



User's Manual
SD345 Spectroscope III
Part Two
(S/N 180 and On)
Legacy Manual

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains unpacking, initial checkout and operating instructions for the Spectral Dynamics SD345 FFT Analyzer. The manual is divided into four sections, each section covers a specific aspect of the instrument. This section contains a list of other documents available, a brief description of the instrument, ancillary equipment and options, accessories furnished and a replacement parts list.

The manual is written for the operator and contains no maintenance information other than that which can be performed without removing the covers or front panel. It is recommended that each section be read in its entirety before proceeding to the next section.

1.2 OTHER DOCUMENTATION

Spectral Dynamics produces two basic manuals for all equipments: A User's Manual, and a Service Manual. The User's Manual is shipped with each instrument; the Service Manual with engineering drawings can be ordered separately.

The Service Manual is available upon request. It contains detailed theory of operation, calibration procedures, maintenance information, parts lists, engineering drawings and wire lists. The manual is written for technical personnel with experience in analog and digital circuits. Manual contents will provide the maintenance technician with information guidelines to repair the instrument.

1.3 EQUIPMENT DESCRIPTION

The Model SD345 Micro FFT Analyzer is a stand-alone, hard wired instrument that combines a 400-line analyzer, ensemble averager, and a dual-trace raster scan crt in a single portable unit.

The instrument is a microprocessor-based FFT analyzer that analyzes frequencies up to 100 kHz with 400-line resolution.

Spectral data is displayed on the crt. Harmonic relationships (orders) between machine components can be directly displayed and any 25% of the display can be

expanded to the full width of the crt for detailed examination. An alphanumeric readout on the crt, in conjunction with a cursor and the crt display grid, provides information in a variety of immediately usable forms. Quantities can be read out in engineering units (e.g., mil/sec, mil displacement, g). Automatically-scaled X-Y recorder outputs and X-Y display outputs are also provided.

The design of the SD345 adapts it to almost any application in the design, production testing, and maintenance troubleshooting of rotating machinery. In addition, since sound pressure level can be read out directly, it is useful in a broad variety of acoustic studies.

1.4 STANDARD FEATURES

The following features are provided as standard in the SD345:

- Front-panel selection of sixteen frequency ranges in 1, 2, 5 sequence from 1 Hz to 100 kHz full scale.
- A built-in dual-trace raster scan crt with cursor-controlled X4 magnification for expanding any selected 25% of the X axis spectrum for full screen viewing. A display grid which is internally generated by the Microprogram and projected on the crt to correspond with selected front-panel functions.
- A built-in averager for signal-to-noise enhancement in the frequency domain. Averaging can be performed on 2 through 1024 number of averages selected in binary sequence. The average number is updated at integer counts on the crt. Averaging in the LIN mode is performed linearly up to the selected number of averages and then stops.

Averaging in the EXPO mode is performed linearly up to the selected number of averages and then continues exponentially, with a selected time constant, until terminated by the operator.

- A peak hold mode, which detects and retains the highest level in each of the 400 displayed cell locations. The peak values can be stored or erased by the operator.

- An alphanumeric readout on the raster scan crt gives a readout of the following parameters for any point on the spectrum display:
 - a. Frequency in Hz
 - b. Frequency in KCPM
 - c. Harmonic order number relative to any selected fundamental.
 - d. Amplitude Volts (rms), (P-P), (O-P)
 - e. Amplitude dB
 - f. Amplitude in EU
 - g. ΔX
 - h. SEC
 - i. Overall level in Vrms, dB and EU
 - j. Time Mode Readout
 - k. ΔP
 - l. PSD(EU²/Hz)

Transducer sensitivity, dB REF and threshold percentage for transient capture are entered by means of a front-panel keyboard for direct engineering unit, relative dB readings or to capture transients exceeding a set threshold level in a positive or negative direction.

- A cursor that combines an intensified dot and a vertical line for locating specific spectral components.
- A harmonic cursor mode with fine tuning which intensifies all integer orders of the selected fundamental component.
- A SIMULPLOT feature which enables continuous viewing of the complete spectrum display of all 400 cells while plotting, plus:
 - a. SIMULPLOT (with X-axis sweep rate feedback control). Two different plotter rates, (20 seconds and 40 seconds) can be selected from the rear panel.
 - b. Interface to analog X-Y plotters with pen lift.

- c. Plot time waveform.
 - d. Plot expanded display (X-axis X4 mode).
- A remote feature that provides the following lines for remote control OR'ed with front-panel control:
 - a. START/STOP AVG
 - b. Erase
 - c. +1
 - d. TRANS ARM
 - e. MEMORY Hold/Update
 - f. TRANSFER M1→M2

1.5 SD345 OPTIONS

The options described in the following subparagraphs are available for the SD345.

1.5.1 Digital Translator (-1 Option)

The -1 Option is the addition of three printed circuit assemblies PWA 21076600 location A5A4, PWA 21061300 location A5A5 and PWA 21052300 location A5A6. With the Digital Translator option the SD345 can now provide over 50 different zoom expansions for observing and analyzing signals which have frequency terms so close to each other that basic 400 line resolution analysis cannot separate them for proper identification. With the Digital Translator this resolution can be increased from 10 to 100.

1.5.2 1/3, 1/1 Octave Capability (-2 Option)

The -2 Option is the addition of one printed circuit assembly PWA 21138200 location A5A2. With the 1/3, 1/1 octave option the SD345 can provide 1/3 or 1/1 octave contiguous-band Spectrum Analysis.

1.5.3 Digital I/O System (-3 Option)

The -3 Option is the addition of one printed circuit assembly PWA 21185900 location A5A16. With the '-3' option the SD345 can provide IEEE 488 and RS232 interface for complete remote front-panel control and convenient output of digital data.

1.6 SD345 ACCESSORY KIT

The SD345 Accessory Kit consists of the following items:

- 1 SD345 User's Manual SDC P/N 21263000
- 1 Belden No. 17250 Power Cord
- 1 Extender Assembly SDC P/N 10499600
- 2 Rack Mounting Brackets (3½ ") SDC P/N 21145500
- 2 Rack Mounting Brackets (5¼ ") SDC P/N 21145600
- 1 Bail (Tilt Stand) SDC P/N 10570700
- 1 Extender Card SDC P/N 21010400
- 8 Phillips Oval Head Screws 10-32 × 3/8

1.7 ANCILLARY EQUIPMENT

Separate connectors are provided on the SD345 rear panel for an external raster scan display, an X-Y plotter and an X-Y display.

1.8 REQUIRED EQUIPMENT

An external sensing device is required to produce the input signal to be analyzed. This device may be any one of several types of dynamic motion, tape recording equipment, signal generators or audio measuring devices (transducers).

Depending upon the equipment being tested, the input transducer can be either an accelerometer, microphone, velocity pickup or displacement probe.

If the input device has an output impedance of other than 50 ohms, spurs will appear below 50 dB on the display with the 100 kHz analysis range selected and the 10 mV level selected.

1.9 SPECIFICATIONS

1.9.1 Inputs

Frequency Ranges

Standard (16 Ranges) 1 Hz to 100 kHz as shown below:

Upper Frequency Limit-Hz (KCPM)		Resolution Hz (CPM)		Time Window-Sec
100k	(6000)	250	(15k)	0.004
50k	(3000)	125	(7.5k)	0.008
20k	(1200)	50	(3.0k)	0.02
10k	(600)	25	(1.5k)	0.04
5k	(300)	12.5	(750)	0.08
2k	(120)	5	(300)	0.2
1k	(60)	2.5	(150)	0.4
500	(30)	1.25	(75)	0.8
200	(12)	0.50	(30)	2.0
100	(6)	0.25	(15)	4.0
50	(3)	0.125	(7.5)	8.0
20	(1.2)	0.05	(3)	20.0
10	(0.6)	0.025	(1.5)	40.0
5	(0.3)	0.0125	(0.75)	80.0
2	(0.12)	0.005	(0.3)	200.0
1	(0.06)	0.0025	(0.15)	400.0

Sensitivity (For full

scale output) Eleven full scale ranges from 10 mV to 20 V in 1, 2, 5 sequence. Selectable in rms, O-P, or P-P. Selectable Manual or Auto-ranging mode.

Absolute Maximum

Input 50 Vrms

Transducer

Sensitivities Set by front-panel SENSITIVITY Group keyboard. 1 mV/EU to 99.9 mV/EU in 0.1 mV increments. 100 mV/EU to 999 mV/EU in 1.0 mV increments.

dB Reference

Sensitivities Set by the front-panel SENSITIVITY Group keyboard. 0 dB to 99.9 dB in 0.1 dB increments. 100 dB to 200 dB in 1.0 dB increments. (138 dB is maximum at 10mVrms input level; 204 dB maximum at 20 Vrms input level.)

Impedance 100k ohms

Weighting Acoustic A or C

Coupling DC/AC (-3 dB at 0.5 Hz; 50 mV Input Level and below AC coupling only).

Overload Indication LED located on the LEVEL, VOLTS touch control for input overload. LED located on the Y, GAIN touch control for output overload.

1.9.2 Processing Parameters

Anti-Aliasing Filters Automatically selected for each frequency range with initial 120 dB/octave roll-off for 70 dB rejection of aliasing terms; 1, 2, and 5 Hz frequency ranges utilize the 10 Hz lowpass antialiasing filter.

Sampling Rate (f_s) $2.56 \times$ full-scale frequency range selected on internal sampling control. External sampling control provided.

Transient Capture a. Front-panel adjustable threshold.
 b. Line threshold on crt display with readout.
 c. Retains 10% of previous data when transients are loaded into memory.
 d. Weighting in or out.

Weighting Rectangular or Hanning, front-panel selectable.

1.9.3 Analysis Characteristics

Resolution 400 lines of real time or averaged spectrum information on each analysis range. Processes a 1024 point transform.

Real Time Frequency 3 kHz (Nominal)

Frequency Response ± 1 dB over the entire frequency range.

Dynamic Range 65 dB typical with averaging from full scale to minimum discernible signal. The 50 kHz and 100 kHz frequency ranges with input levels of 50mV or below may have spurious frequency components below 50 dB. All other input levels and frequency ranges will have spurious components below 60 dB.

Average Noise Floor 70 dB typical, with averaging; greater than 70 dB with noise subtraction.

Amplitude Linearity (Linear dynamic range)

Spectrum $\pm 0.05\%$ of full scale or ± 1.0 dB, whichever is greater.

Overall $\pm 1.0\%$ of full scale or ± 1.0 dB, whichever is greater.

1.9.4 Averager Characteristics

Calculation True Power

Number of Averages 2 through 1024 in binary sequence. Average number updated at integer counts on the crt.

Modes

LIN Performs a linear average (ideal integrator) on a selected number of ensembles on a non-redundant basis until the selected number of ensembles has been reached.

EXPO Performs a linear average (ideal integrator) on a selected number of ensembles on a non-redundant basis until the selected number of ensembles has been reached. Averaging then continues exponentially with a selected time constant.

The average process is indicated by a flashing LED and continues indefinitely until terminated by pushing the STOP touch control. Averaged information can be stored in memory until the next averaging is initiated.

PEAK The highest level for each of the 400 lines and the overall signal is retained until exceeded. Information for all 400 filter locations is updated every 130 ms on all frequency ranges. Values can be stored or erased by using the front-panel AVG group ERASE and the XFER M1→M2 touch controls.

+1 MODE Will function if either LIN, EXPO or PEAK is selected, provided the start mode is not initiated prior to selecting the +1 MODE. This mode will allow the user to step through each ensemble of the LIN, EXPO and PEAK modes as desired.

1.9.5 Displays

Built-in TV Raster Scan
 Display Continuous
 Amplitude Viewing
 Range 70 dB

Display Rate 65 sweeps per second

Display Modes
 Spectrum 400 lines of real-time or averaged spectrum information for each analysis range. X4 expansion (around cursor location) on the frequency axis for high reading resolution. Linear or logarithmic amplitude (Y axis) vs. linear frequency (X axis). RMS value of overall input signal displayed in

cell locations 401 through 409. Grid is internally generated by the Microprogram and projected on the crt to correspond with selected front-panel functions. Alphanumerics are displayed simultaneously above and below projected grid display and correspond to read out units as selected by the front-panel controls. Dual display of the following functions is provided:

- a. Time, Real Time
- b. Time, M1
- c. Time, M2
- d. Real Time, M1
- e. M1, M2
- f. Real Time, M2

Time Input signal displayed as a function of time. 512 points (every other point) of the 1024 points processed for the FFT is displayed as a function of time.

1.9.6 Output Characteristics

X-Y Recorder Features SIMULPLOT (continuous CRT display during PLOT mode) and Sweep rate feedback plotting with two selectable plotting rates; X, Y, and pen-lift output. Plots contents of input memory or expanded part of input memory as selected by X axis LIN X4 mode. Plots single or dual trace displays. Plots contents of M2 while averaging data in M1.

Amplitude (Y axis) Linear 0-5 Vdc (Nominal)
 Log 0-5 Vdc (70 dB).

Frequency (X axis) Linear 0-5 Vdc (Nominal)
Log -0.6 Vdc to +5 Vdc
(Nominal) 2 V per decade.

dB REF Amplitude of any compo-
nent selected by the cursor
can be set to 0 dB or to any
positive value up to 200 dB
(138 dB is maximum at
10 mVrms input level. 204
dB is maximum at 20 Vrms
input level).

Internal Calibration Internally generated square
wave is available by de-
pressing the front-panel
SIGNAL group TEST touch
control. The fundamental is
- 10 dB from full scale and
is located at cell 256 for all
frequency ranges. This sig-
nal can be used for opera-
tional check-out of the in-
strument. Other frequency
components may appear on
the 100 kHz frequency
range with the test signal.

Display Calibration

Y Axis Log: Full scale and -40 dB
selectable.

Lin: Full scale and linear
zero selectable.

Log: Full scale and -2
decade selectable.

X Y Recorder Simulplot . . . Data is displayed con-
tinuously on the crt while
plotting. An intensified dot
with a vertical line moves
across the spectrum auto-
matically to indicate the
position on the plotter. Two
plotter rates, 20 and 40
seconds, can be selected
from the rear panel. Plotter
sweep rate control is fur-
nished for automatic slow-
down during recording of
data peaks.

External CRT (Raster Scan) Outputs (Composite video)

Amplitude (Y Axis) Linear X1, X2, X5, X10
Log -30 dB to +30 dB in
10 dB steps.

Frequency (X Axis) Linear X1, X4
Log X

Retrace Blanking Positive TTL

Display

Amplitude (Y Axis) Linear X1, X2, X5, X10
Log -30 dB to +30 dB in
10 dB steps.

Frequency (X Axis) Linear X1, X4
Log X

Output Overload

Indicator LED located on the Y GAIN
increase touch control up-
per left hand corner. An
output overload will be in-
dicated by the LED being lit
constantly.

1.9.7 Miscellaneous

Intensity Mark (Cursor)

Normal Can be moved left or right
at a preselected rate or can
be stopped to locate on any
desired component of real-
time or averaged data. A
vertical line also appears
when the cursor is moved.

Harmonic Intensified dot placed
automatically at all integer
harmonics of selected fun-
damental. Fine resolution of
1/256 is available at a fun-
damental location to align
higher order harmonics.
Harmonics can be frozen
and a line cursor can then

be moved to any harmonic for direct amplitude and order readout on the alpha-numeric display on the crt.

Depth 48,6 cm (19")
Weight 22,68 Kg (50 lbs.) Nominal
Temperature Range 5°C to 45°C (40°F to 113°F)
Power 105-125/210-250 Vac (90 to 121 Vac for Japan), 47-65 Hz, at 400 watts.

External Inputs (Rear Panel)

SIG IN Performs the same function as the INPUT BNC connector located at the lower right-hand corner of the front panel.

TIME SYNC Accepts TTL level input as trigger reference for time-domain signal averaging or synchronous spectrum functions.

Dimensions

Height 22,2 cm (8.75")
Width 43,2 cm (17")

1.10 REPLACEMENT PARTS

Except for some special SDC specification controlled parts listed in tables 1-1 through 1-4, standard electronic parts are used in the Model SD345 circuitry. To aid in replacement some miscellaneous parts are also listed. Spectral Dynamics maintains a stock of parts used in this instrument.

When ordering parts, include assembly number of card reference designation, description, and SDC part number. Also include the instrument serial number and complete model number including "dash" number.

Table 1-1. Special Replaceable Parts List, Printed Wiring Assemblies.

Reference Designator	Description	Part No.
A1	Main Frame Assy.	10498000
A1A1	Mother Board Assembly	10491400
A1A2	Chassis Assembly	21077600
A1A21	BNC Interface Assembly	10488000
A2	Front Panel Assembly	21026000
A3	CRT Assembly	21014400
A4	Rear Panel Assembly	21018800
A5	PWA Assembly	10482200
A5A1	Low Pass Filter #1 Assembly	21082100
A5A2	1/3 Octave Assembly (Option)	21138200
A5A3	A/D Converter Assembly	21085000
A5A4	Translator Assembly (Option)	21076600
A5A5	Translator Assembly (Option)	21061300
A5A6	Translator Assembly (Option)	21052300
A5A7	Input Memory and Timing Assembly	10487700
A5A8	Processor Memory Assembly	10488900
A5A9	Multiplier Assembly	10479200
A5A10	Microprogram Control Assembly	10481800
A5A11	Central Processor Assembly	10483200
A5A12	Refresh Memory Assembly	10497300
A5A13	Video Interface Assembly	10492500
A5A14	Display Control Assembly	10486300
A5A15	Memory Address Assembly	10481500
A5A16	Digital I/O System Assembly (Option)	21185900
A5A18	Front Panel Interface Assembly	21014700
A5A19	Front Panel Control Assembly	21069100
A5A20	TV Signal Transfer Assembly	21081800
PS1	Power Supply Assembly	21025100
PS1A1	Regulator Assembly	21025300
PS1A2	Inverter Assembly	21025500
PS1A3	Power Panel Assembly	21047000

Table 1-2. Special Replaceable Parts List, PROMS.

Reference Designator	Description	Part No.
A5A1U29	IC,PROM(AR)	21135800
A5A1U32	IC,PROM(LEVEL)	21135900
A5A7U24	IC,PROM(INP1)	21150000
A5A7U25	IC,PROM(INP2)	21150100
A5A8U9	IC,PROM(MCXB9-1)	21172800
A5A8U11	IC,PROM(MCXB9-2)	21172900
A5A8U13	IC,PROM(MCXB9-3)	21173000
A5A8U8	IC,PROM(MCXB10-1)	21173100
A5A8U10	IC,PROM(MCXB10-2)	21173200
A5A8U12	IC,PROM(MCXB10-3)	21173300
A5A10U21	IC,PROM(MCXB1-1)	10493200
A5A10U22	IC,PROM(MCXB1-2)	10493400
A5A10U23	IC,PROM(MCXB1-3)	10493600
A5A10U30	IC,PROM(MCXB2-1)	10493300
A5A10U31	IC,PROM(MCXB2-2)	10493500
A5A10U32	IC,PROM(MCXB2-3)	10493700
A5A10U41	IC,PROM(MCXB3-1)	10493800
A5A10U42	IC,PROM(MCXB3-2)	10494000
A5A10U43	IC,PROM(MCXB3-3)	10494200
A5A10U52	IC,PROM(MCXB4-1)	10493900
A5A10U53	IC,PROM(MCXB4-2)	10494100
A5A10U54	IC,PROM(MCXB4-3)	10494300
A5A10U1	IC,PROM(MCXB5-1)	10494400
A5A10U2	IC,PROM(MCXB5-2)	10494600
A5A10U3	IC,PROM(MCXB5-3)	10494800
A5A10U5	IC,PROM(MCXB6-1)	10494500
A5A10U6	IC,PROM(MCXB6-2)	10494700
A5A10U7	IC,PROM(MCXB6-3)	10494900

Reference Designator	Description	Part No.
A5A10U9	IC,PROM(MCXB7-1)	10495000
A5A10U10	IC,PROM(MCXB7-2)	10495200
A5A10U11	IC,PROM(MCXB7-3)	10495400
A5A10U14	IC,PROM(MCXB8-1)	10495100
A5A10U15	IC,PROM(MCXB8-2)	10495300
A5A10U16	IC,PROM(MCXB8-3)	10495500
A5A12U47	IC,PROM(MSQ1)	21082900
A5A12U70	IC,PROM(MSQ2)	21082800
A5A12U50	IC,PROM(MSIN1)	21083100
A5A12U73	IC,PROM(MSIN2)	21083000
A5A12U49	IC,PROM(MCOS1)	21083300
A5A12U72	IC,PROM(MCOS2)	21083200
A5A12U48	IC,PROM(LOGX1)	21134400
A5A12U71	IC,PROM(LOGX2)	21134500
A5A12U19	IC,PROM(TVXFR)	21133500
A5A13U17	IC,PROM(DET)	21135000
A5A13U28	IC,PROM(TXA)	21134900
A5A13U31	IC,PROM(TYA)	21135400
A5A13U51	IC,PROM(Y-LINE)	21135200
A5A13U71	IC,PROM(X-LINE)	21135100
A5A13U73	IC,PROM(Y-INST)	21135300
A5A14U36	IC,PROM(RFSH1)	21132800
A5A14U37	IC,PROM(RFSH2)	21132900
		(INTEL) (TI)
A5A19U38	*IC,PROM(Z80MCX1)	21170000/21135500
A5A19U39	*IC,PROM(Z80MCX2)	21170100/21135600
A5A19U40	*IC,PROM(Z80MCX3)	21170200/21135700

*Before ordering this part, ascertain the proper manufacturer of the IC in your instrument and use the part number in the corresponding column. Since the pin configurations are different, these parts are not interchangeable.

Table 1-3. Special Replaceable Parts List, Integrated Circuits.

Reference Designator	Description	Part No.
A5A1U1,11,37,38	IC, Operational Amplifier, JFET Input, Precision Monolithics Part No. OP-16E	21156600
A5A1U2-4,13,16-19,33-36	IC, Operational Amplifier, Buffered JFET Input, National Part No. LF356N.	10674901
A5A1U5-10,21-18	*IC, CMOS, Triple 2-Channel Analog Multiplexer, RCA Part No. CD4053BF.	10705100
A5A1U14,39	IC, Quad Comparator, Motorola Part No. LM339N.	10656400
A5A1U20	*IC, CMOS, Multiplexer/Demultiplexer, Single 8-Channel with Logic Level Conversion, Fairchild Part No. 4051PC.	10627400
A5A3U1	IC, A/D Converter, Ultra High Speed, Computer Labs Part No. MAS 1001-3-C2SC.	10707800
A5A3U2,11-13	IC, Operational Amplifier, Voltage Follower, National Part No. LM310N.	10667200
A5A3U3-9,14-17,19,20	IC, Operational Amplifier, High Speed, National Part No. LM318N.	10667300
A5A3U10	*IC, CMOS, Quad Bilateral Switch, Fairchild Part No. 4066PC.	10615500
A5A3U18	IC, Quad Comparator, Motorola Part No. LM339N.	10656400
A5A3U21	IC, Timer, Intersil Part No. NE555V.	10535501
A5A3U23	IC, Operational Amplifier, National Part No. LM301AN	10666400
A5A3U25	IC, Operational Amplifier, Frequency Compensated, National Part No. LM741CN.	10670000
A5A3U36	*IC, PMOS, Analog Switch, Texas Instruments Part No. TL601CD.	10688101
A5A3U37	IC, Operational Amplifier, Buffered JFET Input, National Part No. LF356N.	10674901
A5AU44-49,60-65	IC, 1 X 1024 Bit Random Access Memory, Synertek Part No. SYP21L02A.	10587301
A5A8U19-27,38-41,56-58	IC, Random Access Memory, (1)24 X 4), Intel Part No. P2114-3.	10692900
A5A8U52-55	IC, Tri-State Quad Bus Transceivers Signetics Part No. N8T28B.	10662100
A5A9U17,18,27,28,36,37	IC, 2's complement Multiplier (4 X 2), Fairchild Part No. F93S43PC.	10594802
A5A11U24-30	IC, Central Processing Element, Signetics Part No. N3002N.	10672500
A5A12U10	IC, D/A Converter, Burr Brown Part No. DAC80-CBI-V.	10663900
A5A12U11	IC, 8-Bit Multiplexing D/A Converter, Motorola Part No. MC1408L.	10675800
A5A12U13	IC, Dual Operational Amplifier, RCA Part No. CA1458G.	10514001
A5A12U55-65,78,89	IC, 1 X 1024 Bit Random Access Memory, Synertek Part No. SYP21L02A.	10587301
A5A12U90	*IC, PMOS, Analog Switch, Texas Instruments Part No. TL601CD.	10688101
A5A13U66,68	IC, Random Access Memory (1024 X 4), Intel Part No. P2114-3	10692900
A5A13U77,86	IC, Random Access Memory, (1K X 1) Signetics Part No. N82S11N.	10702400
A5A13U101	IC, Operational Amplifier, National Part No. LH0002CH.	10587200
A5A13U102	IC, General Purpose Transistor Array, RCA Part No. CA3046.	10516300
A5A13U105	IC, Read Only Memory, Character Generator, 64 Character, National Part No. DM8678 BWFN.	10713000
A5A18U34,35	*IC, CMOS, Random Access Memory (512 X 4), 270 ns, Harris Part No. Part No. HM3-6513L-9.	10710500
A5A18U37	IC, Microprocessor, Zilog, Part No. Z80-CPU.	10704200
A5A18U38,39	IC, Tri-State Quad Bus Transceivers, Signetics Part No. N8T28B.	10662100
A5A18U64,65	IC, Random Access Memory, (1K, 256 X 4) Fairchild Part No. 93422DC.	10703200
PS1A1U1	IC, Positive Voltage Regulator, Adjustable, +12 to +37 Volts, National Part No. LM317K.	10680901
PS1A1U2	IC, Positive Adjustable Voltage Regulator, Fairchild Part No. uA78GKC.	10661603
PS1A1U3	IC, Negative Voltage Regulator, Adjustable, -1.2 to -3.7 Volts, National Part No. LM337K.	10721100
PS1A2U1	IC, Operational Amplifier, High Speed, National Part No. LM318N.	10667300
PS1A2U2	IC, Precision Voltage Regulator, 2-37V, Fairchild Part No. uA723DC.	10511001
PS1A2U3	IC, Positive 12VDC Voltage Regulator, Motorola Part No. MC7812KC.	10643000
PS1A2U4	*IC, CMOS, Buffered Quad 2-Input NOR Gate, Fairchild Part No. 4001BDC.	10606600
PS1A2U5	*IC, CMOS, Buffered Quad 2-Input NAND Gate, Fairchild Part No. 4011PC.	10622600
PS1A2U6	*IC, CMOS, Dual Flip-Flop with Set/Reset, Fairchild Part No. 4013PC.	10589000
PS1A2U7	*IC, Voltage Comparator, Fairchild Part No. LM311H.	10514500

*These IC's are highly susceptible to damage from electrostatic charges. Any time the MOS IC is not in the circuit, special handling is required. Upon removal from the shipping container or the circuit, the IC should be placed in special conductive foam if available. If not, any material such as tin foil should be used to short the IC pins together when the IC is not in the circuit.

Table 1-4. Special Replaceable Parts List, Controls and Indicators.

Reference Designator	Description	Part No.
A1	Cable/Switch Assembly, Power ON/OFF	10453500
A1R1	Potentiometer, Panel Mounted, 5K ohms, (contrast) Allen Bradley Part No. WA1G040P502VA.	10548501
A1R2	Potentiometer, Panel Mounted, 10K ohms (Grid) Allen Bradley Part No. WA2G040S103UA.	10548521
A1A21S1,2	Switch, Dual In-Line, 8 position, SPST, Amp Part No. 435166-5	10604701
A3	Monitor, Video, 5" CRT Data Display, Ball Bros. Part No. Model TV-50 (P-39 Phosphor).	10713301
A3	Knob, Rogan Part No. RB-67-O-M-3501 1/8" Round Shaft.	10714400
A5A1K1,3-9	Relay, 12V, 500 ohms Coil Resistance, Elec-Trol Part No. RA30381121.	10610901
A5A1K2	Relay, Dual In-Line, 5V, 200 ohms Coil Resistance, Elec-Trol Part No. RA30421121.	10631702
A5A1R19	Potentiometer, 5K ohms Beckman Part No. 72XR5K.	10648200
A5A1R33,66,71,81,97, 124,134,149	Potentiometer, 500 ohms, Beckman Part No. 72PR500.	10648302
A5A1R34,56,58	Potentiometer, 100K ohms, Beckman Part No. 72PR100K.	10648310
A5A1R48,68,95,121,147	Potentiometer, 1K ohm, Beckman Part No. 72PR1K.	10648303
A5A1R49	Potentiometer, 2K ohms, Beckman Part No. 72PR2K.	10648304
A5A1R53	Potentiometer 10K ohms, Beckman Part No. 72PR10K.	10648306
A5A1R92	Potentiometer, 200 ohms, Beckman Part No. 72PR200.	10648301
A5A1R119	Potentiometer, 100 ohms, Beckman Part No. 72PR100.	10648309
A5A3K1	Relay, Dual In-Line, 5V, 200 ohms Coil Resistance, Elec-Trol Part No. RA30421121.	10631702
A5A3R2,15,27,35	Potentiometer, Trimmer, 1K ohm, Beckman Part No. 66WR1K.	10544305
A5A3R5,56	Potentiometer, Trimmer, 2K ohms, Beckman Part No. 66WR2K.	10544306
A5A3R13,24,108,116	Potentiometer, Trimmer, 500 ohms, Beckman Part No. 66WR500.	10544304
A5A3R50	Potentiometer, Trimmer, 100K ohms, Beckman Part No. 66WR100K.	10544312
A5A3R51	Potentiometer, Trimmer, 5K ohms, Beckman Part No. 55WR5K.	10544307
A5A3R121	Potentiometer, Trimmer, 25K ohms, Beckman Part No. 66WR25K.	10544310
A5A3R127	Potentiometer, Trimmer, 10K ohms, Beckman Part No. 66WR10K.	10544308
A5A7S1	Switch, SPDT (Sine/Dither) C & K Components Part No. 7101A.	10531800
A5A7R25	Potentiometer, 100 ohms, Beckman Part No. 72XR100.	10648204
A5A12R18	Potentiometer, 100K ohms, Beckman Part No. 72XR100K.	10648205
A5A12R4	Potentiometer, 2K ohms, Beckman Part No. 72XR2K.	10648208
A5A12R19	Potentiometer, 1K ohm, Beckman Part No. 72XR1K.	10648206
A5A13Q2	Transistor, MOS FET, Enhancement, Signetics Part No. SD211.	10649500
A5A13R23,25	Potentiometer, Trimmer, 5K ohms, Beckman Part No. 62PR5K.	10544110
A5A14K1	Relay, 5V, 500 ohms Coil Resistance, Teledyne Part No. 712-5	10526800
A5A19DS1	Audio Indicator, 3-16 Volt, Projects Unlimited Part No. A1-254.	10713201
A4A19R2	Potentiometer, 500 ohms, Beckman Part No. 72XR500.	10648201
A5A20R1	Potentiometer, Trimmer, 100K ohms, Beckman Part No. 89PR100K.	10544713
PS1A1A1	Rectifier Assembly	21045600
PS1A1S1	Switch, SPDT, (Low Line Voltage) C & K Components Part No. 7101AQ	10531807
PS1A1R2	Potentiometer, 500 ohms, Beckman Part No. 72XR500.	10648201
PS1A1R5	Potentiometer, 5K ohms, Beckman Part No. 72XR5K.	10648200
PS1A1R8	Potentiometer, 20 ohms, Beckman Part No. 72XR20.	10648209
PS1A2Q1,2	Transistor, RCA Part No. 2N6674	10727500
PS1A2DS1	Protector, Voltage Surge, Siemens Part No. B1-A230.	10620300
PS1A2DS2	Lamp, Neon, Chicago Miniature Part No. A1A.	10614900
PS1A2RT1,2	Thermistor, 5 ohms, 0.09 ohms with a Maximum Current of 7 Amps, Rodan Part No. SD-6.	10696900
PS1A2BT1	Battery, 2.4VDC, 0.07AH, General Electric Part No. 41B901 BD11-G1.	10710400
PS1A2CR4	LED, Solid State Red-Clear, Monsanto Part No. MV5022.	10535600
PS1A2R7,13	Potentiometer, 10K ohms, Beckman Part No. 72XR10K.	10648202
PS1A2CR19	Rectifier, Single-Phase, Full Wave, Motorola Part No. MDA201.	10502603
PS1A3CR1	Rectifier, Single-Phase, Full Wave 25 Amp, 400 Volt, General Instruments Part No. KBPC2504.	10612603
PS1A3S1,2	Switch, Slide, Voltage Selector, DPDT Locking, Switchcraft Part No. 46256LFR.	10528600
PS1A3XF1	Fuseholder, Littlefuse Part No. 34-2001A.	10637501

SECTION II

INSTALLATION

2.1 INTRODUCTION

This section contains instructions for performing an initial inspection of the Model SD345 FFT Analyzer. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

2.2 INITIAL INSPECTION

The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors and dents or scratches. If damage is found, refer to the claims paragraph in this section.

2.2.1 Unpacking

Use care in removing the instrument from its shipping container to prevent damage to the front and rear panel controls and connectors. Save the shipping container and all packing material until the instrument has been inspected and checked for operation.

2.2.2 Equipment Furnished

Check to insure that each item on the packing slip is included with the shipment. Accessory kits may be shipped in separate containers and each item should be inspected for damage.

2.2.3 Check for Physical Damage

Inspect all panels for dents, signs of chipped paint or scratches. Check for broken or bent connectors, switches and broken knobs. If there is damage, photos of the damage may be helpful in any subsequent claims.

2.2.4 Reshipment Procedure

If the Model SD345 is to be shipped after receipt, use the original shipping container and packing material. If original packing material is not available, materials for reshipment normally include the following:

- a. A double wall carton with a test strength of 350 pounds. Carton size should be such that the packing material listed below can be used.

- b. Heavy paper or sheets of cardboard to protect all surfaces.
- c. Nonabrasive material such as polyurethane or cushioned paper between projecting parts and wall of carton.
- d. At least 4 inches of shock absorbing material such as extra-firm polyurethane.

2.2.5 Returned Equipment with Warranty or Damage Claims

If the SD345 is found to be damaged in transit or does not operate as specified when received, notify the carrier and the nearest Spectral Dynamics sales/service office or representative immediately. Spectral Dynamics' sales/services offices and representatives are listed at the back of this manual. The local office will arrange for repair or replacement. Be sure to attach a card showing the owner's name, address, telephone number and a description of the service required.

2.3 SAFETY PRECAUTIONS

WARNING

Read the following safety precautions before attempting to operate this instrument.

The Model SD345 FFT Analyzer presents no hazard to operating personnel if operated in accordance with the instructions in this manual.

2.3.1 Explosion Hazard

Do not operate the SD345 in any environment where flammable vapors may exist. Operation of any electrical instrument in such an environment constitutes a definite explosion hazard.

2.3.2 Shock Hazard

When connected to a three-contact power receptacle, the three conductor ac power cable supplied with the

SD345 grounds the panel and chassis. This grounding protects the operator from possible injury. To preserve this protection when operating from a two conductor outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to ground at the power outlet before connecting the instrument. Covers and safety plates should be removed *only* by *qualified* maintenance personnel. Voltages are present inside this instrument whenever the power cord is connected even when the power switch is off.

2.4 PREPARATION FOR USE

2.4.1 Power Requirements

The SD345 FFT Analyzer is designed to operate on either 115 Vac or 230 Vac. Therefore, before applying power to the instrument check the following:

- There are two transformer slide switches located on the rear panel labeled S1 and S2. Both switches must be in the 115 Vac or the 230 Vac position.
- The fuse in fuse holder F1 should be a 10A SLO-BLO for both 115 Vac and 230 Vac.
- For operation in Japan or low line voltage operation, there is a toggle switch located in the power supply (Refer to Figure 2-1). For normal operation with both rear-panel slide switches either in the 115 Vac or 230 Vac positions, the toggle switch must be in the 120 V position. For operation in Japan the rear-panel slide switches must be in the 115 Vac position and the toggle switch must be in the 100/110V position. If low line voltage is experienced in countries other than Japan, this toggle switch can be utilized in the 100/110V position even if both rear-panel slide switches are in the 230 Vac position.

CAUTION

Removal of the top cover of the SD345 is required for access to the low line voltage switch. Prior to removing the cover, insure that power to the instrument is turned off and the power cord is unplugged. After the cover is removed, do not touch any components in the power supply assembly or the crt assembly other than the low line voltage toggle switch.

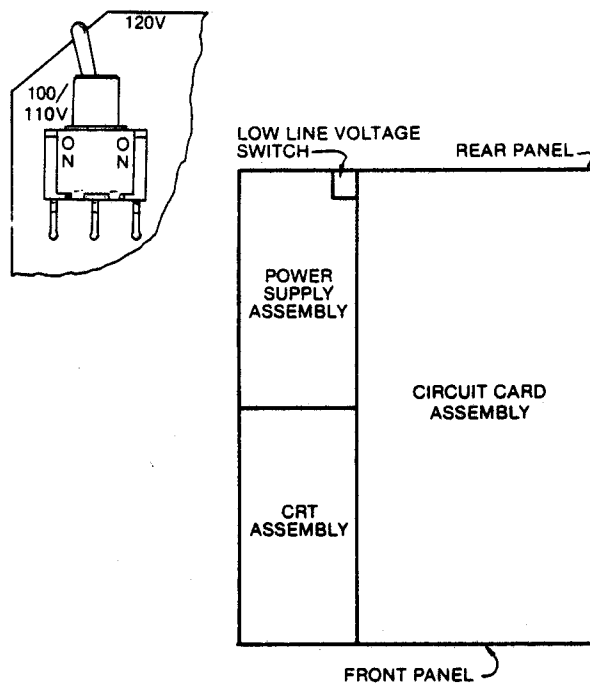


Figure 2-1. Low line voltage toggle switch and a simplified top view of the SD345 with the cover removed showing the location of the toggle switch.

2.4.2 Mounting

The SD345 is shipped from the factory as a bench instrument with bail (tilt stand) and trim in place. If rack mounting is required, rack mounting hardware is provided as part of the accessory kit and must be attached before mounting in the rack.

CAUTION

- The SD345 requires at least 1-3/4" open space above the top cover and at least 4" open space behind the rear-panel fan for proper cooling.
- To prevent damage to the cooling fan, never set the instrument on its rear panel.

2.4.3 Equipment Interconnections

The Model SD345 is self-contained requiring only an analog input signal to function. However, external signals are provided at the rear panel for an external X-Y plotter, an external X-Y display and an external raster scan display. Optional interconnects are also available as described in section III paragraph 3.3.

SECTION III

OPERATION

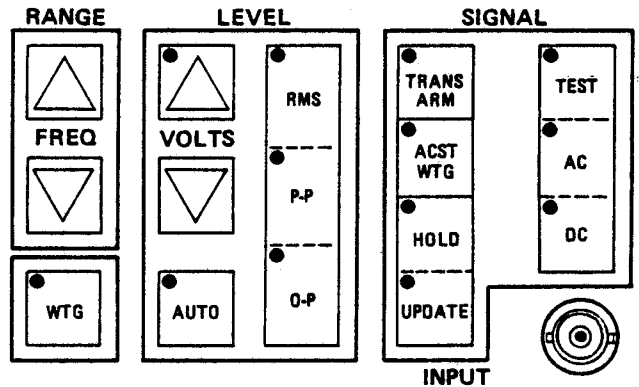
3.1 INTRODUCTION

This section provides the operator with a description of all controls and indicators, initial setup and adjustments, operational checkout and instrument operation including operator maintenance.

3.2 FRONT PANEL FUNCTIONAL DESCRIPTION

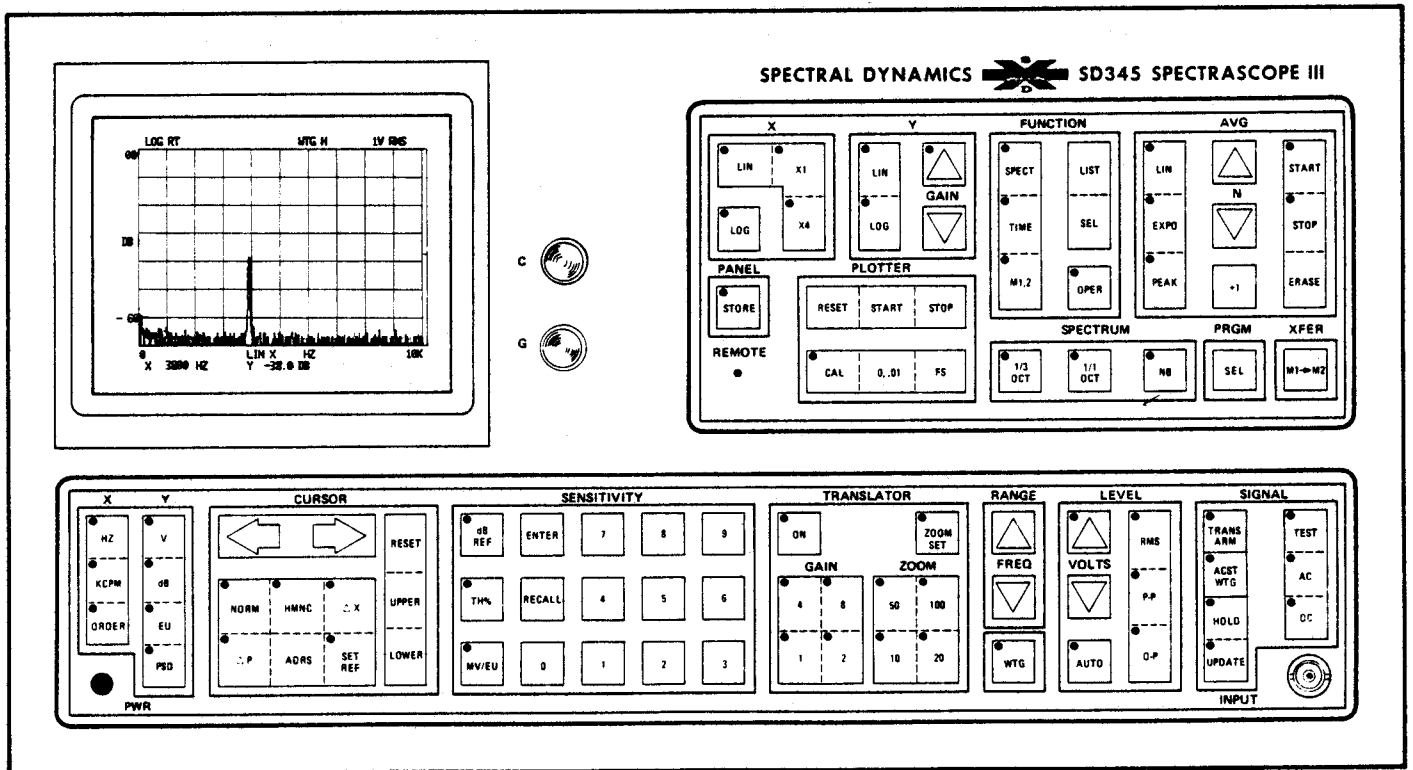
Figure 3-1 is a front view of the SD345. The front-panel controls, indicators and connectors are arranged into groups according to the functions performed. The following paragraphs describe the functions performed by each group and each control. Each group is separately illustrated to facilitate the description.

3.2.1 Input Group



INPUT BNC Connector

Accepts the input analog data signal for analysis.



RANGE (FREQ) Touch Controls

Selects the analysis frequency range for the input data signal (upper frequency limit) in sixteen ranges in 1, 2, 5, sequence as follows: 1 Hz, 2 Hz, 5 Hz, (with a 10 Hz LPF) 10 Hz, 20 Hz, 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, and 100 kHz. The frequency selected will appear as an alphanumeric on the crt. When operating in frequency ranges 20 Hz and below, aliasing terms from the sine dither square wave may be present on the display. These aliasing terms can be eliminated by placing the sine dither switch in the OUT position. The sine dither switch is a toggle switch located on the A7 circuit card. Viewing the component side of the circuit card, the sine dither switch can be located either on the upper right-hand corner of the card or towards the upper left-hand corner of the card. In some cases the switch may not be labeled with the words IN or OUT. In cases where labeling is not present, sine dither is OUT when the switch toggle is pointing towards the right and IN when the switch toggle is pointing to the left.

NOTE

The top cover of the instrument must be removed and the A7 circuit card extracted for access to the sine dither switch. Power to the instrument should be removed and extreme caution should be exercised when extracting the A7 circuit card to prevent damage to the components on the circuit card.

LEVEL (VOLTS) Touch Controls

Selects the input signal level for 10 mV through 20 V full scale input in 1, 2, 5 sequence for the following eleven ranges: 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1V, 2V, 10V, and 20V. Signal level can be displayed in volts rms, O-P, or P-P as selected by the front-panel controls. The AUTO touch control, when depressed, automatically selects the proper voltage range that corresponds to the input signal. When the proper range is reached, the AUTO function stops and the LED goes out. Selected voltages will appear as alphanumerics on the crt. When the input signal exceeds the full scale limit, an overload condition will be indicated by a LED located on the VOLTS, LEVEL increase touch control upper left hand corner. An overload will cause the LED to stay lit constantly. The LED will indicate an overload condition when the Input A/D converter starts clipping the input samples.

WTG Touch Control

When the WTG touch control is depressed and the LED turns on, Hanning weighting from internal ROMS is applied in the input data during transfer from Input Memory to Processor Memory, for those functions with which it can be used. When the WTG touch control is depressed again the LED goes out and Rectangular weighting is applied.

SIGNAL Touch Controls

TRANS ARM Touch Control

Local or remote command sets transient capture circuitry to trigger on the incoming data signal. 10% of the pre-trigger information is displayed.

TEST Touch Control

Depressing the TEST touch control places an internally generated square wave calibration signal in the input. The fundamental of this signal has an amplitude of -10 dB from full scale and is located at cell 256 for all frequency ranges. This signal can be used for operational checkout of the instrument.

AC Touch Control

Selects AC coupling for the input signal (-3 db at 0.5 Hz). This touch control must be selected for Input Levels of 50 mV and below.

DC Touch Control

Selects DC coupling for the input signal for the 100 Hz range and below.

HOLD Touch Control

Depressing this control places the input memory in HOLD.

NOTE

When the HOLD mode is activated, the Input Group settings should not be changed. This will avoid incorrect frequency or level information on the crt display. Also when in the HOLD mode, selecting the TEST signal or the TRANSLATOR ON controls will have no effect on the crt display.

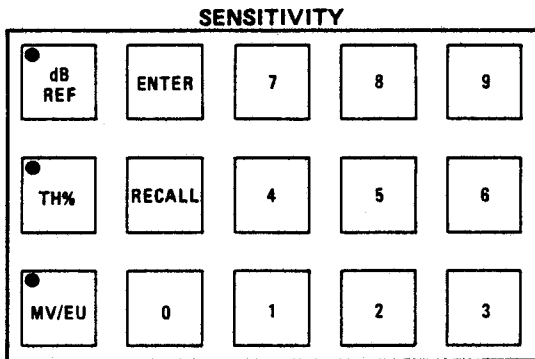
UPDATE Touch Control

Depressing this control allows the operator to update the information in the input memory.

ACST WTG Touch Control

Depressing this touch control applies acoustic weighting to the input signal. Acoustic "A" or "C" weighting is internally selectable on circuit card A5A3.

3.2.2 SENSITIVITY Group Keyboard



dB REF Touch Control

Selects dB reference sensitivity in units of dB (EU readout blanked). A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected and any desired dB reference level can be selected for any point on the spectrum display. This is accomplished by moving the cursor to the desired reference point, selecting the desired dB reference level on the keyboard and depressing the ENTER touch control. The dB reading for any other selected point on the spectrum display will now be referenced to the set dB reference level (point). The value selected will appear in the upper right hand corner of the grid. After the dB value is selected and entered, the numerical REF value on the display will disappear. To recall the numerical value selected, depress the dB REF control and then the RECALL control. The numerical value of the dB reference selected will reappear momentarily and disappear again. (Refer to paragraph 3.5.4). If the dB REF touch control is depressed while the HMNC cursor is in Mode 1, the cursor will be the same as in the NORM mode. If the touch control is depressed while the HMNC cursor is in Mode 2, the cursor will be the same as in HMNC Mode 2 with the intensified dots frozen at the harmonics of the fundamental. (Refer to paragraph 3.2.6).

TH% Touch Control

Selects threshold percentage for the transient capture function. A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected. Percentage values are selected by the keyboard and entered by the ENTER touch control.

The numerical display appears in the same place as the dB REF display and functions in the same manner. A 50% threshold level corresponds to 0 volt input signal. Threshold percentages between 50% and 100% indicate positive thresholds. Threshold percentages between 50% and 0% indicate negative thresholds.

MV/EU Touch Control

Selects transducer sensitivity in units of mV/EU. A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected. Values are selected by the keyboard and entered by the ENTER touch control. The numerical display appears in the same location as the dB REF and TH% displays and functions in the same manner.

ENTER Touch Control

Enters the values selected for dB REF, TH%, mV/EU, and ADRS.

RECALL Touch Control

Recalls and momentarily displays the values entered for dB REF, TH%, mV/EU, PRGM SEL, and ADRS.

Numbered Keyboard Touch Controls

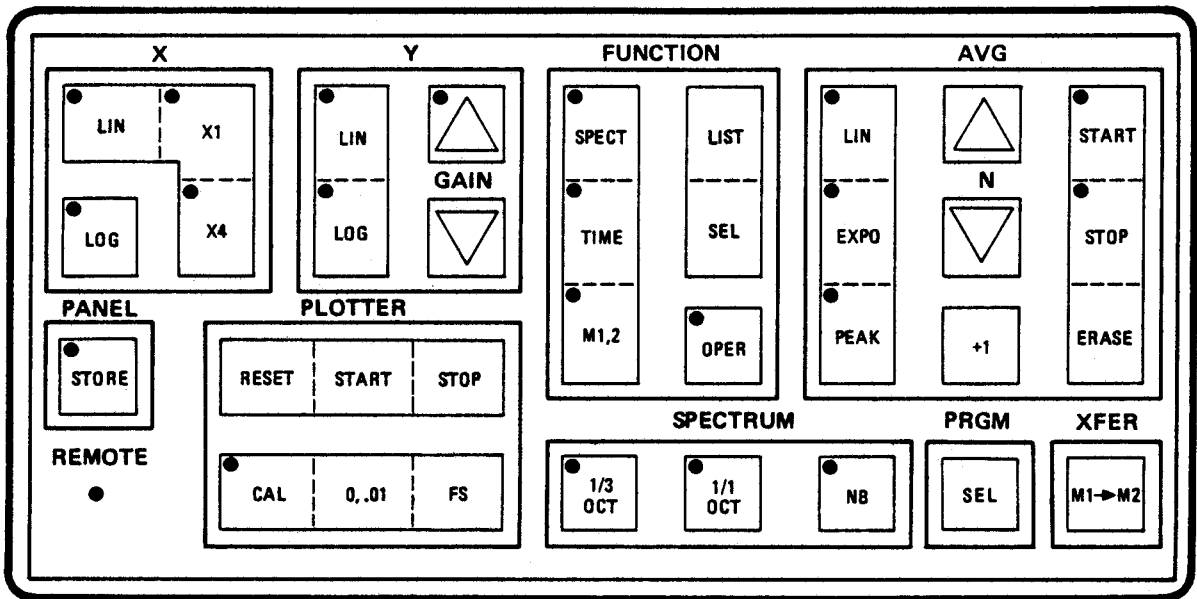
Provides means of entering units of sensitivity as follows:

For dB REF: 0 dB to 99.9 dB in 0.1 dB increments and 100 dB to 200 dB in 1.0 dB increments (138 dB is maximum at 10mVrms input level; 204 dB is maximum at 20 Vrms input level).

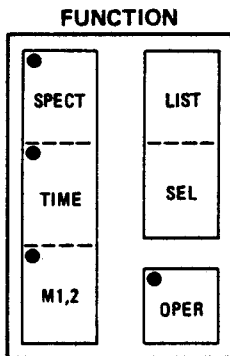
For TH%: 11% to 89% in 0.1% increments. The display range for TH% is as follows:

RMS: 0% to 100%
P-P: 37.5% to 62.5%
O-P: 25% to 75%

3.2.3 Analysis Group



FUNCTION Touch Controls



Provides selection of one of the following modes of operation:

SPECT Mode

Real time analysis, memory 1 averaging, memory 2 input, SYNC SPECTRUM, dual display of memory 1 and real time, dual display of memory 2 and real time, dual display of memory 1 and memory 2 can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

TIME Mode

Time, dual display of time and real time, SYNC TIME AVERAGING, dual display of time and memory 1, dual

display of time and memory 2, can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

M1,2 Mode

Displays the following arithmetic functions: Memory 2 divided by memory 1, memory 1 divided by memory 2, memory 2 minus memory 1, memory 1 minus memory 2, and memory 1 plus memory 2 can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

LIST Mode

When the LIST touch control is depressed, the data display on the crt is blanked and a numbered list (MENU) of available display combinations for the selected function appears on the crt. An asterisk appears to the left of the selected function. Any function on the list can now be directly selected by depressing the desired keyboard number in the SENSITIVITY Group. The asterisk will move to the selected function. Depressing the OPER touch control will return the crt display to correspond with the selected function. Use this mode to display stored M1 and M2 information. Do not use the SEL mode to display stored M1 and M2 information.

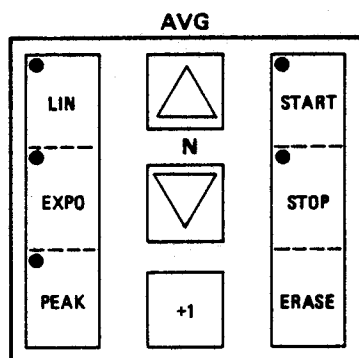
SEL Mode

Performs the same function as the LIST mode with the following exceptions: The MENU is not displayed and random selection is not available. Function selection is accomplished by stepping through each function in sequence.

OPER Mode

Initiates the selected function.

AVG Touch Controls



LIN Mode

Performs a linear average (ideal integrator) until the selected number of ensembles has been reached. The number of averages (from 2 to 1024) can be selected by depressing the N touch controls. The number selected will appear as an alphanumeric on the crt. When linear averaging is in process, the spectrum information is normalized at each binary step of the number of averages performed.

EXPO Mode

Performs a linear average (ideal integrator) until the selected number of ensembles has been reached, then averaging continues exponentially with a selected time constant. When linear averaging is in process, the spectrum information is normalized at each binary step of the number of averages performed. Exponential averaging will continue indefinitely until terminated by depressing the STOP touch control.

PEAK Mode

Retains the highest level in each of the 400 filter locations and for the overall signal until exceeded. Values can be stored by depressing the XFER, M1 M2 touch control. This transfers the values from Memory 1 to Memory 2 for later use. Averaged values can be erased by depressing the ERASE touch control. Information for all 400 filter locations is updated approximately every 130 milliseconds.

START Touch Control

Starts averaging process.

STOP Touch Control

Freezes memory and N count.

ERASE Touch Control

Clears Average Memory (M1).

+1 Touch Control

On any given analysis range, each new ensemble is automatically processed every memory period. However, in the Add One Ensemble (+1) Mode, these ensembles can be processed manually when desired. The mode is initiated by pressing the AVG N, STOP, ERASE, and +1 controls in sequence. Linear, exponential or peak averaging can now be selected by pressing the appropriate LIN, EXPO or PEAK control. In the LIN/AVG mode, each time the +1 control is depressed, a new ensemble will be added, up to the number of averages selected on the AVG N touch controls.

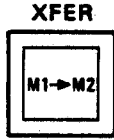
The following information is the proper sequence selecting the +1 mode of operation:

- a. Select the number of averages.
- b. Press STOP.
- c. Press ERASE.
- d. Press +1 (Locks out automatic start).
- e. Press LIN, EXPO or PEAK.
- f. Press +1 for adding one ensemble to averaging process. (Up to selected number of averages in LIN.)

AVG N Touch Controls

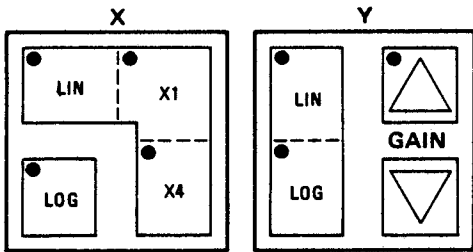
Selects the number of averages (from 2 to 1024). Average number selected is displayed by alphanumerics on the crt.

XFER M1→M2 Touch Control



Transfers information from Memory 1 to Memory 2. When displaying the contents of M2, the following front-panel controls should be selected to reflect the same conditions at the time the M1 to M2 transfer occurred: Frequency range selection, TRANSLATOR controls, SPECTRUM controls, LEVEL controls and AVG controls.

Display Mode Touch Controls



Display Y Touch Controls

LIN Mode

Selects linear Y-axis with an output gain of X1, X2, X5 and X10 for crt display. Output gain can be selected by depressing the GAIN touch controls. Rear-panel outputs follow crt display whereas amplitude readings on crt alphanumerics remain normalized to the input signal.

LOG Mode

In the LOG mode the GAIN touch controls select +30 dB to -30 dB in 10 dB steps as follows:

	Graticule Reading	Usable Range
0 dB gain-display	0 dB to -60 dB	0 dB to -70 dB
10 dB gain-display	-10 dB to -70 dB	-10 dB to -80 dB
20 dB gain-display	-20 dB to -80 dB	-20 dB to -90 dB
30 dB gain-display	-30 dB to -90 dB	-30 dB to -100 dB
10 dB atten-display	+10 dB to -50 dB	+10 dB to -60 dB
20 dB atten-display	+20 dB to -40 dB	+20 dB to -50 dB
30 dB atten-display	+30 dB to -30 dB	+30 dB to -40 dB

Display X Touch Controls

LIN Mode

Provides for selection of either normal or expanded X axis sweep as follows:

X1

Provides normal X axis for crt and rear-panel outputs. All 400 filter locations and overall will be displayed in the frequency domain. Full memory contents will be displayed in the time domain.

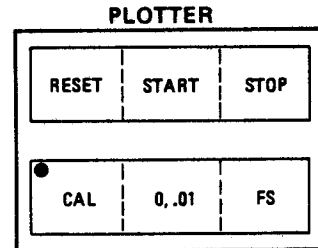
X4

Provides expanded X axis sweep for internal crt display. Approximately 100 filter locations will be displayed. By operating the CURSOR control left or right, any 25% (-12½ to +12½ %) of the X-axis can be selected for full screen viewing.

LOG Mode

Provides a logarithmic display of the X-axis information.

PLOTTER Touch Controls



RESET Mode

Effective when the FUNCTION touch controls are in the SPEC, TIME or M1, 2 modes. Depressing the RESET touch control resets the cursor to the cell 1 position.

START Mode

Starts plotting in the SIMULPLOT mode when this touch control is depressed. Plotter pen will move at one of two rates selected from the rear panel (20 seconds and 40 seconds). Plotter pen will move at a rate of approximately 100ms per filter location and will require approximately 40 seconds to complete one plot when the rear panel selector is in the 40 second position. Plotter pen will move at a rate of approximately 50ms per filter location and will require approximately 20 seconds to complete one plot when the rear panel selector is in the 20 second position.

STOP Mode

Stops plotting mode, activates pen lift command, and allows updating to restart. When using X4 in the PLOTTER mode, the cursor dot will return to the center of the display upon completion of the plot.

CAL / 0, .01 / FS

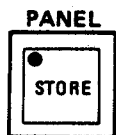
Positions plotter pen on X-Y recorder for calibration and positions an intensified dot on an externally connected X-Y display for calibration.

Y-Axis: Log-full scale and -40 dB selectable.
Lin-full scale and linear zero selectable.
X-Axis: Lin-full scale and linear zero selectable.
Log-full scale and -2 decade selectable.

NOTE

If the display to be plotted is in LIN X format, insure that the DISPLAY X, LIN touch control is selected for plotting or calibrating the plotter. If the display to be plotted is in LOG X format insure that the DISPLAY X, LOG touch control is selected for plotting or calibrating the plotter.

PANEL STORE Touch Control



REMOTE



When this touch control is depressed the entire front-panel setup is stored in the Z-80 memory. The information entered by the PANEL STORE Touch Control can be recalled by depressing the center of the front-panel Spectral Dynamics LOGO. This function provides flexibility for storing any desired setup which can be recalled at any time at the operator's discretion. The setup is stored for approximately 10 days even if power is turned off. An internal battery supply keeps the stored front-panel information until power is restored to the equipment. If the battery supply is allowed to discharge while there is stored information, upon repowering the instrument, the PANEL STORE information will no longer be

present. If the LOGO is depressed under these conditions it will return the equipment to the Initial POWER ON condition as described in Paragraph 3.5.1.

After the desired front-panel setup is selected and entered by depressing the PANEL STORE touch control, the LED located on the touch control will light. If the LOGO is depressed or if the equipment is turned off and then on again, the LED on the PANEL STORE Touch Control will go out.

This does not mean that the PANEL STORE function has lost its information. This is normal operation.

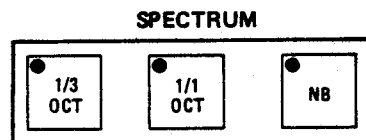
NOTE

When storing information in the dual display mode and displaying both TIME and SPECTRUM, it is advisable to place the cursor on the upper trace before storing the information. Values entered for mV/EU, dB REF and TH% will not be stored.

REMOTE LED Indicator

Indicates equipment is in the remote mode of operation when lighted.

SPECTRUM Touch Controls (Standard Option)



1/3 OCT Touch Control

Selects 1/3 octave contiguous-band spectrum analysis.

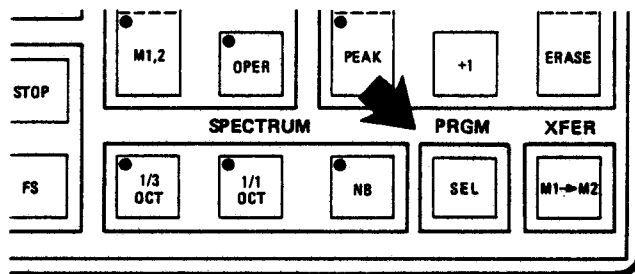
1/1 OCT Touch Control

Selects 1/1 octave contiguous-band spectrum analysis.

NB Touch Control (Standard feature)

Depressing the NB touch control restores the equipment to the standard (narrowband) mode of operation. Without the octave option the instrument must always be in the NB mode.

PRGM SEL Touch Control



The PRGM SEL touch control is used to select special programs. The special programs consist of a menu display with menu subprogram selection. Menu display of the available programs can be displayed by depressing the PRGM SEL touch control and the FUNCTION group LIST touch control. When this is accomplished, the resulting display will be:

PROGRAMS

21. I, II, D, DD

22. DIGITAL PLOTTER

23. ID BLOCK

24. SELF TEST

Each special program has its own menu and can be selected as follows:

PROGRAM 21 — INTEGRATION

Selection of PROGRAM 21 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 21 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST

touch control. The following menu will be displayed:

INTEGRATION MENU

*1. NORMAL

2. I UNITS

3. II UNITS

4. I CM/SEC

5. II CM

6. I IN/SEC

7. II IN

8. D

9. DD

Selection of these functions can be accomplished as follows: On the SENSITIVITY group keyboard, select the number that corresponds to the desired function. The asterisk will move to the number of the function selected. Depress the FUNCTION group OPER touch control. The desired function will be displayed.

PROGRAM 22 — DIGITAL PLOTTER

Selection of the DIGITAL PLOTTER MENU subprogram is dependent upon the presence of the '-3' Option in the instrument. (Refer to paragraph 1.5.3, Digital I/O

System (-3 Option) located in Section 1.) If the '-3' Option is not installed, the crt will display "OPTION AVAILABLE" when this subprogram is selected. If the '-3' Option is installed, selection of PROGRAM 22 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 22 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

PLOTTER MENU

- *1. ANALOG PLOTTER
- 2. DIGITAL PLOT
- 3. GRIDS
- 4. ANNOTATION
- 5. DATA TRACE

Selection of these functions can be accomplished as follows: On the SENSITIVITY group keyboard, select the number that corresponds to the desired function. The asterisk will move to the number of the function selected. Depress the FUNCTION group OPER touch control. The instrument is now ready to initiate the desired plot as follows:

ANALOG PLOTTER (PLOTTER MENU Selection 1.)

When this mode is selected the PLOTTER group touch controls have control over the plotting function as described in paragraph 3.2.3 Analysis Group, subparagraph PLOTTER Touch Controls.

DIGITAL PLOT (PLOTTER MENU Selection 2.)

Selecting this mode will result in a complete digital plot of the grid, alphanumerics and data input. This is accomplished by selecting PLOTTER MENU Selection 2 and then depressing the PLOTTER group START touch control. When the plot is completed, the operator may, if it is desired, plot multiple overlays of the input data without repeating the grid and alphanumerics by depressing the PLOTTER group START touch control. This can be repeated as many times as desired as long as the DIGITAL PLOT is completed and no other selection is made.

GRIDS (PLOTTER MENU Selection 3.)

Selecting this mode will result in the display grid only being plotted. To plot the grid, depress the PLOTTER

group START touch control. After the grid is plotted, the asterisk on the PLOTTER MENU will automatically move to selection 4, ANNOTATION.

ANNOTATION (PLOTTER MENU Selection 4.)

When this mode is selected or after the grid is plotted, depressing the PLOTTER group START touch control will cause the instrument to plot all of the displayed alphanumerics. After the alphanumerics are plotted, the asterisk on the PLOTTER MENU will automatically move to selection 5, DATA TRACE.

DATA TRACE (PLOTTER MENU Selection 5.)

When this mode is selected or after the annotation is plotted, depressing the PLOTTER group START touch control will cause the instrument to plot the displayed data input information. When the plot is completed, the asterisk will remain at selection 5. Depressing the PLOTTER group START touch control again will plot another trace of data input information. This allows the operator to plot one grid, one set of alphanumerics, multiple overlay plots or any combination of PLOTTER MENU selections 3, 4 and 5 by stepping around the undesired selections.

Use of the PLOTTER Group RESET Touch Control

The PLOTTER group RESET touch control recalls the last function selected by the operator from the PLOTTER MENU. For example: If PLOTTER MENU Selection 3 is made by the operator and the operator decides to plot selections 3, 4 and 5 separately by allowing the instrument to step to each selection automatically as previously described; upon reaching selection 5, if RESET is depressed, the instrument will return to selection 3, the last selection made by the operator.

PROGRAM 23 — ID BLOCK

Selection of PROGRAM 23 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 23 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

ID BLOCK MENU

- *1. OFF
- 2. ON

Selection of this function can be accomplished as follows:

On the SENSITIVITY group keyboard, select the number 2. The asterisk on the menu will move to number 2. Depress the FUNCTION group OPER touch control. The letters "ID" will appear on the upper left of the crt. The SENSITIVITY group keyboard will now be enabled such that any number entered will move into the LSB of the ID number. A complete ID number will be "ID XXXX". As long as the ID BLOCK is ON and the SENSITIVITY group keyboard is not being used for sensitivity or list, the keyboard will always be enabled for the ID BLOCK.

PROGRAM 24 — SELF TEST

Selection of PROGRAM 24 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 24 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

SELF TEST MENU

- *1. OFF
- 2. ON

Selection of this function can be accomplished as follows: On the SENSITIVITY group keyboard, select the number 2. The asterisk on the menu will move to number 2. Depress the FUNCTION group OPER touch control. The self test will start and the SELF TEST MENU will automatically reset to 1 (OFF).

Listed below are descriptions of the self test functions. There are eight self tests. All tests use the front-panel test signal as a source of predictable outcome.

Test No. 1 — Real time spectrum. The front-panel test signal is checked every 40 cells using the DELTA P mode. The acceptable limits are listed in the following table:

Cell No.	40	80	120	160	200
Min.	—	—	—	—	—
Max.	-50 dB	-49 dB	-48 dB	-47 dB	-47 dB
Cell No.	240	280	320	360	400
Min.	—	-10.5 dB	—	—	—
Max.	-47 dB	-9.5 dB	-9.5 dB	-9.5 dB	-9.5 dB

Test No. 2 — M1 average. 16 averages of the front panel test signal are taken. M1 is then checked as in test no. 1.

Test No. 3 — M1 transfer to M2. The resulting M1 data of test no. 2 is transferred to M2. M2 is then checked as in test no. 1.

Test No. 4 — Plus 1 averaging. Number of averages is set to 2. +1 is pushed twice and M1 is then checked as in test no. 1.

Test No. 5 — M1 erase. DELTA P mode is used and the cursor value is checked at cell 400 for exactly -70.0 dB.

Test No. 6 — Volts, EU, PSD. The cursor is checked at cell 256 for various Y axis units as listed in the table below. 10 mV/EU sensitivity is used.

UNITS	V	EU	PSD
MIN.	.299	29.9	23.84
MAX.	.335	33.5	29.93

Test No. 7 — Translator. The translator is turned on and the ZOOM SET is set at cell 256. The cursor is checked at the center of the screen for -10.5 dB to -9.5 dB. This test is skipped if the translator option is not installed.

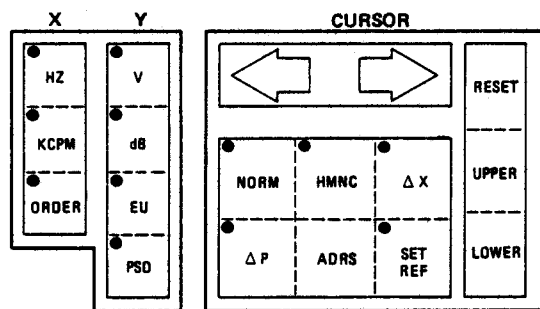
Test No. 8 — 1/3, 1/1 Octave. 1/3 octave is turned on and the cursor is checked at band number 28 for -10.5 dB to -9.5 dB. 1/1 octave is then turned on and the cursor is checked at band number 10 for -10.5 dB to -9.5 dB. This test is skipped if the 1/3, 1/1 octave option is not installed.

Upon completion of the self test, a list of results will appear on the crt and these results will get a pass or fail indicated by a P or F after the test number. If all the tests pass, the instrument will automatically return to the normal mode of operation. If any of the tests fail, the list on the crt will remain until any one of the front-panel controls are depressed.

NOTE

The FUNCTION group SEL touch control is also operable in the PRGM SEL mode. If it is desired to use the FUNCTION group SEL touch control while in the PRGM SEL mode, the LIST mode must be selected first.

3.2.6 CURSOR Group



X Y Touch Controls

The X Y touch controls select the units for the alphanumeric values to be displayed on the crt as follows:

HZ Touch Control

Alphanumeric readout displays frequency in Hz of the actual cursor location.

KCPM Touch Control

Alphanumeric readout displays frequency in KCPM of the actual cursor location.

ORDER Touch Control

When the HMNC cursor mode has been selected and the intensified dots are frozen, (SET REF) the alphanumeric readout displays the location of the cursor in terms of its harmonic relationship to the fundamental component.

V Touch Control

Alphanumeric readout displays amplitude at the cursor location in volts rms, Volts P-P or Volts O-P depending on the mode selected by the Input Group, LEVEL touch controls.

dB Touch Control

Alphanumeric readout displays amplitude in dB of the cursor location. The dB readings will have prescribed reference levels as follows:

- a. With the CURSOR Group touch controls in the NORM or HMNC positions and SENSITIVITY Group touch control in the mV/EU or TH% position, the full scale level selected by the Input Group VOLTS selector, will represent 0 dB.

- b. With the SENSITIVITY Group touch control in the dB REF position, readings will be referenced to the set dB REF and will track with changes in the position of the Input Group VOLTS selector.

EU Touch Control

Alphanumeric readout displays amplitude in engineering units at the cursor location. The Display Group Y touch controls can be in either LIN or LOG position. The readings correspond to transducer sensitivities entered via the SENSITIVITY Group keyboard. The crt display is attenuated to provide a convenient full scale display of 0.1 through 20,000 in 1,2,5 sequence. In certain conditions full scale of 2.5 and 4 sequence also exists. The selected full scale can be read by placing the PLOTTER Group touch controls in the CAL-F.S. position.

PSD Touch Control

Selects Power Spectral Density mode of operation represented by $(\frac{EU^2}{Hz})$ Data amplitude display and readout

is automatically normalized to 1 Hz effective noise bandwidth.

CURSOR Left/Right Control

Touch Controls with arrows pointing to the left and right control the horizontal movement of the cursor on the crt display. Depressing either touch control once changes the position of the cursor by one step (left or right). Holding the control in either position provides continuous movement of the cursor across the crt display (left or right) at approximately 0.5 seconds after it receives the command.

NORM Touch Control

In this mode, the cursor consists of an intensified dot which can be moved to any of the 400 cell locations and the overall signal (cells 401 through 409) on the crt display. When the intensified dot is moved, it is accompanied by a vertical line. The alphanumeric readout will display the data at the cursor location as selected by the CURSOR Group X-Y touch controls.

HMNC Touch Control

In this mode, an intensified dot is automatically placed on the crt display at all multiples of the cursor location. The harmonic cursor has two distinct modes of operation depending upon the set command from the SET REF touch control as follows:

Mode 1 — Align Higher Order Harmonics

This mode is selected when the CURSOR Group selection is switched from NORM to HMNC. The cursor has a finer resolution of 256 parts for the fundamental position to permit more precise alignment of the intensified dots of the higher order harmonics of the fundamental. This alignment can be achieved by moving the cursor control as required.

Mode 2 — Freeze ORDERS Aligned in Mode 1

This mode is selected by depressing the SET REF touch control after completing the alignment of Mode 1. When the SET REF touch control is depressed, the positions of the intensified dots are frozen and a line cursor appears at the fundamental. The line cursor (intensified dot plus vertical line) can now be moved to any of the 400 cell locations of the crt display. The alphanumeric readout will display data at the line cursor location as selected by the X Y units selectors. The SET REF touch control provides alternate selection between Mode 1 and Mode 2.

ΔX Touch Control

The ΔX mode of operation can be selected in either the NORM or the HMNC mode as follows:

NORM Mode

When ΔX is selected, a line and dot appear on the display and the ΔX LED will be on. If no other mode is selected, the equipment will still be in the NORM mode with a permanent line cursor. When the SET REF touch control is depressed in the ΔX mode, the line cursor will become frozen at its present position and another line cursor accompanied by the intensified dot will appear when the cursor is moved to the right or left. The Hz and KCPM readout will be referenced to the frozen line cursor and will appear as positive values on either side of the frozen line. In this mode the X-axis cursor value will be designated DX representing the difference between the two cursor lines.

HMNC Mode

The ΔX mode can be selected while the instrument is in the HMNC mode as follows: First select HMNC Mode 2. Move the cursor to any point on the display. Depress ΔX . The SET REF LED will go out. Depress SET REF. The SET REF LED will come back on. ΔX will now function as it does in the NORM mode. To go back to HMNC Mode 2, depress SET REF, then depress HMNC. The instrument will return to the original HMNC, SET

REF setting. Note that while in the ΔX mode that HZ, KCPM and ORDERS will read zero at the frozen cursor position.

ΔP Touch Control

Provides a summation of the rms value of the power level of all the displayed information to the left of the cursor, regardless of its position on the display. Changing the position of the cursor will vary the power level. The ΔP mode also operates in conjunction with the ΔX mode. The Y-axis cursor value in this mode will be designated DP representing the RMS value of spectrum information displayed on the crt.

ADRS Touch Control

The ADRS touch control operates in conjunction with the SENSITIVITY Group touch controls. (Refer to paragraphs 3.2.2, SENSITIVITY Group and 3.5.4 SENSITIVITY Selection.) When the ADRS touch control is depressed, the crt display will appear as shown in paragraph 3.5.4, figure 3-7 and will read ADRS 0000. The operator may then place the cursor at any cell location on the display as follows: depress the ADRS touch control. Utilizing the SENSITIVITY Group keyboard, select any cell location between 1 through 409. (Overall is located in cells 401 through 409.) Depress the ENTER touch control. The cursor will appear at the selected cell location.

SET REF Touch Control

This touch control has a dual function depending upon the position of the CURSOR Group touch controls as follows:

HMNC Mode

If the CURSOR Group HMNC touch control is depressed, depressing the SET REF touch control freezes the intensified dots at the harmonics of the fundamental; depressing the SET REF touch control again clears the freeze condition.

ΔX Mode

If the CURSOR Group ΔX touch control is depressed, a permanent line cursor will appear at the present cursor location. When the SET REF touch control is depressed in the ΔX mode, the line cursor will become frozen at its present position and another line cursor accompanied by the intensified dot will appear when the cursor is