Specification 463
March 11, 1974

ENGINEERING
INSTRUMENT SPECIFICATION

7L13
SPECTRUM ANALYZER

FOR INTERNAL USE ONLY
TEKTRONIX, INC.

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PREFACE

This Engineering Instrument Specification (EIS) is the reference document for company activities concerned with the electrical environmental and physical characteristics of the subject product.

The information in this document is generally intended for use in customer-oriented publications such as the Catalog and Instruction Manual. However, performance characteristics in Section 2 are specifically classified for use in the Catalog and in certain sections of the Instruction Manual (see page 2-1 for further information concerning the tabular data).

A copy of this EIS appears in Product Reference Book with additional copies available from Product Specifications in the Manuals department.

Changes to the EIS may be made only via the Change Request form of which 3 are included at the back of this document (contact Product Specifications for additional copies).

Approved changes are issued in the form of replacement pages slit-punched for easy insertion in the EIS. Changed information appears in italicized print with a cross-hatch symbol in the left margin opposite the latest change. The data of the latest change appears at the bottom left corner of the page.

The following publications contain reference information relative to this document:

Tektronix Standard No. A-100, Recommended Short Forms

Tektronix Standard No. A-101, Glossary of Technical Terms

Product Specifications
September 6, 1972

CHANGE INFORMATION LOG

This page is used as a guide to insure that all change pages have been inserted. When change pages are received, log them on this page, then insert the change pages in their appropriate place. Change numbers (located in upper right corner of Change Notice form) are assigned in sequence. Absence of a number from the sequence indicates a change which has not been inserted.

CHANGE NOTICE NUMBER	EFFECTIVE DATE OF CHANGE	DESCRIPTION

7L13 SPECTRUM ANALYZER

Description

The 7L13 Spectrum Analyzer is a tri-width plug-in unit, for the 7000 Series-Oscilloscopes. When used with any of these oscilloscopes, it displays a spectrum of signal energy within any frequency span to 1.8 GHz. The unit contains horizontal sweep and timing circuits for frequency and time domain displays, and provides means for using an external sweep source to slave the 7L13 to some external device, such as a recorder.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

The following characteristics and features apply to the 7L13 Spectrum Analyzer after a warmup period of 20 minutes or more.

Center Frequency

Range:	1 kHz to 1.8 GHz
Resolution:	Within 1 MHz
Accuracy:	$\pm$(5 MHz + 20% of Frequency Span/Div)

Frequency Span

Calibrated steps, in 1-2-5 sequence, from 200 Hz/Div to 100 MHz/Div. Accuracy is within 5% of the span selected and linearity is within 5%, over the center 8 divisions of a 10 division display.

A MAX SPAN position provides approximately 1.8 GHz (180 MHz/Div) of span, and a 0 position provides fixed frequency operation for time domain display.

Display Flatness

+ 1 dB, -2 dB with respect to 50 MHz, over any selected frequency span.

Display Modes

LOG 10 dB/Div: Provides a calibrated 70 dB dynamic range. Accuracy within $\pm$0.1 dB/dB to a maximum of 1.5 dB over the 70 dB dynamic range.

Display Modes (cont)

LOG 2 dB/Div: Provides a calibrated 14 dB dynamic range. Accuracy within ± 0.4 dB/2 dB to a maximum of 1.0 dB over the 14 dB range.

LIN: Provides a linear display, within 10% over the graticule height.

Reference Level:

Reference level operation is in calibrated 10 dB steps from -110 dBm to +30 dBm, within ± 2 dB. (Accuracy includes the attenuator and gain switching effects when the two are not offsetting each other.) Reference level operation below 100 kHz, becomes limited to a range from +30 dBm to -50 dBm, as the center frequency approaches 1 kHz.

Reference level deviation between display modes, is less than 2 dB from 2 dB/DIV to 10 dB/DIV, and less than 0.5 divisions from 3 dB/DIV to LIN. This deviation is a function of the oscilloscope vertical linearity.

An UNCAL indicator signifies when the display is not calibrated.

Calibrator

50 MHz ± 0.01% with an absolute amplitude level of -30 dBm ± 0.3 dB, at 25°C.

RF Attenuator

Calibrated 10 dB steps. Accuracy; ± 0.2 dB or 1% of dB reading, whichever is greater.

Gain

Range: 80 dB (70 dB with the Gain selector, plus 10 dB which is available when operating with 30 Hz resolution bandwidth.)

The selector is an eight position switch that changes the IF gain in 10 dB steps. Four positions (blue sector) provide three 10 dB steps, for a total of 30 dB gain change in the 10 dB/DIV display mode. All eight positions of the selector provide 70 dB of gain change in the 2 dB/DIV and LIN display modes. The additional 10 dB, for 30 Hz resolution, is selected with a push button.

Resolution

Six resolution bandwidth selections from 30 Hz to 3 MHz, in decade steps, are provided. Bandwidth accuracy, at the 6 dB down level, is within 20% of the resolution selected. Shape factor over the 60 dB to 6 dB level is 12:1 or better for 30 Hz resolution and 4:1 or better for 300 Hz to 0.3 MHz resolution. The maximum bandwidth (60 dB down) for 3 MHz resolution, is 13 MHz. Signal level change over the six bandwidths is less than 0.5 dB.

Sensitivity For A CW Signal

Signal + noise = 2X noise, in LIN vertical mode. The following sensitivity characteristics apply at 50 MHz and are applicable from 100 kHz to 1.8 GHz. Below 100 kHz the sensitivity degrades approximately 0.3 dB/kHz; for example, the sensitivity at 50 kHz with 30 Hz resolution, is -113 dBm or more and -98 dBm or more at 1 kHz.

Signal Level	Resolution Bandwidth	Typical Noise Floor (10 dB/Div Mode)
-128 dBm	30 Hz	-140 dBm
-120 dBm	300 Hz	-130 dBm
-110 dBm	3 kHz	-120 dBm
-100 dBm	30 kHz	-110 dBm
-90 dBm	.3 MHz	-100 dBm
-80 dBm	3 MHz	-90 dBm

Intermodulation Distortion

100 kHz - 1.8 GHz: Third order intermodulation products are down 70 dB more from two -30 dBm signals within any frequency span, second order products are down 70 dB or more from two -40 dBm signals, within any frequency span.

Spurious Signals From Internal Sources

(Residual Response)

Equal to or less than -100 dBm, referred to the 1st mixer input.

Incidental Fm'ing

≤ 10 Hz (P-P) when phase locked. ≤ 10 kHz (P-P) for 5 seconds when not phase locked.

Stability (After a 2 hour warmup period)

Within 2 kHz per hour at a fixed temperature, when phase locked. Within 50 kHz when not phased locked over a 1 hour period, at a fixed temperature.

Maximum Input Power Level

-30 dBm with the RF attenuator at 0 dB, for linear operation, +30 dBm with the RF attenuator at 60 dB. (+30 dBm is also the power rating of the RF attenuator.) NOTE: The maximum input power level to the RF attenuator is 1 watt average and 200 watts peak. +13 dBm will destroy the 1st mixer.

Sweep Modes and Rate

Selection of an external sweep source, manual sweep, or calibrated sweep rates from 10 s/Div to 1 μs/Div in a 1-2-5 sequence are provided. Sweep rate accuracy is within 5% of that selected.

Triggering

Three triggering sources can be selected. INTERNAL selects the vertical or video component from either vertical plug-in compartment, EXTERNAL selects the signal applied to the EXT IN HORIZ/TRIG connector and LINE selects a sample of the mainframe line voltage. Internal signal is ac coupled with an approximate frequency range from 15 Hz to 1 MHz. The external and line signals are dc coupled. Input impedance for the external input is about 30 kΩ for the trigger mode and 9 kΩ for external horizontal sweep mode.

Trigger sensitivities are: 1) ≤ 0.5 division of signal (peak-to-peak) and ≤ 0.5 volt of signal (peak-to-peak) of external signal for NORM mode. 2) ≤ 0.5 division of signal (P-P) and ≤ 0.5 volt of external signal for SGL SWP mode.

In the NORM mode the sweep will automatically recur at the end of holdoff time if a trigger signal is absent to provide a baseline on the crt.

The SGL SWP and "start" buttons function together to provide a signal sweep each time the "start" button is pushed.

Video Output Connector

Provides 50 mV ± 5% of video signal per display division, about the crt vertical center. Source impedance is approximately 1 kΩ. A maximum of 50 mV offset may be introduced by the error from the mainframe vertical centering interface.

External Horizontal/Trigger Input Connector

Requires 0 V to 10 V ± 1 V, to sweep the frequency to full span.

Requires 0.5 volts peak to peak to trigger the sweep circuits. Maximum safe input; 50 volts (dc + peak ac).

Environmental Characteristics

This instrument will meet the electrical characteristics over the environmental limits of the 7000-Series mainframe. Complete details on test procedures, including failure criteria, etc., can be obtained from Tektronix, Inc. Contact your local TEKTRONIX Field Office or representative.

Power Drain from the Mainframe (Internal Use Only)

+50 V	≈ 170 mA
-50 V	≈ 16 mA
+15 V	≈ 600 mA
-15 V	≈ 780 mA
+5 V	≈ 700 mA
+5 V lights	≈ 360 mA

ACCESSORIES AND OPTIONS

Standard Accessories

1) Spectrum Analyzer Graticule: Clear plastic implosion shield with LOG, LIN, REF and f (frequency) direction markings. TEKTRONIX Part No. 337-1439-01 for 7403N oscilloscope and 337-1159-02 for other 7000 Series oscilloscopes.

2)	Filter Light Amber	378-0684-01
3)	50 Ω Coaxial Cable, with BNC connectors, 6 foot	012-0113-00
4)	BNC Male to N Female Adapter	103-0058-00
5)	Manual	070-1673-00

Optional Accessories

1)	DC Block (for applying signals riding on a DC potential. Maximum potential is 50 V DC	015-0221-00
2)	75 Ω to 50 Ω minimum loss attenuator with DC block	011-0112-00

Options to 7000-Series Oscilloscopes

1) CRT with P7 phosphor and time domain graticule. The external graticule for spectrum analysis (part of standard accessories) should be used.

2) CRT with P7 phosphor and an internal spectrum analyzer graticule (designated P7SA). This is recommended with the oscilloscope mainframe that is to be used exclusively with spectrum analyzer systems.

FUNCTION OF THE FRONT PANEL CONTROLS AND ADJUSTMENTS

Triggering

SOURCE

Triggering source is selected by four push buttons: EXTernal selects the triggering signal that is applied to the TRIG IN connector, FREE RUN causes the sweep circuit to free run. INTernal selects the vertical triggering signals from the 7000-Series mainframe and LINE selects a sample of the power line voltage as the triggering signal.

MODE

NORM: Triggering occurs at the level and slope selected by the SLOPE/LEVEL control. The minimum signal amplitude for internal triggering must equal or exceed 0.5 division on the display. If the trigger signal is absent or beyond the amplitude and frequency limits specified, the sweep will run (after the holdoff time) at the rate selected by the TIME/DIV selector.

SGL SWP and RESET: These two buttons function together to provide a single sweep each time the "start" button is pushed. Switching to SGL SWP mode provides a single sweep each time the "start" button is pushed.

Triggering (cont)

SLOPE/LEVEL

A control and switch that select the amplitude and the slope at which triggering occurs for the various triggering modes. Mid-range of either slope is the main level at which triggering occurs.

Horizontal Sweep

TIME/DIV

Selection of an external sweep source, manual sweep, or calibrated sweep rates from 10 s/Div to 1 μs/Div (in a 1-2-5 sequence) are provided.

The EXT position allows the analyzer to be swept from an external sweep source which can be applied through the HORIZ IN connector, or by way of a Vertical Amplifier unit. External sweep can be used to slave the spectrum analyzer to some device such as a recorder.

MANUAL SCAN position provides manual positioning of the beam with the MANUAL SCAN control.

The OFF position disables the sweep circuit, and the crt beam represents the center of the frequency span. The analyzer operates as a fixed tuned receiver. This position is used for the Tracking Generator operation.

SWEEP CAL

Calibrates the amplitude of the sweep voltage to the horizontal deflection circuits and compensates for slight differences in deflection sensitivities between oscilloscopes.

Horizontal Sweep (cont)

HORIZ POSITION: Positions the CRT beam horizontally.

HORIZ Trigger IN Jack

Used to apply an external trigger signal or the horizontal (sweep) drive from a chart recorder or other device, to the 7L13 sweep circuits. Requires a sweep voltage of 0 V to 10 V $\pm$ 1 V, to sweep the full span. A $\pm$ 1.0 V tolerance, at the upper end, is used to calibrate the external voltage ramp, so the frequency span of the 7L13 is accurate. 0 V corresponds to the left edge of the graticule and 10 V to the right. Sensitivity is about 1 V/div.

VERTICAL Control and Output Connector

VERT POSITION

Positions the CRT beam vertically.

VIDEO OUT Connector

Provides $\pm$50 mV of video signal per displayed division. The amplitude and polarity of this signal is relative to the graticule vertical centerline. Source impedance is about 1 kΩ. The signal can be used to drive an external recorder.

Display Controls and Selectors

BASELINE CLIPPER

Controls the vertical amplitude of that portion (baseline plus signal) of the display that is decreased or subdued in intensity.

CONTRAST

Adjust the brightness ratio between the clipped (subdued) baseline and the unclipped display. Display intensity is set by the oscilloscope Intensity control.

Display Controls and Selectors (cont)

VIDEO FILTER

Depresssing either of the two buttons restricts the video bandwidth so that high frequency components, such as noise are reduced. One button reduces the bandwidth to 30 kHz, the other to 300 Hz and by activating both buttons, the bandwidth is reduced to 10 Hz. The 30 kHz filter is automatically switched in when the RESOLUTION bandwidth is changed to 30 kHz or less.

PULSE STRETCHER

This enhances the visibility of pulsed RF signals within wide spans and wide resolution bandwidths by stretching the fall time of the vertical signal.

FREQ SPAN/DIV

Selects the frequency span (200 Hz/Div to 100 MHz/Div in a 1-2-5 sequence) for the display. Two additional positions, MAX SPAN and 0 are also provided. The MAX SPAN position provides a frequency span that is approximately 1.8 GHz. A frequency marker notch is also displayed, to indicate that portion of the spectrums that will be displayed when the FREQ SPAN/DIV is reduced. The 0 position converts the analyzer to a tuned receiver for time domain display. Time analysis of signal characteristics, within the bandwidth capabilities selected by the RESOLUTION setting, can then be analyzed.

RESOLUTION

Selects six calibrated resolution bandwidths, from 30 Hz to 3 MHz (within 20%), in decade steps. Shape factor of the response over the 60 dB to 6 dB amplitude levels, is 12:1 or better for 30 Hz and 4:1 or better for the remaining resolution settings.

PULL TO UNLOCK

A concentric sleeve that unlocks the RESOLUTION from the FREQ SPAN/DIV selector and allows each selector to be independently set.

Display Controls and Selectors (cont)

FREQUENCY MHz

Indicator reads out the CENTER or MARKER frequency of the display. Frequency and readout are tuned by the TUNING control. Fine and coarse tuning are provided by the two position control. Approach the frequency readout setting from low to high for the most accuracy readings.

When the FREQ SPAN/DIV is switched to MAX SPAN position, the MARKER indicator lights and a notch appears on the baseline of the display to indicate that portion of the span that will be displayed when the FREQ SPAN is reduced.

LOG and AMPL CAL Adjustments

The LOG adjustment calibrates the display window and the AMPL adjustment sets the REFERENCE LEVEL to the top graticule line.

AUTO PHASE LOCKED Switch

This switch disables the phase locked mode.

CAL OUT Connector

Provides an accurate -30 dBm, 50 MHz signal source. This signal provides an absolute reference on the display to check dBm readings and calibrate the REFERENCE LEVEL. Harmonics of the 50 MHz provide picket fence markers across the frequency span for accurate frequency and span calibrations.

TRACKing GENerator Output Connector

Provides control signals for a Tracking Generator.

LOG 10 dB/DIV

Selects a display mode with a calibrated dynamic range of 70 dB (to the 7th graticule line from the top) at 10 dB/DIV. The bottom graticule division is not calibrated.

Display Controls and Selectors (cont)

LOG 2 dB/DIV

Selects a display mode with a calibrated dynamic range of 14 dB (to the 7th graticule line from the top) at 2 dB/DIV. The bottom graticule division is not calibrated.

LIN

Selects a linear display, that corresponds to the linear calibration on the left side of the graticule overlay.

REFERENCE LEVEL, RF Attenuation, and MAXimum Power Level indicators and Selectors.

Concentric controls that are connected in an electromechanical differential arrangement which select input attenuation and instrument gain.

Input attenuation (from 0 dB to 60 dB) and Gain (0 dB to 70 dB) are selected in 10 dB steps. An electromechanical arrangement and readout windows establish and indicate to the user, MAXimum power input level (in dBm), RF attenuation (in dB), and the REFERENCE LEVEL (in dBm) of the top graticule line. REFERENCE LEVEL is also displayed on the CRT of oscilloscopes with the readout feature.

NOTE

A blue tint borders the 10 dB/DIV display switch, and four positions of the Gain selector. This is to correlate REFERENCE LEVEL readout to Gain switch settings that are applicable in the 10 dB/DIV display mode. Readings outside the blue sector are not valid because the gain is electrically locked out. The CRT readout will display the < symbol to signify the readings are erroneous. The dynamic window of the display will not exceed -130 dBm (REFERENCE LEVEL of 60 dBm PLUS 70 dB/DIV display mode, the full 70 dB range of the Gain selector is usable. Switching the Gain full CW with the RF attenuator a 0 dB, produces an accurate -100 dBm reference level. The display is now calibrated to -114 dBm (100 dBm plus 14 dB graticule window to the 7th graticule line).

Display Controls and Selectors (cont)

LIN (cont)

UNCAL Indicator: Lights when the display is not calibrated because of incorrect sweep rate or resolution.

VARIABLE (Gain) Control

Provides at least 10 dB of gain variation. The REFERENCE LEVEL readout on the CRT changes to the < symbol to indicate an uncalibrated condition when it is out of its CAL detent. The readout of the REFERENCE LEVEL window on the 7L13 is only applicable when this control is in its CAL detent.

10 dB GAIN:

When the REFERENCE LEVEL is -100 dBm, the RESOLUTION 30 Hz, and the display mode is 2 dB/Div or LIN, this push-button provides 10 dB of additional gain. It does not have any effect with other combinations of reference level and gain.

1st LO OUT and 2nd LO OUT Connectors

Provide access to the 1st and 2nd local oscillators. This signal is used by the Tracking Generator. These ports must be terminated in 50 Ω at all times.

RF Input Connector

A 50 Ω input connector for applying the input RF signal. REFERENCE LEVEL indicator referes to the maximum RF level for linear operation, at the RF input. Refer to General Operating Information in the manual in regards to signal application.

ENGINEERING INSTRUMENT SPECIFICATION

CHANGE REQUEST

This form is a worksheet used to make changes in an Engineering Instrument Specification (EIS) or (for the case when an EIS does not exist) in performance claims quoted in other publications.

Return completed form to Product Specifications 76-440 for action and distribution.

Product: _____

Publication affected: _____ No. _____ Dated _____

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Change: Subject: _____ Page No. _____

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Reason for change: _____

Initial in appropriate space

Recommended Action	Prog. Mgr.	Proj. Eng.	Eval. Mgr.	Eval. Eng.	CRT Eng.	
Approve						
Reject						

Date Received in Product Spec's _____ by: _____

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