M² 2M-1K2 High Power 2 Meter Amplifier

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You can have a lot of fun on 2 meters with the 50 or 100 W available from a modern transceiver or transverter. That’s plenty of power for local contacts and for DX when the band is open, but you’ll eventually want more power if you start to get serious about working VHF contests, DX or some of the more challenging propagation modes such as scatter or EME (moonbounce).

VHF operators have a number of choices for power amplifiers up to the legal limit of 1500 W. Solid state “brick” amplifiers typically provide power up to about 300 to 400 W. Beyond that power level, tube type amplifiers have traditionally been required. High power solid state amplifiers are now practical with a new generation of MOSFET devices that run at higher voltage levels (about 50 V) instead of 12 or 28 V. This creates some interesting new choices.

Enter M², long known for a wide selection of antennas and accessories. M² has expanded into the solid state power amplifier arena as well with high power amplifiers for 6 and 2 meters. Both models are compact and light weight, offering substantial power in a package that fits comfortably in any home shack or portable station. This review takes a look at the 2M-1K2 for 2 meters, capable of running 1250 W output on SSB or CW and about 900 W on continuous modes such as FM voice or digital modes that you can operate using WSJT.

Options

The 2M-1K2 allows the option of using an integrated power supply from M² or supplying your own (48-50 V at 40-50 A). The review unit included the M² supply. One of the goals M² set for this amplifier was to make it small and lightweight. With the power supply, the package measures 7¼ x 15 x 14 inches (HWD) and weighs just over 20 pounds — small and lightweight indeed.

Setup

The M² amplifier package is ready to go and reminiscent of adding a linear amplifier to an HF station. Setup involved only a few steps, starting with a 240 V ac line for the power supply. It came with an ac power cord that I then mated with a plug to match the existing 240 V wall socket in my shack. If the optional M² power supply is not used, the amplifier comes with #10 AWG leads for connecting an external dc supply.

The 2M-1K2 has a built-in TR relay (ground to transmit), connected through a phono jack on the back panel. My station uses a TR sequencer that is operated with a footswitch. The TR sequencer makes sure that my transceiver, amplifier and preamplifier are all keyed in the correct order, with no “hot switching” of relays. Hooking up a connection between the sequencer and the amplifier for keying was straightforward. A direct connection between the transceiver and the amplifier can also be used, but for reasons discussed later it is advantageous to use a sequencer.

The rear panel has Type N female connectors for coaxial cable rated to handle 1200 W on 2 meters. The manual recommends using a wattmeter between the amplifier and antenna as no internal wattmeter or SWR meter is included. Once these connections are made the amplifier is ready to go.

Bottom Line

The M² 2M-1K2 is a quiet and convenient solution for high power operation on 2 meters. It puts out near legal limit power and is compatible with most modern transceivers or transverters.

Front Panel

The straightforward front panel has all of the information needed to operate the amplifier except a wattmeter to show power output. The ON/OFF switch controls the integrated ac power supply, and the POWER switch places the amplifier inline or bypasses it as needed. The JT MODE switch moves the amplifier into more efficient class C operation to run continuous modes such as WSJT and FM that do not require linear operation. Amplifier output is slightly reduced when it is in JT MODE (see Table 2).

The +50V LED indicates that power is on, and READY lights if the amplifier is inline. There is also a VSWR/TEMP LED to indicate high SWR or amplifier overheating. The JT LED shows that the amp is in JT mode, and the TX indicator shows that the amplifier has been keyed and is in transmit mode.

Rear Panel Connections

The rear panel includes jacks for the input from the transceiver and the output to the antenna. Neither jack is marked, though they are clearly shown in the instructions. This is not a major issue, but labels would be nice (and easy to add), especially for those who take the amplifier to a portable location and need to break down the station from time to time. Internally there is an RF coaxial relay on the input side and a high power vacuum relay on the output. No additional relays should be needed, a nice feature for added simplicity of operation.

The rest of the rear panel includes the phono jack to key the amp, as well as a terminal strip with a 13.6 V at 500 mA output and a switching contact that could be useful for external relays and preamps. Early versions of the amplifier had a 20 pin connector used for factory testing only. This connection has been moved inside on later versions. Other than the chassis ground, I did not need to use any of these connection points.

Using the Amplifier

After years of using tube type amplifiers requiring high voltage supplies and warm up periods, I found that operating the 2M-1K2 is about as simple and quick as it can get. After pushing the ON and POWER buttons, the amplifier is ready to go. That is a nice feature of solid state amplifiers and it made me think of all the times over the years that I have run into
brief sporadic E openings on 2 meters and had to wait several agonizing minutes before I could run high power!

Two fans come on at startup to keep the built in power supply cool. There are also two fans on top of the amplifier that come on to cool the RF section as needed. They would usually come on for transmissions longer than a minute or so, or when I was doing some intense heavy duty cycle operating during a contest. Even with all fans going, the noise level in my shack was far lower than the normal level for my 8877 tube type amplifier that I use on 2 meters.

The LDMOSFET device at the heart of the 2M-1K2 needs only a few watts to drive it to maximum output. Recognizing that many typical transceivers run considerably more power, M² built in a 10 dB attenuator so that the amplifier will operate at maximum power with about 50 W drive. I set my TS-2000 drive level at 45 W and found this consistently created more than 1200 W of output power as measured with my Bird wattmeter. See Table 2 for the results of the ARRL Lab tests at various drive levels. While using the amplifier in JT Mode, the power output was around 900 W.

I did run into one issue along the way. When I first received the amplifier, every time I turned it on the noise floor rose in my receiver. Typically it would jump about two S units, more than enough to be problematic for serious 2 meter operators. Cycling the amplifier on and off confirmed the noise was coming from the new installation. I was able to use external relays to bypass the amplifier on receive, indicating the noise was coming from the amplifier. M² suggested returning the amplifier, and testing on their end indicated that the built in switching power supply was the source of the noise. It was not a problem they had heard about from others, so perhaps it was just a single bad supply. M² sent a new amplifier and supply and the problem was solved.

### Amplifier Protection

The 2M-1K2 comes with two important protection features. If the SWR at the output reaches 2.5:1, the amplifier is deactivated and the VSWR/TEMP indicator will let the user know of the problem. The second feature is a temperature sensor. If the amplifier reaches.

#### Table 2

<table>
<thead>
<tr>
<th>Manufacturer’s Specifications</th>
<th>Measured in ARRL Lab</th>
</tr>
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<tbody>
<tr>
<td>Frequency range: 144-148 MHz.</td>
<td>As specified.</td>
</tr>
<tr>
<td>Power requirements: 180-264 V ac, 47-63 Hz, 15 A maximum.</td>
<td>As specified.</td>
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<tr>
<td>Driving power required: 50 W (maximum).</td>
<td>As specified.</td>
</tr>
<tr>
<td>Power output: 1200 W PEP with 50 W drive.</td>
<td>As specified, typically:</td>
</tr>
<tr>
<td>RF Input</td>
<td>RF Output*</td>
</tr>
<tr>
<td>(W)</td>
<td>(W)</td>
</tr>
<tr>
<td>5</td>
<td>335</td>
</tr>
<tr>
<td>10</td>
<td>580</td>
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<tr>
<td>15</td>
<td>760</td>
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<td>1200</td>
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<td>45</td>
<td>&gt;1200</td>
</tr>
<tr>
<td>50</td>
<td>&gt;1200</td>
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</tbody>
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Spurious and harmonic suppression: Not specified. 65 dB; meets FCC requirements.

Transmit intermodulation distortion: Not specified. 3rd/5th/7th/9th order: –26/–43/–43/–52 dB.

Size (height, width, depth): 9 × 7 × 13 inches; weight, 20.6 lbs.

Price: $2995 with power supply; $2425 without power supply.

*RF Output using SSB and CW. JT Mode represents 100% duty cycle modes, such as JT65 and FSK441 digital modes or FM voice.

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**WSJT — Digital Modes on VHF**

WSJT by Joe Taylor, K1JT, is a free software program for weak signal digital communication. Using a standard transceiver with a computer interface, the program allows communication with signal levels near or below the audible signal level. It allows operators to work more stations than they might ordinarily be able to work using SSB or CW.

WSJT offers several modes of operation. FSK441 is used for meteor scatter, JT65 is used for EME (Earth-Moon-Earth) and troposcatter, and JT6M is used for scatter mainly on 6 meters. Because it allows much greater ability to work weak signals, much of the EME and scatter work on the VHF bands is now done using WSJT. Stations with single Yagis and medium power can routinely work scatter, long haul troposcatter and EME by using the program.

To learn more about WSJT or download the program, you can go to the WSJT home page at physics.princeton.edu/pulsar/K1JT/. As discussed in the text, the 2M-1K2 has a JT MODE switch to be used for WSJT operation with its longer duty cycle. — Jeff Klein, K1TEO

![Figure 5 — The 2M-1K2 rear panel.](image-url)
40°C, the fans come on to cool the RF deck heat sink. If the temperature reaches 90°C, the amplifier will shut down and the indicator light on the front panel will come on. The amplifier can be reset by cycling the READY switch.

I used the amplifier for a number of long WSJT attempts and also for the ARRL January VHF Contest. Under those intense operating conditions I never ran into any problems that tripped the protection circuitry. The manual indicates that it is unlikely for the amp to shut down in an over-temp condition, and that was my experience even running this amplifier flat out for extended periods.

**TR Switching**

As noted earlier, I keyed the amplifier through my existing sequencer, which itself is activated by a footswitch. As a result, I had no problems with my preamps, or with timing for keying the amplifier on CW. Testing in the ARRL Lab, however, did show that the TR relay is a bit slow to engage. The manual indicates that the there is a 15 to 20 ms delay built in before bias voltage is applied to the MOSFET device.

This is consistent with what was seen in the ARRL Lab. The TR switching circuitry in the 2M-1K2 is slow enough that the first character may be lost during semi break-in CW operation or the first syllable may be truncated if using VOX on SSB. For transceivers with adjustable delays, this problem can likely be solved with a delay to match the amplifier’s engagement time. Better yet, use a sequencer to create the small delay before keying. There is no problem if you’re using a mic with a manual PTT switch or a footswitch on CW, or for someone starting a digital transmission.

**Documentation**

The 21 page operating manual does a good job of describing setup and operation. It also provides helpful background on the amplifier’s capabilities and on the protection circuitry. I found the troubleshooting section helpful as well. For those inclined to “open up the hood” there are clear schematics of all of the boards as well as pictures. M² has also added helpful information on WSJT operation, knowing that many who are interested in high power operation will also want to use that mode to work either scatter or EME.

**On the Air**

I was able to use the amplifier for several weeks with regular over the air contacts and to give it a real workout during WSJT skeds and during the ARRL January VHF Contest. I live in Connecticut where there are quite a few locals who know me well and have heard my signal at high power using my TS-2000 and 8877 amplifier for many years. A big concern in a relatively congested area for 2 meter operation is to be sure you have a clean signal. Living in a good location with four high gain antennas means I am pushing a lot of RF in the direction the array is pointed. I have always gotten good reports on my signal — how would that hold up with the 2M-1K2?

Bottom line is that after a good deal of testing, all reports came back with excellent audio quality. Testing showed that the TS-2000 barefoot and with the amplifier inline sounded the same, confirming the amplifier was “clean” over the air. I actually ran the amplifier at slightly higher power most times (around 1200 W) versus my tube amplifier (800 W).

Overall it was a fun experience to use a new piece of equipment and have it perform as it was supposed to. For me the appeal of the amplifier is the small size, broadband tuning, low voltage supply and lower noise level compared to my own tube amplifier. Solid state operation near the legal limit at 2 meters is now a reality, and M² offers an excellent candidate for those choosing to head in that direction.

Manufacturer: M² Antenna Systems, 4402 N. Selland Ave, Fresno, CA 93722; tel 559-432-8873; www.m2inc.com.

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