

**A lot has changed in 10 years.**

**Are you considering a New Radio?**

**Rob Sherwood**  
**NCØB**

**Let's demand cleaner transmitters.  
Plus - Comments on popular rigs**

Are you considering a new HF rig?

## Subjects to emphasize today

Choosing a new rig is both subjective and complex.

What do you need for your typical on-air day?

Mainly SSB rag chew and FT8? You don't need a \$4000 rig.

You may need a better antenna, possibly limited by an HOA or family desiring the antenna be invisible.

# What has changed in 10 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.
- Computer operated or not, software runs all current rigs on the market today.

# How do we interface with a radio?

- Stand-alone or computer controlled?
- Large or small LCD screen
- Mostly knobs and buttons or touch screen & mouse?
- How complex and intuitive are the menus?
- Is a band scope and waterfall important to you?

# 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 Direct Sampling” \* Coined by Dr. Ulrich Rohde
- TS-890S = Hybrid 3 Yaesus = IF Direct Sampling
- Only Kenwood doesn't offer direct sampling.

# Does the architecture matter?

- Most of the time it doesn't matter.
- A superhet has a roofing filter, 5 to 70 MHz IF.
- Hybrid Superhet adds a direct sampling band scope
- "IF Direct Sampling" also has roofing filters, **ADC at IF**.
- Direct Sampling does not have roofing filters.
- If signals are S9+60 dB a roofing filter helps.

# Architectures Dominating Today

- Superhet: TS-590SG, IC-7100
- Hybrid Superhet: TS-890S
- IF Direct Sampling: FTdx-101D/MP, FTdx10
- Direct Sampling: K4D, IC-7610, Flex 6x00  
Plus the new FT-710
  
- Either direct sampling has ADC in RX path.
  
- Only IF direct sampling have roofing filters.

# 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
- Composite noise is often a Field Day problem.
- Field Day, very close by hams & MM contest stations are prime examples of where a roofing filter helps.



# The Challenge – Cleaner Transmitters

- 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?
- **He should !**

# What bandwidth is appropriate?

- CW = On/Off keying modulation has to have a minimum transmit bandwidth.
- It's not a dead carrier that would be very narrow.
- Excessive key clicks are the issue.
  
- SSB 2.8 kHz to 3.0 kHz voice bandwidth is fine.
- It's the added distortion products that are the problem.
- **Typical splatter bandwidth at -50 dB is > 8 kHz !**
  
- How can the TX IMD be reduced?

# ARRL Clean Signal Initiative

- Reduce CW key clicks with **software** update
- Reduce SSB IMD splatter. (**Pre-distortion?**)
  
- Today that is Apache PureSignal & Icom DPD
- Yaesu Class A no longer offered with 101MP  
(The 5000D and Mk V had Class A at 75 watts.)
  
- Reduce TX Composite Noise
- (Usually an excessive AM noise issue)
- Not a simple fix.

# Some tips from contesting experience

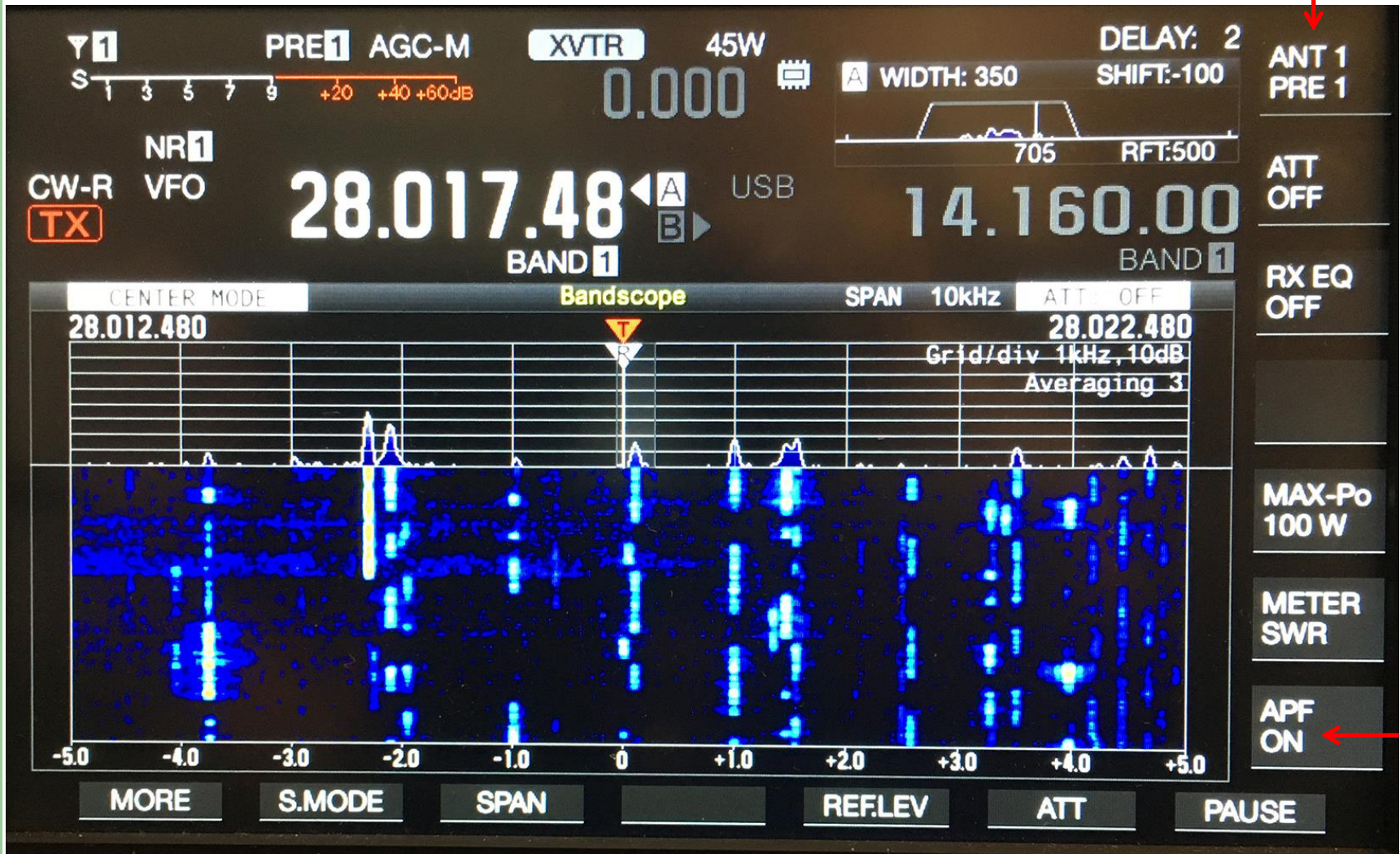
- You can learn a lot from proper receiver settings and band scope observations.
- What you see on a direct sampling band scope and waterfall is reality!
- Preamps and attenuation are **tools** to be used when appropriate, **not on by default**.
- Let's take a look at 10m and 160m examples.

December 2018

Over 20 stations in 10 kHz TS-890S

# ARRL 10m Saturday afternoon

Note preamp

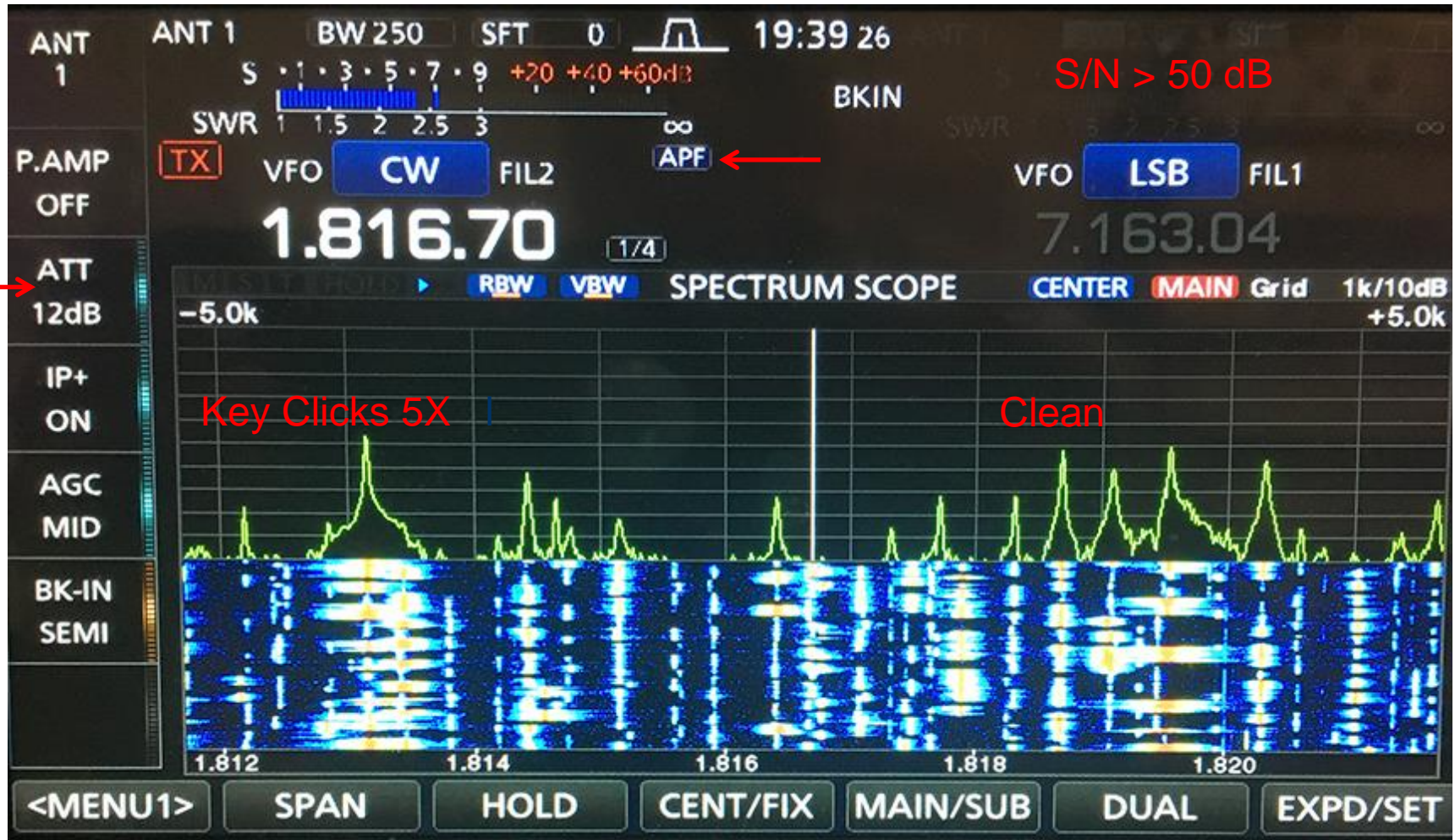


Bottom of the sun spot cycle 2018

December 2018

Over 30 stations in 10 kHz IC-7610

# ARRL 160m CW Friday 7:40 PM



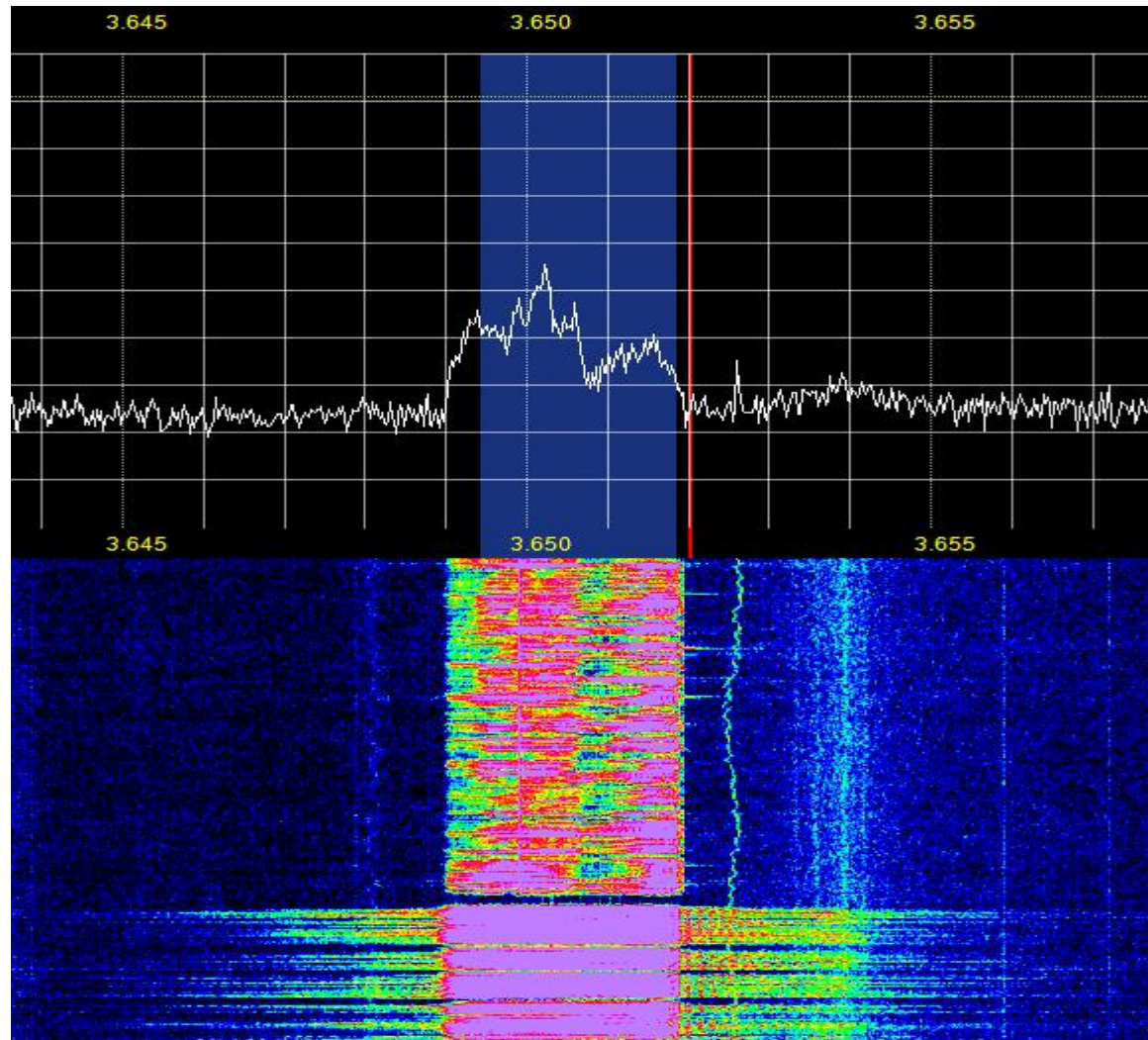
Note  
ATT

IC-7300 & TS-990S 18 dB attenuation example 2019

# When do you need a preamp?

- Upper HF bands:
- Make your dummy load one of your antenna options.
- If you can barely hear band noise increase when switching from your dummy load to your antenna then **add preamp gain**.
  
- Lower HF bands:
- There is no point in band noise running your AGC.
- **Add attenuation or raise AGC threshold slider**
- This does not hurt sensitivity !

## PureSignal Adaptive Pre-Distortion vs. Typical SSB Splatter



Class A is gone with current rigs

Icom now offers DPD predistortion

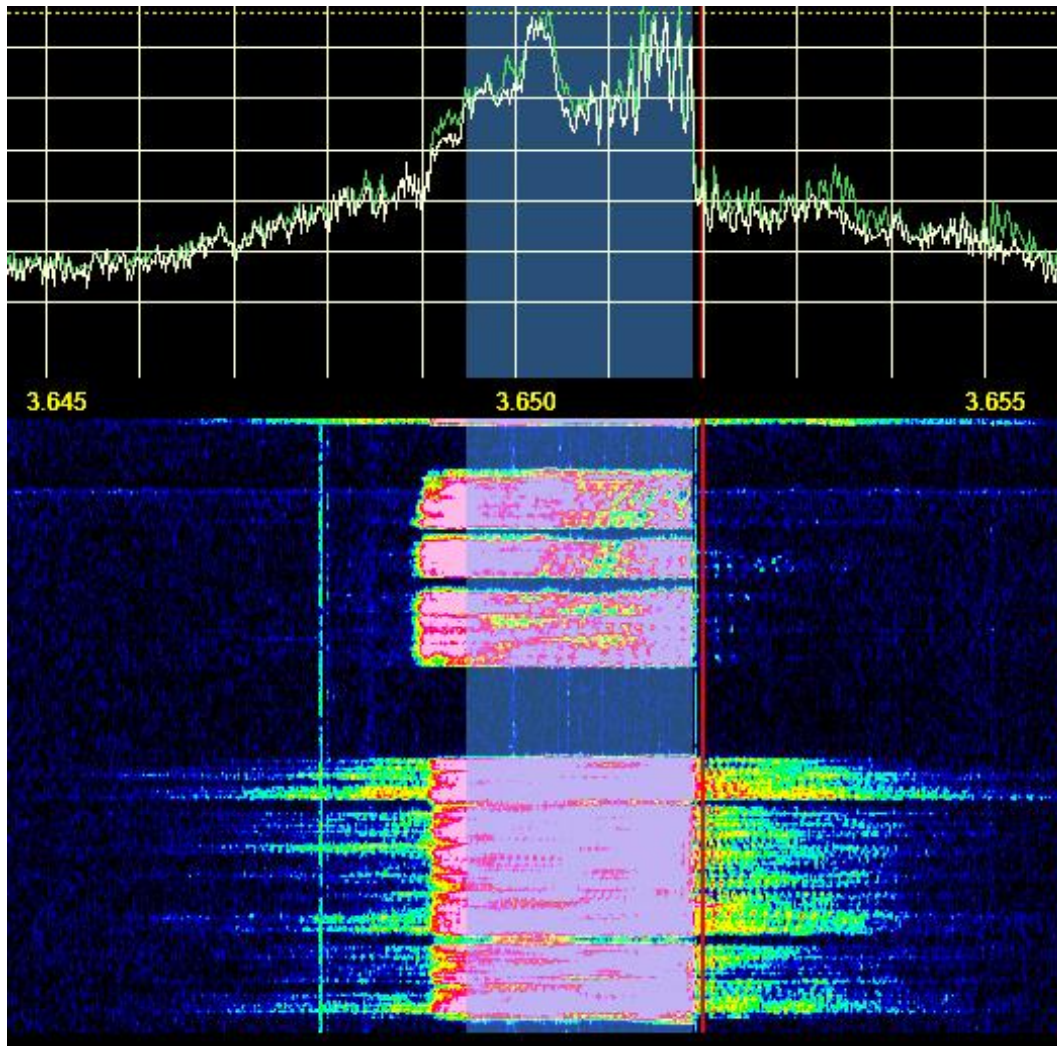
Flex & K4 ?

Apache 200D & PureSignal APD & Amp

Kenwood TS-890S & Alpha 89



## 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

# Is it time for a new rig in you shack?

- 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.
- Current rigs with built-in sound cards make WSJT X or other digital software setup much easier than years ago.

# 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 \$1000 to \$12,000+

Used market price even lower !

100 dB radios unheard of 20 years ago !

(16 dB preamp ON)

(Preamp OFF)

(IP+ ON)

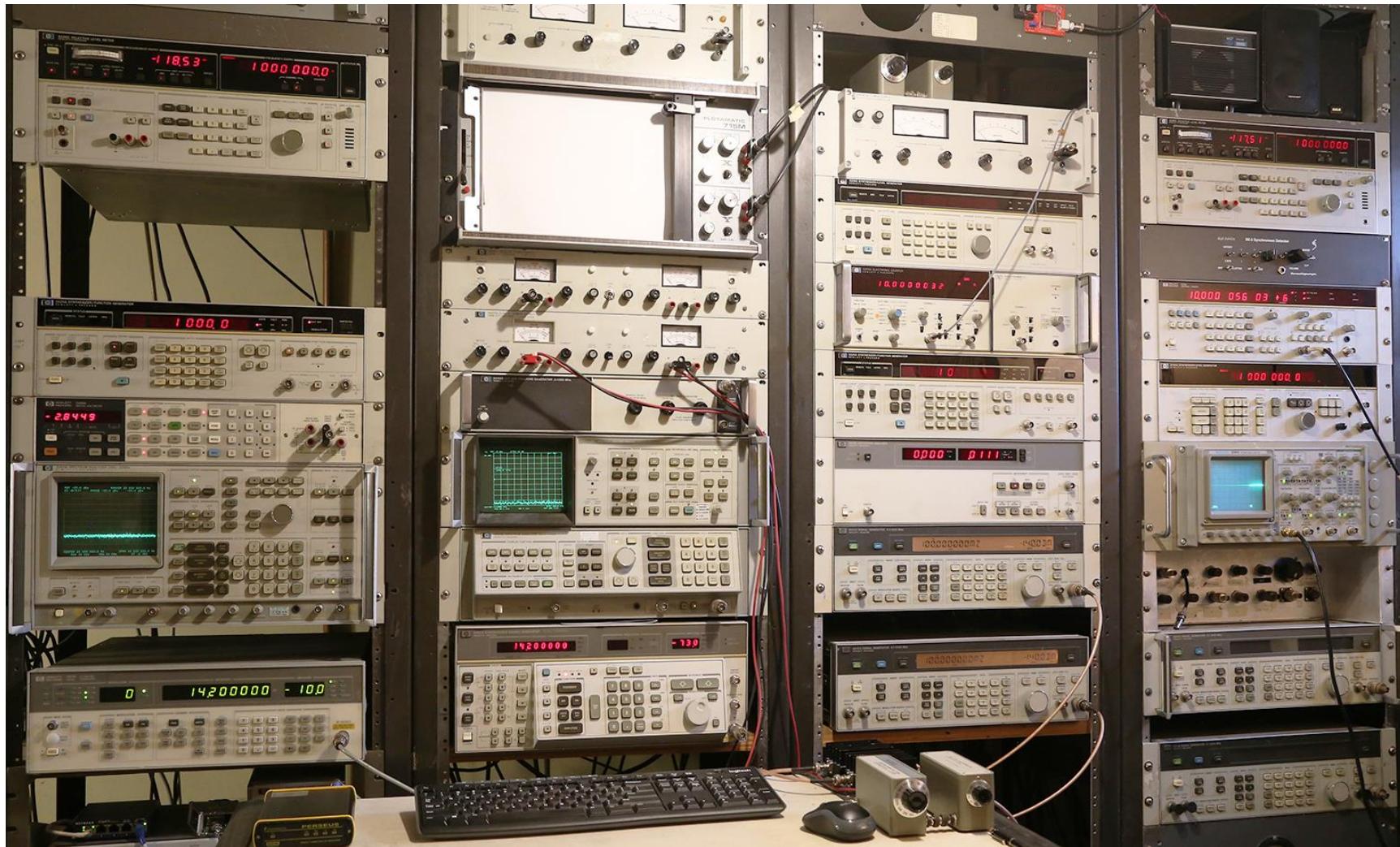
(IP+ ON, S/N around 10,000 and up)

I have run contests with 20 of these 25

(No IP+ ADC linearization)

(RMDR limited close-in)

# Denver Lab for testing transceivers



# 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 \$ that fits your budget.
- Price range for new rigs today \$1000 to \$12,000+
- Ergonomics and User Interface (UI) are very important.
- Quality of Noise Mitigation, NB and NR, is particularly important in a noisy urban environment.

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
Flex 6400	-112 dBm	100 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 Flex you likely need preamp gain 20m and up.

Elecraft is in the middle as to net gain.

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

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

# Current Rig Offerings

- **Subjective** comments to follow on several current transceiver models.
- Observations from operating all the following transceivers in major CW and SSB contests.
- Operating positions contest evaluations next

# Comments on Flex

- Busy with military contracts for several years
- 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.
  
- No schematics or service manual available.
  
- New 8000 series replaces the 6000 series
  
- Maestro C shipping now. Rigs nominally in August



# Comments on Apache

- Leading noise mitigation (NB and NR)
- 1 of 2 brands 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

# Comments on the IC-7300

- A game changer that came out 8 years ago.
- First direct sampling transceiver with knobs
- **More than 100,000 sold worldwide !**
- 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
- Scrolling & re-center feature for all 4 Icom rigs.
- Very stable firmware.
- No Audio Peak Filter (APF)

# Comments on the Yaesu FT-710

- Yaesu's first direct sampling transceiver
- Similar to IC-7300 but better lab numbers 7 years later
- Price FT-710 AESS:       \$1100 with external speaker
- Price FT-710 Field:       \$1000 no external speaker
- Price 7300:                 \$1000
- Price FTdx10:             \$1200
- (Pricing as of 6/17/2024)
- User Interface and band scope could be improved.
- Multiple contest evaluations 4<sup>th</sup> 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.
- “IF direct sampling” superhet with roofing filters
- Both 710 and 10 have an Audio Peak Filter for CW.
- Multiple contest evaluations 4<sup>th</sup> 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 two 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 left side of the VFO while the 710 has it on the right side of VFO.
- The 710 has less crowded button placement
- Neither of the band scopes and waterfall displays automatically re-center when tuning, a major limitation for me as an S&P contester.

# 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 or Elecraft P3
- 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 Ten-Tec 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 2023 only announced a new TH-D75A handheld.
- Planned competitors to 7300 & 9700 have never materialized.
- Nothing new announced at Hamvention 2024.

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 an IC-705 POTA on new year's day 2023  
S9 2m 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 2+ years.
- Firmware and features still under development.
- Many Beta firmware releases between production software
- Remote K4 to K4 firmware released before Hamvention 2024
- Rather expensive current mainstream rig. \$6480 with tuner
- HD model, pre-distortion, transverters still under development.
- No schematics or service manual available.

## 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, DXpedition split or other band
- More physical buttons and larger LCD screen
- Buttons for each band
- Two transmit antenna ports
- One RX antenna port (Beverage or receive loop?)
- DVI-D port for external LCD monitor
- Much quieter fan
- RC-28 tuning knob for Sub RX \$300 as with other brands
- **Firmware 1.42 provides pre-distortion (DPD) barefoot.**
- If you only operate SSB and FT8, IC-7300 is just fine.

## 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.
- **Icom DPD**, awaiting PW2 & 3<sup>rd</sup> party amp hack

## 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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