QST Magazine Product Reviews - Key Measurements Summary - HF-Transceivers or Receivers

#	Subject of measurement, band: 14 MHz	20 kHz reciprocal mixing dynamic range	2 kHz reciprocal mixing dynamic range	20 kHz blocking gain compression	2 kHz blocking gain compression	20 kHz 3rd-order dynamic range	**2 kHz 3rd-order dynamic range**	20 kHz 3rd-order intercept	2 kHz 3rd-order intercept	Transmit 3rd-order IMD	Transmit 9th-order IMD	Rx-Tx turnaround time (SSB tx delay)	Price in USD (2012/2013)	Company's site
		Receiver												
	Min/max of scale	-60/-140 dBc	-60/-140 dBc	70/140 dB	70/140 dB	50/110 dB	**50/110 dB**	-40/+35 dB	-40/+35 dB	-20/-35 dB	-20/-70 dB	50/10 ms		
	Transceivers/receivers sorted by 2 kHz 3rd-order dynamic range. Please take into account that there might be a difference in the numbers when comparing the older product reviews (before February 2007) compared to the later product reviews, due to changes in the testing methodology, measurements filters, etcetera.													
1	**Yaesu FTdx5000D, December 2010**	N/M	N/M	136 dB *	136 dB *	114 dB **	**114 dB ****	+41 dBm **	+40 dBm **	-43 dB #**	-72 dB #**	37 ms	$ **5.529**	www.yaesu.com
2	**WiNRADIO WR-G31DDC, January 2012**	N/M	N/M	128 dB	128 dB	107 dB	**107 Db**	+32 dBm	+32dBm	N/A	N/A	N/A	$ **899**	www.winradio.com
3	**Elecraft K3, January 2009**	N/M	N/M	142 dB **	140 dB	106 dB	**103 dB**	+29 dBm	+28 dBm	-29 dB	-51 dB	12 ms	$ **2.200**	www.elecraft.com
4	**Elecraft K3, April 2008**	N/M	N/M	139 dB	139 dB	103 dB	**102 dB**	+26 dBm	+26 dBm	-27 dB	-53 dB	22 ms	$ **2.200**	www.elecraft.com
NEW 5	**Yaesu FTdx3000, April 2013**	-106 dBc	-82 dBc	137 dB *	127 dB	110 dB	**100 dB**	+40 dBm **	+23 dBm	-27 dB	-52 dB	34 ms	$ **2.699**	www.yaesu.com
6	**Elecraft KX3, December 2012**	-120 dBc	-114 dBc	130 dB	128 dB	103 dB	**100 dB**	+34 dBm	+34 dBm	-30 dB	-55 dB	30 ms	$ **999**	www.elecraft.com
7	**FlexRadio FLEX-5000A, July 2008**	N/M	N/M	123 dB	123 dB	99 dB	**99 dB**	+35 dBm	+30 dBm	-34 dB	-54 dB	29 ms	$ **2.799**	www.flexradio.com
8	**TenTec 599AT Eagle, August 2011**	N/M	N/M	136 dB	121 dB	98 dB	**98 dB**	+22 dBm	+22 dBm	-28 dB	-48 dB	16 ms	$ **1.795**	www.tentec.com
9	**Kenwood TS-590S, May 2011**	N/M	N/M	141 dB **	126 dB	106 dB	**97 dB**	+26 dBm	+22 dBm	-29 dB	-52 dB	14 ms	$ **1.649**	www.kenwood.com
10	**Perseus SDR, December 2008**	N/M	N/M	129 dB	129 dB	100 dB	**97 dB**	+35 dBm	+35 dBm	N/A	N/A	N/A	$ **999**	www.microtelecom.it
11	**Icom IC-7700, October 2008**	N/M	N/M	125 dB	102 dB	106 dB	**95 dB**	+35 dBm	+24 dBm	-28 dB	-53 dB	15 ms	$ **7.179**	www.icomamerica.com
12	**TenTec Orion-II, September 2006**	N/M	N/M	136 dB	136 dB	92 dB	**95 dB**	+20 dBm	+21 dBm	-28 dB	-52 dB	30 ms	$ **4.295**	www.tentec.com
13	**Flex-3000, Oct/Nov 2009**	N/M	N/M	113 dB	113 dB	99 dB	**95 dB**	+28 dBm	+26 dBm	-30 dB	-45 dB	48 ms	$ **1.699**	www.flexradio.com
14	**Icom IC-7410, October 2011**	N/M	N/M	143 dB **	111 dB	106 dB	**88 dB**	+29 dBm	+5 dBm	-30 dB	-61 dB	45 ms	$ **1.949**	www.icomamerica.com
15	**Icom IC-7600, November 2009**	N/M	N/M	122 dB	102 dB	106 dB	**88 dB**	+31 dBm	+13 dBm	-31 dB	-48 dB	13 ms	$ **4.976**	www.icomamerica.com
16	**Icom IC-9100, April 2012**	-101 dBc	-77 dBc	142 dB **	111 dB	108 dB	**87 dB**	+29 dBm	+2 dBm	-29 dB	-64 dB	61 ms	$ **3.650**	www.icomamerica.com
17	**Icom IC-7800 V2, March 2007**	N/M	N/M	144 dB **	117 dB	108 dB	**86 dB**	+38 dBm **	+22 dBm	-32 dB	-52 dB	15 ms	$ **12.499**	www.icomamerica.com
18	**FlexRadio FLEX-1500, December 2011**	N/M	N/M	107 dB	107 dB	100 dB	**86 dB**	+31 dBm	+13 dBm	-22 dB	-48 dB	200 ms	$ **649**	www.flexradio.com
19	**Yaesu FTdx9000MP, July 2010**	N/M	N/M	137 dB	102 dB	99 dB	**85 dB**	+28 dBm	+7 dBm	-37 dB #**	>-75 dB #**	32 ms	$ **11.629**	www.yaesu.com
20	**TenTec R4020 QRP, February 2011**	N/M	N/M	N/M	N/M	84 dB	**84 dB**	-10 dB	-10 dB	N/M	N/M	N/M	$ **249**	www.tentec.com
21	**TenTec Omni-VII, July 2007**	N/M	N/M	137 dB	134 dB	91 dB	**82 dB**	+11 dBm	+6,5 dBm	-27 dB	-55 dB	20 ms	$ **2.695**	www.tentec.com
22	**Icom IC-R9500, January 2008**	N/M	N/M	144 dB **	109 dB	5kHz/92 dB	**81 dB**	+32 dBm	-4dBm	N/A	N/A	N/A	$ **17.000**	www.icomamerica.com
23	**Yaesu FTdx9000C, March 2006**	N/M	N/M	128 dB	97 dB	101 dB	**78 dB**	+35 dBm	+1 dBm	-34 dB #	-80 dB #**	35 ms	$ **5.779**	www.yaesu.com
24	**Yaesu FT-450D, November 2011**	N/M	N/M	134 dB	88 dB	97 dB	**76 dB**	+16 dBm	-21 dBm	-25 dB	-50 dB	17 ms	$ **999**	www.yaesu.com
25	**Yaesu FT-950, March 2008**	N/M	N/M	128 dB	98 dB	95 dB	**71 dB**	+21 dBm	-4 dBm	-35 dB	-56 dB	25 ms	$ **1.449**	www.yaesu.com
26	**Alinco DX-SR8T, June 2011**	N/M	N/M	100 dB	83 dB	94 dB	**70 dB**	+1 dB	-30 dB	-28dB	-53 dB	50 ms	$ **519**	www.alinco.com
27	**Yaesu FT-2000D, October 2007**	N/M	N/M	136 dB	87 dB	98 dB	**69 dB**	+26 dBm	-16 dBm	-41 dB #**	-65 dB #	37 ms	$ **3.549**	www.yaesu.com
28	**Icom IC-7200, June 2009**	N/M	N/M	140 dB	83 dB	99 dB	**67 dB**	+23 dBm	-11 dBm	-32 dB	-58 dB	30 ms	$ **1.396**	www.icomamerica.com
29	**Yaesu FT-450, December 2007**	N/M	N/M	134 dB	90 dB	97 dB	**67 dB**	+13 dBm	-31 dBm	-30 dB	-48 dB	40 ms	**N/A**	www.yaesu.com
30	**Yaesu FT-2000, February 2007**	N/M	N/M	126 dB	92 dB	95 dB	**64 dB**	+16 dBm	-22 dBm	-32 dB	-60 dB	27 ms	$ **2.819**	www.yaesu.com
31	**Icom IC-7000, May 2006**	N/M	N/M	112 dB	86 dB	89 dB	**63 dB**	+6 dBm	-27 dBm	-33 dB	-58 dB	12 ms	$ **1.299**	www.icomamerica.com

Transceivers/receivers sorted by 2 kHz 3rd-order dynamic range. Please take into account that there might be a difference in the numbers when comparing the older product reviews (before February 2007) compared to the later product reviews, due to changes in the testing methodology, measurements filters, etcetera.

Subject of measurement, band: 14 MHz	20 kHz reciprocal mixing dynamic range	2 kHz reciprocal mixing dynamic range	20 kHz blocking gain compression	2 kHz blocking gain compression	20 kHz 3rd-order dynamic range	**2 kHz 3rd-order dynamic range**	20 kHz 3rd-order intercept	2 kHz 3rd-order intercept	Transmit 3rd-order IMD	Transmit 9th-order IMD	Rx-Tx turnaround time (SSB tx delay)	Listprice in USD (2011/2012)	Company's site
Min/max of scale	60/140 dB	60/140 dB	70/140 dB	70 - 141 dB	50/110 dB	**50/110 dB**	-40/+35 dB	-40/+35 dB	-20/-35 dB	-20/-70 dB	50/10 ms		
	Receiver												

*** = Blocking exceeded the levels indicated**
**** = Below/above measurable levels**
 # = Class A operation
$ = Listprice in US according to Elecraft, FlexRadio, TenTec and Universal Radio
N/M = Not measured

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Green = excellent
Light green = good
Yellow = average
Orange = moderate
Red = poor

Blocking gain compression:
When a very strong off channel signal appears at the input to a receiver it is often found that the sensitivity is reduced. The effect arises because the front end amplifiers run into compression as a result of the off channel signal. This often arises when a receiver and transmitter are run from the same site and the transmitter signal is exceedingly strong. When this occurs it has the effect of suppressing all the other signals trying to pass through the amplifier, giving the effect of a reduction in gain.
Blocking is generally specified as the level of the unwanted signal at a given offset (normally 20 kHz) which will give a 3 dB reduction in gain. A good receiver may be able to withstand signals of about ten milliwatts before this happens.
The blocking specification is now more important than it was many years ago. With the increase in radio communications systems in use, it is quite likely that a radio transmitter will be operating in the close vicinity to a receiver. If the radio receiver is blocked by the neighbouring transmitter then it can seriously degrade the performance of the overall radio communications system.

Reciprocal mixing dynamic range:
ARRL Lab reports three dynamic range measurements that determine a transceiver's overall performance.
Along with blocking gain compression dynamic range and two tone third order dynamic range, we must consider RMDR while evaluating how well a receiver hears.
Which of these measurements is the most important factor in comparing receivers depends a lot on how you plan to use that receiver. For hearing weak signals at or near the receiver's noise floor, receiver noise typically is the limiting factor. For the reception of stronger signals under crowded band conditions, two tone third order DR is the most important number.
To assess a receiver's ability to perform well in the presence of a single, strong off-channel signal (common within geographical ham radio "clusters" or with another ham on the same block), blocking gain compression DR is usually the dominant factor.
Reciprocal mixing is noise generated in a superheterodyne receiver when noise from the local oscillator (LO) mixes with strong, adjacent signals . All LOs generate some noise on each sideband, and some LOs produce more noise than others. This sideband noise mixes with the strong, adjacent off-channel signal, and this generates noise at the output of the mixer.
This noise can degrade a receiver's sensitivity and is most notable when a strong signal is just outside the IF passband. RMDR at 2 kHz spacing is almost always the worst of the dynamic range measurements at 2 kHz spacing that we report in the "Product Review" data table.

3rd order dynamic range:
The difference in decibels between the weakest signal the receiver can handle and the strongest signal the same receiver can handle simultaneously,
- without the need of using additional controls of the receiver, manually carried out by the operator - within 20 kHz (wide spaced) and 2 kHz (close in) within the receiver's passband.
For more information on this important item, written by Rob Sherwood NC0B, please use this link: http://www.sherweng.com/documents/Barc2008.pdf

3rd order intercept:
This more or less theoretical point, gives a good indication of a receiver's overall strong signal performance. Third order intercept is related to two-tone third order IMD. When receiver's response on desired and undesired signals (within the passband) were plotted in the same graph, the two lines would intersect at a point called the third-order intercept.

Tx-Rx turnaround time:
The delay between receive and transmit, important for digital modes. A transmit-to-receive delay of 35 ms or less in SSB indicates that the rig is suitable for digital operation.

Transmit 3rd and 9th order IMD:
Transmit two-tone intermodulation distortion, or two-tone IMD, is a measure of spurious output close to the desired audio of a transmitter being operated in SSB mode. This spurious output is often created in the audio stages of a transceiver, but any amplification stage can contribute**
If you have ever heard someone causing "splatter", the noisy audio that extends beyond a normal 3 kHz nominal SSB bandwidth, then you have heard the effects of transmit IMD.
Frequencies close to the transmit signal are affected the most, but depending on the amount of IMD, large portions of the band can suffer from one poor transmitter**

For more information (including what the numbers really mean) please read ARRL's QST Magazine August 2004 very interesting article on the pages 32-36.

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Please send me an e-mail (to: hans at pa1hr dot nl) if you have corrections, remarks, etc.

Disclaimer: