ELECTRONIC DESIGN SPECIALISTS
LeakSeeker 89 AutoRanging Fault Locator
OPERATIONS MANUAL

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Please read this manual completely before trying to use the LeakSeeker for the first time. There is a short tutorial on page 6 that will guide you on your way to the "Ah-Hah!" moment of understanding. Skipping the tutorial will make your understanding far more difficult. Watching the videos at www.eds-inc.com/leak.html is advised.

This unit is designed to be used on a non-powered circuit, as it supplies its own precise test voltages. Be sure power is disconnected from the unit under test, or your LeakSeeker may be damaged!

It is advised to check the Technical Assistance page at www.eds-inc.com for any last-minute additions to this manual and to answer frequently asked questions.

Preliminary

The ***LeakSeeker*** model ***EDS-89*** will locate a shorted or leaky component or any other shorted condition (such as a pinched wire or solder bridge) with a short resistance value from zero to 300 ohms, to the exact spot on a pc board. If the unit has multiple pc boards, *LeakSeeker* will first identify *which board* contains the defective component, then will guide the technician directly to the *location* of the defective component on that board. The EDS-89 version is an updated version of the original *LeakSeeker* EDS-82 series with three sensitivity modes, all fully automatic. Tests are done simply by touching the solder pads along a "shorted" foil trace and the pad with the highest pitch marks the defect.

This unit includes a universal AC adapter with a 2.1mm plug. The internal regulator in LeakSeeker allows it to run from any AC or DC adapter or battery from 9 to 25 volts AC or DC, as long as it has a 2.1mm plug.

How the *Leakseeker* works

The EDS-89 *LeakSeeker* pinpoints the exact location of a shorted or leaky component by comparing the resistance at different component solder pads along a shorted pc foil trace, and subtracts the foil's milliohm resistance from the value of the defective component. Therefore, there is a different reading at each pad, although by a very small amount, with the lowest reading at the short. *Leakseeker* consists of a 16 bit self-calibrating digital comparator with a range of zero to 300 ohms, auto memory, and a variable gain comparison circuit with visual and audible indicators. Initial search for a shorted component automatically starts at the *LeakSeeker*'s maximum range and counts down to the resistance of the defective component, within a "*window*" that is indicated by nine small distance LEDs. It also uses a variable pitch tone, which will be at its highest when the test probe is touching the pad where the resistance is lowest.

LeakSeeker can use one of two different test methods to locate the defect. The **NORM**AL test causes a precise voltage/current to appear at the test **PROBE**, and as the technician touches each pad, the small difference in the voltage/current readings is translated into the change of the beep pitch and distance LEDs. This test method is ideal for finding the location of typical "dead" shorts under a few ohms.

The **3-WIRE** test is used when the readings are confusing, for example, if the "short" is actually *many* ohms, and a large electrolytic capacitor is somewhere along the trace. Instead of a steady tone, the pitch may constantly change as the capacitor tries to charge or the leaky defective component warms up, making stable readings impossible. The **3-WIRE** test separates the precise voltage reference **+REF** from the **PROBE** port. It is more difficult to use, so the technician should have a thorough understanding of the

normal testing methods first.

First, some important notes that you need to remember:

LeakSeeker recalibrates itself automatically to a new range as you get *closer* to the defect, as ohms get lower. If you get *further* from the short and resistance goes higher, a lower pitch of the tone, and eventually no tone at all and the lowest red indicator will be the only indication. If you loose your way, or accidentally touch the wrong pad, you can push **RESET** and *LeakSeeker* will re-calibrate itself again, as soon as the **PROBE** is touched to the correct pad. Remember that all tests *must* start by pushing the **RESET** button to clear the memory.

During the normal test, you would touch any pad along the "shorted" foil and allow *LeakSeeker* to recalibrate *automatically* as you get closer to the defect. However, if all of the solder pads seem to have the same tone because of the low resistance of the ground plane power source of a multi-layer board, using a higher **GAIN** allows you to increase the resolution many times.

Normal testing

You should be sure that you are looking for a shorted or leaky part by verifying that the pc board trace you are about to test shows a suspiciously low ohms reading. A quick method for checking any type of unit for shorts is to simply measure the resistance across the largest main filters in the power supply with your ohmmeter. In a normal circuit, you will usually see the cap charging up to several thousand ohms. If you own a ***CapAnalyzer 88***, set the **LOW DCR** warning slider to 50 ohms. Any cap that shows 50 ohms or less is probably the supply line that feeds the shorted component. Be advised that using an ordinary DVM ohmmeter will not find *active* shorts. Instead, use the *CapAnalyzer* or *LeakSeeker* as you would an ohmmeter. Normal circuit conditions would produce no warnings, while passive or active shorts 300 ohms or less will make *LeakSeeker* calibrate to the short and give you a steady reading.

For example, a normal power supply output usually shows several thousand ohms, after the filter caps finish charging. If you feel that you have a problem with the supply because voltage readings are low while the unit is powered up, or *CapAnalyzer* warned you with **DCR TOO LOW**, remove power and use an ohmmeter across the cap to see if the reading is lower than 300 ohms (the maximum range of the *LeakSeeker*) to ground. Typically, most good supplies show resistances in the thousands of ohms while most with "shorts" will show just a few ohms, or even less than an ohm. The exception to this

instance is when you suspect an *active short*, where a supply is pulled down by a component that does not show shorted with your ohmmeter. This can happen when, for example, a component shorts, but is powered through a diode. Although your ohmmeter cannot measure past the diode, the *LeakSeeker* (and *CapAnalyzer)* can. A steady tone after the *LeakSeeker* calibrates indicates that it found a suspicious reading under 300 ohms and your search can go on. If it simply chirps or gives no reading at all, then no short (active or normal) was found.

Getting Started

Look at the **GAIN** switch. Notice that the lower gain setting is best for thin pc foil traces, and should be your first choice. If you notice very little pitch changes as you hop from pad to pad, you can raise the **GAIN**, as the foil traces might be thicker. You would use the highest **GAIN** setting for very thick traces or multi-layer boards with ground planes.

In the **NORM**AL test, the **BLACK** ground wire alligator clip is connected to the best ground available, preferably at the power source. The connection must be of high quality or the results will be misleading. You can ignore the alligator clip and solder the bare wire (behind the alligator clip) to ground to eliminate this source of errors.
Push the **RESET** button to let *LeakSeeker* know to start a new search. The test probe is then touched on a solder pad *anywhere* along the pc board copper trace that you believe a shorted or leaky component is soldered to. If the board is dense, you might use a thin Sharpie marker to outline the trace, to prevent confusion so that you don't accidentally touch the wrong pad.

As you hold the test probe on the first pad, *LeakSeeker* will beep at its highest pitch and light the **WAIT** lamp brightly for a few seconds as it ramps quickly down to the short value. Be patient. As it gets closer, the search will slow, the **WAIT** LED will flash dimly and you will hear the pitch clicking step by step as it gets a few milliohms closer and closer. When it has calibrated, the pitch will be low and steady and one (or a group) of the nine distance LEDs will be lit. Touching the test probe to the next solder pad along the pc trace should make the pitch higher or lower, depending on whether you are moving in the correct direction. The distance lamps will also give rough indications that you are getting closer or further from the defective component. As you touch the probe from pad to pad in the correct direction, the beeps will get higher in pitch and the distance LEDs will go **CLOSER >** to the green LEDs. As you get out of range of the *window*, the **WAIT** LED will come on as *LeakSeeker* recalibrates the window. If you get further from the short, the LEDs will reverse toward the red LEDs and the pitch will get lower. You should always make it a habit to go back one pad after each new pad test to make sure the pitch is higher on the new pad and lower on the old pad, as *LeakSeeker* will recalibrate very quickly and you might not notice.

If you accidentally touch the probe to a wrong pad not on the shorted circuit, like maybe ground, and *LeakSeeker* notices the huge change, it intentionally waits a second before accepting the huge change and recalibrating. The delay is intentional; if you accidentally touched the wrong pad (like a ground), this delay gives you the time to change your mind as long as you lift off of the pad before the **WAIT** LED comes on and recalibration is complete. You should always double-check your progress by touching the previous pad---the pitch should be lower than the pad closest to the short. If you goof, just press **RESET** and start off the last valid solder pad.

On older boards with large traces, or on multi-layer boards with groundplanes, you may find that many pads close to each other may have the same pitch. Use the highest **GAIN** setting and now you will see and hear a slight change between the two pads. The pad with the highest pitch is your objective. When the tone no longer changes and the **WAIT** LED is off, the window is perfect.

As you touch each pad, remember to always go back one to double-check that the tone is lower (or gone completely as that window is now long gone). At some point, the beep will be highest in pitch at only *one* pad along the trace. *This is the short, and may be the location of the defective component.* If you continue past this pad, the pitch will start to go lower and the distance indicator will start to head towards the red indicators. If you backtrack, the pitch will always be highest at the pad with the lowest resistance, and of the possible defective component.

But what if the highest pitch can't be the bad part?

If the highest pitch comes from a pad that is a jumper or wire, or coil or transformer, for example, a component that is *supposed* to conduct, this means that the defect is probably on the other side of the component, in another area of the board. For example, if you are tracing a short at the collector of the horizontal output transistor and find that the highest pitch is at the flyback transformer primary, this does not necessarily mean that the transformer is shorted; the short may be on the other side of the winding, at the B+ supply. Follow it like a detective, as you may find that you may be jumper-hopping, coil-hopping, possibly even board-hopping, for example from the HV board, to the supply board and so on, to where the bad part actually is. The obvious parts that *could* be bad are parts that should *never* show as a low resistance in the first place, such as a capacitor, cathode of a diode, B+ pin of an IC chip and so on.

Using the Hot/Cool thermal test method

If the defect is several ohms, you can search for the defective component in another, much easier way. To keep your hand free to hold a can of freeze spray or a soldering iron or hot air blower, use the extra plug-in test cable supplied with *LeakSeeker* that has the

solder wire tip, plug it into the **REF+** port, and solder the tip to any pad along the shorted trace. The test mode switch remains in the **NORM**AL position, which joins the **REF+** and **PROBE** ports together. Press the **RESET** button and wait for a stable reading.

Higher resistance defective components are *always* thermally responsive. You can use a can of freeze spray to spray each component on the board while the solder tip test cable is soldered on the suspected trace. The spray will make the *LeakSeeker* change quickly in pitch when the defective component is sprayed.

3-Wire testing

3-Wire testing is used for times when **Normal** testing becomes difficult. In these cases, a component may not be shorted, but just leaky; perhaps 50 or more ohms, and a capacitor along the trace tries to charge each time the test probe is touched to a pad. Instead of steady tones, the *LeakSeeker* will chirp from high to low, or the pitch will vary, making testing very difficult in the **NORM**AL position as you wait forever for the pitch to get stable, but the **3-Wire** test will separate the **+REF** from the **PROBE** port, and allow the circuit to stabilize under power. Only use the 3-wire test for higher-ohm shorts over about 10 or 15 ohms and when normal testing is too difficult.

Solder the **+REF** wire solder tip to the normal source of the power in the supply line you are troubleshooting, for example, at the output of the power supply at the big electrolytic that shows a short to ground. This is important, as the 3-Wire test does *not* allow testing to start *anywhere* on the board as the **NORM**AL testing allows. Make sure the mode switch is in the **3-WIRE** test mode. *You must start probing at the normal source of power*, like at one end of the trace by the large power supply capacitors. Allow about 15 seconds for all voltages, currents and temperatures to stabilize, push the **RESET** button, then touch and hold the test **PROBE** at the starting point where the **+REF** is soldered, and allow *LeakSeeker* to calibrate. Then touch each pad along the bus and proceed as you would in the **NORM**AL test. Each reading should now be quick and easy since the special signal from *LeakSeeker* **+REF** now is no longer changing.

As you proceed, just as in the **NORM**AL test, the pitch of the tone and distance indicators will guide you towards the defect. As you probe different branches, you will find that some branches do not have any changes from pad to pad. That is because there are no problems in that branch. Go back to the fork and try another branch.

At some point, you will reach the defect and pass it, and the distance indicators and tone pitch will again no longer change, just like the previous branches that had no problems. The ***first*** pad on the branch that is highest in pitch is the location of the defect. Going back towards any other branch will cause the tone to get lower, and going forward will no

longer cause the highest pitch to change. Therefore, be sure to notice the exact location at which point the readings no longer change as you pass the defect. The exact location of the *first* pad that has the highest pitch will be the exact location of the defect. All pads beyond this point will have the same pitch as the *first* pad of the highest pitch. You can verify the defect by using a blast of freeze spray or directed heat on the suspicious component. *LeakSeeker* will change pitch drastically only when the defective part is cooled or heated.

Tutorial

To best be familiar with *LeakSeeker*, try this little experiment. It will give you the direction and understanding in real time of how to use *LeakSeeker*. You will intentionally create a defect by soldering in a low-value resistor across a capacitor in a power supply trace, and then use your *LeakSeeker* to find it.

On an old pc board or discarded electronic component, locate a power supply trace on the main board and check the resistance to ground. You will see how a normal circuit should show, probably a few thousand ohms. Now, solder in a low-value resistor across a large capacitor, or maybe somewhere further down the trace to ground, to simulate a leaky capacitor. For example, you could solder a 4.7 ohm resistor to ground at an integrated circuit B+ or small filter cap. (Of course, don't power up the unit, or you might damage its power supply). Use your DVM or ohmmeter to verify that you get the same 4.7 ohm reading to ground, everywhere along the trace.

With the *LeakSeeker* power switch in the **NORM**AL test, push **RESET** once. Start at some distance from the "short" resistor, along the same foil. Use a Sharpie marker if the trace is very thin so you don't get lost. You should follow the instructions for the **NORM**AL test and follow the *LeakSeeker's* advice, tracing a path along the pcb foil trace pads, wires, jumpers and connectors, and end up at the resistor that you soldered in. (Don't forget to remove the tutorial resistor from your experiment when done!)

As you progress, you will get the feel and the personality of your *LeakSeeker*. Try the **3-WIRE** test method only *after* you have mastered the **NORM**AL test, as this test is more difficult. You'll usually only need this test with shorts higher than 10 ohms anyway, which are rare.

IN CASE OF TROUBLE

If you accidentally forget to remove power from the unit under test, the power would try to feedback into the *LeakSeeker* and cause damage. There are two 0.47 ohm fusible resistors and one 9 volt zener diode soldered to the board near the test probe, clearly marked on the board. These are designed to self-destruct and protect the *LeakSeeker's*

electronics. There are indications that these protection devices have done their job; *LeakSeeker* will immediately beep and try to calibrate to nothing as soon as it is turned on and the **RES**ET button is pressed if the zener diode is shorted, or you would get no function at all if the fusible resistor is open.

60 DAY MONEY-BACK GUARANTEE

EDS, Inc. guarantees that the user may return this product to original place of purchase for a full refund within 60 days of receipt under the following conditions:

1: The product must be undamaged and returned in the same condition as received and with the original packing material. A copy of the bill of sale is required. You must call the reseller for a return authorization number. You are responsible for return shipping charges and for providing correct insurance coverage. Units received damaged will be returned to you. Any missing probes or hardware will be deducted from the refund. Original shipping costs will be refunded *only* if the unit has a *factory* defect.

2: All EDS products are unique and some effort is required to learn to use an unfamiliar new device. It is expected that you attempt to use and learn this product for at least two months, and to read and follow the directions in the owner's manual. If you are confused about any instructions in the manual or need any assistance, please contact your distributor or EDS-Inc for assistance and make an honest effort to learn to use the product. If the product proves to be too difficult for you to learn, feel free to make comments or suggestions to help EDS improve the product or revise the owner's manual when you return your *LeakSeeker*.

THREE-YEAR LIMITED WARRANTY

EDS, Inc. warrants this product to be free from factory defects for a period of three years from date of purchase. A copy of the original bill of sale is required for any claims. The customer will call for return authorization and mail the unit to EDS for repair or replacement. This warranty does not include any damage caused by shipping, abuse, lightning, or incorrect testing procedures. Test probes or any other wires or cables are not covered under this warranty. EDS shall not be responsible for any action or consequential damages caused by the user, and assumes no responsibility for liability due to the actions of the user. The user/operator assumes complete responsibility in using this product and is expected to conduct their operating procedure in a safe and professional manner.

Declaration of Conformity for European Union

The product listed on this Declaration of Conformity has been tested and verified to comply with the essential requirements of the Electromagnetic Compatibility Directive 2004/108/EC of 15 December 2004, as amended July 2011, on the approximation of the laws of the Member States Relating to Electromagnetic Compatibility (EMC).

Standards to which conformity is declared:

EN 61326-1, CISPR 11, EN 55011 Electrical equipment for measurement, control and laboratory use - EMC requirements

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Description of Equipment:
Product Name: ***LeakSeeker 89***
Model Number: EDS-89
Designed and built in the U.S.A.

Electronic Design Specialists, Inc. hereby declares that the equipment specified above conforms to the protection requirements of the above named Directive(s) and Standards.

David T. Miga, CET President, EDS Inc. June 9, 2013

Product category 9 exclusions as amended July 2011

Industrial Monitoring and Control Instruments are considered RoHS Category 9 products. The EU recognizes that these products are manufactured in small numbers and generally have a long product life. Further, these products are often used in mission-critical applications where their failure can reasonably be expected to be extremely disruptive, if not catastrophic. The EU

has established at least a temporary moratorium for Category 9 products until July 2017. EDS products use parts that are RoHS compliant, but may use conventional 60/40 solder for reliability at certain junction points.

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