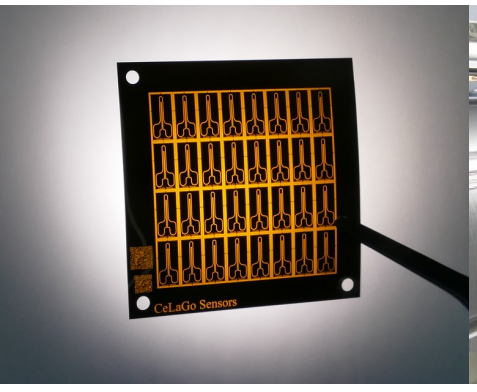
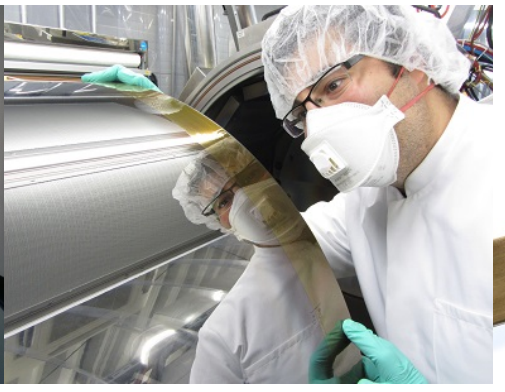
CeLaGo Sensors

CATALOGUE

THIN FILM BASED SENSOR ELEMENTS

Products & Services





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CONTENT

BASICS

Introduction

When the standard is no longer sufficient, it's time for CeLaGo Sensors. Thanks to the innovative Thin-film foil strain gauges (SG) previous limits are exceeded and a new sensor element is provided to the today's SG users that enables them to design their systems:

- more robust
- more sensitive
- Energy saving
- individually
- smart

The core of the innovation are functional thin films, which have outstanding physical properties.

Below is an overview given of the functional thin films and their properties.
Furthermore, the structure and the specific to the layouts are in the focus, as well as the strain sensitivity, especially the transverse sensitivity.

Each thin film series has the special feature that the temperature coefficient of the electrical resistance of the thin film can be adjusted on the thermal expansion coefficient of the transducer material. This provides a high sensitivity to strain paired with almost complete temperature independence.

In addition to the SG, sensor elements are offered for the measuring of temperature using especially temperature-dependent thin films.
Thanks to the thin film technology and a laser structuring there is also the possibility of development and production of SG with integrated temperature sensors, flow sensors, heating elements, etc.
CeLaGo would be glade to work out the benefits for your application, see page 21.

Structure

For sensor elements based on thin films, e.g. in the case of thin film foil strain gauges, the carrier material is a polyimide foil (PI foil) with a thickness of 50 µm. In special cases there are also thinnerPI foils or different substrates possible.
The thin films have a thickness in the order of magnitude of 100 nm and are direct sputtered on the foil. As mechanical protection the measuring grid is laminated with a cover layer.
Optionally, these can also be dispensed with. This is particularly recommended for applications with higher accuracy classes.
The contact pads, consisting of a multi-layer system made of titanium, tungsten, nickel and gold, is directly solderable and must not be mechanical pretreated.
For optimal adhesion, the back of the sensor elements is roughened and the measuring grid centers are marked with arrows on the edges.
Each individual sensor element has a characteristic signature, which ensures a 100% traceability.
In addition to the structure described, on request customized sensor solutions can also be developed and produced. See our range of services from page 21.

BASICS
Functional thin films

Depending on the thin film that is used, foil strain gauges (SG) are implemented, for example, which achieve a gauge factor of up to 30. Depending on the corresponding requirements, specific thin films can be offered or developed to satisfy the needs of the customer application. Besides the gauge factor, the focus lies on stability, temperature-sensitivity and, of course, reproducibility..
In addition, temperature-dependent thin films are available, which are used, for example, to manufacture temperature sensors or trimming resistors.
The possible film characteristics at a glance:

Code	Thin film material	Properties	Possible applications
W	NiCr	- gauge factor=2 - linear signal strain behaviour - adjustable temperature coefficient of electrical resistance - design dependent resistance starting with 120 ohms - nearly no transverse sensitivity	e.g. measurement transducers, weighing, stress analysis
S	modified NiCr	- gauge factor≈10 - linear signal strain behaviour - adjustable temperature coefficient of electrical resistance - design dependent resistance starting with 350 ohms - transverse sensitivity of the thin film up to 50% - compared to code U with improved stability and creep behaviour - creep compensation possible	e.g. measurement transducers
U	modified Ni	- gauge factor=10...30 - linear signal strain behaviour - adjustable temperature coefficient of electrical resistance - design dependent resistance starting with 350 ohms - transverse sensitivity of the thin film up to 50%	e.g. dynamic measurements, short-term use
T	Ni	- temperature coefficient of the electrical resistance >5000 ppm/K - to use as temperature sensor or for compensation - design dependent resistance starting with 10 ohms	e.g. measurement transducers, temperature sensors, flux sensors

Transverse sensitivity

In addition to the transverse sensitivity that results from the contributions of the reverse loop to the total resistance, an additional component must be considered for the modified thin films. This component has the origin in the intrinsic transverse sensitivity of the modified thin film and can be up to 50%. This varies to the choosen the thin film material and adjustment. To pay tribute to this fact, in addition to the known specification of the gauge factor, based on the VDI / VDE guideline 2635, the longitudinal gauge factor k-long. and the transverse gauge factor k-trans are specified . These are defined as the sensitivity of the strain gauge with purely longitudinal strain load or purely transverse strain load. These values are measured with the test devices specified in the VDI / VDE 2635 guideline for the determination of the cross sensitivity.
Through the determination of three parameters it's easier for the user to expect the strain sensitivity of a full bridge depending of the type of transducer.

Type description

P - P - SA - MA - XX - GG.GG - RR.RR _ X

P-P: product group
SA: thin film material/adjustment
MA: measuring grid arrangement
XX: type
GG.GG: grid length
RR.RR: resistance
X: supplement (optional)

Product group (P-P)
Strain gauges are in the product group 1-0 or 1-1 to find. Accessories are through 3-0 characterized.

Thin film materials (S)
The thin films W, S and U are used for strain gauges. T is a temperature sensitive layer. It is used for example for temperature sensors or trimming resistors.

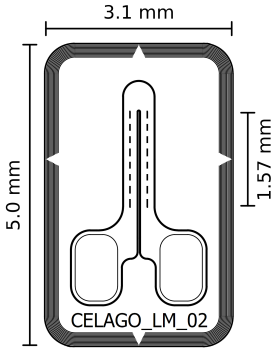
Adjustment (A)
The adjustment of the temperature coefficient of resistance (TCR) to the thermal expansion of the transducer material is divided into classes. Optionally, the batchwise determined TCR and the temperature curve can be specified more precisely. The classification is as follows:

Code	Adjustment to	e.g.
A	0-4 ppm/K	Quartz
B	4-8 ppm/K	Molybdenum
C	8-10 ppm/K	Titanium
D	10-14 ppm/K	Cast iron
E	14-18 ppm/K	Steel austenitic
F	18-24 ppm/K	Aluminum
S	unadjust	For temperature measuring

Measuring grid arrangement (MA)
In addition to a number of standardized layouts costumized one can also be supplied. The division of the measuring grid arrangement is according to the table:

Code	Type
LM	linear pattern
SM	shear pattern
TR	T-rosette
PM	half bridge
VB	full bridge
MR	membrane rosette

Type (XX)
Consecutive two-digit number for pure differentiation of the varying dimensions. As dimensions are indications of the total size of the sensor elements, as shown here in the example of version *02* of type *LM*:



Grid length: 1,57 mm
Total length: 5,0 mm
Total width: 3,1 mm

Grid length (GG.GG)
The size describing the measuring grid is the measuring grid length. The measuring grid width can be specified, if desired. The information is given according to this table:

Code	Grid length
00.80	0,8 mm
01.57	1,57 mm
02.80	2,8 mm
...	...

Resistance (RR.RR)
The nominal resistance is given according to the following table:

Code	Nominal resistance
00.35	350 Ω
01.00	1 kΩ
50.00	50 kΩ
01.XX	1,XX kΩ
...	...

Information such as 01.XX indicates the possibility to obtain specified variants also with desired nominal resistances. These are type and thin film dependent and require a preliminary examination. Ask about it gladly our sales.

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Type description

Supplement (X)
Due to a flexible production line and the philosophy of CeLaGo Sensors in particular to offer customer-specific sensor elements as well as OEM products, there is a broad portfolio of additional options. You can recognize these by the item number endings. You have the following options:

Code	Feature
E	samples
R	right alignment (shear SG)
L	left alignment (shear SG)
RL	double-SG with right+left alignment (shear SG)
S	customer-specific design
D	double-SG
O	uncovered
T	thin substrate
K	chain-SG

Application notes

- The sensor elements can only be gripped at the edges and avoid buckling of them.
- If cleaning is necessary, pure isopropanol is recommended.
- To be used with standard adhesives for strain gauges. If you have any questions, please contact our sales department.
- Make sure that the surface is clean and degreased before gluing.
- Follow the instructions for use of the strain gauge adhesive you are using, taking into account the requirements of the thin-film foil strain gauge.
- For adhesive processes with separating foils, use smooth foils, such as the PTFE foil (smooth), see page 20. This prevents the solder pads from flooding.
- **The solder pads must not be mechanically pretreated.**
- Remove the flux residues after soldering.
- Avoid any improper use of the strain gauges.

Packaging units

The standardized packaging unit size for the strain gauges and the trimming resistors is 10 measuring grids for single- or double-SG. If required, this can be expanded to 20, 50 or 100 measuring grids per packaging unit. With full bridge layouts, 5 full bridges form a packaging unit.
Individual packaging options are also available on request for simplified further processing in existing production lines.
The sizes of the packaging units of the accessories can be found in the article descriptions from on page 20.

BASICS
Technical specifications

	unit	Thin film material				
		W	S			U
Thin film						
material		NiCr	modified NiCr			modified Ni
thickness	nm	100-200	100-200			100-200
Carrier						
material		Polyimide	Polyimide			Polyimide
thickness	µm	50±5	50±5			50±5
moisture absorption	%	approx. 1	approx. 1			approx. 1
Cover						
material		Polyimide, adhesive	Polyimide, adhesive			Polyimide, adhesive
thickness	µm	40±7,5	40±7,5			40±7,5
Pads						
material		Ti, W, Ni, Au	Ti, W, Ni, Au			Ti, W, Ni, Au
thickness	nm	200-400	200-400			200-400
Adjustment		D	D	E	F	A
Temperature response						
adjust to	ppm/K	10-14	10-14	14-18	18-24	0-4
range	°C	-10 - 85	-10 - 85			-10 - 85
tolerance	ppm/K	±0,5	±1			±2
Reference temperature	°C	23	23			23
Application temperature range	°C	-40 - 200	-40 - 125			-10 - 85
Nominal resistance (z.B.: LM02)	Ω	>300	>900	>1400	>2800	>1400
Resistance tolerance	%	±0,5	±1	±1	±1	±2
Gauge factor (z.B.: LM02)		1,9	10	11	8	10-30
Gauge factor-longitudinal		1,9	12	13	9	10-30
Gauge factor-transversal		-0,02	6	7	4	5-20
Gauge factor tolerance	%	±5	±10			±20
(related to gauge factor-long.)						
Maximum elongation	µm/m	5000	5000			5000
Number of load cycles (±1100µm/m)		>>10 Mio.	>>10 Mio.			>>10 Mio.
Radius of curvature,						
inner radius	mm	>6	>6			>6
outer radius	mm	>6	>6			>6
Requirement bonding materials						
max. curing temperature	°C	165	165			165
max. curing pressure	bar	2-4	2-4			2-4
max. after curing temperature	°C	200	200			200
Requirement solder						
max. soldering temperature	°C	300	300			300
max. duration	s	<3	<3			<3

Note: Further adjustments, which you can see on page 6, as well as variants of the thin film material U with higher gauge factors you can get on request. Our technical department will be happy to provide you with information on thin film material T.

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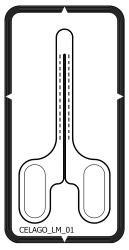


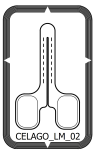
Linear strain gauges: LM01

Grid length: 2,8 mm
Overall length: 8,0 mm
Overall width: 4,0 mm

Info: For first trials or application tests we recommend matching solder samples of type XK1. See p.20.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-LM-01-02.80-	00.70	_O,T,D	2	2	0	10-14 ppm/K	700 ±0,5%
	01.00						1.000 ±0,5%
	01.35						1.350 ±0,5%
	01.XX						1.XXX ±0,5%
1-1-SD-LM-01-02.80-	02.00	_O,T,D	11	13	6	10-14 ppm/K	2.000 ±1%
	02.25						2.250 ±1%
	02.50						2.500 ±1%
	02.XX						2.XXX ±1%
1-1-SE-LM-01-02.80-	03.00	_O,T,D	11	13	6	14-18 ppm/K	3.000 ±1%
	03.25						3.250 ±1%
	03.50						3.500 ±1%
	03.XX						3.XXX ±1%
1-1-SF-LM-01-02.80-	06.00	_O,T,D	9	10	5	18-24 ppm/K	6.000 ±1%
	06.50						6.500 ±1%
	07.00						7.000 ±1%
	07.XX						7.XXX ±1%
1-1-UA-LM-01-02.80-	03.00	_O,T,D	14	16	9	0-4 ppm/K	3.000 ±2%
	03.25						3.250 ±2%
	03.50						3.500 ±2%
	03.XX						3.XXX ±2%

For explanations of the item number, see page 6.



Linear strain gauges: LM02

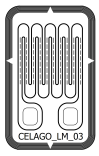
Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 3,1 mm

Info: For first trials or application tests we recommend matching solder samples of type XK2. See p.20.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-LM-02-01.57-	00.35	_O,T,D	1,9	1,9	-0,02	10-14 ppm/K	350 ±0,5%
	00.3X						3XX ±0,5%
	00.40						400 ±0,5%
	00.4X						4XX ±0,5%
1-1-SD-LM-02-01.57-	01.00	_O,T,D	10	12	6	10-14 ppm/K	1.000 ±1%
	01.10						1.100 ±1%
	01.35						1.350 ±1%
	01.XX						1.XXX ±1%

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-1-SE-LM-02-01.57-	01.50	_O,T,D	11	13	7	14-18 ppm/K	1.500 ±1%
	01.75						1.750 ±1%
	02.00						2.000 ±1%
	01.XX						1.XXX ±1%
1-1-SF-LM-02-01.57-	03.00	_O,T,D	8	9	4	18-24 ppm/K	3.000 ±1%
	03.25						3.250 ±1%
	03.50						3.500 ±1%
	03.XX						3.XXX ±1%
1-1-UA-LM-02-01.57-	01.50	_O,T,D	14	16	9	0-4 ppm/K	1.500 ±2%
	01.75						1.750 ±2%
	02.00						2.000 ±2%
	02.XX						2.XXX ±2%

For explanations of the item number, see page 6.



Linear strain gauges: LM03

Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 3,1 mm

Info: Especially for energy-saving applications. Also as double strain gauges available.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-LM-03-01.57-	03.50	_O,T,D	2	2	0	10-14 ppm/K	3.500 ±0,5%
	03.75						3.750 ±0,5%
	04.00						4.000 ±0,5%
	04.XX						4.XXX ±0,5%
1-1-SD-LM-03-01.57-	10.00	_O,T,D	11	13	6	10-14 ppm/K	10.000 ±1%
	11.00						11.000 ±1%
	13.50						13.500 ±1%
	10.XX						10.XXX ±1%
1-1-SE-LM-03-01.57-	15.00	_O,T,D	11	13	6	14-18 ppm/K	15k ±1%
	17.00						17k ±1%
	20.00						20k ±1%
	1X.00						1Xk ±1%
1-1-SF-LM-03-01.57-	30.00	_O,T,D	9	10	5	18-24 ppm/K	30k ±1%
	32.00						32k ±1%
	35.00						35k ±1%
	3X.00						3Xk ±1%
1-1-UA-LM-03-01.57-	15.00	_O,T,D	14	16	9	0-4 ppm/K	15k ±2%
	17.00						17k ±2%
	20.00						20k ±2%
	1X.00						1Xk ±2%

For explanations of the item number, see page 6.

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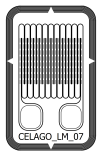

Linear strain gauges: LM07

Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 3,1 mm

Info: Especially for energy-saving applications. Also as double strain gauges available.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-LM-07-01.57-	15.00	_O,T,D	2	2	0	10-14 ppm/K	15.000 ±0,5%
	17.50						17.500 ±0,5%
	20.00						20.000 ±0,5%
	1X.XX						1X.XX0 ±0,5%
1-1-SD-LM-07-01.57-	45.00	_O,T,D	11	13	6	10-14 ppm/K	45k ±1%
	50.00						50k ±1%
	55.00						55k ±1%
	5X.00						5Xk ±1%
1-1-SE-LM-07-01.57-	60.00	_O,T,D	11	13	6	14-18 ppm/K	60k ±1%
	65.00						65k ±1%
	75.00						75k ±1%
	6X.00						6Xk ±1%
1-1-SF-LM-07-01.57-	M0.13	_O,T,D	8	9	4	18-24 ppm/K	130k ±1%
	M0.15						150k ±1%
	M0.17						170k ±1%
	M0.1X						1X0k ±1%
1-1-UA-LM-07-01.57-	60.00	_O,T,D	13	15	9	0-4 ppm/K	60k ±2%
	65.00						65k ±2%
	75.00						75k ±2%
	7X.00						7Xk ±2%

For explanations of the item number, see page 6.

Linear strain gauges: LM06

Grid length: 1,0 mm
Overall length: 3,0 mm
Overall width: 1,0 mm

Info: Also as double or chain strain gauges available.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-LM-06-01.00-	00.10	_O,T,D,	2	2	0	10-14 ppm/K	100 ±0,5%
	00.12	K					120 ±0,5%
	00.15						150 ±0,5%
	00.1X						1X0 ±0,5%
1-1-SD-LM-06-01.00-	00.30	_O,T,D,	11	13	6	10-14 ppm/K	300 ±1%
	00.35	K					350 ±1%
	00.40						400 ±1%
	00.3X						3X0 ±1%

PRODUCTS
Linear strain gauges

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-1-SE-LM-06-01.00-	00.50 00.60 00.65 00.5X	_O,T,D, K	11	13	6	14-18 ppm/K	500 ±1% 600 ±1% 650 ±1% 5X0 ±1%
1-1-SF-LM-06-01.00-	01.00 01.10 01.35 01.XX	_O,T,D, K	9	10	5	18-24 ppm/K	1.000 ±1% 1.100 ±1% 1.350 ±1% 1.XXX ±1%
1-1-UA-LM-06-01.00-	00.50 00.60 00.65 00.5X	_O,T,D, K	14	15	6	0-4 ppm/K	500 ±2% 600 ±2% 650 ±2% 5XX ±2%

For explanations of the item number, see page 6.

Example 1: 1-1-SD-LM-01-02.80-02.00
Linear strain gauges with a measuring grid length of 2.8 mm, a overall length of 8 mm, a total width of 4 mm, with a gauge factor according to VDI guideline 2635 of 11, adapted to a transducer made of a material with a temperature coefficient of thermal expansion between 10 and 14 ppm/K, and with a nominal electrical resistance of 2 kΩ.

Example 2: 1-1-SD-LM-01-02.80-02.00_O
Linear strain gauges in a version as in Example 1, but without covering the measuring grid with a cover.

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Shear strain gauges: SM01_R

Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 2,5 mm
Grid alignment: +45°

Info: Also in combination with SM01_L available as a T-rosette SM01_RL.

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Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-SM-01-01.57-	00.35_R	O,T,D	2	2	0	10-14 ppm/K	350 ±0,5%
	00.3X_R						3XX ±0,5%
	00.40_R						400 ±0,5%
	00.4X_R						4XX ±0,5%
1-1-SD-SM-01-01.57-	01.00_R	O,T,D	9	11	6	10-14 ppm/K	1.000 ±1%
	01.35_R						1.350 ±1%
	01.50_R						1.500 ±1%
	01.XX_R						1.XXX ±1%
1-1-SE-SM-01-01.57-	01.50_R	O,T,D	9	11	6	14-18 ppm/K	1.500 ±1%
	01.65_R						1.650 ±1%
	02.00_R						2.000 ±1%
	01.XX_R						1.XXX ±1%
1-1-SF-SM-01-01.57-	03.00_R	O,T,D	8	9	5	18-24 ppm/K	3.000 ±1%
	03.25_R						3.250 ±1%
	03.50_R						3.500 ±1%
	03.XX_R						3.XXX ±1%
1-1-UA-SM-01-01.57-	01.50_R	O,T,D	13	15	9	0-4 ppm/K	1.500 ±2%
	01.65_R						1.650 ±2%
	02.00_R						2.000 ±2%
	02.XX_R						1.XXX ±2%

For explanations of the item number, see page 6.

Shear strain gauges: SM01_L

Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 2,5 mm
Grid alignment: -45°

Info: Also in combination with SM01_R available as a T-rosette SM01_RL.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-SM-01-01.57-	00.35_L	O,T,D	2	2	0	10-14 ppm/K	350 ±0,5%
	00.3X_L						3XX ±0,5%
	00.40_L						400 ±0,5%
	00.4X_L						4XX ±0,5%
1-1-SD-SM-01-01.57-	01.00_L	O,T,D	9	11	6	10-14 ppm/K	1.000 ±1%
	01.35_L						1.350 ±1%
	01.50_L						1.500 ±1%
	01.XX_L						1.XXX ±1%

PRODUCTS
Shear strain gauges

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-1-SE-SM-01-01.57-	01.50_L	O,T,D	9	11	6	14-18 ppm/K	1.500 ±1%
	01.65_L						1.650 ±1%
	02.00_L						2.000 ±1%
	01.XX_L						1.XXX ±1%
1-1-SF-SM-01-01.57-	03.00_L	O,T,D	8	9	5	18-24 ppm/K	3.000 ±1%
	03.25_L						3.250 ±1%
	03.50_L						3.500 ±1%
	03.XX_L						3.XXX ±1%
1-1-UA-SM-01-01.57-	01.50_L	O,T,D	13	15	9	0-4 ppm/K	1.500 ±2%
	01.65_L						1.650 ±2%
	02.00_L						2.000 ±2%
	02.XX_L						2.XXX ±2%

For explanations of the item number, see page 6.

Example 3: 1-1-SD-SM-01-01.57-01.00_R
Shear strain gauges with a measuring grid alignment of + 45 °, a measuring grid length of 1.57 mm, a overall length of 5 mm, a overall width of 2.5 mm, with a gauge factor according to VDI guideline 2635 of 9, adapted to a transducer, which consists of a material with a temperature coefficient of thermal expansion between 10 and 14 ppm / K, and with a nominal electrical resistance of 1 kΩ.
Example 4: 1-1-SD-SM-01-01.57-01.00_RO
Shear strain gauges in a version as in Example 3, but without covering the measuring grid with a cover.

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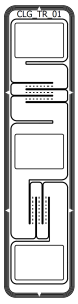


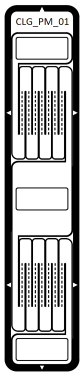
T-rosettes: TR01

Grid length: 0,8 mm
Overall length: 8,4 mm
Overall width: 2,0 mm

Info: Nominal resistance refers here on the single measuring grids.
The adjustment as well as the gauge factors are measured on the lower measuring grid.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-TR-01-00.80-	00.40	_O,T	2	2	0	10-14 ppm/K	400 ±0,5%
	00.45						450 ±0,5%
	00.50						500 ±0,5%
	00.XX						XXX ±0,5%
1-1-SD-TR-01-00.80-	01.20	_O,T	10	12	6	10-14 ppm/K	1.200 ±1%
	01.35						1.350 ±1%
	01.50						1.500 ±1%
	01.XX						1.XXX ±1%
1-1-SE-TR-01-00.80-	01.80	_O,T	11	13	6	14-18 ppm/K	1.800 ±1%
	02.00						2.000 ±1%
	02.25						2.250 ±1%
	02.XX						2.XXX ±1%
1-1-SF-TR-01-00.80-	03.60	_O,T	8	9	4	18-24 ppm/K	3.600 ±1%
	04.00						4.000 ±1%
	04.50						4.500 ±1%
	04.XX						4.XXX ±1%
1-1-UA-TR-01-00.80-	01.80	_O,T	13	15	9	0-4 ppm/K	1.800 ±2%
	02.00						2.000 ±2%
	02.25						2.250 ±2%
	02.XX						2.XXX ±2%

For explanations of the item number, see page 6.



Half-bridge strain gauges: PM01

Grid length: 1,15 mm
Overall length: 10,0 mm
Overall width: 2,0 mm
Distance between grid centers: 4,71 mm

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-PM-01-01.15-	01.00	_O,T	2	2	0	10-14 ppm/K	1.000 ±0,5%
	01.10						1.100 ±0,5%
	01.35						1.350 ±0,5%
	01.XX						1.XX0 ±0,5%
1-1-SD-PM-01-01.15-	03.50	_O,T	10	12	6	10-14 ppm/K	3.500 ±1%
	03.65						3.650 ±1%
	04.00						4.000 ±1%
	04.XX						4.XXX ±1%
1-1-SE-PM-01-01.15-	05.00	_O,T	11	13	6	14-18 ppm/K	5.000 ±1%
	05.50						5.500 ±1%
	06.00						6.000 ±1%
	05.XX						5.XXX ±1%
1-1-SF-PM-01-01.15-	10.00	_O,T	8	9	4	18-24 ppm/K	10.000 ±1%
	11.00						11.000 ±1%
	13.50						13.500 ±1%
	1X.XX						1X.XX0 ±1%
1-1-UA-PM-01-01.15-	05.00	_O,T	13	15	9	0-4 ppm/K	5.000 ±2%
	05.50						5.500 ±2%
	06.00						6.000 ±2%
	05.XX						5.XXX ±2%

For explanations of the item number, see page 6.

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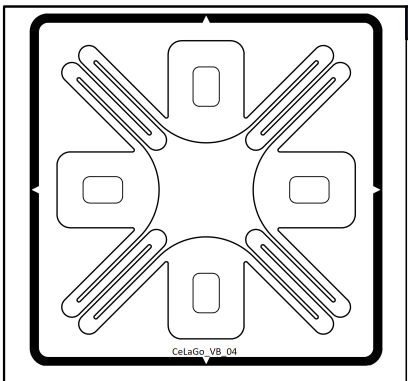


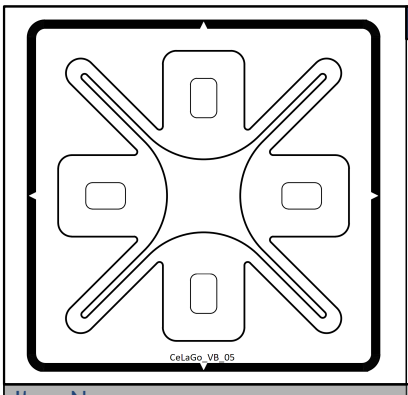
Full-bridge strain gauges: VB04

Grid length: 2,0 mm
Overall length: 8,0 mm
Overall width: 8,0 mm

Info: Nominal resistance refers here on the bridge resistance. The adjustment as well as the gauge factors are determined from the corresponding linear strain gauges LM02.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-VB-04-02.00-	01.00 01.XX	_O,T	1,9	1,9	-0,02	10-14 ppm/K	1.000 ±5% 1.XX0 ±5%
1-1-SD-VB-04-02.00-	02.50 02.XX	_O,T	10	12	6	10-14 ppm/K	2.500 ±5% 2.XX0 ±5%
1-1-SE-VB-04-02.00-	04.00 04.XX	_O,T	11	13	7	14-18 ppm/K	4.000 ±5% 4.XX0 ±5%
1-1-SF-VB-04-02.00-	08.00 08.XX	_O,T	8	9	4	18-24 ppm/K	8.000 ±5% 8.XX0 ±5%
1-1-UA-VB-04-02.00-	04.00 04.XX	_O,T	14	16	9	0-4 ppm/K	4.000 ±10% 4.XX0 ±10%

For explanations of the item number, see page 6.



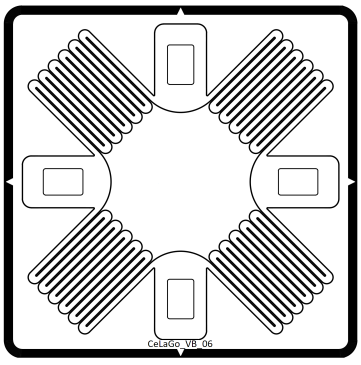
Full-bridge strain gauges: VB05

Grid length: 2,0 mm
Overall length: 8,0 mm
Overall width: 8,0 mm

Info: Nominal resistance refers here on the bridge resistance. The adjustment as well as the gauge factors are determined from the corresponding linear strain gauges LM02.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-VB-05-02.00-	00.35 00.3X	_O,T	1,9	1,9	-0,02	10-14 ppm/K	350 ±5% 3XX ±5%
1-1-SD-VB-05-02.00-	01.00 01.XX	_O,T	10	12	6	10-14 ppm/K	1.000 ±5% 1.XX0 ±5%
1-1-SE-VB-05-02.00-	01.50 01.XX	_O,T	11	13	7	14-18 ppm/K	1.500 ±5% 1.XX0 ±5%
1-1-SF-VB-05-02.00-	03.00 03.XX	_O,T	8	9	4	18-24 ppm/K	3.000 ±5% 3.XX0 ±5%
1-1-UA-VB-05-02.00-	01.50 01.XX	_O,T	14	16	9	0-4 ppm/K	1.500 ±10% 1.XX0 ±10%

For explanations of the item number, see page 6.



Full-bridge strain gauges: VB06

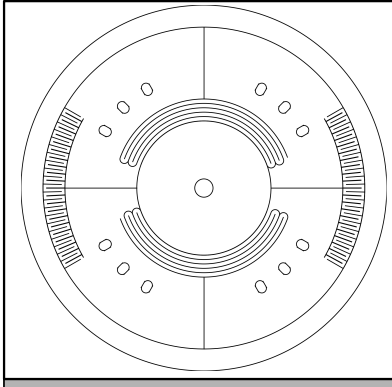
Grid length: 2,0 mm
Overall length: 8,0 mm
Overall width: 8,0 mm

Info: Nominal resistance refers here on the bridge resistance. The adjustment as well as the gauge factors are determined from the corresponding linear strain gauges LM02.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-VB-06-02.00-	04.00 04.XX	_O,T	1,9	1,9	-0,02	10-14 ppm/K	4.000 ±5% 4.XX0 ±5%
1-1-SD-VB-06-02.00-	10.00 1X.XX	_O,T	10	12	6	10-14 ppm/K	10.000 ±5% 1X.XX0 ±5%
1-1-SE-VB-06-02.00-	15.00 1X.XX	_O,T	11	13	7	14-18 ppm/K	15.000 ±5% 1X.XX0 ±5%
1-1-SF-VB-06-02.00-	30.00 3X.XX	_O,T	8	9	4	18-24 ppm/K	30.000 ±5% 3X.XX0 ±5%
1-1-UA-VB-06-02.00-	15.00 1X.XX	_O,T	14	16	9	0-4 ppm/K	15.000 ±10% 1X.XX0 ±10%

For explanations of the item number, see page 6.

Membrane-rosettes



Membrane-rosettes: MR01

Outer diameter: 20,0 mm
Diameter trough the centers of the
inner grid: 8,3 mm
outer grid: 16,0 mm
Radial grid width: 2,0 mm

Info: Incl. matching possibility to the Zero point. Nominal resistance refers here on the bridge resistance. The adjustment as well as the gauge factors are determined from the corresponding linear strain gauges LM02.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-0-WD-MR-01-16.00-	04.00 04.XX	_O,T	1,9	1,9	-0,02	10-14 ppm/K	4.000 ±5% 4.XXX ±5%
1-1-SD-MR-01-16.00-	10.00 1X.XX	_O,T	10	12	6	10-14 ppm/K	10.000 ±5% 1X.XX0 ±5%
1-1-SE-MR-01-16.00-	15.00 1X.XX	_O,T	11	13	7	14-18 ppm/K	15.000 ±5% 1X.XX0 ±5%
1-1-SF-MR-01-16.00-	30.00 2X.XX	_O,T	8	9	4	18-24 ppm/K	30.000 ±5% 2X.XX0 ±5%
1-1-UA-MR-01-16.00-	15.00 1X.XX	_O,T	14	16	9	0-4 ppm/K	15.000 ±10% 1X.XX0 ±10%

For explanations of the item number, see page 6.

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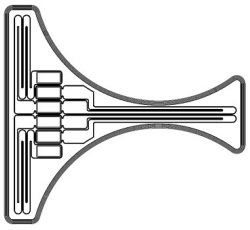
Custom-made strain gauges



Example

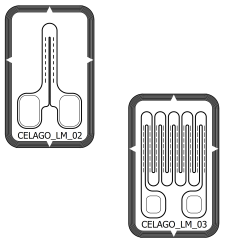
Costum-made strain gauges

Overall length: max. 400,0 mm
Overall width: max. 42,0 mm

Info: Shape freedom in measuring grids position and outer contour. Thin film material as well as adjustment free selectable. Optional with integrated temperature sensor.

Item No.		optional	gauge factor	k-long.	k-trans.	adjustment	nom. resistance in Ω
1-X-XX-XX-XX-XX.XX-	XX.XX	_S	1.9-25	1.9-30	0-15	A-F	XXX ±2%

Temperature sensors (trimming resistors)

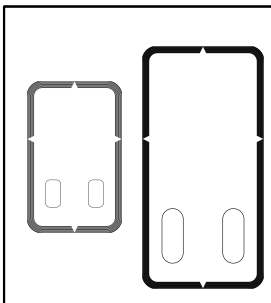


Temperature sensors (trimming resistors)

Grid length: 1,57 mm
Overall length: 5,0 mm
Overall width: 3,1 mm

Info: Further nominal resistances to request. For first trials or application tests we recommend matching solder samples of type XK2. See p.20.

Item No.		optional	gauge factor	k-long.	k-trans.	TCR	nom. resistance in Ω
8-0-TS-LM-02-01.57-	35.00	_O,T,D	2	2	0	5240 ppm/K	35 ±2%
	3X.00						3X ±2%
	40.00						40 ±2%
	4X.00						4X ±2%
8-0-TS-LM-03-01.57-	60.00	_O,T,D	2	2	0	5600 ppm/K	60 ±2%
	70.00						70 ±2%
	80.00						80 ±2%
	90.00						90 ±2%



Test samples

Samples for adhesive or soldering test

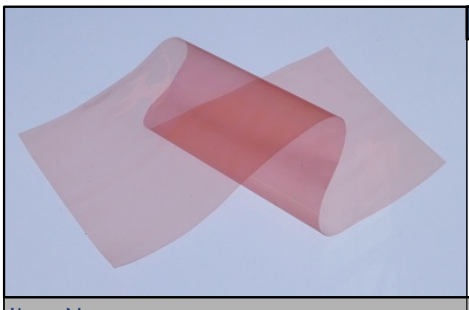
Info: Not to use as a sensor element. Only for adhesive or soldering test.

Item No.	optional	overall length	overall width	nom. resistance in Ω
3-0-05-XK-01	_O	8,0 mm	4,0 mm	1-10
3-0-05-XK-02	_O	5,0 mm	3,1 mm	1-10

Tweezers

Info: The accessories have been tested with regard to their suitability for strain gauge application and are suitable for both cold and hot curing bonds.

Item No.	pcs.	width	length	tip width	feature
3-0-03-120.002.sa	1	10 mm	125 mm	2 mm	Flat tip

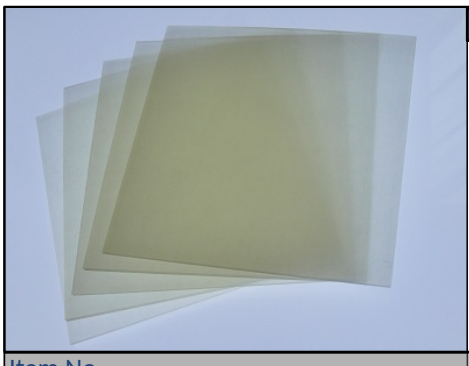


PTFE film

Available on roll or cutted.

Info: The accessories have been tested with regard to their suitability for strain gauge application and are suitable for both cold and hot curing bonds.

Item No.	pcs.	width	length	thickness	feature
3-0-01-050.060.025	1	60 mm	50 m	25 µm	on roll
3-0-01-050.100.025	1	100 mm	50 m	25 µm	on roll
3-0-01-100.100.025.g	5	100 mm	100 mm	25 µm	cutted



Silicone mats

Available only cutted.

Info: The accessories have been tested with regard to their suitability for strain gauge application and are suitable for both cold and hot curing bonds.

Item No.	pcs.	width	length	thickness	feature
3-0-04-100.100.002.g	5	100 mm	100 mm	2 mm	cutted

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SERVICES
Consultation

Benefit from years of experience in the field of sensor and thin film technology.

We would be pleased to support you with questions like:
- What added value do thin film strain gauges offer for my application?
- How can thin film technology be used to solve my measuring tasks?
- Which new freedom grades does the increased sensitivity of the strain gauges bring with for the designing of transducers?
- How can I get through a customer-specific layout reduce the application effort and thus saving resources?

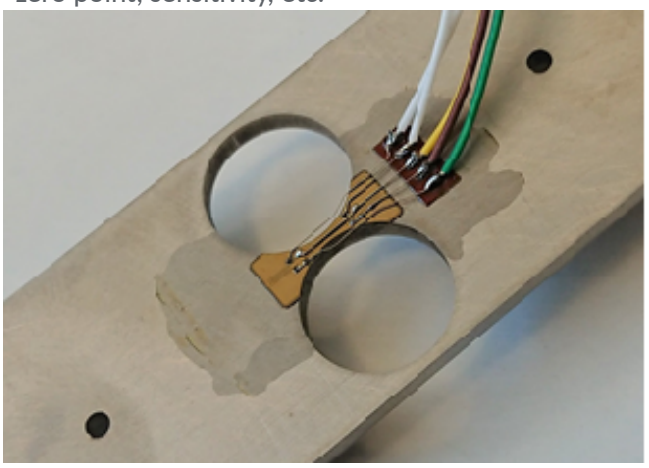
Training

Whether you are a beginner or experienced strain gauge user, we will teach you the basics or sensitize you to the finer points of working with thin film strain gauges. During the on-site seminars at your company the technical basics are taught. In the second step, the practical know-how and the application itself are discussed. Of course, our experienced experts will be available during the entire event to answer questions and to enable an efficient transfer of knowledge.

Application

Is it too costly to interrupt running processes or do you have not enough free ressources?
We would be happy to take over the application and carry out an initial characterization so that you can profit from the added value of our thin film strain gauges with minimal effort. You get the opportunity to check the functionality of a finished transducer in your field of application.

We offer:
- Revision of your application instructions with regard to the requirements of thin film foil strain gauges.
- Application of strain gauges on transducers according to your application instructions.
- Initial characterization of parameters such as zero point, temperature coefficient of the zero point, sensitivity, etc.



SERVICES

Feasibility studies

Are you reaching the limits of conventional metal foil strain gages?
Is the high temperature dependence of alternative strain gauge technologies a thorn in your side?
Do you want to break new ground in solving measurement tasks that arise in the age of predictive maintenance, industry 4.0, IoT or smart tools?

We would be pleased to offer you the execution of feasibility studies with the aim of testing whether functional thin films will solve your measuring task.

Here is a selection of the offered work packages:
- Workshop for joint brainstorming and preparation of a specification sheet
- Development of the sensor geometry
- Choice of material
- Thin film development
- Layout development
- Setup of a functional model
- Characterization
- Support with field trials

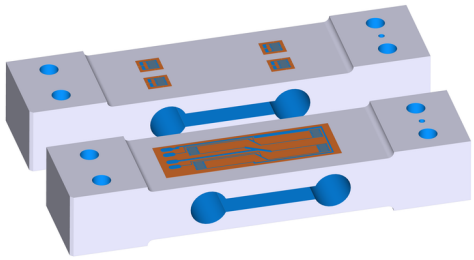
Since every customer is individual, we offer an adapted timetable with entry and exit oppportunities.

Technology transfer

After a successful feasibility study, we will support you on request in implementing the new technology in your processes.
We support you in adapting the work instructions and training the personnel. Together we define the interfaces and quality controls between supplier and user.

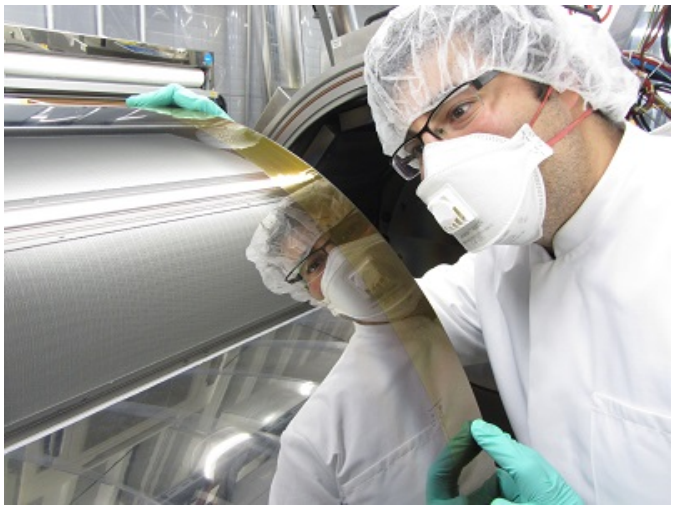
Developement of OEM products

Starting with the design of the transducer, whether for pressure or force, for example, through the selection of the appropriate functional layer to the characterization of the prototypes at your site. We are happy to support you throughout the entire development process from beginning.



Contract manufacturing

After successful development we also offer the production of OEM products.



As an expert for coating of flexible substrates and laser structuring/trimming, we also offer you our know-how to apply metallic coatings on substrates like:
- polyimide foils
- PEEK foils
- Thin Ceramics
- Thin glass
- or others

and to structure and trim the thin films on the carrier substrates.

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When the standard is no longer enough

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