

# Specifications

## Appendix A

### Measurement Modes

X	In-phase	)	The unit can simultaneously present any two of these as outputs
Y	Quadrature		
R	Magnitude		
$\theta$	Phase Angle		
	Noise		
		)	
	Harmonic		2F or 3F
	Noise		Measures noise in a given bandwidth centered on frequency F

### Displays

Two LED backlit, two-line, 16-character alphanumeric dot-matrix LCDs giving digital indication of current instrument set-up and output readings. Edge indicating analog panel meter. Menu system with dynamic key function allocation.

### Signal Channel

Voltage Inputs	
Modes	A only or Differential (A-B)
Full-scale Sensitivity	20 nV to 1 V in a 1-2-5 sequence
Dynamic Reserve	> 100 dB
Impedance	
FET Device	10 M $\Omega$ // 30 pF
Bipolar Device	10 k $\Omega$ // 30 pF
Voltage Noise	
FET Device	5 nV/ $\sqrt{\text{Hz}}$ at 1 kHz
Bipolar Device	2 nV/ $\sqrt{\text{Hz}}$ at 1 kHz
CMRR	> 100 dB at 1 kHz degrading by 6 dB/octave
Frequency Response	0.001 Hz to 120 kHz
Gain Accuracy	0.5 % typ (full bandwidth)
Distortion	-90 dB THD (60 dB AC Gain, 1 kHz)
Line Filter	attenuates 50, 60, 100, 120 Hz
Grounding	BNC shields can be grounded or floated via 1 k $\Omega$ to ground

Current Input	
Mode	Low Noise or Wide Bandwidth
Full-scale Sensitivity	
Low Noise	20 fA to 10 nA in a 1-2-5 sequence
Wide Bandwidth	20 fA to 1 $\mu$ A in a 1-2-5 sequence
Dynamic Reserve	> 100 dB (with no signal filters)
Frequency Response	
Low Noise	-3 dB at 500 Hz
Wide Bandwidth	-3 dB at 50 kHz
Impedance	
Low Noise	< 2.5 k $\Omega$ at 100 Hz
Wide Bandwidth	< 250 $\Omega$ at 1 kHz
Noise	
Low Noise	13 fA/ $\sqrt{\text{Hz}}$ at 500 Hz
Wide Bandwidth	130 fA/ $\sqrt{\text{Hz}}$ at 1 kHz
Gain Accuracy (midband)	
Low Noise	$\leq 0.6$ % typ
Wide Bandwidth	$\leq 0.6$ % typ
Line Filter	attenuates 50, 60, 100, 120 Hz
Grounding	BNC shields can be grounded or floated via 1 k $\Omega$ to ground

## Reference Channel

TTL Input (rear panel)	
Frequency Range	1 mHz to 120 kHz
Analog Input (front panel)	
Impedance	1 M $\Omega$ // 30 pF
Sinusoidal Input	
Level	1.0 V rms**
Frequency Range	1 Hz to 120 kHz
Squarewave Input	
Level	100 mV rms**
Frequency Range	300 mHz to 120 kHz

\*\*Note: Lower levels can be used with the analog input at the expense of increased phase errors.

Phase	
Set Resolution	0.01° increments
Accuracy	0.5° typ
Noise at 100 ms TC, 12 dB/octave	
Internal Reference	< 0.0001° rms
External Reference	< 0.01° rms at 1 kHz

Orthogonality	$90^\circ \pm 0.0001^\circ$
Drift	$< 0.01^\circ/\text{C}$ below 10 kHz $< 0.1^\circ/\text{C}$ above 10 kHz
Acquisition Time	
Internal Reference	instantaneous acquisition
External Reference	2 cycles + 50 ms
Reference Frequency Meter Accuracy	
120 kHz > F > 40 kHz	$\pm 4$ Hz
40 kHz > F > 400 Hz	$\pm 0.8$ Hz at F = 40 kHz improving to $\pm 0.008$ Hz at F = 400 Hz
400 Hz > F > 1 mHz	$\pm 0.040$ Hz at F = 400 Hz improving to better than $\pm 0.0001$ Hz at F = 1 mHz

## Demodulator and Output Processing

Description	$2 \times 18$ -bit ADCs driving two DSP elements managed by a powerful 68000-series host processor
Output Zero Stability	
Digital Outputs	No zero drift on all settings
Displays	No zero drift on all settings
Analog Outputs	$< 5$ ppm/ $^\circ\text{C}$
Harmonic Rejection	-90 dB
Time Constants	
Digital Outputs	5 ms to 100 ks in a 1-2-5 sequence
Fast Outputs	10 $\mu\text{s}$ to 640 $\mu\text{s}$ in a binary sequence
Roll-off	6, 12, 18 and 24 dB/octave
Synchronous Filter Operation	Available for F < 20 Hz
Offset	Auto and Manual on X and Y: $\pm 300$ % FS

## Oscillator

Frequency	
Range	0.001 Hz to 120 kHz
Setting Resolution	0.001 Hz
Absolute Accuracy	25 ppm + 30 $\mu\text{Hz}$
Distortion (THD)	-80 dB at 1 kHz

Amplitude	
Range	1 mV to 5 V
Setting Resolution	
1 mV to 500 mV	1 mV
501 mV to 2 V	4 mV
2.001 V to 5 V	10 mV
Accuracy	
0.001 Hz to 60 kHz	$\pm 0.3\%$
60 kHz to 120 kHz	$\pm 0.5\%$
Stability	50 ppm/°C
Output	
Impedance	50 $\Omega$

## Auxiliary Inputs

ADC 1 and 2	
Maximum Input	$\pm 10$ V
Resolution	1 mV
Accuracy	$\pm 0.2\%$
Input Impedance	1 M $\Omega$ // 30 pF
Sample Rate	
ADC 1 only	40 kHz max
ADC 1 and 2	13 kHz max
Trigger Mode	Int, ext or burst
Trigger input	TTL compatible

## Outputs

CH1 CH2 Outputs	
Function	X, Y, R, $\theta$ , Noise and aux functions
Amplitude	$\pm 10$ V
Impedance	1 k $\Omega$
Fast X Output	
Time Constant	$\leq 640\ \mu\text{s}$
Amplitude	$\pm 10$ V
Update Rate	170 kHz
Output Impedance	1 k $\Omega$
Fast Y Output	
Time Constant	$\leq 640\ \mu\text{s}$
Amplitude	$\pm 10$ V
Update Rate	170 kHz
Output Impedance	1 k $\Omega$

Signal Monitor	
Amplitude	$\pm 10$ V FS
Impedance	1 k $\Omega$
Aux D/A Output 1, 2	
Maximum Output	$\pm 10$ V
Resolution	1 mV
Accuracy	$\pm 0.1$ %
Output Impedance	1 k $\Omega$
8-bit Digital Output	8 TTL compatible lines that can be independently set high or low to activate external equipment
Reference Output	
Waveform	0 to 5 V square wave
Impedance	TTL compatible
Power - Low Voltage	$\pm 15$ V at 100 mA rear panel DIN connector for powering EG&G preamplifiers

## Data Storage

Data Buffer	
Size	32k 16-bit data points, may be organized as 1 $\times$ 32k, 2 $\times$ 16k, 3 $\times$ 10.6k, 4 $\times$ 8k, etc.
Max Storage Rate	
From LIA	up to 800 16-bit values per second
From ADC	up to 40,000 16-bit values per second

## Interfaces

RS232, IEEE-488. A auxiliary RS232 port is provided to allow "daisy-chain" connection and control of multiple units from a single RS232 computer port.

## Power Requirements

Voltage	110/120/220/240 VAC
Frequency	50/60 Hz
Power	< 40 VA

## General

Dimensions	
Width	432 mm (17 ")
Depth	415 mm (16.4 ")
Height	
With feet	74 mm (2.9 ")
Without feet	60 mm (2.4 ")
Weight	7.4 kg (16.3 lb)