Arduino Digital Transmitter

Kit Assembly Manual

May 4, 2025: Add 6m modification.
CRKITS.COM

The ADT is short for Arduino Digital Transmitter. It is a HF band QRPP digital transmitter based on the Arduino Nano module. This minimalist design is cropped from the ADX-S V2 from CRKITS.COM. The ADT is a QRPP level transmitter and it relies on a SW broadcast receiver to make a complete transceiver, while the ADX-S V2 is a QRP level digital transceiver. The ADT keeps the good part of the ADX-S V2 design, such as auto band filter detection, TCXO module and the band filter module is compatible with each other.

Features

- Support 40/30/20/17/15/12/10m band filters. Compatible with the ADX-S V2 filters with band auto detection
- Support WSPR/JS8/FT4/FT8 four modes on each band
- Radiate carrier as beat frequency to support digital signal receiving on a normal AM broadcast receiver to make a complete transceiver. The carrier radiation can be turned off to work with SSB receivers as well
- Support Low/Middle/High RF output and the High RF output on 20m is about 500 mW
- Support manual TX for 12 seconds for testing purpose
- Support VOX only
- Reuse the L LED on the Arduino Nano module for all the indicator and one push button to complete all the settings
- Powered by USB 5V, no other power supply input
- Two PCB architecture, main PCB and cover PCB

Functions

The above is the cover PCB design. Check out the button first. The characters on the left mean the hidden settings at power on if you press and hold the button. The dot means short press while the dash means press and hold for more than 1 second. W/J/4/8 means the mode 1-4 (corresponding to 1-4 times of L LED flash, the counting begins at the first time LED off and ends at the last time LED off, no matter what the intial LED status is) are WSPR/JS8/FT4/FT8 (default to FT8). BFO SW means BFO switch (default on). When the L LED is solid on, it means the BFO radiation is turned on and it is the critical part to enable the normal AM receiver to receive digital signal. When the LED is off, it means the BFO radiation is turned off to avoid interference to SSB receiver nearby. Exit the hidden settings by pulling out the USB cable or pressing the reset button through the R hole by a pin.

The characters on the right mean the normal settings. Again, the dot means short press while the dash means press and hold for more than 1 second. L/M/H means the power level 1-3 (corresponding to 1-3 times of L LED flash, default to H). TX 12S means it will activate the transmitter at carrier plus 1 kHz frequency for 12 seconds after you press and hold for more than 1 second. If the L is always on and not responding to any button press, please make sure your band filter is properly inserted. The power level setting will be lost after power off and default to H again after power on.

Operation	Press and hold the button at power on to start setting, reset or power off to exit setting	Normal power on
Short press for less than 1 sec	Toggle WSPR/JS8/FT4/FT8 frequency, corresponding to 1-4 times of L LED flash, default to FT8	Toggle Low/Mid/High RF output, corresponding to 1-3 times of L LED flash, default to High at each power on
Press and hold for more than 1 sec then release	BFO switch, default ON (L LED solid on)	Transmit at carrier plus 1 kHz frequency for 12 seconds (L LED on 12 seconds then off)

Theory of Operation

Check out the schematic. The ADT is basically the simplied transmitter portion of the ADX-S V2. The output of U2 is amplified by Q1 to QRPP level and then filtered by the ADX-S V2 compatible band filter. Meanwhile, U2 can radiate BFO signal and it is air coupled to a neaby normal AM receiver to receive the digital signal. The RX and TX frequencies can be well sync'ed by this design.
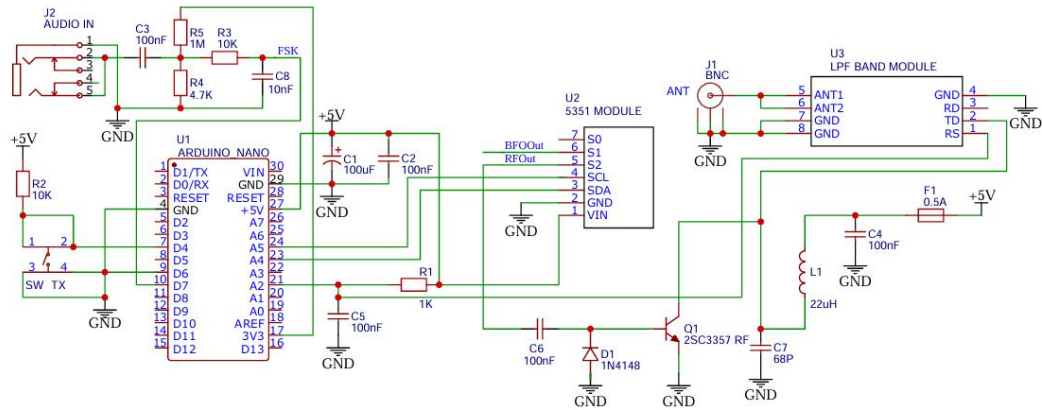
TITLE: Arduino Digital Transmitter

Part List of main PCB

Designator	Value	Designator	Value
R1	1K	J1	ANT
R2,R3	10K	J2	AUDIO IN
R4	4.7K	SW	6x6 push button
R5	1M	U1	Arduino Nano or compatible
C1	100uF	U2	SI5351 module or compatible
C2-C6	104	U3	Band filter
C7	68pF	F1	0.5A glass body fuse
C8	103	L1	22uH black inductor
D1	1N4148	Q1	RF surface mount part

Band frequecy table and band filter part list
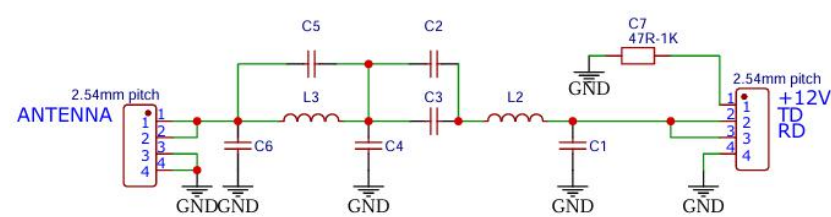
Top to down: 20m, 15m and 10m filters

BAND	20m	17m	15m	12m	10m
WSPR	**14095.6**	**18104.6**	**21094.6**	**24924.6**	**28124.6**
JS8	**14078**	**18104**	**21078**	**24922**	**28078**
FT4	**14080**	**18104**	**21140**	**24919**	**28180**
FT8	**14074**	**18100**	**21074**	**24915**	**28074**
C1	68P	68P	68P	39P	39P
C2	471	331	331	271	271
C3	Blank	Blank	Blank	Blank	Blank
C4	471	331	331	271	271
C5	151	101	101	68P	68P
C6	471	331	331	271	271
C7	470R resistor	330R resistor	220R resistor	100R resistor	47R resistor
L1	Blank	Blank	Blank	Blank	Blank

L2	10 turns on red core	11 turns on yellow core	11 turns on yellow core	9 turns on yellow core	9 turns on yellow core
L3	7 turns on red core	7 turns on yellow core	7 turns on yellow core	6 turns on yellow core	6 turns on yellow core

Main PCB Top
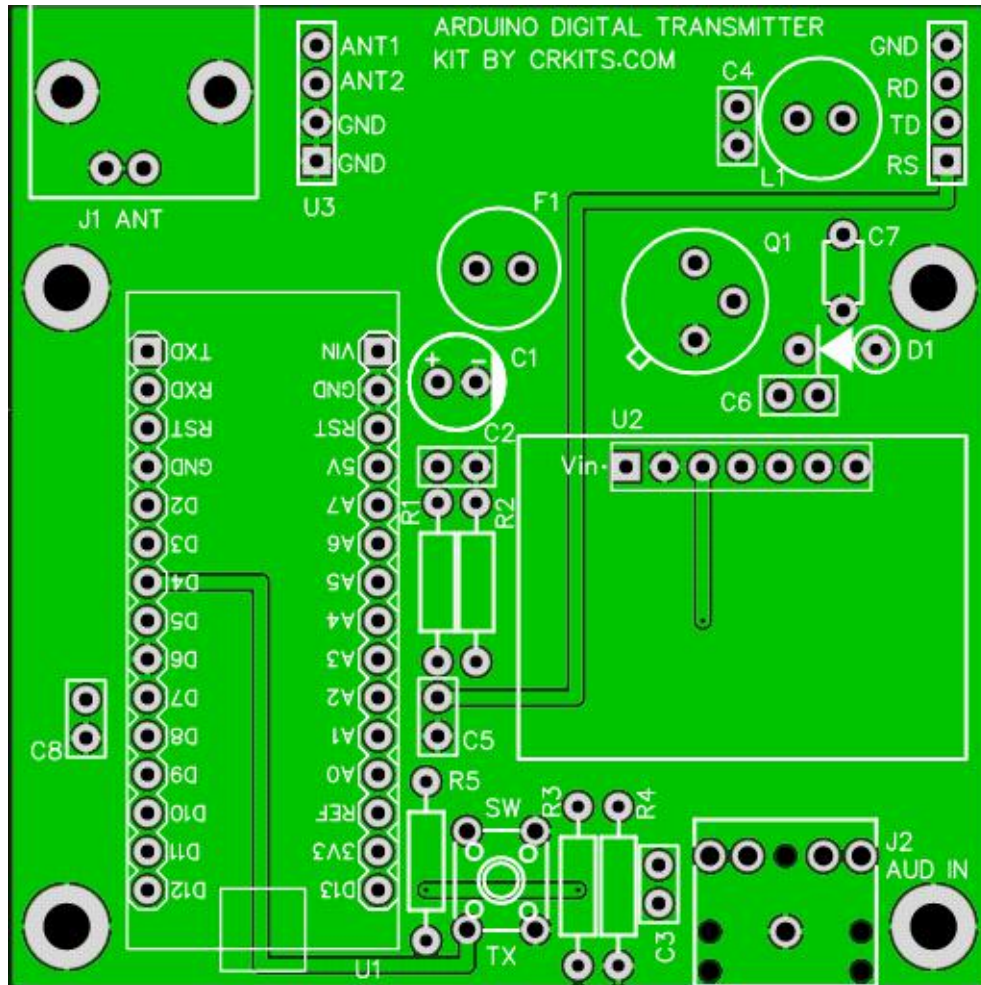
# Main PCB Bottom
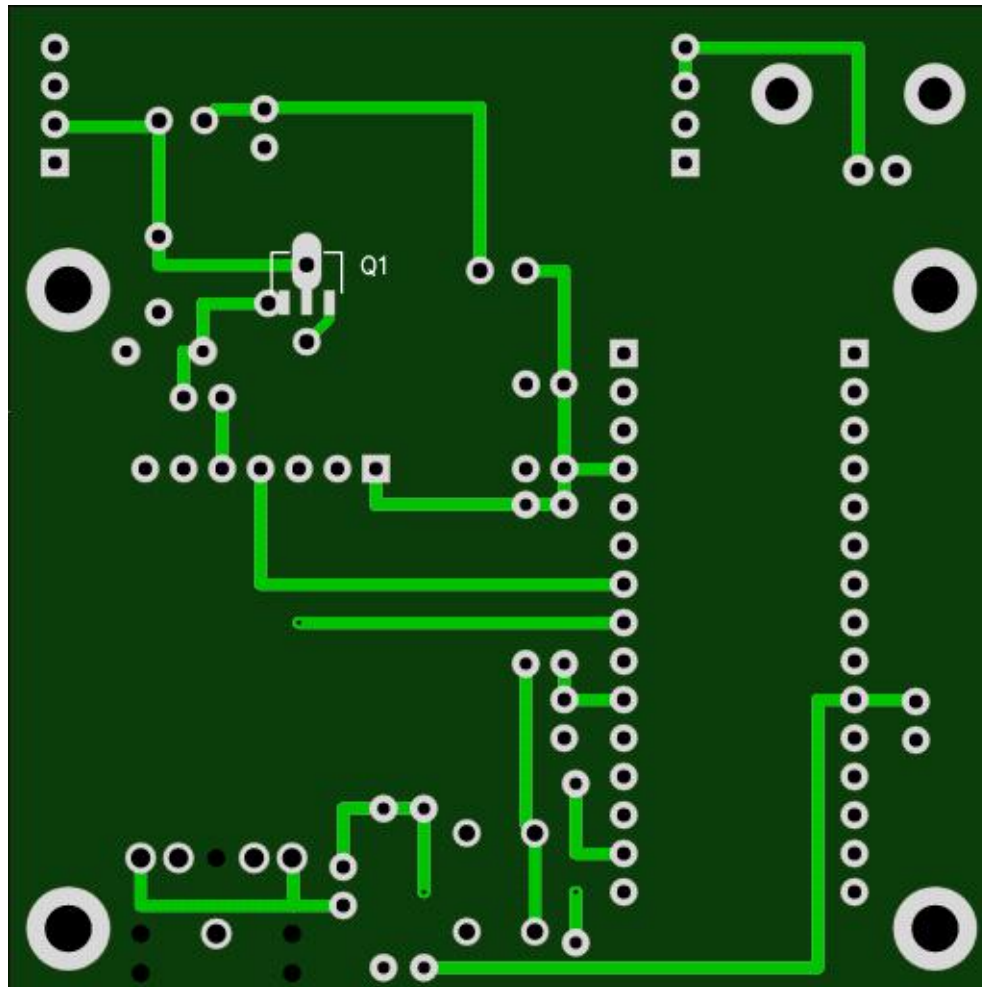
Cover PCB

Assembly

The assembly is relatively easy. Check out C1, D1 and Q1 polarities. Don't touch the parts on the modules by your hand to avoid ESD damage. Check solder bridges and cold soldering before you power on. You can refer to the below photo if you cannot tell the parts. Don't leave space for the leads due to the heigh limitations. Note : Only insert band filter after you put on the cover PCB to avoid misalignment or mistake. The edge with capacitors will be on the outside.
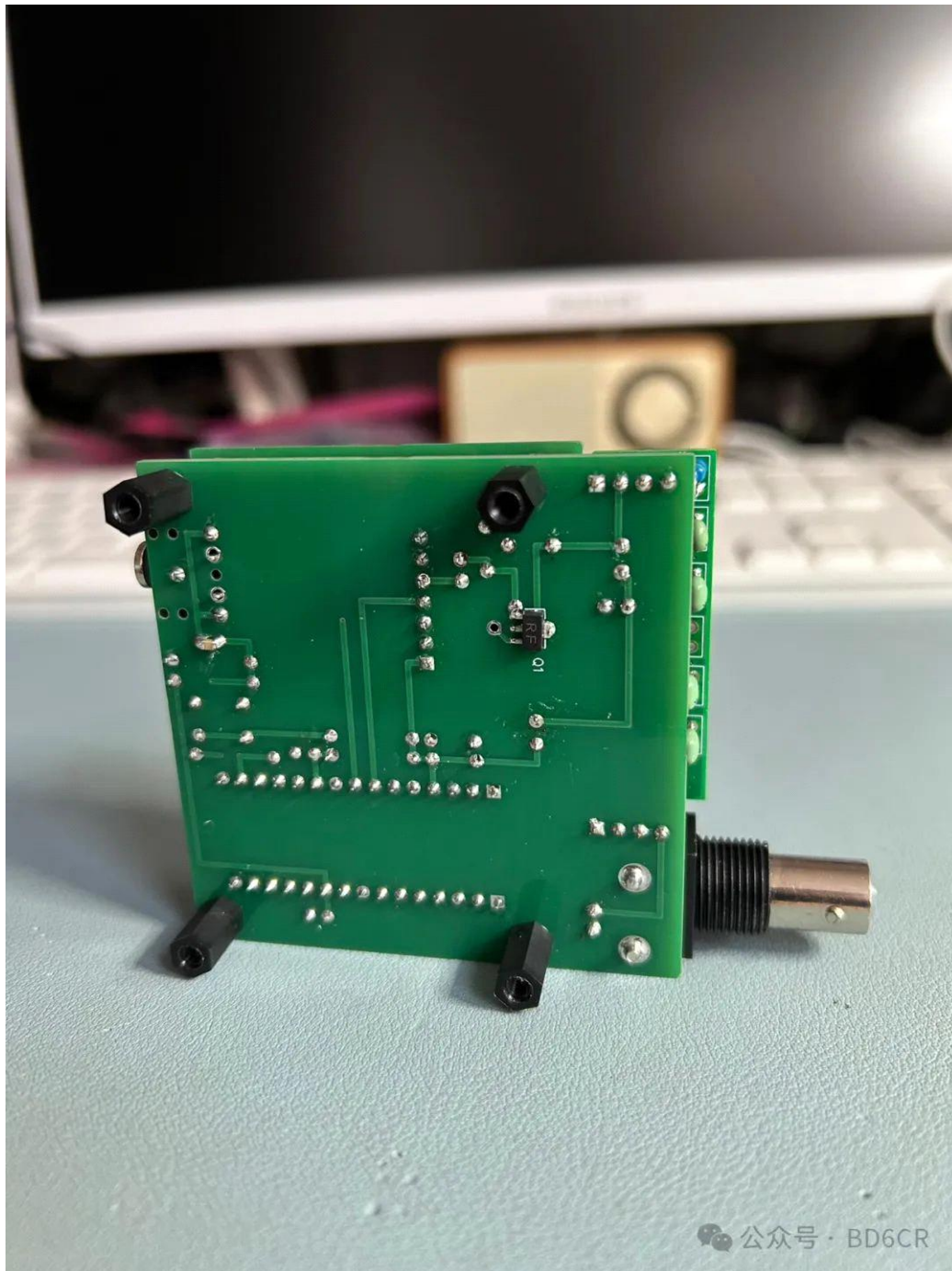
Alignment

After inserting the band filter, apply 5V power from the USB port. Power on the AM receiver, check the frequency table and tune to the nearest frequency for FT8 (default mode), for example, if you use 20m band filter, the FT8 frequency is 14074 kHz, and you can tune to 14074 or even 14075 kHz. Place the receiver near the ADT, and the noise will reduce. If you already receive some FT8 signal, you can launch a FT8 App on your phone and let the microphone hear the signal for more than 30 seconds and it could decode something. For the FT8 Applications, here is a list:

Device	Applications	Note
Android Phones	FT8CN	Free
iPhone	iFTx	About 2 dollars
PC, Mac or Raspberry Pi	WSJT-x or JTDX	Free

Connect the ADT to a 50 ohm dummy load , power on with USB cable, press and hold the button for more than 1 second and release, it will activate the transmitter for 12 seconds. If you have a SSB receiver on hand, tune to the carrier frequency and select USB (Upper Side Band) mode, you should hear a tone of about 1kHz. If you have a power meter, you can check the default High power level is about 150-500 mW (it varies with band). You can short press the button to switch to lower levels and confirm the lower RF output.

Put in Use

It is best to go to the field if you want to test two way QSO. Even with QRPP power level you can make a few QSO's. See the photo for the wiring. The green board is the audio cable adapter kit (same in ADX-S V2). At home, you can use the ADT as a WSPR transmitter. The TCXO module will provide good frequency accuracy and stability and the RF output level is very suitable for WSPR transmitter.
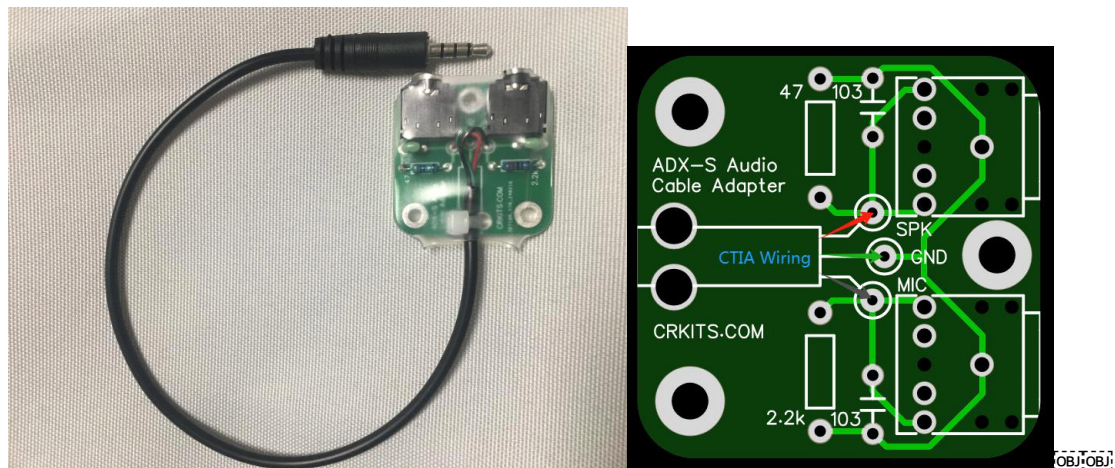
Always set the audio input level to the MAX and don't worry about over driving it. The transmitter needs a full sized antenna, while the receiver can just use the whip antenna. Place the receiver to a distance where it receive the best.

If you just bring an audio cable, you can use it for the transmitter while let the microphone on your phone or laptop hear your receiver (by air coupling). It is still possible to make QSO.

Modification to 6m magic band

It is possible to modify the ADT to support 6m band. The RF output is about 100 mW and it is quite useful when the band is open. The frequency table:

F_FT8 = 50313000;
F_FT4 = 50318000;
F_JS8 = 50318000;
F_WSPR = 50293000;

Step 1: Prepare the 6m band filter. The design is different with HF bands but it is still possible to leverage the filter PCB, so you can modify the band filter in the kit, or order additional 6m band filter kit from us. See the photo. L2 and L3 are both 16 turns on yellow core. The resistor on C7 is 27 ohm, and the capacitor on C2 is 0.01uF. Note the trimmer capacitor of 9-50pF should be soldered on the left pads of C4 and C6. If you don't have a trimmer capacitor, you can consider a fixed capacitor of 33pF.
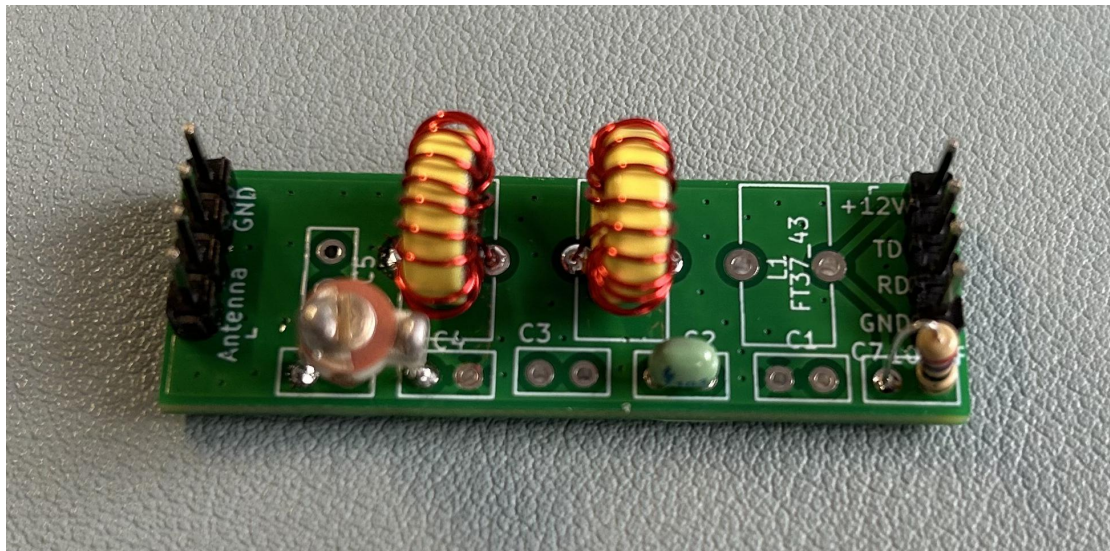
Step 2: Update the Arduino code to support 6m band. You can download the code from https://groups.io/g/crkits/files/ADT and compile with Arduino IDE. Don't forget the necessary library file. Update the ADT code simply by a USB cable.

Step 3: If you have a trimmer capacitor on your band filter, you can preset it to the mid position (that is, turn about 90 degrees from the default position, either in Clock Wise or Counter Clock Wise). Connect a power meter with dummy load or TinySA with a fixed attenuator. Plug in the 6m band filter properly and power on the ADT. Press and hold the button for more than 1 second, and it will trigger the transmitter for 12 seconds. Adjust the trimmer capacitor to peak the RF output and you are good.