



**LDG Z-817 20-Watt  
Automatic Tuner with  
FT-817 Integration**



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# Table Of Contents

<b>Introduction</b>	<b>3</b>
<b>Jumpstart, or “Real hams don’t read manuals!”</b>	<b>3</b>
<b>Specifications</b>	<b>4</b>
<b>Getting to know your Z-817</b>	<b>5</b>
<i>Front Panel</i>	
<i>Rear Panel</i>	
<b>Installation</b>	<b>8</b>
<i>FT-817 Installation</i>	
<i>Non-FT-817 Installation</i>	
<i>Grounding</i>	
<b>Operation</b>	<b>9</b>
<i>Basic Tuning Operation</i>	
<i>Toggle Bypass Mode:</i>	
<i>Initiate a Memory Tune Cycle:</i>	
<i>Force a Full Tune Cycle:</i>	
<i>Status Indicators</i>	
<b>Application Information</b>	<b>13</b>
<i>Mobile Operation</i>	
<i>MARS/CAP Coverage</i>	
<i>Operation with a PC / CAT</i>	
<b>Theory of Operation</b>	<b>15</b>
<b>The LDG Z-817</b>	<b>17</b>
<b>Care and Maintenance</b>	<b>18</b>
<i>General Care</i>	
<i>Internal Battery Replacement</i>	
<b>Technical Support</b>	<b>20</b>
<b>Two-Year Transferrable Warranty</b>	<b>20</b>
<b>Out Of Warranty Service</b>	<b>21</b>
<b>Returning Your Product For Service</b>	<b>21</b>

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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-817 20-watt automatic tuner for QRP transceivers. While the Z-817 works well with any radio with a maximum power of 20 watts, it offers enhanced features when coupled with the Yaesu FT-817 QRP transceiver. The Z-817 provides semi-automatic antenna tuning across the entire HF spectrum plus 6 meters, at power levels up to 20 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 Z-817 is similar to previous LDG tuners, but is specially engineered to integrate with the Yaesu FT-817 QRP HF radio. The Z-817 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 Z-817 to control the FT-817 by sending it serial commands. The Z-817 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, reduce output power, transmit a carrier, measure the transmit frequency, and then restore the radio to its previous mode and power level!

Of course, the Z-817 will also function as a general-purpose QRP antenna tuner with other radios. Manual operation will be required in this case.

The Z-817 is powered by internal batteries, so there is no additional power cable required to use the Z-817. Latching relays are used, so the Z-817 consumes no power when not tuning, so batteries only need to be replaced once per year or less.

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

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

1. Turn off power to your FT-817<sup>1</sup> radio.
2. Connect the rear antenna jack on the transceiver to the “TX” jack on the Z-817, using a 50 ohm coax cable jumper.
3. Connect a 50 ohm coax antenna feedline to the “ANT” jack on the Z-817.
4. **FT-817:** (If non-FT-817, skip to step 10) Connect one end of the supplied radio interface cable to the ACC port on the back of your FT-817 radio.
5. Connect other end of the supplied radio interface cable to the “Radio” jack on the back of the Z-817.
6. Turn on power to your transceiver. Once it powers up, hold in the F key for one second to access the extended menus. Rotate the SEL knob until menu #14, “CAT RATE” appears. Rotate the dial knob until “38400” is selected. Hold in the F key again for one second, to return to normal operation.
7. Select the desired operating frequency and mode.

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<sup>1</sup> Or any QRP radio with maximum output power of 20 watts or less.

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8. Push and hold the **TUNE** button on the front of the Z-817 for one second (until the **Tuning** LED comes on), then release. The transceiver automatically switches to PKT mode, and keys up with a minimal amount of power, and the Z-817 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!
  10. (**Non-FT-817 Radios**): Select operating frequency, and switch mode to CW or AM.
  11. Key the radio, press and hold the **TUNE** button on the Z-817 until the **Tuning** LED comes on, then release the **TUNE** button.
  12. Wait for the tuning cycle to complete.
  13. Un-key the radio, then return to the desired operating mode; you're ready to operate!

## SPECIFICATIONS

- 0.1 to 20 watts SSB, CW, and digital modes.
- Latching relays for ultra low power operation.
- 2,000 memories for instantaneous frequency and band changing (when used with FT-817 radio. 200 memories otherwise.)
- Battery powered. 4x 1.5V AA (Alkaline recommended for long life)
- Designed specifically for the Yaesu FT-817 QRP HF transceiver.
- Also works with any transceiver with maximum 20 watts power rating.
- Pass-thru CAT port allows Z-817 to control the FT-817 over the CAT bus while still allowing a host PC to also control the radio.
- 1.8 to 54.0 MHz coverage. Frequency for memory storage is read from the radio via CAT.
- Tunes 6 to 600 ohm loads (16 to 150 on 6M), 24 to 2400 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: 5.1L" x 4.7W" x 1.7H". Fits on top the FT-817 with room to spare, allowing access to aftermarket add-ons such as internal DSP.
- Weight: 9.3 ounces (without batteries)

### AN IMPORTANT WORD ABOUT POWER LEVELS

The Z-817 is rated at 20 watts maximum power input *at most*. Many ham transmitters and transceivers, and virtually all amplifiers, output well over 20 watts. Power levels that significantly exceed specifications will definitely damage or destroy your Z-817. If your tuner fails during overload, it could also damage your transmitter or transceiver. Be sure to observe the specified power limitations.

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## 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-817

Your Z-817 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-817 is designed especially for use with the FT-817. Tuning is performed when the **Tune** button is pushed on the front of the Z-817 and held for one second. The tuner can be placed in bypass mode by pressing the **Tune** button momentarily.

The Z-817 is powered directly from internal AA batteries; no separate power supply is needed. The Z-817 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 internal batteries should last for approximately one year under normal operating circumstances; longer or shorter depending upon how frequently tuning is performed.

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

When used with a radio other than the FT-817, the supplied CAT interface cable is not connected. Instead, the radio must be manually keyed during tuning. Also, only 200 memories are available when used with a radio other than the FT-817.

The Z-817 is designed to tune with a maximum of 20 watts of forward power. Many “QRP” radios are capable of transmitting more than the traditional 5 watts maximum for QRP; the Z-817 works well with these radios, such as the FT-897 operating in battery-only mode (20 watts).

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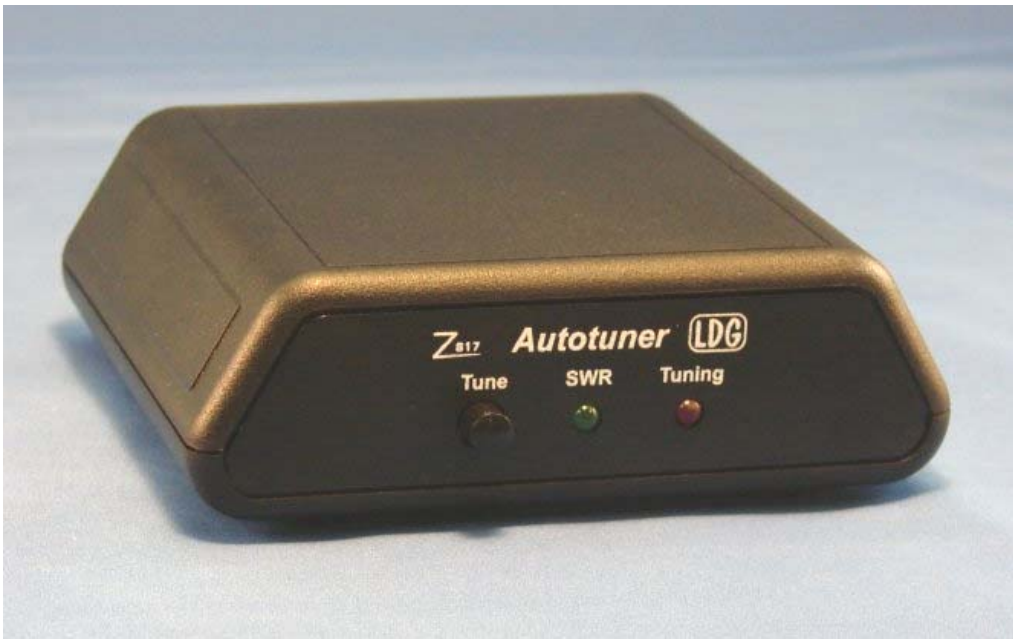
<sup>2</sup> 200 memories when not used with an FT-817 radio.

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*Front Panel*

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

- **Tune:** Initiates either a memory tune or a full tune, and also toggles the tuner between “active” and “bypass” modes.
- **SWR LED:** Lights steady green at the end of a tuning cycle to indicate a good match has been found.
- **Tuning LED:** Lights during tuning operation, will also blink error codes if a good tuning match is not found.



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### Rear Panel

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

- **ANT connector:** Connect the 50-ohm coax antenna feedline to this standard SO-239 connector.
- **TX 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-817 via computer. This is a pass-thru port to the Radio port, and is switched under software control by the Z-817's microprocessor. The firmware of the Z-817 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 FT-817.
- **Radio connector:** This 8-pin mini-DIN connector is for connection to the FT-817's CAT ("ACC") jack. The Z-817 controls the PTT, power level, and operating mode via CAT commands sent to the FT-817. The Z-817 also reads the operating frequency directly from the FT-817 so that it knows where to store tuning memory data.
- **GND connector (5/16" nut):** Connect to antenna system ground.



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## INSTALLATION

The Z-817 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-817 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.

Connect the rear antenna jack on the FT-817 to the **TX** jack on the back of the Z-817, using a 50 ohm coax cable rated 20 watts or greater.

### *FT-817 Installation*

Connect the supplied radio interface cable to the mini-DIN 8-pin jack on the rear of the Z-817, marked "**Radio**". Connect the other end of this cable to the "ACC" port on the rear of the FT-817.

On the FT-817, 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.

If it is desired to operate the FT-817 via computer control, connect the Yaesu CT-62 CAT interface cable to the Z-817 port labelled "**Computer**". The Z-817 will automatically feed through any CAT commands coming in over this port to the FT-817 and vice versa. Note that any software used to control the FT-817 will have to be set for 38,400 baud while connected through the Z-817.



### *Non-FT-817 Installation*

As above, but do not connect the supplied CAT cable, and no radio menu settings are required.



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### *Grounding*

Grounding the Z-817 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 on all antenna cables.

## **OPERATION**

### *Basic Tuning Operation*

The Z-817 is operated from the front panel **TUNE** button on the Z-817 itself. 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-817 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-817 “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 LEDs 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-817 transceiver is designed to transmit and receive on all HF bands plus 6 meters, 2 meters and 70 centimeters, the Z-817 is designed only to work on HF and 6 meters. The Z-817’s microprocessor will check the operating frequency before tuning, and will not allow tuning on 2 meters or 70 cm. If tuning on these bands is attempted, the Tuning LED blinks 10 times quickly, and no tuning is performed.

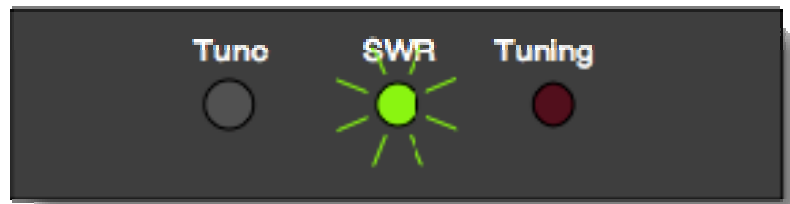
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*Toggle Bypass Mode:*

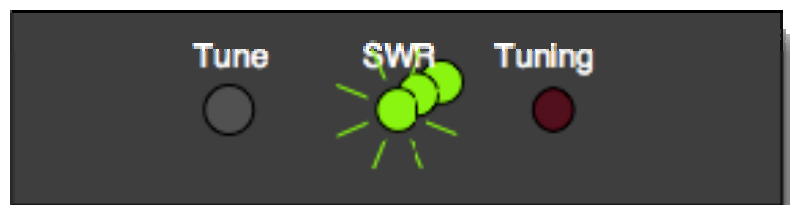
To toggle between bypassed and active mode, press the front panel Tune button on the Z-817 momentarily. The SWR LED will flash three times to indicate that the tuner is in bypass mode. Press the front panel Tune button momentarily again to recall the previous tuner settings. The SWR LED will flash once 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**

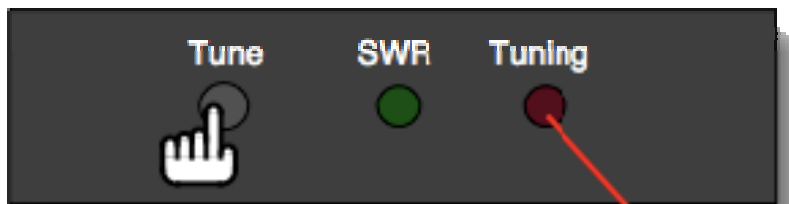
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*Initiate a Memory Tune Cycle:*

To initiate a memory tuning cycle, press and hold the Tuning button on the front of the Z-817 until the Tuning LED lights up. A memory tuning cycle will begin. The Z-817 will force the FT-817 into PKT mode, change the power level to one that is appropriate for tuning, and key the radio. When tuning is complete, the FT-817 will return to the operating mode and power level previously set.

**NOTE:** Wait until the tuning cycle is complete before keying the radio or pushing the PTT button on the mic. Failure to do so will leave the radio in PKT mode upon completion of the tuning cycle.

If not using an FT-817 radio, you must manually switch the radio's mode to CW or AM, and key the radio once the Tuning LED is lit. Continue to keep the radio keyed until the tuning cycle completes. Then switch the radio back to the desired operating mode.



Press and hold until Tuning LED lights.



Release when Tuning LED lights  
to begin memory tune.

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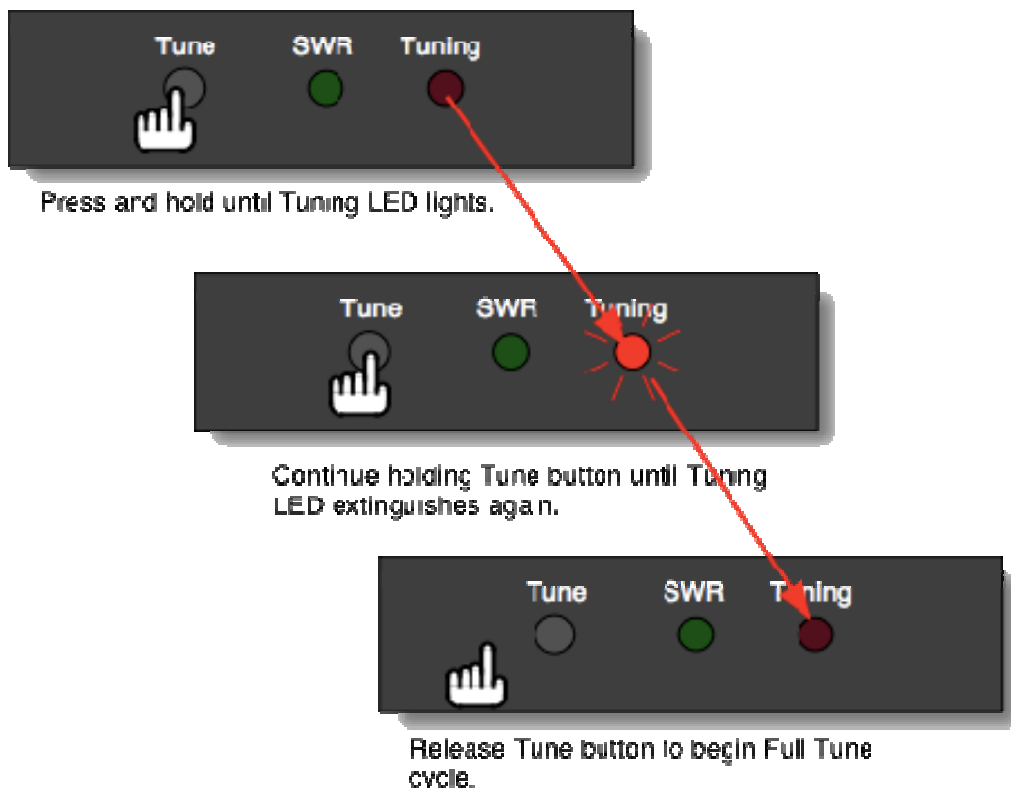
### *Force a Full Tune Cycle:*

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-817 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 Z-817 until the **Tuning LED** lights up, and keep holding until the **Tuning LED** goes out again. Release the **Tune** button once the **Tuning 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.

**NOTE:** Wait until the tuning cycle is complete before keying the radio or pushing the PTT button on the mic. Failure to do so will leave the radio in PKT mode upon completion of the tuning cycle.

If not using an FT-817 radio, you must manually switch the radio's mode to CW or AM, and key the radio once the Tuning LED is lit. Continue to keep the radio keyed until the tuning cycle completes. Then switch the radio back to the desired operating mode.



### Status Indicators

The **SWR LED** and **Tuning LED** are both 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
Tuning LED on.	Tuner is tuning.
Tuning LED goes out, SWR LED comes on solid.	Tuner has completed a tuning cycle; a good SWR match was found.
Tuning LED goes out, SWR LED blinks 5 times.	Tuning cycle is complete, tuning match is between 1.5:1 and 3.0:1 SWR.
Tuning LED goes out, no SWR LED.	Tuning cycle is complete, tuning match is between greater than 3.0:1 SWR.
Tuning LED blinks 4 times.	Tuning cycle failed, RF was lost in the middle of the tune.
Tuning LED blinks 5 times.	Tuning cycle failed, no RF was detected.
Tuning LED blinks 10 times.	Attempted to tune on 2m or 70cm.

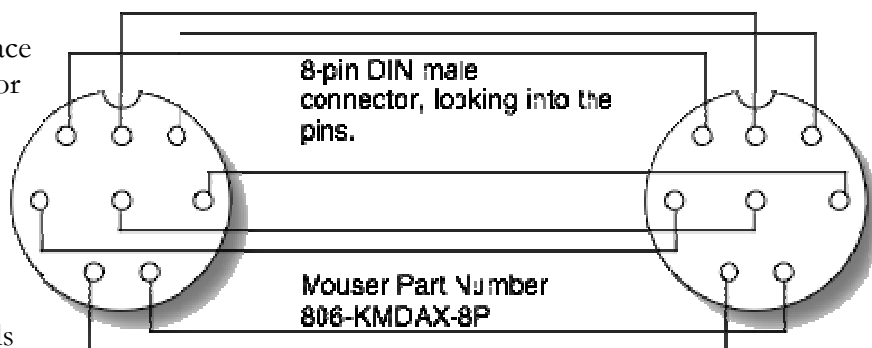
## APPLICATION INFORMATION

### Mobile Operation

The Z-817 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 remain dry.

The supplied radio interface cable is 14 inches long. If it is desired that the Z-817 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.



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### *MARS/CAP Coverage*

The Z-817 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*

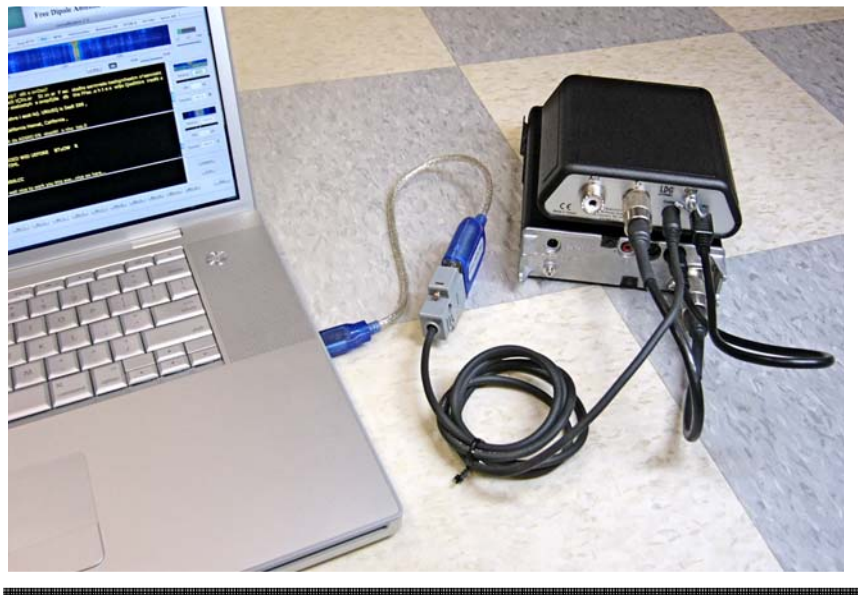
Although the Z-817 uses the FT-817's CAT port for tuning control, the Z-817 is designed to allow the user to continue to use the CAT interface with the FT-817 for PC control, also.

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 Z-817.

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-817 for controlling the FT-817.

The Z-817 monitors the **Computer** port for activity before beginning any tuning activity. Only when the CAT line is idle for a period of time will the Z-817 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-817 when tuning is desired.



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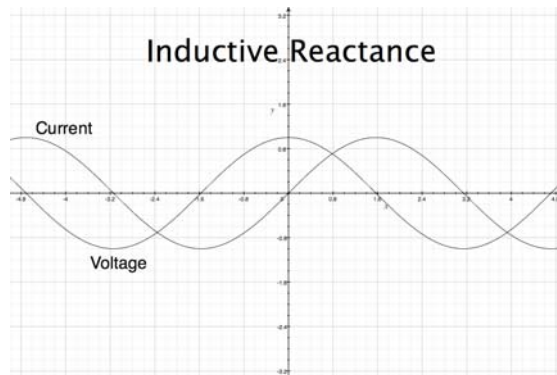
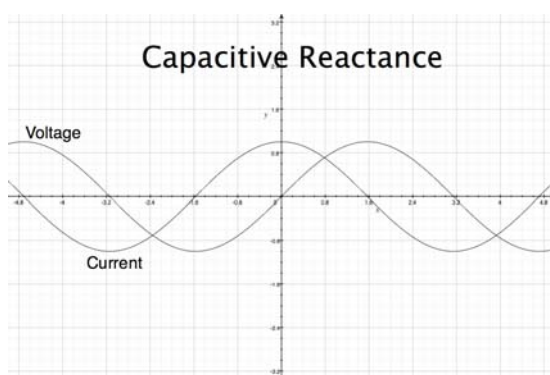
## THEORY OF OPERATION

### *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 subject<sup>3</sup>, but a little background will help in understanding what the Z-817 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.



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

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<sup>3</sup> For a very complete treatment of this subject, see any edition of the ARRL Handbook for Radio Communications (previously the Handbook For Radio Amateurs).

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.

$$SWR = \frac{1 + \sqrt{\frac{R}{F}}}{1 - \sqrt{\frac{R}{F}}} \quad \text{where F = Forward power (watts), R = Reflected power (watts)}$$

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-817 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.

	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	1.75	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	2.96	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	3.95	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			77.99	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				47.98	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



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## THE LDG Z-817

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-817 to handle loads that are either greater than or less than 50 ohms. All relays are sized to carry 20 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 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 6VDC input provided by the internal batteries. The relays are a latching type, and so they consume no current when not actively switching.

Although the microprocessor’s oscillator runs at 8 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 the 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-817’s very short tuning cycle, as little as a fraction of a second, minimizes the impact of tuning transmissions.

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## CARE AND MAINTENANCE

### *General Care*

The Z-817 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-817 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.

### *Internal Battery Replacement*

The Z-817 is powered by four 1.5V AA alkaline batteries, which are located inside the tuner. If tuning operation becomes erratic, or the Z-817 fails to operate at all, it is likely due to low batteries. Battery life is expected to be approximately one year for alkaline cells under normal use. More frequent use, or use of batteries other than alkaline cells may yield somewhat shorter battery life. For maximum battery life and minimum battery weight, lithium AA cells may be used. Although rechargeable AA's such as NiMH (nickel-metal-hydride) are also usable, note that these types of batteries exhibit self-discharge -- they will go dead slowly even if the tuner is not being used.

To replace the batteries in the Z-817, first turn off power to the FT-817, and disconnect the CAT cables and coax cable from the Z-817. There are four screws on the underside of the Z-817's case that hold the lid on. Turn the Z-817 over and carefully remove these screws with a Philips screwdriver.



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Now, turn the Z-817 over again and lift off the lid. Inside you will see a four-cell AA battery holder.

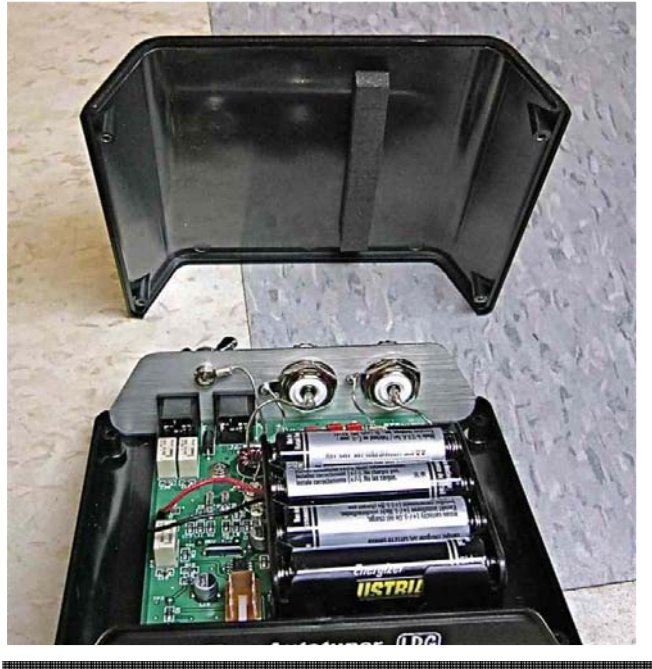


Remove the four AA batteries, and replace them with fresh ones of the alkaline or lithium type. Be sure to observe the polarity markings on the battery holder.



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Replace the lid, paying careful attention to orient the lid such that the internal rubber strip on the lid lines up over top the battery holder. This helps to hold the batteries in place in the event of vibration.



Re-install the four screws. Hook up the coax and CAT cables; the Z-817 is ready to go!

## **TECHNICAL SUPPORT**

The LDG Customer Support Center staff is ready to answer your product question by telephone and over the Internet. We know that you will enjoy your product even more knowing LDG is ready to answer your questions as the need arises.

Our website also links you to the on-line Customer Support Center where you can send us a question, do your own research in the LDG Product Knowledge Books, and read through lists of frequently asked product questions. 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 remainder of the two-year warranty goes with the new owner.

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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 a copy of 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.

## **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 website 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. 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,  
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>