

Product Review – A comparison between ICOM IC-7800 and IC-781

1. Background

I had used nearly the entire IC756 family from IC756 (original), IC756Pro2 to IC756Pro3 and eventually bought my IC-7800 in early 2006. I have been very satisfied with this new ICOM DSP flagship transceiver since then.

Upon joining the Yahoo groups for the IC-7800 (ic7800@yahoogleroups.com) and IC-781 (IcomIC781@yahoogleroups.com), I notice that there have been interesting discussions on various pros and cons between these two high-end transceivers. Some of these comments are from learned and experienced RF engineers.

I think the only way for me to really know the true picture is to buy an IC-781 and do the comparison myself. I consider this exercise should be educational to me as I am not a radio professional.

2. Transceivers used in the test



IC-7800

My IC-7800 was bought in early 2006 and is the latest version with 3 kHz roofing filter. The firmware was updated to ver. 2.10. It has been functioning flawlessly since the first day in my radio shack.

IC-781

I deliberately did not buy a second-hand IC-781 from US for this project but I bought an IC-780 (Japanese version of IC-781) instead. The mains voltage in Japan is 100V, which is the designed operation voltage for the IC-781. Therefore, there is less chance of having the well-known heat problems in the REG unit of the PSU for the Japanese version.

The IC-781 and IC-780 are electrically identical. I bought my IC-780 in Osaka, Japan. The rig was re-aligned by ICOM Japan before sending to Hong Kong in early April 2007. I also have official information on readjusting the output power from 100 watts to 150 watts, and on the general TX frequency coverage modification for the IC-780. In other words, the IC-780 in this test is identical to any IC-781 except the front-panel nameplate.

Furthermore, this IC-780 comes with all stocked filters. Unlike my previous owned IC756 (original) <http://www.qsl.net/icom/ic756/fl44a.html>, no “NATO” IF filter modification <http://www.qsl.net/icom/ic781/ic781filter.html> was done to the IC-780.

In the rest of the text, all mention of the IC781 refers to this IC-780 purchased in Osaka.

3. Limitations of the Test

This is not a laboratory test, because I do not have the sort of high-end test equipment encountered in the ARRL Lab or other test entities. It is only an A-B comparison test in my QTH using the same antenna and my ears.

In Hong Kong, most of us live in high-rise apartments in urban areas. Full-size antennas or even Yagis are out of the questions. My QTH is on a very high floor of a high-rise multi-storey residential apartment. It is about 150 metres

above sea level and has a spectacular view towards Victoria Harbour. I am using monoband ham sticks manufactured by www.hamstick.com

All the antennas are mounted horizontally, pointing towards Victoria Harbour.

4. Test Areas

4.1 Receiver noise floor (i.e. quietness)

According to the specifications of both transceivers, the sensitivity at 14 MHz is $0.16\mu\text{V}$. However, IC-781 has only one PREAMP but IC-7800 has PREAMP 1 and PREAMP 2.

By using a simple XG2 reference signal generator from Elecraft www.elecraft.com, under PREAMP 'off' situations, the IC-781 is more sensitive than the IC-7800 and shows a higher reading on the S-meter for a given input signal level from the XG2.

On the other hand, if both transceivers are set up with PREAMP turned on, the sensitivity is more or less the same and shows similar S-meter readings with the signal supplied by the XG2.

I do not have any advanced equipment to measure the noise floor, but I tested the radios under the following setup:

4.1.1 Antenna input terminated with 50 ohms dummy load

The transceivers were at their maximum sensitivity and with PREAMP turned on. The AF gain was turned all the way up (fully clockwise). The DSP NR in the IC-7800 was off. The internal noise of the radio, as heard in my headphones, was definitely less for the IC-7800. The finding was the same no matter whether I used a pair of Sennheiser Hi-Fi headphones or Heil communications headphones (www.heilsound.com).

With DSP NR in the IC-7800 turned on, the difference in the above is enormous.

4.1.2 On-the-air test

The band condition was not all that brilliant during the test, and there were many weak signals. Both radios were set up with PREAMP OFF, where the IC-7800 is supposed to be less sensitive (see 2nd paragraph of 4.1 above). However, there was nothing I could hear on the IC-781 and not on the IC-7800.

In other words, the IC-7800 receiver is clearly quieter than that of the IC-781, and hence has better ability to dig out the weak signals. If the IC-7800 DSP NR is turned on, the ability will be further enhanced.

4.2 Selectivity and survival among local KW stations

Hong Kong is a small city and well known for its population density. There are a few KW stations near my QTH, within line-of-sight distance.

By using the same IF filter bandwidth in both radios and the roofing filter of the IC-7800 set to 15 kHz, I noticed that the IC-7800 could work weak stations much closer to those local “big guns”. I can conclude that the selectivity of IC-7800 is far better than that of the IC-781, and its IF-DSP filters are much tighter than the analogue filters in the IC-781.

If DSP NR is ON and a tighter roofing filter (e.g. 3 kHz) is used, the IC-7800 is an even better performer. If you need to hunt weak DX signals among “big guns”, IC-7800 is your combat fighter.

4.3 Manual Notch

The notch functions of both IC-781 and IC-7800 are effective, but the IC-7800 has a much deeper notch. When notching the same carrier signal, the AF Gain on the IC-7800 has to be turned all the way up to give the same audio output as in the IC-781. For example, when the AF Gain in the IC-781 is at 9 o'clock, the AF Gain in IC-7800 has to be turned fully clockwise to produce the same audio level in my headphones when notching out the same carrier signal.

4.4 Spectrum scope

Having mentioned so many of the IC-7800's strengths, there is something interesting in this area. No doubt, the colorful TFT display and the ability to view a 250 kHz span in IC-7800 is attractive. However, the grass level of the background noise / signal shown in the IC-7800 spectrum scope is indeed higher.

In other words, it will be easier to find a signal among the grass on the IC-781 band scope than on the IC-7800. The 'desired signal' to 'grass' ratio in the IC-781 band scope is in fact higher.

In this regard, I would wonder whether the display scales in both band scopes are the same. Is the band scope in the IC-781 a linear scale? Or is the band scope in the IC-7800 a logarithmic scale?

***Editor's note:** The vertical scales of both scopes are logarithmic (nominally 10 dB/div.*

Editor's note: The IC-781 spectrum scope is analogue, whilst the IC-7800 scope is DSP-based. It is possible that the higher grass level on the IC-7800 scope is caused by noise generated in the ADC associated with the scope DSP. The IC-756Pro3 scope is also analogue, and can "see" a -131 dBm signal at the antenna socket. The IC-756Pro3 scope's grass level is some 10 dB lower than that of the I-7800.

4.5 Audio quality and the pleasure of listening

While the IC-7800 has all the cutting edges and capabilities required for weak-signal hunting, there are audible DSP artifacts in both SSB and CW reception. There is nothing irritating in listening to the IC-7800 - but simply a bit of listening fatigue. On the other hand, the audio from the IC-781 is more pleasant to listen to. When using the IC-781 for SWL and listening to shortwave broadcasts, the audio is sweet and musical. My two young sons, who have much sharper ears, also concur with my observation. Does this imply a similar argument between LP records and CD's?

4.6 AGC System

The AGC systems in both radios are effective but the operator will have more flexibility in changing the AGC settings on the IC-7800. I did not observe any irritating AGC "pumping" due to sudden signal bursts (transients) on the IC-7800.

4.7 Twin PBT

I find the Twin PBT on the IC-781 to be less tight than that of the IC-7800. Perhaps, this is due to the difference between analogue and DSP filters. One should bear in mind that the stock 455 kHz IF filter in the IC-781 is the FL-96 (2.8 kHz). As the stock 9 MHz IF filter is the FL-80 (2.4 kHz), this bandwidth mismatch tends to make Twin PBT somewhat "sloppy".

5. Conclusion

In terms of weak-signal hunting, selectivity and survival among the local "big guns", the IC-7800 is clearly ahead of the IC-781. However, if you are only interested in working the S9 stations and fond of rag chewing or even some SWL,

the IC-781 offers very pleasant audio.

Furthermore, the IC-781 is constructed by using through hole components which are user-repairable to some degree. For the IC-7800, my hands are up in the air, and the only way to have the radio serviced is via a trip to the ICOM service centre.

6. Acknowledgement

In writing this review, I read Matt Erickson KK5DR's similar review in his webpage. At the same time, my friend Adam VA7OJ/AB4OJ has kindly edited my report and provided valuable input and Editor's notes to this report. If you want to learn more about IC-7800, IC756Pro3 and IC-781, please read his comprehensive and informative webpage <http://www.ab4oj.com/icom/main.html>

73 de Johnny Siu VR2XMC

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