smartEDDY® Standard Test Software

SE Systems' Standard Test Software is available for 1-, 2- and 4-channel/ frequency eddy-current instruments. By using a KVM switch, the 4-channel instrument can be integrated with 8-, 12-, 16-, 20-, 24-, 28- and 32-channel/ frequency instruments. Each channel provides a 16-bit in-phase and a 16-bit quadrature precision output that is recorded, analyzed and displayed to user-defined instructions.

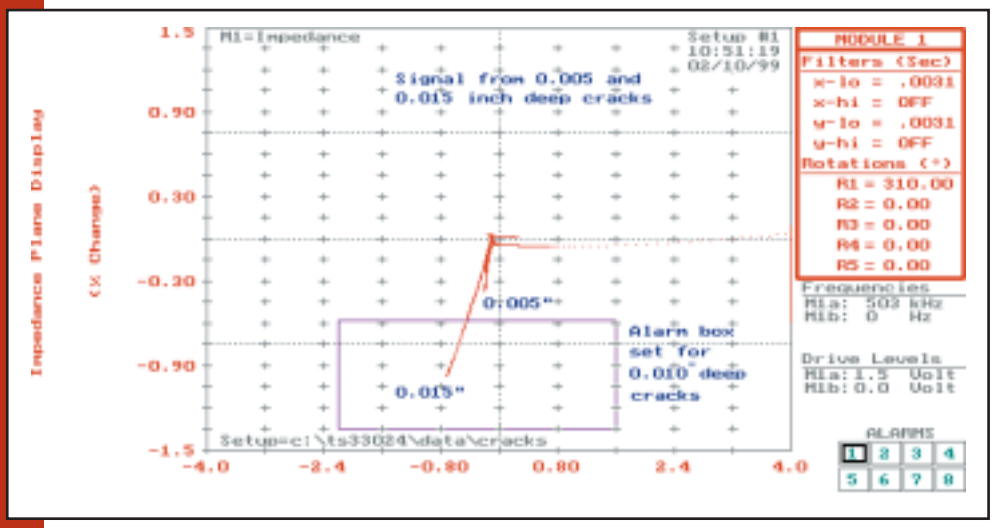

Figure 1 Crack Detection

Operating System

smartEDDY Test Software is a DOS program that can be run under DOS or Windows™. This provides greater flexibility, better reliability and faster real-time performance than if it were only a Windows program. For instance, when operated under DOS, smartEDDY can simply be turned off. That means a "careful shutdown" is **not** required and start-up is rapid. Also, data is processed in a fraction of a millisecond. As an example, the standard test software can perform four independent, complex, four dimensional vector analyses and independent time domain analyses on eight channels of data. It can then compare the results with 32 alarm thresholds and output eight yes/no decisions—all in less than 50 microseconds. No other eddy-current test system comes close to this performance.

Operation

smartEDDY operations are executed by using the four cursor control "arrow" keys, the "escape" key, the "enter" key, and an occasional use of the "shift" key. That means no mouse or new language is required. Instructions for the use of these keys are automatically displayed on-screen. Speed keys are also available to speed common operations; or you can make your own speed keys using ten programmable macro-keys.

Start-up is then simply a matter of attaching the eddy-current sensor leads to the connectors on the smartEDDY instrument and, with an appropriate autoexec file, turning on the power.

Two basic test modes:

Bridge Mode

In this mode the first connector is in series with one side of a 50 ohm bridge, and the second connector is in series with the other side of the bridge. The bridge voltage is amplified and the in-phase and quadrature signal is digitized and analyzed.

Reflectance Mode

The Reflectance Mode bypasses the bridge circuit and uses separate drive and pickup coils. The first connector is the driver output while the second connector and the third connector are for the pickup coils. The difference in voltage between the second and the third is then amplified while the in-phase and quadrature signal is digitized and analyzed. This mode can be used with absolute or differential, remote or direct field sensors.

Software functions:

Balance

This measures the existing eddy-current response and records it for use in the inspection mode. The balance value is the average of an operator set number of measurements.

Inspection

This mode continuously measures the eddy-current response, stores the data in RAM, and normalizes the data by subtracting the balance value. It processes and displays the data according to pre-set instructions. Then, it compares the output with thirty-two operator set

alarm thresholds. Data also can be processed simultaneously with four independent sets of parameters. Additionally, the alarm violations are combined according to pre-set instructions to drive eight independent alarm outputs. No other eddy-current inspection instrument permits real time analysis as sophisticated and at such a high decision rate as smartEDDY.

Parameters

These provide precise control of test, processing, alarm and display parameters. No other test instrument has the range of command as smartEDDY.

Hardware Parameters: The software permits programming of the following hardware parameters:

Mode: This setting determines the instruments' data channel configuration and mode of operation. It sets a dual channel/mixed frequency instrument to operate as two independent single frequency data channels or as a single data channel with mixed frequency operation (four dimensional vector). Mode settings also determine if the instrument operates in a voltage mode, a reflectance mode or an absolute/differential mode.

Test Frequencies: The number of simultaneous test frequencies that can be set are equal to the number of channels. Each frequency can be set independently between 0 Hz and 25 MHz.

Drive Levels: The drive voltage for each channel can be set independently between 0 to 5 volts peak to peak into an open circuit. Output impedance is 50 ohms.

Variable Gain Stage: The variable gain stage for each channel can be set independently between 1 and 16. There is a pre-amplifier with a fixed gain of 4.

Data Rates: Data processing rate can be set by the operator from 10 data points per second up to the maximum allowed by the computer. Normally, the maximum data rate is greater than fifteen thousand data points per second.

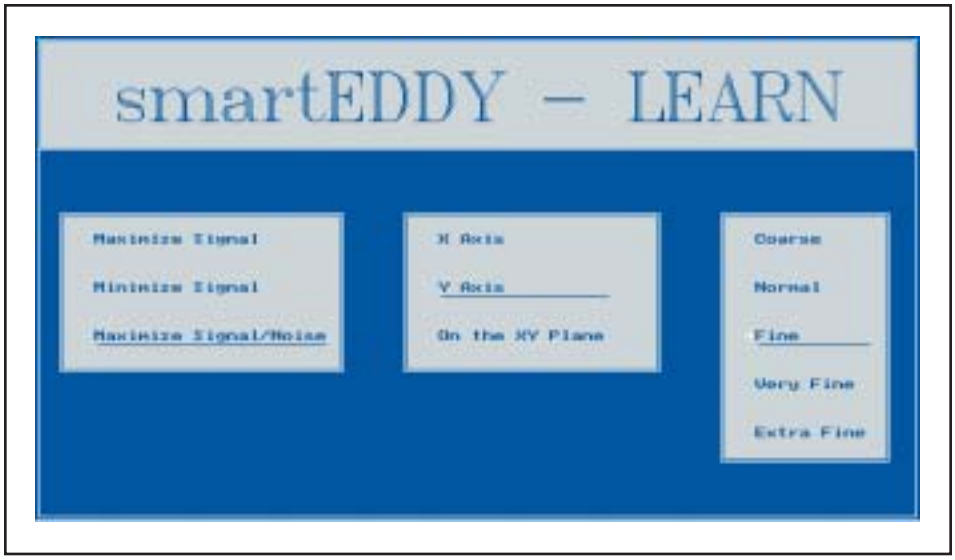

Figure 2 Learn Selection Screen

Data Processing Parameters: The software permits extensive real-time processing of the data. Four independent and simultaneous set-ups can be programmed. This leads to eight independent, user-defined and simultaneous metrics of the data. Each set-up has the following user-defined data processing parameters:

Rotation: 0 to 360 degrees in 0.25-degree increments. This mixes in-phase and quadrature data.

Mixing parameters: 0 to 360 degrees in 0.25-degree increments. This mixes the data from both data channels.

Learn functions: "Learn" is an exclusive feature that helps select rotation and mixing parameters for four-dimensional vector-analysis. It can save days, even weeks of experimentation to determine the optimum rotations and mixtures. Four dimensional vector analysis often provides measurements and detection not possible by other means.

Up to six data files with signals and up to six data files with noise or other obscuring responses are selected by the operator. "Learn" will determine the optimum vector analysis parameters which are then used in subsequent inspections to perform automatically, in real time, optimized vector analysis of the data.

CPANS: This exclusive feature of smartEDDY is used to continuously adjust the phase angle (rotation) to suppress normal material variation and vibration.

LAC Processing Parameters: Lift-off Amplitude Correction (LAC) is a unique feature of smartEDDY and is analogous to Distance Amplitude Correction (DAC) in ultrasonic testing. This feature corrects for the change in sensitivity resulting from variation in the separation between part and sensor.

Low Pass Filters: Independent four-pole, digital low pass filters for each axis can be set from 30,000 Hz to DC (10 microseconds to ∞).

High Pass Filters. Independent high pass filter for each axis can be set from DC to 30,000 Hz (∞ to 10 microseconds).

Noise Filters: This is another unique feature of smartEDDY. Each axis of data, after normal high and low pass filtering, is rectified and pass-

ed through a second digital low pass filter.

Full Scale: ±5 microvolt to ±5 volts in discrete steps.

Offset: ±1 microvolt to ±5 volts in discrete steps.

Alarms: Eight independent box alarms can be set, two for each set-up. Each alarm box consists of four alarm thresholds with upper and lower thresholds on each data axis. The thresholds can be shown with the data on the display. Both momentary and latched alarm conditions are shown on the screen. Alarms can be defined to activate either when the signal is inside or outside the alarm thresholds.

▶ Display

This provides choices that customize the display for better test control and data monitoring. Up to four user selected displays (four set-ups) can be viewed simultaneously. Data can be collected in one display mode and processing set-up, then replayed in any other display mode and processing set-up. No other test instrument has the display flexibility of smartEDDY.

Plane Display: This displays one data metric vs. another data metric. The two data metrics can be thought of as a two dimensional vector. In the simple case of no rotation or mixing, the horizontal axis corresponds to change in resistance of the sensor while the vertical axis corresponds to changes in reactance. The vector is the change in vector impedance.

Cartesian/time display: This display shows two data metrics as a function of time. The horizontal component of the vector response is displayed across the upper half of the screen and the vertical component is displayed across the lower half of the screen. Full time scale can be set from 1/4 second to 500 hours.

Additionally, this display provides potent, supplementary post-processing capabilities when used with the standard *replay-between-flags* feature. For instance, the operator can move the *start* and *end flag* to any time represented on the screen. Numerical values of the eddy-current response at a selected flag and the maximum values between the flags are shown in a window. By pushing *enter*, the data-between-flags fills the screen, providing a magnified view of the data.

Titles: This function enables the user to customize the display by placing any number of alpha numeric characters anywhere on the display screen. Operators can record specific information about the test including part number, lot number, part type, defect locations, inspectors name, sensors used, etc. Test supervisors can assist the operator by adding information such as description of alarm thresholds, operator instructions, test description, etc.

Line/dot display: Processed data can be displayed graphically as individual data points or as line segments between individual data points.

Test parameter/summary display: Specific test parameters or summary information for the particular test can be displayed. The test parameters are the drive levels, test frequencies, filter values, rotation and mixing parameters. The alternative summary display includes the data source, display mode and number of alarms accumulated since last cleared.

Date and time: The date and time of the inspection can be displayed automatically at the option of the test supervisor.

Digital display toggle: With the *digital display* on, the numeric values of the data will appear in a window. The digital display permits precise reading of critical data points. Either balanced or absolute data can be displayed.

Auto clear toggle: With the *auto clear* on, the data will be cleared from the screen after a selected time interval.

Auto print toggle: With the *auto print* on, the screen display will be sent to a printer just prior to the screen being cleared.

▶ Store and retrieve

This feature permits storage as well as recall of test parameters, test data, comments and header information. No other eddy-current inspection instrument has the storage flexibility of smartEDDY.

Standard store and retrieve: The operator can store test set-ups alone or with raw test data; and can also select all the data in RAM, the last "n" seconds of data or data between operator set flags. Data can be sent to the smartEDDY hard or floppy disk, or any other installed storage medium. If the smartEDDY is connected to a network, then the raw data and set-ups can be sent to network storage facilities. Storage is in an efficient binary format.

Text file header: smartEDDY can be commanded to append automatically a text file header to the data and set-up files. File header contains the test time, test date and file name. In addition, smartEDDY can be instructed to ask automatically for any other desired information, i.e., part number, lot number, inspector, etc.

Comments: A 512-character comment can be stored with the test set-up and data. This eliminates the need for hard-to-read and easy-to-lose hand written notes.

Insert: This feature permits the operator to store any selected data point by simply pushing *insert*. Insert will

store the processed data to a selected storage media in an ordered text file. A comment can then be added with each data point. This file is imported easily into a spreadsheet or other data processing program for analysis.

▶ Replay

This is used to re-examine the data stored in RAM. This data can be from the last tests performed or retrieved from files. Data can be replayed in slow motion, at normal or accelerated speed. Data also can be replayed with original processing, alarm and display parameters or with new parameters. Interesting sections of the data can be flagged and replayed, or the last "n" seconds of data can be replayed. This feature simplifies selection of the data processing parameters and set-up of the alarms.

The purpose of smartEDDY is to perform all analyses and automatically make decisions at high-speed and in real-time. However, instances may occur when the inspection analysis is not optimum or another analysis is desired. Also, you might be interested in another defect type, in different acceptance criteria, or unexpected perturbing signals. The replay feature, combined with data storage, permits you to re-inspect the parts with optimized data processing and refined acceptance criteria–all without having to physically re-inspect the parts.

▶ Print screen

This is used for printing or storing any screen displays. If the system is connected to a network or a printer, the screen can be printed by simply pushing the *print screen* key.

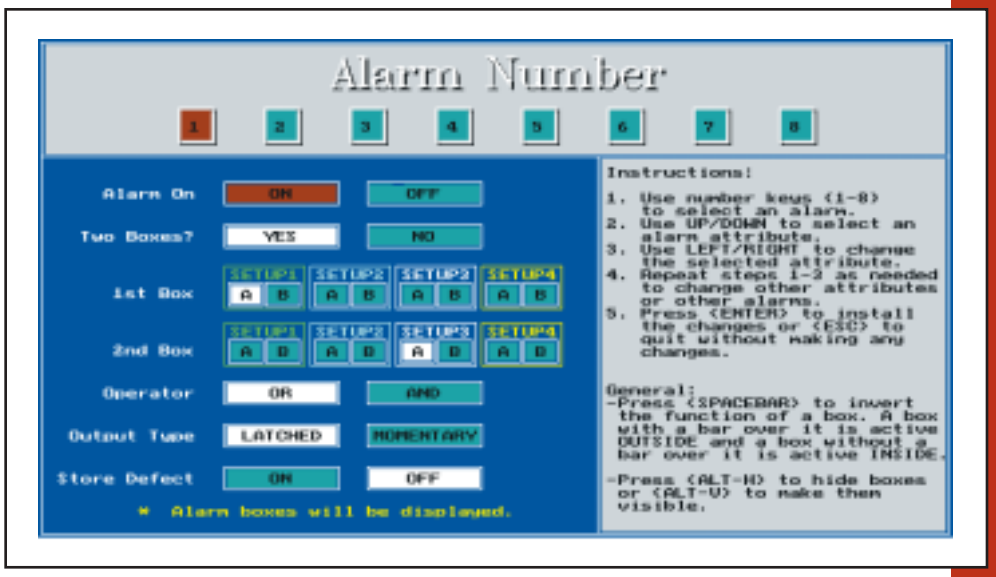

Figure 3 Alarm Control Panel

A number of third party screen storage utilities are available that allow stor-age of the screen as a *picture file*. The picture file then can be added to *reports* or printed as needed.

Remote Communication

SmartEDDY Test Software allows rapid communication with many other devices besides keyboards, monitors, disk-drives, printers and networks. With a 37 pin "D" connector, communication is achieved with alarm lights, marking systems, audio alarms, PLCs, control panels and other remote devices. Communication is through parallel alarm outputs and control input lines.

▶ Alarm outputs

Pairs of alarm boxes can be applied in logic combination to eight alarm outputs. Each alarm output can be delayed and/or stretched by a programmable amount in order to suppress end-effects or to time downstream markers and diversion devices. The output form depends upon the output card that's used with the instrument. Outputs can either be mechanical relays or solid-state signals.

▶ Control input

Standard control inputs monitor signals up to 32 volts. By applying specified signals to the eight input lines, the test can be balanced, started or paused; the alarms can be reset, the screen cleared, a tick mark can be added to the data, selected data can be highlighted, the current data point can be recorded to an ASCII file, or the alarm outputs inhibited.

SE Systems, Inc.

26203 Production Ave., Suite 10
Hayward, CA 94545
(510) 293-3000
FAX (510) 784-0810
www.smarteddy.com