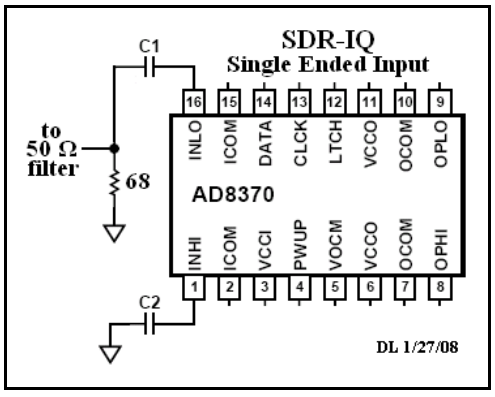
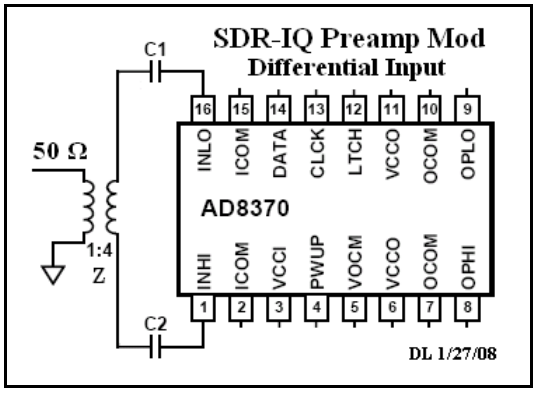
SDR-IQ Preamp Mod

Dallas Lankford, 1/27/08, rev. 1/29/08

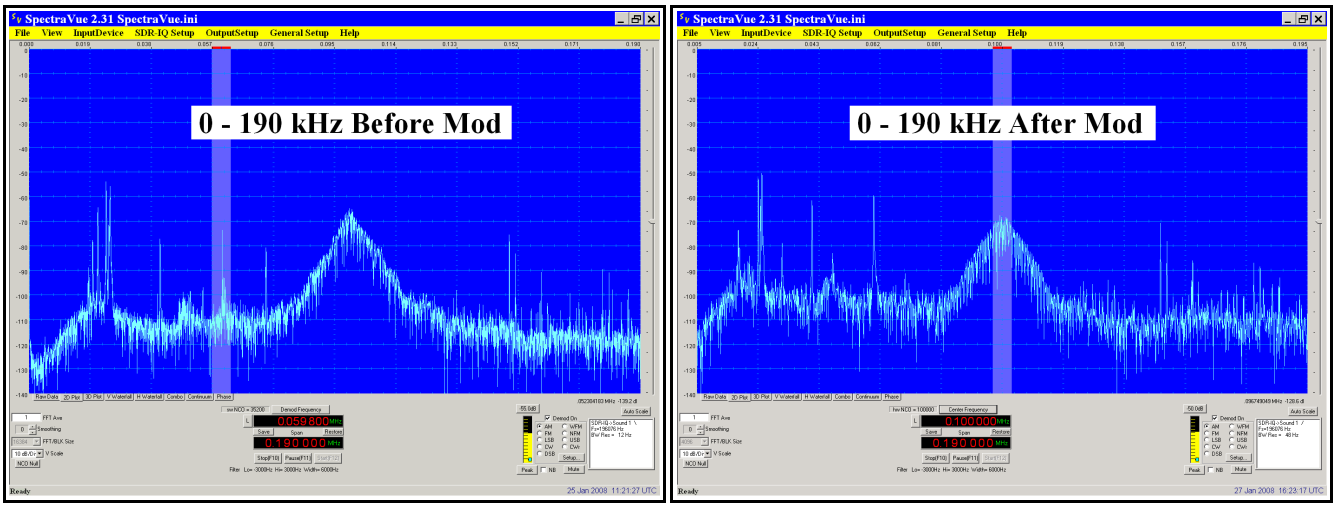




The SDR-IQ uses an AD8370 in single ended to differential conversion for its preamp as shown in the figure above left. The 68 Ω resistor in parallel with the 200 ohm input resistance of the AD8370 presents 50 ohms to

the filter output which precedes it. But it also causes 6 dB loss compared to transformer impedance matching. As stated in the AD8370 data sheet, the differential input in the figure above right has better 2nd order performance compared to the single ended input. When the single ended SDR-IQ input was replaced with the differential input above right, IIP2 in the MW band increased from about +40 dBm to about +55 dBm. MW band sensitivity (6 kHz BW, 400 Hz @ 30% modulation) also improved from 2.0 µV before to 1.25 µV after, about 5 dB. This means the effective increase in SDR-IQ IIP2 was actually about 20 dB.

The transformer was made with a small ferrite toroid of A_L about 8000 with a 10 turn primary wound between the center turns of a 20 turn secondary using #26 enameled copper wire. The original input capacitors C1 and C2 and the 68 ohm resistor were carefully removed and saved for reuse. The values of the capacitors were not measured, but it is assumed they were 1 µF. The capacitors were remounted vertically on the PC board pads which were connected to pins 1 and 16 so that the tops of the capacitors could be used a pads for connecting the secondary leads of the transformer. One lead of the primary was connected to the PC board pads connected to the (removed) 68 ohm resistor pad and the filter side of the removed capacitor which was connected to the input of the AD8370. The other lead of the primary was connected to an unused ground hole where a miniature connector was to have been mounted. The surface mount work for this mod was only mildly hair raising, but you should have experience with such matters if you attempt the mod. A MiniCircuits T4-6-X65 might be satisfactory for this for this mod, although connecting the transformer pins to the appropriate pads and ground might present difficulties. A better choice than the MiniCircuits transformer for the mod might be 10:20 turns of #26 enameled copper wire on an Amidon FT-50-75.



As shown in the SDR-IQ before – after displays above, with an appropriate transformer there is no loss of low frequency response down to at least 20 kHz. There are some minor differences due to the displays being made at different times of the day, but the 6 dB additional gain due to the mod is apparent in the "after" display.

In the initial version of this article I stated that there was one negative aspect of this mod. When I tested the mod with an antenna attached for the for the first time, the numerous spurious responses (international broadcasters heard on frequencies where they should not be) most noticeable above 15 MHz, and to a lesser extent between 5 and 15 MHz were stronger than previously. However, this turned out to be due not to my preamp mod, but to much lower than normal man made noise and propagation conditions which increased the spurs levels.

These spurs appear to be due to spurious mixing products and can be simulated with a signal generator tuned between 1 and 30 MHz. The spurious mixing products seem to be worse when the IQ is tuned above about 15 MHz, decreasing in number and intensity down to about 5 MHz, and few and far between when the IQ is tuned below 5 MHz. They can be eliminated by a *suitable* filter between the antenna and IQ antenna input connector. Unfortunately, such filters are not available to the average consumer. I bought my IQ mainly for MW DXing,

and I have found no such spurs in the MW band with an antenna connected. There also seem to be no such spurs up to about 5 MHz or so or below 500 kHz with an antenna connected. But even with the improved 2nd order performance due to this mod, I still found weak 2nd (and 3rd) order products due to MW signals and NDB band signals in the 90 meter band on one occasion when man made noise was much lower than normal and signal levels were higher than normal. And I do not live in a high level RF environment or use beverage antennas!

So if you want a spur free and intermodulation distortion free SDR at all frequencies, then the SDR-IQ may disappoint you as it has disappointed me in the case of the mixing spurs. A Perseus, although it costs more, has no such spurs, either when using a signal generator or when listening with an antenna connected. Aside from a few sporadic fixed (not mixing) spurs, the only Perseus spurs of note are very, very weak "internal" spurs every 500 kHz which are unheard in normal listening with an antenna (they are below the man made and atmospheric noise floor). And the Perseus intercepts are typically greater than +70 dBm for 2nd order, and greater than +30 dBm for 3rd order, more than 15 dB greater than the SDR-IQ in both cases.