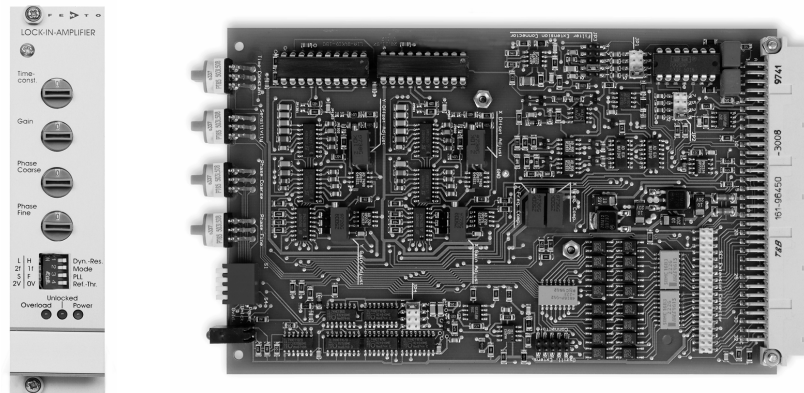


Single-Board Dual Phase Lock-In Amplifier



Picture shows Lock-in Amplifier card with optional Mounting Kit LIA- MK- 2 (to be ordered separately)

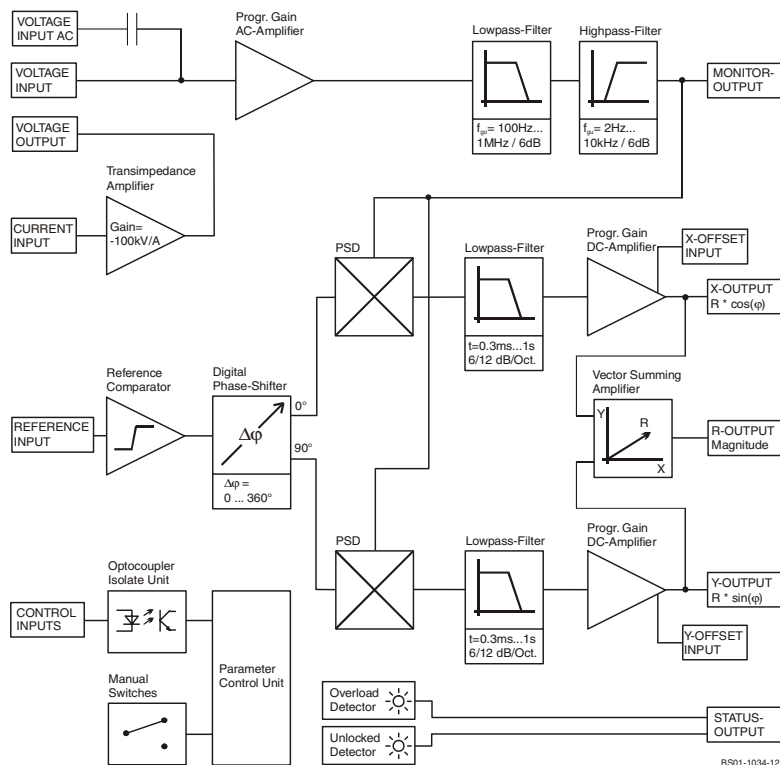
Features

- Dual Phase Detection with X, Y and Magnitude Output
- Working Frequency 50 Hz ... 120 kHz
- Digital Phase Shifter 0 ... 360°
- Current and Voltage Input
- Parameter Control by local Switches and opto-isolated digital Inputs
- Optional Mounting Kit and Reference Oscillator Modules available

Applications

- Spectroscopy
- Luminescence, Fluorescence, Phosphorescence Measurements
- Light Scattering Measurements
- Opto-electronical Quality Control
- Integration in Industrial and Scientific Measurement-Systems
- Multi-Channel-Systems at moderate Costs

Block Diagram



Single-Board Dual Phase Lock-In-Amplifier

Specifications	<i>Test Conditions</i>	<i>V_s = ± 15 V, T_a = 25°C</i>			
Voltage Input	Voltage Input Characteristic	True Differential Instrumentation-Amplifier			
	Voltage Input Range	3 μV ... 1V in 1-3-10 steps (for Full Scale Output)			
	Voltage Input Coupling	AC or DC (selectable at Connector)			
	Voltage Input Impedance	1 MΩ // 4 pF			
	Voltage Input Noise	12 nV/√Hz			
	Voltage Input CMRR	110 dB @ 1 kHz, 100 dB @ 10 kHz			
	Voltage Input Gain Drift	100 ppm/K			
Current Input	Current Input Characteristic	Transimpedance-Amplifier, -100 kV/A (inverting)			
	Current Input Range	30 pA ... 10 μA in 1-3-10 steps (for Full Scale Output)			
	Current Input Noise	0.4 pA/√Hz			
	Current Input Source- Capacit.	10 pF – 500 pF (recommended)			
	Current Input Gain Error vs. Source Capacitance	Cs	f < 20 kHz	f = 50 kHz	f = 100 kHz
		10 pF	< 1 %	1 %	4 %
		100 pF	< 1 %	1 %	3 %
	500 pF	< 1 %	4 %	3 %	
Signal Filter	Signal Filter Lowpass (-3 dB BW)	1 MHz, 100 kHz, 10 kHz, 1 kHz, 100 Hz; 6 dB/Oct. Selectable per jumper			
	Signal Filter Highpass (-3 dB BW)	2 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz; 6 dB/Oct. selectable per jumper			
	Signal Filter Cutoff accuracy	± 20 %			
	Max. Dynamic Reserve	80 dB			
Signal Monitor Output	Signal Monitor Output Gain	1 ... 3333 (depends on Gain-Setting)			
	Signal Monitor Output Voltage	± 8 V max.			
	Signal Monitor Output Impedance	100 Ω			
	Signal Monitor Output Current	± 10 mA max.			
	Note	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	± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold) - 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold)		
	Reference Input Impedance	1 MΩ			
Phase Shifter	Reference Acquisition Time	max. 2 s @ Fast Setting max. 4 s @ Slow Setting			
	Phase Shifter Type	Digital, Working Frequency 50 Hz ... 120 kHz			
	Phase Shifter Range	0 ... + 360 °			
Time Constants	Phase Shifter Resolution	1.4 ° @ f < 60 kHz, 2.8 ° @ f > 60 kHz			
	Phase Shifter Drift	< 100 ppm/K			
	Phase Shifter Accuracy	< 0.3 °			
	Phase Shifter Orthogonality	< 0.1 °			
	Time Constant Range	300 μs ... 1 s in 1-3-10 steps			
	Time Const. Filter Characteristic	6 dB/Oct. or 12 dB/Oct. switchable			

Single-Board Dual Phase Lock-In-Amplifier

Specifications (continued) 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, Y = Quadrature, R = Magnitude ± 10 V (@ 2 kΩ Load) ± 5 mA max. 50 Ω 5 ppm/K @ Ultra Stable Setting 50 ppm/K @ Low Drift Setting 500 ppm/K @ High Dynamic Setting 2 % (X and Y-Output) @ sinusoidal input signal 4 % (R-Output) @ sinusoidal input signal ± 100 % Full Scale by ± 10 V Control Voltage > 2 kΩ																																																
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 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 ... ± 18 Vdc - 60 mA, + 120 mA																																																
Case	Board Weight	19" Euro-Card, (100 mm x 160 mm Board) 100 gr. (0.22 lbs)																																																
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	50 Vpp ± 70 V ± 15 V - 5 V, + 15 V ± 22 V																																																
Switch Settings	4 Dip Switch - Presettings Sensitivity Setting, Output DC-Gain Modes	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 40%; text-align: center;">Switch</td> <td style="width: 20%; text-align: center;">OFF</td> <td style="width: 30%; text-align: center;">ON</td> </tr> <tr> <td colspan="4" style="border-top: 1px solid black; border-bottom: 1px solid black;"></td> </tr> <tr> <td>S1</td> <td>Low Drift & High Dynamic</td> <td></td> <td>Ultra Stable & Low Drift</td> </tr> <tr> <td>S2</td> <td>1-f Mode</td> <td></td> <td>2-f Mode</td> </tr> <tr> <td>S3</td> <td>Fast PLL-Locking</td> <td></td> <td>Slow PLL-Locking</td> </tr> <tr> <td>S4</td> <td>Reference-Input-Threshold = 0 V</td> <td></td> <td>Reference-Input-Threshold = +2 V</td> </tr> </table> <table style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="4" style="text-align: center;">3 Output DC-Gain Modes are selectable:</td> </tr> <tr> <td style="width: 15%; text-align: center;">Mode</td> <td style="width: 25%; text-align: center;">DC-Gain</td> <td style="width: 25%; text-align: center;">Dyn. Reserve</td> <td style="width: 35%; text-align: center;">DC-Stability</td> </tr> <tr> <td colspan="4" style="border-top: 1px solid black; border-bottom: 1px solid black;"></td> </tr> <tr> <td>Ultra Stable</td> <td style="text-align: center;">10</td> <td style="text-align: center;">Low</td> <td style="text-align: center;">High</td> </tr> <tr> <td>Low Drift</td> <td style="text-align: center;">100</td> <td style="text-align: center;">Medium</td> <td style="text-align: center;">Medium</td> </tr> <tr> <td>High Dynamic</td> <td style="text-align: center;">1000</td> <td style="text-align: center;">High</td> <td style="text-align: center;">Low</td> </tr> </table> <p style="font-size: small;">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.</p>		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	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
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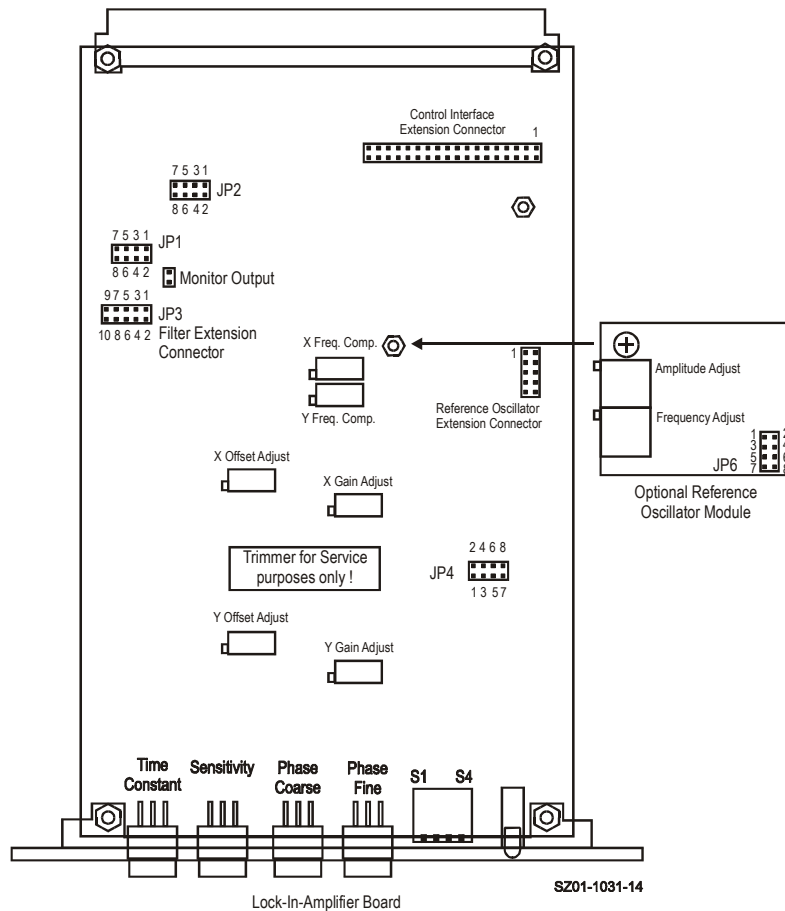
Single-Board Dual Phase Lock-In-Amplifier

Switch Settings (continued)	<p>S1 = ON: Sensitivity Setting for Full Scale (= 10 V Output)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th colspan="3">Ultra Stable Mode</th> <th colspan="3">Low Drift Mode</th> </tr> <tr> <th>Setting</th> <th>Voltage</th> <th>Current</th> <th>Setting</th> <th>Voltage</th> <th>Current</th> </tr> </thead> <tbody> <tr><td>0</td><td>1 V</td><td>10 μA</td><td>8</td><td>100 mV</td><td>1 μA</td></tr> <tr><td>1</td><td>300 mV</td><td>3 μA</td><td>9</td><td>30 mV</td><td>300 nA</td></tr> <tr><td>2</td><td>100 mV</td><td>1 μA</td><td>A</td><td>10 mV</td><td>100 nA</td></tr> <tr><td>3</td><td>30 mV</td><td>300 nA</td><td>B</td><td>3 mV</td><td>30 nA</td></tr> <tr><td>4</td><td>10 mV</td><td>100 nA</td><td>C</td><td>1 mV</td><td>10 nA</td></tr> <tr><td>5</td><td>3 mV</td><td>30 nA</td><td>D</td><td>300 μV</td><td>3 nA</td></tr> <tr><td>6</td><td>1 mV</td><td>10 nA</td><td>E</td><td>100 μV</td><td>1 nA</td></tr> <tr><td>7</td><td>300 μV</td><td>3 nA</td><td>F</td><td>30 μV</td><td>300 pA</td></tr> </tbody> </table> <p>S1 = OFF: Sensitivity Setting for Full Scale (= 10 V Output)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th colspan="3">Low Drift Mode</th> <th colspan="3">High Dynamic Mode</th> </tr> <tr> <th>Setting</th> <th>Voltage</th> <th>Current</th> <th>Setting</th> <th>Voltage</th> <th>Current</th> </tr> </thead> <tbody> <tr><td>0</td><td>100 mV</td><td>1 μA</td><td>8</td><td>10 mV</td><td>100 nA</td></tr> <tr><td>1</td><td>30 mV</td><td>300 nA</td><td>9</td><td>3 mV</td><td>30 nA</td></tr> <tr><td>2</td><td>10 mV</td><td>100 nA</td><td>A</td><td>1 mV</td><td>10 nA</td></tr> <tr><td>3</td><td>3 mV</td><td>30 nA</td><td>B</td><td>300 μV</td><td>3 nA</td></tr> <tr><td>4</td><td>1 mV</td><td>10 nA</td><td>C</td><td>100 μV</td><td>1 nA</td></tr> <tr><td>5</td><td>300 μV</td><td>3 nA</td><td>D</td><td>30 μV</td><td>300 pA</td></tr> <tr><td>6</td><td>100 μV</td><td>1 nA</td><td>E</td><td>10 μV</td><td>100 pA</td></tr> <tr><td>7</td><td>30 μV</td><td>300 pA</td><td>F</td><td>3 μV</td><td>30 pA</td></tr> </tbody> </table> <p>Time Constant Setting</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th>Setting</th> <th>6 dB/Oct.</th> <th>12 dB/Oct.</th> <th>Time Constant</th> </tr> </thead> <tbody> <tr><td>0</td><td>8</td><td></td><td>300 μs</td></tr> <tr><td>1</td><td>9</td><td></td><td>1 ms</td></tr> <tr><td>2</td><td>A</td><td></td><td>3 ms</td></tr> <tr><td>3</td><td>B</td><td></td><td>10 ms</td></tr> <tr><td>4</td><td>C</td><td></td><td>30 ms</td></tr> <tr><td>5</td><td>D</td><td></td><td>100 ms</td></tr> <tr><td>6</td><td>E</td><td></td><td>300 ms</td></tr> <tr><td>7</td><td>F</td><td></td><td>1 s</td></tr> </tbody> </table> <p>Phase Shift Setting</p> <p>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 $^{\circ}$. One step with switch marked "Coarse" changes phase shift by 22.5 $^{\circ}$. The "Fine"-switch changes phase shift by 1.4 $^{\circ}$ - steps:</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;"> <p>Coarse</p> </div> <div style="text-align: center;"> <p>Fine</p> </div> </div> <p>If Frequency Range $f > 60$ kHz or 2-f Mode is selected, the resolution of digital phase control changes to 2.8 $^{\circ}$ and the phase shift range doubles to 0 ... + 720 $^{\circ}$.</p>	Ultra Stable Mode			Low Drift Mode			Setting	Voltage	Current	Setting	Voltage	Current	0	1 V	10 μ A	8	100 mV	1 μ A	1	300 mV	3 μ A	9	30 mV	300 nA	2	100 mV	1 μ A	A	10 mV	100 nA	3	30 mV	300 nA	B	3 mV	30 nA	4	10 mV	100 nA	C	1 mV	10 nA	5	3 mV	30 nA	D	300 μ V	3 nA	6	1 mV	10 nA	E	100 μ V	1 nA	7	300 μ V	3 nA	F	30 μ V	300 pA	Low Drift Mode			High Dynamic Mode			Setting	Voltage	Current	Setting	Voltage	Current	0	100 mV	1 μ A	8	10 mV	100 nA	1	30 mV	300 nA	9	3 mV	30 nA	2	10 mV	100 nA	A	1 mV	10 nA	3	3 mV	30 nA	B	300 μ V	3 nA	4	1 mV	10 nA	C	100 μ V	1 nA	5	300 μ V	3 nA	D	30 μ V	300 pA	6	100 μ V	1 nA	E	10 μ V	100 pA	7	30 μ V	300 pA	F	3 μ V	30 pA	Setting	6 dB/Oct.	12 dB/Oct.	Time Constant	0	8		300 μ s	1	9		1 ms	2	A		3 ms	3	B		10 ms	4	C		30 ms	5	D		100 ms	6	E		300 ms	7	F		1 s
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Jumper Settings	<p>Input Signal Filter</p> <p>Set Cut-Off Frequency of Input Lowpass Filter</p>																																																																																																																																																												

Single-Board Dual Phase Lock-In-Amplifier

Setting	with JP1 + JP2 (always same position) and Highpass Filter with JP3:			
	JP3	Highpass -3 dB Cut-Off	JP1, JP2	Lowpass -3 dB Cut-Off
	3 - 4	2 Hz	1 - 2	100 Hz
	1 - 3	10 Hz	3 - 4	1 kHz
	2 - 4	100 Hz	5 - 6	10 kHz
	3 - 5	1 kHz	7 - 8	100 kHz
	4 - 6	10 kHz	none	1 MHz *
	* (At Sensitivity Settings 6,7 & E,F max. 200 kHz)			
Frequency Range Selection	JP4	Frequency Range		
	1 - 2	f < 60 kHz		
	3 - 4 & 5 - 6	f > 60 kHz		
	7, 8	test pins, do not use		
	(if 2-f mode is used, position is always 1-2)			

Jumper Position Diagram



Single-Board Dual Phase Lock-In-Amplifier

Connector	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 A12:	R-Signal Output
		Pin C14:	X-Signal Output
		Pin A14:	Y-Signal Output
		Pin C15:	Output GND
	Offset Input	Pin A10:	X-Offset Input
		Pin A11:	Y-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 (DYNO)
		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

Single-Board Dual Phase Lock-In-Amplifier

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.

Disable Local Switches

By forcing Input Bit "Disable Local Switch Control" (Pin C24) to "High", the LIA is set to exclusively remote control operation and the manual switches are out of function.

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	DYNO	(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

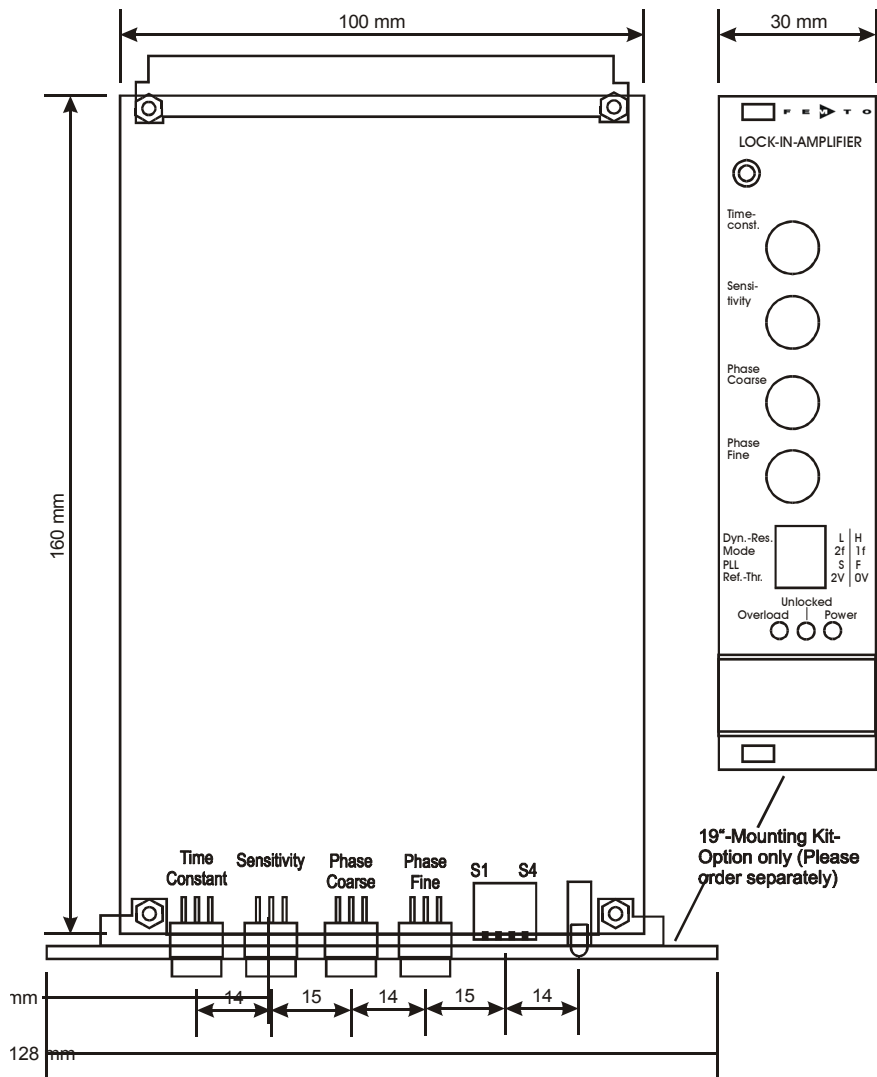
Bit	Corresponding Control Port Input	
Bit 0	PH0	(Pin A28)
Bit 1	PH1	(Pin C28)
Bit 2	PH2	(Pin A27)
Bit 3	PH3	(Pin C27)

Single-Board Dual Phase Lock-In-Amplifier

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 when "Disable Local Switch Control" (Pin C24) is not active ("Low" or just not connected).

Dimensions



DZ01-1031-12

Single-Board Dual Phase Lock-In-Amplifier

Optional Extensions	Mounting Kit	Model No.: MK-LIA-2 - 19" – Frontpanel, printed - EMI – shielding Board-Backplane
	Reference Oscillator Module	Model No.: SOM-1 - Frequency Range 5 Hz ... 130 kHz, User adjustable - Output Voltage 0 ... 2 Vrms, User adjustable - 100 ppm/K Amplitude Accuracy

FEMTO Messtechnik GmbH
 Klosterstr. 64
 D-10179 Berlin • Germany
 Tel.: +49-(0)30-280 4711-0
 Fax: +49-(0)30-280 4711-11
 e-mail: info@femto.de
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