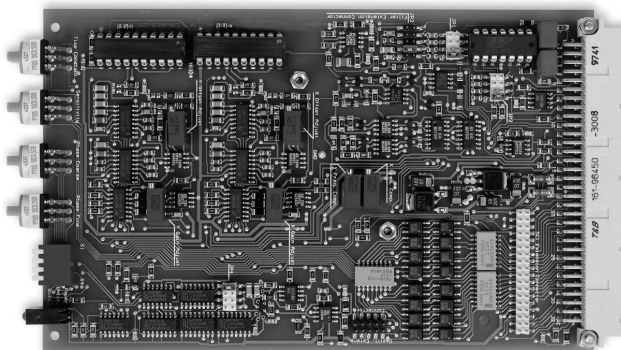


Single-Board Dual Phase Lock-In Amplifier



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

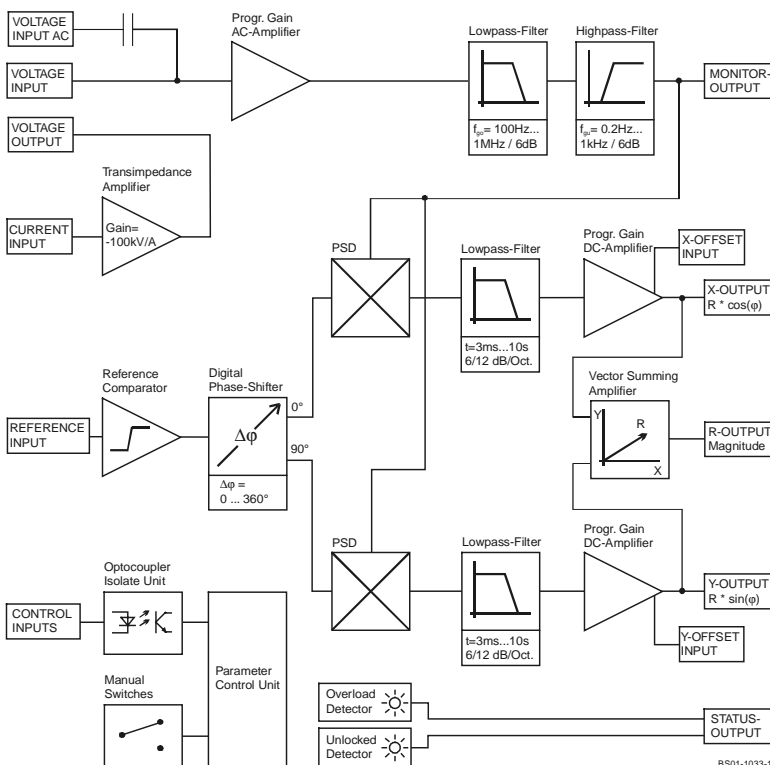
Features

- Dual Phase Detection with X, Y and Magnitude Output
- Working Frequency 5 Hz ... 10 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 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 or DC (selectable at Connector) 1 MΩ // 4 pF 12 nV/√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/√Hz 10 pF – 500 pF (recommended) Cs f < 10 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 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 ± 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) ± 8 V max. 100 Ω ± 10 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	± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold) - 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold) 1 MΩ 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 Phase Shifter Orthogonality	Digital, Working Frequency 5 Hz ... 10 kHz 0 ... + 360 ° 1.4 ° < 100 ppm/K < 0.3 ° < 0.1 °
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

Single-Board Dual Phase Lock-In-Amplifier

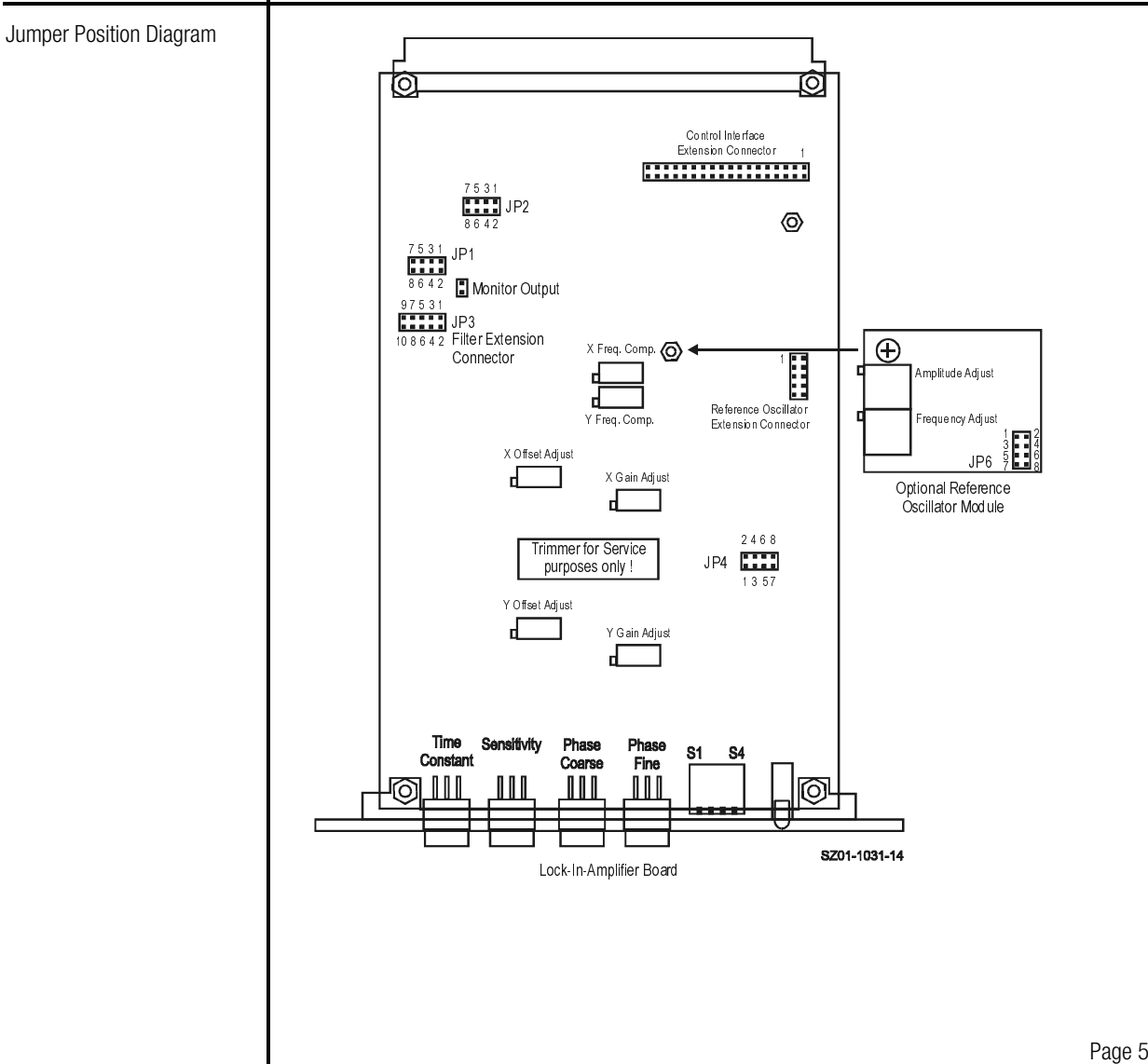
Specifications (continued) Output	Output Channels Output Voltage Range Output Current Output Impedance Output DC-Stability Output Basic Accuracy Output Voltage Offset Range Output Voltage Offset Control-Voltage Impedance	X = In Phase, Y = Quadrature, R = Magnitude ± 10 V (@ 2 kΩ Load) ± 5 mA max. 50 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, + 100 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;"> <thead> <tr> <th style="text-align: left;">Switch</th> <th style="text-align: left;">OFF</th> <th style="text-align: left;">ON</th> </tr> </thead> <tbody> <tr> <td>S1</td> <td>Low Drift & High Dynamic</td> <td>Ultra Stable & Low Drift</td> </tr> <tr> <td>S2</td> <td>1-f Mode</td> <td>2-f Mode</td> </tr> <tr> <td>S3</td> <td>Fast PLL-Locking</td> <td>Slow PLL-Locking</td> </tr> <tr> <td>S4</td> <td>Reference-Input-Threshold = 0 V</td> <td>Reference-Input-Threshold = +2 V</td> </tr> </tbody> </table> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Mode</th> <th style="text-align: left;">DC-Gain</th> <th style="text-align: left;">Dyn. Reserve</th> <th style="text-align: left;">DC-Stability</th> </tr> </thead> <tbody> <tr> <td>Ultra Stable</td> <td>10</td> <td>Low</td> <td>High</td> </tr> <tr> <td>Low Drift</td> <td>100</td> <td>Medium</td> <td>Medium</td> </tr> <tr> <td>High Dynamic</td> <td>1000</td> <td>High</td> <td>Low</td> </tr> </tbody> </table> <p>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	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

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Phase Shift Setting	<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 °.</p> <p>One step with switch marked "Coarse" changes phase shift by 22.5 °. The "Fine"-switch changes phase shift by 1.4 ° - steps:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Coarse</p> </div> <div style="text-align: center;"> <p>Fine</p> </div> </div> <p>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 °.</p>																																																													

Single-Board Dual Phase Lock-In-Amplifier

Jumper Settings	Input Signal Filter Setting	Set Cut-Off Frequency of Input Lowpass Filter with JP1 + JP2 (always same position) and Highpass Filter with JP3:	
		Highpass -3 dB Cut-Off	Lowpass -3 dB Cut-Off
	JP3		JP1, JP2
	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



Single-Board Dual Phase Lock-In-Amplifier

Connector	Connector Type	Euro-Card DIN 41612 Connector, 64 pin male, (a+c)	
Input	Pin C2: Pin C3: Pin C4: Pin C5: Pin C7: Pin C6: Pin A2- A6:	Voltage Input, Non Inverting, DC-Coupled Voltage Input, Non Inverting, AC-Coupled Voltage Input, Inverting, AC-Coupled Voltage Input, Inverting, DC-Coupled Current Input Current Amplifier Voltage Output Input GND	
Monitor Output	Pin C9: Pin A9:	Monitor Output Monitor GND	
Output	Pin A12: Pin C14: Pin A14: Pin C15:	R-Signal Output X-Signal Output Y-Signal Output Output GND	
Offset Input	Pin A10: Pin A11: Pin A13:	X-Offset Input Y-Offset Input Offset GND	
Status Output	Pin C10: Pin C11: Pin C17:	Unlocked Status Output Overload Status Output Status Output GND (=Power Supply GND)	
Power Supply	Pin A16+C16: Pin A18+C18: Pin A17+C17:	Power Supply – 15V Power Supply + 15V Power Supply GND	
Remote Control Inputs (Opto-Isolated)	Pin C19: Pin A19: Pin C20: Pin A20: Pin A22: Pin C21: Pin A21: Pin C22: Pin A28: Pin C28: Pin A27: Pin C27: Pin A26: Pin C26: Pin A25: Pin C25: Pin C24: Pin A23+A24:	Time Constant (TC0) Time Constant (TC1) Time Constant (TC2) Time Constant Slope (TCSL) Sensitivity (SEN0) Sensitivity (SEN1) Sensitivity (SEN2) Dynamic Mode (DYNO) Phase Shift (PH0) Phase Shift (PH1) Phase Shift (PH2) Phase Shift (PH3) Phase Shift (PH4) Phase Shift (PH5) Phase Shift (PH6) Phase Shift (PH7) Disable Local Switch Control Remote Control GND (Common Optocoupler Cathode)	
Reference Input	Pin A32: Pin A31:	Reference Input Reference Input Ground	
Reference Output (Connected only if optional Oscillator Module is installed)	Pin A30: Pin A17: Pin A29:	Reference Output Refer. Output GND (=Power Supply GND) Reference Synchronization Input	
Standard Control Interface (Connected only if optional Control Interface Module (future product) is installed)	Pin C29: Pin C30: Pin C31: Pin C32:	Interface 0 Interface 1 Interface 2 Interface 3	

Single-Board Dual Phase Lock-In-Amplifier

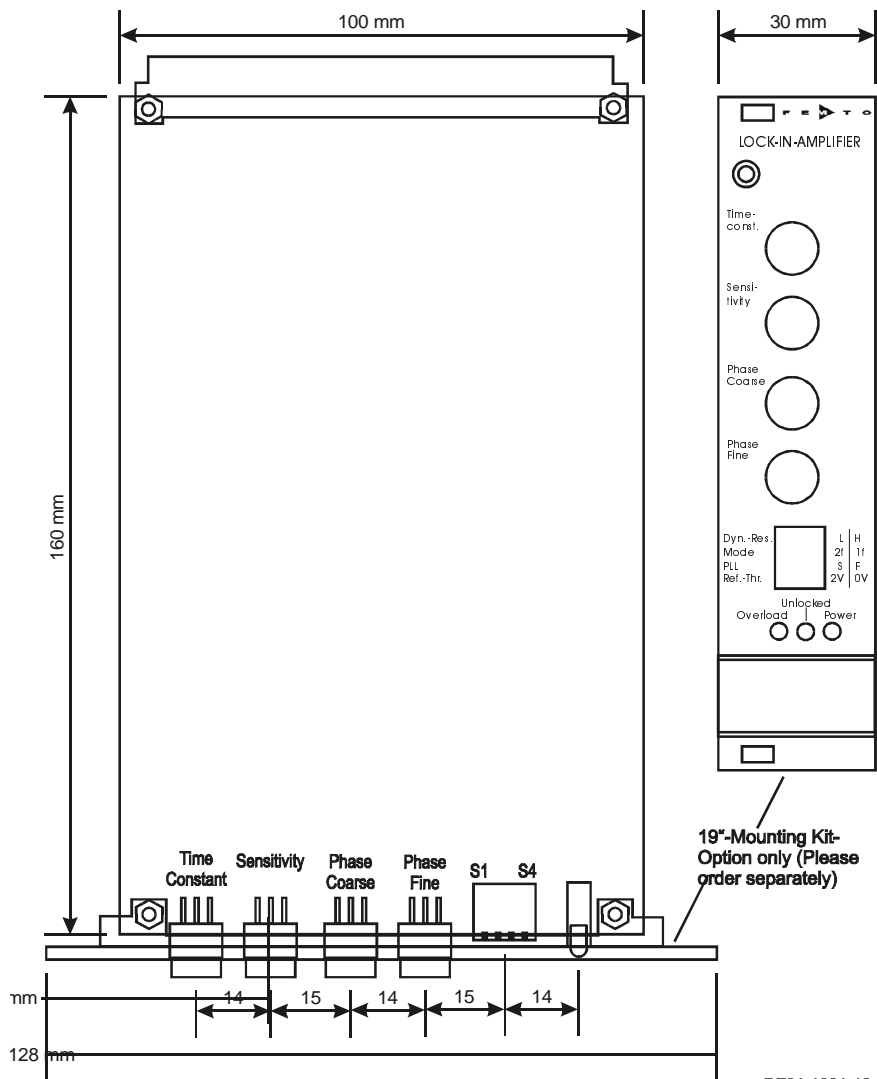
Remote Control Operation	General	<p>Remote Control Input Bits are opto-isolated and connected by logical OR to local switch setting. The 4 hexadecimal switches are 4 Bit-coded as shown in the following table:</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="border-bottom: 1px solid black;">Switch Code</th> <th style="border-bottom: 1px solid black;">MSB Bit 3</th> <th style="border-bottom: 1px solid black;">Bit 2</th> <th style="border-bottom: 1px solid black;">Bit 1</th> <th style="border-bottom: 1px solid black;">LSB Bit 0</th> </tr> </thead> <tbody> <tr><td>0</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr> <tr><td>1</td><td>Low</td><td>Low</td><td>Low</td><td>High</td></tr> <tr><td>2</td><td>Low</td><td>Low</td><td>High</td><td>Low</td></tr> <tr><td>3</td><td>Low</td><td>Low</td><td>High</td><td>High</td></tr> <tr><td>4</td><td>Low</td><td>High</td><td>Low</td><td>Low</td></tr> <tr><td>5</td><td>Low</td><td>High</td><td>Low</td><td>High</td></tr> <tr><td>6</td><td>Low</td><td>High</td><td>High</td><td>Low</td></tr> <tr><td>7</td><td>Low</td><td>High</td><td>High</td><td>High</td></tr> <tr><td>8</td><td>High</td><td>Low</td><td>Low</td><td>Low</td></tr> <tr><td>9</td><td>High</td><td>Low</td><td>Low</td><td>High</td></tr> <tr><td>A</td><td>High</td><td>Low</td><td>High</td><td>Low</td></tr> <tr><td>B</td><td>High</td><td>Low</td><td>High</td><td>High</td></tr> <tr><td>C</td><td>High</td><td>High</td><td>Low</td><td>Low</td></tr> <tr><td>D</td><td>High</td><td>High</td><td>Low</td><td>High</td></tr> <tr><td>E</td><td>High</td><td>High</td><td>High</td><td>Low</td></tr> <tr><td>F</td><td>High</td><td>High</td><td>High</td><td>High</td></tr> </tbody> </table> <p>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.</p>	Switch Code	MSB Bit 3	Bit 2	Bit 1	LSB 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
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Disable Local Switches	Disable Local Switches	<p>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.</p>																																																																																					
Sensitivity Switch - Corresponding Inputs	Sensitivity Switch - Corresponding Inputs	<table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="border-bottom: 1px solid black;">Bit</th> <th colspan="2" style="border-bottom: 1px solid black;">Corresponding Control Port Input</th> </tr> </thead> <tbody> <tr><td>Bit 0</td><td>SEN0</td><td>(Pin A22)</td></tr> <tr><td>Bit 1</td><td>SEN1</td><td>(Pin C21)</td></tr> <tr><td>Bit 2</td><td>SEN2</td><td>(Pin A21)</td></tr> <tr><td>Bit 3</td><td>DYNO</td><td>(Pin C22)</td></tr> </tbody> </table>	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)																																																																						
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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



**Single-Board
Dual Phase Lock-In-Amplifier**

<p>Optional Extensions</p>	<table> <tr> <td data-bbox="515 492 847 629"> <p>Mounting Kit</p> </td> <td data-bbox="847 492 1465 629"> <p>Model No.: MK-LIA-2 - 19" – Frontpanel, printed - EMI – shielding Board-Backplane</p> </td> </tr> <tr> <td data-bbox="515 629 847 763"> <p>Reference Oscillator Module</p> </td> <td data-bbox="847 629 1465 763"> <p>Model No.: SOM-1 - Frequency Range 5 Hz ... 130 kHz, User adjustable - Output Voltage 0 ... 2 Vrms, User adjustable - 100 ppm/K Amplitude Accuracy</p> </td> </tr> </table>	<p>Mounting Kit</p>	<p>Model No.: MK-LIA-2 - 19" – Frontpanel, printed - EMI – shielding Board-Backplane</p>	<p>Reference Oscillator Module</p>	<p>Model No.: SOM-1 - Frequency Range 5 Hz ... 130 kHz, User adjustable - Output Voltage 0 ... 2 Vrms, User adjustable - 100 ppm/K Amplitude Accuracy</p>
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