California Instruments

Lx Series
Power Systems
3-18 kVA Programmable AC and DC Power Source / Analyzer

CE

Backward Compatible
Compatible with HP6834B & iL Series AC Sources Function & bus compatible with the Agilent HP6834B & California Instruments iL Series

Three phase and Single phase modes
Ideally suited for avionics and defense applications

3 KVA to 18 KVA Power LeveLx
Match power source and cost to application requirements

Arbitrary Waveform Generator
Test products for harmonics susceptibility

Built-in Power Analyzer
Performs voltage and load current harmonic analysis and waveform acquisition

Standard IEEE-488, USB & RS232
Remote control interface for ATE system integration included

Advanced Features
Options available to add arbitrary waveform generation, harmonic analysis, GPIB

Integrated System

The Lx Series represents a modern AC power source that addresses increasing demands on test equipment to perform more functions at a lower cost. By combining a flexible AC power source with a harmonic power analyzer, the Lx Series systems are capable of handling applications that would traditionally have required multiple instruments.

The sleek integrated approach of the Lx Series avoids the cable clutter that is commonly found in AC test setups. All connections are made internally and the need for external digital multimeters, power harmonics analyzer and current shunts is completely eliminated.

Using a state of the art Digital Signal Processor in conjunction with precision A/D converters, the Lx Series provides more accuracy and resolution than can be found in most dedicated harmonic power analyzers. Since many components in the Lx Series are shared between the AC source and the power analyzer, the total cost of the integrated system is less than the typical cost of a multiple unit system.

Easy To Use ControLx

The Lx Series is completely microprocessor controlled and can be operated from a simple front panel keypad. An analog control located next to the backlit alphanumeric LCD display allows output voltage and frequency to be slewed up or down dynamically. The control employs a dynamic rate change algorithm that combines the benefits of precise control over small parameter changes with quick sweeps through the entire range. A keypad makes precise entries simple.

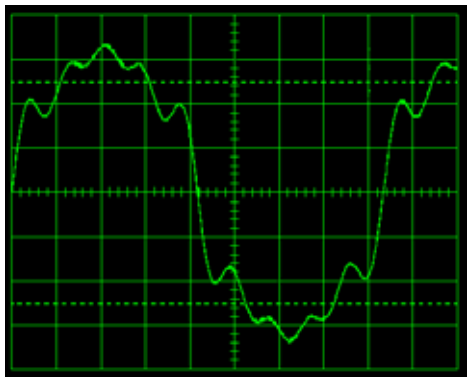
Applications

With precise output regulation and accuracy, high load drive current, multi or single phase mode and built-in power analyzer measurement capabilities, Lx Series AC source/analyzers address many application areas for AC power testing. Additional features, like line arbitrary waveform generation and available DO 160, MIL 704, or Airbus test standards, make the Lx Series a good choice for avionics or defense applications. All Lx Series AC sources are equipped with IEEE-488 (GPIB), USB and RS232C remote control interfaces and support SCPI command language programming. An ethernet interface option is available.

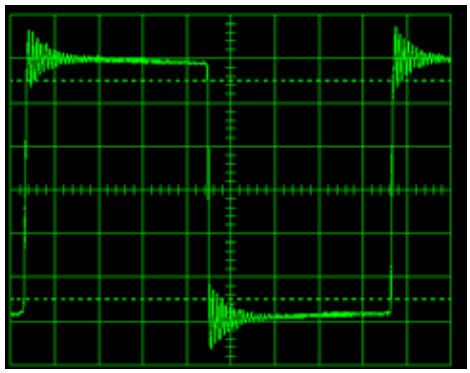
HP6834B Compatibility

The Lx Series offers functional and bus compatibility with the Agilent HP6834B AC power sources as well as the CI iL Series AC power sources and may be used in existing test systems without the need to modify program code.

Lx Series - AC Transient Generation



Harmonic waveform, Fund., 3rd, 5th, 7th and 9th.



Simulation of severe ringing on the output of a UPS.

Standard Waveforms

The Lx Series provides three standard waveforms that are always available for output. The standard waveforms are:

- Sinewave for normal AC applications.
- Squarewave for special applications.
- Clipped Sinewave - Simulates THD leveLx to test for harmonic distortion susceptibility.

In addition to these standard waveforms, user defined waveform can be downloaded over the bus.

Harmonic Waveform Generation

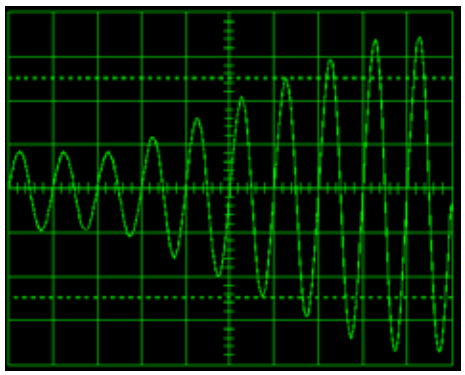
Using the latest DSP (Digital Signal Processing) technology, the Lx Series controller is capable of generating harmonic waveforms to test for harmonics susceptibility of a unit under test. With the help of the supplied Windows Graphical User Interface program, defining harmonic waveforms is as easy as specifying the relative amplitude and phase angle for each of up to 50 harmonics. The waveform data points are generated and downloaded by the GUI to the AC source through either IEEE-488 or RS232C bus and remain in non-volatile memory. Up to twelve waveforms can be stored and given a user defined name for easy recall.

Arbitrary Waveform Generation

Using the provided GUI program or custom software, the user aLxo has the ability to define arbitrary waveform data. Complex AC voltage anomalies can be simulated this way. The GUI program provides a catalog of custom waveforms and aLxo allows real-world waveforms captured on a digital oscilloscope to be downloaded to one of the AC source's waveform memories.

Downloaded waveforms are retained in non-volatile memory for recall over the bus or from the front panel. User defined waveform names make it easy to recall the desired waveform when needed.

Lx Series - Configuration Options



Voltage sweep transient causes output voltage to change at a programmed rate.

Transient Programming

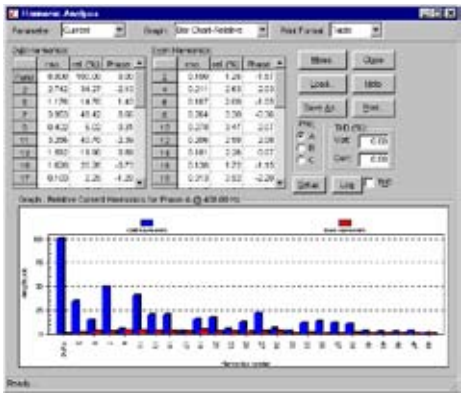
To simulate common line disturbance occurrences, the Lx Series offers a list of transient steps. These steps can be programmed from the front panel or downloaded over the interface using the GUI program supplied. The GUI allows libraries of commonly used line disturbances to be created on disk for quick recall. Once downloaded, the transient program can be executed from the PC or from the front panel.

AC transient generation allows the effect of rapid changes in voltage, frequency, phase angle and waveform shape on the unit under test to be analyzed. The combination of transients and user defined arbitrary waveforms creates a powerful test platform for AC powered products.

Lx Series - Measurement and Analysis

The Lx Series measurement system is based on real-time digitization of the voltage and current waveforms using a 4K sample buffer. The digitized waveform data is processed by a Digital Signal Processor to extract conventional load values such as rms voltage, rms current, real and apparent power. The same data is aLxo used to perform Fast Fourrier Transformation (FFT) to extract the harmonic amplitude and phase angle of 50 harmonics.

Standard measurements for all phases.



Relative Current Harmonics shown in table and chart.

Soft front panel control through Windows GUI.

Standard Measurements

The following standard measurements are available from the front panel or via the bus:

- Frequency and Phase
- Voltage (rms)
- Current(rms) and Peak Current
- Crest Factor
- Neutral Current (rms)
- Real Power and Apparent Power
- Power Factor

Advanced Measurement Functions

In addition to standard load parameters, the Lx Series is capable of measuring voltage and current amplitude and phase harmonics up to the 50th harmonic (for fundamental frequencies up to 250 Hz). Total harmonic distortion of both voltage and current is aLxo available.

Harmonic analysis data can be displayed on the front panel display or on the PC using the GUI program. The GUI can aLxo be used to save and print harmonics data in tabular, bar graph or time domain formats.

The acquired voltage and current time-domain waveforms for each output phase can be displayed using the GUI program. Waveform displays on the PC include voltage and current combined, three phase voltage, three phase current and true power. The time-domain data is aLxo available for transferr to a PC through IEEE-488, USB, RS232C, or Ethernet (option) when using custom software.

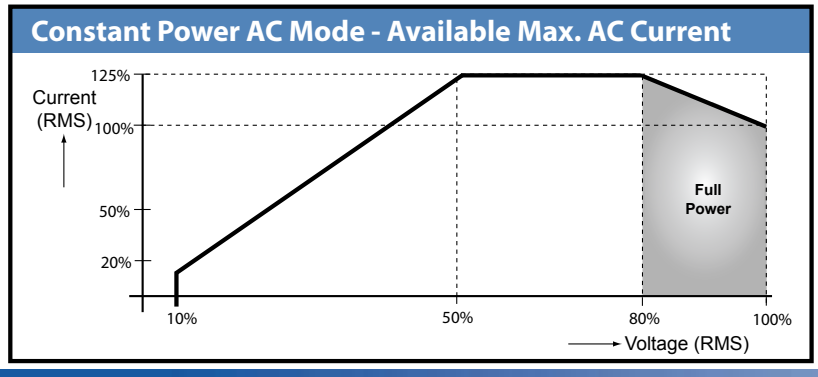
Diagnostics Capability

The AC Source can perform a self test and report any errors. The self test will run until the first error is encountered and terminate. The response to the self test query command will either be the first error encountered or 0 if no error was found. (Self test passed).

Windows Graphical User Interface

A Windows Vista/2000/XP™ compatible Instrument Control Software (ICS) offers a soft front panel interface for operation from a PC. The following functions are available:

- Steady state output control (all parameters).
- Create, run, save and print transient programs.
- Generate and save harmonic waveforms.
- Generate and save arbitrary waveforms.
- Download data from a digital storage oscilloscope.
- Measure and log standard measurements.
- Capture and display Voltage and Current waveforms.
- Measure, display, print and log harmonic voltage and current measurements.



Lx Series - Measurement and Analysis

Output

Maximum Power per phase:	3000Lx: 1 phase: 3000 VA, 3 phase: 1000 VA; 4500Lx: 1 phase 4500 VA, 3 phase 1500 VA; 6000Lx: 1 phase 5770 VA, 3 phase: 1923 VA
Power factor:	0 to unity at full output VA

Voltage Ranges:

Range:	V Low	V High
AC	0-150 V	0-300 V

See -HV and EHV options for alternative voltage range pairs.

VA Programming Resolution:	100 mV
Load Regulation:	< 0.1 % FS
Line Regulation:	< 0.02 % for 10 % line change

Programming Accuracy (25°C ±5°C):	Voltage (rms): ± (0.05% + 0.25) V from 5.0 V to FS; Frequency: ± 0.025 45 Hz - 819.1 Hz, ± 0.7 % > 819.1 Hz; Phase: ± 1° 45-100 Hz, ± (1° + 1°/kHz) 100 Hz-1kHz
Frequency Range:	6000Lx - 45 Hz - 1000 Hz (see -HF option for higher output frequencies)
Frequency Resolution:	0.01 Hz at < 81.9 Hz, 0.1 Hz at 82.0 to 819.1 Hz, 1 Hz at > 819 Hz

Max RMS Current:

V Range	V high	V low	< At Full Power	Model	3000Lx - 3 Ø	3000Lx - 1 Ø	4500Lx - 3 Ø	4500Lx - 1 Ø	6000Lx - 3 Ø	6000Lx - 1 Ø
-3 3 ø	6..4 A	12.8 A	At FS Voltage >	V Low	6.6 A	20.0 A	10.0 A	30.0 A	19.2 A	38.4 A
-1 1 ø	19.2 A	38.4 A		V High	3.3 A	10.0 A	5.0 A	15.0 A	6.4 A	12.8 A

Note: Constant power mode on 3000Lx and 4500Lx provides increased current at reduced voltage; 6000Lx provides maximum voltage.

Current Limit:	Programmable from 0 Amps to maximum current for selected range		
Peak Current:	3000Lx: 5.7 X (Irms @ full scale voltage); 4500Lx: 3.8 X (Irms @ full scale voltage); 6000Lx: 3 X (Irms @ full scale voltage)		
Output Noise:	100mV rms typ. (20 kHz to 1 MHz)	Harmonic Distortion:	< 1% (at full scale voltage, full resistive load)
Isolation Voltage:	300 V rms output to chassis	Output Relay:	Push button controlled and bus controlled output relay

Input

Voltage:

ModeLx 3000Lx, 4500Lx, 9000Lx, 13500Lx: Standard: 208-230 ± 10% VAC, (L-L, 3 Phase); Option -400: 400 ± 10% VAC (L-L, 3 Phase); ModeLx 6000Lx, 12000Lx, 18000Lx: Standard 208-230 + 10% VAC (L-L, 3 Phase)

Notes: 1. Input must be specified when ordering. 2. -400 option not availble on 6000Lx, 12000Lx, 18000Lx. 3. 3000Lx can be operated from 1 phase AC.

Line Current (rms per phase):

Model	3000Lx	3000Lx (1Phase)	4500Lx	6000Lx (@ 280V)
187 VLL	19 A	32 A	31 A	38 A
360 VLL	10 A	n/a	16 A	n/a

Inrush Current (Per phase):	@ 180-254 V: 50 A peak @ 360-440 V: 83 A peak
Line Frequency:	47-440 Hz

Efficiency:	75% typical	Power Factor:	0.6 typical	Hold-up Time:	At least 10 ms

Measurement

Measurements - Standard *(AC Measurements):*

Parameter	Frequency	Phase	Voltage (AC)	Current (AC rms)	Real Power	Apparent Power	Power Factor
Range	45-81.91 Hz 82.0-819.1 Hz > 819 Hz	45-100 Hz 100-1000 Hz	0-300 V	0-50 A	0-6 kW	0-6 kVA	0.00-1.00
Accuracy* (±) 1 ø mode (-1)	0.1% + 1 digit	0.5° 2°	0.5% + 250 mV	0.1% + 150 mA	0.15% + 9 W	0.15% + 9 VA	0.03
3 ø mode (-3)				0.1% + 50 mA	0.15% + 3 W	0.15% + 3 VA	0.01
Resolution*	0.01 Hz / 0.1 Hz / 1 Hz	0.1° / 1°	10 mV	1 mA	1 W	1 VA	0.01

* Accuracy specifications are in % of reading and apply above 100 counts. For multi-chassis configurations, current, power range and accuracy specifications are times three. Power factor accuracy applies for PF > 0.5 and VA > 50% of max. Frequency measurement specification valid for output > 30 Vrms.

System

Storage:	Setup: 16 complete instrument setups / Transient List: 100 transient steps per list (SCPI mode) or 16 transient registers (APE mode)
Trigger Input/Output:	Input: Triggers measurements or transient steps - SMA connector: 10K pull-up / Output: SMA Connector: HCTTL output

Protection

Overload/Temp/Voltage:	Overload: Constant current or constant voltage mode; Over temperature: Automatic Shutdown; Over voltage: Automatic shutdown
Regulatory/RFI Suppresion:	IEC1010, EN50081-2, EN50082-2, CE, EMC, and safety mark requirements / RIF Suppression: CISPR 11, Group1, Class A

Note: Specifications are subject to change without notice. Specifications are warranted over an ambient temperature range of 25°± 5° C. Unless otherwise noted, specifications are per phase for a sinewave with a resistive load and apply after a 30 minute warm-up period. For three phase configurations, all specifications are for L-N. Phase angle specifications are valid under balanced load conditions only.

Lx Series - Specifications

Remote Control

IEEE-488 Interface (option):	IEEE-488 (GPIB) talker listener. Subset: AH1, C0, DC1, DT1, L3, PP0, RL2, SH1, SR1, T6, IEEE-488.2 SCPI Syntax
USB Interface & Ethernet:	Version: USB 1.1; Speed: 460 Kb/s maximum / Ethernet Interface (Optional): specify -LAN option. 10BaseT, 100BaseT, RJ45
RS232C Interface:	Bi-directional serial interface; 9-pin D-shell connector. Handshake: CTS, RTS. Databits: 7 w/ parity, 8 w/o parity. Stopbits: 2. Baud rate: 9600 to 115200. Supplied with RS232C cable / Code and Format: SCPI; APE (option -GPIB)

Physical Dimensions

Dimensions (per chassis):	Height: 10.5" (267 mm), Width: 19" (483 mm), Depth: 23.7" (602 mm) (depth includes rear panel connectors)
Weight:	Chassis: Net: 193 lbs / 87.7 Kg, Shipping: 280 lbs / 127.3 Kg (for /2 or /3 model configuarations multiply number of chassis).
Vibration and Shock:	Designed to meet NSTA project 1A transportation leveLx
Air Intake/Exhaust:	Forced air cooling, side air intake, rear exhaust
Temperature:	Operating: 0 to 35° C, full power / Storage: -40 to +85° C
Diagnostics:	Built-in self test available over bus (*TST)
Rear Panel Connectors:	* Three phase AC input and output terminal block with safety cover. * IEEE-488 (GPIB) connector, USB connector, RJ45 connector (with -LAN Option). * 9-pin D-Shell RS232C connector (RS232 DB9 to DB9 cable supplied). * Remote Inhibit (INH) and Discrete Fault Indicator (DFI). * Remote voltage sense terminal block. * Trigger In1 and Trigger Out1. * System interface connectors. * Auxilary Output (Option -AX)

Option -AX Specifications

Option -AX	Provides seperate isolated 26 VAC regulated and 5 Vac unregulated outputs. The 26 V is normally used for servo-synchro excitation, and the 5 V for lamp power. Availble on the LX00000000000000000 modeLx. 26 Volt-Accuracy: ± 2%. Current capacity: 3 ARMS. Frequency: 360/440 Hz. Regulation ± 0.05%. 5 Volt-Accuracy: ± 5%. Current capacity: 5 ARMS

Option -ADV Specifications

Measurements - Harmonics:

Parameter	Frequency Fundamental Harmonics	Voltage	Current
Range	45-250 Hz / 0.09 - 12.5 kHz	Fundamental Harmonics 2 - 50	Fundamental Harmonics 2 - 50
Accuracy* (±)	0.01% + 1 digit / 0.5% + 1 digit	750 mV 0.3% + 750 mV+0.3% /1 kHz	0.5 A / 0.3% + 150 mA +0.3% /1 kHz
Resolution	0.01 Hz / 0.1 Hz	10 mV / 10 mV	10 mA / 10 mA

* Accuracy specifications are in a percent of reading for single unit in 3-phase mode.

Waveforms:	Pre defined: Sine, Square, Clipped User defined, 1024 addressable data points; Storage: 50 user waveforms, non-volatile memory
Data Acquisition:	Parameters: Voltage, Current time domain, per phase; Resolution: 4096 data points, 10.4 usec (1ø) or 31.25 usec (3ø) sampling interval

Option -HV Specifications

Voltage/Frequency Ranges:	Low: 0-135 Volt; High: 0-270 Volt / Frequency: With -HF option: 3000Lx, 4500Lx, 6000Lx: 45 Hz - 5000 Hz; 9000Lx, 12000Lx, 13500Lx, 18000Lx: 45 Hz - 2000 Hz
Max RMS Current at Full Power:	3 Phase: High: 7.4 A, Low 14.8 A; 1 Phase: High: 22.2 A, Low: 44.4 A; Note: Constant power modes on 3000Lx and 4500Lx. Current available at reduced voltage for 3000Lx, 4500Lx, and max voltage for 6000Lx
Max RMS Current at FSVoltage:	3000Lx: 3 Phase: High: 3.7 A, Low: 7.4 A; 1 Phase: High 11.1 A, Low: 22.2 A; 4500Lx: 3 Phase: High: 5.6, Low 11.1; 1 Phase: High: 16.7 A, Low: 33.3 A; 6000Lx: 3 Phase: High: 7.4 A, Low 14.8 A; 1 Phase: High: 22.2 A, Low: 44.4 A

Option -EHV Specifications

Voltage/Frequency Ranges:	Voltage: Low: 0-200 Volt; High: 0-400 Volt / Frequency: With -HF option: 45 Hz - 2000 Hz
Max RMS Current at Full Power:	3 Phase: High: 5.0 A, Low 10.0 A; 1 Phase: High: 15.0 A, Low: 30.0 A; Note: Constant power modes on 3000Lx and 4500Lx. Current available at reduced voltage for 3000Lx, 4500Lx, and max voltage for 6000Lx
Max RMS Current at FS Voltage:	3000Lx: 3 Phase: High: 2.5 A, Low: 5.0 A; 1 Phase: High 7.5 A, Low: 15.0 A; 4500Lx: 3 Phase: High: 3.8, Low 7.5; 1 Phase: High: 11.3 A, Low: 22.5 A; 6000Lx: 3 Phase: High: 5.0 A, Low 10.0 A; 1 Phase: High: 15.0 A, Low: 30.0 A

Option -HF Specifications

Measurements:

F < 2000 Hz: See standard Lx Specifications;

F > 2000 Hz: See table >

Parameter	Frequency	Phase	Voltage (AC)	Current (AC rms)	Real Power	Apparent Power	Power Factor
Range		< 2000 Hz > 2000 Hz	0-300 V < 1000 Hz / > 1000 Hz	0-50 A	0-5 kW	0-5 kVA	0.00-1.00
Accuracy* (±) 1 ø mode (-1) 3 ø mode (-3)	0.1% + 1 digit	0.5° 5°	0.05% + 250 mV 0.1 % + 0.1%/kHz + 300MV	0.5% + 150 mA 0.5% + 50 mA	0.5% + 9 W 0.5% + 3 W	0.5% + 9 VA 0.5% + 3 VA	0.03 0.01
Resolution*	0.01 Hz / 0.1 Hz / 1 Hz	0.1° / 1°	10 mV	1 mA	1 W	1 VA	0.01

* Accuracy specifications are in % of reading and apply above 100 counts. For multi-chassis configurations, current, power range and accuracy specifications are times three. Power factor accuracy applies for PF > 0.5 and VA > 50% of max. Frequency measurement specification valid for output > 30 Vrms.

Note: Specifications are subject to change without notice. Specifications apply at 25° ± 5°C ambient temperature range. Unless otherwise noted, specifications are per output phase for sinewave with a resistive load and apply after a 30 minute warm-up period. For three phase configurations, all specifications are for L-N. Phase angle specifications are valid under balanced load conditions only.

Frequency Range:	3000Lx 34500Lx, 6000Lx: Standard: -HV 45 Hz- 5000 Hz; - EHV: 45 Hz - 2000 Hz; All other modeLx: 45 Hz - 2000 Hz
Output Noise:	250 mVrms typical (20 kHz to 1 MHz)

California Instruments

Ordering Information

Model[1]	Output Power	No of Output Phases -1	-3	Nom. Input Voltage[2]
3000Lx	3 kVA	1	3	208-230 V
3000Lx-400	3 kVA	1	3	400 V
4500Lx	4.5 kVA	1	3	208-230 V
4500Lx-400	4.5 kVA	1	3	400 V
6000Lx	6 kVA	1	3	208-230 V
9000Lx/2	9 kVA	1	3	208-230 V
9000Lx/2-400	9 kVA	1	3	400 V
12000Lx/2	12 kVA	1	3	208-230 V
13500Lx/3	13.5 kVA	1	3	208-230 V
13500Lx/3-400	13.5 kVA	1	3	400 V
18000Lx/3	18 kVA	1	3	208-230 V

Note 1: The /2 or /3 designation indicates number of chassis.

Note 2: All input voltage specifications are for Line to Line three phase, delta or wye. Model 3000Lx (208 V input) can be operated on 230 V L-N single phase if needed.

Ordering Information

Model

Refer to table shown for model numbers and configurations. Specify number of output phases (-1 or -3) as part of model number, eg 4500Lx-1 or 4500Lx-3.

Supplied with

User / Programming Manual on CD-ROM, Software and RS232C serial cable.

Options

Input Options

-400 400 ±10% Volt Line to Line AC input. [Not available on 6000Lx, 12000Lx and 18000Lx ModeLx]

Output Options

-AX[1] Auxiliary outputs, 26 VAC, 5 VAC. Limits upper frequency to 800 Hz.

-HV[1] 156/312 V output range.

-EHV[1] 200/400 V output range.

-HF[1] Extends upper frequency limit. See HF table.

HF Table Model	Max. Freq.
3000Lx 4500Lx 6000Lx	5000 Hz
9000Lx/2 12000Lx/2 13500Lx/3 18000Lx/3	2000 Hz

-LF[1] Limits output frequency to 500 Hz.

Keypad Options

-KPD Upgraded keypad control panel.

Controller Options

-160 RTCA/DO-160D, Change 2, EuroCAE-14D and Airbus test firmware [Section 16, AC only. Refer to -160 option data sheet for detaiLx]

-704 Mil-Std 704 rev D and E test firmware. [AC only, Refer to -704 option data sheet for detaiLx]

Note 1: See option matrix

Note2 : -LKS, -LNS and -EXS are mutually exclusive and with Ext Trig function.

Feature Comparison

-ABD Airbus Directive 0100.1.8 tests. [AC only]. Requires -ADV and use of Windows PC and included LxGui software.

-ADV Advanced feature set. Adds arbitrary waveform generation and harmonic analysis of voltage and current.

-GPIB GPIB interface and APE programming language.

-LAN Ethernet Interface.

-MB Multi-box. Adds controller to auxiliary chassis of multi-chassis systems.

-MODE Adds phase mode selections for -3 modeLx.

-L22 Locking Knobs.

-LKM[1] Clock and Lock Master

-LKS[1,2] Clock and Lock Auxiliary

-LNS[2] Line Sync.

-EXS[2] External Sync.

Cabinet Options

-RMS Rackmount Slides. Recommended for rack mount applications.

C prefix Cabinet System. Installed and pre-wired in 19" cabinet.

Option Matrix:

Note that some options are mutually exclusive as indicated in the table below. An 'o' means the options can be combined. An 'x' means they cannot.

	HF	LF	HV	EHV	LKM	LKS	EXS	AX
HF	-	x	o	o	x	x	o	x
LF	x	-	o	o	o	o	o	o
HV	o	o	-	x	o	o	o	o
EHV	o	o	x	-	o	o	o	o
LKM	x	o	o	o	-	x	o	o
LKS	x	o	o	o	x	-	x	o
EXS	o	o	o	o	o	x	-	o
AX	x	o	o	o	o	o	o	-

9689 Towne Centre Drive, San Diego, CA 92121-1964 ● (858) 677-9040 ● FAX: (858) 677-0940 ● sales@calinst.com

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