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MFJ Model 9406 6-Meter SSB Transceiver

QST Compares: Medium-Power 2-Meter Amplifiers
(Mirage B-5016G; TE Systems 1412G; Teletec DXP-V175; Tucker V-100W)

Advanced Electronic Applications AEA HALO-6 Antenna for 6 Meters

Edited by **Rick Lindquist, KX4V** • Assistant Technical Editor

MFJ Model 9406 6-Meter SSB Transceiver

by Peter Budnik, KB1HY
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With the ever-increasing popularity of 6 meters (aka "The Magic Band"), I knew it wouldn't be long before an *affordable* single-band 6-meter SSB transceiver would come on the market. And MFJ did it! The MFJ-9406 is a compact 6-meter SSB transceiver that will get you on this special band with very little effort on your part. It's an excellent choice for the new operator, and it makes for a good back-up radio for the veteran VHF enthusiast.

The MFJ-9406 is small and lightweight. It's housed in a compact aluminum box and weighs just under 2 lb, making it an ideal radio for those backpack VHF expeditions as well as fixed-service operating. With the optional MFJ-416 module, the MFJ-9406 also can operate semi-break-in CW. The black-vinyl-finished top cover is held in place by six machine screws that provide relatively easy access to the inside of the radio. The model MFJ-9406*X* package, which we reviewed, includes a large mobile-type hand mike (MFJ-290) with a coiled cord. MFJ also offers a dc power supply (MFJ-4110) for the MFJ-9406, which we ordered and used during the review. It powers the radio quite well and never faltered, but it's a clunky bit of apparatus that's comprised of a huge plug-in cube (it covered up three outlets on a typical power strip) that supplies 14 V ac, and a separate in-line box that contains components to rectify and filter the supply voltage.

MFJ's power supply is not your only choice. Any well-filtered 13.8-V dc power source can energize this radio. For expedition-type operating, MFJ offers the optional MFJ-4114 dry-cell battery pack, which holds 10 D-cell NiCd batteries. That should provide up to approximately 12.5 V.

The manual says the MFJ-9406 will run off 12 V "at reduced RF output." We found, however, that our review unit behaved badly when the supply voltage dropped below 12.2 V, and it began to generate illegal spurs (MFJ says it has received no reports of this happening on other MFJ-9406s.). Adjusting the internal voltage regulator (**V-REG**) trimpot lowered the voltage at which the radio went haywire to 11.7 V. A second transceiver supplied by MFJ performed properly and did not generate spurs when the voltage was dropped below 10.5 V. Suffice it to say that the transceiver could operate erratically if the power supply voltage is less than 12 V, however, and you might want to tweak the **V-REG** adjustment if you plan to run the unit exclusively from battery power.

The '9406 at a glance

My first impressions of the radio itself were quite positive: Just take it out of the box, hook it up to the power supply, add a 50-MHz antenna, and away you go! Or, as MFJ puts it: "Just turn on and tune in."

Connected to a 13.8-V power source, it develops 10 W PEP RF output. At this output level, the radio consumes slightly more than 1 A on transmit and 140 mA on receive (including the S-meter lamp). Such low power consumption might even make the '9406 a good candidate for use with a solar panel, making the radio capable for use during "back-country" operating, for example (and for a portable antenna suggestion, see our review of the AEA HALO-6 in this "Product Review"—*Ed*).

The front panel has few controls, so it's an easy radio to operate. The analog dial has a vernier-driven plastic pointer. It tunes from 50.0 to 50.3 MHz. The silk-screened dial is calibrated in 25-kHz steps, with printed markers for 50.0, 50.1, 50.2 and 50.3 MHz. The dial proved surprisingly accurate across the band. But remember: this is an *analog* dial, and unless you keep a frequency counter handy, you won't know *exactly* where you are with the '9406. The VFO knob has a nice solid feel to it, however, and it tunes easily.

As a veteran user of an old ICOM IC-502 6-meter radio that also has an analog frequency display, I found tuning the '9406 to the desired operating frequency to be a snap. It was easy to be "pretty darn close" to the frequency that I wanted to dial in. Using another 6-meter radio as test receiver, I set the VFO on the MFJ to 50.100, 50.125 and 50.150 MHz. I found that the radio was usually right on the frequency displayed on my (uncalibrated) test receiver—not bad at all, I think. (In contrast, I could *never* do that with my old ICOM '502!)

I also tried to "split the difference," by attempting to tune the MFJ-9406 to exactly 50.137.5 MHz (halfway between the two front-panel dial markings of 50.125 and 50.150 MHz). When I transmitted, the digital display on my test receiver indicated 50.138.62. Now, to me, that's *analog accuracy*!

A front-panel **FINE TUNE** control (which MFJ calls VFT or Variable Frequency

BOTTOM LINE

The MFJ-9406 is a welcome economy-class ticket to "The Magic Band." A superb performer for its price and great fun to use!

Table 1
MFJ-9406 6-Meter Transceiver

Manufacturer's Claimed Specifications	***Measured in the ARRL Lab***
Frequency coverage: Receive and transmit, 50.0-50.3 MHz.	Receive and transmit, 49.99-50.32 MHz.
Modes of operation: USB and CW (with CW adapter)	As specified.
Power requirement: Receive, 60 mA (S meter lamp disabled); transmit, 2.0 A (max) at 13.8 V.	Receive, 140 mA (including the S-meter lamp); transmit: CW, 1.02 A; SSB, 1.4 A; tested at 13.8 V.
Receiver	*Receiver Dynamic Testing*
SSB/CW sensitivity (bandwidth not specified, 12 dB S/N): 0.15 μV.	0.12 μV (–135 dBm).
Blocking dynamic range: Not specified.	87 dB.
Two-tone, third-order IMD dynamic range:	72 dB.
Third-order intercept point: Not specified.	–33 dBm.
S-meter sensitivity: Not specified.	S9 signal, 6 μV
Receiver audio output: 1 W at 10% THD into 8 Ω.	0.6 W at 10% THD into 8 Ω.
Spurious and image rejection: Not specified.	IF rejection 104 dB; image rejection 130 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: SSB, 10 W PEP; CW, 5-8 W	As specified.
Spurious-signal and harmonic suppression: 60 dB.	As specified. Meets FCC requirements for spectral purity.
SSB carrier suppression: Not specified.	≥ 50 dB.
Undesired sideband suppression: Not specified	≥ 60 dB.
Third-order intermodulation distortion products: Not specified.	See Figure 1
CW keying characteristics: Not specified.	See Figure 2
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, ≈110 ms.
Receive-transmit turnaround time ("tx delay"):	≈17.5 ms.
Composite transmitted noise: Not specified	See Figure 3
Size (height, width, depth): 2.5×6.5×6 inches; weight, ≈2 pounds.	

NOTE: Dynamic-range measurements are made at the ARRL Lab standard spacing of 20 kHz.

Tune), works in conjunction with the main VFO knob. VFT controls *both* your transmit and receive frequencies at the same time—allowing you to tune in SSB signals for clear, pleasant, voice recognition or just keep abreast of the drift (more on that later). The control shifts frequency approximately ±2 kHz from its midpoint.

The front panel also has a separate red (on and) **OFF** button. There is a 5-pin (DIN-type) **MIC** jack, a 1/8-inch CW **KEY** jack (for use with the optional CW board), a red LED **TX** indicator and an analog S meter. The S meter measures signal strength on receive and ALC (**PROCESS**) on transmit.

The rear panel has three jacks plus one potentiometer that sets the mike gain.

The jacks include the **ANTENNA** jack for a 50-Ω antenna, a 5.5×2.1-mm coaxial power jack (for 12 to 14 V dc) and an **EXT**ernal **AMP** phono jack, which provides a ground path during transmit for keying an external 6-meter power amplifier. (Be sure to follow all of the manufacturer's instructions before using an external power amplifier with the '9406.) The factory setting for the mike gain pot was at the 12-o'clock position. This worked fine on the air. All transmit audio reports were excellent: "Very clear, with some audio punch," was one typical report. "Sounds really, really good. Great audio!" was another. The MFJ 9406 has built-in speech processing that—according to MFJ—gives you an added "4- to 6-dB advantage."

At first glance, the MFJ-9406 seemed to have all the bases covered, but I uncovered one glaring exception. As an avid 6-meter operator, there are times when I just can't hear the other station. The received signal may be down in the noise a little, or, worse, the kids are causing (playtime!) QRM in the background! (I have two boys, Adam, 6, and Ben, 8). To help me overcome such "obstacles," I usually grab my headphones so I can get a little "closer" to the desired signal. However, when I went to plug my 'phones into the MFJ-9406, I got stopped in my tracks! *What, no headphone jack?!* That's right, there is *no* provision for headphones. (We had the same complaint when we reviewed the MFJ-9420 Travel Radio; see "Product Review," *QST*, Feb 1996, p 76.)

A headphone jack sure would make a more-than-handy addition to this radio, and MFJ says it plans to include a 1/4-inch headphones jack in the future on its SSB transceivers. As this review went to press, MFJ announced that it is offering an adapter kit (MFJ-62) to add a headphones jack to this and its other SSB transceivers. The retrofit will provide a 1/4-inch jack on the rear panel that accepts both mono and stereo plugs.

While we're on the subject of audio, I found the receive audio from the 3-inch, top-firing, internal speaker to be quite good; it offered plenty of volume—even in a noisy mobile environment (like that found inside my 4-wheel-drive truck, for example). Audio from a loud, strong signal will distort if you crank the volume up too far. By the way, operating mobile with the MFJ-9406 turned out to be a frustrating experience because there's no noise blanker to kill the ignition noise. It may not be a problem in *your* vehicle, however. Of course, you could always use it only when you're stopped, say on a nice high mountain or hill. If MFJ had included an effective noise blanker, I'd have no problem recommending this radio to mobile ops.

The *Instruction Manual* for the MFJ-9406 is only seven pages long, but it still provides a good description of all the radio's features and controls. It also gives you good insight into why the 6-meter band is often called "The Magic Band." To introduce newcomers to 6 meters, it covers the different types of operating conditions you may encounter while on the air. For ragchewers and DXers alike, the manual also gives a brief explanation of the many different types of propagation typical on the 6-meter band, including tropospheric bending, sporadic E and FAI, meteor scatter, F2 and others. Sections on theory of operation and troubleshooting, a one-page schematic, a block diagram and a pictorial diagram—showing internal adjustment points—also are included. For convenience, the manual even reproduced the *ARRL Grid Locator for North America* map. For those who want to chase grid squares and earn your ARRL VUCC Award, all you have to do is work and confirm 100 different grid squares to qualify for the initial award. Try it! It's one of the most prestigious VHF operating awards the League offers. (Bill Moore, NC1L, DXCC Supervisor, e-mail **bmoore@arrl.org**, has details.)

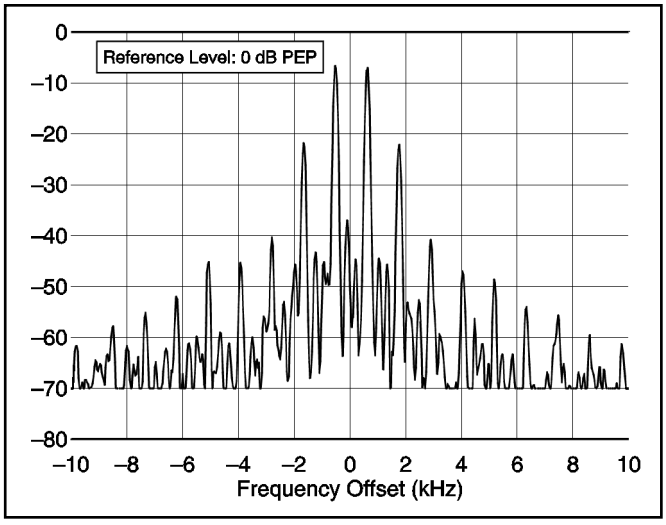


Figure 1—Worst-case spectral display of the MFJ-9406 transmitter during two-tone intermodulation distortion (IMD) testing. Worst-case third-order product is approximately 22 dB below PEP output, and the fifth-order product is approximately 40 dB down. The transceiver was being operated at 9.2 W PEP output at 50.2 MHz.

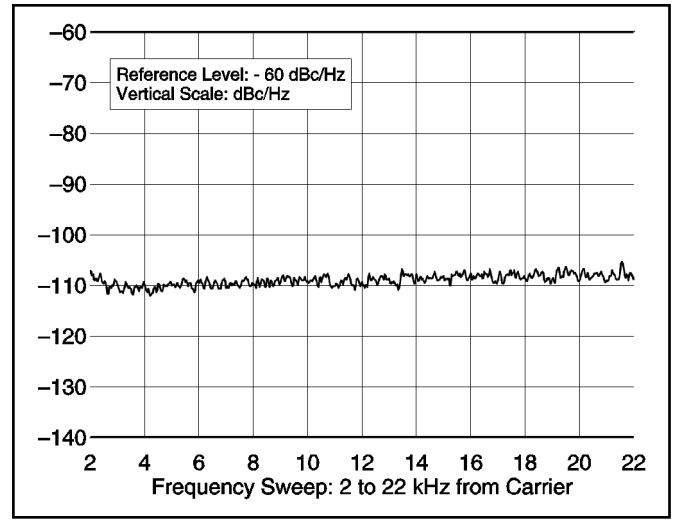


Figure 3—Worst-case spectral display of the MFJ-9406 transmitter output during composite-noise testing. Power output is 6 W at 50.2 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

On the Air!

"CQ 6 meters, this is KB1HY" With the band fading after a really good opening (as indicated by the "spots" on the local packet node), I was greeted by a reply to my CQ from a fellow ham in grid square EM-91 in southeastern Georgia! We exchanged reports—and out went the band. I was very pleased—especially during such marginal conditions—that my 10-W signal was being heard. That's part of the "magic" of this band!

My second contact was with a local, Joe, N1SBA, in Durham, Connecticut. Joe was also using a MFJ-9406, so this gave me a chance to hear his reaction to the radio, and to hear the transmit audio firsthand. Joe lives on a farm and mentioned that he was able to hear QRN from his electric fence and milking machine. (Another op also found it was quite vulnerable to computer hash that wasn't audible on his other 6-meter radio.) During the course of the review, we worked several other more-distant stations that were also using the MFJ-9406. On this end of the circuit, they all sounded quite impressive. One fellow allowed he was "having a ball" with his.

I have to say that I was impressed with the receiver, though. The preamp on the front end made it easy to copy signals that were way down in the noise. While we were occasionally troubled by QRM from strong, close-in signals when the band was crowded, most times, its six-pole crystal IF filter did an adequate job. On the transmit side, the MFJ-9406 also has a built-in seven-element low-pass filter to help minimize the chances of FM broadcast interference and TVI (you wouldn't want any phone calls or knocks at your door from your neighbor while you're making contacts with those rare grid squares).

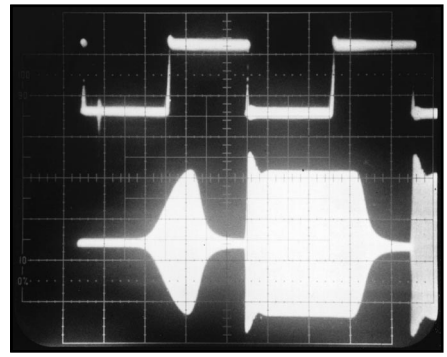


Figure 2 —CW keying waveform for the MFJ-9406 in the semi-break-in mode. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 6 W output at 50.1 MHz. Note the significant shortening and slower rise time of the first dit.

I did encounter a problem with frequency stability. The review radio would shift (or drift) from its initial operating frequency. ARRL Lab testing confirmed this. When first turned on, the radio drifted lower in frequency by a few dozen Hz, then drifted higher in frequency—less than 450 Hz all told in the space of an hour. Curiously, I didn't notice the drift problem while talking to N1SBA. Perhaps it was because we were both using the same radio and were drifting along in sync! During other contacts, however, I found myself retuning a lot as the QSO progressed. Just a small correction with the **FINE TUNE** control was enough to put the radio back on track. This wasn't a problem when making quick contacts. But, while ragchewing for any length of time, it was pretty annoying for both parties.

Conclusions

After many years as a 6-meter operator—and after owning numerous radios for this band—I enjoyed the MFJ-9406 immensely. It's an affordable, compact, easy-to-operate transceiver. While it doesn't have some of the typical creature comforts—like a noise blanker or a headphone jack—it does incorporate many excellent features.

When the band was open, I found its 10 W of SSB output let me work just about any station I could hear. The built-in speech processor gives you the punch needed to cut through QRM, too. Don't let the analog tuning scare you away. Earlier, I coined the phrase "analog accuracy," because I believe you'll have few problems when tuning to your favorite operating frequency. The CW adapter board lets you run 5 to 8 W. The sidetone is via a piezo sounder on the adapter board, however, not through the speaker.

All in all, I think this radio would make an excellent choice for your first 6-meter station. While the MFJ-9406 lacks some of the features of "full-sized" 6-meter radios (or HF radio/transverter combinations), it sure puts you on the band quickly and at minimal expense (about the same as you might spend for a transverter to use with your HF transceiver). The MFJ-9406 puts The Magic Band within easy reach.

My thanks to Rick Lindquist, KX4V; Mike Gruber, WA1SVF, of the ARRL Lab; and Glenn Swanson, KB1GW, for their valuable contributions to this review.

Manufacturer: MFJ Enterprises Inc, PO Box 494, Mississippi State, MS 39762; tel 601-323-5869; fax 601-323-6551; Manufacturers suggested retail price, MFJ-9406, $249.95; MFJ-9406X (includes the MFJ-290 hand mike), $259.95; MFJ-4110 ac power supply, $39.95; MFJ-4114 battery pack, $69.95; MFJ-416 CW adapter; $39.95. MFJ-62 headphones adapter, $4.95.

QST Compares: Medium-Power 2-meter Amplifiers

By Steve Ford, WB8IMY
Managing Editor

Bottom Line

If you're looking to make a bigger splash on 2 meters, one of these medium-power RF amplifiers could be just the ticket. Any of these units would be quite acceptable for home-station or mobile applications.

These are the "big bricks." They're dense, rugged devices with a single-minded purpose: RF amplification.

Many of us are content with the output levels our VHF rigs provide, everything from a couple of watts (most H-Ts) to 50 W or more (mobile and base radios). But there are times when a *serious* RF boost is clearly necessary. If you're going to try your hand at DXing on 2-meter SSB or CW, you need to step up to the 100 to 200-W class. This is especially true if you want to sample the joys of meteor scatter. You also need RF muscle to work FM voice or packet from the fringes of a repeater or network coverage area.

The brick amplifiers meet these needs with elegant simplicity. There are few switches to worry about, and installation is easy. They're hefty, often weighing in at 5 lb or more, but most of that bulk is contributed by the heat sink. When you consider the amount of power they provide, these amplifiers are actually quite compact.

In addition to boosting your transmit gain, many amplifiers offer *receive* preamplifiers as well. The preamps may give received signals an 8 to 15-dB kick, but their ultimate benefit is questionable. Many VHF/UHF DXers and other "weak signal" enthusiasts prefer to install receive preamps at the antenna where gain is added *before* a long run of coax can detract from the signal-to-noise ratio. After all, when you amplify received signals at the amplifier, you boost the noise, too. This effect isn't very significant for FM work, but it could make a *huge* difference when you're trying to pull in a weak SSB or CW signal from 900 miles away. The amplifiers themselves also contribute to the noise level. Despite more-than-optimistic specifications, noise figures for the units we reviewed hovered around 2 dB for the most part. If you're operating FM, this probably isn't much to worry about. For weak-signal work, however, some ops might consider a preamp noise figure of 2 dB as unacceptable. All of the amps we reviewed had provisions (usually a front-panel switch) to turn the preamps off. Similar models without RF preamps are sometimes available.

A number of amplifiers include a switch labeled **FM/SSB**. This handy feature selects the "hang time"—the length of time the amp will "hesitate" before switching from transmit to receive. When you're operating SSB, your RF power levels fluctuate constantly from nearly zero to maximum. An amp that senses the presence of RF to control its transmit/receive switching (most do) will jump wildly from transmit to receive and back again with every utterance! With the switch in the **SSB** position, however, the amp will remain in the transmit mode for a short time after power levels drop to zero. This makes SSB operating much smoother and reduces wear and tear on the amp. If you're running FM, your radio is generating full output at all times, making the switching delay unnecessary. In that case, you place the switch in the **FM** position for immediate transmit/receive switching. (All of the amps in the review are designed for CW, SSB and FM.)

A word on IMD: At the rated output, the SSB transmit IMD for each of these amplifiers never quite reached –30 dB for third-order products. At maximum *input* power, the IMD figures became substantially worse. In light of this, the best approach might be to not try to get every bit of power out of these bricks. Your fellow band users will appreciate it too.

Finally, it's important to note one of the principal laws of physics: There is no such thing as a free lunch. An amp that generates 180 W of RF output from a relatively low-power input while operating from a 12 to 14-V dc source requires current—*lots* of current. If you're thinking about adding one of these bricks to your station, don't forget to include the cost of a high-current 13.8-V power supply that's capable of delivering 20 to 25 A.

Mirage B-5016G

Promising 160 W with a 60-W input, the B-5016G is one of several amps that Mirage makes in this power category. The B-1016G offers 160 W output from 10 W input; the B-2516 generates 160 W from 25 W input. During our Lab tests we found that our B-5016G could deliver 160 W with only 39 W of drive! When we increased the drive to 50 W the B-5016G responded with an output of 179 W. At the 179-W level, the brick drew about 18 A of current. While the B-5016 works at low power levels (0.5 W in gives you about 2 W out, and 2.5 W in yields just over 16 W out), you'd probably be better off with another model at those input levels.

The B-5016G includes circuitry to protect itself from high SWR (in excess of 3:1), high operating temperature (above 79° C or 175° F) and excessive RF drive (more than 55 W). To test the SWR protection, I deliberately hooked up the amp to my 440-MHz antenna and transmitted. I have no idea what the SWR might have been, but I didn't have more than a millisecond or so to think about it. The front-panel **SWR OVERLOAD** indicator lit up and the amp shut down completely.

The amp boasts a GaAsFET receive preamplifier that you can turn on or off via a front-panel switch. You can also use an internal DIP switch to reduce the preamp's gain if necessary. (This might be the case if

Mirage B-5016G, serial number 19199

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*		
Frequency range: 144-148 MHz	As specified.		
Power requirements: <25 A (nominal) at 13.8 V.	Transmit, 18.2 A (at 179 W out); receive, 200 mA.		
Power input/power output: 50 W/160W	39 W/160 W; 50 W/179 W.		
Spectral purity: Not specified.	Better than –60 dBc. Meets FCC requirements for spectral purity.		
Transmit IMD: Not specified.	3rd order, –28 dB; 5th order, –42 dB, measured at 160 W output.		
Receive preamp gain:	*144 MHz*	*146 MHz*	*148 MHz*
Low-gain setting, 15 dB	12.2 dB	11.6 dB	10.8 dB
High-gain setting, 21 dB	17.8 dB	17.3 dB	16.7 dB
Receive preamp noise figure: < 0.6 dB.	1.5 dB	1.8 dB	1.8 dB (low)
	1.5 dB	1.7 dB	1.8 dB (high)
Size (HWD): 3×5.5×12 inches; weight: 5 lb.			

TE Systems model 1412G, serial number A6981

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency range: 144-148 MHz	As specified.
Power requirements: Transmit 20 A (nominal) at 13.6 V.	Transmit, 22 A (at 160 W out); receive, 70 mA (Preamp only), measured at 13.8 V.
Power input/power output: 30 W/160 W.	As specified, FM and SSB.
Spectral purity: Not specified.	–60 dBc. Meets FCC requirements for spectral purity.
Transmit IMD: Not specified.	3rd order, –28 dB; 5th order, –43 dB, measured at 160 W output.

	144 MHz	*146 MHz*	*148 MHz*
Receive preamp gain: 15 dB (nominal min.).	11.7 dB	12.5 dB	12.9 dB
Receive preamp noise figure: 0.6 dB (nominal).	2.0 dB	1.9 dB	2.0 dB

Size (HWD): 2.8×5.8×10.5 inches; weight, 4 lb.

you're experiencing severe intermod interference.) Even after some tweaking (as suggested in the *Instruction Manual*), the preamp's gain and noise figure missed the manufacturer's specifications in either the high or low-gain positions, but we were able to get the noise figure below 2 dB. The *Instruction Manual* notes, however, that "because of the devices used," 12 dB might be all the gain you'll get in the high-gain position "in a worst-case event."

Like most bricks, the B-5016G relies on RF sensing to switch the unit from receive to transmit. That works well in most applications, but there are circumstances where you might want to key the amp from another source. To make this possible, Mirage has built in a separate keying jack on the back of the B-5016G. The "hang time" of the amplifier is selectable from the **SSB/FM** switch on the front panel. The 12-page *Instruction Manual* also describes a procedure for adjusting the delay using an internal potentiometer.

One B-5016G feature that captures the imagination is the remote-control capability. You can control all of the amplifier's front-panel functions remotely through the Mirage RC-1 Remote Control Unit. We did not test the RC-1 for our review, but I was intrigued by the possibilities. Earlier I spoke of the ideal scenario of installing preamps at the antenna. Why not install the entire amplifier and its preamp at the antenna? The B-5016G isn't weatherproof, so you'd have to come up with a protective housing. You'd also have to run some hefty cables to supply power to the brick, or also mount the DC power supply on the tower.

Manufacturer: Mirage Communications Equipment, 300 Industrial Rd, Starkville, MS 39759; tel 601-323-8287; 800-647-1800 (orders or dealer information only); fax 601-323-6551. Manufacturer's suggested retail price, B-5016G, $299; RC-1 Remote Control Head, $45.

TE Systems 1412G

The 1412G offers 160 W output when driven at 30 W input and includes a receive preamp. The power amplifier and the preamp have separate **IN/OUT** switches. The obligatory **FM/SSB** switch is present as well, but TE Systems takes a slightly different approach to adjusting the SSB hang time—they put the delay-adjustment pot on the *rear* panel with a prominent knob! Front-panel LEDs indicate which functions are active.

Remote control is also available in the 1412G in a manner similar to the Mirage B-5016G. Assuming you have adequate ventilation and a power source, you can install the 1412G just about anywhere and control most of its functions at your operating position. Both the remote control and external keying lines are available via a 7-pin rear-panel accessory jack. The appropriate plug is supplied, and the very thorough *Operating and Service Manual* details the connections, but you'll have to make up your own remote control box.

Speaking of power, TE rates the current requirements of the 1412G at 20 A, but the manual recommends a supply with an even higher current capacity. ARRL Lab tests proved this advice to be right on target. When driven to full output, our 1412G required *22* A of current. Power-supply voltage regulation seems critical for this brick. If the voltage falls much below 13.6 V when the amp is running at full throttle, output levels tend to drop sharply.

Although the 1412G is ruggedly put together, some extra care is necessary. Unlike some of the other amps we received, the 1412G does *not* include SWR or overdrive protection. The 1412G will shut down automatically if it gets too hot (above 65° C or 149° F), but it's up to you to keep an eye on your SWR and input power levels.

The only problems encountered with the 1412G concerned the spectral purity of its output and the performance of its preamplifier. The FCC requires that any spurious signals in the output of a transmitter or

Teletec DXP-V175, serial number 541

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency range: 144-148 MHz.	As specified.
Power requirements: 25 A (at 175 W out) at 13.8 V.	Transmit, 20 A (at 222 W out); receive, 60 mA, measured at 13.8 V.
Power input/power output: 0.5 W/2.5 W; 25 W/125 W; 50 W/180 W.	0.5 W/2.5 W; 19 W/125 W; 30 W/180 W; 50 W/222 W.
Spectral purity: Not specified.	Better than –60 dBc. Meets FCC requirements for spectral purity.
Transmit IMD: Not specified.	3rd order, –29 dB; 5th order, –45 dB, measured at 180 W output.

	144 MHz	*146 MHz*	*148 MHz*
Receive preamp gain: 8 dB.	8.7 dB	10.8 dB	11.2 dB
Receive preamp noise figure: Not specified.	2.7 dB	2.7 dB	3.5 dB

Size (HWD) 2×7.7×11 inches; weight: 8 lb.

amplifier be at least –60 dBc. During our initial tests we measured spurs (primarily second-harmonic energy) from the 1412G at –52 dBc. After obtaining another amp from TE Systems, we tested again and found that the spurs on that unit were down to legal levels, but just barely. The preamp was another matter. TE specs the preamp as having 15 dB of gain and a 0.6 dB noise figure. We measured the gain at 12.5 dB and the noise figures at or near 2 dB. TE Systems says the noise figure can be tweaked lower. A single-section band-pass filter follows the preamp in the TE 1412G.

The unit will amplify small transmitted signals *somewhat*. For 0.5 W input, our model 1412G turned out nearly 4 W, and at 2.5 W in, it provided nearly 24 W output. TE Systems offers similar amplifiers that accept lower power inputs. The model 1409G takes 2 W in for 150 W output; the model 1410G needs 5 to 10 W in for 160 W output.

Manufacturer: TE Systems, PO Box 25845, Los Angeles, CA 90025; tel 310-478-0591. Suggested retail price, Model 1412G, $275.

Teletec DXP-V175

Of the amplifiers chosen for this review, the Teletec DXP-V175 offers the highest RF output. It's *rated* at 180 W output for 50 W input, but the ARRL Lab was able to achieve 222 W with the same input (Teletec says its output transistors are rated at 100 W apiece)! Interestingly, the DXP-V175 also is able to work with *very* low RF drive levels. One-half watt of drive is boosted to about 2.5 W, for example.

The DXP-V175 includes protection against high SWR (beyond 3:1) and overheating (above 100° C or 212° F), but does not guard against excessive RF drive. It survived my crude SWR "overload" test very well; it popped off right away and returned after I cycled the **ON/OFF** switch.

Speaking of switches and controls, you'll only find one on the DXP-V175: **ON/OFF**. There isn't an FM/SSB mode switch, although you can adjust the hang time by turning a pot through a hole on the bottom panel. Teletec says the DXP-V175 operates in class AB_2 from low to high drive power, so it doesn't need an FM/SSB switch. The DXP-V175 includes a JFET preamp that slightly exceeded its 8-dB specification by up to 3 dB or so. There is no switch for the preamp; it can be disabled by applying 13.8 V at a rear-panel jack. At first glance, that might not seem to be the most convenient method, but it is great for remote-switching purposes. A two-section band-pass filter follows the preamp. Another rear-panel jack offers external transmit/receive switching.

The dearth of external controls indicates that the DXP-V175 is designed to be installed and forgotten, perhaps reflecting Teletec's status as a major manufacturer of commercial and public safety radios. The amp's low-profile design makes this quite easy to do. However, I found that the rugged aluminum heat sink became very warm after just a few minutes of operating. With that in mind, adequate ventilation is the order of the day.

If you tend to operate the same mode on a regular basis and want a minimal-adjustment, well-constructed, no-frills amp, the DXP-V175 is a good choice. The single-sheet *Instruction Manual* is sparse (how much does it really need to say?), but does offer a large, easy-to-read schematic diagram.

Manufacturer: Teletec Corp, 10101 Capital Blvd, Wake Forest, NC 27587; tel 800-776-0551; fax 919-556-6180. Manufacturer's suggested retail price, $289.

Tucker V-100W

The V-100W is the smallest amplifier in the group, both physically and in terms of output power. (It also costs less than the others.) When you consider its versatility, however, the V-100W excels.

The V-100W is designed to appeal to H-T users and owners of the popular ICOM IC-706 (an instruction sheet with the amplifier explains how to lower the IC-706's 2-meter output for use with the V-100W). Drive the V-100W with 0.5 W and you'll get at least 50 W output (we achieved 64 W). That's quite a boost for an H-T! If your H-T can generate 2 W, you'll end up with a whopping 100 W from the V-100W. Consider a 25-W mobile rig that has a 2-W or 5-W "low-power" setting. You could connect that mobile transceiver to the V-100W and achieve about 100 W output.

And the V-100W is an FM/SSB amplifier (the push-button switch is on the front panel). This creates some interesting possibilities for those who want to couple transverters to their HF rigs and get on 2-meter SSB or CW. Most transverters provide only a few watts of output. Feed that output to the V-100W, however, and suddenly you have a respectable 100-W signal!

The V-100W's switchable receive preamplifier showed extraordinary gain in our tests. It is rated at 15 dB gain, but we measured as much as 26.3 dB! While this is terrific gain for weak-signal work, 26.3 dB is way too much for most FM applications, especially if you live in a large metropolitan area. Of course, that's why they included the **RX ON/OFF** switch on the front panel. The noise figure was around 2 dB.

SWR protection is provided in the V-100W, and it survived my attempts to break it. There is no protection against excessive heating, but a fan mounted on the underside of the brick keeps it reasonably cool. The fan is small and quiet, but you must be careful not to inadvertently block the fan's airflow when you install the amp.

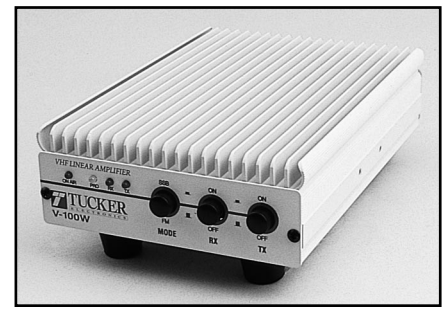
The V-100W lacks remote control options, but they really aren't missed. It does provide an external transmit/receive keying jack on the back panel, and that's sufficient for most applications.

Manufacturer: Distributed by Tucker Electronics, PO Box 551419, Dallas, TX 75335-1419; tel 800-559-7388; 214-348-8800 (local calls). Suggested retail price, $199.

Tucker V-100W

Manufacturer's Claimed Specifications	***Measured in the ARRL Lab***
Frequency range: 144-148 MHz	As specified.
Power requirements: Transmit, 16 A (max) at 12-14 V.	Transmit, 17 A (at 100 W out); receive, 60 mA, measured at 13.8 V.
Power input/power output: 0.5 W/50 W; 1 W/70 W; 2 W/95 W; 3-8 W/100 W.	0.5 W/64 W; 1 W/85 W; 1.9 W/100 W; 2 W/105 W; 3 W/109 W; 8 W/110 W.
Spectral purity: –60 dBc or better.	As specified. Meets FCC requirements for spectral purity.
Transmit IMD: Not specified.	3rd order, –21 dB; 5th order –34 dB, measured at 100W ouput.
	144 MHz *146 MHz* *148 MHz*
Receive preamp gain: 15 dB.	24.6 dB 26.3 dB 25.9 dB
Receive preamp noise figure: Not specified.	2.0 dB 1.8 dB 1.8 dB

Size (HWD): 1.8×4.8×7.8 inches; weight, 2.4 lb.



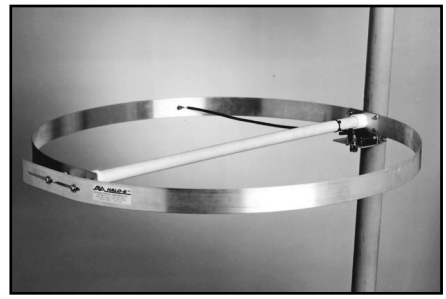
AEA HALO-6 Antenna for 6 Meters

By Rick Lindquist, KX4V
Assistant Technical Editor

You could say that AEA has reinvented the wheel with its HALO-6 antenna for "The Magic Band." Even so, they did a marvelous job of it, especially when you consider the cost and quality of this unit. When I was first licensed in the late 1950s, vehicle-mounted halo antennas for 6 meters were not an uncommon sight (and most 6-meter operation back then was AM). The halo design was a regular in *The ARRL Antenna Book* for a number of years in the '50s and '60s. Unlike the earlier double-loop design, the HALO-6 features a single loop—actually a $1^1/_2$-inch band of anodized aluminum—that overlaps on the ends by 6 inches or so to provide the necessary capacitive loading. A halo is a "fractional dipole," and end loading is what permits the compact design, so the antenna is ideal for restricted-space applications or mobile for that matter (minimum mounting height is 6 feet). As one example, AEA suggests supporting the HALO-6 in your attic using fishing line. But it can easily side mount on a tower or even a TV mast. Of course, the higher you mount it, the better the performance.

The antenna arrives in pieces. The 11-page *Assembly Instructions* includes a detailed parts list and step-by-step instructions to put your HALO-6 together and tune it for minimal SWR on the desired frequency range (with tuning, the antenna will resonate anywhere in the 6-meter band). You don't need but a Phillips head screwdriver and a pair of pliers to put the HALO-6 together, but, as AEA suggests, nut drivers can speed up the job if you have them. Most folks can probably put this antenna together in 20 or 30 minutes. The hardware, by the way, is all stainless. The loop's shape gets distorted during shipping, so you might need to reshape it as you go along. In addition to the loop, the major components are the PVC pipe—which spans the loop's diameter to provide horizontal support—and the aluminum L bracket that supports one end of the PVC pipe and also the SO-239 UHF feed-line connector. The loop is approximately 26 inches across.

We went through a couple of HALO-6s before we got one that worked down on the



low end of the band. During our conversations with AEA, we discovered that early production runs of the unit had a shorter gamma-matching wire and did not permit as much overlap on the ends of the loop. When we couldn't get it to load on the low end of the band, AEA recommended increasing the length of the gamma wire to $17^1/_2$ inches. That helped some, but we still could not get the unit to resonate any lower than approximately 51.6 MHz. Additionally, our package was missing four screws to mount the ceramic standoff insulators that separate the loop ends. You loosen the two screws in the slot at one end of the loop to make adjustments. To tune lower in frequency, you increase the amount of overlap at the ends of the loop; to tune higher in frequency, you decrease the amount of overlap. The only way our first HALO-6 would tune lower was to modify it to permit greater overlap than the slot drilled at the factory would permit. AEA subsequently replaced the first unit with a later production run that had a longer slot and a longer gamma wire. (It also had all the hardware.)

To test the second unit, I installed it on a 15-foot aluminum mast and lashed it in place next to a screen porch on my house. The radio I tested it with was the MFJ-9406 transceiver—also reviewed in this issue—which covers approximately 300 kHz on the low end of the band. I first tried it with the loop fully "closed" (ie, maximum overlap), but the SWR was too high—well over 2:1. The restricted range on the transceiver made it hard to determine if the HALO-6 was tuned too low or too high in frequency. Decreasing the overlap eventually got me to a point where the SWR on my little meter was in the range of 1.8:1.

BOTTOM LINE

A great value in a compact antenna for 6 meters that you can use fixed, mobile or portable.

AEA warns you not to be alarmed if you find you can't get the SWR better than 1.6:1. I found the MFJ-906 6-meter antenna tuner to be very handy at this point, although the MFJ-9406 did not balk at the SWR. AEA rates the antenna for up to 750 W, and—as the DANGER label on the loop warns—if you run enough power, you can anticipate some very high voltages at the point of overlap. The ceramic insulators keep the two ends approximately $1^1/_2$ inches apart, and AEA suggests you keep an eye on things when you first fire it up to make sure it doesn't arc over (running but 10 W, I didn't consider that to be likely). AEA includes a length of cord to provide additional horizontal support, once you have the HALO-6 in its final resting place, so to speak. However, this also is a very portable antenna, so you might want to have one on hand for Field Day or similar occasions.

In use, the antenna was a decent performer, especially given my relatively low power. I was able to hear and work several stations in various directions, all with excellent reports on both ends of the QSO. The HALO-6 is horizontally polarized, but because it's physically small in terms of wavelength, it radiates pretty much the same in all directions. The SWR was essentially the same across the 300-kHz range of the MFJ-9406. AEA says the antenna should provide some 500 kHz of usable bandwidth between the 2:1 SWR points.

AEA suggests stacking HALO-6 antennas for additional gain. The company plans to offer the necessary stacking harness in the future, but the *Assembly Instructions* booklet includes a detailed diagram of a stacked array and stacking harness for the do-it-yourself crowd.

Manufacturer: Advanced Electronic Applications Inc, PO Box C2160, Lynnwood, WA 98036; tel 206-774-5554; fax 206-775-2340. Manufacturer's suggested retail price, $69.