High-resolution strain sensors

Version: 25.08.2020

ME-Meßsysteme GmbH
Neuendorfstr. 18a
16761 Hennigsdorf

Tel.: +49 3302 89824 60
Fax: +49 3302 89824 69

Mail: info@me-systeme.de
Web: www.me-systeme.de

Table of contents

Description ... 3
Strain sensors DA26, DA40 and DA54 ... 4
Dimensions ... 5
Technical Data ... 6
Pin assignment ... 7
Options ... 7
Pin assignment SAC-8P-M12FS ... 7
Strain sensor DAdX ... 8
Description ... 8
Dimensions ... 9
Technical Data ... 9
Pin assignment ... 10
Pin assignment Dadx HB ... 10
Wiring diagram for bending ... 10
Wiring diagram for axial force ... 11
Pin assignment (application on one side) ... 11
Pin assignment (application on two sides) ... 11
tensile-/compressive load ... 11
Bending and shear loads ... 12
Shear ... 13
Torsional load ... 14
Strain sensors DA54-mag, DA54-tiewrap, DA68 and DA68e ... 15
Description ... 15
Dimensions ... 15
Technical Data ... 18
Configuration ... 19
Type DA68e with integrated Electronic GSV-15L ... 19
Standard type ... 19
Installation position ... 20
Options ... 20
Type designations ... 20
Mounting instruction ... 20
Surface preparation ... 20
Mixing the adhesive ... 21
Prepare of the strain sensor ... 21
Bonding process ... 21
Function control ... 22
Connecting cable ... 22
approx. 5 times the cable diameter unmoved or 10 times the cable diameter moved ... 22
Installation notes for magnet fastening ... 22
Accessories ... 24

Description

The strain transducers are used for the high-resolution detection of forces and deformations on solid components, e.g. of presses, hoists, containers, steel beams, bridges, as well as on piles or racks of production machines. A distinction is made between flat (for installation on a flat surface) and cylindrical strain sensors (for installation on a cylindrical surface).

The subsequent installation makes these strain transducers universal, retrofittable sensors for force and load monitoring. These strain transducers are durable and resistant to oil and moisture.

The best installation is transverse to the load direction. No forces are transmitted through the housing then. It is, however, possible to mount it longitudinally to the direction of stress without any restrictions in accuracy up to a strain of 100 microns/m.

The high-resolution strain transducers are ideal for static and dynamic measurements.

The strain transducers DA26, DA40, DA54 differ only in the dimensions and the fastening screws (M4 or M6). The DA54 transducer is also available without a flat recess for mounting with attached threaded bolts.

The strain transducers DA54-mag, DA68 and DA68e are attached by magnetic clamps.

Cylindrical strain sensors include DA54-tiewrap and Dadx. The DadX strain transducers consist of two half-shells, which are mounted on columns. They are available for diameters from 50mm to 250mm. DA54-tiewrap is fastened via cable ties.

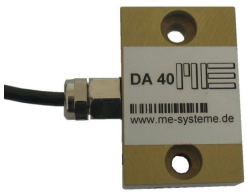
With these strain transducers in the robust and easy-to-install aluminium housing, the same performance characteristics are achieved as with the direct application of strain gauges. These include high resolution, very low drift phenomena and the possibilities for both static and dynamic measurement.
The strain transducer contains a fully wired strain gauge, which is pressed onto the component to be glued by a specially shaped contact mechanism when the strain transducer is screwed on. The housing serves as an assembly frame for the strain gauge application. An integrated seal provides an initial protection against dust and moisture.
The strain sensor has two filler necks for potting with cable resin after installation.

The surface of the component must be sanded and cleaned in the area of the strain gauge before screwing the strain sensor. The strain gauge is permanently protected against moisture by a special, oil-proof seal.
The zero adjustment is carreid out by the strain gauge measuring amplifier GSV-2 after the

installing of the strain sensor. The strains from 0,1µm/m can be displayed. This corresponds to a mechanical tension of about 0,2N/mm^2 on a component surface made of steel. With the combination of strain transducer and measuring amplifier GSV-2, switching thresholds from approx. 1µm/m (corresponding to 0,2N/mm^2) can be monitored if a zero adjustment is carried out periodically.
For applications in weighing technology, an expansion range of at least 30 µm/m (6 N/mm^2) is recommended in order to achieve the lowest possible drift.

Strain sensors DA26, DA40 and DA54

Measuring range: 0,1 µm/m up to 1300 µm/m

DA26	DA40	DA54 PUR/10S	DA54 M12/10S
			
62mm x 26mm x 20mm	40mm x 26mm x 10mm	54mm x 30mm x 20mm	54mm x 30mm x 20mm
Built-in socket M12 Type 763 spring contacts	5m cable 4x0,14, Ø3mm	5m cable 2x2x0,25, Ø6mm	Built-in socket M12 Type 763 spring contacts

Dimensions

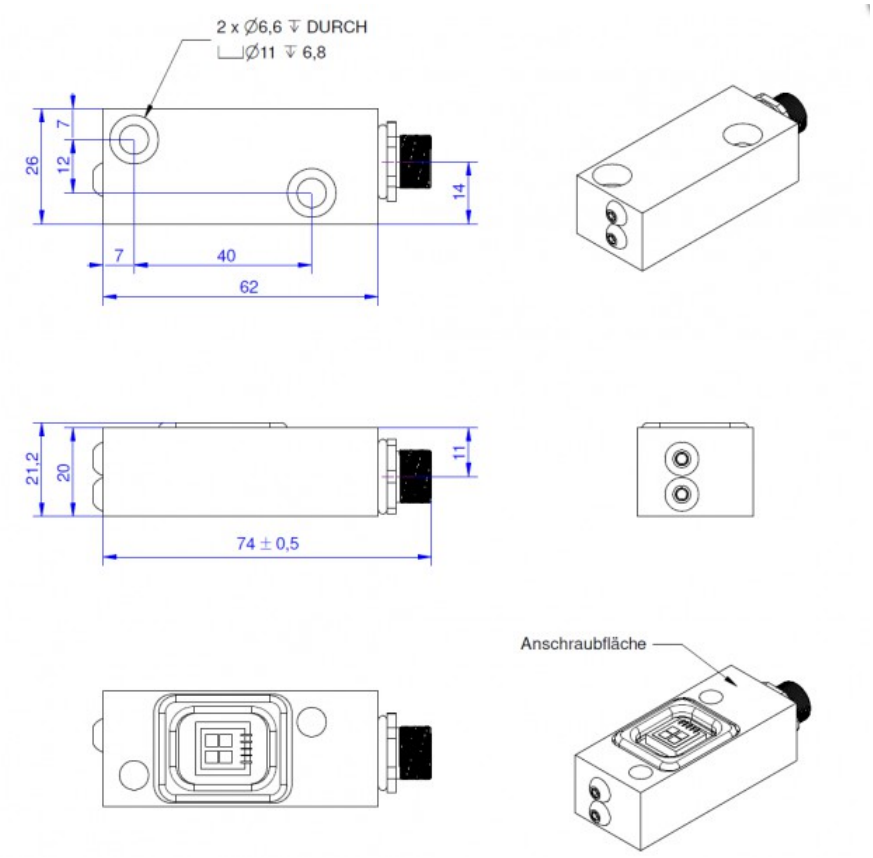


Figure 1: DA26

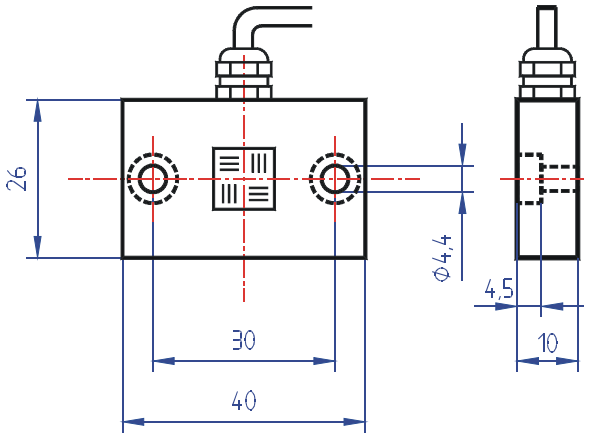


Figure 3: DA40

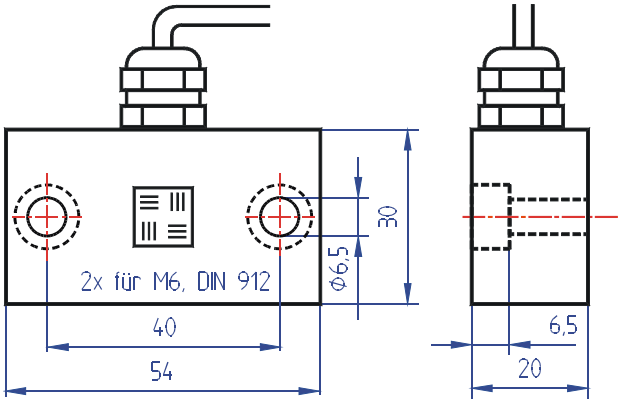


Figure 2: DA54

positive strain: <-->

Technical Data

Material		
Construction design		Strain sensor (tension-compression)
Material		Aluminum alloy
IP protection class		IP65
Fastening DA26 DA40 DA54		 2x M6 x 25 2x M4 x 12 up to 16 2x M6 x 20 up to 25
mechanical Data		
Nominal strain ($F_{N)}$	µm/m	±1000/ 1300
Operation strain	$\%F_N$	±150
elektrical Data strain gauge		
k-factor		2,04
Input sensitivity (with v=0,28)	µm/m @ 1 mV/V	766
Zero signal	mV/V	< ± 1,0
max. supply voltage	V	10
Input resistance	Ohm	350 ± 7
Output resistance	Ohm	350 ± 7
Insulation resistance	Ohm	$> 5 \cdot 10^9$
Connection DA26 DA40 DA54 Pur/10s DA54 M12T/10s		 4-pin flange connector 763 5m 24-4/Pur 5m 2x2x0,25/Pur 4-pin flange connector 763
Accuracy		
Temperature coefficient of the zero signal (typical)	mV/V / 10K	< 0,005
Temperature coefficient of the characteristic value	% v.S. /10K	< 1
Temperature		
Nominal temperature range	°C	-10...+65
Operation temperature range	°C	-20...+85
Storage temperature range	°C	-20...+85

Pin assignment

		DA40 DA54 Pur/10S	Pin-Nr for DA26 DA54 M12T/10S	DA26 DA54 M12T/10S Cable „SAC-M12FS“
+U_S	positive bridge supply	brown	1	brown
-U_S	negative bridge supply	white	2	white
+U_D	positive bridge output	green	3	blue
-U_D	negative bridge output	yellow	4	black

Shield: transparent;

Options

- Cable outlet in the longitudinal direction for DA54;
- Strain gauge type S120P with 1000 Ohm connection resistance;
- Strain gauege type 125US for shear stress measurements;
- integrated temperature sensor PT100 or PT1000 for DA54 M12 with 8-pin plug connector;

Pin assignment SAC-8P-M12FS

		Pin-Nr for DA54 M12	Cable „SAC-M12FS“
+U_S	positive bridge supply	2	brown
-U_S	negative bridge supply	1	white
+U_D	positive bridge output	3	green
-U_D	negative bridge output	4	yellow
I1-PT100(0)	input 1 temperature sensor	5	gray
S2-PT100(0)	Sense 1 Temperature sensor	6	pink
I2-PT100(0)	Input 2 Temperature sensor	7	blue
S2-PT100(0)	Sense 2 Temperature sensor	8	red

gray-pink: 0 Ohm; blue-red: 0 Ohm;

Strain sensor DAdX

Measuring range: ±0,1 µm/m up to ±1000 µm/m

Description

The two half-shells of the strain transducer DAdX are mounted on columns in order to increase the pressing force e.g. of punching or the pre-tensioning force of tools. Like the DA40 and DA54, this strain transducer is suitable for both static and dynamic force monitoring.
Moreover, this is a universal, retrofittable sensor for force and load monitoring. The extensometer is durable and resistant to oil and moisture.

With the strain sensor in aluminum half-shells, the same performance features are achieved as with the direct application of strain gauges.This includes high-resolution and low drift. Each half-shell contains a completely wired strain gauge full bridge, which is pressed onto the component to be glued by a specially shaped pressure mechanism when the strain sensor is screwed on. The housing becomes the mounting frame for the strain gauge application. Any bending stresses in the column are compensated for by connecting the two strain gauge full bridges in parallel.

Individual equipment of the half-shells e.g. with strain gauge half bridges in a 90° arrangement or with strain gauge half bridges for torque measurement are possible.

Dimensions

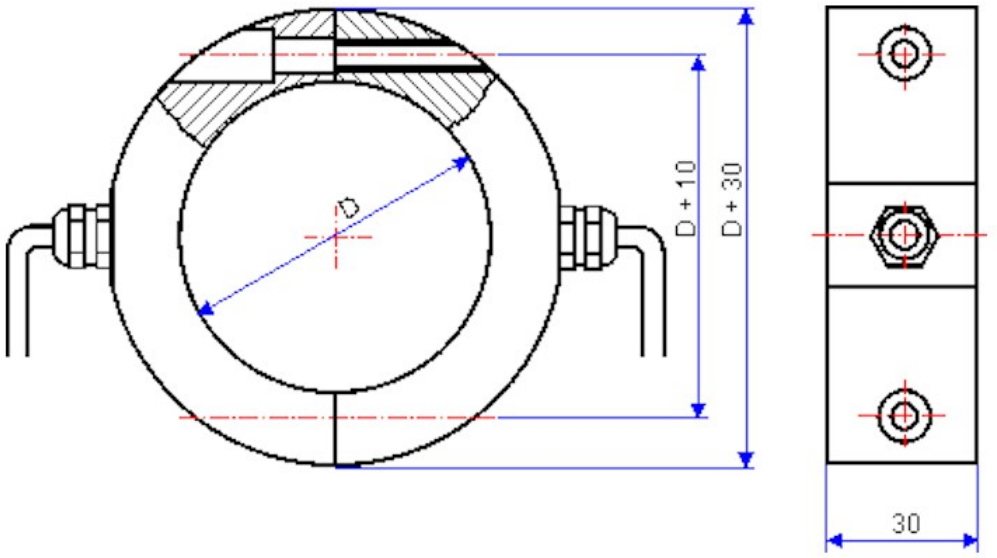


Figure 4: Strain sensor DAdx

Technical Data

Strain transducer	strain / compression	
Outer diameter x length	(inner diameter+30) x 30	mm × mm
Fastening straingauge	bonding	
fastening housing	2 × M6	mm
Material housing	Aluminum	
Measuring range (ε_N)	± 0,1 ... ± 1000	µm/m
Input resistance 1)	175 ± 0,7	Ohm
Output resistance 1)	175 ± 0,7	Ohm
Insulation resistance	> 5 · 10^9	Ohm
Supply voltage	2,5…10	V
connection 4 wires	10	m

1) after parallel connection of the half shells;

Pin assignment

+U_S	positive bridge supply	brown	
-U_S	negative bridge supply	white	shield: transparent
+U_D	positive bridge output	green	
-U_D	negative bridge output	yellow	

All individual wires are connected in parallel to compensate for bending stresses.

Pin assignment Dadx HB

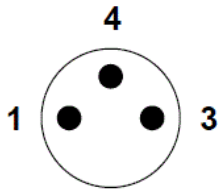
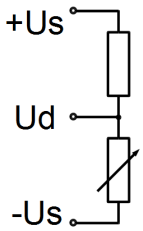
Version with integrated M8 round plug connector, 3-pin, pin contacts

1 active quarter bridge of the each half shell, resistance 350 Ohm;

integrated completion of the half bridge;

The active strain gauge is between pin 1and pin 4.

The measuring direction is parallel to the cylinder axis. Bending or axial force is measured, depending on the interconnection of the half-shells.

plug pin contacts		Pin	Function	Wire color
		3	+Us	blue
		1	Ud	brown
		4	-Us	black

Wiring diagram for bending

	Half-shell 1	Half-shell 2
+supply	3 (blue)	3 (blue)
-supply	4 (black)	4 (black)
+ signal	1 (brown)	
- signal		1 (brown)

Wiring diagram for axial force

	half-shell 1	half-shell 2
+supply	3 (blue)	4 (black)
-supply	4 (black)	3 (blue)
+ signal	1 (brown)	
- signal		1 (brown)

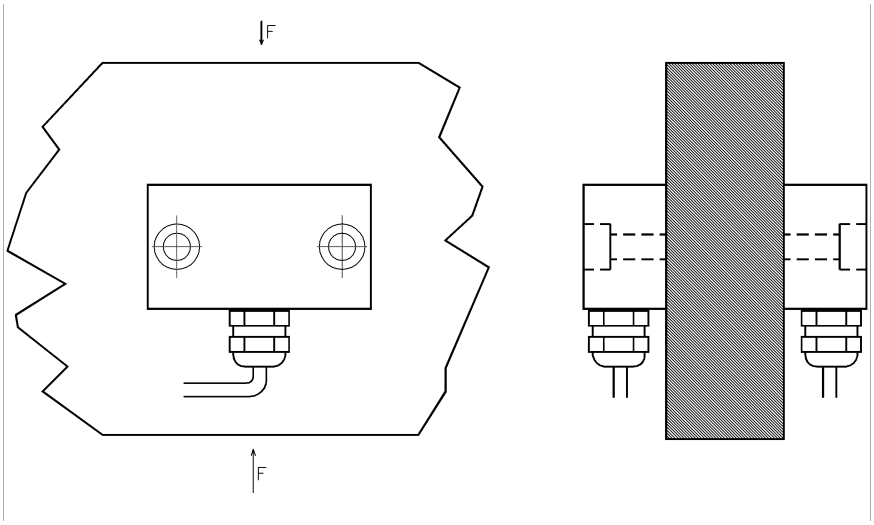
Pin assignment (application on one side)

Suitable for tensile / compressive, bending, shear and torsional loads.

		DA40	DA54	
$+U_S$	positive bridge supply	brown	brown	
$-U_S$	negative bridge supply	white	white	shield: transparent
$+U_D$	positive bridge output	green	green	
$-U_D$	negative bridge output	yellow	yellow	

Pin assignment (application on two sides)

tensile-/compressive load

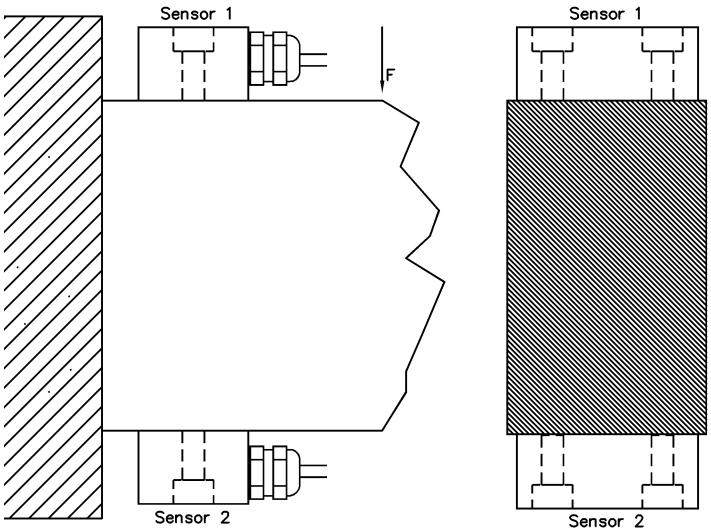


Note: The assignment reacts positive to compression

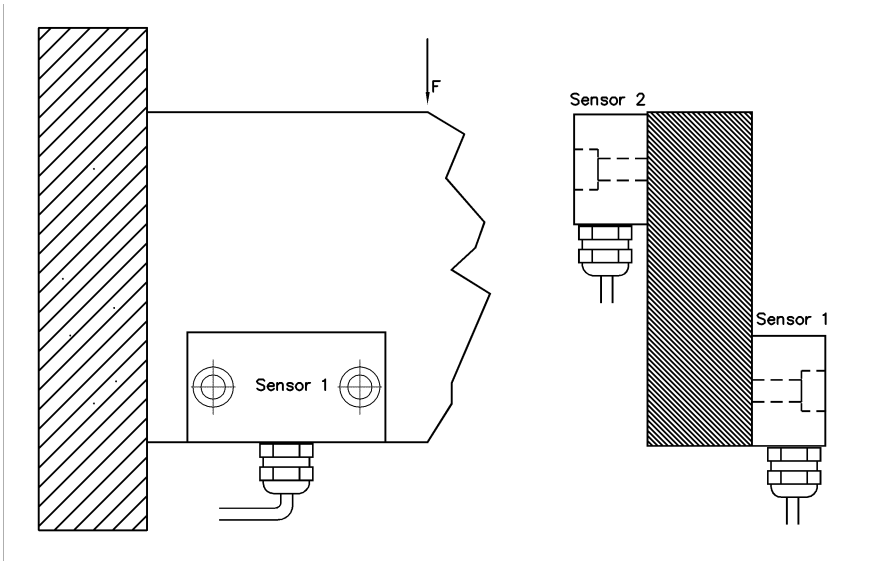
				DA40 or DA 54	
		Sensor 1	Sensor 2	Sensor 1	Sensor 2
$+U_S$	positive bridge supply	red	red	brown	brown
$-U_S$	negative bridge supply	black	black	white	white
$+U_D$	positive bridge output	green	green	green	green
$-U_D$	negative bridge output	white	white	yellow	yellow

Bending and shear loads

Bending variant 1
Mounted directly on the upper and lower edge fibers.

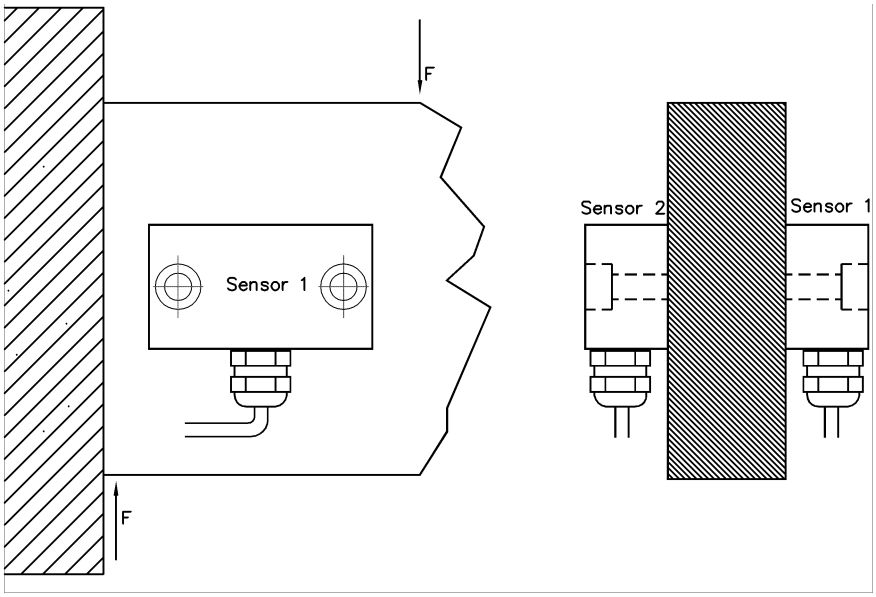


Bending variant 2
Installation close to the respective edge fiber.



Shear

Note: use strain transducers with "herringbone strain gauges" for shear loads.

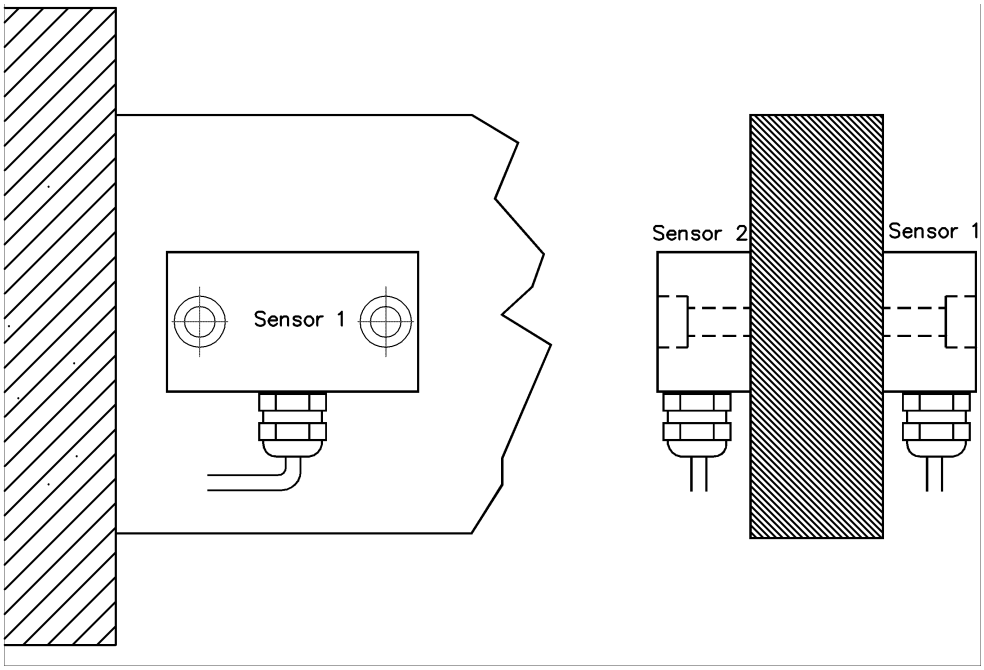


Assignment shear and bending

				DA40 or DA54	
		Sensor 1	Sensor 2	Sensor 1	Sensor 2
$+U_S$	positive bridge supply	red	black	brown	white
$-U_S$	negative bridge supply	black	red	white	brown
$+U_D$	positive bridge output	green	green	green	green
$-U_D$	negative bridge output	white	white	yellow	yellow

Torsional load

Use strain transducers with "herringbone strain gauges" for torsion.



				DA40 oder DA54	
		Sensor 1	Sensor 2	Sensor 1	Sensor 2
$+U_S$	positive bridge supply	red	red	brown	brown
$-U_S$	negative bridge supply	black	black	white	white
$+U_D$	positive bridge output	green	green	green	green
$-U_D$	negative bridge output	white	white	yellow	yellow

With this assignment, the sensor reacts positively to the left (counter-clockwise rotation).
To change the direction of rotation, swap $+U_D$ and $-U_D$

Strain sensors DA54-mag, DA54-tiewrap, DA68 and DA68e

Description

Figure 6: DA54-mag

Figure 7: DA54-tiewrap

Figure 5: DA68/DA68e

The strain sensors DA54-mag, DA54-tiewrap, DA68 and D68e are suitable for high-resolution detection of forces and deformation of structural works such as bridges, silo legs, offshore wind farms, railway lines, etc.

With these models in an anodised aluminium or stainless steel housing, the same performance features are achieved as when applying strain gauges directly. These features include a high resolution, very low drift effects and the options for both static and dynamic measurement.

Unlike strain sensors DA40 and DA54, the pressure strength is generated by integrated high-performance magnets or cable ties. Time-consuming drilling of threads is not required as a result.

The strain sensor can also be used for stress analysis in offshore applications. The strain gauges are also evaluated as active quarter bridges and are supplemented with passive precision resistors within the strain sensor.

The strain sensor DA68e is available with integrated evaluation electronics GSV-15L.

Dimensions

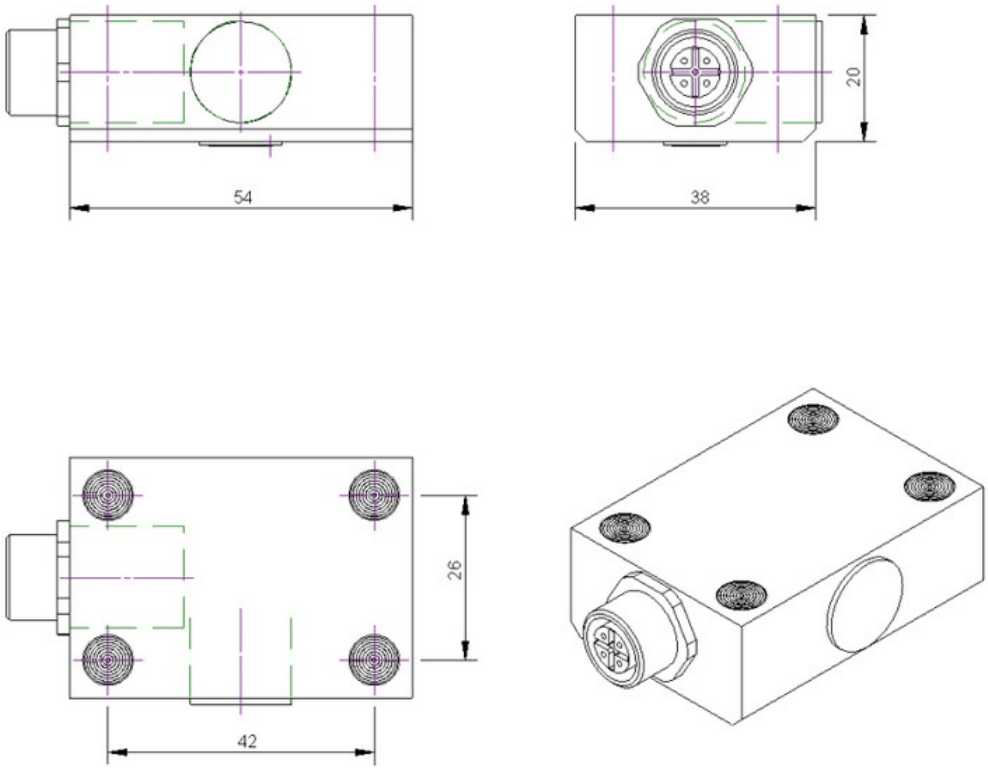


Figure 8: DA54-mag

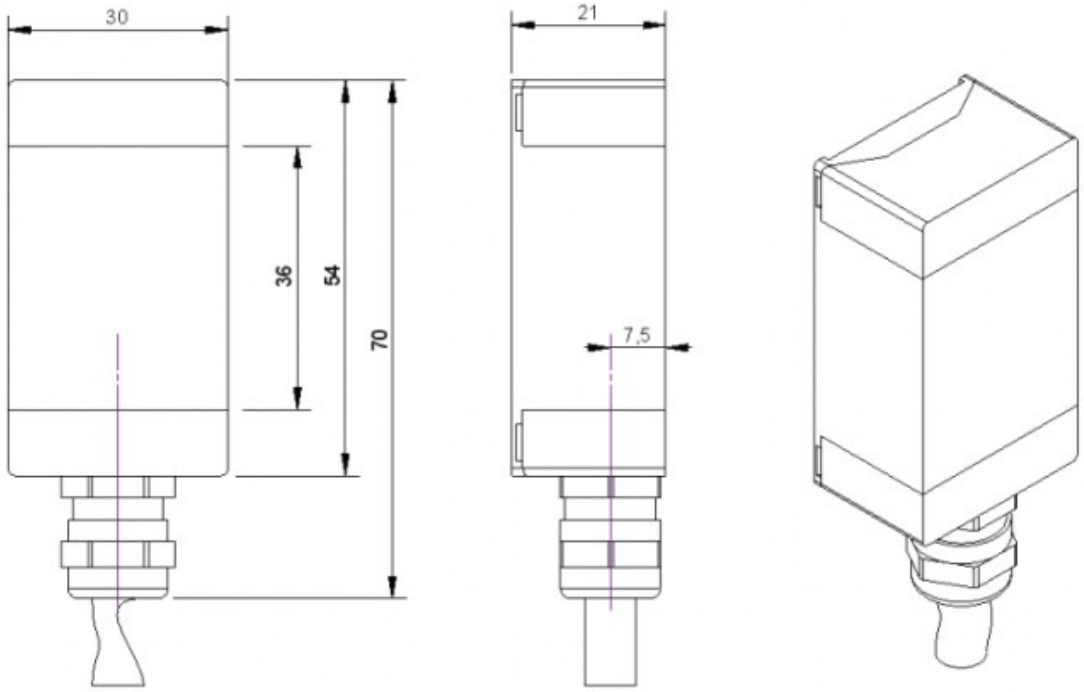


Figure 9: DA54-tiewrap

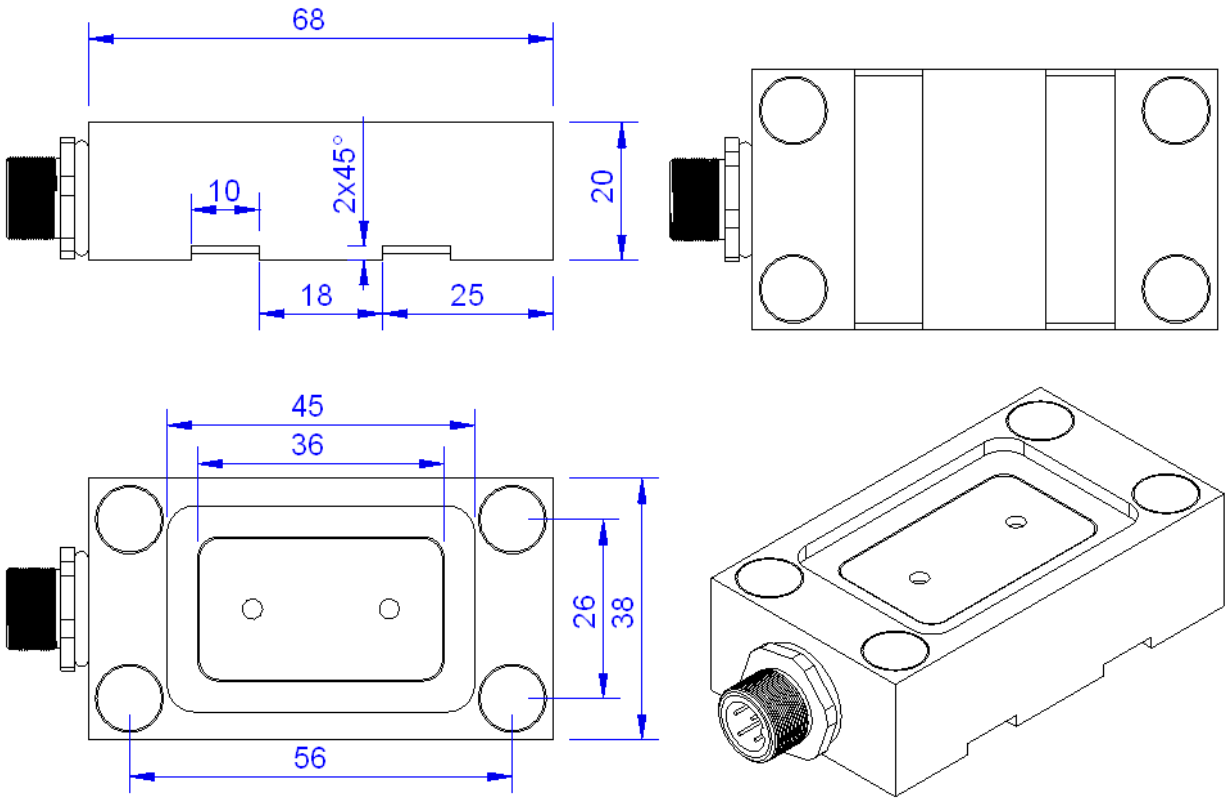


Figure 10: DA68, DA68e

Technical Data

Measurements / Material		
Design		Strain sensor (push-pull)
Material		Aluminium alloy or stainless steel
IP protection class		IP65
Attachment DA68		M-Bond 31 + magnets + stainless steel binder
Mechanical data		
Nominal strain (F_N)	µm/m	±1300
Working strain	%F_N	±150
Electrical data strain gauge		
k-factor		01.02.00
Input sensitivity (with v=0.28)	µm/m @ 1 mV/V	766
Zero signal	mV/V	< ± 1.0

Max. supply voltage	V	10
Input resistance	Ohm	350 ± 7
Output resistance	Ohm	350 ± 7
Insulation resistance	Ohm	> 5 · 10
Pin DA68		4-pin Flange connector M12
Pin DA68e		8-pin Flange connector M12
Accuracy		
Temperature coefficient of the zero signal (typical)	mV/V / 10K	< 0.005
Temperature coefficient of the parameter	% v.S. /10K	< 1
Temperature		
Nominal temperature range	°C	-10…+65
Working temperature range	°C	-20…+85
Storage temperature range	°C	-20…+85

Configuration

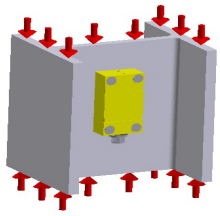
Type DA68e with integrated Electronic GSV-15L

Ub	Supply voltage (24V or 12V DC optional)	brown
GNDb	Connect ground, supply voltage	white
Ua	Output signal 4...20mA or 0...10V	green
GNDa	Connect ground signal	blue
Tara	Control input for zero balance	yellow
Scale	Control input for amplification factor	grey
SW	Threshold output	pink
	Shield (is not connected with the housing)	

Standard type

Symbol	Description	DA54-tiewrap	DA54-mag, DA68	Pin
+Us	positive bridge supply	brown	brown	1
-Us	negative bridge supply	white	white	2
+Ud	positive bridge output	green	blue	3
-Ud	negative bridge output	yellow	black	4

Installation position

Compressive stress of the DA68 sensor in the longitudinal axis results in a negative signal. The sensor DA68 can also be installed across the compression direction. In this case, a positive output signal is received during compression. The sign of the DA68 output signal can be inverted by switching the cables +Ud and -Ud.	 negative signal

Options

•Cable outlet in transverse direction for DA68
•Strain gauge type S120P with 1000 ohm terminal resistance;
•Strain gauge type 125US for shear stress measurements;
•Integrated temperature sensor PT100 or PT1000 for DA68 with 8-pin connector;

Type designations

Designation	Function
DA68 VA	Stainless steel housing;
DA68 AL	Aluminium housing, anodized;
DA68e 010-5/M12L/10s/VA	With integrated electronics; stainless steel housing; analogue output 0...10V; zero adjustment via 5V control line.
DA68e 010-5/M12L/10s/AL	With integrated electronics; stainless steel housing, anodized; analogue output 0...10V; zero adjustment via 5V control line.

Mounting instruction

Surface preparation

The strain transducers should be installed on the metal surface. If necessary, please remove the paint with a belt or fan sander.

When using belt or fan sander, a grain size of 120 is sufficiently fine. Finally, the surface should be processed manually with grain 240.

There must be no grooves in the area of the strain gauge. A power cutter is unsuitable for surface preparation!

Remove completely the grinding dust from the surface with a lint-free cloth and solvent, e.g. acetone, MEK or isopropyl alcohol.
Please ensure that you always apply a clean cloth to the edge of the application area and that the grease is wiped out of the application area. Moving it back and forth has no effect, especially at the end of cleaning, as the fat is only pushed back and forth.

For the final cleaning, cotton swabs are recommended as this prevents the unintentional entry of grease from the uncleaned edge area.
Please do not touch the application area with your hand anymore and protect it from any contamination.

Mixing the adhesive

a) pre-dosed bag M-bond-101
Please remove the middle bar that separates the hardener from the resin. Knead the bag until the resin and hardener are thoroughly mixed and have an even color.
Alternatively, you can empty both chambers onto a clean surface (paper) and mix with a spatula.

Take the corners of the bag into account when mixing. The mixing process takes approximately three minutes. The pot time after mixing is 30 minutes, depending on the ambient conditions.
b) 2-components double cartridge M-Bond-30/31
please use mixing nozzles and dispensing gun. Dispense some adhesive directly onto the strain gauge or onto a clean surface (paper).

Prepare of the strain sensor

Take the extensometer out of the packaging and remove the protective cover. Do not touch the strain gauge with your hand.

Bonding process

Carefully apply adhesive with a spatula, wooden stick, toothpick or similar to the strain gauge including the protruding surface of the pressure pad in a thin, just closed layer.

Do not apply the adhesive to the gasket.
Put on the strain transducer and screw it on immediately.
Tighten the screw connections alternately, pulling the strain transducer against the screw heads until the strain transducer rests properly.
The pressure pad with the strain gauge should not be subjected to shear stress if possible.

From now on, the screws must not be loosened, otherwise damage to the strain gage would be expected. With the DA40, the screws should be retightened after 5 minutes because the seal will settle.
After a curing time of approx. 12 hours (EPY150 at 22 ° C) or 30 minutes (M30 at 22 ° C), the transducer is ready for unrestricted use.

Function control

The basic function can also be checked if the bond has not yet hardened by connecting the supply voltage US and then measuring the zero signal at the bridge output UD. The signal should not be higher than 2 mV per V supply voltage.

A stress test can also be performed. However, depending on the level of the load, you will notice a slight to significant creep, i.e. the displayed measured value decreases over time.

The insulation resistance between one of the connection lines and the component should be at least 20MOhm, better 2GOhm.
The resistance between $+U_S$ and $-U_S$ is 350 Ohm.
The resistance between $+U_D$ and $-U_D$ is also 350 Ohm.

Connecting cable

A 6mm PUR cable is used for the connection cable. This conforms to
EC Low Voltage Directive 73/23 / EEC. The temperature range is -40 ° C to + 70 ° C moving and -50 ° C to + 70 ° C stationary. The minimum bending radius is

approx. 5 times the cable diameter unmoved or 10 times the cable diameter moved.

Installation notes for magnet fastening

The full pressure strength of the magnets is only achieved on a flat surface. If there are small surface irregularities, air gaps occur between the magnet and the component meaning that the pressure strength is potentially insufficient to compress the strain gauge and the seal.

Therefore please check whether the pressure strength of the integrated magnets is sufficient before applying the adhesive.

For series DA68e, the following should be observed in particular:

•The strain gauge AND the housing bottom are coated with adhesive; it is only on the seal that no adhesive is applied.

•The same adhesive, “M-bond 30”, is recommended for the strain gauge AND housing bottom.

•Alternatively, adhesive “M-bond 31” is recommended. This adhesive is characterised by a longer working life and a higher final strength.

•The extension sensor is put down with light pressure. Excessive adhesive is squeezed on the gap by means of a light, oscillating (±1mm) movement.

•Stop the oscillating movement when the metal surface of DA68-mag rubs noticeably on the surface of the component.

•It is recommended that an additional sealing gap with silicone TSE397C or similar silicone is laid around the housing.

•The sensor can also be attached to the designated pockets using stainless steel cable ties.

•After attaching, the sensor must be filled with casting compound (cable resin). Two M4 threaded holes (sealed with round-headed screws) are provided for filling and ventilation.

•The cable resin must be mixed thoroughly before being drawn into the syringe. In doing so, the centre bar (Image 1) must be loosened in the middle by pulling apart (Image 2) and both liquids must be mixed for approximately 3 minutes by kneading, moving and spreading out from the corners (Image 3).



•Fill syringe and inject the cable resin with the syringe;

•the pot life of cable resin is approximately 10 minutes.

Depending on the planned duration of use, additional measures to protect against moisture are applied after installation, such as Sealing of the joints with silicone, encapsulation with additional enclosing hoods etc.

Accessories

Accessory	Illustration
Adhesive Double Bubble pre-dosed Epoxy-adhesive (included in delivery)	
Adhesive M-Bond 30 (Option)	
Dispensing gun (Option)	
Connection cable for DA54 M12/10S Mixing nozzles for M-Bond 30	Type SAC-M12FS, Phoenix Contact; Type 503-385

Änderungen vorbehalten.
Alle Angaben beschreiben unsere Produkte in allgemeiner Form.
Sie stellen keine Eigenschaftszusicherung im Sinne des §459 Abs. 2, BGB, dar
und begründen keine Haftung.

Made in Germany