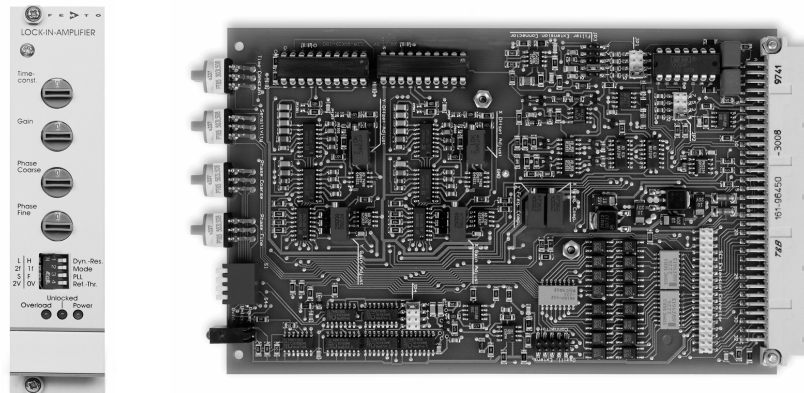


Single-Board Dual Phase Lock-In Amplifier



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

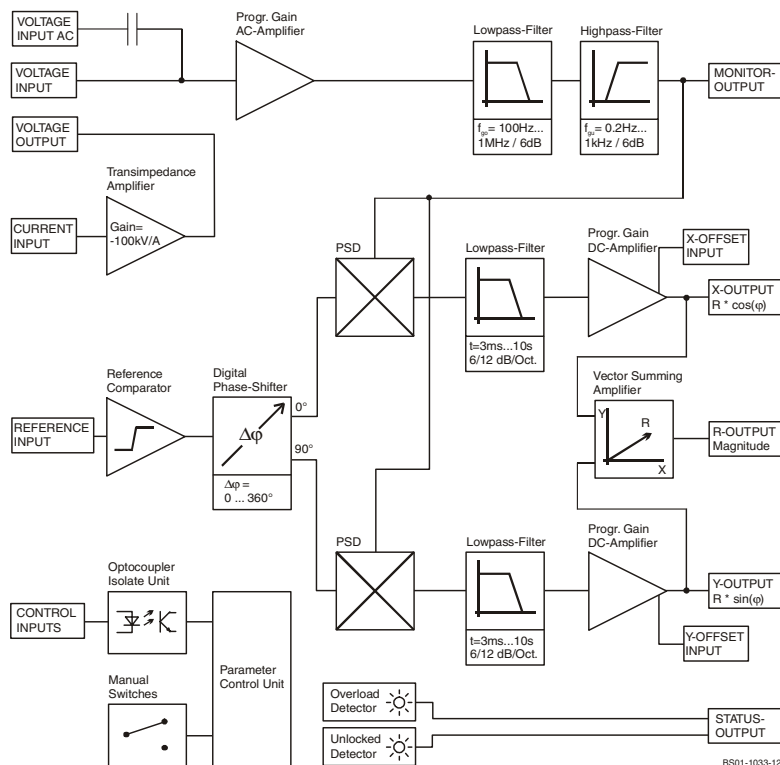
Features

- 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) <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: left;">Cs</td> <td style="width: 50%; text-align: left;">f < 10 kHz</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black;"></td> </tr> <tr> <td>10 pF</td> <td>< 1 %</td> </tr> <tr> <td>100 pF</td> <td>< 1 %</td> </tr> <tr> <td>1 nF</td> <td>< 2 %</td> </tr> </table> | Cs | f < 10 kHz | | | 10 pF | < 1 % | 100 pF | < 1 % | 1 nF | < 2 % |
| 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 | <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 40%; border-bottom: 1px solid black;">Switch OFF</th> <th style="width: 50%; border-bottom: 1px solid black;">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> Sensitivity Setting, Output DC-Gain Modes <table style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 25%;"></th> <th colspan="3" style="text-align: center; border-bottom: 1px solid black;">3 Output DC-Gain Modes are selectable:</th> </tr> <tr> <th style="border-bottom: 1px solid black;">Mode</th> <th style="border-bottom: 1px solid black;">DC-Gain</th> <th style="border-bottom: 1px solid black;">Dyn. Reserve</th> <th style="border-bottom: 1px solid black;">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 style="font-size: small; margin-top: 10px;">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 |
| | 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Single-Board Dual Phase Lock-In-Amplifier

Switch Settings (continued)

S1 = ON: Sensitivity Setting
for Full Scale (= 10 V Output)

Ultra Stable Mode

| Setting | Voltage | Current |
|---------|---------|---------|
| 0 | 1 V | 10 µA |
| 1 | 300 mV | 3 µA |
| 2 | 100 mV | 1 µA |
| 3 | 30 mV | 300 nA |
| 4 | 10 mV | 100 nA |
| 5 | 3 mV | 30 nA |
| 6 | 1 mV | 10 nA |
| 7 | 300 µV | 3 nA |

Low Drift Mode

| Setting | Voltage | Current |
|---------|---------|---------|
| 8 | 100 mV | 1 µA |
| 9 | 30 mV | 300 nA |
| A | 10 mV | 100 nA |
| B | 3 mV | 30 nA |
| C | 1 mV | 10 nA |
| D | 300 µV | 3 nA |
| E | 100 µV | 1 nA |
| F | 30 µV | 300 pA |

S1 = OFF: Sensitivity Setting
for Full Scale (= 10 V Output)

Low Drift Mode

| Setting | Voltage | Current |
|---------|---------|---------|
| 0 | 100 mV | 1 µA |
| 1 | 30 mV | 300 nA |
| 2 | 10 mV | 100 nA |
| 3 | 3 mV | 30 nA |
| 4 | 1 mV | 10 nA |
| 5 | 300 µV | 3 nA |
| 6 | 100 µV | 1 nA |
| 7 | 30 µV | 300 pA |

High Dynamic Mode

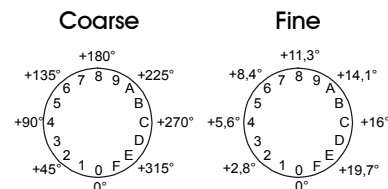
| Setting | Voltage | Current |
|---------|---------|---------|
| 8 | 10 mV | 100 nA |
| 9 | 3 mV | 30 nA |
| A | 1 mV | 10 nA |
| B | 300 µV | 3 nA |
| C | 100 µV | 1 nA |
| D | 30 µV | 300 pA |
| E | 10 µV | 100 pA |
| F | 3 µV | 30 pA |

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 °.

Jumper Settings

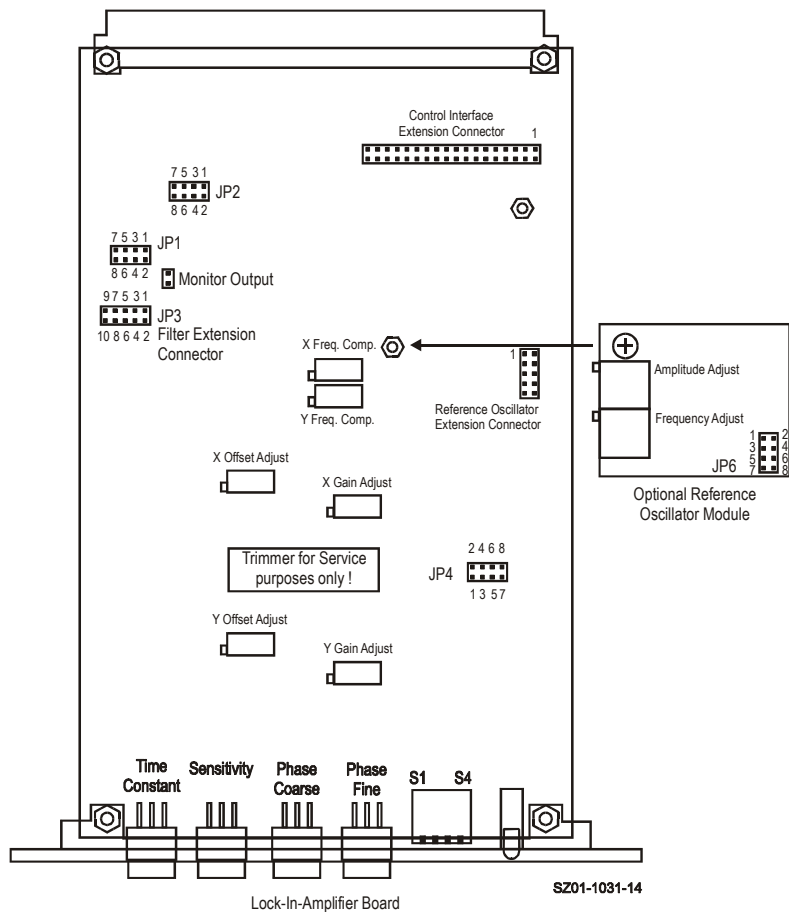
Input Signal Filter

Set Cut-Off Frequency of Input Lowpass Filter

Single-Board Dual Phase Lock-In-Amplifier

| | | | | |
|---------------------------|---|-----------------------|----------|---------------|
| Setting | with JP1 + JP2 (always same position) and Highpass Filter with JP3: | | | |
| | Highpass | | Lowpass | |
| | JP3 | -3 dB Cut-Off | JP1, JP2 | -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 | | |

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

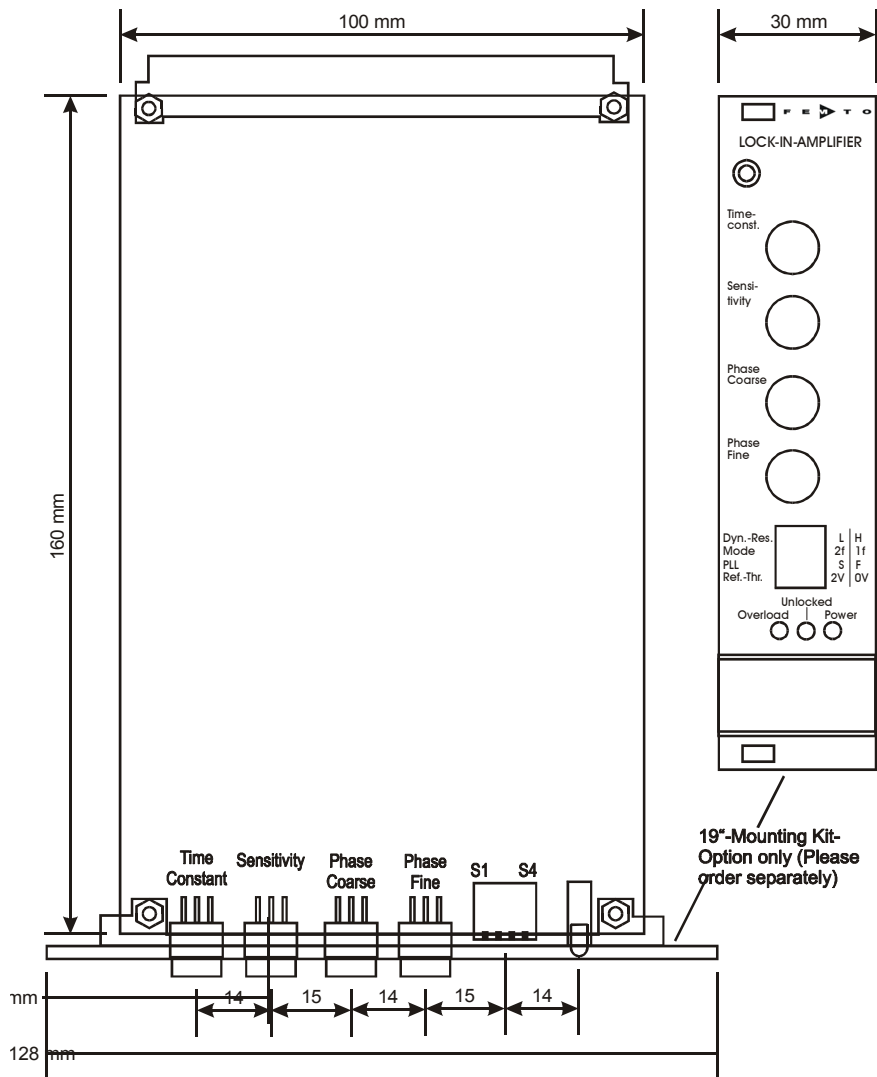
| Bit | Corresponding Control Port Input | |
|-------|----------------------------------|-----------|
| Bit 0 | PH0 | (Pin A28) |
| Bit 1 | PH1 | (Pin C28) |
| Bit 2 | PH2 | (Pin A27) |
| Bit 3 | PH3 | (Pin C27) |

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 |
| | | |
| | | |

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