A SIMPLE CRYSTAL NOTCH CIRCUIT FOR NOISE MEASUREMENTS

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I used Mini Circuits ZFSC-2-4 Broadband Combiner/Splitter

FROM: 50 Ω GENERATOR Under Test

OUT
PORT

200 Ω

Shielded

IN
PORT

TO: 50 Ω SPECTRUM ANALYZER

Combiner/splitter

MFJ Antenna Tuner

Adjust tuner for best notch

XTAL Tuner

~100 Ω Controls Notch Width

12 MHz Crystal

5 Ω ESR

Crystal Tuning Capacitor
Adjust for best notch

Select L to resonate above and below XTAL frequency.

References:
Oscillator Noise Evaluation with a crystal Notch Filter by Wes Hayward, W7ZOI
QEX July/August 2008

HP RF & Microwave Phase Noise Measurement Seminar
Simulations

20 Hz Span

R = 0 Ω

R = 100 Ω

DB[S21] –

<table>
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<th>9.99999</th>
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<td>-16.4879</td>
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<td>-25.3551</td>
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SIMULATIONS

2 KHz Span

R=0 Ω

R=100 Ω

DB[S21] -

9.999 9.9996 10.0004 10.001
-6.87582 -6.7582 -7.20975 -7.0563
0 0 0 0
SIMULATIONS

20 KHz Span

R=0 Ω

R=100 Ω

DB[S21] -

9.99 9.996 10.004 10.01
-6.9593 -6.94242 -6.9833 -6.96606
0 0 0 0
NOTCH MEASUREMENTS

CH1 S21 log MAG 10 dB/ REF 0 dB 1: -69.394 dB

200 Hz Span

200 Hz

SPAN

CENTER: 12.000 000 MHz
SPAN: .000 200 MHz

30 Aug 2008 17:05:30
NOTCH MEASUREMENTS

2 KHz Span

CENTER 12.000 000 MHz

SPAN .002 000 MHz
NOTCH MEASUREMENTS

200 KHz Span

+55 KHz -21.2 dB
+97 KHz -15.6 dB
+135 KHz -9.5 dB
Not shown
MEASUREMENTS on Marconi 2019A Signal Generator (set at 0 dBm, 12.00000 MHz)

Calibration signal
Tuner disconnected
20 KHz Span
Level = -6.86 dBm

10 dB/div
50 traces averaged
MEASUREMENTS on Marconi 2019A Signal Generator (set at 0 dBm, 12.00000 MHz)

- Carrier nulled with tuner and XTAL series LC
- 20 KHz Span
- Level = -68.28 dBm
- Delta = 61.4 dB
- 10 dB/div
- 50 traces averaged

Shows residual generator noise, after carrier has been notched by \(-6.86 - (-68.28) = 61.4\) dB

Correction at 2 KHz: add 3 dB
Effective BW = 300 Hz x 1.2 = 360 or - 25.6 dB / Hz
Random signal Correction = +2.5 dB
Example at 2 KHz offset, graph reads -103 dBc + 3 - 25.6 + 2.5 = -123 dBc/Hz.
At 10 KHz offset: -134 dBc/Hz