DIGITAL LOCK-IN AMPLIFIER
LI 5640/LI 5630

Advanced Functions Made Possible Only with Digital Systems, with DSP and by NF

NF Corporation
Our Experience and Know-How Made Sure the Amplifier Was Packed with the Advantages of DSP.

NF has full confidence in its experience and know-how in lock-in amplifiers. For the DSP lock-in amplifier, we have taken full advantage of the sophisticated computation capacities of digital signal processors, while significantly improving the speed for setting and response during measurement, the stability of output and the compatibility of data with computers, at the same time as pursuing operability and lower cost.

High stability
The amplifier features high stability and low drift designs in which all processes have been digitized except for the preamplifier used for input. Zero output drift was reduced to minimize levels in the high sensitivity regions. Phase stability is 0.01 °C and gain stability is ±100 ppm/°C. This high stability has formed the backbone for high resolution of 4 1/2 digits and the low noise levels indicated by input referred noise voltage of 4.5 nV/√Hz and phase noise of 0.01°. These features enable very reliable small signal measurements.

Measurement is possible starting from 1 mHz
Measurement is possible from 1 mHz, something that could never be achieved with analogue lock-in amplifiers. A new way has been paved for low-speed phenomenon analysis, such as infrared spectroscopy and temperature response. Digital systems naturally allow high stability. You need never worry about drift in measurements. It is also to the advantage of low frequency measurements that signals are locked to the reference signal in approximately two periods.

Prompt and smooth responses
“Prompt and smooth measurement responses”
The minimum time constant for the wave detection part is 150s. DA conversion of direct current output is possible with high speed and accuracy, at up to 256k samples/sec and 16 bit. Responses are prompt not only for X Y but also for R-F output. Up to 16k samples/second is possible for recording with digital data memory. Moreover, the amplifier features the new synchronised filter, which allows a moving average to be maintained with signal period. Ripples in measurement are significantly reduced, even with small time constants. In addition, the synchronized filter can be used in all frequency ranges. We invite everyone to enjoy fully the prompt and smooth responses.

Easy operation
The amplifier features a one-way set up for signal input, filter, dynamic reserve, sensitivity and time constants, in that order from left to right. Because it is easy to see the key arrangement, errors in settings are prevented. The auto-set button is convenient for setting unknown input signals.

There are three sets of large displays. They ensure accurate reading of settings and measurements. In addition, modifiable dial and analogue meters are also provided. You can enjoy the capabilities of the digital lock-in amplifier in an analogue style.

Line-up of two products
There are two models available for the product, namely the multi-functional and fully equipped digital lock-in amplifier LI 5640 and the economic digital lock-in amplifier LI 5630 with the same basic performance but of simpler functional line-up. Both models are of two-phase type.

Spectroscopic reflective measurement of materials
Optical measurement (intensity, absorption, etc.)
Spectroscopy analysis (general spectroscopy, auger electron spectroscopy, photo-acoustic spectroscopy, Raman spectroscopy, etc.)
Photo gyro
Magnetic measurement (Evaluation of magnetic materials, vibration type magnetometer, magnetic detection using SQUID)
Sensor evaluation
Bridge detector
Impedance measurement
Mechanical vibration measurement
Biological/physiological signal measurement

Instantaneous responses when settings are switched
Even when the settings for phase and sensitivity are changed during a measurement, the latest value is converted to the value for the new setting, allowing instantaneous responses for measurement. Even when the time constant is large, you need not wait for the time constant response.

Line-up of two products
- LI 5640 model
- LI 5630 model
- Digital Lock-In Amplifier LI 5640 model
- Multi-function Digital Lock-In Amplifier LI 5640 model
Incorporating a high level of functionality, reflecting NF’s confidence in its unrivalled level of expertise.

- **Minimum time constant 10μs**
  - Use it as high speed phase sensitive detector

- **3 large-size display windows**
  - Adopted large displays making measured or setting value easy to look.
  - It’s convenient to 3 displays at one time.
  - Measured value is high resolution of 4½ digits.

- **dB, % display**
  - In addition to the ratio measurement that is convenient for the relative measurement, the percentage (%) display and the decimal (logarithmic scale) display which effectively evaluate the signals changing largely, are available.

- **Synchronized filter**
  - A synchronized filter is equipped, which realizes the moving average at the span of integral multiple of the reference signal frequency.
  - The output of less ripples can be derived even if low frequency or short time constant.

- **Switching the slope**
  - It is possible to switch the roll-off of the time constant (smoothing filter) into 6, 12, 18 and 24dB/oct. It helps the high speed convergence of measured value.

- **Auto zero off-set**
  - When the key is pressed, the off-set of X, Y output is set to 0.

- **Output expansion**
  - The output can be expanded up to 100 times. Also slight change of measured value can be detected exactly if combined with the output off-set.

- **Low frequency response**
  - Wide bandwidth of 1mHz to 100kHz is available.

- **Harmonics measurement**
  - It is possible to measure by designating of only harmonic elements which are contained in measurement signals.

- **Dial**
  - Large type of modify dial is provided, which enables setting in analog touch.

- **Synchronized edge selection**
  - The synchronized edge of reference signals is set up.
  - Standard position of the phase is specified.

- **Reference signal source**
  - In addition to the external signal and internal oscillator, signal input synchronized mode is also provided, which can measure even if excluding reference signals.

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**Simple, but high efficiency**

**Digital Lock-in Amplifier LI 5630**

LI 5630 is economical Digital Lock-in Amplifier, of which function is focused in simple, taking over the basic performance of LI 5640.

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**LI 5640**

- **Filter**
  - Line filter effectively eliminating the ham noise.
  - Also it can set not to use anti-alias filter (THRU) for super high speed response.

- **2-Meters**
  - An analog meter catching directly the change of measured values.

- **Noise measurement**
  - Equipped noise measurement mode that can measure the noise density. Measurement range of noise density:
    - Voltage 20mV/μV to 1V FULL
    - Current 100μA/μA to 1μA/μA FULL

- **Auto set**
  - Each setting of sensitivity, time constant, dynamic reserve and phase is automatically set to the optimum value of that time.
# Specifications F.S. Full Scale, D.R. Dynamic Reserve

## 1. General

### Measured signal system

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## 2. Voltage input

### Input mode

- **Sensitivity**
  - Gain 4 (single-end) and 8 (differential)
  - 2 V/F, 1 V/F, 0.5 V/F (1-2.5 sequence)
  - ±0.5% 1 kHz (DC/AC) signal level 1 mV or greater, 30% or higher of full scale, ±200 mV, ±100 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input, ±20 mV, ±10 mV, ±20 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

- **Gain drift** ±100 ppm/°C (typ.) (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).
  - 10 MA ±0.5% of FSR at 25°C (±10°C, ±10°C).
  - 100 mV (30°C, ±10°C, D, R, LV, 20% or less of input range).

- **Input noise**
  - DC coupling: ±0.5 µV PE (±100 mV, ±10°C, ±10°C).
  - AC coupling: ±2 µV PE (±100 mV, ±10°C, ±10°C).

- **Nonlinear drift**
  - ±0.5% 1 kHz (DC/AC) signal level 1 mV or greater, 30% or higher of full scale, ±200 mV, ±100 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

- **Harmonic distortion**
  - ±0.05% 1 kHz (DC/AC) signal level 1 mV or greater, 30% or higher of full scale, ±200 mV, ±100 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

- **Nonlinear maximum input voltage**
  - ±2 V (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

### Gain accuracy

- ±2% (1 kHz, D.R.L.O.W, signal level of 1 mV or greater, ±250 mV, ±50 mV to ±10 mV).

### Frequency range

- ±12 dB/oct or more (Sine wave reference signal, time constant 100 ms, attenuation slope 12 dB/oct or more, time constant 100 ms, attenuation slope 12 dB/oct or more, time constant 100 ms, attenuation slope 12 dB/oct or more, time constant 100 ms, attenuation slope 12 dB/oct or more).

### Reference oscillator

- **Frequency range**
  - ±5.5% 100 Hz to 10 kHz.

### Internal output

- **Output voltage**
  - ±0.05% 1 kHz (DC/AC) signal level 1 mV or greater, 30% or higher of full scale, ±200 mV, ±100 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

- **Nonlinear drift**
  - ±0.5% 1 kHz (DC/AC) signal level 1 mV or greater, 30% or higher of full scale, ±200 mV, ±100 mV (1 kHz, ±10 VmV RMS, ±200 mV, ±100 mV input).

### Measurement output section

1. **Digital display**

   - **Type of Data**
     - [DATA1, DATA2, AUX IN1, AUX IN2]
   - **Type of Interface**
     - GPIB/RS-232
   - **Power supply voltage range**
     - ±15 V (±9 V, 5 V in differential measurement)
   - **Sampling rate**
     - 10 kHz
   - **Accuracy**
     - ±0.3% (for reading value ±15 mV)
   - **Power consumption**
     - 50 V or less
   - **External dimensions**
     - 195 mm x 456 mm x 223 mm
   - **Weight**
     - Approx. 4 kg

2. **Analog output**

   - **Type of data**
     - [DATA1, DATA2, AUX IN1, AUX IN2]
   - **Type of Interface**
     - GPIB/RS-232
   - **Power supply voltage range**
     - ±15 V (±9 V, 5 V in differential measurement)
   - **Sampling rate**
     - 10 kHz
   - **Accuracy**
     - ±0.3% (for reading value ±15 mV)
   - **Power consumption**
     - 50 W or less
   - **External dimensions**
     - 195 mm x 456 mm x 223 mm
   - **Weight**
     - Appox. 4 kg

### Automatic setting function

- **Auto SET**
  - Set the optimum sensitivity, dynamic range, time constant, phase etc. according to the input signal.

### Sensitivity

- Adjust the sensitivity of voltage or current, and display according to the input signal.

### Time constant

- Adjust time constant according to the phase of the reference signal.

### Phase

- Set the phase of reference signal as that the measurement # of phase will be zero.

### Offset

- Set the offset as that output of X and Y will be zero.

## Other performance specifications

### Recommended setting

- **Trigger input**
  - LI 5640: 40 V, 120 V, ±100 V (±90 V, ±90 V in differential measurement), LI 5630: 40 V, ±100 V (±90 V, ±90 V in differential measurement), TRIG IN: 40 V, ±100 V (±90 V, ±90 V in differential measurement) (±10 V per channel or the external interface). TRIG IN: 40 V, ±100 V (±90 V, ±90 V in differential measurement) (±10 V per channel or the external interface).

### Power supply voltage range

- LI 5640: ±120 V to ±100 V, ±50 V or less
  - LI 5630: ±120 V to ±100 V, ±50 V or less
  - LI 5610: ±120 V to ±100 V, ±50 V or less

### Dimensions

- LI 5640: 456 mm x 195 mm x 223 mm
  - LI 5630: 195 mm x 456 mm x 223 mm
  - LI 5610: 223 mm x 195 mm x 456 mm

### Weight

- LI 5640: approx. 19 kg
  - LI 5630: approx. 14 kg
  - LI 5610: approx. 10 kg
Related products totally supporting small signal measurement

**Low noise amplifier**
SA series

The SA series are amplifiers, challenging the limitation of the detection of small signals. In addition of 7 kind line-up because of different input styles, dedicated low noise power supplies and DC bias power supplies for sensors are provided.

**Differential Amplifiers**
5307

Low noise differential amplifiers with wide band of DC to 10MHz and max.1000 times of gain. This meets to wide applications as a versatile pre-amplifier or a differential amplifier since necessary functions are consolidated in a small signal amplifier.

**Low noise pre-amplifier**
LI-75A

For improving the sensitivity of Lock In Amplifiers and for the common mode noise elimination. 100 times of gain and, wide band of DC to 1MHz.

**Current Input Preamplifier**
LI-76

This is a current input / voltage output pre-amplifier which is used for the signal amplify (convert) of photo-multiplier.

**DC Power Supply**
PS-70A

Dedicated power supply for LI-75A and LI-76

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