By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

Beckoning Beacons, Part 2

In last quarter's column, we discussed the challenges of calibrating amateur and professional SETI receiving stations (please see box with figures A and B). We concluded that a narrow-band signal from space, such as the S-band telemetry beacon aboard NASA's Pioneer 10 spacecraft, would be ideal for this purpose. Unfortunately, that particular beacon now is not only beyond the edge of our solar system, it is also beyond the range of reception by even Earth's most sensitive radio telescopes. In 2001, the nonprofit, grass roots SETI League sought to create a Pioneer 10 surrogate for use by radio astronomers around the world.

Radio amateurs have successfully been bouncing microwave signals off the rough lunar surface and detecting their echoes back on Earth since 1960. In 2001, SETI League members exploited the EME (Earth-Moon-Earth) path from W2ETI, their club station in New Jersey, for the benefit of radio astronomers worldwide. As seen in figure 1 and reported in *QST*[1], W2ETI's weak EME signal on 1296 MHz, its frequency precisely calibrated to atomic-clock accuracy, was first detected at the 20-watt level by the Arecibo Observatory in Puerto Rico, the world's largest radio telescope. The beacon subsequently was copied by a handful of radio amateurs possessing state-of-the-art stations, including a few reception reports logged during ARRL EME Contests, although its low power limited its utility, restricting reception to only the best equipped stations. Clearly, more power was needed to turn this facility into a truly universal calibration source.

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More Power Needed

Over the next two years, the author and station trustee Richard Factor, WA2IKL, upgraded the W2ETI beacon to automatic tracking, remote monitoring, and unat-

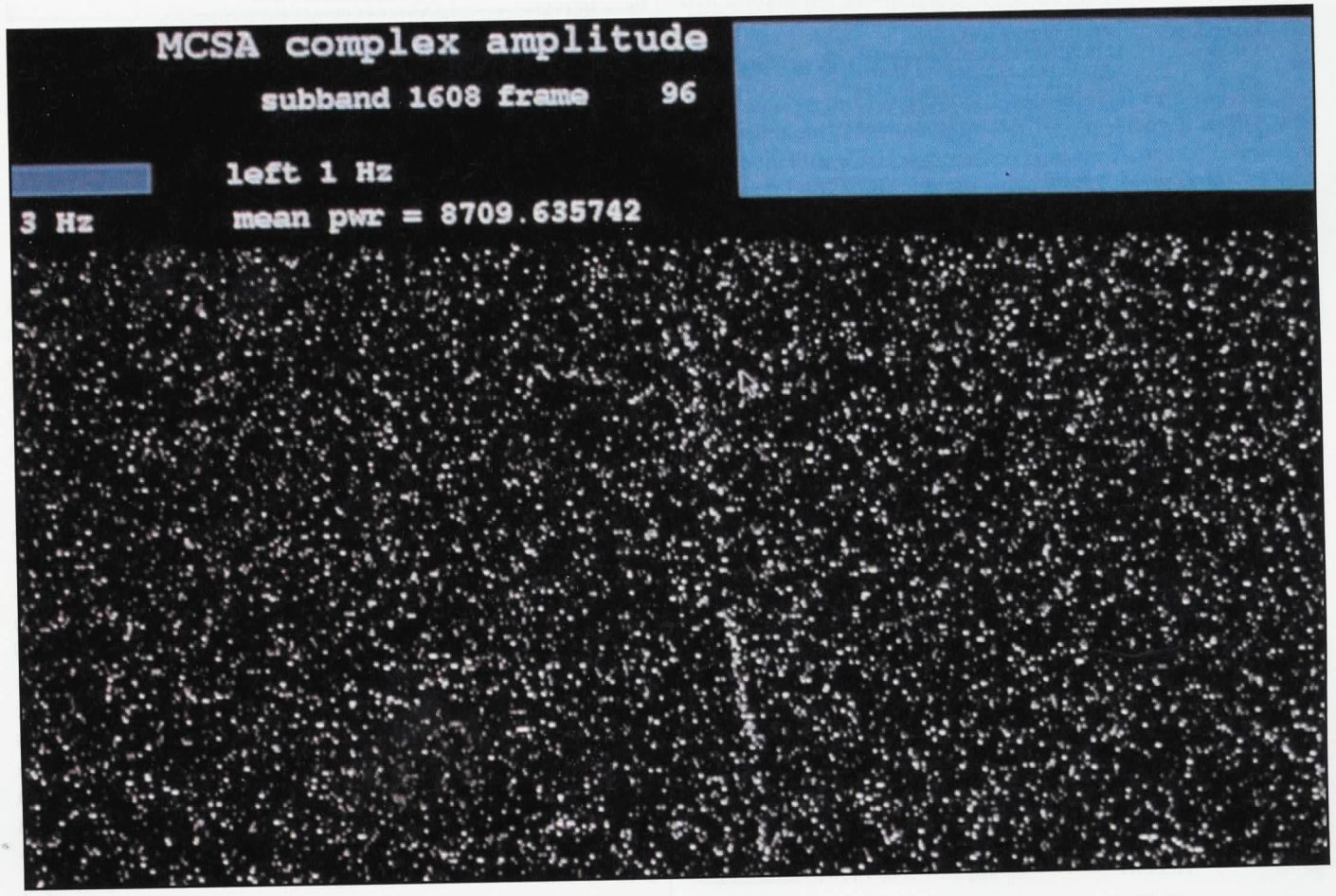

Figure 1. First Light of W2ETI QRP EME Beacon, as received at Arecibo by N6UDK, March 2001.

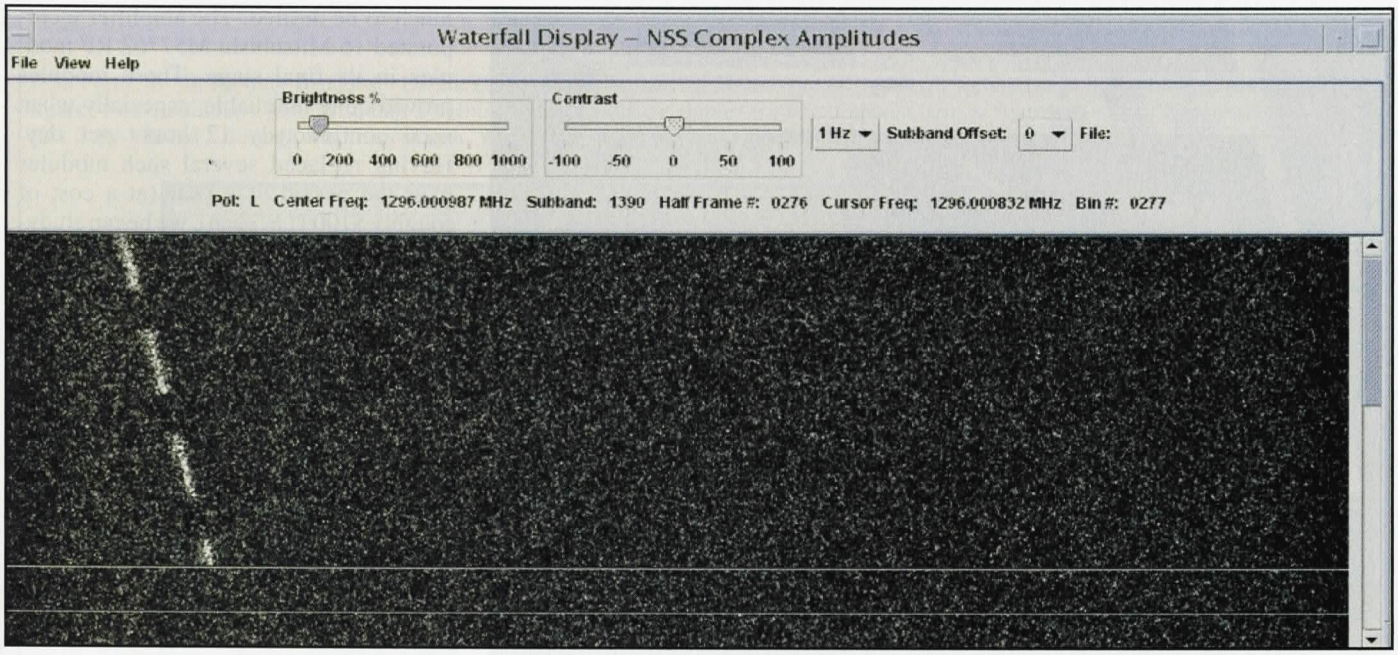

Figure 2. W2ETI's QRO CW signal received at Arecibo, March 2003.

tended QRO operation, with the addition of a solid-state power amplifier. Two years after "first light," calibration tests were repeated with Arecibo at the 100-watt level. The resulting CW signals, depicted in figure 2, were received clearly not only at Arecibo, but also by a host of radio amateurs, on dishes as small as 3 meters in diameter. At the 200-watt level the beacon transmitter was able to provide continuous signals, detectable by typical amateur radio telescopes around the world, any time the Moon was above the horizon at the station's New Jersey QTH.

Unfortunately, the reliability of the solid-state amplifier left

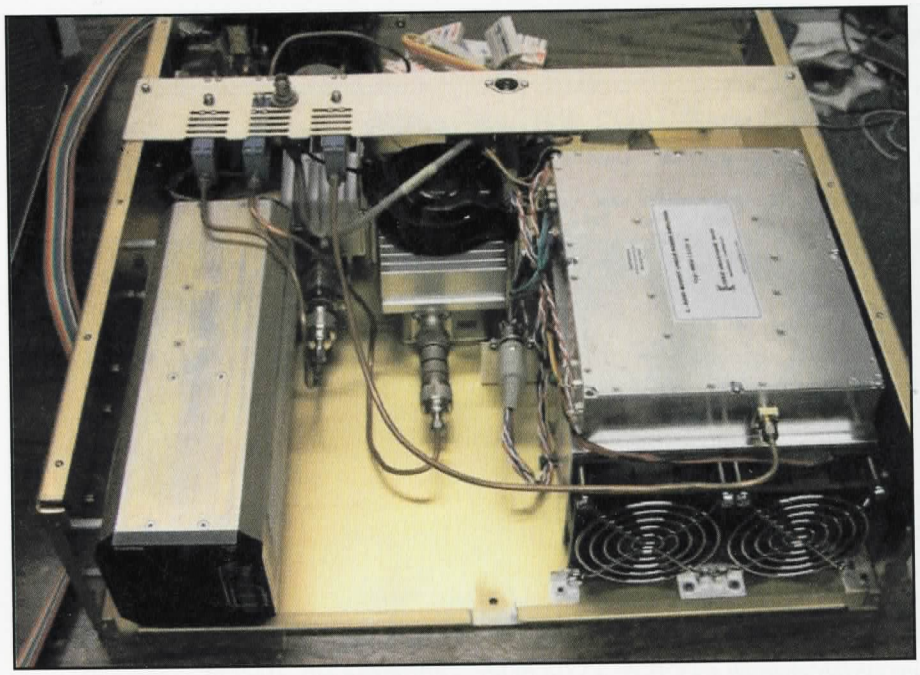

Figure 3. Kunhe MOSFET power amplifier installed in W2ETI EME beacon.

much to be desired. The amplifier incorporated 16 Mitsubishi M57762 RF modules in its final stage. These modules proved quite unreliable, especially when used continuously 12 hours per day. Having replaced several such modules over the period of a year (at a cost of roughly $100 U.S. each), we began studying alternatives to this particular solid-state power amplifier.

The SETI League was spared the expense of replacing more RF modules in the spring of 2004 by a lightning strike that damaged the fragile power amplifier beyond repair. Two years of total redesign followed. The beacon was returned to service in March 2006. The completely refurbished beacon gained a new 1/2-kw MOSFET power amplifier, the MKU 13500 A (see figure 3), ordered from Kunhe Electronics in Germany. WA2IKL has added a completely repackaged exciter, atomic and GPS frequency standards, new control computers and

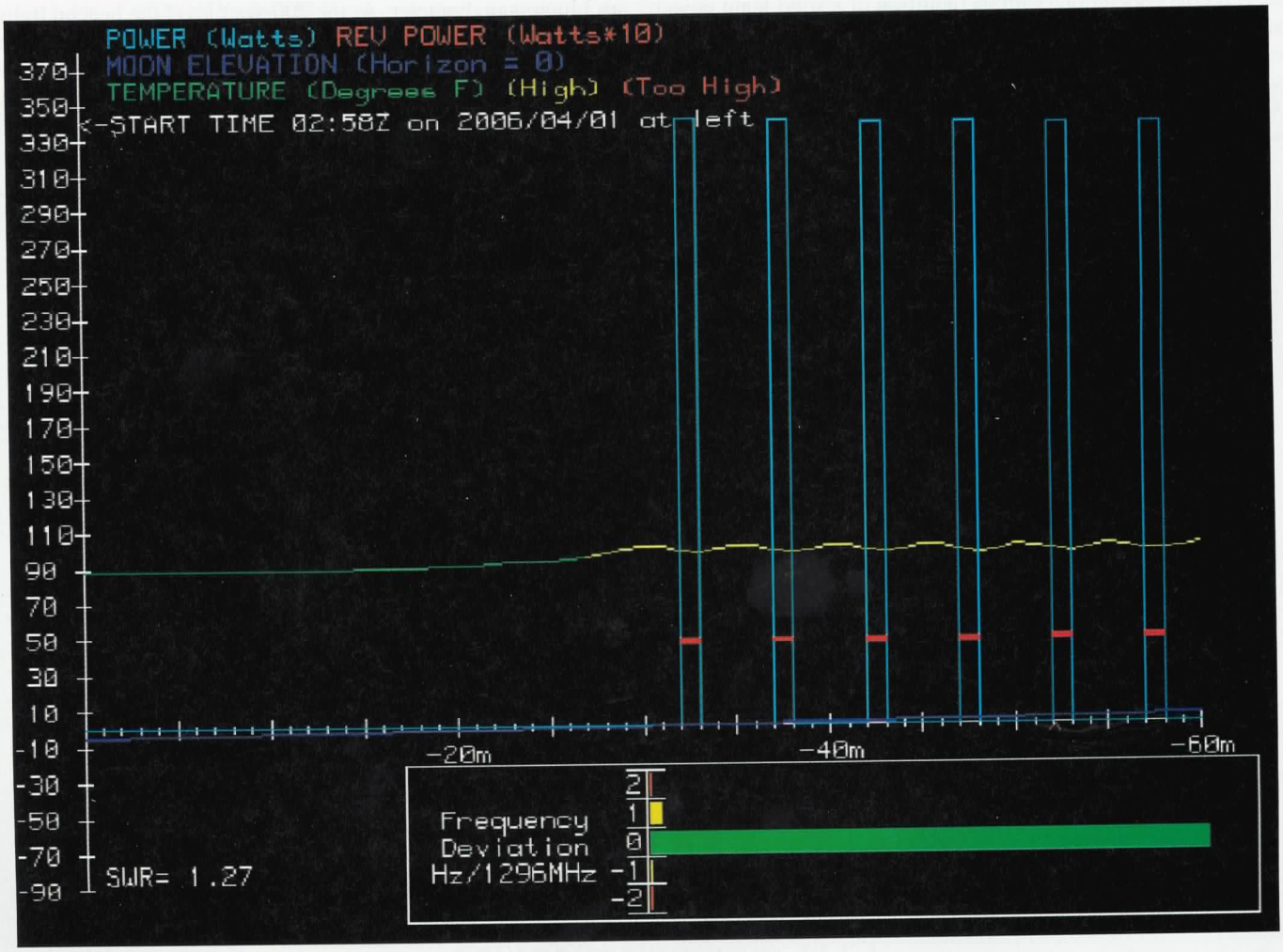

Figure 4. W2ETI Remote Telemetry displays beacon forward and reverse power, cooling air temperature, and frequency for the most recent hour, updated once per minute.

Correction

In Part 1 of "Beckoning Beacons," Dr. SETI's Starship, in the Fall 2008 issue of *CQ VHF*, we inadvertently published incorrect figures, figures that should have gone with Part 2 in this issue. The correct figures for Part 1 appear here as figures A and B. The figures that go with Part 2 are labeled 1 through 4 in this column. We apologize for any confusion.

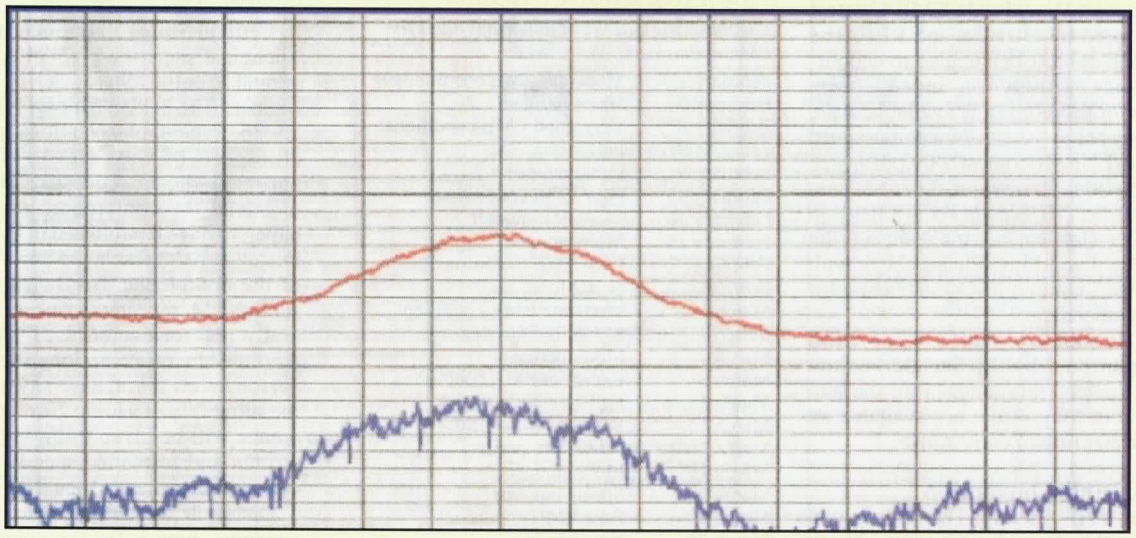

Figure A. Drift-scan sweep of Quasar 3C273 about 3 dB out of the noise.

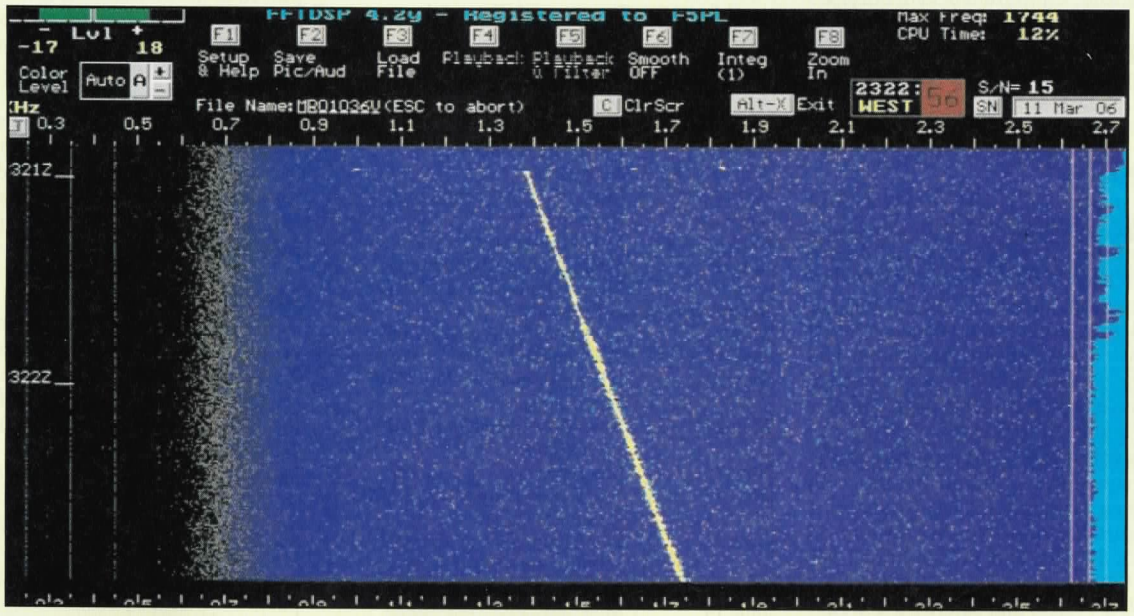

Figure B. Mars Reconnaissance Orbiter beacon received by F5PL from Martian orbit.

ssociated software, new power supplies, nd a 3-kw UPS. The resulting beacon ppears robust and reliable, offering ama- eur radio telescopes around the world recisely calibrated test signals emanat- ng from a known spot in space.

An important feature of the renovated ME beacon is the use of remote moni- oring via the internet. Any user can track ansmitter power (forward and reflect- ed), PA cooling air temperature, and frequency (in real time) by logging on to www.setileague.org/eme. As seen in figure 4, one hour of history, updating once per minute, is displayed.

The Next Step

Plans are under way to replace the existing quad helix antenna array with eight loop Yagis from Directive Systems of ME. The resulting improvement in gain promises to make the W2ETI 1296-MHz beacon accessible even to entry-level SETI, satellite, and EME stations.

Note

1. Shuch, H. Paul, N6TX, *2001,* "A Moonbounce Odyssey," *QST,* Vol. 85 (11): pp. 38–43, November 2001.