

# Specifications F.S.: Full Scale, D.R.: Dynamic Reserve

## ■ Measured signal system

### 1. General

Input coupling	AC/DC
Input ground	Float / Chassis ground Float : Voltage between chassis and signal ground $\pm 1V_{max}$ . Ground : ground impedance approx. 10 $\Omega$ (DC)
Line filter	line frequency (50 or 60Hz) and double (100 or 120Hz)
Anti areas filter	<b>LI 5640</b> on/off <b>LI 5630</b> on (always)

### 2. Voltage input

Input modes	A (single end) and A-B (differential)
Sensitivity	2 nV / F.S. to 1 V / F.S. (1-2-5 sequence)
Gain accuracy	$\pm 0.5\%$ (1 kHz, D.R.LOW, signal level of 1 mV or greater, 30% or higher of full scale, $23 \pm 5^\circ\text{C}$ ) $\pm 2\%$ (1 kHz, D.R.LOW, signal level of 1 $\mu\text{V}$ or greater, 30% or higher of full scale) $\pm 0.5\%$ (for DC coupling, 20 kHz or less) $\pm 1\%$ (for DC coupling, 50 kHz or less) $\pm 2.5\%$ (for DC coupling, 100 kHz or less) (Dynamic reserve at LOW, sensitivity 1V, signal level 1Vrms)
Gain drift	$\pm 100$ ppm / $^\circ\text{C}$ (typ.) (1 kHz)
Input impedance	10 M $\Omega \pm 1.5\%$ , approx. 50 pF in parallel
Common mode rejection ratio	120dB (typ.) (at 1kHz) 100dB (min.) (50Hz to 1kHz, D,R, LOW, less than 20mV range, 50Hz to 1kHz, D,R, MED, less than 2mV range) Both of them are at the AC coupling.
Input noise	4.5 nV/ $\sqrt{\text{Hz}}$ (typ.), 6 nV/ $\sqrt{\text{Hz}}$ (max) (at 1 kHz, 2 mV or less, D.R.LOW, and input short-circuited)
Maximum input voltage saturation	$\pm 7$ V (DC coupling) 5 Vrms (AC coupling, sine wave)
Nondestructive maximum input voltage	For AC coupling : AC 10 Vrms, DC $\pm 50$ V For DC coupling : $\pm 14$ V
Frequency range	1mHz to 100 kHz (DC coupling), 0.5 Hz to 100 kHz (AC coupling)
Harmonic distortion	-90 dB (typ.), (1kHz, 1V range, D.R.LOW, 1Vrms input) -80 dB or less (10 Hz to 5 kHz, 1V range, D.R.LOW, 1Vrms input)

### 3. Current input (only for LI 5640)

Sensitivity	50 fA / F.S. to 1 $\mu\text{A}$ / F.S. 1-2-5 sequence (for conversion gain 10 $^6$ V/A) 5 fA / F.S. to 10 nA / F.S. 1-2-5 sequence (for conversion gain 10 $^8$ V/A)
Current accuracy	$\pm 1\%$ (1 kHz and magnitude of signal 1 nA to 1 $\mu\text{A}$ for conversion gain 10 $^6$ V/A ; 10Hz and magnitude of signal 10pA to 10nA for conversion gain 10 $^8$ V/A, both for dynamic reserve at LOW and magnitude of signal at 30% or greater of sensitivity full scale and $23 \pm 5^\circ\text{C}$ )
Gain drift	$\pm 150$ ppm / $^\circ\text{C}$ (typ.) (at 1 kHz for 10 $^6$ V/A and 10 Hz for 10 $^8$ V/A)
Frequency range	1 mHz to 50kHz (DC coupling, for conversion gain 10 $^6$ V/A) 1 mHz to 500 Hz (DC coupling, for conversion gain 10 $^8$ V/A)
Input noise	130 fA/ $\sqrt{\text{Hz}}$ (typ.) (1 kHz for conversion gain 10 $^6$ V/A) 13 fA/ $\sqrt{\text{Hz}}$ (typ.) (125 Hz for conversion gain 10 $^8$ V/A)
Input impedance	$\leq 1$ k $\Omega$ (500 Hz for conversion gain 10 $^6$ V/A) $\leq 20$ k $\Omega$ (500 Hz for conversion gain 10 $^8$ V/A)
Nondestructive maximum input current	10mA

## ■ Phase sensitive detector section

Dynamic reserve	100 dB or greater
Time constant	10 $\mu\text{s}$ to 30 ks (1-3 sequence)
Attenuation slope	6, 12, 18 and 24 dB/oct ( <b>LI 5640</b> ) 24 dB/oct ( <b>LI 5630</b> )
Synchronous filter	ON/OFF
Phase noise	0.001 $^\circ$ rms (typ.) (1 kHz) Sine wave reference signal, time constant 100 ms, attenuation slope 18 dB/oct or more 0.003 $^\circ$ rms (typ.) (100 kHz) Sine wave reference signal, time constant 100 ms, attenuation slope 12 dB/oct or more
Phase drift	Within $\pm 0.01^\circ/\text{C}$ ( $\leq 10$ kHz) Within $\pm 0.1^\circ/\text{C}$ ( $> 10$ kHz, $\leq 60$ kHz) Within $\pm 0.2^\circ/\text{C}$ ( $> 60$ kHz)

## ■ Reference signal system

Reference mode	<b>LI 5640</b> : REF IN , INT OSC , SIGNAL <b>LI 5630</b> : REF IN
Frequency range	0.5 mHz to 102 kHz for TTL input or INT OSC 0.5 Hz to 102 kHz for SINE input or SIGNAL
Harmonics measurement	<b>LI 5640</b> : 2 to 19999 times of the reference signal <b>LI 5630</b> : 2 times of the reference signal (frequencies of harmonics to be within the above frequency range)
Input impedance	Approx. 1 M $\Omega$ (1 kHz), 100 pF or less
Input voltage range	0.3 to 30 Vp-p (SINE input) 0 to 5V (TTL input) $\pm 40$ V
Nondestructive maximum input voltage	$\pm 40$ V
External reference signal waveform	SINE/TTL POS/TTL NEG
External reference signal synchronization time	2 cycles + 50ms (typ.)
Phase adjustment range	-180.00 $^\circ$ to +179.99 $^\circ$ , resolution 0.01 $^\circ$
Orthogonality	Within $\pm 0.001^\circ$
Phase accuracy	$\pm 1^\circ$ (DC coupling, $\leq 10$ kHz) $\pm 5^\circ$ (DC coupling, $\leq 100$ kHz)
Frequency measurement resolution	4 1/2 digits (maximum 19999) at 0.1 mHz or more
UNLOCK indication	Indicates that the system is not synchronized to external reference signal.
Reference signal output	TTL (0 to 5V)

## ■ Internal oscillator (for LI 5640)

Frequency	Range : 0.5 mHz to 105 kHz Resolution : 4 1/2 digits at 0.1 mHz or more Accuracy : $\pm 30$ ppm
Output voltage Range and Resolution	0 to 0.0500 Vrms, resolution 0.1mV 0 to 0.500 Vrms, resolution 1mV 0 to 5.00 Vrms, resolution 10mV 3-range by manual switching
Output voltage accuracy	2% of set value + 0.5% of full scale (frequency $\leq 1$ kHz) 5% of set value + 0.5% of full scale (frequency $\leq 10$ kHz) 20% of set value + 0.5% of full scale (frequency $\leq 100$ kHz)
Output voltage stability	$\pm 50$ ppm / $^\circ\text{C}$ (typ.) (for 1 kHz, 1 Vrms)
Maximum output current	$\pm 10$ mA, recommendable load impedance $\geq 1$ k $\Omega$
Output impedance	50 $\Omega \pm 3\%$ (1 kHz)
Harmonics distortion factor	-80 dB (0.01%) or less (for 20 Hz to 5 kHz, maximum amplitude selected) -70 dB (0.03%) or less (for frequency $\leq 100$ kHz, maximum amplitude selected)

## ■ Measurement output section

### 1. Digital display

<b>LI 5640</b> DATA1 parameter DATA2 parameter	X (= R cos $\theta$ ), R, NOISE, AUX IN 1 Y (= R sin $\theta$ ), $\theta$ , AUX IN 1, AUX IN 2
<b>LI 5630</b> DATA parameter X, Y and R	X, Y, R, $\theta$ Indication range 0 to 120% of sensitivity setting resolution 4 1/2 digits (maximum 19999) Indication range -180.00 to +179.99 $^\circ$ , resolution 0.01 $^\circ$ Indication range 0 to 120% of the sensitivity setting Voltage : 20 nV/ $\sqrt{\text{Hz}}$ to 1V/ $\sqrt{\text{Hz}}$ Current (10 $^6$ V/A) : 1pA $\sqrt{\text{Hz}}$ to 1 $\mu\text{A}$ $\sqrt{\text{Hz}}$ Current (10 $^8$ V/A) : 100 fA $\sqrt{\text{Hz}}$ to 10 nA $\sqrt{\text{Hz}}$ Resolution 4 1/2 digits (maximum 19999)
$\theta$ NOISE ( for <b>LI 5640</b> only)	Indication range 0.000 to $\pm 12.000$ V Resolution 0.001 V K constant range : 0.1000 to 1.9999, and 2.000 to 9.999 Displays the ratio of X, Y and R to AUX input. Indication range: 0.0000 to $\pm 1.9999$ Resolution 0.0001
AUX INPUT (for <b>LI 5640</b> only) Ratio indication	Displays the ratio of X, Y and R to AUX input. Indication range: 0.0000 to $\pm 1.9999$ Resolution 0.0001
Normalize (for <b>LI 5640</b> only)	Indicates the ratio of the X and R to the standard value in dB or %. Indication range : 0.00 to $\pm 120.00$ dB, resolution 0.01 dB 0.00 to $\pm 199.99\%$ , resolution 0.01% Standard value range : Voltage 1.0000 nV to 1.0000V (4 1/2 digits, maximum 19999) Current 1.0000 fA to 1.0000 $\mu\text{A}$ (4 1/2 digits, maximum 19999) 0.00 to $\pm 100.00\%$ of the sensitivity to X and Y.
Offset EXPAND	Magnifies X, Y and R by 1, 10 or 100 times

## 2 Analog output

Common specifications	
Maximum output voltage	±12V
Maximum output current	±6 mA
Output impedance	Approx. 1 kΩ for DC
Output voltage accuracy:	± (Analog output voltage equivalent to 0.35% of displayed value +15 mV) for DC, exclude monitor output
Full-scale(F.S.)	Measurement values corresponding to meter full scale (analog output ±10 V)
X, Y, R, NOISE	Sensitivity Full-scale (NOISE: for <b>LI 5640</b> only)
AUX IN1 and AUX IN2	±10 V ( for LI 5640 only)
θ	±180°
Ratio	±2
% indication	±200% (for <b>LI 5640</b> only)
dB indication	±100 dB (for <b>LI 5640</b> only)
Front panel output (for <b>LI 5640</b> )	
DATA1 OUT	Same as DATA1 display parameter
DATA2 OUT	Same as DATA2 display parameter
DATA1 OUT, DATA 2 OUT Reset rate	X, Y, R and θ : 256k samples/s Others : 16k samples/s
(for <b>LI 5630</b> )	
DATA OUT	Same as DATA display parameter
DATA OUT Reset rate	256k samples/s
Monitor out :	Phase detector input signal
Rear panel	
X OUT, Y OUT Reset rate	16k samples/s.

## 3. Analog meter

<b>LI 5640</b> DATA1	Indicates the same parameter as DATA1 display parameter
DATA2	Indicates the same parameter as DATA2 display parameter.
<b>LI 5630</b> DATA	Indicates the same parameter as DATA display parameter

## ■Auxiliary input (DC voltage measurement)

Number of channels	<b>LI 5640</b> 2 <b>LI 5630</b> 1
Maximum allowable input voltage	±12 V
Maximum nondestructive input voltage	±40 V
Input impedance	Approx. 1 MΩ, 100 pF or less
Accuracy	± (0.35% of reading value + 15 mV)
Frequency band width	DC to approx. 130 Hz (−3 dB)
Sampling rate	16k samples/s

## ■Auxiliary output (DC voltage output) (for LI 5640 only)

Number of channels	2
Setting voltage range	±10.000 V (resolution 0.001 V)
Maximum output current	±5 mA
Output impedance	Approx. 1 kΩ
Output voltage accuracy	± (0.35% of setting + 15 mV)

## ■Automatic setting function

AUTO SET	Set the optimum sensitivity, dynamic reserve, time constant, phase etc. according to the input signal.
Sensitivity	Adjust the sensitivity of voltage or current, and dynamic reserve according to the input signal.
Time constant	Adjust time constant corresponding to the frequency of the reference signal.
Phase	Set the phase of reference signal so that the measurement θ of phase will be zero.
Offset	Set all offsets so that output of X and Y will be zero.

## ■Data memory

Type of data	<b>LI 5640</b> [DATA1], [DATA2], [DATA1, DATA2], [DATA2, AUX IN2], [DATA1, DATA2, reference signal frequency], [DATA1, DATA2, AUX IN1, AUX IN2] <b>LI 5630</b> [DATA], [AUX IN], [X, Y], [R, θ], [DATA, AUX IN], [X, Y, reference signal frequency], [R, θ, reference signal frequency], [X, Y, AUX IN, R], [R, θ, AUX IN, X]
Data resolution	16 bits (reference signal frequency is 32 bits)
Recording capacity	64k data (total of all parameters to be recorded ; assuming 16 bits per data)
Number of memory divisions	1, 2, 4, 8, 16 and 32
Sampling interval	1/16 ms, 1/8 ms, 1/4 ms, 1/2 ms, 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s; or by trigger signal
Trigger signal	TRIG IN on the rear panel or the external interface
TRIG IN	Signal level : TTL level (falling edge) Minimum trigger interval : 1/16 ms Input impedance : Approx. 10 kΩ Maximum nondestructive input voltage : ±40V

## ■General specifications

Power output to preamplifier	±24V, ±50mA (possible to supply to LI-75A/LI-76)
Setting memories	9
Initializing function	Return to specified initial setting
Key lock	ON/OFF
Lamp control	ON/OFF
Fan control	ON/OFF
External interface	GPIB/RS-232
Power supply voltage range	100/120/230V±10%
Power supply frequency range	50/60 Hz±2 Hz
Power consumption	50 VA or less
Temperature/humidity range for performance guarantee	0 to +40°C, 10 to 95%RH (no dew condensation)
External dimensions	434 (W) × 132.5 (H) × 450 (D) mm (excluding protruding portions)
Weight	Approx. 10 kg