

Z-11

Automatic Antenna Tuner

Manual

Version 1.5G



LDG Electronics

1445 Parran Road, PO Box 48
St. Leonard MD 20685-2903 USA
Phone: 410-586-2177 Fax: 410-586-8475
ldg@ldgelectronics.com www.ldgelectronics.com





Introduction: Congratulations on choosing the LDG Z11 tuner. The Z11 is a full featured low power automatic or semiautomatic antenna tuner designed for the HF ham bands (1.8 to 30 MHz). It will work with virtually any transceiver or transmitter providing between 0.1 and 30 watts continuous RF output (60 watts SSB or CW). The tuner uses the highly versatile "Switched L" configuration with 256 capacitor, 256 inductor and High/Low impedance settings to provide over one hundred and thirty thousand possible tuning combinations. The "L" network will match practically any coax-fed antenna (dipole, vertical, sloper, beam, etc). Long wires, and dipoles fed with ladder line can be matched using the LDG RBA-1 external balun, sold separately. Regardless of antenna type, tuning time is between 0.1 and 3.0 seconds, typically about 1.5 seconds.

The Z11 uses latching relays to switch tuning components in the "L" network. These relays hold the tuning configuration even when power is removed; once matched, the tuner automatically enters a low-power mode where it draws only 0.8 milliamps. Placing the tuner into "Standby" reduces power consumption to zero; the latching relays maintain the tuned configuration indefinitely. During tuning, the Z11 may draw up to 300 milliamps, but only for a few seconds. These exclusive LDG features make the Z11 ideal for portable, battery-powered HF operation.

An important word about power levels: The Z11 is intended for low-power operation *only*. The Z11 is rated at 30 watts continuous power input, *at most*. On CW and SSB, whose duty cycle is approximately 50%, this translates into 60 watts peak RF into the tuner. Many ham transmitters and transceivers output 100 watts or more; this power level will *definitely* damage your Z11. Be sure to observe the 60 watt power limitation for CW and SSB operation, and 30 watts when tuning, or using FM, RTTY or any other 100% duty cycle mode. Most transceivers and transmitters have a level control to adjust the output. Use a good quality wattmeter to find the setting that corresponds to these rated power output levels, and note the setting of the level control. Never exceed that level in operation with the Z11.

Front panel controls: The Z11 is operated from the front panel through four switches, four LEDs and one pushbutton. Refer to the index numbers on photo below.

LEDs: Three LEDs show SWR while tuning or transmitting: green (6) indicates an SWR of less than 1.5, green and yellow together is 1.5 - 2.0, yellow (7) alone is 2.0 - 2.5, yellow and red together is 2.5 - 3.0 and red (8) alone indicates more than 3.0. A fourth Tuning LED (9) indicates that the Z11 is tuning, searching for a match.



Power/Standby: The Power/Standby switch (1) turns the unit on and off. In Power position (up), the Z11 is on, and in Standby position (down), off with zero current draw. Remember, after tuning you can set this switch to Standby, eliminating current draw, and the latching relays will still retain their tuned setting.

System Reset: Pressing both the CAP (3) and IND (4) switches down together resets the processor and bypasses the tuner; RF from your transmitter goes directly to the antenna with no matching.

Auto Switch: The Auto switch (2) determines whether tuning will begin automatically. In Auto mode (up), the tuner will automatically start the tuning process any time the SWR rises above 3.0. In manual mode (down), the tuner will seek a match only when you press the Tune button on the front panel, regardless of SWR. Both modes require at least 0.1 watts of RF power.

Capacitor and Inductor: The Capacitor (3) and Inductor (4) Up and Down switches are used to fine tune the inductors and capacitors, and can be used in either Auto or Manual mode. Pressing either of them Up will add capacitance or inductance, respectively, until it reaches its maximum value, when all four LEDs will flash. Conversely, pressing either of them down will remove capacitance or inductance until it reaches its minimum value, when again, all four LEDs will flash. You can press these switches in short clicks, or hold them up or down to run the capacitance and inductance through their range. You will usually see the LED indicators change as you add or subtract capacitance or inductance while transmitting a carrier.

These switches allow you to adjust the match reached automatically by the processor. In most cases, you will not need to use them; they simply give you the flexibility to manually adjust the match in difficult or unusual antenna situations.

Tune Button: The Tune button (5) starts the tuning process. In manual mode (Auto switch down), this is the only way to begin the tuning cycle. Once started, the tuning cycle will run to completion

and stop automatically. If the Tune button is pressed and there is less than 0.1 watts of power, the four front LEDs will flash to indicate that there was not enough RF to tune properly.

The Tune button has some additional functions when used in combination with other switches. Pressing the Tune button and Ind Up switch together will set the High/Low impedance relay to the High impedance position. The Tuning LED (red) will flash to indicate the change. Pressing the Tune button and Ind Down switch together will switch the High/Low impedance relay to the Low impedance position. The 1.5 SWR LED (green) will flash to indicate the change. This allows you to manually adjust the match as needed. Again, you will rarely need to use this function; it is provided for maximum flexibility. Note that even if you manually set the High/Low impedance relay, it will automatically be reset as needed by the processor the next time the tuning cycle is started.



Back Panel Connections: The back panel has standard SO-239 jacks for connecting to the antenna and transmitter; use standard PL-259 plugs. A coaxial power jack (5.5 by 2.5 mm, center pin positive) provides DC power to the tuner. The power supply must provide between 11 and 20 volts DC at 200 milliamps for up to three seconds. If your transceiver or transmitter operates on 12 volts DC, the Z11 can be powered by the same source.

Another power option is two “9 volt” batteries in series, providing about 14 to 18 volts DC. For rechargeable 9V batteries, you can expect to get about 500 tuning cycles on a charge. Regular 9V alkaline batteries will last longer, but cannot be recharged.

Operation: Connect your transceiver or transmitter to the jack marked “Transmitter”, and the antenna to the jack marked “Antenna”. Connect the power supply to the coaxial power jack. Your Z11 is now ready to use.

Turn on the unit by placing the Power switch in the Power position (up). This initializes the microprocessor; all four LEDs will flash once to indicate a successful power-up. If previously tuned prior to the last power-down, the Z11 will retain the tuned state on power-up; the Z11 does not reset on power-up.

Set the Auto switch to either Auto (up) or Manual (down) as desired. We recommend you start in the Manual (down) mode until you become familiar with the Z11, and with your antenna.

Set your transmitter or transceiver to transmit a continuous carrier of at least 0.1 watt and not more than 30 watts output. CW or FM are usually the most convenient modes for tuning.

While transmitting the carrier, press and release the Tune pushbutton on the Z11 front panel. The tuning cycle will start, as indicated by the red Tuning LED. You will also hear the latching relays cycling as the processor tries different combinations of inductance and capacitance, searching for a match; this makes a fairly loud “buzzing” noise. You can observe the SWR on the indicator LEDs; it will decrease as the Z11 approaches a match (watch closely; it happens fast). The tuning cycle will end automatically in a few seconds with the LEDs indicating the final match. Unkey your transmitter; the tuning process is complete.

In the unlikely event that the Z11 fails to achieve a satisfactory match, you can manually adjust capacitance and inductance using the front panel switches. Key your transmitter again and adjust up or down while observing the SWR on the indicator LEDs. Unkey when you find a satisfactory match.

In either tuning mode (Auto or Manual), if power (either RF or DC) is removed before the tuning cycle is complete, the LEDs will all go out and tuning will stop unmatched. Correct the problem to restore RF and DC power, and begin a new tuning cycle.

After tuning, you can leave the Power switch in the Power position (up) and the mode switch in Auto (up). If you shift frequency significantly, causing the SWR to exceed 3.0, the Z11 will automatically begin a new tuning cycle when you transmit a carrier. In many cases, however, you can set the Power switch to Standby (down), eliminating current drain entirely. You can always power up and tune in a few seconds any time you need to.

A word about tuning etiquette: Be sure to pick a vacant frequency to tune. With today’s crowded ham bands, this is often difficult. However, do your best to avoid interfering with other hams as you tune. The Z11’s very short tuning cycle, usually only a second or so, minimizes the impact of your tuning transmissions.

Performance: The performance of the Z11 will surprise you. It will match an amazing range of antenna types, locations and setups. Using an Autek RF-1 analyzer, we found that the Z11 would consistently tune impedances from about 6 ohms to about 850 ohms. This corresponds to an SWR of about 10:1.

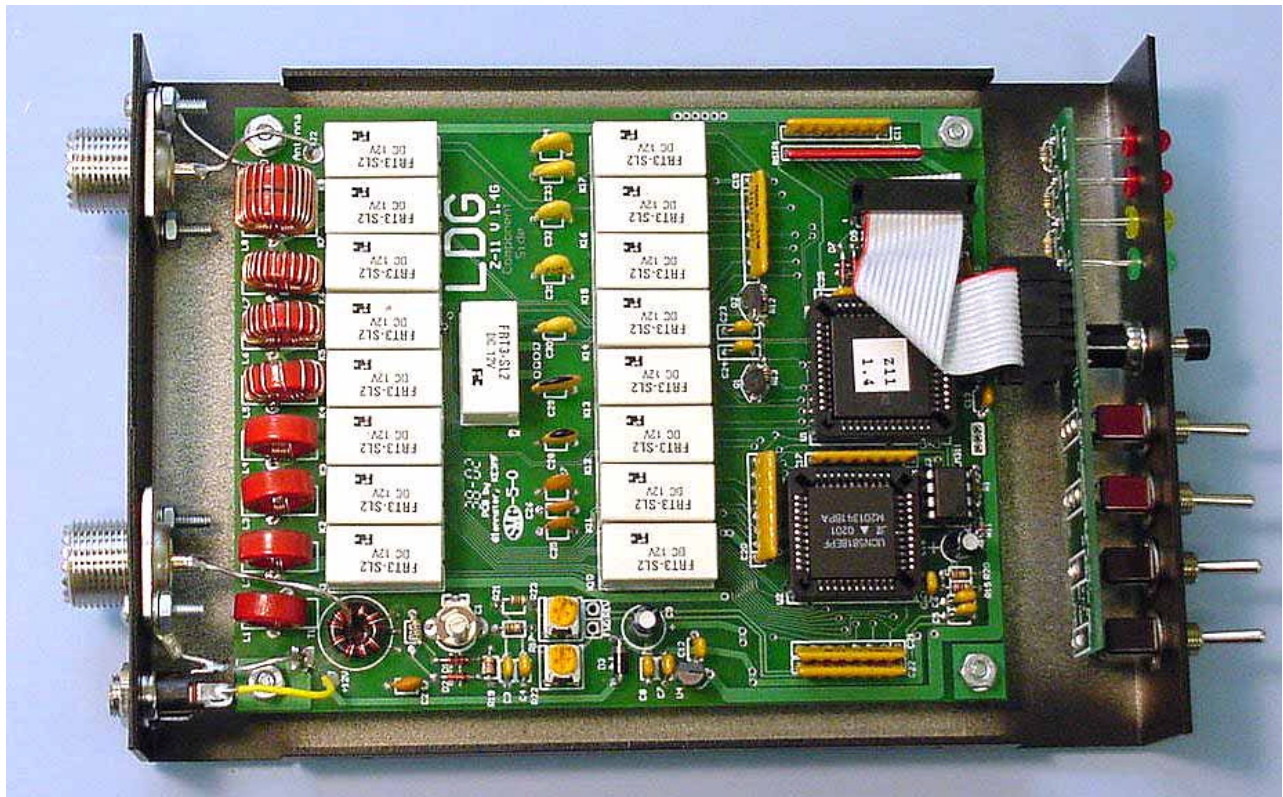
Here are some informal field test results to give you a feeling for the Z11’s capabilities:

Antenna	Performance
Full-sized 40 meter dipole 30 feet above ground	Tuned practically anywhere from 3.1 to 30 MHz, with some problems at 19 and 28 MHz. In these cases, the Z11 usually achieved an SWR of 2.0 automatically; we then used the manual switches to get below 1.5.
Antron-99	Tuned practically anywhere from 5 to 30 MHz. The auto mode worked very well over the whole range.
3-element tri-band beam (20, 15 and 10 meters) 70 feet above ground	Tuned all of the ham bands (including WARC) except 160 and 80. Some problems finding a match around 27.2 MHz, but we got around it by moving to 27.0, letting the Z11 find a match, then moving back to 27.2.
80-meter inverted “Vee”	Tuned everything from 3.1 to 30 MHz. On 160 meters it found good matches from 1.8 to 1.9 MHz.

Even though the Z11 will match a very wide variety of antennas and frequency bands, achieving a match far from resonance is very inefficient; much of your transmitter's power will be dissipated in the tuner, never reaching the antenna. For best results, your antenna should be as close to resonance as circumstances permit.

The Z11 will match some balanced or random wire antennas connected to the SO-239 output jack, but again, it will be somewhat inefficient. For best results, balanced and random wire antennas should be fed through a balun such as the LDG RBA-1.

The tuning bandwidth of the Z11 (usable frequency excursion before exceeding a 1.5 SWR) varies considerably with frequency band, ranging from about 75 kHz on 80 meters, to about 400 kHz on 10 meters. In Auto mode, the Z11 will automatically retune as necessary when you transmit a carrier after changing frequency.



One Touch Tune (OTT) Operation: The Z11 can also be interfaced to directly control an FT-817. The One Touch Tune interface from W4RT Electronics (www.w4rt.com) can be purchased separately. With the OTT installed, the user simply presses the tune button the Z11 and the OTT sends a command to the 817 to transmit a carrier while the tuner is tuning. While not required for operation with the FT-817, the OTT makes changing bands and re-tuning a snap.

Care and Maintenance: Your Z11 tuner is essentially maintenance-free, and rugged enough for normal field use. The outer case may be cleaned as needed with a soft cloth slightly dampened in household cleaning solution. As with any modern electronic device, the Z11 can be damaged by temperature extremes, water, impact or static discharge.

Technical Support: We are happy to help you with your Z11. Telephone technical support is available at 410-586-2177 weekdays from 9 am to 5pm Eastern time. Inquiries by Fax at 410-586-8475 are welcome, and e-mail (ldg@ldgelectronics.com) is answered daily when practical.

Warranty and Service: Factory assembled units are warranted against defects in parts or workmanship for one year from purchase. Kits are warranted against defects in parts only for one year from purchase. This warranty applies to the original purchaser only; it is not transferable. Units returned for warranty service must be accompanied by a copy of the receipt showing the purchaser's name and the date of purchase. All returns must be shipped to us pre-paid; we will not accept units with postage due. A return form is provided on our web site for your convenience.

If you need to return your Z11 to us for service, package it carefully, keeping in mind that we will re-use your packaging to return the unit to you. A self-addressed return shipping label, while not required, will help insure speedy and accurate delivery of your repaired unit. Include a full description of the problem, along with your name, address and a phone number or e-mail where we can reach you with any questions. Repair turnaround can vary from 2 to 6 weeks, depending on the particular problem.

We will be glad to service your Z11 after the warranty period. We will notify you of repair charges by phone or e-mail, and bill you after repairs are completed.

Firmware upgrades: From time to time we will release upgraded firmware for the Z11, refining operation and adding features. Your Z11 is not field programmable; you will have to remove the present chip and replace it with the upgrade chip. To remove the chip (68HC11, U1(location D7 on parts placement grid)) you will need an appropriate tool. A PLCC extraction tool is ideal, but if you don't have one you can fashion a substitute from an ordinary paperclip. Straighten the paper clip, then bend it into a "U" shape. Use pliers to bend the last 1/8" of each end toward the center (see illustration).

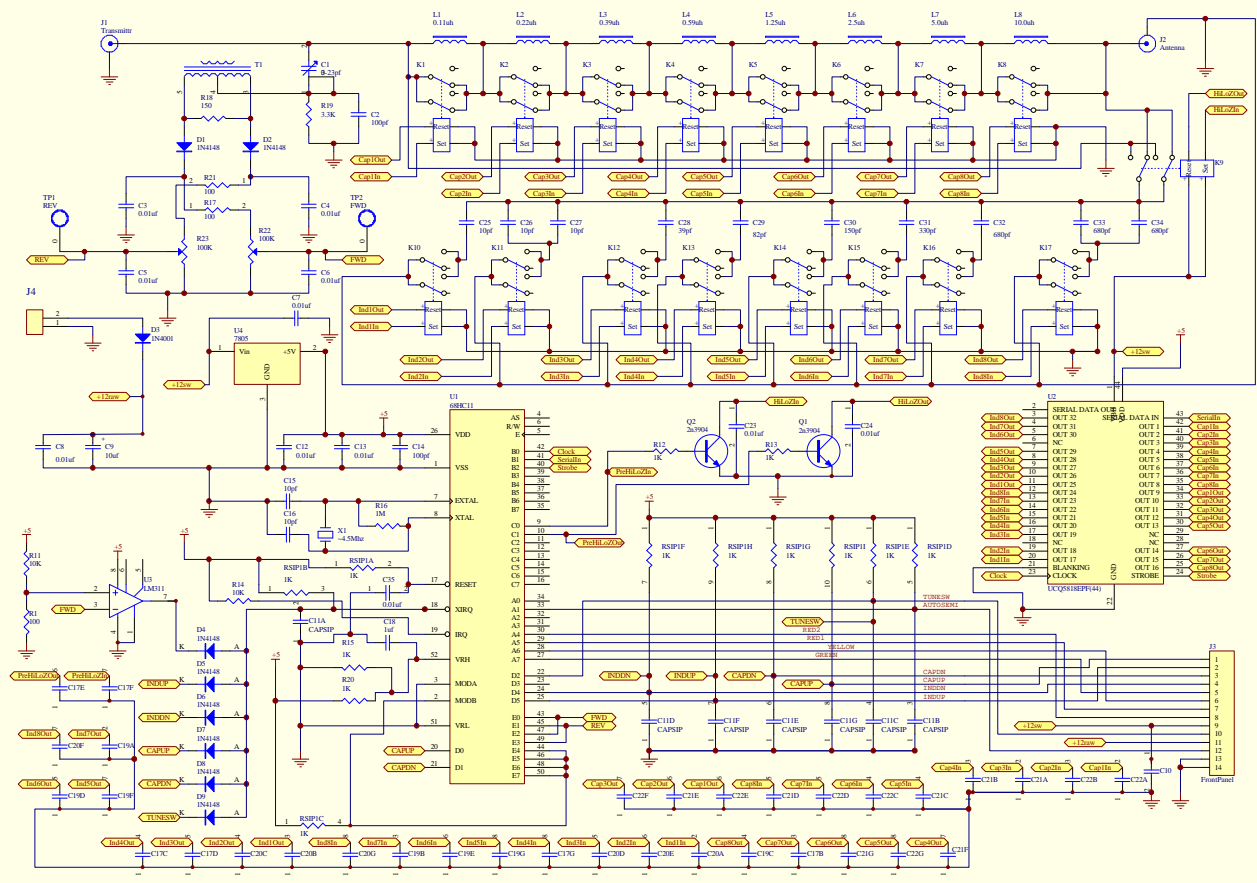


The extraction tool fits into opposite corners of the 68HC11 socket; the bent ends will lift the chip from beneath. Touch a ground point to avoid static discharge damage, and remove the case top. Insert the tool and pull gently and evenly on both sides to extract the chip. Press the upgrade chip into the socket, observing the small diagonal corner key. Replace the case top; your upgraded Z11 is ready for service.

You will return the old processor chip to LDG; the upgrade is sold by exchange only. The processors are recycled and reprogrammed to minimize future upgrade costs. Upgrades will cost \$10-20 with chip exchange, and will be announced on our web site when available.

Feedback: If you have an idea to improve our software or hardware, please send us a description. If we incorporate your idea in the Z11, we'll send you a free upgrade as a "thank you".

We encourage everyone who uses the Z11 to contact us (card, letter or e-mail preferred) telling us how well it works for you. We are also always looking for photographs of the Z11 in use; we frequently place such pictures in the LDG Newsletter and on our Web site (www.ldgelectronics.com).



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