Digital Lock-In Amplifier

OE2052 -Dual-channel Lock-in Amplifier V250421

Key Features

- 2-independently synchronized input channels
- DC - 400 MHz frequency range
- Input noise as low as 3 nV/$\sqrt{Hz}$
- Input range 1 nV to 1 Vrms
- Dynamic reserve＞120 dB
- 3-channel demodulator synchronization measurements
- 4-channel oscilloscopes with FFT analysis function
- 2-channel PID controllers

Overview

The OE2052 dual-channel lock-in amplifier is the latest core technology product currently available with excellent high performance and broadband measurement capability. The instrument is based on digital modulation technology, equipped with 1GSPS 16-bit digital-to-analog converter (DAC) and 14-bit analog-to-digital converter (ADC), and adopts the DSP platform architecture, which is capable of accurately and quickly detecting the effective signal components hidden in the strong noise.

With two independent and synchronized input channels, the OE2052 is not only able to measure the amplitude and phase information of two input signals at the same time, but also reaches the international leading level in terms of key performance indicators such as measurement accuracy, operating frequency range, signal-to-noise ratio and dynamic reserve. In addition, the addition of multi-harmonic measurement, oscilloscope and spectrum analysis function, and PID control functions make the OE2052 widely applicable to a wide range of needs in the scientific research and industrial fields.

Input Signal Channel

The OE2052 is equipped with a low-noise analog front-end amplifier, capable of efficiently processing differential or single-ended signals with an equivalent input noise as low as 3nV/$\sqrt{Hz}$. The channel's input impedance can be selected from 50Ω or 10MΩ, and the full-scale sensitivity range is from 1nV to 1V, with a dynamic range of more than

Reference Signal Channel

The reference signal of the lock-in amplifier can be selected as a sine wave or square wave signal according to the user's actual needs, or the reference signal can be digitally synthesized inside the instrument. When the OE2052 is set to internal reference signal mode, the instrument's internal high-precision oscillator and digital synthesis algorithm will generate a sine wave signal for multiplying with the input signal, and this internal reference signal is almost unaffected by phase noise.

The phase resolution of the internal reference signal can be as high as 1μdeg by digital phase shifting technique.

When the OE2052 operates in the external reference signal mode, it can accept a sine wave signal or TTL logic level as the external reference signal, and this signal will be locked by the internal digital phase-locked loop. Based on the frequency of the reference signal, the OE2052 can detect the same frequency of the signal and its harmonics, up to the 65,535th harmonic of the fundamental frequency, but the maximum harmonic frequency cannot exceed the upper limit of the measurement bandwidth of the instrument.

Digital Demodulator

The time constant of the OE2052 can be flexibly set from 25ns to 4ks, and users can customize the time constant according to their needs. The filter steepening rate can be selected from 6 to 48 dB/oct in 8 steps. With digital modulation technology and advanced filter structure, the OE2052 offers higher dynamic reserve (>120dB), more

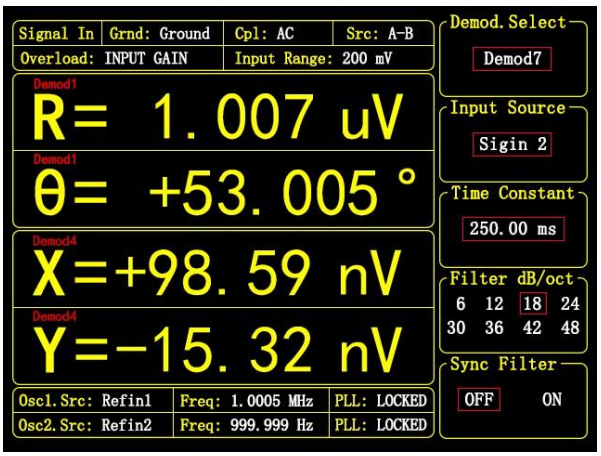
120dB. In addition, the signal input channel adopts a dual ADC design, taking into account the needs of high-speed and high-precision measurements. Users can choose between a high-speed 14-bit ADC (supporting DC to 400MHz band) or a high-precision 24-bit ADC (supporting DC to 100kHz band) according to the actual application scenario.

Output Signal Channel

Based on a 1GSPS 16-bit digital-to-analog converter (DAC), the OE2052 is capable of generating sine wave signals over a frequency range of 1 μHz to 400MHz with adjustable DC bias. Under a 50Ω load, the signal amplitude ranges from 1 Vpp to 1.5 Vpp, and the DC bias range is ±1.5 Vdc. For external devices that require a bias voltage, such as electro-optical modulators, the OE2052, with its excellent drive capability, can directly drive the device without the need for an additional level shifting amplifier. The phase of the output signal is synchronized with the instrument's internal oscillator, and the phase offset can be set independently.

Display

The OE2052 is equipped with a 5.6-inch, 640 x 480 resolution TFT color display, which serves as the main display interface of the instrument and allows full independent control of the instrument through the keyboard. On the display, users can flexibly view the demodulator's X, Y, R, θ and other parameters, and also configure a variety of basic settings such as filter constants, making operation intuitive and convenient.



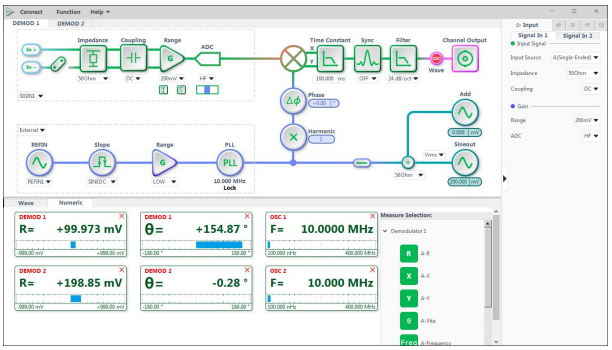
accurate phase (absolute phase error <1deg), zero DC drift, and excellent quadrature performance than traditional analog lock-in amplifiers. In addition, the OE2052 provides an optional synchronization filter that effectively eliminates the effects of reference signal harmonics, ensuring that the instrument accurately detects low-frequency signals while providing a fast response.

Communication Interface

The OE2052 has USB2.0 (host and slave interfaces), 1000Mbps RJ45 network port and RS232 serial port. Through each communication interface, users can effectively use all the test functions of OE2052 on the control computer, set up reasonable control parameters of the instrument and read the data measured by the instrument.

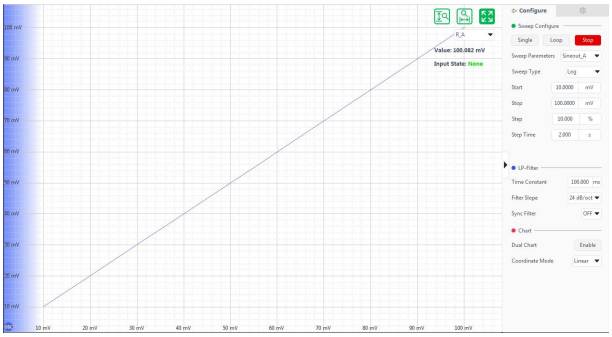
Remote Operation

OE2052 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).



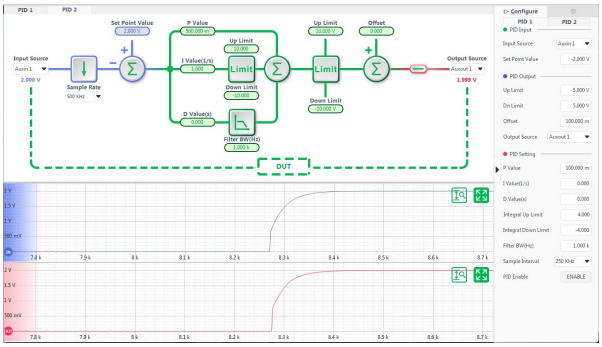
Parametric Scanner

The parameter scanner provides users with convenient and fast scanning for instantaneous plotting of frequency response, amplitude response and other curves, and offers single or cyclic scanning modes.



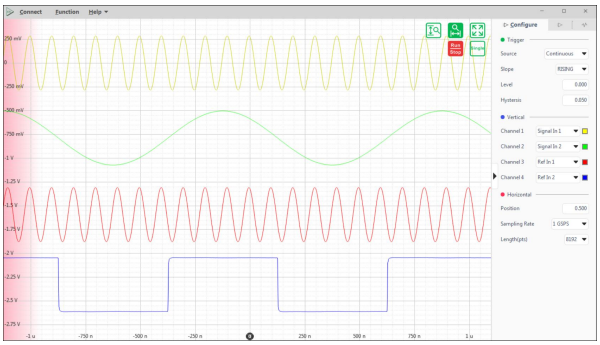
PID Controllers

The OE2052 has a built-in independent 2-channel digital PID controller with a sampling rate of up to 4 MSPS, which is tightly coupled with a lock-in amplifier to control the amplitude, phase, frequency and other signals of the output signal according to the measured value of the demodulator, thus realizing the precise regulation of a variety of controlled quantities.



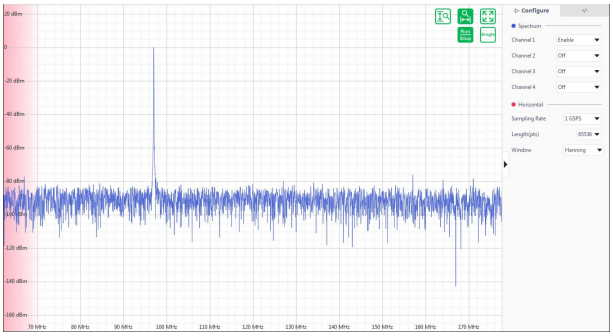
Oscilloscope

Oscilloscope function with 4 signal channels, selectable signal input, reference input, signal output, auxiliary input and output signals, with a variety of triggering methods, for the user real-time display of time domain signals. Maximum 65536 sampling depth, adjustable sampling time 65us - 1s.



FFT Spectrum Analysis

FFT spectrum analysis provides the frequency domain information of a signal based on the waveform captured by an oscilloscope. Depending on the sampling rate, the frequency resolution of the spectrum analysis is approximately 1Hz - 15kHz.



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Input Signal Channel

Voltage input Mode	Single-ended or Differential
Full-scale Sensitivity	1nV to 1 Vrms
Measuring Range	100μV, 500μV, 2mV, 10mV, 50mV, 200mV, 1.3V
Maximum Amplitude	< 1.3 Vrms
Input Coupling	DC or AC
Input Impedance	50Ω or 10 MΩ‖15 pF
Dynamic Reserve	>120 dB
Amplitude Accuracy	0.5% typ.， 1% max
Temperature Drift	0.1%/°C typ.
Input Voltage Noise	4 nV/$\sqrt{Hz}$（f > 100 kHz）
	3 nV/$\sqrt{Hz}$（f > 1 MHz）
Data Conversion	14bit, 1 GSPS
	24bit, 244 kSPS

Reference Signal Channel

Signal	
Frequency range	DC - 400 MHz
Reference input	Sine or Square Wave
Input impedance	50 Ω or 1 MΩ
Sine Reference Level	
Low Range	250 mV_{pp} < V_{pp} < 2.5 V_{pp}
High Range	2.5 V_{pp} < V_{pp} < 10 V_{pp}
Square Reference Level	
Low Range	-0.1 V < V_{IL} < 0.1 V,
	0.25 V < V_{IH} < 2.5 V
High Range	-0.5 V < V_{IL} < 0.5 V,
	2.5 V < V_{IH} < 5.0 V
Phase	
Resolution	1.0 μdeg
Relative phase error	±0.5deg typ.，±3deg max
Harmonic detection	1-65535F (nF < 400MHz)
Acquisition time	
Internal Ref.	Instantaneous
External Ref.	100 cycles or 1.5 ms
Data Conversion	14 bit, 1 GSPS

Internal Oscillator

Number of Oscillators	2
PLL Source Select	Ref in ports or Signal in ports
System Crystal Oscillator	
Accuracy	±0.1 ppm
Temp. Stability	±0.01 ppm/°C
Aging	±0.05 ppm/year
Phase Noise	-150 dBc/$\sqrt{Hz}$@10 kHz

Signal Output Channel

Frequency Range	1 μHz - 400MHz
Sine Out	
Amplitude(HiZ Load)	2μV_{pp} - 3.0 V_{pp} (< 250 MHz)
	2μV_{pp} - 2.2 V_{pp} (< 320 MHz)
	2μV_{pp} - 1.2 V_{pp} (< 400 MHz)
Amplitude(50Ω Load)	1μV_{pp} - 1.5 V_{pp} (< 250 MHz)
	1μV_{pp} - 1.1 V_{pp} (< 320 MHz)
	1μV_{pp} - 0.6 V_{pp} (< 400 MHz)
Resolution	1μV_{pp}
Amplitude Accuracy	±0.5% typ.，±1% max
Output Bias (50Ω Load)	-1.5V to 1.5V
Output Impedance	50Ω
Max Output Current	±100 mA
Data Conversion	16 bit, 1 GSPS

Demodulators

Number of Demodulators	3
Input Source Select	2 input channels selectable
Time Constant	25ns - 4ks
Measurement Bandwidth	40 μHz - 6 MHz
Filter Slope	6, 12, 18, 24,30, 36,
	42, 48 dB/oct

Auxiliary Inputs and Outputs

AUX Inputs	
Function	4 channel inputs
Range	±10V, 1mV resolution
Impedance	1 MΩ
Data Conversion	16 bit, 244.14 kSPS
AUX Outputs	
Function	4 channel outputs
Range	±10V, 1mV resolution
Drive Current	±30 mA max
Data Conversion	16 bit, 976.56 kSPS

Communication Interface

RS-232、USB2.0 and 1000 Mbps Ethernet

General

Power requirements	
Voltage	220-240 V AC
	100-120 V AC(Optional)
Power	100 W typ., 120W max
Dimensions	438mm×550mm×147mm
Weight	12 kg