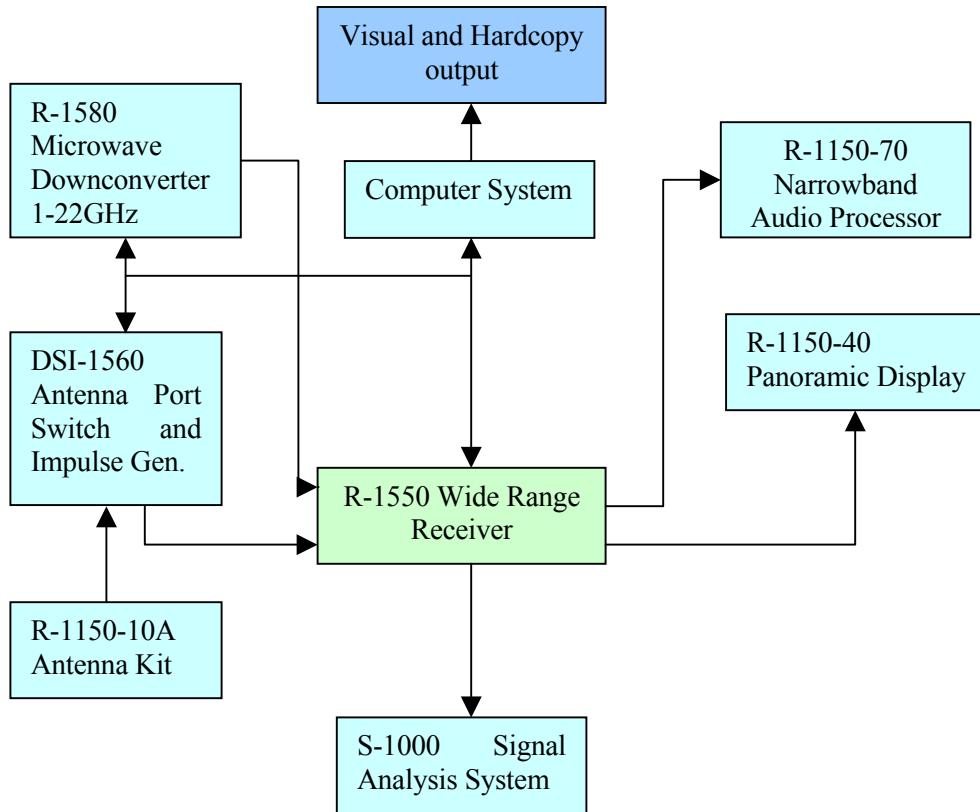


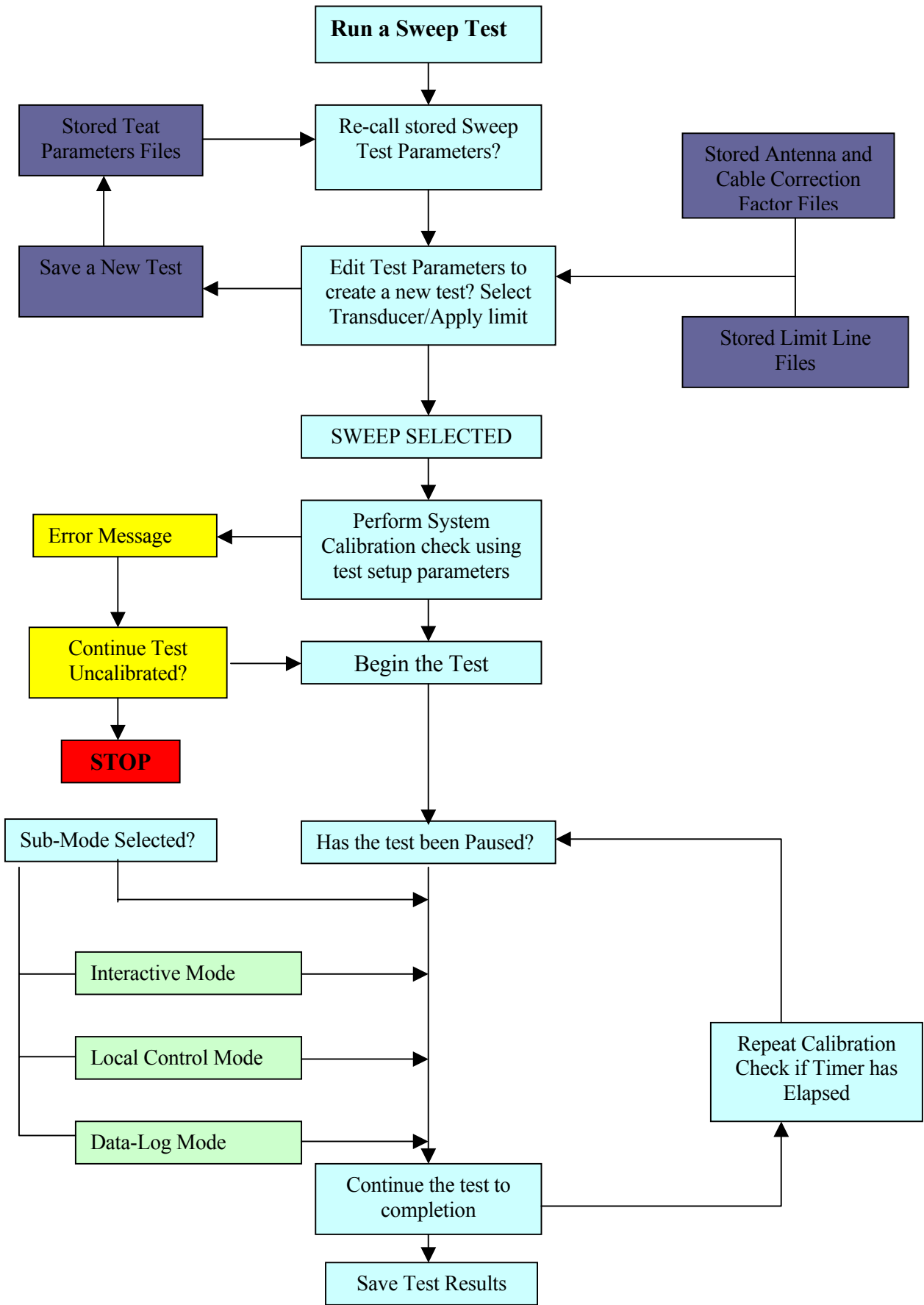
DSI – 1550

Tempest Measurement System



DSI – 1550 Tempest Measurement System Block Diagram





OVERVIEW

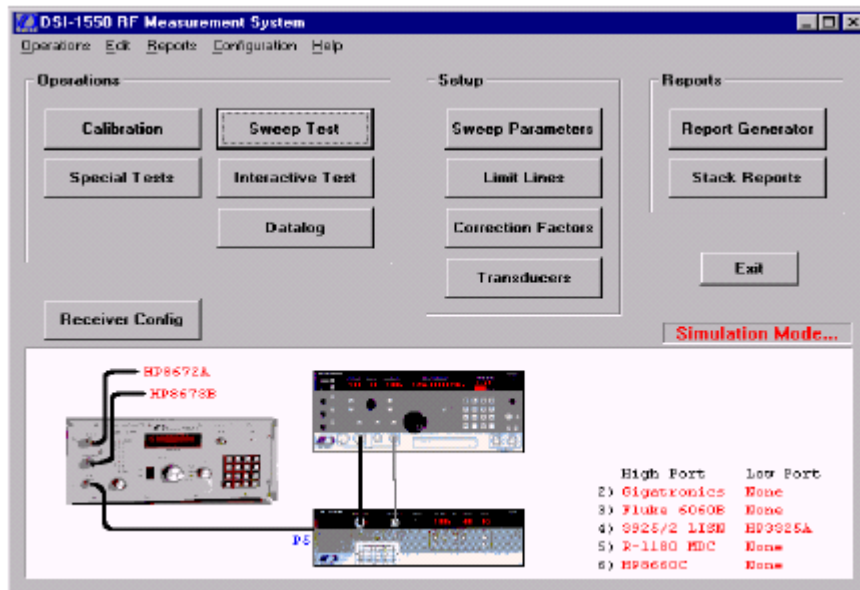
The **DSI-1550** system quickly enable the user to discover that there are many other ways to operate the system to accomplish a particular task, some of which bypass steps and accelerate operations.

System Description

The **DSI-1550** RF Measurement System is designed to fully utilize the capabilities of the R-1550 receiver to accurately measure signals using a variety of sensors and measurement methods. The system software provides for:

- ▣ *Definition and correction of sensors*
- ▣ *Creation of tests*
- ▣ *Set-up of the system hardware*
- ▣ *Sweep testing*
- ▣ *Interactive control of the receiver (Interactive Mode)*
- ▣ *Automated recording of manual receiver settings and signals (Data-log Mode)*
- ▣ *Preparation of hard copy outputs.*

The R-1560 System Interface unit helps to simplify the operation and periodic calibration of the system by allowing multiple input devices to be defined as part of the system and automatically selected by the software when required without further operator involvement. The system operates through the use of Windows "screens". These screens provide a powerful human interface to facilitate full utilization of the system's capabilities. There is a set of primary screens; from these, secondary screens and "dialog boxes" are activated. When the system is turned-on, the first screen to appear is the Main screen; from it the other screens can be selected.



System Implementation

Knowledge of system signal flow paths is helpful in understanding how to fully utilize the **DSI-1550** System. There are two sets of RF ports. The ports are selectable manually or via the computer. The amplitude of the selected input signal is controlled with the receiver's input attenuator. It, and all of the other receiver controls, can be manually operated or remotely controlled. The signal is then sent to one of the receiver's three RF circuits or "bands". The band is automatically selected internally by the tuned frequency. The circuits in each band amplify, condition, and convert the incoming RF signal to a 21.4MHz IF signal for further processing in the receiver's IF section. At this point in the path the IF signal has a maximum bandwidth of approximately 20MHz. A portion of this IF signal is tapped off and called the "Signal Monitor" because it provides a convenient point for monitoring all of the RF signals entering the receiver around the tuned frequency. The optional R-110-40A Panoramic Display can be attached to the Signal Monitor port to view the spectrum within ± 5 MHz of the tuned frequency. The receiver's IF section provides bandpass filtering and amplification of the IF signal. A large number of bandwidths are provided to facilitate investigation of both **CW** and impulsive signals. The "DCIF" is a variable filter module, which provides the narrow bandwidths up to 20kHz. Noise filtering

is automatically provided to insure signal quality. A portion of the final IF signal is tapped and provided at the rear the receiver for use in special applications. The output of the IF section is peak detected or FM demodulated, depending on the detection mode selected. The resulting video is supplied to a peak-hold and conversion circuit (DVM) which captures and digitizes peak signals at all bandwidth settings. The receiver's analog video signal is supplied in three separate forms: the main output on the front panel; the auxiliary output on the front panel; and the Z-axis on the rear panel. The auxiliary output has pulse stretch and slideback controls to facilitate signal examination, and the Z-axis has both level and inversion controls making it well suited to drive CRT guns for observation of raster signals.

The R-1560 contains two Impulse Generators available as a precise reference for periodic calibration of the system. Each IG is a solid state RF impulse generator covering the frequency range of 100Hz to 1GHz. 1IG is chassis isolated to function as a low frequency source the other IG is used for high frequencies. Either IG will provide impulses at repetition rates and amplitudes selected by front panel controls or via the IEEE-488 bus. The R-1560 features an uncomplicated front panel with discrete LED displays to indicate the pulse repetition rate and the actual output amplitude in dBuV/ MHz, referenced to 50Ω. Provision is made for pulses to be triggered by an adjustable internal time base (manually, externally, or by the AC line). Pulse repetition rate and amplitude may also be programmed via the IEEE-488 interface bus. The R-1560 also provides both low and high frequency input ports which are available for antenna or other signal source connections which can be automatically selected by the system software as required by programmed tests.

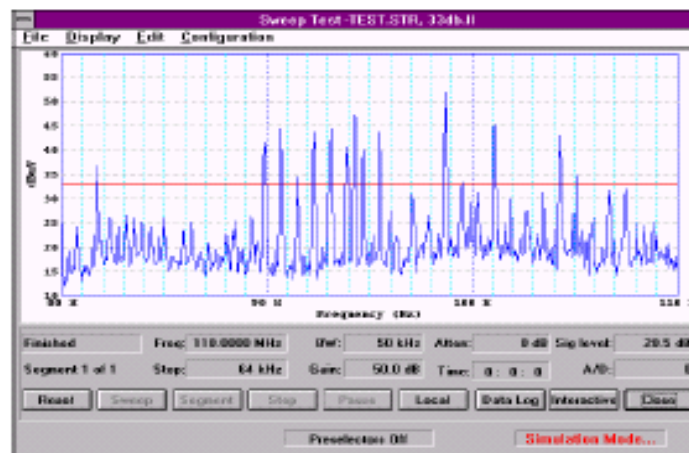
SWEEP TESTING

The **DSI-1550** system can be used for a variety of measurement tasks. The following example, showing how a sweep test is performed, illustrates many of the techniques and processes available. In this example, the user:

- 1. Configures the system*
- 2. Defines sensors and hard-copy equipment*
- 3. Sets up the test by establishing sweep test parameters and limit lines*

4. Performs the sweep test
5. Interrupts the sweep to interactively investigate signals
6. Manually controls the receiver to further investigate signals and uses data-log feature to record information
7. Completes the sweep test
8. Prepares hard-copy results The Main Screen is the starting point for the process.

The Main Screen has a Menu Bar, various "buttons", and a block diagram showing the system configuration. While the sweep test can be initiated by clicking on the Sweep button and performing the set-up operations from the Sweep Test screen, it is a bit more "orderly" to set-up the configuration and the sweep test parameters first



Configuration

The block diagram on the Main Screen shows the last-used system configuration, this configuration must be adjusted by the user to reflect the present or desired set-up. Clicking on the **Receiver Configuration** on the entry screen will bring up the setup screen. The setup screen dialog is used to select the receiver inputs and show how they are configured with the R-1560. First select a port to which the connection will be made by clicking on the circle to the left of the port. Then select the appropriate sensor or Signal Generator from the pull-down list. Various antennas, other sensors, and signal generators can be selected for

the receiver's signal sources. A cable may also be selected if you want the correction factor to be applied. If the desired sensor or cable has not been defined.

When a new sensor is used, it must be defined. In general, sensors require correction tables to yield accurate measurements, and correction data must be entered. By clicking on the Main screen's **Correction Factors** button. The **Edit Correction Factors** screen appears. The default screen has two entries: 100Hz and 18GHz. These can be edited or deleted by highlighting and selecting one of the "Point" buttons. Additional points can be added and then edited. If another correction line table is similar to the one required for the new sensor, it can be recalled and edited, using the **File** pull-down and selecting **Open** to find the file. All correction line table files have a ".cf or .cl" extension. By pulling down the **Configuration** menu and clicking on **Transducer** the **Edit Transducer List** dialog will appear. Existing transducers are shown and can be edited. To add a new transducer click on **Add** and the **Edit Transducer** dialog will appear. Fill out the table, then select the related correction line files to be applied by highlighting the selected .CF file in the left column and then click on **Apply**. The list of applied files appears in the right column.

Signal Sources

The **Configuration** pull-down menu permits definition of signal sources (i.e. signal generators and impulse generators) as well as transducers. When a signal source is used as an input device, the system automatically controls the device's operation during sweep testing. Clicking on **Signal Source** in the menu brings up the **Define Input Device** dialog..

Other Configuration Functions

The **Configuration** pull-down menu includes other entries: **Directories**: selecting Directories brings up the Directory Configuration dialog which specifies the DOS paths for each of the file types used by the system, these may be changed by the user to suit special installation requirements. When enabled in a sweep, a front-end overload will adjust the attenuator setting and this setting will not be decreased until the end of a segment. **Cal Table Stat**: brings up a screen containing a summary of the current calibration data showing the date when the data was taken.

Set-up of the Test

Set-up of the test from the Main screen is accomplished by clicking on the **Sweep Parameters** button or by using the **Edit** pulldown and selecting **Sweep Parameters**. Setup can also be accomplished or changed after the Sweep test is activated.

Sweep Test Parameters

When **Sweep Parameters** is selected the **Edit Sweep Parameters** dialog will appear. The sweep can be conducted in any number of segments (including a single segment). Each vertical column represents a segment of the sweep. More segments can be added by clicking on the Segment **Add** button, and segments can be inserted or deleted. A previously created set of parameters can be recalled using the **File** pull-down and selecting **Open**. The test files all have the extension ".stp" or ".tp". Clicking on **New** brings up the default set of parameters. These can be edited to create the desired test conditions.

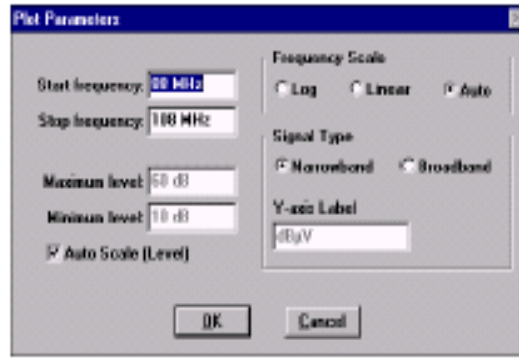
Limit Lines

Limit lines for a user defined sweep test are prepared by clicking on the **Limit Line** button on the Main screen. The **Edit Limit Line** dialog appears. The process for their creation and editing is identical to that described previously for Correction Factors, except that files are automatically saved with an ".ll" extension.

Interactive Mode

The Interactive Mode can be initiated by clicking on the **Interactive** button during a sweep test, or directly from the Main screen, since it is not necessary to be sweep testing to use the mode. When the mode is active, the **Interactive Test** screen is present. It is similar to the sweep screen, but the receiver controls are now active. A square cursor shows the receiver's tuned frequency and the signal amplitude. The frequency can be changed, the frequency can be set by typing a new value. The frequency may also be adjusted by single clicking on the frequency box to highlight it. The step size can be changed by selecting the value; the arrows make decade adjustments, while the + and - buttons change the reading by a factor of 2. Bandwidth, attenuation, gain, can be adjusted in a similar fashion. The spectrum can

be scanned using the controls at the lower left. The "Up" and "Down" define the direction of the scan, while "Dwell" holds at the current frequency. The "Pen Down" causes the data to be plotted on the screen. In the lower right corner of the screen the receiver Status is displayed, as follows:



FROL Front-end overload

BKOL Back-end (detector) overload

FRUL Front-end underload

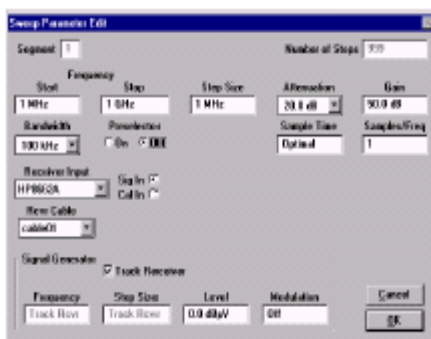
LOCK Synthesizer is not locked

A powerful feature of the Interactive mode is the ability to re-scale the graph range. Pulldown Display, and select Change Plot Parameters. Enter the start and stop frequencies on the screen for the desired range. If the receiver is currently tuned outside of the new range, the system will automatically re-tune the receiver to put it in the specified range.

Datalog Mode

The Datalog mode makes it possible to examine signals in more detail, which may have been at, or near the limit line during a sweep test. If a limit-crossing mode is selected (one of three types of lists under the key **GEN LIST**) the operator will have the opportunity to specify an offset from the limit in order to accommodate measurement uncertainties. A list of frequencies where the measurement was above the limit will be automatically generated and inserted in the datalog table. The operator may examine the time domain signal information at the Receiver Video Output using an oscilloscope. Make measurements by comparing the amplitude to a standard signal source (signal, or impulse generator), which travels exactly the same signal path through the receiver, and log the measurement in one of four categories, i.e., **Data Related, Unrelated, Compromising and Noise**. In the upper

right hand screen the selected signal source conditions are displayed. The up-down arrows control the signal amplitude and percent of modulation within the allowable parameters of the selected device. Any device may be selected which has previously been defined as part of the system. On the right center of the screen are displayed the current selections for input source to the receiver, and the device selected for comparison measurements. The selection box to the left of each input device allows the operator to toggle between the devices to compare measurement results. Each device travels the same signal path in the receiver. On the left center of the screen are the frequency and bandwidth displays for the receiver. While the antenna input is selected, the displays are active and the receiver frequency and bandwidth may be entered directly into the boxes, or the receiver may be tuned manually. The **ADD** key will cause the new selections to be entered into the datalog table. Each data type to be recorded has a measurement value box with a record button below. When the record button is selected, the signal generator value is recorded for that measurement type. the operator can enter a value directly. After all of the values have been recorded in the datalog table the operator may choose to sort the table in either ascending or descending order based on any value recorded in the table. Comments, or test conditions may also be recorded in the associated field for any table entry. The measurements are collected in a buffer. The buffer can be stored for future use. Previously saved files can be recalled to load the buffer, and then used to set the receiver controls to repeat previous measurements. Previously acquired and inserted data can be read and used to return the receiver to the



associated settings. If a data-logging file is recalled, the user must insure the configuration is consistent with the hardware set-up that was previously utilized for the test. Selecting RECORD will add this information to the log as a new data point. As many conditions as desired may be entered at a given frequency for measurement of video information.

When data logging is completed the temporary file may be permanently stored. The Data-logging dialog screen presents the following information:

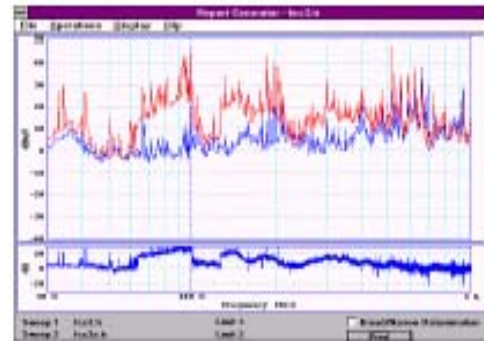
1. **Frequency:** the manually-tuned frequency of the receiver or of the downconverter.
2. **Bandwidth:** the bandwidth control setting.
3. **DRE:** data related emission value
4. **URE:** not data related value
5. **CE:** compromising emission value
6. **NOISE:** noise related value
7. **LIMIT:** limit at the specified frequency.
8. **DELTA:** amount over the limit line for that measurement

All data related to the measurement is stored in the datalog file

Broad/ Narrowband Determination

Clicking on the **Broad/Narrowband Determination** box changes the display to indicate the characteristics of signals in the plot.

All of the narrowband signals are marked on the plot and a list is generated. Broadband and narrowband limit lines can be opened; when this is done the narrowband exceedances are noted on the list and a separate broadband list is created.



Broad and Narrow Band

Tabular Reports

In addition to graphical reports, parameter summaries, data log files, limit line exceedances, and the narrowband list can be printed by first using the **File** pull-down and then clicking on **Open Data-log** to select the file. Select **Print** and click on the appropriate box in the dialog.

Printing

Various print options are provided by **Print**. Printing is initiated using the Print button on the screen or by using the **File** pull-down menu. The **Print** dialog has different report types available, and the output can be directed to a printer, plotter, or file.

Stack Reports

The **Stack Reports** mode, selected from the Main Screen, permits background outputting of hard-copy results. The **Hardcopy Output** screen appears when this mode is selected; this screen allows selection of test result files from the default directory, other hard disk locations, or from the floppy drive. Controls are included for selection of the number of copies, orientation (portrait or landscape), and the order, which the outputs are.

Specifications

SYSTEM

Measurement Precision:

For SNR>10 dB, 4 dB (uncalibrated),
2 dB with calibration sources

Sensitivity:

Typically 6 dB above Johnson noise

RECEIVER

Noise Figure:

Less than 13 dB (10dB typ. in mid-range)

IF and Image Rejection:

At least 80 dB

Spur-free Dynamic Range:

Better than 60dB

Frequency Stability:

1 ppm per year

Autoranging:

Selectable - uses 100dB 10dB step attenuator/
receiver gain in 1dB steps

Audio:

>1 Vrms; + 3 dB, 20 Hz-20 kHz

Power:

120 watts 115/230 50 or 60 Hz

Mechanical:

Receiver has side handles and collapsible feet
(front); rack mount kit available.

Weight:

44 lb. (20 kg)

RECEIVER SYSTEM CONNECTIONS

RF Input Connectors: 50Ω Type N Signal In

Type N Calibrate In

Type BNC Signal In (Low Freq.)

Frequency Range:

100Hz to 1 GHz (extendable to 22GHz with
the R-1580 Microwave Downconverter)

Input Attenuator:

0-100 dB in 10 dB steps

IF Bandwidths:

35 BW from 50 Hz to 200 MHz

1:2:5 sequence**Detection Modes:**

AM/FM/CW

DVM:

Peak-hold, 100 MHz BW, 12 bit A/D, 4-digit
DVM display and LED BAR

IF Output:

1450 MHz, 21.4 MHz

Video Outputs:

AM (peak) and FM, Linear/Log, Aux video
with pulse stretch/slidebac

Power: 100 Watts typical

15/230V 50 or 60 Hz

SOFTWARE

Operating System:

DOS 7.0

Environment:

Windows 3.1x, 95/98/00, NT4.0

Application:

DSI A-1550 Version 1.0

Type BNC Calibrate In (Low Freq.)

Video/IF:

BNC, 50Ω

1560 SYSTEM INTERFACE CONNECTIONS

RF Connectors: 50Ω

5-Each Type N High Frequency

5-Each Type N Low Frequency (isolated)

Instrumentation:

GPIB IEEE-488.2 bus

Instrumentation:

GPIB IEEE-488.2 bus

Impulse Generator:

BNC Sync. Out

BNC External Trigger Input

Weight: 25 lbs (11.4 kg)

Power: 75 Watts Typical

COMPUTER

Processor:

Pentium or equivalent

CPU Speed:

700 MHz (3min)

RAM:

128 M-byte (min)

Hard-disk:

20 GB (min)

Floppy Drive:

1.44 MB

CD ROM:

24X (min)

Display:

SVGA/VESA 640x480

Input:

Mouse, 101 keyboard

Expansion:

2 ISA, 2PCI (min)

Weight:

20 lbs (9 kg)

Power:

100 watts typical

115/230 50 or 60 Hz



“ Detection with Direction “

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