

Lock-In-Amplifier Module



Features	• Working Frequency 10 Hz ... 45 kHz • Digital Phase Shifter 0 ... 360° • Current and Voltage Input • Parameter Control by local Switches and opto-isolated digital Inputs • Compact and EMI-Shielded Case
Applications	• Spectroscopy • Luminescence, Fluorescence, Phosphorescence Measurements • Light Scattering Measurements • Opto-electronical Quality Control • Integration in Industrial and Scientific Measurement-Systems
Block Diagram	The block diagram illustrates the internal architecture of the LIA-MV-150. It starts with a SIGNAL INPUT and a REFERENCE INPUT. The signal path includes a Voltage-/Current Input Selector, a Transimpedance Amplifier (Gain = -1kV/A), a Progr. Gain AC-Amplifier, a Lowpass-Filter (f_c = 150 kHz, 12 dB/Oct.), and a Highpass-Filter (f_c = 0.4 Hz, 6 dB/Oct.). The reference path includes a Reference Comparator, a Digital Phase-Shifter (Δφ = 0 ... 360°), a PSD (Phase-Sensitive Detector), a Lowpass-Filter (f_c = 3ms...10s, 6/12 dB/Oct.), and a Progr. Gain DC-Amplifier. The output is X-OUTPUT R * cos(φ). Control inputs include CONTROL INPUTS (Optocoupler Isolate Unit, Manual Switches) connected to a Parameter Control Unit. Status outputs include OVERLOAD DETECTOR, UNLOCKED DETECTOR, and STATUS-OUTPUT. The diagram is labeled BS01-1051-16.

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Specifications	Test Conditions	$V_s = \pm 15\text{ V}$, $T_a = 25^\circ\text{C}$
Voltage Input	Voltage Input Characteristic Voltage Input Range Voltage Input Coupling Voltage Input Impedance Voltage Input Noise Voltage Input CMRR Voltage Input Gain Drift	Model “-S”: Single-Ended Instrumentation-Amplifier Model “-D”: True Differential Instrumentation-Amplifier 3 μV ... 100 mV in 1-3-10 steps (for Full Scale Output) AC, 0.015 Hz Model “-S”: 1 $\text{M}\Omega$ // 4 pF Model “-D”: 2 $\text{M}\Omega$ // 2 pF differential 12 nV/ $\sqrt{\text{Hz}}$ Model “-D”: 110 dB @ 1 kHz, 100 dB @ 10 kHz 100 ppm/K
Current Input	Current Input Characteristic Current Input Range Current Input Noise Current Input Source- Capacit. Current Input Gain Error vs. Source Capacitance	Transimpedance-Amplifier, -1 kV/A (inverting) 3 nA ... 100 μA in 1-3-10 steps (for Full Scale Output) 13 pA/ $\sqrt{\text{Hz}}$ 10 pF – 1 nF (recommended) Cs f < 20 kHz 10 pF < 1 % 100 pF < 1 % 1 nF < 2 %
Signal Filter	Signal Filter Lowpass (-3 dB BW) Signal Filter Highpass (-3 dB BW) Signal Filter Cutoff accuracy	150 kHz; 12 dB/Oct. 0.4 Hz; 6 dB/Oct. $\pm 20\%$
Demodulator	Demodulator Dynamic Reserve	35 dB @ Low Drift Setting 55 dB @ High Dynamic Setting
Reference Input	Reference Input Voltage Range Reference Input Impedance Reference Acquisition Time	$\pm 100\text{ mV}$... $\pm 5\text{ V}$ @ bip. Mode (0 V Comparator Threshold) - 5 V / +10 V @ TTL Mode (2 V Comparator Threshold) 1 $\text{M}\Omega$ max. 2 s @ Fast Setting max. 4 s @ Slow Setting
Phase Shifter	Phase Shifter Type Phase Shifter Range Phase Shifter Resolution Phase Shifter Drift Phase Shifter Accuracy	Digital, Working Frequency 10 Hz ... 45 kHz 0 ... + 360 ° 1.4 ° < 100 ppm/K < 0.3 °
Time Constants	Time Constant Range Time Const. Filter Characteristic	3 ms ... 10 s in 1-3-10 steps 6 dB/Oct. or 12 dB/Oct. switchable
Output	Output Channels Output Voltage Range Output Current Output Impedance Output DC-Stability Output Basic Accuracy Output Voltage Offset Range Output Voltage Offset Control- Voltage Impedance	X = In Phase $\pm 10\text{ V}$ (@ 2 $\text{k}\Omega$ Load) $\pm 5\text{ mA}$ max. 50 Ω 50 ppm/K @ Low Drift Setting 500 ppm/K @ High Dynamic Setting 2 %, Frequency > 30 kHz 5% $\pm 100\%$ Full Scale by $\pm 10\text{ V}$ Control @ Low Drift Setting $\pm 100\%$ Full Scale by $\pm 1\text{ V}$ Control @ High Dyn. Setting 22 $\text{k}\Omega$

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Specifications (continued)

Status Indicator LED	Functions	Amplifier Overload Status Reference PLL Unlocked Status
Digital Control	Control Input Voltage Control Input Current Digital Status Output Voltage Digital Status Output Current	Low: - 0.8 V ... + 0.8 V High: + 1.8 V ... + 12 V, TTL / CMOS compatible 0 mA @ 0V, 1.5 mA @ + 5 V, 4.5 mA @ + 12V typ. Active: + 4.5 V typ. Non Active: 0 V typ. 10 mA max.
Power Supply	Supply Voltage Supply Current	± 15 Vdc ... ± 20 Vdc - 60 mA, + 100 mA
Case	Weight Material	370 gr. (0.86 lbs) AlMg4.5Mn, nickel-plated
Temperature Range	Storage Temperature Operating Temperature	- 40 ... + 100 °C 0 ... + 60 °C
Absolute Maximum Ratings	Signal Input AC Voltage Signal Input DC Voltage Reference Input Voltage Control Input Voltage Power Supply Voltage	20 Vpp ± 30 V ± 30 V - 5 V, + 30 V ± 22 V

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Switch Settings

3 Dip Switch - Presettings

Switch	OFF	ON
S1	Reference-Input-Threshold = 0 V	Reference-Input-Threshold = 2 V
S2	Fast PLL-Locking	Slow PLL-Locking
S3	Current Input	Voltage Input

Sensitivity Setting, General

8 steps of input AC-gain are selectable. Output DC-gain is selectable in 2 settings. The DC-gain settings are marked as "Low Drift" and "High Dynamic" mode:

Mode	DC-Gain	Dyn. Reserve	DC-Stability
Low Drift	100	Low	High
High Dynamic	1000	High	Low

Select mode by sensitivity switch settings 0–7 or 8–F. If only low dynamic reserve is required, select the high DC-stability settings ("Low Drift" mode).

Sensitivity Setting for Full Scale (= 10 V Output)

Low Drift Mode			High Dynamic Mode		
Setting	Voltage	Current	Setting	Voltage	Current
0	100 mV	100 μ A	8	10 mV	10 μ A
1	30 mV	30 μ A	9	3 mV	3 μ A
2	10 mV	10 μ A	A	1 mV	1 μ A
3	3 mV	3 μ A	B	300 μ V	300 nA
4	1 mV	1 μ A	C	100 μ V	100 nA
5	300 μ V	300 nA	D	30 μ V	30 nA
6	100 μ V	100 nA	E	10 μ V	10 nA
7	30 μ V	30 nA	F	3 μ V	3 nA

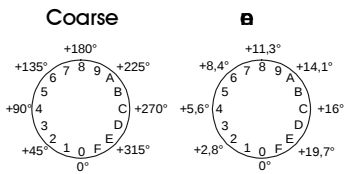
Time Constant Setting

	6 dB/Oct.	12 dB/Oct.	Time Constant
0	8		3 ms
1	9		10 ms
2	A		30 ms
3	B		100 ms
4	C		300 ms
5	D		1 s
6	E		3 s
7	F		10 s

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Phase Shift Setting

Phase shift is adjusted by 2 phase switches with 8 Bit resolution. Values 0 ... 255 (Hex 00 ... FF) correspond to phase shift setting 0 ... +360 °. One step with switch marked "Coarse" changes phase shift by 22.5 °. The "Fine"-switch changes phase shift by 1.4 ° - steps:



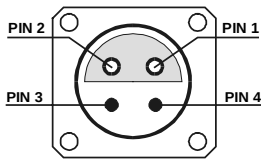
Connectors

Signal Input

Model "-S": BNC
Model "-D": LEMO Series 1S, 4-pin fixed Socket

Voltage Input: Pin 1: Non Inverting Input
Pin 2: Inverting Input
Pin 3: GND
Pin 4: N.C.

Current Input: Pin 1: Current Amplifier Input
Pin 2: If Current Input is used, connect to Pin 3 (GND)
Pin 3: GND
Pin 4: N.C.



Reference Input

Output

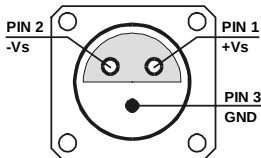
Power Supply

BNC

BNC

LEMO Series 1S, 3-pin fixed Socket

Pin 1: + 15V
Pin 2: - 15V
Pin 3: GND



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Control Port

- Sub-D 25-pin, female, Qual. Class 2
- Pin 1: +12V (Stabilized Power Supply Output)
 - Pin 2: -12V (Stabilized Power Supply Output)
 - Pin 3: AGND (Analog Ground)
 - Pin 4: +5V (Stabilized Power Supply Output)
 - Pin 5: X-Output
 - Pin 6: Overload Status Output
 - Pin 7: Unlocked Status Output
 - Pin 8: X-Output Offset Control Input
 - Pin 9: DGND (Ground f. Digital Control Pin 10 - 25)
 - Pin 10: Dynamic Mode (DYN0)
 - Pin 11: Sensitivity (SEN0)
 - Pin 12: Sensitivity (SEN1)
 - Pin 13: Sensitivity (SEN2)
 - Pin 14: Time Constant Slope (TCSL)
 - Pin 15: Time Constant (TC0)
 - Pin 16: Time Constant (TC1)
 - Pin 17: Time Constant (TC2)
 - Pin 18: Phase Shift (PH0)
 - Pin 19: Phase Shift (PH1)
 - Pin 20: Phase Shift (PH2)
 - Pin 21: Phase Shift (PH3)
 - Pin 22: Phase Shift (PH4)
 - Pin 23: Phase Shift (PH5)
 - Pin 24: Phase Shift (PH6)
 - Pin 25: Phase Shift (PH7)

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Remote Control Operation

General

Remote control input bits are opto-isolated and connected by logical OR to local switch setting. The 4 hexadecimal switches are 4 bit-coded as shown in the following table:

Switch Code	MSB		LSB	
	Bit 3	Bit 2	Bit 1	Bit 0
0	Low	Low	Low	Low
1	Low	Low	Low	High
2	Low	Low	High	Low
3	Low	Low	High	High
4	Low	High	Low	Low
5	Low	High	Low	High
6	Low	High	High	Low
7	Low	High	High	High
8	High	Low	Low	Low
9	High	Low	Low	High
A	High	Low	High	Low
B	High	Low	High	High
C	High	High	Low	Low
D	High	High	Low	High
E	High	High	High	Low
F	High	High	High	High

For remote control a Lock-In-Amplifier switch setting, set the local switch to "0" and select the wanted setting via a 4-bit-code at the corresponding digital inputs:

Sensitivity Switch - Corresponding Inputs

Bit	Corresponding Control Port Input	
Bit 0	SEN0	(Pin 11)
Bit 1	SEN1	(Pin 12)
Bit 2	SEN2	(Pin 13)
Bit 3	DYN0	(Pin 10)

Time Constant Switch - Corresponding Inputs

Bit	Corresponding Control Port Input	
Bit 0	TC0	(Pin 15)
Bit 1	TC1	(Pin 16)
Bit 2	TC2	(Pin 17)
Bit 3	TCSL	(Pin 14)

Phase Switch Coarse - Corresponding Inputs

Bit	Corresponding Control Port Input	
Bit 0	PH4	(Pin 22)
Bit 1	PH5	(Pin 23)
Bit 2	PH6	(Pin 24)
Bit 3	PH7	(Pin 25)

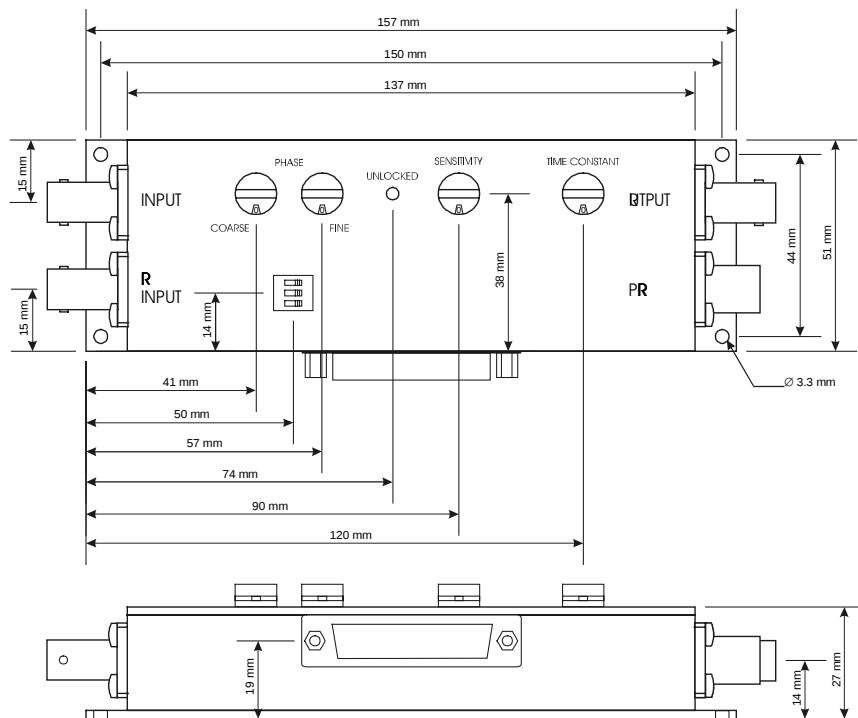
Phase Switch Fine - Corresponding Inputs

Bit	Corresponding Control Port Input	
Bit 0	PH0	(Pin 18)
Bit 1	PH1	(Pin 19)
Bit 2	PH2	(Pin 20)
Bit 3	PH3	(Pin 21)

For example to select a switch setting code "6", you have to connect a "High"- level signal to the corresponding control input pins Bit 1 & Bit 2. Mixed operation, e.g.local phase setting and remote controlled sensitivity setting, is also possible.

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Dimensions



DZ01-1051-13a

Ordering Information

Available Models

Model No.: LIA-MV-150-S
- Single-Ended Input (BNC-Connector Input)

Model No.: LIA-MV-150-D
- True Differential Input (LEMO-Connector Input)

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