

AT-897Plus Automatic Tuner for Yaesu FT-897(D)



LDG Electronics

1445 Parran Road
St. Leonard MD 20685-2903 USA
Phone: 410-586-2177
Fax: 410-586-8475
ldg@ldgelectronics.com
www.ldgelectronics.com

Table Of Contents

| | |
|--|-----|
| Introduction | 3 |
| Jumpstart, or “Real hams don’t read manuals!” | 3 |
| Specifications | 4 |
| An Important Word About Power Levels | 5 |
| An Important Word About Tuning on the Six Meter Band | 5 |
| Important Safety Warning | 5 |
| Getting to know your AT-897Plus | 6 |
| <i>Front Panel</i> | 7 |
| <i>Rear Panel</i> | 8 |
| Installation | 9 |
| <i>Compatible Transceivers</i> | 9 |
| <i>Mounting the AT-897Plus to the FT-897 Radio</i> | 9 |
| <i>Cable Installation</i> | 11 |
| <i>Finishing Up Installation</i> | 11 |
| Operation | 12 |
| <i>Power-up</i> | 12 |
| <i>Basic Tuning Operation</i> | 12 |
| <i>Toggle Bypass Mode:</i> | 13 |
| <i>Initiate a Memory Tune Cycle:</i> | 14 |
| <i>Force a Full Tune Cycle:</i> | 15 |
| <i>Status LED</i> | 16 |
| Application Information | 16 |
| <i>Mobile Operation</i> | 16 |
| <i>MARS/CAP Coverage</i> | 17 |
| <i>Operation with a PC / CAT</i> | 17 |
| Theory of Operation | 17 |
| The LDG AT-897Plus | 19 |
| A Word About Tuning Etiquette | 21 |
| Care and Maintenance | 21 |
| Technical Support | 21 |
| Two-Year Transferrable Warranty | 21 |
| Out Of Warranty Service | 21 |
| Returning Your Product For Service | 22 |
| Product Feedback | 222 |

INTRODUCTION

LDG pioneered the automatic, wide-range switched-L tuner in 1995. From its laboratories in St. Leonard, Maryland, LDG continues to define the state of the art in this field with innovative automatic tuners and related products for every amateur need.

Congratulations on selecting the AT-897Plus automatic tuner for the Yaesu FT-897 transceiver. The AT-897Plus provides semi-automatic antenna tuning across the entire HF spectrum plus 6 meters, at power levels up to 125 watts. It will tune dipoles, verticals, Yagis, or virtually any coax-fed antenna. It will match an amazing range of antennas and impedances, far greater than some other tuners you may have considered, including the built-in tuners on many radios.

The AT-897Plus is similar to previous LDG tuners, but is specially engineered to integrate with your Yaesu FT-897 HF radio. The AT-897Plus connects to the CAT (Computer Automated Transceiver) port on the back of the radio. The CAT interface allows an external device such as a PC or the AT-897Plus to control the FT-897 by sending it serial commands. The AT-897Plus takes advantage of this interface to simplify the tuning process -- one button push is all that is needed in order to switch the radio to AM mode, reduce output power, transmit a carrier, measure the transmit frequency, and then restore the radio to its previous mode and power level!

The AT-897Plus is powered by the transceiver's CAT interface itself, so there is no additional power cable required to use the AT-897Plus. Latching relays are used, so the AT-897Plus consumes no power when not tuning.

The AT-897Plus improves upon the previous AT-897 automatic antenna tuner, in that the memory has been expanded to 2,000 frequency memories. The transmit frequency is actually read directly from the FT-897, so memory tuning is a snap.

JUMPSTART, OR "REAL HAMS DON'T READ MANUALS!"

Ok, but at least read this one section before operating the AT-897Plus:

1. Turn off power to your FT-897 radio.
2. Connect the HF/50 MHz antenna jack on the transceiver to the "Radio" SO-239 jack on the AT-897Plus, using the supplied 50 ohm coax cable jumper.
3. Connect a 50 ohm coax antenna feedline to the "ANT" SO-239 jack on the AT-897Plus.
4. Connect one end of the supplied radio DIN-8 interface cable to the CAT/Linear port on the back of your FT-897 radio.
5. Connect the other end of the supplied radio DIN-8 interface cable to the "Radio" jack on the back of the AT-897Plus.
6. Turn on power to your transceiver. Once it powers up, hold in the FUNC key for one second to access the extended menus. Rotate the SEL knob until menu #001, "EXT MENU" appears. Rotate the dial knob until "ON" appears, to activate the extended menus. Rotate the SEL knob until menu #019, "CAT RATE" appears. Rotate the dial knob until "4800" appears. Rotate the SEL knob again until menu #020, "CAT/LIN/TUN" appears. Rotate the dial knob until "CAT" appears. Hold the FUNC key for one second again to return to normal

operation.

7. Select the desired operating frequency and mode.
8. Push and hold the **TUNE** button on the front of the AT-897Plus for one second (until the **Tuning** LED comes on), then release. The transceiver automatically switches to AM mode, and keys up with a minimal amount of power, and the AT-897Plus begins a tuning cycle. At the end of the tuning cycle, the original mode and power level is restored.
9. Wait for the tuning cycle to end; you're now ready to operate!

SPECIFICATIONS

- 0.1 to 125 watts SSB and CW peak power, 100W on digital modes and 6 meters¹.
- Latching relays for ultra low power operation.
- 2,000 memories for instantaneous frequency and band changing.
- Powered from the radio -- no extra power supply to hook up.
- Designed specifically for the Yaesu FT-897/FT-897D HF transceivers. Can be mounted directly to the side of the FT-897.
- Pass-thru CAT port allows AT-897Plus to control the FT-897 over the CAT bus while still allowing a host PC to also control the radio.
- Pass-thru CAT port waits for idle CAT activity before controlling the transceiver.
- 1.8 to 54.0 MHz coverage. Frequency for memory storage is read from the radio via CAT.
- Tunes 6 to 800 ohm loads (16 to 150 on 6M), 24 to 3200 ohms with optional 4:1 Balun.
- For Dipoles, Verticals, Vees, Beams or any Coax Fed Antenna.
- Optional external Balun allows tuning of random length, long wire or ladder line fed antennas.
- Less than 1 mA power consumption in standby mode -- ideal for battery operation.
- Dimensions: 11.5"L x 1.5"W x 3.25"H.
- Weight: 2.0 pounds

¹ NOTE: On 6 meters, load must be less than 3.0:1 SWR match prior to tuning, or you must reduce power to 50 watts during tuning.

AN IMPORTANT WORD ABOUT POWER LEVELS

The AT-897Plus is rated at 125 watts maximum power input. Many ham transmitters and transceivers, and virtually all amplifiers, output well over 125 watts. Power levels that significantly exceed specifications will definitely damage or destroy your AT-897Plus. If your tuner fails during overload, it could also damage your transmitter or transceiver. Be sure to observe the specified power limitations.

AN IMPORTANT WORD ABOUT TUNING ON THE SIX METER BAND

The AT-897Plus is designed to tune loads on 6m that start out at 3.0:1 SWR or lower. Attempting to tune a greater than 3.0:1 load on six meters at full power can damage your AT-897 tuner. Power levels in excess of 50 watts should be used on 6 meters only if the SWR of the load was lower than 3.0:1 **prior** to tuning. **If you are unable to check, or are unsure of the SWR of the load prior to tuning, be sure to reduce power to 50 watts or less when operating on six meters.**

IMPORTANT SAFETY WARNING

Never install antennas or transmission lines over or near power lines. You can be seriously injured or killed if any part of the antenna, support or transmission line touches a power line. Always follow this antenna safety rule: the distance to the nearest power line should be at least twice the length of the longest antenna, transmission line or support dimension.

GETTING TO KNOW YOUR AT-897PLUS

Your AT-897Plus is a quality, precision instrument that will give you many years of outstanding service; take a few minutes to get to know it.



The AT-897Plus is designed specifically for use with the FT-897, and can be mounted to the side of the FT-897. The four side feet from your FT-897 fit on the tuner so you can set it down on its side without danger of scratching the finish. While your AT-897Plus is intended to be integrated with your FT-897 transceiver, you can also use the tuner simply sitting on a table, not mounted on the FT-897 transceiver.

Tuning is performed when the **Tune** button is pushed on the front of the AT-897Plus and held for one second. The tuner can be placed in bypass mode by pressing the **Tune** button momentarily.

The AT-897Plus is powered directly from the CAT port on the radio; no separate power supply is needed. The AT-897Plus automatically powers up at the start of a tuning cycle, and goes into an ultra low-power sleep mode when tuning is complete. The latching relays hold the tuned configuration indefinitely, even when DC power is completely removed. Tuning memories are stored in FLASH memory.

The AT-897Plus has 2,000 frequency memories. When tuning on or near a previously tuned frequency, the AT-897Plus uses “Memory Tune” to recall the previous tuning parameters in a fraction of a second. If no memorized settings are available, the tuner runs a full tuning cycle, storing the parameters for memory recall on subsequent tuning cycles on that frequency. In this manner, the AT-897Plus “learns” as it is used, adapting to the bands and frequencies as it goes.

Front Panel

On the front panel there is one pushbutton and one LED indicator light.



- **Tune Button:** Initiates either a memory tune or a full tune, and also toggles the tuner between “active” and “bypass” modes.
- **Status LED:** Lights to give feedback on button presses, lights during tuning; gives tune status at the end of a tuning cycle.

Rear Panel

The rear panel of the AT-897Plus features five connectors.



- **Antenna connector:** Connect to station antenna using this standard SO-239 connector.
- **GND connector (nut):** Connect to station ground.
- **Radio connector:** Connect the 50-ohm coax jumper cable from this standard SO-239 connector to the ANT jack on the back of the transceiver.
- **Computer connector:** This 8-pin mini-DIN connector connects to a personal computer via Yaesu's CT-62 cable or similar computer-to-CAT interface cable. Use of this port is optional; it is provided for those hams who would like to control their FT-897 via computer. This is a pass-thru port to the CAT Out port, and is switched under software control by the AT-897Plus's microprocessor. The firmware of the AT-897Plus has been written such that this will seem transparent to the user -- if using CAT to control your FT-897, just plug the PC's CAT cable into this port instead of the CAT jack on the back of the transceiver.
- **Radio connector:** This 8-pin mini-DIN connector is for connection to the FT-897's CAT/LINEAR jack. The AT-897Plus controls the PTT, power level, and operating mode via CAT commands sent to the transceiver. The AT-897Plus also reads the operating frequency directly from the transceiver so that it knows where to store tuning memory data.

INSTALLATION

The AT-897Plus tuner is designed for indoor operation only; it is not water resistant. If you use it outdoors (Field Day, for example), you must protect it from the rain. The AT-897Plus is designed for use with coax-fed antennas. If use with longwires or ladder-line-fed antennas is desired, an external balun is required. The LDG RBA-4:1 or RBA-1:1 is ideal, depending on the antenna and transmission line used.

Always turn your radio off before plugging or unplugging anything. The radio may be damaged if cables are connected or disconnected while the power is on.

Compatible Transceivers

The AT-897Plus is designed to be used **ONLY** with the following two Yaesu 100 watt transceivers:

- FT-897
- FT-897D
- For the FT-857 and FT-857D, use the YT-100 tuner.

WARNING: Do not attempt to use the AT-897Plus with any other transceivers, even if the CAT plug fits. At best, the AT-897Plus simply won't work with these radios. At worst, it could cause damage to the AT-897Plus, the radio, or both.

Mounting the AT-897Plus to the FT-897 Radio

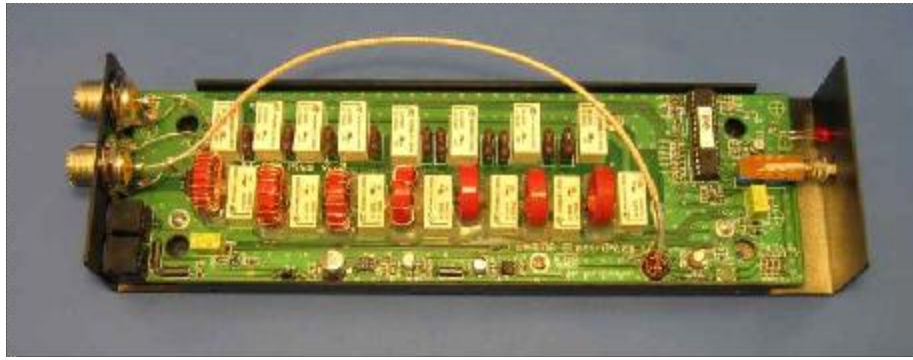
The AT-897Plus tuner is designed to be integrated with the FT-897 transceiver by mounting it to the left side of the transceiver. Mounting is not required, but if it is desired to mount the tuner to the left side of the radio, no modifications to the radio are needed.

Mounting the tuner to the radio requires a small Phillips (cross-point) screwdriver, preferably one with a magnetized tip. If a magnetized-tip screwdriver is not available, tweezers may be needed to aid in positioning the mounting screws.

Use of a grounded anti-static mat or wrist strap is best, but if these are not available, be sure to periodically touch a grounded device, such as a light switch, to avoid static buildup.

Mounting is performed as follows:

1. Turn off the FT-897 and disconnect all cables from the AT-897Plus. Disconnect the FT-897 from its power source, including the internal batteries, if they are installed.
2. Looking at the front of the FT-897, remove the four plastic feet from the left side of the radio. Carefully set these aside; they will be re-installed later.
3. Remove the cover of the AT-897Plus tuner by removing the four screws on the top and bottom of the tuner. Also set these aside; they will be reinstalled later. Lift off the cover. During the remainder of the mounting procedure, the internal circuitry of the AT-897Plus is exposed; take care not to damage the circuitry.



4.P sed to hold on the radio's plastic feet. The end of the tuner with the SO-239 jacks goes toward the rear of the radio. There are four recessed mounting holes inside the AT-897Plus, these should line up with the holes in the side of the radio. Using a magnetized screwdriver or tweezers, place the four included mounting screws into the mounting holes and carefully tighten them. Do not over tighten.



5.Place the cover

6.Screw the four plastic feet onto the left side of the tuner.

That's it! Next, follow the instructions on how to connect the cables.

Cable Installation

Connect the HF/50 MHz antenna jack on the FT-897 to the **Radio** jack on the back of the AT-897Plus, using the supplied coax jumper cable, or a similar 50 ohm coax cable rated 125 watts or greater.

Connect the supplied radio interface cable to the mini-DIN 8-pin jack on the rear of the AT-897Plus, marked "**Radio**". Connect the other end of this cable to the CAT/LINEAR jack on the rear of the FT-897.



On the extended menu system. Rotate the SEL knob until menu #001, "EXT MENU" appears. Rotate the dial knob until "ON" appears, to activate the extended menus. Rotate the **SEL** knob until menu #019 "CAT RATE" is visible. Rotate the main tuning knob until "4800bps" is showing. Next, rotate the **SEL** knob one click clockwise, to select menu #020, "CAT/LIN/TUNER". Rotate the main tuning knob until "CAT" is showing. Now press and hold **FUNC** again, to return to normal operation.

Finishing Up Installation

Connect a 50-ohm coax feedline to the jack marked **ANT** on the rear of the AT-897Plus, and connect this to the antenna system.

If it is desired to operate the FT-897 via computer control, connect the Yaesu CT-62 CAT interface cable to the AT-897Plus port labeled "**CAT In**". The AT-897Plus will automatically feed through any CAT commands coming in over this port to the transceiver and vice versa. Note that any software used to control the transceiver will have to be set for 4,800 baud while connected through the AT-897Plus.

OPERATION

Power-up

The AT-897Plus is powered by the transceiver over the CAT interface cable. When the transceiver is turned on, the AT-897Plus powers up. At this time, the AT-897Plus checks the connection to the transceiver. If this check fails, the **Status** LED will blink continuously. Possible causes for failure are an improperly seated CAT cable, a damaged CAT cable, incorrect CAT baud rate setting, or plugging the CAT cable into a radio other than an FT-897 or FT-897D.

Basic Tuning Operation

The AT-897Plus is operated from the front panel **TUNE** button on the AT-897Plus. Two types of tuning cycles are available; a memory tuning cycle and a full tuning cycle.

The **memory tuning cycle** attempts to tune quickly based on having previously tuned on the present frequency selection. If the tuner previously was successful in tuning on the currently selected frequency, the settings for that match will be loaded into the tuner relays, and checked to see that an acceptable SWR match is found.

A **full tuning cycle** “starts from scratch” and begins a fixed tuning sequence where the AT-897Plus rapidly tries varying combinations of inductance and capacitance values, and then zeroes-in on the best match possible. When the tuning cycle is complete, if an acceptable match was found, the inductance and capacitance settings are saved in a memory associated with the selected frequency, so that they may be recalled quickly in the future via a memory tuning cycle.

In this manner, the AT-897Plus “learns”; the longer you use it, the more closely it adapts itself to the bands and frequencies used. Most users will probably use memory tuning most of the time; it takes advantage of any saved tuning settings, but automatically defaults to a full tuning cycle if no stored data is available.

In both cases, at the end of the tuning cycle, the carrier is held for 1.5 seconds after tuning is complete, so that the final SWR may be read on the transceiver’s internal SWR meter or another inline SWR meter, and the front panel LED will indicate the status of the tuning cycle.

The tuner may also be placed in “bypass” mode where it is electrically removed from the antenna system.

Although the FT-897 is designed to transmit and receive on all HF bands plus 6 meters, 2 meters and 70 centimeters, the AT-897Plus is designed only to work on HF and 6 meters. In addition, the FT-897 transceiver transmits UHF and VHF on a different antenna jack than the jack used for HF and 6 meters. For this reason, the AT-897Plus’s built-in software asks the transceiver for its operating frequency before beginning a tuning cycle, and will not allow a tuning cycle to begin if the radio is set above 60 MHz. This protects both the tuner and the radio!

Toggle Bypass Mode:

To toggle between bypassed and active mode, press the front panel Tune button on the AT-897Plus momentarily. The Status LED will flash three times to indicate that the tuner is in bypass mode. Press the front panel Tune button momentarily again to recall the previous tuner settings. The Status LED will flash once to indicate that the tuner is no longer bypassed. This function may be useful if you wish to compare antenna performance with and without the benefit of the tuner's matching network.



Momentary Press



1 Blink = Active

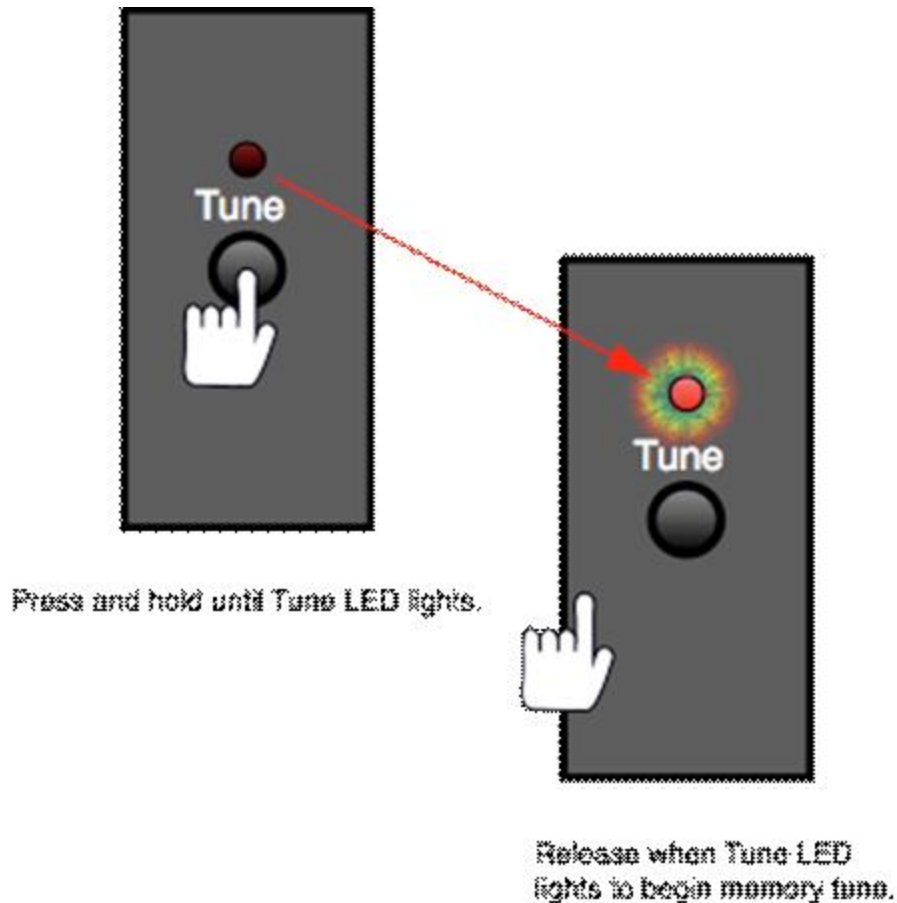


3 Blinks=Bypass

Initiate a Memory Tune Cycle:

To initiate a memory tuning cycle, press and hold the Tune button on the front of the AT-897Plus until the Status LED lights up. A memory tuning cycle will begin. The AT-897Plus will force the transceiver into AM mode, change the power level to one that is appropriate for tuning, and key the radio. When tuning is complete, the transceiver will return to the operating mode and power level previously set.

Be aware that the AT-897Plus tunes in **AM** mode. The microphone input is live during tuning, so anything you say will be heard while tuning!

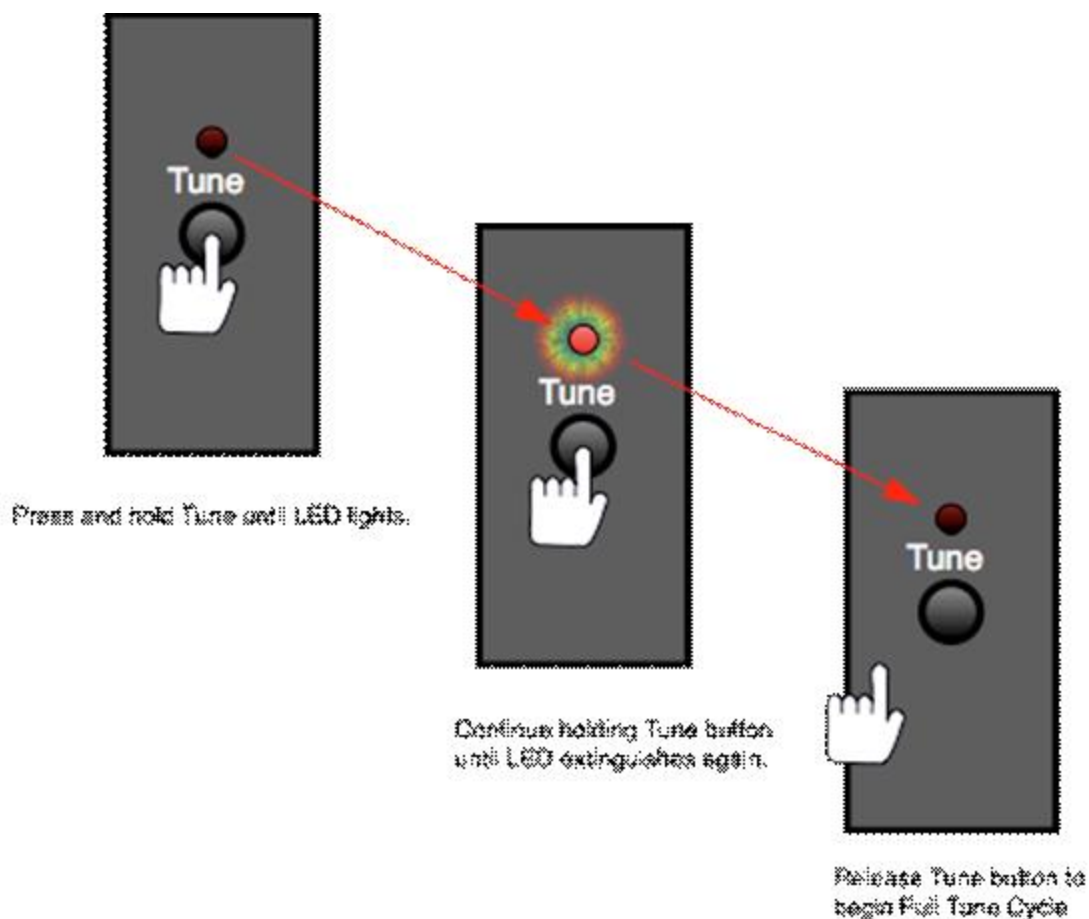


Force a Full Tune Cycle:

Sometimes, if you are transmitting on a previously tuned frequency, but something has slightly changed in your antenna system (maybe the antenna was re-oriented, for example), performing a memory recall tune will find a stored match that is acceptable, but is not as optimal as could be. In this case, forcing a full tune will cause the AT-897Plus to seek a better match than the match already stored in memory for this frequency.

To force a full tuning cycle, press and hold the **Tune** button on the front panel of the AT-897Plus until the **Status LED** lights up, and keep holding until the **Status LED** goes out again. Release the **Tune** button once the **Status LED** goes out. A full tuning cycle will begin. When tuning is complete, the transceiver will be restored to its previous operating mode and power level.

Be aware that the AT-897Plus tunes in **AM** mode. The microphone input is live during tuning, so anything you say will be heard while tuning!



Status LED

The **Status LED** is used to indicate both operating modes, tuning status, and error codes. The following table lists the LED status codes and their meaning.

| LED Indication | Meaning |
|---|--|
| Status LED on. | Tuner is tuning. |
| Status LED goes out, then blinks once. | Tuner has completed a tuning cycle; a good SWR match was found. |
| Status LED goes out, then blinks twice. | Tuning cycle is complete, tuning match is between 1.5:1 and 3.0:1 SWR. |
| Status LED goes out, then blinks three times. | Tuning cycle is complete, tuning match is greater than 3.0:1 SWR. |
| Status LED blinks 4 times. | Tuning cycle failed, RF was lost in the middle of the tune. |
| Status LED blinks 5 times. | Tuning cycle failed, no RF was detected. |

APPLICATION INFORMATION

Mobile Operation

The AT-897Plus is perfectly suited to mobile operation. It can be installed under the dashboard along with the transceiver, or mounted remotely. The only requirement is that the tuner remains dry.

The supplied radio interface cable is 14 inches long. If it is desired that the AT-897Plus is positioned farther from the transceiver than this cable length allows, a custom cable will need to be constructed. This can be accomplished in two ways: Cut the supplied cable and solder a jumper wire between all the connections, or purchase new connectors and cable to construct a custom-length interface cable from scratch.

The 8-pin CAT interface connector is Kycon Connector part number KMDAX-8P, available from available from <http://www.mouser.com/> as Mouser part number 806-KMDAX-8P. Pinning for this cable is one-to-one, straight through; all eight signals are used.



MARS/CAP Coverage

The AT-897Plus provides continuous tuning coverage over its specified range; not just in the ham bands. This makes it useful for MARS or CAP operation, or any other legal HF operation.

Operation with a PC / CAT

Although the AT-897Plus uses the transceiver's CAT port for tuning control, the AT-897Plus is also designed to allow the user to continue to use the CAT interface with the transceiver for PC control.

If PC control of the radio is desired, simply hook the PC's CAT interface cable (such as Yaesu CT-62) to the **Computer** jack on the rear of the AT-897Plus.

Any rig control software on the computer must be set to use the 4,800 baud rate, as this is the communication rate used by the AT-897Plus for controlling the radio.

The AT-897Plus monitors the **Computer** port for activity before beginning any tuning cycle. Only when the CAT line is idle for a period of time will the AT-897Plus take over control of the CAT line in order to perform a tuning cycle. When the tuning cycle is complete, control of the CAT interface is returned to the PC.

This procedure is completely automatic, and is transparent to the user. Simply hook up a PC, and use the rig control software as normal. Press the **TUNE** button on the AT-897Plus when tuning is desired.

THEORY OF OPERATION

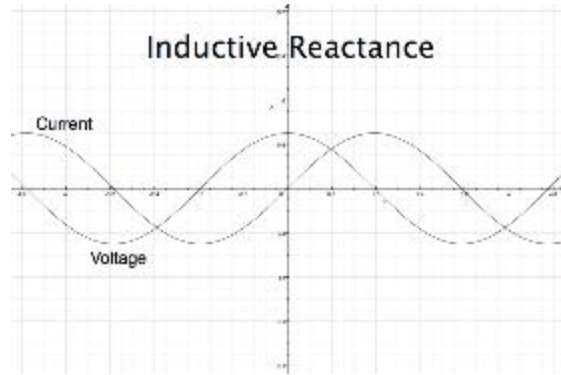
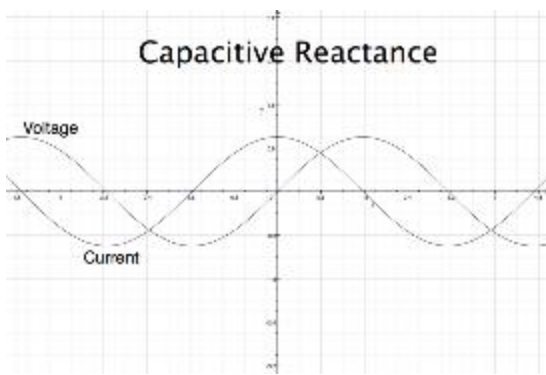
Some basic ideas about impedance

The theory underlying antennas and transmission lines is fairly complex, and in fact employs a mathematical notation called "complex numbers" that have "real" and "imaginary" parts. It is beyond the scope of this manual to present a tutorial on this subject², but a little background will help in understanding what the AT-897Plus is doing, and how it does it.

In simple DC circuits, the wire resists current flow, converting some of it into heat. The relationship between voltage, current, and resistance is described by the elegant and well-known "Ohm's Law", named for Georg Simon Ohm of Germany, who first discovered the principle in 1826. In RF circuits, an analogous but more complicated relationship exists.

RF circuits also resist the flow of electricity. However, the presence of capacitive and inductive elements causes the voltage to lead or lag the current, respectively. In RF circuits, this resistance to the flow of electricity is called "impedance", and can include all three elements: resistive, capacitive, and inductive.

² For a very complete treatment of this subject, see any edition of the ARRL Handbook for Radio Communications (previously the Handbook For Radio Amateurs).



The output circuit of a transmitter consists of inductors and capacitors, usually in a series/parallel configuration called a “pi network”. The transmission line can be thought of as a long string of capacitors and inductors in series/parallel, and the antenna is a kind of resonant circuit. At any given RF frequency, each of these can exhibit resistance, and impedance in the form of capacitive or inductive “reactance”.

Transmitters, transmission lines, antennas, and impedance

The output circuit of a transmitter, the transmission line, and the antenna, all have a characteristic impedance. For reasons beyond the scope of this document, the standard impedance is nominally 50 ohms resistive, with zero capacitive and zero inductive components. When all three parts of the system have the same impedance, the system is said to be “matched”, and maximum transfer of power from the transmitter to the antenna occurs. While the transmitter output circuit and transmission line are of fixed, carefully designed impedance, the antenna presents 50-ohm, non-reactive load only at its natural resonant frequencies. At other frequencies, it will exhibit capacitive or inductive reactance, causing it to have an impedance other than 50 ohms.

When the impedance of the antenna is different from that of the transmitter and transmission line, a “mismatch” is said to exist. In this case, some of the RF energy from the transmitter is reflected from the antenna back down the transmission line and into the transmitter. If this reflected energy is strong enough, it can damage the transmitter’s output circuits.

The ratio of transmitted to reflected energy is called the “standing wave ratio”, or SWR. An SWR of 1 (sometimes written 1:1) indicates a perfect match. As more energy is reflected, the SWR increases to 2, 3, or higher. As a general rule, modern solid state transmitters must operate with an SWR of 2 or less. Tube excitors are somewhat more tolerant of high SWR. If a 50 ohm antenna is resonant at the operating frequency, it will show an SWR close to 1. However, this is usually not the case; operators often need to transmit at frequencies other than resonance, resulting in a reactive antenna and a higher SWR.

where F = Forward power (watts), R = Reflected power (watts)

$$SWR = \frac{1 + \sqrt{R/F}}{1 - \sqrt{R/F}}$$

SWR is measured using a device called an “SWR bridge”, inserted in the transmission line between the transmitter and the antenna. This circuit measures forward and reflected power from which SWR may be calculated (some meters calculate SWR for you). More advanced units can measure forward and reflected power simultaneously, and show these values and SWR at the

same time.

An antenna tuner is a device used to cancel out the effects of antenna reactance. Tuners add capacitance to cancel out inductive reactance in the antenna, and vice versa. Simple tuners use variable capacitors and inductors; the operator adjusts them by hand while observing reflected power on the SWR meter until a minimum SWR is reached. The LDG Electronics AT-897Plus automates this process.

No tuner will fix a bad antenna. If the antenna is far from resonance, the inefficiencies inherent in such operation are inescapable; it's simple physics. Much of the transmitted power may be dissipated in the tuner as heat, never reaching the antenna at all. A tuner simply "fools" the transmitter into behaving as though the antenna were resonant, avoiding any damage that might otherwise be caused by high reflected power. For best performance, the antenna used should always be as close to resonance as is practical.

THE LDG AT-897PLUS

In 1995, LDG Electronics pioneered a new type of automatic antenna tuner. The LDG design uses banks of fixed capacitors and inductors, switched in and out of the circuit by relays under microprocessor control. An additional relay switches between high and low impedance ranges. A built-in SWR sensor provides feedback; the microprocessor searches the capacitor and inductor banks, seeking the lowest possible SWR. The tuner is a "Switched L" network, consisting of series inductors and parallel capacitors. LDG chose the L network for its minimum number of parts and its ability to tune unbalanced loads, such as coax-fed dipoles, verticals, Yagis, and virtually any coax-fed antenna.

The series inductors are switched in and out of the circuit, and the parallel capacitors are switched to ground under microprocessor control. The high/low impedance relay switches the capacitor bank either to the transmitter side of the inductor bank, or to the antenna side. This allows the AT-897Plus to handle loads that are either greater than or less than 50 ohms. All relays are sized to carry 125 watts continuously.

The SWR sensor is a variation of the Bruene circuit. This SWR measuring technique is used in most dual-meter and direct-reading SWR meters. Slight modifications were made to the circuit to provide voltages instead of currents for the analog-to-digital converters that provide signals proportional to the forward and reflected power levels. The single-lead primary through the center of the sensor transformer provides RF current sampling. Diodes rectify the sample and

| | FWD Power (watts) | | | | | | | | |
|-----|-------------------|-------|-------|-------|-------|-------|------|------|------|
| REV | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 2 | 1.92 | 1.70 | 1.58 | 1.50 | 1.45 | 1.41 | 1.38 | 1.35 | 1.33 |
| 4 | 2.62 | 2.15 | 1.92 | 1.79 | 1.70 | 1.63 | 1.58 | 1.53 | 1.50 |
| 6 | 3.42 | 2.62 | 2.26 | 2.06 | 1.92 | 1.83 | 1.76 | 1.70 | 1.65 |
| 8 | 4.44 | 3.14 | 2.62 | 2.35 | 2.15 | 2.02 | 1.92 | 1.85 | 1.79 |
| 10 | 5.88 | 3.73 | 3.00 | 2.62 | 2.38 | 2.22 | 2.09 | 2.00 | 1.92 |
| 12 | 7.87 | 4.44 | 3.42 | 2.92 | 2.62 | 2.41 | 2.26 | 2.15 | 2.06 |
| 14 | 11.24 | 5.31 | 3.90 | 3.25 | 2.87 | 2.62 | 2.44 | 2.30 | 2.20 |
| 16 | 17.54 | 6.42 | 4.44 | 3.60 | 3.14 | 2.83 | 2.62 | 2.46 | 2.33 |
| 18 | 37.87 | 7.87 | 5.08 | 4.00 | 3.42 | 3.06 | 2.80 | 2.62 | 2.47 |
| 20 | | 9.90 | 5.88 | 4.44 | 3.78 | 3.30 | 3.00 | 2.78 | 2.62 |
| 22 | | 12.92 | 6.74 | 4.94 | 4.07 | 3.55 | 3.21 | 2.96 | 2.77 |
| 24 | | 17.94 | 7.87 | 5.61 | 4.44 | 3.83 | 3.42 | 3.14 | 2.92 |
| 26 | | 27.96 | 9.32 | 6.17 | 4.85 | 4.12 | 3.65 | 3.32 | 3.08 |
| 28 | | 57.98 | 11.24 | 6.95 | 5.31 | 4.44 | 3.90 | 3.52 | 3.25 |
| 30 | | | 13.93 | 7.87 | 5.83 | 4.79 | 4.16 | 3.73 | 3.42 |
| 32 | | | 17.94 | 9.00 | 6.42 | 5.18 | 4.44 | 3.95 | 3.60 |
| 34 | | | 24.68 | 10.40 | 7.09 | 5.60 | 4.75 | 4.19 | 3.80 |
| 36 | | | 37.97 | 12.20 | 7.87 | 6.07 | 5.08 | 4.44 | 4.09 |
| 38 | | | 77.99 | 14.60 | 8.80 | 6.60 | 5.44 | 4.71 | 4.21 |
| 40 | | | | 17.94 | 9.90 | 7.19 | 5.83 | 5.00 | 4.44 |
| 42 | | | | 22.96 | 11.24 | 7.87 | 6.26 | 5.31 | 4.68 |
| 44 | | | | 31.30 | 12.92 | 8.65 | 6.74 | 5.65 | 4.94 |
| 46 | | | | 47.88 | 15.08 | 9.56 | 7.27 | 6.02 | 5.22 |
| 48 | | | | 97.99 | 17.94 | 10.63 | 7.87 | 6.42 | 5.51 |
| 50 | | | | | 21.95 | 11.92 | 8.55 | 6.85 | 5.83 |

provide a DC voltage proportional to RF power. These two voltages are read by the ADCs in the microprocessor, and are used to compute SWR in real time.

The relays are powered by the 12VDC input provided by CAT interface cable. The relays are a latching type, and so they consume no current when not actively switching.

Although the microprocessor's oscillator runs at 20 MHz, which allows the main tuning routine to execute in only a few milliseconds, the relays require several milliseconds of settling time for every combination of inductors and capacitors. Thus, it may take several seconds before all relay combinations are exhausted, in the case of a difficult tune.

The tuning routine uses an algorithm to minimize the number of tuner adjustments. The routine first de-energizes the high/low impedance relay if necessary, and then individually steps through the inductors to find a coarse match. With the best inductor selected, the tuner then steps through the individual capacitors to find the best coarse match. If no match is found, the routine repeats the coarse tuning with the high/low impedance relay energized. The routine then fine tunes the inductors and capacitors. The program checks LC combinations to see if a 1.5:1 or lower SWR can be obtained and stops when it finds a good match.

The microprocessor runs a fine tune routine just after the tuner finds a match of 1.5:1 or less. This fine tune routine now tries to the SWR as low as possible (not just to 1.5); it takes about half a second to run.

A WORD ABOUT TUNING ETIQUETTE

Be sure to use a vacant frequency when tuning. With today's crowded ham bands, this is often difficult. However, causing interference to other hams should be avoided as much as possible. The AT-897Plus's very short tuning cycle, as little as a fraction of a second, minimizes the impact of tuning transmissions.

CARE AND MAINTENANCE

The AT-897Plus tuner is essentially maintenance-free. Power limits in this manual should be strictly adhered to. Be sure also to observe the proper precautions when tuning on the 6 meter band.

The outer case may be cleaned as needed with a soft cloth slightly dampened with household cleaning solution. As with any modern electronic device, the AT-897Plus can be damaged by temperature extremes, water, impact, or static discharge. LDG strongly recommends the use of a good quality, properly installed lightning arrestor in the antenna lead.

TECHNICAL SUPPORT

The LDG website provides links to product manuals, just in case you lose this one! When you are thinking about the purchase of other LDG products our website also has complete product specifications and photographs you can use to help make your purchase decision. Don't forget the links to all of the quality LDG Dealers also ready to help you make that purchase decision.

TWO-YEAR TRANSFERRABLE WARRANTY

Your product is warranted against manufacturer defects in parts and labor for two full years from the date of purchase. This two-year warranty is also transferable. When you sell or give away your LDG product give the new owner a copy of the original sales receipt and the two-year warranty goes with the new owner.

There is no need to complete a warranty card or to register an LDG product. Your product receipt establishes eligibility for warranty service so save that receipt. Send your receipt with the product whenever you send your product to LDG for repair. Products sent to LDG without a receipt are considered requests for out-of-warranty repair.

LDG does not warranty against product damage or abuse. This means that a product failure, as determined by LDG, to be caused by the customer or by other natural calamity (e.g. lightning) is not covered under the two-year warranty. Damage can be caused by failure to heed the product's published limitations and specifications or by not following good Amateur practice.

OUT OF WARRANTY SERVICE

Any time a product fails after the warranty, LDG wants to help you get it fixed. Send the product to us for repair. We will determine what needs to be done, and based on your prior instruction; either contact you with an estimate or fix it and contact you with a request to pay any repair charges. Please contact LDG if you have any questions before you send us an out-of-warranty product for repair.

RETURNING YOUR PRODUCT FOR SERVICE

Returning a product to LDG is easy. We do not require a return merchandise authorization, and there is no need to contact LDG to return your product. Simply ship your tuner to the address below, and include a note describing the issue in as much detail as possible, and include your name and contact information.

Ask your shipper for a tracking number or a delivery verification receipt. This way you know the product arrived safely at LDG. Be sure to give us your email address so our shipper can alert you online when your product is en-route back to you. Periodic updates on the status of the repair are not available. We can only indicate the repair is in process until it ships back to you. Please be assured that our staff makes every effort to complete repairs ahead of our published wait time. Your patience is appreciated.

Repairs can take six to eight weeks, but are usually faster. The most recent information on returning products for service is found at the LDG Customer Support Center. Send your carefully packaged unit with the Repair Form to:

LDG Electronics, Inc.
Attn: Repair Department
1445 Parran Rd
St. Leonard, MD 20685

PRODUCT FEEDBACK

We encourage product feedback! Tell us what you really think of your LDG product. In a card, letter, or email (preferred) tell us how you used the product and how well it worked in your application. Send along a photo or even a schematic or drawing to illustrate your narrative. We like to share your comments with our staff, our dealers, and even other customers at the LDG website.

<http://www.ldgelectronics.com/>

