Operating manual

Sensor Signal Amplifier SV_flex

1-Channel, PCM

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Disclaimer Documentation

The texts and examples were prepared with care. Mistakes can not be excluded. The enterprise Manner Sensortelemetrie will assume no liability for missing or incorrect information and resulting consequences, neither judicial nor otherwise.

Modifications

The enterprise Manner Sensortelemetrie GmbH may change or upgrade hardware and software – or parts of them - as well as the provided documents (operation instructions, start-up instructions, spare parts lists) – or parts of them – without notification.

We would be pleased for suggestion for improvement and notes about mistakes.

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1 Safety

1.1 Definition of Warnings

DANGER!
Hint for possible dangerous situation. Ignoring the security terms may cause death or serious injury.

WARNING!
Hint for possible dangerous situation.

Ignoring the security terms may cause injury.

CAUTION!
Hint for possible damage of property, if the corresponding protective measure were disregarded.

Further information

1.2 General Warnings

The system startup has to be carried out by trained qualified personnel, who is able to evaluate the potential risks. All chapters of this instruction manual had to be read and fully understood before startup.

On non-observance it's not possible to assert a claim for the incurred losses from the manufacturer. Any changes to the system, except those described in the instruction manual and customer documentation, will invalidate any warranty.

DANGER!
Risk of Injury by Incorrect Installation
Incorrect installation can cause injury to persons directly while the installation or during the subsequent startup

Note the Mounting Hint (see chapter 4, installation instruction)

The system startup has to be carried out by instructed qualified personnel that's familiar with

– the professional handling of security relevant components,
– the valid regulations for operational safety und rules for accident prevention.

DANGER!
Risk of Injury by Unintentional Startup
Rotating or moving of parts by inadvertent startup of the machine can cause injury .

During all mounting, demounting or repairing the system has to be powered-off. Note the mounting instructions.

DANGER!

Risk of Injury by Movable Parts

While normal operation, as well as inadvertent loosening of parts of the telemetry system during operation, present persons may be injured if protective equipment is absent.

Check the safety function of the protective equipment particularly

- before each startup
- after each replacement of a component
- after a longer standstill
- after each defect

Independent thereof the safety function of the protective equipment must be checked in suitable time intervals as part of the maintenance work!

WARNING!

Risk of Burn Injury

While operation the sensor signal amplifier and the stator antenna may become warm.

Avoid contact.

CAUTION!

Risk of Property Damage

If the connectors disconnected / connected while the system is powered on the telemetry system as well as the connected devices can be damaged.

Plug connectors must not be disconnected / connected when the system is powered on.

2 Conventional Usage

Sensor telemetry systems are used for contact-free data and power transfer from passive and active sensors (e.g. on rotating shafts).

DANGER!
Risk of Subsequent Damages caused by Malfunctions

If the telemetry system is used for controlling or regulating functions it is not conceive for, subsequent damages up to injury to persons can be caused.

The delivered system has to be used exclusively used for the purpose for which it was ordered.

The operator must take care of his health and safety.

The operator of the equipment must prevent subsequent errors following faulty measuring results. This is particularly necessary if the telemetry system is used in controlling or regulating functions.

The customer, as the builder of a system with an integrated sensor telemetry system, is responsible for the correct and conform operation and also assumes the responsibility for ensuring that the system at start-up complies with all provisions of Directives 2014/53/EU and 2014/35/EU.

Scope of Delivery

A telemetry system normally contains:

- Evaluation unit
- Stator antenna
- Rotor antenna
- Sensor signal amplifier
- HF cable

For the detailed purchased parts package of the delivered telemetry system mind the corresponding shipping ticket.

3 Technical Data

3.1 Measuring System

Technical Data Telemetry System

Term	Value
HF frequency	13.56 MHz
Number of channels	1
Bandwidth	0 to 1 kHz (-3dB)
Linearity	<0.1%

General Measuring Configuration

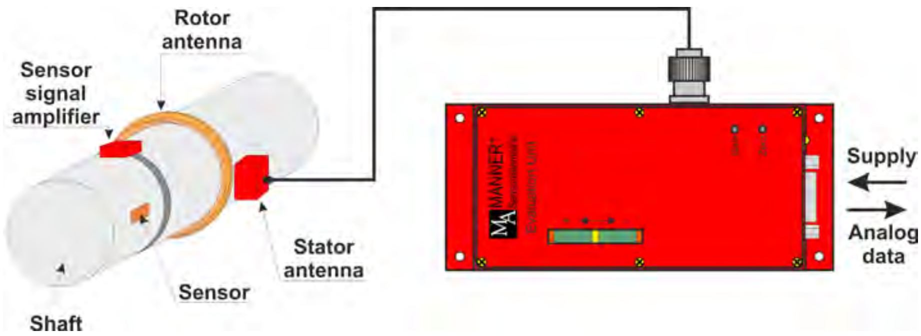


Fig. 1: General measuring configuration

Block Diagram

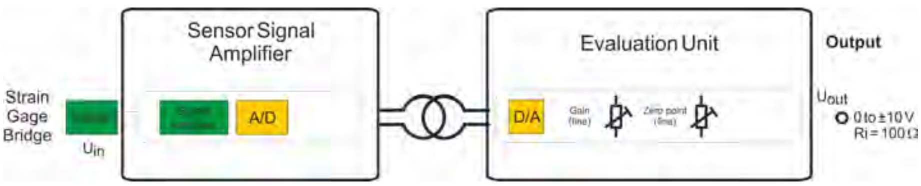


Fig. 2: Block diagram

Energy and Data Flow

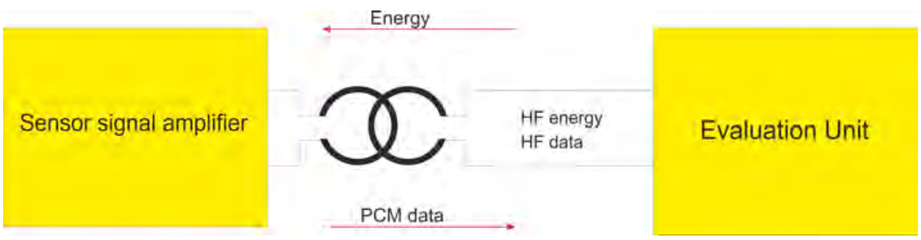


Fig. 3: Energy and data flow

3.2 Sensor Signal Amplifier, Sensors

Technical Data Sensor Signal Amplifier

Term	Value
Sensor signal amplifier type	**SV_flex_PCM16**
Sensor	Strain gauge (strain gauge resistor ≥350 Ω), PT100
Type of modulation	PCM
HF frequency	13.56 MHz
Channel sample rate	6.62 kS/s
Bridge supply voltage [U_B]	3.3 V
Coarse voltage [U_{coarse_max}]	6.4 to 7.2 V
Zeropoint and gain drift	0.02% / °C
Linearity	0.1% typ.
Amplification (adjustable by solder resistor)	0.05 to 20 mV/V
Bandwidth	0 to 1 kHz
Resolution	16 Bit with 16 Bit CRC
Protection class	IP42
Temperature range	-10 to +85°C

Pin Assignment Sensor Signal Amplifier

> **NOTICE!**
> **Possible Damage to the Rotor Electronics while soldering**
> A soldering that is too long or too hot can damage the sensor signal amplifier. Keep soldering as short as possible. If necessary, allow to cool.

> **NOTICE!**
> **Damaging of Electronic**
> *Condensation may cause unwanted contact between the pins*
>
> To prevent any effects of condensation the pin connections must be waterproofed!

> The sensor signal amplifier must be grounded by connecting the GND pin to the rotor .

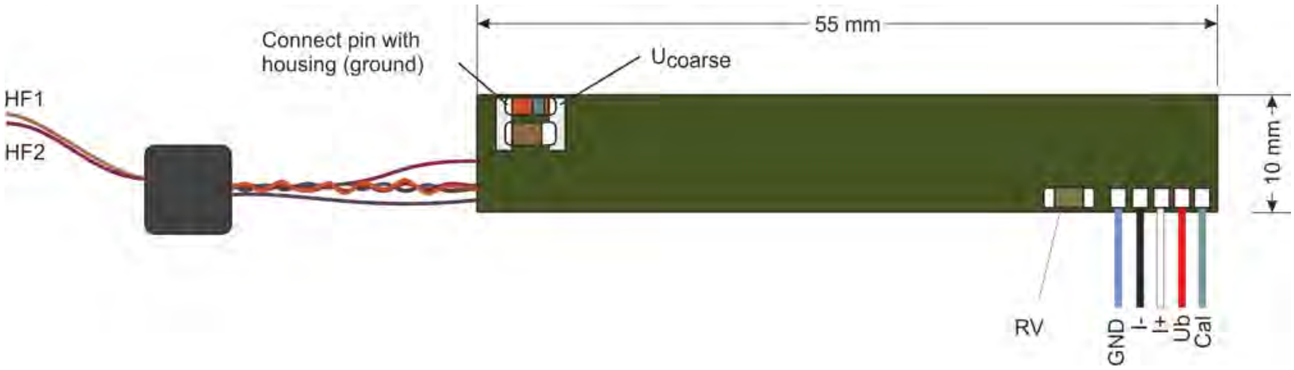


Fig. 4: SV_flex_PCM16, Pin assignment

3.2.1 Gain Bandwidth Characteristic

Gain Bandwidth Characteristic

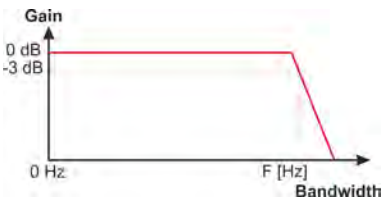


Fig. 5: Gain bandwidth characteristic

> The output signal bandwidth ranges from 0 to 1 kHz.

3.2.2 Operation Mode Strain Gauge Bridge

Operation Mode Strain Gauge (Full Bridge)

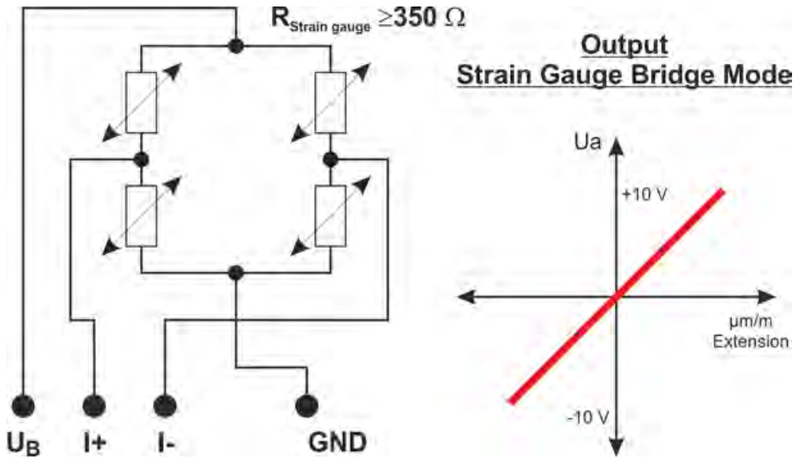


Fig. 6: Operation mode strain gauge (full bridge)

Resistor Rv [kΩ]	Sensitivity [mV/V]
24.8	4
12.4	2
6.2	**1**
3.1	0.5
1.55	0.25
0.775	0.125

Operation Mode Strain Gauge (Half Bridge)

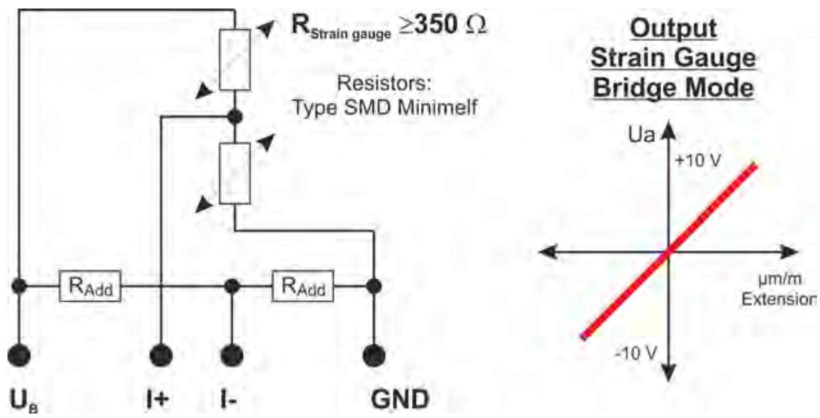


Fig. 7: Operation mode strain gauge (half bridge)

Additional resistors R_{Add} = 1 kΩ, 0.1 %, Tk 15

Operation Mode Strain Gauge (Quarter Bridge)

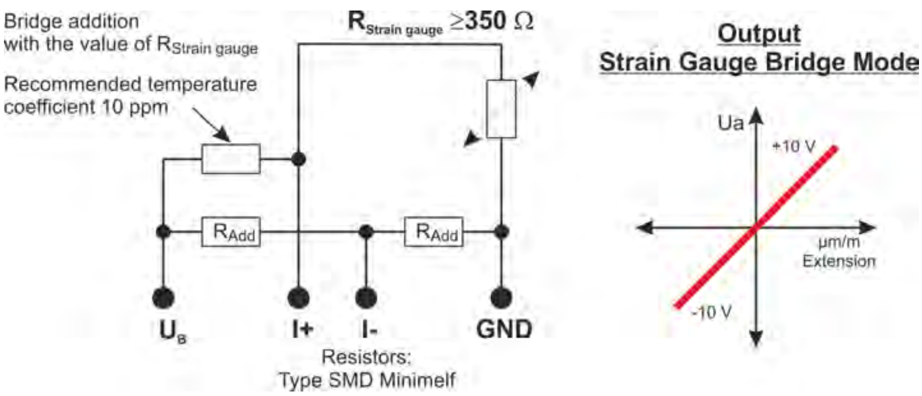


Fig. 8: Operation mode strain gauge (quarter bridge)

Additional resistors R_{Add} = 1 kΩ, 0.1 %, Tk 15

3.2.3 Remote Shunt Calibration Function

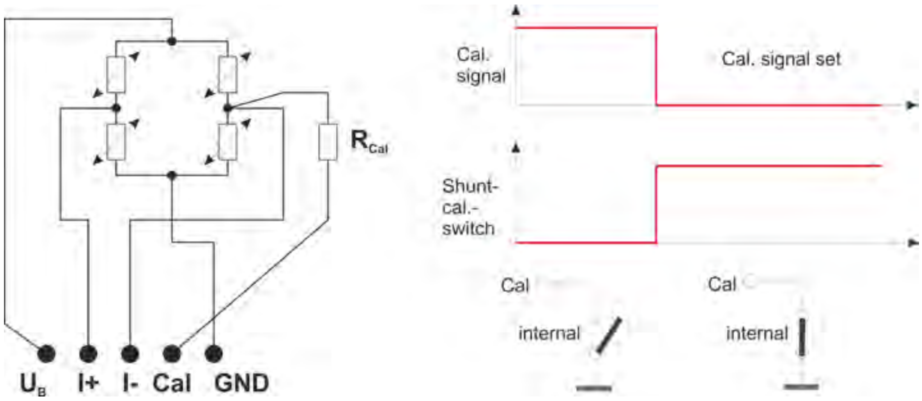


Fig. 9: Remote shunt calibration function

R_{Cal} see "List for Shunt Calibration Resistor"

3.2.4 List for Shunt Calibration Resistor

$E = dL * k_{Factor}$

$R_{shunt} = 1 / (-1+ 1 / (-1+1 / (0.5+E / 1000))) * R_{strain} = (500-E) / (2*E) * R_{strain}$

The system is based on a 350 Ω **full** strain gauge bridge !!!

List for the Shunt Resistor (Strain Gauge Full Bridge)					
k_{Factor}	2.05				
Expansion dL (µm/m)	Electrical signal E (mV/V)	Rshunt (kΩ) for a 350Ω $R_{Strain\ gauge}$ (100% adjustment)	Rshunt (kΩ) for a 350Ω $R_{Strain\ gauge}$ (80% adjustment)	Rshunt (kΩ) for a 1000Ω $R_{Strain\ gauge}$ (100% adjustment)	Rshunt (kΩ) for a 120Ω $R_{Strain\ gauge}$ (100% adjustment)
3902.4390	8	10.76	13.45	30.75	3.69
3414.6341	7	12.33	15.41	35.21	4.23
2926.8293	6	14.41	18.01	41.17	4.94
2439.0244	5	17.33	21.66	49.50	5.94
1951.2195	4	21.70	27.13	62.00	7.44
1463.4146	3	28.99	36.24	82.83	9.94
975.6098	2	43.57	54.47	124.50	14.94
487.8049	1	87.32	109.16	249.50	29.94
439.0244	0.9	97.05	121.31	277.28	33.27
390.2439	0.8	109.20	136.50	312.00	37.44
341.4634	0.7	124.82	156.03	356.64	42.80
292.6829	0.6	145.66	182.07	416.17	49.94
243.9024	0.5	174.83	218.53	499.50	59.94
195.1220	0.4	218.58	273.22	624.50	74.94
146.3415	0.3	291.49	364.36	832.83	99.94
121.9512	0.25	349.83	437.28	999.50	119.94
97.5610	0.2	437.32	546.66	1249.50	149.94
60.9756	0.125	699.82	874.78	1999.50	239.94
48.7805	0.1	874.83	1093.53	2499.50	299.94
43.9024	0.09	972.05	1215.06	2777.28	333.27
39.0244	0.08	1093.57	1366.97	3124.50	374.94
34.1463	0.07	1249.82	1562.28	3570.93	428.51
30.4878	0.0625	1399.83	1749.78	3999.50	479.94
29.2683	0.06	1458.16	1822.70	4166.17	499.94
24.3902	0.05	1749.82	2187.28	4999.50	599.94
19.5122	0.04	2187.32	2734.16	6249.50	749.94
14.6341	0.03	2916.49	3645.61	8332.83	999.94
9.7561	0.02	4374,82	5468.53	12499.50	1499.94

Note:

When using a **half** strain gauge bridge the same mechanical expansion [dL] results in a **half** of the electrical signal [E] shown in the table above.

e.g. dL = 487.8049 µm/m → E = 0.5 mV/V → R_{Shunt} = 174.84 kΩ ...

When using a **quarter** strain gauge bridge the same mechanical expansion [dL] results in a **quarter** of the electrical signal [E] shown in the table above.

e.g. dL = 487.8049 µm/m → E = 0.25 mV/V →R_{Shunt} 349.83 kΩ ...

Usage of a strain gauge bridge resistor deviating from the standard resistor

Deviation of sensor signal **gain** [mV/V] when using strain gauge bridge resistor other than 350 Ω.

Applied bridge resistor $R_{strain\ gauge}$ [Ω] fullbridge	Deviation of the sensor signal gain to the reference value $R_{strain\ gauge}$ = 350 Ω fullbridge
120	+1.0%
350	0.0%
700	-1.8%
1,000	-3.1%
1,400	-5.0%
2,000	-7.5%
3,000	-11.5%
4,400	-16.6%
5,000	-18.6%

3.2.5 Operation Mode PT100

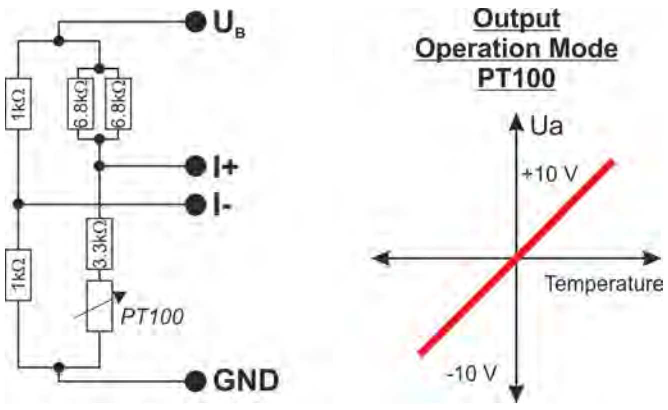


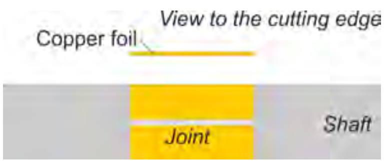
Fig. 10: Operation mode PT100

Resistor Rv kΩ	Temperature °C
72	500
36	250
18	125
8	62.5

4 Mounting / Starting

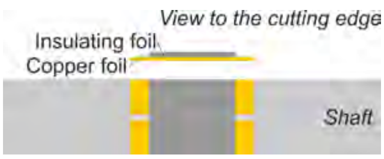
4.1 Mounting of Sensor Signal Amplifier

1. Clean the area for the rotor loop with denatured alcohol and acetone and dry with compressed air

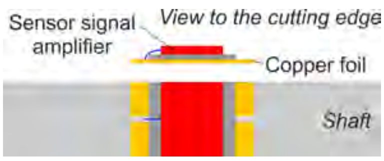


2. Glue the strip of copper foil **without bubbles** round the shaft with an overlap of 2 mm

3. Solder the copper foil thin and plane Soldering iron 80W, soldering tip about 3 mm wide Soldering temperature 450°C



4. Glue an insulating foil over the copper foil There must be no breakthrough from the sensor signal amplifier at any time



5. Fix the sensor signal amplifier at two locations on the insulating foil with superglue

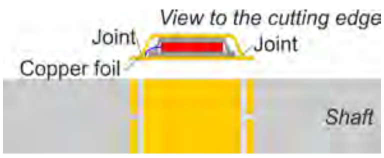
Fix the transformer on the insulating foil with superglue

6. Solder the wire 'GND for grounding' to the copper foil

7. Connect the sensor signal amplifier and the transformer with the rotor antenna (soldering terminal)

8. HF adjustment- see 'Adjustment rotor antenna'

9. Operate functional check



10. If there are too much disturbances from the rotor antenna and the signal has too much noise:

Glue an insulating foil over the sensor signal amplifier

There must be no breakthrough from the sensor signal amplifier at any time

11. Glue a piece of copper foil over the sensor signal amplifier (not over the transformer) and solder the copper foils

12. Operate functional check

13. Seal the sensor signal amplifier and the rotor antenna.

4.2 Adjustment of the Rotor Antenna Loop

Pinning Sensor Signal Amplifier

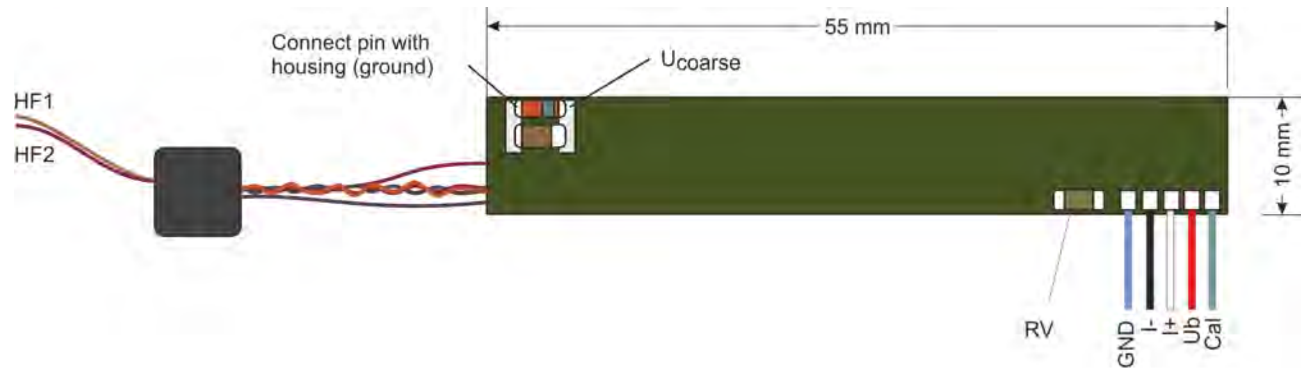


Fig. 11: SV_Flex_PCM

4.2.1 Adjustment Rotor Antenna

Installation for Adjustment

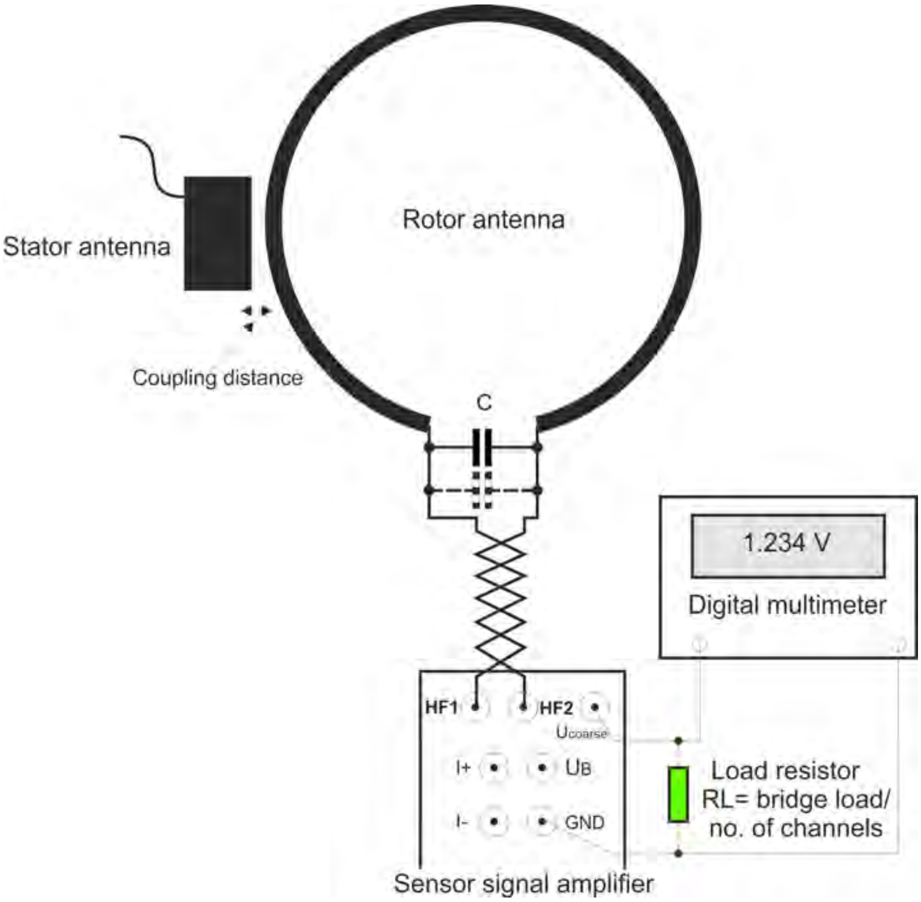
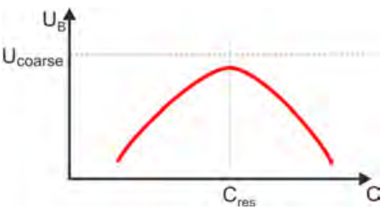


Fig. 12: Adjustment rotor antenna loop

Adjustment with Variable Capacitor



1. Build up the measuring system. Add a load resistor R_L = bridge load/number of channels between U_{coarse} and GND.

   Connect the terminals of the sensor signal amplifier HF1 and HF2 to the rotor antenna.

2. Solder a variable capacitor (0 to 500 pF) parallel to the rotor antenna (pay attention to short connecting leads), set the HF energy adjustment screw (if present) on the stator antenna to the middle position and align the stator antenna correctly to the rotor antenna.

3. Connect the voltage U_{coarse} with a digital multimeter for voltage measurement.

4. Set the HF power control of the evaluation unit (if available) to MINIMUM.

   Switch on the evaluation unit and measure U_{coarse}.

   The voltage U_{coarse} must be less than (U_{coarse_max} - 3,0 V) for the adjustment procedure. If U_{coarse_max} is reached the load resistor can be downsized or the coupling distance between rotor and stator antenna can be enlarged.

   U_{coarse_max} see technical data of the sensor signal amplifier.

5. Change the variable capacitor until the maximum voltage is reached. If the voltage exceeds U_{coarse_max} reduce the HF power.

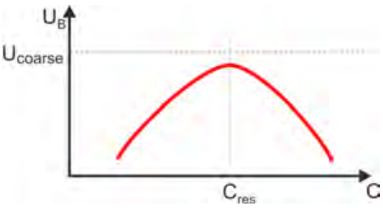
   If the range is not in the variable range of the variable capacitor, connect a static capacitor (470 pF) parallel.

6. Disconnect the variable capacitor and determine the set value with a capacitance meter

7. Solder the next smaller value from the DIN series as a static capacitor (ceramic multilayer, COG).
8. Repeat the procedure to refine the result. Solder the determined difference value as a static capacitor parallel to the first one.
9. Remove the load resistor.
10. Check the strain gauge bridge supply.
11. Remove the digital multimeter.

Adjustment without Variable Capacitor

> **NOTICE!**
> All used capacitors **must be** COG type ≥100 V
>
> For a HF power >3 W **two** capacitors must be connected in series for load spreading.



1. Build up the measuring system. Add a load resistor R_L = bridge load/number of channels between U_{coarse} and GND.

   Connect the terminals of the sensor signal amplifier HF1 and HF2 to the rotor antenna.

   Solder in a 47 pF capacitor parallel to the rotor antenna, turn the HF power adjustment screw of the stator antenna (if existent) to mid-position and position the stator antenna correct to the rotor antenna.
2. Connect the voltage U_{coarse} with a digital multimeter for voltage measurement.
3. Set the HF power control of the evaluation unit (if available) to MINIMUM.

   Switch on the evaluation unit and measure U_{coarse}.

   The voltage U_{coarse} must be less than (U_{coarse_max} - 3,0 V) for the adjustment procedure. If U_{coarse_max} is reached the load resistor can be downsized or the coupling distance between rotor and stator antenna can be enlarged.

   U_{coarse_max} see technical data of the sensor signal amplifier.
4. Increase the value of the capacitor in 47 pF steps and establish the maximum of U_{coarse}
5. Improve the result with 22 pF steps.
6. Remove the load resistor.
7. Check the strain gauge bridge supply.
8. Remove the digital multimeter.

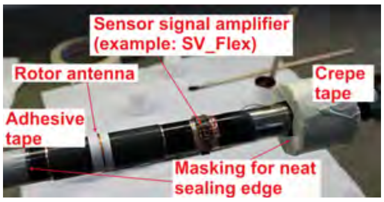
After successful adjustment of the rotor antenna, the data reception by the stator antenna must be correct when switching off and on the evaluation unit without further corrective actions. Yellow and green LED must be on, see 'Control LEDs', description evaluation unit

If data are not available after switching on the evaluation unit (green LED off, see 'Control LEDs', description evaluation unit) the HF1 and HF2 connections of the sensor signal amplifier must be changed at the rotor antenna. Proceed the rotor antenna adjustment again.

> **After successful adjustment of the rotor antenna the connections HF1 / HF2 of the sensor signal amplifier must not be changed!**

4.3 Sealing with Ultifil

Sealing of Sensor Signal Amplifier and Rotor Antenna

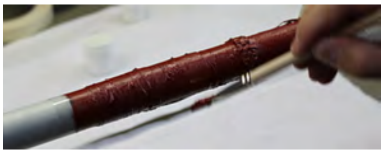


1. Mask the area which will be sealed with a suitable adhesive tape (e.g. Tesa tape, crepe tape)
2. Mix the grouting **Ultifil** according to instruction
(50% component A + 50% component B, depending on proportion of weight)

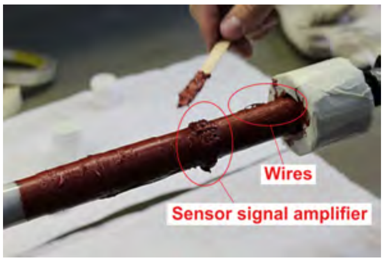
3. Cover the complete area abundant with sealing compound by dint of a spattle or paint-brush .

4. Distribute the sealing compound with a paint-brush onto the sealing area.

> **!**
> **NOTICE!**
> Do not to disconnect or damage the connections and cables at the sensor signal amplifier!



5. Even the sealing compound thoroughly with a paint-brush.



6. Put additional sealing compound with a spattle onto the area of increased parts (sensor signal amplifier, cables).

7. Apply fabric tape. The inflexible fabric edge of the first layer should be positioned outside.

8. Wrap the fabric tape onto the sealing and cover concurrently the surface of the tape with sealing compound. Overlapping range approx. 50%.

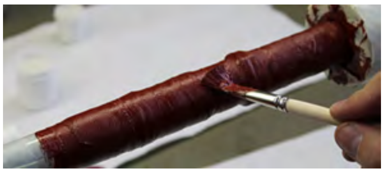
   The fabric layers must become a compound. Cover the complete area of measuring position, sensor signal amplifier and rotor antenna thoroughly with sealing compound.
9. After wrapping coat the surface completely with **Ultifil**.

   Mind that the fabric tape is warped close to the masking tapes but not above!

10. Without interruption add a further layer of fabric tape and fix it with sealing compound.

11. At the end of the second layer cover the upper and lower side of the fabric tape with sealing compound.

12. Cut the fabric tape with scissors diagonally.



13. Even the sealing area once again completely with a paint-brush.

14. Remove the masking tape with the sealing is wet.

15. Hardening of sealing compound in horizontal rotating posture.

Requirements:

- 24 h with room ambient temperature
- or alternative 2 h with radiant heater 125 W, distance 100 mm ±20 mm

16. **Final test of shaft for function:**

- torsion,
- energy / maximum distance
- data communication RMC

4.4 Coupling / Installation

Antenna Coupling

DANGER!

Risk of Faulty Measuring Data and Resulting Subsequent Errors, up to Injury to Persons

Damaging, modifications or disturbance of the coaxial cable(s) may falsify the measuring results and optionally cause subsequent errors according to operation purpose.

Do not buckle the coaxial cable!

Do not modify the coaxial cable!

Do not keep data cable and the coaxial cable together with energy- / high-power current cables!

The connectors of the HF energy and / or HF data coaxial cable must not have connection to the grounding of the machine!

Permissible bending radii for coaxial cables:

- RG58 → R_B = 25 mm
- RG400 → R_B = 30 mm static / 50 mm dynamic
- RG178 → R_B = 15 mm
- RG213 → R_B = 50 mm
- RG316 → R_B = 15 mm

The bending radii of the used coaxial cables must not be undercut

CAUTION!

Damaging of Antenna System

Contact between rotor antenna and stator antenna while operating may cause mechanical damages of the antennas

The stator antenna must not touch the rotor antenna.

CAUTION!

Risk of Damaging of Electronic, Faulty Measuring Data

While overheating of the evaluation unit the built-in electronics may be damaged

An overheated evaluation unit may cause faulty measuring values and respectively subsequent errors

The evaluation unit must be mounted onto a heat conductive base.

CAUTION!

Damaging of Evaluation Unit Caused by High Vibrancy

High Vibrancy of the evaluation unit may cause damaging

While mounting in environments with high vibrancy (e.g. in vehicles) the evaluation unit must be mounted vibration damped, e.g. by rubber buffer.

The stator antenna must be mounted directly opposite to the rotor antenna

The stator antenna must be mounted in the middle of the moving range of the rotor antenna

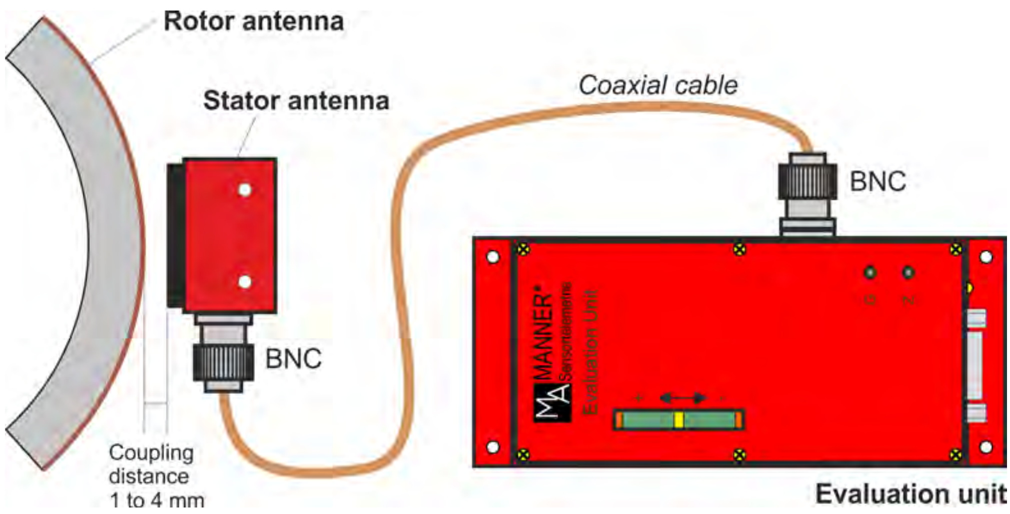


Fig. 13: Coupling

Startup

> **DANGER!**
> **Risk of Injury**
> *Incorrect installation can cause injury to persons directly while the installation or during the subsequent startup*
>
> Follow mandatory the rules for accident prevention!

1. Mount the sensor signal amplifier with rotor antenna
2. Position the stator antenna correct to the rotor antenna
3. Connect the stator antenna with the evaluation unit
4. Switch the system on
5. Release the measuring position complete
6. Adjust the output signal to 0.000 V by using the screw ‘0’
7. Load the measuring position with nominal load or set the Cal.signal permanently
8. Adjust the output signal to +10.000 V by using the screw 'G' and measuring the "Analog output signal' or adjust to the value noted in the calibration protocol.
9. Release the measuring position complete or remove Cal.signal
10. Check the output signal to zero. Repeat step 5 to 10, if necessary.

4.5 Test Circuit

Operation mode strain gauge sensor (full bridge)

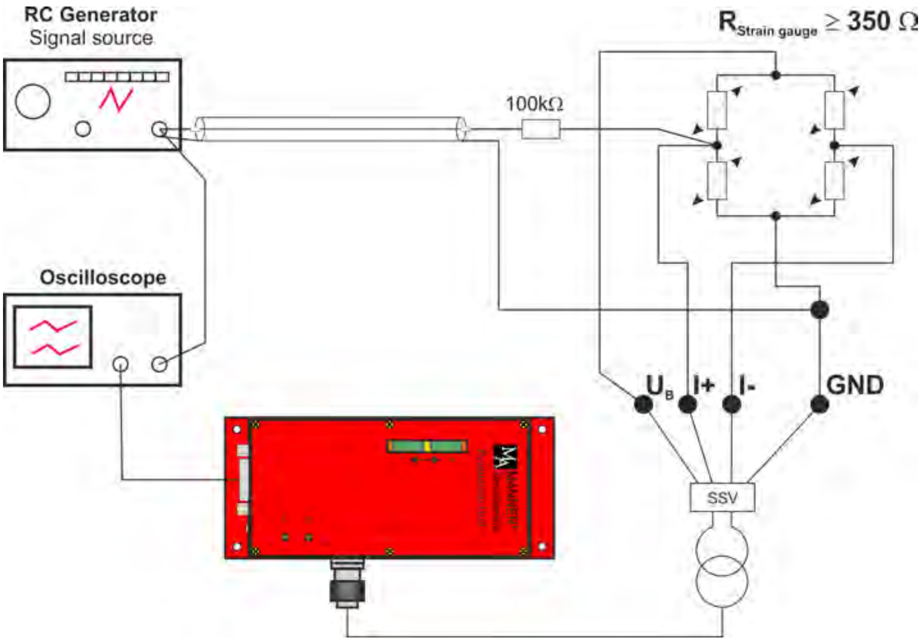


Fig. 14: Test circuit

5 Options

Optionally available

- Temperature measurement (PT100, Thermocouple)
- Remote Control
- waterproof (sealed)
- ATF oilproof (sealed)

If you have any questions regarding customer-specific solutions, please contact our sales department.

6 Maintenance

The systems of Manner Sensortelemetrie are low-maintenance.

DANGER!
Risk of Injury Caused by Defects on System Built-Up
Particularly loose or damaged parts may endanger present persons

Carry out the maintenance regularly and assiduously.

Within a periodical repeating maintenance following operations have to be done:

- Clean the antenna system, vacuuming of dust deposit
- Check the antenna system for scrub marks or mechanical damages
- Check the fastening of the stator antenna for a fix seat and tighten of the screwed fastenings where necessary.
- Check the plug connections and cables

Document the completed annual maintenance

7 Contact

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