

# Lock-In-Amplifier Module



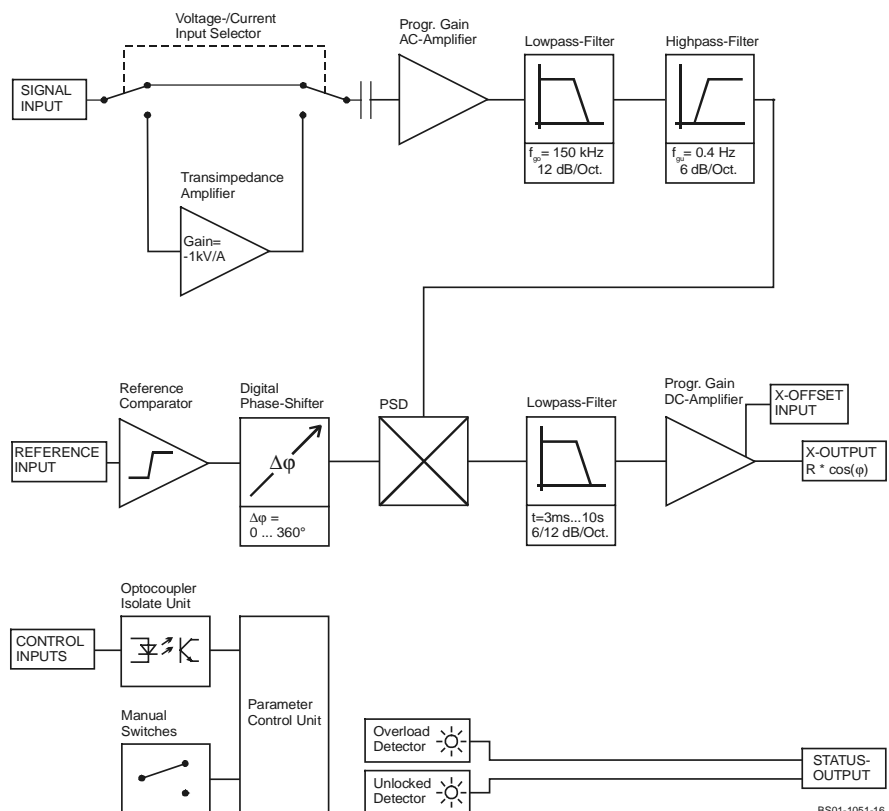
Features

- 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



BS01-1051-16

# Lock-In-Amplifier Module

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

**Lock-In-Amplifier Module**

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

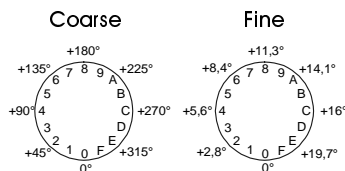
## Lock-In-Amplifier Module

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

# Lock-In-Amplifier Module

**Phase Shift Setting**

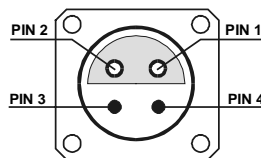
Phase shift is adjusted by 2 phase switches with 8 Bit resolution. Values 0 ... 255 ( Hex 00 ... FF ) correspond to phase shift setting 0 ... +360 °. One step with switch marked "Coarse" changes phase shift by 22.5 °. The "Fine"-switch changes phase shift by 1.4 ° - steps:



**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**

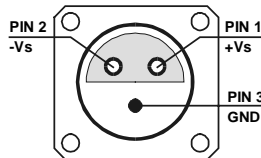
BNC

**Output**

BNC

**Power Supply**

LEMO Series 1S, 3-pin fixed Socket  
 Pin 1: + 15V  
 Pin 2: - 15V  
 Pin 3: GND



## Lock-In-Amplifier Module

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 (DYNO)
- 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)

## Lock-In-Amplifier Module

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	DYNO	(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)

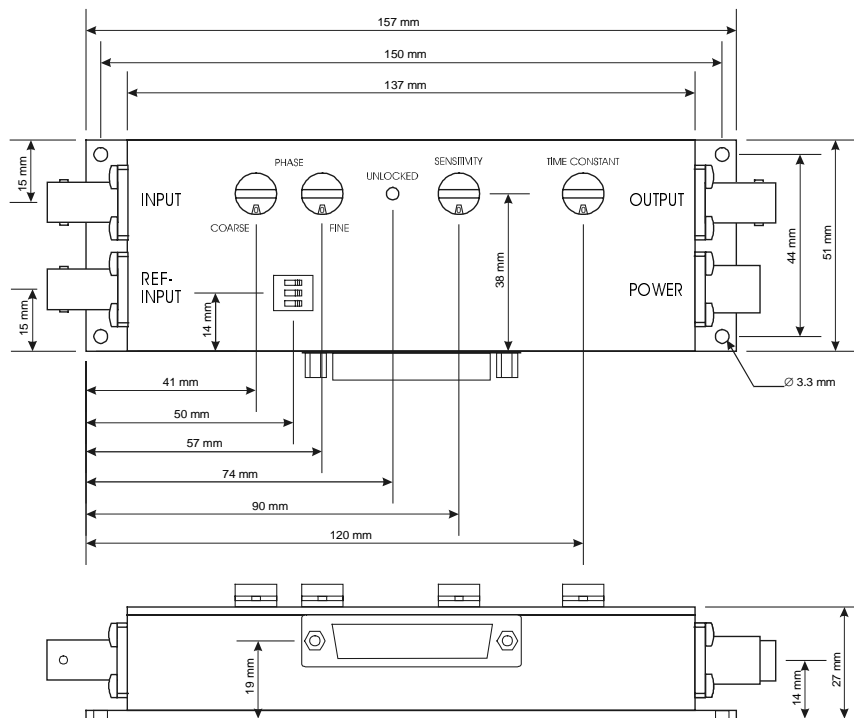
Phase Switch Fine -  
Corresponding Inputs

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.

### Lock-In-Amplifier Module

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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