

**LDG Z-817H 75-Watt
Automatic Tuner
for Yaesu FT-817 and
Other QRP Radios with
Amplifiers**



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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 Z-817H 75-watt automatic tuner for the Yaesu FT-817 transceiver. The Z-817H provides semi-automatic antenna tuning across the entire HF spectrum plus 6 meters, at power levels up to 75 watts. It will tune dipoles, verticals, Yagis, or virtually any coax-fed antenna. It will match an amazing range of antennas and impedances (up to 10 to 1 SWR), far greater than some other tuners you may have considered, including the built-in tuners on many radios.

The Z-817H is similar to previous LDG tuners, but is specially engineered to integrate with your Yaesu FT-817 HF radio and external amplifier. The Z-817H connects to the ACC port or sometimes called CAT (Computer Automated Transceiver) port on the back of the radio. The CAT interface allows an external device such as a PC or the Z-817H to control the FT-817 by sending it serial commands. The Z-817H 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 PKT mode, transmit a carrier, read the transmit frequency, and then restore the radio to its previous mode and power level! Additionally, the Z-817H is powered by internal batteries, so no extra power cable is needed.

JUMPSTART, OR “REAL HAMS DON’T READ MANUALS!”

Ok, but at least read this one section before operating the Z-817H:

1. Turn off power to your FT-817 radio.
2. Open up the Z-817H and install 4 AA alkaline batteries, being careful to observe correct polarity. Reassemble the tuner.
3. Connect the antenna jack on the transceiver to the “TX” or “INPUT” jack on the external amplifier, using a 50 ohm coax cable jumper.
4. Connect the “ANTENNA” or “OUTPUT” jack of the amplifier to the “ANT” jack on the Z-817H.
5. Connect a 50 ohm coax antenna feedline to the “ANT” jack on the Z-817H.
6. Connect one end of the 8-pin mini-DIN plug on the supplied radio interface cable to the “ACC” port on the back of your FT-817.
7. Connect the other end of the radio interface cable to the “Radio” port on the back of your Z-817H.
8. Using the radio’s menu system, set the CAT RATE to 38,400 baud.
9. Select the desired operating frequency and mode.
10. Bypass the external amplifier.

-
11. Push and hold the **TUNE** button on the front of the Z-817H for one second (until the **Status** LED comes on), then release. The transceiver automatically switches to PKT mode, and keys up with a minimal amount of power, and the Z-817H begins a tuning cycle. At the end of the tuning cycle, the original mode and power level is restored.
 12. Wait for the tuning cycle to end, then un-bypass the amplifier if desired, and you're now ready to operate!

SPECIFICATIONS

- 0.1 to 75 watts SSB and CW peak power, 50W on digital modes and 6 meters. 50W max when used with non-FT-817 radio.
- Latching relays for ultra-low power operation.
- 2,000+ memories for instantaneous frequency and band changing.
- Power: 6V power supplied from long-lasting internal AA alkaline batteries.
- Designed specifically for the Yaesu FT-817 transceiver.
- Will also work with non-FT-817 radios, but without automation of the radio.
- Pass-thru CAT port allows Z-817H to control the FT-817 over the CAT bus while still allowing a host PC to also control the radio. Also permits seamless integration with Tokyo Hi Power HL-45B amplifier.
- 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 4 to 800 ohm loads (16 to 150 on 6M), 16 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.
- Dimensions: 7.6"L x 5.6"W x 1.75"H.
- Weight: 1 lb., 6 oz.

AN IMPORTANT WORD ABOUT POWER LEVELS

The Z-817H is rated at 75 watts maximum power input *at most*, when connected to an FT-817 via the supplied CAT radio interface cable, and 50 watts maximum if not using the supplied CAT cable. Many ham transmitters and transceivers, and virtually all amplifiers, are capable of transmitting well over 75 watts. Power levels that significantly exceed specifications will definitely damage or destroy your Z-817H. If your tuner fails during overload, it could also damage your transmitter or transceiver. Be sure to observe the specified power limitations.

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 Z-817H

Your Z-817H is a quality, precision instrument that will give you many years of outstanding service; take a few minutes to get to know it.

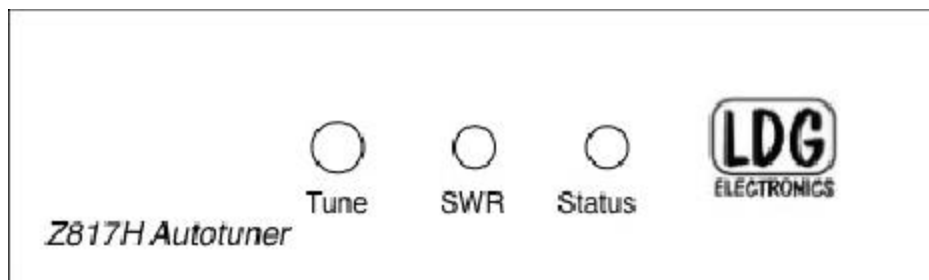
The Z-817H is designed specifically for use with the Yaesu FT-817 radio. Tuning is performed when the **Tune** button is pushed on the front of the Z-817H and held for one second. The tuner can be placed in bypass mode by pressing the **Tune** button momentarily. The Z-817H may also be used with other radios; see the section on *Using The Z-817H With Other Radios*.

The Z-817H is powered via four internal AA alkaline batteries. The Z-817H powers up at the start of a tuning cycle, and powers-down completely when tuning is complete. The latching relays hold the tuned configuration indefinitely, even when DC power is completely removed. Tuning memories are stored in non-volatile FLASH memory.

The Z-817H has 2,000 frequency memories. When tuning on or near a previously tuned frequency, the Z-817H 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 Z-817H “learns” as it is used, adapting to the bands and frequencies as it goes.

Front Panel

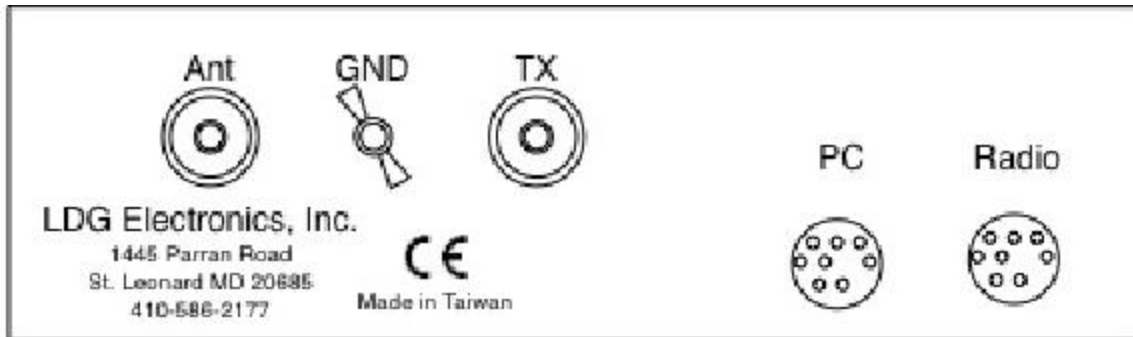
On the front panel there is one pushbutton and two LED indicator lights.



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

Rear Panel

The rear panel of the Z-817H features five connectors.



- **ANT connector:** Connect a 50-ohm coax antenna feedline to this standard SO-239 connector.
- **GND connector** (wing nut): Connect to antenna system ground.
- **TX connector:** Connect a 50-ohm coax jumper cable from this standard SO-239 connector to the ANT (OUTPUT) jack on the back of the amplifier. If running barefoot (no amplifier), connect to the FT-817's ANT jack.
- **PC connector:** This 8-pin mini-DIN connector connects to a personal computer via CT-62 compatible PC interface cable (not included). Use of this port is optional; it is provided for those hams who would like to control their radio via computer. This is a pass-thru port to the **RADIO** port, and is switched under software control by the Z-817H's microprocessor. The firmware of the Z-817H has been written such that this will seem transparent to the user -- if using CAT to control your FT-817, 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-817's ACC jack. The Z-817H controls the PTT, power level, and operating mode via CAT commands sent to the transceiver. The Z-817H also reads the operating frequency directly from the transceiver so that it knows where to store tuning memory data.

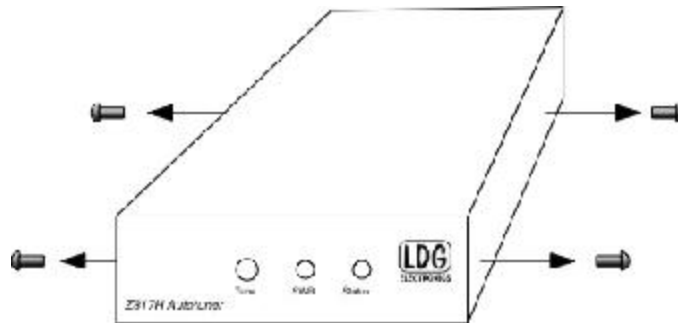
INSTALLATION

The Z-817H 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 Z-817H 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.

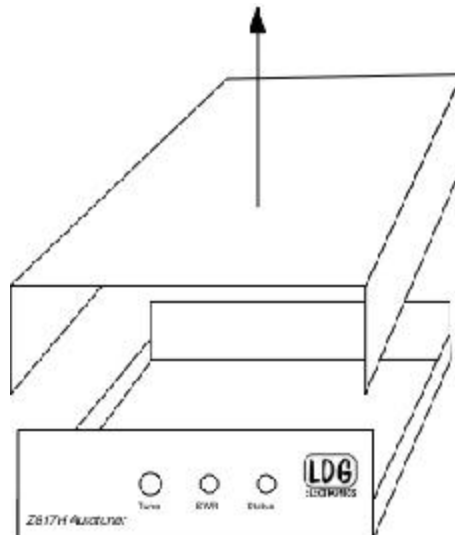
Always turn your radio off before plugging or unplugging anything. The radio may be damaged if cables are connected or disconnected while the power is on.

Battery Installation

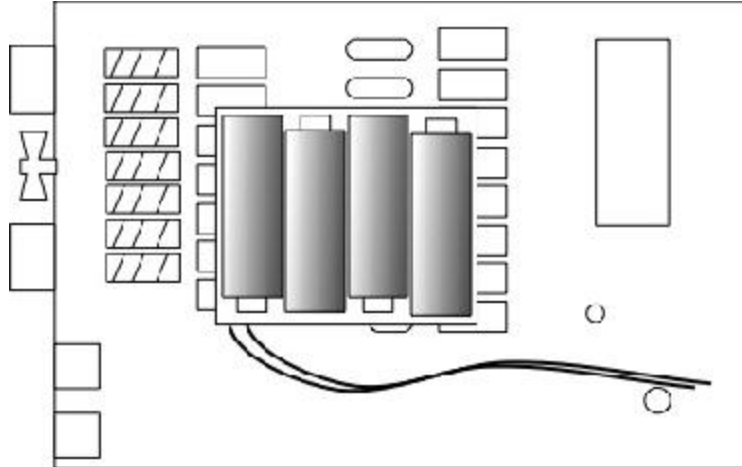
The Z-817H is powered from 4 internal AA alkaline batteries. To install the batteries, first remove the four screws that hold on the lid, using a Philips screwdriver.



Next, remove the lid by gently lifting it upward:



Now, install 4 AA alkaline batteries, being careful to observe correct polarity. Reinstall the lid, and reinstall the four screws to secure the lid. **Never operate the Z-817H with the lid off, as hazardous and potentially lethal RF energy is present while transmitting.**



Compatible Transceivers

Although the Z-817H is designed to work with any radio / amplifier combination, the CAT¹ interface allows additional automation of the tuning process with compatible transceivers. The Z-817H CAT radio interface cable is designed to be used **ONLY** with the following Yaesu transceivers:

- FT-817
- FT-817ND

WARNING: Do not attempt to use the Z-817H's radio interface cable with any other transceivers, even if the CAT plug fits. At best, the Z-817H simply won't work with these radios. At worst, it could cause damage to the Z-817H, the radio, or both. If using the Z-817H with another radio, do not hook up the included CAT cable.

Interface Cable

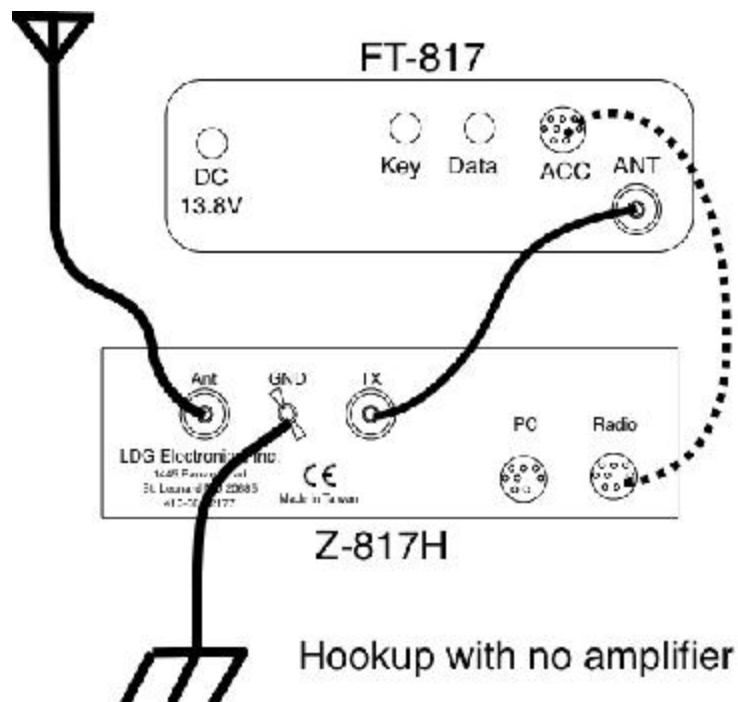
The Z-817H is supplied with a radio interface cable. Each end has an 8-pin mini-DIN connector. The end with a round 8-pin mini-DIN connector goes to the radio, and the other end goes to the tuner.

¹ CAT - Computer Assisted Transceiver, a serial communication protocol allowing external devices to control certain Yaesu radios.

FT-817 Installation, No Amplifier

If using the FT-817 radio “barefoot” (no external amplifier), connect the **ANT** output of the FT-817 radio to the **TX** input on the rear of the Z-817H. Then connect the antenna feedline to the **ANT** jack on the Z-817H. Finally, connect the supplied CAT radio interface cable from the 8-pin mini-DIN jack marked “**Radio**” on the rear of the Z-817H to the jack marked “**ACC**” on the rear of the FT-817.

Grounding the Z-817H tuner will enhance its performance and safety. LDG recommends that you connect your tuner to a suitable ground; a common ground rod connected to buried radials is preferred, but a single ground rod, a cold water pipe, or the screw that holds the cover on an AC outlet can provide a serviceable ground. LDG strongly recommends the use of a properly installed, high quality lightning arrestor, such as the LDG SP-200, on all antenna cables.



Once the cables are all hooked up, turn on the FT-817 radio, then press and hold the “F” button on the front panel for one second, to enter the extended menu. Rotate the SEL knob until menu # 14, “CAT RATE” is showing. Rotate the tuning dial until “38400” is displayed. Now press and hold the “F” button again to resume normal operation.

FT-817 Installation, With Amplifier

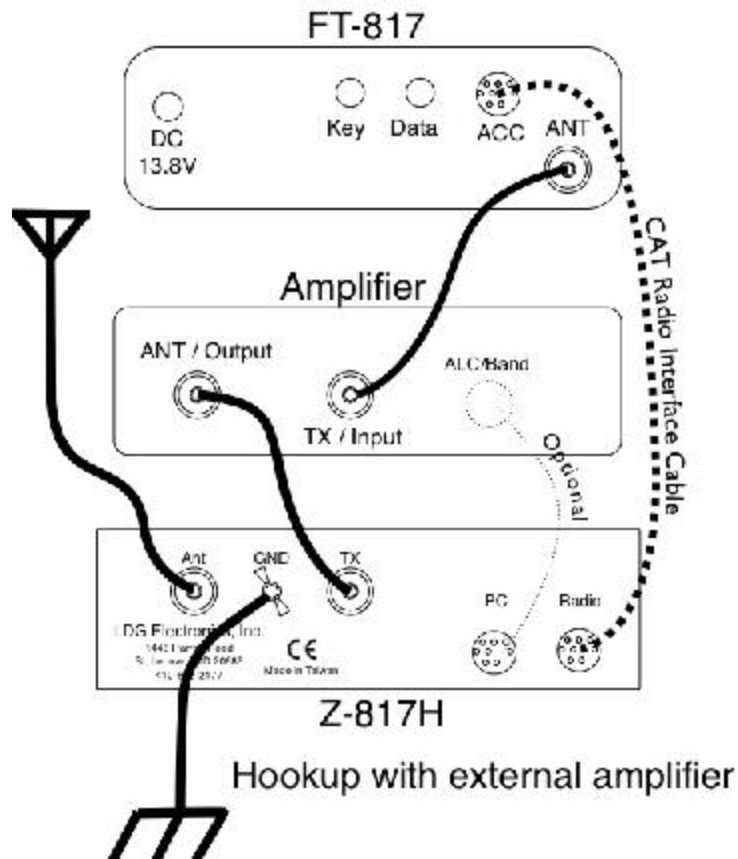
Connect the antenna jack on the FT-817 to the **TX** or **INPUT** jack on the back of the external amplifier, using a 50 ohm coax jumper cable.

Connect the **ANT** or **OUTPUT** jack on the amplifier to the **TX** jack on the rear of the Z-817H with a coax jumper.

Connect the antenna system feedline to the **ANT** jack on the back of the Z-817H.

Connect the round end of the supplied radio interface cable to the jack marked “ACC” on the FT-817. Connect the opposite end to the jack marked “**Radio**” on the rear of the Z-817H.

If your amplifier interfaces directly with the FT-817’s **ACC** port, you may plug the amplifier’s interface cable into the **PC** port on the rear of the Z-817H. Amplifiers such as the Tokyo Hi-Power HL-45B use the ACC port to determine the radio’s band and also to send back ALC data to the radio. The Z-817H is designed to allow such amplifiers to still work correctly with the FT817.



Once the cables are all hooked up, turn on the FT-817 radio, then press and hold the “F” button on the front panel for one second, to enter the extended menu. Rotate the SEL knob until menu # 14, “CAT RATE” is showing. Rotate the tuning dial until “38400” is displayed. Now press and hold the “F” button again to resume normal operation.

Finishing Up FT-817 Installation

If it is desired to operate the FT-817 via computer control, connect a Yaesu CT-62 cable (not supplied) to the jack on the Z-817H marked “PC”. The Z-817H 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 38,400 baud while connected through the Z-817H.

Hookup For Radios Other Than FT-817

If using the Z-817H tuner with a radio other than a Yaesu FT-817, the hookup is the same as for use with the FT-817 (with or without amplifier), but the CAT radio interface cable is not used. Tuning operation with a non-FT-817 radio is slightly different; see the section on *Using The Z-817H With Other Radios*.

OPERATION

Power-up

The Z-817H is powered by internal batteries. Each time the **TUNE** button is pressed, the Z-817H first checks the connection to the transceiver. If an FT-817 radio is detected, the **SWR** LED will flash briefly before continuing on with normal operation. If an FT-817 radio is hooked up, but the SWR LED does not flash briefly each time the **TUNE** button is pressed, then the Z-817H has not properly detected the attached radio.

Possible causes for failure to detect the radio properly are: an improperly seated CAT cable, a damaged CAT cable, incorrectly selected CAT baud rate, FT-817 not turned on, or plugging the CAT cable into a radio other than an FT-817. If checking all of these things does not correct the situation, try turning the radio off and back on again.

Basic Tuning Operation, Using With The FT-817 Radio

The Z-817H is operated from the front panel **TUNE** button on the Z-817H. 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 Z-817H 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 Z-817H “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.

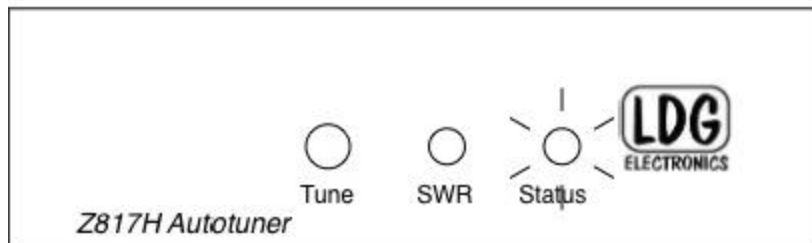
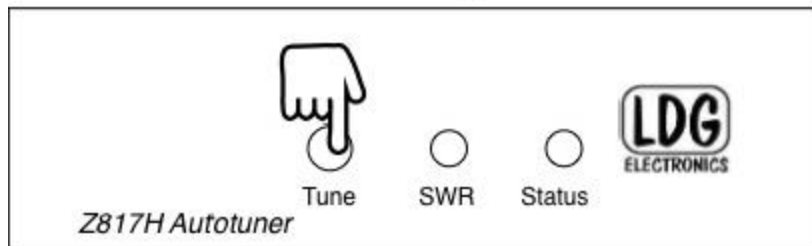
In both cases, at the end of the tuning cycle, the carrier is held for 1.5 seconds after tuning is complete, so that the final SWR may be read on the transceiver’s internal SWR meter or another inline SWR meter, and the front panel LED will indicate the status of the tuning cycle.

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

Toggle Bypass Mode

To toggle between bypassed and active mode, press the front panel Tune button on the Z-817H 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



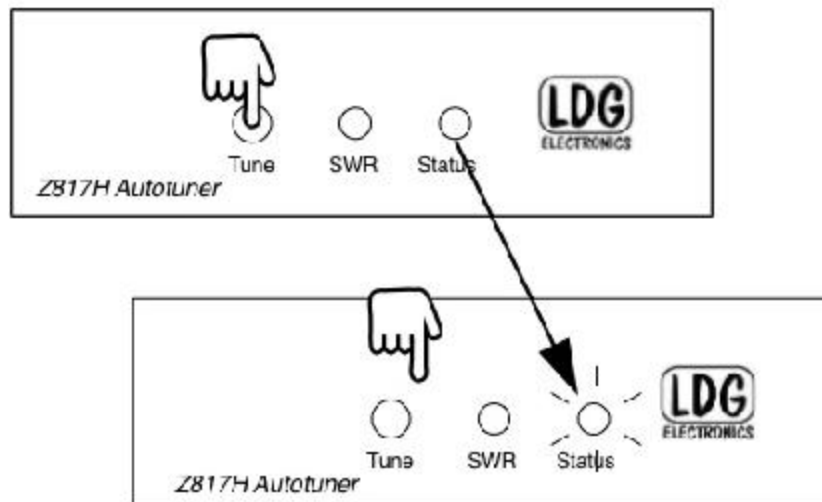
**1 Blink = Active,
3 Blinks = Bypass**

Initiate a Memory Tune Cycle

To initiate a memory tuning cycle, first, bypass the amplifier. Next, press and hold the Tune button on the front of the Z-817H until the Status LED lights up. A memory tuning cycle will begin. The Z-817H will force the transceiver into PKT mode, and key the radio. When tuning is complete, the transceiver will return to the operating mode and power level previously set. Place the amplifier back in “active” mode and begin transmitting.

You will notice that the radio toggles between VFO A and VFO B before and after a tuning cycle. This is normal; the Z-817H is determining if the radio is operating in split mode, and acting accordingly. The Z-817H will tune under all sorts of odd-split conditions, storing the tuning memory information associated with the transmit frequency.

Hold until Status LED lights.



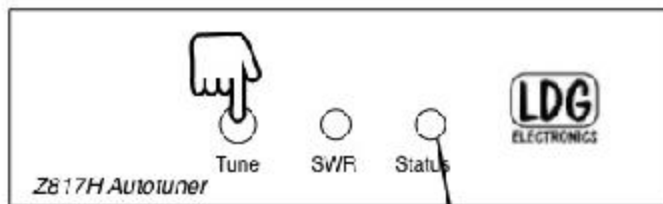
Release when Status LED lights, to begin memory tune.

Force a Full Tune Cycle

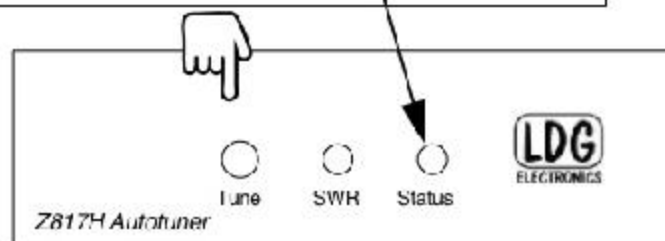
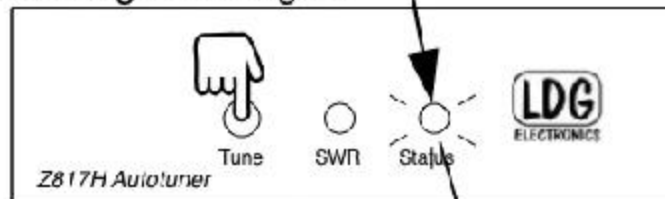
Sometimes, if you are transmitting on a previously tuned frequency, but something has slightly changed in your antenna system (maybe the antenna was re-oriented, for example), performing a memory recall tune will find a stored match that is acceptable, but is not as optimal as could be. In this case, forcing a full tune will cause the Z-817H to seek a better match than the match already stored in memory for this frequency.

To force a full tuning cycle, first bypass the amplifier. Then, press and hold the **Tune** button on the front panel of the Z-817H 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. Place the amplifier back in active mode, and begin transmitting.

Hold until Status LED lights.



Keep holding until Status extinguishes again



Release Tune button to begin Full Tune.

Using The Z-817H With Other Radios

Although the Z-817H is designed to integrate seamlessly with the Yaesu FT-817 radio, it can also be used to tune other QRP radios with external amplifiers, so long as the maximum power output is kept under 50 watts.

Additionally, because there is no frequency counter on the Z-817H, memory recall tuning works slightly differently. The button push sequence is the same as for tuning with an FT-817, but memories are stored sequentially rather than stored in a memory associated with the operating frequency. Over 200 sequential memories are available, and the Z-817H searches the memory from most recently used frequencies to least frequently used, so memory recall in most cases is still nearly instantaneous.

Because the Z-817H's CAT interface only works with FT-817 radios, the Z-817H will not be able to automatically key the radio. Thus, you must key the radio during tuning.

Tuning operation is the same as for tuning with an FT-817, except that you must key the radio manually during the entire tuning process. CW or AM modes work best for tuning, but it is possible to tune in other modes as long as a carrier is present. Be sure to bypass the external amplifier first before tuning, then re-enable it once tuning is complete.

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 blinks once.	Tuner in "Active" mode.
Status LED blinks three times.	Tuner is bypassed.
Status LED goes out, then SWR LED on steady for 1 second.	Tuning cycle is complete, tuning match is less than 1.5:1 SWR.
Status LED goes out, then SWR LED blinks five times.	Tuning cycle is complete, tuning match is between 1.5 and 3.0:1
Status LED goes out, no SWR LED.	Tuning cycle failed, match greater than 3.0:1.
Status LED blinks 4 times.	RF lost during tune.
Status LED blinks 5 times.	No RF detected.

APPLICATION INFORMATION

Mobile Operation

The Z-817H 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.

MARS/CAP Coverage

The Z-817H 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 Z-817H uses the transceiver's CAT port for tuning control, the Z-817H is designed to allow the user to continue to use the CAT interface with the transceiver for PC control, also.

If PC control of the radio is desired, simply connect a CT-62-compatible cable from the PC to the 8-pin mini DIN jack marked "**Computer**" on the rear of the Z-817H.

Any rig control software on the computer must be set to use the 38,400 baud rate, as this is the communication rate used by the Z-817H for controlling the radio.

The Z-817H 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 Z-817H 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 Z-817H when tuning is desired. Some rig control software will detect that the radio is no longer communicating with the PC during tuning. This is normal, and communications with the PC will resume once the tuning cycle is complete.

THEORY OF OPERATION

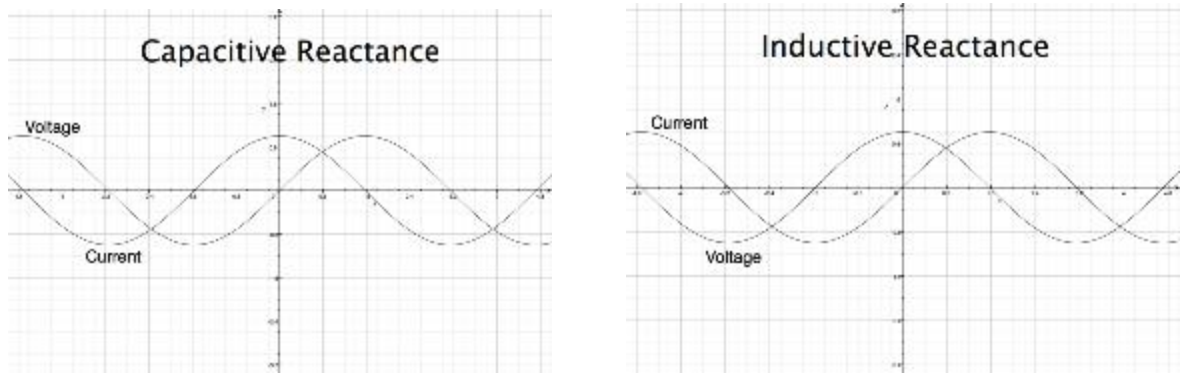
Some basic ideas about impedance

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 Z-817H 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.

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).

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.



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 exciters 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.

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

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

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 Z-817H automates this process.

REV	FWD Power (watts)								
	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	1.75	1.70	1.65
8	4.44	3.14	2.62	2.33	2.15	2.02	1.92	1.85	1.79
10	5.83	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	17.94	6.42	4.44	3.60	3.14	2.83	2.62	2.46	2.33
18	37.97	7.87	5.08	4.00	3.42	3.06	2.80	2.62	2.47
20		9.90	5.83	4.44	3.73	3.30	3.00	2.78	2.62
22		12.92	6.74	4.94	4.07	3.55	3.21	2.86	2.77
24		17.94	7.87	5.51	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	3.85	3.60
34			24.63	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	4.00
38			77.98	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				47.98	15.08	9.56	7.27	6.02	5.22
48				97.99	17.94	10.83	7.87	6.42	5.51
50					21.95	11.92	8.55	6.85	5.83

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 Z-817H

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, in fact, 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 Z-817H to handle loads that are either greater than or less than 50 ohms. All relays are sized to carry 75 watts.

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 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 a latching type, and so they consume no current when not actively switching.

Although the microprocessor’s oscillator runs at 32 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, 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 get 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 Z-817H's very short tuning cycle minimizes the impact of tuning transmissions.

CARE AND MAINTENANCE

The Z-817H tuner is essentially maintenance-free. Power limits in this manual should be strictly adhered to. 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 Z-817H 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 customer support staff is ready to answer your product question by telephone and by e-mail. We know that you will enjoy your product even more knowing LDG is ready to answer your questions as the need arises.

LDG regularly updates on-line information so the best on-line support information is available all day and every day.

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

If a product fails after the warranty period, LDG wants to help you get it fixed. Send the product to us for repair any time you like. We will determine what needs to be done and based on your instructions, 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. Visit the LDG web site and download the LDG Product Repair Form. On the Repair Form tell the LDG technicians exactly what happened or didn't happen and why you believe the product needs servicing. The technician attempts to duplicate the problem(s) you had based on how well you describe it so take the time to be accurate and complete.

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. 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 up to six to eight weeks, but are usually faster. The most recent information on returning products for service is found on the LDG website under Support, then Tech Support. 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/>

