
1.3 Key Specifications and Benefits

The **SIGNAL RECOVERY** Model 7225BFP is a cost-effective DSP lock-in amplifier suitable for many applications, and offers:-

- Frequency range: 0.001 Hz to 120 kHz
- Voltage sensitivity: 2 nV to 1 V full-scale
- Current input mode sensitivities: 2 fA to 1 μ A full-scale
2 fA to 10 nA full-scale
- Line frequency rejection filter
- Dual phase demodulator with X-Y and R- θ outputs
- Very low phase noise of < 0.0001° rms
- 5-digit output readings
- Direct Digital Synthesizer (DDS) oscillator with variable output amplitude and frequency
- Oscillator frequency and amplitude sweep generator via computer control
- Output time constant: 10 μ s to 100 ks
- 8-bit programmable digital output port for system control
- Two external ADCs, two external DACs
- Full range of auto-modes
- Standard IEEE-488 and RS232 interfaces with RS232 daisy-chain capability
- Dual back-lit liquid crystal display (LCD) with variable contrast control
- 32768 point curve storage buffer

Specifications

Measurement Modes

X In-phase))	The unit can simultaneously present any two of these as outputs
Y Quadrature		
R Magnitude		
θ Phase Angle		
Noise		
Harmonic	nF, $n \leq 32F$	
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	2 nV to 1 V in a 1-2-5 sequence
Dynamic Reserve	> 100 dB
Impedance	
FET Device	10 M Ω // 30 pF
Bipolar Device	10 k Ω // 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 Ω 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 μ 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 Ω at 100 Hz
Wide Bandwidth	< 250 Ω 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 shield can be grounded or floated via 1 k Ω to ground

Reference Channel

TTL Input (REF TTL Mode)

Frequency Range	1 mHz to 120 kHz
-----------------	------------------

Analog Input (EXT REF Mode - factory default)

Impedance	1 M Ω // 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 $^\circ$ increments
Accuracy	0.5 $^\circ$ typ
Noise at 100 ms TC, 12 dB/octave	
Internal Reference	< 0.0001 $^\circ$ rms
External Reference	< 0.01 $^\circ$ rms at 1 kHz
Orthogonality	90 $^\circ$ \pm 0.0001 $^\circ$
Drift	< 0.01 $^\circ$ /C below 10 kHz < 0.1 $^\circ$ /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	±4 Hz
40 kHz > F > 400 Hz	±0.8 Hz at F = 40 kHz improving to ±0.008 Hz at F = 400 Hz
400 Hz > F > 1 mHz	±0.040 Hz at F = 400 Hz improving to better than ±0.0001 Hz at F = 1 mHz

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/°C
Harmonic Rejection	-90 dB
Time Constants	
Digital Outputs	5 ms to 100 ks in a 1-2-5 sequence
Fast Outputs	10 μs to 640 μs in a binary sequence
Roll-off	6, 12, 18 and 24 dB/octave
Synchronous Filter Operation	Available for F < 10 Hz
Offset	Auto and Manual on X and Y: ±300 % FS

Oscillator

Frequency	
Range	0.001 Hz to 120 kHz
Setting Resolution	0.001 Hz
Absolute Accuracy	25 ppm + 30 μHz
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	±0.3 %
60 kHz to 120 kHz	±0.5 %
Stability	50 ppm/°C
Output Impedance	50 Ω

Auxiliary Inputs ADC1 & 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	13 kHz max
Trigger Mode	Int, ext or burst
Trigger input	TTL compatible

Outputs

CH1 CH2 Outputs	
Function	X, Y, R, θ, Noise and aux functions
Amplitude	±10 V
Impedance	1 kΩ
Fast X and Fast Y Outputs	
Time Constant	≤ 640 μs
Amplitude	±10 V
Update Rate	166 kHz nominal
Output Impedance	1 kΩ
Signal Monitor	
Amplitude	±10 V FS
Impedance	1 kΩ
Aux D/A Output 1, 2	
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
Power - Low Voltage	±15 V at 100 mA rear panel 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 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)