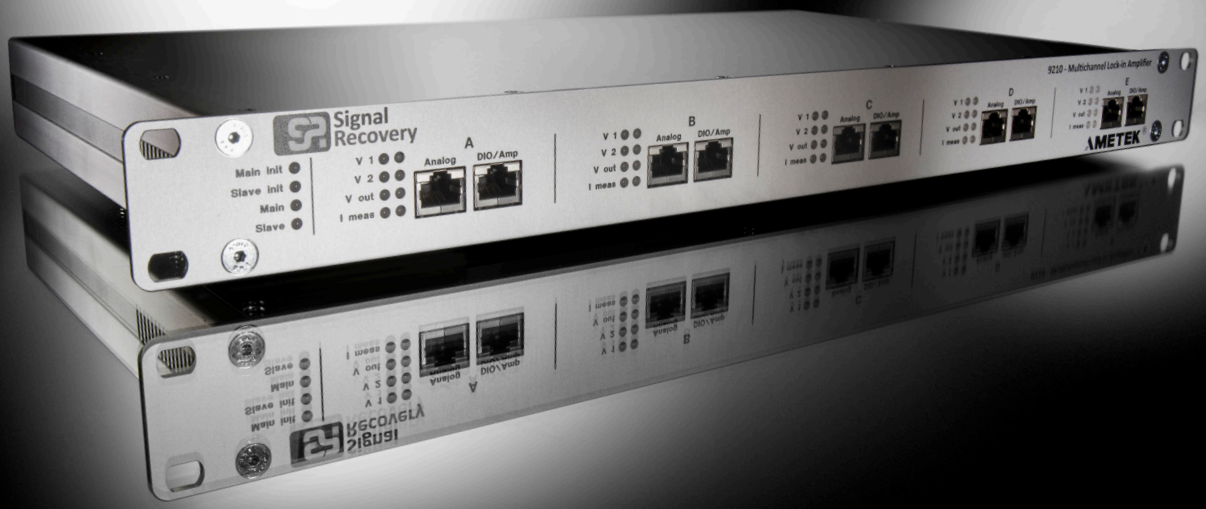
Signal Recovery

9210

Multichannel Lock-in Amplifier



AMETEK

A Complete Measurement Solution...

The SIGNAL RECOVERY Model 9210 is a compact multichannel lock-in amplifier which uses the latest FPGA technology to deliver an instrument which can make complex AC and DC measurements on up to ten different analog signals. In addition it can generate excitation signals to drive the experiment, as well as measure the current delivered by these signals. It is therefore ideally suited to making direct impedance measurements on samples such as superconductors or in material analysis, as well as for use in optical, calorimetric, AC susceptibility, and many other experiments.

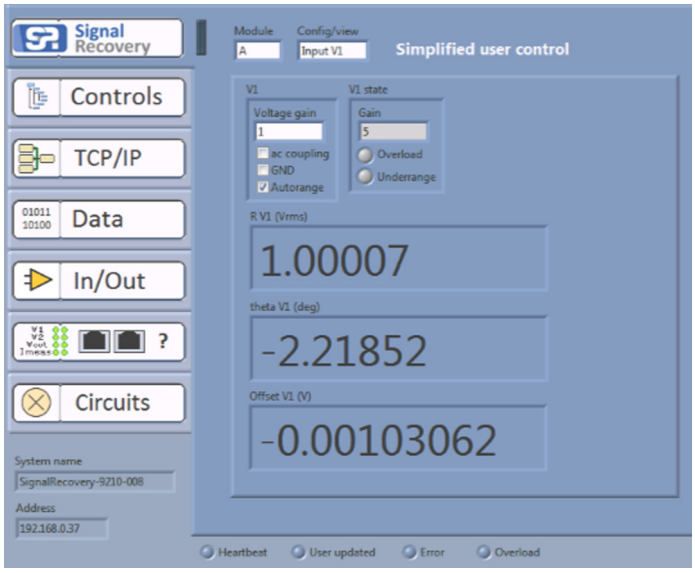
The unit is operated via a Gigabit Ethernet or USB interface from a free Windows compatible software package, or via a LabVIEW 2016 driver. Both packages allow full instrument setup and display of measured results in a wide range of digital and graphical formats.

This powerful instrument, in a slimline console which can stand on the benchtop or be rack mounted, makes the 9210 a valuable addition to any laboratory as well as a cost effective alternative to purchasing multiple instruments.

9210
Multichannel Lock-in Amplifier

The Model 9210 can be ordered with between one and five dual channel signal processing modules. Each module includes a 20-bit DDS signal generator with 1MSa/s update rate which is capable of outputting a sine, sawtooth, triangle, square, or noise waveform with or without a DC offset. The output frequency is selected from one of six programmable values or from one of two phase locked loops which will lock to external TTL logic signals, and the output amplitude is adjustable within three full scale ranges of ±10 V, ±1 V and ±0.1 V. The generator output can be taken directly as a single-ended voltage signal or as a floating signal with integrated output current measurement.

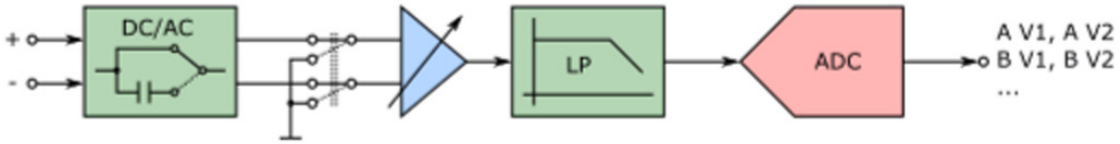
The signal generator output is coupled to the experiment. For example, in the case of a sample resistance measurement, it would be wired in series with the sample, while the voltage generated across it will then be connected to the model 9210's signal inputs.



Easy Access to Controls and Output Readings

Each signal processing module includes two analog differential voltage input channels with twelve adjustable gain stages ranging from x1 to x5000, giving a full scale sensitivity range (pk-pk) of ±10 V to ±2 mV with a noise floor down to 1.8 nV/√Hz . Signals are then passed through anti-aliasing low pass filters before being sampled at 1 MSa/s by two 18-bit precision ADCs. A further ADC samples the signal representing the current being delivered by the generator.

9210 Multichannel Lock-in Amplifier



The three digitized signals are then coupled to two sets of three parallel dual phase lock-in amplifiers per module. The reference channel inputs for all of these lock-ins can be the fundamental or harmonics of any of the frequencies being output by the signal generator(s). Each lock-in has output filters with selectable time constant and slope, and the resulting X, Y Magnitude and Phase readings are then available for display, storage or further processing.

Hence for a fully equipped system comprising five signal processing modules there are a total of 30 dual phase lock-in amplifiers. Each group of fifteen run at a common frequency, but the two groups can use different harmonics of the same frequency (Dual Harmonic Mode) or two unrelated frequencies (Dual Reference Mode). Because the instrument includes two phase locked loops the references can be either internally generated or from external frequency sources.

In addition to classic lock-in detection, the digitized signals can also be shown in a waveform plot (like an oscilloscope), or processed to give an FFT display. DC levels can also be measured and displayed synchronously.

Each module also includes a digital input which can be used to drive one of the two phase locked loops for external reference lock-in operation, and a digital output to use as a phase marker signal for the output from the signal generator.

Finally, a range of feedback options permit measured signals to affect the generator outputs on other channels, or to allow auto-levelling operation, where the generator level is continuously adjusted to give a constant input signal.

RJ45 connectors are used for the signal connections, since these provide a very compact way of terminating multiple connections using screened twisted pair cables. Cat-7 cables can be connected directly to the connectors, with the other end prepared for direct connection to the experiment. Alternatively, if the system is to be used with cryostats in which the signal connections will be made within the vacuum chamber, then Cat-7 jumpers can be connected from the 9210 to low-cost vacuum compatible multipin feedthroughs on the cryostat which allow vacuum integrity to be maintained.

Software

The 9210 is operated from a Windows compatible program that is supplied with each unit, or via a LabVIEW2016 driver. Both options allow all instrument settings to be adjusted and output readings to be collected and displayed in graphical and numerical format.

Useful additional features include oscilloscope and FFT displays, as well as information screens showing the pinouts of the input connectors and clear system block diagrams.

A panel in the software gives quick access to the controls and digital displays corresponding to one selected channel, making it even simpler to use.

The Ethernet connection to the model 9210 can be made either directly to the controlling computer or via a router.

Breakout Box

The BB-BNC breakout box, which is also available, makes connecting conventional BNC terminated signal cables to the RJ45 connectors a great deal easier. The 24 BNC jacks on the front panel are internally connected to flying leads which can be plugged onto pin headers which terminate the connections from the six RJ45 front panel sockets. These are in turn then cabled to the sockets on the front panel of the 9210 with Cat7 patch cords.

The box also includes screw terminal connections to each of the RJ45 connector pins which can be used for direct connection to cables from the experiment.

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Specifications

Signal Processing Module

Each module provides:

Two differential analog signal inputs with:

- Input Full Scale Sensitivity ±10 V to ±2 mV via 12 gain settings
- DC & AC-coupling, <0.2 Hz break frequency
- 18-bit ADC running at 1 MSa/s
- Signal channel passband flat to within ±5% for gains up to x100 and frequencies up to 100 kHz

One analog output with:

- DDS generator using a 20-bit DAC running at 1 MSa/s
- ±10 V, ±1 V and ±0.1 V full range
- 50 mA output current
- Grounded and floating outputs
- Integrated current measurement of floating output (50 mA to 25 nA full scale in 20 steps)
- Noise floor at lowest range < 4 nV/√Hz (grounded) and < 30 nV/√Hz (floating), max 55 nV/√Hz at 10 V full range
- Amplitude accurate to ±5% of set value for frequencies up to 100 kHz

Other:

- Digital (3.3 V or 5 V level) trigger input for external reference frequency input, and phase marker output
- RJ45 signal connectors
- Warning and information LEDs

There are three types of module available, which differ only in the input impedance and voltage noise of the analog inputs, as follows:

- 1.8 nV/√Hz at 1 GΩ amplifier impedance (typical 15/0.5 nA input bias/offset current)
- 3.7 nV/√Hz at 30 GΩ amplifier impedance (typical 0.5/0.1 nA input bias/offset current)
- 18 nV/√Hz at ~TΩ amplifier impedance (typical 10 – 5 pA input bias current)

System Chassis and Common Features

Lock-in Amplifier:

- Recommended Frequency range DC – 100 kHz (operates from DC – 500 kHz)
- Two dual phase lock-ins per input channel, and two per signal generator output, operating at internal or external reference frequency or harmonic.
- Synchronous X, Y, R and θ outputs for each lock-in, and DC measurement

Signal Generator:

- Sinewave, square-wave, triangle, sawtooth, noise
- Frequency, amplitude, DC offset, and duty cycle user controllable
- Composite and modulated waveforms

General

- Real-time feedback options
- Gigabit Ethernet and USB interface ports
- LabVIEW 2016 Driver available
- Integral 40 W line power supply suitable for 100 V to 240 V AC 50/60 Hz

Dimensions, excluding connectors
19" wide x 10" deep x 1¾" high
(483 mm x 255 mm x 44.5 mm)

Weight 6.6 lb. (3 kg)

Operating Location
Indoor use only

Altitude	Up to 2000 m
Pollution Degree Level	2
Operating Temperature	5° to 40°C
Storage Temperature	–25° to 70°C
IP Rating	N/A
Max. Humidity	80% for T up to 31°C, decreasing linearly to 50% relative humidity at 40°C

Model BB-BNC

Dimensions, excluding connectors
19" wide x 5½" deep x 1¾" high
(483 mm x 140 mm x 44.5 mm)

Weight 3.1 lb. (1.4 kg)

Ordering Information

Model 9210-CHS	Chassis assembly, no signal processing modules
Model 9210-LO	Signal processing board, 1.8 nV√Hz
Model 9210-MED	Signal processing board, 3.7 nV√Hz
Model 9210-HI	Signal processing board, 18 nV/√Hz
Model BB-BNC	Breakout Box, 6 x RJ45 to internal pin headers for connection to up to 24 x BNC jacks via flying leads
1108346	cat7 cables with RJ45 male plugs, 2m length

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