Where do you need 10 MHz?

A project using some surplus 10 MHz ovens.

By Gary Hitchner, WA2OMY

Overview

- Some 10 MHz oven sources have appeared on the surplus market
- These are low phase noise, temperature controlled, +5v operation, small footprint.
- We sold a few and generated a lot of interest using these in various applications.

Various manufacturers, all the same specs, footprints, etc. Here are some examples.

Some oven spec's

5V supply

0 to 4V control voltage

About +7 dBm output power into 50 ohms

Harmonics better than 30 dBc

Phase Noise

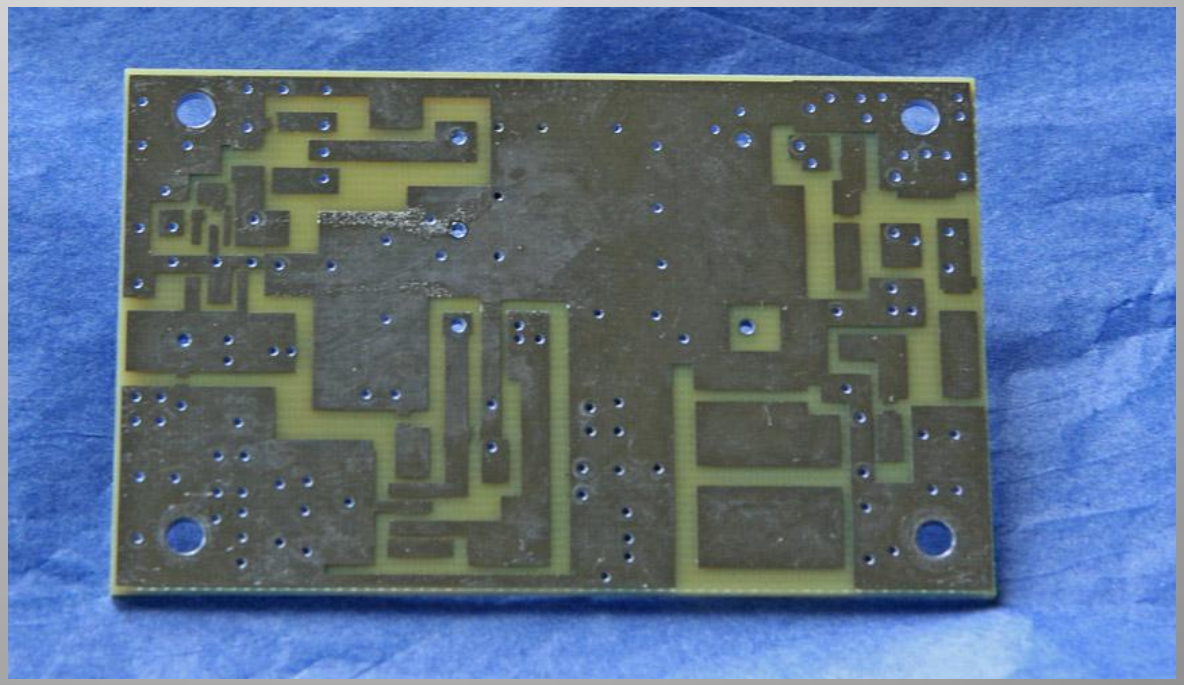
Integrated: 0.001° Integrated from 10Hz to 625 kHz

Spot Phase Noise

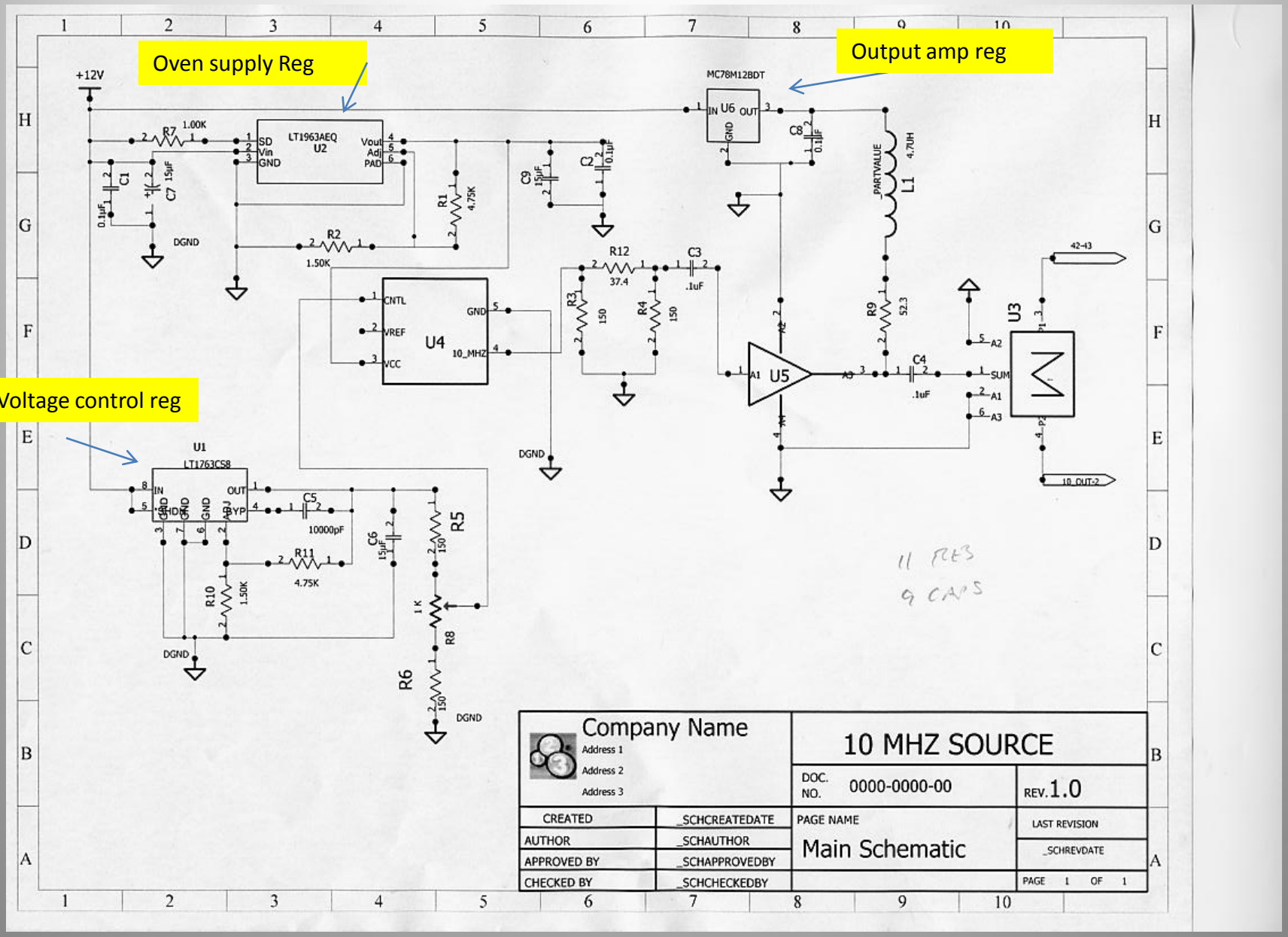
Offset	Level (dBc/Hz)
10 Hz	-120
100 Hz	-130
1 kHz	-140
10 kHz	-145
100 kHz	-145

Board Prototype

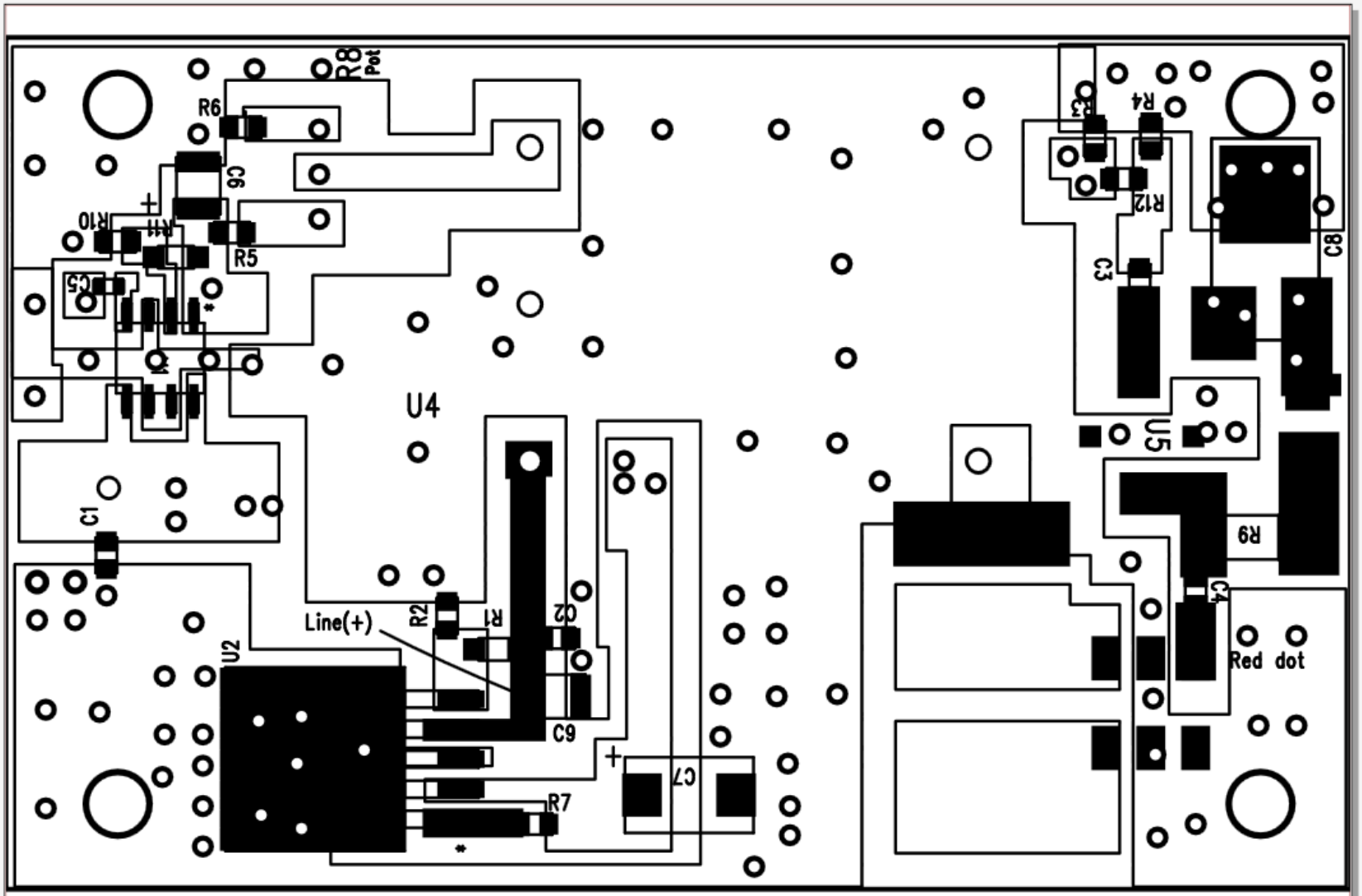
- Bare board, simple layout using polygons,
- Sunstone (PCB123) board supplier
- 4-40 mounting holes.



Schematic

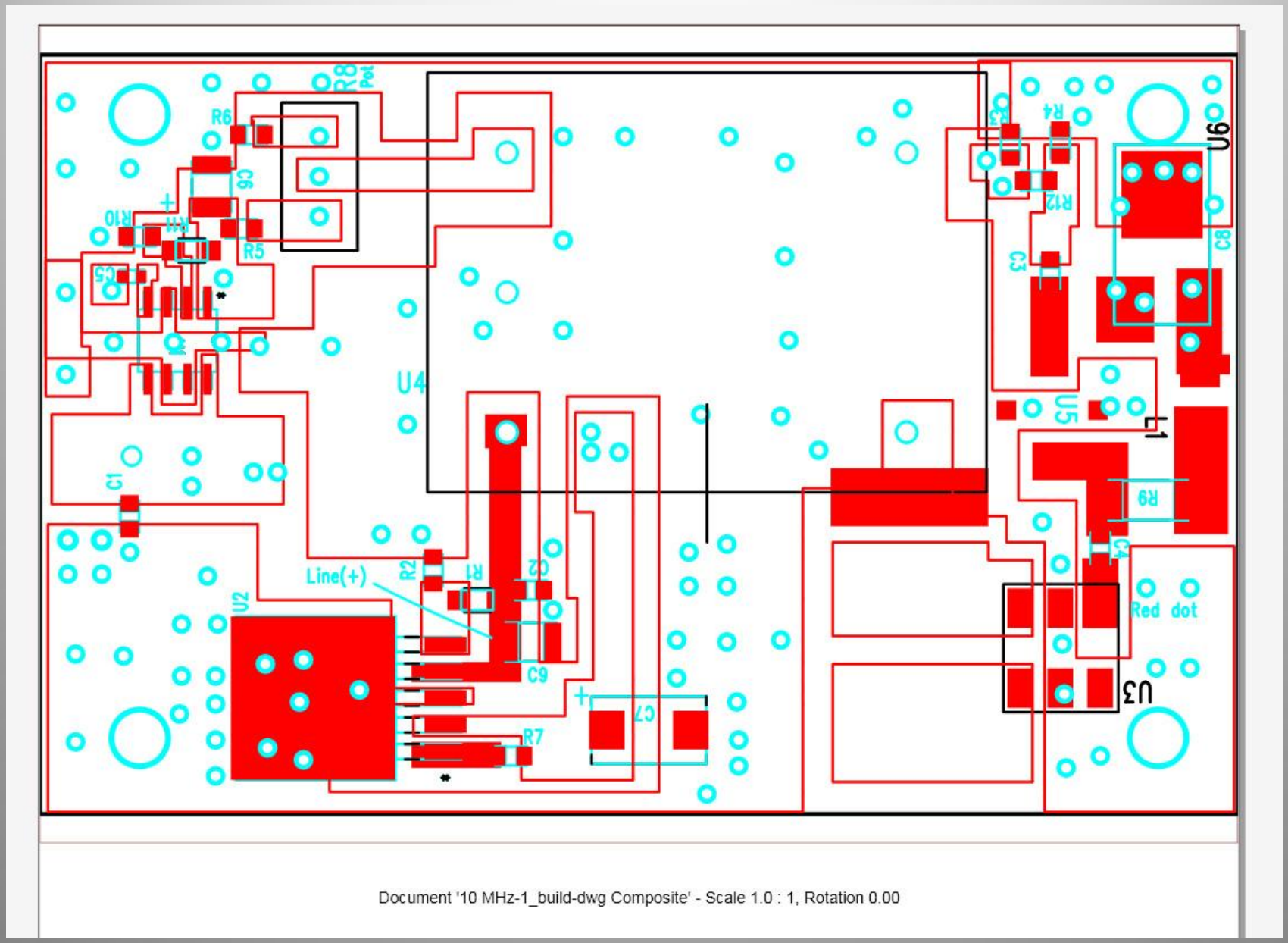

Oven supply Reg
Output amp reg
Voltage control reg
+12V
MC78M12BDT
U6
IN
OUT
GND
LT1963AEQ
U2
SD
Vin
GND
Vout
Adj
PAD
R7
1.00K
C1
0.1uF
C7
15uF
DGND
R1
4.75K
R2
1.50K
C9
15uF
C2
0.1uF
C8
0.1uF
_PARTVALUE
L1
4.7UH
R12
37.4
C3
.1uF
R3
150
R4
150
U4
CNTL
VREF
VCC
GND
10_MHZ
U5
A1
A2
A3
R9
52.3
C4
.1uF
U3
SUM
A1
A3
42-43
10_OUT-2
U1
LT1763CS8
IN
OUT
GND
ADJ
BYP
C5
10000pF
R11
4.75K
R10
1.50K
C6
15uF
R5
150
R8
1 K
R6
150
11 RES
9 CAPS
Company Name
Address 1
Address 2
Address 3
10 MHZ SOURCE
DOC. NO.
0000-0000-00
REV.1.0
CREATED
_SCHCREATEDATE
AUTHOR
_SCHAUTHOR
APPROVED BY
_SCHAPPROVEDBY
CHECKED BY
_SCHCHECKEDBY
PAGE NAME
Main Schematic
LAST REVISION
_SCHREVDATE
PAGE 1 OF 1

Component placement



Document '10 MHz-1_build-dwg Composite' - Scale 1.0 : 1, Rotation 0.00

Component Placement (Color)



Parts List

R1	4.75K	0805
R2	1.5K	0805
R3	150 Ohms	0805
R4	150 Ohms	0805
R5	150 Ohms	0805
R6	150 Ohms	0805
R7	1K	0805
R8	1K Pot	Through hole
R9	52.3 Ohms	2512
R10	1.5 K	0805
R11	4.75K	0805
R12	37.4 Ohms	0805

C1	.1uF	Ceriamc	0805	
C2	.1uF	Ceriamc	0805	
C3	.1uF	Ceriamc	0805	
C4	.1uF	Ceriamc	0805	
C5	.01uF	Ceriamc	0805	
C6	15uF	Tant		
C7	10UF/25V	Tant		
C8	.1uF	Ceriamc	0805	(mount bottom board)
C9	15uF	Tant		

U1	LT1963AEQ	5V Reg
U2	LT1763CS8	5V reg
U6	MC78M12BDT	8V Reg
U4	10 MHz Oven	
U5	MAV11	RF amplifier
L1	L1	4.7uH
U3	JPS2-1W	2 way power divider

Construction notes

- See details next page.
- Do not solder pin 2 (middle pin) on the oven, leave open.
- Some kits have shown high harmonics and distortion at the output, use contacts on last slide and a fix will be made.
- Read all details before construction on next page and your source will last a long time!

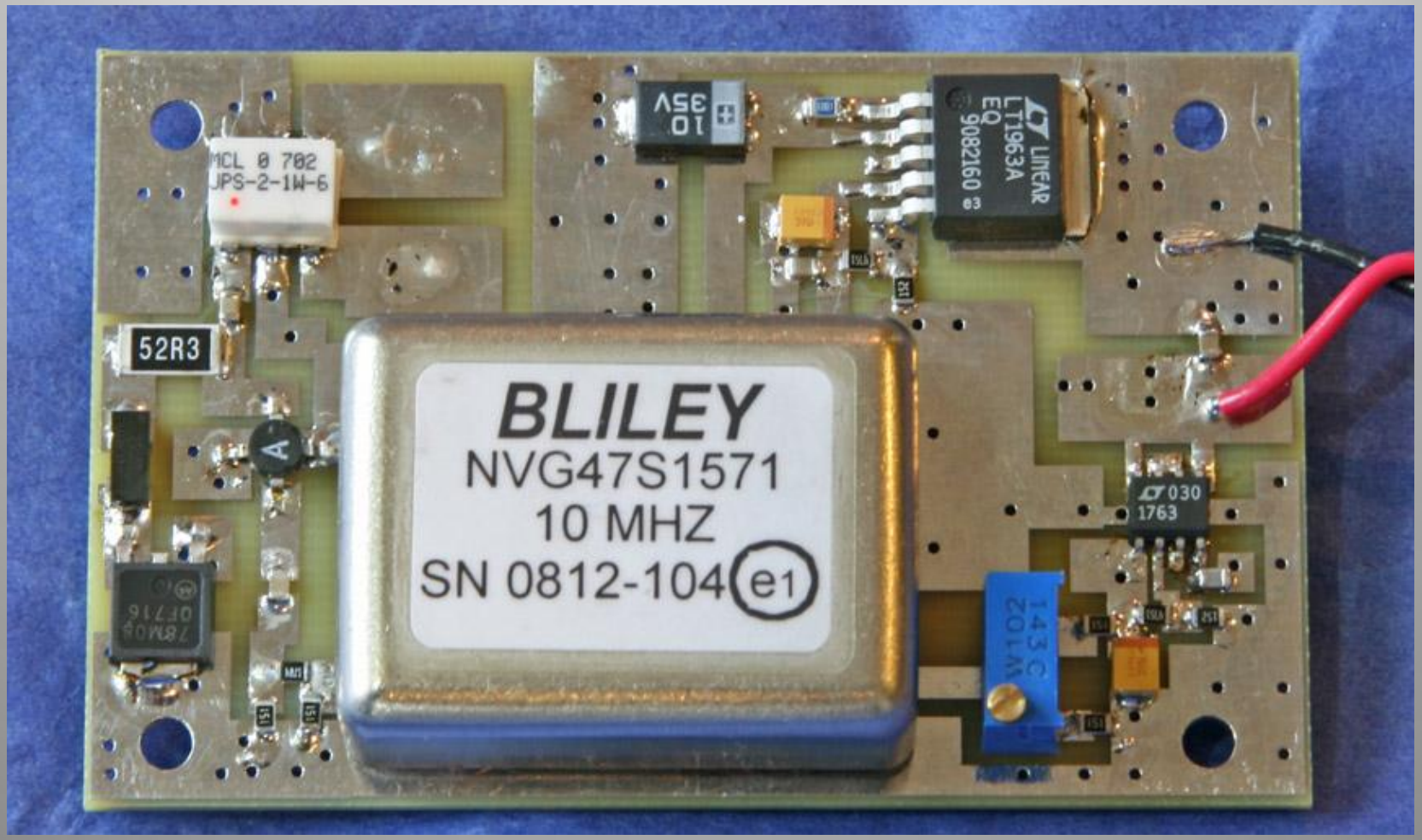
Construction notes:

I generally like to mount the small surface mount components 1st, then the larger ones. Mount all the 0805 parts, bypass capacitors, then the 3 voltage regulators. Be sure to solder the tab on the edge of U1, the large voltage regulator to ground. This conducts heat through the bottom, also U6, the 8V regulator for the MMIC amplifier.
The line on the tantalum capacitors (C6, C9, and C7) is +, install correctly!
C8 can be installed on the bottom of the board, see picture.
+9 to +12 Volts can then be applied to the board and the 3 voltage regulators verified for correct operation before the oven is mounted. LT 1963, (U1), +5V out, LT 1763, U2, +5 V out, and +8 from the 78M08 U6.
Then mount the oven, leave a small gap to the board. DO NOT SOLDER THE UNUSED PIN , should be open when measured to gnd.
Install L1, MMIC, and any other parts not installed. MMIC Dot is the output, cut lead input, - pin 1 connected to C3. JPS power divider red dot is pin 1, RF input from C4, see picture.

Checkout

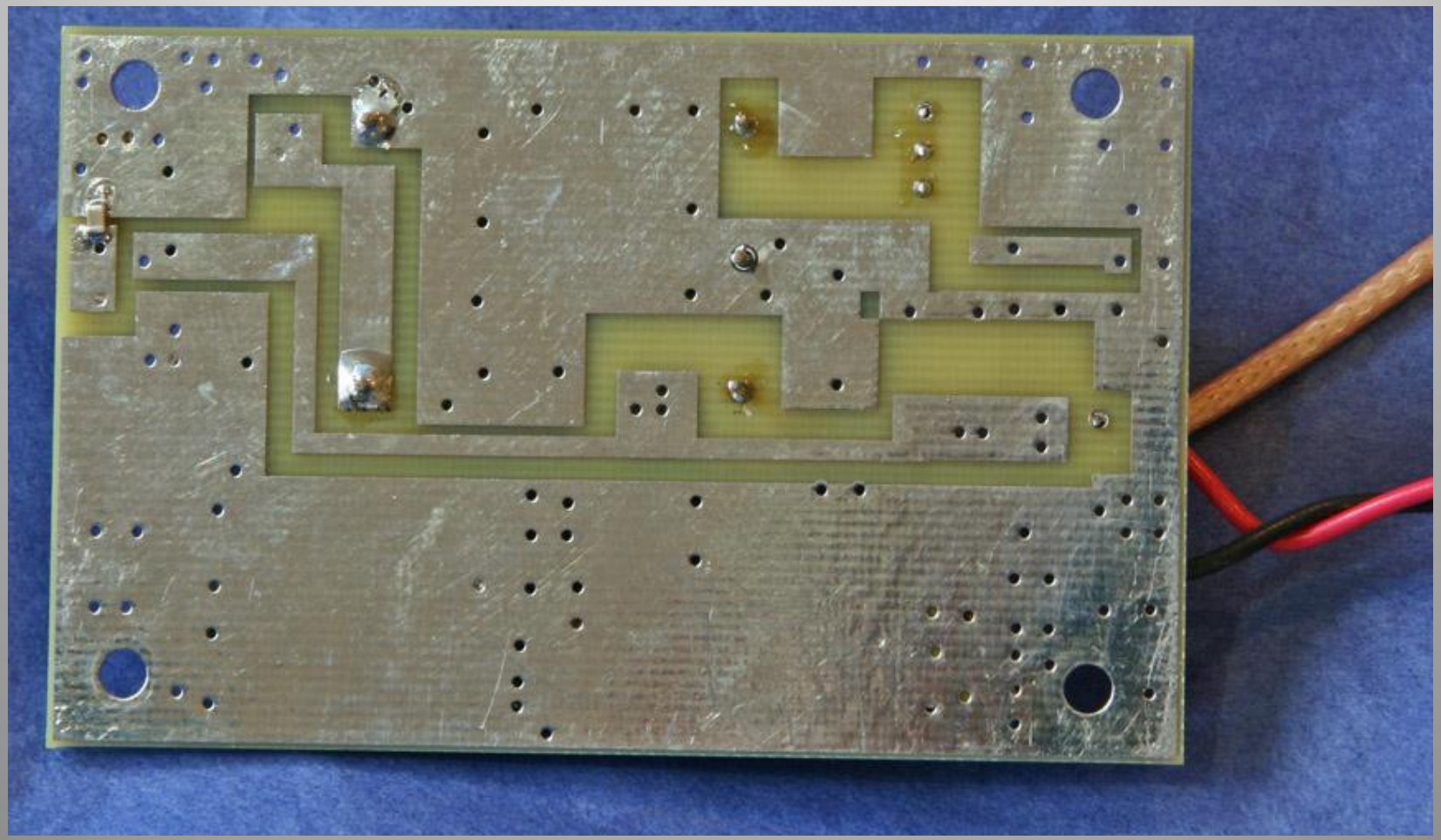
The pot should vary DC volts from about .59V to 4.5V Check on the trace from the center lead of the pot to the oven. 10 MHz will be about 1.92V, but the frequency will need to be set with a counter, not all the ovens will be the same.
The LT1963 will get hot for a minute or so after turn on, the current the oven needs during initial turn on is over 500 mA, but only for a short time. The current will drop to under 200 mA, this can be verified with a mA meter if available.
The DC bias for the MMIC can be verified by measuring the voltage drop across R14. U6 out, 7.9 V, L1 drop about .1V, 5.1 V on R14 to MAV11 MMIC.
RF out from either of the two pads by the power divider should be over 11 dBm

Finished Board TOP

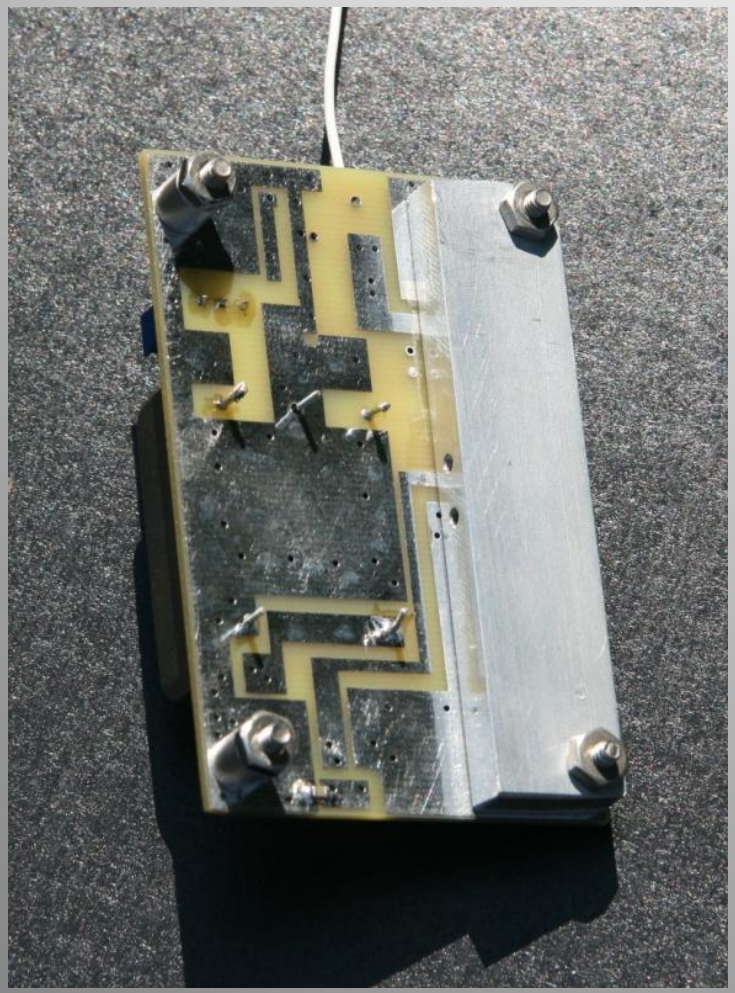


Finished Board, rotated same as Component placement drawing.

Finished Board bottom
Note C8 installed

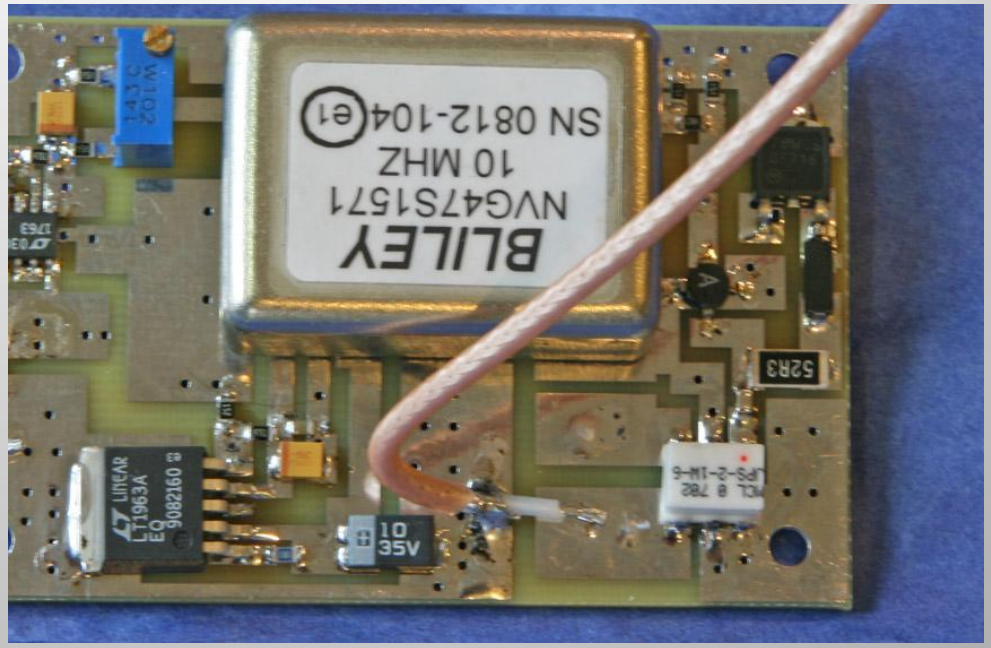


- **Bottom of board - note heatsink for 12 to 5V regulator.**
- **¼" standoff and heatsink material.**
- **Will sit flat on bench using flathead screws, or put in a box.**



- Size designed for a Bud CU3001A box 3" x 2.1" (Digi-Key) or
- Use a junkbox box, any enclosure will work, holes should be in lid to allow heat to escape. Or-
- Mount on any flat plate.
- 13.8 volt operation is ok, (rovers), but additional flat heatsink is recommended. Any small surplus heatsink will work.

- Suggested Cable dress for 10 MHz out to a RF connector



A 2nd cable can be added next to the one shown on the 2nd pad for two outputs.

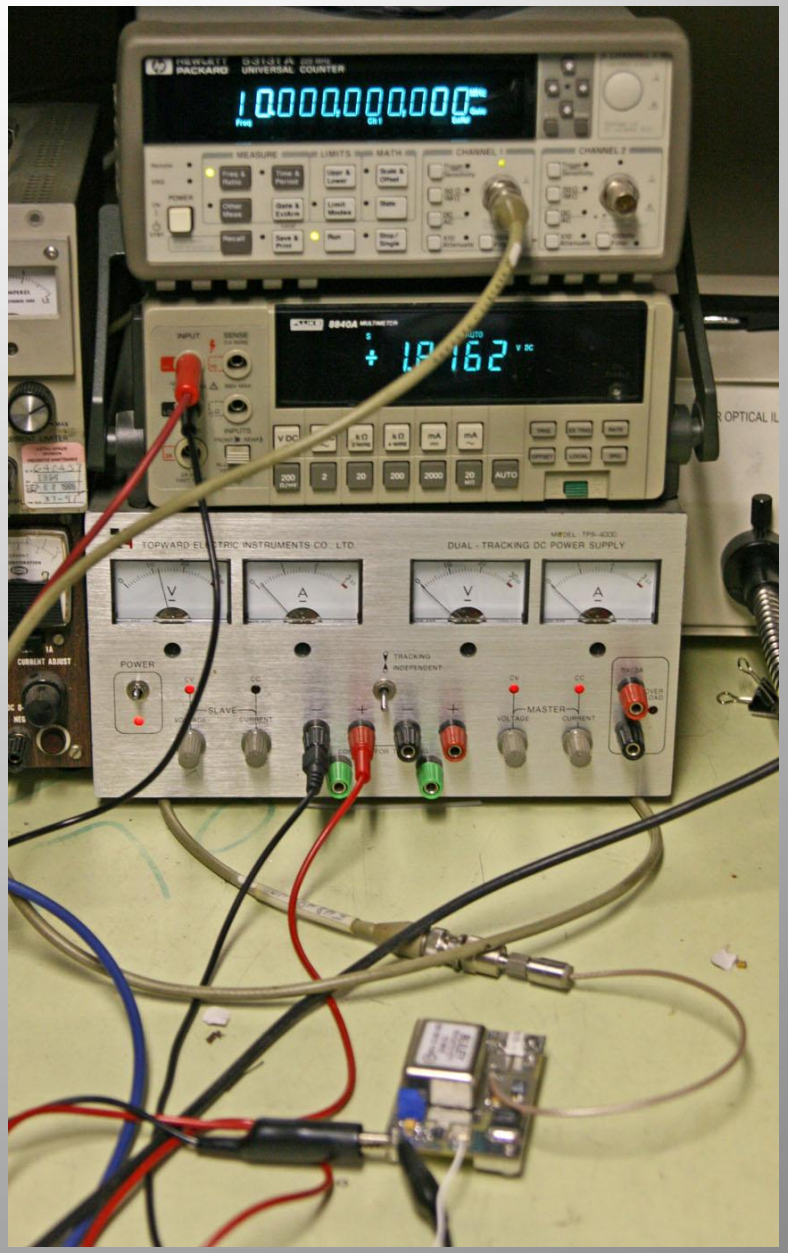
How well does it work?

Measurements:

- DC Current, 12V at 680 mA at turn on, after a few minutes, drops to 280 mA
  - After full warm up current is 220 mA. Warm to the touch, well within temperature ratings, rover operation at 13.8 V may require additional heat sink.
  - Any power supply should work as low as 9V, wall supply, re-chargeable cells. A 9V supply will run everything much cooler.
- RF output power, 10.5 dBm, both ports loaded with 50 ohms.
- Voltage adjust using 5V, with 2)- 150 ohms and 1K pot is:
  - Low .588V = 9.999948 MHz
  - High 4.48V= 10.0000094 Mhz
    - » Not centered on 10 MHz, about 5 ppm
    - » 10 MHz is about 1.92V, net on frequency if a known 10 MHz source is available using a counter.
- This source was used as a external reference on a 8671A sig gen. Receiver tuned to 2304.1. Using the trimmer, frequency tune was a smooth and stable change through the passband. Just like tuning a rig through a carrier.

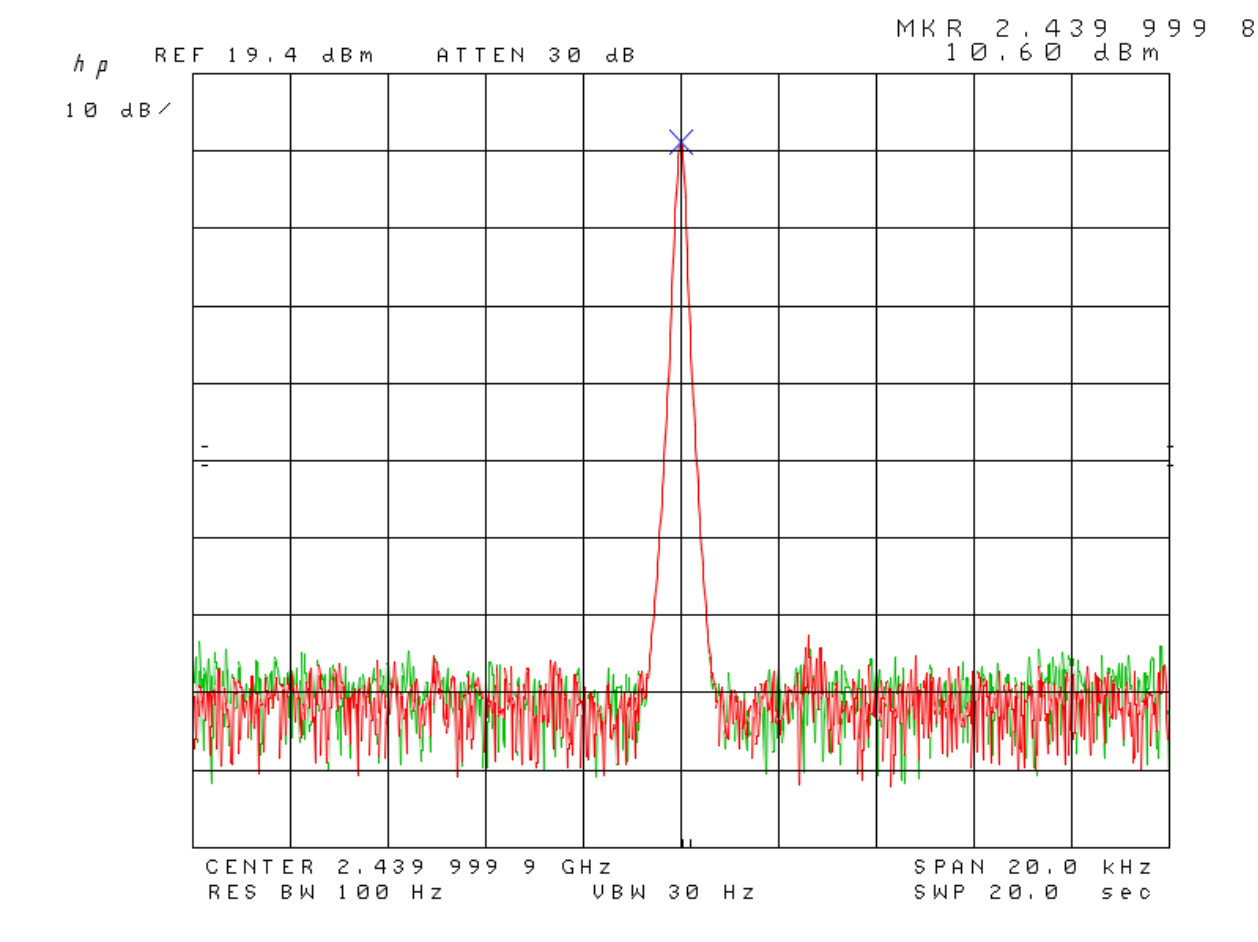
  Sounds great!

- Bench setup to set frequency.
- Counter on high quality external reference.
- Some counters can also show a difference between 2 channels, so set freq to 0 Hz.

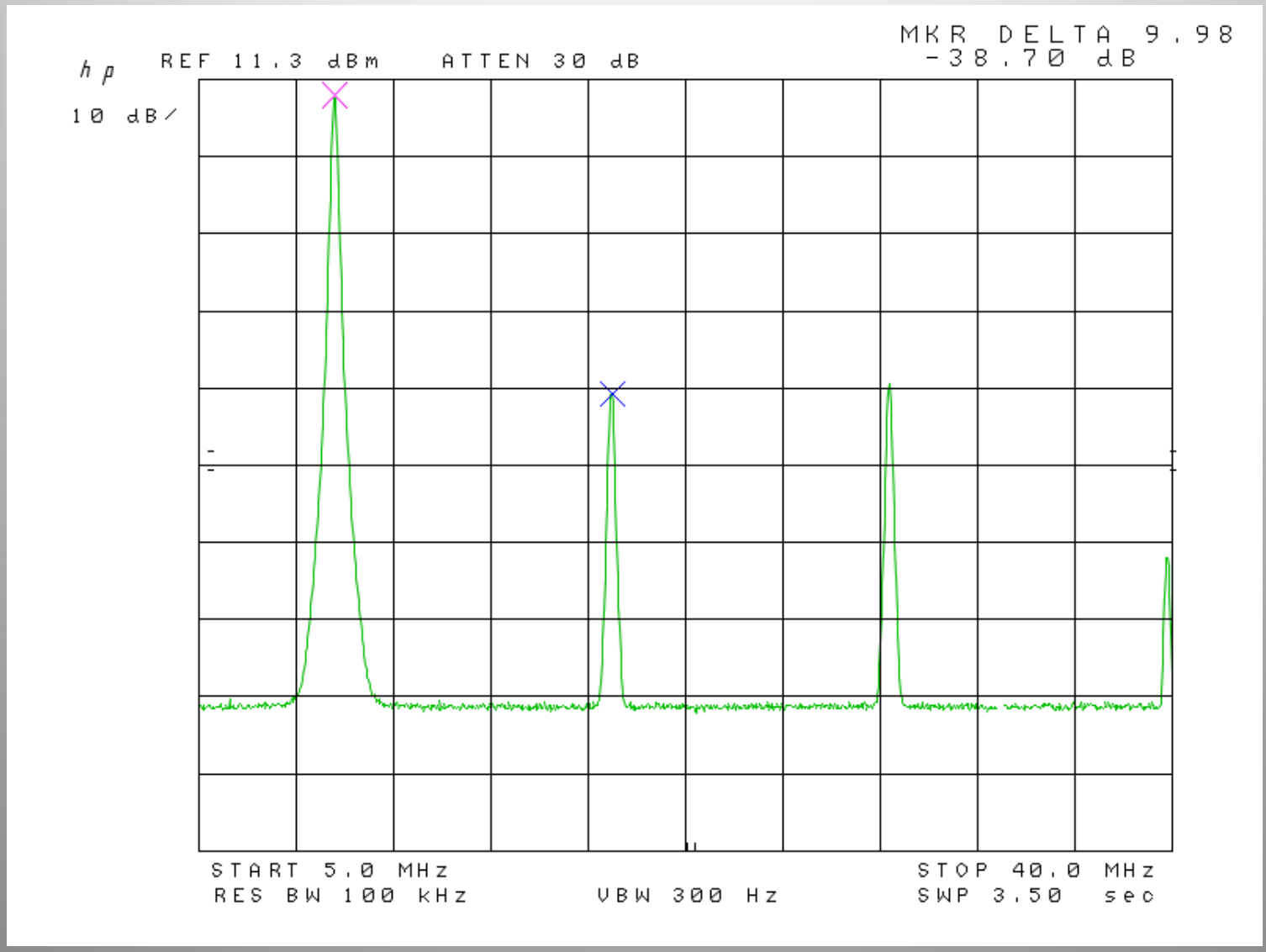


Phase noise

Comparison at S band to a quality HP 10 MHz oven (TNX, KE5FX software.) Noise is likely the noise floor of the analyzer.

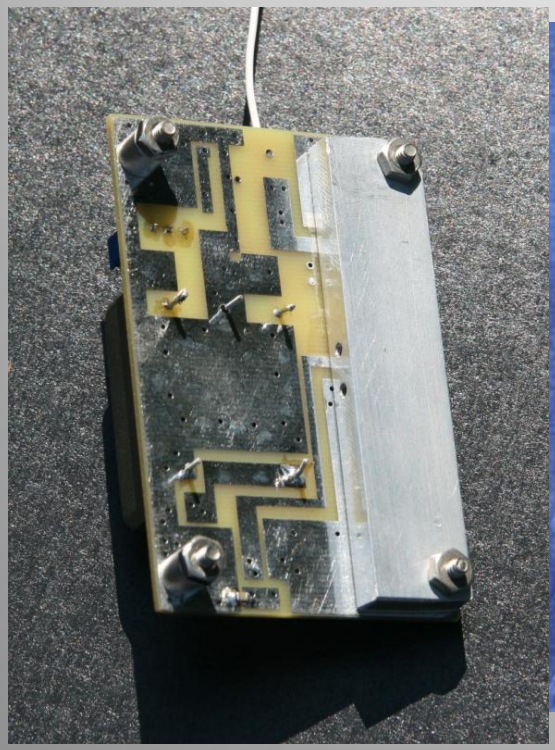


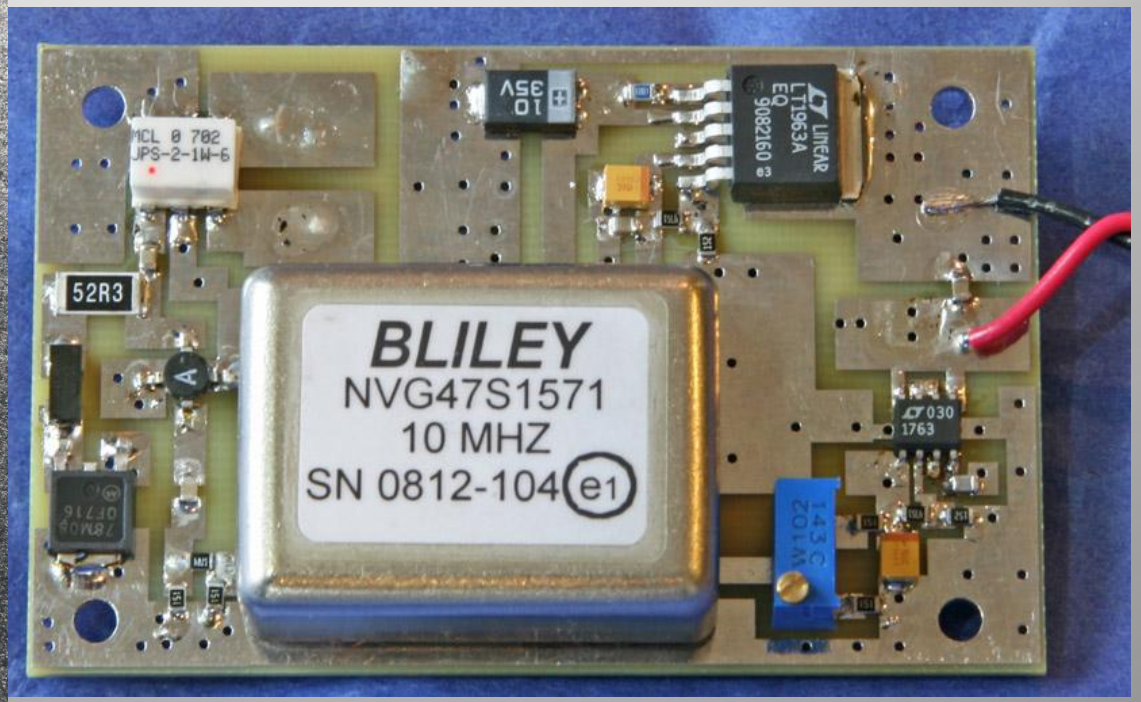
Harmonics


hp
REF 11.3 dBm
ATTEN 30 dB
MKR DELTA 9.98
-38.70 dB
10 dB/
START 5.0 MHz
RES BW 100 kHz
VBW 300 Hz
STOP 40.0 MHz
SWP 3.50 sec

What in the kit?

- Everything you see here!





- Including 4-40 hardware.

What not included?

- A box, BNC or other RF connectors, and a DC connector.
  - Suggested examples of box.
  - Bud CU3001A, 3.25” x 2.13”, about $6.00
  - Hammond Die-cast box, 1590N1FL, 4.76” x 2.6” about $10.00 . (Di-cast box also serves as heatsink to allow higher voltage operation)
  - Both available from Digi-Key.

Example of board mounted in a box by Phil, TUF

Drill some holes in the top of the box to allow heat from the oven to escape.

Build Info and check out details

- A component layout and build details are on the Packrat website:
  - http://packratvhf.com/techinal.htm
  - Look under 10 MHz source.
  - A technicial contact
    - Gary wa2omyatcomcast.net

Most important

- The following club members made this project possible.
  - Phil K3TUF
  - Rick K1DS
  - Mike WB2RVX
  - Gary WA2OMY

- Due to the above generosity, all of the funds received go to support this conference, the Packrats and VHF.