INSTRUCTION MANUAL

MODEL 1121A
PROGRAMMABLE
AUDIO ANALYZER

REV DATE 05/16
MANUAL P/N 98407600A

Wireless Telecom Group
25 EASTMANS ROAD, PARSIPPANY, NJ 07054
Telephone: **973-386-9696**
Fax: 973-386-9191
Email: boonton@boonton.com
Web: www.wtcom.com

This page intentionally blank.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation and maintenance of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Boonton Electronics assumes no liability for the customerôs failure to comply with these requirem

THE INSTRUMENT MUST BE GROUNDED

To minimize shock hazard the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor, three prong power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to a two-contact adapter with the (green) grounding wire firmly connected to an electrical ground at the power outlet.

DO NOT OPERATE THE INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions dangerous voltages may exist even though the power cable was removed; therefore, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to Boonton Electronics for repair to ensure that the safety features are maintained.

SAFETY SYMBOLS

This safety requirement symbol (located on the rear panel) has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, paragraph 5.3, which directs that the instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source. Verify that the correct fuse is installed for the power available, and that the switch on the rear panel is set to the applicable operating voltage.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond the CAUTION sign until the indicated conditions are fully understood and met.

WARNING

The WARNING sign denoted a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

Indicates dangerous voltages.

Table of Contents

Paragraph **Page**

SECTION I - GENERAL INFORMATION

SECTION II - INSTALLATION

SECTION III - OPERATION

Paragraph **Page**

Paragraph **Page**

SECTION IV - THEORY OF OPERATION

SECTION V - MAINTENANCE

Paragraph **Page**

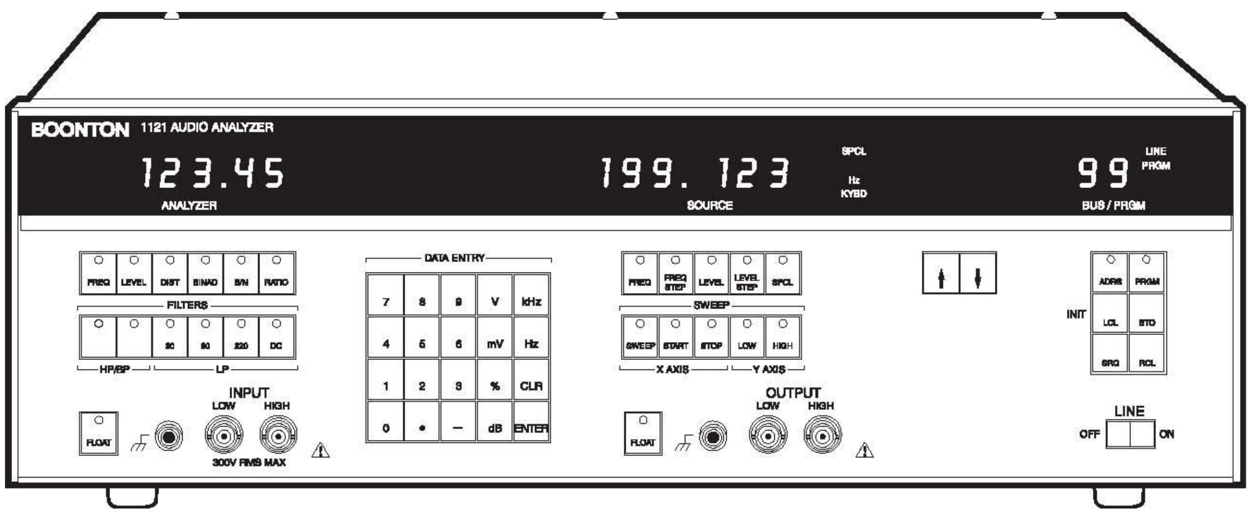
SECTION VI - PARTS LIST

SECTION VII - SCHEMATIC DIAGRAMS

LIST OF TABLES

List of Figures

Figure	Page



MODEL 1121A AUDIO ANALYZER

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This instruction manual provides installation, operating and maintenance instructions, theory of operation, schematics and parts lists for the Model 1121A Audio Analyzer.

1-3. DESCRIPTION.

1-4. The Model 1121A is a versatile, precision, solid-state instrument with features and performance characteristics especially suited to laboratory and industrial applications. Human engineering considerations have been emphasized in both the mechanical and electrical design of the Model 1121A. The result is an audio analyzer that is easy and convenient to use. Among the outstanding features are:

a. **Versatile Audio Analyzer.** Advanced generation and measurement techniques enable the Model 1121A to provide fast, accurate measurements. Measurement modes include frequency, AC or DC level, distortion, SINAD, signal-to-noise and full ratiometric capability. The precision audio source provides accurate, low distortion signals over wide frequency and level ranges. Demanding applications are satisfied by the high output power capability and selectable output impedance.

b. **Ultra-low Distortion.** The mark of quality for any audio analyzer is low residual distortion and noise. The total harmonic distortion of the Model 1121A is specified as less than 0.01% with typical performance an order of magnitude better than specified.

c. **Versatile Source Output.** The Model 1121A fea tures wide control over its output configurations. Source impedance can be set to 50, 150, or 600 ohms in either a floating or single-ended configuration. All source impedances are available at the same set of output connectors, eliminating the need to multiplex separate 50 ohm and high impedance outputs.

d. **Balanced Input.** The Model 1121A has a fully differential/balanced input for testing bridged amplifiers and power supplies.

e. **Separate Displays of All Functions.** The Model 1121A has 3 separate display windows to simultaneously present analyzer measurements, source settings and program number or bus address information. Continuous display of IEEE-488 bus status is also presented.

f. **Full Range of Filter Selections.** The Model 1121A provides a wide range of filter selections and weighting characteristics for industry-standard audio measurements.

g. **Sweep Operation.** Frequency or level can be swept in user-selected linear or logarithmic steps over any portion of the range. The selected analyzer measurement provides the Y axis information. Rear panel X axis, Y axis and PEN outputs are provided for plotter application.

h. **Instrument Setup Memory.** Up to 99 front panel setups containing all data required to configure the instrument to a previous operating mode can be stored in non-volatile memory for future recall. The last valid instrument setup before power interruption is also saved automatically and restored when power is resumed.

i. **IEEE-488 Interface Bus.** All instrument functions are programmable except line on/off. Annunciators to the left of the BUS/PRGM display window show the status of bus activity. The 1121A is designed to interface easily with controllers currently in use. A versatile free-form number entry system is used so that the 1121A will accept any conceivable valid number string. Triggering may be performed in immediate or wait modes. There are six talk modes which can be addressed in either the remote or local state. The 1121A also provides a choice of several end-of-string terminators. Service-request (SRQ) can be asserted on errors or using the front panel SRQ key and the LCL/INIT key will force return to local control when using the bus as long as a lockout message has not been sent.

1-5. ACCESSORIES.

1-6. The available accessories are listed in Table 1-1. The AC power cord, spare input, output and line fuses are supplied with the instrument.

1-7. OPTIONS.

1-8. The available options are listed in Table 1-1.

1-9. SPECIFICATIONS.

1-10. Performance specifications for the Model 1121A Audio Analyzer are listed in Table 1-1.

TABLE 1-1 PERFORMANCE SPECIFICATIONS.

SYSTEM SPECIFICATIONS

Signal-to-Noise
Fundamental Frequency Range:
10 Hz to 100 kHz usable to 140 kHz
Display Range: 0.00 to 140.00 dB
Accuracy: ±1 dB
Input Voltage Range: 250 mV to 300 V
Residual Noise (the greater of):
85 dB or 10 µV; 80 kHz BW
85 dB or 20 µV; 220 kHz BW
85 dB or 40 µV; 500 kHz BW

Distortion
Residual Distortion and Noise (the greater of):
-80 dB or 10 µV; 10 Hz to 20 kHz, 80 kHz BW
-74 dB or 20 µV; 10 Hz to 50 kHz, 220 kHz BW

-70 dB or 40 µV; 10 Hz to 50 kHz, 500 kHz BW
-65 dB or 40 µV; 50 to 100 kHz, 500 kHz BW

SOURCE SPECIFICATIONS

Frequency
Range: 10 Hz to 140 kHz
Resolution:
0.001 Hz; 10.000 to 199.999 Hz
0.01 Hz; 200.00 to 1999.99 Hz
0.1 Hz; 2.0000 to 19.9999 kHz
1.0 Hz; 20.000 to 140.000 kHz
Accuracy: 10 ppm + timebase accuracy + 1 count

Level
Range: 0.01 mV to 16.000 V rms, open circuit
Full Scale Ranges:
16.000 V, 3.000 V, 300.0 mV, 30.00 mV
Resolution:
0.01 mV; 0.00 to 30.00 mV
0.1 mV; 30.0 to 300.0 mV
1 mV; 300 to 3000 mV
5 mV; 3.000 to 16.000 V
Accuracy (settings from 0.60 mV to 16.000 V):
± 0.5% of setting + 0.05% of range;
10 Hz to 50 kHz
± 1.0% of setting + 0.05% of range;
50 kHz to 100 kHz
± 1.5% of setting + 0.1% of range;
100 kHz to 140 kHz

Flatness, ref 1 kHz (0.30 mV to 8 V into 50 ohms):
± 0.5%; 10 Hz to 50 kHz
± 1.0%; 10 Hz to 100 kHz
± 1.5%; 10 Hz to 140 kHz

Output
Impedance:
50 ohms ± 2%
150 ohms ± 1%
600 ohms ± 1%
Distortion and Noise (the greater of):
0.01% (-80 dB) or 10 µV;
10 Hz to 20 kHz, 80 kHz bandwidth
0.02% (-74 dB) or 20 µV;
10 Hz to 50 kHz, 220 kHz bandwidth
0.032% (-70 dB) or 35 µV;
10 Hz to 50 kHz, 500 kHz bandwidth
0.056% (-65 dB) or 35 µV;
50 to 100 kHz, 500 kHz bandwidth
0.1% (-60 dB) or 35 µV;
100 to 140 kHz, 500 kHz bandwidth
Output Power (50 ohm source):
31.07 dBm (8.00 V) into 50 ohm load
29.82 dBm (12.00 V) into 150 ohm load
25.60 dBm (14.76 V) into 600 ohm load
1.0 Hz; 20.000 to 199.999 kHz

ANALYZER SPECIFICATIONS

Frequency Measurement
Range: 5 Hz to 200 kHz
Sensitivity:
5 mV in the Frequency mode
50 mV in the Distortion and SINAD modes
Accuracy: Timebase accuracy + 1 count

Resolution: (for input levels below 100 mV the resolution is reduced by a factor of 10)
0.001 Hz; 5.000 to 199.999 Hz
0.01 Hz; 200.00 to 1999.99 Hz
0.1 Hz; 2.0000 to 19.9999 kHz

TABLE 1-1 PERFORMANCE SPECIFICATIONS

Timebase
Type: 10 MHz TCXO **Accuracy:** ±1 ppm/yr

AC Level Measurement
Range: (full scale) 300.0 V, 30.00 V, 3.000 V, 300.0 mV, 30.00 mV, 3.000 mV, 0.3000 Mv
Overrange: 33% except on 300 V range
Accuracy:
± 1%; 50 Hz to 50 kHz, 1 mV to 300 V
± 2%, 20 Hz to 100 kHz, 1 mV to 300 V
±3% 10 Hz to 100 kHz, 1 mV to 300 V
± 4%; 10 Hz to 100 kHz, 0.3 mV to 300 V
Flatness: (1 mV to 300 V)
± 0.5%; 50 Hz to 50 kHz ±
1.0%; 20 Hz to 100 kHz ±
2.0%; 10 Hz to 100 kHz

DC Level Measurement
Range (full scale) 300.0V, 30.00 V, 3.000 V
Overrange: 33% except on 300 V range
Accuracy: ± 1% or 6 mV whichever is greater

Common Mode Rejection Ratio
CMRR:
> 70 dB; 20 Hz to 1 kHz
> 45 dB; 1 kHz to 20 kHz

Limits:
4.25 V pk; 3.000 V range
42.5 V pk; 30.00 V range
425 V pk; 300.0 V range

Analyzer Input
Type: Balanced (full differential)
Impedance:
100 k ohms ± 1 %, < 300 pF, each side to ground
Protection: Excessive common mode levels are hardware limited on all input ranges and fuse protection is employed against peak levels exceeding 425 volts

Distortion Measurement
Fundamental Frequency Range:
10 Hz to 100 kHz usable to 140 kHz

Resolution:
0.00001%; <0.11000%
0.0001%; <1.1000%
0.001%; <11.000%
0.01%; <100.00%

Display Range:
0.00001 to 100.00% (-140.00 to 0.00 dB)

Accuracy:
± 1 dB; 20 Hz to 20 kHz
± 2 dB; 10 Hz to 100 kHz
Input Voltage Range: 50 mV to 300 V
Distortion Measurement Range:
10 Hz to 20 kHz, 80 kHz bandwidth
0.056% (-65 dB); 100 mV to 200 mV Input Voltage Range
0.032% (-70 dB); 200 mV to 350 mV Input Voltage Range
0.010% (-80 dB); 350 mV to 300 V Input Voltage Range

10 Hz to 50 kHz, 220 kHz bandwidth
0.056% (-65 dB); 100 mV to 200 mV Input Voltage Range
0.020% (-74 dB); 200 mV to 300 V Input Voltage Range

10 Hz to 50 kHz, 500 kHz bandwidth
0.056% (-65 dB); 100 mV to 200 mV Input Voltage Range
0.032% (-70 dB); 200 mV to 300 V Input Voltage Range

50 kHz to 100 kHz, 500 kHz bandwidth
0.056% (-65 dB); 100 mV to 300 V Input Voltage Range

10 Hz to 100 kHz, all bandwidths
0.10% (-60 dB) (typical); 50 mV to 100 mV Input Voltage Range

SINAD Measurement
Fundamental Frequency Range:
10 Hz to 100 kHz usable to 140 kHz
(tuned to source frequency setting)
Display Range: 0.00 to 140.00 dB
Accuracy:
± 1 dB; 20 Hz to 20 kHz
± 2 dB; 10 Hz to 100 kHz
Input Voltage Range: 50 mV to 300 V
SINAD Measurement Range:
10 Hz to 20 kHz, 80 kHz bandwidth
65 dB; 100 mV to 200 mV Input Voltage Range
70 dB; 200 mV to 350 mV Input Voltage Range
80 dB; 350 mV to 300 V Input Voltage Range

10 Hz to 50 kHz, 220 kHz bandwidth
65 dB; 100 mV to 200 mV Input Voltage Range
74 dB; 200 mV to 300 V Input Voltage Range

10 Hz to 50 kHz, 500 kHz bandwidth
65 dB; 100 mV to 200 mV Input Voltage Range
70 dB; 200 mV to 300 V Input Voltage Range

50 kHz to 100 kHz, 500 kHz bandwidth
65 dB; 100 mV to 300 V Input Voltage Range

TABLE 1-1 PERFORMANCE SPECIFICATIONS

10 Hz to 100 kHz, all bandwidths
60 dB (typical); 50 mV to 100 mV Input Voltage Range

Standard Audio Filters

30 kHz Low-pass Filter
Accuracy: 30 kHz ± 2 kHz
Rolloff: Third-order Butterworth, 60 dB/decade

80 kHz Low-pass Filter
Accuracy: 80 kHz ± 4 kHz
Rolloff: Third-order Butterworth, 60 dB/decade

220 kHz Low-Pass Filter
Accuracy: 220 kHz ± 20 kHz
Rolloff: Third-order Butterworth, 60 dB/decade

TABLE 1-1 PERFORMANCE SPECIFICATIONS

Optional Audio Filters

400 Hz High-pass Filter Accuracy:
Accuracy: 400 Hz ± 40 Hz
Rolloff: Seventh-order Butterworth, 140 dB/decade

Audio Band-pass Filter
Accuracy:
22.4 Hz ± 5%, 60 dB/decade rolloff
22.4 kHz ± 5%, 60 dB/octave rolloff

A, B, C Weighting Filter
Accuracy:
± 0.2 dB; 1.0 kHz
± 1.0 dB; 40 Hz to 5.0 kHz
± 1.5 dB; 25 to 40 Hz, 5.0 to 10.0 kHz
± 2.0 dB; 20 to 25 Hz, 10.0 to 20.0 kHz

SUPPLEMENTAL INFORMATION

AC Measurement

Bandwidth: 5 Hz to 500 kHz
RMS Detector:
True rms responding for signals with a crest factor of <3
Average Detector:
Average responding rms calibrated
Quasi-peak Detector:
Meets CCIR recommendation 458-3
Accuracy: ± 6%; 20 Hz to 20 kHz

Analyzer Measurement Speed

Function	First Reading	Rate:
Frequency	< 1 sec	4 rdngs/sec
Level	< 1 sec	10 rdngs/sec
Distortion	< 1 sec	8 rdngs/sec
SINAD	< 1 sec	8 rdngs/sec
S/N	< 2 sec	1 rdngs/sec

Frequency Measurement
Technique:
Reciprocal measurement with 10 MHz timebase

Physical and Environmental Specifications

General:
Manufactured to the intent of MIL-T-28800E, Type III, Class 5, Style E
Power Requirements:
100, 120, 220, 240 volts AC, ± 10%, 50 to 400 Hz, 80 VA

CCITT or C-MESSAGE Band-pass Filter
± 0.2 dB; 800 Hz CCITT,
± 0.2 dB; 1000 Hz C-MESSAGE
± 1.0 dB; 300 to 3000 Hz
± 2.0 dB; 50 to 300 Hz, 3.0 to 3.5 kHz
± 3.0 dB; 3.5 to 5 kHz

CCIR or CCIR/ARM Band-pass Filter
Accuracy:
± 0.2 dB; 6.3 to 7.1 kHz
± 0.4 dB; 7.1 to 10 kHz
± 0.5 dB; 200 to 6300 Hz
± 1.0 dB; 31.5 to 200 Hz, 10 to 20 kHz
+ 2.0 dB - ; 20 to 31.5 kHz

Operating Temperature: 0 to 55 degrees centigrade
Operating Humidity: <95 ± 5% non-condensing
Warm-up Time: 30 minutes
Dimensions:
17.34 inches (44.04 cm) wide, 5.88 inches (14.9 cm) high, 18 inches (45.8 cm) deep
Weight: 25 lbs (11.3 kg)
Accessories Included:
Spare input, output and line fuses and AC power cord
Accessories Available:
950044 Rack mounting hardware
950043 Chassis slide kit
954018 Single binding post to BNC (M)
954019 BNC (F) to phono plug
954020 Phono jack to BNC (M)
954021 Two conductor shielde
954022 XLR Audio connector to three banana plugs

TABLE 1-1 PERFORMANCE SPECIFICATIONS

Options:

-01 Rear panel input and output
-11 400 Hz high-pass filter
-12 CCITT band-pass filter
-13 CCIR band-pass filter
-15 A weighting filter
-16 B weighting filter
-17 C weighting filter
-18 Audio band-pass filter
-19 C-Message band-pass filter

Remote Interface:
IEEE-488-1978. Implements AH1, SH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1

Ventilation Requirements:

1-1/2 inch clearance after installation, top, side, rear

Temperature:
Non-Operating: -40 to 75 degrees C

AltitudeOperating: 10,000 Ft EEC,

Humidity: and 95% (non-condensing)

Battery Type: Refer to page 6-12

CE MARK: Declares Conformity to European Community (EC) Council Directives 89/336/EED//93/68/EEC, 73/23/EEC//93/68EEC & Standards EN55011, EN50082-1

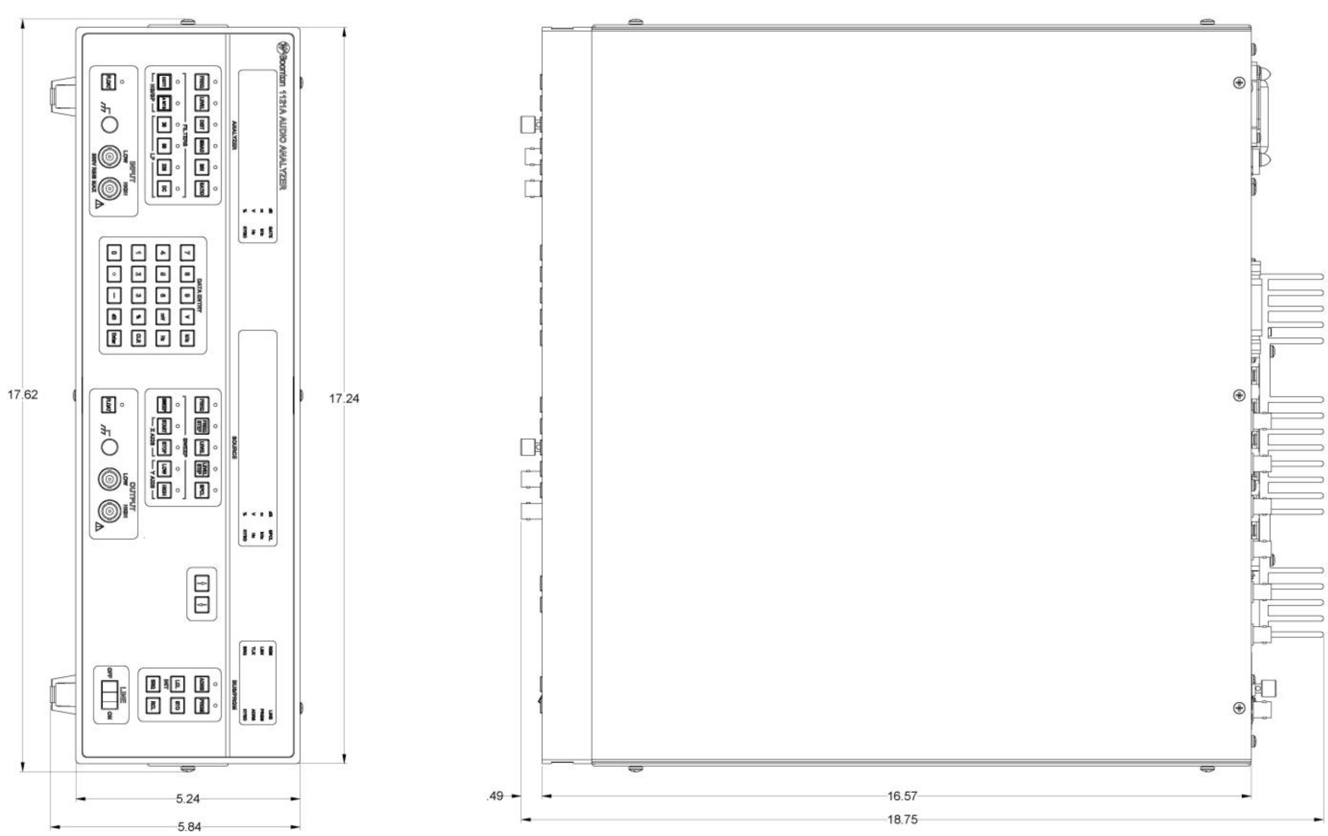


Figure 1-1. Outline Dimensions.

This page intentionally blank.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains the unpacking, mounting, power requirements, cable connections, and preliminary check-out instructions for the Model 1121A Audio Analyzer.

2-3. UNPACKING.

2-4. The instrument is shipped complete and is ready to use upon receipt. Unpack the instrument from its shipping container and inspect for damage that may have occurred during shipment. Refer to Figure 2-1.

NOTE

Save the packing material and container for possible use in reshipment of the instrument.

2-5. MOUNTING.

2-6. For bench mounting choose a clean, sturdy, uncluttered mounting surface. For rack mounting, an accessory kit is available which provides mounting ears. The rack mounting kit contains the required hardware and instructions.

2-7. POWER REQUIREMENTS.

2-8. The instrument has a tapped power transformer and two line voltage selection switches which permit operation from 100, 120, 220, or 240 volt ± 10%, 50 to 400 Hz, single phase AC power sources.

CAUTION

Always make certain that the line voltage selection switches are set to the correct positions corresponding to the voltage of the AC power source, and that a fuse of the correct rating is installed before connecting the

VAC ± 10%	**100 120**	**220 240**	**50 to 400 Hz**
Fuse	3/4 A T	3/8 A T	80 VA

instrument to any AC power source.

2-9. Set the rear panel line voltage selector switches to the appropriate positions as indicated in the Line Voltage Select Chart and check that the line fuse is correct for the selected power source.

2-10. CABLE CONNECTIONS.

2-11. Front panel connector:

INPUT. Analyzer Input HIGH and LOW BNC type connectors and chassis ground allow connection of external audio signals for analysis. The input impedance is 100 k ohms either side to ground. The LOW terminal is connected to chassis ground in the non-floating mode.

OUTPUT. Source output HIGH and LOW BNC type connectors and chassis ground allow connection to external devices and components. The output impedance is selected using special functions 75, 76, and 77. The LOW terminal is connected to chassis grounding the non-floating mode.

2-12. Rear panel connectors:

MONITOR. The MONITOR BNC type output connector provides a scaled output of the input signal in the level, frequency and signal-to-noise measurement modes and a scaled output of the input signal with the fundamental removed in the distortion and SINAD measurement modes. The output impedance is 600 ohms.

X CLK. The X CLK BNC type input connector provides a means of connecting to an external 10 MHz counter reference. The external reference is automatically selected when a TTL level signal is present.

SYNC. The SYNC BNC type output connector provides a TTL compatible signal relative to the source frequency setting.

X AXIS. The X AXIS BNC type output connector provides a 0 to 5 volt d.c. level relative to the sweep frequency or level in the sweep mode. The output impedance is 1000 ohms.

Y AXIS. The Y AXIS BNC type output connector provides a 0 to 5 volt d.c. level relative to the analyzer measurement and entered HIGH and LOW plot limits. The output impedance is 1000 ohms.

PEN. The PEN BNC type output connector provides a TTL compatible signal to control the pen of an external recorder.

2-13. PRELIMINARY CHECK.

2-14. The preliminary check verifies that the Model 1121A is operational and should be performed before the instrument is placed into use. To perform the preliminary check, set the front panel LINE switch to ON. Wait several seconds then depress the LCL/INIT key. The SOURCE display will contain the instrument firmware number and the other displays will contain dashes for a period of about two seconds. The SOURCE display will then contain 1000.00 Hz with the KYBD legend illuminated. The ANALYZER display will contain the message for one level measurement cycle. The initialize sequence resets all functions and operating modes of the Model 1121A to the initialized values and conditions listed in Table 2-1.

TABLE 2-1. INITIAL CONDITIONS.

Analyzer Group:	Source Group:	Sweep Group:	Bus/Prgm Group:
LEVEL function enabled	KYBD legend illuminated	SWEEP disabled	ADRS is unchanged
Linear display units	FREQ function enabled	START set to 20.000 Hz	PRGM is set to 99
RATIO mode disabled	FREQ set to 1000.00 Hz	STOP set to 20.000 kHz	SRQ is cleared
Filters disabled	FREQ STEP set to 0.000 Hz	LOW set to 0.000 mV	Bus status is unchanged
FLOAT mode disabled	LEVEL set to 0.0 mV	HIGH set to 300.0 V	
RMS detector enabled	LEVEL STEP set to 0.0 mV		
	SPCL functions 0, 10, 40, 55, 63, 70, 77, and 80 are selected		
	FOAT mode disabled		

2-15. Program location 99 is a recall-only location which contains the initialize values. The operating conditions at the time the instrument power is interrupted are maintained in non-volatile memory and restored when power to the Model 1121A is resumed.

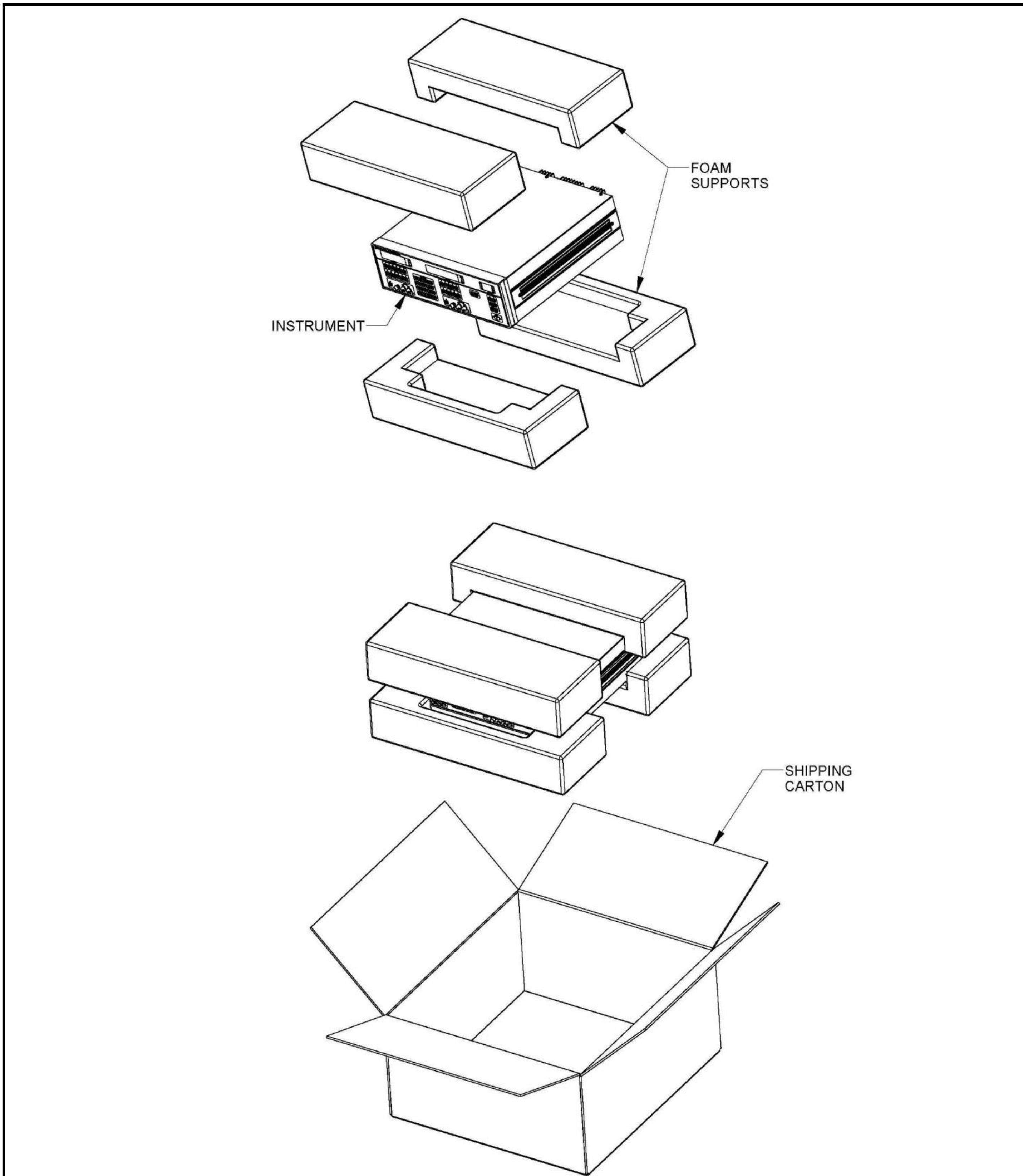


Figure 2-1. Packing and Unpacking Diagram.

This page intentionally blank.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section contains the operating instructions for the Model 1121A Audio Analyzer.

3-3. OPERATING CONTROLS, INDICATORS AND CONNECTIONS.

3-4. The controls, indicators and connectors used during the operation of the instrument are listed in Table 3-1 and shown in Figures 3-1 and 3-2.

3-5. OPERATING INSTRUCTIONS.

3-6. The operating instructions for the Model 1121A are divided into sections of Initial Conditions, Local Operation and Remote Operation.

3-7. INITIAL CONDITIONS.

3-8. Initialize the instrument as follows:

a. Connect the power cord to the instrument and to the desired power source. Refer to paragraph 2-7 for proper power application.

b. Set the front panel power switch to ON.

c. Depress the LCL/INIT key.

d. The SOURCE display will contain the instrument firmware identification number and the other displays will contain dashes for a period of about two seconds. The SOURCE display will then contain 1000.00 Hz with the KYBD legend illuminated and the ANALYZER display will change to contain the message for one level measurement cycle.

3-9. LOCAL OPERATION.

3-10. Function Selection. The DATA ENTRY keypad is common to all functions of the Model 1121A. The KYBD legend determines the active display window to which the DATA ENTRY keypad is dedicated at any given time. To select a function simply depress the function key desired. The results will be the LED of the function key will be illuminated, the current value of the selected function will be displayed in the window above the key, and the KYBD legend will be illuminated in the display window. The DATA ENTRY keypad is dedicated to the selected function and any unit selection or number entry will appear in the active display window. When selecting measurement functions the message may appear to indicate that a measurement cannot be displayed instantly for any of five possible reasons:

1. The first measurement cycle is in progress and cannot be displayed.

2. The measurementsô mi-nimum ments are not met, for example, frequency measurements cannot be made if the input level is too low.

3. The input level is overrange.

4. The input signal is changing faster than the analyzer can respond.

5. The notch filter is in the process of being tuned to the fundament frequency in the distortion or SINAD modes.

3-11. Data Entry Operation. Once a function has been selected, new values may be entered with the DATA ENTRY keypad. To enter data simply depress the desired digit keys followed by the appropriate unit key or ENTER key. During digit sele appear in the display to the left of the first digit selected to indicate the number in the display is in the process of being entered. No action is taken until the unit or ENTER key is depressed. The unit keys can also be used aside from number entry to select display modes. For example, to change the level measurement displayed in mV to logarithmic units in dBV, simply select the analyzer LEVEL key and depress the dB key in the DATA ENTRY keypad. The display program will calculate and display the logarithmic value. The ENTER key serves a dual function as a dimensionless unit key for SPCL, ADRS, and PRGM number entry and also as a default unit terminator of V, %, and Hz for functions where more than one unit can be selected.

3-12. Many of the Model 1121A functions have multiple display and entry modes. Listed in Table 3-2, Function Display And Data Entry Units, are the display legends which can be active for each function along with the unit keys in the DATA ENTRY keypad which select the available display modes. Argument entry ranges for all the Model 1121A functions are described in Table 3-3, Valid Function Argument Range. Number entry out of range of the selected functions will result in an error displayed in the SOURCE display window. Errors can be cleared by depressing any key. If at any time prior to entry a wrong digit is entered, depress the CLR key to clear and restore the previous display.

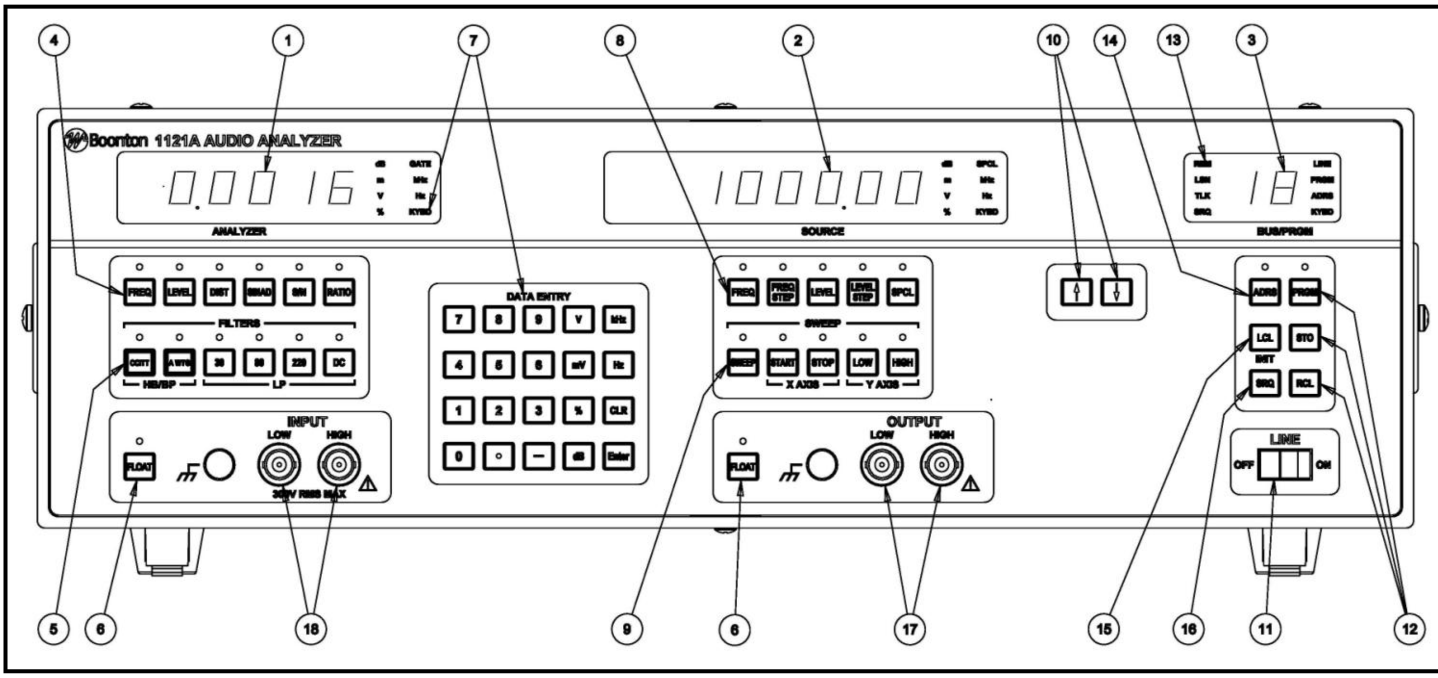


Figure 3-1. Model 1121A, Front View

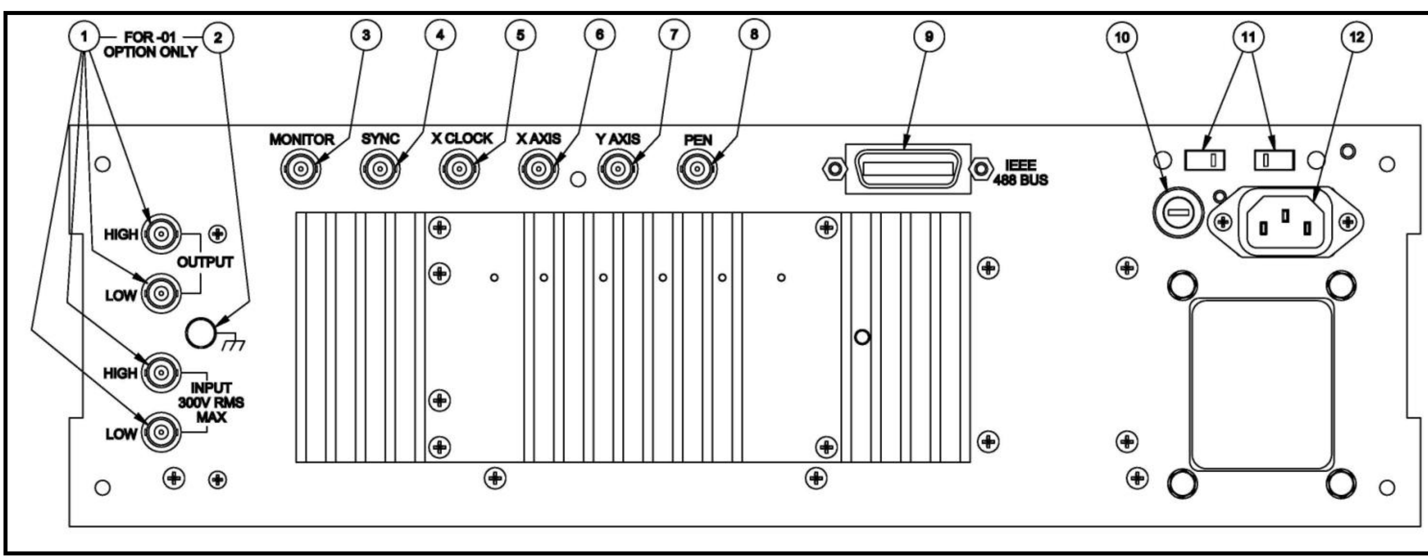


Figure 3-2. Model 1121A, Rear View

TABLE 3-1. CONTROLS, INDICATORS AND CONNECTORS.

Control, Indicator, or Connector	Figure and Index No.	Function
ANALYZER display	3-1,1	Displays frequency, AC and DC level, distortion, SINAD, S/N and ratio measurements. (6 digit LED display)
SOURCE display	3-1,2	Displays source frequency and level, frequency and level step sizes, special function, start, stop, low and high sweep values. Alternately displays error codes and messages. (8 digit LED display)
BUS/PRGM display	3-1,3	Displays current program number or IEEE-488 bus address. (2 digit LED display)
ANALYZER keys	3-1,4	Selects the following active analyzer functions.
FREQ key		Displayed in Hz or kHz with GATE indication.
LEVEL key		Displayed in V, mV, dBV or dBm.
DIST key		Displayed in %, dB, dBV, dBm, V, or mV. Notch tune frequency displayed in Hz or kHz. Notch capable of automatic or manual tuning.
SINAD key		Displayed in dB. Notch filter is tuned to the source frequency setting.
S/N key		Displayed in dB. Measured by monitoring the AC level while turning the source level on and off.
RATIO key		Displays amplitude ratios in % or dB and frequency ratios in Hz or kHz.
FILTER keys	3-1, 5	Selects optional filters, 30 kHz, 80 kHz, 220 kHz low-pass or DC level filters.
FLOAT keys	3-1, 6	Selects floating or single-ended input and output connection.
DATA ENTRY keypad	3-1, 7	Used with the function keys to enter data into the active display designated by the KYBD annunciator.
SOURCE keys	3-1, 8	Selects the following active functions.
FREQ key		Allows display and entry of the source frequency in Hz or kHz units.
FREQ STEP key		Allows display and entry of the frequency increment value in Hz or kHz units for use with the step keys and the linear frequency sweep mode.
LEVEL key		Allows display and entry of the source level in mV, V, dBV or dBm units.
LEVEL STEP key		Allows display and entry of the level increment value in mV, V, or dB units for use with the step keys and the linear and log level sweep mode.
SPCL key		Allows alteration to the normal analyzer modes of operation such as: range hold, notch tune hold, slow responding detector, and special modes for testing, troubleshooting, and automatic calibration.

TABLE 3-1. CONTROLS, INDICATORS AND CONNECTORS CONTINUED.

Control, Indicator, or Connector	Figure and Index No.	Function
SWEEP keys	**3-1, 9**	Selects the following sweep parameters.
SWEEP key		Enables the start of the sweep sequence and indicates sweep in progress.
START key		Allows display and entry in Hz or kHz units of the starting sweep frequency or in mV, V, dBV or dBm units of the starting sweep level.
STOP key		Allows display and entry in Hz or kHz units of the ending sweep frequency or in mV, V, dBV or dBm units of the ending sweep level.
HIGH key		Allows display and entry of the upper Y axis scale value in units compatible with the active analyzer measurement mode.
LOW key		Allows display and entry of the lower Y axis scale value in units compatible with the active analyzer measurement mode.
Step keys	**3-1, 10**	Step keys increment or decrement the active source or sweep function in frequency or level step sizes and single steps the program location function.
LINE switch	**3-1, 11**	Switches the instrument AC power on or off.
PROGRAM keys	**3-1, 12**	Selects the following program functions
PRGM key		Allows display and entry of the store/recall program location.
STO key		Stores the instrument setup at the current program location.
RCL key		Recalls the instrument setup at the current proram location.
Bus status	**3-1, 13**	Displays the current IEEE-488 bus status; REM (remote enabled), LSN (listener addressed), TLK (talker active), and SRQ (service request).
ADRS key	**3-1, 14**	Allows display and entry of IEEE-488 bus address.
LCL/INIT key	**3-1, 15**	Causes the instrument to "go-to-local" when remote enabled otherwise executes the initialize sequence.
SRQ key	**3-1, 16**	Sets the IEEE-488 bus SRQ line true.
OUTPUT connectors	**3-1, 17**	LOW and HIGH. Used to connect the source to external devices. The LOW terminal is connected to chassis ground in the non-floating mode.
INPUT connectors	**3-1, 18**	LOW and HIGH. Used to apply an external audio signal for analysis. The LOW terminal is connected to chassis ground in the non-floating mode.
Optional connectors	**3-2, 1**	Used to replace the front panel input and output connectors.

TABLE 3-1. CONTROLS, INDICATORS AND CONNECTORS CONTINUED.

Control, Indicator, or Connector	Figure and Index No.	Function
Ground connector	3-2, 2	Chassis ground connector.
MONITOR connector	3-2, 3	Provides a scaled output of the input signal in the frequency, level and S/N modes. Provides a scaled output of the input signal with the fundamental removed in the distortion and SINAD modes.
SYNC connector	3-2, 4	Provides a TTL compatible output relative to the source frequency.
X CLK connector	3-2, 5	Provides a TTL compatible input for an external 10 MHz timebase reference. Automatic switching to external reference when present.
X AXIS connector	3-2, 6	Provides a 0 to 5 v DC output for plotter application.
Y AXIS connector	3-2, 7	Provides a 0 to 5 v DC output for plotter application.
PEN connector	3-2, 8	Provides a TTL compatible output for plotter pen control.
IEEE-488 connector	3-2, 9	Provides a means for connecting the standard IEEE-488 bus interface cable.
Fuse holder	3-2, 10	AC line fuse holder.
Line voltage selector switches	3-2, 11	Selects the desired line operating voltage.
AC connector	3-2, 12	AC power connector.

3-13. Analyzer Measurement Description. The Model 1121A contains an independent distortion analyzer which can measure frequency, AC and DC level, distortion, SINAD and signal-to-noise. In addition, ratio measurements can be made with all analyzer measurement modes. A wide range of special functions enhance the basic measurement modes without sacrificing the simplified operation of the analyzer. Standard and optional audio filters are provided to aid in harmonic distortion analysis and weighted noise measurements. Finally, the ability to store and recall specific measurement combinations aid in configuring measurement applications for manual and remote use.

3-14. Analyzer Input Description. The input configuration of the Model 1121A can be selected for single-ended or balanced/differential operation. The input mode can be enabled using the front panel FLOAT key or over the IEEE-488 bus interface.

3-15. Frequency Measurement Function. The Model 1121A measures wide ranges of audio frequency with high accuracy and resolution. Microprocessor control of the reciprocal counter results in automatic selection of frequency ranges for maximum resolution. Measurements are referenced to an internal 10 MHz timebase accurate to 0.0001% and external reference capability is also provided.

3-16. Frequency Measurement Display Units. Frequency measurements can be displayed in Hz or kHz for values above 199.999 Hz with automatic selection of Hz units below this limit. To select the Frequency measurement functions simply depress the FREQ key which illuminates both the keyôs LED and the KYBD legend in the ANALYZER display. Display units can then be selected by depressing the Hz or kHz keys.

3-17. Special Frequency Measurement Modes. Special function 11 is provided to preset and hold spe cific level ranges for frequency measurement. Refer to paragraph 3-65. The frequency measurement mode can function to input levels 14 db below the selected level range. For example by setting the 3.000 volt level range, measurements can be made with signal levels as low as 600 mV.

3-18. Level Measurement Function. The Model 1121A measures both AC and DC voltage with high dynamic range and selectable AC bandwidth. Resolution at full scale is 3000 counts with an additional 33% overrange capability. The AC rms detector is true rms responding for signals with crest factors less than 3. Average and quasi-peak responding detectors (rms calibrated) can also be selected. Refer to paragraph 3-74. A period sampling measurement technique is employed which results in adaptive measurement rates optimized to the period of the dominant AC component of the input signal. This technique yields fast settled measurements in the AC level mode while effectively filtering large AC components in the DC level mode. Measurement bandwidth is selectable using the standard and optional filters to reject out-of-band noise or provide industry-standard weighting characteristics.

3-19. Level Measurement Display Units. AC and DC level measurements can be displayed in linear or logarithmic units. Linear measurements are displayed in mV or V with V automatically selected for levels above 750 mV and mV automatically selected for levels below 0.300 V. Logarithmic measurements are displayed in various forms. The default mode uses dBV units (dB relative to 1.000 V rms). Power in dBm units (dB relative to 1 mW) can be selected for various impedances as described in paragraph 3-74. To select the Level measurement function simply depress the LEVEL key which illuminates both the keyôs LED and the KY ANALYZER display. The various display modes can then be selected by depressing the appropriate units associated with the desired display mode. For example, to select AC level in logarithmic units depress the dB key and to return the display to linear units depress the mV or V keys.

3-20. Special Level Measurement Modes. Special function 11 is provided to preset and hold specific level ranges to achieve faster first measurement rates and to eliminate possible range-to-range nonlinearity. Refer to paragraph 3-65. Special function 17 extends the measurements sampling period to provide a more consistent reading in the presence of noise. AC and DC calibration is performed through the use of special function codes 20 through 24. The rms, average or quasi-peak AC detector type can be selected using special function 70, 71 or 72, respectively. Special functions 80 through 86 select logarithmic display modes in dBV or dBm units.

3-21. Distortion Measurement Function. The Model 1121A measures total harmonic distortion and noise over a

wide range of frequency. The notch filter is automatically tuned to reject the fundamental frequency and pass only the harmonic and noise content. The AC measurement techniques are similar to those used in the level measurement function yielding fast settled measurements. Measurement bandwidth is selectable to reject noise while accurately preserving harmonic components. Measurement results can be displayed in several forms. The combination of harmonics and noise can be displayed as an absolute level in mV, V, dBV or dBm units or as a ratio in % or dB units to the total input signal consisting of fundamental, harmonics and noise.

3-22. Distortion Measurement Display Units. Distortion measurements can be displayed in linear or logarithmic units. Linear ratiometric measurements are displayed in % while logarithmic measurements are displayed in dB where 0.00 dB is referenced to 100.0%. Distortion measurements can also be displayed as an absolute level in units of mV, V, dBV or dBm. The distortion level display mode is useful to measure noise level in the presence of a holding tone. The holding tone is removed by the notch filter and the noise level alone is measured and displayed. In addition the frequency of the displayed in Hz or kHz units. To select the distortion measurement function simply depress the DIST key which illuminates both th KYBD legend in the ANALYZER display. The various display modes can then be selected by depressing the the appropriate units associated with the desired display mode. For example, to select distortion level in logarithmic units (dBV or dBm)depress the DIST key followed in sequence by the mV or V keys and the dB key. The mV or V keys select the distortion measurement to be displayed as an absolute level and the dB key converts the results to logarithmic unit.

TABLE 3-2. FUNCTION DISPLAY AND DATA ENTRY UNITS.

Function	Display Legends	Unit Keys	Default Units (ENTER Key)
ANALYZER GROUP:			
FREQ	Hz kHz	mV V Hz kHz	V
LEVEL	mV V dBV dBm	mV V dB	V
DIST	mV V Hz kHz % dB dBV dBm	mV V Hz kHz % dB	%
SINAD	dB	mV V dB	dB
S/N	dB	dB	no entry
RATIO	% dB	% dB	no entry
SOURCE GROUP:			
FREQ	Hz kHz	Hz kHz	Hz
FREQ STEP	Hz kHz	Hz kHz	Hz
LEVEL	mV V dBV dBm	mV V dB	V
LEVEL STEP	mV V dB	mV V dB	V
SPCL	SPCL	ENTER	dimensionless
START	mV V Hz kHz dBV dBm	mV V Hz kHz dB	Hz
STOP	mV V Hz kHz dBV dBm	mV V Hz kHz dB	Hz
LOW	mV V Hz kHz % dB dBV dBm	mV V Hz kHz % dB	V
HIGH	mV V Hz kHz % dB dBV dBm	mV V Hz kHz % dB	V
BUS/PRGM GROUP:			
ADRS	ADRS	ENTER	dimensionless
PRGM	PRGM	ENTER	dimensionless

TABLE 3-3. VALID FUNCTION ARGUMENT RANGE.

Function	Argument Range	Entry Action	Error No.
ANALYZER GROUP:			
FREQ	0 mV to 300 V	Set input level range	12
LEVEL	0 mV to 300 V	Set input level range	13
DIST	0 mV to 300 V	Set input level range	14
	0 to 100%	Set distortion range (lin)	14
	-140 to 0.0 dB	Set distortion range (log)	14
	5 Hz to 140 kHz	Set notch tune frequency	14
SINAD	0 mV to 300 V	Set input level range	15
	0 to 140 dB	Set SINAD range (log)	15
S/N	no entry allowed		20
RATIO	no entry allowed		17
SOURCE GROUP:			
FREQ	10 Hz TO 150 kHz	Set source frequency	01
FREQ STEP	0 Hz to 150 kHz	Set frequency increment	02
LEVEL[1]	0 mV to 16 V	Set open circuit output level (lin)	03
	-140 to 24.08 dBV	Set open circuit output level (log)	03
LEVEL STEP	0 mV to 16 V	Set level increment (lin)	04
	0 to 140 dB	Set level increment (log)	04
SPCL	See TABLE 3-7	See TABLE 3-7	05
START[1]	10 Hz to 150 kHz	Set sweep start frequency	06
	0 mV to 16 V	Set sweep start level (lin)	06
	-140 to 24.08 dBV	Set sweep start level (log)	06
STOP[1]	10 Hz to 150 kHz	Set sweep stop frequency	07
	0 mV to 16 V	Set sweep stop level (lin)	07
	-140 to 24.08 dBV	Set sweep stop level (log)	07
LOW	-300 to 300 V	Set low plot limit (lin)	08
	-30000 to 30000%	Set low plot limit (lin)	08
	-140 to 49.54 dB	Set low plot limit (log)	08
	-49.54 to 140 dB	Set low plot limit (S/N, SINAD)	08
	-300 to 300 kHz	Set low plot limit (lin)	08
HIGH	-300 to 300 V	Set high plot limit (lin)	09
	-30000 to 30000%	Set high plot limit (lin)	09
	-140 to 49.54 dB	Set high plot limit (log)	09
	-49.54 to 140 dB	Set high plot limit (S/N, SINAD)	09
	-300 to 300 kHz	Set high plot limit (lin)	09
BUS/PRGM GROUP:			
ADRS	0 to 30	Set IEEE-488 bus address	10
PRGM	0 to 99	Set store/recall location	11

NOTE[1] Amplitude values can be entered and displayed in dBm units. The allowable argument range for dBm values varies based on the source and load impedance settings and is limited by the open-circuit voltage range.

3-23. Special Distortion Measurement Modes. Special functions 12 and 13 are provided to preset and hold specific input level and distortion ranges. Refer to paragraph 3-65. Special function 17 extends the measurements sampling period to provide a more consistent reading in the presence of noise. Using special function 14, notch filter tuning can be held at specific frequencies to aid in tuning the notch filter in the event that a stable frequency measurement cannot be achieved or to enable notch filter tuning to frequencies other than the fundamental. As with all amplitude measurement functions, the rms, average, or quasi-peak detector type can be selected using special function 70, 71 or 72, respectively. Special functions 80 through 86 select logarithmic distortion level display units in dBV or dBm.

3-24. SINAD Measurement Function. The Model 1121A measures SINAD (signal-to-noise and distortion) in the same manner as the distortion measurement except that the notch filter is tuned and held at the source frequency to permit measurements in the presence of large amounts of noise. If an external oscillator is used, it must be tuned to within 3% of the source frequency setting. The AC measurement techniques are similar to those used in the level measurement function yielding fast settled measurements. Measurement bandwidth is selectable to reject noise while accurately preserving harmonic components. The combination of harmonics and noise is displayed as a percentage of the total input signal consisting of fundamental, harmonics and noise.

3-25. SINAD Measurement Display Units. SINAD measurements are only displayed in dB units. To select the SINAD measurement function simply depress the SINAD key which illuminates both the keyôs LED and the KYBD legend in the ANALYZER display.

3-26. Special SINAD Measurement Modes. Special functions 12 and 12 are provided to preset and hold specific input level and SINAD ranges. Refer to paragraph 3-65. Special function 17 extends the measurements sampling period to provide more consistent readings in the presence of noise. When measuring large amounts of noise (0 to 10 dB SINAD), the notch filter turning may become indeterminate and causes the to be displayed. Special function 15 is designed to disable the message in this circumstance. As with all amplitude measurement functions, the rms, average, or quasi-peak detector type can be selected using special function 70, 71 or 72, respectively.

3-27. S/N Measurement Function. The Model 1121A measures S/N (signal-to-noise) by alternately turning the source output on and off and displaying the ratio of the two measurements. The measurement techniques are similar to those used by the level measurement mode. Measurement bandwidth is selectable using the filters to reject out of band noise or provide industry standard weighting characteristics.

3-28. S/N Measurement Display Units. S/N measurements are only displayed in dB units. To select the S/N measurement function simply depress the S/N key which illuminates both the keyôs LE the ANALYZER display.

3-29. Special S/N Measurement Modes. Special function 17 extends the measurement sampling period to provide more consistent readings in the presence of noise. Special functions 40 through 49 are used to program the amount of delay between the signal measurement and noise measurement to allow time for the device under test to respond to the change in amplitude. As with all amplitude measurement functions, the rms, average, or quasi-peak detector type can be selected using special functions 70, 71, and 72.

3-30. Using the Ratio Mode. The Model 1121A enables all measurement modes to be displayed as a relative value to a previous measurement value. In a ratiometric measurement, such as flatness response, amplitude measurements at various frequencies are displayed relative to a reference level at a frequency of 1 kHz. Another sample of a ratiometric measurement is the measurement of the percent of AC ripple on a DC level.

3-31 Ratio Measurement Display Units. Ratiometric level measurements are displayed in % or dB units whereas relative frequency measurements are displayed in Hz or kHz. To select the ratio mode simply depress an analyzer measurement key such as LEVEL followed by the RATIO key. The LEDs of both keys will be illuminated along with the KYBD legend in the ANALYZER display. When the next measurement cycle is complete, the measurement value will become the ratio reference and the display will indicate 100.00%, 0.00 dB or 0.000 Hz depending on the previous log/linear display mode.

TABLE 3-4. INPUT LEVEL RANGES.

AC Level Ranges:	DC Level Ranges:	Distortion and SINAD Input Level Ranges
300.0 to 150.1 V	300.0 to 150.1 V	300.0 to 150.1 V
150.0 to 75.1 V	150.0 to 75.1 V	150.0 to 75.1 V
75.00 to 30.1 V	75.00 to 30.1 V	75.00 to 30.1 V
30.00 to 15.01 V	30.00 to 15.01 V	30.00 to 15.01 V
15.00 to 7.51 V	15.00 to 7.51 V	15.00 to 7.51 V
7.500 to 3.01 V	7.500 to 3.01 V	7.500 to 3.01 V
3.000 to 1.501 V	3.000 V and below	3.000 to 1.501 V
1500 to 751 mV		1500 to 751 mV
750.0 to 301 mV		750.0 to 301 mV
300.0 to 150.1 mV		300.0 to 150.1 mV
150.0 to 75.1 mV		150.0 to 100.1 mV
75.00 to 30.1 mV		100.0 to 50.1 mV
30.00 to 15.01 mV		50.0 mV and below
15.00 to 7.51 mV		
7.500 to 3.01 mV		
3.000 to 1.501 mV		
1.500 to 0.751 mV		
0.7500 to 0.301 mV		
0.3000 mV and below		

Selection of display units can be made by depressing either the %, dB, kHz or Hz keys. On subsequent measurement cycles the results will be displayed relative to the original ratio reference. The RATIO key is an alternate action key, therefore, depressing the RATIO key again will deselect the ratio mode, extinguish the LED and return the display to the normal measurement mode. If another measurement function is selected while the ratio mode is active, the LED on the RATIO key will be extinguished but the ratio reference is preserved for the original measurement function and can be reactivated by depressing the original measurement function key. The ratio mode is limited to only one reference value and the old ratio reference is lost if the ratio mode is activated in an alternate measurement function.

3-32 Using Analyzer Filters. The audio filter keys are alternate action keys which [illegible] on and off with each key stroke. The optional filters are mutually exclusive; therefore, depressing on of the keys will cancel the other. The same is true of the low-pass filters, only one low-pass filter can be used at a time. The DC filter, however, is mutually exclusive with all filters and will also be canceled by selecting any measurement functions other than Level.

3-33. The minimum bandwidth consistent with the measurement bandwidth should be used to minimize noise errors. For example, when measuring the distortion of a 1 kHz fundamental tone, the 30 kHz low-pass filter is recommended. The DC low-pass filter is provided to attenuate all AC components and measure DC level directly. The DC low-pass filter can only be activated in the analyzer level mode. Band-pass filters are combinations of high- and low-pass filters and are used in some measurements to simulate the sensitivity of the human ear to the audible frequency spectrum. High-pass filter selection is used to eliminate power line harmonics when present. The 400 Hz high-pass filter typically provides more than 80 dB of attenuation at 60 Hz.

3-34. The CCIR filter is a special case since its application depends on whether the average or quasi-peak detector is selected. The CCIR recommendation 468-3 specifies the filter should be used with the quasi-peak detector. Another application referred to as the CCIR/ ARM calls for using the average responding meter (ARM) and applying a gain correction value of -6.6 dB. The Model 1121A will accommodate both applications. The average or quasi-peak detector can be selected using special function 71 or 72 respectively. The level readings will also be adjusted by -6.6 dB automatically when the average detector is selected.

3-35. Audio Oscillator General Description. The Model 1121A contains a variable frequency, low distortion audio oscillator and a precision programmable amplifier/attenuator. The oscillator frequency tuning uses a frequency lock technique under microprocessor control to yield high accuracy and resolution. The output level can be varied in very fine increments over a wide range of levels. Levels can be set in either linear or logarithmic units to accommodate existing test procedures and applications. The oscillator incorporates a user configurable sweep

TABLE 3-5. DISTORTION AND SINAD RANGES.

Linear:	Logarithmic:
100.0 to 50.01%	0.00 to -6.01 dB
50.00 to 20.01%	-6.02 to -13.97 dB
20.00 to 10.01%	-13.98 to -19.99 dB
10.00 to 5.001%	-20.00 to -26.01 dB
5.000 to 2.001%	-26.02 to -33.97 dB
2.000 to 1.001%	-33.98 to -39.99 dB
1.000 to 0.5001%	-40.00 to -46.01 dB
0.5000 to 0.2001%	-46.02 to -53.97 dB
0.2000 to 0.1001%	-53.98 to -59.99 dB
0.1000 to 0.05001%	-60.00 to -66.01 dB
0.05000 to 0.02001%	-66.02 to -73.97 dB
0.02000 to 0.01001%	-73.98 to -79.99 dB
0.01000% and below	-80.00 dB and below

mode which can be programmed to sweep frequency or level in logarithmic or linear increments.

3-36. Oscillator Output Description. The output configuration of the Model 1121A can be selected for single-ended or balanced/floating operation using the FLOAT key. Special functions 75, 76, and 77 select the respective 50 ohm, 150 ohm, and 600 ohm source output impedance.

3-37. Source Frequency Display and Selection. To select the Frequency function simply depress the FREQ key. The keyôs LED and the KYBD legend will be illuminated and the SOURCE display window will contain the current frequency setting. Once the function is selected a new frequency may be entered using the DATA ENTRY keypad. Display units can be selected by depressing either the Hz or kHz keys.

3-38. Source Frequency Lock Mode Description. The Model 1121A source oscillator achieves high frequency accuracy and resolution through the use of a frequency lock technique. The design of the Model 1121A enables internal measurement of the oscillator frequency. During initialization after power is applied or when the LCL/INIT key is depressed, the oscillator is sequenced through its five frequency bands and specific frequencies settings are verified for accuracy. Tuning errors are stored by the control program in internal memory as calibration factors. If the oscillator fails to function on any of the frequency bands, an error (30-34) will be displayed as an indication of a hardware fault requiring service.

3-39. When a frequency setting is entered the oscillator is coarse tuned to the setting by the control program. Thereafter, the internal frequency of the oscillator is measured and fine adjustments are made by the control program to tune the oscillator to within tolerance. Special function 16 disables the frequency lock mode to enable faster frequency updates and sweep rates where the full frequency accuracy of the oscillator is not required.

3-40. Source level Display and Selection. To select the Level function simply depress
LED and the KYBD legend will be illuminated and the LEVEL display window will contain the current level setting. Once the function is selected a new level may be entered using the DATA ENTRY keypad. The level function allows display and selection of the open-circuit output level. When a level is selected, the programmable amplifier/attenuator is configured by the microprocessor circuits to one of the ranges listed in Table 3-6. Special function 18 disables the automatic range selection and holds the range that is active at the time the special function was enabled. When the range-hold mode is active, new levels may be entered from 0 V up to the maximum value for the selected range. This mode provides the ability to set levels over a wide dynamic range without the possible delay and transients associated with range to range transitions. The LEVEL function can be incremented or decremented by the value in the LEVEL STEP function.

3-41. Amplitude Display Units. Amplitude values for the LEVEL, START and STOP functions may be displayed in linear units of mV or V or as a logarithmic value in units of dBV or dBm. Display units can be selected by depressing either the mV, V, or dB keys. Special functions 80 through 86 select the logarithmic display mode converts the linear voltage display (open-circuit) to a logarithmic value relative to 1.000 V rms. When a dBm mode is selected, the actual power into the load is calculated and displayed based on the open-circuit level and source and load impedance selections.

3-42. Step Size and Step Key Operation. The keys marked with up and down arrows are used to increment and decrement source and program function values in the active window designated by the KYBD legend. If an arrow key is constantly depressed, the stepping will repeat. Functions which can be stepped are PRGM, FREQ, START, STOP, and LEVEL. Stepping any other function has no effect.

3-43. Increment/Decrement Program Number. The Program number can be stepped in single increments. A special Auto-recall function is provided which automatically executes the recall operation after the program location function has been incremented or decremented with the step keys. This function allows rapid recall of sequential program setups by using a single key or bus mnemonic. The auto-recall function can be enabled or disabled using the internal option switch A4S1-5 or special functions 7 and 8.

3-44. Increment/Decrement Frequency Values. Frequency values in the FREQ, START, and STOP functions can be stepped by the value in the FREQ STEP function. Available frequency step sizes are listed in Table 3-3. If the step size is smaller than the resolution of the selected function, the function will be stepped by the resolution value. The frequency step size also functions as the step size for the linear frequency sweep mode.

3-45. Increment/Decrement Level Values. Amplitude values in the LEVEL, START, and STOP functions can be stepped by the value in the LEVEL STEP function. Level step sizes can be linear or logarithmic values. Available level step sizes are listed in Table 3-3. If the step size is smaller than the resolution of the selected function, the function will be stepped by the resolution value. Table 3-6 lists the output level ranges and resolution. The level step size also functions as the step size for the linear and logarithmic level sweep modes.

3-46. Sweep Mode General Description. The Model 1121A provides a user programmable sweep capability which simplifies time consuming measurements such as flatness, distortion vs. power output and compression/expansion linearity. In the sweep mode the source of the Model 1121A is used as the stimulus and can be configured to sweep frequency or level in linear or logarithmic steps. The source provides the X axis and pen control signals for an external plotter/recorder. The analyzer measurement provides the Y axis information. The Y axis scale can be set using the HIGH and LOW plot limit functions.

3-47. SWEEP Key Description. The SWEEP key is an alternate action key which initiates and terminates the sweep. The keyôs LED indicates a sweep is in progress and will be illuminated for the period of one sweep.

3-48. START Key Description. The START key allows entry of either the frequency or level START value. The START value defines the origin of the X axis which corresponds to 0 volts at the X AXIS output connector. When the START key is depressed the SOURCE display will contain the START value and 0 volts is presented at the X AXIS output connector as an aid in setting the offset adjustment on most X-Y plotters.

3-49. STOP Key Description. The STOP key allows entry of either the frequency or level STOP value. The STOP value defines the end of the X axis which corresponds to 5 volts at the X AXIS output connector. When the STOP key is depressed the SOURCE display will contain the STOP value and 5 volts is presented at the X AXIS output connector as an aid in setting the sensitivity adjustment on most X-Y plotters.

3-50. X AXIS Output Description. The X AXIS output of the Model 1121A is the scaled result of the sweep frequency or level relative to the START and STOP values. The Model 1121A can be swept in level or frequency with 4096 points of resolution on the X axis. Selection of a level or frequency sweep is determined by the type of START and STOP values entered: START and STOP level entries designate a level sweep and START and STOP frequency entries designate a frequency sweep.

3-51. Y AXIS Output Description. The Y AXIS output of the Model 1121A is the scaled result of the analyzer measurement value relative to the HIGH and LOW values. There are 4096 points of resolution between 0 and 5 volts on the Y axis. Any measurement mode can be used for sweeping. Various measurement modes and applications require greater measurement settling before a data point is generated. The Model 1121A allows for user configurable settling times using special functions 61 through 69. The settling time is based on the number of consecutive measurement cycles achieved before a data point is plotted. Special function 60 disables the analyzer measurement and the YAXIS output and allows the source to be used as a rapid incremental sweep generator with X AXIS and PEN control.

3-52. The HIGH and LOW plot limits are always displayed in the same units as the analyzer measurement mode. The Y AXIS output will be scaled linearly or logarithmically depending on the display units. For example, if the distortion measurement is displayed in % units the result will be plotted linearly between the LOW and HIGH plot limits and if displayed in dB units the result will be a logarithmic plot. Analyzer measurements displayed in mV or V units will be plotted linearly and those displayed in dBV or dBm will be plotted logarithmically.

3-53. PEN Output Description. The Model 1121A generates a TTL compatible pen control output for use with a plotter/recorder. The active state of the PEN output is selected using option switch A4S1-3 or special functions 5 and 6.

3-54. Using The Sweep Mode. When the SWEEP key is depressed the START value is transferred to the LEVEL or FREQ function, and the function is activated. When the sweep is in progress the X AXIS output will produce an incrementing voltage between 0 and 5 volts. The START and STOP values must be compatible in level or frequency units or an error will be displayed when the SWEEP key is depressed. When the sweep sequence is initiated the X axis information is presented at the rear panel X AXIS output and after an approximate 1 sec delay the PEN output is set true. When the sweep is terminated the PEN output is immediately set false. The PEN output can be set independent of any sweep operation using the PU and PD bus mnemonics.

3-55. The sweep mode will be terminated if any number entry is attempted, any function is selected other than the functions displayed at the start of the sweep sequence, or either the SWEEP key or the LCL/INIT key is depressed. Selecting filters, floating modes and display units will not terminate the sweep mode. If a sweep has been terminated, it can be resumed by selecting the appropriate LEVEL or FREQ function and depressing the SWEEP key. The sweep will be activated and will resume from the displayed value until the STOP value is reached.

3-56. Generating Frequency Sweeps. The Model 1121A can generate user configurable frequency sweep sequences up to the entire frequency range of the oscillator in logarithmic or linear increments. The range of the sweep is defined by the START and STOP values which can be in ascending or descending order. Logarithmic frequency increments are selected using special function 1 through 59 and vary from 16 to 4096 steps. Linear frequency increments are selected using special function 50 and the FREQ STEP function defines the increment value. Linear sweep step sizes which exceed the X axis resolution limit of 4096 steps are allowed, however, the X AXIS output voltage will dwell at the same level for more than one frequency increment.

3-57. Generating Level Sweeps. The Model 1121A can generate user configurable level sweep sequences up to the entire level range of the oscillator in logarithmic or linear increments. The range of the sweep is defined by the START and STOP values which can be in ascending or descending order. Logarithmic and linear level increments are selected using the LEVEL STEP function. Special functions 50 through 59 have no effect on level sweep. A logarithmic level sweep is defined by a LEVEL STEP value expressed in dB units and a linear level sweep is defined by a LEVEL STEP value expressed in mV or V units. Level sweep step sizes which exceed the X axis resolution limit of 4096 steps are allowed, however, the X AXIS output voltage will dwell at the same level for more than one level increment.

3-58. Program Store And Recall Description. The entire status of the Model 1121A, including all functions, entered values and display modes, can be saved in a program location of non-volatile memory for recall at a later time. Up to 99 such programs (0-98) can be stored and recalled.

3-59. Store Operation. To save the complete frontpanel setup in the program memory, first set all the desired instrument operating parameters to be stored. Next depress the PRGM key and enter the desired program location with the DATA ENTRY keypad and the ENTER key. Finally, depress the STO key to save the complete instrument status in program memory. Below is a list of all the parameters which are retained in program memory.

1. All entered values of all functions.

2. All source impedance and floating settings.

3. All display modes and selected display units.

4. All special function settings.

3-60. Recall Operation. To recall the front-panel setup in the program memory, depress the PRGM key and enter the desired program location with the DATA ENTRY keypad and the ENTER key. After the memory location has been selected, depress the RCL key. Program location 99 is a recall-only location that restores the initialize parameters in the same manner as the LCL/INIT key. Any panel setting may be changed after recalling a program location.

3-61. Program Memory Initialization. In normal use the internal memory is never erased, new programs are simply written over the old ones. It is necessary, however, to erase the program memory after a new firmware revision has been installed or after the CPU circuit board has been serviced. Entering special function 25 will erase the entire program memory. Attempting to recall an erased program will result in Error 11 being displayed. Special function 25 can be disabled using the internal option switch A4S1-4.

3-62. Special Function Description. The Model 1121A provides special modes of operation for specific application situations. Special function modes shown in Table 3-5 can be selected using the SPCL key and the DATA ENTRY keypad.

3-63. Option Switch Functions. Codes 1 through 8 supersede current settings of the internal option switch, A4S1. The option switch settings are restored on pow-er-up, by executing special function 0, or by depressing the LCL/INIT key.

3-64. Mode Alteration Functions. Codes 11 through 19 alter the normal operation of the Model 1121A. When selected, the SPCL legend in the SOURCE display window will remain illuminated as an indication of the special operating mode regardless of the function displayed.

3-65. The range-hold functions, 11 through 13, affect the analyzer measurements by defeating the autorange capability. The input level or post-notch distortion range can be held at its present value by entering the appropriate special function code. Other ranges can be set and held by selecting the desired analyzer measurement mode and entering the level or distortion range directly into the ANALYZER display window using the DATA ENTRY keypad. Available level and distortion ranges for all analyzer measurement modes are listed in Tables 3-4 and 3-5. It is not necessary to enter the exact full scale value to set a range, rather the value need only fall within the desired range. When a range is selected the appropriate special code will automatically be activated and the SPCL legend will be illuminated. Range-hold mode is cleared by selecting an alternate analyzer function, using special function 10 or initializing the instrument.

3-66. The notch-hold and ignore-tune-status functions, 14 and 15, affect the analyzer distortion and SINAD measurement modes by defeating the auto-tune capa-bility in the distortion mode and disabling the tune-status information in the SINAD mode. Tune-status information is unreliable in the presence of very high amounts of noise (0 to 10 dB SINAD) resulting in the [ ] message being displayed. The ability to select the frequency of the notch filter enables the distortion mode circuits to function as a programmable notch filter to attenuate selected tones other than the fundamental. These special modes can be activated by entering the special code or by selecting the analyzer distortion mode and entering the notch frequency directly into the ANALYZER display window using the DATA ENTRY keypad. Direct entry of the notch frequency will automatically select Special 14 and the SPCL legend will be illuminated. Notch-hold and ignore-tune-status modes are cleared by using special function 10 or initializing the instrument.

TABLE 3-6. OUTPUT LEVEL RANGES.

Level Ranges:	Resolution:
16.000 to 3.005 V	5. 0 mV
3.000 to 0.301 V	1.0 mV
300.0 to 30.1 mV	<0.1 mV
30.00 to 0.00 m	0.01 mV

3-67. The unlock frequency function, 16, is provided to speed repetitive frequency setting and measurements. In normal operation a variable period of 20 to 200 mS is required to measure the actual oscillator frequency, calculate the frequency deviation and apply tine tune correction. Inhibiting the frequency lock mode results in faster operation at the cost of frequency accuracy. The unlock mode is cleared by entering special function 10 or initializing the instrument.

3-68. The slow detector function, 17, is provided to extend the level measurement sampling time to provide more consistent readings in the presence of noise. The level measurement employs a period sampling technique which adjusts the measurement period to include the period of the dominant AC signal. This process is extended to include low frequency components which cause inconsistent readings. The slow detector mode is cleared by using special function 10 or initializing the instrument.

3-69. The output range-hold function, 18, is provided to hold selected output level ranges. The active range at the time the special function is activated will be held. Available level ranges and resolution are listed in Table 3-6. Range-hold mode is cleared by entering special function 10 or initializing the instrument.

TABLE 3-7. SPECIAL FUNCTIONS.

Option Switch A4S1 Functions:

0 Restores settings of internal option switch

		Listen:	Talk:
1	EOS Character:	LF or CR LF	CR LF
2	EOS Character:	CR	CR LF
3	EOS Character:	CR	CR
4	EOS Character:	CR	CR

5 Pen-up is active high
6 Pen-up is active low
7 Disable program auto-recall
8 Enable program auto-recall

Mode Alteration Functions:

10 Clear functions 11 through 19.
11 Range Hold: input voltage range and post notch detector range
12 Range Hold: input voltage range.
13 Range Hold: post notch detector range.
14 Notch Hold: hold notch frequency tuning at preset frequency in distortion mode
15 Ignore Tune Status: display SINAD measurements without regard to tune-status information.
16 Unlock frequency
17 Slow Detector: noise rejecting filter response.
18 Hold output level range

Automatic Calibration and Test Functions:
(Can be disabled using Option Switch A4S1-4)

20 Auto Cal AC Level
21 Auto Cal Optional Filter No. 1
22 Auto Cal Optional Filter No. 2
23 Auto Cal DC Offset
24 Auto Cal DC Level
25 Erase all program memory locations
26 300 Volt range - special calibration mode
27 30 Volt range - special calibration mode
28 3 Volt range - special calibration mode
30 Dac test mode
31 Counter plug-in board test mode
32 Input and Filter plug-in board test mode
33 Notch and Detector plug-in board test mode
35 Frequency check mode

Signal-to-Noise Delay Functions:

40 Automatic Selection
41 0.2 sec delay
42 0.4 sec delay
43 0.6 sec delay
44 0.8 sec delay
45 1.0 sec delay
46 1.2 sec delay
47 1.4 sec delay
48 1.6 sec delay
49 1.8 sec delay

Frequency Sweep Resolution Functions:

50 Linear frequency sweep (FREQ STEP value determines resolution)
51 16 step logarithmic sweep
52 32 step logarithmic sweep
53 64 step logarithmic sweep
54 128 step logarithmic sweep
55 256 step logarithmic sweep
56 512 step logarithmic sweep
57 1024 step logarithmic sweep
58 2048 step logarithmic sweep
59 4096 step logarithmic sweep

Sweep Rate Functions:

60 Rapid Sweep (disable analyzer)
61 1 measurement/step
62 2 measurement/step
63 3 measurement/step
64 4 measurement/step
65 5 measurement/step
66 6 measurement/step
67 7 measurement/step
68 8 measurement/step
69 9 measurement/step

AC Detector Selection Functions:

70 RMS detector enabled
71 Average detector enabled
72 Quasi-peak detector enabled.

Source Output Impedance Selection Functions:

75 50 ohm output impedance
76 150 ohm output impedance
77 600 ohm output impedance

dBV/dBm Display Mode Selection Functions:

80 dBV display reference: 1.000 V
81 dBm display reference: 1 mW, 50 ohms
82 dBm display reference: 1 mW, 75 ohms
83 dBm display reference: 1 mW, 150 ohms
84 dBm display reference: 1 mW, 300 ohms
85 dBm display reference: 1 mW, 600 ohms
86 dBm display reference: 1 mW, 900 ohms

TABLE 3-9. ERROR CODES.

TABLE 3-8. OPTION SWITCH A4S1.

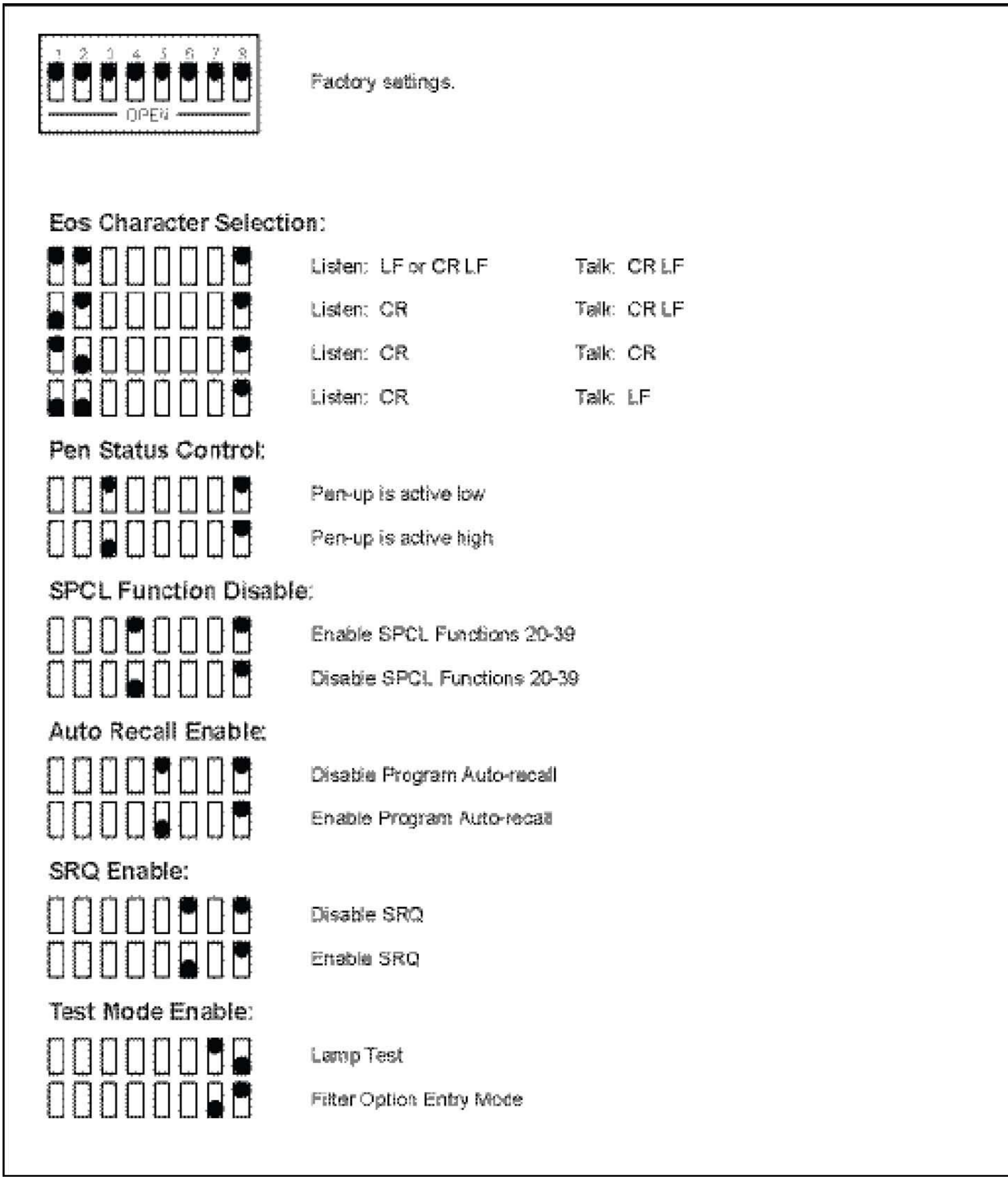


TABLE 3-9. ERROR CODES.

Error Code	Description
01	Illegal source frequency entry
02	Illegal frequency step size entry
03	Illegal source level entry
04	Illegal level step size entry
05	Illegal special function entry
06	Illegal start frequency or level entry
07	Illegal stop frequency or level entry
08	Illegal low plot limit entry
09	Illegal high plot limit entry
10	Illegal bus address entry
11	Store/recall error: attempting to recall an erased location or store in read-only location No. 99
12	Frequency error: attempting to set an illegal voltage range or any frequency entry
13	Level error: attempting to set an illegal input voltage range
14	Distortion error: attempting to set an illegal input range, notch frequency, or distortion range
15	SINAD error: attempting to set an illegal input range or SINAD range
17	Ratio error: attempting to enter an analyzer setting while in the ratio mode
18	Ratio error: ratio display overrange
19	Ratio error: unable to enter ratio mode while displaying notch tune frequency
20	Illegal units for active function
21	Buffer overflow: too many key entries for display or IEEE-488 buffer overflow
22	IEEE-488 bus error: non existent mnemonic
23	IEEE-488 bus error: illegal Learn string format
24	IEEE-488 bus error: illegal Burst string format
25	Sweep error: start and stop units are not compatible
26	Sweep error: start and stop values are equal
30-34	Hardware error: unable to Frequency lock
40	Auto cal error: unable to calibrate post-notch rms detector
41	Auto cal error: unable to calibrate average detector
42	Auto cal error: unable to calibrate input rms detector
43	Auto cal error: unable to calibrate DC detector at full scale
44	Auto cal error: unable to calibrate quasi-peak detector
45	Auto cal error: unable to calibrate option filter No. 1
46	Auto cal error: unable to calibrate DC detector offset
47	Auto cal error: unable to calibrate option filter No. 2
50-92	Diagnostic error codes. See Table 5-23 for description

3-70. Calibration and Test Functions. Codes 20 through 39 are used in calibration, testing and trouble-shooting of the Model 1121A. These functions can be disabled using Option switch A4S1-4 to prevent accidental use resulting possible loss of current calibration and memory data.

3-71. S/N Delay Functions. Codes 40 through 49 provide user configurable delay between the signal measurement and noise measurement. The delay allows time for a device under test to respond to the change in output level during the signal-to-noise measurement cycle.

3-72. Frequency Sweep Resolution Functions. Codes 50 through 59 allow selection of linear or logarithmic frequency sweep modes and logarithmic sweep resolution. The default mode after initialization is code 55.

3-73. Sweep Rate Functions. Codes 60 through 69 allow selection of the delay for each sweep step. The delay is based on the number of consecutive analyzer measurements before a data point is plotted. The default mode after initialization is code 63.

3-74. AC Detector Selection Functions. Codes 70 and 71 are used as an alternate mode for selection of the AC detector type. The default mode after initialization is the rms detector, code 70.

3-75. Source Impedance Selection Functions. Codes 75 through 77 are used for selection of the source output impedance. The default mode after initialization is 600 ohms, code 77.

3-76. dBV/dBm Display Mode Functions. Codes 80 through 86 are used to select the reference used to calculate the logarithmic display value. All logarithmic levels will be displayed in the form selected. The default mode after initialization is code 80, dBV.

3-77. Option Switch, A4S1, Operation. Several of the Model 1121A operating features are internally programmable by setting bit switch A4S1. Gaining access to the switch requires that the cover be removed. The option switch consists of eight separate switches which change the operating conditions of the Model 1121A. Some of the option switch functions can be altered using the special functions 1 through 8. Table 3-8 list the individual switches and their function.

3-78. Positions 1 and 2 of A4S1 are used for end-of-string (EOS) control for the IEEE-488 bus. End-or-Identify (EOI) is always recognized and asserted in addition to the EOS characters selected. Position 3 determines the pen-up active state of the PEN output on the rear panel. Position 4 is available to restrict the use of special functions 20 through 39. These special functions are associated with calibration and repair of the instrument. Position 5 determines the operation of the IEEE-488 SRQ function. When enabled the SRQ line will be set true if the SRQ key is depressed or if the instrument is in the remote condition and an error is generated. Position 6 determines the auto-recall function. Normally the REC key must be depressed in order to recall any program location. When enabled the auto-recall function automatically performs the REC function when using the step keys to increment or decrement the PRGM function. However, entering a program location directly using the DATA ENTRY keypad requires that the REC key be depressed to execute the recall function. Positions 7 and 8 are used for test modes. When the lamp test is selected the display LEDs, display legends, and key LEDs with the exception of the LEVEL and SOURCE function keys will be constantly illuminated. The remaining function keys will be illuminated in sequence.

3-79. Error Codes. Error codes and descriptions for the Model 1121A are listed in Table 3-9. The error codes will appear in the SOURCE display window and will be returned by the talk-status (TS) IEEE-488 bus function if executed. The SRQ status byte will consist of the error code expressed in excess sixty-four. The status code 64 decimal means the SRQ was activated by the front panel SRQ key rather than an error.

3-80. REMOTE OPERATION.

3-81. Any front-panel operation of the instrument with the exception of the LINE ON/OFF switch can be remotely controlled under direction of an IEEE-488 interface controller.

3-82. Setting the Bus Address. To set the IEEE-488 bus address (MLTA), depress the ADRS key, enter the address number by means of the DATA ENTRY keypad and use the ENTER key to complete the entry. The address may be any decimal number from 0 to 30, inclusive. A secondary address is not implemented.

3-83. Entering the Remote Mode. The instrument is put in the remote mode by addressing it as a listener with remote enable (REN) true. In the remote state the keyboard is disabled, except for the LCL/INIT key and the POWER ON/OFF switch, and the REM status annunciator is illuminated.