Contest University 2025

Performance and Feature differences among top OEMs.

Rob Sherwood
NCØB

Great rigs but different individual designs
Examples of current rigs

Sherwood Engineering

Are you considering a new HF rig?

Subjects to emphasize today

Choosing a new rig is both subjective and complex.

Contesters and DXers have many options.

Each OEM* has chosen to emphasize different feature sets.

Consider improving your antenna, possibly limited by an HOA or the family desiring the antenna be invisible.

Order importance: Location, Antenna, Skill, Radio Model

* OEM = Original Equipment Manufacturer

Rig evaluations the past 18 years 50 miles east WWV

Do what you can, if not this much !

What has changed in 5 years?

- While receiver lab numbers for most current transceivers are excellent, the user interface is all over the map.

- If possible try out a potential new rig to see if it fits your operating style.
- Make use of your local club member's rigs.

- Each OEM has chosen a niche for differentiation.

How old is your current rig?

- If older than 10 years it is a new experience.
- Major types today:
- Superhet, Hybrid Superhet, Direct Sampling & “IF Sampling”
- TS-890S = Hybrid 3 Yaesu models = IF Sampling
- Only Kenwood doesn’t offer a sampling option.

Does the architecture matter?

- Most of the time it doesn't matter.
- A superhet has a roofing filter with a 5 to 70 MHz IF.
- Hybrid Superhet adds a direct sampling band scope.
- "IF Sampling" also has roofing filters, ADC at IF.
- Pure Direct Sampling has no roofing filters.
- If signals are S9+60 dB a roofing filter can help.

Some Examples per Type

Architectures Dominating Today

- Superhet: TS-590SG, IC-7100
- Hybrid Superhet: TS-890S
- IF Sampling: FTdx-101D/MP, FTdx10
- Direct Sampling: K4, Icom, Flex, Apache
  Plus the new FT-710

- Either sampling method has ADC in RX path.

- IF sampling mixer, LO & roofing filters at first IF

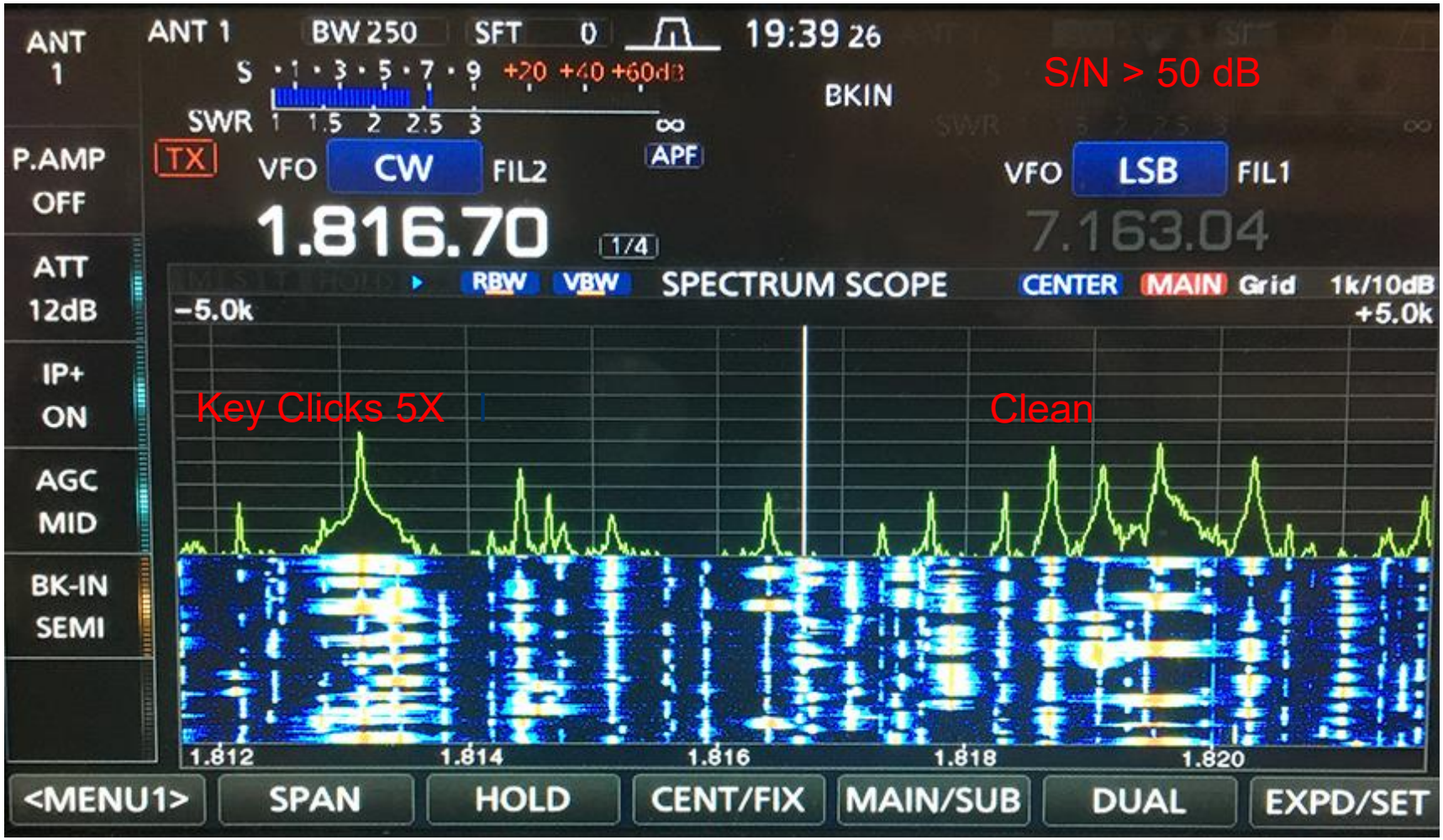
We can see transmit bandwidth problems

- You can learn a lot from band scope observations of on-air signals.
- What you see on a direct sampling band scope and waterfall is reality!
- You can see the wide signals causing QRM.
- Let’s take a look at some examples.

December 2018

Over 30 stations in 10 kHz IC-7610

ARRL 160m CW Friday 7:40 PM



CSI = ARRL Clean Signal Initiative

CW Key Click Improvements

- Flex & Elecraft have fixed rise & fall times, don't currently meet CSI.
- Bandwidths could meet CSI CW masks with new firmware.

- Apache G2 with latest firmware can meet the CSI CW mask.

- Icom, Kenwood & Yaesu have CW menu adjustable rise & fall times.
- None meet CSI key click mask at the default menu setting.
- Rise and Fall times menus should never have options of 1 or 2ms.

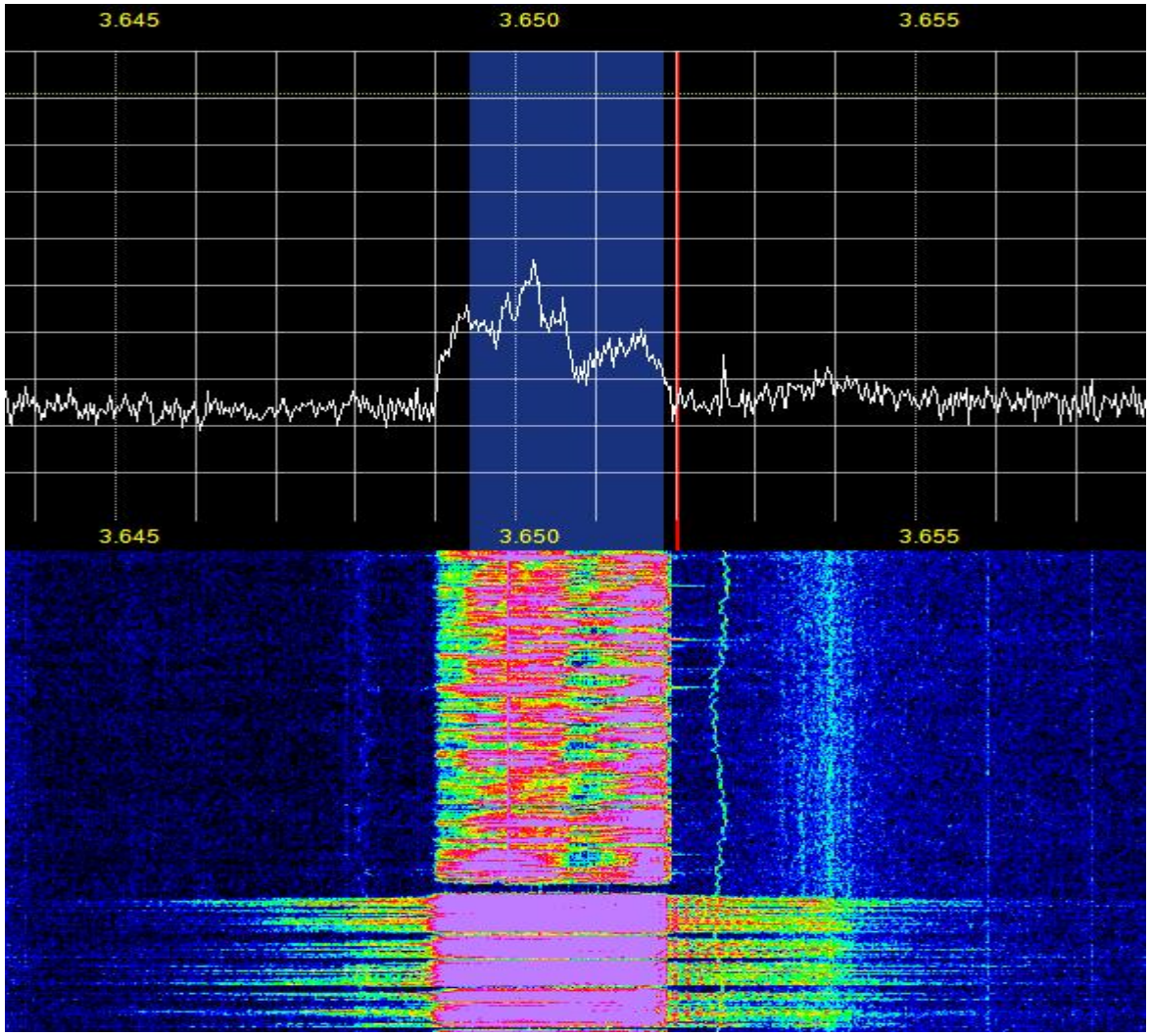
- Most but not all rigs have worse key clicks in full break-in.

- If menu adjustable, pick the slowest rise and fall time option.

Screen shot W0IVJ

Both stations running legal limit amplifiers

PureSignal Adaptive Pre-Distortion vs. Typical SSB Splatter



Class A is gone with current rigs

Icom now offers DPD predistortion

Flex & K4 ?

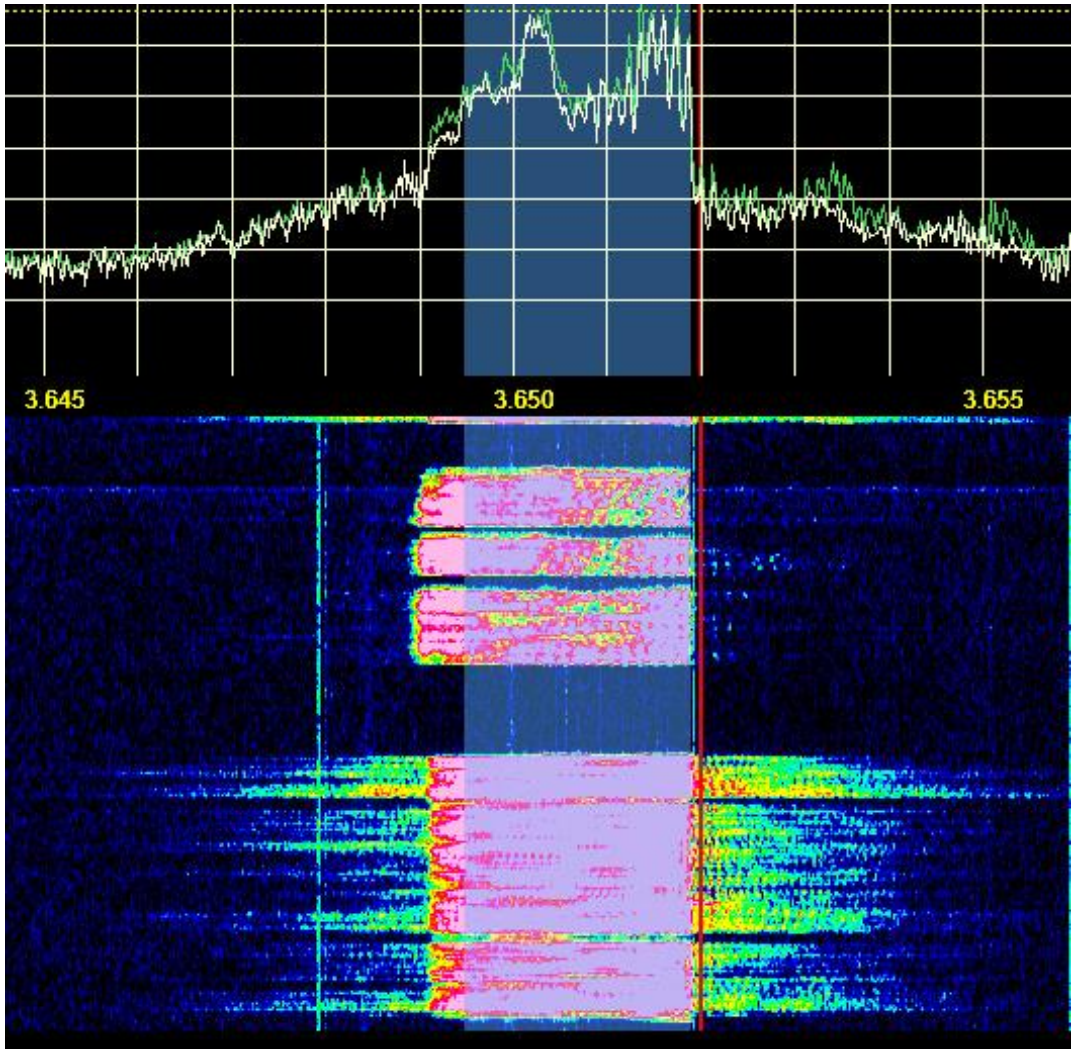
Apache 200D & PureSignal APD & Amp

Kenwood TS-890S & Alpha 89

Screen shot W0IVJ

Both stations 75 meters S9+30 dB

Icom Digital Pre-Distortion (DPD) vs. Typical SSB Splatter



Display 10 kHz span
Apache 7000DLE RX

Blue shading is the
2.4 kHz RX bandwidth

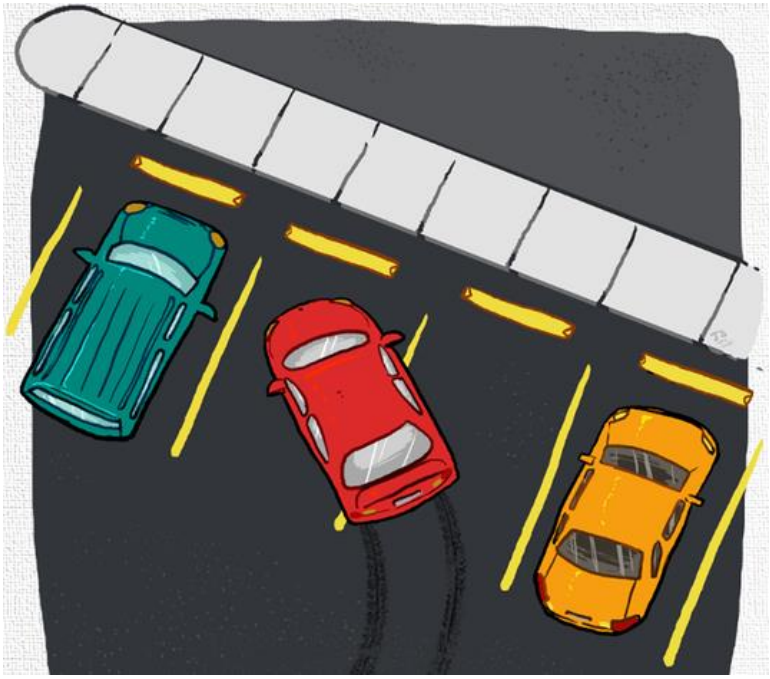
Icom 7610 with DPD
driving an Acom 1000
Amp not in DPD loop
NC0B

Flex 6600M driving a
PowerGenius XL
W5AP

Wide signal = Rudeness

Breaking a written rule

Breaking an unwritten rule

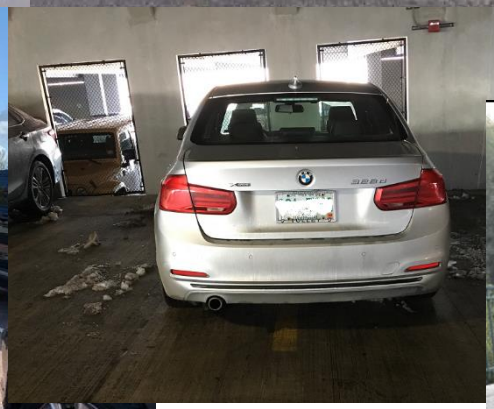


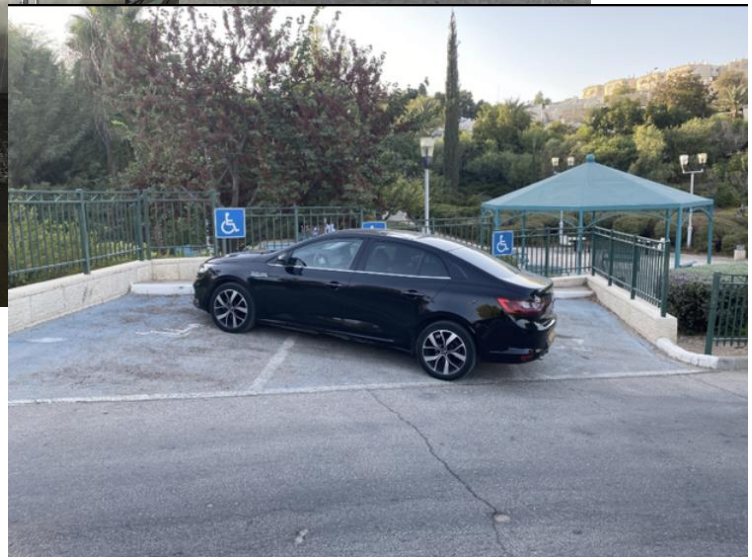
Who really parks like this?

Breaking written and unwritten rules at the same time

It is not hard to find examples of this…

Really…





…and THIS guy…

1 car – 4 spaces…
NEW WORLD RECORD!!!!

You don’t even need a car!

Great basic performance from all OEMs

- You can contest and DX with dozens of rigs.
- The magic “100 dB radio” is now common.
- Choices by brand, cost & size
- I operated multiple CW contests 4th quarter 2022 with $1000 to $1300 rigs with only user interface and ergonomics not optimized.

Top 25 out of 150 radios nc0b.com

Lab data from my web site

Dynamic Range of Top 25 HF Transceivers

Yaesu FTdx-101D	110 dB	
Yaesu FTdx10	107 dB	
Yaesu FT-710	107 dB	
Elecraft K3S	106 dB	
Icom 7851	105 dB	
Kenwood TS-890S	105 dB	
Hilberling PT-8000A	105 dB	
Elecraft KX3	104 dB	
Apache 7000DLE	103 dB	
Elecraft K4	101 dB	
Yaesu FTdx-5000D	101 dB	
Flex 6400	100 dB	
Flex 6600	99 dB	(16 dB preamp ON)
Flex 6700 (2017)	99 dB	(Preamp OFF)
Icom 7760	99 dB	
Icom 7610	98 dB	(IP+ ON)
Icom 7300	97 dB	(IP+ ON, S/N around 10,000 and up)
Flex 5000	96 dB	
Ten-Tec Orion II	95 dB	
Ten-Tec Orion I	93 dB	
Kenwood TS-590SG	92 dB	
Ten-Tec Eagle	90 dB	
Flex 6300	89 dB	
Icom 705	88 dB	(No IP+ ADC linearization)
TS-990S	87 dB	(RMDR limited close-in)

You can effectively work DX and Contests with any of these fine transceivers.

New price range $1000 to $12,000+

Used market price even lower !

100 dB radios unheard of 20 years ago !

I have run contests with 20 of these 25

How do you select a new radio?

- Do you pick one of those top 25 models?
- That would be a good start.

- Married to one brand? Pick price that fits your budget.

- Price range for current new rigs today $900 to $7,000+

- Size of the rig for DXpeditions, SOTA, POTA, etc.
- You likely don't take 40 pound rigs out in the field.

- Let's look at niche features by brand in no particular order.

Brand Feature Differences

- Remote options hardware and software
- Reducing wide transmit signal bandwidth
- Architecture differences harsh RF environments
- DSP filter performance and noise mitigation

Comments on Flex

- Focused last several years on remote operation
- Maestro or tablets for remote
- Very few DSP improvements for years
- New 8000 series replaces the 6000 series but few if any new software features yet.
- Awaiting pre-distortion feature for 8000 series
- What is Aurora teased in the June issue of QST?

Comments on Apache

- Leading noise mitigation (NB and NR)

- 1 of 2 brands with pre-distortion splatter reduction.
- (Apache PureSignal and Icom DPD)

- Don’t consider an Apache “plug and play”.

- Not recommended for your first HF transceiver.
- Buy a 100-watt standalone radio (no computer).
- Don’t recommend starting out with HF QRP !

Comments on the Yaesu

- Offers IF sampling FTdx-101D/MP & FTdx10
- Roofing filters for super strong out of passband signals.
- A ham very close by, Field Day, Multi-Multi contests
- Not a typical issue for most hams.

- Yaesu's FT-710 direct sampling transceiver
- (No roofing filters by definition)
- Smaller size and weight than the FTdx10.
- Price as low as $900 for the Field version.

Small rig niche QRP (5 to 10 watts)

- Elecraft: KX3, KX2, KH1
- $1550, $1170, $1230

- Yaesu FTX-1 Field 160m – 70cm
- Replaces discontinued FT-817 & FT-818
- Pricing $1500
- (FTX-1 Optima 100 watts $1900)

- Icom IC-705 160m – 70cm
- Pricing $1350

Comments on the Elecraft K4

- Major firmware improvements in the last 3 years.
- Remote K4 to K4 firmware released before Hamvention 2024
- K4/0 prototype shown at Hamcation Orlando Florida February 2025
- Price range around $2000. Delivery ?
- IF sampling K4HD superhet upgrade prototype also at Hamcation 2025
- Price range around $1000 or so. Delivery ?
- Promised Pre-Distortion & general coverage timeline unknown.
- CW DSP filters surprisingly not as sharp as a other current brands.
- (Or the K3S with optional roofing filters)

A Learning Experience for me

- For decades IF filters were mundane as to shape factor. Mostly 6 or 8 pole crystal plus some Collins mechanical filters.
- Along came DSP filters & I didn't always measure them carefully.
- Some rigs had roofing filters ahead of the DSP filtering.
- December 2021 the K4 CW filters were too broad in a contest.
- I hadn't measured these filters in May in the lab, a sloppy mistake.
- I stopped in the middle of the ARRL 160m CW contest to measure the K4 DSP filters vs. the DSP filters in an IC-7610.
- Oops, there was a massive difference.
- Lesson learned, don't assume anything.
- I should have known better !
- Here is the data from that contest.

CW comparisons K4D & IC-7610

Measured Bandwidth/Attenuation

Attn. dB	K4D Filter: 100 Hz BW (Hz)	IC-7610 Filter: 150 Hz BW (Hz)
-6	180	160
-20	300	185
-40	410	210
-60	475	240

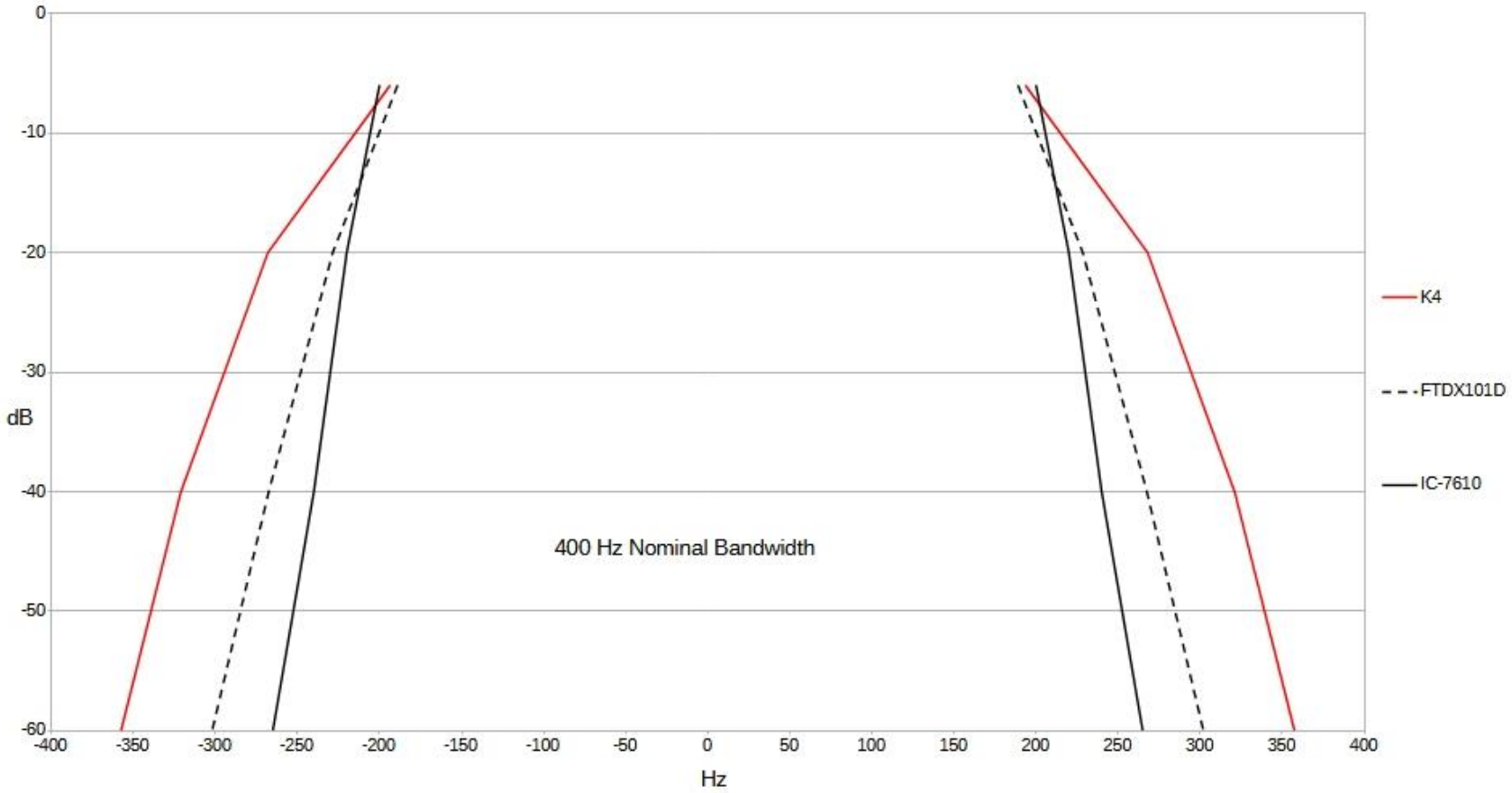
After I posted these results, four operators said they noticed the same thing during the previous week's CQWW CW.

Elecraft updated their CW filtering

- With a new CW filter option I assumed that all was now well with the K4 shape factors.
- Scott K9MA recently revisited CW filtering and provided me with the following graphs.
- Bottom line is DSP filtering is not all the same.
- Comparisons of the K4, FTdx-101D and the IC-7610 at three bandwidths.
- Again I was surprised.

Graphs courtesy K9MA, K4, 101D & 7610

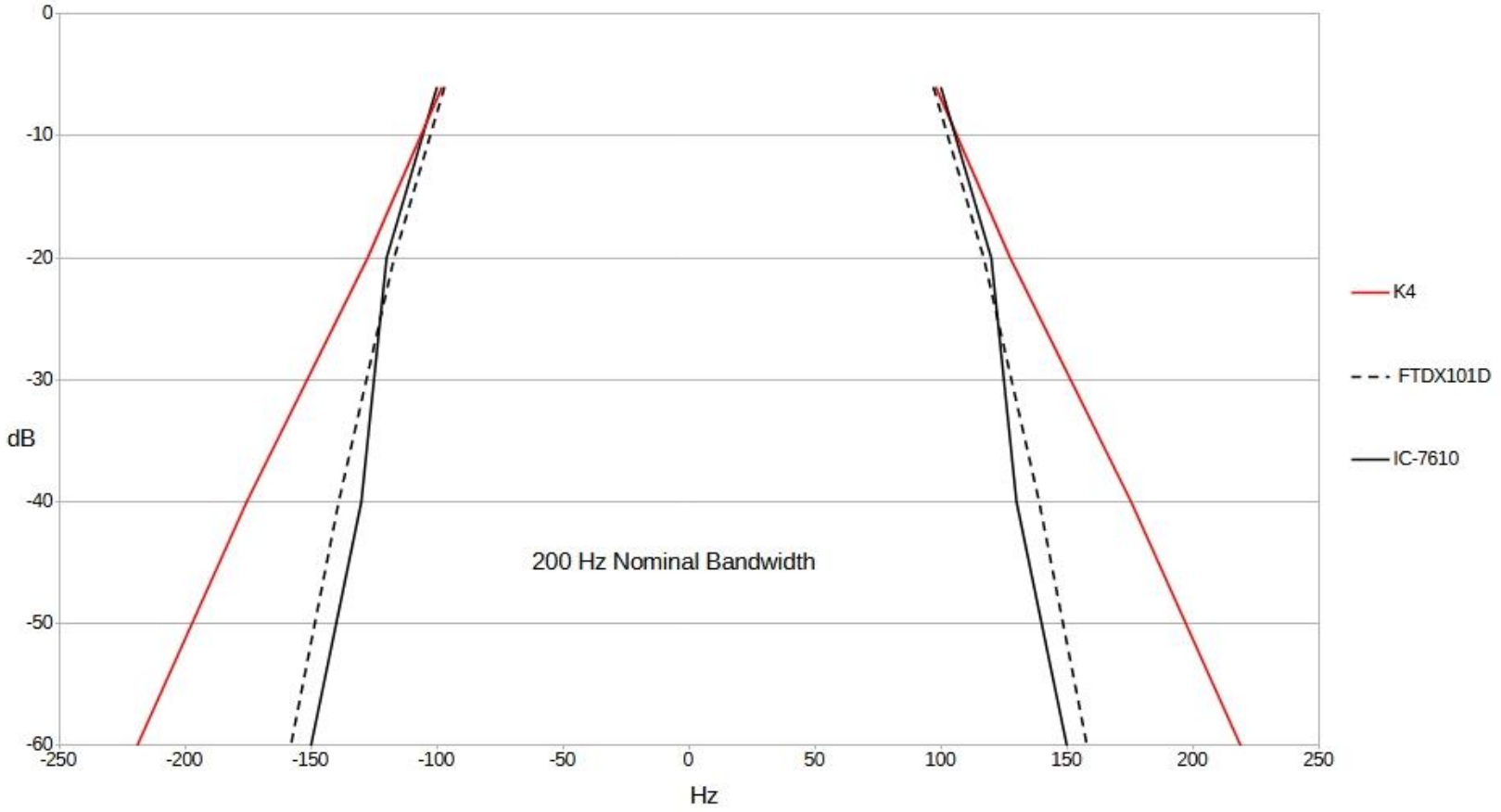
400 Hz DSP filter shape (K4 FIR) *



* FIR = Finite Impulse Response

K4 in red is the widest with 7610 the sharpest

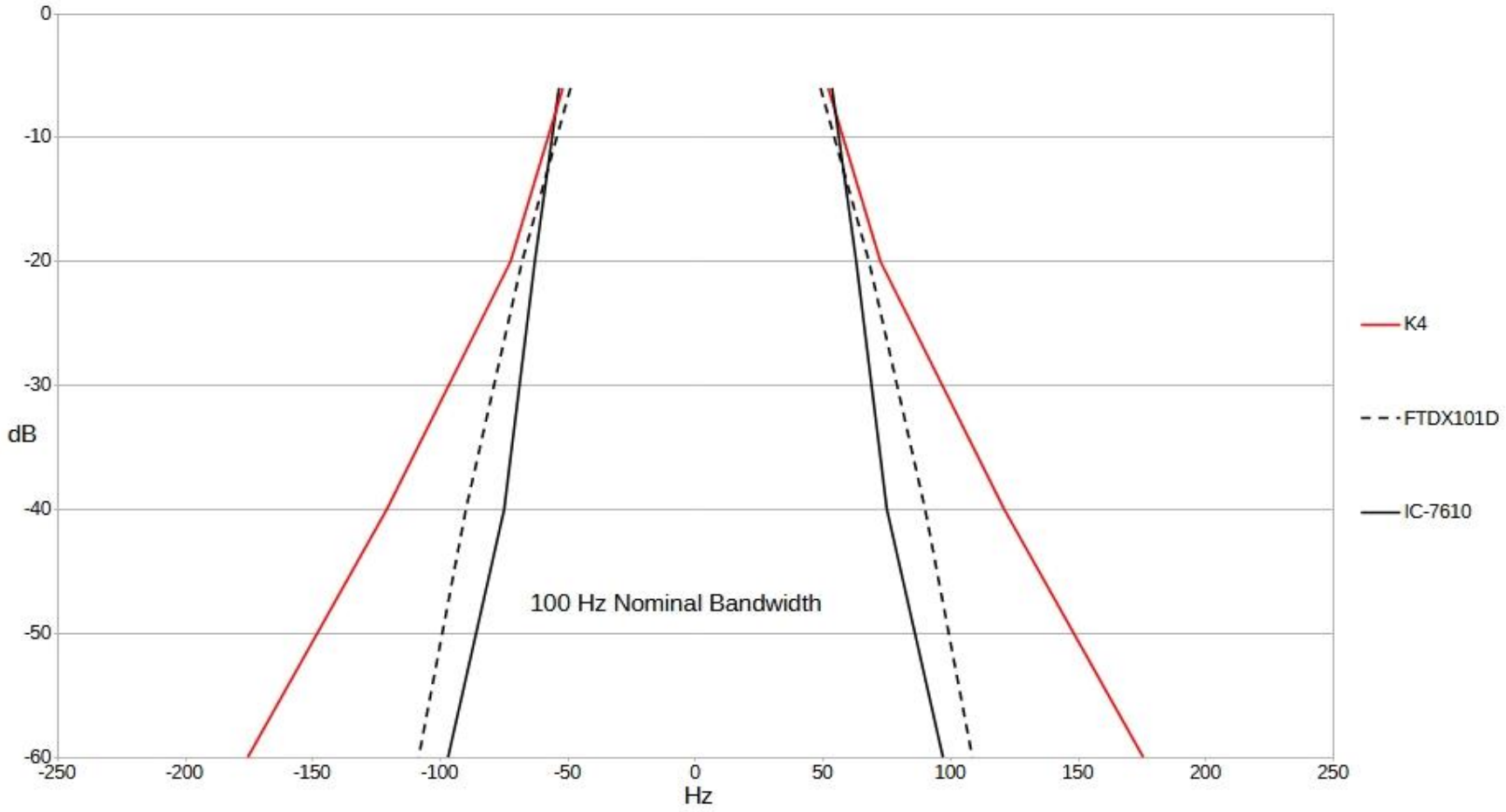
200 Hz DSP filter shape (K4 IIR) *



* IIR = Infinite Impulse Response

K4 in red, 101D dashed line, 7610 in black

100 Hz DSP filter shape (K4 IIR)



Ringing is not a problem with any of these rigs.

The Bottom Line

- You don’t know how a given DSP filter performs until it is measured.
- The Apache I used in the same 160m contest years ago had a CW shape factor of 4:1 when I stopped contesting to measure it.
- Luckily this was correctable with a phone call to the DSP developer. Default settings in a menu were not optimized.
- A few clicks and the shape factor was 1.6:1

Digital Pre-Distortion (DPD) arrived November 2023

Comments on IC-7610 & IC-7760

- Both rigs offer pre-distortion (DPD) barefoot.

- Only PW2 offers DPD with the amp in the correction loop.
- (Neither PW1 nor 3rd party amps supported with DPD)
- Excellent PW2 TX IMD with either exciter, 7610 or 7760

- 7760 200 watts as with other flagship offerings.
  (FTdx-101MP, TS-990S, Apache 8000)

- 7760 can have wired control head up to 100 meters away.
- New firmware allows remote via wireless LAN or Internet.
- Requires user supplied wireless access point.

DPD = Digital Pre-Distortion

Don’t select a new radio by one single number !

Important factors to consider

- Operator fatigue is made worse by poor receive audio and poor AGC operation.

- NB and NR very important for urban QTHs.
- You might select a radio mainly due to its ability to do noise mitigation.

- Flex may currently be the best for remote operation.
- Apache has PureSignal and great NR & NB.

- Icom DPD barefoot or with PW2 1 KW amp.
- Barefoot + tube type linear = big IMD improvement.

More factors to consider

- Bad ergonomics are frustrating.
- Is speech processor adequate?
- Standalone or Computer Operated?
- Is firmware regularly updated?
- Is warranty service done well and quickly?
- Is the radio supported with parts and service after it is out of production? K3?

- Bottom Line: Do you enjoy using your radio?

Sherwood Engineering

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Email: rob@nc0b.com

Feel free to email questions !