

Direct sampling SDR receiver measurements – IK1ODO, April 2008

	SDR-IQ (1)	Perseus (1) (5)	QS1R (1)
Noise floor, 2.4kHz BW, dither off, max gain, at 14.2 MHz (2)	- (has fixed gain)	-123 dBm (high gain, preselector OFF)	- 107 dBm
Equivalent noise figure	- (has fixed gain)	17 dB	33 dB
Noise floor, 2,4kHz BW, dither off, normal gain, at 14.2 MHz	-117dBm (no attenuator)	-121.5 dBm (preamp OFF, preselector OFF)	-106.5 dBm
Equivalent noise figure	23 dB	18.5 dB	34 dB
Noise floor, 2,4kHz BW, dither on, normal gain, at 14.2 MHz	- (has no dither)	-120.5 dBm (preamp OFF, preselector OFF)	-97 dBm (3)
Equivalent noise figure	- (has no dither)	19.5 dB	43 dB
A/D clipping level, normal gain	-9 dBm	-3.5 dBm	+12 dBm
A/D clipping level, high gain	-	-7 dBm	+8.5 dBm
Blocking dynamic range, 2.4 kHz BW (7)	108 dB	118dB	118.5dB
Blocking dynamic range with dither ON	-	117dB	109dB
3 rd order Intercept point (4)	+14 dBm	+33dBm (8)	+47.5 dBm
IMD3DR (6)	90 dB	102 dB (theoretical from IIP3, dither on)	101 dB (theoretical from IIP3, dither off)
Decimation aliases (9)	< -43 dBc (190 kS/s), (-80 dBc up to 100 KS/s)	< -105 dBc at 1MS/s (-130 dBc up to 500 KS/s)	< -40 dBc (10)

Notes:

- (1) SDR-IQ and Perseus include a preselector and a preamplifier before the ADC. Currently QS1R has no front-end, so the input is direct to the ADC, except for a low-pass filter. SDR-IQ tested with SpectraView v2.31 and Winrad v1.30, Perseus tested with Perseus 1.00E SW and Winrad v1.30, QS1R tested with SDRMAXII ver. 04092008.
- (2) QS1R has been tested at 2.1 kHz BW, 1250 kHz sampling rate.
- (3) Noise increases by approx 9dB enabling the dither function (6dB when in high gain mode).
- (4) Measured about 1dB before ADC clipping, in normal gain mode. This is the IIP3 of the analog section, and is not modified by inserting dither.
- (5) Perseus has been tested with the preselector bypassed. Inserting the preselector causes a noise increase of approx. 2 dB
- (6) Measured at 10kHz. No difference changing the carrier spacing, due to the very low oscillator phase noise.
- (7) For an SDR receiver, the blocking dynamic range is the distance between the ADC full scale (clipping) level and the noise floor.
- (8) Perseus has an IIP3 from +27 to +33 dBm depending on gain and preselector settings.
- (9) Decimation aliases are typically visible at $F_0 \pm$ sampling frequency
- (10) The current version of QS1R (SW ver. 04092008) exhibits a spurious response at band center if a signal is present in the downconversion band or near. The worst case level is approx. -40dBc. This is, probably, a software issue that may be corrected. The alias responses at $F_0 \pm$ sampling frequency are < -105 dBc at 1250 kS/s.

Equipment used: two selected HP 8640B signal generators, followed by two isolation amplifiers (0dB gain, >30 dB isolation). Minicircuits ZFSC2-4 power combiner, HP 8494B attenuator.

Thanks to Andrea IW0HDV for the loan of the QS1R. SDR-IQ and Perseus are my own. Please note that the indicated figures may change a bit from one radio to the other, because of component tolerances; also, measurement errors are always possible. In particular, the sensitivity figures are accurate to ± 1 dB.