

ARRL Clean Signal Initiative & Selection of a New Radio

Focus on your antenna !
Directivity is a big deal.

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Consider the overall picture.
It may be more than just a new rig.

Are you considering a new HF rig?

Subjects to emphasize today

- What is the ARRL Clean Signal Initiative?
- I am vice-chair of the committee.
- We have been meeting for about a year.

- Current rigs that cost \$1600 or less
- IC-7300, FTdx10, FT-710, TS-590SG & IC-705

- Lab measurements to weed out poor choices
- Subjective contest evaluations of the above rigs

What has changed in 20 years?

- Receiver performance has drastically improved with 100 dB dynamic range typical.
- Transmitters have not improved as far as transmitted noise.
- **TX Noise consists of:**
 - Key Clicks
 - SSB Splatter
 - Wideband Composite Noise

My November 2019 QST Article

- A start on the subject of poor transmitters
- “It’s Time to Clean Up our Transmitters”
- You can download the PDF at this URL:
- <http://nc0b.com/qst-article/NC0B-QST-Nov-2019.pdf>
- I have some copies available today.

CSI Announcement in QST

- Mike Ritz W7VO published an article in the June 2023 issue of QST describing CSI.
- Hamvention in May ARRL emphasized CSI
- Goals of CSI is to encourage OEMs to now emphasize reducing transmitted interference.

What is a Transmit Mask?

- A clean signal should be no wider than X Hz
- An excerpt from the proposed spec
- CW key clicks: -60 dB @ +/- 300 Hz
- SSB splatter: 3rd order -42 dB PEP
- SSB splatter: 5th order -48 dB PEP
- CN: -136 dBc/Hz @ 10 kHz offset
- Composite noise = Phase Noise + AM noise
- <http://nc0b.com/txnoise/TX-Noise-Chart-Rev-F.pdf>

What often limits reception?

- Receivers cannot eliminate key clicks in your passband or splatter from an adjacent signal.
- Transmit composite noise is mostly a line of sight issue with signals in excess of S9+60 dB
- (Field Day and close by hams are prime examples)

The Challenge

- Since we all share our bands we need to support OEMs who improve their transmitters.
- Competition drove massive RX improvements.
- Can competition do the same for TX?
- Does the typical ham care if his signal is wide?

Is it time for a new rig in you shack?

- New or used, there are lots of great choices today if you operate contests or DX pile-ups.
- In general if all you do is rag chew and operate FT8 your current rig is likely fine.

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
• Flex 6700 (2017)	99 dB
• Icom 7610	98 dB
• Icom 7300	97 dB
• 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
• TS-990S	87 dB
• Elecraft KX2	86 dB

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

New price range \$900 to \$12,560+

Used market price even lower !

100 dB radios unheard of 20 years ago !

(16 dB preamp ON)

(Preamp OFF)

(IP+ ON)

(IP+ ON, S/N around 10,000 and up)

I have run contests with 20 of these 25

(No IP+ ADC linearization)

(RMDR limited close-in)

How do you select a new radio?

- Do you pick one of those top 25 models?
- Married to one brand? Pick \$ that fits your budget.
- Price range for new rigs \$900 to \$12,000+
- Ergonomics and User Interface (UI) are important
- Quality of Noise Mitigation – NB and NR
- Antennas are more important than the rig model.
- Location, Antennas, Operator Skill, Radio Model

Every ADC needs preamp gain on upper HF bands

Direct Sampling Radio Examples

You need to know your radio

Model	Noise floor no preamp	Dynamic Range
Flex 6600	-111 dBm	99 dB
Elecraft K4	-121 dBm	101 dB
Yaesu FT-710	-127 dBm	106 dB
Apache 7000	-131 dBm	103 dB
Icom 7610	-132 dBm	98 dB
Icom 7300	-133 dBm	97 dB

Up to 22 dB gain differences with no preamp or attenuation.

With the Flex you likely need preamp gain 20m and up.

With the Icom you likely need attenuation on 40m and down.

None of the designs are right or wrong, but they are VERY different.

You want receiver noise floor 10 dB lower than band noise.

Typical gain setting mistake

If in doubt turn the preamp ON ? **No**

Only use a preamp if necessary. (CQ WW SSB example)

If an attenuator is ON, you can't copy! **Incorrect !**

Most radios are too sensitive on 40m and below.

Preamps and attenuators are “**tools**” to be used when needed, **not ON or OFF** all the time.

Current Rig Offerings

- The next part is my **subjective** comments on several different transceivers.

Main Architecture Types Today

- Hybrid Superhet or Direct Sampling architecture
- Most common UI today: Internal LCD or computer screen
- Flex runs on Windows or Apple OS
- Apache runs on Windows only
- **Windows updates can “break” things !**
- Complication – Computer OS not real-time operating system
- All others are stand-alone embedded operating system
- How you interface with your radio is very personal.
- Let’s look at some examples.

Prices as of October 16, 2023

Some Rig Price Comparisons

• Model	Price	New since 2020
• Elecraft K4D	\$6480 (tuner included)	Yes
• Yaesu FTdx10	\$1500	Yes
• Icom IC-705	\$1350	Yes
• Yaesu FT-710 AESS	\$1000	Yes
• Yaesu FT-710 Field	\$900	Yes
• Icom IC-7300	\$1000	For comparison
• Icom IC-7610	\$3250	
• FTdx-101D	\$3500	
• FTdx-101MP	\$4600	
• TS-890S	\$4200	
• Flex 6600	\$4600	

Comments on Flex

- Preoccupied with a military contract for 4 years
- That project may be wrapping up by year end.
- Focused last 5 years on remote and contesting
- Very few DSP improvements for years
- Some CW bugs have been around for a very long time.
- Very loyal customer base
- No schematics or documentation published
- Current non-M models are shipping again. Maestros slated for year end, and M models first quarter 2024.

Comments on Apache

- Leading noise mitigation (NB and NR)
- The only brand with pre-distortion splatter reduction.
- A fiddlers delight
- Don't consider it "plug and play".
- **Not recommended for your first HF transceiver.**
- **Buy a 100-watt standalone radio (no computer).**
- Incomplete documentation on dozens of settings
- OEM makes the radio
- Open Source software runs the radio
- Consider a separate computer for just the radio.

Comments on the IC-7300

- A game changer that came out 7 years ago.
- First direct sampling transceiver with knobs
- More than 50,000 sold in just the USA and Canada !
- Good Dynamic Range
- 7300 operates much like more expensive IC-7610
- Excellent ergonomics and scope display
- Common user interface for all the Icom direct sampling transceivers: 7300, 7610, 9700 & 705
- **Added scrolling & re-center feature** for these Icom rigs.
- Very stable firmware
- Last firmware update summer of 2021

Comments on the Yaesu FT-710

- Yaesu's first direct sampling transceiver
- Similar to IC-7300 but better lab numbers

- Price FT-710 AESS: \$1000 (with external speaker)
- Price FT-710 Field: \$900 (no external speaker)
- Price 7300: \$1000
- Price FTdx10: \$1500

- User Interface and band scope could be improved.
- Multiple contest evaluations 4th quarter 2022.
(CQ WW CW, ARRL 160 & 10m)

Comments on the Yaesu FTdx10

- Excellent Lab numbers
- Ergonomics different than the FT-710
- User Interface & band scope could be improved.
- Classic hybrid superhet with roofing filters.
- Both 710 and 10 have an Audio Peak Filter for CW.
- Multiple contest evaluations 4th quarter 2022.
(ARRL 160 & 10m plus Stew Perry Top Band CW)

Yaesu FTdx10 vs. FT-710

- Sitting in front of both it is as if they were designed by different companies.
- Adjusting filter bandwidth & IF shift easy on the 10 and not very flexible on the 710.
- The 10 has the volume control on the wrong side of the VFO for right handed people.
- The 710 has less crowded button placement
- Neither of the band scopes and waterfall displays automatically re-center when tuning.

Kenwood TS-590 series

- TS-590SG shipped late 2014
- Excellent overall performer
- **Lacks a band scope that is now typical.**
- (Can be added with an SDR dongle)
- TS-590S goes back to late 2010
- Reasonable used price option
- Easy User Interface
- I operated both S and SG 160m CW contests several years ago along with T-T Eagle.

Will Kenwood bring out a new rig in 2024?

- The TS-590SG came out in late 2014.
- The TS-890S came out in late 2018.
- **TS-890S has the best waterfall in my opinion.**
- The HF to UHF TS-2000 discontinued with no replacement.
- Hamvention only announced a new TH-D75A handheld.
- Planned competitor to 7300 & 9700 has never materialized.
- Every new radio in last 7 years has a band scope and waterfall.

10 watts and a battery

Summits and Parks on the air

- Does operating outdoors interests you?
- Consider the Icom IC-705
- 160 m through 70cm
- SSB, CW, FM, Digital FT8 (with laptop) \$1350
- Companion AH-705 single wire tuner \$360
- 23 foot single wire plus a radial 40m – 6m

- I worked a 705 POTA new year's day on 2 meters.
- S9 SSB signal on a mountain 100 miles away

Much smaller than 9.3 pound IC-7300

2.4 pound Icom IC-705



Comments on the IC-705

- For HF, operates much like an IC-7300
- Lots of VHF features
- Excellent ergonomics and scope display
- Common user interface for all the Icom direct sampling transceivers: 7300, 7610, 9700 & now the 705
- Display re-centers when tuning as with the other three.
- Operated ARRL 160m & 10m contests December 2020

Comments on the Elecraft K4

- Much of the K3 firmware was ported to the K4.
- Major firmware improvements in the last two years.
- Firmware and features still under development.
- New Beta releases often have new bugs.
- R34 Beta 4 recently went production.
- The most expensive current mainstream rig. \$6480 with tuner
- Price increased 9% April 20, 2023. (Some \$200 discounts at festivals)
- HD model, pre-distortion, transverters & remote still in development.
- Customer base is likely past K3 owners.
- Lots of brand loyalty and reflector support.
- Note: With a single multi-band antenna Sub RX cannot be on a higher band than the main RX due to TX low pass filter in the circuit.

Comments on IC-7610 compared to IC-7300

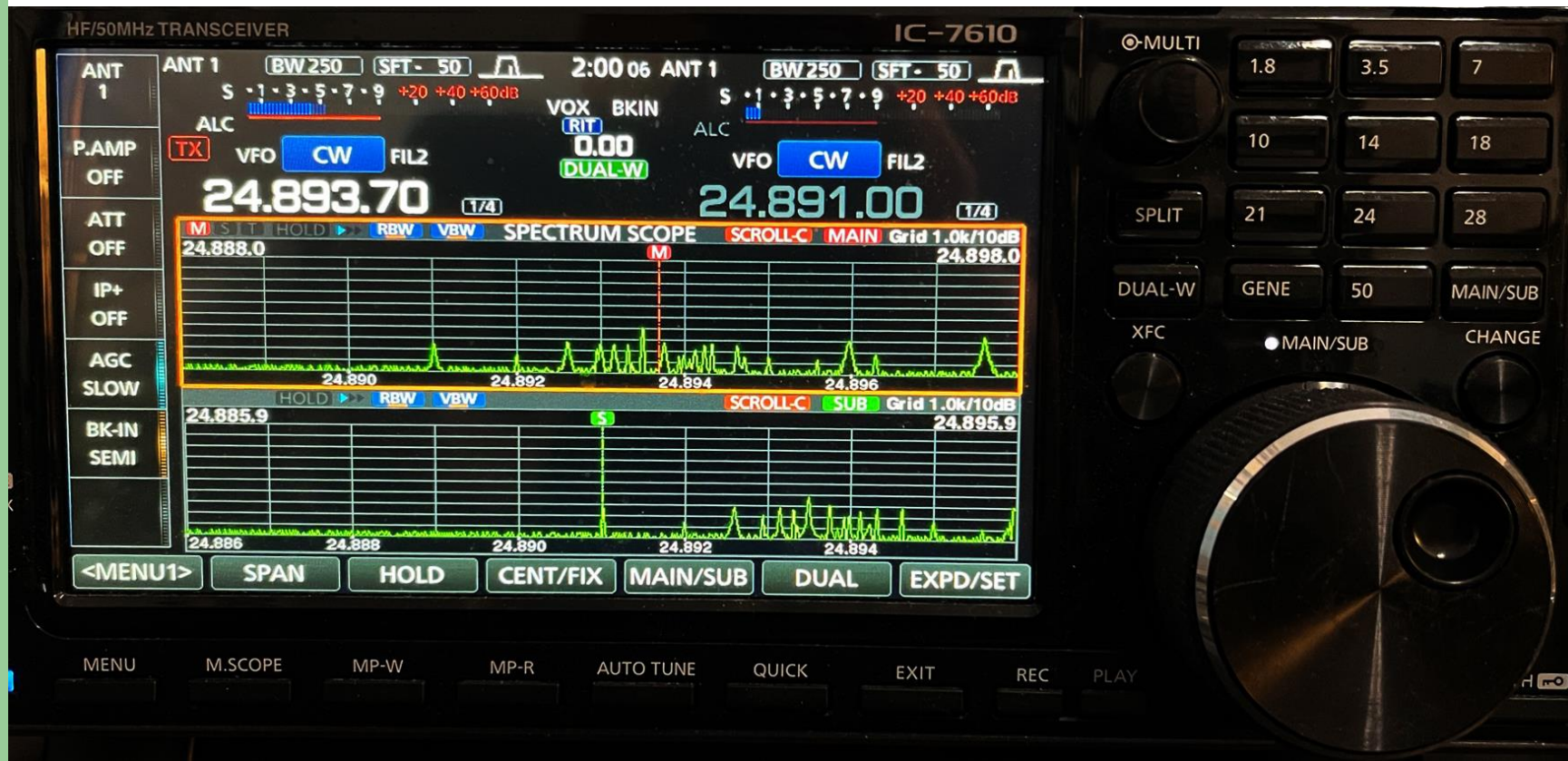
- No noisy relays for T/R or amp key line
- Audio Peak Filter (APF) for CW
- Identical dual receivers, DX split or other band
- More physical buttons and larger LCD screen
- Buttons for each band
- Two transmit antenna ports
- One RX antenna port (Beverage?)
- DVI-D port for external LCD monitor
- Quieter fan
- RC-28 tuning knob for Sub RX \$300 as with other brands
- **If you only operate SSB and FT8, IC-7300 is just fine.**

Note Preamp OFF !

TX Upper Screen, RX Lower Screen

IC-7610 & Swains Island

- I rarely use a sub receiver.
- Dxpeditions are the exception.
- Working W8S on 12m was like falling off a log



Don't select a new radio just from one number !

Important factors to consider

- Operator fatigue is made worse by poor receive audio and poor AGC performance.
- NB and NR very important for urban QTHs.
- You might select a radio mainly due to its ability to do noise mitigation.
- Flex may be best for remote operation.
- Apache has PureSignal and great NR & NB.
- Both require an internal or external computer.

Don't select a new radio just from my chart !

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?

- Bottom Line: Do you enjoy using your radio?



Sherwood Engineering

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