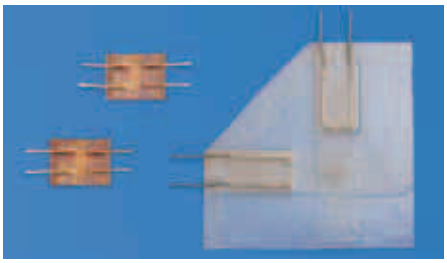
Strain Gages
and Accessories

Strain Gages - forever young...

Since the invention of strain gages more than 60 years ago, the technology for manufacturing such strain gages has been continuously perfected. Starting with a simple wire strain gage, a wide range of types for a wide range of very different applications has been designed and developed in this period. The range of applications has fast expanded



Modern foil structure and wire strain gages

from the initial material testing applications to innumerable areas in experimental measurement technology, as well as strain gages for the design and construction of transducers.
There is no other physical process in the area of experimental mechanics which supplies such manifold and reliable measurement information at such small financial cost.

Single source enterprise

Hottinger Baldwin Messtechnik (HBM) at Darmstadt has been manufacturing strain gages since the 1960s.
Continuous improvements in technology and quality has made HBM market leader in Germany and beyond.
In addition to a wide range of strain gage types, and the associated application acces-

HBM production site at Darmstadt

Mobile HBM data acquisition system Spider-Mobil

sories, HBM also offers complementary equipment of hard- and software. The development and production of customer-specific strain gages can be implemented in the shortest possible time. Complete measurement chains by HBM for a wide range of very different tasks, in combination with the HBM software package **catman®** , meet the growing customer requirement for a **„one stop shop"**, that is, a single source for all their needs.
A comprehensive range of training and seminar courses, special starter sets, specialist literature, as well as application distinctions complement the program for strain gage users with different knowledge levels.

Computer aided construction of a strain gage

Guaranteed quality

Numerous quality controls, a proven team with many years of experience, as well as a quality assurance system certified according to ISO/DIN 9001 guarantee strain gages with excellent technical measurement characteristics and a consistently high quality.
Strain gages are designed and dimensioned

Continuous etching machine

by means of modern CAD systems.
Photo-lithographic processes and etching processes always take place in clean room conditions.
The high HBM quality standards require optical checks of the strain gage after two specific process stages within the overall process of strain gage manufacturing .
Resistance balancing, a 100% resistance check, as well as further electrical tests complete these comprehensive quality assurance measures.

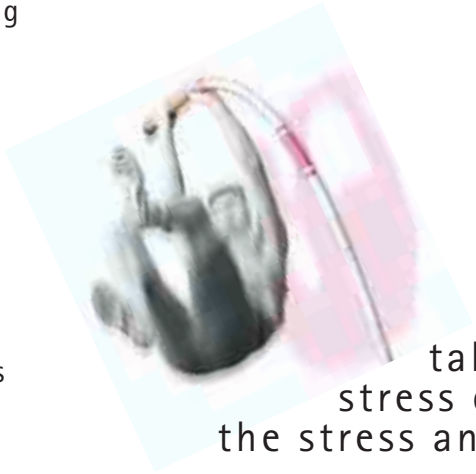
Visual inspection

Strain Gages in:
Civil Engineering – Sports – Medicine –

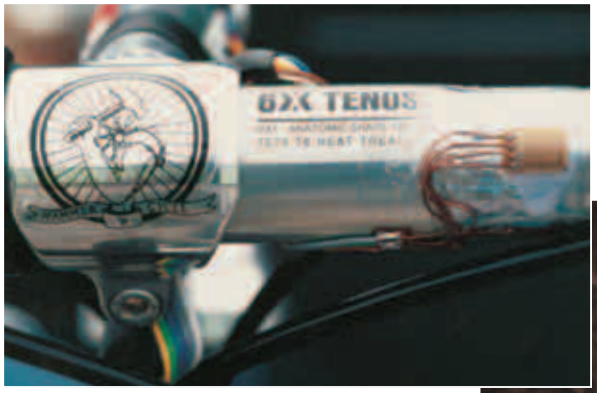
Stress investigation on a building material sample, using strain gages

Strain gages for building tests and monitoring

Reconstruction of the „Frauenkirche" in Dresden



take the stress out of the stress analysis



Strength testing of new type materials for high quality sports bicycle

Strain gages in sports

Ride testing with different material stresses

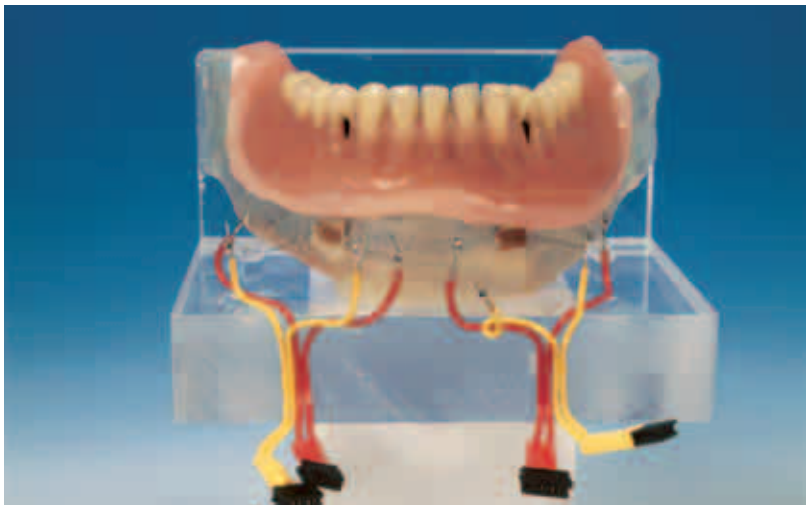
Transducer Construction – Experimental Stress Analysis

Strain gages for experimental stress analysis

helicopter

Strain gages in transducer construction

Modern HBM transducer U3 complete with strain gage installation (cross-sectional view)



Strain gages in medical engineering models

Model experiments for determining force and load curves in dental and oral medicine

Geometry of the strain gage

The selection of strain gage geometry depends on the measurement task to be solved.

Linear gages feature a measuring grid and measure the strain in measuring grid direction.

T-Rosettes with two measuring grids (e.g. XY11) feature two measuring grids arranged such that they are offset by 90 degrees relative to each other. These strain gages are used above all, if there is a biaxial stress state whose principal direction is known.

In the case of a single axis stress state, which occurs in tie rods and struts only, there is a biaxial strain state due to the lateral contraction of the material. The maximum points of both strains are located such that they are offset by 90 degrees relative to each other. T-Rosettes provide for the strain in force direction and the lateral contraction to be detected simultaneously. If both measuring grids are connected such that a half bridge is formed, an excellent temperature variation compensation will be achieved, and additionally a greater output signal. These effects result from the technical circuit characteristics of the Wheatstone bridge circuit used in strain gage technology.

Rosettes with three measuring grids are used to determine a biaxial stress condition where the principal stress directions are unknown. Here, three strain signals must be detected from which it will then be possible to calculate the amounts of the first and second principle stress, as well as the principal stress direction.

V-shaped strain gages (e.g. XY21) are ideally suited for measurements on shafts subject to torsion strains. Here, a dual axis stress condition exists whose principal standard stress are distributed at an angle of ±45 degrees relative to the shaft direction. If these strain gages are installed such that they are in parallel with the shaft axis, the measuring grids will be oriented in the direction of the principle standard strains. In addition, these strain gages can be used to determine shear stresses such as occur in shear rods within the neutral fibre area.

Poisson Full bridge strain gages (e.g. VY11) are suited, amongst other things, for determining shear stresses.

Diaphragm rosettes (e.g. MY11) are ideally suited for diaphragm pressure transducers.

Chain strain gages (e.g. KY11) comprise several strain gages fitted at a constant distance relative to each other on a common carrier. This allows strain distributions to be determined. HBM also supplies chain strain gages complete with several rosettes and alternating measuring grid directions so that it is even possible to determine the distribution of biaxial stress states with unknown direction.

Strain gage measuring grid length

The result of a measurement, using a strain gage, will be the mean value of the strains underneath the measuring grid. Therefore, the measuring grid length to be used is dependent on the measurement target. In most application cases, measuring grid lengths of 3 or 6 mm represent a good solution. Long measuring grids are recommended where there is an inhomogeneous material such as e.g. concrete or wood. In concrete, short strain gages would detect the partial strains of pebbles or cement stones. A long strain gage will bridge the inhomogeneities of the workpiece and, as a measurement result, will supply the mean strain underneath the measuring grid. In contrast, short measuring grids are suitable for detecting a local strain condition. Therefore, they are to be recommended for determining strain distributions (see chain strain gages), as well as for detecting the maximum point of notch strains (and similar strains).

Temperature range

The temperatures detailed in the technical specification should not be exceeded, neither should the actual temperature fall below the values stated. Note in this connection the explanations provided in „Technical Specification: Explanations".

Strain gage series

The HBM standard product range comprises 5 different type series for the following typical applications,

Y strain gages: universal strain gage for stress analysis and simple transducers; easy to handle, flexible, many geometries available, excellent price/performance ratio.

C strain gages: Ni-Cr strain gages for measurements at extreme temperatures; temperature variation, on steel or aluminum, adjusted to the range -200... +250° C, usable from -269... to +250° C.

G strain gages: for transducer manufacturing, very high quality gages; carrier: phenolic resin, glass fiber reinforced.

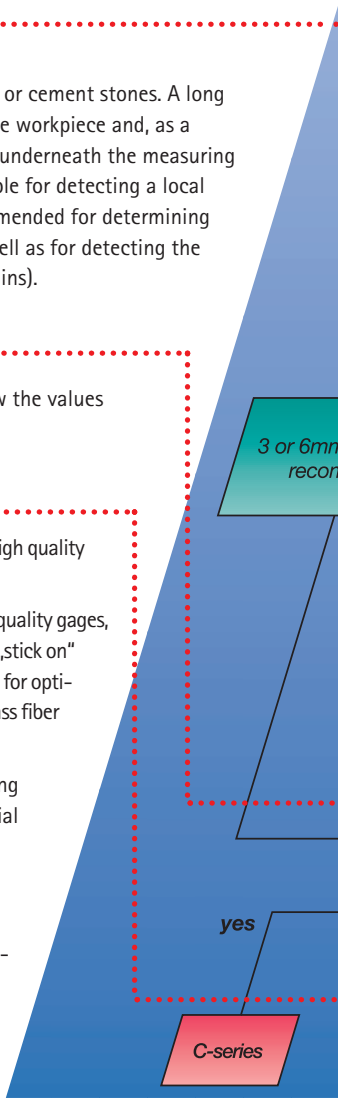
K strain gages: especially for transducers, ultra high quality gages, three different creep adjustments available, also as a „stick on" version complete with dry-handling adhesive coating for optimum measurement results, carrier: phenolic resin, glass fiber reinforced.

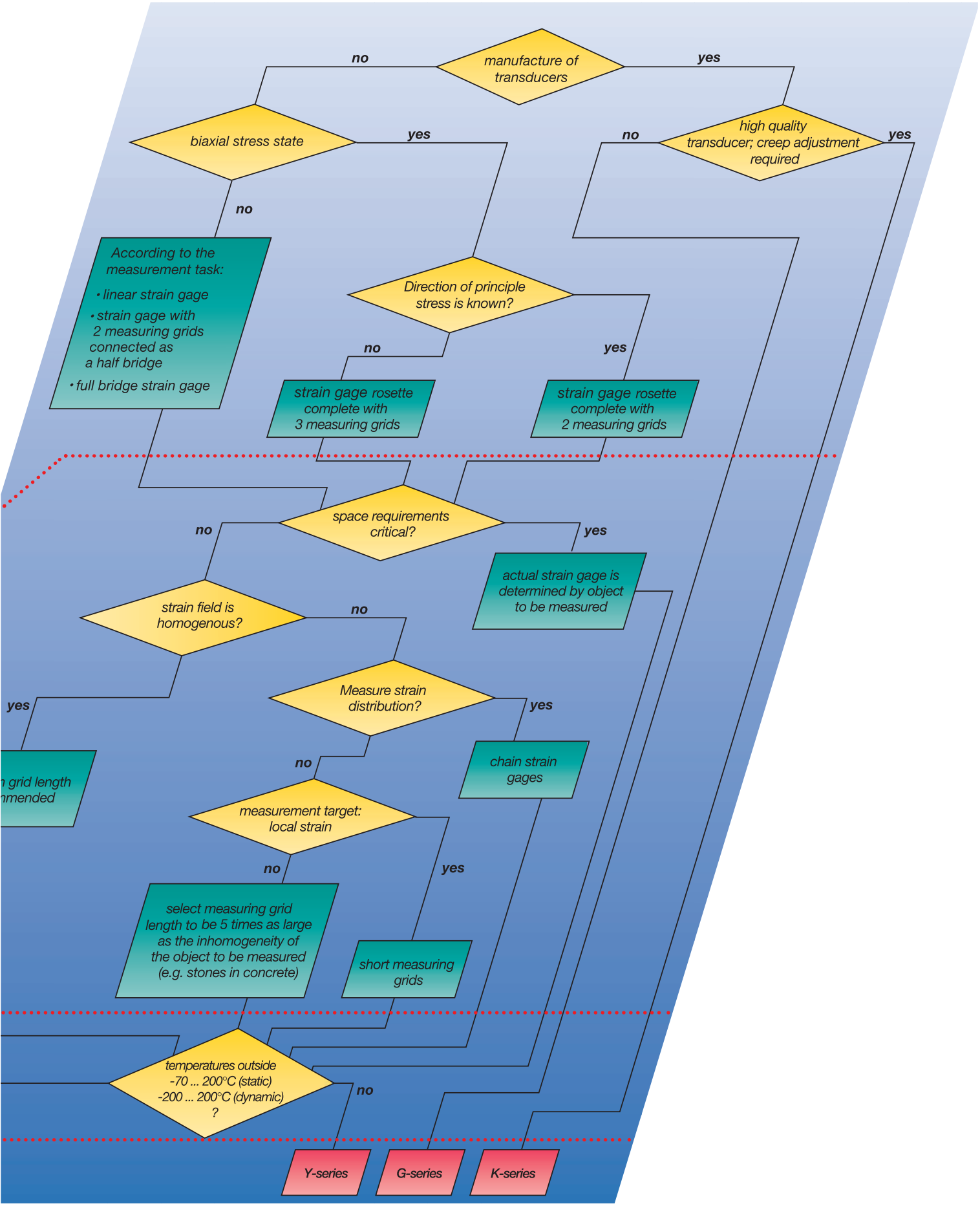
V strain gages: encapsulated strain gages featuring an encapsulation made of special synthetic material and 3 m able.

Strain gage resistance

HBM strain gages are offered in 120, 350, 700, and 1000 ohms. It depends on the constraints of the measurement task which resistance is optimal.

The advantage of 120 ohms strain gages is their insensitivity with regard to variations in insulation resistance, e.g. such as may be caused by the effects of humidity. The selfheating of strain gages with a higher resistance is low due to the lower measurement current. They are thus less sensitive with regard to ohmic resistances in the lines to the measurement amplifier. But they are better antennae for detecting fault impulses.




manufacture of transducers
no
yes
biaxial stress state
yes
no
high quality transducer; creep adjustment required
yes
no
According to the measurement task:
• linear strain gage
• strain gage with 2 measuring grids connected as a half bridge
• full bridge strain gage
Direction of principle stress is known?
no
yes
strain gage rosette complete with 3 measuring grids
strain gage rosette complete with 2 measuring grids
space requirements critical?
no
yes
actual strain gage is determined by object to be measured
strain field is homogenous?
no
yes
Measure strain distribution?
yes
no
chain strain gages
measurement target: local strain
no
yes
select measuring grid length to be 5 times as large as the inhomogeneity of the object to be measured (e.g. stones in concrete)
short measuring grids
temperatures outside -70 ... 200°C (static) -200 ... 200°C (dynamic) ?
no
Y-series
G-series
K-series

Technical Specification: Explanations

The HBM strain gage product range comprises the strain gage series Y, C, G, K, V, as well as the special strain gages; among these various gage types there are characteristic differences in construction and technical specification. These strain gage series are further subdivided into different type lines. For each strain gage series, the technical specifications relative to all type lines are stated together.

The technical data have been determined according to the conditions and procedures established in OIML directive IR62.

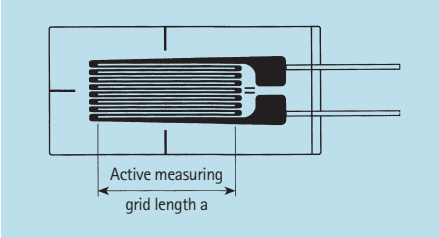
The tolerances have been stated according to OIML complete with double standard deviation, in contrast to the single standard deviation according to VDI/VDE. Therefore, the details also comply with VDI/VDE directive 2635, if the stated tolerance values of the gage factor, transverse sensitivity, temperature coefficient, gage factor and temperature variation is halved.

Below you will find further explanations regarding the terms used in the technical specification tables.

Strain gage dimensions

In strain gages, the specified active measuring grid length „a" is the net length of the grid without the transverse bridges (end loops).

The strain gage carriers have been designed for the optimum function of the strain gages. Nevertheless it is possible to cut the carrier foil. But you should be aware that shortening the carrier foil perpendicular to the direction of the grid will influence the way the strain is introduced into the measuring grid. Thereby also changing the sensitivity and creep characteristics of the strain gage. Therefore we recommend to leave a minimum of 1mm between cutting edge and measuring grid.



Schematic depiction of a strain gage

When cutting parallel to the measuring direction, strain gage characteristics will be affected to a minor degree only.

Strain gage resistance

The electric resistance between the two metal leads for connecting the measuring cable, or between the integrated solder tabs, is defined as the resistance of a strain gage.

The HBM product range comprises strain gages with nominal resistances of 120 Ω, 350 Ω, 700 Ω, and 1000 Ω.

The nominal resistance is stated on each strain gage package including a tolerance limit. At HBM, the resistance of each single strain gage will be measured.

Gage factor (strain sensitivity)

The strain sensitivity k of a strain gage is the proportionality factor between the relative change in resistance ($\Delta R/R_0$ and the strain to be measured:

$$\Delta R/R_0 = k \cdot \varepsilon$$

The strain sensitivity yields a number without dimension and is designated as gage factor.

This gage factor is determined for each production batch by measuring and specified on each strain gage package as a nominal value complete with tolerance. The gage factors vary between the production batches by just a few thousandth.

Temperature coefficient of the gage factor

The gage factor, which is printed on strain gage packages, applies at room temperature. This factor changes as the temperature changes; however, this correlation is linear to an excellent approximation. In the case of Constantan measuring grid (series V, G, K, Y) the gage factor will increase as the temperature increases; in the case of chromium/nickel measuring grid (series C) the gage factor will reduce as the temperature increases. The temperature coefficient of the gage factor is stated on each strain gage package.

Maximum permissible bridge supply voltage

The maximum values specified are permissible only for application on materials featuring excellent heat conduction characteristics (e.g. steel of sufficient thickness). Otherwise temperature increases in the measuring grid area may lead to measuring faults. Special measurements on plastic materials, and similar materials with poor heat conduction characteristics, require a reduction of the supply voltage or switch-on period (impulse operation).

Even for very low temperatures, the reducing heat capacity of the materials make a small supply voltage necessary.

Reference temperature

The reference temperature is the ambient temperature, which the technical data of the strain gage refer to, inasmuch as specific temperature ranges have not been specified.

The technical data specified for the strain gage are based on the reference temperature of 23°C.

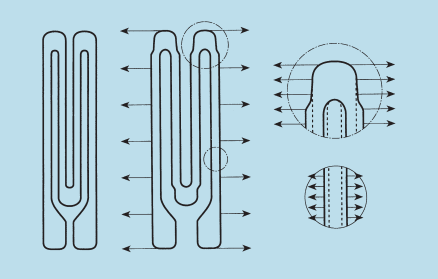
Transverse sensitivity

The transverse sensitivity is the ratio of the relative change in the resistance of a strain gage, applied perpendicular to a single axis deformation field (transverse strain), to the relative change in the resistance of an equal strain gage which is applied in parallel to the same deformation field (longitudinal strain).

The transverse sensitivity is stated on each strain gage package.

Operation temperature range

The operation temperature range is that ambient temperature range within which the strain gages can be applied without any permanent changes in measuring characteristics occurring. Depending on whether static (with zero point reference) or dynamic (without zero point reference) measurements are to be carried out, there are different operation temperature ranges.



Transverse sensitivity of a measuring grid (schematic)

Temperature variation in a 1/4-bridge

If there is a temperature change at a measuring point, there will also be a change in the resistance of the measuring grid. Which is caused by the change of the specific resistance and the thermal expansion of the strain gage itself as well as by the thermal expansion of the test object. This signal is designated as the thermal output strain or as temperature variation of the measuring point and it arises without any mechanical load on the workpiece. However, it is possible to adjust the temperature behaviour of a strain gage such that the temperature effects of the measuring point are largely compensated. Each HBM strain gage, with the exception of type LD20, will be adjusted to a specified thermal expansion coefficient. HBM offers strain gages for ferritic steel, aluminum, plastic, austenitic steel, titanium/grey cast iron, molybdenum, and quartz. All series Y strain gages can be supplied for all the above-mentioned thermal expansion coefficients (with only a few exceptions).

Therefore please mind the explanations regarding type designation on page 12.

Technical Specification: Explanations

Thus, for example, the temperature variations of the strain gages with the type designations LY 11, XY 21, RY 31, and KY 11 have been adjusted to ferritic steel with $\alpha = 10.8 \cdot 10^{-6}/K$ (last digit: 1).

1	for ferritic steel	with α =	10.8	$\cdot 10^{-6}/K$
3	for aluminum	with α =	23	$\cdot 10^{-6}/K$
5	for austenitic steel	with α =	16	$\cdot 10^{-6}/K$
6	for quartz	with α =	0.5	$\cdot 10^{-6}/K$
7	for titanium/gray cast iron	with α =	9	$\cdot 10^{-6}/K$
8	for plastic material	with α =	65	$\cdot 10^{-6}/K$
9	for molybdenum	with α =	5.4	$\cdot 10^{-6}/K$

The thermal expansion coefficient of the material, which the respective strain gage has been adjusted to, is specified on the package and can be read off from the part code number key. This adjustment significantly reduces the temperature output. The remaining temperature variation is defined by a diagram on the package and a polynome so that the arising measurement fault can be corrected mathematically. If strain gages featuring leads are used, then the temperature effect of the leads can be corrected in line with their length. Apparent strains can also be reduced by circuit measures (e.g. circuit complete with compensation strain gage, half-bridge circuit ...). The temperature variation is subject to a tolerance and only applies within the temperature range of the temperature variation adjustment. This temperature range is specified within the technical data of the various individual series in this catalogue.

Creep adjustment

Elastic materials react with a spontaneous positive or negative strain when subjected to a sudden load. In the event of a constant load being applied, the material will continue to strain slowly in load direction, i.e. the material will creep. As transducers are loaded within the strictly elastic range only, the process described here is reversible. It is designated as an elastic afterworking. The elastic afterworking thus causes a time-dependent fault with a positive sign (in the direction of the deformation by the measuring quantity).

If a strain gage is subjected to a static load, it will show a slow change in resistance over time - in spite of the component strain being constant. This change in the measuring signal of a strained (or compressed) strain gage is effected in relief direction. This creep can be explained as follows: the strained measuring grid acts similar to a tensioned spring which generates shear stresses between measuring grid and carrier (mainly within the range of the measuring grid end loops). Due to the influence of these stresses, the plastic materials of the strain gage and the adhesive relax. It is possible to influence such strain gage creep directly by modifying the end loops.

De facto therefore, the elastic afterworking of the body material will lead to a positive fault whilst the strain gage creep generates a negative fault. In an ideal case, both faults will compensate each other. In order to approximate this ideal case as closely as possible, it is necessary to determine the most suitable strain gage by experiment. It is for this reason, that the K strain gage series provides three different creep adjustments for each strain gage type.

Mechanical hysteresis

The mechanical hysteresis of a strain gage is defined as the difference of the measured value displayed between an increasing and a decreasing strain load for the same workpiece strain values. Hysteresis distribution is not only dependent on the strain gage but to a major extent it is also dependent on application parameters such as type and layer thickness of the adhesive etc. For this reason, it will not be possible to specify mechanical hysteresis data for all variant options.

Maximum elongation

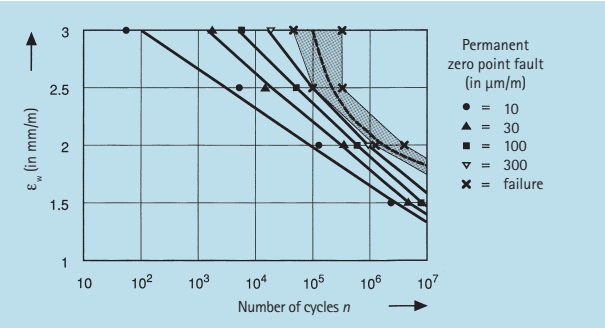
The maximum elongation of a strain gage is defined as the strain at which the gage characteristic (change in resistance/strain characteristic) deviates by more than 5% from the mean characteristic for the type.

Minimum radius of curvature

The flexibility of a strain gage is characterized by the minimum radius of curvature which it will withstand, without any auxiliary measures, in each direction respectively. The polyimide carrier of series Y and C strain gages are flexible to an extent that they can be bonded around edges. Although the carrier materials of the other strain gage series are more brittle, they can also be easily prepared for application to smaller radii by „pre-forming" (e.g. hot tip stretching).

Fatigue life

If a strain gage is subjected to an alternating strain which can be superimposed over a static mean strain, an increase in the stress cycle figure may create changes with regard to zero position and the center strain of the strain gage, as well as with regard to the resistance strain characteristic. In general the gage factor remains constant. These effects are summarized as „fatigue life" of strain gages; they do depend on the numbers of alternating strain gage amplitudes and mean strains but they are largely independent of actual frequencies.



Fatigue life of strain gages (exemplary)

Alternative bonding methods

For each strain gage type, the relevant bonding methods are specified. With regard to application technology, the HBM accessory product range distinguishes among cold- and hot curing adhesives as well as spot weld procedures. One of the most important selection criteria is the operation temperature range of the various different bonding devices.

Type designation

1- L Y 1 1 - 3 / 120 A

Options[1]: A = application aid
V = four wire connection
Z = two wire connection

Measuring grid resistance in Ohms

Measuring grid length in mm
- for RY1X, RY3X, RY4X, RY7X: diameter of circle which encloses the measuring grids
- for chain strain gages, distance of measuring grid centres relative to each other (pitch dimension)

Material which the strain gage is temperature-adjusted to: for standard strain gages, you will find placeholders „x" in this position; replace this placeholder by the identification number of the temperature variation you have selected

1	for ferritic steel	with $\alpha = 10.8 \cdot 10^{-6}$/K
3	for aluminum	with $\alpha = 23 \cdot 10^{-6}$/K
5	for austenitic steel	with $\alpha = 16 \cdot 10^{-6}$/K
6	for quartz	with $\alpha = 0.5 \cdot 10^{-6}$/K
7	for titanium/gray cast iron	with $\alpha = 9 \cdot 10^{-6}$/K
8	for plastic material	with $\alpha = 65 \cdot 10^{-6}$/K
9	for molybdenum	with $\alpha = 5.4 \cdot 10^{-6}$/K

Layout of grids, type and position of connections

Strain gage series:
Series C = carrier and cover polyimide / measuring grid foil = chromium/nickel alloy
Series Y = carrier and cover polyimide / measuring grid foil Constantan
Series G = carrier and cover glass-fibre reinforced phenolic resin / = measuring grid foil Constantan
Series K = carrier and cover glass-fibre reinforced phenolic resin / = measuring grid foil Constantan; additionally, three different = creep adjustments are available ex stock
Series V = carrier: polyimide/measuring grid foil Constantan, = moulded with special plastic material, 3 m stranded wire = fitted as standard

Number of measuring grids and their relative position to each other

L	= one measuring grid, linear strain gage
D	= two measuring grids, measuring grid direction: parallel
X	= two measuring grids, measuring grid direction, = T-or X-shaped, offset by 90°
R	= three measuring grids, rosettes
V	= 4 measuring grids, full bridge strain gages
M	= full bridge strain gages as diaphragm rosettes
K	= strain gage chains for determining strain gradients

Special strain gages for a wide variety of different measuring tasks

- Strain gage rosettes for determining residual stresses according to the borehole and ring core methods.
- Strain gages for extremely high strains (± 100.000 µm/m ≙ ± 10 %)
- Encapsulated strain gages for use in extreme ambient conditions, with absolutely easy handling and operation.
- Weldable strain gages for strain measurements on weldable components.
- Crack propagation gages for measuring the growth of cracks on any type of surface

[1] available for preferred strain gages only

An even greater range of types - Easy to order

This catalogue offers a wide choice of strain gages. In addition to our wide range of preferential strain gages, we have a comprehensive selection of standard strain gages.

This is how easily you can order our strain gages

In the price list, preferential strain gages are shown as shaded areas (pattern shading); such gages are always available ex stock. In this catalogue, preferential strain gages are listed in the column „Preference types".

Standard strain gages are not shown against a shaded area; and they are not always available ex stock. We will be pleased to provide information on current availability if requested. Standard strain gages are listed in a separate column within this catalogue. The minimum order quantity for these strain gages is 3 packages.

What does the „x" in the type designation of the strain gages in column „Variable Order Designation" stand for?

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY11-0,6/120	1-LY13-0,6/120		120	0.6	1	5	3.2	1.5	LS 7
1-LY11-1,5/120	1-LY13-1,5/120	1-LY1x-1.5/120	120	1.5	1.2	6.5	4.7	2.5	LS 7
1-LY11-3/120	1-LY13-3/120	1-LY1x-3/120	120	3	1.4	8.5	4.5	4	LS 7
1-LY11-3/120A		1-LY1x-3/120A	120	3	1.4	8.5	4.5	4	LS 7
1-LY11-6/120	1-LY13-6/120	1-LY1x-6/120	120	6	2.8	13	6	8	LS 5
1-LY11-6/120A		1-LY1x-6/120A	120	6	2.8	13	6	8	LS 5
1-LY11-10/120	1-LY13-10/120	1-LY1x-10/120	120	10	4.9	18.5	9.5	13	LS 5
1-LY11-10/120A		1-LY1x-10/120A	120	10	4.9	18.5	9.5	13	LS 5
1-LY11-1,5/350	1-LY13-1,5/350		350	1.5	1.2	5.7	4.7	4.5	LS 212
1-LY11-3/350	1-LY13-3/350	1-LY1x-3/350	350	3	1.5	8.5	4.5	7	LS 7
		1-LY1x-3/350A	350	3	1.5	8.5	4.5	7	LS 7
1-LY11-6/350	1-LY13-6/350	1-LY1x-6/350	350	6	2.9	13	6	14	LS 5
1-LY11-6/350A		1-LY1x-6/350A	350	6	2.9	13	6	14	LS 5
1-LY11-10/350		1-LY1x-10/350	350	10	5	18.5	9.5	23	LS 5
1-LY11-10/350A		1-LY1x-10/350A	350	10	5	18.5	9.5	23	LS 5

Instead of the „x" in the type designation of the strain gages in column „Other", enter the numeric code for the relevant temperature variation compensation.

Example:

You wish to adjust the type 1-LY1x-10/120 for plastic material. Then enter an „8" instead of the placeholder „x" when ordering; the exact order designation will then be 1-LY18-10/120.

The preferential strain gages are adjusted as standard for steel or aluminum.
Please note the exceptions in the case of types marked by # .

To ease your order procedure please use also our **CD-ROM „DMS*direkt*".**
Order your CD-ROM free of charge right now.

Series Y

- The universal strain gage featuring an optimum price/performance ratio
- Flexible, therefore easy to handle
- Wide range of geometries available as standard
- Excellent measuring characteristics
- Wide range of geometries available with different nominal resistance values (120, 350, 700, 1000 Ω)

Dynamometer on a Sailing boat made by Technical University of Berlin with HBM strain gages (series Y)

Series C

- The specialist for extreme temperatures (4 K ... 500 K)
- Flexible, therefore easy to handle
- Temperature variation adjusted across the entire operation temperature range

Series K

- The optimum strain gage for manufacturing transducers
- Carrier material: glass fibre reinforced phenolic resin measuring grid material: Constantan
- Each strain gage is available ex stock, complete with three creep adjustments
- Specially adjusted compensation elements for zero point, TC_0, and TC-Span balancing
- On request, each K strain gage without leads can be supplied as a stick-on strain gage (complete with dry-to-the-touch adhesive coating, hot curing) - for maximum precision in transducer manufacturing

HBM-torque transducer T10F with K-series strain gages inside (non visible)

Series G

- Optimum strain gage for the manufacture of transducers
- Nominal resistances 120 ohms and 350 ohms available
- Carrier material: glass fibre reinforced phenolic resin measuring grid material: Constantan
- Leads: fitted as standard

Series V

- Strain gage complete with 3m of stranded wire
- No soldering on the strain gage is required
- Encapsulation is provided as standard

Series Y Strain Gages

Technical Data

strain gage construction		foil strain gage complete with embedded measuring grid
measuring grid		
material		Constantan foil
thickness	µm	3.8 or 5, depending on strain gage type
carrier		
material		polyimide
base thickness	µm	45 ± 10
cover thickness	µm	25 ± 5
connections		
for strain gages without leads		nickel plated Cu leads, approx. 30mm in length. integrated solder tabs, approx. 1.5mm in length, approx. 1.6 ... 2.2mm wide
nominal resistance	Ω	120, 350, 700, or 1000, depending on strain gage type
resistance tolerance	%	± 0.3 without; ± 0.35 with leads[2]
except for KY types, per chain	%	± 0.5
gage factor		approx. 2
nominal factor of gage factors		specified on each package
gage factor tolerance for 0.6mm and 1.5mm measuring grid length	%	± 1.5
for ≧ 3 mm measuring grid length		%± 1
temperature coefficient of the gage factor	1/K	ca. (115 ± 10) · 10^{-6}
nominal value of temperature coefficient of gage factor		specified on each package
reference temperature	°C	23
operation temperature range		
for static, i.e. zero point related measurements	°C	- 70 ... + 200
for dynamic, i.e. not zero point related measurements	°C	-200 ... + 200
transverse sensitivity		
within reference temperature range using adhesive Z 70 on strain gage type LY 11-6/120	%	- 0.1
temperature variation		specified on each package
temperature variation acc. to selection, adjusted to thermal expansion coefficient α		
α for ferritic steel	1/K	10.8 · 10^{-6}
α for aluminium	1/K	23 · 10^{-6}
α for plastic material	1/K	65 · 10^{-6}
α for austenitic steel	1/K	16 · 10^{-6}
α for titanium/ grey steel	1/K	9 · 10^{-6}
α for molybdenum	1/K	5.4 · 10^{-6}
α for quartz	1/K	0.5 · 10^{-6}
temperature variation tolerance	1/K	± 0.3 · 10^{-6}
adjustment of temperature variation within range	°C	-10 ... + 120
mechanical hysteresis[1]		
at reference temperature and strain ε = ± 1000 µm/m strain gage type LY 11-6/120		
at 1st load cycle and adhesive Z 70	µm/m	1
at 3rd load cycle and adhesive Z 70	µm/m	0.5
at 1st load cycle and adhesive X 60	µm/m	2.5
at 3rd load cycle and adhesive X 60	µm/m	1
at 1st load cycle and adhesive EP 250	µm/m	1
at 3rd load cycle and adhesive EP 250	µm/m	1
maximum elongation[1]		
at reference temperature using adhesive Z 70 on strain gage type LY 11-6/120		
strain limit ε for positive direction	µm/m	50 000 (≙ 5 %)
strain limit ε for negative direction	µm/m	50 000 (≙ 5 %)
fatigue life[1]		
at reference temperature using adhesive X 60 on strain gage type LY 11-6/120		
stress cycle value L_w at		
alternating strain ε_w = ± 1000 µm/m and zero point drift $\varepsilon_m \Delta \leqq 300$ µm/m		>> 10^7 (test was interrupted at 10^7)
$\varepsilon_m \Delta \leqq 30$ µm/m		> 10^7 (test was interrupted at 10^7)
minimum radius of curvature, longitudinal and transverse, at reference temperature		
for strain gages c/w leads	mm	0.3
for strain gages c/w integrated leads		
within the measuring grid area	mm	0.3
within the area of the solder tabs	mm	2
usable bonding materials		
cold curing adhesives		Z 70; X 60; X 280
hot curing adhesives		EP 250; EP 310

[1] The data depend on the various parameters of the specific application and are therefore stated for representative examples only.
[2] With measuring grid lengths of 0.6 mm, the nominal resistance may deviate by ± 1%. For the types LY 51/ ... the deviation is ± 0,75%.

Y

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY11-0,6/120	1-LY13-0,6/120	1-LY1x-0,6/120#	120	0.6	1	5	3.2	1.5	LS 7
1-LY11-1,5/120	1-LY13-1,5/120	1-LY1x-1,5/120	120	1.5	1.2	6.5	4.7	2.5	LS 7
1-LY11-3/120	1-LY13-3/120	1-LY1x-3/120	120	3	1.4	8.5	4.5	4	LS 7
1-LY11-3/120A		1-LY1x-3/120A	120	3	1.4	8.5	4.5	4	LS 7
1-LY11-6/120	1-LY13-6/120	1-LY1x-6/120	120	6	2.8	13	6	8	LS 5
1-LY11-6/120A		1-LY1x-6/120A	120	6	2.8	13	6	8	LS 5
1-LY11-10/120	1-LY13-10/120	1-LY1x-10/120	120	10	4.9	18.5	9.5	13	LS 5
1-LY11-10/120A		1-LY1x-10/120A	120	10	4.9	18.5	9.5	13	LS 5
1-LY11-1,5/350	1-LY13-1,5/350		350	1.5	1.2	5.7	4.7	4.5	LS 212
1-LY11-3/350	1-LY13-3/350	1-LY1x-3/350	350	3	1.5	8.5	4.5	7	LS 7
		1-LY1x-3/350A	350	3	1.5	8.5	4.5	7	LS 7
1-LY11-6/350	1-LY13-6/350	1-LY1x-6/350	350	6	2.9	13	6	14	LS 5
1-LY11-6/350A		1-LY1x-6/350A	350	6	2.9	13	6	14	LS 5
1-LY11-10/350		1-LY1x-10/350	350	10	5	18.5	9.5	23	LS 5
1-LY11-10/350A		1-LY1x-10/350A	350	10	5	18.5	9.5	23	LS 5

LY11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LY13

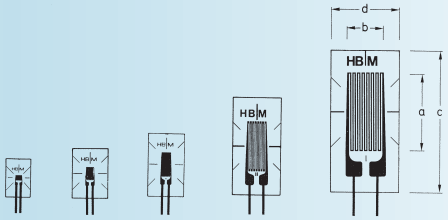
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

LY1x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 10 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY21-0,6/120		1-LY2x-0,6/120#	120	0.6	0.6	3.5	6.4	1	LS 7
1-LY21-1,5/120		1-LY2x-1,5/120	120	1.5	1.4	4.7	8.3	2	LS 5
1-LY21-3/120		1-LY2x-3/120	120	3	2.8	7.5	10	6	LS 5
		1-LY2x-6/120	120	6	5.7	11	16	12	LS 4

LY21

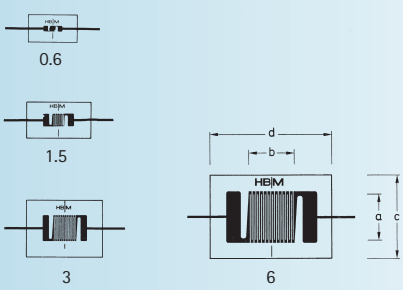
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LY2x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 10 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY41-0,6/120		1-LY4x-0,6/120#	120	0.6	1.2	6	4	1.5	LS 5
1-LY41-1,5/120		1-LY4x-1,5/120	120	1.5	1.2	7	5	2.5	LS 5
1-LY41-3/120	1-LY43-3/120	1-LY4x-3/120	120	3	1.1	8	5	3.5	LS 5
		1-LY4x-3/120A	120	3	1.1	8	5	3.5	LS 5
1-LY41-6/120	1-LY43-6/120	1-LY4x-6/120	120	6	2.3	13.9	5.9	8	LS 5
1-LY41-6/120A		1-LY4x-6/120A	120	6	2.3	13.9	5.9	8	LS 5
1-LY41-10/120		1-LY4x-10/120	120	10	5	18	8	14	LS 5
		1-LY4x-10/120A	120	10	5	18	8	14	LS 5
1-LY41-20/120		1-LY4x-20/120	120	20	0.7	31.8	8.2	6.5	LS 5
1-LY41-50/120		1-LY4x-50/120	120	50	0.9	63.6	8.2	12	LS 5
1-LY41-100/120		1-LY4x-100/120	120	100	1	114.8	8.2	19	LS 5
1-LY41-150/120		1-LY4x-150/120	120	150	1.3	165.6	8.2	25	LS 5
1-LY41-1,5/350		1-LY4x-1,5/350#	350	1.5	2.3	9.2	5.9	6.5	LS 5
1-LY41-3/350	1-LY43-3/350	1-LY4x-3/350	350	3	2.5	10.9	5.9	9	LS 5
1-LY41-3/350A		1-LY4x-3/350A	350	3	2.5	10.9	5.9	9	LS 5
1-LY41-6/350	1-LY43-6/350	1-LY4x-6/350	350	6	2.7	13.9	5.9	15	LS 5
1-LY41-6/350A		1-LY4x-6/350A	350	6	2.7	13.9	5.9	15	LS 5
1-LY41-10/350		1-LY4x-10/350	350	10	5	18	8	24	LS 5
		1-LY4x-10/350A	350	10	5	18	8	24	LS 5
1-LY41-3/700	1-LY43-3/700	1-LY4x-3/700	700	3	2.7	10.9	5.9	13	LS 5
1-LY41-6/700		1-LY4x-6/700	700	6	4.1	13.9	5.9	23	LS 5
1-LY41-10/700		1-LY4x-10/700	700	10	5	18	8	33	LS 5
		1-LY4x-3/1000#	1000	3	2.7	10.9	5.9	16	LS 5
1-LY41-6/1000		1-LY4x-6/1000#	1000	6	4.3	13.9	5.9	27	LS 5
		1-LY4x-10/1000#	1000	10	5	18	8	40	LS 5

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only
(1) Requirement for solder terminals is not mandatory

LY41

Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

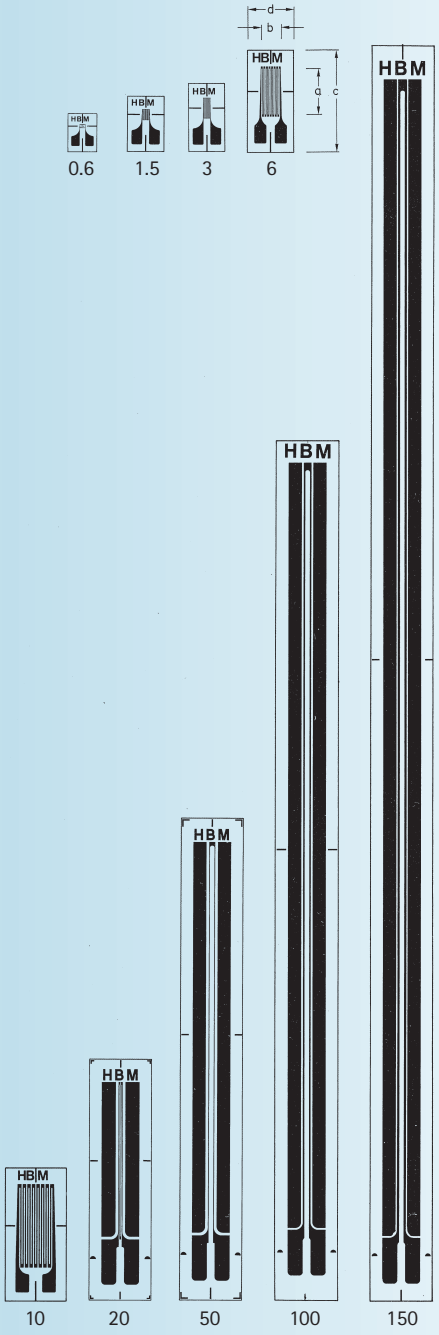
LY43

Strain gage complete with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

LY4x

Temperature variation adjusted acc. to customer specification
see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Y

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY51-3/120		1-LY5x-3/120	120	3	0.3	9	4.7	2	LS 7
		1-LY5x-6/120	120	6	0.4	13	4.7	3	LS 7

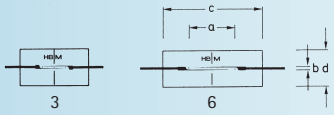
LY51

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LY5x

Temperature variation adjusted acc. to customer specification see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 10 pcs.

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LY61-1,5/120		1-LY6x-1,5/120	120	1.5	1.0	7.8	4.7	2.5	-
1-LY61-3/120		1-LY6x-3/120	120	3	1.4	9.8	4.7	4	-
		1-LY6x-3/120A	120	3	1.4	9.8	4.7	4	-
1-LY61-6/120	1-LY63-6/120	1-LY6x-6/120	120	6	2.5	16	6.3	8	-
		1-LY6x-6/120A	120	6	2.5	16	6.3	8	-
1-LY61-10/120		1-LY6x-10/120	120	10	4.3	23.5	9.3	13	-
1-LY61-3/350		1-LY6x-3/350	350	3	1.7	9.8	4.7	7	-
		1-LY6x-3/350A	350	3	1.7	9.8	4.7	7	-
1-LY61-6/350	1-LY63-6/350	1-LY6x-6/350	350	6	2.6	16	6.3	13	-
1-LY61-6/350A		1-LY6x-6/350A	350	6	2.6	16	6.3	13	-
1-LY61-10/350		1-LY6x-10/350	350	10	4.3	23.5	9.3	9.3	-

LY61

Strain gage complete with integrated solder tabs and integrated strain relief
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

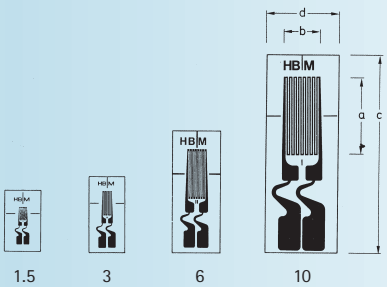
LY63

Strain gage complete with integrated solder tabs and integrated strain relief
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

LY6x

Temperature variation adjusted acc. to customer specification see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 10 pcs.

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-DY11-3/350	1-DY13-3/350	1-DY1x-3/350	350	3	2.7	9	8	9	LS 7
1-DY11-6/350	1-DY13-6/350	1-DY1x-6/350	350	6	3.2	12.5	9.4	14	LS 7

DY11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

DY13

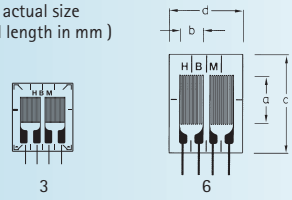
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

DY1x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-XY11-0,6/120		1-XY1x-0,6/120#	120	0.6	1	6	4	1.5	LS 7
1-XY11-1,5/120	1-XY13-1,5/120	1-XY1x-1,5/120	120	1.5	1.5	9	5	3	LS 5
1-XY11-3/120	1-XY13-3/120	1-XY1x-3/120	120	3	3	14.5	7.5	6	LS 4
1-XY11-6/120		1-XY1x-6/120	120	6	6	23.5	11	12	LS 5
1-XY11-1,5/350	1-XY13-1,5/350	1-XY1x-1,5/350#	350	1.5	1.5	9	5	5	LS 5
1-XY11-3/350	1-XY13-3/350	1-XY1x-3/350	350	3	3	14.4	7.3	10	LS 4
1-XY11-6/350	1-XY13-6/350	1-XY1x-6/350	350	6	6	23.3	10.5	20	LS 4

XY11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XY13

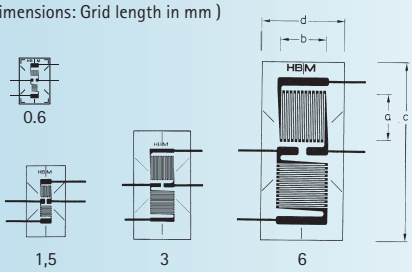
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

XY1x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b_1	b_2	c	d	V	
1-XY21-0,6/120		1-XY2x-0,6/120#	120	0.6	2	1.1	7.5	4	2.5	LS 7
1-XY21-1,5/120		1-XY2x-1,5/120	120	1.5	1.7	2.5	6.8	4.5	4.5	LS 7
1-XY21-3/120		1-XY2x-3/120	120	3	4.3	5.3	11.2	9.5	6	LS 5
1-XY21-6/120		1-XY2x-6/120	120	6	8.0	10	17.5	12.7	11	LS 4
1-XY21-1,5/350		1-XY2x-1,5/350#	350	1.5	2.1	2.5	7.4	4.5	5	LS 7
1-XY21-3/350	1-XY23-3/350	1-XY2x-3/350	350	3	4.0	5.3	11.2	9.5	10	LS 4
1-XY21-6/350	1-XY23-6/350	1-XY2x-6/350	350	6	7.8	10	17.5	12.7	19	LS 4
1-XY21-3/700		1-XY2x-3/700#	700	3	4.0	5.3	11.2	9.5	14	LS 5
		1-XY2x-6/700	700	6	7.8	10	17.5	12.7	27	LS 4

XY21

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XY23

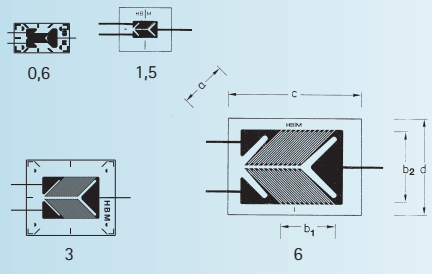
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

XY2x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

Y

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-XY31-0,6/120		1-XY3x-0,6/120#	120	0.6	1	7	6	1.5	LS7
1-XY31-1,5/120	1-XY33-1,5/120	1-XY3x-1,5/120	120	1.5	1.5	8	6.3	3	LS7
1-XY31-3/120		1-XY3x-3/120	120	3	3	10.5	8	5.5	LS7
1-XY31-6/120		1-XY3x-6/120	120	6	6	17.5	12	11	LS4
1-XY31-3/350	1-XY33-3/350	1-XY3x-3/350	350	3	3	10.9	7.6	10	LS5
1-XY31-6/350	1-XY33-6/350	1-XY3x-6/350	350	6	6	18	12	20	LS4

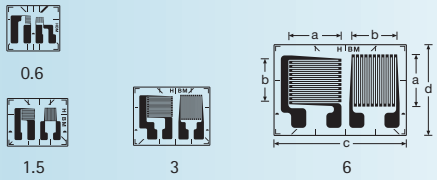
XY31
T-rosette strain gage with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XY33
T-rosette strain gage with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

XY3x
Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b_1	b_2	c	d	V	
1-XY41-0,6/120		1-XY4x-0,6/120#	120	0.6	2.1	1.6	6.5	4.6	1.5	LS 7
1-XY41-1,5/120	1-XY43-1,5/120	1-XY4x-1,5/120	120	1.5	1.7	3.1	7.5	4.6	2.5	LS 7
1-XY41-3/120		1-XY4x-3/120	120	3	3	5.4	11	8	5	LS 7
1-XY41-6/120		1-XY4x-6/120	120	6	6	10.2	16	12.2	9.5	LS 4
1-XY41-3/350	1-XY43-3/350	1-XY4x-3/350	350	3	4.1	5.6	11	8	9.5	LS 7
1-XY41-6/350		1-XY4x-6/350	350	6	6	10	16	12.2	16	LS 4
1-XY41-3/700		1-XY4x-3/700#	700	3	4.1	5.6	11	8	13.5	LS 7
		1-XY4x-6/700	700	6	6	10	16	12.2	23	LS 4

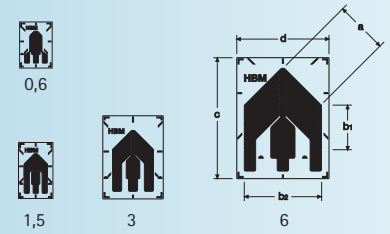
XY41
Strain gage with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XY43
Strain gage with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

XY4x
Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b_1	b_2	c	d	V	
1-XY91-1,5/120	1-XY93-1,5/120	1-XY9x-1,5/120	120	1.5	1.2	1.2	4.7	5.2	2	LS 5
1-XY91-3/120	1-XY93-3/120	1-XY9x-3/120	120	3	1.4	1.3	6.2	7.9	3.5	LS 7
1-XY91-6/120	1-XY93-6/120	1-XY9x-6/120	120	6	1.9	2.2	10	9.6	5.5	LS 4
1-XY91-10/120		1-XY9x-10/120	120	10	3.2	3.8	15.2	14.0	9	LS 5

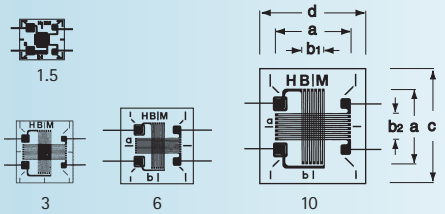
XY91
Stacked T-Rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XY93
Stacked T-Rosette
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

XY9x
Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

(1) Requirement for solder terminals is not mandatory

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a_1	a_2	b	c	d	V	
1-RY11-3/120	1-RY13-3/120	1-RY1x-3/120#	120	0.8	3	0.8	7	7	1.5	LS 7
1-RY11-6/120	1-RY13-6/120	1-RY1x-6/120	120	2	6	1.3	11	11	3	LS 5
1-RY11-10/120		1-RY-1x-10/120	120	2.9	10	2.6	15.4	15.4	5	LS 4

RY11

0°/45°/90° – rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

RY13

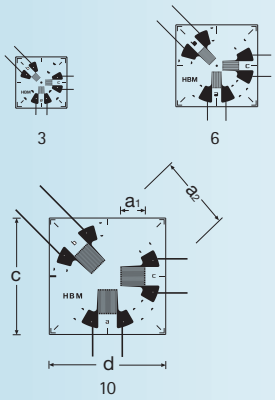
0°/45°/90° – rosette
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

RY1x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: a_2 in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a_1	a_2	b	c	d	V	
1-RY31-3/120		1-RY3x-3/120#	120	0.8	3	0.8	7		1.5	LS 7
1-RY31-6/120	1-RY33-6/120	1-RY3x-6/120	120	2	6	1.3	11		3	LS 5
1-RY31-10/120		1-RY3x-10/120	120	2.9	10	2.6	15.4		5	LS 4

RY31

0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

RY33

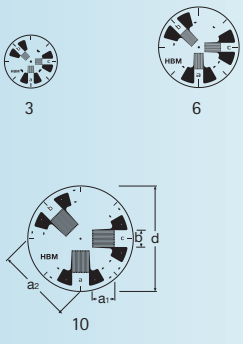
0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

RY3x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: a_2 in mm)



Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

(1) Requirement for solder terminals is not mandatory

Y

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a_1	a_2	b	c	d	V	
1-RY41-3/120		1-RY4x-3/120#	120	0.8	3	0.8	7	7	1.5	LS 7
1-RY41-6/120		1-RY4x-6/120	120	2	6	1.3	11	11	3	LS 5
1-RY41-10/120		1-RY4x-10/120	120	2.9	10	2.6	15.4	15.4	5	LS 4

RY41

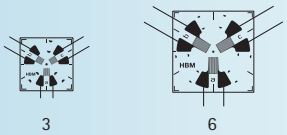
0°/60°/120° – rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

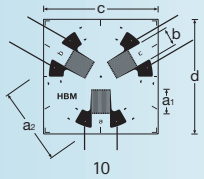
RY4x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: a_2 in mm)





Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals (1)
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a_1	a_2	b	c	d	V	
		1-RY7x-3/120#	120	0.8	3	0.8	7		1.5	LS 7
		1-RY7x-6/120	120	2	6	1.3	11		3	LS 5
		1-RY7x-10/120	120	2.9	10	2.6	15.4		5	LS 4

RY71

0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

RY73

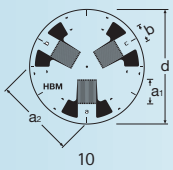
0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

RY7x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: a_2 in mm)



Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

(1) Requirement for solder terminals is not mandatory

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
		1-RY8x-0,6/120#	120	0.6	1.2	4.8	8.7	1.6	LS 7
1-RY81-1,5/120		1-RY8x-1,5/120	120	1.5	1.2	8.2	14.6	2.5	LS 7
1-RY81-3/120	1-RY83-3/120	1-RY8x-3/120	120	3	0.9	9.7	14.6	3	LS 7
1-RY81-6/120		1-RY8x-6/120	120	6	2.6	13.2	22.9	7.5	LS 7
		1-RY8x-1,5/350#	350	1.5	1.6	8.2	14.6	5	LS 7
		1-RY8x-3/350	350	3	0.9	9.7	14.6	5.5	LS 7
1-RY81-6/350		1-RY8x-6/350	350	6	2.6	13.1	22.9	13	LS 5

RY81

0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

RY83

0°/45°/90° – rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

RY8x

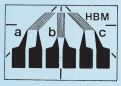
Temperature variation adjusted acc. to customer specification

see page 12

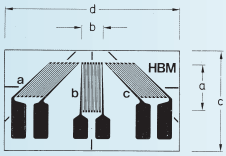
Illustrations show actual size
(Dimensions: Grid length in mm)

1.5


0.6



3



6

Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-RY91-1,5/120		1-RY9x-1,5/120	120	1.5	1.25	9	8	1.5	LS 7
1-RY91-3/120	1-RY93-3/120	1-RY9x-3/120	120	3	1.25	9	9	2	LS 7
1-RY91-6/120	1-RY93-6/120	1-RY9x-6/120	120	6	2.5	12.5	11	4.5	LS 7
1-RY91-10/120		1-RY9x-10/120	120	10	4	18.5	16	7	LS 7

RY91

0°/45°/90° – rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

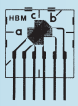
RY93

0°/45°/90° – rosette
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

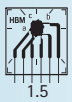
RY9x

Temperature variation adjusted acc. to customer specification

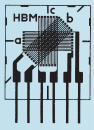
Illustrations show actual size
(Dimensions: Grid length in mm)



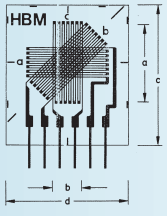
3



1.5



6



10

Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

(1) Requirement for solder terminals is not mandatory

Y

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-VY11-3/120		1-VY1x-3/120	120	3	7	13.5	13.5	6	LS 5/7
1-VY11-6/120		1-VY1x-6/120	120	6	14	23	23	12	LS 5/7

VY11

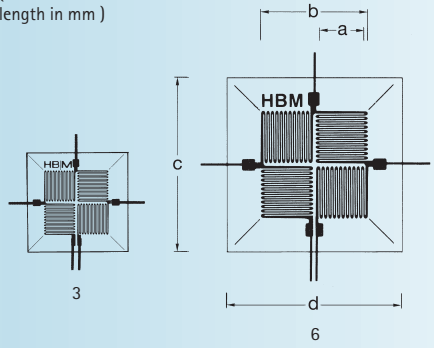
90° – full bridge rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

VY1x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: Grid length in mm)



Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
		1-MY2x-6/120	120	6	–	7.3	–	3.5	LS 7
1-MY21-15/350		1-MY2x-15/350	350	15	–	17	–	13	LS 5

MY21

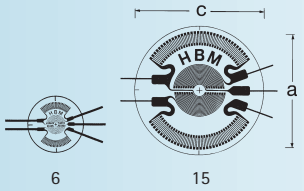
Diaphragm rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

MY2x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimensions: a in mm)



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
1-KY11-1/120	1-KY13-1/120	1-KY1x-1/120#	120	0.6	1	7.2	14.5	1	2	LS 7
1-KY11-2/120	1-KY13-2/120	1-KY1x-2/120	120	1.5	1.3	6.7	24.5	2	2.5	LS 7
1-KY11-4/120		1-KY1x-4/120	120	3	2.1	9.7	44.5	4	5	LS 7

KY11

Chain strain gage
Comprising 10 measuring grids in **parallel** to the chain axis and 1 compensation strain gage
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

KY13

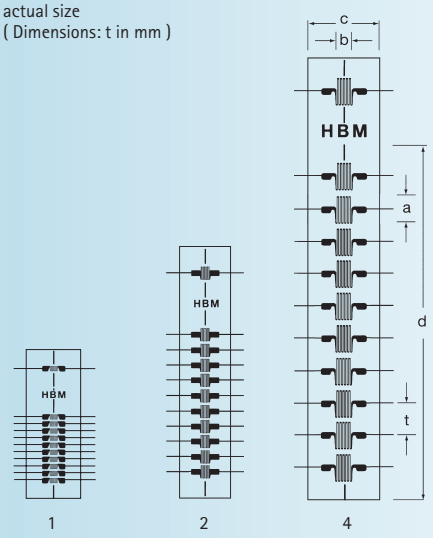
Chain strain gage
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

KY1x

Temperature variation adjusted acc. to customer specification

Illustrations show actual size
(Dimensions: t in mm)

see page 12



Order designation of preference types		Variable order designation	Nominal resis-tance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
1-KY21-1/120	1-KY23-1/120	1-KY2x-1/120#	120	0.8	0.8	6.9	15	1	1.5	LS 7
1-KY21-2/120		1-KY2x-2/120	120	1.7	1.7	9.5	27	2	3.5	LS 7

KY21

Chain strain gage
comprising 10 measuring grids **vertical** to the chain axis and 1 compensation strain gage
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

KY23

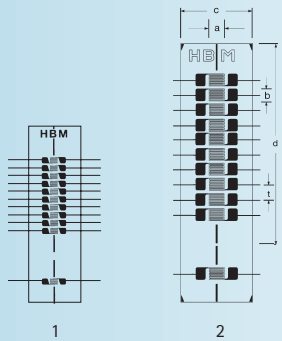
Chain strain gage
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

KY2x

Temperature variation adjusted acc. to customer specification

Illustrations show actual size
(Dimensions: t in mm)

see page 12



Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

Y

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
		1-KY4x-2/120	120	1.2	1.3	9.2	24.5	2	2.5	LS 7
1-KY41-4/120		1-KY4x-4/120	120	3	3	11.5	44.5	4	6	LS 5

KY41

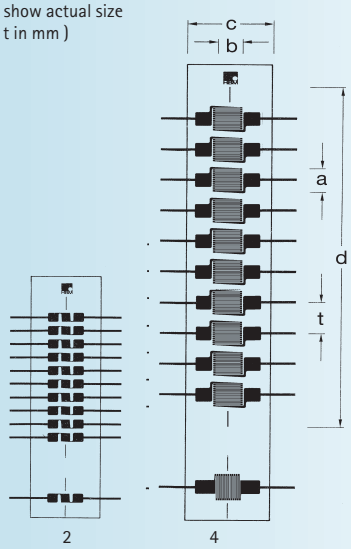
Chain strain gage
comprising 10 measuring grids (5 parallel, 5 vertical to the chain axis, **alternating** and 1 compensation strain gage. Temperature variation adjusted to steel $\alpha = 10{,}8 \cdot 10^{-6}/K$.

KY4x

Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimension t in mm)



Contents per package: 1 pc.

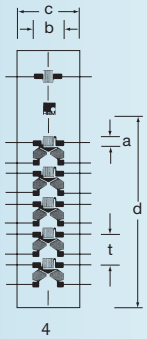
Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
		1-KY3x-4/120	120	1.3	4.1	8.3	25	4	2.5	LS 7

KY3x

Chain strain gage
contains five 0/60/120 degree rosettes comprising 5 rosettes with 3 measuring grids each, 0°/60°/120°, and 1 compensation strain gage
Temperature variation adjusted acc. to customer specification

see page 12

Illustrations show actual size
(Dimension t in mm)



Contents per package: 1 pc.

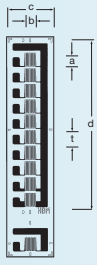
KY5x

Comprising 10 measuring grids parallel to the chain axis and one compensation strain gage
Complete with integrated solder tabs
Temperature variation according to customers specification
see page 12

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
		1-KY5x-1/120#	120	0.6	1.1	5.6	12.8	1	1.5	
		1-KY5x-2/120	120	1.5	1.3	6	22.8	2	2.5	

Illustrations show actual size
(Dimensions: t in mm)


1



2

Contents per package: 5 pc.

KY6x

Comprising 10 measuring grids 90° to the chain axis and one compensation strain gage
Complete with integrated solder tabs
Temperature variation according to customers specification
see page 12

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
		1-KY6x-1/120#	120	0.8	0.6	5.6	12.8	1	1.2	
		1-KY6x-2/120	120	1.3	1.5	6	22.8	2	2.5	

Illustrations show actual size
(Dimensions: t in mm)


1

2

Contents per package: 5 pc.

KY7x

Comprising 10 measuring grids alternating parallel and 90° to the chain axis and one compensation strain gage
Complete with integrated solder tabs
Temperature variation according to customers specification
see page 12

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier				
Steel	Aluminum	Other	Ω	a	b	c	d	t	V	
		1-KY7x-2/120#	120	1.3	1.5	6	22.8	2	2.5	

Illustrations show actual size
(Dimension: t in mm)

Contents per package: 5 pc.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

Series C Strain Gages

- specialist for extreme temperatures (4 K...500 K)
- flexible, therefore easy to handle
- temperature variation adjusted across the entire measuring range

C

Technical Data

strain gage construction		foil strain gage complete with embedded measuring grid
measuring grid		
material		CrNi special alloy
thickness	µm	5
carrier		
material		polyimide
base thickness	µm	45 ± 10
cover thickness	µm	25 ± 5
connections		nickel plated Cu leads, approx. 30mm length
nominal resistance	Ω	120, 350
resistance tolerance	%	± 0.35
gage factor		ca. 2.2
nominal value of gage factor		specified on each package
gage factor tolerance		%± 1
temperature coefficient of the gage factor		specified on each package
reference temperature	°C	23
operation temerature range		
for static, i.e. zero point related measurements	°C	- 200 ... + 200
for dynamic, i.e. not zero point related measurements	°C	- 269 ... + 250
transverse sensitivity within reference temperature range using adhesive Z 70 on strain gage type LY 11-6/120	%	- 0.15
temperature variation		specified on each package
temperature variation acc. to selection, adjusted to thermal expansion coefficient α	1/K	10.8· 10^{-6}
for ferritic steel		
for aluminum	1/K	23 ·10^{-6}
temperature variation tolerance	1/K	± 0.6 · 10^{-6}
adjustment of temperature variation within range	°C	-200 ... + 250
mechanical hysteresis[1] at reference temperature and strain ε = ± 1000 µm/m strain gage type LY 11-6/120		
at 1st load cycle and adhesive Z 70	µm/m	1.25
at 3rd load cycle and adhesive Z 70	µm/m	0.75
maximum elongation[1] at reference temperature using adhesive Z 70 on strain gage type LY 11_6/120		
strain limit ε for positive direction	µm/m	20 000 (≙ 2 %)
strain limit ε for negative direction	µm/m	100 000 (≙ 10 %)
fatigue life[1] at reference temperature using adhesive X 60 on strain gage type LY 11-6/120		
stress cycle value L_w at		
alternating strain ε_w = ± 1000 µm/m and zero zero point drift $\varepsilon_m \Delta \leqq 300$ µm/m		>> 10^7 (test was interrupted at 10^7)
$\varepsilon_m \Delta \leqq 30$ µm/m		> 10^7 (test was interrupted at 10^7)
minimum radius of curvature, longitudinal and transverse, at reference temperature		
within the measuring grid area	mm	0.3
within the area of the solder tabs	mm	2
usable bonding materials		
cold curing adhesives		Z 70; X 60; X 280
hot curing adhesives		EP 250; EP 310

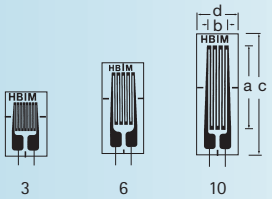
[1] The data depend on the various parameters of the specific application and are therefore stated for representative example only

LC11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-LC11-3/120			120	3	3.2	8.5	5.5	6	LS 5
1-LC11-6/120			120	6	3.2	12	5.5	9	LS 5
1-LC11-10/120			120	10	3.2	16	5.5	11	LS 5
1-LC11-3/350		1-LC1x-3/350*	350	3	3.2	8.5	5.5	10	LS 5
1-LC11-6/350		1-LC1x-6/350*	350	6	3.2	12	5.5	14	LS 5
1-LC11-10/350		1-LC1x-10/350*	350	10	3.2	16	5.5	18	LS 5

Illustrations show actual size
(Dimensions: Grid length in mm)



3 6 10

Contents per package: 10 pcs.

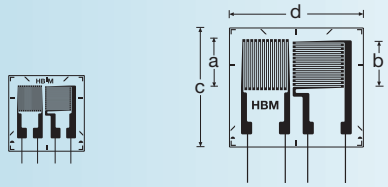
Types marked by * are only available with adjustment for aluminum and/or steel

XC11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-XC11-3/350		1-XC1x-3/350*	350	3	3.2	10	10	10	LS 7
		1-XC1x-6/350*	350	6	6.2	16	18	20	LS 4

Illustrations show actual size
(Dimensions: Grid length in mm)



3 6

Contents per package: 5 pcs.

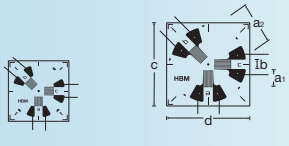
Types marked by * are only available with adjustment for aluminum and/or steel

RC11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid			Measuring grid Carrier			
Steel	Aluminum	Other	Ω	a_1	a_2	b	c	d	V	
1-RC11-4/350		1-RC1x-4/350*	350	1.1	4	1.1	8	8	3.5	LS 7
		1-RC1x-6/350*	350	2	6	1.3	11	11	5	LS 5

Illustrations show actual size
(Dimensions: Grid length in mm)



4 6

Contents per package: 5 pcs.

Types marked by # are available adapted to aluminum, ferritic steel or austenitic steel only

Series G Strain Gages

- strain gages for the manufacture of transducers
- nominal resistance 120 Ω and 350 Ω are available
- carrier material: glass fibre reinforced phenolic resin
  measuring grid material: Constantan

Technical Data

strain gage construction		foil strain gage complete with embedded measuring grid
measuring grid		
material		Constantan foil
thickness	µm	3.8 or 5. depending on strain gage type
carrier		
material		polyimide
base thickness	µm	35 ± 10
cover thickness	µm	25 ± 8
connections		nickel plated Cu leads, 0.2 bzw. 0.3 x 0.06 x 30 mm
nominal resistance	Ω	120 oder 350, depending on strain gage type
resistance tolerance	%	± 0.35[2]
gage factor		approx. 2
nominal value of gage factors		specified on each package
gage factor tolerance for 0.6 mm and 1.5 mm measuring grid length	%	± 1.5
for ≧ 3 mm measuring grid length	%	± 0.7
temperature coefficient of the gage factor	1/K	approx. (115 ± 10) · 10^{-6}
nominal value of temperature coefficient of gage factor		specified on each package
reference temperature	°C	23
operation temperature range		
for static, i.e. zero point related measurements	°C	- 70 ... + 200
for dynamic, i.e. not zero point related measurements	°C	-200 ... + 200
transverse sensitivity		
within reference temperature range using adhesive Z 70		
on strain gage type LG 11-6/120	%	- 0.1
temperature variation		specified on each package
temperature variation acc. to selection, adjusted to thermal expansion coefficient α		
α for ferritic steel	1/K	10.8 · 10^{-6}
α for aluminum	1/K	23 · 10^{-6}
other temperature variation adjustment on request		
temperature variation tolerance	1/K	± 0.3 · 10^{-6}
adjustment of temperature variation within range	°C	-10 ... + 120
mechanical hysteresis[1]		
at reference temperature and strain ε = ± 1000 µm/m		
strain gage type LG 11-6/120		
at 1st load cycle and adhesive EP 250	µm/m	0.5
at 3rd load cycle and adhesive EP 250	µm/m	0.5
at 1st load cycle and adhesive X 60	µm/m	3
at 3rd load cycle and adhesive X 60	µm/m	1.5
at strain gage type LG11-3/350		
at 1st load cycle and adhesive Z 70	µm/m	1.6
at 3rd load cycle and adhesive Z 70	µm/m	0.8
maximum elongation[1]		
at reference temperature using adhesive Z 70 on		
strain gage type LG 11-6/120		
strain limit ε for positive direction	µm/m	20 000 (≙ 2 %)
strain limit ε for negative direction	µm/m	50 000 (≙ 5 %)
fatigue life[1]		
at reference temperature using adhesive Z 70 on		
strain gage type LG 11-6/120		
stress cycle value L_w at alternating strain ε_w = ± 1000 µm/m and		
zero zero point drift $\Delta \varepsilon_m \leqq 300$ µm/m		>> 10^7
$\Delta \varepsilon_m \leqq$ 30 µm/m	3 · 10^6	
at strain gage type LG11-6/350		
$\Delta \varepsilon_m \leqq 300$ µm/m	>> 10^7	
$\Delta \varepsilon_m \leqq$ 30 µm/m	3 · 10^6	
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	3
usable bonding materials		
cold curing adhesives		Z 70; X 60; X 280
hot curing adhesives		EP 250; EP 310

[1] The data depend on the various parameters of the specific application and are therefore stated for representative examples only.
[2] With measuring grid lengths of 0.6 mm, the nominal resistance may deviate by ± 1%.

LG11

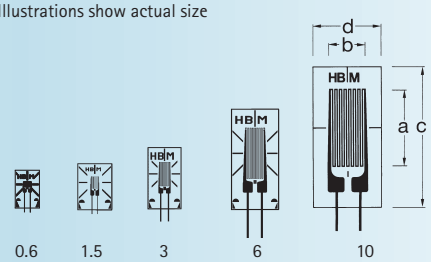
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LG13

Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Order designation of preference types		Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid		Measuring grid carrier			
Steel	Aluminum	Ω	a	b	c	d	V	
1-LG11-0,6/120		120	0.6	1.4	5	3.2	1.5	LS 7
1-LG11-1,5/120		120	1.5	1.2	6.5	4.7	2.5	LS 7
1-LG11-3/120		120	3	1.4	8.3	4.5	4	LS 7
1-LG11-6/120	1-LG13-6/120	120	6	2.8	13	6.3	8	LS 5
1-LG11-10/120		120	10	4.9	18.5	9.5	13	LS 5
1-LG11-3/350	1-LG13-3/350	350	3	1.5	8.5	4.5	7	LS 7
1-LG11-6/350	1-LG13-6/350	350	6	2.9	13	6	14	LS 5
1-LG11-10/350	1-LG13-10/350	350	10	5.0	18.5	9.5	23	LS 5

Illustrations show actual size



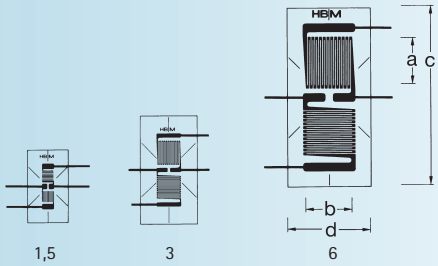
Contents per package: 10 pcs.

XG11

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid		Measuring grid carrier			
Steel	Aluminum	Ω	a	b	c	d	V	
1-XG11-1,5/120		120	1.5	1.5	10.3	5.7	3	LS 5
1-XG11-3/120		120	3	3.0	14.5	7.5	6	LS 4
1-XG11-6/120		120	6	6.0	23.5	11	12	LS 5
1-XG11-3/350		350	3	3.0	14.4	7.3	10	LS 4
1-XG11-6/350		350	3	6.0	23.3	10.5	20	LS 5

Illustrations show actual size



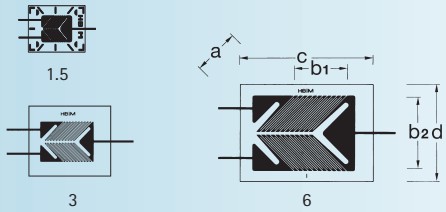
Contents per package: 5 pcs.

XG21

Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]					Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid			Measuring grid carrier			
Steel	Aluminum	Ω	a	b_1	b_2	c	d	V	
1-XG21-1,5/120		120	1.5	1.9	2.5	7.6	6.3	2.5	LS 7
1-XG21-3/120		120	3	4.3	5.3	11.2	9.5	6	LS 5
1-XG21-6/120		120	6	8	10	17.5	12.7	11	LS 5
1-XG21-6/350		350	6	7.8	10	17.5	12.7	19	LS 5

Illustrations show actual size



Contents per package: 5 pcs.

Series K Strain Gages

Technical data

Type		LK11, LK13, DK11, DK13, XK51, XK53, XK11, XK13, MK11	LK21,LK23, LK41, DK21, DK23, XK61, XK21, MK21
strain gage construction		foil strain gage with embedded measuring grid, with integrated leads	foil strain gage open face, with integrated solder tabs
measuring grid			
material		Constantan foil	
thickness	µm	5	
carrier			
material		phenolic resin, glass fibre reinforced	
base thickness	µm	35 ± 10	
cover thickness	µm	25 ± 8	–
connections		nickel plated Cu leads, approx. 30mm in length	–
nominal resistance	Ω	350	
resistance tolerance [2]	%	± 0,35	± 0,3
gage factor		approx. 2	
nominal value of gage factor		specified on each package	
gage factor tolerance	%	± 0,7	
temperature coefficient of the gage factor	1/K	ca. (115 ± 10) · 10^{-6}	
nominal value of temperature coefficient of gage factor		specified on each package	
reference temperature	°C	23	
operation temperature range			
for static, i.e. zero point related measurements	°C	- 70 ... + 200	
for dynamic, i.e. not zero point related measurements	°C	- 200 ... + 200	
transverse sensitivity			
within reference temperature range using adhesive Z 70	%		
on strain gage type LK 11-6/120		- 0,9	
temperature variation		specified on each package	
temperature variation acc. to selection, adjusted to thermal expansion coefficient α			
α for ferretic	1/K	10,8 · 10^{-6}	
α für Aluminum	1/K	23 · 10^{-6}	
other adaptions on request			
temperature variation tolerance	1/K	± 0,3 ...· 10^{-6}	
adjustment of the temperature variation within range	°C	-10 ... + 120	
creep adjustment			
The end loop length „u" corresponds to a multiple of the grid line width s		ID letter	
 end loop		A: u = 1s C: u = 2s E: u = 3s G: u = 4s I: u = 5s K: u = 6s	M: u = 7s O: u = 8s Q: u = 9s S: u = 10s U: u = 11s W: u = 12s
mechanical hysteresis[1]			
at reference temperature and strain ε = ± 1000 µm/m			
on strain gage type LK11E-3/350			
at 1st load cycle and adhesive Z 70	µm/m	1,1	
at 3rd load cycle and adhesive Z 70	µm/m	0,8	
maximum elongation[1]			
at reference temperature using adhesive Z 70 on			
strain gage type LK 11-6/120			
strain limit ε for positive direction	µm/m	20 000 (≙ 2 %)	
strain limit ε for negative direction	µm/m	50 000 (≙ 5 %)	
fatigue life[1]			
at reference temperature using adhesive Z 70			
on strain gage type LK 11-6/120			
stress cycle value L_a at alternating strain ε_w = ± 1000 µm/m and			
zero zero point drift $\Delta \varepsilon_m \leqq$ 300 µm/m		>> 10^7	
$\Delta \varepsilon_m \leqq$ 30 µm/m		3 · 10^6	
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	3	
usable bonding materials			
cold curing adhesives		Z 70; X 60; X 280	
hot curing adhesives		EP 250; EP 310	

[1] The data depend on the various parameters of the specific application and are therefore stated for representative examples only.
[2] With measuring grid lengths of 0.6 mm, the nominal resistance may deviate by ± 1%.

Type		creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid		Measuring grid carrier			
Steel	Aluminum		a	b	c	d	V	
1-LK11E-3/350	1-LK13E-3/350	E	3	3	9.5	5	10	LS 212
1-LK11K-3/350	1-LK13G-3/350	K/G	3	3	9.5	5	10	LS 212
1-LK11O-3/350	1-LK13K-3/350	O/K	3	3	9.5	5	10	LS 212
1-LK11E-6/350	1-LK13A-6/350	E/A	6	3	12.5	5	14	LS 212
1-LK11G-6/350	1-LK13C-6/350	G/C	6	3	12.5	5	14	LS 212
1-LK11I-6/350	1-LK13E-6/350	I/E	6	3	12.5	5	14	LS 212

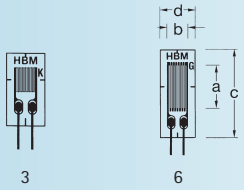
LK11

with cover
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LK13

with cover
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)



3 6

Contents per package: 10 pcs.

Type		creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
			Measuring grid		Measuring grid carrier			
Steel	Aluminum		a	b	c	d	V	
1-LK21K-3/350	1-LK23O-3/350	K/O	3	3	9.5	5	9	LS 212
1-LK21O-3/350	1-LK23S-3/350	O/S	3	3	9.5	5	9	LS 212
1-LK21S-3/350	1-LK23W-3/350	S/W	3	3	9.5	5	9	LS 212
1-LK21G-6/350		G	6	3	12.5	5	13	LS 212
1-LK21K-6/350		K	6	3	12.5	5	13	LS 212
1-LK21O-6/350		O	6	3	12.5	5	13	LS 212

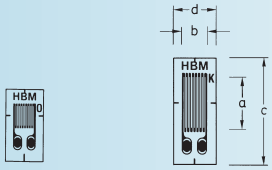
LK21

open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

LK23

open face
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)



3 6

Contents per package: 10 pcs.

Type	creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
		Measuring grid		Measuring grid carrier			
Steel		a	b	c	d	V	
1-LK41K-3/350	K	3	3	10.5	5	9	LS 212
1-LK41O-3/350	O	3	3	10.5	5	9	LS 212
1-LK41S-3/350	S	3	3	10.5	5	9	LS 212

LK41

open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)

3

Contents per package: 10 pcs.

(1) Requirement for solder terminals is not mandatory

K

Type		creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid		Measuring grid carrier			
Steel	Aluminum		a	b	c	d	V	
1-DK11G-3/350	1-DK13E-3/350	G/E	3	3	9.5	8.5	10	LS 224
1-DK11K-3/350	1-DK13G-3/350	K/G	3	3	9.5	8.5	10	LS 224
1-DK11O-3/350	1-DK13K-3/350	O/K	3	3	9.5	8.5	10	LS 224
1-DK11E-6/350	1-DK13A-6/350	E/A	6	3	12.5	8.5	14	LS 224
1-DK11G-6/350	1-DK13C-6/350	G/C	6	3	12.5	8.5	14	LS 224
1-DK11I-6/350	1-DK13E-6/350	I/E	6	3	12.5	8.5	14	LS 224

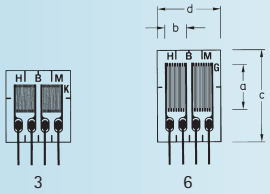
DK11

with cover
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

DK13

with cover
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Type		creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
			Measuring grid		Measuring grid carrier			
Steel	Aluminum		a	b	c	d	V	
1-DK21K-3/350	1-DK23O-3/350	K/O	3	3	9.5	8.5	9	LS 224
1-DK21O-3/350	1-DK23S-3/350	O/S	3	3	9.5	8.5	9	LS 224
1-DK21S-3/350	1-DK23W-3/350	S/W	3	3	9.5	8.5	9	LS 224
1-DK21G-6/350	1-DK23G-6/350	G/G	6	3	12.5	8.5	13	LS 224
1-DK21K-6/350	1-DK23K-6/350	K/K	6	3	12.5	8.5	13	LS 224
1-DK21O-6/350	1-DK23O-6/350	O/O	6	3	12.5	8.5	13	LS 224

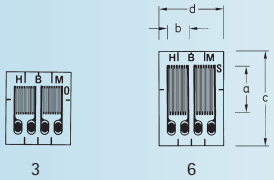
DK21

open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

DK23

open face
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

Type		creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
			Measuring grid		Measuring grid carrier			
Steel	Aluminum		a	b	c	d	V	
1-XK51A-3/350	1-XK53A-3/350	A	3	3	10	10	10	LS 224
1-XK51E-3/350	1-XK53E-3/350	E	3	3	10	10	10	LS 224
1-XK51M-3/350	1-XK53M-3/350	M	3	3	10	10	10	LS 224
1-XK51A-6/350		A	6	6	16	18	20	LS 224
1-XK51C-6/350		C	6	6	16	18	20	LS 224
1-XK51E-6/350		E	6	6	16	18	20	LS 224

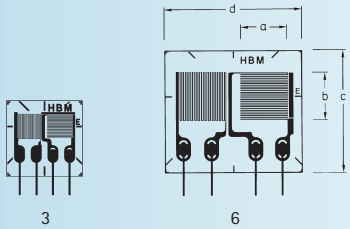
XK51

with cover
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XK53

with cover
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

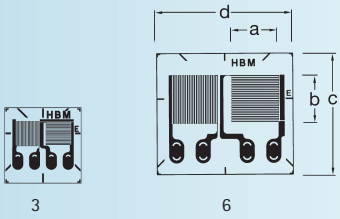
(1) Requirement for solder terminals is not mandatory

XK61

open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Type Steel	Type Aluminum	creep adjustment	Dimensions (mm) [1 inch = 25.4 mm] Measuring grid a	Measuring grid b	Measuring grid carrier c	Measuring grid carrier d	Max. perm. effective bridge supply voltage V	Solder terminals (1)
1-XK61A-3/350		A	3	3	10	10	9	LS 224
1-XK61E-3/350		E	3	3	10	10	9	LS 224
1-XK61M-3/350		M	3	3	10	10	9	LS 224
1-XK61A-6/350		A	6	6	16	18	18	LS 224
1-XK61E-6/350		E	6	6	16	18	18	LS 224
1-XK61I-6/350		I	6	6	16	18	18	LS 224

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

XK11

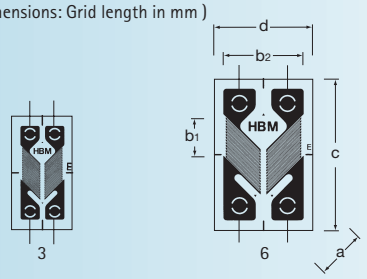
with cover
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

XK13

with cover
Temperature variation adjusted to Aluminum with $\alpha = 23 \cdot 10^{-6}/K$

Type Steel	Type Aluminum	creep adjustment	Dimensions (mm) [1 inch = 25.4 mm] Measuring grid a	Measuring grid b_1	Measuring grid b_2	Measuring grid carrier c	Measuring grid carrier d	Max. perm. effective bridge supply voltage V	Solder terminals
1-XK11E 3/350	1-XK13E 3/350	E	3	4.5	5.5	15	8	10	LS 224
1-XK11K 3/350	1-XK13G 3/350	K/G	3	4.5	5.5	15	8	10	LS 224
1-XK11O 3/350	1-XK13K 3/350	O/K	3	4.5	5.5	15	8	10	LS 224
1-XK11E 6/350	1-XK13A 6/350	E/A	6	5.5	10.4	20	13	15	LS 212
1-XK11G 6/350	1-XK13C 6/350	G/C	6	5.5	10.4	20	13	15	LS 212
1-XK11I 6/350	1-XK13E 6/350	I/C	6	5.5	10.4	20	13	15	LS 212

Illustrations show actual size
(Dimensions: Grid length in mm)



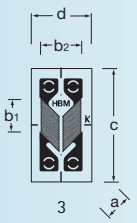
Contents per package: 5 pcs.

XK21

open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Type Steel	Type Aluminum	creep adjustment	Dimensions (mm) [1 inch = 25.4 mm] Measuring grid a	Measuring grid b_1	Measuring grid b_2	Measuring grid carrier c	Measuring grid carrier d	Max. perm. effective bridge supply voltage V	Solder terminals (1)
1-XK21K 3/350		K	3	4.5	5.5	15	8	9	LS 224
1-XK21O 3/350		O	3	4.5	5.5	15	8	9	LS 224
1-XK21S 3/350		S	3	4.5	5.5	15	8	9	LS 224

Illustrations show actual size
(Dimensions: Grid length in mm)



Contents per package: 5 pcs.

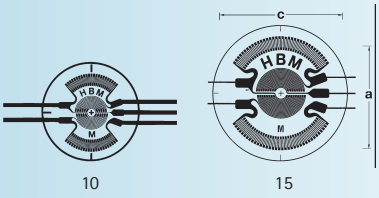
(1) Requirement for solder terminals is not mandatory

Type	creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
		Measuring grid		Measuring grid carrier			
Steel		a		c	d	V	
1-MK11M-10/350	M	10	–	13	–	8	LS 224
1-MK11M-15/350	M	15	–	18	–	13	LS 224

MK11

diaphragm rosette with cover
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimension a in mm)



Contents per package: 5 pcs

Type	creep adjust-ment	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals (1)
		Measuring grid		Measuring grid carrier			
Steel		a		c	d	V	
1-MK21M-10/350	M	10	–	12	–	7	LS 224

MK21

diaphragm rosette open face
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Illustrations show actual size
(Dimensions: Grid length in mm)

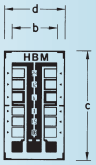
Contents per package: 5 pcs.

(1) Requirement for solder terminals is not mandatory

NA1 6/4,73

Adjustable foil resistor for zero point balancing on a polyimide carrier with a raw resistance of twice 9 Ω ± 20%. For each bridge branch, a maximum of 4.73 ohms can be adjusted - with the following stages:
2,4 Ω – 1,2 Ω – 0,6 Ω – 0,3 Ω – 0,15 Ω – 0,08 Ω ± 20%

Zero point balancing resistor

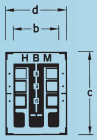


Contents per package: 10 pcs.

TN1 3/1,05

Adjustable foil resistor for the temperature compensation of the zero point. Nickel foil on a polyimide carrier with a raw resistance of twice 0.7Ω ±20%. For each bridge branch, a maximum of 1.05 ohms can be adjusted - with the following stages: 0,6 Ω – 0,3 Ω – 0,15 Ω ± 20%
Temperature coefficient of the resistor:
(+ 20°C...+ 70°C): 4,9 · 10^{-3}/K

TC_0 compensation resistor

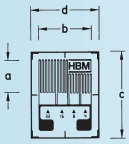


Contents per package: 10 pcs.

TC1 4/60

Adjustable foil resistor for compensation of TCspan. Nickel foil on a polyimide carrier with a raw resistance of twice 1 Ω ±20%. A maximum of 60 Ω can be adjusted - with the following stages:
32 Ω – 16 Ω – 8 Ω – 4 Ω ± 20%
Temperature coefficient of the resistor:
(+ 20°C...+ 70°C): 4,9 · 10^{-3}/K

TCspan compensation resistor

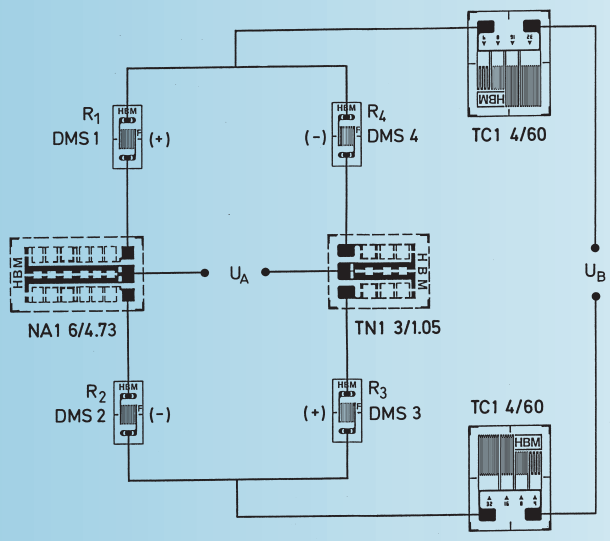


Contents per package: 10 pcs.

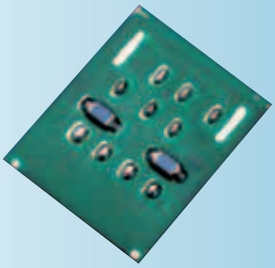
Type	Dimensions (mm); 1 inch = 25.4 mm			
	grid	carrier		
	a	b	c	d
1-NA1-6/4,73		6	14.5	8
1-TN1-3/1,05		6	11	8
1-TC1-4/60	4.2	7	11.5	9

K

Wheatstone bridge circuit with integrated balancing and compensation elements

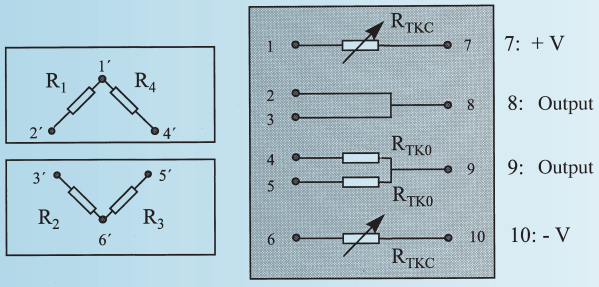


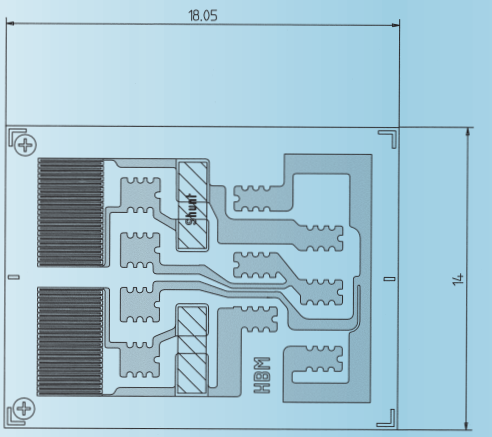
Features



- compensation of the TC-span error
- compensation of TC_0-error
- closely tolerated TC-span error
- significantly reduced wiring effort
- excellent quality
- short response time in the event of temperature changes

Function Diagram





Technical Data

- TC-span compensation for aluminum tolerance +- 30 ppm/10K (for bridge resistance R_B = 350 Ω ± 0,7 Ω)
- TC-zero compensation range ± 500ppm/10K
- pre-tinned soldering tabs
- the element is coated with a protective finish
- dimensions: 18.05 mm x 14 mm x 0.8 mm

Are you interested ?

Request additional information material or contact us directly

or attend our seminar

The following scripts are available

- Notes on installing a compensation element
- TC-zero balancing with the 1-TCE 01-AL
- Zero balancing of the Wheatstone bridge
- Correction of TC-span errors
- Calibration of a load cell

Seminar DM

- Everything you need to know regarding the manufacture of transducers on a strain gage basis
- Application of compensation element 1-TCE 01-AL
- Stress analysis with strain gages

Series V Strain Gages

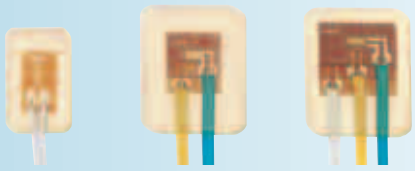
- low cost encapsulated strain gages
- 3m cable, PVC insulated
- high mechanical protection

Order designation of preference types	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage
		Measuring grid		Measuring grid carrier		
Steel	Ω	a	b	c	d	V
1-LV41-3/120	120	3	1.1	19	12	2
1-XV91-3/120	120	3	1.4	24.5	20.5	2
1-RV91-3/120	120	3	1.25	24.5	20.5	1

LV41
Contents per package: 10 pcs.
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}$/K

XV91
T-rosette 0°/90°
Contents per package: 5 pcs.

RV91
0°/45°/90° rosette
Contents per package: 5 pcs.



LV41 XV91 RV91

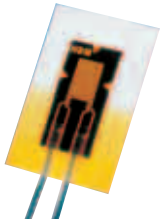
Technical Data

strain gage constuction		foil strain gage with embedded measuring grid
measuring grid		in plastic resin
material		Constantan foil
thickness	µm	5
carrier		
material		polyimide
base thickness	µm	45 ± 10
cover thickness	µm	25 ± 5
total thickness	mm	1.5
connections		PVC coated stranded wire for connection, 3m in length, two wire connection
nominal resistance	Ω	120; connection leads inclusive
resistance tolerance	%	± 0.5
gage factor		approx. 2
nominal value of gage factor		specified on each package
gage factor tolerance	%	± 1
temperature coefficient of the gage factor	1/K	ca. (115 ± 10) · 10^{-6}
nominal value of temperature coefficient of gage factor		specified on each package
reference temperature	°C	23
operation temperature range		
for static, i.e. zero point related measurements	°C	–30 ... + 105
for dynamic, i.e. not zero point related measurements	°C	–30 ... + 105
temperature variation		specified on each package
Adjustment of temperature variation within range	°C	–10 ... + 105
maximum elongation[1]		
bat reference temperature using adhesive Z 70 on strain gage type LV41-3/120		
strain limit ε for positive direction	µm/m	20 000 (≙ 2 %)
strain limit ε for negative direction	µm/m	50 000 (≙ 5 %)
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	10
usable bonding materials		
cold curing adhesives		Z 70; X 60; X280

[1] The data depend on the various parameters of the specific application and are therefore stated for representative examples only.

Encapsulated Strain Gage complete with stranded wire

- according to protection class IP 67[1)]
- with 1 m teflon-insulated connection wire
- proof against humidity and resistant against chemicals[2)], as encapsulated on all sides
- excellent zero signal stability with changing humidity
- optional selection of 2-wire or 4-wire circuit

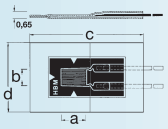


Order designation of preference types	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage
		Measuring grid		Measuring grid carrier		
Steel	Ω	a	b	c	d	V
1-LE11-3/350Z (2-wire connection)	350	3	2	15	9	6
1-LE11-3/350V (4-wire connection)	350	3	2	15	9	6

LE11

encapsulated linear gage
Temperature variation adjusted to steel with
$\alpha = 10.8 \cdot 10^{-6}$ /K

Illustration shows actual size



Contents per pack. 5 pcs.

Technical Data

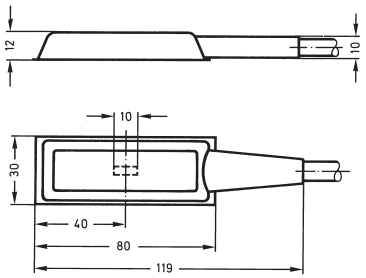
Type		LE11-3/350
strain gage construction		foil strain gage, IP 67, resistant against chemicals[2)]
measuring grid material		Constantan foil
measuring grid length	mm	3
carrier		
material		special plastic material
thickness	µm	25
cover material		special plastic material, 25 µm in thickness
thickness of the complete strain gage	mm	0.65
nominal resistance	Ω	350
resistance tolerance per package	%	± 0.5
gage factor		approx. 2
nominal value of gage factors		specified on each package
gage factor tolerance	%	± 1
reference temperature	°C	+ 23
operation temperature range		
for application with Z 70	°C	- 70 ... + 120
for application with EP 250/EP 310/X 280	°C	-200 ... + 180
temperature variation adjusted to		
thermal expansion coefficient α for ferretic steel	1/K	$10.8 \cdot 10^{-6}$
adjustment of temperature variation within range	°C	- 10...+ 120
transverse sensitivity at reference temperature using adhesive Z 70	%	0.25
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	3
maximun elongation at reference temperature	µm/m	± 50 000 (≙ ± 5 %)
fatigue life[1)] at reference temperature using adhesive Z 70		
stress cycle value L_w at alternating strain $\varepsilon_w = \pm 1000$ µm/m and zero zero point drift $\Delta \varepsilon_m \leqq 300$ µm/m		>> 10^7 (test was interrupted at 10^7)
$\Delta \varepsilon_m \leqq 30$ µm/m		> 10^7 (test was interrupted at 10^7)
connection cable 1m in length		2 or 4 teflon-insulated wires
adhesive		Z 70, EP 310, EP 250, X 280

[1)] Please note the resistance of the adhesive used for bonding the strain gage
[2)] Strongly concentrated acids (sulphuric acid, nitric acid) only will destroy this special plastic material.
High resistance against fuels and engine oils.

Here, you will find the suitable strain gage for applications in unfavourable conditions, e.g. on building sites or in difficult to access positions, already completely wired up and perfectly protected against environmental influences.

This encapsulated strain gage complete with connection wires or cables is particularly suitable for use in rough environmental conditions which require a special protection for the strain gage.

DA2



Illustrations do not show actual size
Contents per package 1 pc.

Type	Application	Special Requirements	R_{nenn}	Temperature variation adjusted to	Bonding
DA2	Steel beams, ships, etc.	half-bridge, one gage active	120 Ω	Steel with $\alpha = 10.8 \cdot 10^{-6}$ /K	X60

Technical Data

Type		DA 2
strain gage construction		foil strain gage
measuring grid material		Constantan foil
mesuring grid length	mm	10
carrier		
material		polyimide/brass sheet metal
thickness	mm	0.2
cover material		rubber
nominal resistance	Ω	120 (half-bridge), 1 strain gage is active
resistance tolerance	%	± 1
gage factor		approx. 2
nominal value of gage factor		specified on strain gage
maximum permissible bridge supply voltage	V	6
reference temperature	°C	+ 23
operation temperature range		
for applications with X 60/Z 70	°C	- 70 ... + 60
temperature variation adjusted to		
thermal expansion coefficient α for ferretic Steel	1/K	$10.8 \cdot 10^{-6}$
temperature variation on steel 0°... 50°C	$\frac{\mu m}{m}$/K	< 3
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	–
maximum elongation at reference temperature	µm/m	± 3000 (≙ ± 0.3%)
for 1000 strain alternations	µm/m	± 1000 (≙ ± 0.1%)
for 10000 strain alternations	µm/m	± 500 (≙ ± 0.05%)
strain related restoring force	$\frac{N}{1000\ \mu m/m}$	approx. 550
weight c/w cable, approx.	g	395
connection cable, 5m in length		three wire, screened
usable bonding materials		
adhesive		X 60
contents per package	pcs.	1

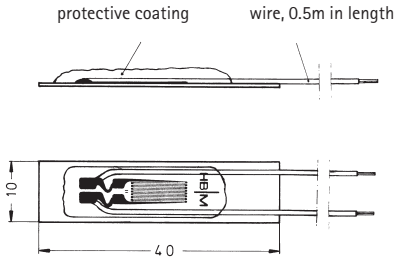
Application

Strain measurements in increased temperatures on weldable components, on which - due to their size - strain gage application with hot curing adhesive is not possible. Strain gage use „on site" where the cleanliness required for bonding cannot be guaranteed (on construction sites, in production plants etc.).

Attachment

Spot welding is among the simplest attachment procedures for strain gages as hardly any preparations are necessary, and very little practical experience is required of users.

LS31



Illustrations do not show actual size
Contents per package: 5 pcs.

Technical Data

Type		LS 31
strain gage construction		foil strain gage (quarter bridge), polymide carrier and Constantan measuring grid, hot-bonded to carrier sheet
measuring grid length	mm	6
carrier sheet		
l x b	mm	40 x 10
thickness	mm	0,1
material		X 8 Cr 17 (1.4016)
nominal resistance	Ω	350
resistance tolerance per package	%	± 1
gage factor		approx. 2
nominal value of gage factor		specified on strain gage
maximum permissible bridge supply voltage	V	15
reference temperature	°C	+ 23
operation temperature range	°C	- 200 ... + 150
temperature variation adjusted to thermal expansion coefficient		
thermal expansion coefficient α for ferretic steel	1/K	$10.8 \cdot 10^{-6}$
adjustment of temperature variation within range	°C	- 10...+ 120
minimum radius of curvature, longitudinal and transverse, at reference temperature	mm	75
maximum elongation at reference temperature	µm/m	±3000 (≙ ± 0.3 %)
srtain related restoring force	$\frac{N}{1000\ \mu m/m}$	< 250
bonding type	spot welding	

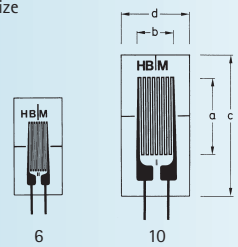
[1] Each package contains 2 metal sheets for welding exercise

LD20

for high strains
Temperature variation not adjusted

Order designation	Nominal resistance Ω	Dimensions (mm) [1 inch = 25.4 mm] Measuring grid a	b	Measuring grid carrier c	d	Max. perm. effective bridge supply voltage V	Solder terminals
1-LD20-6/120	120	6	2,8	12,8	6	8	LS 7
1-LD20-10/120	120	10	4,9	18,5	9,5	13	LS 5

Illustrations show actual size



Contents per package: 10 pcs.

Strain gages for high strain

These strain gage can be used wherever there is extreme strain or compression.

Technical Data

maximum elongation:
± 100000µm/m (≙±10%).
Fatigue life: cannot stand as much cycles as Y strain gages.
Temperature variation: not adjusted

Other data: see p. 15

Crack propagation gages

Using crack propagation gages, it is possible to determine the crack propagation on a component. HBM offers three different types: Type RDS22 consists of grid lines connected in parallel which will tear if the crack extends underneath the crack propagation gage.

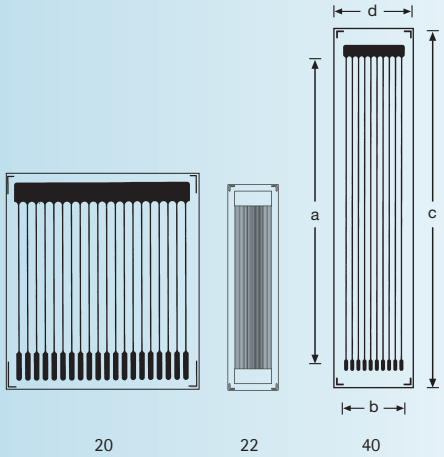
This will increase the electrical resistance of the strain gage in stages as the crack continues to extend.

The types RDS20 and RDS40 consist of electrically separated grid lines, that is, as the crack extends individual circuits will be interrupted.

Order designation of standard type	Resistance per tie	Dimensions (mm); [1 inch = 25.4 mm] tie length	measuring grid width	carrier		Pitch t tie centre/ tie centre	Number of ties	Max. perm. effective bridge supply voltage
	Ω	a	b	c	d	mm		V
1-RDS20	13	20	22.5	28	25	1.15	20	1.5
1-RDS22	44	22	5	27.8	6.8	0.1	50	0.8
1-RDS40	28	40	8.4	47	10	0.8	10	2.5
Resistance tolerance ± 15%								

RDS20, RDS22, RDS40

Illustrations show actual size



20 22 40

Contents per package: 5 pcs.

Construction:

Carrier: phenolic resin, glass fibre reinforced, thickness (35 ± 10) µm
Grid: Constantan foil, thickness 5 µm

Strain Gages for Determination of Residual Stress

For determining residual stresses, the two following proven strain gage based technologies are frequently used: the ring core method and the hole-drilling method. A common feature of both methods is the following application of the strain gage rosettes onto the workpiece, the residual stress condition is disturbed by a suitable process. In case of ring core method this is done by cutting a circular groove around the strain gage rosette. In case of the hole-drilling method, a milling cutter is used to drill a hole into the centre of a strain gage rosette. Following this action, residual stresses effect strains on the surface of the workpiece, which are detected by the strain gage rosettes, and then used for calculating the residual stress state.

Within the HBM product range, you can select among three different processes for determining residual stresses.

Ring core method

The rosettes XY51 (for residual stresses with known principal direction) and RY51 (for residual stresses with unknown principal direction) are specifically designed for the ring core method. This process enables to carry out high precision measurements and as a result you`ll get the residual stresses in relation to the depth.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-XY51-5/350			350	5	2.5	12	–	6.5	–

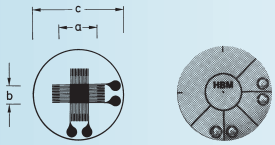
XY51

0°/90° ring core rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel
with $\alpha = 10.8 \cdot 10^{-6}/K$
Adjustment of the temperature variation within the range: + 10°... + 60°C

Technical Data:
Resistance tolerance ± 1 %
Other data: see p. 15

As these strain gages are covered by a print plate, they can be used on level or weakly curved surfaces only.

Illustrations show actual size



Contents per package: 5 pcs.

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-RY51-5/350			350	5	2.5	12	–	4.5	–

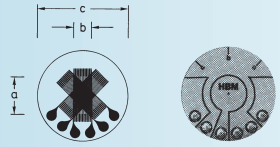
RY51

0°/45°/90° ring core rosette
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel
with $\alpha = 10.8 \cdot 10^{-6}/K$
Adjustment of the temperature variation within the range: + 10°... + 60°C

Technical Data:
Resistance tolerance ± 1 %
Other data: see p. 15

As these strain gages are covered by a print plate, they can be used on level or weakly curved surfaces only.

Illustrations show actual size



Contents per package: 5 pcs.

Hole-drilling method according to the integral procedure

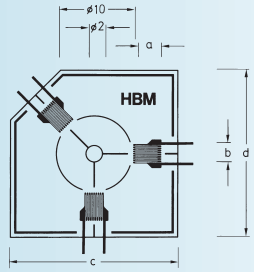
Using RY21 or, particularly easy to handle, RY61 and the associated drilling device (page 48), it is possible to determine the residual stresses according to the integral method. The result is the integral mean value of the residual stresses over the entire drilling depth.

RY21

0°/45°/90° hole-drilling rosette
Temperature variation adjusted to steel with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-RY21-3/120			120	3	2.5	22	22	4.5	LS 5

Illustrations show actual size



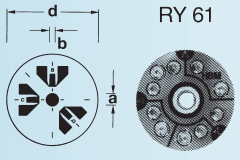
Contents per package: 5 pcs.

RY61

0°/45°/90° hole-drilling rosette
for application with HBM hole-drilling device RY 61 (see p. 48)
with $\alpha = 10.8 \cdot 10^{-6}/K$
Adjustment of the temperature variation within the range: + 10°... + 60°C (s. p. 48).

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-RY61-1,5/120			120	1.5	0.7	–	12	2	LS 5

Illustrations show actual size



Contents per package: 5 pcs.

Technical Data:

Resistance tolerance ± 1 %
Other data: see p. 15

As these strain gages are covered by a print plate, they can be used on level or weakly curved surfaces only.

Hole-drilling method by means of „High speed drilling"

The rosettes RY 61S, RY 61K, and VY 61S have been specially designed for th7e requirements of high speed drilling. This procedure uses a special drilling technology, with the milling cutter operating at a speed of 300.000 revs./min. This prevents new residual stresses from arising due to processing. The result are highly precise measurement values which al lows a very precise representation of the residual stresses in relation to the drilling depth. The relevant measuring chain (MTS 3000) is shown on page 47.

RY61K

0°/45°/90°rectangular hole-drilling rosette
for application with HBM MTS 3000
(see p. 47)
Strain gage complete with integrated solder tabs
Temperature variation adjusted to steel
with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
		1-RY6x-1,5/120K**	120	1.5	0.7	5.3	10.2	2	LS 7

Illustrations show actual size

Contents per package: 5 pcs.

** = Available only in a steel adjustment version

RY61S

0°/45°/90° hole-drilling rosette
for application with HBM MTS 3000
(see p. 47)
Temperature variation adjusted to steel
with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
1-RY61-1,5/120S			120	1.5	0.7	–	10.2	2	LS 5

Technical Data:
Resistance tolerance ± 1%
Other data: see p. 15

Illustrations show actual size

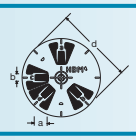
Contents per package: 5 pcs.

VY61S

0°/45°/90°/135° hole-drilling rosette
for application with HBM MTS 3000
(see p. 47)
Temperature variation adjusted to steel
with $\alpha = 10.8 \cdot 10^{-6}/K$

Order designation of preference types		Variable order designation	Nominal resistance	Dimensions (mm) [1 inch = 25.4 mm]				Max. perm. effective bridge supply voltage	Solder terminals
				Measuring grid		Measuring grid carrier			
Steel	Aluminum	Other	Ω	a	b	c	d	V	
		1-VY6x-1,5/120S**	120	1.5	0.7	-	10.2	2	LS 5

Illustrations show actual size



Contents per package: 5 pcs.

** = Available only in a steel adjustment version

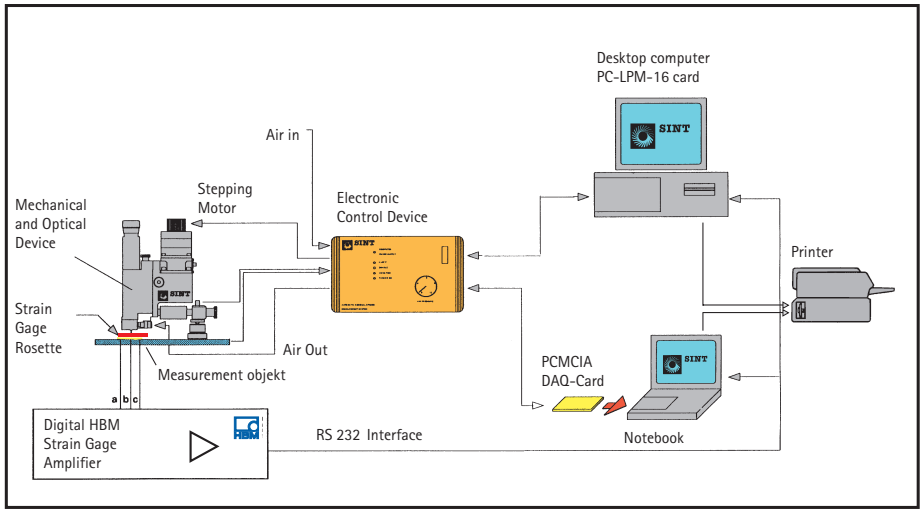
MTS 3000

Residual stresses which exist in components, without there being any visible symptoms, influence their strength behaviour. Therefore, it is endeavoured to determine the stresses existing in the components in order to take them into account when dimensioning components. With the hole-drilling method for determining residual stresses, a small drill bit of 1.6 mm will be drilled into the object; and any strain changes which occur will be measured by means of strain gages. HBM now offers a complete measuring chain by means of which this process is easy to implement. A milling machine rotating with 300 000 revs./min is used to generate the hole whose advance is effected by a stepper motor. The strain changes arising due to the step-by-step drilling of the hole into the workpiece will be detected by a strain gage rosette specially designed for this process.

The entire signal processing is effected digitally. In addition to system control functions, the software package comprises four different evaluation algorithms.

The entire measurement process is PC-controlled. This ensures a high degree of measurement precision as well as optimum reproducibility.

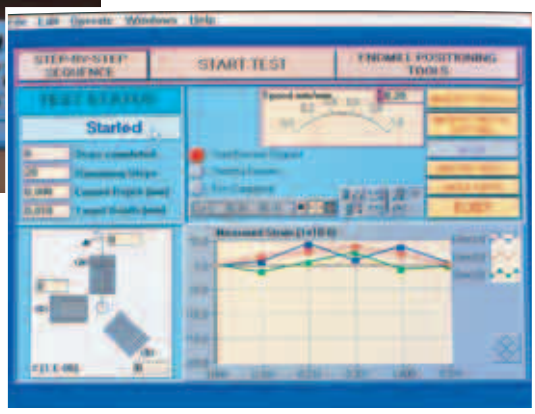
RY61S-special strain gage rosette



Block diagram
of the complete measuring chain

SINT

To provide you with more detailed information, we will be pleased to send you our technical data sheet MTS 3000.



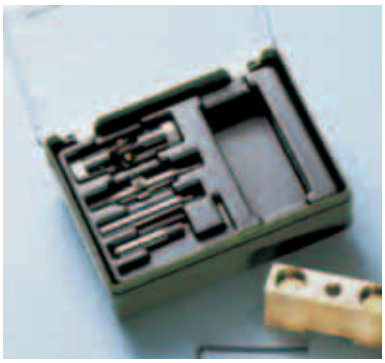
Complete measuring chain with amplifier and control PC

Spare turbine for MTS 3000:
Order no.: 1-SINTT

Spare drill for MTS 3000:
Order no.: 1-SINTB

Diamond drill for MTS 3000:
Order no.: 1-SINTD

Drilling device for hole drilling rosette RY 61



The drilling device is used to apply the hole in the centre of the applied hole drilling rosette. It comprises a magnetic holder, a centering pin, a shaft drill, and a universal coupling:
Order no.: 1-RY61

Spare drill for material hardness up to 30 HRC:
Order no.: 5-8410.0019

Carbide drill for material hardness up to 45 HRC:
Order no.: 2-9219.9133

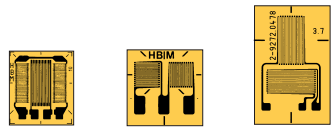
Special Strain Gages

You have special requirements which cannot be met by a strain gage from our standard product range ? You are looking for a strain gage which is equivalent to the one you currently use ? Or you have designed your own strain gage ? Then send us your layout direct via fax or e-mail.

Contact us, we will produce specially customized strain gages according to your requirements.

Below, there are just a few examples out of more than 2000 special strain gages which we have already implemented.

If requested, the grid geometries shown here by way of example are available in the following versions:



T-Gages

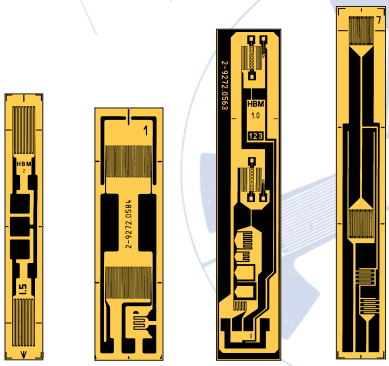
Carrier material

- phenolic resin
- polyimide
- PEEK

Diaphragm rosettes

Measuring grid material

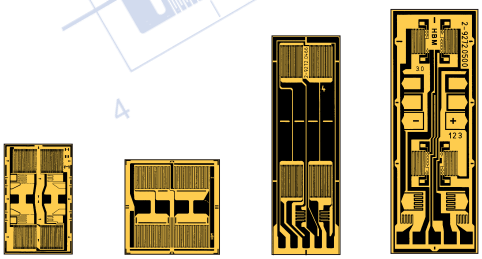
- Constantan (CuNi-alloy)
- Modco (CrNi-alloy)
- Nickel Ni for modulus gages
- Manganin for high pressure measurement gages



Half-bridge gages

Options

- adhesive coating
- Covered measuring grid
- Lead wires



Full-bridge gages

HBM adhesive program

The most common way in which strain gages are attached to measured objects is by bonding.

The adhesives listed below meet the following requirements:

- transmission, as much as possible without loss, of the deformations of the measured object to the strain gages
- stable behaviour across a temperature and strain range which is as wide as possible
- strain gage and measured object must not be chemically attacked

Your criteria for adhesive selection should be:

Adhesive	Description	suitable strain gage	Pot life at room temperature	Storage time dry
cold curing				
Z 70 Order no.: 1-Z 70	single component adhesive thin liquid very easy to handle	optimum: Y, C, LD, LE, V residual stress strain gages good: K, G	––	6 Month at – 15°C: almost unlimited
for optional use with Z 70:				
BCY Ø1	accelerator for Z 70			
X 60 Order no.: 1-X 60	two component adhesive pasty, even on absorbent or uneven surfaces	optimum: Y, C, LD, DA, V residual stress strain gages good: K, G, LS	5 minutes	> 1 Year
X 280 Order no.: 1-X 280	two component epoxy resin adhesive for smooth and absorbent surfaces	optimum: Y, C, LD, LE, V good: G, K	30 minutes	1 Year at + 4°C
hot curing				
EP 310 S Order no.: 1-EP 310 S	two component adhesive thin liquid very easy to handle	optimum: Y, C, K, G, LD, LE	1 month (at RT) 6 month (at + 2°C) 12 month (at – 32°C)	6 month
EP 250 Order no.: 1-EP 250	two component adhesive pasty, even on absorbent or uneven surfaces	optimum: Y, C, K, G, LD, LE good: residual stress strain gages	24 h	1 Year

[1] zero-point-related measurement; [2] non zero-point-related measurement; [3] curing conditions: relative humidity of between 30 – 80 %

- application temperature
- material of your workpiece and recommendations for the relevant strain gage
- requirements for long-term stability and reproducibility

Hot curing adhesives

Hot curing adhesives can be used where the measured object can be brought up to the curing temperature. This is generally possible in the manufacture of transducers, but also where installations can be made before machine assembly or where the machine can be disassembled. Hot curing adhesives meet higher quality demands and can be used within a greater temperature range than cold curing adhesives.

Cold curing adhesives

Cold curing adhesives are easy to use and can be processed at minimum cost and effort since they harden under normal ambient conditions. The preferred field of application is in experimental stress analysis.

Spot welding

Spot welding is only possible with the special strain gage type LS 31, and if the object to be measured is of a weldable material. Since hardly any preparations are necessary and the installer needs very little previous experience, spot welding is one of the simple installations. HBM offers the compact spot welder SG 01A for this purpose.

Curing temperature[3]	Curing period[3]	Contact pressure (N/mm²)	Temperature limits lower	Temperature limits upper static[1]	Temperature limits upper dynamic[2]	Delivery quantity
5°C 20°C 30°C	10 minutes 1 minute 0.5 minutes	thumb pressure	– 70°C	+ 100°C	+ 120°C	10 ml
0°C 20°C 35°C	60 minutes 10 minutes 2 minutes	thumb pressure	– 200°C	+ 60°C	+ 80°C	component A = 0.1 kg B = 80 ml other quantities see price list
RT . . . 95°C	8 h . . . 1 h	0.05 . . . 2.0	– 70°C	+ 200°C	+ 280°C	6 double pouches à 10 g = 60 g
95 . . . 205°C	5 h . . . 0.5 h	0.1 . . . 0.5	– 270°C	+ 260°C	+ 310°C	component A = 60 ml B = 30 ml
95 . . . 200°C	16 h . . . 0.5 h	0.1 . . . 1.5	– 240°C	+ 250°C	+ 315°C	5 double pouches à 10.5 g = 52.5 g

The quality of a measuring point with strain gages is not only dependent on the strain gage itself but also on the type of application and its implementation. A perfectly functioning measuring point requires a thorough preparation of the application surface, careful bonding, correct connection, and a protective coating. It is therefore important to provide the applicator with all necessary aids. With its strain gage accessories, the HBM product range offers everything necessary for a good strain gage application.

Strain gage protective coatings

Strain Gage Protective Coatings

In general, it is recommended that strain gages be protected against external effects such as humidity or mechanical damage since even small fluctuations in the atmospheric humidity affect the measured signal of an open gage.

The following table will help in the selection of a suitable means of gage protection, which for special requirements can also be carried out in several steps. For instance, it would make sense to apply AK22, with - in extremely humid environments - additional sealing by ABM 75.

Strain gage protective coating	Temperature range of resistance in air in °C	Package contents	one package suffices for approx.	Application method	Curing conditions	Storage capability at room temperature	Components
AK 22 viscous putty Order no.: 1-AK 22	– 50 . . . + 170	1 kg	30 strain gages	Kneading on by hand	–	unlimited	viscous, kneadable sticky putty
ABM 75 aluminum foil c/w knead. compound Order no.: 1-ABM 75	– 196 . . . + 75	11 pcs. 205 mm x 100 mm	200 strain gages	Pressing on by hand	–	unlimited	0,05 mm thick aluminum foil, coated with 3 mm thick kneading compound
NG 150 nitrile rubber Order no.: 1-NG 150	– 269 . . . + 150	3 bottles c/w approx. 25 cm^3 each	35 strain gages	Brush application	air drying at room temperature	max. 1 year	single component nitrile rubber cont. solvents
SG 250 transparent silicon rubber Order no.: 1-SG 250	– 70 . . . + 250	tube with approx. 85 g	20 strain gages	Tube application	air drying at room temperature	6 month	transparent single component silicon rubber without any solvents
PU 120 polyurethane paint Order no.: 1-PU 120	– 40 . . . + 120	4 bottles c/w approx. 30 ml each	250 strain gages	Brush application	room temperature . . . + 100°C	1 year	single component polyurethane paint with solvents
SL 450 transparent silicon resin Order no.: 1-SL 450	– 50 . . . + 450	3 bottles c/w approx. 25 g each	90 strain gages	Brush application	in temperature steps from 95°C bis 315°C	6 months	transparent silicon resin cont. solvents

Chemical resistance of HBM protective coatings

Chemical substance	AK 22	ABM 75	NG 150	SG 250	PU 120	SL 450
Exposure	yes	yes	yes	yes	yes	yes
Water:	yes	yes	yes	yes	yes	yes
Water under pressure (400 bar)	yes	–	–	–	–	–
condensation	–	–	–	–	yes	–
tropical climate	–	–	–	–	yes	–
vapour	no	–	–	–	–	–
Oils:	no	no	yes	yes	yes	–
engine oil (RT/70°C)	–	–	yes	–	–	–
mineral oil (RT/70°C)	–	–	yes	–	–	–
hydraulic oil (RT/70°C)	–	–	yes	–	–	–
Fats	–	–	–	–	yes	–
Solvents general	no	conditional	conditional	no	conditional	conditional
Fuels:	no	no	yes	no	–	–
petrol	no	no	yes	no	–	–
kerosene	–	–	yes	–	–	–
Aromatic substances/aliphatic mixtures	–	–	conditional	–	–	–
Aromatic substances:	no	no	conditional	no	conditional	no
benzene	–	–	no	–	–	–
toluene	no	no	conditional	no	yes	no
xylene	no	no	conditional	no	conditional	no
Chlorinated solvents	no	no	no	no	no	no
dichloromethane	no	no	no	no	no	no
carbon tetrachloride	–	–	no	–	–	–
perchloroethylene	–	–	no	–	–	–
1.2-dichloroethane	–	–	no	–	–	–
o-dichlorobenzene	–	–	no	–	–	–
Alcohols	conditional	yes	conditional	conditional	conditional[1]	yes
ethyl alcohol	conditional	yes	conditional	conditional	conditional	yes
methyl glycole	–	–	no	–	conditional	–
butyl alcohol	–	–	conditional	–	conditional	–
iso-propyl alcohol	–	–	conditional	–	conditional	–
ethylene glycole	–	–	yes	–	–	–
Ketone:	conditional	conditional	no	no	no	conditional
acetone	conditional	conditional	no	no	no	yes
methyl ethyl ketone (MEK)	no	no	no	no	no	conditional
Terpene:	–	–	conditional	–	–	–
dipenten	–	–	conditional	–	–	–
turpentine	–	–	yes	–	–	–
Acids:	no	conditional[2]	conditional	yes	no	yes
hydrochloric conc.	no	–	conditional	yes	no	yes
sulphuric acid 50 %	no	–	yes	yes	no	yes
acetic acid 50 %	no	–	no	yes	no	conditional
nitric acid 50 %	no	–	no	yes	no	yes
oleic acid conc.	–	–	yes	–	–	–
lactic acid conc.	–	–	conditional	–	–	–
air which contains acid	–	–	–	–	yes	–
Lyes	conditional	conditional[2]	conditional	no	conditional	yes
sodium hydroxide 10 %	conditional	–	no	no	no	yes
potassium hydroxide 10 %	–	–	no	–	–	–
ammonia 28 %	–	–	conditional	–	–	–
air which contains alkaline	–	–	–	–	yes	–
Liquified gas (except oxygen)	–	–	yes	–	–	–
UV resistance	yes	yes	yes	yes	yes	–

[1] low alcohol
[2] up to 5 % (destruction of aluminum foil)
conditional = conditionally resistant (minimum 10 days at RT)

Chemical resistance:

Unless identified specifically, the resistance referred to is room temperature. No information can be provided on long term effects. The data is based on our own experience or was taken from literature. Since the specific conditions vary with each user, it is recommended individual users carry out their own tests on resistance. Some protective coatings become milky when in contact with some chemicals.

Cleaning agent RMS 1

Satisfactory bonding joints are only achieved if the adhesive covers the bonded surfaces well. Therefore, the application surfaces must be cleaned prior to bonding with a chemically pure solvent and a clean cleaning pad. RMS 1 is an environmentally friendly solvent which dissolves all normal contamination.
Order no.: 1-RMS 1

Cleaning agent dispenser

Cleaning pads

Cellulose for cleaning of strain gages and strain gage application surfaces.
Format 5 cm x 5 cm.
Package contents: 500 pcs.
Order no.: 3-8402.0026

Cleaning agent dispenser „RSP 120"

In order to avoid contamination of the solvent during the course of time, we recommend the cleaning dispenser „RSP 120".
Order no.: 1-RSP 120

Teflon foil

33 m Teflon foil on reel, suitable for cold curing and hot curing strain gage bonding.
Thickness: 0.05 mm, width: 60 mm
Order no.: 1-Teflon

Polyimide tape

33 m heat resistant tape, 19 mm in width. Suitable for all standard strain gage application procedures to ensure safe positioning of the strain gage on the workpiece.
Order no.: 1-Klebeband

Resin cored solder

Resin cored solder as used in strain gage applications. Soldering wire
Ø 0.5 mm consisting of solder
S-SN60Pb38Cu2 c/w resin core, type
F-SW32. Melting range: 183 to 190 C.
Delivery form: 1 kg on reel
Order no.: 1-Lot

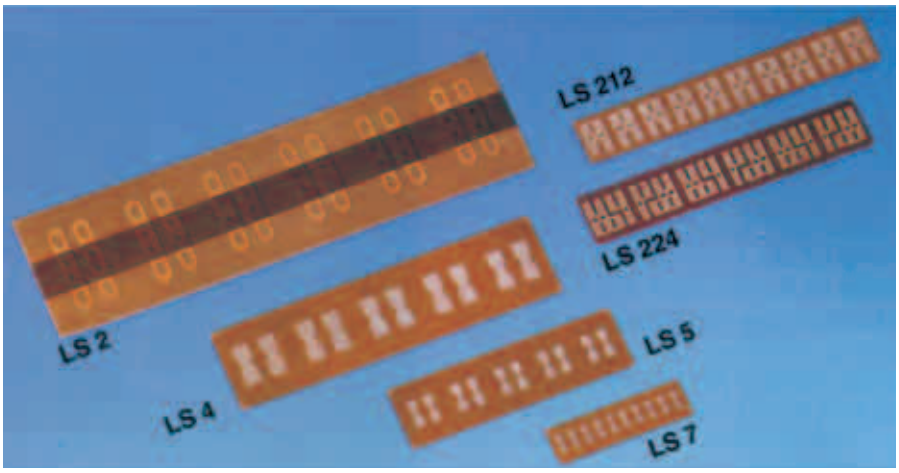
Flux pen

Soldering aid in felt pen format helps to achieve perfect small soldering connections. Suitable for solders with melting points up to 350°C. The flux pen contains non-corrosive flux without chloride.
Package contents: 5 pcs.
Order no.: 1-FS 01

Fluxpen FS 01

For strain gages with leads or wires solder terminals should be installed between the connecting cables and the strain gage itself. This facilitates the perfect soldering joint and strain relief of the gage connection. The solder terminals are installed in the same manner as the strain gages onto the object to be measured.

HBM offers solder terminals in different designs and dimensions.



HBM's range of solder terminals

Technical Data

Type / Illustrations	Type	Dimensions (mm) Soldering ear a	Soldering ear b	Carrier c	Carrier d	Distance t	Contents per package
LS2 bronze soldering ears on teflon carrier suitable for dynamic loads attachement to measured object: bonding usable up to 180°C, for short periods up to 260°C	1-LS 2	2.5	14	72	20	4	36 Pairs
LS7/5/4 copper, nickel-plated, on polyimide attachment to measured object: bonding usable up to 180°C, for short periods up to 260°C	1-LS 7 1-LS 5 1-LS 4	1 1.5 2.5	3 4.5 6.5	20 35 50	6 10 13	2 2.5 4	125 Pairs 125 Pairs 125 Pairs
LS212 copper nickel-plated on polyimide attachement to measured object: bonding usable up to 180°C, for short periods up to 260°C	1-LS 212	3.7	6	47.5	8	1	125 Pairs
LS224 copper nickel-plated on polyimide attachement to measured object: bonding usable up to 180°C, for short periods up to 260°C	1-LS 224	6.5	6	45	8	1	75 Pairs

PVC-flat strip cable

PVC insulated flat band strip cable consisting of six leads with a cross section of each 0.14 mm², 50 m per reel, resistance 0.131 Ω/m.
Order no.: 4-3133.0034

HBM Jumper wire and Paint insulated Cu-wire

Paint insulated copper wire

Polyurethane-insulated copper wire with a cross section of 0.04 mm², 25 m in length.
Order no.: 1-CULD01

Jumper wire

Teflon insulated jumper wire with a cross section of 0.05 mm², yellow, 100 m per reel, resistance 0.34 Ω/m.
Order no.: 1-3130.0239-G

Very flexible wire

For internal, exposed wiring of transducers; cross section of 0.04 mm² with 20 cores and 0.6 mm outer diameter, resistance 0.417 Ω/m, permissible temperature +70°C, 25 m per reel, PVC insulation.
Order no. 1-SLI 01

Flexible wire

Teflon-insulated flexible wire with a cross section of 0.24 mm² with 19 cores and an external diameter of 0.9 mm, 100 m per reel, resistance 0.0741 Ω/m.

blue	Order no.: 1-3301.0092-B
green	Order no.: 1-3301.0091-Gr
white	Order no.: 1-3301.0094-W
black	Order no.: 1-3301.0088-S
red	Order no.: 1-3301.0089-R

Designation	Insulation	Thermal resistance	Chemical resistance
Flexible wire 1-3301.0088-S 1-3301.0089-R 1-3301.0091-Gr 1-3301.0092-B 1-3301.0094-W	Teflon	– 200 . . . + 260 °C	Resistant against nearly all chemicals: Except: elementary flouride, chlorine triflouride, molten alkali metals
Jumper wire 1-3130.0239-G	Teflon	– 200 . . . + 260 °C	see flexible wire
Very flexible wire 1-SLI 01	PVC	short period 105 °C permanent ...90 °C	non resistant against: ester, chlorinated hydrocarbons, ketone, aromatic hydrocarbons, benzene, liquid halogens, nitric acid conc., depending on the softener used, also aqueous solutions
PVC flat strip cable 4-3133.0034	PVC	short period 105 °C permanent ...90 °C	see very flexible wire
Paint insulated copper wire 1-CULD 01	polyurethane	short period 120 °C permanent -40...80 °C	non resistant against: strong acids, strong lyes, alcohols, aromatic hydrocarbons, saturated vapour, hot water

Resistance half bridges

Resistance half bridges are wired together with the strain gages on the measuring point to set up the Wheatstone bridge circuit. In accordance with the nominal strain gage resistances, HBM offers various different resistance values.

2 x 120 Ω, Order no.: 3-3054.0334
2 x 350 Ω, Order no.: 3-3054.0282

Resistance measuring unit TO 3

The TO 3 is an electronic measuring unit (ohmmeter and megohmmeter) for determining resistances within the range 0 to 50 G Ω.

This pocket megohmmeter has been designed, and is particularly suitable, for fast checking of the insulation resistance of strain gage installations and strain gage resistances in the field and in service. It features a total of 16 measuring ranges for insulation resistance and throughput measurements. Four measuring voltages (50 V, 25 V, 10 V, and 2,5 V) provide for adjustment to the measuring task in hand and prevent any possible destruction of a test piece by a test voltage which is too high.

The megohmmeter is accommodated in a solid plastic housing complete with carrying handle, and it is supplied with a protective bag and two measuring cables.

Order no.: 1-TO3

Technical Data		Resistance measuring unit TO 3
measuring ranges	MΩ	0 – 50 000
number of measuring ranges		16
minimum resistance	Ω	20 is the minimum value that can still be read off
measuring voltages	V	2;5; 10; 25 und 50, dep. on measuring range
open circuit voltage		1.1 x UN max.
display		analog display c/w mirror scale, scale length 110 mm
application position		horizontal
precision class		2.5 (IEC publication 51)
adjustment time, max.	s	4
operational temperature range	°C	0...+40 (30% up to 60% rel. humidity)
temperature fault	%/10K	±1.5
batteries		6 pcs. 1.5 V, rod batteries (type IEC LR 14)
measuring time/numberof measurements		approx. 2000 with a single battery set
protection class acc. to EN 60529 (IEC 529)		IP 50 (measuring mechanism), IP 20 (other parts)
safety		EN 61010-1 class 2, (tested at 1 kV AC / 1 Min.)
conformity (CE symbol)		EN 45014, EN 50081-1, EN 50082-1, EN 61010-1, IEC 51, IEC 529, VDE 0410
housing		plastic, impact resistant, c/w carrier strap
dimensions	mm	205 x 128 x 100
weight, approx.	kg	1

Strain gage starter kit DAK 1

The starter kit DAK1 provides the first time user with a low cost and interesting option to start with the application of strain gages. The well-designed and robust plastic case contains all aids required for initial applications. An original package containing 10 strain gages and the cold curing adhesives X60 and Z70 ensure the best possible results from different measurements in experimental stress analysis. In addition to the practical components of the starter kit DAK1, the specialist book on strain gages „An Introduction to Measurements using Strain Gages" by Karl Hoffmann, an experienced specialist in strain gage technology, is also included in the scope of delivery. This book is available in a German as well as an English language version. Due to many years of DAK1 use in company-internal strain gage and instrumentation seminars, the contents of this book has been constantly optimized.

Order no.: 1-DAK1

Contents of DAK 1

10 pieces	Strain gages LY11-6/120A
1	Z 70, cold curing adhesive
1	X 60, cold curing adhesive
1	AK 22, protective coating
1	ABM 75, protective coating
	Solder terminals
	Connecting wire
	Sand paper
	Cleaning agent RMS 1
	Cleaning pads
	Solder
1	Specialist book on strain gages „An Introduction to Measurements using Strain Gages"
1	Petri dish

Starter kit DAK 1

Strain gage installation case DAK 2

The strain gage installation case DAK 2 contains all tools and aids required for strain gage installations. It is portable and lockable.

Dimensions: 470 x 170 x 360 mm
Weight: approx. 6 kg
(incl. standard scope of delivery)
Order no.: 1-DAK 2

In the bottom part of the strain gage installation case there is empty space for various adhesives and other uses, below the removable insert.

Contents of DAK 2

1	Ersa soldering iron (16 W)
1	flat brush
1	folding magnifying glass (6 times)
1	graduated ruler, 150 mm
1	glass fibre erasing brush, plus 1 spare brush
1	pair of scissors, toothed
1	pair of pointed scissors
1	wide pair of tweezers
1	pointed pair of tweezers
1	flexible ruler, 300 mm
1	dental probe with bent tip
1	cement spatula
1	cutting pliers with wire strippers
1	Petri dish 60/15
1	scalpel holder, plus 6 blades
10 m	flat strip cable 6 x 0.14 mm^2, multi-coloured
25 g	solder diameter Ø 1 mm
1	flux pen
1	roll of Scotch tape
1	rubber
1	HBM pen
1 each	sheets of sand paper grade 180/220/360
100 cm^3	cleaning agent RMS 1
200	cleaning pads 50 x 50 mm

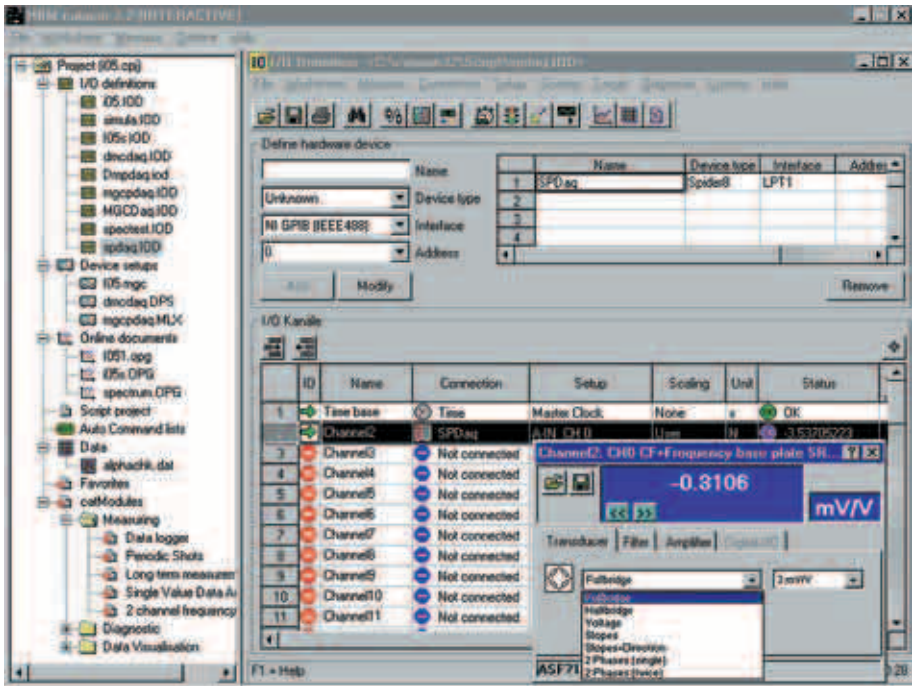
catman®

For all computer-controllable HBM amplifier systems, we now offer the universal measuring technology software package catman® for MS-Windows 95/98 and NT.

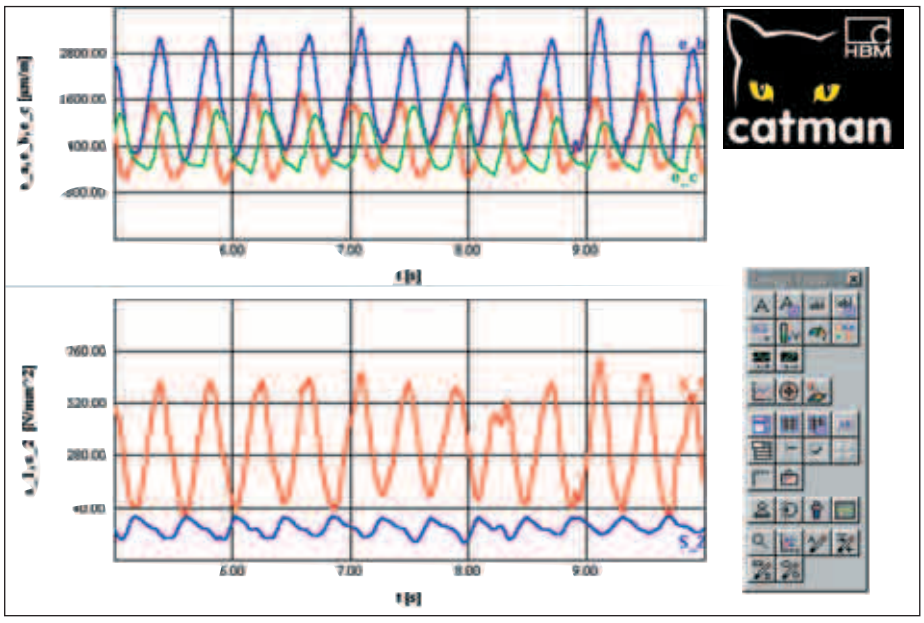
Using catman®, the devices are conveniently adjusted by means of virtual front panels. In addition, all parameters can be printed, stored, and retrieved again.

Having defined device type and interface in catman®, pre-fabricated measuring sequences - catModules - can be used to start measurements immediately. The measured values will be instantly visualized in ready-made graphics screens. However, the user is also able to define his own graphics screens and use them - without any programming effort being required - in combination with measurement assistants. The format for data storage is selectable.

An excellent characteristic feature of the new catman® 3.1.2 version is the simultaneous data input from different devices on different interfaces. However, it is possible to continue mathematical processing of the measurement data during or after the actual measurement.



Simple device configuration



Rosette evaluation

catman® offers mathematical functions for this purpose ranging from simple arithmetic via FFT, digital filters, rosette calculation for experimental stress analysis to rainflow analysis. Using the AutoCommand list, offline calculations and other actions such as saving, printing, or direct transmission of data into an Excel spreadsheet can be automated.

With its script language, catman® is a development tool for complete applications. The object-oriented syntax and code builder simplify the generation of a script. Via this script language, catman® is also open for extensions. Easy to install script drivers enable the inclusion of almost all intelligent measuring systems.

DMD20A

Portable mains-independent measuring amplifier for strain measurements

- for strain gage full bridges and half bridges
- digital indication of the strain
- analogue output
- connect via terminal clamps or connectors
- power supply from own accumulator

DMD20 A, amplifier from HBM

MGC*plus*

Modular computer-controllable measuring amplifier system for universal applications

- autarchic measuring amplifier slide-in units for all standard measurement quantities
- different computer interfaces (RS232, RS485, IEEE-488, Ethernet, 2 PC-Card-Slots) with standard and field bus protocols (CAN profibus DP)
- parallel synchronous data aquisition of up to 128 channels per device
- measuring rate up to 19.200 measured values / sec. / channel
- resolution 20 bit
- can be operated manually via operating panel or computer
- autarchic measuring data detection of the PC-Card hard disk
- Quarter, half- and full bridges, even with 8-channel plug-in units in famous HBM technology

Scout55

Single channel universal amplifier, carrier frequency 4.8 kHz, for strain gages (half- and full bridges) as well as inductive half- and full bridges, LVDT, piezo-resistant and potentiometric transducers

- Serial interface RS 232 for signal output and conditioning
- Functional compact housing with support grip
- Complete operation via LCD display and keyboard

HBM-Amplifier MGCplus

Centipede

Multipoint measuring unit with up to 100 measuring points especially for experimental stress analysis

- for serial measurement of static and quasistatic measurement quantities such as strain, pressure, force, displacement, temperature, etc. (e.g. up to 100 strain gage measuring points, 1/4 and/or 1/2 and/or 4/4 bridges, can be connected simultaneously)
- integrated triple measuring amplifier (DC, TF 600 Hz, and 5 kHz) will be individually programmed for each measuring point
- 100% computer-controllable via serial or parallel interface

Centipede

Spider 8 and Spider 8/30

PC measurement technology with parallel signal processing with 4 carrier frequency amplifiers SR55/4.8 kHz or S2 30 (600 Hz), another 4 channels can be equipped optionally with SR01 modules (DC-voltage) or with SR55/ 4.8kHz (max. 8 channels per device).

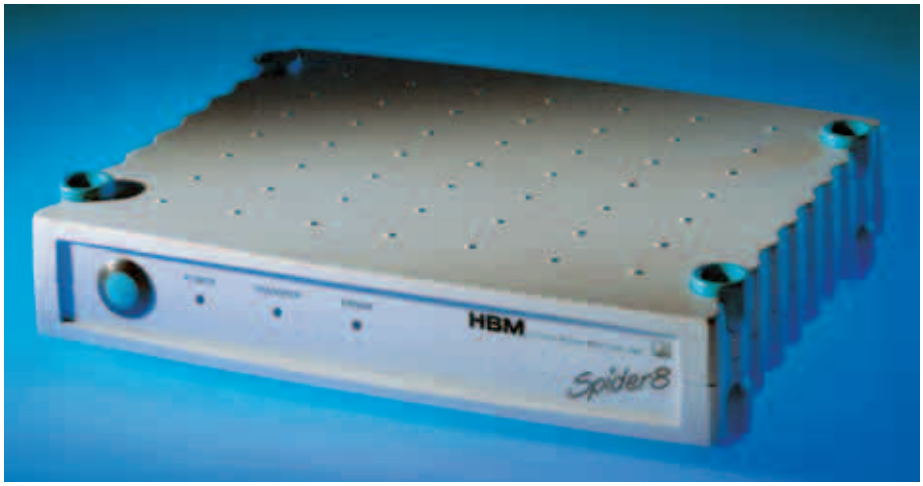
- power supply via power pack, or 10 -16 V/DC (e.g. 12 V/DC battery voltage in a car)
- measurement of voltages, currants, frequencies, quarter bridge (Spider 8/30 only) half-, full bridges, temperatures
- sensor feed, signal adaptation, A/D conversion, digital filter and computer interface in one single housing that fulfils the EMC-requirements
- high sampling rate with a resolution of 16 bit
- Serial and parallel interface for conditioning the device and data acquisition (connection for example via printer interface)
- No operation inside the computer necessary
- 8 devices can be cascaded via printer interface

Spider Mobil

Digital multichannel measurement acquisition system (8 or 16 channel version) fitted in an aluminium case

- measurement electronics with eight 4.8 kHz carrier frequency amplifiers, a further eight channels optionally equipped with modules of type SR55 or SR01
- power management electronics complete with wide range power pack, fitted accumulator and auto adapter for mains-independent operation
- notebook, well equipped brand name notebook in the top quality product segment as well as colour inkjet printer, completely functionally tested and configured with MS Windows Software and Spider8 Control

Spider 8, amplifier

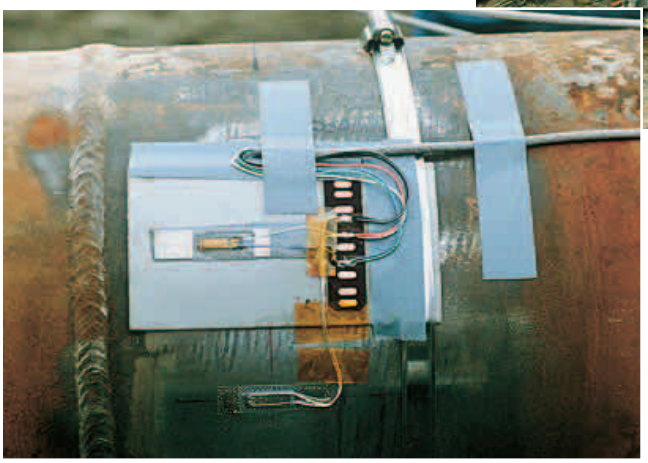


Strain Gage Application Service

At your premises

Our experienced service engineers will

- Visit you
- Advise you
- Install strain gages
- Carry out measurement



Strain gage application for stress analysis on pipes

For applications in field Tel.: +49 (0) 80 00 18 23 88
For applications at HBM factory Tel.: +49 (0) 61 51/80 36 19

In our Darmstadt works

HBM is equipped with an application laboratory which will inplement strain gage applications for:

- Component investigation
- Quality assurance
- Identifying the cause of damage on single workpieces
- Monitoring of operational loads in a small series
- Examinations support in medical and dental medicine
- Support in research and teaching

Special transducers which are constructed, applied and tested in the strain gage application laboratory.

Specialist Book on Strain Gages

„An introduction to measurements using strain gages". A practical introduction into this specialist area of measuring technology.

The book covers the use of strain gages in stress analysis as well as the construction of simple transducers for measuring forces and torques. Particular emphasis is put on how to identify the cause of faults and how to take measures to avoid or correct measuring faults in order to obtain reliable measurement results.
Order no. 1-Hoffmann Buch

Strain Gage Teaching Pack

For newcomers and occasional users, the strain gage teaching pack provides helpful support for installing strain gages.

Two video cassettes explain the competent installation of strain gages by means of cold curing and hot curing adhesives. In addition, the tips and tricks shown can be read in the manuscript „Introduction to the application of strain gages". In addition, the specialist book „An introduction to measurements using strain gages" by Karl Hoffmann explains the laws in strain gage technology.
Order no.: 1-DMS-Lernpaket

Strain Gage Seminars

Due to the rapid advances in technological development today it is particularly important to keep up with the new technologies by comprehensive continuing education. But also for users who use strain gages for the first time and /or convert from one type to another, practical training and continuing education is necessary with regard to the specific problems of the electric measuring of mechanical quantities. Make use of our specialist know-how which has been acquired in decades of practical experience for your success in the solution of your technical measurement problems.

By means of experimental lectures, the basics of the specialist area will be explained in a first part and then demonstrated. This is subsequently followed by training on devices and transducers or even bonding of strain gages. Theory and practice sessions alternate several times during the course of the seminar, in order e.g. to discuss and clarify questions - which usually first occur in practical application sessions - in the next theory block. Learning by rote is not quite our style, for we know that learners need to solve prepared tasks independently - following appropriate instruction - in order to expand and strengthen their newly acquired knowledge.

In order to support effective working, each practical experience place will be allocated a maximum of two participants only. In the case of strain gage applications, each participant will be given his/her own workplace.

DK

Basics of strain gage bonding and measuring technology

Target group

Specialist personnel, master tradesmen or engineers who want to implement strain gage applications independently and under their own responsibility.

DM

Strain gage measuring technology in transducer construction and experimental stress analysis

Target group

Users from all specialist disciplines
who want to carry out measurements by means of strain gages.

In addition to the two strain gage application seminars mentioned above, HBM offers additional seminars in HBM device technology and software. It is naturally possible to implement all seminars that are offered in our seminar centre at Darmstadt directly on your own premises. On request, we will modify our seminars in order to enable us to offer a target-oriented and practical training and continuing education.

DMS*direkt* CD

electronic order catalog and manual for strain gages

The CD-ROM **DMS*direkt*** is to make it as easy as possible for you to apply and order strain gages. The CD-ROM **DMS*direkt*** contains help and assistance with regard to strain gage selection, application notes, as well as tips and tricks in strain gage handling. The CD-ROM provides you with the option to generate a legally binding strain gage quotation for yourself as well as to print out the appropriate order and send it to the relevant sales office. As all strain gages (preferential types as well as standard types) are stored in the CD-ROM, each type can be correctly ordered. In addition to the graphical illustration of the strain gage, all type-specific features such as dimensions, nominal resistance, maximum feed voltage etc are also stated. The relevant product range of application accessories completes the package.

To request your free DMS*direkt* CD, please contact your local representative

Or visit our shop: www.hbmwt.com

List of Representatives

Germany

Hottinger Baldwin Messtechnik GmbH:
Büro Berlin: Magirusstraße 5, D-12103 Berlin
Tel. (030) 75 48 95 50, Fax (030) 75 48 95 52
Büro Dresden: Würzburger Str.35, D-01187 Dresden
Tel. (0351) 4 70 06 21, Fax (0351) 4 70 06 22
Büro Düsseldorf: Hauptstraße 13, D-40699 Erkrath
Tel. (02104) 93 56 01, Fax (02104) 93 56 11
Büro Frankfurt: Robert-Bosch-Str. 52,
D-63225 Langen
Tel. (06103) 48 629-172, Fax (06103) 48 629-120
Büro Hannover: Gutenbergstraße 3,
D-30966 Hemmingen / Hannover
Tel. (0511) 94 26 48 0, Fax (0511) 94 26 48 20
Büro Nürnberg/München: Goldbachstr. 9,
D-90480 Nürnberg
Tel. (0911) 940 83 10, Fax (0911) 940 83 33
Büro Stuttgart: Bassermannstraße 7,
D-70563 Stuttgart
Tel. (0711) 901 55 50, Fax (0711) 901 55 88

Europe

Austria:
Hottinger Baldwin Messtechnik GmbH,
Carlbergergasse 38, Pf. 19, A-1233 Wien
Tel. (+43) 1 865 84 41, Fax (+43) 1 865 84 41-420
e-mail: hbm@hbm.at
Baltic provinces (Estonia, Latvia, Lithuania):
ISOmetrija SIA, Mukusalas iela 42, LV-1004 Riga,
Tel. (+371) 76 14 427, Fax (+371) 76 15 140
e-mail: isometrija@apollo.lv
Belgium: refer to Netherlands
Bulgaria:
SKELIT GMBH, 56, Janko Sakazov Bul., BG-1504 Sofia
Tel. (+359) 2 9449 546, Fax (+359) 2 46 65 54
e-mail: skelit@exco.net
Croatia: refer to Slowenia
Czech Republic and Slovakia Republic:
HBP, Ing. Ivan Wasgestian, Podskalska 7,
CZ-128 00 Praha 2,
Tel. (+42) 02 24 92 18 61, 02 24 91 24 37
Fax (+42) 02 24 91 36 57
e-mail: hbmcz@mbox.vol.cz
Denmark:
NORIS Måleteknik ApS, Nydamsvej 19D,
DK-8362 Hørning
Tel. (+45) 87 68 05 00, Fax (+45) 87 68 05 01
e-mail: thorkil_hyllested@noris.dk
Finland:
Oy Transmotec Ab, Kutomotie 9C, SF-00380 Helsinki
Tel. (+358) 98 67 830 0, Fax (+358) 98 67 830 30
e-mail: kurt.lindstrom@transmotec.fi
Web: http://www.transmotec.fi
France:
HBM France SAS, 46 rue du Champoreux, BP 76
F-91542 Mennecy Cedex
Tel. (+33) 1 69 90 63 70, Fax (+33) 1 69 90 63 80
e-mail: infohbm@hbm.fr
Greece:
Meta Engineering, 54 Agias Marinis Str.,
GR-15127 Melissia
Tel. (+30) 10 6130929, Fax (+30) 10 6131329
e-mail: meta@ath.forthnet.gr
Web: http://www.meta-gr.com
Great Britain:
HBM United Kingdom Ltd., 1 Churchill Court, 58 Station
Road, North Harrow, Middlesex, HA2 7SA
Tel. (+44) 20 85 15 61 00, Fax (+44) 20 85 15 61 49
e-mail: sales@hbm-uk.co.uk
Hungary:
HB Mérnöki Iroda, Ákos Teleki, Remsey krt. 13,
P.O. Box 81, H-2101 Gödöllö
Tel. (+36) 28 430 209, Fax (+36) 28 430 115
e-mail: hbmiroda@mail.digitel2002.hu
Ireland: refer to Great Britain
Italy:
R.G.F. Rilevazione Grandezze Fisiche s.r.l.
Milano Office: Via Teodosio 7, I-20131 Milano
Tel. (+39) 0270 630 851, Fax (+39) 0223 61 228
Web: www.rgf.it, e-mail: info@rgf.it
Torino Office: Via San Rocco 47, I-10045 Piossasco (TO)
Tel. (+39) 0119 04 20 46, Fax (+39) 0119 04 17 08
Web: www.rgf.it, e-mail: info@rgf.it
Liechtenstein: refer to Switzerland
Luxembourg: refer to Netherlands
Netherlands:
HBM Benelux, Laan van Westroijen 2F-G, NL-4003 AZ
Tiel, Postbus 6035, NL-4000 HA Tiel
Tel. (+31) 344 67 3434, Fax (+31) 344 67 3435
e-mail: benelux@hbm.com
Norway:
IAF Maaleteknikk AS, P.B. 254,
Kapellveien 18, N-1411 Kolbotn,
Tel. (+47) 66 82 31 60, Fax (+47) 66 82 31 61
e-mail: post@iaf.no

Europe (Continuation)

Poland:
***Biuro Inzynierskie M. Zajaczkowski**
ul. Towarowa 17/19, PL 61-586 Poznan
Tel. + Fax (+48) 61 83 52 230
e-mail: info@bimzajac.com.pl
****Biuro Inzynierskie, mgr. Inz. Jan Zajaczkowski,**
ul. Grunwaldzka 250B, 60-166 Poznan
Tel. (+48) 61 661 9333, Fax (+48) 61 868 5664
e-mail: janzajaczkowski@hottinger-baldwin.pl
Portugal: refer to Spain
Romania:
PROCSIMEX INTEC Srl
Büro Bukarest: Str. Turda 119, bl.6, Ap. 77,
RO-78201 Bucuresti, Sect. 1
Tel. (+40) 12 24 29 81, Fax (+40) 12 11 53 75
e-mail: procsimex@dnt.ro
Büro Cluj-Napoca: Dipl. Eng. Dragos Muntean
Str. Donath 17, Bloc M2, Scara 2, Ap. 14
RO-3400 Cluj-Napoca
Tel. + Fax (+40) 64 18 64 26
e-mail: dragos_muntean@mail.dntcj.ro
Russia (West):
*KWT-M, Romanov per., 3, of. 87, RUS-103009 Moskau
Tel. (+7) 095 743 6827, Fax (+7) 095 747 8362
e-mail: hbmwt@aha.ru
****Messtechnik Moskau**
A/ja (post-Box) 63, RUS-125047 Moskau
Tel. (+7) 095 787 11 84, Fax (+7) 095 787 11 83
e-mail: hbmimt@aha.ru
Slovenia and Croatia:
TRC, Vreckova 2, SLO-4000 Kranj
Tel. (+386) 4 235 83 10, Fax (+386) 4 235 83 11
e-mail: ljudmila.licen@siol.net
Sweden:
Metrolink Scandinavia AB, P.O. Box 224,
Reprovägen 6, S-183 23 Täby,
Tel. (+46) 87 56 23 33, Fax (+46) 87 56 23 47
e-mail: info@metrolink.se
Switzerland:
Spectris (Schweiz) AG - Hottinger Baldwin Messtechnik
Postfach 69, Grabenstraße 6, CH-8606 Nänikon
Tel. (+41) 19 43 60 80, Fax (+41) 19 43 60 81
Büro Yverdon: Spectris (Suisse) SA
Rite de Bellevue 11, 1400 Yverdon-les-bains
Tel. (+41) 24 426 72 80, Fax (+41) 24 426 72 85
Spain:
HBM Ibérica, S. L.,
Avda. de los Encuartes, 19, E-28760 Tres Cantos
(Madrid)
Tel. (+34) 91 806 2610, Fax (+34) 91 804 9327
e-mail: hbm@spectris.es
Turkey:
Elimko Elektronik Imalat ve Kontrol Tic. Ltd. Sti.,
8. Cadde 68. Sokak No. 16, TR-06510 Emek / Ankara
Tel. (+90) 312 2 12 64 50, Fax (+90) 312 2 12 41 43
e-mail: elimko@elimko.com.tr
Ukraina:
***ANWIT,** Metallistiwstr. 17, w.401, UA-03057 Kiew
Tel. + Fax (+380) 44 53 61 017
e-mail: but@ukrnet.net
****WPS-Kiev,** bulvar Lesi Ukrainki, 15, Komn.27,
UA-252133 Kiev
Tel. + Fax (+380) 44 295 01 89
e-mail: wps@public.ua.net
Yugoslavia and Macedonia:
TRC, Bul. M. Pupina 17/II, YU-21000 Novi Sad
Tel. + Fax (+381) 21 22 267
e-mail: trcpro@neobee.net

Non-European Countries

Algeria:
ALITECH SARL, Algérie Industries et Technologies
28, Rue le Savoie, 16000 Hydra-Alger
Tel. (+213) 2 603 575, Fax (+213) 2 603 438
e-mail: alitech@mail.wissal.dz
Argentina:
****Coasin S.A.C.I. y F.**, Virrey del Pino 4071,
C1430CAM Buenos Aires
Tel. (+54) 11 45 52 31 85, Fax (+54) 11 45 55 33 21
coasin@coasin.com.ar
Australia:
***Ranger Instruments**, 41 Success Street, Acacia Ridge,
Qld. 4110, P.O. Box 300, Archerfield, Qld. 4108
Tel. (+61) 7 3216 7166, Fax (+61) 7 3216 6211
Web: www.rangerinstruments.com
e-mail: sales@rangerinstruments.com
Brazil:
Spectris do Brasil Ltda, Rua José Carvalho, 55
São Paulo, SP, 04714-020 Brazil
Tel. (+55) 11 5182 8166, Fax (+55) 11 5181 7400
*e-mail: hbm.wt.jrdamelio@uol.com.br
**e-mail: rdvivo@uol.com.br

Non-European Countries (Continuation)

Canada: refer to USA
Chile: refer to USA
China:
Hottinger Baldwin Measurement (Suzhou) Co., Ltd.
11-2 Binhe Road, Suzhou 215011, Jiangsu, P.R. China
Tel. (+86) 512 825 6146, Fax (+86) 512 825 5422
e-mail: hbmchina@public1.sz.js.cn
Egypt:
****SOI Scientific Office for Instruments,** P.O. Box 262;
Sidi Gaber, El Horia Avenue behind 330 Sidi Gaber
Alexandria
Tel. (+20) 3 542 5609, Fax (+20) 3 546 5412
e-mail: ebtehalf@aast.edu
Hong Kong: refer to China
India:
IPS, Integrated Process Systems, 9 MP Avenue,
Santhome, Madras-600 004
Tel. (+91) 44 498 17 86, 44 498 00 91 + 92
Fax (+91) 44 498 17 90
e-mail: ips@vsnl.com
Indonesia: refer to China
Israel:
****Elina Technologies Ltd.**, P.O. Box 11475,
3 Hametzuda St., Ind. Area Azur, Azur 58001
Tel. (+972) 3 559 0277, Fax (+972) 3 559 0360
e-mail: elina@inter.net.il
Japan:
Spectris Co., Ltd., HBM Division
Yagishita Bldg., 5F, 3-13-10 Urawa-Nakacho,
Saitama City, Saitama Pref., 336-0007, Japan
Tel. (+81) 48 814 0251, Fax (+81) 48 814 0252
e-mail: kyomi_yokokawa@spectris.co.jp
Korea:
Spectris Korea Co. Ltd. / HBM Team,
#431-070, 4Fl., Shinsegi town., Phungchon-dong,
Dongan-Ku, Anyang city, Kyounggi-Do, Korea
Tel. (+82) 31 387 8023, Fax (+82) 31 387 8025
e-mail: wcjung@hbmkorea.co.kr
Web: http://www.hbmkorea.co.kr
Malaysia: refer to China
Mexico: refer to USA
Morocco:
Auterep S.A.R.L., 8 Bis, Rue Neufchatel - Belvédère,
Casablanca 05
Tel.: (+212) 22 24 73 -36 / -46, Fax: (+212) 22 24 79 74
www.auterep.co.ma,
e-mail: auterep@alpha.net.ma
Singapore: refer to China
South-Africa:
****H. Rohloff (Pty) Ltd.**
770, 4th Street, P.O. Box 202, Bergvlei 2012 (Tvl.)
Tel. (+27) 11 78 63 0 20, Fax (+27) 11 88 77 1 99
e-mail: info@rohloff.co.za
***Massamatic (Pty) Ltd.**
Boompies Street, P.O. Box 6007,
Parow East 7501, Western Cape Province
Tel. (+27) 21 930 25 10, Fax (+27) 21 939 84 88
e-mail: sales@massamatic.com
Syria:
***Charbek & Harirah Est.**, Al-Taweel Building, New Clock
Square, P.O. Box 4439, Homs / Syria
Tel. (+963) 31 226 577, Fax (+963) 31 222 020
e-mail: abc.net@scs-net.org
Taiwan:
Liu-Weight Enterprise Inc., General Manager Tony Liu,
9F-2, No. 240, Sec. 2, Ta-Tung Rd., Hsi-Chi Town,
Taipei Hsien, Taiwan R.O.C.,
Tel. (+886) 2 2649 7330, Fax (+886) 2 2649 7335
e-mail: liu.wt@msa.hinet.net
Tunisia:
SCOPIA , 24 Bis, Rue Said Abou Baker, 1001 Tunis
Tel. (+216) 1 354 435, Fax (+216) 1 332 706
e-mail: Sonelect.scopia@gnet.tn
Thailand:
****Dynistec Co Ltd.**, 200 / 76 Moo 8, Nuanchan Rd.,
Klongkum, Bungkum, Bangkok 10230
Tel. (+66) 2 946 1314, Fax (+66) 2 946 0458
e-mail: dynistec@asiaaccess.net.th
Uruguay: refer to USA
USA:
Hottinger Baldwin Measurements, Inc.
19 Bartlett Street, Marlborough, MA 01752
Tel. (+1) 508 624 45 00, Fax (+1) 508 485 74 80
e-mail: hbmsales@hbminc.com
Venezuela: siehe USA
Vietnam:
****Thuan Quoc & Co.**, 6 VU ngoc Phan, Dong Da -Hanoi
Tel. (+84) 4 776 0616, Fax (+84) 4 776 0626
e-mail: tqco@hn.vnn.vn

*= for Weighing components
**= for Industrial Measurement components

HBM
measurement with confidence

Hottinger Baldwin Messtechnik GmbH
Im Tiefen See 45
D-64293 Darmstadt
Germany

Tel. +49/6151/803-0
Fax +49/6151/803-9-100
e-Mail: info@hbm.com
Internet: www.hbm.com

wt01.02.10e