SGA2

Strain Gauge Amplifier

Elsys

User Manual

SGA2 Boxed
SGA2 Rack

Contact Information

Elsys AG
Mellingerstrasse 12
CH-5443 Niederrohrdorf
Switzerland

+41 (0) 56 496 01 55
info@elsys-instruments.com
www.elsys-instruments.com

Thank you!

Thank you for purchasing Elsys Strain Gauge Measurement Equipment.
For more information, please visit
www.elsys-instruments.com

Notice
The information in this document is subject to change without notice.

ELSYS AG SHALL NOT BE LIABLE FOR TECHNICAL OR EDITORIAL ERRORS OR OMISSIONS CONTAINED HEREIN; NOR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE FURNISHING, PERFORMANCE, OR USE OF THIS MATERIAL

Safety Information
This instrument is intended for indoor use and should be operated in a clean, dry environment. Do not block any ventilation openings.

Make sure this product's operating environment is kept within the parameters as specified in the chapter Operating Condition!

The design of the instrument has been verified to conform to the EN 61010-1 safety standard per the following limits:

- Installation (Over voltage)
- Category II (Main Supply Connector) and Category I (Measuring Terminals)
- Pollution Degree 2
- Protection Class I

Warning (Rack Unit only)

Lethal voltages exist inside the instrument. Only qualified technicians of supplier staff are authorized to open the case of the Base Unit. Otherwise warranty will be lost!

Always ensure that power cord is removed before opening the case.

Content

1. Introduction

1.1 Overview

The Strain Gauge Amplifier SGA-2 MK2 is designed as a differential front-end amplifier to connect full, half or ¼ bridge strain gauges with internal bridge completion.

The amplifier is available as a 2-channel boxed version or as a multi-channel rack system.

Typical Applications:

- Deformation testing for material characterization
- High speed dynamic material deformation
- Load Cell measurements

1.2 Key Capabilities

- Internal ½- and ¼ bridge completion
- Two independent channels per module
- Gain x1, x10, x100
- 4-wire and 6-wire technique
- 1.5 MHz bandwidth at gain x1, x10
- Low offset voltage drift
- Low output noise
- Auto-Offset compensation
- USB or RS485 interface for configuring all settings and read back of the actual output signal.
- Different input connector variant available (6-Pin, 7-Pin and 16-Pin)

2-Channel Boxed Variant

- 2-Channel modules SGA-Box/6, SGA-Box/7 or SGA-Box/16
- USB interface (emulated COM port)

- External power supply

Multi-Channel Rack Version

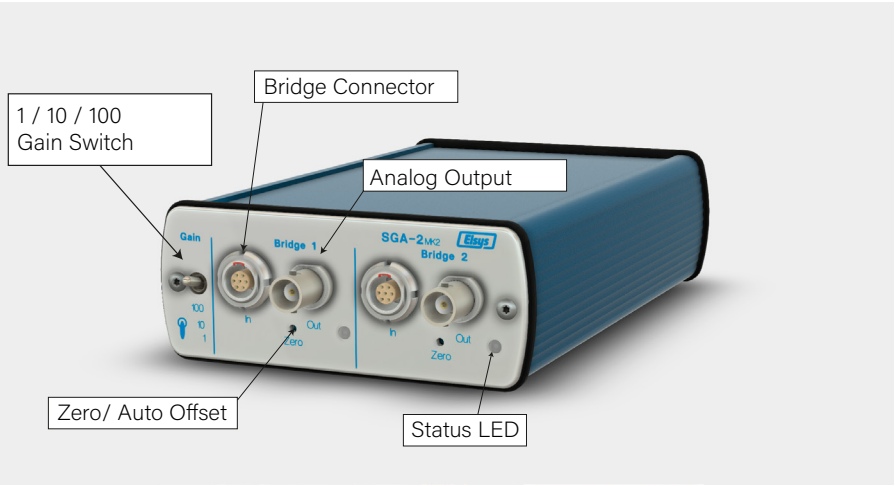
- 2-Channel Rack-Modules SGA-Box/6, SGA-P/7 or SGA-P/16
- Amp-BU-10

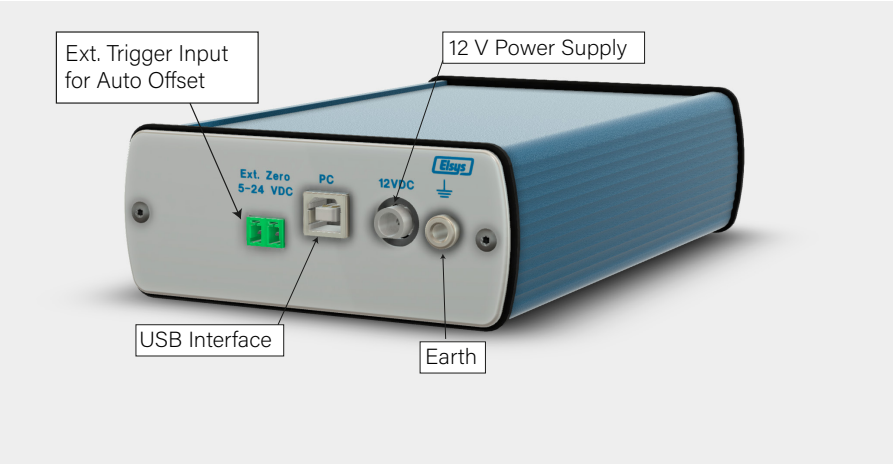
(for up to 5 modules / 10 channels)

- Amp-BU-24
  (for up to 12 modules / 24 channels)
- USB interface (emulated COM port) for accessing all installed amplifier (Internally over RS485)

1.3 Operating Elements

The following illustrations show the operating elements of the SGA in the boxed version.





2. Connections

2.1 Connector and Cable

The SGA cable assembly with LEMO circular push pull connectors, straight plug male with cable collet. CLAD72 defines the maximum outer cable diameter, e.g. 7.2mm.

Connector Type	Lemo part Number
6 pin	Lemo FGG.1B.306.CLAD72
7 pin	Lemo FGG.1B.307.CLAD72
16 pin	Lemo FGG.2B.316.CLAD72

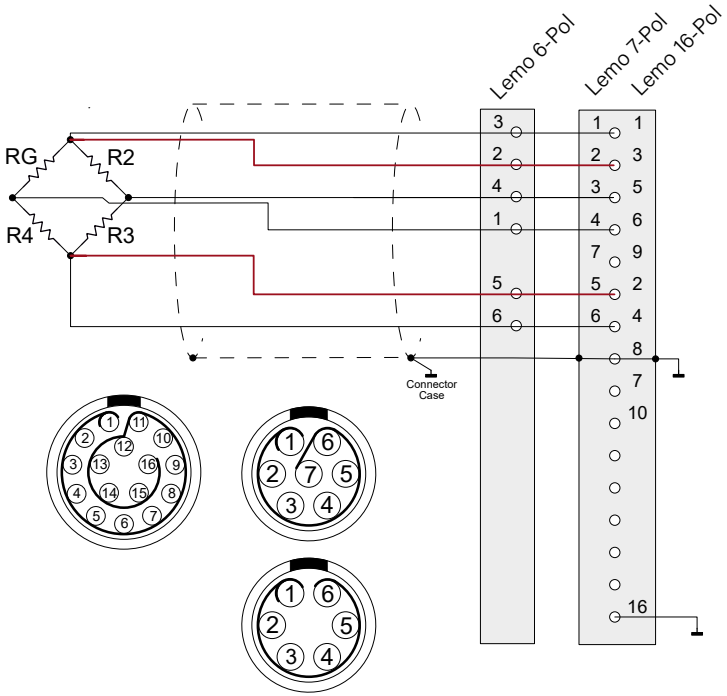
Recommended cable for 7 pin connectors: Data cable, shielded 4x2x0.25 mm², bare copper, stranded wire.

E.g.: VOLLTRON-TWIST-CY 4X2X0,25mm², VOLLAND

2.2 Pin Assignment

1) Applies to cables manufactured by Elsys only.

6-Pin	7-Pin	16-Pin	Color[1)]	Signal
3 6	1 6	1 4	White Brown	+Vex -Vex
2 5	2 5	3 2	Green Yellow	+Sense -Sense
4 1	3 4	5 6	Grey Pink	+Vin -Vin
-	7	9	Blue	¼ Bridge



Solder cup view of male connector

3. Operating Modes

3.1 Basics

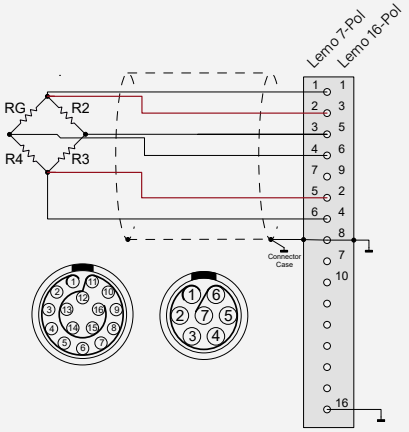
The amplifier can be used for quarter, half or full bridge strain gauges. Depending on the sensor type, the bridge must be completed inside or outside the amplifier to create a full bridge.

For long cables, we recommend using 6-wire wiring to compensate for the voltage drop across the cables. With 6-wire, the voltage is regulated directly at the sensor and not in the amplifier itself.

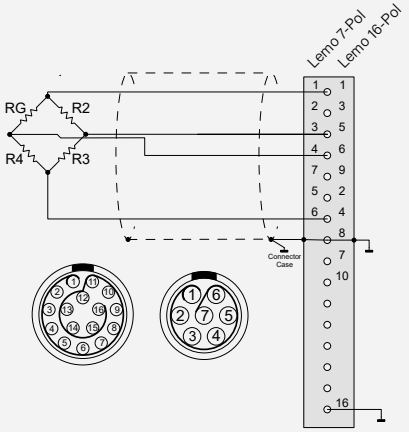
Sensor	Int. Half Bridge	Int. Quarter Bridge R4
Full Bridge	Disabled	not assembled
Half Bridge	Enabled	not assembled
Quarter Bridge	Enabled	assembled

3.2 Full Bridge

The complete bridge is formed outside the amplifier.



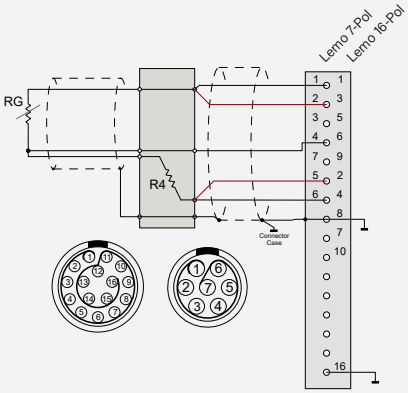
6-Wire Full Bridge



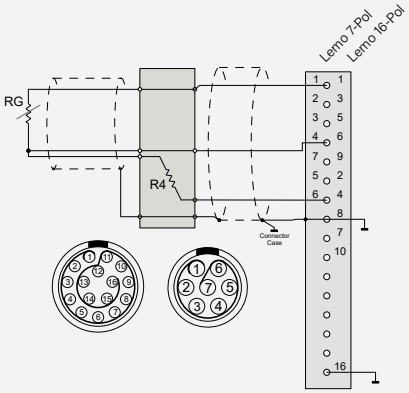
4-Wire Full Bridge

3.3 Half Bridge

Half of the bridge is formed internally in the amplifier. The external bridge is formed by one or two active sensor elements.



6-Wire Half Bridge



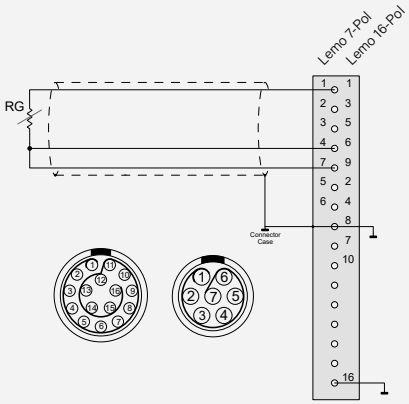
4-Wire Half Bridge

3.4 Quarter Bridge

The Quarter Bridge consists externally only of the active sensor element. To complete the bridge, **the resistor R4 must be fitted internally to match the sensor element.**

Temperature Compensation

Strain Gauge sensors are very sensible on temperature changes. For compensating the change in resistance due the temperature change, a second strain gauge sensor can be used as completion resistor R4. This “dummy” sensor must be mounted as close as possible to the active sensor Rg but must not follow the deformation of the device under test. Even if two sensors are used, it is still a quarter bridge as only one sensor is active.



Quarter Bridge

4. Configuration

Each SGA module can be configured by its on-board dip-switches or with the free available SGA 2.0 configuration software. The software is available on the website under www.elsys-instruments.com

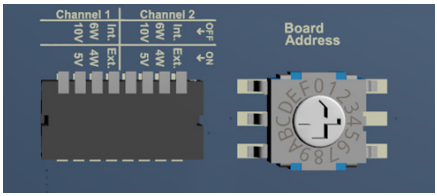
4.1 Hardware Settings

Hardware configuration is straight forward and (except for gain) individually configurable for both channels.

Independent gain selection per channel is only available with the SGA2 configuration software.

Board Address (Rack Only)

The board address (rotary switch) has to be selected ones for a board. In the boxed version, this address is per default set to 0. In a rack version with multiple boards, each device needs a unique address.

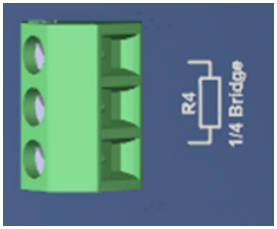


Bridge Configuration

For each channel, there are four DIP switches available. According to the position of these switches, the excitation voltage will be set to 10 V or 5 V, 6-wire or 4-wire, enable internal or external Half Bridge. The fourth DIP switch is not used at the moment.

4.2 Quarter Bridge Resistor R4

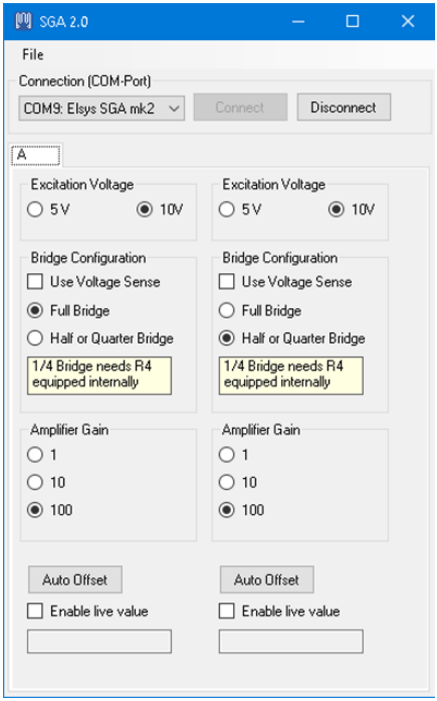
There are two screw terminals, one for each channel, for assembling the internal Quarter Bridge R4 Resistor. This will be necessary in case of using a Quarter Bridge sensor. The resistance of R4 has to match the one of the used sensor, eg. 120 Ω.



4.3 Software Settings

All hardware settings that are set via the DIP switches can also be configured via the software. As soon as a setting has been made via the software, the DIP switch settings are ignored.

To return to the hardware settings, the corresponding reset command must be sent via software or the reset button on the front panel must be pressed for at least 3 seconds.



When the software is started, all COM ports are scanned for a connected amplifier. If an amplifier is found, the connection is established automatically.

Bridge Configuration

- For 6-wire measurements, enable "Use Voltage Sense"
- Configure the amplifier as Full-Bridge or as Half/Quarter bridge.
- If Quarter bridge is used, the internal resistor R4 must be mounted.

Auto-Offset / Zero

Before the measuring bridge can be used, it must be balanced, otherwise an offset voltage is measured which can overdrive the amplifier. To a certain extent, the amplifier can compensate for the offset. To do this, press the "Zero" button on the front panel or click on "Auto Offset" in the software. The LEDs on the front indicate whether the offset compensation was successful.

Front LEDs

There is a two-colour LED (red and green) for each channel.

Color	Description
Off	Output signal outside ± 100mV
Green	Output signal within ± 100mV
Red	Error during Zero compensation
Orange	Error during Zero compensation, currently gain settings within ± 100mV

Live Values

The Check box "Enable live value" returns the measured voltage of the selected channel according to its configuration. Please note that the live value or the software command GETADC returned value has a precision of approx. 2% and is meant to see a trend or position of a sensor or measurement. For high speed and high resolution, the signal must be measured on the analog output with a dedicated Transient Recorder.

5. Calculations

5.1 Quarter Bridge

Calculating the strain from the measured output voltage:

$$V_o = -V_{ex}\frac{G_f\,\varepsilon}{4}\left(\frac{1}{1+G_f*\frac{\varepsilon}{2}}\right)*G_{amp}$$

$$strain\ (\varepsilon) = \frac{-4\,\frac{V_o}{V_{ex}}}{G_f * G_{amp} * \left(1+2\,\frac{V_o}{V_{ex} * G_{amp}}\right)}$$

where

- G_{amp} Amplifier Gain
- V_o Output Voltage
- V_{ex} Excitation Voltage
- G_f Gauge Factor

5.2 Half Bridge

5.3 Full Bridge (Load Cell)

$$V_o = -V_{ex}\frac{G_f\,\varepsilon}{2} * G_{amp}$$

$$strain\ (\varepsilon) = \frac{-2\,\frac{V_o}{V_{ex}}}{G_f * G_{amp}}$$

where:

$$V_{out}[mV] = G * V_{ex} * S * \frac{L}{LR}$$

$$L = V_{out}\,\frac{LR}{G * V_{ex} * S}$$

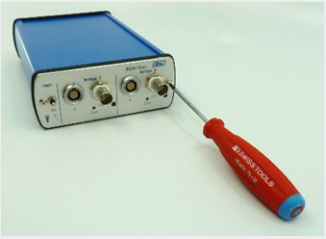
- G Amplifier Gain
- V_o Output Voltage in mV
- S Sensitivity in mV/V
- LR rated load in Kg

6. Open the SGA Box Enclosure

In case of changing the Dip-Switch settings, the SGA boxed version has to be opened. Please note that all settings can be done with the Elsys SGA 2.0 Tool.

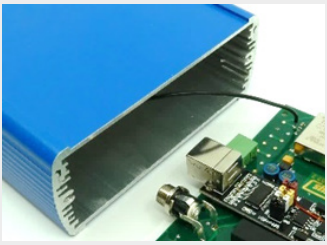
Necessary tools:
T8 Torx or star screwdriver

Remove the connector for external calibration on the rear side.



Loose and remove the two Torx screws using a T8 Torx or star screwdriver.

Pull gently on the BNC connectors to get the Board out of its housing.



Be careful; don't pull off the earthing cable connect-ed to the rear side.

7. Base Unit Specifications

7.1 Mechanical Specification

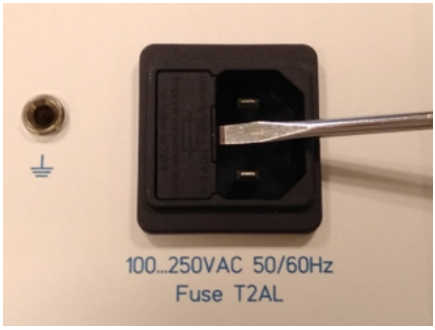
Product Type	Mechanical Dimensions	Max. Nr. of Modules
Amp-BU24	19"-Rack Case approx. 480x290x140 mm	up to 24 channels, 12 modules
Amp-BU10	Desktop Case approx. 250x290x140 mm	up to 10 channels, 5 modules

7.2 Power

Main Power Voltage
100 to 250 VAC, 50/60 Hz

Power consumption
max. 75 W

Inlet Protection Fuse
Type 5x20 mm, only T2AL fuses must be used.
There are two fuses installed.



8. SGA2-Box MK2

8.1 Mechanical Specification

Case
Aluminum case
Approx. 110x45x185 mm (WxHxD)

8.2 Power

12 VDC, max. 700mA
by a Mains Adapter
100 to 240 VAC, 50/60Hz

9. Amplifier Specifications

Configurable Modes
6-wire, 4-wire, Full Bridge,
½ Bridge, ¼ Bridge

Gain
x1, x10, x100

Indication of adjusted Bridge
Front-LED

Input stage
Differential Amplifier

Bandwidth
1.5 MHz (G=1, 10)
600 kHz (G=100)

Input Impedance
2 x 1 MΩ II approx. 25 pF to GND

Input Bias Current
< ±60 nA

Offset Voltage (Referred to Output)
< ±2.5mV, Note *1)

Offset Voltage Drift (Referred to Output)
< ± (30 + 1 * Gain) µV/°C, Note *1)

Gain Error
< ±0.1 % (G= 1, 10), < ±0.5 % (G=100)

Slew Rate (10 - 90 %)
< 300ns (Gain=1, 10)
< 700ns (Gain=100)

*Note: *1) after 1h Warm-Up Time at Tamb = 25°C and auto zero*

Output Noise		Int. ½ Bridge Off		Int. ½ Bridge On	
		Bandwidth		Bandwidth	
	Gain	100 kHz	Full	100 kHz	Full
	x 1	0.03 mV_{rms} 0.3 mV_{pp}	0.3 mV_{rms} 2.0 mV_{pp}	0.05 mV_{rms} 0.8 mV_{pp}	0.4 mV_{rms} 6 mV_{pp}
	x 10	0.08 mV_{rms} 0.6 mV_{pp}	0.5 mV_{rms} 5 mV_{pp}	0.3 mV_{rms} 2.5 mV_{pp}	2.5 mV_{rms} 40 mV_{pp}
	x 100	0.6 mV_{rms} 4 mV_{pp}	1.5 mV_{rms} 15 mV_{pp}	3 mV_{rms} 20 mV_{pp}	20 mV_{rms} 150 mV_{pp}

Noise performance is measured without USB connection. Detach or disconnect USB during the measurement!

Output Impedance
50 Ω +/-1%

Output Voltage Swing
max. ±5 V (no Load)
max. ±2 V (Load = 50 Ω)

Input Voltage (Protected Input Range)
max. ±42 V (Signal Inputs)
max. ±5 V (Excitation Voltage Pins)

Excitation Voltage
10 V (±5V) or 5 V (±2.5V), ±0.1%

Excitation Voltage Load
max. 90 mA

Internal ½ Bridge Asymmetry
max. ±0.1% (= 10 mV @ 10V)

Power Supply
12 Vdc ±10%, max. 5 W per 2 Ch

Operating Temperature
0 to 45 °C

Storage Temperature
-20 to 60 °C

Relative Humidity
< 80 % (up to 31 °C)
decreasing to < 50% at 31 to 45°C

Operating Elevation
max. 2'000 m

Connector Type Output
BNC

Connector Type Input
Lemo 16-Pol. Model FGG.2B.316.xx
Lemo 7-Pol. Model FGG.1B.307.xx
Lemo 6-Pol. Model FGG.1B.307.xx

File Revision:

Date	Description
09.11.2023	Manual Update

EU Declaration of Conformity

Declaration Number: 231113

The Manufacturer:
Elsys AG
Mellingerstrasse 12
5443 Niederrohrdorf
Switzerland

Declare that the product: **SGA2 Box | SGA2 Rack**

2 to 24 channel strain gauge amplifier device

is conformal to the following directives and standards:

Product Standards:
IEC 61326-1:2020 (ed.3.0)
CISPR 11:2015 class B
CISPR 11:2015/AMD1:2016 class B
CISPR 11:2015/AMD2:2019 class B
CISPR 32:2015 class B
CISPR 32:2015/AMD1:2019 class B

Basic Standards:
EN 61000-3-2:2019
IEC 61000-3-2:2018/AMD1:2020
EN 61000-3-3:2013+AMD:2019
IEC 61000-3-3:2013
IEC 61000-3-3:2013/AMD1:2017
IEC 61000-3-3:2013/AMD2:2021
EN 61000-4-2:2009
IEC 61000-4-2:2008
EN 61000-4-3:2020
IEC 61000-4-3:2020
EN 61000-4-4:2012
IEC 61000-4-4:2012
EN 61000-4-5:2014+A1:2017
IEC 61000-4-5:2014
IEC 61000-4-5:2014/AMD1:2017
EN 61000-4-6:2014IEC 61000-4-6:2013 (ed 4.0)
EN 61000-4-8:2010
IEC 61000-4-8:2009
EN 61000-4-11:2020
IEC 61000-4-11:2020

This declaration of conformity is issued under the exclusive responsibility of the manufacturer.

Niederrohrdorf, 13.11.2023

Elsys AG
Roman Bertschi