(Yet Another) Universal PLL Source for Low VHF Through Microwave

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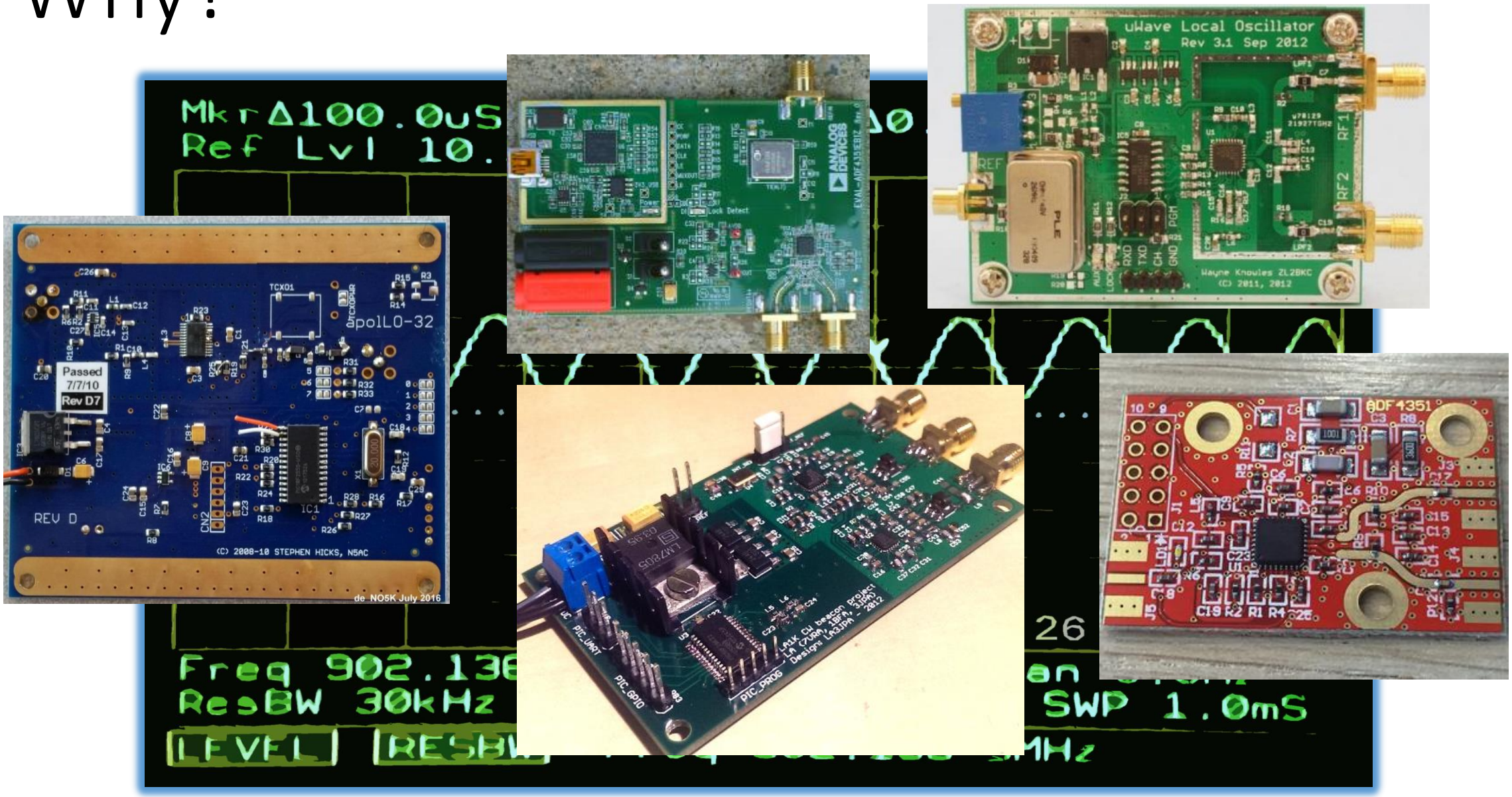
Ben Bibb, NO5K

(Or…what I did on my spring vacation)

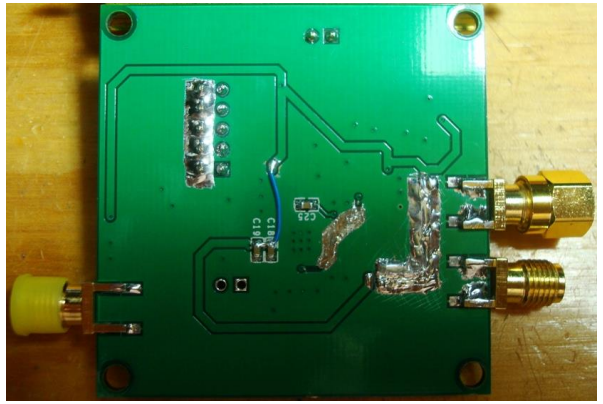
Why?


MkrΔ100.0uS
Ref Lvl 10.
Freq 902.13
ResBW 30kHz
SWP 1.0mS
LEVEL
RESBW
uWave Local Oscillator
Rev 3.1 Sep 2012
Wayne Knowles ZL2BKC
(C) 2011, 2012
apolLO-32
Passed
7/7/10
Rev D7
REV D
(C) 2008-10 STEPHEN HICKS, N5AC
de NO5K July 2016
ADF4351

I’m NOT going to discuss “WHY?”…

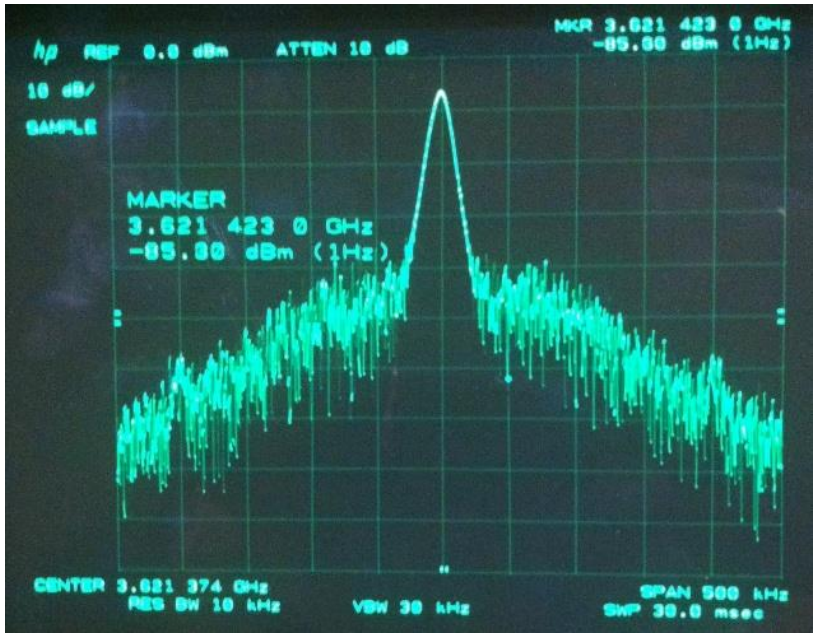
- OK, this is why:

T/G Project: needed a µW (3.6214 GHz) source:

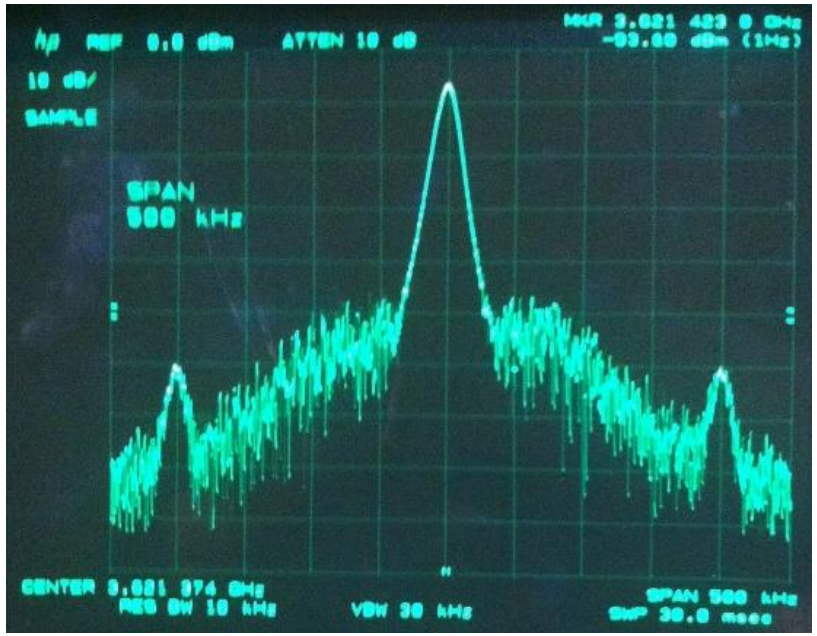


“Store-Bought” Synthesizer

- Extensive modifications to layout and power supplies



Original output at 3.6 GHz



3.6 GHz output after adding one ULN-LDO

- Addition of two ULN-LDOs ultimately reduces PN by about 23 dB/Hz

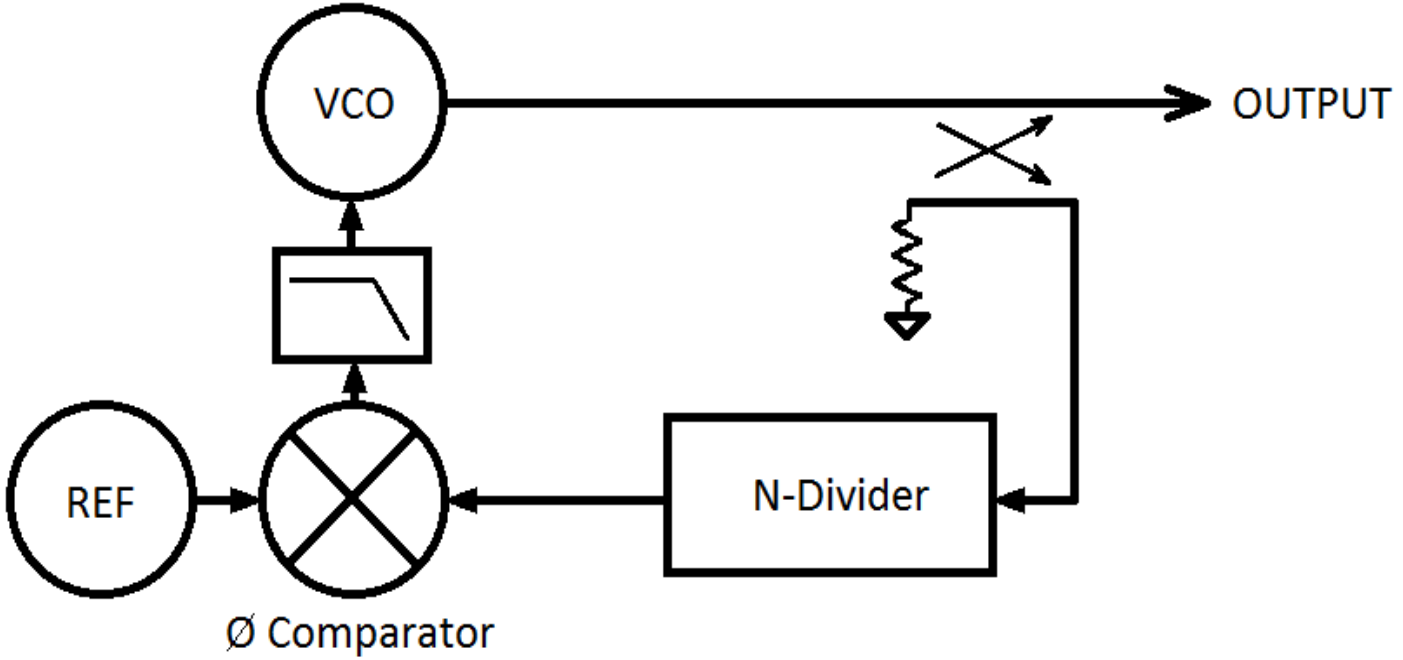
Soon, other needs arose:

- Signal Generator/Sweep osc.
- Transmitters
- XVRTR LOs
- Beacons
- etc…

Overarching need:
Stand-alone operation (No PC needed to operate).

(THAT's why)

The Basic PLL

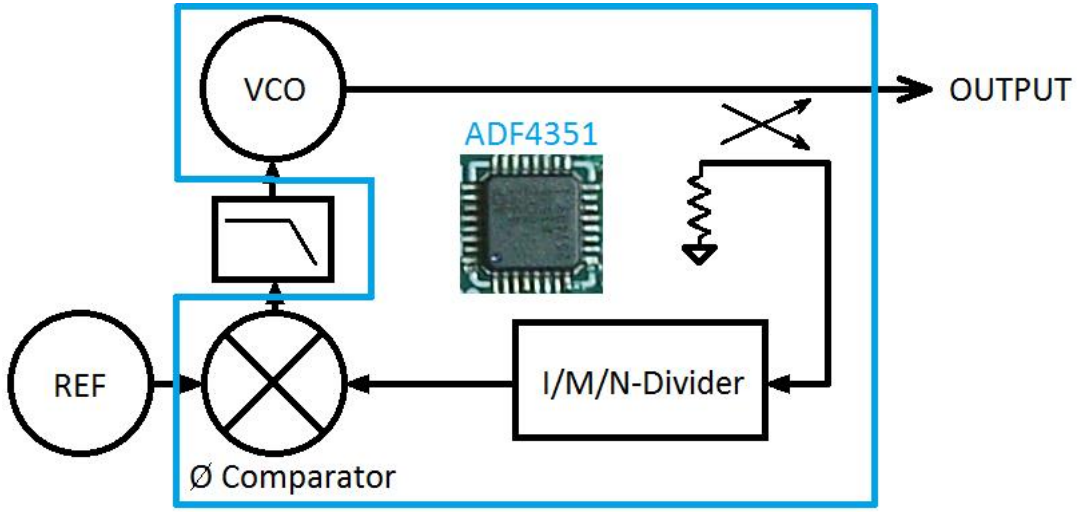


Basic Components:

- VCO Fc output across a given BW (Fc from Audio to µW, depending on application)
- Splitter/Coupler (configuration depends on cost and performance requirements)
- N-Divider “reduces” VCO frequency to “match” the REF oscillator
- The phase comparator produces an error signal that feeds the VCO
- The loop filter removes unwanted harmonics and spurious components from the error signal.

The ADF-4351 Is the “Whole Enchilada”

- Integrated VCO
- Covers 35 to 4400 MHz
- Small size
- Reasonable cost.
- Fine-frequency resolution
- Requires a controller to program internal configuration registers



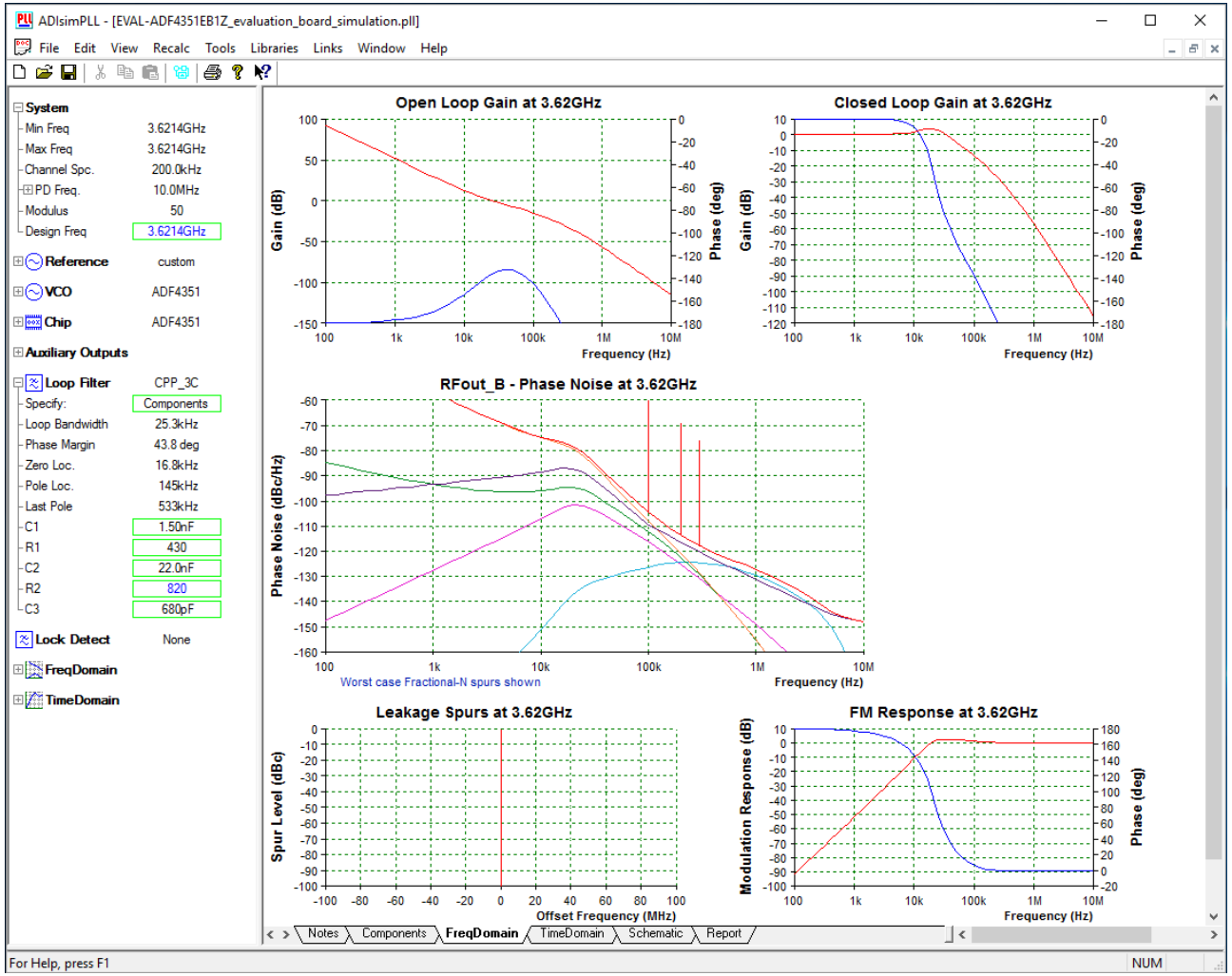
All that is needed is a Microcontroller, a decent REF oscillator, and a few passive components (and really quiet power supplies).

The Pudding

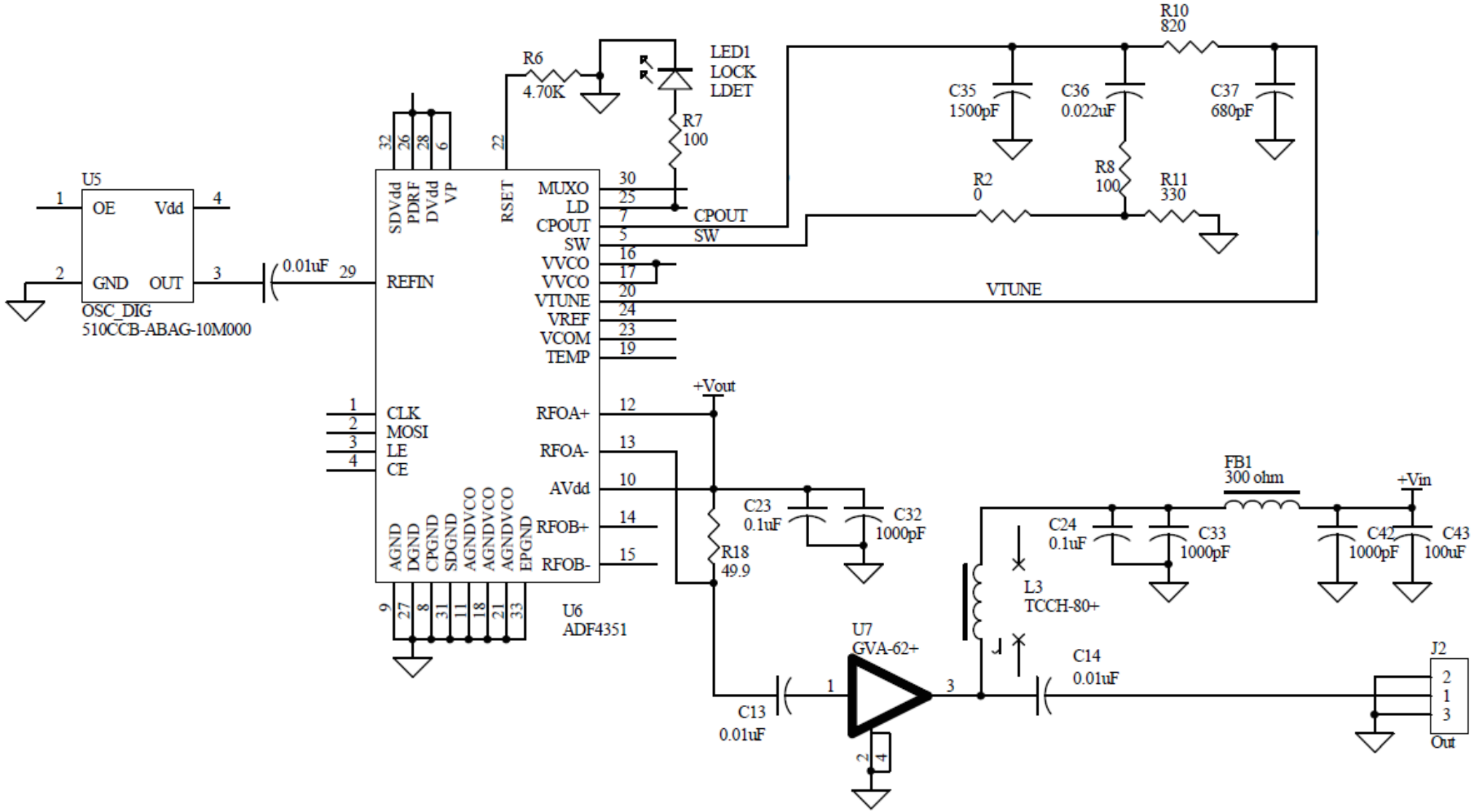
The Orion-I design specifications:

- 100 Channels (8 bits, 2-digit BCD)
- Serial control option (RS-232)
- Field-selectable on-board/ext REF (option)
- +10dBm out
- “Reasonable” PN (~~ -100 dBc/Hz or better at 1KHz)
- “PTT” input (option)
- Other possibilities: Sweep, Morse ID, etc… (it’s just software, man!)
- Parts cost <$70 (pedigreed parts, QTY 1) – Mass production can reduce cost considerably

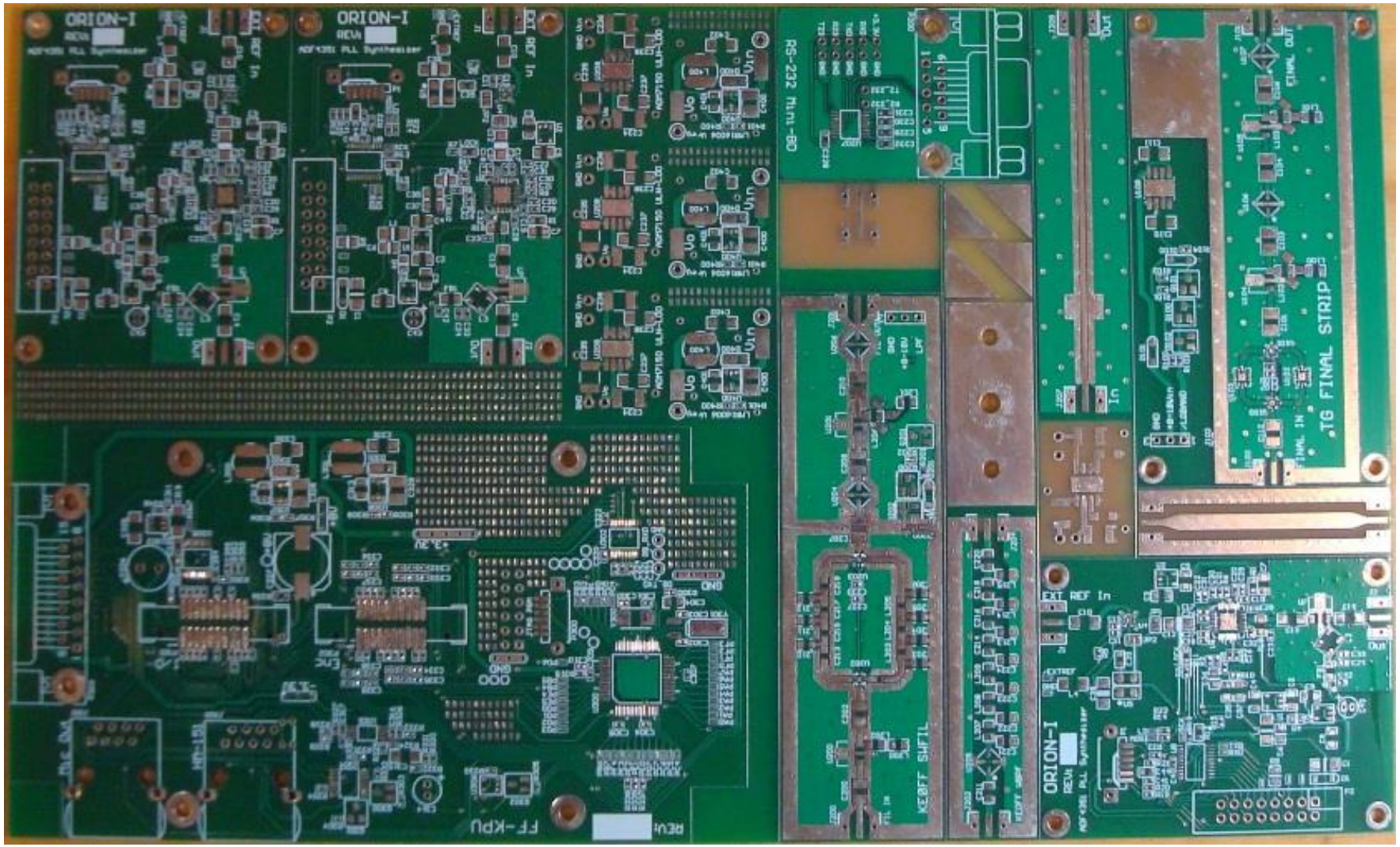
ADIsimPLL Design SW



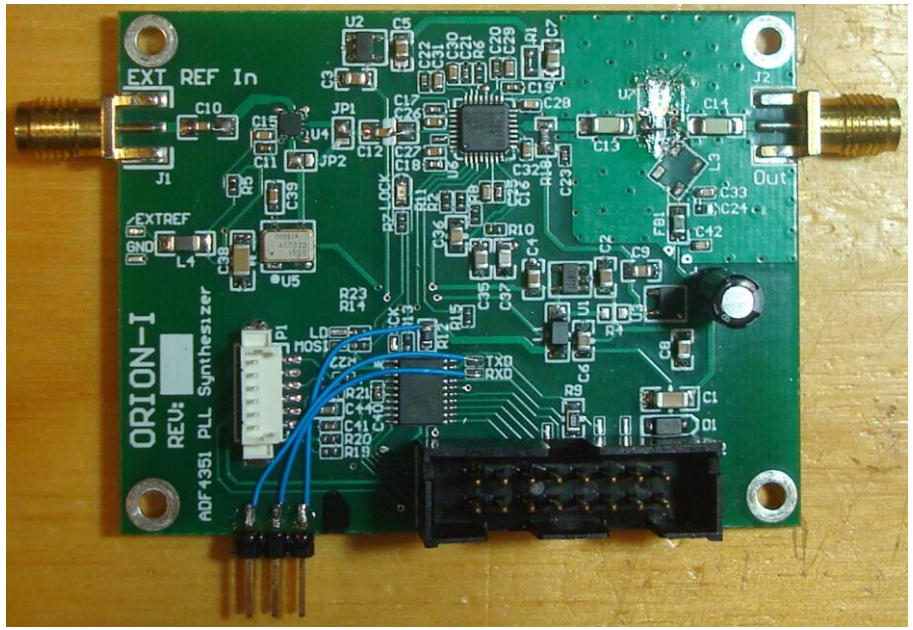
Simplified Schematic

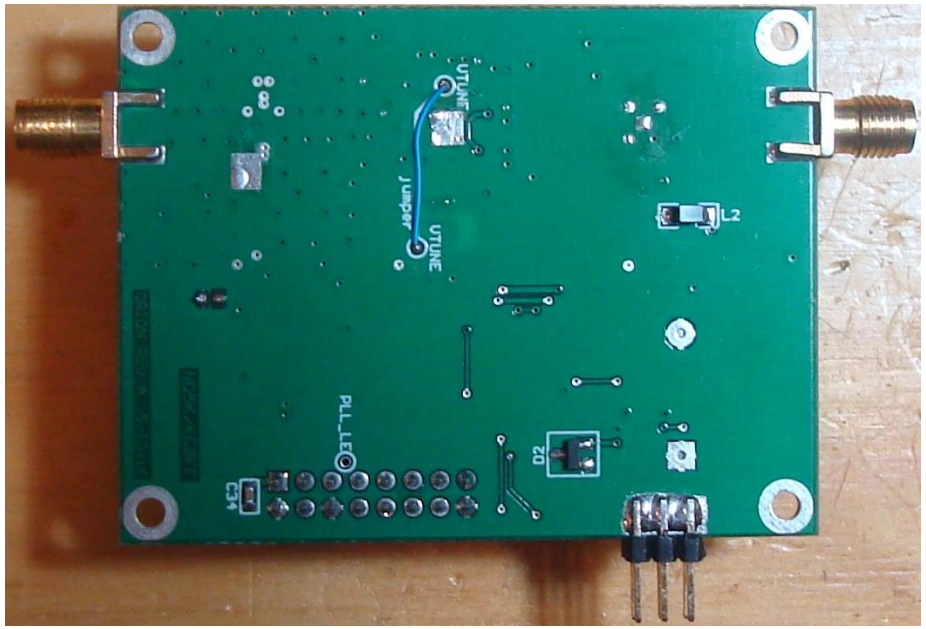


No Kitchen Sink…

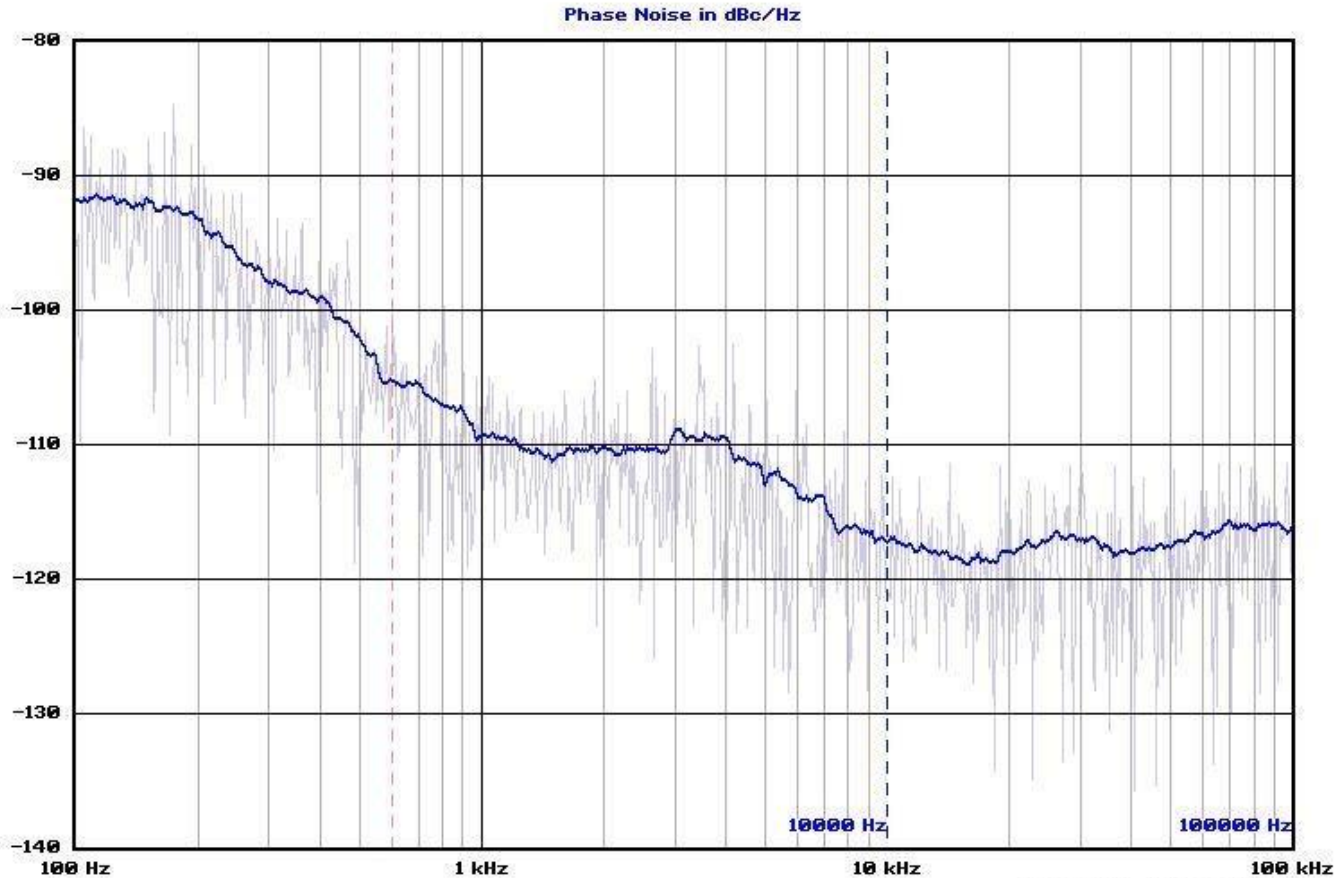


Ta…Da.


EXT REF In
ORION-I
REV:
ADF4351 PLL Synthesizer
Out
EXTREF
GND
J1
J2
JP1
JP2
U5
LOCK
MOSI
TXD
RXD

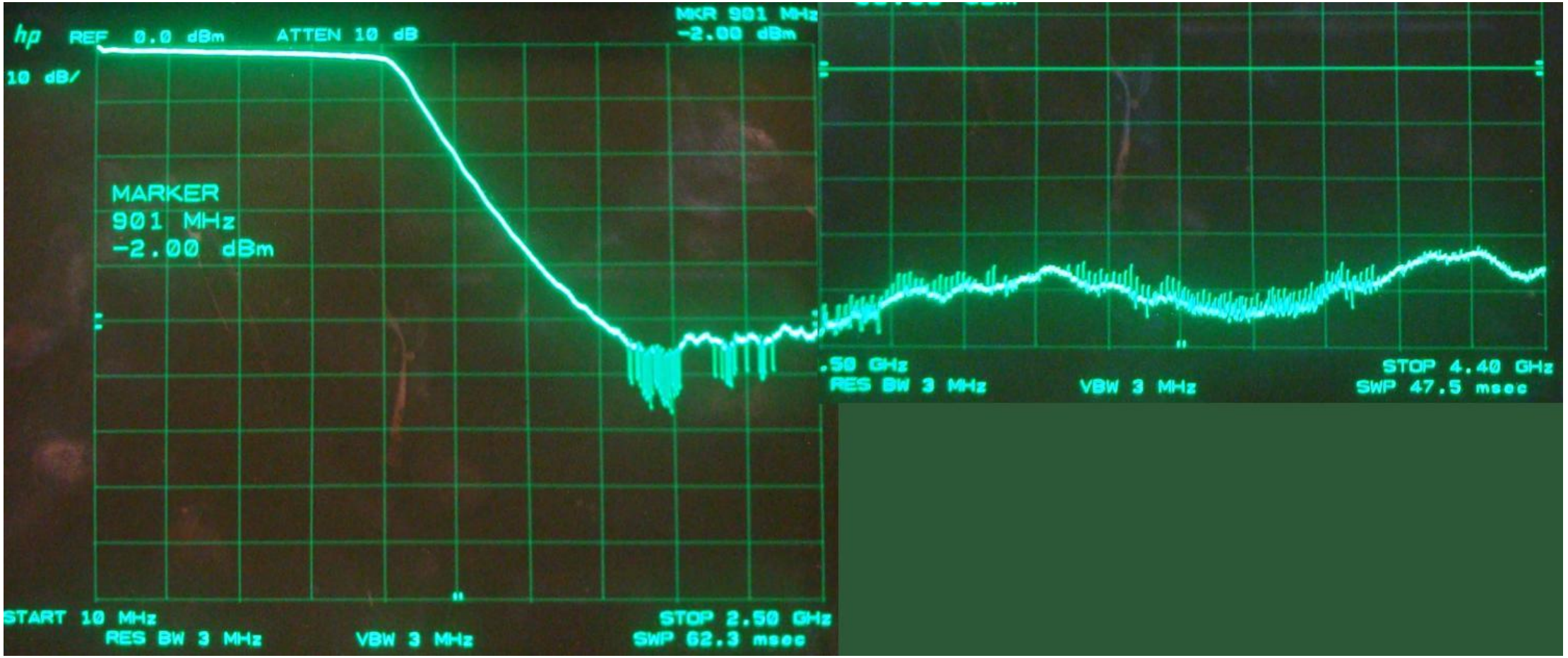

UTUNE
Jumper
PLL_LED

Plots (PN)



Trace	Carrier Hz	dBc/Hz at 600 Hz	Residual FM Hz	RMS Jitter	Instrument
ORION-I S/N 01 at NO5K	902 166 900	-105.3	3.90E+001	1.1E-013 s	TEK/2782

Plots (PLP-1000+ LPF)

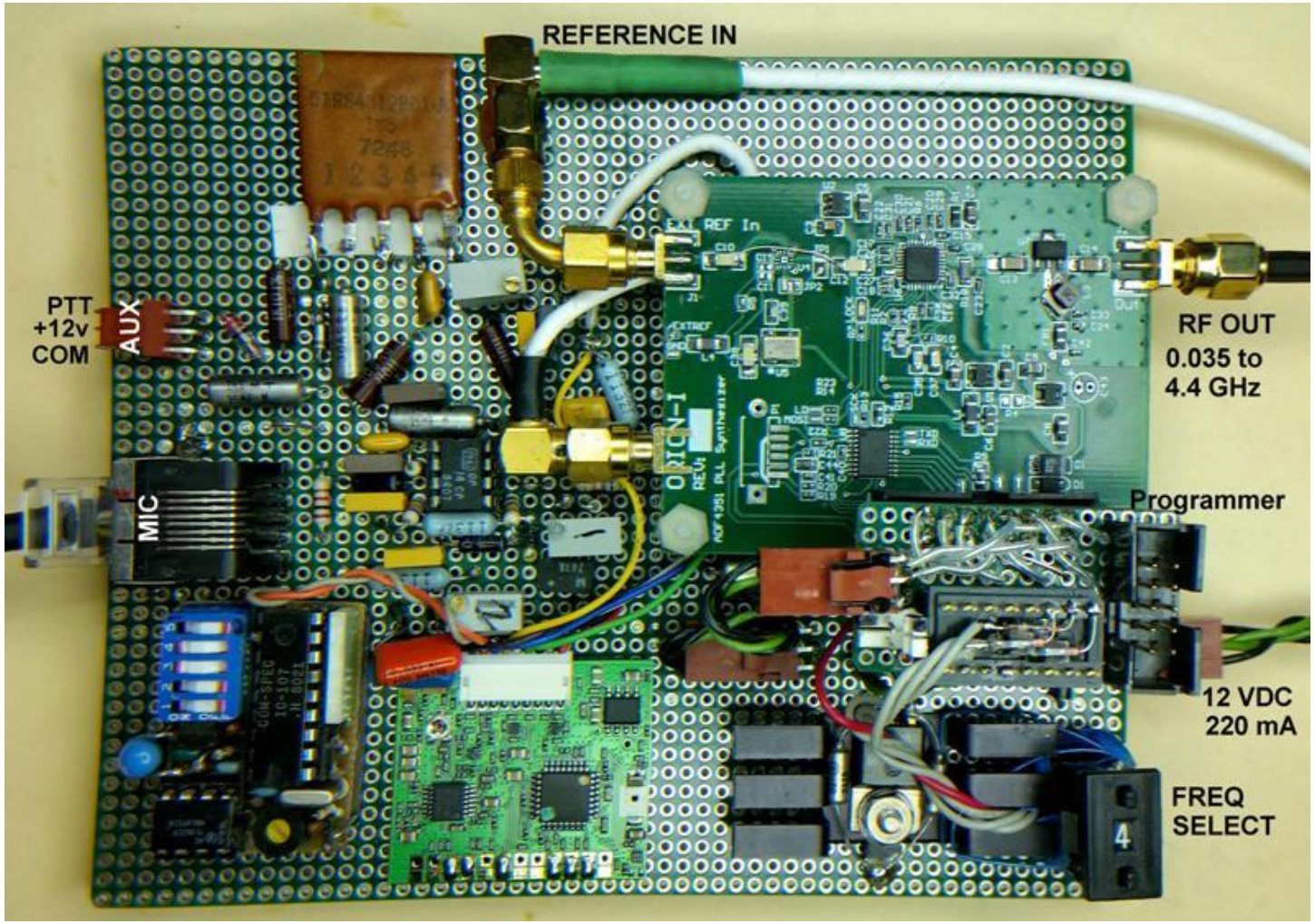


UX-902

902 MHz FM TX module for the IC-901

- Single channel
- Looks like a UX-129 (1200MHz) in the IC-901 stack
- 18W output, max. Dialed back to 4 W (high) and 400mW (low)
- Modulation injected at Vtune pin of the ADF4351
- This injection method requires baseband frequency compensation to counteract PLL response

FM Test Set


REFERENCE IN
PTT
+12v
COM
AUX
MIC
RF OUT
0.035 to
4.4 GHz
Programmer
12 VDC
220 mA
FREQ
SELECT
4

Links/References

- ADF-4351 Datasheet:
  - http://www.analog.com/media/en/technical-documentation/data-sheets/ADF4351.pdf
- ADIsimPLL:
  - https://form.analog.com/form_pages/rfcomms/adisimpll.aspx
- RMG:
  - http://www.k5rmg.com/
- KEØFF Projects:
  - http://www.rollanet.org/~joeh/projects/