

DO NOT COPY

2017 HF Update

(Sept. 12, 2017)

Bill Shanney, W6QR

w6qr@arrl.net

DO NOT COPY

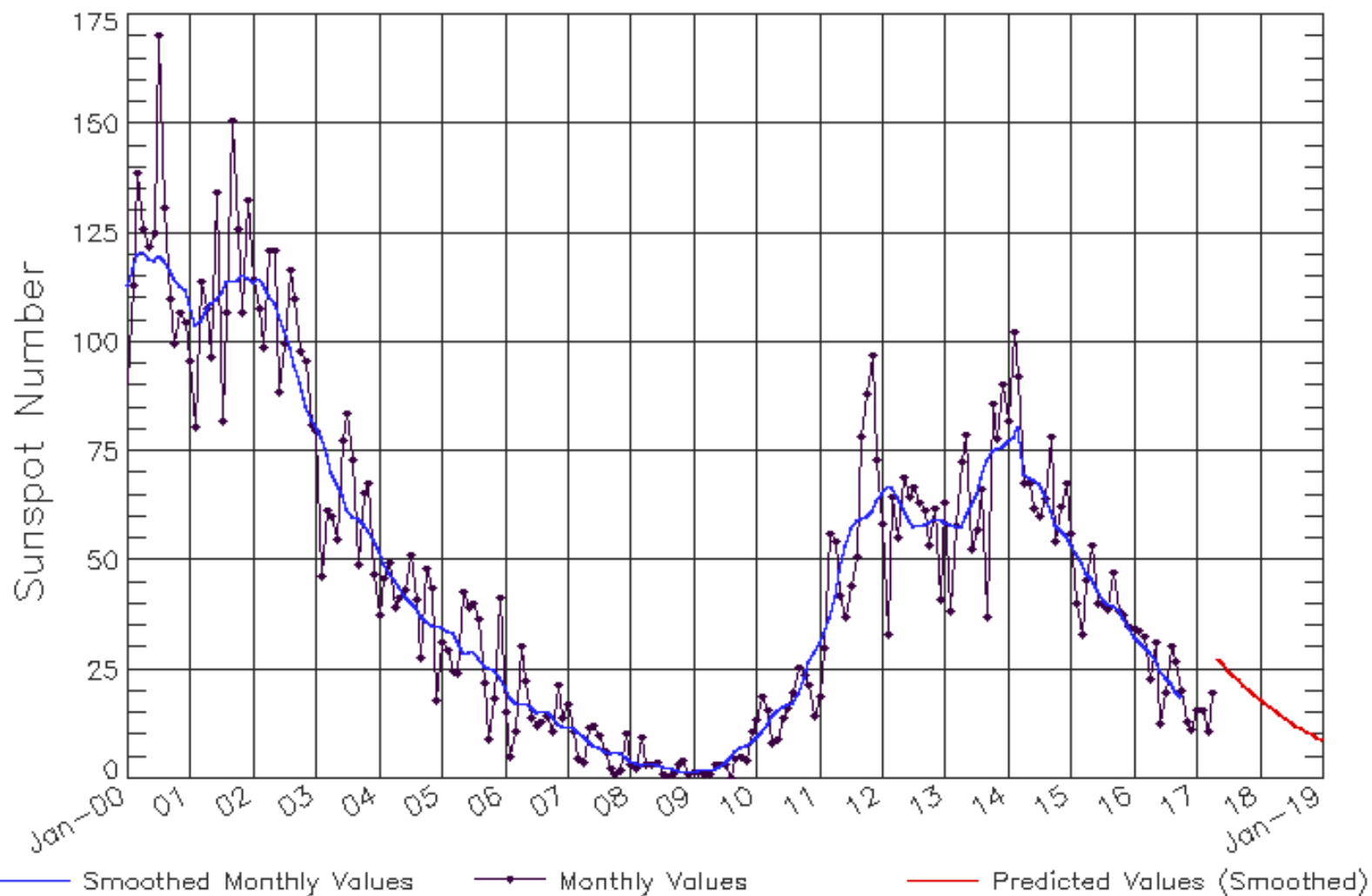
What's New in HF Operating

- Since my last talk there have been several noteworthy things to discuss
 - We are on the down slide of the solar cycle
 - Exciting new equipment developments continue
- Let's begin with the solar cycle
 - Cycle 24 Peaked in early 2014, it is the weakest cycle in recent history
 - It should bottom out around 2020
 - No one really knows what the next cycle will bring, most estimates are for another weak one
 - We will start to see better conditions in about 5 years

DO NOT COPY

Sunspot Number Progression

ISES Solar Cycle Sunspot Number Progression
Observed data through Apr 2017



DO NOT COPY

Low Sunspot Number Operating

- Experience tells us that the low frequency bands are less affected by the Sun Spot (SS) number than the high bands
 - This is because less ionization is required to support low frequency propagation
- 160/80/40M propagation may even be enhanced around the SS minimum
 - This statement is true for “normal” cycles
 - Cycle 24 is so low that some experts are predicting a reduction in low band propagation as well
- 20/30M openings still occur during the day, less frequently however. Signal strengths will be reduced as well.
 - Check 30M around Sunset for DX
- The higher bands may experience brief openings around high energy solar events that cause brief increases in ionization
 - Non-polar paths
 - Check the 10M beacons (28.250-28.300mHz)
 - Only lasts an hour or so before absorption gets too high
- 6M Sporadic E (Es) can be fun when present
 - Peaks in June
 - Lesser Peak in December
 - Check the beacons (50.05-50.1mHz)

DO NOT COPY Low Sunspot Number Operating – cont'd

- A change in operating habits is required
 - 80/40M are generally open from sunset to sunrise
 - I won't discuss 160M since it is a very difficult band to work from the city
 - 20M is the best DX band but will become less and less reliable
 - Monitor The Reverse Beacon Network for activity
 - Radios with Spectrum Scopes let you see band openings
 - Even if the band looks dead call CQ a few times
 - If you are a contester, focus on local contests
- Improve your antennas
 - A 20M or triband Yagi is not very large (+1 S-unit)
 - A Hex Beam is another alternative
 - Antennas are the biggest bang for your buck
- Buy a power amplifier
 - 400W gets you 1 S-unit more signal than 100W
 - 1500W is 2 S-units better than 100W
 - Many hams are looking at the 1500W route right now (quite expensive)
 - Can be a real help when the bands are first opening
- A mid to high end radio will hear weak signals better
- Don't get discouraged, find operating activities to keep you active
 - Digital and weak signal modes

DO NOT COPY

Technology Transition

- 2017 is a time of transceiver technology transition
- The last major transition gave us DSP IF processing with analog front ends
 - In a receive sense these radios are good enough for casual operation
 - Most used up-conversion architectures which limited close in dynamic range to ~70dB, not optimum for contesters or DXers who need >85dB
 - The Ten Tec Orion broke the 90dB barrier using a down conversion architecture
- Today's transition is to an all digital architecture
 - Driven by the availability of fast, high dynamic range A/D converters
 - Still requires analog front end filtering to reject large interferers that could overload the A/D converter
- The Direct Sampling Digital Radio architecture does have performance advantages
 - Linear filters, better NB/NR
 - Pre-distortion of transmit signals
- Until recently these radios needed a fast PC to operate
 - FLEX and Apache listened to potential customers and developed stand alone control units
- ICOM is leading the development of self contained direct sampling radios using modern display technology
 - IC 7300 is a basic radio with limited front end filtering but very good performance
 - IC 7610 is a dual receiver radio with advanced features and good front end filtering

Technology Transition – cont'd

- Direct sampling digital architecture receive advantages
 - Better noise blanking
 - Quieter receivers, hear weak signals better on the low bands...sometimes
 - No analog AGC. AGC overshoot and IMs are often an issue in conventional radios.
- Transmit advantages
 - SSB operation has long suffered from adjacent signal splatter that effectively triples the transmit bandwidth
 - Digital distortion cancellation techniques can reduce SSB bandwidth to speech bandwidth, Apache does this
 - CW waveform shaping reduces bandwidth as well
- Digital interface makes digital modes easier to implement
- All these may result in increased operator enjoyment for both contesting and weak signal operating

DO NOT COPY

Rob Sherwood's *Disruptive Technologies* Talk at 2017 CTU

- I encourage anyone interested in HF radios to listen to Rob's talk on YouTube
- There are 18 radios on his chart with close in DR3 >85dB that we should be very happy using
 - Select based on personal preferences for price, features and ergonomics.
- We have been using superhet radios for a very long time, they work for us
- Direct Sampling (DS) SDRs are also very good radios
 - Some have excess latency, not good for QSK CW
 - IC-7300 latency 10msec, same as most superhets
 - ANAN 200/8000 latency is 20msec, very good
 - FLEX latency has been 50-100msec depending on filter setup, not very good
- Rob feels it will take a few years before the dust clears and we see which new products survive
 - Poor performing up-conversion radios are a thing of the past
 - Many hams seem to want a DS SDR with a conventional front panel (IC 7300)
 - Ergonomics is very important to many of us
 - FLEX is going to offer integrated units, but I don't like their Maestro control panel. You might, we are all different
 - Apache ANAN is another very good DS SDR
 - What will the impact of the IC-7610 be?? It depends on performance
 - What products will the other manufacturers offer??

DO NOT COPY

Transceiver Comparisons

Manufacturer	Model	DR3 2kHz	RMDR	LO Noise (dBc/Hz)	Spacing (kHz)	Notes
Apache	ANAN-200D	99		131	10	
Elecraft	KX3	104 (65 1kHz)		144	10	The image bleedthru makes this a non-starter for a base rig
	K3s	106		144	10	
	K3	105		145	10	
FLEX	6700	108		145	10	New models introduced
	6300	88		140	10	No front end filtering
Hilberling	PT-8000A	105		144	10	\$20K
Icom	7851	105		148	10	
	7300	94		137	10	Poor front end filtering
Kenwood	TS-590SG		92	139	10	
	590S		88	140	10	
	990	87		138	10	
Ten Tec	Orion II	95		126	10	
	Orion	93		130	10	
	Argo VI		92	127	10	
	Eagle		90	131	10	
Yaesu	FT-5000		101	135	10	
	9000		85	135	10	
	Out of production					

This is my summary of Sherwood's chart. I've left off some older FLEX models I do not recommend. FLEX has redone their 6000 series product line in a positive direction, data on the new models is not yet available but expected to be good. Apache is shipping a new ANAN-8000 model which should also be very good. Ten Tec may not be a viable supplier.

DO NOT COPY

New Transceiver Watch List

- IC 7610, \$3.5K, dual Rx & display, dual front end filtering, better A/D than the 7300
 - Look and feel of a traditional radio
- ANAN 8000, \$4K, w/o controller (+\$600), 200W 50V PA, runs off 13.8V, dual A/D
- ANAN 7000, \$3K, w/o controller (+\$600), 100W, Dual A/D
 - Direct IC 7610 competitor
- FLEX 6400, dual Rx, 100W, ATU option, 3rd order band preselectors
 - \$2K no Maestro front panel
 - \$3K w/front panel
 - Direct IC 7610 competitor
- FLEX 6600, Four Rx, 100W, ATU, contest grade band preselectors
 - \$3K no front panel
 - \$4K w/front panel

I expect all of these radios to perform at least as well as present high end radios costing >\$5K for general operating

DO NOT COPY

ICOM IC-7300 Discussion

- Last year I told you how enthusiastic I am about this little radio. My opinion has not changed.
- Many other hams must agree. Over 13,000 7300s were sold last year
- WHY??
 - Price
 - Performance
 - Fun to operate
- Many hams felt that the price was low enough that they could give the radio a try and not lose much
 - Not cause problems with significant others
 - Resale only loses a few hundred dollars
- Performance testing by Rob Sherwood and the ARRL was very positive
- Modern features like the band scope and touch screen make operating more fun

DO NOT COPY

ICOM IC 7300 Short Comings

- For \$1300 you can only get so much radio, however, DS SDR radios can provide more features for the dollar.
- ICOM advertised the 7300 as a beginners basic radio and it is. If you want an upgradable rig that is compatible with every software product out there you may be disappointed
- IC 7300 short comings as a basic radio
 - The biggest one for me is the poor adjacent band rejection, only 10dB. That is a problem in contests or if you have neighboring hams. Its also a problem if you have a local broadcast station (like KNX).
 - Many folks complained about interference on FD, they were warned
 - Keying relays limit full QSK operation. Rob Sherwood said he could only run 26wpm with his amplifier.
 - Power output is still present for a short time after you switch off. Some Power Amps can't take this
- For most casual operation these are not big deals
 - I use a broadcast band reject filter to kill KNX
 - Array systems sells switched filter assemblies for the ham bands (\$650/6 bands)
 - Operate semi-QSK, many folks don't like full QSK (They never had a TenTec rig or a K3)
 - Many folks have complained about the power tail to ICOM, hopefully they will fix it. Many modern amps will work fine, but check yours to make sure

DO NOT COPY

IC-7300 Common Criticisms

- The ATU is only designed to match a 3:1 VSWR. This is adequate to match a tuned antenna across a whole ham band. It is not adequate for ladder line fed multi-band antenna use.
 - A wide range tuner would be bigger and more expensive
 - This is not out of line with other basic and mid-level radios
 - I use an LDG wide range tuner with my 7300, it works seamlessly (\$200)
- The radio does not have dual receive capability, neither do any other basic radios
 - Higher end DS SDRs use dual A/D converters
- Lack of a video output to display the spectrum scope on a bigger screen
 - Probably a cost/benefit trade that lost out
 - I find the small screen adequate, but would not if I were a contester
- Lack of a receive antenna input
 - Not normally found on basic radios, seldom found on mid-level radios
 - DX Engineering RTR-2 Receive-Transmit Interface can be added (\$260)

DO NOT COPY

Beginner Options

- Some of you will think I'm an ICOM salesman, I'm not.
- I get excited when there is a new product that has a big bang for the buck
- The TS-590SG has a fantastic receiver and an output for an SDR so you can add a spectrum scope. This is a <\$1,300 radio.
 - Front end filtering included
 - Used by at least one big name contester for SO2R
- FLEX has recently announced a revamped product line. The new 6400 DS SDR will retail for \$2K. It has 2 receivers, front end band filters plus other features not found in the 6300 for a cheaper price
 - It will be \$3K with an integrated Maestro display/controller (Model 6400M)
 - This is an example of market pressure created by the IC-7300 😊
- Buy a used radio. A byproduct of the IC 7300 success is the drop in used equipment value.
 - As more new radios are introduced (like the IC 7610) more used gear will be available

DO NOT COPY

Advice to New HF Operators

1. Put up the best antenna you can
2. Buy at least 1 rig up from what you think you need
 - a) As soon as you become more active you will find more features you want
 - b) Today's transceivers are complex, get help
3. Find an Elmer, someone who has been on HF for many years, to provide advice
 - a) Preferably a local ham with similar interests
 - b) Find club members with similar interests
4. Try one mode for a while, long enough to see if you like it
 - a) Try it on different bands too, each one has its own personality
5. Eventually try different modes
6. Build up a small library of reference books
 - a) ARRL Handbook
 - b) ARRL Antenna Book
7. Have FUN! If its not fun you won't stick with it.

DO NOT COPY

High-End Transceiver Product Overview – W6QR's Opinion

- Elecraft has taken a lot business from the Japanese radio manufacturers
 - Outstanding customer service
 - Continuous product upgrades
 - K3/K3s is a very high performance, customizable radio
 - KX3 and KX2 are very high performance portable radios
- It was only a matter of time before the JA's came back
- ICOM is leading the way
 - Despite it's limitations the IC 7300 direct sampling SDR is very popular with hams of all experience levels...more Fun to use
 - 13,000 7300's sold in the 1st year...WOW!
 - The IC 7610 addresses the deficiencies of the 7300 and adds a second receiver. If the price point is right it will be very popular, expected to be <\$3500.

DO NOT COPY

Transceiver Product Overview – cont'd

- Yaesu's mid/high end products are Ho-Hum
 - Yaesu understands how to design good radios
 - FT-5000 has excellent performance but is an old design, poor spectrum scope
 - FT-3000 performance is not state-of-the-art
- Kenwood has the same issue
 - TS-990 performance does not justify the price, not a bad radio
 - TS-590 continues to be a great value for a beginners radio, new SG model has a spectrum scope output
- Many hams want self contained radios with good ergonomics and high performance
- One could wonder about the timing; will new mid/high end transceivers sell at the beginning of a sunspot minimum??
 - I think yes, as long as they offer weak signal receive performance enhancements
 - Many hams, especially contesters, want cleaner transmit performance. ARRL is now testing this in their reviews
- Yaesu and Kenwood will be back with new radios, it will be interesting to see what they bring to the table. Both companies understand Ham Radio
 - We have to remember it is a world-wide market and products are often not USA centric

DO NOT COPY

New USA Manufactured SSPAs

- FLEX has recently upped their run at contest operators by adding a 1.5KW solid state amplifier to their product line
 - FLEX 6000 series radios are very good performers
- Elecraft followed suit with a legal limit amplifier of their own
 - Built in coupler, could be used for pre-distortion feedback
- I've seen a lot of high power amplifier discussion on the Yahoo groups, many hams feel this is one way to overcome bad solar conditions. There is some truth to this.
- Having an amplifier that integrates well with your radio is very convenient
 - Its one of the reasons the Elecraft K-Line is so popular
 - Remember if you increase your transmit power you will need a higher power tuner. ATUs in amplifiers are only good to 3:1 VSWR
 - Some 1500W tuners will only handle that power over a small tuning range. Read the specs very carefully

DO NOT COPY

Legal Limit HF Power Amplifier Summary

- The table below includes some of the available high quality power amplifiers that will deliver 1500W CW. You need to read the fine print on amplifier specs....many are rated legal limit for SSB, but must be derated for CW
- As you can see, a good power amplifier is a big investment. You won't see a serious contester with an Ameritron amplifier.

Manufacturer	Model	Type	Auto-Tune	Price	Notes
ACOM	A2000	Tube	Yes	\$6,500	ATU, 160-10M
Alpha	9500	Tube	Yes	8,000	3:1 VSWR, 160-10M
	8410	Tube	No	5,900	3:1 VSWR, 160-10M
Elecraft	KPA1500	SS	Yes	6,000	ATU, 160-6M
Expert Linears	1.5K-FA	SS	Yes	5,000	ATU, 160-6M
FLEX	Power Genius XL	SS	Yes	7,000	external ATU, 160-6M
OM Power	2000A	Tube	Yes	6,000	2:1 VSWR, 160-6M

ATUs handle 3:1 VSWR, [Not yet available](#)

If you have been operating 100W and put a 1500W amplifier on the air you will most likely generate RFI. You will get into stereos and wired phones. Be prepared to work all these issues, they are generally fixable.

- Both manual and automatic antenna tuners have limitations not always clearly described in their manuals. Generally not described in their Ads.
- Power handling:
 - My Palstar AT5K is advertised as a 3500W CW (5000W SSB) tuner. A close reading of the manual, actually on the last page in the troubleshooting section, shows the real ratings for resistive loads:
 - 8-15 Ω , 1000W, all bands
 - 15-25 Ω , 1500W, all bands
 - 25-50 Ω , 3500W, all bands
 - 50-2000 Ω
 - 3500W, 160-15M
 - 1500W, 10M (29.5MHz max)
 - Reactive loads change the tuning range, too complex to specify
 - Power ratings are often given for SSB, CW is usually 30% less and continuous carrier modes like Digital and FM >50% less
- Frequency Response:
 - Tuners that are very good on 160M, like the AT5K above, won't be able to match a wide range of impedances on 10M due to the stray reactance of their large components
 - Choose a tuner that has good performance in the bands you want to operate
 - ARRL Product Review data shows tuner loss performance by band and impedance
- Most radios have tuners that will tune a 3:1 VSWR. These are designed to let you operate your dipole or Yagi over a full band. They are not designed for ladder line fed multi-band antennas.
- If you have a ladder line fed antenna it is best to use a Balanced Antenna Tuner like the Palstar BT1500A
- Many commercially available tuners are T-Networks. They suffer from high losses when low impedances are matched unless they have large capacitors. L-Networks are better.
- The AT5K has 600pf capacitors to allow low impedance matching on 160M
- Manual tuners generally have lower losses and tune a wider range than ATUs

DO NOT COPY

End Fed Antennas Update

- I've done a lot of testing and analyzing End Fed Half Wave and Random Length antennas over the past few years
- I prefer End Fed Half Wave (EFHW) & Half Wave Dipoles since they are well matched and don't have as much common mode current on the shield of the coax
 - Use a simple transceiver w/o a tuner
- EFHW antennas require a 7:1 auto-transformer to match the high end impedance (49:1 impedance ratio).
- The voltages at the end of an end fed antenna are too high to isolate using a balun
- If you are going to put up an EFHW as an Inv-V, why not avoid the need for a transformer and put up a simple dipole or parallel multi-dipole?
- Random length wires generally use a 9:1 balun and counterpoise, they require a wide range tuner and the coax is almost always RF hot
 - Not such a big deal at 5W, but you may be shocked at 50-100W
- You Tube data shows the EFHW and dipole are more efficient than a random wire
 - Random Wire radiation patterns affected by feedline radiation

DO NOT COPY

Summary

- This is a very exciting time for HF operators in terms of equipment performance enhancements
- The IC 7300 success has had another effect...used equipment prices have dropped
 - If the IC 7610 is popular (I think it will be) more used radios will show up for sale
- Band conditions are poor but there are plenty of contacts to be made.
 - Call CQ
 - Improve your station
- Portable operating continues to grow
- Have Fun!
- Questions: W6QR@arrl.net