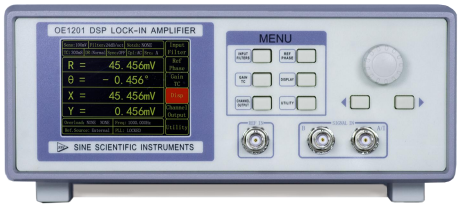
Digital Lock-In Amplifier

OE1201 -DSP Lock-in Amplifier V250418



Key Features

- 50 mHz to 120 kHz frequency range
- Low-noise current and voltage inputs
- 1 nV to 1 V full-scale sensitivity
- Time constants extending from 10 μs to 3 ks
- >100 dB dynamic reserve
- >100dB CMRR

Overview

OE1201 Small-sized DSP Lock-in Amplifier provides a superb performance within its bandwidth from 50 mHz to 120 kHz. With the high-speed 4-core architecture, high-precision ADC and excellent analog performance, OE1201 can easily detect the phase and the magnitude of weak signals overwhelmed by various large noise. The performance of OE1201 is as good as other lock-in amplifiers all over the world, even better than them in some certain parameters, such as measurement accuracy, operating bandwidth , which meets the needs of scientific research and industrial application well.

Digital Demodulator and Output Filter

The key component of the OE1201 is the digital demodulator. Compared to traditional analog lock-in amplifiers, the OE1201's internal digital demodulator effectively rejects the measurement errors caused by DC drift and offset. In addition, by optimizing the multiplication of the internal coherent signal of the digital demodulator, the calculation error is minimized so that the instrument can accurately detect the input weak signal. Time constants of the output low-pass filter from 10 μs to 3 ks can be selected with a choice of 6, 12, 18 or 24dB/oct rolloff. This low-pass digital filter is implemented using a high performance digital filter with a sample rate of 500 kHz. The digital demodulation and the low-pass filter used in OE1201 guarantees a high dynamic reserve (>100dB), accurate phase (absolute phase error<1deg). Moreover, when the frequency of the input signal is lower than 20 Hz, A synchronous filter can be used to eliminate the harmonic influence of the reference signal, ensuring that OE1201 can detect a low-frequency signal quickly and effectively.

Input Signal Channel

OE1201 detects an input signal in a single-ended mode or a differential voltage mode. With an ultra low-noise pre-amplifier, the input noise is as low as 9 nV/$\sqrt{\text{Hz}}$@997 Hz. The input impedance is 10 MΩ and the full-scale input voltage sensitivity ranges from 1 nV to 1 V.

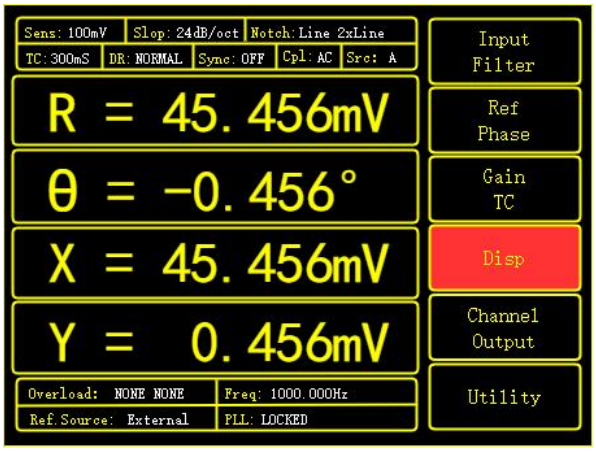
Besides, OE1201 can be used for current measurement with gains of 10^6 or 10^8 V/A. Two line filters (50/60 Hz and 100/120 Hz) are designed to eliminate power frequency interference. A programmable gain amplifier is used to adjust the dynamic reserve of the system, so that OE1201 can keep a high dynamic reserve of 100 dB.

Reference Signal Channel

The reference signal can work in external mode or internal mode. In internal mode, a precise and stable internal oscillator generates sine wave as an internal reference that is multiplied by the input signal. This internal signal is without any phase noise. With the digital phase-shifting technique, the phase resolution of the reference signal is 1μdeg. OE1201 can work at any fixed frequency from 50 mHz to 120 kHz in this mode. In external mode, the reference signal can be a sine wave or a TTL pulse or a square wave. Therising or falling edge of the external reference signal triggers the Phase Lock Loop (PLL) to lock the external signal. Based on the frequency of the reference signal, the OE1201 can detect the harmonics of the input signal. The maximum harmonic signal frequency can reach 32,767 times the fundamental frequency, and the maximum harmonic frequency cannot exceed the maximum operating frequency of the instrument.

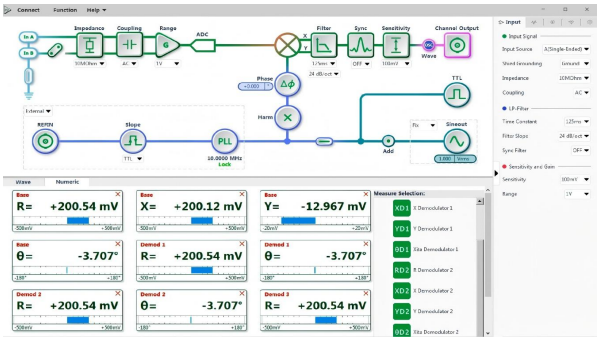
Display

OE1201 has a 3.5-inch 320 x 240 color TFT-LCD. The measurement results of OE1201, such as X, Y, R, and θ, are shown in numerical form.



Remote Operation

OE1201 is equipped with graphical upper computer software. With quick graphic buttons and rich graphic operation functions, in addition, this software has a clear numerical value display and waveform display function, real-time display of measurement data, measurement results can be saved in excel format output for subsequent analysis of professional software, so that the test is easy to use. In addition, we also fully support Python, MATLAB and LabVIEW application program interface (API).

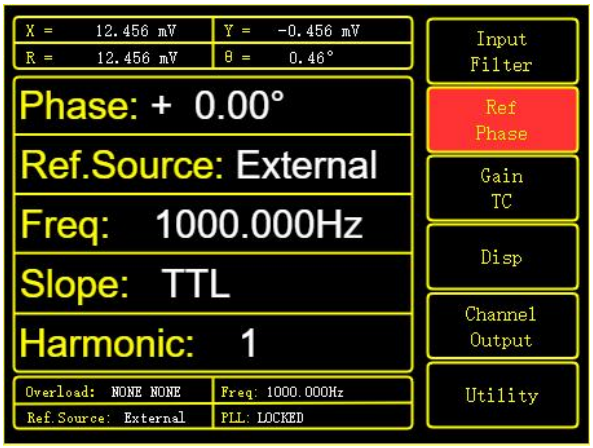


Signal Generator

OE1201 uses a high precision digital-to-analog converter (DAC) to output a sine wave signal at the same frequency as the internal reference signal. The amplitude and phase of the output sine wave can be set through the OE1201's display, where the maximum amplitude of the sine wave is 1 Vrms.

Internal Oscillator

The internal oscillator of OE1201 generates a low distortion (-80 dBc) sine reference signal varying from 50 mHz to 120 kHz, which has a high frequency resolution of 1 mHz. The frequency and amplitude of the reference signal can be set by using the front panel of OE1201 or communication interface. When OE1201 is set in the external reference mode, the internal reference signal is phase-locked with the external reference signal.



Manual Operation

The OE1201 can use the softkeys on the front panel, together with the knobs, to realize convenient and quick parameter adjustments, such as adjusting the frequency and phase of the internal reference signal.

Communication Interface

OE1201 uses 9-pin RS-232 and RS-232 to USB interfaces as standard. Through communication interfaces, all functions of instrument can be controlled and all data can be read in real- time. Meanwhile, all interfaces of OE1201 are distributed on the front panel and the rear panel.

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Input Signal Channel

Voltage input Mode	Single-ended or Differential
Full-scale Sensitivity	1 nV - 1 V (voltage input) 1 fA - 1 μA (current input）
Current input	10^6 or 10^8 V/A
Impedance	
Voltage	10 MΩ // 25pF, AC or DC coupled
Current	1kΩ to virtual ground
C.M.R.R	>100 dB to 10 kHz, Decreasing by 6 dB/oct
Dynamic reserve	>100 dB
Gain accuracy	0.2% typ., 1% max
Voltage Noise	9 nV/$\sqrt{Hz}$@997 Hz
Current Noise	0.15 pA/$\sqrt{Hz}$@97 Hz, 0.13 pA/$\sqrt{Hz}$@997 Hz
Line filters	50/60 Hz and 100/120 Hz
Gounding	BNC shield can be grounded or floated via 1 kΩ to ground

Reference Signal Channel

Input	
Frequency range	50 mHz to 120 kHz
Reference input	TTL or Sine
Input impedance	1 MΩ//25 pF
Phase	
Resolution	1 μdeg
Absolute phase error	<1 deg
Relative phase error	<1 mdeg
Drift	<0.1 deg/℃ below 10 kHz <0.2 deg/℃ above 10 kHz
Harmonic detection	2F, 3F, …nF to 120 kHz (n<32,767)
Acquisition time	
Internal Ref.	Instantaneous acquisition
External Ref.	(4 cycles + 5 ms) or 100 ms

Demodulator

Stability	
Digital outputs	no zero drift on all setting
Display	no zero drift on all setting
Analog outputs	<5 ppm/℃ for all dynamic reserve settings
Harmonic rejection	-90 dB
Time constants	10 μs to 3 ks (<100 Hz) 10 μs to 30 s (>100 Hz) (6, 12, 18, 24 dB/oct rolloff)
Synchronous filters	Available below 20 Hz (18, 24 dB/oct rolloff)

Internal Oscillator

Frequency	
Range	50 mHz - 120 kHz
Accuracy	2 ppm + 30 μHz
Resolution	1 mHz
Distortion	-80 dBc (f<10 kHz), -70 dBc (f>10 kHz)
Amplitude	0.1 - 1 Vrms
Accuracy	1% typ., 3% max
Stability	100 ppm/℃
Sine output	Output impedance 50Ω
TTL sync output	5V TTL/CMOS level Output Impedance 200Ω

Display

Screen	3.5 inch, 320×240 TFT
Screen format	Single display
Display quantities	Display X,Y,R,θ
Display types	Numerical display

Outputs

CH1 and CH2 Outputs	
Function	Output X,Y,R,θ, harmonics
Output Voltage	±5 V
Output Current	±30 mA max
Update Rate	500 kSa/s

Communication Interface

RS-232 to USB interface

Standard 9-pin RS-232 male interface

General

Power requirements	
Voltage	110-220 V AC
Frequency	50/60 Hz
Power	10 W typ., 20W max
Dimensions	
Width	259 mm
Depth	320 mm
Height	
With feet	115 mm
Weight	3.2 kg