

# AC Source Analyzer

- **Single Box AC Power System.**  
*Combined AC power source and power analyzer*
- **3000VA, 4500VA or 4800VA Power Levels**  
*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*
- **Selectable Output Mode**  
*Drives single and three phase loads*
- **High Crest Factor Capability**  
*Drives a wide variety of non-linear loads*
- **CE Marked**  
*Safe, reliable and consistent operation*

## AC Power Systems iL Series

### AC Power Source and Analyzer Combination



### Integrated System

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

The sleek integrated approach of the iL 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 16 bit A/D converters, the iL Series provides more accuracy and resolution than can be found in most dedicated harmonic power analyzers. Since many components in the iL 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 iL 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 pair of analog controls located directly below the bright fluorescent alphanumeric display allows output voltage and frequency to be slewed up or down dynamically. Both controls employ 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 mode and built-in power analyzer measurement capabilities, 3000iL and 4500iL AC source/analyzers address all application areas for AC power testing. Additional features like line distortion simulation (LDS) and arbitrary waveform generation address requirements for product quality and regulatory compliance testing.

### IEC Test System

Model 4801iL is supplied with a special Windows 3.1™ or Windows 95™ Harmonic and Flicker Test System program to support testing of AC loads for IEC 1000-3-2 and IEC 1000-3-3 requirements. This program operates the 4801iL from a PC controller running all required tests automatically. Test data is collected for archiving, analysis and display.

# iL Series - For Easy Transient Programming

## Product Evaluation and Test Applications

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 Applications

With an extended output frequency range of 5000 Hz (Models 3000iL and 4500iL), the iL Series is particularly 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 iL Series can eliminate the need for three or four items of instrumentation, cost and space savings provide a rapid return on investment.

## 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 4801iL provides a cost effective, easy to implement single box solution for many such applications including the new Euronorm IEC-1000 standards.

## Versatility

### High Crest Factor

With a crest factor of up to 4:1 for the 4500iL and no less than 6:1 for the 3000iL, the iL 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 harmonic distortion. The iL Series can deliver up to 120 Amps of repetitive peak current in single phase mode or 40 Amps per phase in three phase mode (low range).

## Multi-phase Configurations

Models 3000iL and 4500iL offer both single or three phase mode switching from either the front panel or the IEEE-488 and RS232C bus. This often avoids the need to purchase more than one AC source for testing both single and three phase products. In single phase mode, output amplifiers are paralleled to provide three times the maximum current on a single phase.

## Advanced Measurements

The iL Series incorporates a sophisticated digital multi-phase power analyzer capable of measuring a wide range of load parameters.

## Standard Measurements

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

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

**AC Source Measurements**

Measurements:

Freq (Hz): 60.0    ☒ Phase A    ☒ Phase B    ☒ Phase C

<input checked="" type="checkbox"/> Voltage (V rms):	239.6	<input type="checkbox"/> 239.2	239.8
<input checked="" type="checkbox"/> Current (A rms):	4.51	4.48	4.50
<input type="checkbox"/> Phase (°):	0.0	0.0	0.0
<input checked="" type="checkbox"/> Power (kW):	0.92	0.91	0.92
<input checked="" type="checkbox"/> Appl. Power (kVA):	1.08	1.07	1.08
<input checked="" type="checkbox"/> Power Factor:	0.85	0.85	0.85
<input checked="" type="checkbox"/> Peak Cur (A): <input type="text" value="ch"/>	13.10	15.00	15.34
<input checked="" type="checkbox"/> Crest Factor:	2.91	3.35	3.41

## Analysis Functions

In addition to standard load parameters, the iL 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 also available.

Measurement analysis data can be viewed from the front panel or transferred to a PC through the IEEE-488 or RS232C bus.

## 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.

## Windows Graphical User Interface

A Windows 3.1™ compatible Graphical User Interface (GUI) offers a soft front panel interface for operation from a PC.

Harmonic and Arbitrary waveforms can be created and downloaded to the iL Series. Up to 12 user defined arbitrary waveforms can be saved in non-volatile memory. The same program provides visual full color displays of harmonic measurement results obtained from the integrated power analyzer. Data can be printed or saved to disk for export to other analysis programs and later recall.

## Low Cost Of Ownership

Through the use of modular construction and quality components, the iL Series is designed to provide many years of uninterrupted service. The modular construction allows components or subassemblies to be replaced quickly to minimize downtime.

All calibration functions can be performed from the front panel or one of the remote control interfaces without removing the covers making in-place calibration possible.

# iL Series - Integrated IEC AC Test System

Model 4801iL is a special single phase version of the iL Series that is optimized for current harmonics and voltage flicker tests as specified in IEC 1000-3-2 and IEC 1000-3-3. (EN 60555-2, EN 6055-3, IEC 555-2, IEC 555-3).

The 4801iL delivers 16 Amps in the 300 Volt range, allowing it to be used to test all AC source loads that fall under the IEC requirements. A complete software package - Harmonics and Flicker Test System software (HFTS) - is included with the 4801iL to accommodate data collection, analysis and reporting. This translates into a single box IEC test solution that does not require additional measurement equipment, system integration or software development on the part of the user. Just connect your IEEE-488 compatible PC, and that's it. Since the 4801iL houses both the AC source and the digital power analyzer / flicker meter, operating on the same internal timebase, the possibility of timing errors between source and analyzer is reduced, producing reliable test data.

When not used for IEC type testing, the 4801iL doubles as a standard single phase, 4800 VA AC power source / analyzer combination. The California Instruments Graphical User Interface can be used to operate the 4801iL in this normal mode of operation.

## Key benefits of the 4801iL

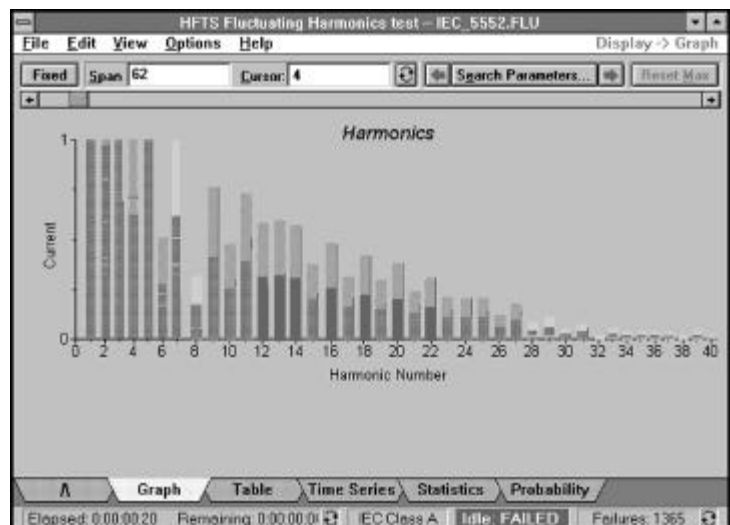
- Single box IEC AC test solution (PC with IEEE-488 interface required)
- Compliance with IEC 1000-3-2, EN 60555-2, and IEC 555-2 quasi static and fluctuating current harmonic measurements
- Compliance with IEC 1000-3-3, EN 60555-3 and IEC 555-3 short term and long term voltage flicker measurements
- Covers all load current requirements for products that require IEC testing (230 Vrms, 16 Arms, single phase)
- Easy to use Windows™ Graphical User Interface for IEC test applications:
  - Automatic test setup and unattended execution
  - Automatic pre-test for EUT class determination (class A, B, C or D for current harmonics)
  - Real-time test data display
  - Archiving of test data to mass storage devices
  - Pass/Fail indication
  - On-line or off-line data analysis and reporting
  - Data analysis to assist in EUT modification to achieve pass status

## Requirements



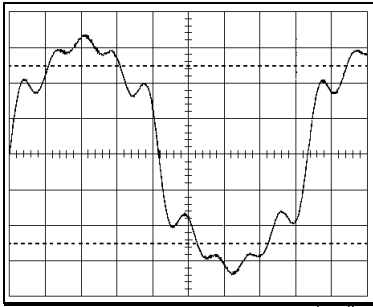
HFTS Screen showing real time fluctuating harmonics

PC:	486DX4, Pentium (100 MHz or better recommended)
Operating System:	Windows 3.1™, Windows 95™
Memory:	8 MB minimum, 16 MB recommended
Hard disk:	HFTS software requires 4 MB of disk space to install.
Networking:	Not supported
Interfaces:	National Instruments AT-GPIB/TNT or HP82335B

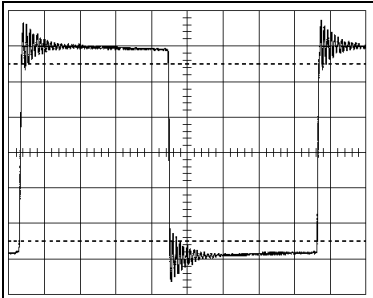




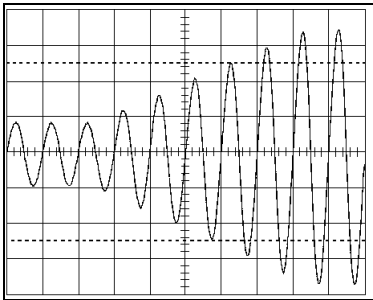
# Harmonics Generation and Analysis



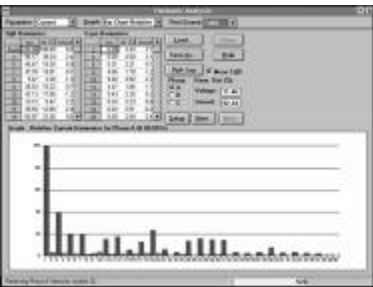
Harmonic waveform, 10%, 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> and 9<sup>th</sup>.



Simulation of severe ringing on the output of a UPS.



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



Relative amplitude bar graph display of current harmonics.



Steady state control screen of GUI application program.

## Harmonic Waveform Generation

Using the latest DSP (Digital Signal Processing) technology, the iL 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 also has the ability to define arbitrary waveform data. Any AC event can be simulated this way. 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 AC source's waveform memories.

## Transient Programming

To simulate common line disturbance occurrences, the iL Series offers a list of 100 transient steps. These steps can be programmed from the front panel or set using the GUI program supplied. This allows the effect of rapid changes in voltage, frequency, phase angle and waveform shape on the unit under test to be analyzed.

## Harmonic Analysis

The measurement system is based on real-time digitization of the voltage and current waveforms using a 4K sample buffer. The digitized waveform data is used to extract conventional load values such as rms voltage, rms current, real and apparent power. The same data is also used to perform Fast Fourier Transformation (FFT) to extract the harmonic amplitude and phase angle of 50 harmonics up to 12.5 kHz.

Harmonic analysis data is available from the front panel or can be displayed, saved and printed in tabular, bar graph or time domain formats using the supplied GUI program.

## Application Software

Windows™ 3.1 application software is provided free of charge with the iL Series<sup>1</sup>. This software allows easy use of the iL Series' many powerful capabilities. The following functions are available through this GUI program:

- 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
- Calibrate measurement functions

## California Instruments

*Total Customer Satisfaction is the goal of all California Instruments' employees. It is the driving force behind everything we do. This not only affects the product that you purchase from California Instruments, but everything about your interface with the company. Our applications engineers are ready to assist you with your AC power application. With over 35 years of experience designing and building precision AC power supplies, chances are we can meet your needs and exceed your expectations. The same dedication to customer satisfaction you will find in our applications group also permeates our modern manufacturing facility where our products are carefully built. No unit leaves our factory without being thoroughly tested to ensure quality, reliability and conformance to specifications.*

## CE Mark

*The iL Series power sources have been fully tested for compliance with 1996 CE Mark requirements. This allows these products to be used throughout the European Economic Community.*



<sup>1</sup> Requires PC running Windows 3.1™. Recommended 486DX 33 MHz or better

# Specifications<sup>1</sup>

## Output

### Power

Maximum power per phase at full scale of voltage range:

Model:	Single Phase	Three Phase
3000iL	3000 VA	1000 VA
4500iL	4500 VA	1500 VA
4801iL	4800 VA	

### Power Factor

0 to unity at full output VA

### Voltage Ranges

Low : 0-150 Volt

High : 0-300 Volt

### Voltage Resolution

80 mV

### Load Regulation

Less than  $\pm 0.5\%$

### Line Regulation

Less than  $\pm 0.1\%$

### Programming Accuracy (25°C $\pm$ 5°C)

#### Voltage (rms):

$\pm(0.15\% + 0.3 \text{ V})$  45-100 Hz

$\pm(0.5\% + 0.3 \text{ V})$  100-500 Hz

$\pm(1.0\% + 0.3 \text{ V})$  500-5000 Hz

#### Frequency:

$\pm(0.01\% + 0.01 \text{ Hz})$  of setting

#### Phase:

$\pm 0.1^\circ$  45- 100 Hz

$\pm 1^\circ$  100 Hz - 1 kHz

$\pm(1^\circ + 1^\circ/\text{kHz})$  > 1 kHz

## Frequency Range

Model:	Range
3000iL	45 Hz - 5000 Hz
4500iL	45 Hz - 5000 Hz
4801iL	45 Hz - 1000 Hz

### Steady State Current Capability

Model:	3000iL	4500iL
phase	range	
three	high	3.3 A
	low	6.6 A
single	high	10
	low	20
Model:		4801iL
phase	range	
single	high	16 A
	low	32 A

### Peak Repetitive AC Current

Model:	3000iL	4500iL
phase	range	
three	high	20 A
	low	40 A
single	high	60 A
	low	120 A
Model:		4801iL
phase	range	
single	high	48 A
	low	96 A

### Current Limit

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

## Measurements\*

Parameter	Range	Accuracy* ( $\pm$ )		Resolution
		1 $\emptyset$ mode	3 $\emptyset$ mode	
Frequency	45 - 5000 Hz	0.01% + 0.01 Hz		0.01 Hz
Phase	45 - 100 Hz	0.1°		0.1°
	100 - 5000 Hz	1°		1°
Voltage (AC)	0 - 300 V	0.05% + 250 mV (45Hz-1KHz)		10 mV
		0.05%+0.05%/KHz+250 mV(1 - 5KHz)		10 mV
Current (AC rms)	0 - 30 A	0.1% + 50 mA	0.1% + 25 mA	6 mA
Real Power	0 - 5 kW	0.15% + 5 W	0.15% + 3 W	10 W
Apparent Power	0 - 5 kVA	0.15% + 5 VA	0.15% + 3 VA	10 VA
Power Factor	0.00 - 1.00	0.01	0.01	0.01

\* Accuracy specifications are in % of reading. For 4801iL, measurement specifications apply in normal AC source mode of operation. Model 4801iL is 1  $\emptyset$  mode only.

## IEC Measurement Specifications (4801iL only)\*

Parameter	Range	Accuracy (±)		
Frequency	50 / 60 Hz			
Current (Low range)				
Fundamental	0 - 3.2 A	0.03 % + 3 mA		
Harmonics 2 - 49		0.03 % + 2 mA + 0.2%/kHz		
Current (High range)				
Fundamental	0 - 32 A	0.05 % + 6 mA		
Harmonics 2 - 49		0.05 % + 3 mA + 0.2%/kHz		
Flicker	Compliant with IEC 868			
Flicker perceptibility	Compliant with IEC 868			
Reference Impedance		3 % (at 0.4 Ω and 796 μH)		
Synchronization		< 1 ppm		
Current shunt burden		0 Volts		
Current harmonic smoothing filter		1.5 sec.		
Pst Integration time		1, 5, 10 or 15 min.		
	Sample rate	Window width	Acq. overlap	
50 Hz Operation				
	Rectangular measurement window	12.8 kHz	16 cycles	None
	Hanning measurement window	8.533 kHz	24 cycles	50 %
60 Hz Operation				
	Rectangular measurement window	15.360 kHz	16 cycles	None
	Hanning measurement window	7.680 kHz	32 cycles	50 %

\* Specifications are in % of reading for 4801iL sinewave output with resistive load at output frequency of 50 or 60 Hz in IEC mode of operation.

### Output Noise

-60 dB from 20 kHz to 1 MHz

### Harmonic Distortion

Less than 1% below 1 kHz

Less than 1% + 1%/kHz from

1 kHz - 5 kHz

### Isolation Voltage

300 V rms output to chassis

### Output Relay

Push button controlled and bus controlled output relay

### Output impedance

Fixed on 3000iL and 4500iL

Programmable on 4801iL

Note 1: Specifications are warranted over an ambient temperature range of 25 $\pm$ 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.

## Input

### Voltage

Standard: 180 - 254 VAC, (L-L, 3 Phase)

Option -400: 360 - 440VAC, (L-L, 3 Phase)

(Input range must be specified when ordering)

### Line Current (per phase)

Model:	3000iL	4500iL 4801iL
@ 180-254 V	25 A	25 A
@ 360-440 V	15 A	15 A

### Inrush Current

Model:	3000iL	4500iL 4801iL
@ 180-254 V	18 A <sub>peak</sub>	18 A <sub>peak</sub>
@ 360-440 V	31 A <sub>peak</sub>	31 A <sub>peak</sub>

### Line Frequency

47 - 63 Hz

### Efficiency

75 % typical

### Power Factor

0.6 typical

### Hold-up Time

At least 10 ms

## System

### Setup storage

16 complete instrument setups

### User waveform storage

12 user defined arbitrary waveforms of 1024 points each

### Transient lists storage

up to 100 transient steps per list

### Output change response time

50 µsec for 10% to 90% of full scale change into resistive load

### Trigger input

Triggers measurements or transient steps

BNC: 10K pull-up

Response time : 400 µsec

### Trigger output

BNC: HC TTL output.

## Remote Control

### IEEE-488.2 Interface

IEEE-488 (GPIB) talker listener.

Subset:

AH1, C0, DC1, DT1, E1, LE4, PP0, RL1, SH1, SR1, TE6

### RS232C Interface

Bi-directional serial interface.

9 pin D-shell connector

Handshake: CTS, RTS

Databits: 7 with parity,  
8 without parity

Stopbits: 2

Baud rate: 300, 600, 1200, 2400,  
4800, 9600

Supplied with RS232C cable

### Code and Format

SCPI

### Response times

Remote command response time typically 10 msec.

## 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

## Physical

### Dimensions

Height<sup>1</sup> : 10.8" (276 mm)

Width : 16.96" (431 mm)

Depth<sup>2</sup> : 23.7" (602 mm)

<sup>1</sup> Height includes feet. Subtract 0.5" (13 mm) for rack mount

<sup>2</sup> Depth includes rear panel connectors

### Weight

193 lbs / 87.7 Kg net.

280 lbs / 127.3 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 Temperature

0 to 40° C

### Storage Temperature

-40 to +85° C

## Rear Panel Connectors

- Three phase AC Input terminal block with cover
- Three phase AC output terminal block with cover
- IEEE-488 (GPIB) connector
- 9 pin D-Shell RS232C connector\*
- Remote Inhibit/Discrete fault indicator (RI/DFI) port
- Remote voltage sense terminal block
- Trigger in and Trigger out BNC  
(\*RS232 DB9 to DB9 cable supplied)

## Ordering Information

### Model

3000iL	208 V, 3ø L-L
3000iL-400	400 V, 3ø L-L
4500iL	208 V, 3ø L-L
4500iL-400	400 V, 3ø L-L
4801iL	208 V, 3ø L-L
4801iL-400	400 V, 3ø L-L

### Supplied with

- User manual
- SCPI programming manual
- Windows Graphical User Interface software
- RS232C Serial cable
- HFTS Software (4801iL only)

### Options

- RMK Rack mount kit
- 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.

## Ordering Information

**Terms:** Net 30 days

**Delivery:** 30 days ARO

**F.O.B.:** Factory, San Diego, CA

**Shipment:** Freight Collect

**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**



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