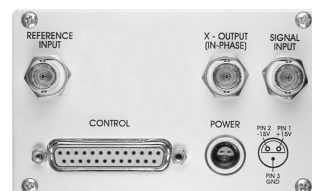
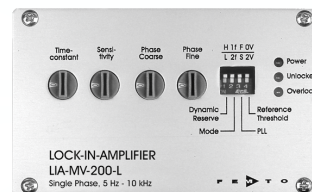


Lock-In-Amplifier Module



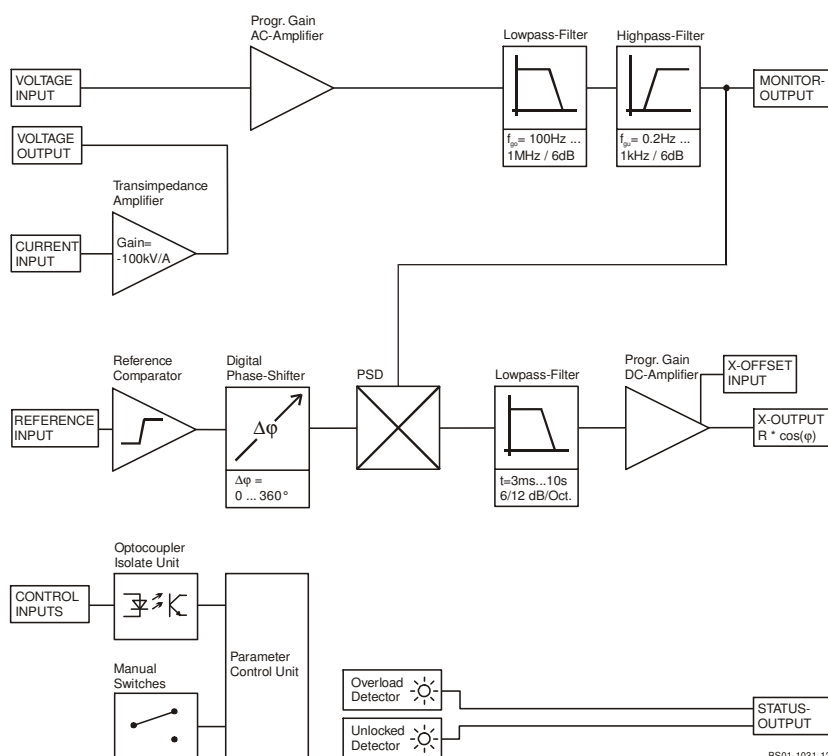
Features

- BNC connectors for input and output signals
- Rugged aluminum housing
- Single phase detection with X output
- Working frequency 5 Hz ... 10 kHz, digital phase shifter 0 ... 360°
- Parameter control by local switches and opto-isolated digital inputs
- Optional reference oscillator module available

Applications

- Spectroscopy
- Luminescence, fluorescence, phosphorescence measurements
- Light scattering measurements
- Opto-electronical quality control

Block Diagram



BS01-1031-12

Lock-In-Amplifier Module

Specifications	Test Conditions	$V_s = \pm 15 \text{ V}$, $T_A = 25 \text{ }^\circ\text{C}$
Voltage Input	Voltage input characteristic Voltage input range Voltage input coupling Voltage input impedance Voltage input noise Voltage input CMRR Voltage input gain drift	true differential instrumentation amplifier 3 μV ... 1V in 1-3-10 steps (for full scale output) AC 1 $\text{M}\Omega$ // 4 pF 12 nV/ $\sqrt{\text{Hz}}$ 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, -100 kV/A (inverting) 30 pA ... 10 μA in 1-3-10 steps (for full scale output) 0.4 pA/ $\sqrt{\text{Hz}}$ 10 pF – 500 pF (recommended) Cs f < 10 kHz 10 pF < 1 % 100 pF < 1 % 1 nF < 2 %
Signal Filter (without optional Bandpass-Module)	Signal filter lowpass (-3 dB BW) Signal filter highpass (-3 dB BW) Signal filter cutoff accuracy Max. dynamic reserve	1 MHz, 100 kHz, 10 kHz, 1 kHz, 100 Hz; 6 dB/oct. selectable per jumper 0.2 Hz, 1 Hz, 10 Hz, 100 Hz, 1 kHz; 6 dB/oct. selectable per jumper $\pm 20 \%$ 80 dB
Signal Monitor Output	Signal monitor output gain Signal monitor output voltage Signal monitor output impedance Signal monitor output current Note	1 ... 3333 (depends on gain setting) $\pm 8 \text{ V max.}$ 100 Ω $\pm 10 \text{ mA max.}$ When using current input with low input ranges, the monitor output may be disabled by opening the soldering jumper at the board (near JP1) to prevent from recoupling.
Demodulator	Demodulator dynamic reserve	15 dB @ ultra stable setting 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) $-5 \text{ V} / +10 \text{ V @ TTL mode}$ (+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 5 Hz ... 10 kHz 0 ... $+ 360^\circ$ 1.4 $^\circ$ <100 ppm/K <0.3 $^\circ$
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

Lock-In-Amplifier Module

Specifications (continued) Output

Output channels	X = in phase
Output voltage range	± 10 V (@ 2 k Ω load)
Output current	± 5 mA max.
Output impedance	50 Ω
Output DC-stability	5 ppm/K @ ultra stable setting 50 ppm/K @ low drift setting 500 ppm/K @ high dynamic setting
Output basic accuracy	2 % @ sinusoidal input signal
Output voltage offset range	± 100 % full scale by ± 10 V control voltage
Output voltage offset control-	
Output load impedance	>2 k Ω

Status Indicator LED

Functions	amplifier overload status reference PLL unlocked status
-----------	--

Digital Control

Control input voltage	low: -0.8 V ... $+0.8$ V, high: $+1.8$ V ... $+12$ V
Control input current	0 mA @ 0V, 1.5 mA @ $+5$ V, 4.5 mA @ $+12$ V typ.
Digital status output voltage	Active: $+4.5$ V typ., Non Active: 0 V typ.
Digital status output current	10 mA max.

Power Supply

Supply voltage	± 15 Vdc ... ± 18 Vdc
Supply current	-60 mA, $+100$ mA

Case

Material	Aluminum anodized
Dimension	64,4 x 105,0 x 223,0 mm (without BNC connectors)
Weight	1000 g (2.2 lb)

Temperature Range

Storage temperature	-40 ... $+100$ $^{\circ}$ C
Operating temperature	0 ... $+60$ $^{\circ}$ C

Absolute Maximum Ratings

Signal input AC voltage	50 V _{pp}
Reference input voltage	± 15 V
Control input voltage	-5 V, $+30$ V
Power supply voltage	± 22 V

Switch Settings

4 dip switch - presettings	switch	OFF	ON
S1	low drift & high dynamic		ultra stable & low drift
S2	1-f mode		2-f mode
S3	fast PLL-locking		slow PLL-locking
S4	reference-input-threshold = 0 V		reference-input-threshold = $+2$ V
Sensitivity setting, output DC-gain modes	3 output DC-gain modes are selectable:		
	mode	DC-gain	dyn. reserve DC-stability
	ultra stable	10	low high
	low drift	100	medium medium
	high dynamic	1000	high low

If only low dynamic reserve is required, select the higher DC-stability settings. Use dip switch S1 to preselect either the two upper or the two lower DC-gain modes, then select best mode by sensitivity switch settings 0–7 or 8–F.

Lock-In-Amplifier Module

Switch Settings (continued)

S1 = ON: sensitivity setting
for full scale (= 10 V output)

ultra stable mode
setting voltage current

0	1 V	10 μ A
1	300 mV	3 μ A
2	100 mV	1 μ A
3	30 mV	300 nA
4	10 mV	100 nA
5	3 mV	30 nA
6	1 mV	10 nA
7	300 μ V	3 nA

low drift mode
setting voltage current

8	100 mV	1 μ A
9	30 mV	300 nA
A	10 mV	100 nA
B	3 mV	30 nA
C	1 mV	10 nA
D	300 μ V	3 nA
E	100 μ V	1 nA
F	30 μ V	300 pA

S1 = OFF: sensitivity setting
for full scale (= 10 V output)

low drift mode
setting voltage current

0	100 mV	1 μ A
1	30 mV	300 nA
2	10 mV	100 nA
3	3 mV	30 nA
4	1 mV	10 nA
5	300 μ V	3 nA
6	100 μ V	1 nA
7	30 μ V	300 pA

high dynamic mode
setting voltage current

8	10 mV	100 nA
9	3 mV	30 nA
A	1 mV	10 nA
B	300 μ V	3 nA
C	100 μ V	1 nA
D	30 μ V	300 pA
E	10 μ V	100 pA
F	3 μ V	30 pA

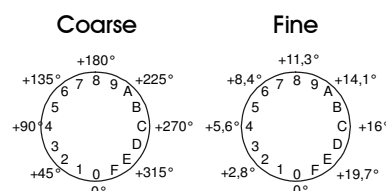
Time constant setting

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

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:



If 2-f mode is selected, the resolution of digital phase control changes to 2.8 ° and the phase shift range doubles to 0 ... + 720 °.

Lock-In-Amplifier Module

Internal Jumper Settings
(jumpers are accessible
when top of case is
removed)

Input signal filter
setting

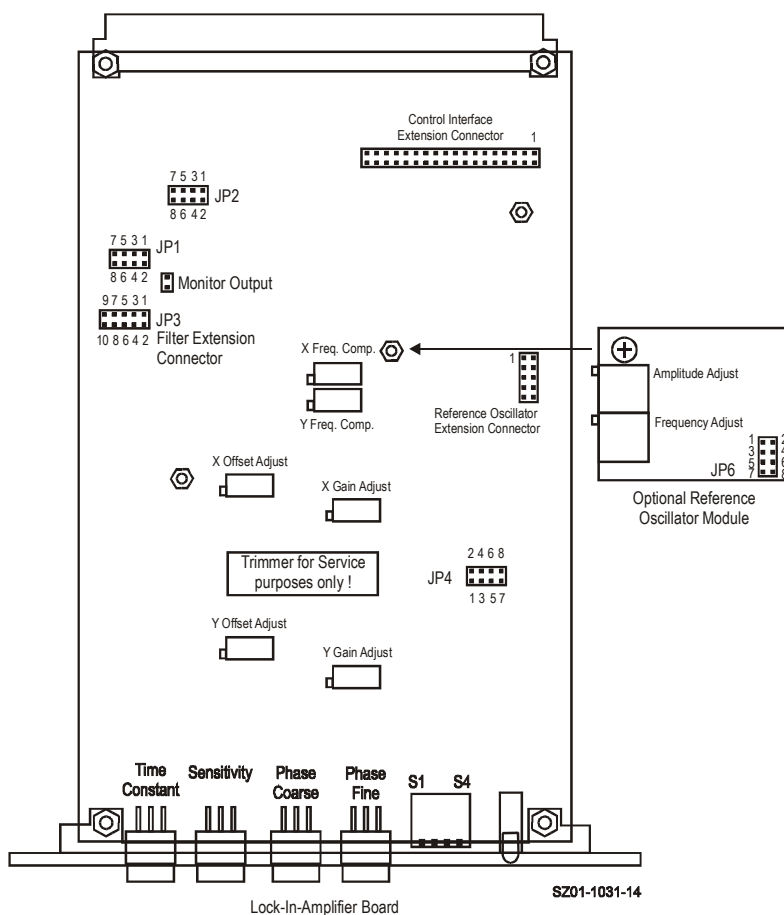
Set cut-off frequency of input lowpass filter
with JP1 + JP2 (always same position) and
highpass filter with JP3:

JP3	highpass	JP1, JP2	lowpass
	−3 dB cut-off		−3 dB cut-off
3 − 4	0.2 Hz	1 − 2	100 Hz
1 − 3	1 Hz	3 − 4	1 kHz
2 − 4	10 Hz	5 − 6	10 kHz
3 − 5	100 Hz	7 − 8	100 kHz
4 − 6	1 kHz	none	1 MHz

Frequency range
selection

JP4	frequency range
1 – 2	normal operation
3, 4, 5, 6, 7, 8	test pins, do not use

Internal Jumper Position
Diagram
(look at top of board when
case is opened)



Lock-In-Amplifier Module

Internal Connector
(of build-in Lock-In Board)

Connector type	Euro-card DIN 41612 connector, 64 pin male, (a+c)
Input	Pin C2: voltage input, non-inverting, DC-coupled Pin C3: voltage input, non-inverting, AC-coupled Pin C4: voltage input, inverting, AC-coupled Pin C5: voltage input, inverting, DC-coupled Pin C7: current input Pin C6: current amplifier voltage output Pin A2- A6: input GND
Monitor output	Pin C9: monitor output Pin A9: monitor GND
Output	Pin C14: X-signal output Pin C15: output GND
Offset input	Pin A10: X-offset input Pin A13: offset GND
Status output	Pin C10: unlocked status output Pin C11: overload status output Pin C17: status output GND (=power supply GND)
Power supply	Pin A16+C16: power supply – 15V Pin A18+C18: power supply + 15V Pin A17+C17: power supply GND
Remote control inputs (opto-isolated)	Pin C19: time constant (TC0) Pin A19: time constant (TC1) Pin C20: time constant (TC2) Pin A20: time constant slope (TCSL) Pin A22: sensitivity (SEN0) Pin C21: sensitivity (SEN1) Pin A21: sensitivity (SEN2) Pin C22: dynamic mode (DYN0) Pin A28: phase shift (PH0) Pin C28: phase shift (PH1) Pin A27: phase shift (PH2) Pin C27: phase shift (PH3) Pin A26: phase shift (PH4) Pin C26: phase shift (PH5) Pin A25: phase shift (PH6) Pin C25: phase shift (PH7) Pin C24: disable local switch control Pin A23+A24: remote control GND (common optocoupler cathode)
Reference input	Pin A32: reference input Pin A31: reference input ground
Reference output (Connected only if optional oscillator module is installed)	Pin A30: reference output Pin A17: refer. output GND (=power supply GND) Pin A29: reference synchronization input
Standard control interface (Connected only if optional control interface module (future product) is installed)	Pin C29: interface 0 Pin C30: interface 1 Pin C31: interface 2 Pin C32: interface 3

Lock-In-Amplifier Module

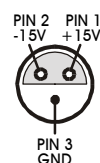
External Connectors
(at backside, Standard
Configuration)

Signal input
X-Output

Factory set to BNC, isolated (single ended)
BNC

Reference input
Power supply

BNC
Lemo® series 1S, 3-pin fixed socket
(mating plug type: FFA.1S.303.CLAC52)
Pin 1: +15V
Pin 2: -15V
Pin 3: GND



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: disable local switch control input
Pin 9: DGND (ground f. digital control pin 8 - 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)

Connector Wiring Options

General

The BNC-connector configuration can be easily changed by setting electrical jumpers at the internal I/O-adapter card. Disconnect the power supply and open the case by loosening the two upper screws at the case front and rear side. Please pay attention to the ground connection at the backplane. Now open the case by lifting the top. The jumper options and functions are described in the following table.

Lock-In-Amplifier Module

Connector Wiring Options,
Jumpers on internal
Adapter Board

Input connectors (JP1)

input wiring

jumper installed

IN A = voltage input
(single ended, AC)

" +V-IN → IN A"
" GND → IN A/SHLD"
" -V-IN → IN A/SHLD"

IN A = voltage input
(differential, AC)

" +V-IN → IN A"
" -V-IN → IN A/SHLD"

IN A / IN B = voltage input
(2 BNC differential, AC)
(OUT A cannot be used)

" +V-IN → IN A"
" GND → IN A/SHLD"
" -V-IN → IN B"

IN A = current input
(single ended)

" C-IN → IN A"
" GND → IN A/SHLD"
" -V-IN → C-OUT"
" +V-IN → GND"

Output connectors (JP2)

output wiring

jumper installed

OUT A = X-output

"X → OUT A"
(JP1) "USE OUT A/NO IN B"

OUT B = X-output

"X → OUT B"

OUT A = Y-output

"Y → OUT A"
(JP1) "USE OUT A/NO IN B"

OUT B = Y-output

"Y → OUT B"

OUT C = Y-output

"Y → OUT C"

OUT A = R-output

"R → OUT A"
(JP1) "USE OUT A/NO IN B"

OUT B = R-output

"R → OUT B"

OUT C = R-output

"R → OUT C"

OUT B = monitor output

"MON → OUT B"

OUT C = monitor output

"MON → OUT C"

OUT B = unlocked output

"UNL → OUT B"

OUT C = unlocked output

"UNL → OUT C"

OUT B = Overload output

"OVL → OUT B"

OUT C = overload output

"OVL → OUT C"

OUT C = reference output

"REF-OUT → OUT C"

Reference connector (JP3)

reference wiring

jumper installed

REF = reference input

"REF-IN → REF" (2 jumper)

REF = reference output
(reference output
connected to ref. input)

"REF-OUT → REF-IN" (2 jp.)
"REF-IN → REF" (2 jumper)

REF = refer. sync. input
(use OUT C as
reference output)

"REF-SYNC → REF" (2 jp.)

(Reference output only if
optional oscillator module
is installed)

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 switch setting, set the local switch to "0" and select the wanted setting via the 4-bit-code at the corresponding digital inputs.

Sensitivity switch - corresponding inputs

Bit	corresponding control port input	
Bit 0	SEN0	(Pin A22)
Bit 1	SEN1	(Pin C21)
Bit 2	SEN2	(Pin A21)
Bit 3	DYN0	(Pin C22)

Time constant switch - corresponding inputs

Bit	corresponding control port input	
Bit 0	TC0	(Pin C19)
Bit 1	TC1	(Pin A19)
Bit 2	TC2	(Pin C20)
Bit 3	TCSL	(Pin A20)

Phase switch coarse - corresponding inputs

Bit	corresponding control port input	
Bit 0	PH4	(Pin A26)
Bit 1	PH5	(Pin C26)
Bit 2	PH6	(Pin A25)
Bit 3	PH7	(Pin C25)

Phase switch fine - corresponding inputs

Bit	corresponding control port input	
Bit 0	PH0	(Pin A28)
Bit 1	PH1	(Pin C28)
Bit 2	PH2	(Pin A27)
Bit 3	PH3	(Pin C27)

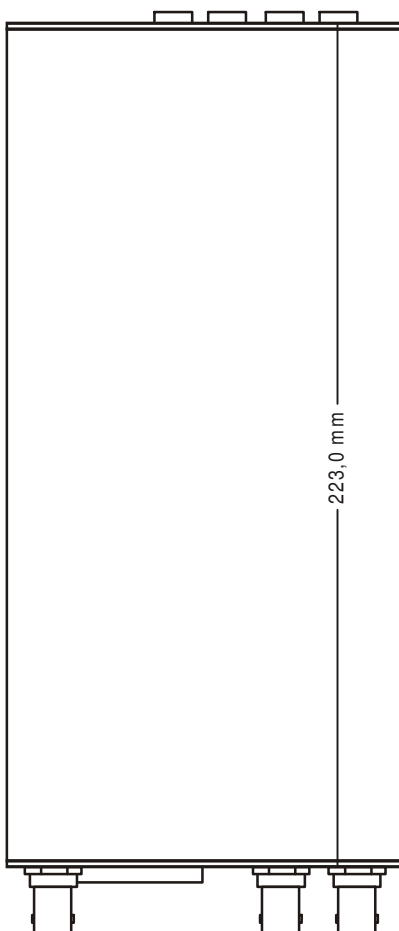
Remote control example

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 settings and remote controlled sensitivity setting, is also possible.

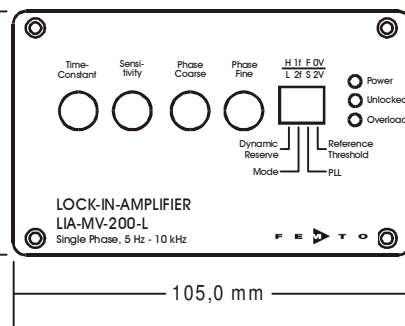
Lock-In-Amplifier Module

Dimensions

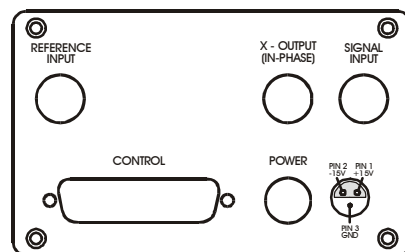
Top View



Front View



Back View



Case Material:
Al, natural anodised

DZ01-1071-10

Optional Extensions

Reference oscillator module

Model No.: SOM-1

- frequency range 5 Hz ... 130 kHz, user adjustable
- output voltage 0 ... 2 V_{RMS}, user adjustable
- 100 ppm/K amplitude accuracy

Factory set

1 kHz, 1 V_{RMS}

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