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## HF-AUTO Automatic Antenna Tuner

### Specifications Summary

- 10W-1800W PEP (160m to 6m)
- Tuning time: < 5s
- Color TFT Touch Screen
- 4 line LCD display
- 12.75" x 6.5" x 16.5"
- Weight: 25 lbs, 11.3 kg

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## HF-AUTO RF NETWORK Technical Manual



Designed and Manufactured in the USA  
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# HF-AUTO SPECIFICATIONS

- CONFIGURATION: High pass network, shunt variable 16  $\mu$ H inductor, series fixed 10  $\mu$ H inductor
- DIFFERENTIAL CAP: 470pF - 10pF, 5.5kV Rating
- L & C: Stepper motor controlled
- FREQUENCY RANGE: 1.8 MHz to 54 MHz
- MATCHING RANGE: 8:1
- POWER RANGE: 1800 W PEP/CW (1.8 - 29.9 MHz)  
800 W PEP (50 - 54 MHz)
- TUNING LEVEL: Minimum level 10W, Single tone carrier up to 50 W Maximum
- TUNING ACCESS TIME: < 10 s (typical), 80m to 6m  
3-5 s, 80m to 160m
- DUTY CYCLE: 100% SSB and CW
- DISPLAY: RF Power, SWR, Frequency, Antenna Selection, L & C Position, Tuning Mode
- OUTPUT: 3 x RF SO-239
- CHASSIS & COVER: .090 ga. aluminum, powder coated (front panel and cover)
- DC POWER: 12 - 13.8 VDC @ 4A peak, 3 pin
- DIMENSIONS: 12.75" W x 6.25" H x 16.5" D
- WEIGHT: 25 lbs., 11.3 kg
- WARRANTY: One year

Fully compatible with Palstar's  
LA-1K Amplifier

# MAINTENANCE

ROLLER SHAFT: The wheel rides should be lubricated with our factory-made conductive grease (one packet is included with the unit and additional packets are available from Palstar)

DIOXIT-D5 spray is useful for cleaning the wire on the roller coil. Do not use the spray directly. Put a small amount on a cotton cloth and hand wipe the roller once a year while turning the roller crank.

All set screws are cap point, take care to fully tighten these with a 5/16" Allen key which is available from any hardware outlet.

## REPAIR OR REPLACEMENT MODULES

All PC boards are removable with standard tools if they need to be replaced.

The rear panel relay PCB has custom SO-239 connectors that can be loosened with a 3/4" socket and 4x 6-32 nuts. Removal of these nuts and the 2 connections from the variable capacitor and the relay board can be removed from the unit.

Both front and rear panels can be removed by removing the 3 countersunk screws located at the bottom of each panel.



# HOW TO UPDATE FIRMWARE

Please visit the Palstar website for the latest firmware and a summary of new features.

<http://www.palstar.com/en/hf-auto/>

## DOWNLOADING AND INSTALLING HF-AUTO FIRMWARE

- CREATE a folder on your computer's hard drive
- NAME the folder HF\_AUTOUPGRADE
- DOWNLOAD the Firmware file (Zip format) from the Palstar website - <http://www.palstar.com/en/hf-auto/> - it is near the bottom of the page.
- The link to the file is named "HF-AUTO Firmware [version]"
- SAVE the file to the folder you created in Step 1
- OPEN the folder by right-clicking on the Zip file and select "Extract All" -
- Follow the steps in the Extraction wizard
- TURN OFF the HF-AUTO
- CONNECT the RS-232 cable to the rear panel
- CONNECT the other end of the RS-232 cable to COM 1 on your computer
- TURN ON the HF-AUTO
- SET Switch at rear of the HF-AUTO to "PROGRAM"
- Note: LED (PROGRAM MODE) on Front Panel is illuminated
- DOUBLE-CLICK "LOAD\_HF\_9600" from your HF\_AUTOUPGRADE folder that you created in Step 2
- A DOS Window appears - wait until the DOS Window closes (approx. 1 min)
- TURN "PROGRAM" Switch to "NORMAL"
- REMOVE the RS-232 cable
- TURN HF-AUTO OFF and then ON again
- LOOK at HF-AUTO display to make sure the new revision level is visible at the top-right corner on initial power up

# THEORY OF OPERATION

The HF-AUTO is a matching system that is a complete standalone RF tunable auto T network tuner.

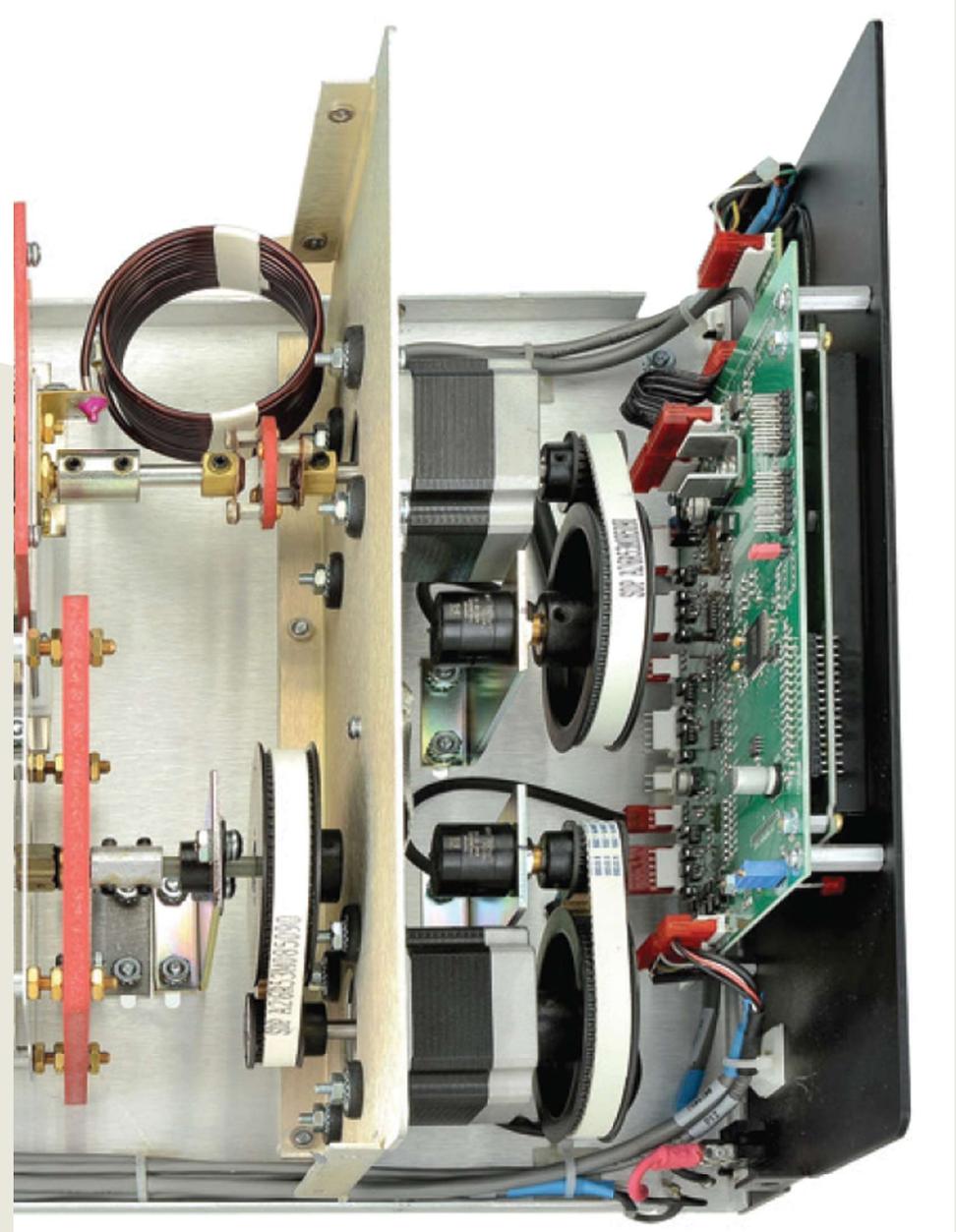
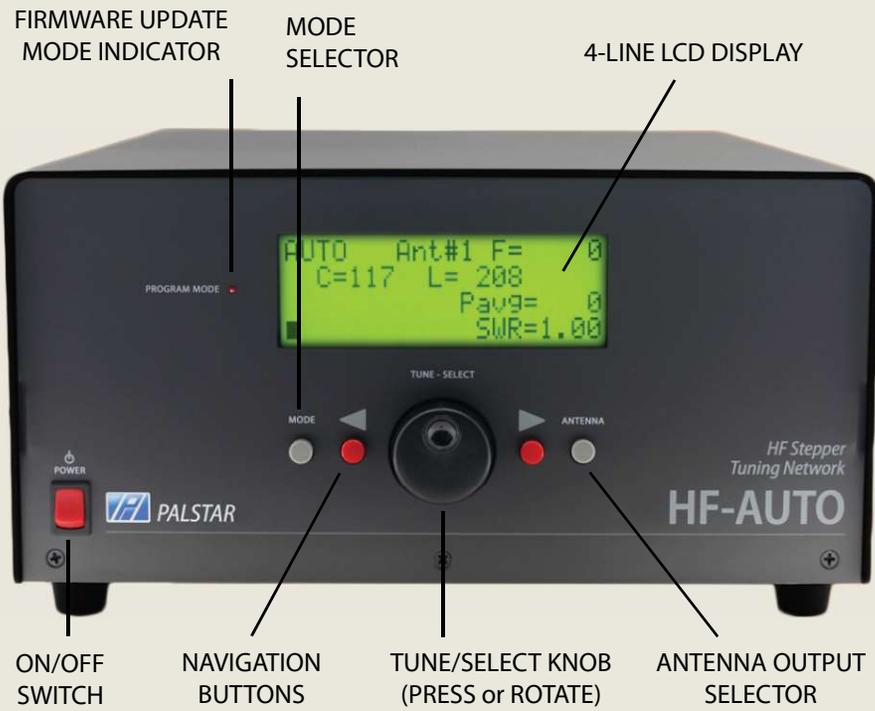
The HF-AUTO is RF sensing and will function with any transmitting device without interconnecting data cable attachments.

The HF-AUTO uses an RF Coupler that provides voltage and current information from 1.8 MHz to 54 MHz. This information is then processed by a pair of processing devices that provide accurate forward and reflected power measurements that are used to calculate SWR. This allows for detection of frequency and SWR at very low levels, typically 10 Watts and is scaled to read these levels up to 1800 Watts.

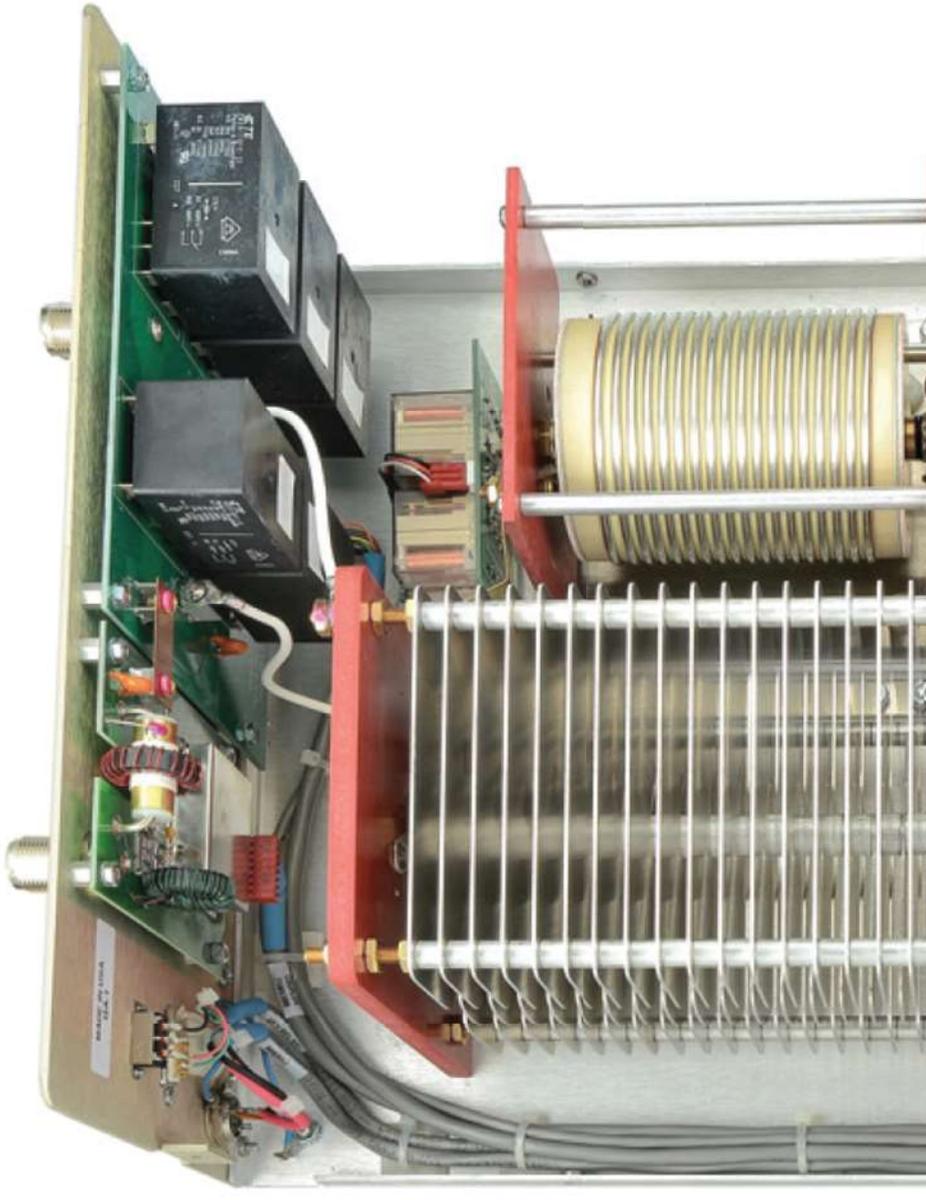
The processors establish the threshold for tuning and uses this information to see if a tuning sequence is required. A preset voltage for all the frequencies are used to determine the positions of the variable differential capacitor and the roller inductor by a precise mechanical sprocket and Kevlar belt system.

The HF-AUTO determines with high accuracy and repeatability the exact value of L & C needed to execute the tuning sequence. This system samples DC voltage and compares this to the intended frequency band and determines that if the SWR is greater than a value set by the user then the steppers for L & C will adjust to the voltage that represents the minimum SWR. This will be better than 1.2:1, typically 1.05.

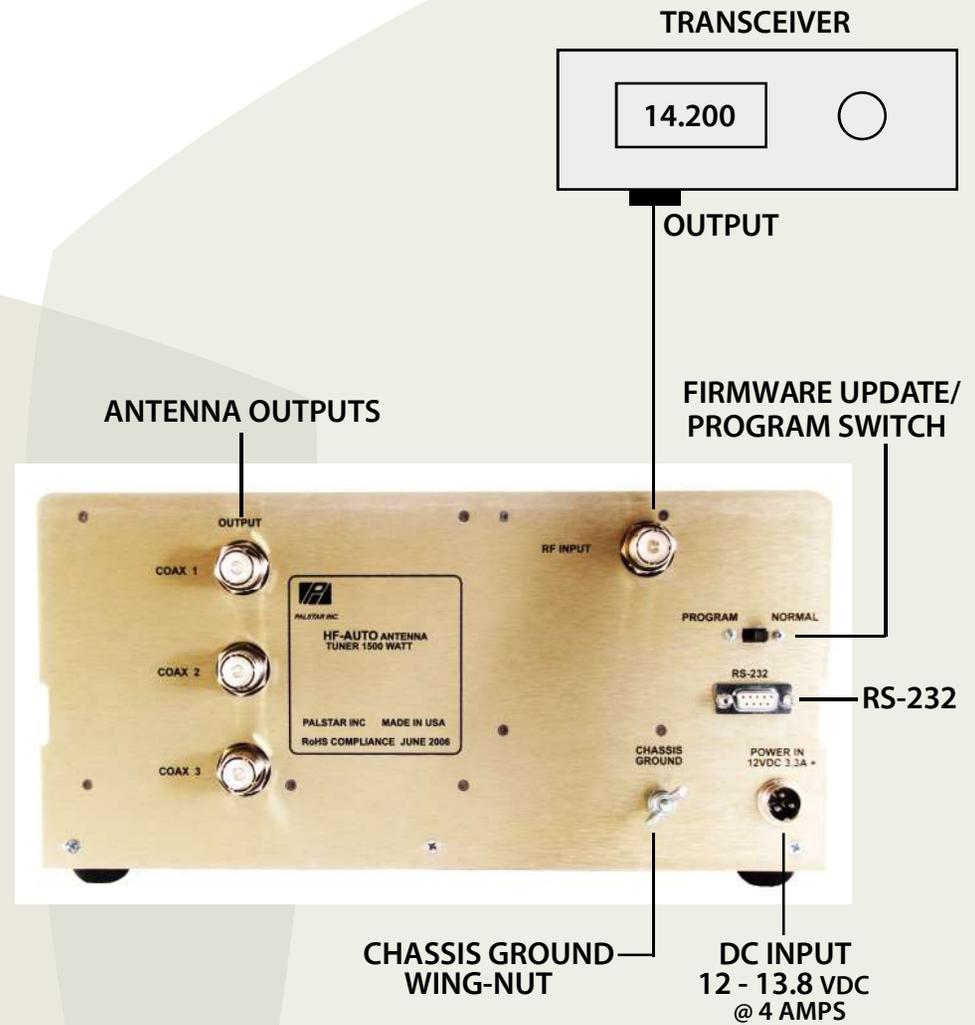
# FRONT PANEL



# INTERIOR VIEW



# REAR PANEL / TRANSCEIVER CONNECTION



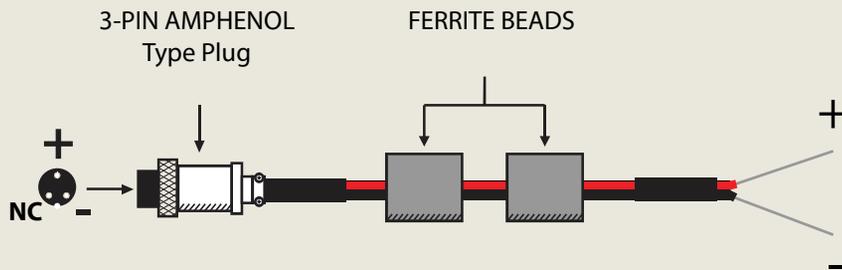
# INCLUDED WITH YOUR HF-AUTO

Included with the HF-AUTO:

- One (1) line cords for connecting to a 12 to 13.8VDC supply (see diagram below)
- User manual and mail-in warranty card
- Shipping box (please keep for warranty repairs etc.)
- Grease packet for periodic maintenance (see maintenance section)

As per FCC 15.21 changes or modifications not expressly approved by Palstar could void the users authority to operate the equipment. No tune up procedure exists.

## DC POWER CORD



# SAVING MEMORY LOCATIONS

TUNE the HF-AUTO using a low power FM or CW signal

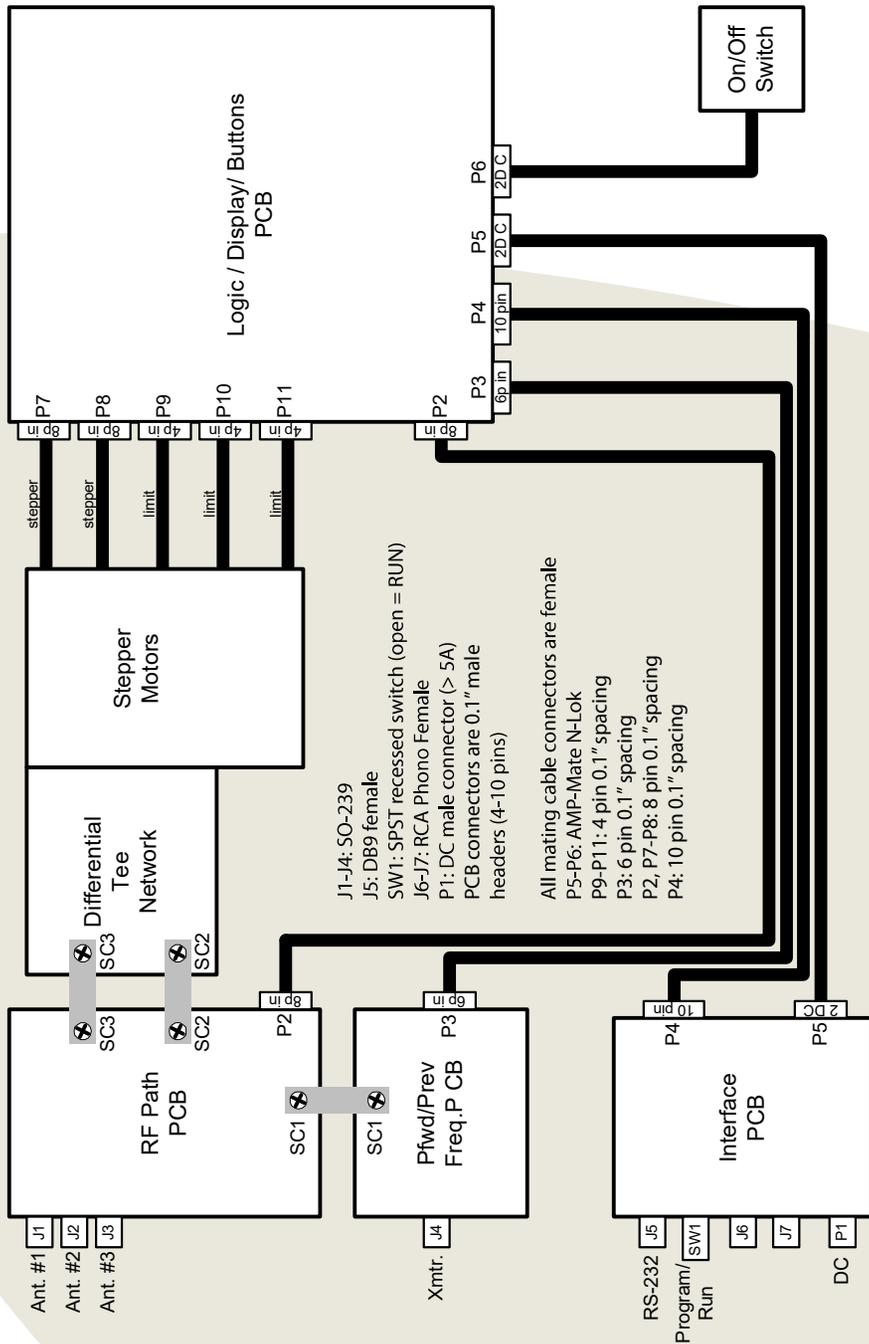
MANUALLY tune L&C for best SWR while power applied

While power is still applied push red button to the right of the tuning knob and hold for 2 seconds or more until the display says "SETTINGS CHANGED"

Remove power and release the red button. The frequency is now saved.

To return to AUTO MODE push left red button

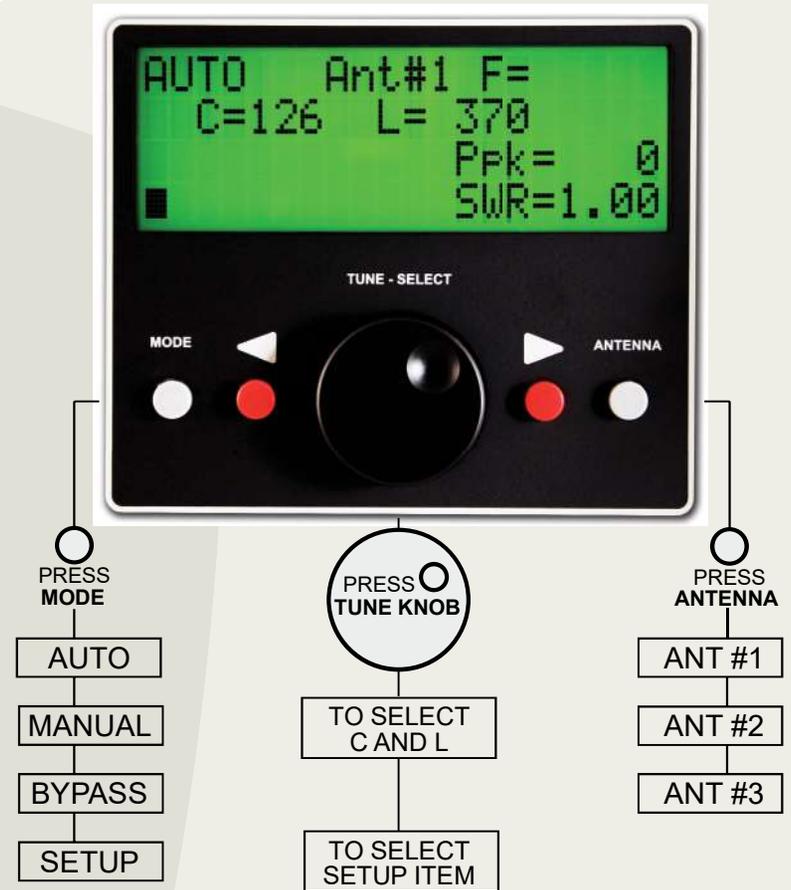
# HF-AUTO SCHEMATIC



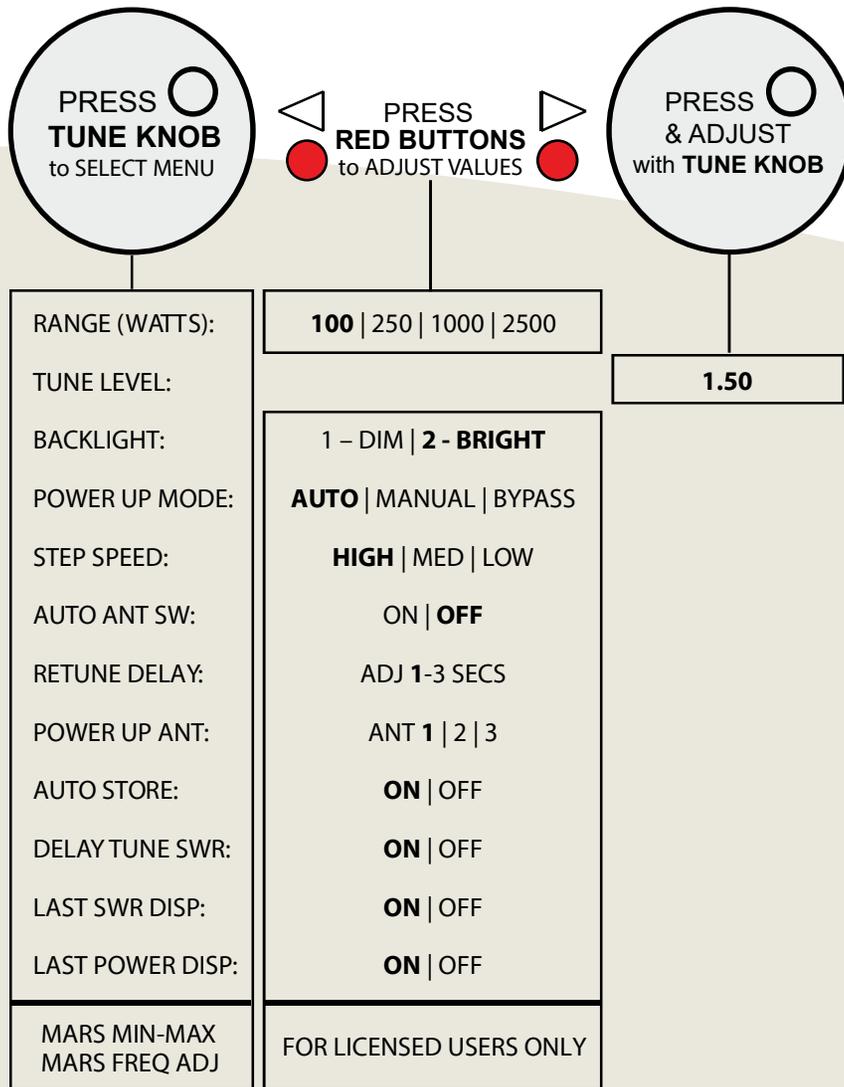
# SCREEN DISPLAY ON POWER-UP

## ON INITIAL POWER-UP

Display will indicate the firmware revision level and the Palstar copyright information.



# SETUP MODE



\*Recommended settings in bold.

# SETUP MODE MENU ITEMS

## **PWR UP MODE:** Auto/Manual/Bypass

This sets the mode the tuner will be in when it is turned on.

## **AUTO STORE: ON/OFF**

When ON the unit will store new L & C settings after a good SWR value has been found. When OFF the unit will not automatically store new L & C values.

The manual storage of L & C positions can still be done independently of this selection. NOTE: After a firmware update this value should be checked since it may change.

## **AUTO ANT SWITCH: ON/OFF**

Switches ON or OFF the automatic selection of the antenna port as defined by the frequency of settings in the ANT menu.

**NOTE:** Pressing the grey ANTENNA BUTTON FOR 2 SECONDS or more will toggle the Auto Antenna Switch ON or OFF, switch to BYPASS and select antenna port #3. With the AUTO ANT Switch OFF, the tuner will stay connected to port #3 regardless of the frequency. This can be used if a dummy load is attached to port #3 for example. Pressing the button again for 2 or more seconds will toggle the Auto Antenna Switch, put the tuner back in Auto Mode and select Antenna port #1.

## **BAND SELECTION:** 160M/80M/40M/30M/20M/17M/15M/12M/10M/6M

This menu item is used to define the amateur band for each antenna port.

## **POWER UP ANT:** 1/2/3

This determines which antenna port will be connected when the tuner is turned on.

## **LAST SWR DISP:** ON/OFF

If ON the last SWR value is left on the display screen.

## **LAST POWER DISP:** ON/OFF

If ON the last peak power value is left on the display screen.

# SETUP MODE MENU ITEMS

The following provides a description of each menu item found in the Set-Up menu screens. To navigate to this menu, choose SETUP using the MODE button.

**OPERATION:** push the tuning knob to step through the menu items. When a menu item is selected use either the left or right arrow buttons to select an option. In the case of defining a digital value, rotate the tuning knob to change the selected value.

**RANGE:** 100/250/1000/2500  
This sets the bar graph full scale display range for the RF output bar graph in the main display.

**TUNING LEVEL:** In Auto mode, if the SWR is above this level the tuner will retune for the lowest possible SWR. Palstar recommends 1.50. Other settings for Tuning Level are RETUNE DELAY and DELAY TUNE SWR (described below).

**RETUNE DELAY:** 1/2/3 seconds  
Once the tuner has set the L and C for the applied RF frequency, this delay determines the period before checking the SWR again after high power is applied to see if retuning is needed. Whether or not the new settings will be memorized depend on the Auto Store setting (ON or OFF)

**DELAY TUNE SWR: ON/OFF**  
When OFF the SWR will be checked prior to moving the L & C positions. This can reduce the movement of the stepper motors when accessing two frequencies that are close. When ON the L & C positions will be recalled and set prior to checking the SWR to see if it exceeds the TUNING LEVEL. This will allow the unit to navigate to the last saved L & C values for that frequency.

**STEP SPEED:** High/Med/Low  
Determines the speed the stepper motors will operate at when searching for a match or memorized set of C & L settings. Palstar recommends HIGH.

**BACKLIGHT:** 1 or 2  
Display window backlight setting #1 is dim, and #2 is bright.

# OPERATION

## PLACE TUNER IN AUTO MODE WITH GREY MODE BUTTON

1. CONNECT the transceiver to the **RF INPUT** chassis connector at the rear of the back panel
2. CONNECT a dummy load to one of the coax outputs or your desired antenna
3. APPLY a single tone level greater than 5 Watts (use FM MODE) typically 5 to 50 Watts
4. DISPLAY will indicate Frequency, Power Level, SWR, and Numerical value for C and L

**NOTE:** To execute a tune sequence at another band or frequency lower the power of the transceiver or any other transmitting device to low power and change frequency and the tuner will immediately follow to the new location. You can also click the PTT button on your microphone in FM MODE and accomplish the same at the lowest power level

## TUNING THE HF-AUTO

Applying a short burst of single tone power to the HF-AUTO will allow the tuner to pretune to a memory segment containing the desired frequency. A second application of RF Power must be applied to complete the final tuning where high power may be applied. You can also apply single tone power continuously until the final tune cycle has completed and achieve the same result. Trying to tune at high power without executing the final tune condition could damage the tuner.

# TUNING INSTRUCTIONS

The HF-AUTO is an automatic tuner for matching a transmitter to a non-resonant antenna. It was designed to fill the role of a differential tuner using an air variable capacitor and roller inductor both driven by stepper motors. The HF-AUTO stores the L and C settings for tuned frequencies and this storage can be automatic or manual.

## **Automatic tuning and memorizing L & C values:**

Turn ON Auto Store in the Set-Up menu.

Apply RF (10-50 Watts) and allow the tuner to find a match. Once the lowest SWR achievable is found and that value is below the Tuning Level (usually 1.50) those settings are automatically memorized.

**NOTE:** When in AUTO mode, and RF is applied with a frequency that has been previously memorized and the SWR is below that set in the Tuning Level (Set-Up Menu), the tuner will not initiate a tuning cycle. If the SWR is above that defined in Tuning Level, the tuner will retune to find a better match. If Auto Store is OFF the tuner will automatically tune to the lowest achievable SWR but will not memorize the settings. At this point one can memorize the settings as described in Manual Memorizing section below.

## **Manual Tuning and Memorizing L & C values:**

To put the tuner in Manual mode push the tuning knob to select the roller inductor (L). Rotate the tuning knob while watching the SWR reading for a dip. Then push the tuning knob again to select the differential capacitor (C) and rotate it to obtain a deeper SWR dip. Continue the process back and forth until a SWR value is achieved that suits your needs.

# TUNING INSTRUCTIONS

A quicker option is to put the tuner in Auto Mode and let it find the match. Then put it in Manual mode and use the manual process to improve the SWR reading.

**NOTE:** When in Manual mode, the Left Arrow button will switch directly back to Auto mode.

**Manually Memorizing:** Once the SWR value for the frequency selected is achieved, with the tuner in Manual mode continue to apply RF (20-40 Watts recommended) then hold the Right Red Arrow button until **Settings Changed** appears on the display. Now the settings have been memorized. Release the button and stop applying RF to the tuner.

**NOTE:** When in Manual mode, the Left Arrow button will switch directly back to Auto mode.

**Antenna Selection:** With Auto Antenna ON, the antenna port (1-3) is Switch selected based upon the amateur band for each antenna port that was defined in Set-Up. With Auto Antenna OFF, the port selection is manual Switch using the gray Antenna button.

**Bypass Mode:** Bypasses the matching network. Some users have the tuner in Bypass allowing them to use their radio's internal antenna tuner. Caution is needed if an amplifier is in the circuit and turned off or in bypass. The standing waves (SWR) will potentially have high voltage nodes that can cause damage to the bypass components in the amplifier. **The SWR and Power Output display will not be accurate in this mode.**

The **Auto Antenna Switch**, if ON, works in Bypass mode.