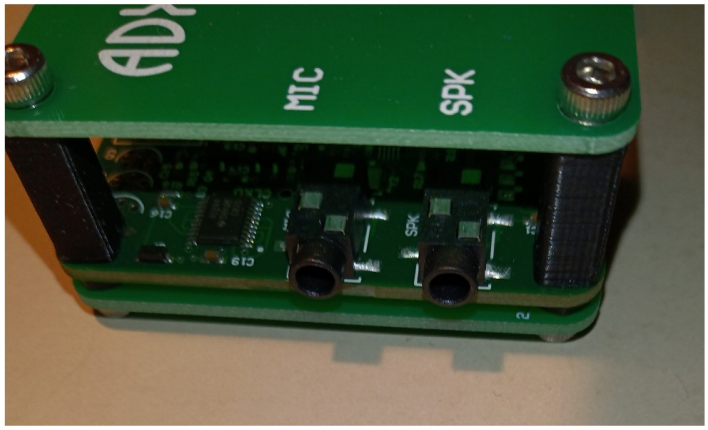
Step 3: Insert the push-button extenders into the top plate and secure them temporarily with tape. Then place the top plate on top of the standoffs and secure it with four m3x6mm screws. The final assembly should look like this:

Connecting to a Host Computer

The ADX-MINI is not a stand-alone radio. It requires a host computer running the FT8 software (such as WSJT-X). The computer can be a laptop (running either Windows or Linux) or a Raspberry Pi or a dedicated microcontroller solution such as the W5BAA Pocket-FT8.

Audio Cables

Communication between the host computer is via audio tone signaling. If you are using a laptop with 3.5mm MIC and SPKR jacks, these can be connected directly to the MIC and SPKR jacks on the ADX-MINI. If your host computer does not have MIC and SPKR jacks, then you can use a USB soundcard to provide these ports.



Standard 3.5mm audio aux cables can be used to make the connection. Shorter is better. In my case I am using 1.5 ft. length audio aux cables.

CAT

ADX-MINI firmware does not support CAT. I have not found CAT to be necessary.

Host Computer Software

WSJTX

Installing and running WSJT-X is not difficult, but there are too many details to cover here. YouTube videos are a good resource to learn how to setup and use WSJT-X.

Other

- Mapping :: FT8 uses a maidenhead locator system. It's useful to have a mapping program that converts the maidenhead locator to actual locations. For example CN85 is the Portland, Oregon area.

- Signal propagation :: Programs such as PSKReporter can show where your signal is being heard.

Operating the ADX

Refer to the ADX-MINI firmware document for detailed information on operating the ADX-MINI.

Operating Precautions

Warning #1: Never operate the ADX-MINI without a band module in place or without a suitable antenna or dummy load. The class-E PA is susceptible to damage under these conditions.

Warning #2: When changing band modules, double check that the module is seated correctly. If the band module is inserted with a 1-pin offset, it will cause a 12V-to-ground short which can burn up components. It is also recommended that you add a 5A inline fuse to your 12V supply line.

Appendix

Band Filter Values

10M Band			
	Value	**Part Number**	**LCSC**
C1	39pF	08051A390JAT2A	
C2	240pF	VJ0805D241KXPAJ	
C3	--		
C4	240pF	VJ0805D241KXPAJ	
C5	240pF	VJ0805D241KXPAJ	
C6	75pF	C0805C750J1GAC7800	
L1	9-turn T37-6		
L2	6-turn T37-6		

12M Band			
	Value	**Part Number**	**LCSC**
C1			
C2			
C3			
C4			
C5			
C6			
L1			
L2			

15M Band			
	Value	**Part Number**	**LCSC**
C1	68pF	CL21C680JC61PNC	
C2	300pF	08051A301FAT2A	
C3	15pF	08051A150JAT2A	
C4	300pF	08051A301FAT2A	
C5	100pF	C0805C101JAGAC7800	
C6	300pF	08051A301FAT2A	
L1	11-turn T37-6		
L2	7-turn T37-6		

17M Band			
	Value	**Part Number**	**LCSC**
C1	91pF	GQM2195G2E910JB12D	
C2	180pF	C0805C181J2GAC7800	
C3	180pF	C0805C181J2GAC7800	
C4	360pF	C0805C361J1GAC7800	
C5	120pF	CL21C121JDCNNNC	
C6	360pF	C0805C361J1GAC7800	
L1	11-turn T37-6		
L2	7-turn T37-6		

20M Band			
	Value	**Part Number**	**LCSC**
C1	68pF	CL21C680JC61PNC	C527207
C2	470pF	C0805C471K1RAC7800	C513677
C3	---		
C4	470pF	C0805C471K1RAC7800	C513677
C5	150pF	08051A151JAT2A	C152846
C6	470pF	C0805C471K1RAC7800	C513677
L1	10-turn T37-6		
L2	7-turn T37-6		

30M Band			
	Value	**Part Number**	**LCSC**
C1	100pF	C0805C101JAGAC7800	
C2	330pF	08051A331JAT2A	
C3	330pF	08051A331JAT2A	
C4	680pF	08051A681FAT2A	
C5	220pF	08052A221JAT2A	
C6	680pF	08051A681FAT2A	
L1	12-turn T37-2		
L2	8-turn T37-2		

40M Band			
	Value	**Part Number**	**LCSC**
C1	130pF	08051A131FAT2A	
C2	470pF	C0805C471K1RAC7800	
C3	470pF	C0805C471K1RAC7800	
C4	1000pF	C2012C0G2A102J060AA	
C5	300pF	08051A301FAT2A	
C6	1000pF	C2012C0G2A102J060AA	
L1	15-turn T37-2		
L2	10-turn T37-2		

60M Band			
	Value	**Part Number**	**LCSC**
C1	430pF	C0805C431J1GAC7800	
C2	620pF	C0805C621J2GAC7800	
C3	620pF	C0805C621J2GAC7800	
C4	1200pF	VJ0805A122FXBMT	
C5	390pF	VJ0805A391JXBAC	
C6	1200pF	VJ0805A122FXBMT	
L1	17-turn T37-2		
L2	12-turn T37-2		

80M Band			
	Value	**Part Number**	**LCSC**
C1	680pF	08051A681FAT2A	
C2	360pF	C0805C361J1GAC7800	
C3	1500pF	C2012C0G2E152J085AA	
C4	1800pF	GRM2165C2A182JA01D	
C5	620pF	C0805C621J2GAC7800	
C6	1800pF	GRM2165C2A182JA01D	
L1	21-turn T37-2		
L2	15-turn T37-2		

160M Band			
	Value	**Part Number**	**LCSC**
C1			
C2			
C3			
C4			
C5			
C6			
L1			
L2			

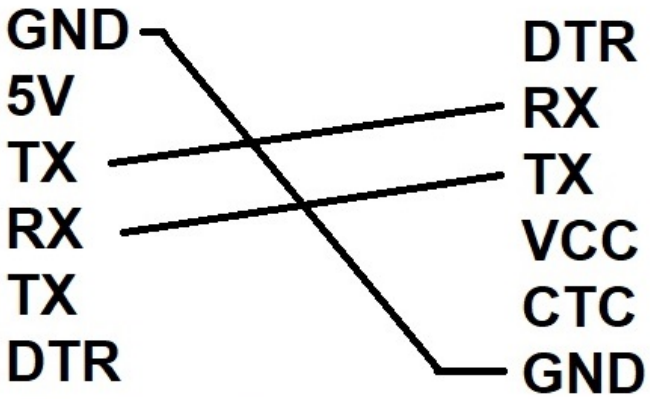
Frequency List

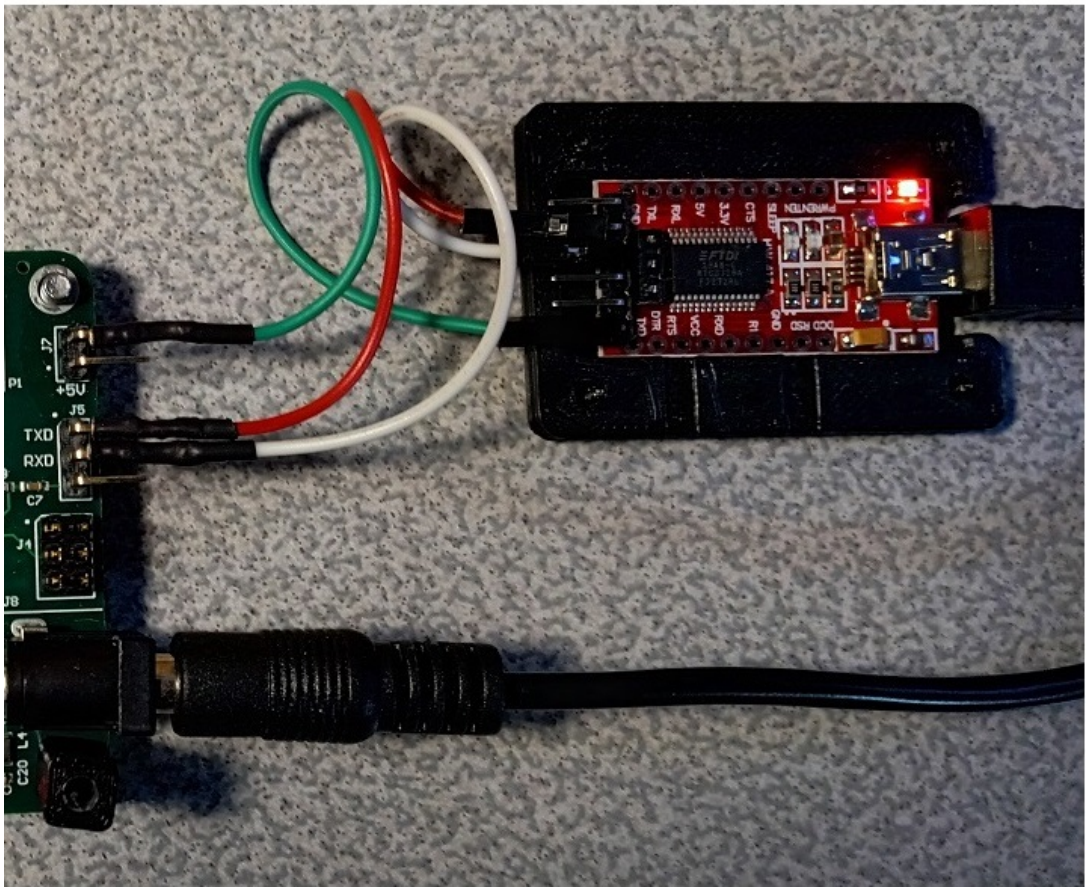
BAND	FT8	JS8	FT4	WSPR
160m	1.840	1.842	NA	1.8366
80m	3.573	3.578	3.575	3.5686
60m	5.357	NA	NA	NA
40m	7.074	7.078	7.0475	7.0386
30m	10.136	NA	10.140	10.1387
20m	14.074	14.078	14.074	14.0956
17m	18.100	18.104	18.104	18.1046
15m	21.074	21.078	21.140	21.0946
12m	24.915	24.922	24.919	24.9246
10m	28.074	28.078	28.180	28.1246
6m	50.313	50.318	50.318	50.2930
6m **	50.323	50.328	NA	NA

** Intercontinental

Connecting a USB-to-Serial Adapter

The following picture shows the connections required when using a serial-to-USB adapter. There are many varieties of these adapters, but they all have the same general set of pins. Make sure that you use a 5V-compatible adapter.

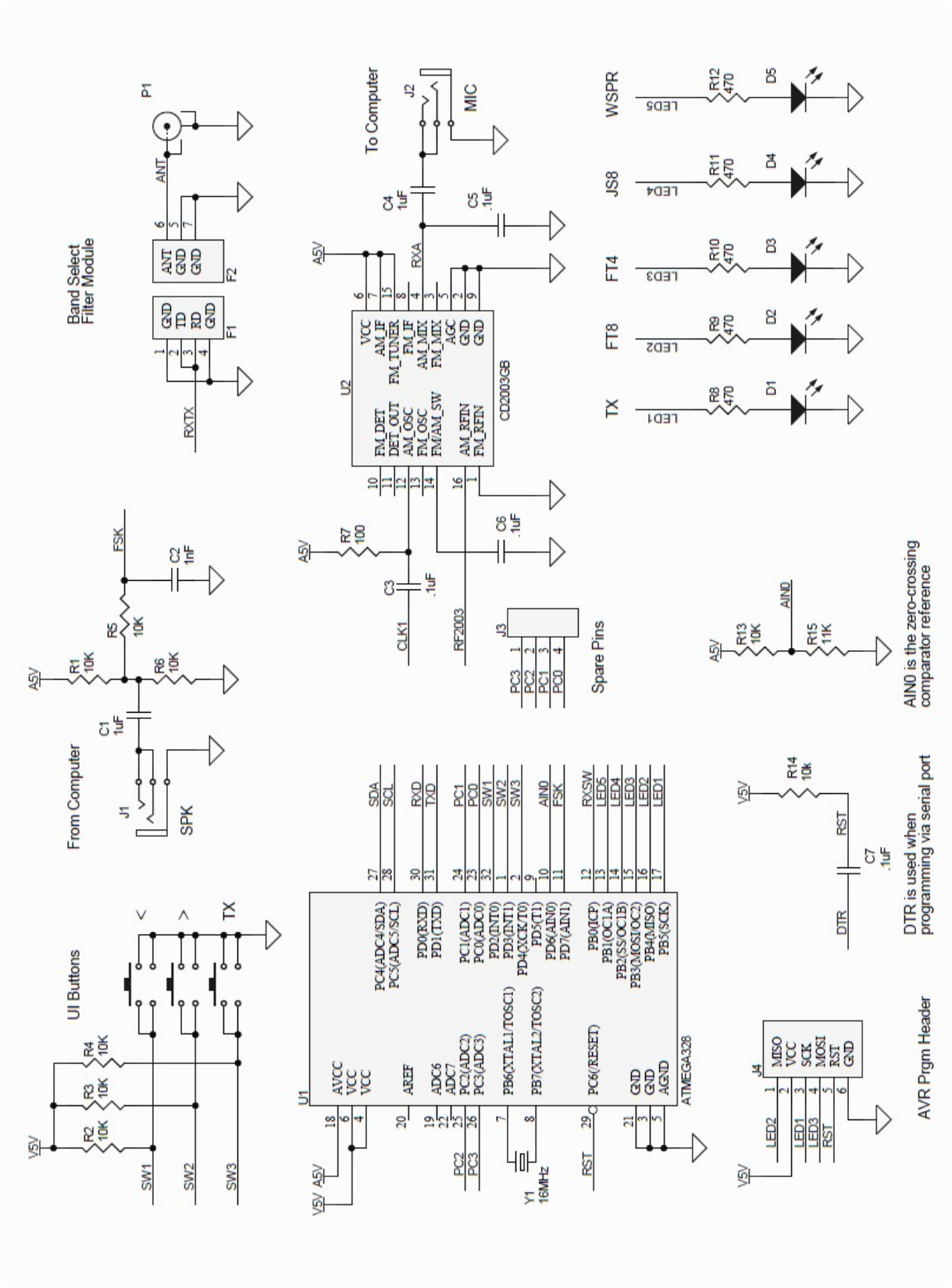




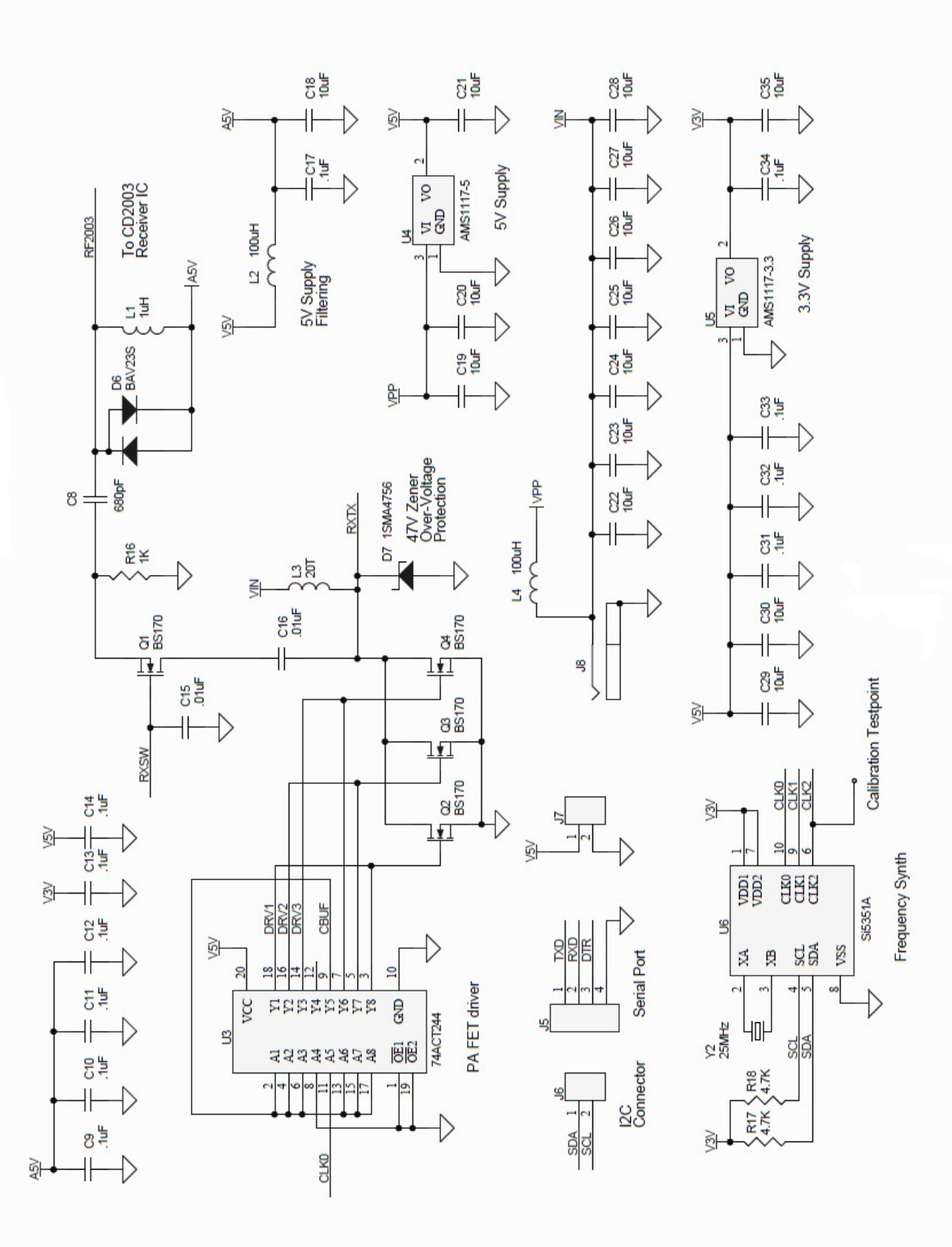
Main Board Parts List (BOM)

Comment	Designator	JLCC Part Number	Alt Supplier
.1uF	C1, C3, C5, C6, C7, C8, C9, C10, C11, C12, C16, C17, C21, C30, C31, C33	C113803	
.01uF	C2, C14, C15	C100042	
1uF	C4	C59302	
680pF	C13	C1630	
10uF	C18, C19, C20, C22, C23, C24, C25, C26, C27, C28, C29, C32	C344022	
LED	D1, D2, D3, D4, D5	C434419	
BAV23S	D6	C44345	
1SMA4756	D7	C438374	
Diode	D8	C2099	
Stereo Jack	J1, J2	C18594	
Header-4	J3	NA	Amazon
Header AVR	J4	NA	Amazon
Header-3	J5	NA	Amazon
Header-2A	J6	NA	Amazon
Header-2	J7	NA	Amazon
Power Connector	J8	NA	Amazon
1uH	L1	C383366	
100uH	L2, L4, L5	C223143	
FT37-43	L3	NA	
BNC	P1	NA	Amazon
BS170	Q1	C558098	
BS170	Q2, Q3, Q4	NA	Amazon
470K	R1	C23178	
10K	R2, R3, R4, R5, R6, R9, R16	C99198	
4.7K	R7, R17, R18	C105428	
100	R8	C22775	
470	R10, R11, R12, R13, R14	C23179	
1K	R15	C14676	
Push Button	S1, S2, S3	C221880	
ATMEGA328	U1	C14877	
CD2003GB	U2	NA	Amazon
74ACT244	U3	C6930	
AMS1117-5	U4	C6187	
AMS1117-3.3	U5	C6186	
Si5351A	U6	C1509083	
16MHz	Y1	C13738	
25MHz	Y2	C9006	

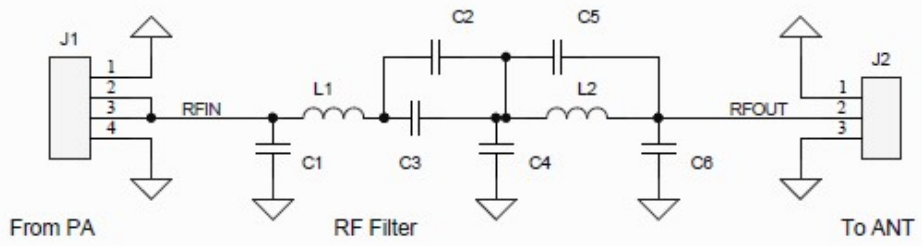
Main Board Schematic (page 1 of 2)



Main Board Schematic (page 2 of 2)



Band Module Schematic (page 1 of 1)



Refer to Filter Tables
for Per-Band Capacitor and Inductor Values