Update and Enhancements for

Locked VCXOs for Stable Microwave Local Oscillators with Low Phase Noise

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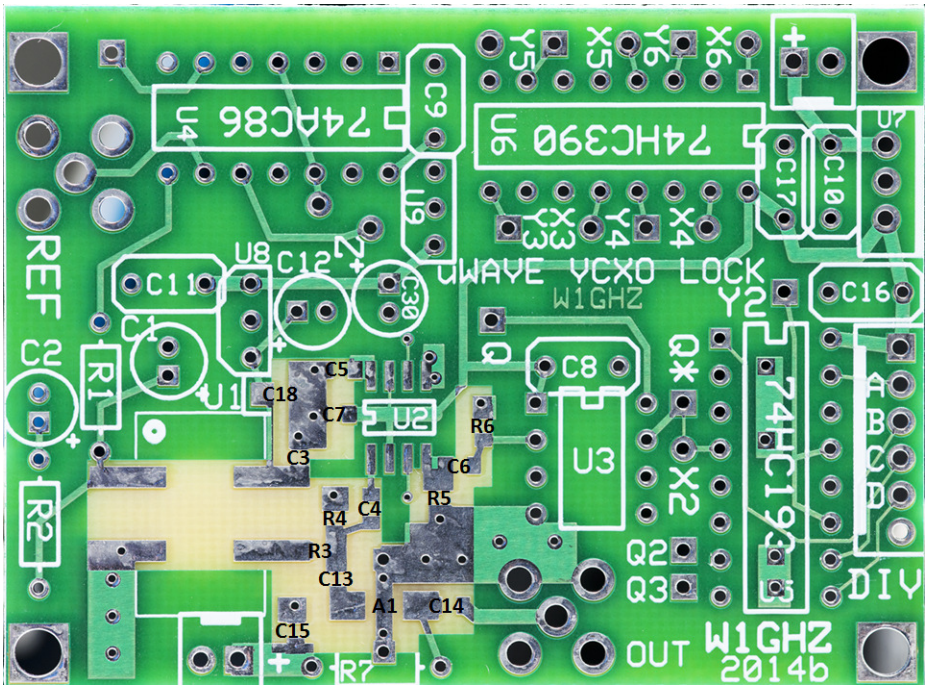
The 96 MHz VCXO is used as an accurate source for a 1152 MHz local oscillator for a 1296 MHz transverter. I found that spurious outputs generated by the locking scheme are reduced by powering the VCXO and the phase detector chip, a 74AC86, from separate voltage regulators. The latest PC board revision, marked "2014b," includes separate voltage regulators – U9 has been added, as shown in the schematic diagram, Rev 1.2. Unfortunately, I got the silk screen shape for U9 backwards, so insert it in the opposite direction.

In order to get the bypass capacitors close to power pins on the chips, some of the chip capacitors are on the bottom of the board.

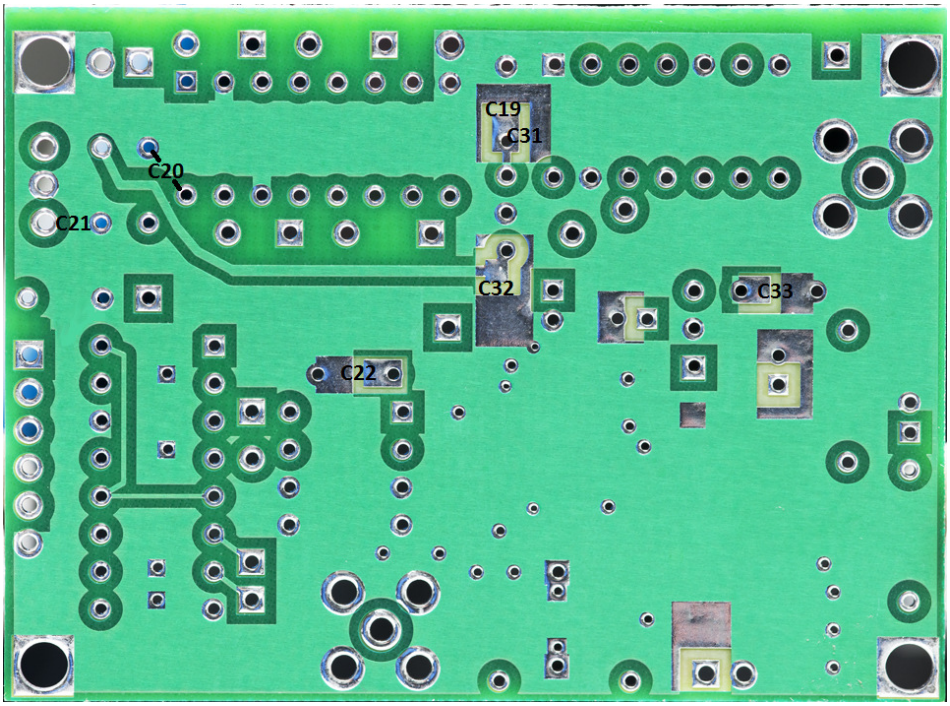
One user reported that his VCXO required a high tuning voltage to reach the desired frequency, near the 3.3 volt limit, and the resistors in the circuit prevented the voltage from rising high enough. The solution is to replace U9, the regulator powering U4, the 74AC86 phase detector, with a 5-volt 78L05 regulator. This provides the needed voltage margin, and the locking circuit prevents overvoltage.

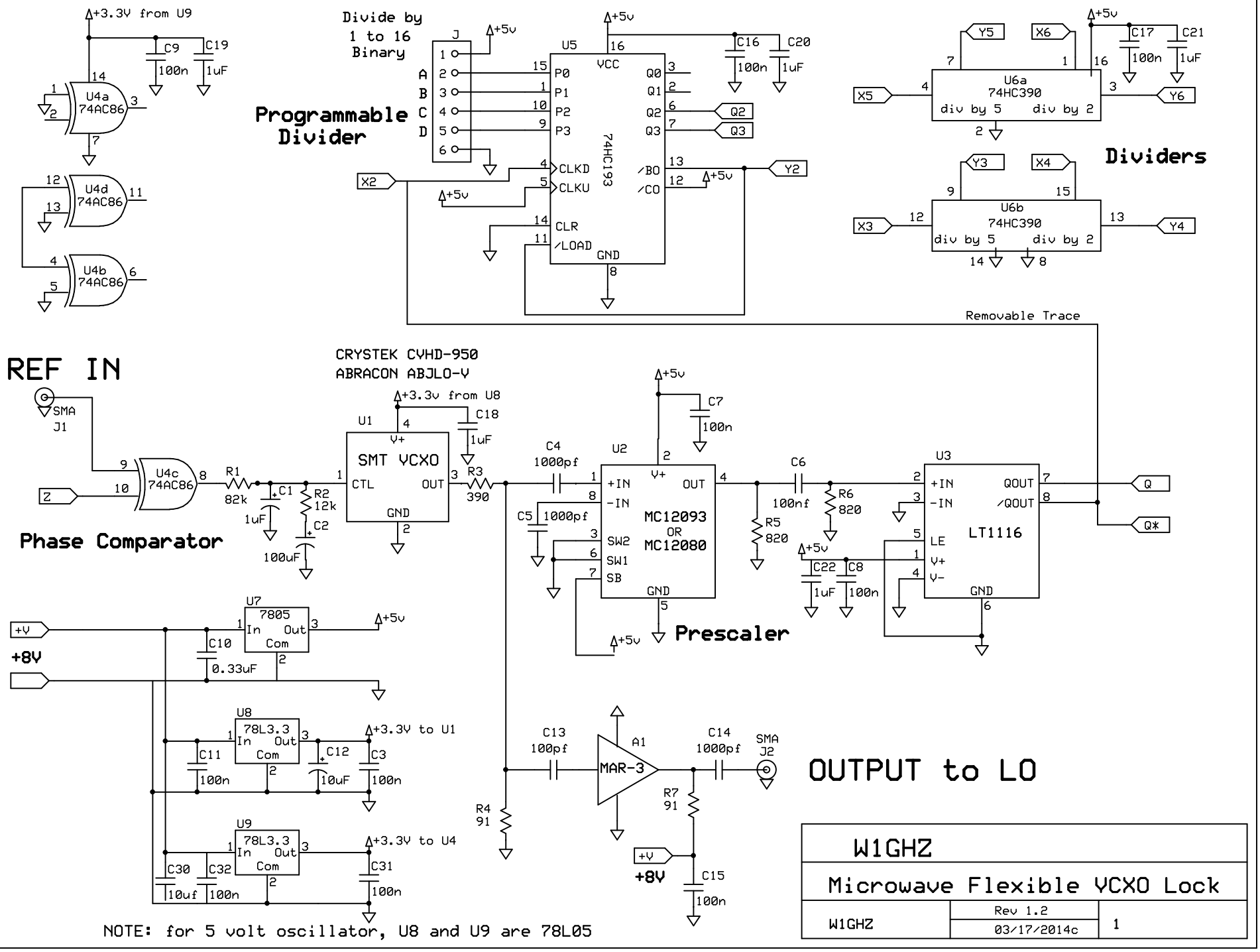
January 2015 – Oliver Barrett, KB6BA, figured out surface-mount component placements from my photos and was kind enough to provide these annotated photos of the bare board.

Oliver also found an error in the programming table, Appendix A. The "Signal" column for 96, 120, and 108 MHz should read "Y4 > Z". The corrected Appendix A is also below.



Remember, U9 symbol is backward




+3.3V from U9
C9
100n
C19
1uF
U4a
74AC86
U4d
74AC86
U4b
74AC86
Divide by
1 to 16
Binary
Programmable
Divider
J
A
B
C
D
U5
74HC193
VCC
P0
P1
P2
P3
CLKD
CLKU
CLR
/LOAD
Q0
Q1
Q2
Q3
/BO
/CO
GND
+5v
C16
100n
C20
1uF
Q2
Q3
X2
Y2
Dividers
U6a
74HC390
div by 5
div by 2
X5
Y5
X6
Y6
C17
100n
C21
1uF
U6b
74HC390
X3
Y3
X4
Y4
Removable Trace
REF IN
SMA
J1
CRYSTEK CVHD-950
ABRACON ABJLO-V
U4c
74AC86
Z
R1
82k
C1
1uF
R2
12k
C2
100uF
U1
SMT VCXO
CTL
OUT
GND
V+
+3.3v from U8
C18
1uF
R3
390
Phase Comparator
C4
1000pf
C5
1000pf
U2
MC12093
OR
MC12080
+IN
-IN
SW2
SW1
SB
C7
100n
C6
100nf
R5
820
R6
820
U3
LT1116
+IN
-IN
LE
V+
V-
QOUT
/QOUT
C22
1uF
C8
100n
Q
Q*
Prescaler
U7
7805
In
Out
Com
C10
0.33uF
+V
+8V
U8
78L3.3
C11
100n
C12
10uF
C3
100n
+3.3V to U1
U9
78L3.3
C30
10uf
C32
100n
C31
100n
+3.3V to U4
C13
100pf
A1
MAR-3
C14
1000pf
SMA
J2
R4
91
R7
91
C15
100n
OUTPUT to LO
NOTE: for 5 volt oscillator, U8 and U9 are 78L05
W1GHZ
Microwave Flexible VCXO Lock
W1GHZ
Rev 1.2
03/17/2014c
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Appendix A - Corrected 2015

Microwave VCXO Board Programming

Freq	VCXO	DigiKey	Prescaler	Prescale	Divide 74HC193	ABCD*	÷2 74HC390	Signal	Comparison Frequency	Ref ÷5 74HC390	Ref ÷2 74HC390	Reference
80 MHz	Crystek	744-1214-ND	MC12093	÷8	na	na	na	Q->Z	10 MHz	na	na	10MHz->REF
80 MHz	Abracon	535-11429-ND	MC12093	÷8	na	na	na	Q->Z	10 MHz	na	na	10MHz->REF
96 MHz	Abracon	535-11431-ND	MC12093	÷8	÷6	LHHL	Q2->X4	Y4->Z	1 MHz	10MHz->X5	Y5->X6	Y6->REF
100 MHz	Abracon	535-11433-ND	MC12080	÷10	na	na	na	Q->Z	10 MHz	na	na	10MHz->REF
120 MHz	Abracon	535-11437-ND	MC12080	÷10	÷6	LHHL	Q2->X4	Y4->Z	1 MHz	10MHz->X5	Y5->X6	Y6->REF
200 MHz	Abracon	535-11451-ND	MC12080	÷20	na	na	na	Q->Z	10 MHz	na	na	10MHz->REF
108 MHz	homebrew?		MC12026	÷9	÷6	LHHL	Q2->X4	Y4->Z	1 MHz	10MHz->X5	Y5->X6	Y6->REF

NOTES:
Y5->X6 means add a wire from point y5 to point X6, etc.
* ABCD = LHHL: L is ground, H is +5 Volts
na means not applicable - chip may be left out
MC12093 ÷8: pins 3 and 6 grounded (unmodified board) Digikey MC12080DGOS-ND
MC12080 ÷10: pins 3 and 6 high (jumpers to pins 2 and 7) Digikey MC12093DGOS-ND
MC12080 ÷20: pins 3 grounded (unmodified) and pin 6 high (jumper to pin 7)
Crystek VCXO are CVHD-950 series
Abracon VCXO are ABLJO-V series
Comparator 74AC86 compares Z and REF inputs

PC Boards marked 2013a are good for all frequencies
PC Boards marked 2012 are good for 80, 100, and 200 MHz. A wire is needed from Pin 1 of U4 (LT116) to +5 Volts.