

Model 7210

multichannel DSP lock-in amplifier

Simultaneous Multiple Detection



- Simultaneous Spectroscopy
- Superconductivity Tests
- Simultaneous Impedance Measurements
- Electro-field Mapping
- Pump-probe experiments

Introducing...

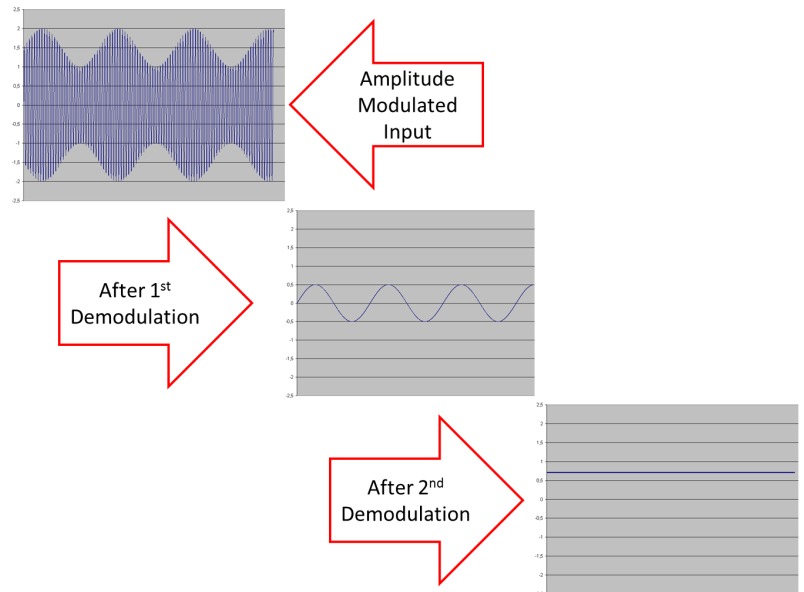
The SIGNAL RECOVERY Model 7210 represents a significant advance in the application of DSP technology for the design of a lock-in amplifier. Until now, instruments have been restricted to a single signal channel, allowing only one, or at most two, signals to be measured at any one time. The model 7210, with its use of the latest technology, allows up to 32 signals to be measured simultaneously. What is more, units can be linked together to give more detection channels. For example, four units give 128 channels, while sixteen would give 512 channels.

The instrument can effectively operate as 32 parallel dual-phase lock-in amplifiers, running at the same external reference frequency, measuring 32 signals and generating 32 pairs of X and Y outputs. It can also operate in a tandem demodulation mode in which an input signal is demodulated against one frequency and that output is then demodulated at a second frequency. This detection method would previously have required two lock-in amplifiers connected in series, so in this mode the 32-channels of the 7210 are equivalent to 64 dual phase lock-in amplifiers. To date, no other lock-in amplifier matches this capability.

Instrument Features:

- Up to 32 DSP dual phase lock-in amplifier channels operating in parallel with a common reference frequency
- 20 Hz to 50.5 kHz operating range
- Independent per-channel control of sensitivity, reference phase and time constant
- Units may be interconnected to increase available channels
- Voltage mode signal channel inputs
- Outputs provided digitally with 208kHz update rate
- Complete with software solutions

...the Model 7210



Single Reference Mode

This is the conventional mode of operation common to all lock-in amplifiers. The instrument measures the amplitude of the components of the signal at its inputs that are in-phase and in quadrature (i.e. 90° out of phase). These two measurement outputs are conventionally known as the X and Y outputs. All signal channels are measured with respect to the same external reference signal, so with a 32 channel instrument there are 64 output values.

Tandem Demodulation Mode

If an amplitude-modulated sinusoidal carrier signal is applied to a conventional lock-in amplifier operated at the carrier frequency and with its reference phase adjusted to yield zero Y output, then the X output signal will be the modulating signal..

If this X output signal is applied to a second lock-in amplifier, but this time running at the modulating frequency, then the second lock-in can directly measure the amplitude of the modulation.

Historically, this type of experiment would have required two instruments, with a physical cable coupling the X output of one to the input of the second. However, the 7210 includes this capability as a standard feature.

In order to allow the second lock-in amplifier's demodulator to run synchronously with the first, it is desirable for its reference frequency to be the result of an integer division of the first reference frequency. Consequently the 7210 is fitted with two reference connectors; REF 1 IN is used to apply the external reference frequency at which the first demodulation stage operates, and the second, REF 2 OUT, outputs a TTL reference waveform at the frequency of the second stage. The user can specify the divisor used to generate the second reference from the first.

It will be appreciated that in tandem mode there are four outputs per signal channel, an X and Y pair from the first stage and an X and Y pair from the second. To avoid confusion, the outputs from the first stage, even when the unit is operating in single reference mode, are referred to as X1 and Y1 and those from the second as X2 and Y2. Therefore, a 32 channel unit running in Tandem mode generates 128 output values.

Specifications

General

Dual-phase 32-channel DSP lock-in amplifier operating over a reference frequency range of 20 Hz to 50.5 kHz. External Reference mode only. Independent control of sensitivity, AC Gain, reference phase and time constant on each channel.

Tandem and 2F detection modes. User-upgradeable firmware.

Measurement Modes

Single-frequency 32 channel dual-phase lock-in amplifier, running with an external reference frequency in the range 20 Hz to 50.5 kHz. Outputs in this mode are X1 and Y1 (in-phase and quadrature components) for each channel

Tandem-operation 32 channel dual-phase lock-in amplifier, running with a first, external reference frequency (the carrier frequency) in the range 20 Hz to 50.5 kHz and generating the second reference frequency by integer division of the first. The range of the second frequency is 0.001 Hz to 100 Hz. Outputs in this mode are X1 and Y1 of the carrier frequency and X2 and Y2 of the amplitude modulation of the carrier frequency by the second reference frequency.

Signal Channel

The signal input specifications depend on the type of signal board fitted, of which three are available:

7210/99 Signal Board - Voltage Mode Inputs

Voltage	
Mode	Virtual Ground
Connector	BNC
Impedance Shell to Ground	0 Ohms
Input Impedance	10 M Ohms
Input Voltage Noise	< 10 nV/Hz-0.5 at 1 kHz
Max Safe Input	± 12.0 V
Frequency Response over which following four specifications apply: 20 Hz to 50.5 kHz	
Typical Gain Accuracy Overall	± 1.5%
Typical Gain Match between Channels	± 3.0%
Phase Accuracy Overall	± 2°
Phase Match between Channels	± 1°
Full-scale sensitivity	100 µV to 1 V rms in a 1-3-10 sequence (9 settings)

Reference Channel

Impedance	1 M Ohms/35 pF
Level	250 mV to 2.5 V rms
Connector	BNC
Frequency Range, F1	20 Hz to 50.5 kHz
Lock Acquisition Time	2 seconds (max)
Reference Phase Shifter (each channel)	Set Resolution 10 m° Orthogonality 90° ± 0.001°

External Frequency	
Meter Resolution	1 Hz
Reference Output (Tandem frequency)	
Frequency	F2 F1/n, where n, an integer, is calculated by the instrument to give a frequency as close as possible to a user-specified value in the range 0.001 Hz to 100 Hz
Amplitude	>3 V pk-pk square-wave
Impedance	<200 Ohms
Connector	BNC
Harmonic Detection f and 2f	
(2f in single-frequency operation only)	2F < 50.5 kHz
Tandem Reference Frequency	
Meter Resolution	0.001 Hz

Demodulator

Main ADC's, each channel	
Type	12 bit
Sampling Range	208 kHz < f _s < 250 kHz, synchronous to external reference (f1) frequency

Single-Frequency Operation

Time Constants	4 ms to 1 ks in 1-3-10 sequence (12 steps)
Slope	12 dB/octave
Type	Synchronous digital FIR filters

Demodulator cont.

Harmonic Rejection	>90 dB
Dynamic Reserve	>80 dB

Tandem-Frequency Operation

Applying to F1 outputs:-

Time Constants	4 ms to 1 ks in 1-3-10 sequence (12 steps)
Slope	12 dB/octave
Type	Synchronous digital FIR filters

Applying to F2 outputs:-

Time constants	30 ms to 1 ks in 1-3-10 sequence (11 steps)
Slope	12 dB/octave
Type	Synchronous digital FIR filters
Harmonic Rejection	>90 dB
Dynamic Reserve	>80 dB

Data Outputs

The outputs available from the instrument are:-

Single Reference Mode	X1 and Y1
Tandem Mode	X1, Y1, and Y2

All outputs are for each of 32 channels. Outputs can be read directly on receipt of a command, or stored on receipt of a GPIB trigger or the GET command for later readout. The output values can be read using commands generating binary or ASCII responses.

Interconnections

Instruments can be interconnected to provide more than 32 detection channels. Interconnections are via RG45 multiple connectors. Each instrument has a rear-panel switch to select whether the connectors function as outputs, in which case the unit is the "master", or inputs, when the unit is a "slave".

Indicators

Front-panel LEDs indicate the following conditions:-

Power On - a single LED which is lit when line power is applied and the unit switched on

Communications Activity - indicates when command is being received and response is waiting to be read or being transmitted

Master/Slave - when lit indicates that the instrument is set to function as a "master" and that its synchronizing signal connectors are configured as outputs

Internal Oscillator - reserved for future expansion

Reference Unlock - lights when no suitable reference is applied

Signal Channel Overload - a single LED warning of input or output overload in any one of the 32 channels. It is possible to identify via a computer status command which channel(s) is affected and the type of overload condition

General

Computer Interfaces	
Type	GPIB (IEEE-488) and RS232
Connectors	Standard GPIB Centronics connector 9-pin female RS232
Comms Settings	Set by rear-panel DIP switches
Command Set	ASCII commands for all instrument controls and data readout. Binary dump commands for data readout
Dimensions	446 mm x 133.5 mm x 435 mm
Weight	12.5 kg

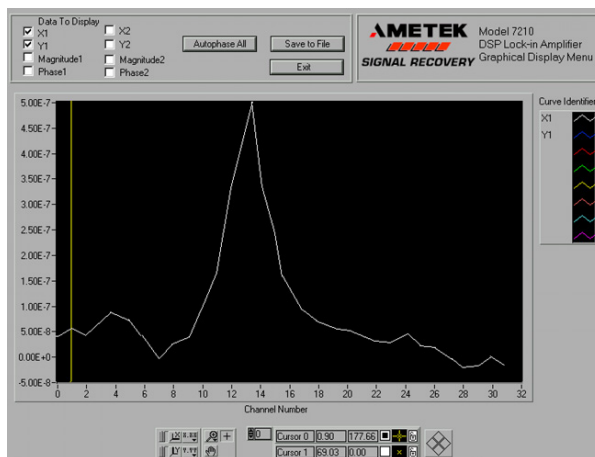
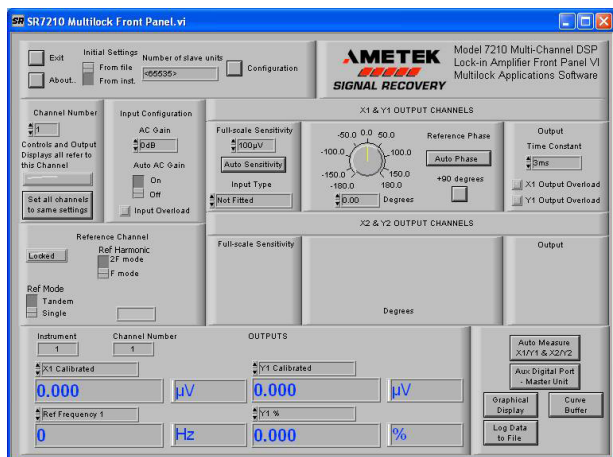
Software Information

SR7210Comms

This is an ActiveX Control and LabVIEW driver that allows full instrument control and is available for this instrument. This software solution can be used, as issued, to control up to four instruments or incorporated into a user's program.

MULTILOCK

This is a fully compiled version of the SR7210Comms, which allows data to be saved directly to disk for later analysis using third-party software.



Ordering Information

In view of the specialized nature of this product, the model 7210 is currently available to special order only, with instruments being individually configured to meet customer requirements.

The basic model 7210 will support up to eight signal boards, each with four signal channels. Orders must include the number of Chassis and Signal Cards required:

Part Number	Description
7210X4	4 Channel System
7210X8	8 Channel System
7210X12	12 Channel System
7210X16	16 Channel System
7210X20	20 Channel System
7210X24	24 Channel System
7210X28	28 Channel System
7210X32	32 Channel System

When more than 32 channels are required then multiple systems can be supplied with 1 meter long interconnecting GPIB and reference link cables. Each instrument is of course supplied complete with a comprehensive instruction manual containing full programming information.

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