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Palstar HF-Auto High Power HF and 6 Meter Automatic Antenna Tuner

Speed up band changes with this legal-limit auto tuner.

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The Palstar HF-Auto is a high-power automatic antenna tuner that covers a continuous frequency range from 1.8 to 54 MHz. This includes the 160 through 6 meter amateur bands, as well as Military Auxiliary Radio Service (MARS) and other frequencies outside the amateur bands. While most automatic tuners that we've seen adjust the tuning through the use of relay switched miniature fixed capacitors and inductors, the HF-Auto makes its adjustments through the use of a full-size rotary inductor and variable capacitor adjusted by precision stepper motors. The only other high power antenna tuner we've seen in this form was its predecessor, the Palstar AT-Auto automatic antenna tuner we reviewed some years ago.¹ While functionally similar, and about the same size, there are some significant differences that make a new review of this tuner appropriate.

Here's What's New

A big change in capabilities from the AT-Auto is that the HF-Auto expands coverage to include 6 meters. This makes sense because more new linear amplifiers include operation on 6 meters, as have most transceivers for some years. Another change is that the HF-Auto includes three switch-selectable antenna ports, rather than the two provided in the AT-Auto.

While the AT-Auto allowed use with balanced antenna systems through an internal



4:1 balun, all three antenna ports on the newer tuner are for coaxial feed lines only. This makes good sense to me for a couple of reasons. First, many amateurs have no need for a balanced output and thus don't need to pay for it. Second, if a balanced output is desired, an external balun offers the opportunity to select the most appropriate transformation ratio (Palstar offers both a 1:1 and 4:1 model, each priced at \$90), as well as the opportunity to move the transformation point a short distance from the tuner. While extending the balun connection through coax does add loss due to the generally mismatched coax, the loss is small if the balun is just a few feet of low-loss coax away. This arrangement can help avoid problems of coupling to and from the unshielded (and often not quite balanced) "balanced" feeders.

Bottom Line

The HF-Auto exhibits the quality of construction, competent design, and ease of operation we have come to expect from Palstar. This smoothly operating tuner would be an appreciated addition to most amateur stations.

Another change is in the metering. The AT-Auto included an analog, cross-needle SWR meter, while the HF-Auto provides a more precise digital power and SWR indicator. The power meter reads actual peak power, a nice feature. Another change is in the architecture of the control system. The earlier unit offered both frequency sensing and direct control of frequency-based tuning through an Icom proprietary interface. The HF-Auto is completely independent of the radio type and quickly tunes based on the measured transmit frequency.

What You'll Find

The HF-Auto is constructed in a heavy-duty powder-coated enclosure with a straightforward front panel as shown in the lead photo. There are four buttons and one knob, which also functions as an additional pushbutton. The MODE button selects operating mode between BYPASS, AUTO, and MANUAL. It's also used for entering SETUP mode. In SETUP mode, you can choose how close to 1:1 SWR you want the tuner to target, as well as a number of other preference items, all described in the manual. The LCD is used for mode and menu selection, but in operational mode provides an indication of mode and antenna selection, the measured transmit frequency, the tuner inductor and capacitor values, the peak power and the SWR.

The inside view (see Figure 1) shows the neat and high-quality construction we have come to expect from the folks at Palstar. Near the front, behind the control and display hardware, are the two precision stepper motors, one for the inductor and the other for the differential capacitor. These are driven by toothed fiberglass belts to

¹J. Hallas, W1ZR, "Product Review: Medium to High Power Auto Antenna Tuners — The Evolution Continues," QST, Aug 2006, pp 56 – 63.

Figure 1 — The interior of the HF-Auto.

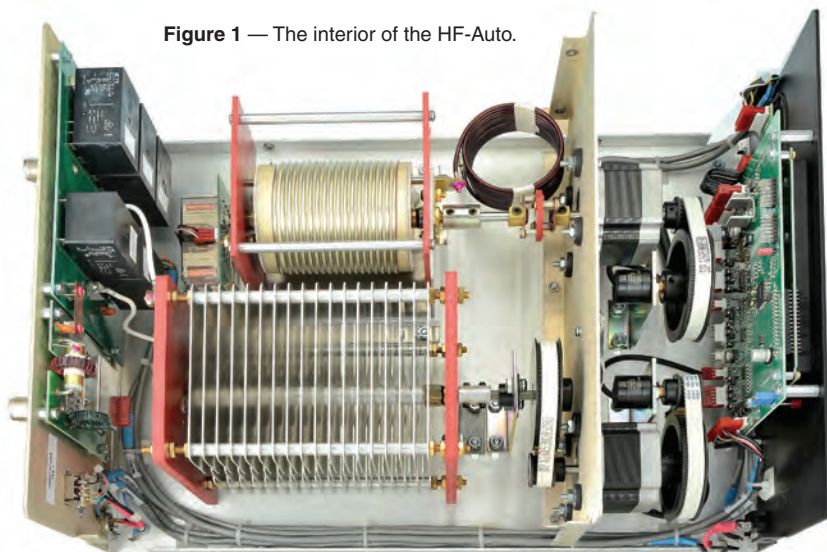


Table 1
Palstar HF-Auto, serial number 20613

Circuit configuration: T network with shunt variable 16 μH inductor, fixed 10 μH series inductor and 470 pF – 10 pF – 470 pF differential capacitor.

Frequency range: 1.8 to 54 MHz.

Matching range: Up to 8:1 SWR.

Power rating: 1800 W PEP SSB/CW (1.8 – 29.7 MHz), 800 W (50 – 54 MHz), 100% duty cycle.

Measured threshold tuning level: 2 W (typical); maximum tuning level: 200 W single tone.

Measured insertion loss (bypass): 1.8 – 25 MHz, <0.1 dB; 28 MHz, 0.1 dB; 50 MHz, 0.35 dB.

Measured current usage: 13.8 V dc at 3.6 A (when tuning), 690 mA (standby), 475 mA (bypass).

Size (height, width, depth): 6.8 \times 12.5 \times 17.5 inches (incl protrusions); weight: 20 lbs.
Price: \$1595.

ARRL Lab Resistive Load and Loss Testing

| SWR | Load (Ω) | | 160 m | 80 m | 40 m | 20 m | 10 m |
|------|-------------------|-------------|-------|------|------|------|------|
| 8:1 | 6.25 | Power Loss% | 41 | 19 | 12 | 4 | NT |
| | | SWR | 1.3 | 1.2 | 1.1 | 1.1 | — |
| 4:1 | 12.5 | Power Loss% | 30 | 14 | 8 | 5 | 11 |
| | | SWR | 1.1 | 1.2 | 1.2 | 1.0 | 1.3 |
| 2:1 | 25 | Power Loss% | 12 | 7 | 5 | 2 | 4 |
| | | SWR | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 |
| 1:1 | 50 | Power Loss% | 12 | 5 | 4 | 2 | 4 |
| | | SWR | 1.1 | 1.1 | 1.1 | 1.0 | 1.1 |
| 2:1 | 100 | Power Loss% | 9 | 4 | 2 | 1 | 1 |
| | | SWR | 1.1 | 1.3 | 1.1 | 1.1 | 1.1 |
| 4:1 | 200 | Power Loss% | 8 | 2 | 1 | 2 | 4 |
| | | SWR | 1.2 | 1.1 | 1.2 | 1.2 | 1.2 |
| 8:1 | 400 | Power Loss% | 6 | 2 | 1 | 2 | 4 |
| | | SWR | 1.1 | 1.2 | 1.2 | 1.1 | 1.2 |
| 16:1 | 800 | Power Loss% | 6 | 4 | 3 | 2 | 8 |
| | | SWR | 1.2 | 1.5 | 1.3 | 1.2 | 1.2 |

At 6 meters, the HF-Auto found a match for all resistive loads except 50 Ω . See text.

Frequency Short Open

| Frequency | Short | Open | |
|-----------|-------|------|---|
| 1.8 MHz | Yes | NT | Will tune 1600 Ω resistive load 160, 80, 10 and 6 meters. |
| 3.5 MHz | NT | NT | |
| 7.0 MHz | NT | NT | |
| 14 MHz | NT | NT | Yes = will tune into open or short circuit. NT = no tuning solution. |
| 28 MHz | Yes | NT | |
| 50 MHz | Yes | NT | |

avoid stretching and slippage. The rear contains the antenna relays and other interface hardware.

The rear panel is straightforward. Three UHF (SO-239) sockets are provided for the antenna outputs, plus another for RF input. A jack is provided for the 12 – 14 V dc power connection, with a furnished cable that includes RFI filtering. A current level of 6 A peak is specified, but we measured a maximum of 3.6 A in the lab during tuning. I found this compatible with my 25 A transceiver power supply, because I was never adjusting the tuner and running full transceiver output power at the same time. There is also a serial connector for software upgrades and a switch to select between PROGRAM UPDATE and NORMAL operation.

What It Does

The HF-Auto operates a bit differently from most automatic tuners. Because it measures frequency (in AUTOMATIC mode), a short “dit” on CW or a few syllables on SSB will let it know your frequency, and it will tune until it gets to the settings last used for that frequency. When it’s finished, a short key down signal (2 W is usually enough, although I needed a little more in some cases) will bring it to a match if more adjustment is needed.

Depending on how far the rotary inductor needs to move, the initial tuning can take up to around 15 seconds. The second pass is generally much shorter, but will somewhat depend on the accuracy you require. A menu setting (TUNING LEVEL THRESHOLD) sets the target tuning goal from 1.05:1 to 1.64:1. That’s a nice feature, but obviously it can take a bit longer to find a 1.05:1 match than, say, the suggested 1.5:1 — but it’s your choice. Though you can hear the precision stepper motors advancing, I did not find them offensive.

In addition to the AUTOMATIC mode, a MANUAL mode is supported. Poke the MODE button and you are into manual tuning mode. The single knob below the LCD panel is used to change the inductance (L) or capacitance (C). It comes up ready to tune the L; push the knob in briefly and it changes the C. The value of L and C are displayed on the LCD as you change them, so you can record the values for later reference. In the manual mode the HF-Auto adjusts capacitance and inductance via the stepper motors, so minimum effort is

required — no heavy cranking needed with this tuner.

Manual tuning can be useful to return to a favorite net or DX frequency without causing interference, or it can be used with an antenna analyzer to adjust to a match outside the ham bands, if desired. The MANUAL setting can also be used to modify a previously memorized setting at a particular frequency, if you need a better match for some reason. The tuner includes more than 1000 frequency memory bins that vary in frequency width from 4 kHz on 160 meters to 500 kHz on 10 meters. There are also bins allocated for frequencies outside of the ham bands.

Three Coax Antenna Ports

Another nice feature of the HF-Auto is that it has provisions for switch selection (via the front panel MODE button) of any of three unbalanced (coax connected) antennas. The tuner can also remember which antenna to select, based on frequency. Our original firmware allowed selection based on ranges of frequency, such as 1.8 to 13 MHz for antenna 1, 14 to 30 MHz for antenna 2 and 50 to 54 MHz for antenna 3. While that would be useful at some stations, at W1ZR I use my modified tribander for 20, 15, 10, and 6 meters and an 80 meter center-fed Zepp on 80, 60, 40, 17, and 12 meters. I was stuck with manual antenna switching until firmware version 1.29, which allows antenna selection by amateur band, a much more flexible arrangement. Unfortunately, there is no provision for 60 meters in this version of the menu — hopefully the omission will be remedied in the next release.

How It Performs

The ARRL Laboratory results are summarized in Table 1. There were few surprises, although the loss with low impedance loads on 160 meters suggests that it would be prudent not to use high duty cycle modes there with full power. A loss of 41% at 6.25 Ω with 1500 W applied, corresponds to a dissipation of 615 W within the tuner — probably not good for very long!

On the air at W1ZR, this tuner worked very well and was able to tune just about any of my antennas on almost any band (possibly a mixed blessing for very low impedance combinations, as noted above). My usual toughest test is to tune my 80 meter center-fed Zepp on 160 meters, where its impedance measures 5.2 + 65.8 Ω . That corresponds to a 50 Ω SWR of 26:1, far

beyond the tuner's specified 8:1 capability, yet it was able to find a 1:1 match. Not many tuners can do that, especially on 160 meters. Note that, having learned from my mistakes, I did not try this with high power!² I did run with up to 500 W, the most I can generate, on multiple bands and observed no problems.

While the lab noted that tuning could take up to 30 seconds, in my testing (with the motor speed set to HIGH), the longest time I found was 20 seconds between memorized settings on 160 to 6 meters.

Lab testing had observed a problem tuning on 6 meters into a matched load. I didn't have anything at my station (including my dummy load) that provided an exact 1:1 match on 6 meters, but the tuner had no trouble tuning my coupled resonator Yagi with a 1.2:1 SWR on 50.2 MHz, nor my Zepp with a higher SWR on that band. Of course, if you have a perfectly matched antenna, you are better off switching to BYPASS mode. My guess is that with a 1:1 SWR, the differential capacitor needed to have the same capacitance on each side, and minimum capacitance was probably too high to tune to 6 meters in that configuration. With a mismatch, the capacitance can be lower on one side or the other.

Documentation

The HF-Auto comes with a well-illustrated 15-page *Technical Manual*. The version on the Palstar website that became available with the version 1.29 firmware release is much more complete and user friendly than the earlier version that came with our tuner. The manual starts with an informative "Theory of Operation" section and follows with detailed descriptions of how to

navigate the many SETUP menus, all illustrated with color photos of the display and indicating the choices. Some of the menu choices were not yet available in our unit. Most menus are of the "set and forget" type, although some, such as ANTENNA selection, are used frequently and are provided with a dedicated button.

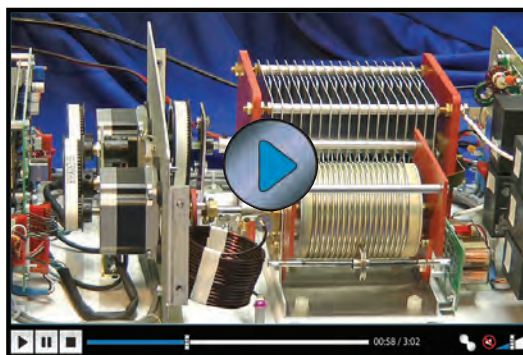
The manual includes a chronology of firmware revisions — the original went up to version 1.25, the newer to version 1.29, along with instructions for downloading new software revisions to the serial port on the rear of the tuner. We made a successful upgrade to version 1.27 before starting Lab testing, and again to version 1.29 while being evaluated at W1ZR. A serial-to-serial cable for updating firmware is provided with the tuner, while a serial-to-USB cable is available from Palstar for those who don't have traditional serial ports. There is no need to have a computer connection, other than for firmware upgrades.

On the Down Side

There are very few issues with this tuner. One possible concern is that the tuner will match into a short on 160, 10, and 6 meters. This is not an uncommon problem, and while we wouldn't plan to do this, it can easily happen by accident in a number of ways. Not only will we make few contacts, but the tuner will then be dissipating the full transmit power. By making note of the L and C values on the display during normal conditions, you will know if something has changed in your antenna system and can investigate it, or better yet, use a simple field strength meter to make sure your antennas are actually radiating.

Manufacturer: Palstar Inc, 9676 N Looney Rd, Piqua, OH 45356; tel 800-773-7931; fax 937-773-8003; info@palstar.com; www.palstar.com.

²J. Hallas, W1ZR, "My Tuner Tuned My Antenna — But Now it Doesn't!" *QST*, Aug 2012, p 46.



See the Digital Edition of *QST* for a video overview of the Palstar HF-Auto High Power HF and 6 Meter Automatic Antenna Tuner.