

# Lock-In-Amplifier Module

LIA-MV-150



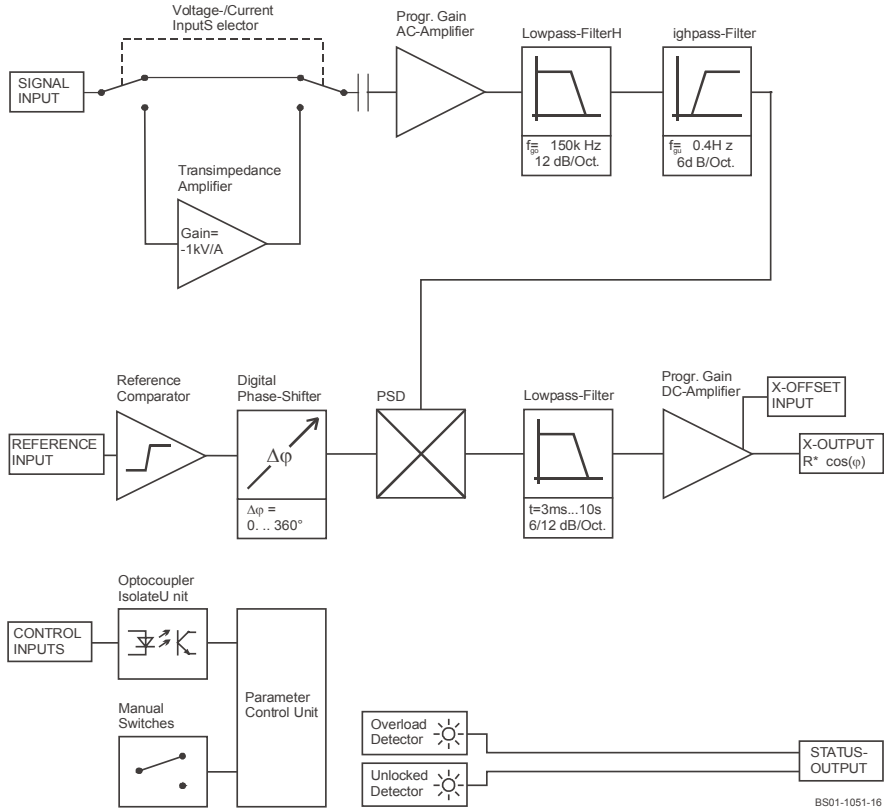
### FEATURES

- 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



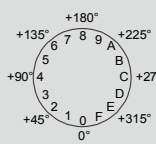
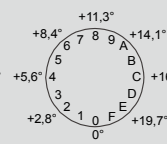
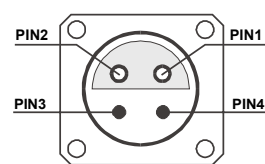
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|----------------|-----------------|----------------------------------------------------|
| Specifications | Test Conditions | $V_s = \pm 15\text{ V}$ , $T_a = 25^\circ\text{C}$ |
|----------------|-----------------|----------------------------------------------------|

|                 |                                                 |                                                                                                                                                   |            |
|-----------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Voltage Input   | Voltage Input Characteristic                    | Model “-S”: Single-Ended Instrumentation-Amplifier<br>Model “-D”: True Differential Instrumentation-Amplifier                                     |            |
|                 | Voltage Input Range                             | 3 $\mu\text{V}$ ... 100 mV in 1-3-10 steps (for Full Scale Output)                                                                                |            |
|                 | Voltage Input Coupling                          | AC, 0.015 Hz                                                                                                                                      |            |
|                 | Voltage Input Impedance                         | Model “-S”: 1 M $\Omega$ // 4 pF<br>Model “-D”: 2 M $\Omega$ // 2 pF differential                                                                 |            |
|                 | Voltage Input Noise                             | 12 nV/ $\sqrt{\text{Hz}}$                                                                                                                         |            |
|                 | 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 $\mu\text{A}$ in 1-3-10 steps (for Full Scale Output)                                                                                |            |
|                 | Current Input Noise                             | 13 pA/ $\sqrt{\text{Hz}}$                                                                                                                         |            |
|                 | Current Input Source- Capacit.                  | 10 pF – 1 nF (recommended)                                                                                                                        |            |
|                 | Current Input Gain Error vs. Source Capacitance | Cs                                                                                                                                                | f < 20 kHz |
| 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                   | $\pm 20\%$                                                                                                                                        |            |
| Demodulator     | Demodulator Dynamic Reserve                     | 35 dB @ Low Drift Setting<br>55 dB @ High Dynamic Setting                                                                                         |            |
| Reference Input | Reference Input Voltage Range                   | $\pm 100\text{ mV}$ ... $\pm 5\text{ V}$ @ bip. Mode (0 V Comparator Threshold)<br>- 5 V / +10 V @ TTL Mode (2 V Comparator Threshold)            |            |
|                 | Reference Input Impedance                       | 1 M $\Omega$                                                                                                                                      |            |
|                 | Reference Acquisition Time                      | max. 2 s @ Fast Setting<br>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                            | $\pm 10\text{ V}$ (@ 2 k $\Omega$ Load)                                                                                                           |            |
|                 | Output Current                                  | $\pm 5\text{ mA}$ max.                                                                                                                            |            |
|                 | Output Impedance                                | 50 $\Omega$                                                                                                                                       |            |
|                 | Output DC-Stability                             | 50 ppm/K @ Low Drift Setting<br>500 ppm/K @ High Dynamic Setting                                                                                  |            |
|                 | Output Basic Accuracy                           | 2 %, Frequency > 30 kHz<br>5% @ sinusoidal input signal                                                                                           |            |
|                 | Output Voltage Offset Range                     | $\pm 100\%$ Full Scale by $\pm 10\text{ V}$ Control @ Low Drift Setting<br>$\pm 100\%$ Full Scale by $\pm 1\text{ V}$ Control @ High Dyn. Setting |            |
|                 | Output Voltage Offset Control-Voltage Impedance | 22 k $\Omega$                                                                                                                                     |            |

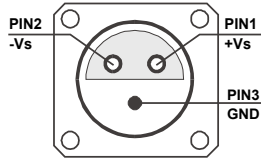
| Specifications (continued) |                               |                                                                             |
|----------------------------|-------------------------------|-----------------------------------------------------------------------------|
| Status Indicator LED       | Functions                     | Amplifier Overload Status Reference PLL Unlocked Status                     |
| Digital Control            | Control Input Voltage         | Low: - 0.8 V ... + 0.8 V<br>High: + 1.8 V ... + 12 V, TTL / CMOS compatible |
|                            | Control Input Current         | 0 mA @ 0V, 1.5 mA @ + 5 V, 4.5 mA @ + 12V 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 ... ± 20 Vdc                                                       |
|                            | Supply Current                | - 60 mA, + 100 mA                                                           |
| Case                       | Weight                        | 370 gr. (0.86 lbs)                                                          |
|                            | Material                      | AlMg4.5Mn, nickel-plated                                                    |
| Temperature Range          | Storage Temperature           | - 40 ... + 100 °C                                                           |
|                            | Operating Temperature         | 0 ... + 60 °C                                                               |
| Absolute Maximum Ratings   | Signal Input AC Voltage       | 20 Vpp                                                                      |
|                            | Signal Input DC Voltage       | ± 30 V                                                                      |
|                            | Reference Input Voltage       | ± 30 V                                                                      |
|                            | Control Input Voltage         | - 5 V, + 30 V                                                               |
|                            | Power Supply Voltage          | ± 22 V                                                                      |

Switch Settings

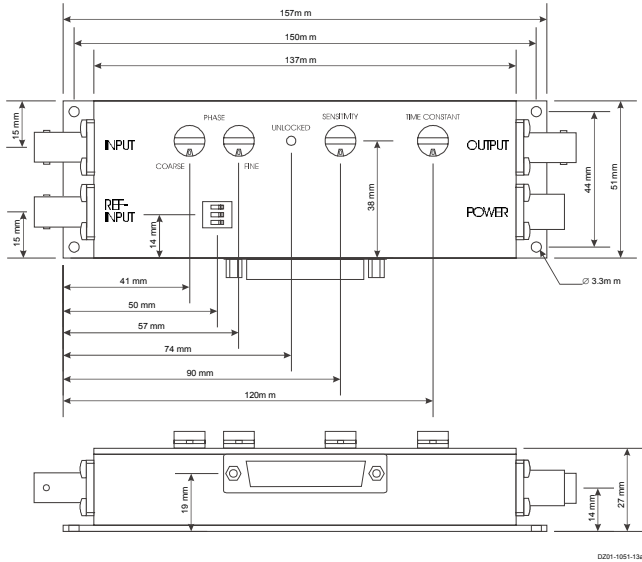
|                              |                                                                                                                                                              |                                 |                                 |              |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------|--------------|
| 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.<br>If only low dynamic reserve is required, select the high DC-stability settings ("Low Drift" mode). |                                 |                                 |              |

| Sensitivity Setting<br>for Full Scale<br>( = 10 V Output) | Low Drift Mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |         |            | High Dynamic Mode                                                                     |               |         |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|---------------------------------------------------------------------------------------|---------------|---------|
|                                                           | Setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Voltage | Current    | 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<br>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 °.<br>One step with switch marked “Coarse” changes phase shift by 22.5 °. The “Fine”-switch changes phase shift by 1.4 ° - steps:<br><div><div><p>Coarse</p></div><div><p>Fine</p></div></div> |         |            |                                                                                       |               |         |
| Connectors                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |         |            |                                                                                       |               |         |
| Signal Input                                              | Model “-S”: BNC<br>Model “-D”: LEMO Series 1S, 4-pin fixed Socket<br>Voltage Input:<br>Pin 1: Non Inverting Input<br>Pin 2: Inverting Input<br>Pin 3: GND<br>Pin 4: N.C.<br>Current Input:<br>Pin 1: Current Amplifier Input<br>Pin 2: If Current Input is used, connect to Pin 3 (GND)<br>Pin 3: GND<br>Pin 4: N.C.                                                                                                                                                                                                        |         |            |  |               |         |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Input | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Output          | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Power Supply    | LEMO Series 1S, 3-pin fixed Socket<br>Pin 1: + 15V<br>Pin 2: - 15V<br>Pin 3: GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Control Port    | Sub-D 25-pin, female, Qual. Class 2<br>Pin 1: +12V (Stabilized Power Supply Output)<br>Pin 2: -12V (Stabilized Power Supply Output)<br>Pin 3: AGND (Analog Ground)<br>Pin 4: +5V (Stabilized Power Supply Output)<br>Pin 5: X-Output<br>Pin 6: Overload Status Output<br>Pin 7: Unlocked Status Output<br>Pin 8: X-Output Offset Control Input<br>Pin 9: DGND (Ground f. Digital Control Pin 10 - 25)<br>Pin 10: Dynamic Mode (DYN0)<br>Pin 11: Sensitivity (SEN0)<br>Pin 12: Sensitivity (SEN1)<br>Pin 13: Sensitivity (SEN2)<br>Pin 14: Time Constant Slope (TCSL)<br>Pin 15: Time Constant (TC0)<br>Pin 16: Time Constant (TC1)<br>Pin 17: Time Constant (TC2)<br>Pin 18: Phase Shift (PH0)<br>Pin 19: Phase Shift (PH1)<br>Pin 20: Phase Shift (PH2)<br>Pin 21: Phase Shift (PH3)<br>Pin 22: Phase Shift (PH4)<br>Pin 23: Phase Shift (PH5)<br>Pin 24: Phase Shift (PH6)<br>Pin 25: Phase Shift (PH7) |



Dimensions



|                      |                  |                                                                                                                                                         |
|----------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ordering Information | Available Models | Model No.: LIA-MV-150-S<br>- Singe-Ended Input (BNC-Connector Input)<br><br>Model No.: LIA-MV-150-D<br>- True Differential Input (LEMO-Connector Input) |
|----------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

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 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       | Low                              | 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                                                                                                                                                                        |           | DYN0 (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

LIA-MV-200-L



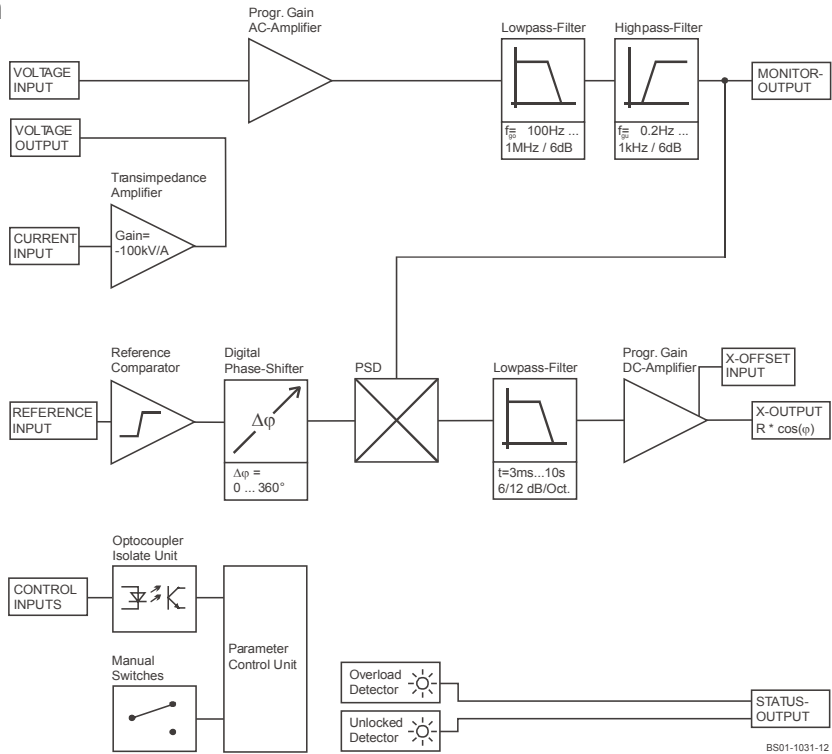
### FEATURES

- BNC Connectors for Input and Output Signals
- Rugged Aluminium 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



| Specifications                                   | Test Conditions                                 | Vs = ± 15 V, Ta = 25°C                                                                                                                                                 |            |
|--------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 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                                                                                                                                                                     |            |
|                                                  | 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 < 10 kHz |
| Signal Filter (without optional Bandpass-Module) | 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)               | 0.2 Hz, 1 Hz, 10 Hz, 100 Hz, 1 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<br>35 dB @ Low Drift Setting<br>55 dB @ High Dynamic Setting                                                                              |            |
|                                                  |                                                 |                                                                                                                                                                        |            |
| Reference Input                                  | Reference Input Voltage Range                   | ± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold)<br>- 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold)                                                      |            |
|                                                  | Reference Input Impedance                       | 1 MΩ                                                                                                                                                                   |            |
|                                                  | Reference Acquisition Time                      | max. 2 s @ Fast Setting<br>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                                                                                                                                     |            |

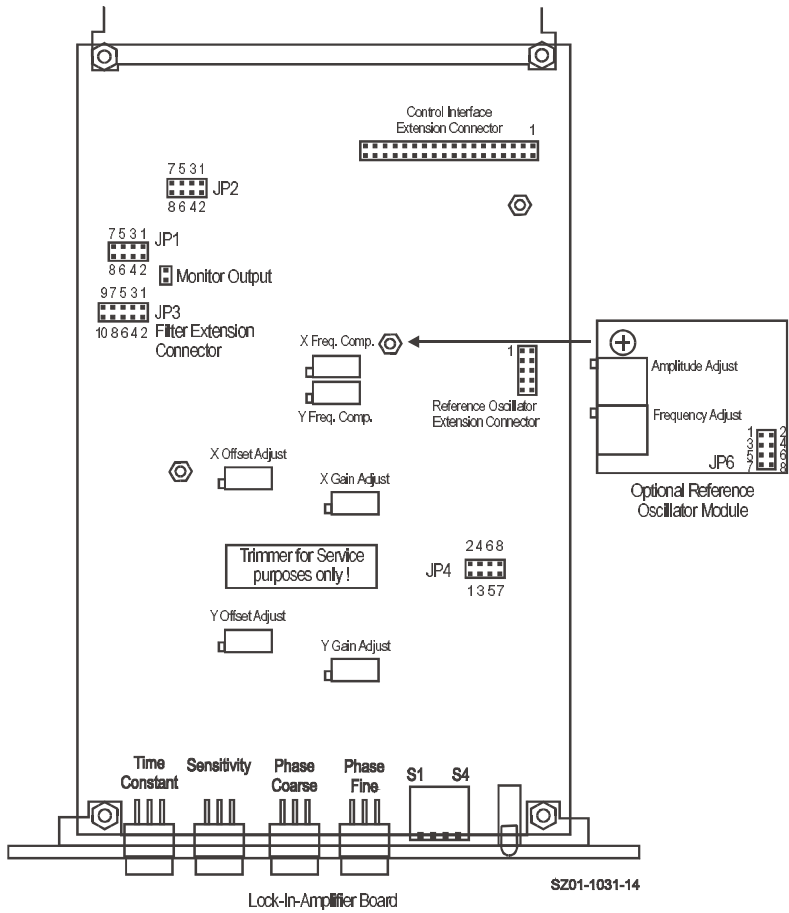


| Specifications (continued) |                                                      |                                                                                                                                                                                                                                        |                                 |                                  |              |
|----------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|--------------|
| 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                                  | 5 ppm/K @ Ultra Stable Setting<br>50 ppm/K @ Low Drift Setting<br>500 ppm/K @ High Dynamic Setting                                                                                                                                     |                                 |                                  |              |
|                            | Output Basic Accuracy                                | 2 %, Frequency > 30 kHz                                                                                                                                                                                                                |                                 |                                  |              |
|                            | Output Voltage Offset Range                          | ± 100 % Full Scale by ± 10 V Control Voltage                                                                                                                                                                                           |                                 |                                  |              |
|                            | Output Voltage Offset Control- Output Load Impedance | >2 kΩ                                                                                                                                                                                                                                  |                                 |                                  |              |
| Status Indicator LED       | Functions                                            | Amplifier Overload Status<br>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 @ + 12V 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                                             | Aluminium anodized                                                                                                                                                                                                                     |                                 |                                  |              |
|                            | Dimension                                            | 64,4 x 105,0 x 223,0 mm (without BNC-connectors)                                                                                                                                                                                       |                                 |                                  |              |
|                            | Weight                                               | 1000 gr. (2.2 lbs)                                                                                                                                                                                                                     |                                 |                                  |              |
| Temperature Range          | Storage Temperature                                  | - 40 ... + 100 °C                                                                                                                                                                                                                      |                                 |                                  |              |
|                            | Operating Temperature                                | 0 ... + 60 °C                                                                                                                                                                                                                          |                                 |                                  |              |
| Absolute Maximum Ratings   | Signal Input AC Voltage                              | 50 Vpp                                                                                                                                                                                                                                 |                                 |                                  |              |
|                            | 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. |                                 |                                  |              |

| Switch Settings (continued)                                   |                                                                                                                                                                                                                                                                                      |         |            |                   |               |         |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|-------------------|---------------|---------|
| S1 = ON: Sensitivity Setting for Full Scale ( = 10 V Output)  | Ultra Stable Mode                                                                                                                                                                                                                                                                    |         |            | Low Drift Mode    |               |         |
|                                                               | Setting                                                                                                                                                                                                                                                                              | Voltage | Current    | Setting           | Voltage       | Current |
|                                                               | 0                                                                                                                                                                                                                                                                                    | 1 V     | 10 µA      | 8                 | 100 mV        | 1 µA    |
|                                                               | 1                                                                                                                                                                                                                                                                                    | 300 mV  | 3 µA       | 9                 | 30 mV         | 300 nA  |
|                                                               | 2                                                                                                                                                                                                                                                                                    | 100 mV  | 1 µA       | A                 | 10 mV         | 100 nA  |
|                                                               | 3                                                                                                                                                                                                                                                                                    | 30 mV   | 300 nA     | B                 | 3 mV          | 30 nA   |
|                                                               | 4                                                                                                                                                                                                                                                                                    | 10 mV   | 100 nA     | C                 | 1 µV          | 10 nA   |
|                                                               | 5                                                                                                                                                                                                                                                                                    | 300 mV  | 30 nA      | D                 | 300 µV        | 3 nA    |
|                                                               | 6                                                                                                                                                                                                                                                                                    | 1 mV    | 10 nA      | E                 | 100 µV        | 1 nA    |
|                                                               | 7                                                                                                                                                                                                                                                                                    | 300 µV  | 3 nA       | F                 | 30 µV         | 300 nA  |
| S1 = OFF: Sensitivity Setting for Full Scale ( = 10 V Output) | Low Drift Mode                                                                                                                                                                                                                                                                       |         |            | High Dynamic Mode |               |         |
|                                                               | Setting                                                                                                                                                                                                                                                                              | Voltage | Current    | Setting           | Voltage       | Current |
|                                                               | 0                                                                                                                                                                                                                                                                                    | 100 mV  | 1 µA       | 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 µV        | 3 nA    |
|                                                               | 4                                                                                                                                                                                                                                                                                    | 1 mV    | 10 nA      | C                 | 100 µV        | 1 nA    |
|                                                               | 5                                                                                                                                                                                                                                                                                    | 300 µV  | 3 nA       | D                 | 30 µV         | 300 pA  |
|                                                               | 6                                                                                                                                                                                                                                                                                    | 100 µV  | 1 nA       | E                 | 10 µV         | 100 pA  |
|                                                               | 7                                                                                                                                                                                                                                                                                    | 30 µV   | 300 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 °.<br>One step with switch marked “Coarse” changes phase shift by 22.5 °. The “Fine”-switch changes phase shift by 1.4 ° - steps: |         |            |                   |               |         |
|                                                               | <div><div><p>Coarse</p></div><div><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>                                                                               |         |            |                   |               |         |

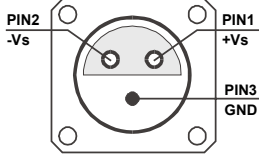
|                          |                           |                                                                                                                           |               |                       |               |
|--------------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|---------------|
| Internal Jumper Settings | Input Signal Filter       | Set Cut-Off Frequency of Input Lowpass Filter 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 |               |

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



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

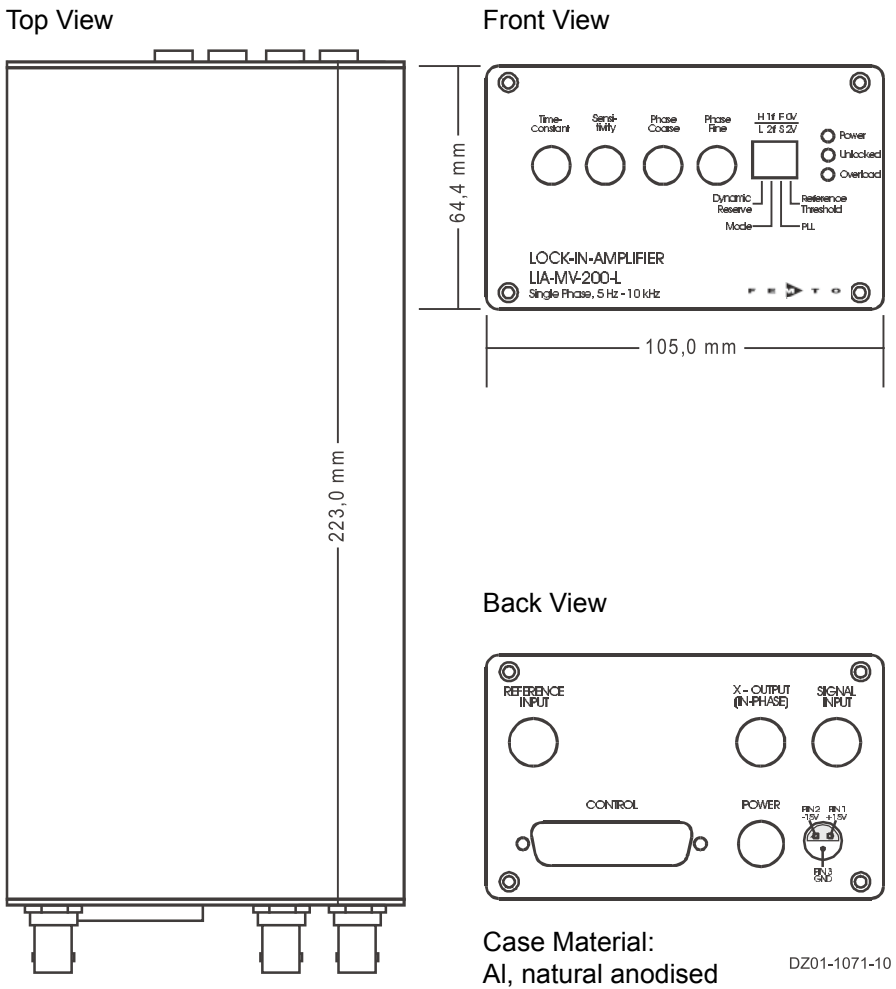
|                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connector Type                                                                                                    | Euro-Card DIN 41612 Connector, 64 pin male, (a+c)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Input                                                                                                             | Pin C2: Voltage Input, Non Inverting, DC-Coupled<br>Pin C3: Voltage Input, Non Inverting, AC-Coupled<br>Pin C4: Voltage Input, Inverting, AC-Coupled<br>Pin C5: Voltage Input, Inverting, DC-Coupled<br>Pin C7: Current Input<br>Pin C6: Current Amplifier Voltage Output<br>Pin A2- A6: Input GND                                                                                                                                                                                                                                                                                                                        |
| Monitor Output                                                                                                    | Pin C9: Monitor Output<br>Pin A9: Monitor GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Output                                                                                                            | Pin C14: X-Signal Output<br>Pin C15: Output GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Offset Input                                                                                                      | Pin A10: X-Offset Input<br>Pin A13: Offset GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Status Output                                                                                                     | Pin C10: Unlocked Status Output<br>Pin C11: Overload Status Output<br>Pin C17: Status Output GND (=Power Supply GND)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Power Supply                                                                                                      | Pin A16+C16: Power Supply – 15V<br>Pin A18+C18: Power Supply + 15V<br>Pin A17+C17: Power Supply GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Remote Control Inputs (Opto-Isolated)                                                                             | Pin C19: Time Constant (TC0)<br>Pin A19: Time Constant (TC1)<br>Pin C20: Time Constant (TC2)<br>Pin A20: Time Constant Slope (TCSL)<br>Pin A22: Sensitivity (SEN0)<br>Pin C21: Sensitivity (SEN1)<br>Pin A21: Sensitivity (SEN2)<br>Pin C22: Dynamic Mode (DYN0)<br>Pin A28: Phase Shift (PH0)<br>Pin C28: Phase Shift (PH1)<br>Pin A27: Phase Shift (PH2)<br>Pin C27: Phase Shift (PH3)<br>Pin A26: Phase Shift (PH4)<br>Pin C26: Phase Shift (PH5)<br>Pin A25: Phase Shift (PH6)<br>Pin C25: Phase Shift (PH7)<br>Pin C24: Disable Local Switch Control<br>Pin A23+A24: Remote Control GND (Common Optocoupler Cathode) |
| Reference Input                                                                                                   | Pin A32: Reference Input<br>Pin A31: Reference Input Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Reference Output<br>(Connected only if optional Oscillator Module is installed)                                   | Pin A30: Reference Output<br>Pin A17: Refer. Output GND (=Power Supply GND)<br>Pin A29: Reference Synchronization Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Standard Control Interface<br>(Connected only if optional Control Interface Module (future product) is installed) | Pin C29: Interface 0<br>Pin C30: Interface 1<br>Pin C31: Interface 2<br>Pin C32: Interface 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| External Connectors (at backside, Standard Configuration) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal                                                    | Input Factory set to BNC, isolated (single ended)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| X-Output                                                  | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Reference Input                                           | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Power Supply                                              | <div>LEMO Series 1S, 3-pin fixed Socket</div> <div>Pin 1: + 15V</div> <div>Pin 2: - 15V</div> <div>Pin 3: GND</div> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Control Port                                              | <div>Sub-D 25-pin, female, Qual. Class 2</div> <div>Pin 1: +12V (Stabilized Power Supply Output)</div> <div>Pin 2: -12V (Stabilized Power Supply Output)</div> <div>Pin 3: AGND (Analog Ground)</div> <div>Pin 4: +5V (Stabilized Power Supply Output)</div> <div>Pin 5: X-Output</div> <div>Pin 6: Overload Status Output</div> <div>Pin 7: Unlocked Status Output</div> <div>Pin 8: Disable Local Switch Control Input</div> <div>Pin 9: DGND (Ground f. Digital Control Pin 8 - 25)</div> <div>Pin 10: Dynamic Mode (DYN0)</div> <div>Pin 11: Sensitivity (SEN0)</div> <div>Pin 12: Sensitivity (SEN1)</div> <div>Pin 13: Sensitivity (SEN2)</div> <div>Pin 14: Time Constant Slope (TCSL)</div> <div>Pin 15: Time Constant (TC0)</div> <div>Pin 16: Time Constant (TC1)</div> <div>Pin 17: Time Constant (TC2)</div> <div>Pin 18: Phase Shift (PH0)</div> <div>Pin 19: Phase Shift (PH1)</div> <div>Pin 20: Phase Shift (PH2)</div> <div>Pin 21: Phase Shift (PH3)</div> <div>Pin 22: Phase Shift (PH4)</div> <div>Pin 23: Phase Shift (PH5)</div> <div>Pin 24: Phase Shift (PH6)</div> <div>Pin 25: Phase Shift (PH7)</div> |
| Connector Wiring Options                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| General                                                   | <div>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.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| 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"<br>" GND → IN A/SHLD"<br>" -V-IN → IN A/SHLD" |
|                                                                                                 | IN A = Voltage Input (Differential, AC)                                     | " +V-IN → IN A"<br>" -V-IN → IN A/SHLD"                       |
|                                                                                                 | IN A / IN B = Voltage Input (2 BNC Differential, AC) (OUT A cannot be used) | " +V-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → IN B"      |
| Output Connectors (JP2)                                                                         | IN A = Current Input (Single Ended)                                         | " GND → IN A/SHLD"<br>" -V-IN → C-OUT"                        |
|                                                                                                 | Output wiring                                                               | Jumper installed                                              |
|                                                                                                 | OUT A = X-Output                                                            | "X → OUT A"<br>(JP1) "USE OUT A/NO IN B"                      |
|                                                                                                 | OUT B = X-Output                                                            | "X → OUT B"                                                   |
|                                                                                                 | OUT A = Y-Output                                                            | "Y → OUT A"<br>(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"<br>(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"                                                 |
| Reference Connector (JP3)<br>(Reference Output only if optional Oscillator Module is installed) | OUT C = Reference Output                                                    | "REF-OUT → OUT C"                                             |
|                                                                                                 | 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.)<br>"REF-IN → REF" (2 Jumper)       |
|                                                                                                 | REF = Refer. Sync. Input (use OUT C as Reference Output)                    | "REF-SYNC → REF" (2 Jp.)                                      |

| 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 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      |
|                                             | 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. |           |                                  |       |           |

Dimensions



| Optional Extensions         |                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Oscillator Module | Model No.: SOM-1<br>- Frequency Range 5 Hz ... 130 kHz, User adjustable<br>- Output Voltage 0 ... 2 Vrms, User adjustable<br>- 100 ppm/K Amplitude Accuracy |
| Factory Set                 | 1 kHz, 1 Vrms                                                                                                                                               |



# Lock-In-Amplifier Module

LIA-MV-200-H



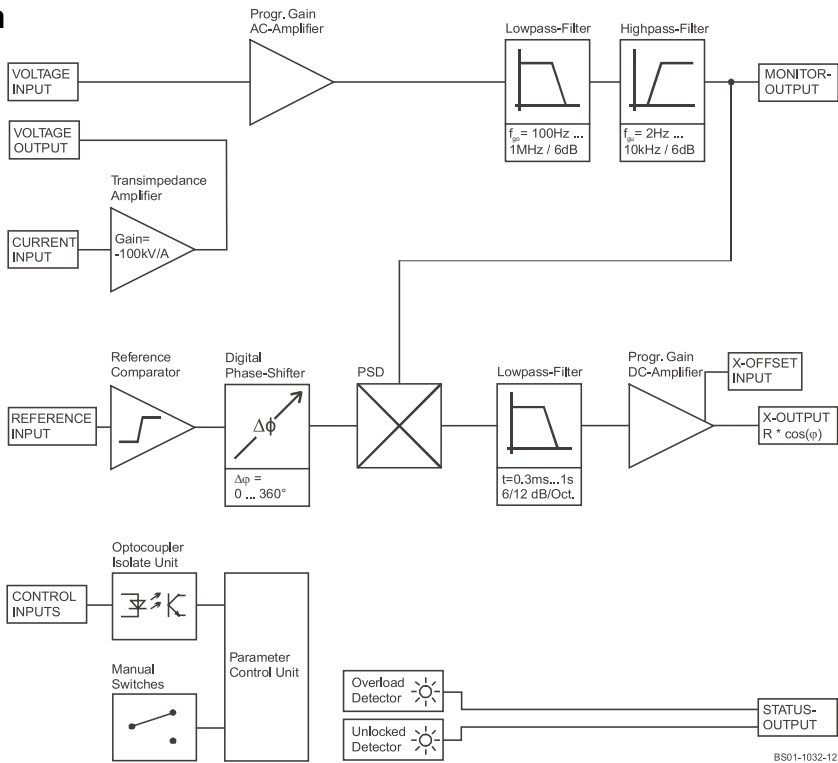
## FEATURES

- BNC Connectors for Input and Output Signals
- Rugged Aluminium Housing
- Single Phase Detection with X Output
- Working Frequency 50 Hz ... 120 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



| Specifications                                   | Test Conditions                                 | Vs = ± 15 V, Ta = 25°C                                                                                                                                                 |            |            |             |
|--------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-------------|
| 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                                                                                                                                                                     |            |            |             |
|                                                  | 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 < 10 kHz | f = 50 kHz | f = 100 kHz |
| Signal Filter (without optional Bandpass-Module) | 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 Gain                      | 1 ... 3333 (depends on Gain-Setting)                                                                                                                                   |            |            |             |
| Signal Monitor Output                            | 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 Dynamic Reserve                     | 15 dB @ Ultra Stable Setting<br>35 dB @ Low Drift Setting<br>55 dB @ High Dynamic Setting                                                                              |            |            |             |
| Reference Input                                  | Reference Input Voltage Range                   | ± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold)<br>- 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold)                                                      |            |            |             |
|                                                  | Reference Input Impedance                       | 1 MΩ                                                                                                                                                                   |            |            |             |
|                                                  | Reference Acquisition Time                      | max. 2 s @ Fast Setting<br>max. 4 s @ Slow Setting                                                                                                                     |            |            |             |
| Phase Shifter                                    | Phase Shifter Type                              | Digital, Working Frequency 50 Hz ... 120 kHz                                                                                                                           |            |            |             |
|                                                  | Phase Shifter Range                             | 0 ... + 360 °                                                                                                                                                          |            |            |             |
|                                                  | Phase Shifter Resolution                        | 1.4 ° @ f < 60 kHz, 2.8 ° @ f > 60 kHz                                                                                                                                 |            |            |             |
|                                                  | Phase Shifter Drift                             | < 100 ppm/K                                                                                                                                                            |            |            |             |
|                                                  | Phase Shifter Accuracy                          | < 0.3 °                                                                                                                                                                |            |            |             |
| Time Constants                                   | Time Constant Range                             | 300 µs ... 1 s in 1-3-10 steps                                                                                                                                         |            |            |             |
|                                                  | Time Const. Filter Characteristic               | 6 dB/Oct. or 12 dB/Oct. Switchable                                                                                                                                     |            |            |             |

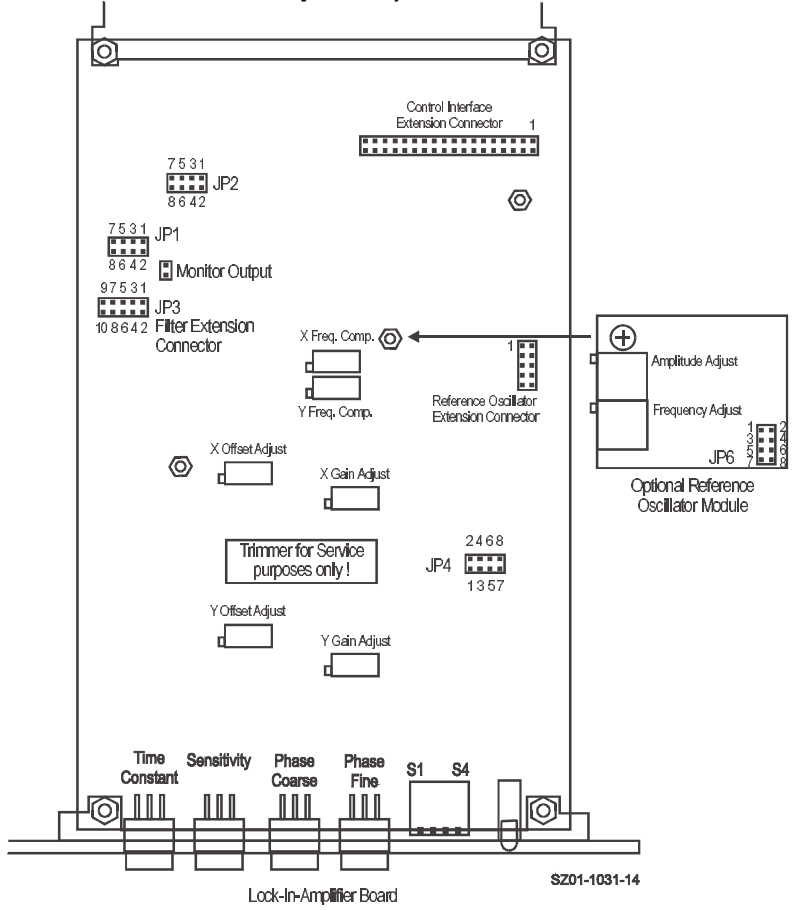
| Specifications (continued) |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |
|----------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|
| Output                     | Output Channels                                     | X = In Phase                                                                                                                                                                                                                           |                                 |                                  |
|                            | Output Voltage Range                                | ± 10 V (@ 2 kΩ Load)                                                                                                                                                                                                                   |                                 |                                  |
|                            | Output Current                                      | ± 5 mA max.                                                                                                                                                                                                                            |                                 |                                  |
|                            | Output Impedance                                    | 50 W                                                                                                                                                                                                                                   |                                 |                                  |
|                            | Output DC-Stability                                 | 5 ppm/K @ Ultra Stable Setting<br>50 ppm/K @ Low Drift Setting<br>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 kΩ                                                                                                                                                                                                                                 |                                 |                                  |
| Status Indicator LED       | Functions                                           | Amplifier Overload Status<br>Reference PLL Unlocked Status                                                                                                                                                                             |                                 |                                  |
|                            | 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 @ + 12V 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, + 120 mA                                                                                                                                                                                                                      |                                 |                                  |
| Case                       | Material                                            | Aluminium anodized                                                                                                                                                                                                                     |                                 |                                  |
|                            | Dimension                                           | 64,4 x 105,0 x 223,0 mm (without BNC-connectors)                                                                                                                                                                                       |                                 |                                  |
|                            | Weight                                              | 1000 gr. (2.2 lbs)                                                                                                                                                                                                                     |                                 |                                  |
| Temperature Range          | Storage Temperature                                 | - 40 ... + 100 °C                                                                                                                                                                                                                      |                                 |                                  |
|                            | Operating Temperature                               | 0 ... + 60 °C                                                                                                                                                                                                                          |                                 |                                  |
| Absolute Maximum Ratings   | Signal Input AC Voltage                             | 50 Vpp                                                                                                                                                                                                                                 |                                 |                                  |
|                            | 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. |                                 |                                  |
|                            |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |
|                            |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |
|                            |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |
|                            |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |
|                            |                                                     |                                                                                                                                                                                                                                        |                                 |                                  |

| Switch Settings (continued)                                         |                                                                                                                                                                                                                                                                                   |         |            |                   |               |         |
|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|-------------------|---------------|---------|
| S1 = ON: Sensitivity Setting<br>for Full Scale<br>( = 10 V Output)  | Ultra Stable Mode                                                                                                                                                                                                                                                                 |         |            | Low Drift Mode    |               |         |
|                                                                     | Setting                                                                                                                                                                                                                                                                           | Voltage | Current    | Setting           | Voltage       | Current |
|                                                                     | 0                                                                                                                                                                                                                                                                                 | 1 V     | 10 µA      | 8                 | 100 mV        | 1 µA    |
|                                                                     | 1                                                                                                                                                                                                                                                                                 | 300 mV  | 3 µA       | 9                 | 30 mV         | 300 nA  |
|                                                                     | 2                                                                                                                                                                                                                                                                                 | 100 mV  | 1 µA       | 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 µV        | 3 nA    |
|                                                                     | 6                                                                                                                                                                                                                                                                                 | 1 mV    | 10 nA      | E                 | 100 µV        | 1 nA    |
|                                                                     | 7                                                                                                                                                                                                                                                                                 | 300 µV  | 3 nA       | F                 | 30 µV         | 300 pA  |
| S1 = OFF: Sensitivity<br>Setting for Full Scale<br>( = 10 V Output) | Low Drift Mode                                                                                                                                                                                                                                                                    |         |            | High Dynamic Mode |               |         |
|                                                                     | Setting                                                                                                                                                                                                                                                                           | Voltage | Current    | Setting           | Voltage       | Current |
|                                                                     | 0                                                                                                                                                                                                                                                                                 | 100 mV  | 1 µA       | 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 µV        | 3 nA    |
|                                                                     | 4                                                                                                                                                                                                                                                                                 | 1 mV    | 10 nA      | C                 | 100 µV        | 1 nA    |
|                                                                     | 5                                                                                                                                                                                                                                                                                 | 300 µV  | 3 nA       | D                 | 30 µV         | 300 pA  |
|                                                                     | 6                                                                                                                                                                                                                                                                                 | 100 µV  | 1 nA       | E                 | 10 µV         | 100 pA  |
|                                                                     | 7                                                                                                                                                                                                                                                                                 | 30 µV   | 300 pA     | F                 | 3 µV          | 30 pA   |
| Time Constant Setting                                               | 6 dB/Oct.                                                                                                                                                                                                                                                                         |         | 12 dB/Oct. |                   | Time Constant |         |
|                                                                     | 0                                                                                                                                                                                                                                                                                 |         | 8          |                   | 300 µs        |         |
|                                                                     | 1                                                                                                                                                                                                                                                                                 |         | 9          |                   | 1 ms          |         |
|                                                                     | 2                                                                                                                                                                                                                                                                                 |         | A          |                   | 3 ms          |         |
|                                                                     | 3                                                                                                                                                                                                                                                                                 |         | B          |                   | 10 ms         |         |
|                                                                     | 4                                                                                                                                                                                                                                                                                 |         | C          |                   | 30 ms         |         |
|                                                                     | 5                                                                                                                                                                                                                                                                                 |         | D          |                   | 100 ms        |         |
|                                                                     | 6                                                                                                                                                                                                                                                                                 |         | E          |                   | 300 µs        |         |
|                                                                     | 7                                                                                                                                                                                                                                                                                 |         | F          |                   | 1 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: |         |            |                   |               |         |
|                                                                     | <div><div><p>Coarse</p></div><div><p>Fine</p></div></div> <p>If Frequency Range f &gt; 70 kHz or 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>                                           |         |            |                   |               |         |

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: |               |                       |               |
|                             | Highpass                                                                                                          |               | Lowpass               |               |
|                             | JP3                                                                                                               | -3 dB Cut-Off | JP1, JP2              | -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)                                                                     |               |                       |               |

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



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<br>Pin C3: Voltage Input, Non Inverting, AC-Coupled<br>Pin C4: Voltage Input, Inverting, AC-Coupled<br>Pin C5: Voltage Input, Inverting, DC-Coupled<br>Pin C7: Current Input<br>Pin C6: Current Amplifier Voltage Output<br>Pin A2- A6: Input GND                                                                                                                                                                                                                                                                                                                           |
| Monitor Output                                                                                                 | Pin C9: Monitor Output<br>Pin A9: Monitor GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Output                                                                                                         | Pin C14: X-Signal Output<br>Pin C15: Output GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Offset Input                                                                                                   | Pin A10: X-Offset Input<br>Pin A13: Offset GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Status Output                                                                                                  | Pin C10: Unlocked Status Output<br>Pin C11: Overload Status Output<br>Pin C17: Status Output GND (=Power Supply GND)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Power Supply                                                                                                   | Pin A16+C16: Power Supply – 15V<br>Pin A18+C18: Power Supply + 15V<br>Pin A17+C17: Power Supply GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Remote Control Inputs (Opto-Isolated)                                                                          | Pin C19: Time Constant (TC0)<br>Pin A19: Time Constant (TC1)<br>Pin C20: Time Constant (TC2)<br>Pin A20: Time Constant Slope (TCSL)<br>Pin A22: Sensitivity (SEN0)<br>Pin C21: Sensitivity (SEN1)<br>Pin A21: Sensitivity (SEN2)<br>Pin C22: Dynamic Mode (DYN0)<br>Pin A28: Phase Shift (PH0)<br>Pin C28: Phase Shift (PH1)<br>Pin A27: Phase Shift (PH2)<br>Pin C27: Phase Shift (PH3)<br>Pin A26: Phase Shift (PH4)<br>Pin C26: Phase Shift (PH5)<br>Pin A25: Phase Shift (PH6)<br>Pin C25: Phase Shift (PH7)<br>Pin C24: Disable Local Switch Control<br>Pin A23+A24: Remote Control GND<br>(Common Optocoupler Cathode) |
| Reference Input                                                                                                | Pin A32: Reference Input<br>Pin A31: Reference Input Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Reference Output (Connected only if optional Oscillator Module is installed)                                   | Pin A30: Reference Output<br>Pin A17: Refer. Output GND (=Power Supply GND)<br>Pin A29: Reference Synchronization Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Standard Control Interface (Connected only if optional Control Interface Module (future product) is installed) | Pin C29: Interface 0<br>Pin C30: Interface 1<br>Pin C31: Interface 2<br>Pin C32: Interface 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



External Connectors (at backside, Standard Configuration)

|                 |                                                                                  |
|-----------------|----------------------------------------------------------------------------------|
| Signal Input    | Factory set to BNC, isolated (single ended)                                      |
| X-Output        | BNC                                                                              |
| Reference Input | BNC                                                                              |
| Power Supply    | LEMO Series 1S, 3-pin fixed Socket<br>Pin 1: + 15V<br>Pin 2: - 15V<br>Pin 3: GND |



|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Control Port | Sub-D 25-pin, female, Qual. Class 2<br>Pin 1: +12V (Stabilized Power Supply Output)<br>Pin 2: -12V (Stabilized Power Supply Output)<br>Pin 3: AGND (Analog Ground)<br>Pin 4: +5V (Stabilized Power Supply Output)<br>Pin 5: X-Output<br>Pin 6: Overload Status Output<br>Pin 7: Unlocked Status Output<br>Pin 8: Disable Local Switch Control Input<br>Pin 9: DGND (Ground f. Digital Control Pin 8 - 25)<br>Pin 10: Dynamic Mode (DYN0)<br>Pin 11: Sensitivity (SEN0)<br>Pin 12: Sensitivity (SEN1)<br>Pin 13: Sensitivity (SEN2)<br>Pin 14: Time Constant Slope (TCSL)<br>Pin 15: Time Constant (TC0)<br>Pin 16: Time Constant (TC1)<br>Pin 17: Time Constant (TC2)<br>Pin 18: Phase Shift (PH0)<br>Pin 19: Phase Shift (PH1)<br>Pin 20: Phase Shift (PH2)<br>Pin 21: Phase Shift (PH3)<br>Pin 22: Phase Shift (PH4)<br>Pin 23: Phase Shift (PH5)<br>Pin 24: Phase Shift (PH6)<br>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.<br>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.<br>The jumper options and functions are described in the following table. |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Connector Wiring Options, Jumpers on internal Adapter Board

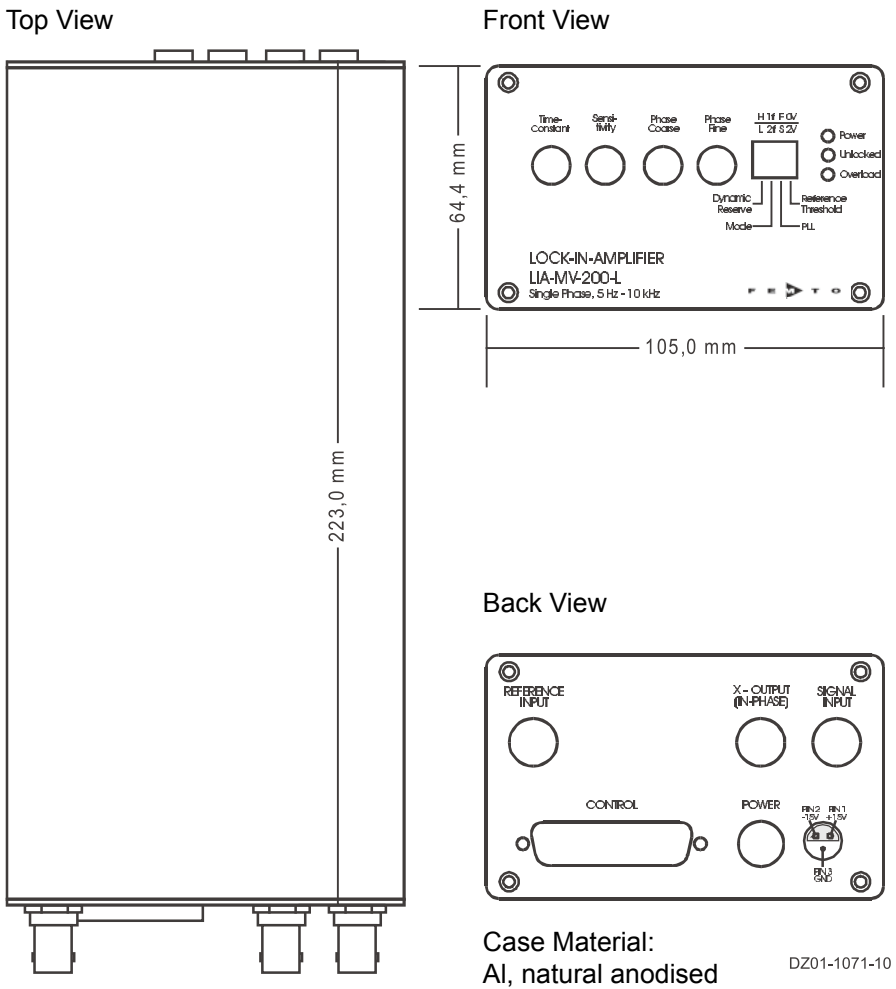
|                                                                                                 |                                                                             |                                                               |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------|
| Input Connectors (JP1)                                                                          | Input wiring                                                                | Jumper installed                                              |
|                                                                                                 | IN A = Voltage Input (Single Ended, AC)                                     | " +V-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → IN A/SHLD" |
|                                                                                                 | IN A = Voltage Input (Differential, AC)                                     | " +V-IN → IN A"<br>" -V-IN → IN A/SHLD"                       |
|                                                                                                 | IN A / IN B = Voltage Input (2 BNC Differential, AC) (OUT A cannot be used) | " +V-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → IN B"      |
|                                                                                                 | IN A = Current Input (Single Ended)                                         | " C-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → C-OUT"      |
| Output Connectors (JP2)                                                                         | Output wiring                                                               | Jumper installed                                              |
|                                                                                                 | OUT A = X-Output                                                            | " X → OUT A"<br>(JP1) "USE OUT A/NO IN B"                     |
|                                                                                                 | OUT B = X-Output                                                            | " X → OUT B"                                                  |
|                                                                                                 | OUT A = Y-Output                                                            | " Y → OUT A"<br>(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 wiring                                                            | Jumper installed                                              |
| Reference Connector (JP3)<br>(Reference Output only if optional Oscillator Module is installed) | REF = Reference Input                                                       | " REF-IN → REF" (2 Jumper)                                    |
|                                                                                                 | REF = Reference Output (Reference Output connected to Ref. Input)           | " REF-OUT → REF-IN" (2 Jp.)<br>" REF-IN → REF" (2 Jumper)     |
|                                                                                                 | REF = Refer. Sync. Input (use OUT C as Reference Output)                    | " REF-SYNC → REF" (2 Jp.)                                     |





| 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 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      |
|                                             | 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. |           |                                  |       |           |

Dimensions



| Optional Extensions         |                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Oscillator Module | Model No.: SOM-1<br>- Frequency Range 5 Hz ... 130 kHz, User adjustable<br>- Output Voltage 0 ... 2 Vrms, User adjustable<br>- 100 ppm/K Amplitude Accuracy |
| Factory Set                 | 1 kHz, 1 Vrms                                                                                                                                               |

# Dual Phase Lock-In-Amplifier Module

LIA-MVD-200-L



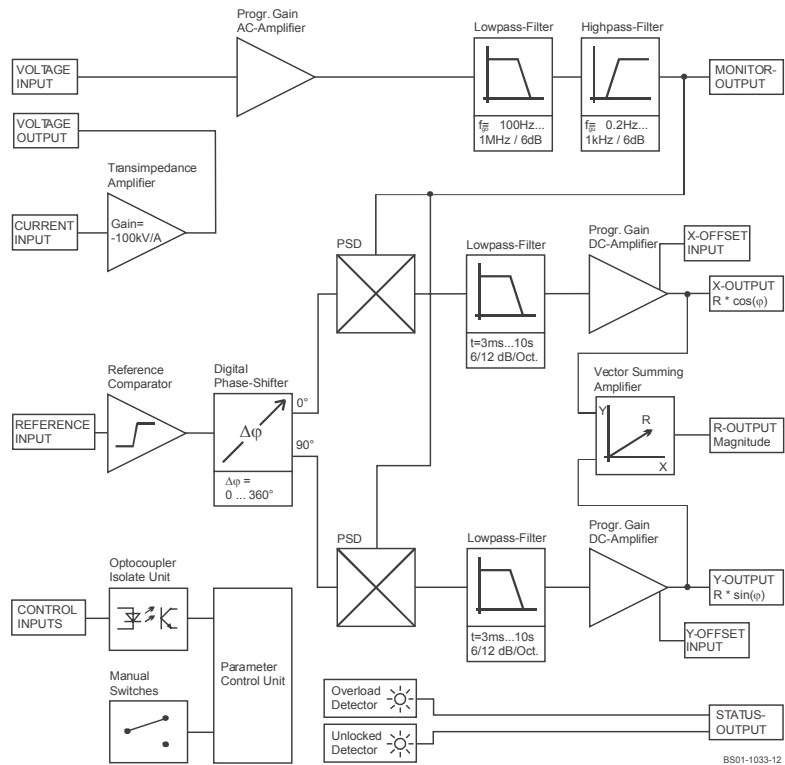
FEATURES

- BNC Connectors for Input and Output Signals
- Rugged Aluminium Housing
- Dual Phase Detection with X, Y and Magnitude 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



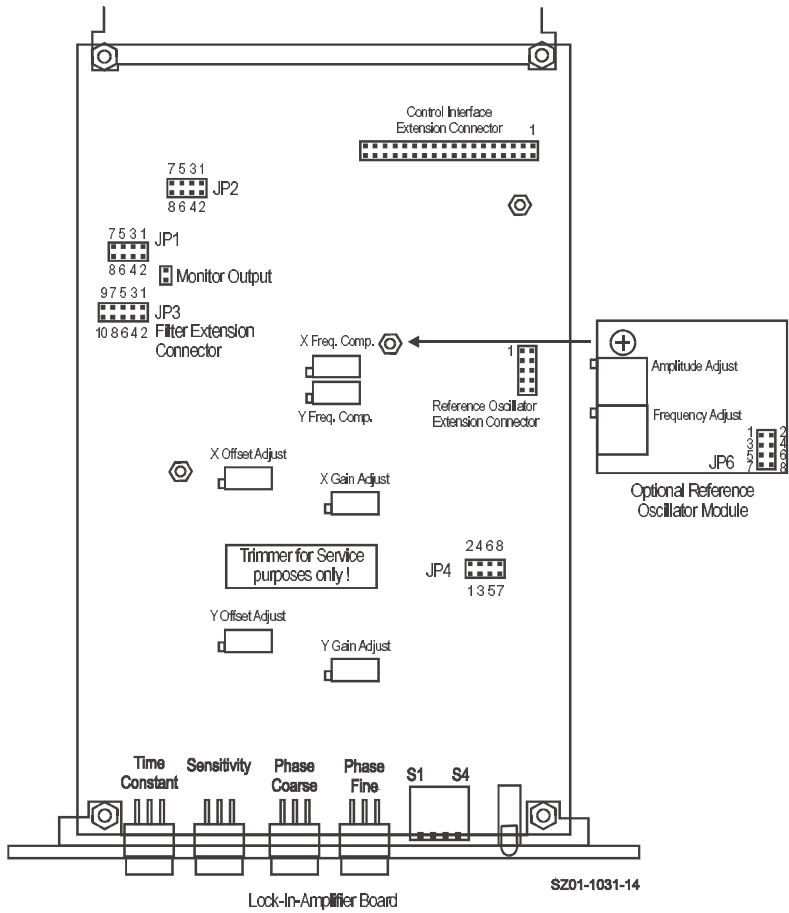
| Specifications                                   | Test Conditions                                 | Vs = ± 15 V, Ta = 25°C                                                                                                                                                 |            |
|--------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 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                                                                                                                                                                     |            |
|                                                  | 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 < 10 kHz |
| Signal Filter (without optional Bandpass-Module) | 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)               | 0.2 Hz, 1 Hz, 10 Hz, 100 Hz, 1 kHz; 6 dB/Oct. selectable per jumper                                                                                                    |            |
|                                                  | Signal Filter Cutoff accuracy                   | ± 20 %                                                                                                                                                                 |            |
|                                                  | Max. Dynamic Reserve                            | 80 dB                                                                                                                                                                  |            |
|                                                  | Signal Monitor Output Gain                      | 1 ... 3333 (depends on Gain-Setting)                                                                                                                                   |            |
| Signal Monitor Output                            | 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 Dynamic Reserve                     | 15 dB @ Ultra Stable Setting<br>35 dB @ Low Drift Setting<br>55 dB @ High Dynamic Setting                                                                              |            |
| Reference Input                                  | Reference Input Voltage Range                   | ± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold)<br>- 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold)                                                      |            |
|                                                  | Reference Input Impedance                       | 1 MΩ                                                                                                                                                                   |            |
|                                                  | Reference Acquisition Time                      | max. 2 s @ Fast Setting<br>max. 4 s @ Slow Setting                                                                                                                     |            |
|                                                  | Phase Shifter Type                              | Digital, Working Frequency 50 Hz ... 10 kHz                                                                                                                            |            |
| Phase Shifter                                    | Phase Shifter Range                             | 0 ... + 360 °                                                                                                                                                          |            |
|                                                  | Phase Shifter Resolution                        | 1.4 °                                                                                                                                                                  |            |
|                                                  | Phase Shifter Drift                             | < 100 ppm/K                                                                                                                                                            |            |
|                                                  | Phase Shifter Accuracy                          | < 0.3 °                                                                                                                                                                |            |
|                                                  | Phase Shifter Orthogonality                     | < 0.1 °                                                                                                                                                                |            |
| 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                                                                                                                                     |            |

| Specifications (continued) |                                                      |                                                                                                                                                                                                                                        |                                 |                                  |              |
|----------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|--------------|
| Output                     | Output Channels                                      | X = In Phase, Y = Quadrature, R = Magnitude                                                                                                                                                                                            |                                 |                                  |              |
|                            | Output Voltage Range                                 | ± 10 V (@ 2 kΩ Load)                                                                                                                                                                                                                   |                                 |                                  |              |
|                            | Output Current                                       | ± 5 mA max.                                                                                                                                                                                                                            |                                 |                                  |              |
|                            | Output Impedance                                     | 50 Ω                                                                                                                                                                                                                                   |                                 |                                  |              |
|                            | Output DC-Stability                                  | 5 ppm/K @ Ultra Stable Setting<br>50 ppm/K @ Low Drift Setting<br>500 ppm/K @ High Dynamic Setting                                                                                                                                     |                                 |                                  |              |
|                            | Output Basic Accuracy                                | 2 % (X and Y-Output) @sinusoidal input signal<br>4 % (R-Output) @sinusoidal input signal                                                                                                                                               |                                 |                                  |              |
|                            | Output Voltage Offset Range                          | ± 100 % Full Scale by ± 10 V Control Voltage                                                                                                                                                                                           |                                 |                                  |              |
|                            | Output Voltage Offset Control- Output Load Impedance | >2 kΩ                                                                                                                                                                                                                                  |                                 |                                  |              |
| Status Indicator LED       | Functions                                            | Amplifier Overload Status<br>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 @ + 12V 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                                             | Aluminium anodized                                                                                                                                                                                                                     |                                 |                                  |              |
|                            | Dimension                                            | 64,4 x 105,0 x 223,0 mm (without BNC-connectors)                                                                                                                                                                                       |                                 |                                  |              |
|                            | Weight                                               | 1000 gr. (2.2 lbs)                                                                                                                                                                                                                     |                                 |                                  |              |
| Temperature Range          | Storage Temperature                                  | - 40 ... + 100 °C                                                                                                                                                                                                                      |                                 |                                  |              |
|                            | Operating Temperature                                | 0 ... + 60 °C                                                                                                                                                                                                                          |                                 |                                  |              |
| Absolute Maximum Ratings   | Signal Input AC Voltage                              | 50 Vpp                                                                                                                                                                                                                                 |                                 |                                  |              |
|                            | 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. |                                 |                                  |              |
|                            |                                                      |                                                                                                                                                                                                                                        |                                 |                                  |              |

| Switch Settings (continued)                                      |                                                                                                                                                                                                                                                                                      |         |            |                   |               |         |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|-------------------|---------------|---------|
| S1 = ON: Sensitivity Setting for Full Scale<br>( = 10 V Output)  | Ultra Stable Mode                                                                                                                                                                                                                                                                    |         |            | Low Drift Mode    |               |         |
|                                                                  | Setting                                                                                                                                                                                                                                                                              | Voltage | Current    | Setting           | Voltage       | Current |
|                                                                  | 0                                                                                                                                                                                                                                                                                    | 1 V     | 10 µA      | 8                 | 100 mV        | 1 µA    |
|                                                                  | 1                                                                                                                                                                                                                                                                                    | 300 mV  | 3 µA       | 9                 | 30 mV         | 300 nA  |
|                                                                  | 2                                                                                                                                                                                                                                                                                    | 100 mV  | 1 µA       | A                 | 10 mV         | 100 nA  |
|                                                                  | 3                                                                                                                                                                                                                                                                                    | 30 mV   | 300 nA     | B                 | 3 mV          | 30 nA   |
|                                                                  | 4                                                                                                                                                                                                                                                                                    | 10 mV   | 100 nA     | C                 | 1 µV          | 10 nA   |
|                                                                  | 5                                                                                                                                                                                                                                                                                    | 3 mV    | 30 nA      | D                 | 300 µV        | 3 nA    |
|                                                                  | 6                                                                                                                                                                                                                                                                                    | 1 mV    | 10 nA      | E                 | 100 µV        | 1 nA    |
|                                                                  | 7                                                                                                                                                                                                                                                                                    | 300 µV  | 3 nA       | F                 | 30 µV         | 300 nA  |
| S1 = OFF: Sensitivity Setting for Full Scale<br>( = 10 V Output) | Low Drift Mode                                                                                                                                                                                                                                                                       |         |            | High Dynamic Mode |               |         |
|                                                                  | Setting                                                                                                                                                                                                                                                                              | Voltage | Current    | Setting           | Voltage       | Current |
|                                                                  | 0                                                                                                                                                                                                                                                                                    | 100 mV  | 1 µA       | 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 µV        | 3 nA    |
|                                                                  | 4                                                                                                                                                                                                                                                                                    | 1 mV    | 10 nA      | C                 | 100 µV        | 1 nA    |
|                                                                  | 5                                                                                                                                                                                                                                                                                    | 300 µV  | 3 nA       | D                 | 30 µV         | 300 pA  |
|                                                                  | 6                                                                                                                                                                                                                                                                                    | 100 µV  | 1 nA       | E                 | 10 µV         | 100 pA  |
|                                                                  | 7                                                                                                                                                                                                                                                                                    | 30 µV   | 300 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 °.<br>One step with switch marked “Coarse” changes phase shift by 22.5 °. The “Fine”-switch changes phase shift by 1.4 ° - steps: |         |            |                   |               |         |
|                                                                  | <div><div><p>Coarse</p></div><div><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>                                                                               |         |            |                   |               |         |

|                          |                           |                                                                                                                           |               |                       |               |
|--------------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|---------------|
| Internal Jumper Settings | Input Signal Filter       | Set Cut-Off Frequency of Input Lowpass Filter 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 |               |

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



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<br>Pin C3: Voltage Input, Non Inverting, AC-Coupled<br>Pin C4: Voltage Input, Inverting, AC-Coupled<br>Pin C5: Voltage Input, Inverting, DC-Coupled<br>Pin C7: Current Input<br>Pin C6: Current Amplifier Voltage Output<br>Pin A2- A6: Input GND                                                                                                                                                                                                                                                                                                                        |
| Monitor Output                                                                                                    | Pin C9: Monitor Output<br>Pin A9: Monitor GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Output                                                                                                            | Pin A12: R-Signal Output<br>Pin C14: X-Signal Output<br>Pin A14: Y-Signal Output<br>Pin C15: Output GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Offset Input                                                                                                      | Pin A10: X-Offset Input<br>Pin A11: Y-Offset Input<br>Pin A13: Offset GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Status Output                                                                                                     | Pin C10: Unlocked Status Output<br>Pin C11: Overload Status Output<br>Pin C17: Status Output GND (=Power Supply GND)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Power Supply                                                                                                      | Pin A16+C16: Power Supply – 15V<br>Pin A18+C18: Power Supply + 15V<br>Pin A17+C17: Power Supply GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Remote Control Inputs (Opto-Isolated)                                                                             | Pin C19: Time Constant (TC0)<br>Pin A19: Time Constant (TC1)<br>Pin C20: Time Constant (TC2)<br>Pin A20: Time Constant Slope (TCSL)<br>Pin A22: Sensitivity (SEN0)<br>Pin C21: Sensitivity (SEN1)<br>Pin A21: Sensitivity (SEN2)<br>Pin C22: Dynamic Mode (DYN0)<br>Pin A28: Phase Shift (PH0)<br>Pin C28: Phase Shift (PH1)<br>Pin A27: Phase Shift (PH2)<br>Pin C27: Phase Shift (PH3)<br>Pin A26: Phase Shift (PH4)<br>Pin C26: Phase Shift (PH5)<br>Pin A25: Phase Shift (PH6)<br>Pin C25: Phase Shift (PH7)<br>Pin C24: Disable Local Switch Control<br>Pin A23+A24: Remote Control GND (Common Optocoupler Cathode) |
| Reference Input                                                                                                   | Pin A32: Reference Input<br>Pin A31: Reference Input Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Reference Output<br>(Connected only if optional Oscillator Module is installed)                                   | Pin A30: Reference Output<br>Pin A17: Refer. Output GND (=Power Supply GND)<br>Pin A29: Reference Synchronization Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Standard Control Interface<br>(Connected only if optional Control Interface Module (future product) is installed) | Pin C29: Interface 0<br>Pin C30: Interface 1<br>Pin C31: Interface 2<br>Pin C32: Interface 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

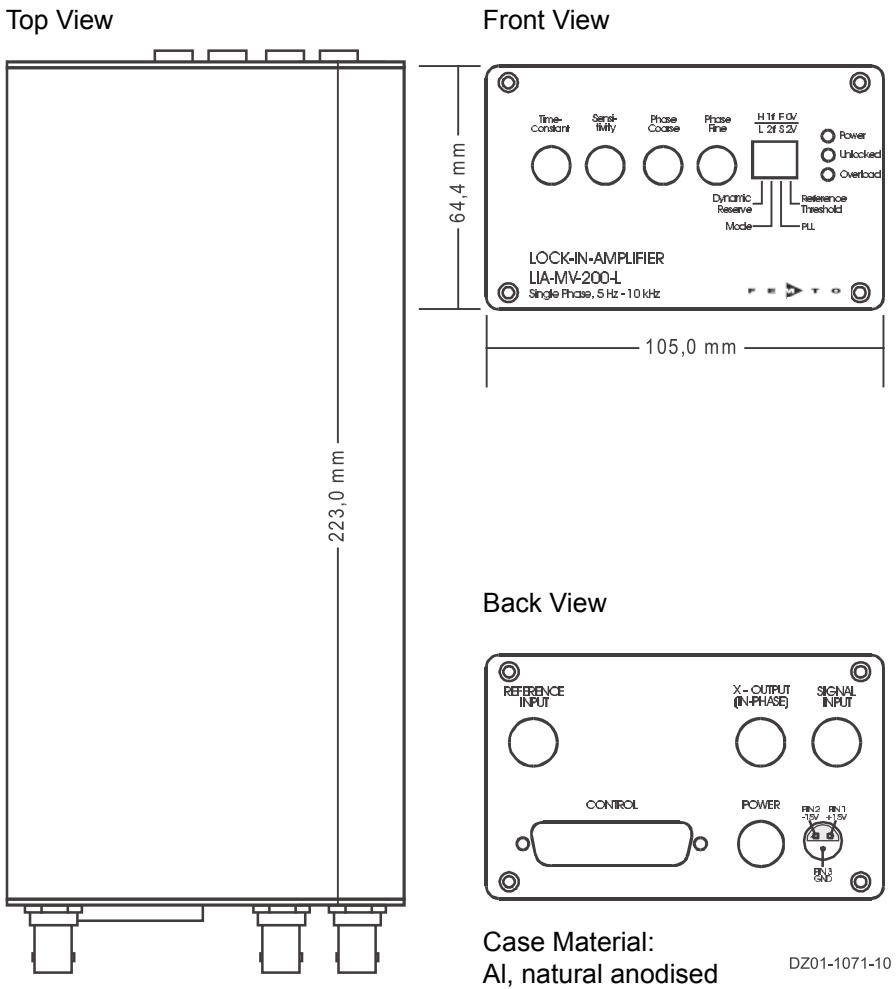


| External Connectors (at backside, Standard Configuration) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Input                                              | Factory set to BNC, isolated (single ended)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| X-Output                                                  | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Reference Input                                           | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Power Supply                                              | <div>LEMO Series 1S, 3-pin fixed Socket</div> <div>Pin 1: + 15V</div> <div>Pin 2: - 15V</div> <div>Pin 3: GND</div> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Control Port                                              | <div>Sub-D 25-pin, female, Qual. Class 2</div> <div>Pin 1: +12V (Stabilized Power Supply Output)</div> <div>Pin 2: -12V (Stabilized Power Supply Output)</div> <div>Pin 3: AGND (Analog Ground)</div> <div>Pin 4: +5V (Stabilized Power Supply Output)</div> <div>Pin 5: X-Output</div> <div>Pin 6: Overload Status Output</div> <div>Pin 7: Unlocked Status Output</div> <div>Pin 8: Disable Local Switch Control Input</div> <div>Pin 9: DGND (Ground f. Digital Control Pin 8 - 25)</div> <div>Pin 10: Dynamic Mode (DYN0)</div> <div>Pin 11: Sensitivity (SEN0)</div> <div>Pin 12: Sensitivity (SEN1)</div> <div>Pin 13: Sensitivity (SEN2)</div> <div>Pin 14: Time Constant Slope (TCSL)</div> <div>Pin 15: Time Constant (TC0)</div> <div>Pin 16: Time Constant (TC1)</div> <div>Pin 17: Time Constant (TC2)</div> <div>Pin 18: Phase Shift (PH0)</div> <div>Pin 19: Phase Shift (PH1)</div> <div>Pin 20: Phase Shift (PH2)</div> <div>Pin 21: Phase Shift (PH3)</div> <div>Pin 22: Phase Shift (PH4)</div> <div>Pin 23: Phase Shift (PH5)</div> <div>Pin 24: Phase Shift (PH6)</div> <div>Pin 25: Phase Shift (PH7)</div> |
| Connector Wiring Options                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| General                                                   | <div>The BNC-connector configuration can be easily changed by setting electrical jumpers at the internal I/O-adapter card.</div> <div>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.</div> <div>The jumper options and functions are described in the following table.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| 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"<br>" GND → IN A/SHLD"<br>" -V-IN → IN A/SHLD" |
|                                                                                                 | IN A = Voltage Input (Differential, AC)                                     | " +V-IN → IN A"<br>" -V-IN → IN A/SHLD"                       |
|                                                                                                 | IN A / IN B = Voltage Input (2 BNC Differential, AC) (OUT A cannot be used) | " +V-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → IN B"      |
|                                                                                                 | IN A = Current Input (Single Ended)                                         | " C-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → C-OUT"      |
| Output Connectors (JP2)                                                                         | Output wiring                                                               | Jumper installed                                              |
|                                                                                                 | OUT A = X-Output                                                            | " X → OUT A"<br>(JP1) "USE OUT A/NO IN B"                     |
|                                                                                                 | OUT B = X-Output                                                            | " X → OUT B"                                                  |
|                                                                                                 | OUT A = Y-Output                                                            | " Y → OUT A"<br>(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 wiring                                                            | Jumper installed                                              |
| Reference Connector (JP3)<br>(Reference Output only if optional Oscillator Module is installed) | REF = Reference Input                                                       | " REF-IN → REF" (2 Jumper)                                    |
|                                                                                                 | REF = Reference Output (Reference Output connected to Ref. Input)           | " REF-OUT → REF-IN" (2 Jp.)<br>" REF-IN → REF" (2 Jumper)     |
|                                                                                                 | REF = Refer. Sync. Input (use OUT C as Reference Output)                    | " REF-SYNC → REF" (2 Jp.)                                     |

| 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 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      |
|                                             | 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. |                |                                  |                                  |           |

Dimensions



| Optional Extensions         |                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Oscillator Module | Model No.: SOM-1<br>- Frequency Range 5 Hz ... 130 kHz, User adjustable<br>- Output Voltage 0 ... 2 Vrms, User adjustable<br>- 100 ppm/K Amplitude Accuracy |
| Factory Set                 | 1 kHz, 1 Vrms                                                                                                                                               |

# Dual Phase Lock-In-Amplifier Module

LIA-MVD-200-H



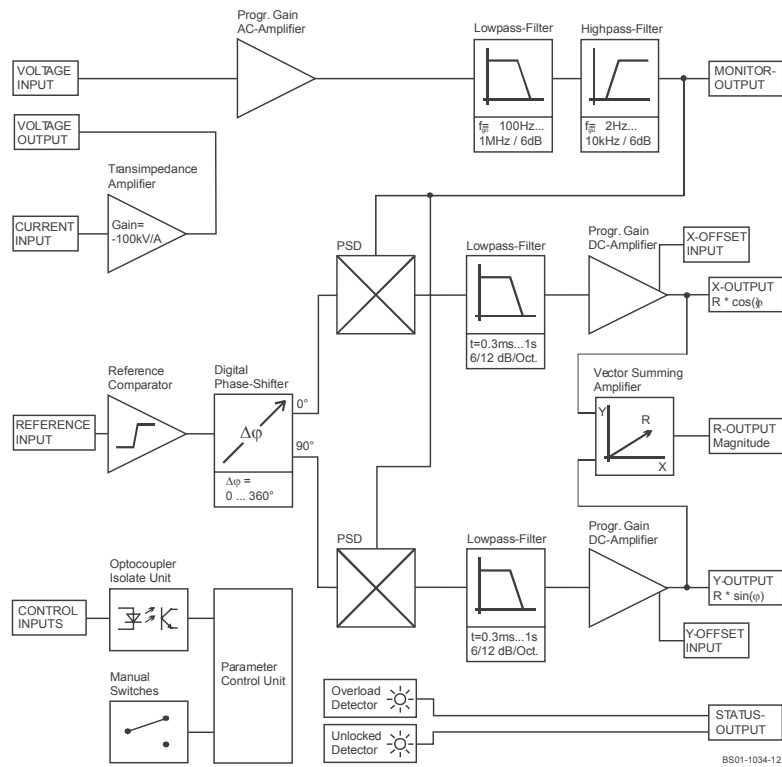
### FEATURES

- BNC Connectors for Input and Output Signals
- Rugged Aluminium Housing
- Dual Phase Detection with X, Y and Magnitude Output
- Working Frequency 50 Hz ... 120 kHz, Digital Phase Shifter 0 ... 360°
- Parameter Control by local Switches and opto-isolated digital Inputs
- Optional Reference Oscillator Module available

### APPLICATIONS

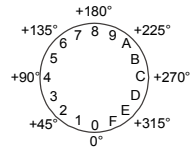
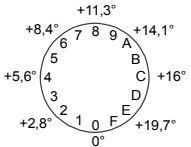
- Spectroscopy
- Luminescence, Fluorescence, Phosphorescence Measurements
- Light Scattering Measurements
- Opto-electronical Quality Control

### Block Diagram



| Specifications                                   | Test Conditions                                 | Vs = ± 15 V, Ta = 25°C                                                                                                                                                 |            |            |             |
|--------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-------------|
| 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                                                                                                                                                                     |            |            |             |
|                                                  | 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 |
| Signal Filter (without optional Bandpass-Module) | 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<br>35 dB @ Low Drift Setting<br>55 dB @ High Dynamic Setting                                                                              |            |            |             |
|                                                  | Demodulator Gain                                | 1 ... 3333 (depends on Gain-Setting)                                                                                                                                   |            |            |             |
| Reference Input                                  | Reference Input Voltage Range                   | ± 100 mV ... ± 5 V @ bip. Mode (0 V Comparator Threshold)<br>- 5 V / +10 V @ TTL Mode (+2 V Comparator Threshold)                                                      |            |            |             |
|                                                  | Reference Input Impedance                       | 1 MΩ                                                                                                                                                                   |            |            |             |
|                                                  | Reference Acquisition Time                      | max. 2 s @ Fast Setting<br>max. 4 s @ Slow Setting                                                                                                                     |            |            |             |
| Phase Shifter                                    | Phase Shifter Type                              | Digital, Working Frequency 50 Hz ... 120 kHz                                                                                                                           |            |            |             |
|                                                  | Phase Shifter Range                             | 0 ... + 360 °                                                                                                                                                          |            |            |             |
|                                                  | Phase Shifter Resolution                        | 1.4 ° @ f < 60 kHz, 2.8 ° @ f > 60 kHz                                                                                                                                 |            |            |             |
|                                                  | Phase Shifter Drift                             | < 100 ppm/K                                                                                                                                                            |            |            |             |
|                                                  | Phase Shifter Accuracy                          | < 0.3 °                                                                                                                                                                |            |            |             |
| Time Constants                                   | Phase Shifter Orthogonality                     | < 0.1 °                                                                                                                                                                |            |            |             |
|                                                  | Time Constant Range                             | 300 µs ... 1 s in 1-3-10 steps                                                                                                                                         |            |            |             |
| Time Constants                                   | Time Const. Filter Characteristic               | 6 dB/Oct. or 12 dB/Oct. Switchable                                                                                                                                     |            |            |             |
|                                                  | Time Const. Filter Gain                         | 1 ... 3333 (depends on Gain-Setting)                                                                                                                                   |            |            |             |

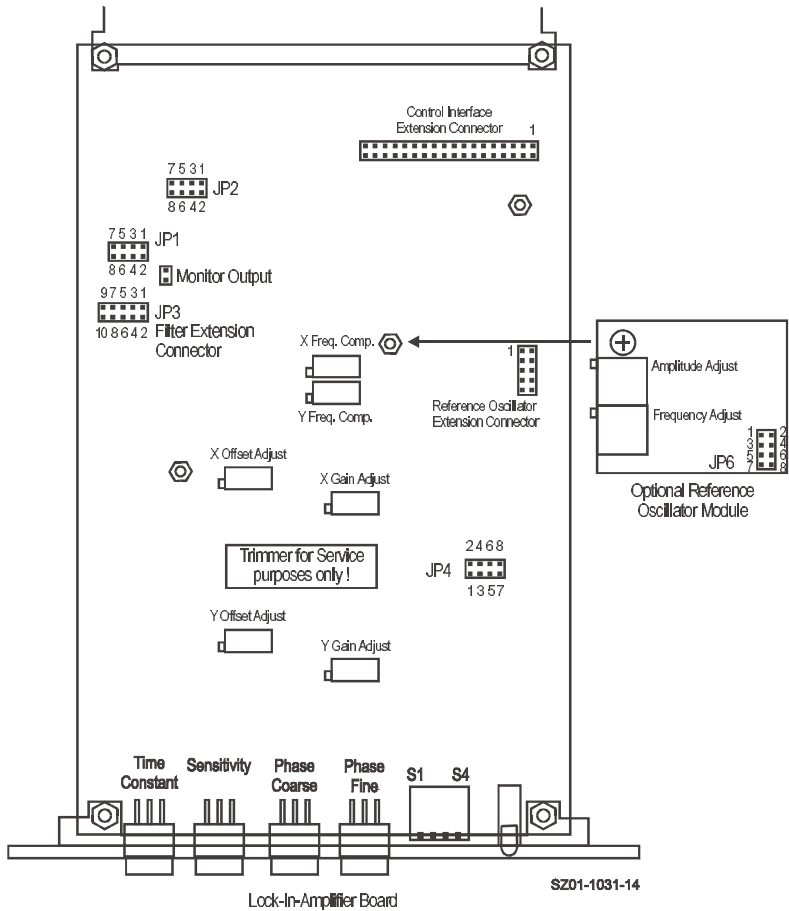
| Specifications (continued) |                                                      |                                                                                                                                                                                                                                        |                                 |                                  |              |
|----------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------|--------------|
| Output                     | Output Channels                                      | X = In Phase, Y = Quadrature, R = Magnitude                                                                                                                                                                                            |                                 |                                  |              |
|                            | Output Voltage Range                                 | ± 10 V (@ 2 kΩ Load)                                                                                                                                                                                                                   |                                 |                                  |              |
|                            | Output Current                                       | ± 5 mA max.                                                                                                                                                                                                                            |                                 |                                  |              |
|                            | Output Impedance                                     | 50 Ω                                                                                                                                                                                                                                   |                                 |                                  |              |
|                            | Output DC-Stability                                  | 5 ppm/K @ Ultra Stable Setting<br>50 ppm/K @ Low Drift Setting<br>500 ppm/K @ High Dynamic Setting                                                                                                                                     |                                 |                                  |              |
|                            | Output Basic Accuracy                                | 2 % (X and Y-Output) @sinusoidal input signal<br>4 % (R-Output) @sinusoidal input signal                                                                                                                                               |                                 |                                  |              |
|                            | Output Voltage Offset Range                          | ± 100 % Full Scale by ± 10 V Control Voltage                                                                                                                                                                                           |                                 |                                  |              |
|                            | Output Voltage Offset Control- Output Load Impedance | >2 kΩ                                                                                                                                                                                                                                  |                                 |                                  |              |
| Status Indicator LED       | Functions                                            | Amplifier Overload Status<br>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 @ + 12V 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, + 120 mA                                                                                                                                                                                                                      |                                 |                                  |              |
| Case                       | Material                                             | Aluminium anodized                                                                                                                                                                                                                     |                                 |                                  |              |
|                            | Dimension                                            | 64,4 x 105,0 x 223,0 mm (without BNC-connectors)                                                                                                                                                                                       |                                 |                                  |              |
|                            | Weight                                               | 1000 gr. (2.2 lbs)                                                                                                                                                                                                                     |                                 |                                  |              |
| Temperature Range          | Storage Temperature                                  | - 40 ... + 100 °C                                                                                                                                                                                                                      |                                 |                                  |              |
|                            | Operating Temperature                                | 0 ... + 60 °C                                                                                                                                                                                                                          |                                 |                                  |              |
| Absolute Maximum Ratings   | Signal Input AC Voltage                              | 50 Vpp                                                                                                                                                                                                                                 |                                 |                                  |              |
|                            | 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. |                                 |                                  |              |
|                            |                                                      |                                                                                                                                                                                                                                        |                                 |                                  |              |

| Switch Settings (continued)                                  |                                                                                                                                                                                                                                                                                                                                                                                                                   |         |            |                   |               |         |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|-------------------|---------------|---------|
| S1 = ON: Sensitivity Setting for Full Scale (= 10 V Output)  | Ultra Stable Mode                                                                                                                                                                                                                                                                                                                                                                                                 |         |            | Low Drift Mode    |               |         |
|                                                              | Setting                                                                                                                                                                                                                                                                                                                                                                                                           | Voltage | Current    | Setting           | Voltage       | Current |
|                                                              | 0                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 V     | 10 µA      | 8                 | 100 mV        | 1 µA    |
|                                                              | 1                                                                                                                                                                                                                                                                                                                                                                                                                 | 300 mV  | 3 µA       | 9                 | 30 mV         | 300 nA  |
|                                                              | 2                                                                                                                                                                                                                                                                                                                                                                                                                 | 100 mV  | 1 µA       | A                 | 10 mV         | 100 nA  |
|                                                              | 3                                                                                                                                                                                                                                                                                                                                                                                                                 | 30 mV   | 300 nA     | B                 | 3 mV          | 30 nA   |
|                                                              | 4                                                                                                                                                                                                                                                                                                                                                                                                                 | 10 mV   | 100 nA     | C                 | 1 µV          | 10 nA   |
|                                                              | 5                                                                                                                                                                                                                                                                                                                                                                                                                 | 3 mV    | 30 nA      | D                 | 300 µV        | 3 nA    |
|                                                              | 6                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 mV    | 10 nA      | E                 | 100 µV        | 1 nA    |
|                                                              | 7                                                                                                                                                                                                                                                                                                                                                                                                                 | 300 µV  | 3 nA       | F                 | 30 µV         | 300 nA  |
| S1 = OFF: Sensitivity Setting for Full Scale (= 10 V Output) | Low Drift Mode                                                                                                                                                                                                                                                                                                                                                                                                    |         |            | High Dynamic Mode |               |         |
|                                                              | Setting                                                                                                                                                                                                                                                                                                                                                                                                           | Voltage | Current    | Setting           | Voltage       | Current |
|                                                              | 0                                                                                                                                                                                                                                                                                                                                                                                                                 | 100 mV  | 1 µA       | 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 µV        | 3 nA    |
|                                                              | 4                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 mV    | 10 nA      | C                 | 100 µV        | 1 nA    |
|                                                              | 5                                                                                                                                                                                                                                                                                                                                                                                                                 | 300 µV  | 3 nA       | D                 | 30 µV         | 300 pA  |
|                                                              | 6                                                                                                                                                                                                                                                                                                                                                                                                                 | 100 µV  | 1 nA       | E                 | 10 µV         | 100 pA  |
|                                                              | 7                                                                                                                                                                                                                                                                                                                                                                                                                 | 30 µV   | 300 pA     | F                 | 3 µV          | 30 pA   |
| Time Constant Setting                                        | 6 dB/Oct.                                                                                                                                                                                                                                                                                                                                                                                                         |         | 12 dB/Oct. |                   | Time Constant |         |
|                                                              | 0                                                                                                                                                                                                                                                                                                                                                                                                                 |         | 8          |                   | 300 µs        |         |
|                                                              | 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           |         |
| 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 °.<br>One step with switch marked “Coarse” changes phase shift by 22.5 °. The “Fine”-switch changes phase shift by 1.4 ° - steps:                                                                                                                              |         |            |                   |               |         |
|                                                              | <div><div><p>Coarse</p></div><div><p>Fine</p></div></div> <p>If Frequency Range f &gt; 70 kHz or 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> |         |            |                   |               |         |



|                          |                           |                                                                                                                           |               |                       |               |
|--------------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|---------------|
| Internal Jumper Settings | Input Signal Filter       | Set Cut-Off Frequency of Input Lowpass Filter 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                                                                                                                     | 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                                                                                                                     | 100 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, 7, 8                                                                                                          |               | f > 60 kHz            |               |
|                          |                           | 7, 8                                                                                                                      |               | test pins, do not use |               |
|                          |                           | (if 2-f mode is used, position is always 1-2)                                                                             |               |                       |               |

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



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

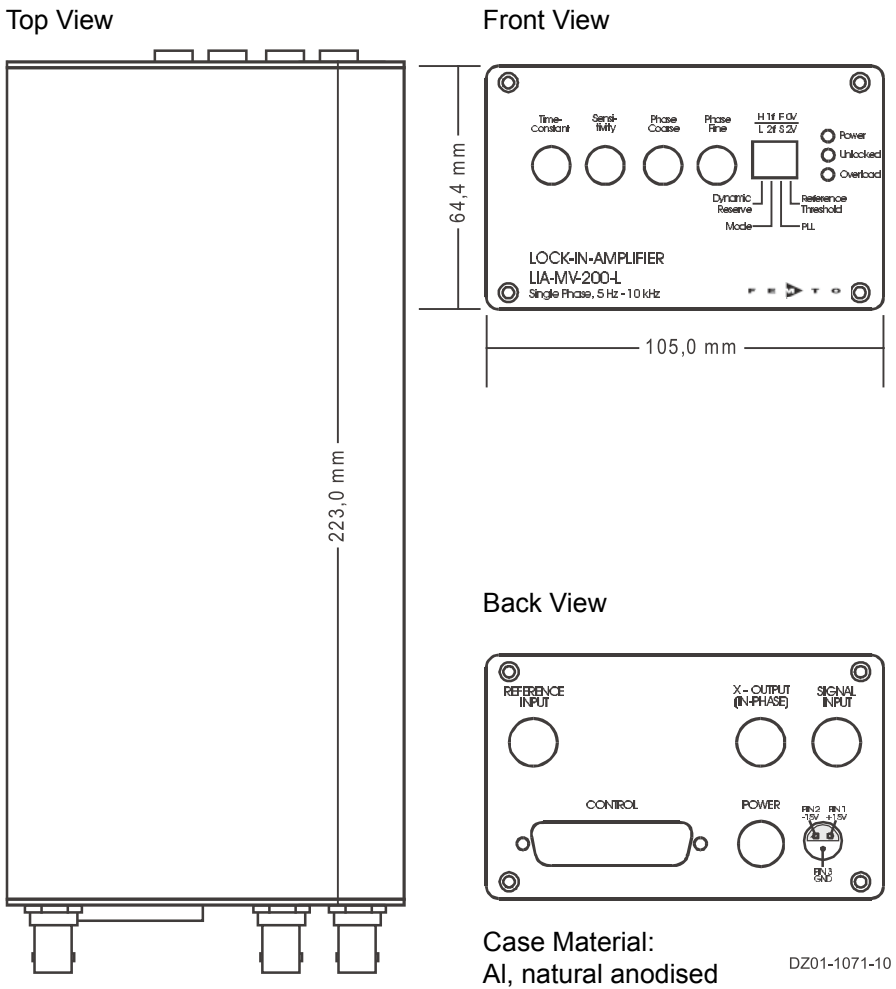
|                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connector Type                                                                                                    | Euro-Card DIN 41612 Connector, 64 pin male, (a+c)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Input                                                                                                             | Pin C2: Voltage Input, Non Inverting, DC-Coupled<br>Pin C3: Voltage Input, Non Inverting, AC-Coupled<br>Pin C4: Voltage Input, Inverting, AC-Coupled<br>Pin C5: Voltage Input, Inverting, DC-Coupled<br>Pin C7: Current Input<br>Pin C6: Current Amplifier Voltage Output<br>Pin A2- A6: Input GND                                                                                                                                                                                                                                                                                                                        |
| Monitor Output                                                                                                    | Pin C9: Monitor Output<br>Pin A9: Monitor GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Output                                                                                                            | Pin A12: R-Signal Output<br>Pin C14: X-Signal Output<br>Pin A14: Y-Signal Output<br>Pin C15: Output GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Offset Input                                                                                                      | Pin A10: X-Offset Input<br>Pin A11: Y-Offset Input<br>Pin A13: Offset GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Status Output                                                                                                     | Pin C10: Unlocked Status Output<br>Pin C11: Overload Status Output<br>Pin C17: Status Output GND (=Power Supply GND)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Power Supply                                                                                                      | Pin A16+C16: Power Supply – 15V<br>Pin A18+C18: Power Supply + 15V<br>Pin A17+C17: Power Supply GND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Remote Control Inputs (Opto-Isolated)                                                                             | Pin C19: Time Constant (TC0)<br>Pin A19: Time Constant (TC1)<br>Pin C20: Time Constant (TC2)<br>Pin A20: Time Constant Slope (TCSL)<br>Pin A22: Sensitivity (SEN0)<br>Pin C21: Sensitivity (SEN1)<br>Pin A21: Sensitivity (SEN2)<br>Pin C22: Dynamic Mode (DYN0)<br>Pin A28: Phase Shift (PH0)<br>Pin C28: Phase Shift (PH1)<br>Pin A27: Phase Shift (PH2)<br>Pin C27: Phase Shift (PH3)<br>Pin A26: Phase Shift (PH4)<br>Pin C26: Phase Shift (PH5)<br>Pin A25: Phase Shift (PH6)<br>Pin C25: Phase Shift (PH7)<br>Pin C24: Disable Local Switch Control<br>Pin A23+A24: Remote Control GND (Common Optocoupler Cathode) |
| Reference Input                                                                                                   | Pin A32: Reference Input<br>Pin A31: Reference Input Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Reference Output<br>(Connected only if optional Oscillator Module is installed)                                   | Pin A30: Reference Output<br>Pin A17: Refer. Output GND (=Power Supply GND)<br>Pin A29: Reference Synchronization Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Standard Control Interface<br>(Connected only if optional Control Interface Module (future product) is installed) | Pin C29: Interface 0<br>Pin C30: Interface 1<br>Pin C31: Interface 2<br>Pin C32: Interface 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| External Connectors (at backside, Standard Configuration) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Input                                              | Factory set to BNC, isolated (single ended)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| X-Output                                                  | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Reference Input                                           | BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Power Supply                                              | <div>LEMO Series 1S, 3-pin fixed Socket</div> <div>Pin 1: + 15V</div> <div>Pin 2: - 15V</div> <div>Pin 3: GND</div> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Control Port                                              | <div>Sub-D 25-pin, female, Qual. Class 2</div> <div>Pin 1: +12V (Stabilized Power Supply Output)</div> <div>Pin 2: -12V (Stabilized Power Supply Output)</div> <div>Pin 3: AGND (Analog Ground)</div> <div>Pin 4: +5V (Stabilized Power Supply Output)</div> <div>Pin 5: X-Output</div> <div>Pin 6: Overload Status Output</div> <div>Pin 7: Unlocked Status Output</div> <div>Pin 8: Disable Local Switch Control Input</div> <div>Pin 9: DGND (Ground f. Digital Control Pin 8 - 25)</div> <div>Pin 10: Dynamic Mode (DYN0)</div> <div>Pin 11: Sensitivity (SEN0)</div> <div>Pin 12: Sensitivity (SEN1)</div> <div>Pin 13: Sensitivity (SEN2)</div> <div>Pin 14: Time Constant Slope (TCSL)</div> <div>Pin 15: Time Constant (TC0)</div> <div>Pin 16: Time Constant (TC1)</div> <div>Pin 17: Time Constant (TC2)</div> <div>Pin 18: Phase Shift (PH0)</div> <div>Pin 19: Phase Shift (PH1)</div> <div>Pin 20: Phase Shift (PH2)</div> <div>Pin 21: Phase Shift (PH3)</div> <div>Pin 22: Phase Shift (PH4)</div> <div>Pin 23: Phase Shift (PH5)</div> <div>Pin 24: Phase Shift (PH6)</div> <div>Pin 25: Phase Shift (PH7)</div> |
| Connector Wiring Options                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| General                                                   | <div>The BNC-connector configuration can be easily changed by setting electrical jumpers at the internal I/O-adapter card.</div> <div>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.</div> <div>The jumper options and functions are described in the following table.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| 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"<br>" GND → IN A/SHLD"<br>" -V-IN → IN A/SHLD" |
|                                                                                                 | IN A = Voltage Input (Differential, AC)                                     | " +V-IN → IN A"<br>" -V-IN → IN A/SHLD"                       |
|                                                                                                 | IN A / IN B = Voltage Input (2 BNC Differential, AC) (OUT A cannot be used) | " +V-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → IN B"      |
|                                                                                                 | IN A = Current Input (Single Ended)                                         | " C-IN → IN A"<br>" GND → IN A/SHLD"<br>" -V-IN → C-OUT"      |
| Output Connectors (JP2)                                                                         | Output wiring                                                               | Jumper installed                                              |
|                                                                                                 | OUT A = X-Output                                                            | " X → OUT A"<br>(JP1) "USE OUT A/NO IN B"                     |
|                                                                                                 | OUT B = X-Output                                                            | " X → OUT B"                                                  |
|                                                                                                 | OUT A = Y-Output                                                            | " Y → OUT A"<br>(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"<br>(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)<br>(Reference Output only if optional Oscillator Module is installed) | 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.)<br>" REF-IN → REF" (2 Jumper)     |
|                                                                                                 | REF = Refer. Sync. Input (use OUT C as Reference Output)                    | " REF-SYNC → REF" (2 Jp.)                                     |

| 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 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      |
|                                             | 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. |           |                                  |       |           |

Dimensions



| Optional Extensions         |                                                                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Oscillator Module | Model No.: SOM-1<br>- Frequency Range 5 Hz ... 130 kHz, User adjustable<br>- Output Voltage 0 ... 2 Vrms, User adjustable<br>- 100 ppm/K Amplitude Accuracy |
| Factory Set                 | 1 kHz, 1 Vrms                                                                                                                                               |