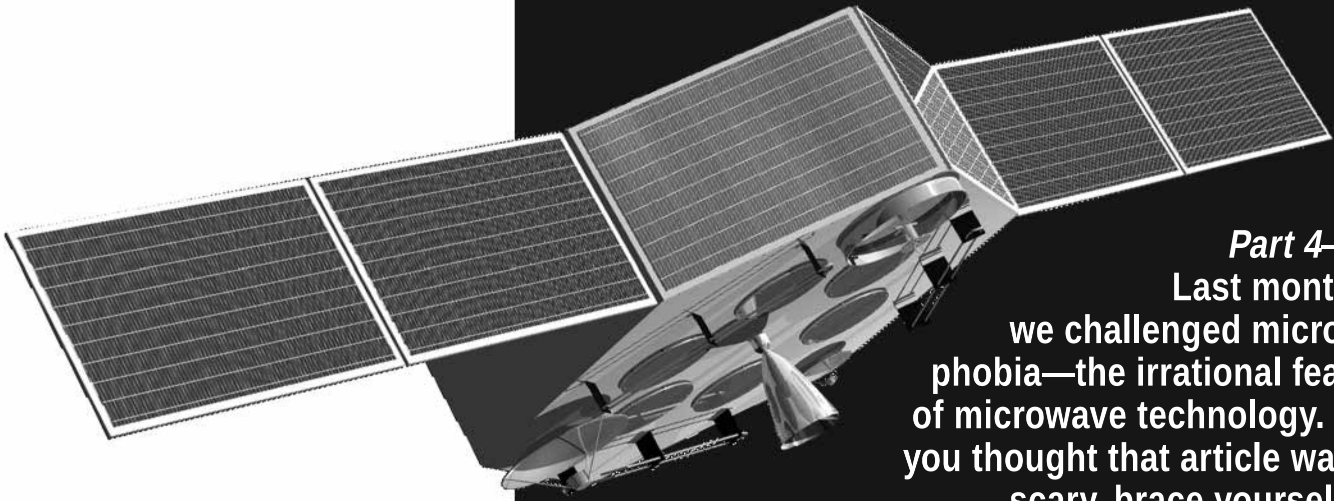
By Steve Ford, WB8IMY, and Zack Lau, W1VT

Get Ready for Phase 3D!



Part 4— Last month we challenged micro-phobia—the irrational fear of microwave technology. If you thought that article was scary, brace yourself.

The rotator hums softly, barely a whisper above the brisk autumn wind. A tiny parabolic dish antenna swings smoothly to the right, then tilts upward at a 40° angle. At the opposite end of the antenna boom, a small loop Yagi follows every movement of the dish. Together they point skyward like an alien hand, grasping eagerly for a distant object no human eye can see.

In a family room 20 feet below, a cheery fire crackles and pops. A 70-cm all-mode transceiver sits on a nearby desk, its red and green LEDs glowing brightly. A 2-meter all-mode rig shares the desktop too, along with a transmit converter for 1.2 GHz.

Sara switches the 70-cm transceiver to SSB and slowly spins the VFO control. Although the LCD display is showing 70-cm frequencies, she knows that the numbers really represent *10-GHz* frequencies. As she dials through one conversation after another, Sara quickly checks the 2-meter (or should we say 1.2-GHz?) transceiver. Good—it's on frequency and ready to go.

The grandfather clock in the hallway begins to chime. "Six o'clock," Sara mutters. "It's midnight in Stockholm."

She arrives on frequency just in time to hear, "KZ4ABC, this is SM5ZZI; do you copy, Sara?"

"Good morning, Arnie! SM5ZZI from KZ4ABC. You're sounding super as usual…"

From nearly 30,000 miles away, the Phase 3D satellite "listens" to Sara's signal on the 1.2-GHz uplink. In a split second it repeats her transmission on the 10.5-GHz downlink. It's a 60,000-mile trip from Alabama to Sweden, but they're spanning the distance without fading, noise, interference, or large antennas.

The 10-GHz *Supersatellite*

If all goes as planned, Phase 3D will have a substantial signal on 10.5 GHz. How substantial? Consider the fact that earthbound 10-GHz operators often use transmitters in the *milliwatt* class to make contacts over distances of 100 miles or more. In contrast, Phase 3D's 10-GHz transponder will generate *50 W* output to a high-gain antenna system. The net result is rock-crushing power, as far as amateur microwave is concerned.

The benefit to you will be good signals without the need for massive antenna arrays. In fact, your 10-GHz downlink antenna need only be a mere 18 inches in diameter. More about these little marvels in a moment.

Getting on 10-GHz is not entirely "plug and play," but it isn't rocket science, either. You can put together a mode L/X station for Phase 3D (1.2 GHz up, 10.5 GHz down) in a single weekend—without exotic tools or test equipment.

The Lure of 1.2 GHz

One of the strengths of Phase 3D is its transponder flexibility. Various combinations of uplinks and downlinks can be implemented, according to the needs of the amateur satellite community. It is possible, for example, to uplink to the bird on 5.6 GHz and relay on 10.5 GHz. That would be mode C/X (see Part 1 of this series). The buzz on the "streets," however, is that most 10.5-GHz aficionados will prefer a 1.2-GHz uplink—mode L/X. The reason is primarily economic—there is more transmitting gear available at affordable prices for 1.2 GHz, as compared to 5.6 GHz.

The easiest road to 1.2 GHz is via a 2-meter all-mode transceiver. By feeding the output through a power attenuator and into a transmitting converter, you can generate a 1.2-GHz signal in a straightforward fashion (Figure 1). And if your bank account can withstand the strain of purchasing a *multiband* all-mode transceiver such as an ICOM IC-821, Yaesu FT-736 or Kenwood TS-790, you'll be in hog heaven. One of these versatile radios can function as your transmitter *and* receiver. (You can even purchase modules for the FT-736 and TS-790 that allow them to generate 1.2-GHz signals directly—no converters required.)

Of course, this is not to say that you can't use an HF rig to drive a 1.2-GHz converter, but it isn't standard practice. Several converter manufacturers *do* offer this option for their 1.2-GHz transverters at an extra cost.

After you've obtained a 1.2-GHz signal, you'll need to amplify it to a useable power level. Most transmit converters provide only a watt or two of output, but you can purchase 1.2-GHz power amps that will take you up to 10 or 20 W. Assuming that you're using a 1.2-GHz beam with reasonable gain, that should be sufficient power for Phase 3D.

The choice of where to install your transverter and power amp depends on the distance between the units and your antenna. Some microwave enthusiasts prefer to install their 1.2-GHz converters and amplifiers outdoors near their antennas. This minimizes the RF loss in long runs of coaxial cable. The disadvantage of this approach is that you may have to provide a heated, weatherproof shelter. If the distance between the transceiver and the antenna is short (less than 50 feet), you may be able to keep your converter and amplifier indoors near your operating position. Make sure to use the best low-loss coax you can afford, though.

And what about that 1.2-GHz antenna?

If you want to save time, you can purchase an off-the-shelf 1.2-GHz Yagi. Most antenna manufacturers carry 1.2-GHz antennas in their product lines. Many of these antennas will be linearly polarized, so you'll miss the optimum uplink gain by about 3 dB. If you're feeding 10 or 20 W of RF to the antenna, however, it may be enough to compensate.

On the other hand, you can cobble together a 1.2-GHz helical antenna from designs in *The ARRL Antenna Book*. Not only is a homebrew helix inexpensive, it offers circular polarization, allowing you to dodge the polarization-mismatch bugaboo.

Listening on 10 GHz

No doubt you've seen advertisements for Digital Satellite Systems (DSS). For $30 a month—depending on the program provider—DSS viewers are treated to gorgeous images and CD-quality audio. DSS households are easy to spot—just look for the 18-inch parabolic dish antennas with the offset feeds.

DSS is becoming so popular that repair and replacement parts are already showing up for sale in the "secondary" electronics market. MCM Electronics (see the "Resources" sidebar) sells replacement DSS dishes for only $50. DSS antennas with "anti-ice" heating elements sell for $73.

So why should you care about DSS antennas?

Well, even though they're designed for higher frequencies, DSS antennas do a bang-up job at 10.5 GHz! For $50 or less, you get a precision antenna—some even have the feed support already in place. All you have to do is install the feed and you're in business.

In an article in the December 1995 issue of *QEX*, Paul Wade, N1BWT, described in detail how to convert commercial DSS antennas to amateur use.[1] The article is more than worth the reprint cost if you decide to use this approach. Of course, you can also expect to see 10.5-GHz antennas from amateur manufacturers if Phase 3D generates sufficient activity on this band.

[1]Notes appear on page 00.

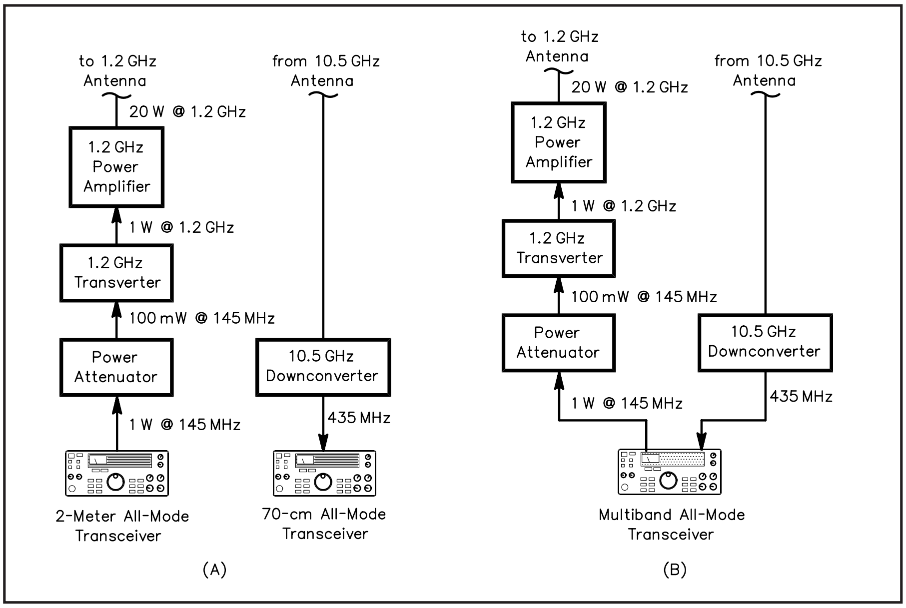


Figure 1—There are several ways to set up a mode L/X ground station for Phase 3D, depending on equipment availability and your personal finances. The configuration shown at **(A)** uses a 2-meter all-mode transceiver to generate a signal on 1.2 GHz. A 70-cm all-mode rig is used to receive the signal from the 10.5-GHz downconverter. At **(B)**, a multiband all-mode transceiver is used to generate the 1.2-GHz signal *and* receive the 10-GHz IF on 70 cm. Note that a separate power attenuator may not be necessary if you purchase a transverter that incorporates this component as part of its design.

PAUL WADE, N1BWT

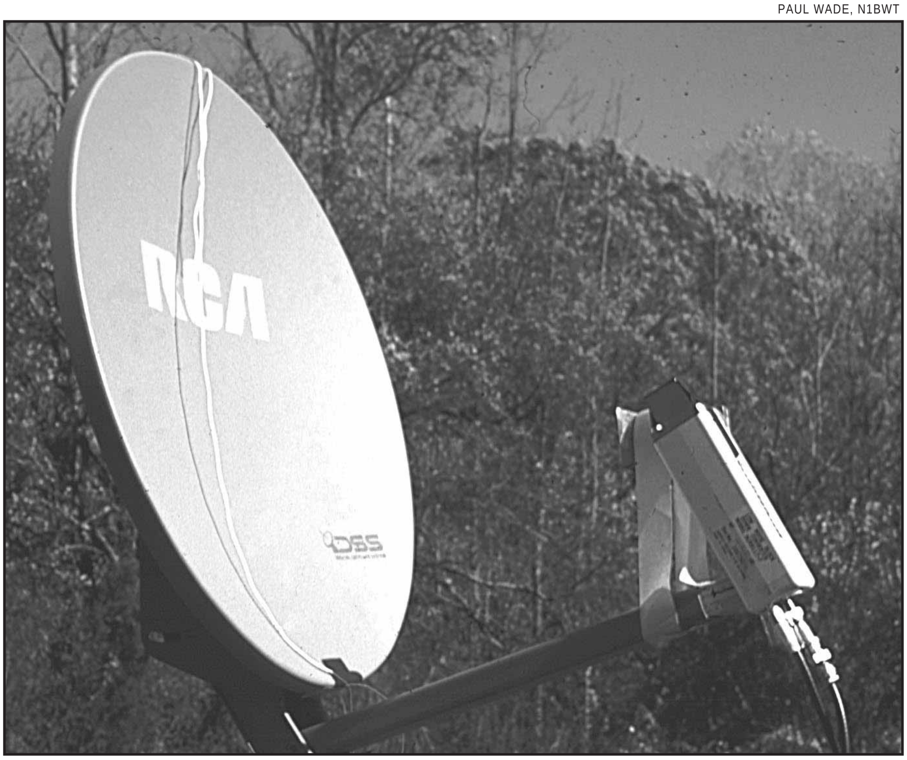


Figure 2—An 18-inch DSS offset dish antenna modified for use on 10.5 GHz.

Resources

Advanced Receiver Research
Box 1242
Burlington, CT 06013
tel 860-485-0310

Down East Microwave
954 Rt 519
Frenchtown, NJ 08825
tel 908-996-3584
fax 908-996-3702
WWW **http://www.downeastmicrowave.com/index.html**

MCM Electronics
("Perfect 10" DSS antennas)
850 Congress Park Dr
Centerville, OH 45459
800-543-4330

Parabolic AB
(See SSB Electronic below)

SSB Electronic USA
124 Cherrywood Dr
Mountaintop, PA 18707
tel 717-868-5643
WWW **http://www.ssbusa.com**

KEITH BAKER, KB1SF

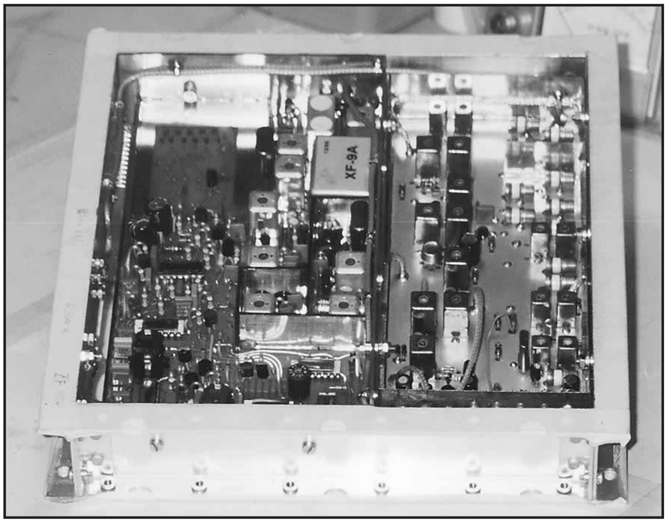


Table 1

Phase 3D Mode C/X and L/X Frequencies

Note: These are *inverting* transponders. For example, if you transmit *upper* sideband in the *lower* portion of the uplink passband, the satellite repeats in *lower* sideband in the *upper* portion of the downlink passband.

UPLINKS

Band	*Digital (MHz)*	*Analog (MHz)*
23 cm(1)	1269.000–1269.250	1269.250–1269.500
23 cm(2)	1268.075–1268.325	1268.325–1268.575
6 cm	5668.300–5668.550	5668.550–5668.800

DOWNLINK

Band	*Digital (MHz)*	*Analog (MHz)*
3 cm	10451.450–10451.750	10451.025–10451.275

When you transmit to Phase 3D on 1.2 GHz, this receiver will be listening for your signal!

Once you have an antenna to focus the 10.5-GHz signals from Phase 3D, you need to convert them to lower frequencies. That's where the *downconverter* comes into play. The good news is that you'll find 10.5-GHz downconverters available from several sources (see the "Resources" sidebar) as ready-to-go units, or in kit form. Homebrewers will be pleased to know that *QST* has published a series of articles featuring 10.5-GHz downconverter[2] and 2-meter IF receiver projects.[3]

If the feed assembly is sturdy, it's best to install the 10.5-GHz downconverter adjacent to the feed itself (Figure 2). You want the downconverter to be as close to the feed point as possible.

Most 10.5-GHz downconverters use either a 2-meter or 70-cm IF, and many manufacturers provide "custom" IFs to suit your needs. Regardless of which IF frequency band you use, you'll need a 2-meter or 70-cm receiver (or all-mode transceiver) in your shack. As we've already discussed, a multiband all-mode rig is ideal for this application. You can also buy single-band all-mode radios off the shelf, and occasionally hunt them down in the used-equipment market.

Strange as this may sound, you don't have to worry too much about the coax between the downconverter and your receiver. Downconverters designed for 10.5 GHz have a wealth of signal gain; sometimes a little *too much* for certain receivers. So, you could be especially clever and use higher-loss coax—such as RG-58—to knock down the signal before it reaches your receiver. If that approach makes you shudder, go ahead and string up low-loss cable instead. Just be prepared to use the receiver's RF attenuator!

To Rotate or Not to Rotate

If you've blown your wad on all this radio hardware, you might be dismayed to learn that an *azimuth/elevation* rotator (such as the Yaesu G-5400B) will set you back another $500. If you want to track Phase 3D as it moves across the sky, an az/el rotator system is critical. You may be able to save money by constructing an az/el rotator of your own using surplus TV units—assuming you can locate the right models.

The alternative might be to leave your antennas in fixed positions. If—and this is a *big* if—Phase 3D gets into the proper orbit, the satellite will take the same path across your local sky every 48 hours. With satellite-tracking software, you can determine exactly where the satellite will appear. You can aim your antennas at the highest elevation point and probably get an hour or two of usable performance every time the bird comes calling.

An az/el rotator system is the way to go if you can afford it. It will give you hours of operating time whenever Phase 3D is available. But if a rotator isn't in your future at the moment, consider the set-and-forget technique.

Next Month

In the last part of our Phase 3D series, we'll wrap up with an overview of some of the less-discussed aspects of the satellite—from GPS to cosmic-ray experiments!

Notes

[1] P. C. Wade, N1BWT, "More on Parabolic Dish Antennas," *QEX*, Dec 1995, pp 14-22. Reprints are available from Bridget DiCosimo, ARRL Technical Secretary, 225 Main St, Newington, CT 06111; $3 for ARRL members, $5 for nonmembers.

[2] Zack Lau, KH6CP, "Home-Brewing a 10-GHz SSB/CW Transverter—*Part 1*," *QST*, May 1993, p 21; *Part 2*, Jun 1993 *QST*, p 29.

[3] R. Campbell, KK7B, "High-Performance, Single-Signal Direct-Conversion Receivers," *QST*, Jan 1993, p 32.

New Products

TEN-TEC QRP CW TRANSCEIVER KITS

◊ Ten-Tec has expanded its T-kit offerings with a new line of low-power CW transceivers for 80, 40, 30 and 20 meters—T-kit models 1380, 1340, 1330 and 1320, respectively. Each transceiver covers a 50-kHz segment of the band, which the builder selects at the time of construction. Kits include all required components and a painted, silk-screened enclosure. All transceivers offer full-break-in operation.

Transmitters are 3 W typical output; receivers are single-conversion superheterodynes (with JFET mixers), and claim a 0.25-µV sensitivity for 10-dB S/N. A four-pole crystal ladder filter provides a 1-kHz nominal bandwidth. AGC is audio-derived. All transceivers have RIT (±1.5 kHz) and sidetone. T/R switching is solid-state.

Kits are $95 each, available from Ten-Tec, 1185 Dolly Parton Pkwy, Sevierville, TN 37862-3710; orders 800-833-7373; information 423-453-7172; fax, 423-428-4483; e-mail **sales@tentec.com**.