Power Source / Analyzer

- Single Box AC Power System. Combines AC & DC power source, digital scope and power analyzer in one instrument
- DC Output Capability Use same instrument for DC output
- 3000 VA to 15000 VA AC Power Levels Match power source and cost to application requirements
- Arbitrary Waveform Generator Test products for harmonics susceptibility
- Built-in DSP based Power Analyzer Performs voltage and load current analysis on all phases
- Programmable Output Impedance Simulate real-world line conditions
- High Crest Factor Capability Drives a wide variety of non-linear loads
- CE Marked Safe, reliable and consistent operation

Integrated System

The iX Series represents a new type of AC and DC 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 high end power analyzer, the iX Series systems are capable of handling applications that would traditionally have required multiple instruments.

The sleek integrated approach of the iX 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 or clamps is completely eliminated.

Using a state of the art digital signal processor in conjunction with precision high resolution A/D converters, the iX Series provides more accuracy and resolution than can be found in some dedicated harmonic power analyzers. Since many components in the iX 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 Controls

The iX Series is completely microprocessor controlled and can be operated from an easy to use front panel keypad. Functions are grouped logically and are directly accessible from the keypad. This eliminates the need to search through various levels of menus and or softkeys.

A large analog control knob can be used to quickly slew output parameters. This knob is controlled by a dynamic rate change algorithm that combines the benefits of precise control over small parameter changes with quick sweeps through the entire range.

Applications

With precise output regulation and accuracy, high load drive current, multi or single phase output mode and built-in power analyzer measurement capabilities, iX Series AC and DC source/analyzers address all application areas for AC and DC power testing. Additional features like line distortion simulation (LDS), arbitrary waveform generation and programmable output impedance address requirements for product quality and regulatory compliance testing.

Waveform Acquisition

Voltage and current waveform data can be acquired on all three phases and shown on the LCD display. Applications include inrush current measurement and load characterization.
Product Evaluation and Test

Increasingly, manufacturers of electronic equipment and appliances are required to fully evaluate and test their products over a wide range of input line conditions. The built-in Line Distortion Simulation and load measurement system combines all needed source and measurement functions in an easy to use system.

Avionics

With an output frequency range to 500 Hz, the iX Series is well suited for aerospace applications. Precise frequency control and accurate load regulation are key requirements in these applications. The standard IEEE-488 control interface and SCPI command language provide for easy integration into existing ATE systems. Since the iX Series can eliminate the need for three or four items of instrumentation and only occupies 7 inches of rack space, cost and space savings provide a rapid return on investment. Instrument drivers for popular programming environments such as National Instruments LabView® are available to speed up system integration.

Regulatory Testing

As governments are moving to enforce product quality standards, regulatory compliance testing is becoming a requirement for a growing number of manufacturers. The iX Series is designed to meet AC source requirements for use in Euronorm IEC-1000 compliance testing. For flicker testing, the programmable output impedance capability of the 3001iX, 5001iX and 15003iX can be used to create the required IEC 725 reference impedance.

Multi-Box Configurations

For high power applications, two or three 5001iX chassis can be combined to provide 10 to 15 kVA of single phase power.

A 15003iX three phase configuration can be ordered with the Mode-iX option. This option allows automatic switching between single or three phase output mode. In single phase mode, all current is available on phase A. The Mode-iX option switches the output from all three 5001iX amplifiers to a single output connector. Without the Mode-iX option, 15003iX systems are configured for three phase operation.

High Crest Factor

With a crest factor of up to 5:1, the iX Series AC source / analyzers can drive difficult non-linear loads with ease. Since many modern products use switching power supplies, they have a tendency to pull high repetitive peak currents. If the AC power source used to test these products has insufficient peak current drive capability, the waveform exhibits voltage distortion. The 5001iX can deliver up to 110 Amps of repetitive peak current (low range) to avoid this problem.

Remote Control

Standard IEEE-488 and RS232C remote control interfaces allow programming of all instrument functions from an external computer. The popular SCPI command protocol is used for programming. Drivers for several popular instrumentation programming environments are available to facilitate systems integration of the iX Series.

Application Software

Windows® application software is provided free of charge with the iX Series. This software provides easy access to the iX Series’ many powerful capabilities without the need to develop any custom code. The following functions are available through this GUI program:

- Steady state output control (all parameters)
- Create, run, save, reload 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
- Run IEC 1000-4-11, IEC 1000-4-14 and IEC 1000-4-28 test programs
- Display IEEE-488 or RS232C bus traffic to and from the AC Source to help you develop your own test programs

1 Requires PC running Windows Win95/98® or WinNT 4.0®. Recommended Pentium 233 MHz or better.
Harmonic Waveform Generation

Using the latest DSP (Digital Signal Processing) technology, the iX Series controller is capable of generating harmonic waveforms to test for harmonics susceptibility of a unit under test. Included is a Graphical User Interface program that can be used to define harmonic waveforms by specifying amplitude and phase for up to 50 harmonics. The waveform data points are generated and downloaded by the GUI to the AC source through either the IEEE-488 or RS232C bus and remain in nonvolatile memory. Up to 200 waveforms can be stored and given a user defined name for easy recall.

The three phase configuration iX Series offers independent waveform generation on each phase allowing three phase anomalies to be programmed. It also allows simulation of unbalanced harmonic line conditions.

Arbitrary Waveform Generation

Using the provided GUI program or custom software, the user also has the ability to define arbitrary AC waveforms. The arbitrary waveform method of data entry provides an alternative method of specifying AC anomalies by providing specific waveform data points. The GUI program provides a catalog of custom waveforms and also allows real-world waveforms captured on a digital oscilloscope to be downloaded to one of the many AC source’s waveform memories.

Arbitrary waveform capability is a flexible way of simulating the effect of real-world AC power line conditions on a unit under test in both engineering and production environments.

The iX Series controller has a powerful AC and DC transient generation system that allows complex sequences of voltage, frequency and waveshapes to be generated. This further enhances the iX’s capability to simulate AC line conditions or DC disturbances. When combined with the multiphase arbitrary waveform capabilities, the AC and DC output possibilities are truly exceptional. In three phase iX system configurations, transient generation is controlled independently yet time synchronized on all three phases. Accurate phase angle control and synchronized transient list execution provide unparalleled accuracy in positioning AC output events.

Transient programming is easily accomplished from the front panel where clearly laid out menu’s guide the user through the transient definition process.

The front panel provides a convenient listing of the programmed transient sequence and allows for transient execution Start, Stop, Abort and Resume operations. User defined transient sequences can be saved to non-volatile memory for instant recall and execution at a later time.

The included Graphical User Interface program supports transient definitions using a spreadsheet-like data entry grid. A library of frequently used transient programs can be created on disk using this GUI program.
The iX Series is much more than a programmable AC and DC power source. It also incorporates an advanced digital signal processor based data acquisition system that continuously monitors all AC source and load parameters. This data acquisition system forms the basis for all measurement and analysis functions. These functions are accessible from the front panel and the remote control interface.

### Conventional Measurements
Common AC and DC measurement parameters are automatically provided by the data acquisition system. These values are displayed in numeric form on the front panel LCD display. The following measurements are available:
- Frequency, $f$
- $V_{rms}$
- $I_{rms}$
- $I_{pk}$
- Crest Factor
- Real Power, $P$
- VA Power
- Power Factor

### Harmonic Analysis
The iX Series provides detailed amplitude and phase information on up to 50 harmonics of the fundamental voltage and current for either one or three phases. Harmonic content can be displayed in both tabular and graphical formats on the front panel LCD for immediate feedback to the operator. Alternatively, the included GUI program can be used to display, print and save harmonic measurement data. Total harmonic distortion of both voltage and current is calculated from the harmonic data.

### Waveform Acquisition
The measurement system is based on real-time digitization of the voltage and current waveforms using a 4K deep sample buffer. This time domain information provides detailed information on both voltage and current waveshapes. Waveform acquisitions can be triggered at a specific phase angle or from a transient program to allow precise positioning of the captured waveform with respect to the AC source output. The front panel LCD displays captured waveforms with cursor readouts. The included GUI program also allows acquired waveform data to be displayed, printed and saved to disk.

### CE Mark
The iX Series power sources (-400 models) have been fully tested for compliance with 1997 CE Mark requirements. This allows these products to be used throughout the European Economic Community.
Operating Modes
AC, DC or AC + DC

AC Mode Output
Frequency
16.00 Hz - 500.0 Hz
Power
Maximum AC power per phase at full scale voltage:

<table>
<thead>
<tr>
<th>Model</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001iX</td>
<td>3000 VA</td>
</tr>
<tr>
<td>5001iX</td>
<td>5000 VA</td>
</tr>
<tr>
<td>10001iX</td>
<td>10000 VA</td>
</tr>
<tr>
<td>15001iX</td>
<td>15000 VA</td>
</tr>
<tr>
<td>15003iX</td>
<td>5000 VA/ø 3ø</td>
</tr>
<tr>
<td></td>
<td>15000 VA/ø 1ø</td>
</tr>
</tbody>
</table>

Power Factor
0 to unity at full output VA

AC Voltage
Ranges
User selectable voltage range pairs:

<table>
<thead>
<tr>
<th>Range:</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Vrms</td>
<td>135 V</td>
<td>270 V</td>
</tr>
<tr>
<td>Max Vrms</td>
<td>150 V</td>
<td>300 V</td>
</tr>
</tbody>
</table>

Load Regulation
± 0.5% DC to 100 Hz
± 0.6 % 100 Hz to 500 Hz in high voltage range
± 2.2 % 100 Hz to 500 Hz in low voltage range

Line Regulation  < ± 0.1% for 10 % line change

Output Noise  < 250 mVrms typ.
(20 kHz to 1 MHz)  < 500 mVrms max.

Harmonic Distortion (linear load)
Less than 1% from 16 - 66 Hz
Less than 2% at 400 Hz

DC Offset  < 20 mV

External Modulation
depth: 0 - 10 %

Isolation Voltage
300 Vrms output to chassis

AC Current
Peak Repetitive AC Current

<table>
<thead>
<tr>
<th>Model</th>
<th>High range</th>
<th>Low range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001iX</td>
<td>96.0</td>
<td>110.0</td>
</tr>
<tr>
<td>5001iX</td>
<td>96.0</td>
<td>110.0</td>
</tr>
<tr>
<td>10001iX</td>
<td>192.0</td>
<td>220.0</td>
</tr>
<tr>
<td>15001iX</td>
<td>288.0</td>
<td>330.0</td>
</tr>
<tr>
<td>15003iX</td>
<td>288.0</td>
<td>330.0</td>
</tr>
<tr>
<td></td>
<td>96.0</td>
<td>110.0</td>
</tr>
</tbody>
</table>

Programming Accuracy
Voltage (rms): ± 0.5 % of range, 16 to 400 Hz
Frequency: ± 0.01 % of programmed value.
Current Limit: - 0 % to + 7 % of programmed value + 0.5 A.
Phase: < 1.5° with balanced load @ 50/60 Hz.

Programming Resolution
Voltage (rms): 100 mV
Frequency:
0.01 Hz from 16 Hz to 81.91 Hz
0.1 Hz from 82.0 Hz to 500.0 Hz
Current Limit:
0.1 A for 5001iX and 15003iX.
1.0 A for 10001iX and 15001iX.
Phase: 0.1°

Standard Measurements (5001iX)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Accuracy (±)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>16.00 - 500.0 Hz</td>
<td>0.01% + 0.01 Hz</td>
<td>0.01 Hz</td>
</tr>
<tr>
<td></td>
<td>&lt; 100 Hz</td>
<td>100 - 500 Hz</td>
<td></td>
</tr>
<tr>
<td>RMS Voltage</td>
<td>0 - 330 V</td>
<td>50 mV</td>
<td>10 mV</td>
</tr>
<tr>
<td>RMS Current</td>
<td>0 - 40 A</td>
<td>50 mA</td>
<td>1 mA</td>
</tr>
<tr>
<td>Peak Current</td>
<td>0 - 119 A</td>
<td>50 mA</td>
<td>1 mA</td>
</tr>
<tr>
<td>Crest Factor</td>
<td>0.000 - 6.000</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Real Power</td>
<td>0 - 6 kW</td>
<td>5 W</td>
<td>1 W</td>
</tr>
<tr>
<td>Apparent Power</td>
<td>0 - 6 kVA</td>
<td>10 VA</td>
<td>1 VA</td>
</tr>
<tr>
<td>Power Factor</td>
<td>0.00 - 1.00</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>DC Measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Voltage</td>
<td>0 - 420 V</td>
<td>500 mV</td>
<td>10 mV</td>
</tr>
<tr>
<td>DC Current</td>
<td>0 - 120 A</td>
<td>500 mA</td>
<td>1 mA</td>
</tr>
<tr>
<td>Power</td>
<td>0 - 6 kW</td>
<td>50 W</td>
<td>1 W</td>
</tr>
</tbody>
</table>

* Measurement system bandwidth = DC to 19.5 kHz; Accuracy specifications are valid above 100 counts. Current and Power Accuracy specifications are times two for 10001iX and times three for 15001iX. For 10001iX and 15001iX, resolution decreases by factor of 10, ranges for current and power increases by factor of three.

Harmonics Measurements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Accuracy (±)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>16.00-500.0 Hz</td>
<td>0.01% + 0.01 Hz</td>
<td>0.01 Hz</td>
</tr>
<tr>
<td>Harmonics</td>
<td>32.00 Hz - 19.5 kHz</td>
<td>0.01% + 0.1 Hz</td>
<td>0.01 Hz</td>
</tr>
<tr>
<td>Phase</td>
<td>0.0 - 360.0°</td>
<td>2° typ.</td>
<td>0.5°</td>
</tr>
<tr>
<td>Voltage</td>
<td>Fundamental</td>
<td>250 mV</td>
<td>10 mV</td>
</tr>
<tr>
<td>Harmonics</td>
<td>2 - 50</td>
<td>0.1% + 50 mV</td>
<td>10 mV</td>
</tr>
<tr>
<td>Current</td>
<td>Fundamental</td>
<td>50 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td>Harmonics</td>
<td>2 - 50</td>
<td>0.1% + 50 mV</td>
<td>10 mA</td>
</tr>
</tbody>
</table>

* Accuracy specifications are valid above 100 counts. Accuracy specifications are times three for three phase mode. Harmonics frequency range in three phase mode is 32 Hz - 6.67 kHz. Resolution decreases by factor of 10 for 10001iX and 15001iX.
Output Relay
Push button controlled or bus controlled output relay

Output impedance
Programmable Z on 3001iX, 5001iX and 15003iX for 50 Hz fundamental

Resistive:
range: 17 - 1000 mΩ
resolution: 4 mΩ
accuracy: 2 % FS

Inductive:
range: 230 - 1000 µH
resolution: 4 µH
accuracy: 2 % FS

DC Mode Output
Maximum DC power at full scale of DC voltage range:

<table>
<thead>
<tr>
<th>Model</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001iX</td>
<td>1500 W</td>
</tr>
<tr>
<td>5001iX</td>
<td>2500 W</td>
</tr>
<tr>
<td>10001iX</td>
<td>5000 W</td>
</tr>
<tr>
<td>15001iX</td>
<td>7500 W</td>
</tr>
<tr>
<td>15003iX</td>
<td>2500 W/ø 3ø</td>
</tr>
<tr>
<td></td>
<td>7500 W/ø 1ø</td>
</tr>
</tbody>
</table>

Voltage Ranges
User selectable voltage range combinations:

<table>
<thead>
<tr>
<th>Range:</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>270 V</td>
<td>135 V</td>
<td>300 V</td>
</tr>
<tr>
<td>135 V</td>
<td>150 V</td>
<td></td>
</tr>
</tbody>
</table>

Load Regulation
see AC mode

Line Regulation
see AC mode

Output Noise
< 250 mVrms Typ (20 kHz to 1 MHz) < 500 mVrms Max

Max. DC Current Capability
Maximum DC current in lowest DC range pair:

<table>
<thead>
<tr>
<th>Model</th>
<th>270 range</th>
<th>135 range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001iX</td>
<td>5.65</td>
<td>11.1</td>
</tr>
<tr>
<td>5001iX</td>
<td>9.25</td>
<td>18.5</td>
</tr>
<tr>
<td>10001iX</td>
<td>18.5</td>
<td>37.0</td>
</tr>
<tr>
<td>15001iX</td>
<td>27.75</td>
<td>55.5</td>
</tr>
<tr>
<td>15003iX</td>
<td>27.75</td>
<td>55.5</td>
</tr>
<tr>
<td></td>
<td>9.25</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Current Limit
Programmable from 0 A to max. current for selected range.

AC + DC Mode Output

Power
Full AC power if DC component is less than 20 % of full scale voltage. Full DC power if DC component is above 20 %.

IEEE-488 Interface
IEEE-488 (GPIB) talker listener. Subset: AH1, C0, DC1, DT1, L3, PP0, RL2, SH1, SR1, T6 IEEE-488.2 SCPI Syntax

RS232C Interface
9 pin D-shell connector Handshake: CTS, RTS Databits: 7,8 Stopbits: 1,2 Baud rate: 9600, 19200, 38400 IEEE-488.2 SCPI Syntax Supplied with RS232C cable

System Interface
Inputs: Remote shutdown External Sync Outputs: Function Strobe

AC Input

Voltage

Model 3001iX:
187 - 264 VAC, (L-N, 1 Phase)

All other models:
Standard:
187 - 264 VAC, (L-L, 3 Phase)
Option -400:
360 - 528 VAC, (L-L, 3 Phase)

(Input range must be specified when ordering)

Current

Input Line Current (per phase)

<table>
<thead>
<tr>
<th>Model</th>
<th>187-264V</th>
<th>360-528V</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001iX</td>
<td>30 A</td>
<td>N/A</td>
</tr>
<tr>
<td>5001iX</td>
<td>24 A</td>
<td>12 A</td>
</tr>
<tr>
<td>10001iX</td>
<td>48 A</td>
<td>24 A</td>
</tr>
<tr>
<td>15001iX</td>
<td>72 A</td>
<td>36 A</td>
</tr>
<tr>
<td>15003iX</td>
<td>72 A</td>
<td>36 A</td>
</tr>
</tbody>
</table>

Inrush Current per chassis
< 14 A rms. / 84 Apeak for 200 µs @ 187-264 V
< 8 A rms. / 36 Apeak for 400 µs @ 360-528 V

Line Frequency: 47 - 63 Hz
Efficiency: 75 % typical
Power Factor: 0.6 typical
Hold-up Time: At least 10 ms

Remote Control

Note 1: 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.
**iX Series - Specifications**

**Protection**
- Over Load
  - Constant Current or Constant Voltage mode
- Over Temperature
  - Automatic shutdown

**Regulatory**
- IEC1010, CSA22.2 No. 231, EN50081-2, EN50082-2 CE
- EMC and Safety Mark requirements

**RFI Suppression**
- CISPR 11, Group1, Class A

**Rear Panel Connectors**
- AC Input terminal block with cover
- AC output terminal block with cover
- IEEE-488 (GPIB) connector
- 9 pin D-Shell RS232C connector*
- Remote voltage sense terminal block
- System Interface Connector
  (*RS232 DB9 to DB9 cable supplied)

**Physical**
- **Dimensions per 5001iX unit**
  - Height : 7" (178 mm)
  - Width : 19" (483 mm)
  - Depth : 24" (610 mm)
  (Depth includes rear panel connectors)
- **Weight per 5001iX chassis**
  - 61 lbs / 28 Kg net
  - 80 lbs / 36 Kg shipping
- **Vibration and Shock**
  - Designed to meet NSTA project 1A transportation levels
- **Air Intake/Exhaust**
  - Forced air cooling, side air intake, rear exhaust
- **Operating Humidity**
  - 0 to 95 % RAH, non condensing.
- **Operating Temperature**
  - 0 to 40° C
- **Storage Temperature**
  - -40 to +85° C

**Ordering Information**
- **Model**
  - 3001iX
  - 5001iX
  - 5001iX -400
  - 10001iX
  - 10001iX -400
  - 15001iX
  - 15001iX -400
  - 15003iX
  - 15003iX -400
- **Line input**
  - 208 VAC L-L, 1ø
  - 208 VAC L-L, 3ø
  - 400 VAC L-L, 3ø
  - 208 VAC L-L, 3ø
  - 400 VAC L-L, 3ø
  - 208 VAC L-L, 3ø
  - 400 VAC L-L, 3ø

**Supplied with**
- User manual
- SCPI programming manual
- Rack mount handles
- Windows® Graphical User Interface software
- RS232C Serial cable

**Options**
- **Mode-iX**
  - Switches between 1 and 3 phase modes, for 15003iX only.
- **-704**
  - Mil Std 704D test firmware
- **-160**
  - RTCA/DO-160C test firmware
- **-411**
  - IEC 1000-4-11 test firmware
- **-413**
  - IEC 1000-4-13 Harmonics and Interharmonics test
- **-EOS-1**
  - IEC 1000-4-11 Electronic Output Switch (1 phase)
- **-EOS-3**
  - IEC 1000-4-11 Electronic Output Switch (3 phase)
- **-LNS**
  - Line Sync. Synchronizes output frequency to line input frequency
- **-RMS**
  - Rack mount slides

**Customer Support**
For technical support and service, or to discuss your AC power application needs, contact California Instruments Corp. or your local representative.

**Contact California Instruments:**
Toll-Free: 800-4AC-POWER
800-422-7693
FAX: 858-677-0940
Email: sales@calinst.com
Web page: http://www.calinst.com

9689 Towne Centre Drive, San Diego CA, 92121-1964
©Copyright 1997, California Instruments Corp.
Specifications subject to change without notice
Printed in the USA.