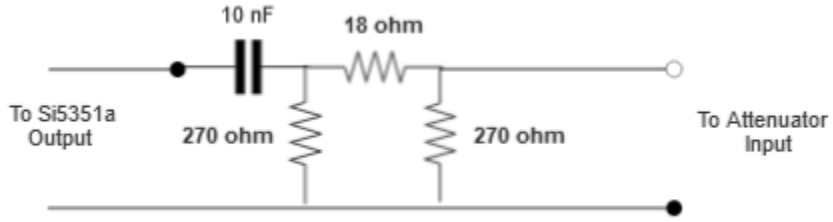
QRP-Labs
Signal Generator
Modifications

Earlier this year I received a **QRP-Labs VFO SigGen** kit. The kit went together without a problem but the results were somewhat less than I had anticipated.

After a post on the QRP-Labs **groups.io** I was contacted by Kevin (ZL1UJG). He suggested that a couple of changes to the output of the SigGen might improve things. The changes included the addition of a 10 nF DC blocking capacitor, 150 ohm series resistor (increasing the load to about 200 ohms) and a 4:1 unun transforming the output back to 50 ohms. This worked, however, the quality of the 4:1 unun transformer gave a wide swing in attenuation achieved.

Joe (VE7BFK) suggested that I try a simple 50 ohm 3 dB pad (see below).



50 ohm input:50 ohm output 3 dB Pad

This circuit improved the SigGen output across the 3 to 30 MHz range providing a more consistent signal with minimal insertion loss. Still a huge signal for most of the work I will be attempting. I needed a broad range attenuator for working on HF equipment. Luckily I came across a step attenuator circuit in ***QEX September/October 2021***. This was a 0 – 60 dB attenuator designed by VA7TA.

This inexpensive attenuator has proven to be accurate and a very useful accessory! However, I still felt that something was missing. It would be REALLY nice if the QRP-Labs SigGen had a **built in** variable attenuator.

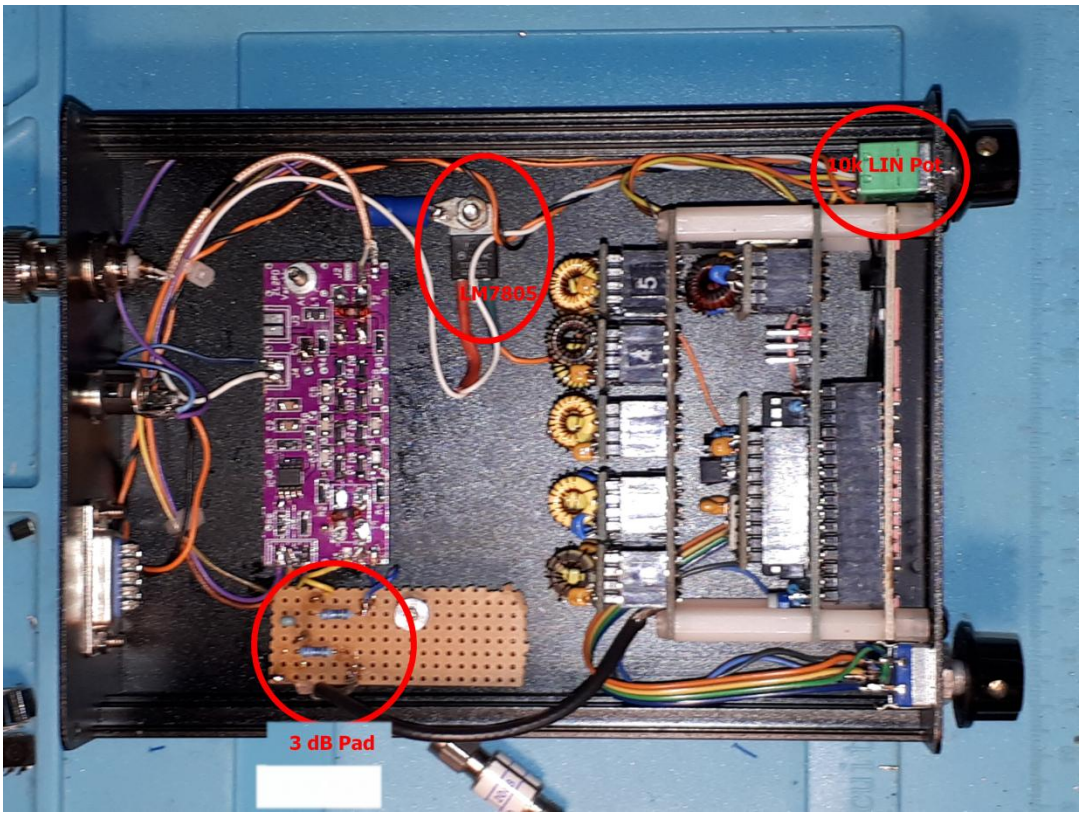
The perfect solution seemed like it was the **HMC346 module** a 32 dB variable attenuator theoretically available from numerous on-line websites in China. Unfortunately, the world electronic chip shortage (2021-202x) raised its head and what was posted on-line was not always a real product and the module proved to be unobtainium!

I had almost given up on locating a small reasonably priced variable attenuator but then I found a 0 – 60 dB continuously variable attenuator design by Andrew (ZL2PD).

https://zl2pd.com/Variable_60dB_500MHz_RF_Attenuator.html

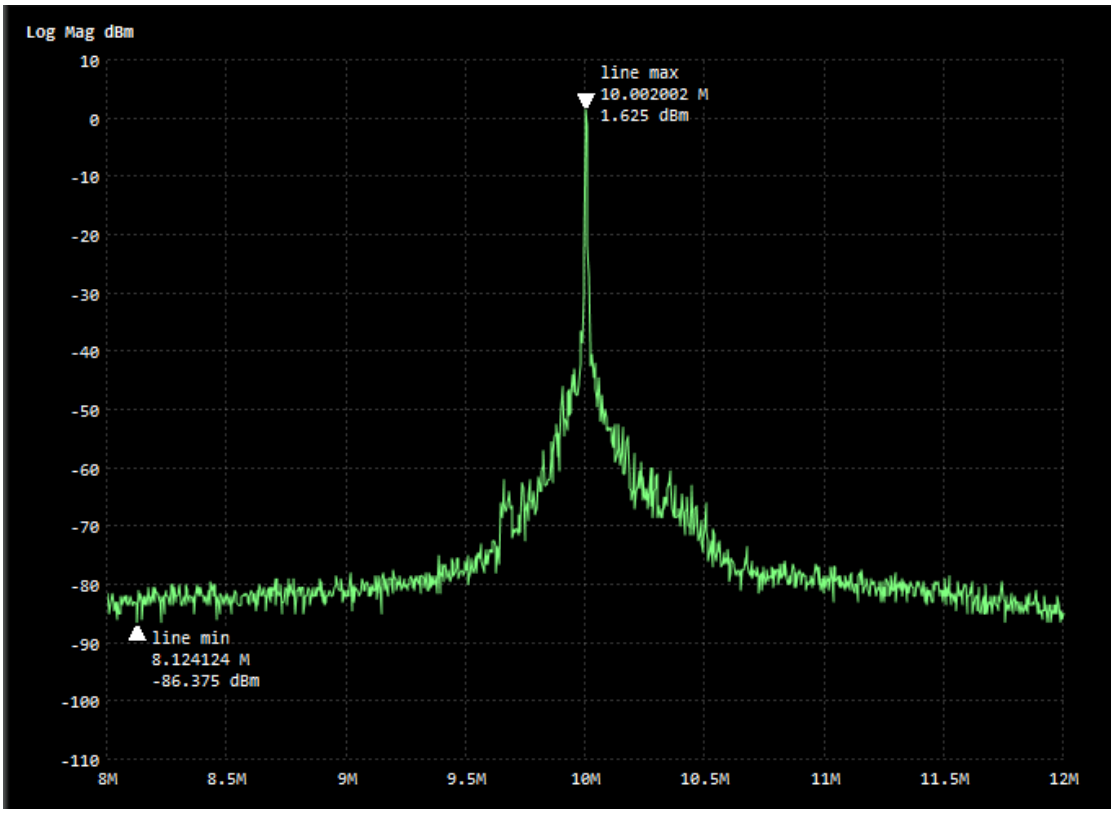
This attenuator was small enough to easily fit inside the QRP-Labs SigGen with only minor modifications needed. The modifications included replacing the power switch with a switched 10k linear pot and providing 12 VDC to the attenuator board. The pot I selected (Digikey 987-1283-ND) fit the front panel of the SigGen with adequate clearance and *without* any drilling!

I replaced the SigGen 5 VDC power supply with a 12 VDC unit and tapped off the 5 VDC required for the SigGen itself using a LM7805. (Luckily the QRP-Labs case for the SigGen has lots of room for additional project boards.) The final assembly is shown below.

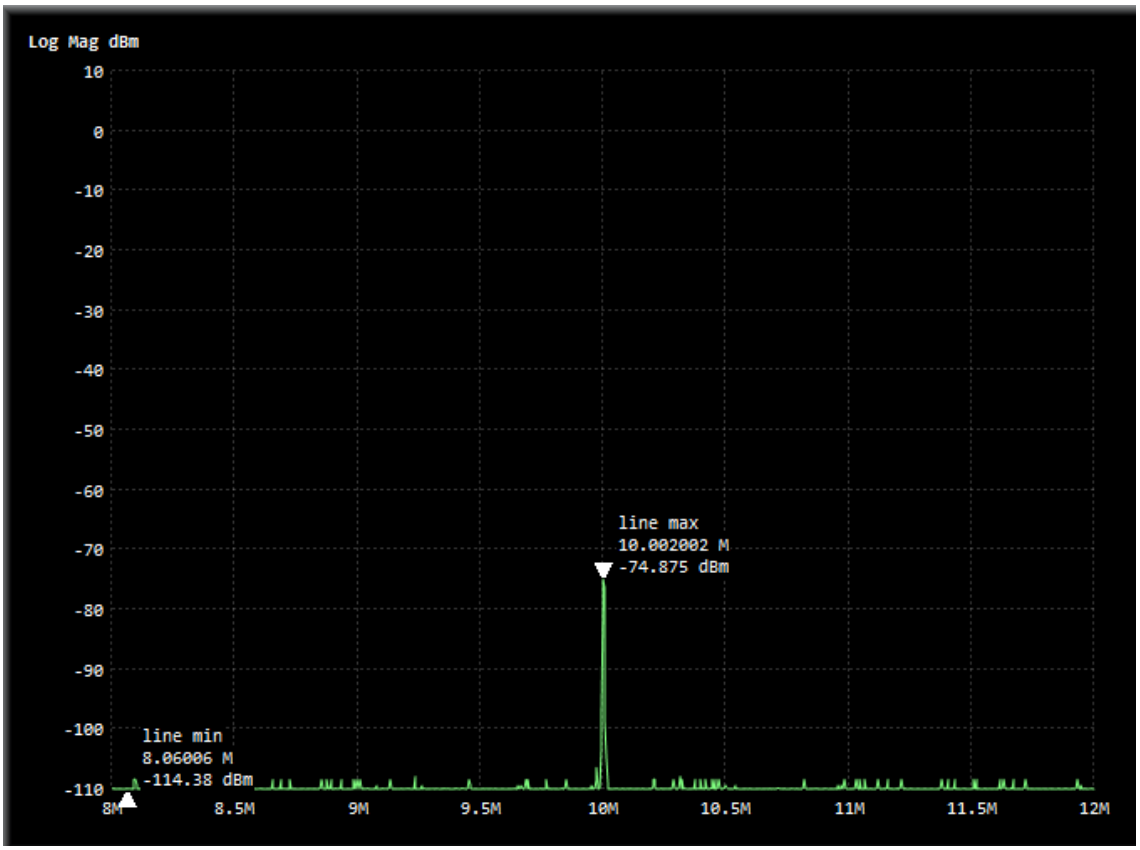


Results:

Nominally the QRP-Labs SigGen has a fixed output in the vicinity of +10 dBm. With these modifications the maximum output of the SigGen is now closer to 0 dBm (it varies slightly depending on the frequency). However, attenuation is now continuously adjustable over a large span via the front panel pot. The 2 figures below show a sample at 10 MHz at minimum and maximum attenuation – measured with a ***TinySA*** signal analyzer.

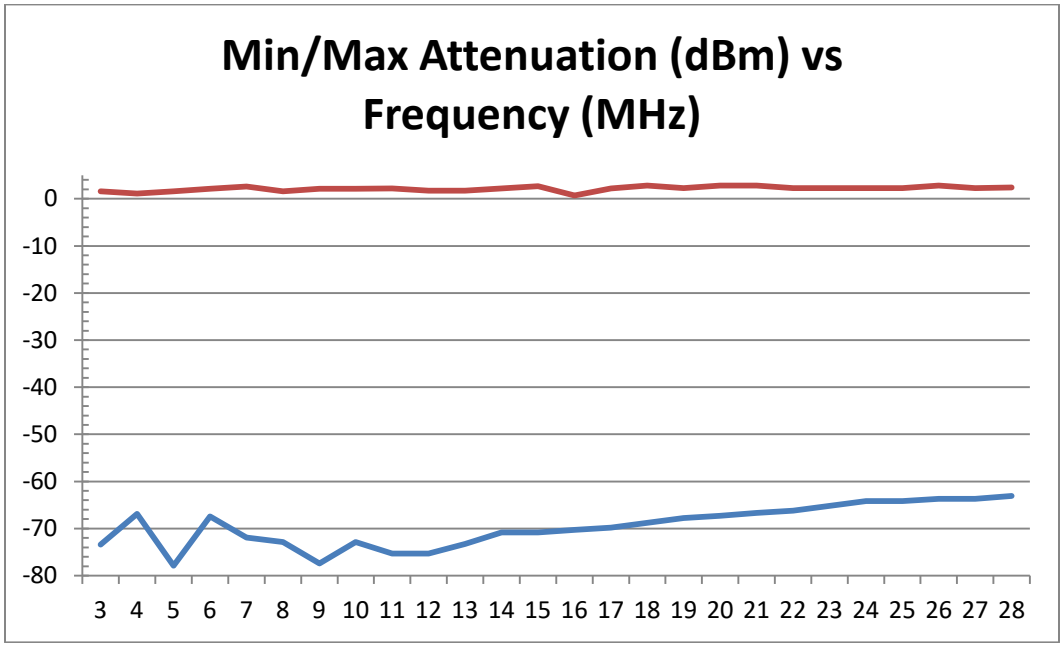


10 MHz minimum attenuation +1.625 dBm



10 MHz maximum attenuation -74.875 dBm

The following figure shows the minimum and maximum attenuation measured at 1 MHz intervals from 3 to 28 MHz.



Summary

The 3 dB pad provides better consistency across the HF spectrum from 3 to 30 MHz. With a minimal attenuation setting the SigGen output varies from +1.1 to +2.8 dBm. This compares well with the QRP-Labs data and is approaching the capability of my TinySA signal analyzer. At full attenuation the output of the SigGen varies from near -63 dBm (at 28 MHz) to -77 dBm (at 5 MHz). Again, likely approaching the capability of the spectrum analyzer at these low signal levels.

For those interested in building the variable attenuator I have attached a list of the parts available from DigiKey.

73, Rick – VE7TK

Last Edited: December 11, 2022

DigiKey
Parts List for ZL2PD Variable Attenuator

All parts EXCEPT the Amidon toroids were available from DigiKey.com

All SMD parts are format 1206 EXCEPT the diodes are SOD-123 and the op amp was an 8SOIC

Below are the DigiKey parts I used:

470 ohm
PART: 541-10644-1-ND
MFG : VISHAY DALE (VA) / RCS1206470RJNEA
DESC: RCS1206 200 470R 5% ET1 E3

1.5k ohm
PART: 311-1.5KERCT-ND
MFG : YAGEO (VA) / RC1206JR-071K5L
DESC: RES 1.5K OHM 5% 1/4W 1206

22k ohm
PART: A130185CT-ND
MFG : TE CONNECTIVITY PASSIVE PRODUCT (VA) / CRGCQ1206J22K
DESC: RES 22K OHM 5% 1/4W 1206

10 k Linear Pot
PART: 987-1283-ND
MFG : TT ELECTRONICS/BI / P091S-FC20BR10K
DESC: POT 10K OHM 1/20W PLASTIC LINEAR

0.1 uF cap
PART: 1276-1017-1-ND
MFG : SAMSUNG ELECTRO-MECHANICS AMERICA, INC (VA) / CL31B104KBCNNNC
DESC: CAP CER 0.1UF 50V X7R 1206

4.7 pF cap
PART: 732-12265-1-ND
MFG : WURTH ELECTRONICS INC (VA) / 885012008035
DESC: CAP CER 4.7PF 50V NP0 1206

1uH choke
PART: 541-2608-1-ND
MFG : VISHAY DALE (VA) / ILSB1206ER1R0K
DESC: FIXED IND 1UH 100MA 400 MOHM SMD

1N4148 diode

PART: 353-1N4148WHE3-TPCT-ND
MFG : MICRO COMMERCIAL CO (VA) / 1N4148WHE3-TP
DESC: 400MW SWITCHING DIODES SOD-123

LM358 op amp

PART: 296-LM358BIDRCT-ND
MFG : TEXAS INSTRUMENTS (VA) / LM358BIDR
DESC: IC OPAMP GP 2 CIRCUIT 8SOIC

0.01 uF cap

PART: 478-1542-1-ND
MFG : KYOCERA AVX COMPONENTS CORPORATION (VA) / 12065C103KAT2A
DESC: CAP CER 10000PF 50V X7R 1206

Note 1: At the time that I built this attenuator DigiKey had Fair-Rite toroids of the correct inside and outside diameter made from #43 material. However, the Fair-Rite toroids are *twice* the height of the Amidon toroids specified for the attenuator. This provides approximately double the A_L /100 turns for the transformers used. Luckily, I was able to source the correct Amidon cores locally from a friend.

Note 2: In the original documentation, ZL2PD specifies SMA connectors for the PCB. I found that the QRP-Labs case was just too tight to make the use of SMA connectors practical. I chose to solder the coax directly to the board.

73, Rick
Dec 7, 2022