

Universal MMIC Preamp

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In 2014, a new low-noise MMIC came to my attention, the PGA-103 from Minicircuits. This device provides a sub-1dB Noise Figure up to 1296 MHz with no tuning and only costs \$2. I made a number of preamps¹ on a simple PC board, like Figure 1. Then I put some of them into small Altoids tins.



Figure 1- MMIC preamps in Altoids tins

Unlike earlier MMICs which require a bias resistor, these devices operate at a fixed 5 volts, although a lower voltage may yield a slightly lower Noise Figure. The 5 volt supply is easily provided by a three-terminal regulator like the 7805. Adding the regulator and required low-frequency bypass capacitors inside the Altoids tin took a bit of metalwork and fiddling, but the result is a nice compact preamp. I use them on several bands.

A more recent low-noise MMIC is the PSA4-5043, which comes in a tiny 4-lead SOT-343 package. This device was found by SM5BSZ² to have lower phase noise than some other MMICs, which may be important in some amplifier applications. I tried one on a simple PC board like Figure 1, mounting the device diagonally with input and output leads just reaching the traces. It works very well, with NF about 0.6 dB up to 902 MHz, and under 1 dB at 1296 MHz.

I started to modify the PC board layout for the 4-lead SOT-343 package, and it occurred to me that it might be possible to make a footprint that could accommodate both the SOT-343 package and the 3-lead SOT-89 package used for the PGA-103 and other recent MMICs. The new footprint is shown in Figure 2a. Figure 2b shows PSA4-5043 in the SOT-343 package soldered in place, and Figure 2c has the older SOT-89 package soldered in place. Finally, Figure 2d shows that an older 4-lead Micro-X MMIC like a MAR-6 or ERA-1 can fit if placed at an angle. Thus we have a universal MMIC footprint, usable for just about any MMIC.



Figure 2a thru 2d, Universal MMIC Footprint

To make assembly quick and easy, I made the PC board a bit wider and added a small 78M05 surface-mount 3-terminal regulator and associated bypass capacitors, and a larger hole for a feedthrough capacitor for the power input. The RF part is still simple with no tuning – an RF choke to supply voltage, and blocking chip capacitors at the input and output. Since the sizes seemed close, I adjusted the PCB outline to match a small Pomona box and added the mounting holes as well – no metalwork required at all. Figure 3 shows a complete preamp in the Pomona box. Of course, the Pomona box is a bit more expensive than the Altoids tin, and the preamp will fit in a small Altoids tin just fine.

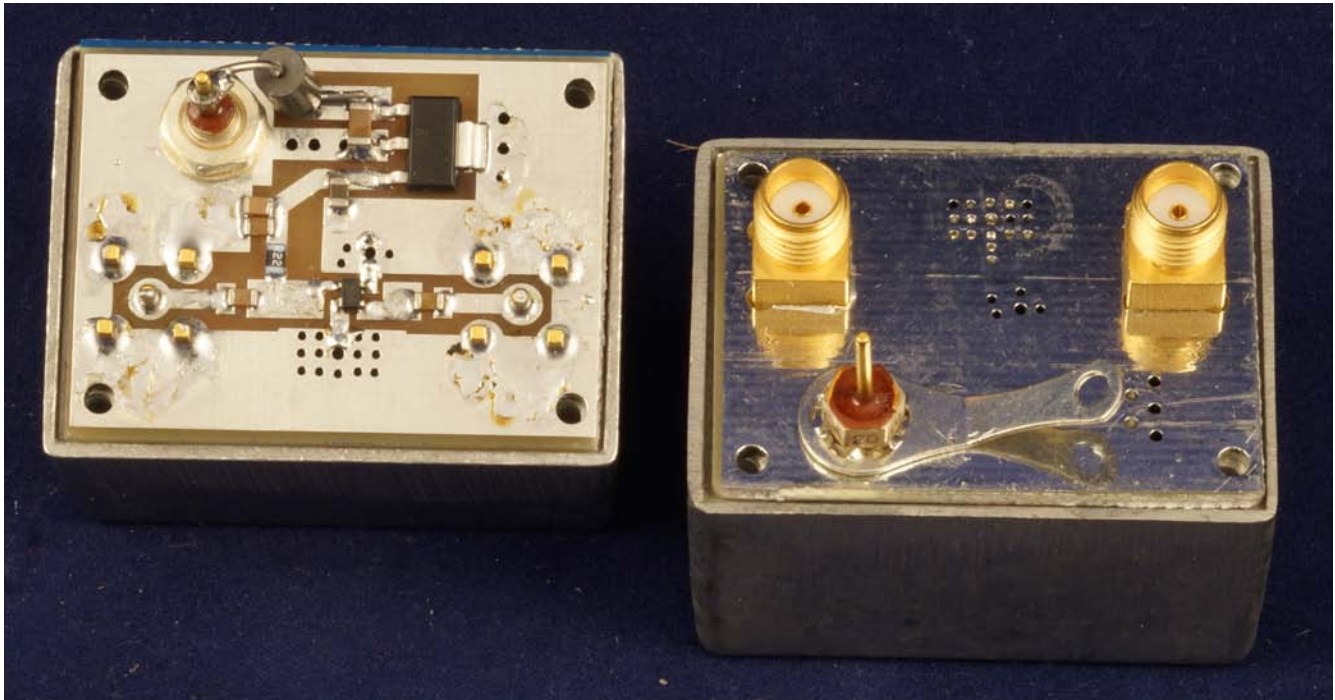


Figure 3- Universal MMIC preamp in small Pomona box

Figure 4 shows the PSA4-5043 preamp, as well as one for 6 meters using a PHA-1H. The PSA4-5043 preamp has a NF around 0.6 dB at 432 MHz. The PHA-1H MMIC has a NF under 2 dB to at least 1296 MHz, an IP3 rating of +40 dBm, and an output power capability around +22 dBm, 150 milliwatts. The noise figure isn't super, but more than adequate to improve an SDR at 6 meters, and it should be close to bulletproof for strong signals.

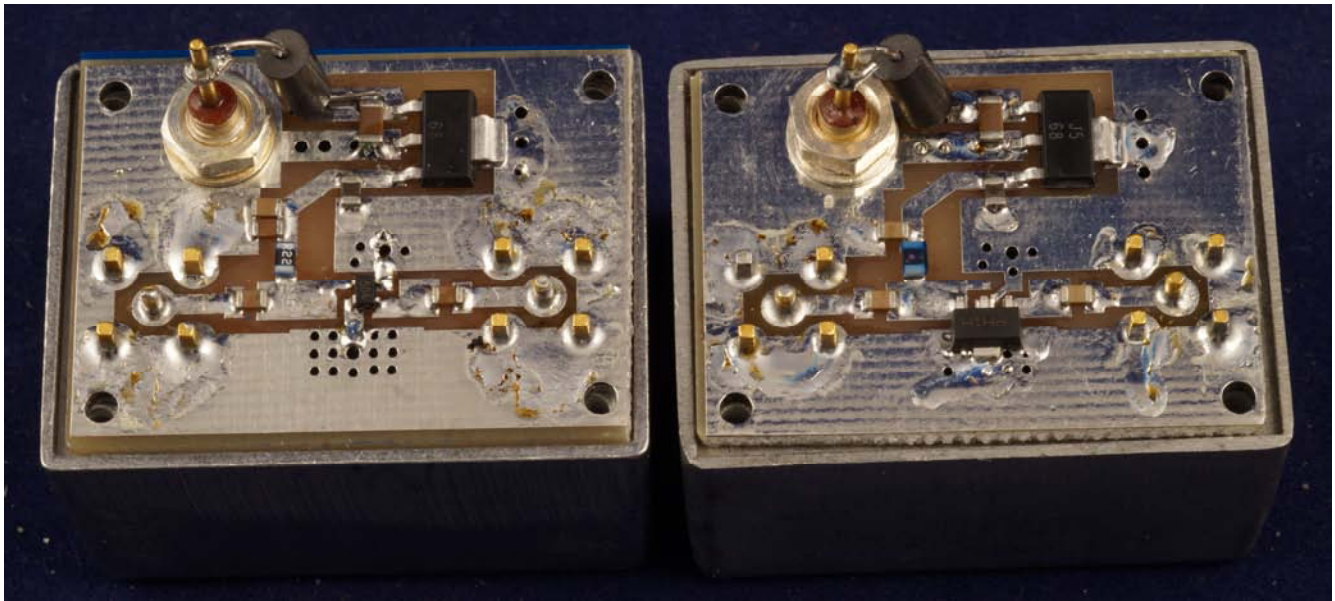


Figure 4 - PSA4-5043 preamp on left, PHA-1H on right

The strong signal concern isn't necessarily in band – there is lots of stuff out there, and these preamps are very broad band, so they will amplify everything coming down the feedline. My antennas are line-of-sight to all the local TV and FM stations. For 222 MHz and lower, I put a good filter³ in front of the preamp – even with a dB of filter loss, the signal-to-noise ratio is improved. At higher bands, the filter goes after the preamp, counting on the antenna to attenuate the lower-frequency strong signals.

NOTES

1. http://www.w1ghz.org/small_proj/Simple_Cheap_MMIC_Preamps.pdf
2. <http://uvideoplay.com/page/spf-5043.html>
3. http://www.w1ghz.org/filter/Comblne_Filters_for_VHF_and_UHF.pdf