EDS-59C
SEMIANALYZER

SE

OPERATING INSTRUCTIONS
and
OWNER'S MANUAL

ELECTRONIC DESIGN SPECIALISTS, INC.
4647 Appalachian Street
Boca Raton, FL 33428
561-487-6103

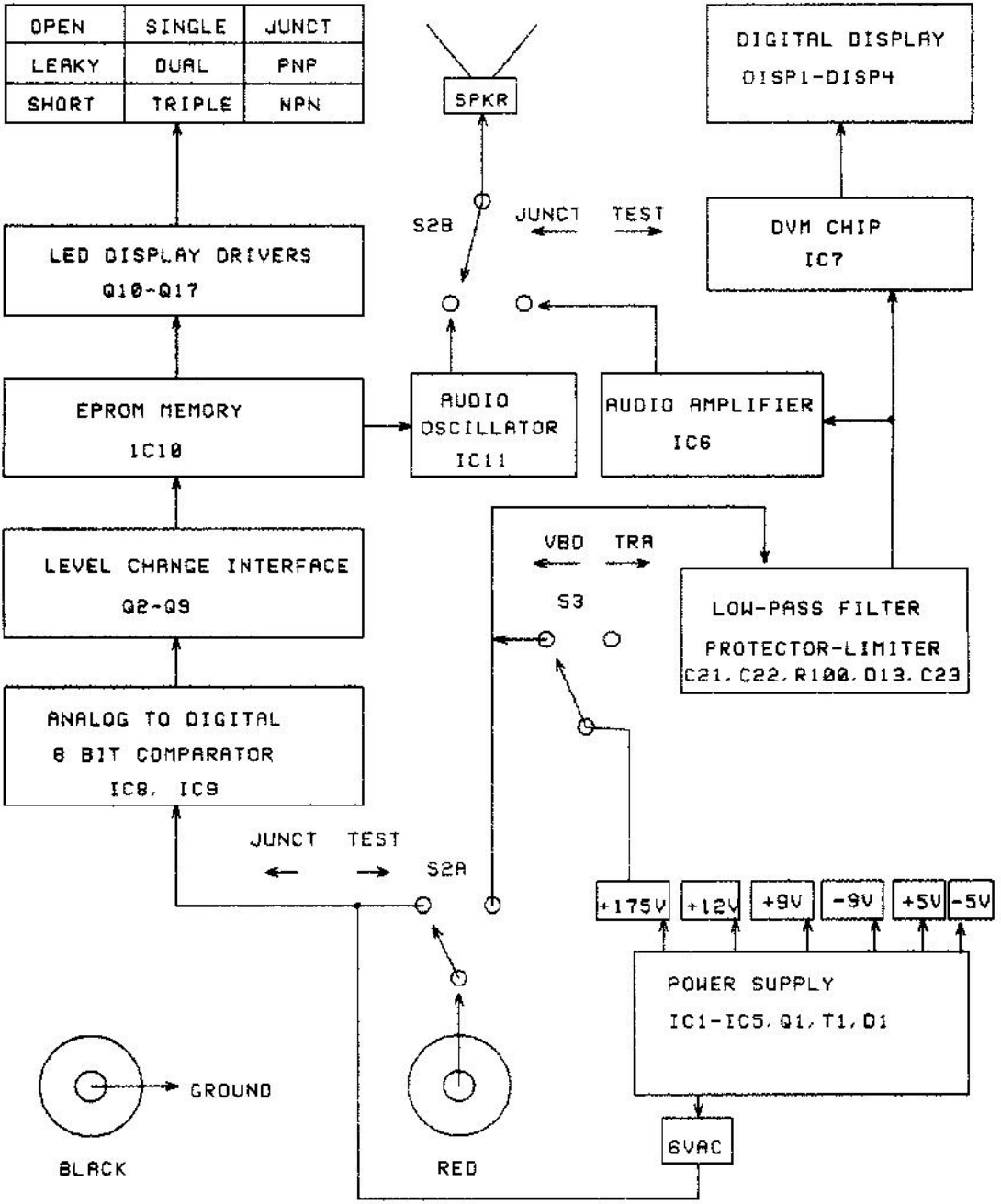

FIGURE 1: BLOCK DIAGRAM OF THE SEMIANALYZER

If you're an electronic technician, chances are that you are using a DVM in the junction test mode, or an inexpensive transistor checker to check transistors and diodes, with marginal success. How would you like to have a machine that would probe a semiconductor device in circuit and read out in English, not only the *type*, but also the *condition* and *number of junctions* of the semiconductor, as well as circuit conditions AROUND the component under test? It would also beep different tones for important circuit parameters such as shorted or leaky components. It would even check LEDs, capacitors, neon bulbs and semiconductors for proper voltage breakdown, up to 175 volts, and even let you *listen* to the breakdown so that you can identify noisy components. It would even have a built-in signal tracer with a digital voltmeter to trace active signals through a difficult circuit. Sound like a fantasy? The equipment does exist: the EDS-59C SEMIANALYZER.

HOW IT WORKS

Looking at the block diagram in figure 1. we can see that the SEMIANALYZER is actually two pieces of test equipment sharing the cabinet, power supply, test leads and speaker. Looking at the left (junction) portion of the SEMIANALYZER we see that a 6 VAC signal is sent out through the test leads to the component under test. The component and the circuitry around it will distort the signal in a certain manner. This signal is converted by the eight-bit comparator which acts as an A to D converter to form an eight-bit word, which is level-shifted to the proper 0 to 5 volt signals to be presented to the 2732 Eprom. The Eprom has been programmed to recognize almost any circuit condition, and it turns on the proper LEDs through the LED display driver circuitry to illuminate the right combination of words on the LED matrix. The Eprom also has five outputs to drive a tone oscillator at different frequencies to warn the user of shorted, leaky or multiple-junction devices.

Looking at the right (voltage breakdown, signal tracer) side of figure 1, the power supply generates a safe, isolated source of 175 volts DC which is applied to the component under test through a high-value resistor to limit current to a maximum of 15 milliamps. As the component breaks down at a certain voltage. the voltage is displayed by the DVM integrated circuit and seven-segment LED readouts. The breakdown noise is monitored by the audio amplifier integrated circuit through the filter protector circuit. A switch can turn off the high-voltage source, so that the amplifier, limiter and DVM circuits remain on line for using the SEMIANALYZER as a signal tracer.

USING THE SEMIANALYZER

The EDS-59C was designed to be as easy to use as possible, so that you, the technician, can spend your energies on the equipment to be repaired, rather than fiddling with knobs or controls of a transistor checker or trying to interpret the readings of a curve tracer or a meter. Therefore, there are only three switches on the 59C SEMIANALYZER: **POWER, JUNCT/TEST** selector, and **VBD/TRA** selector. The **JUNCT** position selects the junction test mode; the **TEST** position allows S3 to operate; the **TRA** mode selects the signal tracer mode, and **VBD** selects the voltage breakdown/noise function.

FAMILIARIZATION WITH THE JUNCTION TEST CIRCUIT

To check transistor junctions in circuit, the **BLACK** test probe is held to the BASE of the transistor to be checked, while the **RED** probe is touched first to the COLLECTOR, then the EMITTER. The SEMIANALYZER should read out the type, polarity and condition of the device. If a diode is checked, touch RED to ANODE, BLACK to CATHODE, and the reading should be SINGLE PNP JUNCT. The SEMIANALYZER will also beep tones, so that with a little practice, you will not have to look up to the display each time. A low buzz shows a leaky or suspicious junction, a high pitch indicates short, and several medium tones indicate the number of junctions of the semiconductor.

Let's check an NPN transistor out of circuit first, to become familiar with the proceedure. Be sure the selector switch is in the out, or **JUNCT** position, and touch the black test lead to the base of a transistor, and the red test lead to the emitter; the 59C should read "SINGLE NPN JUNCT" and beep at a comfortable tone. Now, while the black lead is still on the base, touch the red test lead to the collector; the display should read the same as before. Now, touch the red and black leads to the emitter and collector (in either polarity); there should be an open junction. See the chart below:

BLACK to BASE, RED to COLLECTOR = **SINGLE NPN JUNCTION**

BLACK to BASE, RED to EMITTER = **SINGLE NPN JUNCTION**

BLACK to COLLECTOR, RED to EMITTER = **OPEN JUNCTION**

Shorting the leads together should show **SHORT JUNCT** and the SEMIANALYZER should squeal at an alarming pitch.

You can check a diode in just one step: with the red lead on the anode and the black lead on the cathode, the SEMIANALYZER will read **SINGLE PNP JUNCT**. Reversing the leads will change the **PNP** to **NPN**.

FAMLIARIZATION WITH THE VOLTAGE BREAKDOWN CIRCUIT

Now, switch to **TEST** and to **VBD**. *Don't touch both test leads at the same time!* It won't hurt you because the current is limited to 15 milliamps, but it can suprise you. Take the NPN transistor and touch the red test lead to the collector and the black test lead to the emitter. If you chose a transistor with less than 170 Vce, the 59C will display the Vce along with some hiss created by the avalanche. If the transistor is good, the voltage reading will be steady within a few tenths of a volt and the hiss will be faint and steady. Any crackling shows a defective or noisy junction.

Note that in the junction mode, the black test lead always goes to the base, while the red lead is touched first to the collector, then to the emitter. It doesn't matter which leads go from collector to emitter since you should get an **OPEN JUNCTION** reading anyway. However, in the **VBD** mode, remember that an NPN transistor always requires *positive* (red) at the collector. while a PNP always requires *negative* (black) at the collector. If for example, you inadvertantly tried to measure Vcb of a PNP transistor by touching the red lead to the collector and the black lead to the base, you would simply be forward biasing the junction and would get a reading of 0.7 volts. Below is a chart of typical measurements and readings of a 2SC945 NPN transistor:

VBD Test (done correctly)

Red to collector, black to base = Vcb (between 60-120 volts)

Red to collector, black to emitter = Vce (between 40-80 volts)

Red to emitter, black to base = Veb (between 6-12 volts)

Vcb is always somewhat higher than Vce; Veb is always lower than Vcb or Vce.

VB Test (done INCORRECTLY)

Black to collector, red to base = 0.7 V

Black to collector, red to emitter = 5-10 V

Black to emitter, red to base = 0.7 V

This test would have been correct for a PNP transistor, since all polarities are reversed from an NPN.

IN-CIRCUIT JUNCTION TESTS

The EDS-59C SEMIANALYZER has been designed to check the junctions of semi-conductors with high accuracy in circuit, even when low shunt resistances as low as ten ohms are in parallel with the semiconductor. However, if several semi-conductors are direct coupled, as in the output stages of an amplifier, or a power supply regulator, you may get some strange readings. For example, if the base to emitter and base to collector readings are normal, but between emitter and collector you don't get the expected **OPEN JUNCT** reading, but instead get another junction reading, either single or dual, the transistor is probably fine; in some high power amplifier circuits, a **LEAKY NPN JUNCT** doesn't neccessarily mean that the transistor is defective; there may be a five or ten ohm resistor lurking about, and the 59C is alerting you of this fact. Generally, if either of the **NPN** or **PNP** indicators is illuminated, the device is probably fine. If you get a **LEAKY JUNCT** indication with no **NPN** or **PNP** flag, pull the device out of circuit for testing, because it's probably defective.

What is also important to remember is that shorted final transistors have such a low resistance that they may cause leaky readings on good transistors. After finding the shorted transistors, unsolder them before testing the rest of the semiconductors. High gain or Darlington transistors will show the usual single junction reading from base to collector, but will usually show a dual junction reading when measuring base to emitter. TV horizontal output transistors with a built-in damper diode will show the diode junction measuring from emitter to collector. Bias diodes for high power amplifiers have been known to fail partially; these diodes are actually two, three or four diodes in series. The EDS-59C will show the number of diodes functioning in the package. If you are not sure about the readings in a defective channel of a stereo amplifier, simply test the same junctions in the good channel for comparison.

Here are some finer points to remember:

The SEMIANALYZER will display **DUAL JUNCT** and beep at a slightly higher tone than normal if the base to emitter junction of a darlington or high-gain transistor is investigated. **TRIPLE JUNCT** shows up when a bias diode of an amplifier is probed. **LEAKY NPN PNP JUNCT** illuminates when a pair of diodes in an inverse parallel circuit is measured. **LEAKY JUNCT** lights if the SEMIANALYZER determines that no normal junction can be found. **LEAKY NPN JUNCT** does not necessarily mean that the semi-conductor itself is defective; there may be a low impedance component in circuit with it. Good connections are very important; residues on the test lead points or the component under test will cause the SEMIANALYZER to switch between **SINGLE** and **DUAL** readings.

TESTING ZENER DIODES

Using the **VBD** mode, the SEMIANALYZER will always show the correct zener voltage out of circuit, and usually between 80% and 100% of the correct voltage in circuit. The exception to this rule is if the zener is driving an error amp or regulator transistor that is shorted; obviously, you would have found the shorted transistor first anyway.

Push the switch to the **VBD** position. The digital display will show the maximum voltage that you have at your disposal to measure breakdown. Place the leads across a zener diode in the polarity it was designed to operate at: positive to cathode, negative to anode. The readout should indicate the voltage of the zener, and a small amount of white noise should be heard from the speaker. If the zener were leaky, a lower voltage would be indicated. If the junction being investigated was the emitter to collector junction of a

noisy transistor, the voltage would vary and a loud crackling would be heard from the speaker, along with illumination of the high-signal lamp above the digital display.

TESTING CAPACITORS

The 59C will test all film and aluminum electrolytic capacitors up to 1000 microfarads out of circuit for leakage and maximum voltage using the **VBD** mode. As the capacitor charges, the voltage reading will get higher and higher, slow down, level off, then actually start reducing. This is the voltage breakdown point, at which the capacitor should be disconnected from the 59C. Only the large, high voltage capacitors will take several seconds to reach this point; most electrolytic, and all film capacitors will charge in less than a second. All capacitors will sound noisy at their breakdown point; what you are looking for is a capacitor that is breaking down at a lower voltage than it is supposed to and making thumping noises, or displaying wildly changing voltage readings. Tantalum capacitors cannot be checked in this manner, as they will short because of their low leakage and nonhealing properties. Neon bulbs can be checked in circuit, as well as LEDs and individual segments of LED displays.

THE SIGNAL TRACER

The tracer will probably be the most used feature on the SEMIANALYZER once you've used it a few times and realize that it will do several things at once. The internal amplifier of the SEMIANALYZER is activated, and will enable you to listen to as small a signal as a magnetic phono cartridge, yet is fully protected up to 250 volts DC, or audio signals as high as 50 watts! Besides monitoring audio, you will find that it can be used to trace video signals in VCRs, digital signals in MPU or SYSCON circuits, 30 hz control signals in VCRs, and so on. Practice using this function in working units first, to get an idea what video and microprocessor data signals sound like. Because the sensitivity is much higher than even the most expensive oscilloscopes, and watching a crt is no longer necessary, you will find that this feature will save you hours of troubleshooting time.

In addition to the audible tracer function, the small lamp above the digital display will illuminate on strong signals. This is handy when the signal is higher than human hearing, and will act like a level indicator, illuminating brighter for higher signals.

Finally, the DVM will monitor any DC voltage riding on the signal, so that you can monitor both the audible audio/video/digital signal while making sure that the DC voltage is correct as per the schematic. Be advised, however, that the tracer function has an input impedance of about 40k ohms and may affect some high impedance circuits.

FINDING NOISY COMPONENTS

We all know how frustrating a noisy transistor or capacitor in an amplifier or a protection circuit can be to find. The 59C SEMIANALYZER finds these FAST! After you have traced the circuit to a few suspect components, unsolder at least two of the three leads of transistors, or one of the two leads of diodes and capacitors to electronically remove them from circuit, and check the voltage breakdown and noise levels. Good semiconductors will show an exact voltage breakdown that does not vary more than a few tenths of a volt, and some steady hiss will be heard. Noisy or intermittant semiconductors will cause an erratic voltage display and will be accompanied by plenty of "snap, crackle and pop". Leaky semiconductors may not seem noisy, but will always show a voltage lower than their proper rating.

Noisy capacitors will show a wildly changing voltage at a lower rating than they are supposed to, along with thumping noises. Leaky capacitors usually show a steady voltage reading lower than their rating, but with almost no noise.

TESTING LED AND NEON INDICATORS

Using the **VBD** mode, simply touch the test leads to the LED or neon lamp without removing it from circuit (observe polarity when testing LEDs). The lamp will light normally and the voltmeter will display the correct voltage that the device was designed to operate from. The 59C is smart; it knows exactly what current and voltage the device under test operates from, and will hold maximum current to 15 milliamps or less.

Some Do's. Don'ts and Won'ts...

It is ***VERY*** important to keep the special test leads supplied with this unit as clean as possible. Clean the tips once a month with good quality metal cleaner, or noise will give inaccurate readings.

It is important to realize that the junction mode of the EDS-59C has been designed to check SILICON semiconductors, since germanium transistors have not been used for many years. However, the SEMIANALYZER will still test the majority of germanium transistors, although with some reduction in accuracy. It will not check catwhisker diodes in the junction test mode, as the catwhisker will not pass enough current to obtain a stable reading. The catwhisker diode can be checked out of circuit in the **VBD** mode; forward voltage will usually show 0.3 to 0.7 volts, reverse voltage will usually show 45 to 90 volts.

Because of their very low leakage and tendancy to short on any voltage beyond their rated limits, tantalum capacitors ***cannot*** be tested for breakdown with the 59C.

The **VBD** portion of the SEMIANALYZER uses a safety circuit to provide the technician with a safe, isolated and limited high voltage source for testing. However, the sharp test probes supplied with the 59C can pierce the skin and cause a *very* nasty shock; *PLEASE* keep your 59C in the junction mode at all times, switching to the **VBD** mode only when you need it. ***NEVER*** *leave it in the* ***VBD*** *position while you are not attending your bench.*

Remember that the EDS-59C in the *JUNCT* or **VBD** settings is a "static" tester, not a "dynamic" one. All this means is make sure the circuit under test is unplugged from the power source before you probe it. In the **TRA** tracer mode, testing is now "active" because the circuit under test must now be operating.

The 59C will not check junctions of power transistors in a very low impedance inductive circuit, such as the DC to DC converter of a 12 VDC car amplifier. In this rare case, at least two of the three leads of each transistor must be unsoldered from the circuit before reliable readings can be obtained.

Always disconnect the power cord before opening the cabinet to check the fuse. For continued protection against fire, replace fuse with one amp fast blow fuse only.

Some Sample Readings and What They Mean

The SEMIANALYZER can display as many as 25 different combinations of circuit parameters, most of which are self-explanitory. Here, we will review the exact meanings of these readings.

SHORTED JUNCTION: readings under one semiconductor junction (0.6V) in both directions.

LEAKY JUNCTION: readings under 0.6V in one direction, and one or more junctions in the other direction, or any time the 59C feels that the readings are too unusual or confusing to read out specific information. Device should be checked out of circuit.

LEAKY NPN PNP JUNCTION: two diodes in a clipper circuit, or voltages of one junction in both directions.

LEAKY SINGLE NPN (or **PNP**) **JUNCTION**: readings of one junction in one direction, and two or three junctions in the other direction.

SINGLE NPN (or **PNP**) **JUNCTION**: readings of one junction in one direction and no junctions (infinity) in the other direction.

LEAKY DUAL NPN (or **PNP**) **JUNCTION**: readings of two junctions in one direction and three junctions in the other direction.

DUAL NPN (or **PNP**) **JUNCTION**: readings of two junctions in one direction and no junctions (infinity) in the other direction.

TRIPLE NPN (or **PNP**) **JUNCTION**: readings of three junctions in one direction and no junctions (infinity) in the other direction.

OPEN JUNCTION: readings of no junctions in both directions.

Using the optional Infra-Red Detector Probe

The infra-red probe will work with the EDS-59B, EDS-59C series 001 and the EDS-59C series 002 SEMIANALYZERS.

To use, [redacted] switch to the **VBD** mode. As you know, the SEMIANALYZER normally shows between 160 and 180 VDC, but with the probe plugged in, the readings will be about 25 VDC less. If a conventional IR remote control is pointed at the probe head, the digital pulses emitted will be heard. On some very old IR remotes (like the AOC from the early eighties) you may notice no, or very little sound, but the voltage reading will drop another 15 volts with the remote transmitting at a one inch distance from the probe. This is because the older remotes were not digital, but CW at a certain frequency.

The range of pickup of a conventional digital remote will be about five feet from the sensor, so use this as a reference. You can use the sensor probe to check IR emitters that use DC, such as the central LED in VCRs used for the end sensors. Of course, there will be no sound, but a 15 volt drop in the reading will confirm that the sensor is transmitting correctly.

You can use the sensor to check the laser in CD players as well. The proceedure is the same as measuring any IR source, except that the laser is very finely focused, so that the probe must be directly over the lens. Look for the usual 15 volt drop in the voltage reading. Remember that you will have to bypass whatever interlocks that are used to convince the player to turn on without a CD installed.

IN CASE OF DIFFICULTY

The SEMIANALYZER is a totally different approach to the finding of faulty components. Give yourself plenty of time to familiarize yourself with the readings and what they mean. When you get the chance, use it along with whatever you have been using to find defective diodes, transistors, LEDs and capacitors in a really blown up amplifier. After familiarization, you will find that your troubleshooting time will decrease dramatically! Many of our customers tell us that they have found many other uses for the SEMIANALYZER, such as a low scale audible ohmmeter, woofer speaker voice coil tester, etc. The junction tester portion of the EDS-59C has been calibrated to the sharp, stainless-steel test probes. If you use any other test leads other than the ones recommended, the junction tester may give inaccurate circuit conditions.