QST Compares: Medium-Power 2-meter Amplifiers

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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

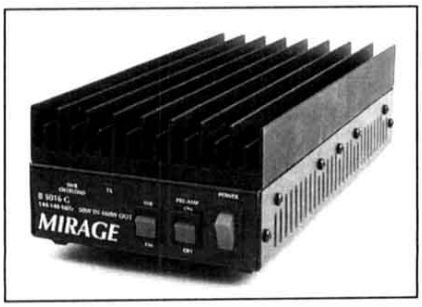
Promising 160 W with a 60-W input, the B-5016G is one of several amps that Mirage makes in this power category. The B-1016G offers 160 W output from 10 W input; the B-2516 generates 160 W from 25 W input. During our Lab tests we found that our B-5016G could deliver 160 W with only 39 W of drive! When 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.	

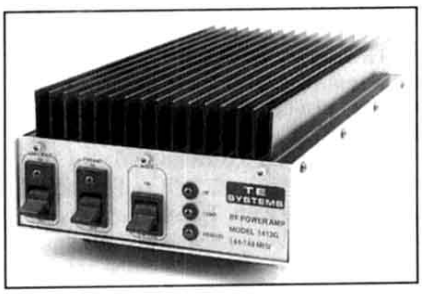


TE Systems model 1412G, serial number A6981

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.

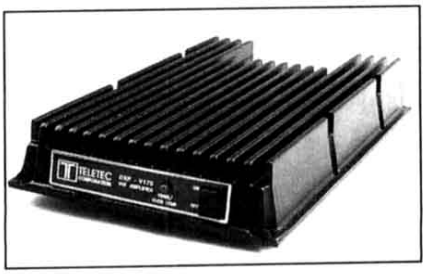
The only problems encountered with the 1412G concerned the spectral purity of its output and the performance of its preamplifier. The FCC requires that any spurious signals in the output of a transmitter or

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.