

# 450DV2 Digital Lock-in Amplifier

## Features

Scitec Instruments Model 450DV2 is a dual phase dual channel DSP lock-in amplifier. It has been designed for computer control and features both Ethernet and RS232 interfaces. All settings can be managed under browser control. State of the art electronics have been used to produce an instrument that is exceptionally versatile and easy to use. The instrument performs all the usual measurements of a dual phase lock-in amplifier, measuring the in-phase and quadrature components, vector magnitude and phase angle.

- Dual Channel Dual phase instrument with 16 channels of demodulation
- Voltage or current input
- Input Gain settings from x1 to x10,000
- Output Gain settings from x0.001 to x1,000,000
- Frequency range from 1 mHz to 200 kHz
- High performance wide bandwidth input gain stage
- 16 channels of digital demodulation
- First, second, third and fourth order digital filters with time constants from 1  $\mu$ s to 500 ks
- Extensive reference options
- Ethernet and RS232 interfaces
- Control selection and adjustment by onscreen menus and sub-menus via web browser
- All outputs are general purpose and fully programmable

Lock-in amplifiers are used to measure the amplitude and phase of small AC signals in the presence of much larger noise levels. They are widely used to recover small optical signals such as those encountered in spectroscopy and studies of fluorescence and luminescence. However, they also have applications in many other fields including electronics and cryogenics where they can be used in component characterisation, bridge networks and to measure the resistance of superconductors.



(laptop not included)

## 2 Inputs, 16 Demodulators, 4 Outputs – Great Flexibility

The output from a lock-in amplifier is a DC voltage proportional to the amplitude of the input signal but with the noise removed. It is also a function of the relative phase difference between the input signal and the associated reference signal. This property allows lock-in amplifiers to be used for measuring the phase properties of the input signal as well.

Scitec Instruments DSP lock-in amplifiers are dual phase instruments. Dual phase lock-in amplifiers have two demodulators which make measurements with a 90° phase separation.

A key figure of merit used for lock-in amplifiers is dynamic reserve. The dynamic reserve of a lock-in amplifier is defined as the ratio of the noise to signal that is allowed before saturation occurs. The maximum dynamic reserve for the Model 450DV2 is 100dB (\*), allowing an input signal buried in noise of up to 100,000 times larger to be recovered.

(\*) This figure is subject to change.

## Specifications

### Input Signal Channels

The two input signal channels amplify the input signals to a level suitable for digitisation. High performance, low-noise, broad-band amplifiers are used throughout. The input circuitry can accept voltage or current inputs via the front panel signal input BNC.

- Input: voltage or current inputs, via front panel BNC
- Input gain settings: x1, x5, x20, x100, x500, x2000, x10000
- Input Impedance: 10<sup>8</sup> ohm//50 pF, dc coupled
- Frequency: 1 mHz to 200 kHz
- Maximum Inputs: 1 V rms for measurements,  $\pm$ 3 V before input protection circuitry comes into operation.
- Dynamic Reserve: 100 dB max(\*), limited by a maximum signal input noise voltage of 1 V

(\*) This figure is subject to change

### Demodulators

There are 16 separate demodulator channels each operating in dual phase mode, producing both an in phase and a 90° out of phase result.

The input to each demodulator can be selected from either input, a combination of them both or 1V.

Each demodulator uses a high accuracy, high bandwidth digital demodulator to recover the input signal.

### Low Pass Filters

Following demodulation, first, second, third and fourth order low pass filters may be selected.

- Time Constant: 1  $\mu$ s to 500 ks in 1, 2, 5, 10 steps
- 1.5 MHz output update rate

## Reference Channels

- Frequency: 1 mHz to 200 kHz
- Input Impedance: 100K ohm
- Trigger: Zero crossing at 0 V and -0.1 V. TTL/CMOS trigger points at 2 V and 1 V
- Rising or falling edge triggered
- Acquisition Time: 2 cycles
- Each of the 16 demodulators has a separate reference input which is generated using the following:

$\pm \text{reference}_a \cdot I/J \pm \text{reference}_b \cdot K/L + \text{osc} + \text{phase}$

I, J, K and L are in the range 1 to 255. osc is the output from an internal oscillator and phase is phase offset. I, K, osc and phase are selectable per demodulator. J and L are the same on all demodulators.

Example reference signals possible:

- Reference A
- Reference B x 2 (2F operation)
- Reference A x 4 / 5
- Reference A / 5 + Reference B x 29 / 7
- 123kHz
- Reference B x 10 - 456Hz
- Reference A x 67 / 13 – Reference B x 9 / 5 + 10Hz

## Outputs

- 4 Analogue Outputs, 2 BNCs on front panel, 2 BNCs on rear panel.

- Variable gain from x1 to x1,000,000
- $\pm 4V$  full scale output
- Each output is selectable from many different internal signals including: Inputs, demodulator outputs, low pass filter outputs, R and theta calculations, internal oscillators, constants.

## Computer Interfaces

- RS232
- Ethernet
- Command line control of all variables via RS232, telnet and SSH.
- Web control of all variables via http interface.
- Data and control output in XML format.
- Internal processor runs uClinux with full source available.

## General

- Power: 9 V, 2A
- Mechanical: 435(W) x 44(H) x 300(D) mm
- Temperature range: 0-50°C
- Warranty: 2 years from date of shipment



450DV2 Front panel

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