

Perseus vs. QS1R

Main figures comparison table

	PERSEUS	QS1R	Notes
Receiver settings	Preselector On Dither Off ADC Preamp Off Att = 0 dB	Dither Off ADC Preamp Off	QS1R has no built-in preselector nor built-in attenuator
MDS SSB ^(a)	-120 dBm	-104 dBm	(a) as declared by manufacturers
MDS CW ^(a)	-127 dBm	-111 dBm	
In-band Clip level ^(a)	-3 dBm +7 dBm ^(b) +17 dBm ^(c) +27 dBm ^(d)	+9 dBm	(b) Att= 10 dB (c) Att= 20 dB (d) Att= 30 dB
Minimum out-of-band preselector attenuation ^{(a)(e)}	15 dB	0 dB	(e) $F_c < \frac{1}{2} Fr_x$ or $F_c > 2 Fr_x$
Attenuator ^(a)	10-20-30 dB	No	
Sensitivity SSB (S+N)/N = 10 dB ^(f)	0.59 μ V (S3)	4.2 μ V (S5-6)	(f) values computed from MDS values declared by manufacturers
In-band BDR SSB ^(f)	117 dB	113 dB	
In-band BDR CW ^(f)	124 dB	120 dB	
Out-of-band BDR (SSB) ^{(f)(e)}	132 dB	113 dB	QS1R has no preselector
Out-of-band BDR (CW) ^{(f)(e)}	139 dB	120 dB	QS1R has no preselector
Out-of-band clip level ^{(f)(e)}	+12 dBm	+9 dBm	
Wideband Record/Playback	Yes	No	
Linux OS support	No	Yes	
Linrad/MAP65 support	Yes	No	
CE Certification	Yes	No	
FCC Certification	Yes	No	
Price (Europe), Euro	~850	~900	VAT & shipping included 1 Euro = 1.4 USD
Price (N.A.), USD	~1200	~1000	
RF Front-End Price	0	? TBD	

Facts

- 1) Perseus has a 16 dB (almost three S units!) sensitivity advantage over the QS1R board.
- 2) The in-band clip level of Perseus is not an issue. If a higher clip level is needed the Perseus built-in attenuator allows to increase it in 10 dB steps. With 10 dB attenuation inserted the Perseus clip level is 2 dB less than that of QS1R but its sensitivity is still 6 dB higher!
- 3) The in-band blocking dynamic range (BDR) of Perseus is 4 dB larger than that of QS1R. This superiority is maintained whatever the selected attenuation in Perseus (as required by theory). QS1R manufacturer provides a larger figure (125 dB) but since $BDR = \text{Clip Level} - \text{MDS}$ at least one of these three figures, as published in the QS1R specification (see http://www.srl-llc.com/files/qs1r_rev_d_specs.pdf) is wrong. Here we arbitrarily assume that SRL published an inconsistent BDR value.
- 4) The Perseus preselector is very useful to limit the amplitude of out of band interferers. The preselection filters are half-octave band-pass filters which attenuate out of band signals (interferers at less than half or more than twice the tuning frequency) by more than 15 dB and increment the receiver out-of-band BDR by the same value. If Perseus is tuned to the 20 m band, signals in the 40 m band or in the 10 m band are attenuated by at least 15 dB before they reach the A/D converter, thus increasing the out-of-band clip level and the out-of-band BDR by the same amount. This allows to use all the superior Perseus sensitivity at the tuning frequency even when very strong out of band interfering signals are present. In the example of the 20 m band, a full sensitivity

of 0.59 μV continues to be achieved (compare it with the 4.2 μV of QS1R) even when a +12 dBm interfering signal is present in the 41 m broadcasting band. In the same situation the QS1R is useless as it has a much worse sensitivity and, even more, its A/D converter has already been driven beyond its clip level!

- 5) If a sensitivity comparable to that of Perseus is desired from the QS1R, the QS1R must be equipped with a RF front-end which has to include attenuators, preselection filters and a preamplifier. The RF front-end which the QS1R must be equipped with to obtain the same versatility of Perseus, the same sensitivity level and the same 3rd order IMD dynamic range at that sensitivity is not for free, its capabilities are still to be demonstrated and its cost adds to the total ownership price.
- 6) The Perseus receiver has already a built-in RF front end. QS1R users have to buy a front-end and pay additional costs if they want a receiver with comparable performance. The total cost of the QS1R and its front-end is higher than that of the Perseus receiver both in Europe and in North America. It's not unlikely that in Europe the QS1R together with its front-end will cost 300 Euros more than Perseus.
- 7) QS1R boards exist in different hardware releases. These releases differ in their performance (as there would have been no need to release new hardware revisions if they didn't). The Perseus receiver knows only ONE hardware revision starting from S/N 00001 and up to now; performance is consistent from the first manufactured unit and made available to users.
- 8) The Perseus receiver is compliant both with the European Community EMC standards and the FCC rules. Test reports made by accredited bodies that certify this compliance are available upon request. The QS1R manufacturer provides no Declaration of Conformity for the CE compliance nor for the FCC. *"Manufacturers can't simply market an RF device without the appropriate FCC approval; standards must be met to insure that the device does not cause undue interference or constitute a hazard to users."* (see "Equipment authorization procedures and information" at <http://www.arrl.org/tis/info/part15.html>). Conclusions about the legality to sale the QS1R in North America or in Europe can be easily drawn.
- 9) For a meaningful comparison of the two receivers I've chosen to list the Perseus performance figures with the A/D converter dither option set to Off, which is the suggested setting of the QS1R receiver. When the A/D dither is enabled the Perseus sensitivity degrades by about 1-2 dB, depending on the input frequency, but its IMD performance is largely improved, in perfect agreement with the A/D converter datasheet. Interestingly the manufacturer of the QS1R receiver suggests to enable this option only for test purposes but, as the importance of dithering in improving the linearity performance of a wideband sampling receiver is widely recognized, it may be argued that the dithering in QS1R is either ineffective or, even worse, it deteriorates significantly one or more performance figures of the receiver.

Conclusions

We shall speak about open software and other issues when the two platforms will be comparable in performance. Now they simply aren't. With its 36 dB Noise Figure (and maybe larger than 40 dB if dithering is enabled) the QS1R alone is one of the least sensitive receivers available. The QS1R board offers an excellent dynamic range but still needs to demonstrate that its dynamic range can be achieved at better sensitivities, which is not as a trivial issue as shifting the dynamic range of a receiver towards higher input levels with an attenuator. Incidentally, this is the reason why the comparison of the 3rd order IMD dynamic range has been omitted.

Up to the present the Perseus receiver hardware has really nothing to envy to the QS1R, neither to its larger FPGA. At Microtelecom we don't use to shot mosquitoes with cannon balls. We do like efficiency and we don't use million gates FPGAs when a more smart and efficient coding allow to design a state of the art digital down converter and related logic just in a fraction of much smaller devices.

I'm not claiming that Perseus is superior as superior is a too vague adjective. I'm just saying that:

- 1) every signal that can be heard by the QS1R board alone can be heard by the Perseus receiver, and that
- 2) not every signal that can be heard by the Perseus receiver can be copied with the QS1R board alone. Detractors should carefully give a look to the main figures comparison table before speaking.

This as of 6 June 2009, almost two years later than the initial availability of the still unsurpassed Perseus receiver hardware. Yes, still unsurpassed.