Specifications

Appendix A

Measurement Modes

X	**In-phase**	The unit can simultaneously present any four of these as outputs
Y	**Quadrature**	
R	**Magnitude**	
θ	**Phase Angle**	
	Noise	

Harmonic	nF n < 65536, nF < 60 kHz (internal reference) n < 2048, nF < 250 kHz (external reference)
Dual Harmonic	Simultaneously measures the signal at two different harmonics of the reference frequency (F_1 and $F_2 \leq 20$ kHz).
Dual Reference	Simultaneously measures the signal at two different reference frequencies (F_1 and $F_2 < 20$ kHz)
Virtual Reference	Locks to and detects a signal without a reference (100 Hz $\leq F \leq$ 60 kHz)
Noise	Measures noise in a given bandwidth centered at the reference frequency F ($F \leq 60$ kHz)
Spectral Display	Gives a visual indication of the spectral power distribution of the input signal in a user-selected frequency range lying between 1 Hz and 62 kHz. Note the display is not calibrated for amplitude and is intended primarily to assist in choosing the optimum reference frequency
Frequency Response	Performs a swept-frequency magnitude and phase measurement using the internal oscillator as a signal source, displaying the results in graphical format on the front panel
Transient Recorder	On receipt of a trigger, samples and records signals at the ADC1 or ADC1 and ADC2 auxiliary inputs at times down to 25 µs per point, displaying the results in graphical format on the front panel

Operational Modes

Signal Recovery	Normal low-noise mode, Baseband ≤ 60 kHz or Highband > 60 kHz
Vector Voltmeter	High precision mode (introduces 5dB noise penalty)

Displays

Cold fluorescent backlit, 240 × 64 pixel, dot-matrix LCD giving digital, analog bar-graph and graphical indication of measured signals. Menu system with dynamic key function allocation. On-screen context sensitive help.

Signal Channel

Voltage Inputs

Modes	A only, -B only or Differential (A-B)
Full-scale Sensitivity	2 nV to 1 V in a 1-2-5 sequence
Dynamic Reserve	> 100 dB
Impedance	
FET Device	10 MΩ // 30 pF
Bipolar Device	10 kΩ // 30 pF
Maximum Safe Input	30 V pk-pk
Voltage Noise	
FET Device	5 nV/√Hz at 1 kHz
Bipolar Device	2 nV/√Hz at 1 kHz
C.M.R.R.	> 100 dB at 1 kHz degrading by 6 dB/octave
Frequency Response	1 mHz to 250 kHz
Gain Accuracy	0.2% typ, 0.6% max.(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 kΩ to ground

Current Input

Mode	Low Noise or Wide Bandwidth
Full-scale Sensitivity	
Low Noise	2 fA to 10 nA in a 1-2-5 sequence
Wide Bandwidth	2 fA to 1 µA 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 kΩ at 100 Hz
Wide Bandwidth	< 250 Ω at 1 kHz
Noise	
Low Noise	13 fA/√Hz at 500 Hz
Wide Bandwidth	130 fA/√Hz at 1 kHz
Gain Accuracy (midband)	
Low Noise	≤ 0.6% typ
Wide Bandwidth	≤ 0.6% typ
Line Filter	attenuates 50, 60, 100, 120 Hz
Grounding	BNC shield can be grounded or floated via 1 kΩ to ground

Reference Channel

TTL Input (rear panel)

Frequency Range	1 mHz to 250 kHz

Analog Input (front panel)

Impedance	1 MΩ // 30 pF
Sinusoidal Input	
Level	1.0 V rms**
Frequency Range	1 Hz to 250 kHz
Squarewave Input	
Level	100 mV rms**
Frequency Range	300 mHz to 250 kHz

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

Phase

Set Resolution	0.01º increments
Accuracy	
Frequency ≤ 60 kHz	0.25° typ, 0.75° max
Frequency > 60 kHz	0.5° typ, 0.75° max.
Noise at 100 ms TC, 12 dB/octave slope	
Internal Reference	< 0.0001º rms
External Reference	< 0.01º rms at 1 kHz
Orthogonality	90º ±0.0001º
Drift	< 0.01º/ºC below 10 kHz
	< 0.1º/ºC above 10 kHz

Acquisition Time

Internal Reference	instantaneous acquisition
External Reference	2 cycles + 50 ms

Reference Frequency Meter Resolution

1 mHz ≤ F < 400 Hz	1 mHz or F/40,000%, whichever is greater
400 Hz ≤ F < 40 kHz	1 mHz or F/20,480,000%, whichever is greater
40 kHz ≤ F ≤ 250 kHz	4 Hz

Demodulator and Output Processing

Description	2 × 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/ºC

Harmonic Rejection	-90 dB

Time Constants	
Digital Outputs	5 ms to 100 ks in a 1-2-5 sequence
Slope (roll-off)	6, 12, 18 and 24 dB/octave
Fast Outputs	10 µs to 640 µs in a binary sequence
Slope (roll-off)f	6 dB/octave only
Synchronous Filter Operation	Available for F < 20 Hz
Offset	Auto and Manual on X and/or Y: ±300% FS

Oscillator

Frequency	
Range	1 mHz to 250 kHz
Setting Resolution	
1 mHz to 900 Hz	1 mHz
900.004 Hz to 250 kHz	4 mHz
Absolute Accuracy	25 ppm + 30 µHz
Distortion (THD)	-80 dB at 1 kHz
Amplitude	
Range	1 µV to 5 V
Setting Resolution	
1 µV to 4 mV	1 µV
4.125 mV to 500 mV	125 µV
500.5 mV to 2 V	500 µV
2.00125 V to 5 V	1.25 mV
Accuracy	
Amplitude ≥ 1 mV	
1 mHz to 60 kHz	±0.3%
60 kHz to 250 kHz	±0.5%
100 µV ≤ Amplitude < 1 mV	
1 mHz to 60 kHz	±1%
60 kHz to 250 kHz	±3%
Amplitude < 100 µV	Not Specified
Stability	50 ppm/ºC
Output	
Impedance	50 Ω

Sweep

Amplitude Sweep	
Output Range	0.000000 to 5.000000 V
Law	Linear
Step Rate	20 Hz maximum (50 ms/step)
Frequency	
Output Range	1 mHz to 250.000 Hz
Law	Linear or Logarithmic
Step Rate	20 Hz maximum (50 ms/step)

Auxiliary Inputs

ADC 1 and 2

Maximum Input	±10 V
Resolution	1 mV
Accuracy	±20 mV
Input Impedance	1 MΩ // 30 pF
Sample Rate	
ADC 1 only	40 kHz max.
ADC 1 and 2	17.8 kHz max.
Trigger Mode	Internal, External or burst
Trigger input	TTL compatible

ADC3 (integrating)

Maximum Input	±10 V
Input Impedance	1 MΩ // 30 pF
Sampling Time	10 ms to 2 s
Equivalent Resolution	12 to 20 bits, depending on sampling time

Outputs

CH1 and CH2 Outputs

Function	X, Y, R, θ, Noise, Ratio, Log Ratio and User Equations 1 & 2.
Amplitude	±10 V
Impedance	1 kΩ
Update Rate	200 Hz

Fast X and Fast Y/Mag Outputs

Time Constant	10 µs to 640 µs in a binary sequence
Slope	6 dB/octave
Amplitude	±10 V (100% = ±2.5 V)
Update Rate	166 kHz
Output Impedance	1 kΩ

Signal Monitor

Amplitude	±10 V FS
Impedance	1 kΩ

Aux D/A Output 1, 2, 3 & 4	
Maximum Output	±10 V
Resolution	1 mV
Accuracy	±10 mV
Output Impedance	1 kΩ
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 squarewave
Impedance	TTL-compatible
Power - Low Voltage	±15 V at 100 mA rear panel 5-pin 180° DIN connector for powering ***SIGNAL RECOVERY*** preamplifiers

Data Storage

Data Buffer	
Size	32k × 16-bit data points, may be organized as 1×32k, 2×16k, 3×10.6k, 4×8k, etc.
Max Storage Rate	
From LIA	up to 800 16-bit values per second
From ADC1	up to 40,000 16-bit values per second

User Settings

Up to 8 complete instrument settings can be saved or recalled at will from non-volatile memory.

Interfaces

RS232, IEEE-488. A second RS232 port is provided to allow "daisy-chain" connection and control of up to 16 units from a single RS232 computer port.

General

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

Dimensions		
Width		350 mm (13.75")
Depth		415 mm (16.5 ")
Height		
	With feet	105 mm (4.1 ")
	Without feet	91 mm (3.6 ")
Weight		8.1 kg (18 lb)

All specifications subject to change without notification