QST Issue: Sep 1987
Title: DX-60B Switch Replacement
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capacitor having a value of perhaps 100 pF. The signal collected by the antenna is quite small and requires amplification. A simple FET amplifier with a transformer input circuit can be used for impedance matching and signal amplification.

Most VLF stations transmit vertically polarized signals. Often, the best VLF antenna is a short (2-5 m) vertical. A good ground system is more important than antenna size.

There is no lack of signals below the AM broadcast band. Most hams can hear at least several beacons in the 190-415 kHz range. These stations identify themselves with modulated CW. The Loran-C network at 100 kHz covers most of the country. Communications stations in the 15-30 kHz range can be heard anywhere in the world. The OMEGA navigation stations at 10.2, 11.3 and 13.6 kHz are used throughout the world for navigational purposes. In each case, commercial users of these services employ little more than a short vertical antenna and preamplifier.

There are several uses the average ham can make of VLF signals:

1) Loran-C transmissions are an accurate source of 100-kHz signals.

2) Monitoring the waveshape of the Loran-C signal can provide reliable information on the state of the upper atmosphere, such as D-layer absorption, E- and F-layer heights, and so on. Because the shape of the Loran pulse follows the sine-square formula, skywave and ground signals are easily discerned using an oscilloscope.

3) Monitoring the amplitude and phase of the OMEGA network stations offers data about the propagation conditions to virtually any place on the globe. The OMEGA transmitters are located in Japan, Norway, Liberia, Hawaii, North Dakota, LaReunion (Reunion) Island, Argentina and Australia.

Information about these services is available from the US Coast Guard. The Naval Observatory in Washington also maintains a bulletin board service with status on these and other navigational services. That BBS number is 202-653-1079. I use 1200 baud, 7 bits, even parity and 1 stop bit. Users must identify themselves each time they access the BBS. No general menu is displayed, but operations information can be had by sending @EXP or @TCO for an explanation of codes and services. Terminate your call with @BYE.—*Bob Fisher, K2ND, 80 Iroquois Dr, Brightwaters, NY 11718*

[3]F. Terman, *Electronic and Radio Engineering*, 4th ed (New York: McGraw-Hill, 1955), p 495.

[4]Bruce O. Williams, "Heath Model HD-1420 VLF Converter and Model HD-1422 Antenna Noise Bridge," Product Review, *QST*, Nov 1986, pp 40-41.

DX-60B SWITCH REPLACEMENT

☐ I was off the air for four months because of a malfunctioning switch in my old Heath DX-60B transmitter. There are still a number of these old rigs on the air, and the FUNCTION switch is often the first part to fail. When I inquired about a replacement switch (part no. 63-246) for my transmitter, Heath said replacement switches were no longer available. But they are! I thought other DX-60B owners might like to know that a Centralab switch, PA 077-0018, works just fine as a *direct replacement*. [The DX-60 and DX-60B FUNCTION switches bear the same Heath part number.—Ed.]

To provide a slightly larger working area when replacing the switch, I removed the adjacent DRIVE LEVEL control mounting hardware and moved the control to one side. When wiring the replacement switch, solder the leads to the *front* wafer first.—*Gordon ("Gus") R. White, KA8BFY, 1944 Northfield NW, Warren, OH 44485.*

VIEW: DIGIVFO

☐ Sometimes, poor choices for electronics terminology lead to misunderstanding of circuit function and design. For example, take "dual digital VFOs"—please! Even though "dual digital VFOs" is a common phrase these days in discussions of synthesized-tuning transceivers and receivers, I suggest that its application to most current consumer step-tuned radio equipment is usually incorrect, in at least two senses, even when there's a switch or button marked VFO A/B somewhere on the front panel.

True enough, nearly every new amateur transceiver these days sports these VFO characteristics: (1) microprocessor frequency control; (2) phase-locked-loop (PLL) frequency synthesis; and (3) digital (that is, direct numeric) frequency readout. But this does not make such a VFO "digital"! Far from it, in fact: The nondigital nature of PLL VFOs is the main reason for the specter we're coming to know all too well as phase noise. High receiver dynamic range is more or less accepted as important by amateur equipment manufacturers. Now, we must increase their understanding of the fact that noisy oscillators can and do offset improvements in dynamic range. (If you've noticed in some receiver/transceiver reviews that a given dynamic-range measurement was said to be "noise limited," you've seen the result of phase-noisy PLL VFOs.)

What does this have to do with whether or not a VFO is PLL or digital? If it's commanded and displayed digitally, it's digital, right? Not necessarily. At the heart of almost all of our PLL VFO rigs are phase-locked LC (inductor/capacitor) or VXO (variable crystal oscillator) circuits. Phase locking is simply a method of forcing a VFO or VXO to a desired frequency and holding it there by negative feedback. (Oscillators tuned in this way are almost always controlled by varying the tuning voltage of one or more varactor diodes; such a VFO is thus called a VCO; a voltage-controlled crystal oscillator is a VCXO.) Because it's possible to use microprocessors to monitor and control PLL circuitry, and because microprocessors "speak digital," many of us feel safe in referring to such microprocessor-controlled PLL VCOs and VCXOs as "digital."

Trouble is, such PLL oscillators aren't digital—they're "analog" oscillators controlled through the use of digital techniques. When your transceiver "remembers" a frequency, its microprocessor isn't actually setting an internal oscillator to that frequency and leaving it there. Rather, the radio's microprocessor/RAM system stores the set of instructions necessary to force the VCO back to that frequency. (Information concerning front-end filters, operator choice of emission [CW, SSB, etc] and IF selectivity is just part of this set of instructions.)

Yes, there are truly digital VFOs—VFOs in which the output signal is fabricated piece by piece in digital circuitry.[5] Because such circuits do not use phase-locked loops to achieve good frequency stability, they can, in theory, provide output very low in phase noise. But the VFOs in most of our "digital VFO" rigs aren't digital at all.

What about the fallacy of the "dual" in "dual digital VFOs"? Well, remember that the designers of most "digital" transceivers have merely implemented digital means of commanding nondigital circuitry. Band/frequency/mode memories involve only the storage and re-execution of commands. Although there are usually several VCOs/VCXOs in a given "digital" transceiver, this is done for enhancement of oscillator function and not for redundancy. (Each oscillator operates over a relatively narrow frequency range; this allows for optimization of frequency control and output purity.) Any VFO "duality" in such a synthesized rig arises from multiple means of storing band/frequency/mode/filter commands. That's all. There is only one set of VCOs/VCXOs in the radio!

There are directly perceptible differences between the performances of true digital and digitally commanded PLL (that is, indirectly synthesized) oscillator circuitries. These circuitries are greatly different electrically. Words do exist that allow us usefully to signify these differences—and improper application of words to a circuit configuration can, as usual, lead to inadequate comprehension of circuit performance and quality on the part of buyers of equipment containing that circuitry.

So, "dual digital VFOs"? Usually not. Here's my vote for better terminology where microprocessor-controlled VFOs are neither dual nor digital: "Dual VFO command registers." It almost sounds like something new.—*David Newkirk, AK7M, Assistant Technical Editor, QST*

[5]Fred Williams, "A Digital Frequency Synthesizer," pp 24-30, Apr 1984 *QST* (Feedback, p 43, Jun 1984), and "A Microprocessor Controller for the Digital Frequency Synthesizer," pp 14-20, Feb 1985 *QST*. A distillation of both articles appears in the 1986 and 1987 editions of *The ARRL Handbook* (Newington: ARRL), M. Wilson, editor, p 29-23. The Apr 1984 *QST* article and *Handbook* writeups also explain the difference between direct, indirect and digital frequency synthesis. As far as I know, all of our present HF/MF "synthesized" receivers and transceivers employ indirect synthesis.—*AK7M*

Note: All correspondence addressed to this column should bear the name, call sign and complete address of the sender. Please include a daytime telephone number at which you may be reached if necessary.

Feedback

☐ Footnote 2 of the article, "A New Chip For Charging Gelled-Electrolyte Batteries" (*QST* Jun 1987, p 26) should read: A complete kit (the PC board the Unitrode chip and other parts) is available from A & A Engineering for $49.95. Their address is 2521 W La Palma, Unit K, Anaheim, CA 92801, tel 714-952-2114. Add $2.50 to all orders for shipping and handling.