Get Ready for the Solar Minimum

Yes, we're heading for the bottom of the solar cycle. No, it won't be the end of the world.

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According to those who study such things, we're presently sliding downward from the peak of Solar Cycle 24. If their predictions are accurate, we will reach bottom in the year 2020. How long we'll dwell at the bottom is anyone's guess. It could be a couple of years, or it could be much longer. (See the sidebar, "The Dreaded Maunder Minimum.")

Among hams who adopt an apocalyptic point of view, the next several years will be something akin to The End of Days. I've even heard from amateurs who say they are planning to sell their equipment and effectively go into hibernation until the year 2023, or beyond.

Seriously?

You may need to make some changes to your station and your operating habits, but it doesn't remotely justify the thought of leaving our fascinating avocation. Rest assured that Amateur Radio is very much alive and will remain so, regardless of how long the coming *solar minimum* — the time of lowest sunspot activity — should last.

Frankly, if you hang out at VHF and above, the solar minimum will be a non-event for you. Other than the loss of those occasional "F-layer" global DX opportunities on 6 meters, little else will change.

The solar minimum will have its greatest impact on the high- and medium-frequency bands, and we're already seeing hints of what is to come. Even so, there will still be plenty to do below 50 MHz. Believe it or not, some HF and MF bands will actually *improve*. Surprised? Read on!

How the HF Bands Will Change

I don't know about you, but I love the quirky behavior of 10 and 12 meters. Unfortunately, during the solar minimum, these bands will lose much of their ability to support long-haul DX. But that's not to say they will be utterly dead, contrary to what you may have heard. Ten and 12 meters will still open occasionally over paths of several hundred miles or more. In addition, the mysterious propagation mechanism known as *sporadic E* will still provide excitement on these bands, even at the bottom of the cycle. As 6-meter enthusiasts will tell you, sporadic E can set off spectacular propagation fireworks. During one opening on 6 meters last year, I worked Missouri from Connecticut using SSB. That doesn't seem out of the ordinary, until I add that I was running 25 W to a dipole antenna in my attic.

Fifteen and 17 meters will behave much like 10 and 12 meters, although short- to medium-haul openings on those bands may be somewhat more frequent in comparison. Twenty and 30 meters will be mostly daytime bands, and both will still offer occasional DX opportunities.

But when you dip to 40 meters, an interesting thing begins to happen. Because the Sun is not as active, the lower layers of the ionosphere will not exhibit as much of their usual propensity to absorb lower-frequency signals. As a result, at wavelengths of 40 meters and longer, propagation will *improve*.

For many, 40 meters will become the

The Dreaded Maunder Minimum

Listen to amateurs and you'll occasionally hear dark mutterings of a coming *Maunder Minimum* — a time when birds will fly backwards, cats will sleep with dogs, and Charlie will have an increasingly difficult time keeping his weekend sked with Sue on 20 meters.

What these amateurs fear is an extended solar minimum. Rather than the bottom of the cycle spanning a few years, an extended solar minimum can drag on for decades.

Technically speaking, there can never be another Maunder Minimum, because there can never be another husband-and-wife team of Annie Russell and E. Walter Maunder. They studied how sunspots changed their solar latitudes over time, and through their research, they identified a period between roughly 1645 and 1715 when sunspots were almost nonexistent. In recognition of their work, this 70-year-long period has been referred to as the Maunder Minimum. There have been many other extended minimums identified through historical records, including the Dalton Minimum (1790 to 1830) and the Sporer Minimum (1460 to 1550), but the words "Maunder Minimum" have an alliterative quality that rolls off the tongue, so amateurs often use "Maunder Minimum" to refer to *any* extended solar minimum.

Could we be facing another long solar minimum, regardless of what name we give it? No one knows. Scientists continue to study the Sun in the hope of picking up more clues that will improve our understanding. For now, we can only hunker down — in frequency, that is — and hope for the best.

"new" 20 meters with major DX popping at certain times, particularly at night and in the early morning. Sixty meters will also pick up steam, and 80 and 160 meters will become downright hot at times. Odd as it may sound, I know 80- and 160-meter operators who are *looking forward* to the solar minimum as a time when their radio horizons will expand substantially.

This doesn't mean that you should completely abandon the higher bands, but consider making changes to your station that will allow you to take advantage of the prime RF real estate at wavelengths longer than 30 meters. For example, see the sidebar, "Choose Your Mode Wisely." Don't wait until 2020 to make these changes; there is low-band excitement to be had *right now*.

"But I Don't Have Enough Room!"

Run the numbers and you'll quickly realize that antennas for 40, 60, 80, and 160 meters can be quite large. At the extreme, a 160-meter, ½-wavelength dipole antenna is 260 feet in length. I don't have that kind of room in my yard, and I'm willing to bet you don't either. (There is a reason why most 160-meter stations rely on vertical antennas rather than ridiculously long horizontal dipoles!)

What about an 80-meter dipole? At around 132 feet, depending on which part of the band you like, it is somewhat easier to accommodate, but it is still a challenge. Sixty meters requires an 87-foot dipole, and at 40 meters, we're down to about 66 feet.

Unless you are blessed with acres of property, it is unlikely that you'll be able to install these hypothetical dipoles at anywhere near their optimum configurations, including optimum heights above ground. Take heart, however, because you don't need sprawling antennas to light up the low bands.

Low-Band Antenna Ideas

Browse the advertising pages of *QST* and you'll find a number of dealers and manufacturers that offer limited-space antennas for the low bands. If you want to make your own antennas, I have a few ideas to offer. You will find even more ideas in the latest editions of *The ARRL Antenna Book* and *ARRL's Small Antennas for Small Spaces*.

A 43-Foot Vertical on 40, 80, and 160 Meters

One of my low-band favorites is the popular 43-foot vertical antenna. This antenna is available from several manufacturers, or you can build your own. If you are fortunate enough to have a tall tree on your property, a length of insulated wire, supported at the top of a 43-foot or higher branch, will do just as well. See Figure 1.

This antenna will have its optimum elevation pattern on 20 meters where it is ⅝ of a wavelength long, but it will radiate well on all bands from 80 through 17 meters and put out a reasonable signal on 15, 12, and 10 meters. Put a few radial wires in the soil (as many as your time and patience will tolerate), connect a length of low-loss coaxial cable, and then feed it through an antenna tuner. The antenna tuner can be inside your station (if it's a short distance away) or at the base of the antenna to eliminate the loss in the mismatched coax. If your tuner seems to have difficulty achieving a match, you may want to consider adding a 4:1 unbalanced-to-unbalanced impedance transformer, better known as an *UNUN*, at the base of the vertical. UNUNs are available from several *QST* advertisers.

You can also make this antenna play on 160 meters. MFJ Enterprises offers its MFJ-2910 matching system that will achieve a match on 80 and 160 meters with a 43-foot vertical. Read the review of the MFJ-2910 by Phil Salas, AD5X, in the October 2015 issue of *QST*.

The Inverted L

The great thing about an inverted L antenna is that it saves space while providing both vertical and horizontal radiation. Low-band operators have sworn by inverted Ls for many years.

An inverted L is really a ¼-wavelength (or longer) vertical antenna

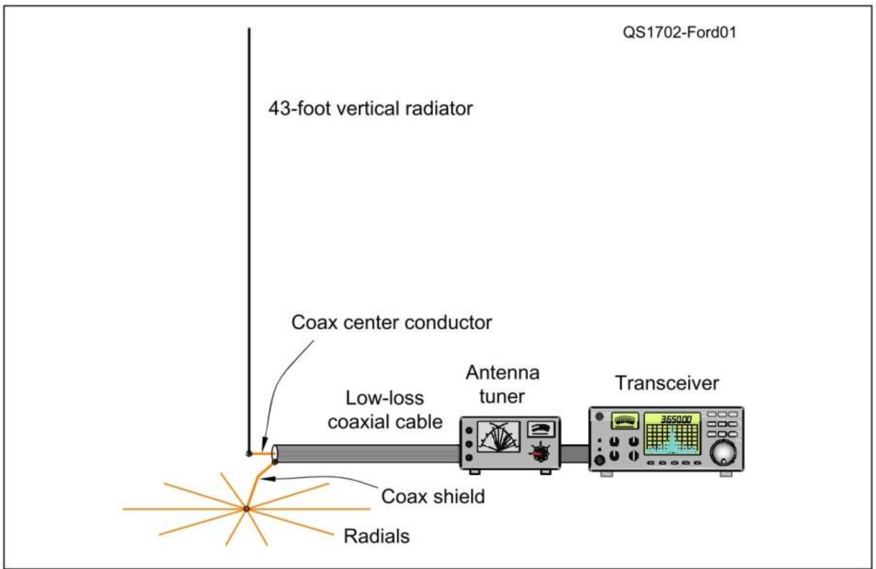

Figure 1 — A 43-foot vertical antenna can offer acceptable performance on 80 through 17 meters, as well as the higher bands. It does require radial wires at the base, but they don't have to be overly long. Radial *quantity* is more important than radial length. Just put down as many as you can, and make them as long as your circumstances allow. The antenna tuner can be a remote tuner at the base, or a tuner indoors at your station. If you use an indoor tuner, be sure to feed the vertical with low-loss coaxial cable, such as RG8X or even LMR-400.

Choose Your Mode Wisely

Another key to improving your station performance during the solar minimum is choosing the most effective operating mode. Many HF and MF operators enjoy SSB, but it may not be the best choice when propagation becomes challenging. Here's why.

An important characteristic of any operating mode is the *bandwidth* its signal occupies. SSB spreads your transmit energy over a little less than 3 kHz of RF spectrum. In contrast, a CW signal may be only 50 Hz wide; a PSK31 digital signal is also quite narrow at about 62 Hz.

Imagine a garden hose with an adjustable nozzle. If you set the nozzle for FINE SPRAY, the water is diffused into a wide cone of droplets. The droplets will strike the ground, and the ground will certainly become wet, but each square inch of soil will receive relatively little water overall, and the droplets will land with little energy.

However, if you switch the nozzle to JET, all the water in the hose is suddenly focused into a narrow stream. The water strikes the ground with considerable force, perhaps enough to actually start ripping away the soil. A high-pressure cleaner works in exactly this way. The water doesn't change — only the focus does.

With the water analogy in mind, generating an SSB signal is somewhat like setting the nozzle to FINE SPRAY. You're spreading your precious RF energy over a wide slice of spectrum, and the receiving station will have to capture a fair amount of it to understand what you are saying.

But if you switch to a narrow-bandwidth mode such as CW, you're effectively setting the nozzle to JET. Now your RF energy is much more concentrated and, if the receiver bandwidth is reduced as well, there will be much less received noise and a higher signal-to-noise ratio. The receiving station doesn't have to capture nearly as much of your signal to decode what you are sending.

Digital modes also use narrow bandwidths (depending on the mode), but they add sophisticated modulation and coding techniques. Digital modes such as JT65, for example, can be decoded at astonishingly low signal levels.

This is not to say that you have to give up SSB during the solar minimum, but if you want to get the best performance possible out of a low-band, limited-space station, CW or digital is definitely the way to go.

Look at Figure A. This is a prediction generated by *VOACAP*, the preeminent propagation forecasting application. This was the result *VOACAP* created with the following parameters:

Band: 80 meters
Antenna: A dipole at a height of just 33 feet
Power: 80 W
Time of Day: 0200 UTC
Location: Hartford, Connecticut
Mode: SSB

Now compare Figure A to Figure B. All the parameters are the same with one exception: *the mode was changed to CW*. Compare the two outcomes and the differences should be obvious!

If you'd like to run some predictions yourself, go to **www.voacap.com/coverage.html**.

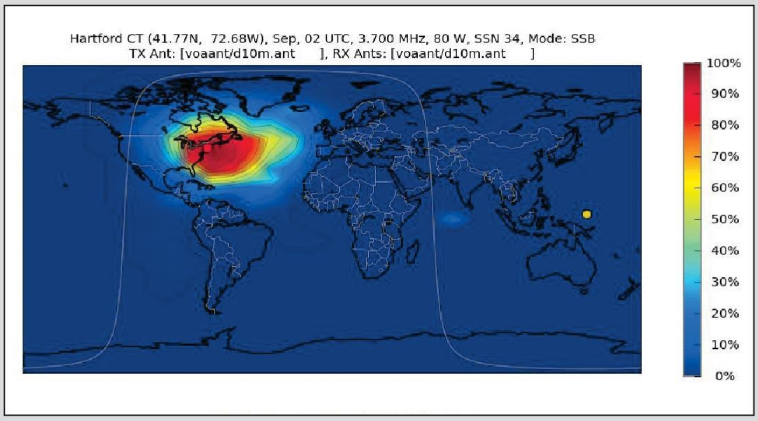

Figure A — A *VOACAP* prediction for 80-meter SSB in September 2016 with 80 W output to a low dipole antenna.

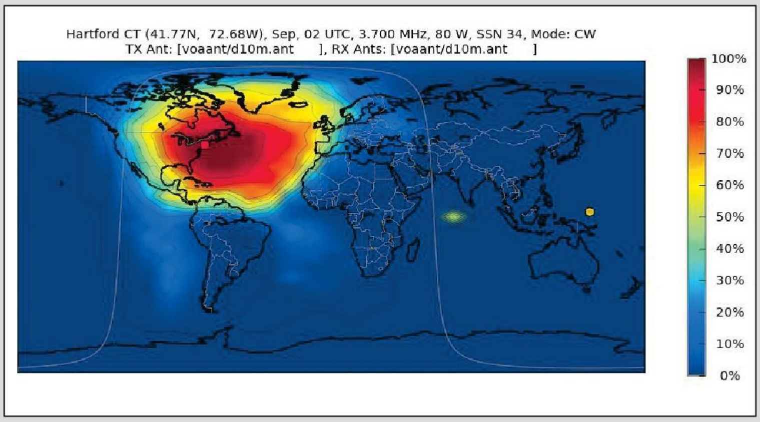

Figure B — The prediction is performed again, but CW is substituted for SSB. Notice the difference!

that has a section of the radiator bent horizontally. In Figure 2, you'll see a 160-meter version of this antenna. Before you gasp at the 130-foot length, remember that a substantial portion of the length is vertical. For instance, let's say you have a 40-foot tree in your yard. If you use the tree to support the inverted L at its bending point, you'll be left with about 90 feet of wire that extends horizontally. Even my postage-stamp sized property could accommodate that much wire.

Do the math for an 80-meter version and you end up with a total length of approximately 70 feet. Hang that antenna from a 40-foot tree and you have only 30 feet of horizontal wire.

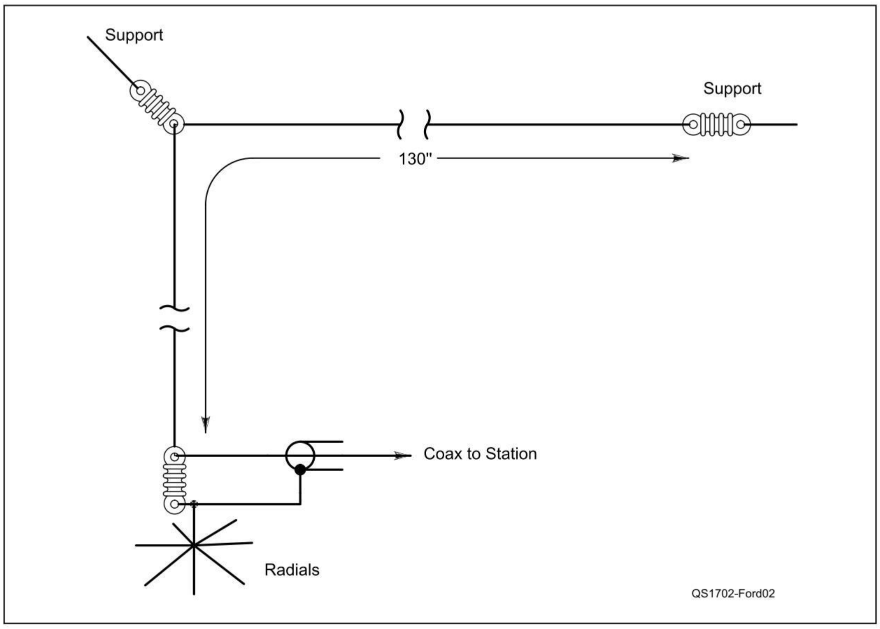

Figure 2 — An inverted L antenna is a ¼-wavelength "bent" vertical antenna. A 160-meter model is shown here, but you can make an inverted L for 80 meters as well (see text). With an antenna tuner, chances are you can use your inverted L on several bands.

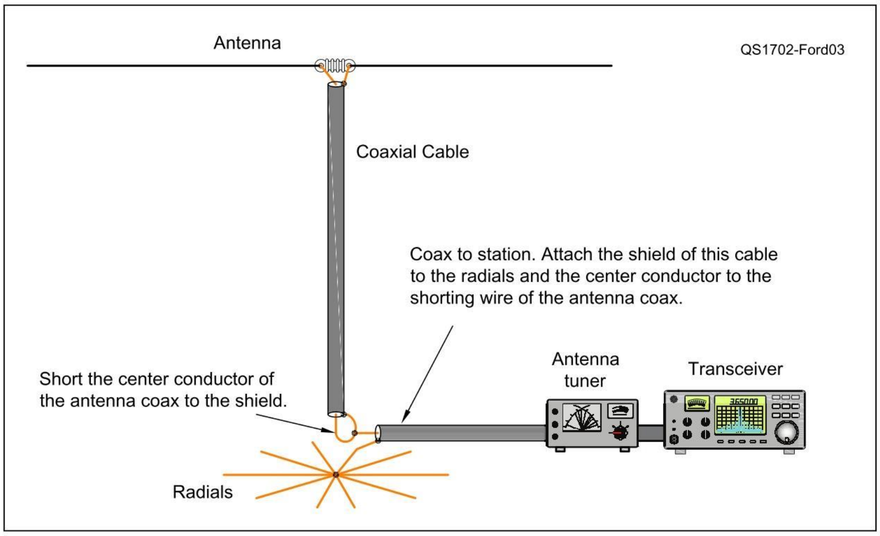

Figure 3 — Short-circuit your dipole feed line and you've created a "T" antenna. With a network of radial wires and an antenna tuner, this antenna can be surprisingly effective on the low bands. A dipole antenna fed with coaxial cable is shown here, but the same technique applies if you are using open-wire feed line.

In Figure 2, you will also notice that the inverted L requires radials. Like any other vertical antenna, you'll need to put down some radial wires for best performance. As with the 43-foot vertical we discussed previously, you can place a remote antenna tuner at the base, or feed it with low-loss coaxial cable back to an antenna tuner at your station for multiband operation.

"Short-Circuiting" Your Dipole

Here's something to try. If you have either a coaxial cable or ladder-line-fed dipole antenna — the longer the dipole the better — try shorting the feed line and creating a "T" antenna (see Figure 3). This antenna requires radials at the base, like the inverted L, but it can be fed with an antenna tuner and potentially give you the ability to operate on bands you could not otherwise access. For example, you can turn a 20-meter dipole antenna into a "T" that may work on 40 meters, or turn a 40-meter dipole into a "T" that may function on 80 meters.

There are many other approaches to low-band antennas, but the guiding principle remains the same: Put up as much wire or metal tubing as possible and load it with RF energy any way you can. You won't be busting pileups on the other side of the world during the solar minimum, and you won't always be the strongest signal on the air, but I guarantee that you'll make enough contacts to stay busy no matter how long the minimum may last.

My thanks to Joel Hallas, W1ZR, and Carl Luetzelschwab, K9LA, for their assistance during the writing of this article.

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