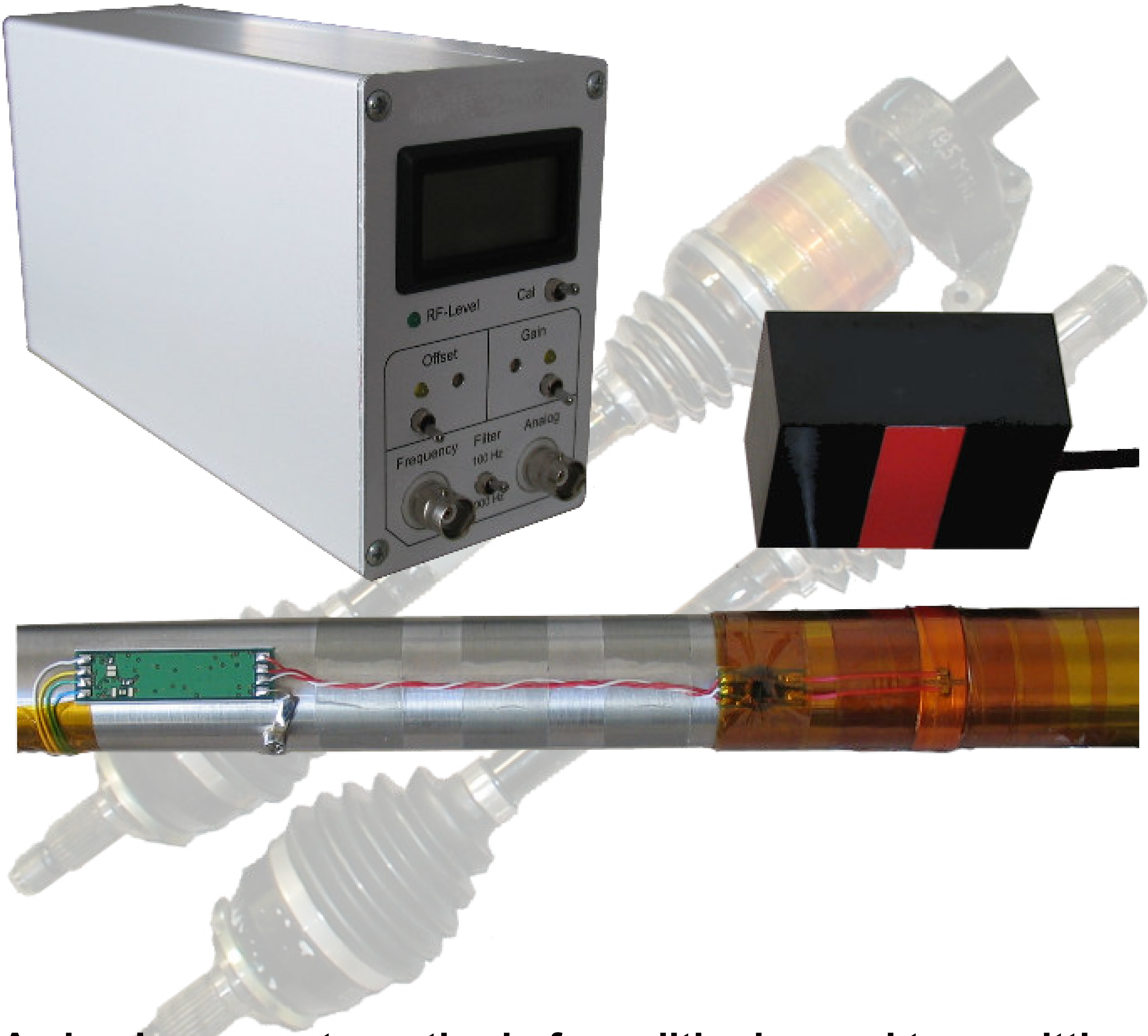
Telemetry System

Type Single   Type Double



A simple, accurate method of conditioning and transmitting strain, thermocouple, voltage, or ICP® signals from moving or rotating components.

Documentation Type **Single/Double Version 3.3**; May, 10th. 2018;

Type Single / Type Double

Contents

Tip

The first letter(s) of the short name of every component shows the usability to the systems **Single** or **Double:**

S- = **Single** only　　**D-** = **Double** only　　**SD-** = **Single** and **Double**

Abbreviations

TC	Thermocouple	**STG**	Strain Gage	**n**	RPM
Mt	Torque	**AC**	Alternating Current	**DC**	Direct Current

Units of physical dimensions

Voltage	1V = 1,000mV	**Current**	1A = 1,000mA
Acceleration	1g = 9.81m/s²	**Torque**	1Nm = 8.851in.lbf
Weight	1kg =1,000g = 35.275 oz	**Length**	1m = 1,000mm = 3.28ft = 39.37“
Temperature	°C = degrees Celsius; °F = degrees Fahrenheit; K = degrees Kelvin		

Important Safety Tips!

The Telemetry system utilizes an inductive electricity supply.

Avoid having combustible material in the area of the inductive head.

The power oscillator is regulated according to power usage.
With high power demand the inductive head can become hot to the touch, up to 60°C/140°F.

With high power use the Control Unit can become warm to the touch and should be located in a well ventilated area.

Potential health hazard for heart pacemakers.

The inductive supply system generates a magnetic field.
Heart pacemakers and other sensitive medical devices should stay clear of the active magnetic field. This area is 50cm/20" around the inductive head.

Potential Burn Hazard.

Avoid metallic objects in and around the active magnetic field. Such as rings, chains and other metallic jewelry. These objects can become very hot and burn the skin.

Electrical Shock Hazard.

The Control Unit should not be opened except by authorized service personnel. High voltages of up to $400V_{pp}$ can be found in the Control Unit and stator head cable. Any damaged or frayed stator cables should be discarded and replaced immediately as they may pose a shock hazard.

It is the responsibility of the user to ensure the rotor electronics and antenna are properly installed on the shaft.
Components not correctly mounted may come loose during operation and cause injury to personnel and damage to the components and property.

Important Installation Tips!

Installation

All cable connections should be done with the power off.

Only apply power to the Control Unit with a stator head connected, otherwise damage to the Control Unit may occur.

If the inductive head is placed on a metallic surface with the power on, the power oscillator will produce maximum power. While there is circuitry to prevent the system from being damaged for a short period of time, this must be avoided.

The inductive head should be fastened to a non-metallic plate or bracket.
If a metallic bracket is used the stator should be isolated from the metal by more than 5 mm of a non metallic material such as rubber or plastic.

Mounting the stator near or on metal could produce unnecessary warming of the stator head and cause damage to the system. Every attempt should be made to keep a metal free area around the stator head for best operation.

The installation of the Telemetry system requires the rotor electronics and antenna be mounted in such a way they do not come loose during operation.

It is the responsibility of the user to ensure the components of the Telemetry system are properly installed.

Knowledge of basic soldering techniques is required.

Soldering should be performed using a small regulated soldering iron. The recommended temperature setting is 400°C / 752°F.

Type Single / Type Double

Technical Data

Rotor electronics S-RE / D-RE		
Mechanical values		
	housing	nickel-plated aluminium housing dust tight and waterproof installable
	Mechanical adaptation	installation on shafts with tapes, glue and resins or screws
	weight; dimensions	**S-RE1** 3g / 0.1oz.; 40mm x 12mm x 3,5mm / 1.57“ x 0.47“ x 0.14“ **S-RE1P** 15g / 0.5oz.; 41mm x 29mm x 9mm / 1.61“ x 1.14“ x 0.35“ **S-RE3** 3.5g / 0.11oz.; 40mm x 14mm x 3,5mm / 1.57“ x 0.55“ x 0.14“ **D-RE1** 5g / 0.17oz.; 45mm x 18mm x 3,5mm / 1.77“ x 0.71“ x 0.14“
	Maximum RPM	dependent on installation, up to 50,000 RPM; higher on request
Operating temperature		-40°C...120°C/ -40°F...248°F, not condensing
Power supply		Battery 6...18V; Inductive supply with module **SD-IP**
Sensor connection		Solder pads (**REx**) or Solder pins (**RE1P**)
Data transmission		integrated RF-transmitter; 10.7 MHz; < 1mW
Transmitting antenna		Dependent on application, single band / wire around shaft
Signal input		differential amplifier for direct connection of sensors
	Configuration	by solder jumpers or resistor
	Sensors	**S-RE1 / RE1P** **Strain gage full-bridge / half-bridge** >=350 Ohm; **S-RE2** **TC Type K** (also non-isolated) ; (**S-RE3 -ICP**) **D-RE1** **two Strain gages full-bridge / half-bridge** >=350 Ohm;
	Strain gage bridge excitation	3VDC, integrated, short circuit protected
	Measurement ranges **S-RE1/D-RE1**	±0.5mV/V, ±2mV/V, set by jumper or ±0.1mV/V... ±16mV/V adjustable
	S-RE2	-100°C .. 1,000°C/-148°F..1,832°F, linearized, cold junction compensated
	S-RE3	±1V, ±5V, set by jumper or ±100mV... ±5V adjustable
	S-RE1P	±0.1mV/V... ±16mV/V adjustable
	Accuracy without sensor	better ±0.1% FS or ±1°K
	Signal bandwidth/ Antialiasing filter	**1kHz / Butterworth**
	Linearity	**< 0.1%**
	Zero drift and Gain drift	**-10°C...80°C/14°F...176°F < 0.001%/K; ...100°C/212°F < 0.002%/K**
		-40°... 120°C/-40°F...248°F < 0.003%/K
	Adjustment function	Offset ±1.8V and gain ±20% by potentiometer at control unit
	Control function	Shunt calibration for STG-application ; power on and switch
		negative full scale if TC break
Stator SD-SH		
Wideband Induktive/Receiving head		Transmission distance dependent on installation, typically:
	SD-SH1	40mm/1.6“; dimensions 35 x 50 x 70 mm³
	SD-SH2	10mm/0.4“; dimensions 25 x 30 x 45 mm³
	SD-SH4	500mm/19.7“ loop length; longer length are available
	SD-SH5	60mm/2.4“; dimensions 35 x 100 x 70 mm³
Wideband Receiving head	**SD-SH3**	0.1m...0.5m /0.3ft..1.5ft. dependent on installation and antenna design, dimensions 24 x 12 x 5.5 mm³; 0.95“x 0.47“x 0.22“
Telemetry cable Cab		
Connection cable for **SD-SH1/-SH2/-SH4/-SH5**		5m/16ft - **Cab-IP-5**; 10m/32ft - **Cab-IP-10**; 20m/64ft - **Cab-IP-20**
Connection cable for **SD-SH3**		5m/16ft - **Cab-RF-5**; 10m/32ft - **Cab-RF-10**; 20m/64ft - **Cab-RF-20**
Control unit S-CU / D-CU		
Signal output	-analog voltage	±10V; BNC jack on front (**S-CU0, S-CUR, D-CU0**); Screw clamps (**S-CUH**)
	-analog frequency	10kHz ±5kHz; BNC jack on front (**S-CU0, S-CUR**)
	-analog current	4...20mA; screw clamps (**S-CUH**)
Display		3½ digit LCD-Display (**S-CU0, S-CUR, D-CU0**)
Power supply		9... 32VDC, with inductive power supply about 12W
Dimensionss (LxHxW); Weight	**S-CU0/D-CU0**	**Compact housing** 180 x 105 x 64 mm³/ 7.09“x 4.13“x 2.54“; 1kg / 35oz.
	S-CUR	**Rack housing 19 "** plug-in / 3RU x 14HP; (3HE x 14TE); 1kg / 35oz.
	S-CUH	**DIN Rail housing**; 164mm x 105mm x (89mm); 1kg / 35oz.
Operating temperature		0°C...60°C/32°F...140°F
Installation Kit SD-IK1		Installation length of 1m; copper band, Mu-metall, Isolation tape
Specials S-f-xMHz		Carrier frequencies other than 10.7MHz, are available

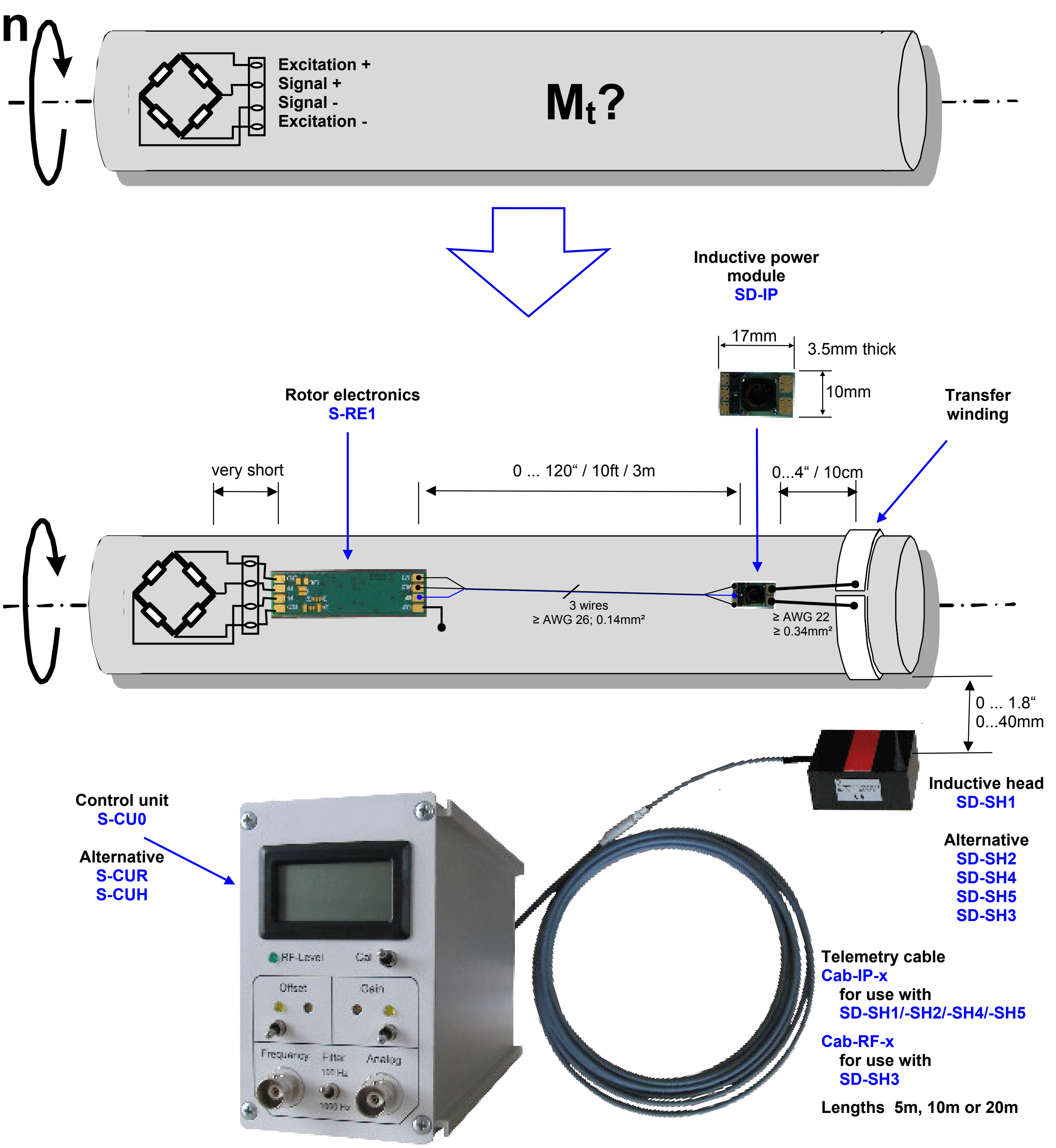
Type Single

RTM
Rainer Thomas Messtechnik

Basically system constellation

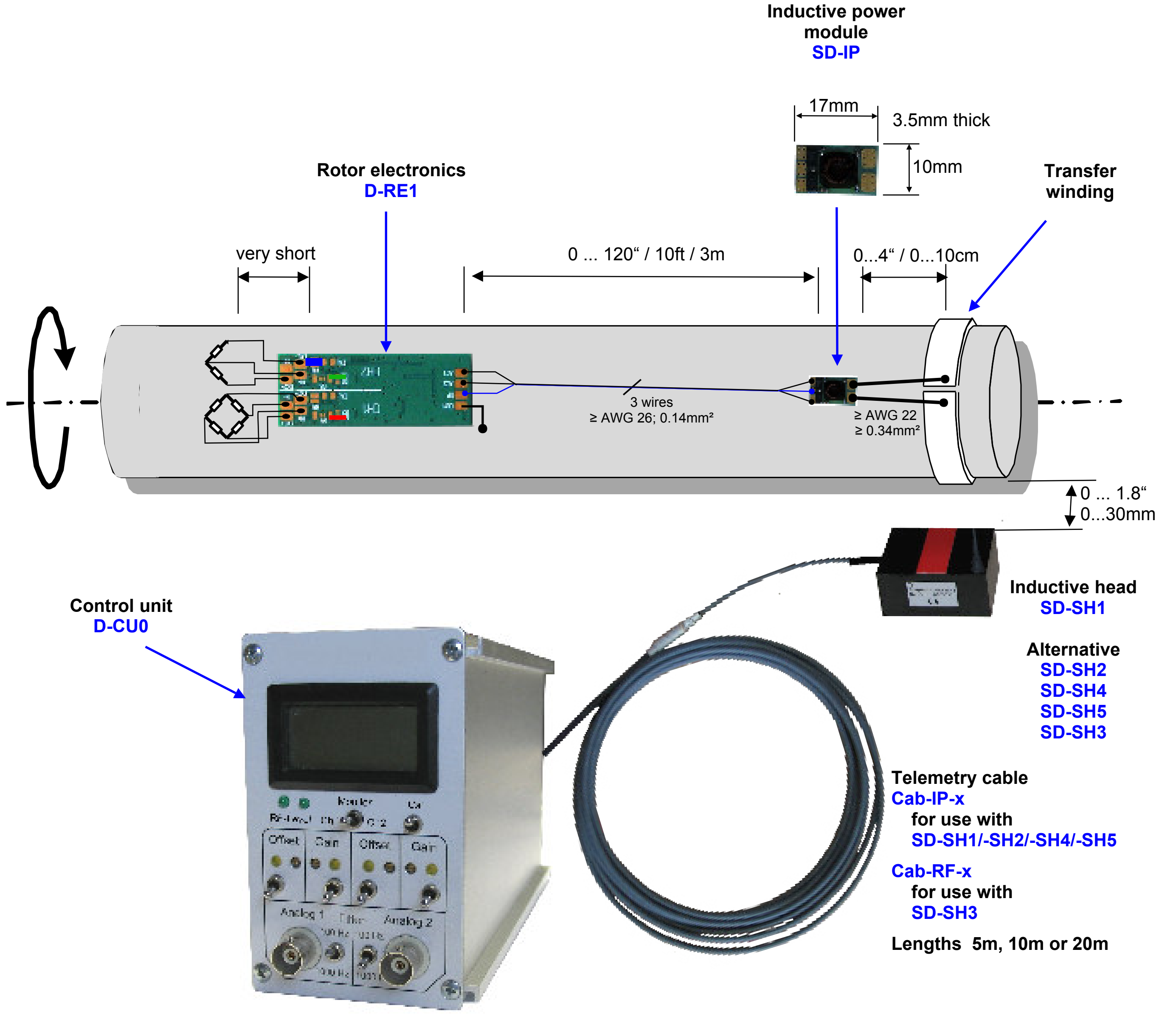
S-RE	+	SD-IP	+	SD-SH	+	Cab	+	S-CU	+	SD-IK
Rotor-electronics		Power-module		Inductive-head		Cable		Control unit		Installation material

Example: torque measurement on a rotating shaft with strain gage, full bridge



Basically system constellation

D-RE	+ SD-IP	+ SD-SH	+ Cab	+ D-CU	+ SD-IK
Rotor-electronics	Power-module	Inductive-head	Cable	Control unit	Installation material



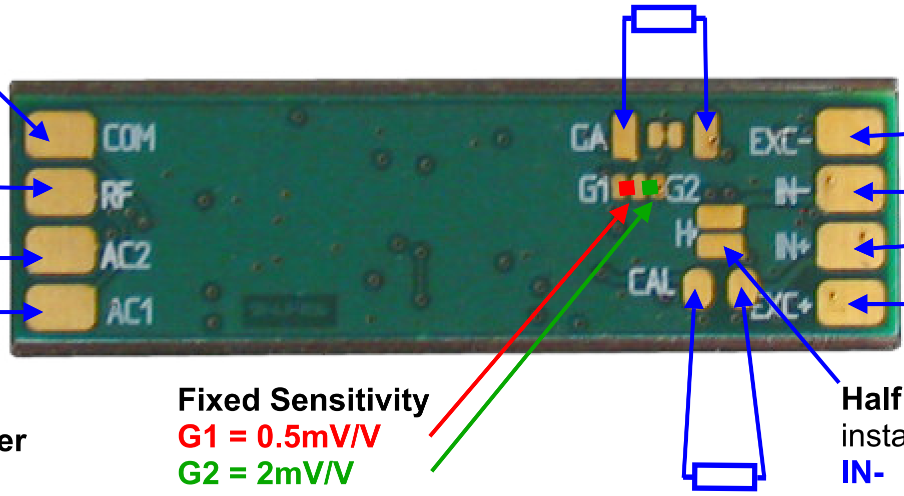
Type Single

Rotor electronics S-RE1

Rotorelectronics for Strain Gage Full or Halfbridge, ≥ 350Ω

RF-Gnd
contact to shaft recomended.

Gain Resistor
GA



Strain gage

Excitation -
Input -
Input +
Excitation +

Antenna

Battery
No polarity
or
IP-module for
Inductive power

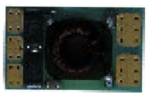
Fixed Sensitivity
G1 = 0.5mV/V
G2 = 2mV/V
install solder jumper!

Half bridge
install **solder jumper!**
IN- not used

CAL
Calibration Resistor

SD-IP Inductive power modul

AC1
RF
AC2



Power winding

Calculation of the resistors to be soldered

Gain Resistor

$$GA = \frac{100}{\dfrac{125}{3 \times S} - 1} \quad [\,k\Omega\,]$$

Calibration Resistor

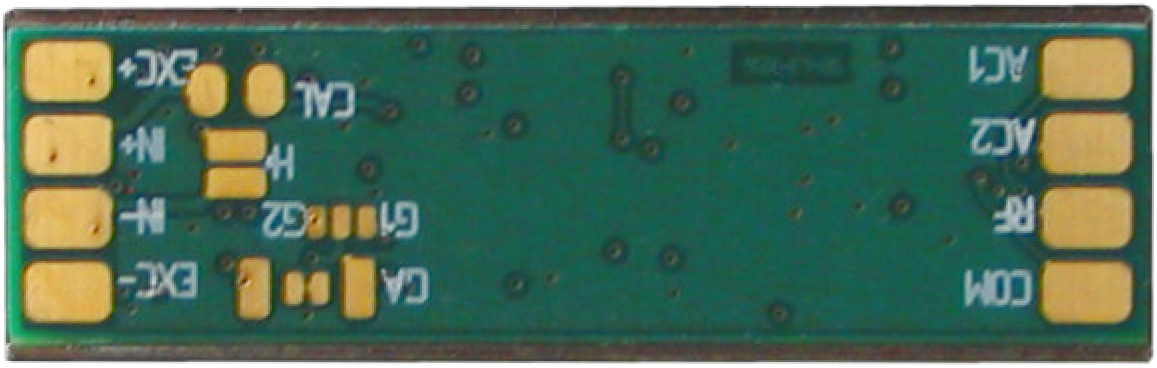
$$CAL = Rb \times \left(\frac{25000}{D \times S} - 0{,}5 \right) \quad [\,k\Omega\,]$$

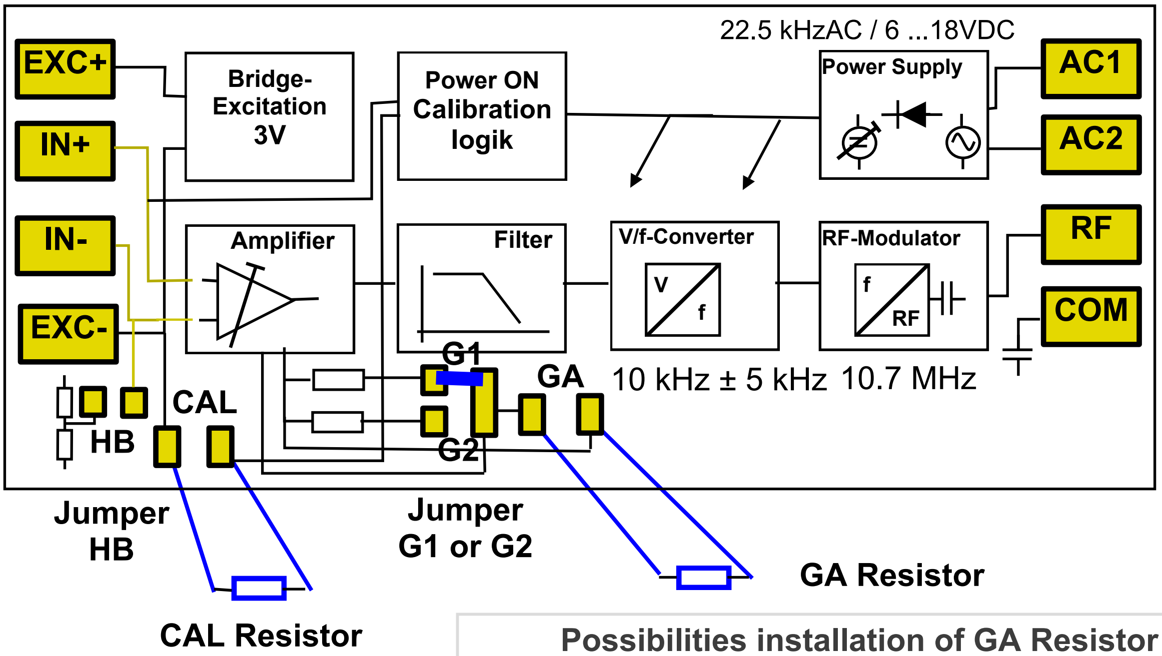
Units S = Sensitivity [mV/V]; Rb = Bridge resistor [kΩ]; D = detuning [%]

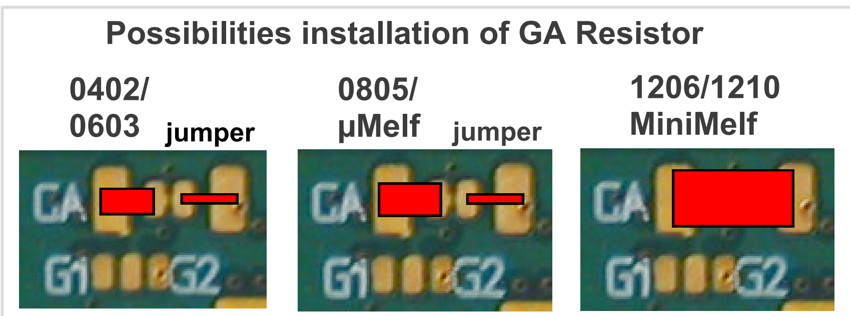
Sensitivity [mV/V]	0.1	0.5	1.0	2.0	4.0	8.0
GA [kΩ]	0.241	1.215	2.459	5.042	10.619	23.762
CAL [kΩ] 80% detuning / 350Ω bridge	1,093.575	218.575	109.200	54.512	27.169	13.497

Type Single

Rotor electronics S-RE1 Overview

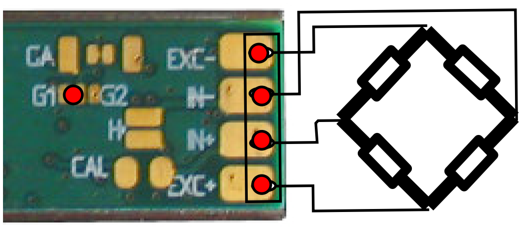






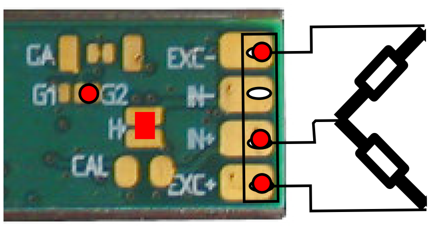
Rotor electronics S-RE1 Input connection

Full bridge



example 0.5mV/V

Half bridge

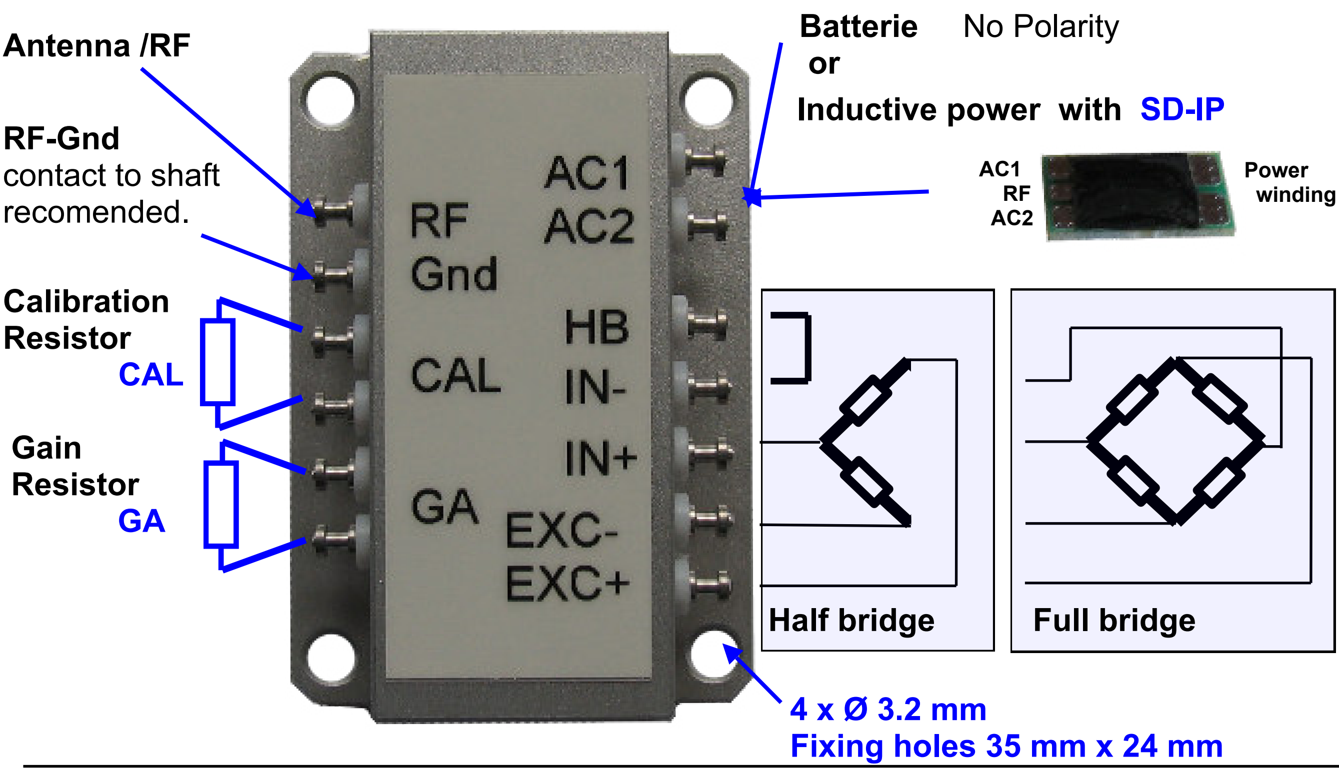


example 2mV/V

Type Single

Rotor electronics S-RE1P version solder pins

Rotorelectronics for Strain gage Full or Halfbridge, ≥ 350Ω



Calculation of the resistors to be soldered

Gain Resistor

$$GA = \frac{100}{\frac{125}{3 \times S} - 1} \quad [\,k\Omega\,]$$

Calibration Resistor

$$CAL = Rb \times \left(\frac{25000}{D \times S} - 0{,}5 \right) \quad [\,k\Omega\,]$$

Units S = Sensitivity [mV/V]; Rb = Bridge resistor [kΩ]; D = detuning [%]

Sensitivity [mV/V]	0.1	0.5	1.0	2.0	4.0	8.0
GA [kΩ]	0.241	1.215	2.459	5.042	10.619	23.762
CAL [kΩ] 80% detuning / 350Ω bridge	1,093.575	218.575	109.200	54.512	27.169	13.497

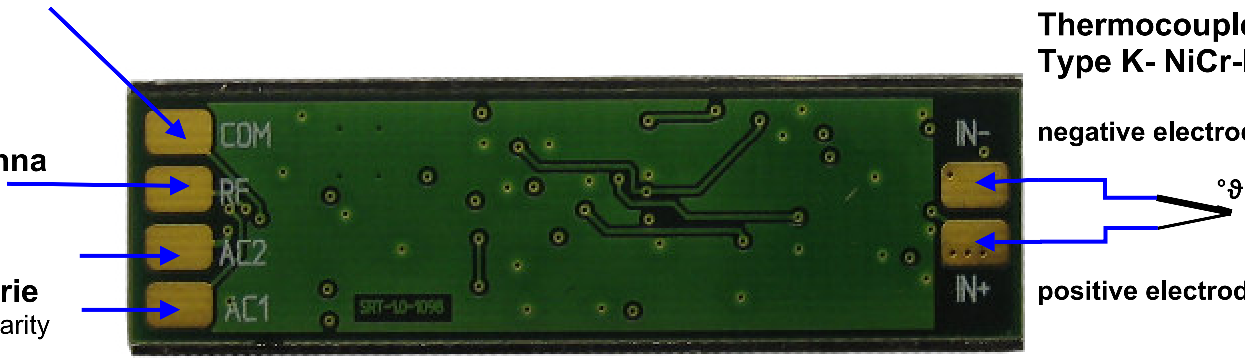
Rotor electronics S-RE2

Rotorelectronics for Thermocouple type K; NiCr-Ni

RF-Gnd
contact to shaft recommended.

Antenna

Batterie
No Polarity
or
Inductive power
with Inductive power module



Thermocouple Type K- NiCr-Ni

negative electrode

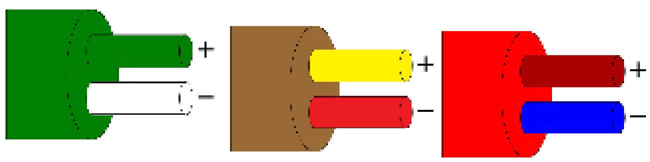
positive electrode

SD-IP Inductive power modul

AC1
RF
AC2

Power winding

Color code of Thermocouples

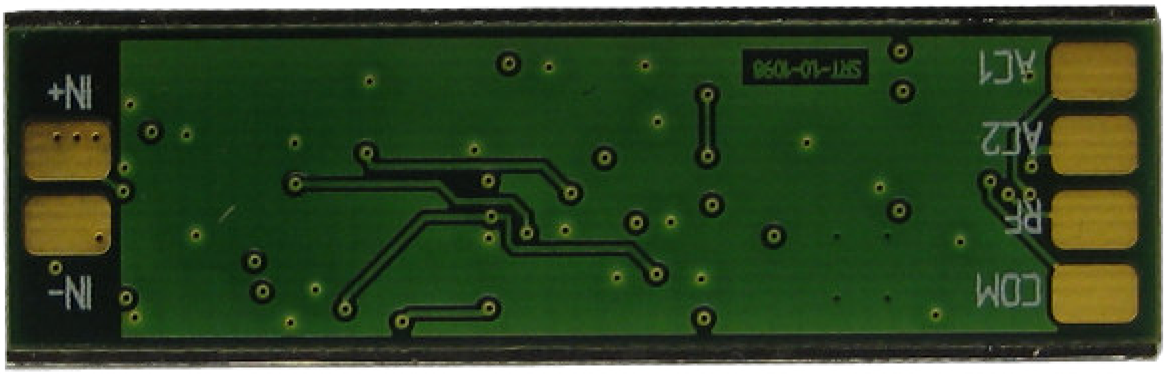


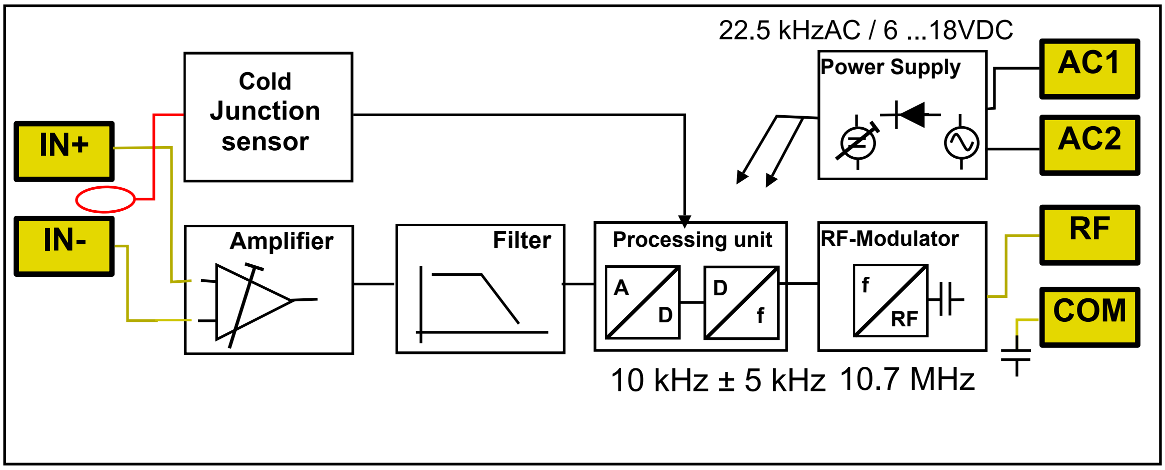
Important hints

1. The rotorelectronics is used together with the Control unit **S-CU**.
   The factory-sided adjustment corresponds to data sheet.
   10 V ==> 1,000°C; 0 V ==> 0°C;-10V ==> (-1,000°C), used range -1V ==> -100°C
2. The possibilities of offset adjustment and gain adjustment should not be used at the **S-CU**.
3. The Shunt Calibration is not used with TC application.
   If the Cal switch is pressed the output goes to 0V (for about 8 seconds) and then the cold junction temperature (== rotor electronics temperature) is shown for about 3 seconds.
4. After system powered on the cold junction temperature is shown for about 3 seconds.
5. Sometimes TC are hardly solderable. It makes sense the connection wires to assemble with crimp barrels .

Type Single

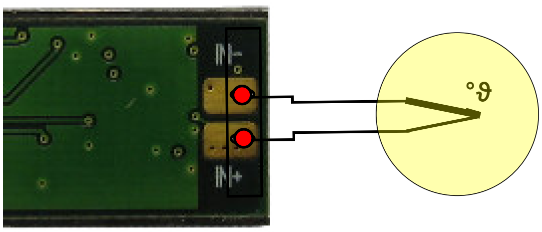
Rotor electronics S-RE2 Overview





Rotor electronics S-RE2 Input connection

Thermocouple type K; NiCr-Ni



Use of isolated and also non-isolated thermocouples is possible

Type Single

Rotor electronics S-RE3

Rotorelectronics for **ICP®** acceleration sensors

RF-Gnd
contact to shaft recomended.

Gain Resistor
GA

Antenna

Batterie
No polarity
or
IP-module for
Inductive power

ICP® sensor
Input -
Input +

Fixed Input Voltage

G1 = ±5V G2 = ±1V
install solder jumper!

SD-IP **Inductive power modul**

AC1
RF
AC2

Power winding

Possibilities installation of GA Resistor

0402/ 0603 jumper	0805/ µMelf jumper	1206/1210 MiniMelf

Calculation of Gain Resistor GA to be soldered

$$U = S \times R$$

$$GA = \frac{100}{\frac{U}{250} - 1} \quad [k\Omega]$$

Units

S = Sensitivity sensor [mV/g]
R = Acceleration Measurement Range [g]
U = Input Voltage [mV]

Input Voltage [mV]	500	1000	2000	3000	4000	5000
GA [kΩ]	100	33.333	14.286	9.091	6.667	5.263

Example: S = 100mV/g; R = 20g

U = 100mV/g x 20g = 2000mV ==> GA = 100 / ((2000 / 250)-1) kΩ = 14.286kΩ

Type Double

Rotor electronics **D-RE1**

Rotorelectronics for use with 2 Strain gages Full or Halfbridge, ≥ 350Ω

Channel1 and Channel2 are built up symmetrically.
The configuration corresponds to the Type Single

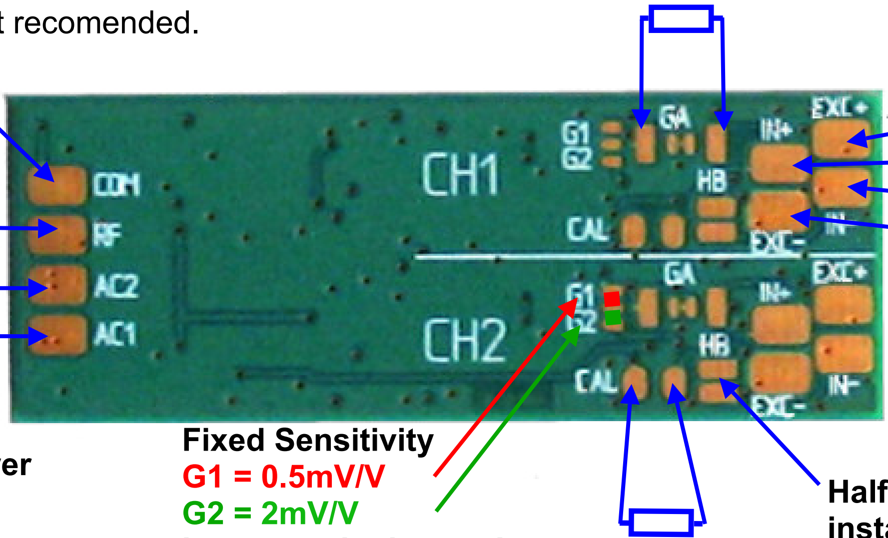
Dimensiones: 45mm x 18mm x 3,5mm; weigth about 5g, (1.77“ x 0.71“ x 0.14“)

Gain Resistor
GA

RF-Gnd
contact to shaft recomended.

Antenna

Battery
No polarity
or
IP-module for
Inductive power



Excitation +
Input +
Input -
Excitation -

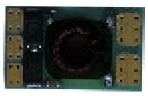
Excitation +
Input +
Input -
Excitation -

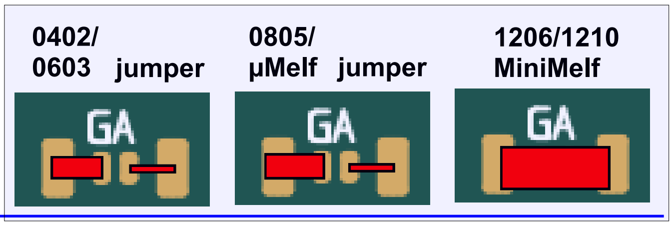
Fixed Sensitivity
G1 = 0.5mV/V
G2 = 2mV/V
install solder jumper!

CAL
Calibration Resistor

Half bridge
install solder jumper!
IN- not used

SD-IP Inductive power modul





Calculation of the resistors to be soldered

Gain Resistor

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Calibration Resistor

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GA [kΩ]	0.241	1.215	2.459	5.042	10.619	23.762
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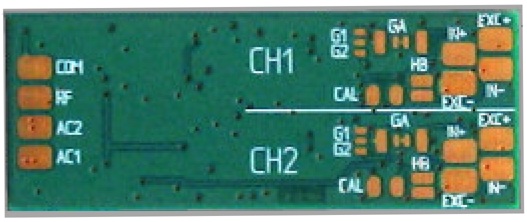
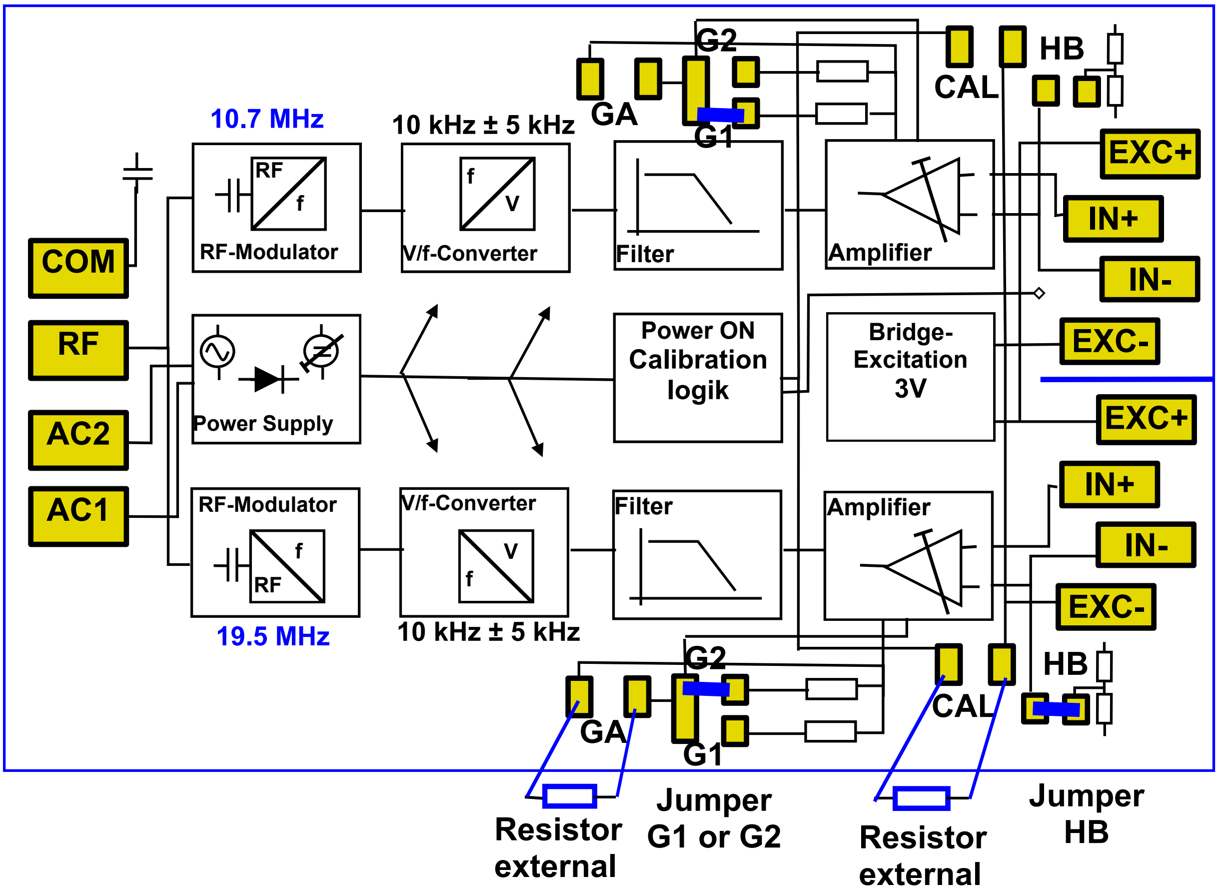
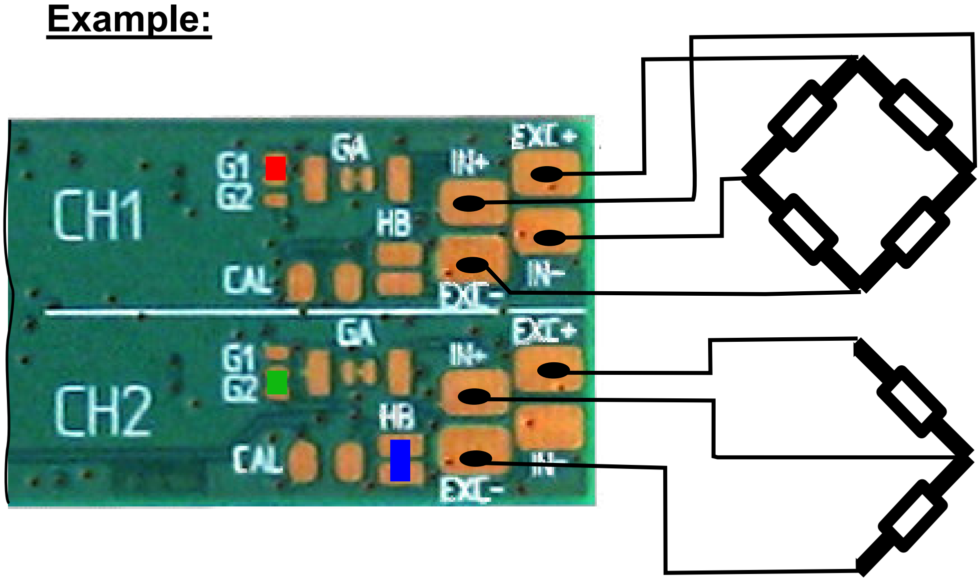
Rotor electronics D-RE1 Overview





Rotor electronics D-RE1 Input connection

Example:



Channel 1

Full bridge,
Sensitivity jumpered to
0.5mV/V

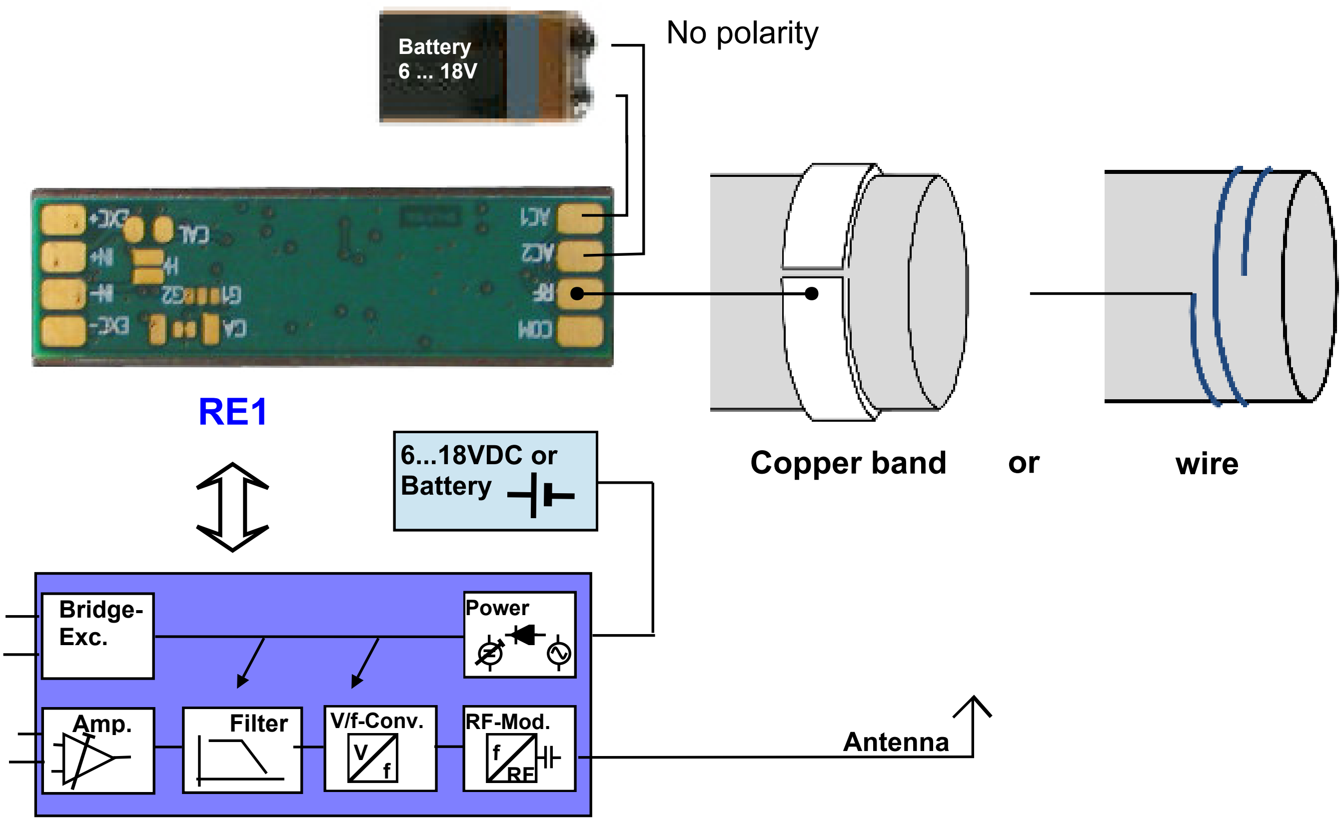
Channel 2

Half bridge,
Sensitivity jumpered to
2mV/V

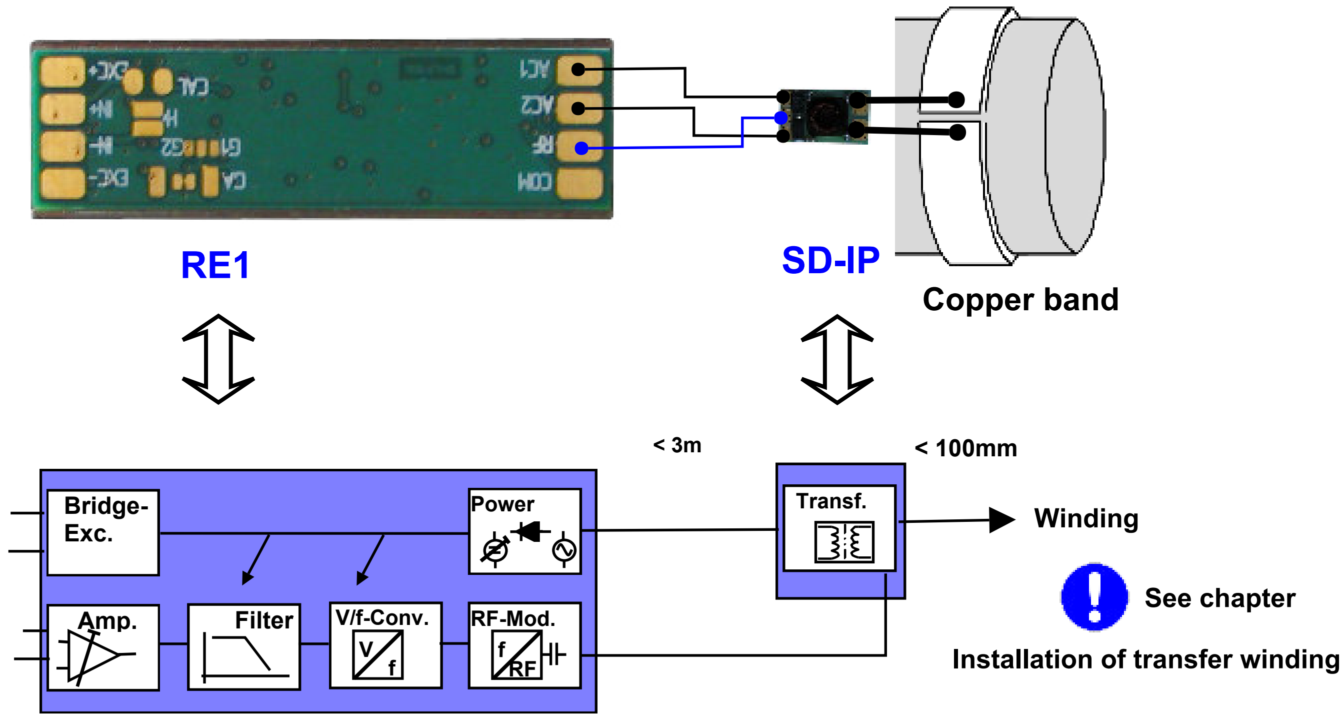
Type Single

Powering the Rotor electronics S-RE1 / S-RE2

DC Supply



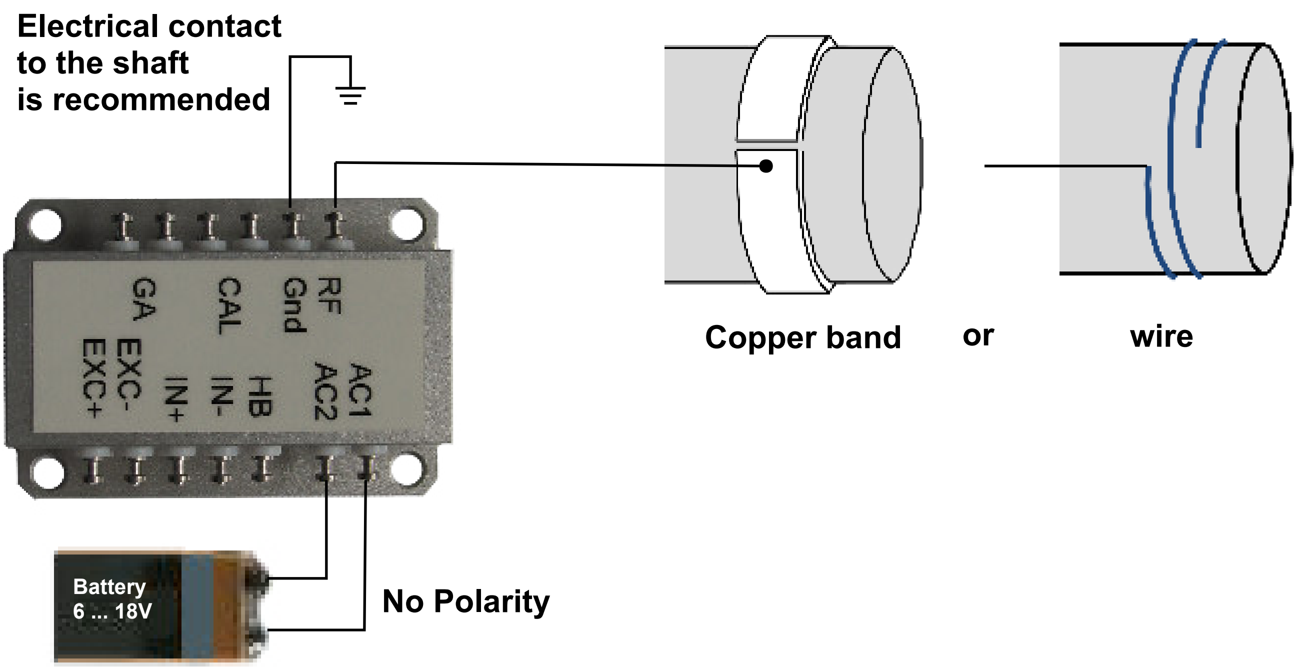
AC Supply



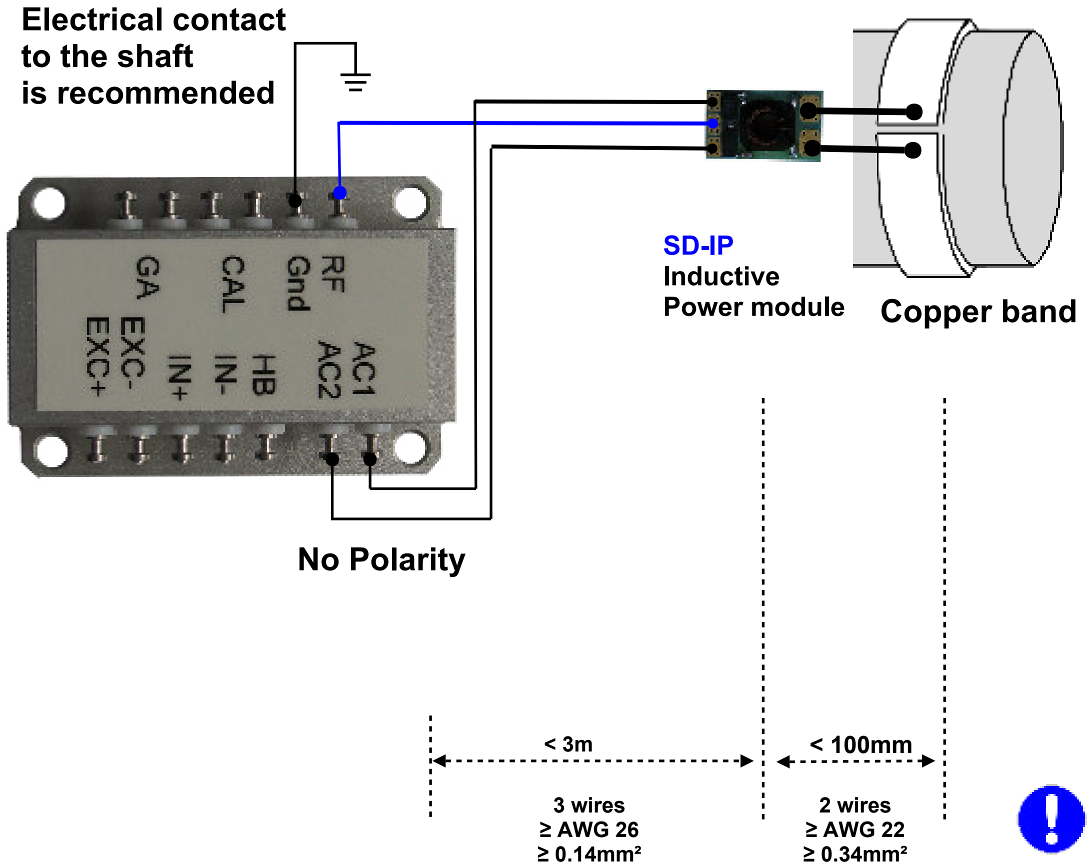
Type Single

Powering the Rotor electronics S-RE1P

DC Supply



AC Supply

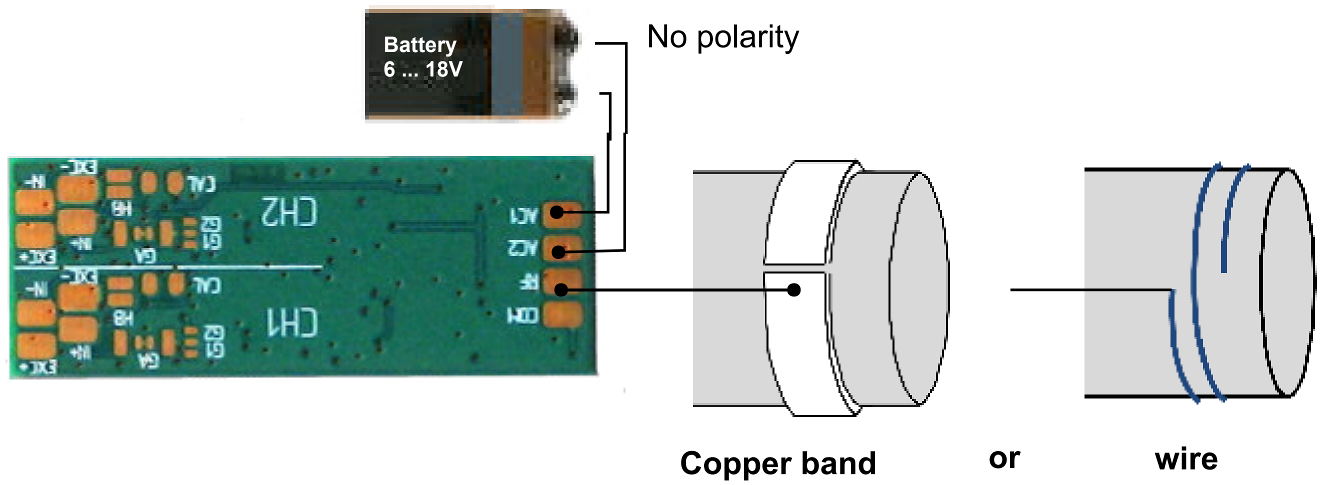


See chapter
Installation of
transfer winding

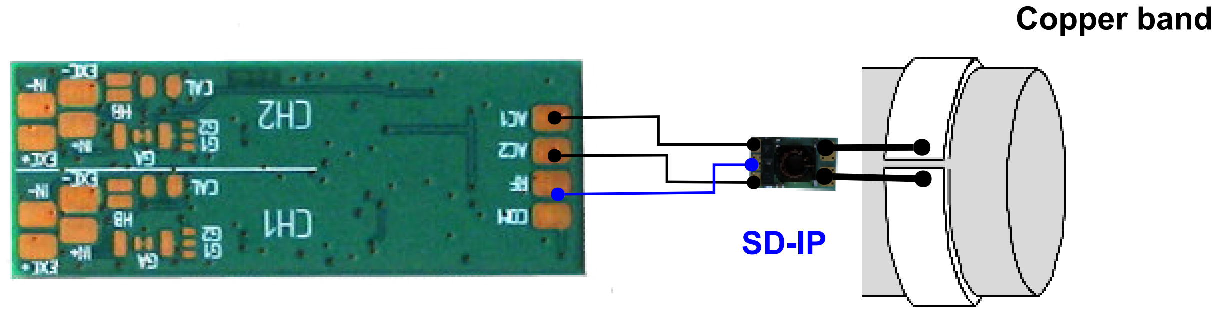
Type Double

Powering the Rotor electronics D-RE1

DC Supply



AC Supply



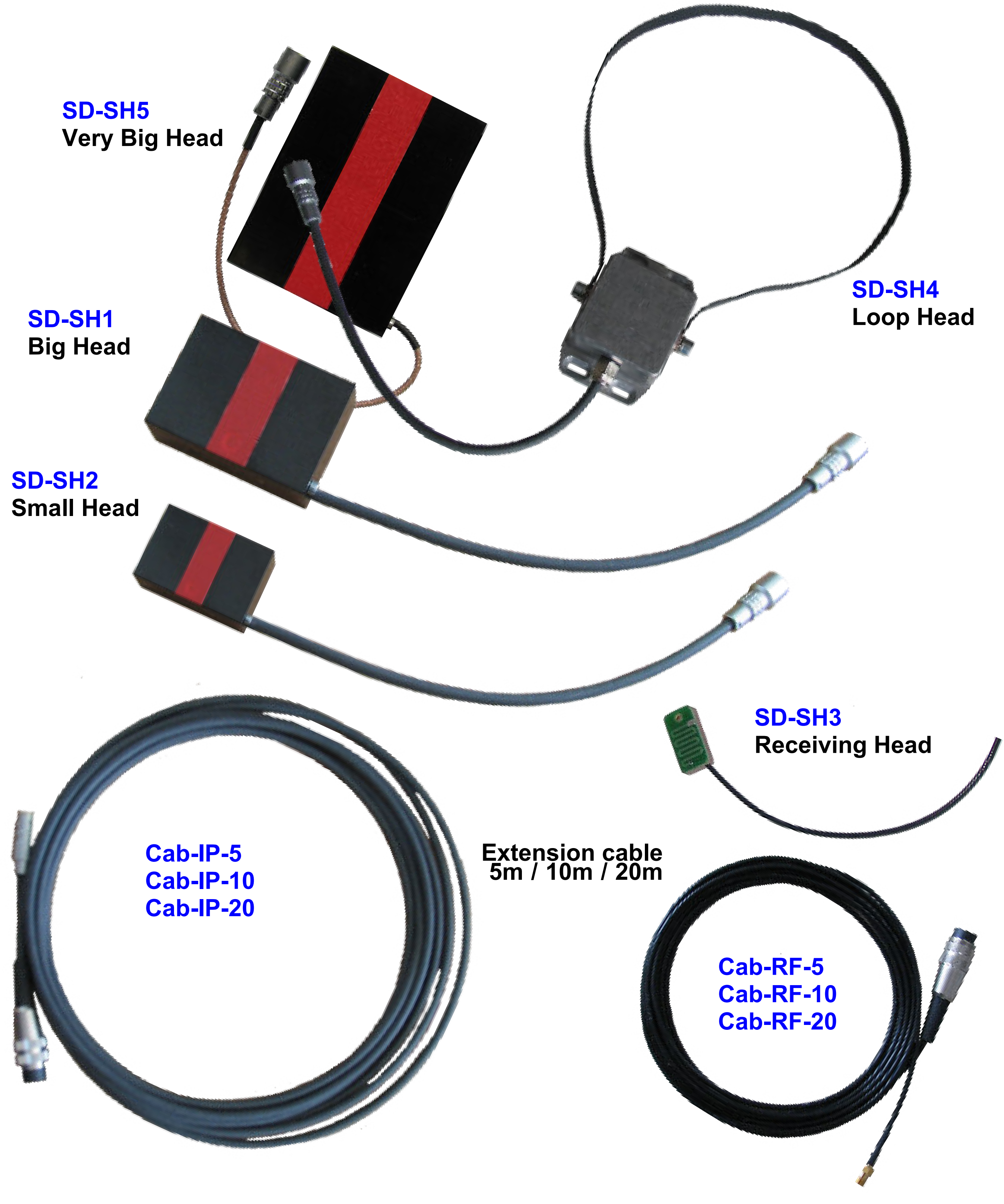
Type Single / Type Double

RTM
Rainer Thomas Messtechnik

Inductive / receiving heads SD-SH

- Version with Lemo-connector and extension cable.

- SD-SH1 /-SH2 /-SH4 /-SH5 have an integrated active antenna.
  Frequency range: wideband range 10 MHz to 40 MHz.
  SD-SH3 too, but is designed for use with battery power only.



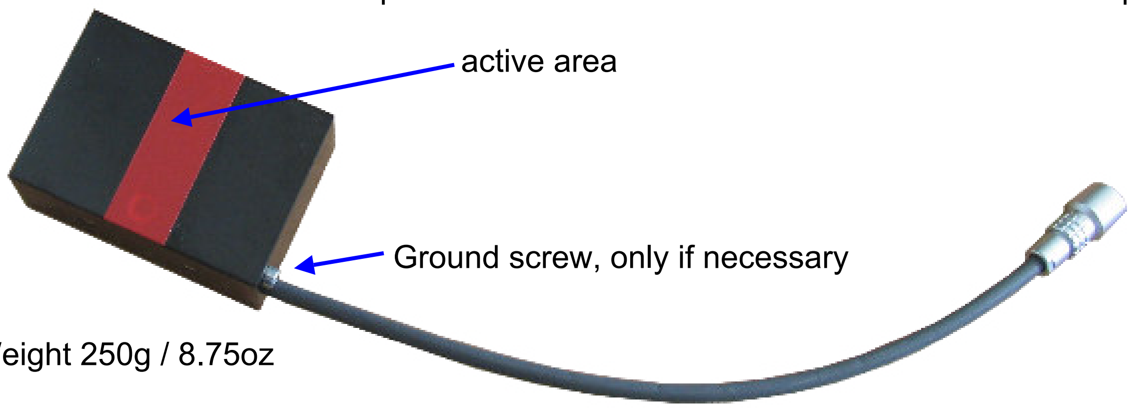
Type Single / Type Double

Inductive head SD-SH1 „Big Head“

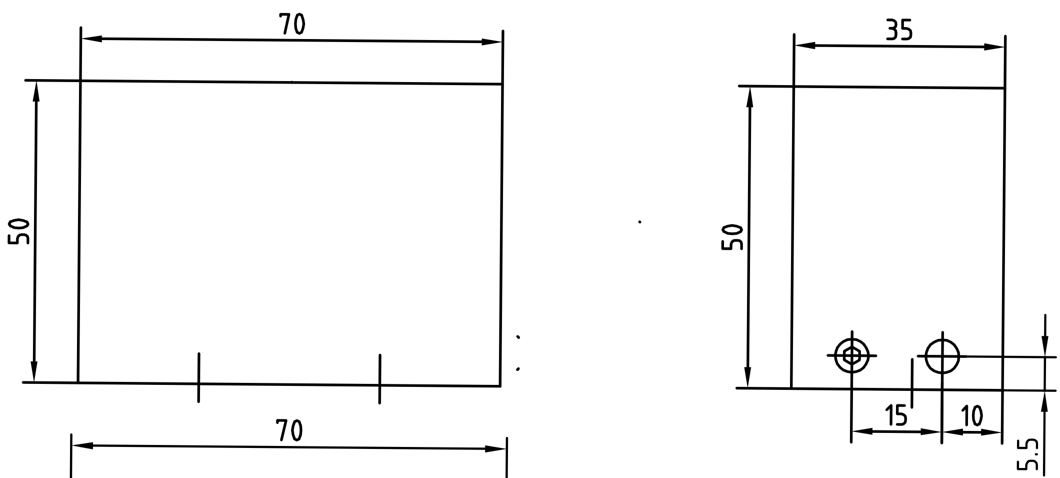
typical air gap 40 mm / 1.58“

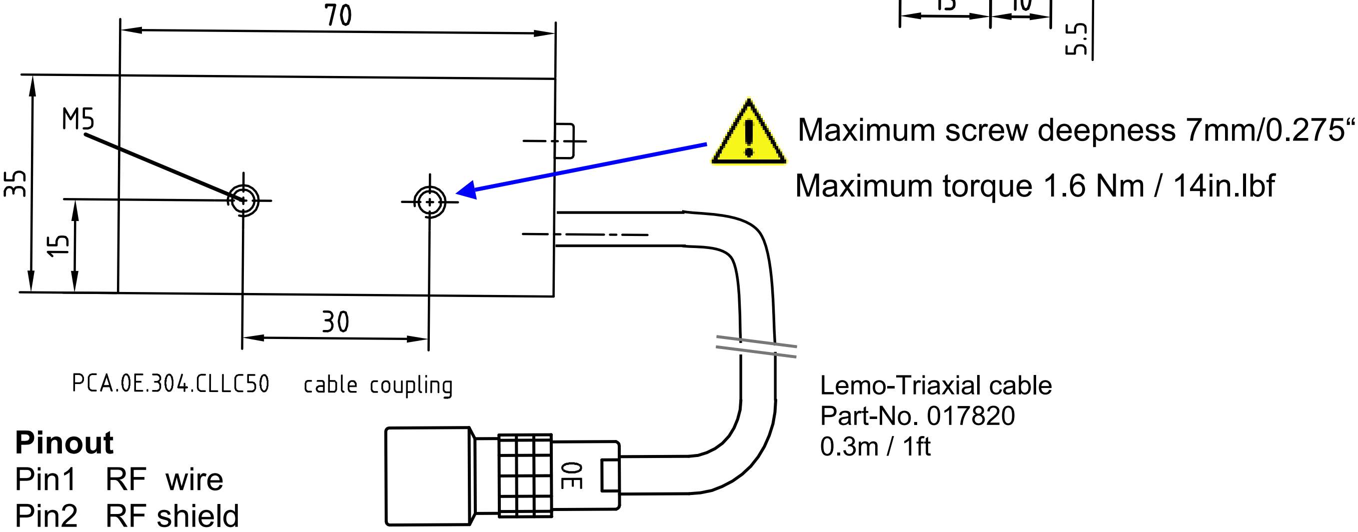
The inductive head should be fastened to a non-metallic plate or bracket.
If a metallic bracket is used the stator should be isolated from the metal by more than 5 mm of a non metallic material such as rubber or plastic.

Mounting the stator near or on metal could produce unnecessary warming of the stator head and cause damage to the system. Every attempt should be made to keep a metal free area around the stator head for best operation.



Weight 250g / 8.75oz





Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2

drawing dimensiones in mm

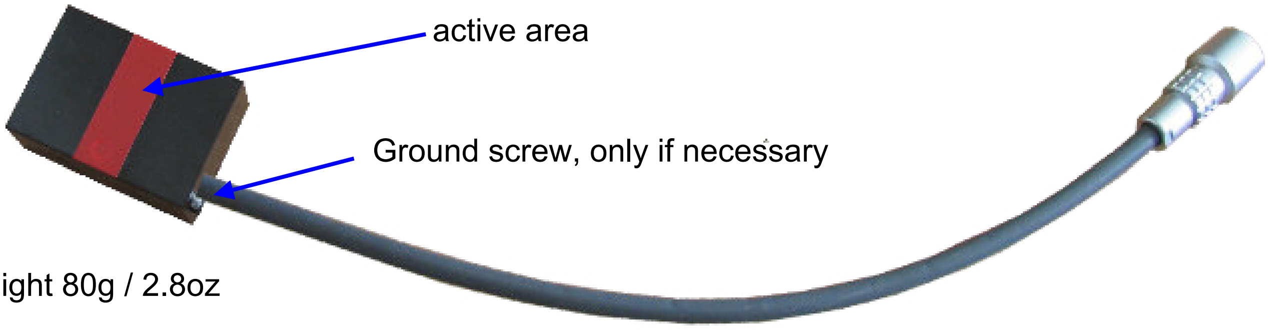
Type Single / Type Double

Inductive head SD-SH2 „Small Head“

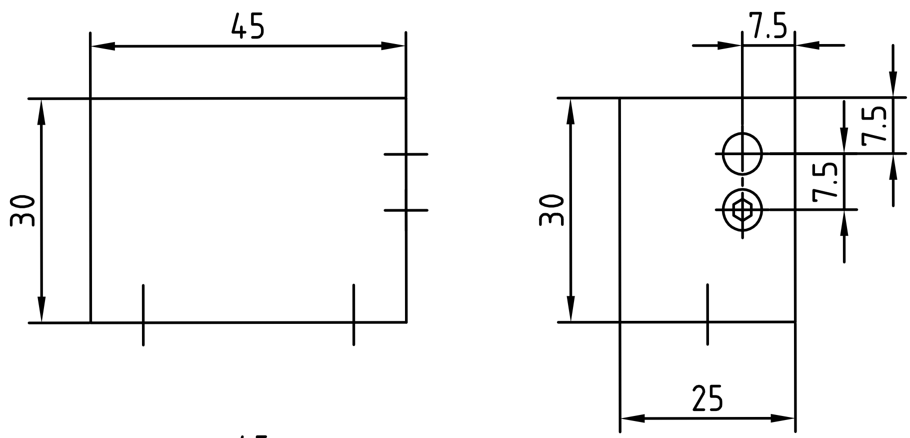
Typical air gap 10 mm / 0.4“

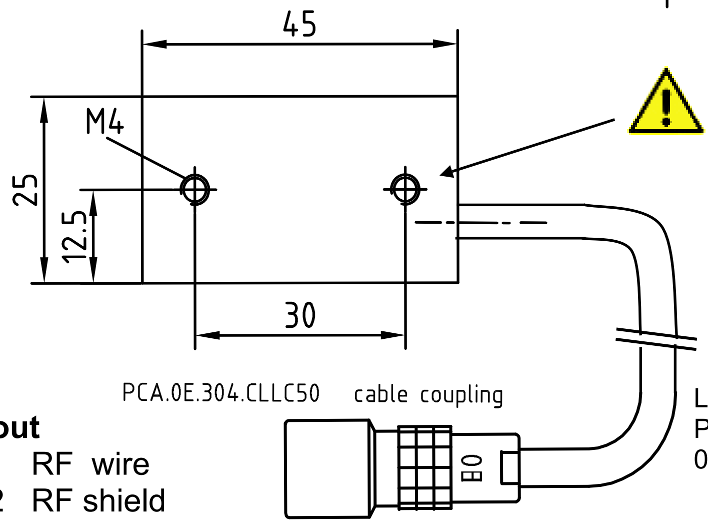
The inductive head should be fastened to a non-metallic plate or bracket. If a metallic bracket is used the stator should be isolated from the metal by more than 5 mm of a non metallic material such as rubber or plastic.

Mounting the stator near or on metal could produce unnecessary warming of the stator head and cause damage to the system. Every attempt should be made to keep a metal free area around the stator head for best operation.



Weight 80g / 2.8oz





Maximum screw depth 6mm/0.236“

Maximum torque 1.3 Nm / 11in.lbf

Lemo-Triaxial cable
Part-No. 017820
0.3m / 1ft

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2

Drawing dimensiones in mm

Type Single / Type Double

RTM
Rainer Thomas Messtechnik

Inductive head SD-SH4 „Loop Head“

typical loop length
350mm...650mm / 13.8“...25.6“

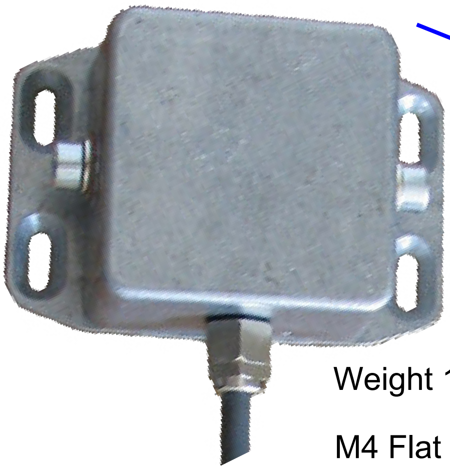
Loop material:

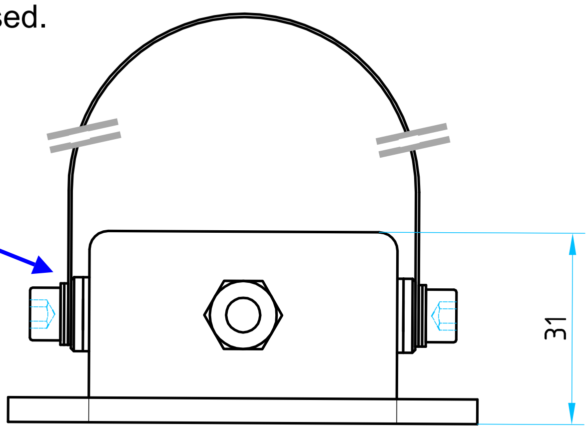
standard and recommended: Copper band 0.3 mm x 10 mm; 1/82“ x 0.39“
Included Loop length: 500mm / 19.7“; Loop length up to 4m is possible

Screws:

Allen-head screw; M5 x 10mm
The screws should be torqued to 2.5 Nm / 22 in.lbf

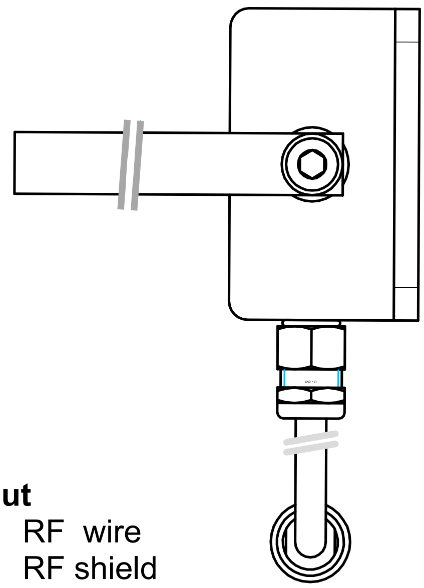
It is very important the contact area of the loop and screws be clean during assembly and should be cleaned with sandpaper.
To improve the connection a
lock washer and washer should be used.

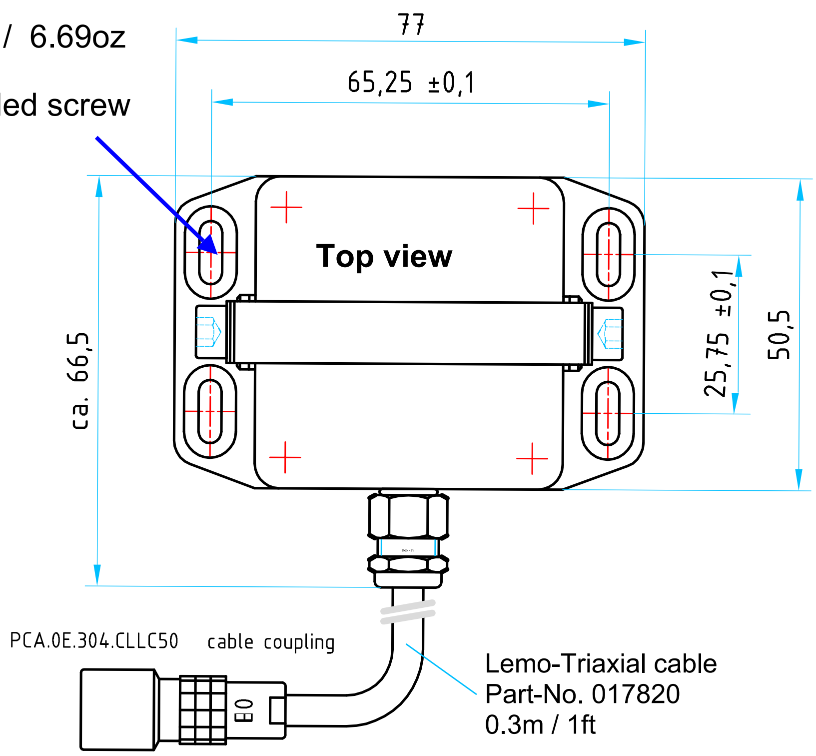




Weight 191g / 6.69oz

M4 Flat headed screw





Lemo-Triaxial cable
Part-No. 017820
0.3m / 1ft

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2

Drawing dimensiones in mm

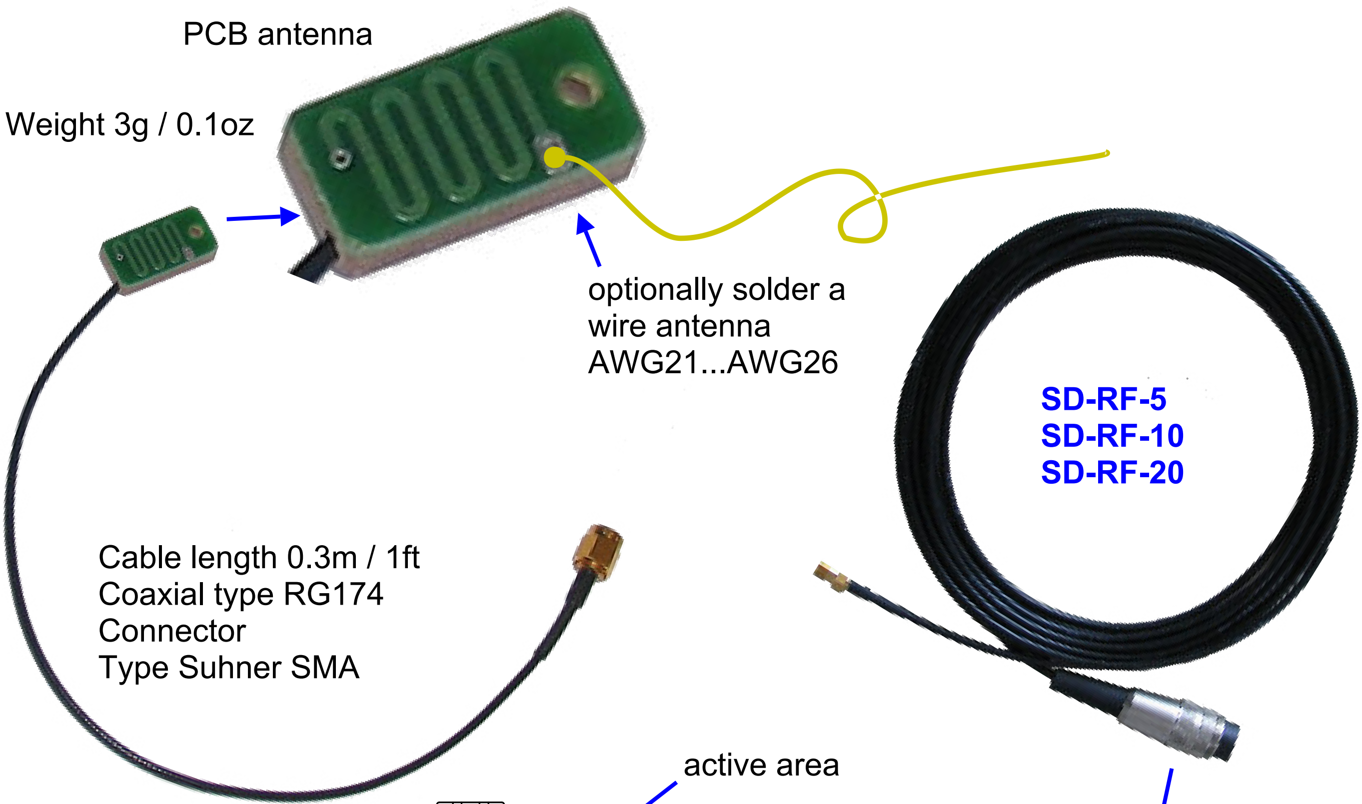
Type Single / Type Double

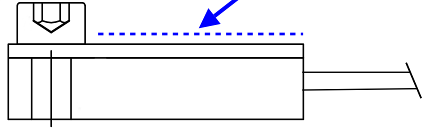
Receiving head SD-SH3 „Antenna Head“

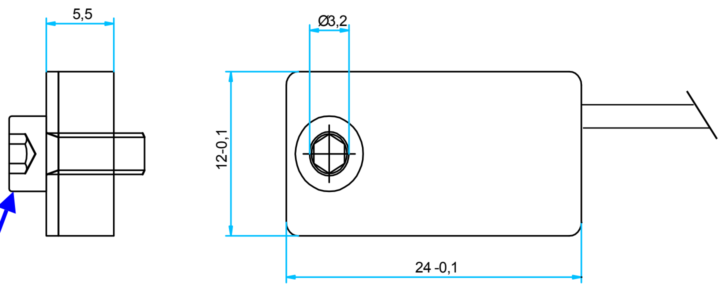
typical receiving distance
200mm / 0.64ft

The receiving head is designed for use with batterie powered installation.
It is not possible to inductively power the rotor electronics with the Head SH3.

While plug in the original connecting cable into the Control unit the power oscillator is not switched on.







Mount with M3 screw, with glue or double-sided adhesive tape depending on application and surface.

Cable connector

Type Binder series 680, 6 pin

680-09-0321-00-06

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 n.c.
Pin4 n.c.
Pin5 n.c. !
Pin6 n.c. !

Drawing dimensiones in mm

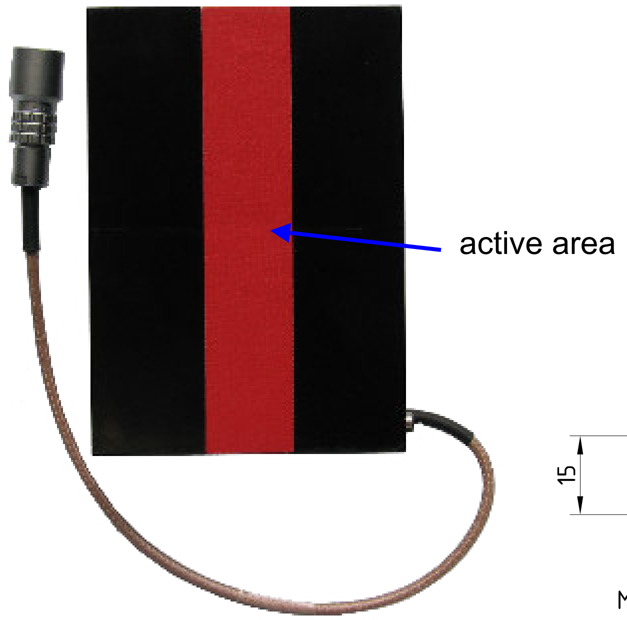
Type Single / Type Double

Inductive head SD-SH5 „Very Big Head“

typical air gap 60 mm / 2.36“

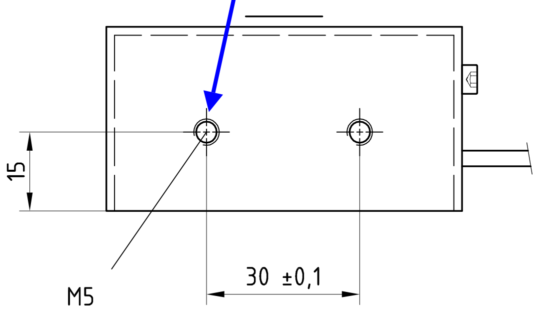
The inductive head should be fastened to a non-metallic plate or bracket.
If a metallic bracket is used the stator should be isolated from the metal by more than 5 mm of a non metallic material such as rubber or plastic.

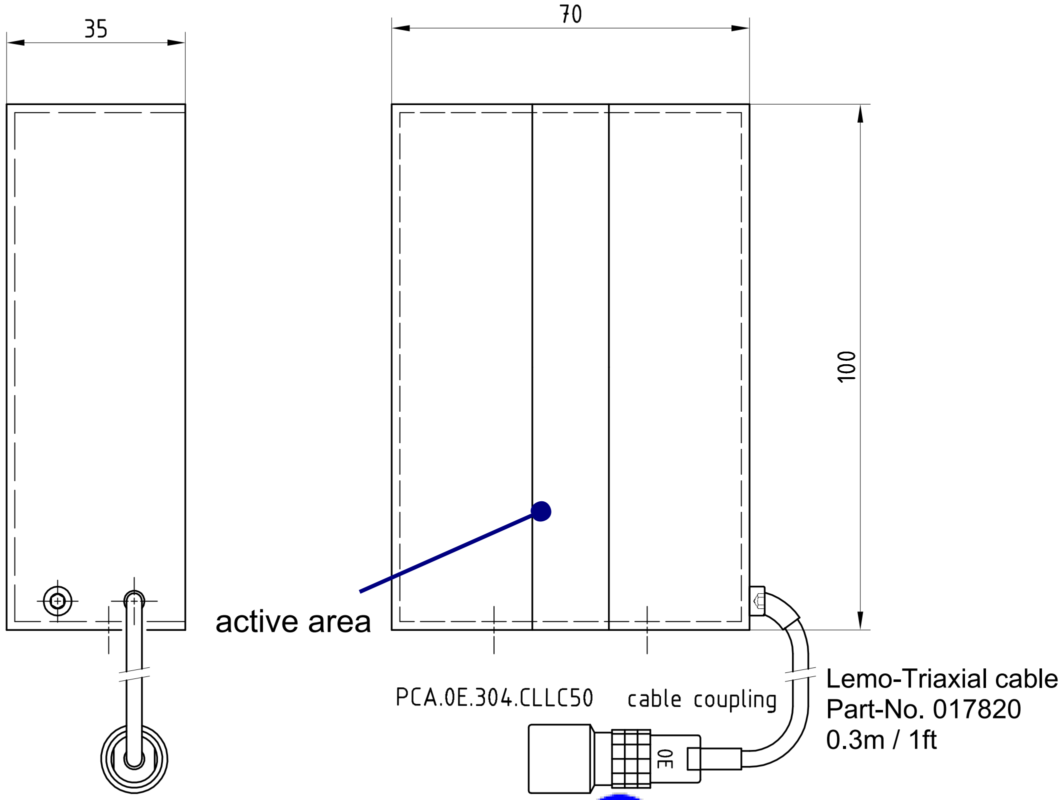
Mounting the stator near or on metal could produce unnecessary warming of the stator head and cause damage to the system. Every attempt should be made to keep a metal free area around the stator head for best operation.



Maximum screw depth 7mm/0.275“

Maximum torque 1.6 Nm / 14in.lbf





Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2

drawing dimensiones in mm

Inductive / receiving heads SD-SHx-3

The Inductive / receiving heads SD-SH1 /-SH2 /-SH4 /-SH5 and receiving head SD-SH3 but with permanently installed 3m cable, no Lemo-connector.
The technical data and the dimensions are identical to the corresponding type:

SD-SH1 ==> SD-SH1-3

SD-SH2 ==> SD-SH2-3

SD-SH4 ==> SD-SH4-3

SD-SH5 ==> SD-SH5-3

SD-SH3 ==> SD-SH3-3

Using a fixed cable type, another Cab-IP-x or Cab-RF-x cable is not required.

fixed cable 3m

SD-SH1-3
Big Head

SD-SH2-3
Small Head

SD-SH4-3
Loop Head

SD-SH5-3
Very Big Head

and

SD-SH3-3
Receiving Head

without picture
but sensibly

Type Single / Type Double

Telemetry cable **Cab-IP**

Cab-IP is used with the heads: **SD-SH1 / SD-SH2 / SD-SH4 / SD-SH5**

available lengths:

Length 5m / 16ft part **Cab-IP-5**
Length 10m / 32ft part **Cab-IP-10**
Length 20m / 64ft part **Cab-IP-20**

Cable connector

Type LEMO series 0E, 4pin
FFA.0E.304.CLAC50

Cable connector

Type Binder series 680, 6pin
680-09-0321-00-06

Lemo-Triaxial cable
Part-No. 017820

Pinout
Pin1 RF wire
Pin2 RF sheeld
Pin3 Power1
Pin4 Power2

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2
Pin5] Jumpered to turn
Pin6] power oscillator on

The cable is resistant to most oils, lubricants, water, and acids.
The bending radius of the cable should not be less than 25mm / 1".
Operating temperature range:-40°F to 248°F / -40°C to 120°C

Caution!
Voltage up to 400V$_{pp}$, 22.5 kHz is on the cable. Only use the approved original cable.
Damaged or frayed cables must be discarded and replaced immediately.

Telemetry cable **Cab-RF**

Cab-RF is used with the head: **SD-SH3**

available lengths:

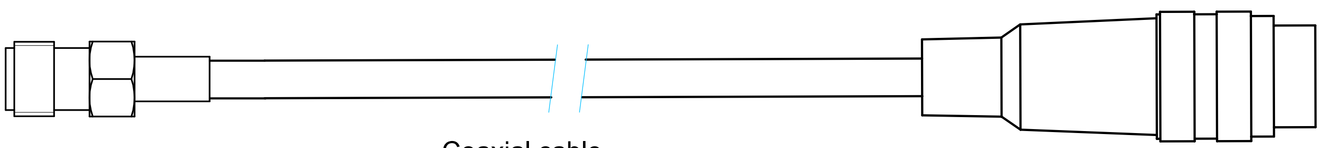
Length 5m / 16ft part **Cab-RF-5**
Length 10m / 32ft part **Cab-RF-10**
Length 20m / 64ft part **Cab-RF-20**

Cable connector

Type Suhner RF
SMA RG174

Cable connector

Type Binder series 680, 6pin
680-09-0321-00-06



Coaxial cable
Part-No. RG174

Pinout
Pin1 RF wire
Pin2 RF sheeld
Pin3 to Pin6 n.c.

Type Single

Control unit S-CU0

(1) LCD Monitor

(2) RF-Level LED

(3) Offset Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(4) Frequency Out

(5) Calibration Switch

(6) Gain Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(7) Filter Switch Frequency 1,000Hz / 100Hz

(8) Voltage Out

(9) ON/OFF Switch

(12) Power supply
Pin 1 + supply
Pin 3 - supply/ Gnd

(11) Inductive Power switch

Position 0 Battery Operation

Position 1 Regular Power

Position 2 High Power

(10) Head connector

Pin 1 RF wire	Pin 2 RF Gnd
Pin 3 Power 1	Pin 4 Power 2
Pin 5 Osz. ON1	Pin 6 Osz. ON2

Pin 5 and Pin 6 are shorted in cable connector

Type Single

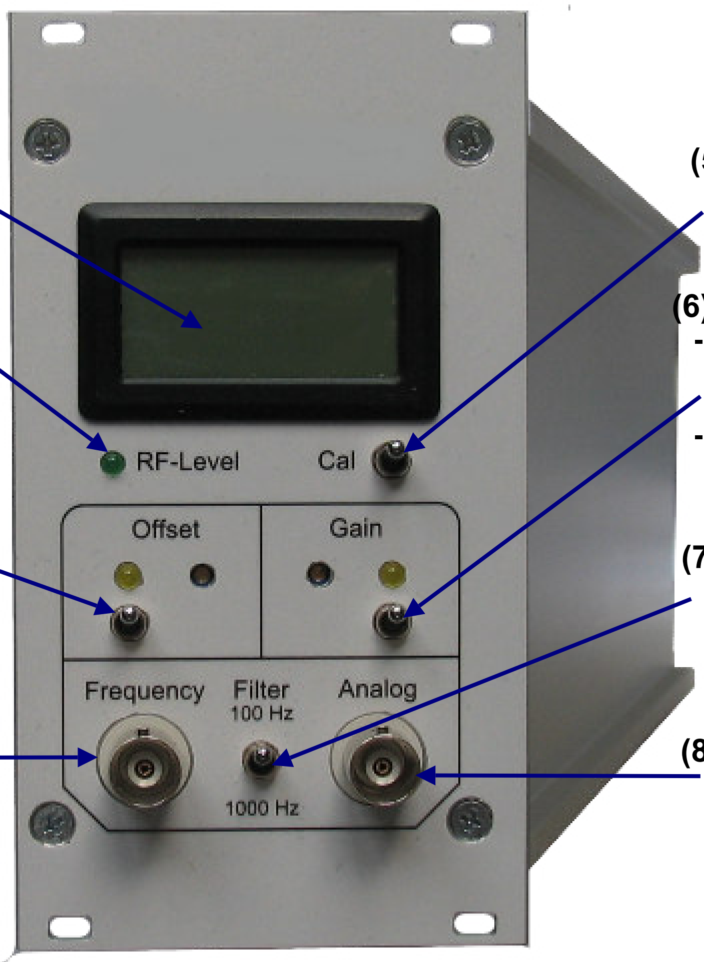
Control unit S-CUR 3RU / 14HP (129mm x 71mm)

(1) LCD Monitor

(2) RF-Level LED

(3) Offset Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(4) Frequency Out



(5) Calibration Switch

(6) Gain Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(7) Filter Switch Frequency 1,000Hz / 100Hz

(8) Voltage Out

(9) ON/OFF Switch

(12) Power supply
Pin 1 + supply
Pin 3 - supply/ Gnd

(11) Inductive Power switch

Position 0 Battery Operation

Position 1 Regular Power

Position 2 High Power

(10) Head connector

Pin 1 RF wire	Pin 2 RF Gnd
Pin 3 Power 1	Pin 4 Power 2
Pin 5 Osz. ON1	Pin 6 Osz. ON2

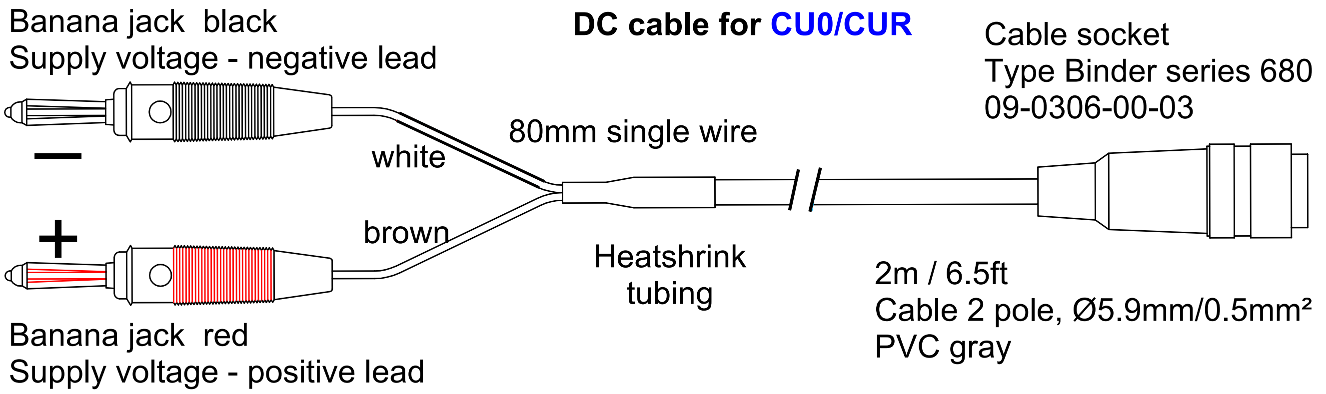
Pin 5 and Pin 6 are shorted in cable connector

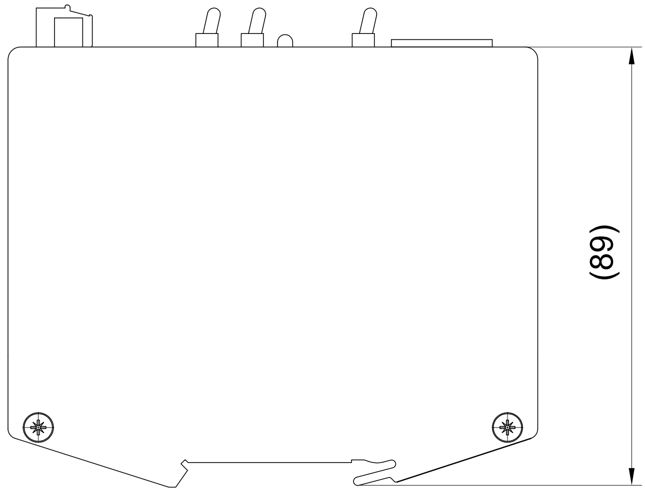
Type Single

Control unit S-CU0 / S-CUR

No.	Name	Short description
1	LCD Monitor	3.5 digit display Shows the analog output voltage, ±10V Less resolution than analog output
2	RF-Level LED	Lit green LED indicates a good RF level. Data link is good.
3	Offset switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 1.8V by potentiometer
4	Frequency out	Frequency range is 10kHz ± 5kHz with TTL-level. 10kHz = 0V; 5kHz = -10V (-FS); 15kHz = 10V (+FS) BNC jack
5	Calibration switch	Initiates a shunt calibration which unbalances the bridge by x % (determined by the user installed shunt resistor)
6	Gain switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 20% by potentiometer
7	Filter switch	switches the output filter (4 pole Butterworth) to a 3dB-frequency of 100 Hz or 1 kHz
8	Voltage out	-10V...0V....+10V single ended BNC jack
9	ON/OFF switch	Rocker switch turns on and off the DC supply voltage to the system.
10	Head connector	Connection for SD-SHx stators with telemetry cable Cab-IP or Cab-RF
11	Ind. Power switch	Position 0 For use with SD-SH3 stator head Position 1 Normal setting for all inductive stator heads Position 2 High power for special conditions
12	Power supply connector	DC power input to power Control Unit

DC cable for CU0/CUR





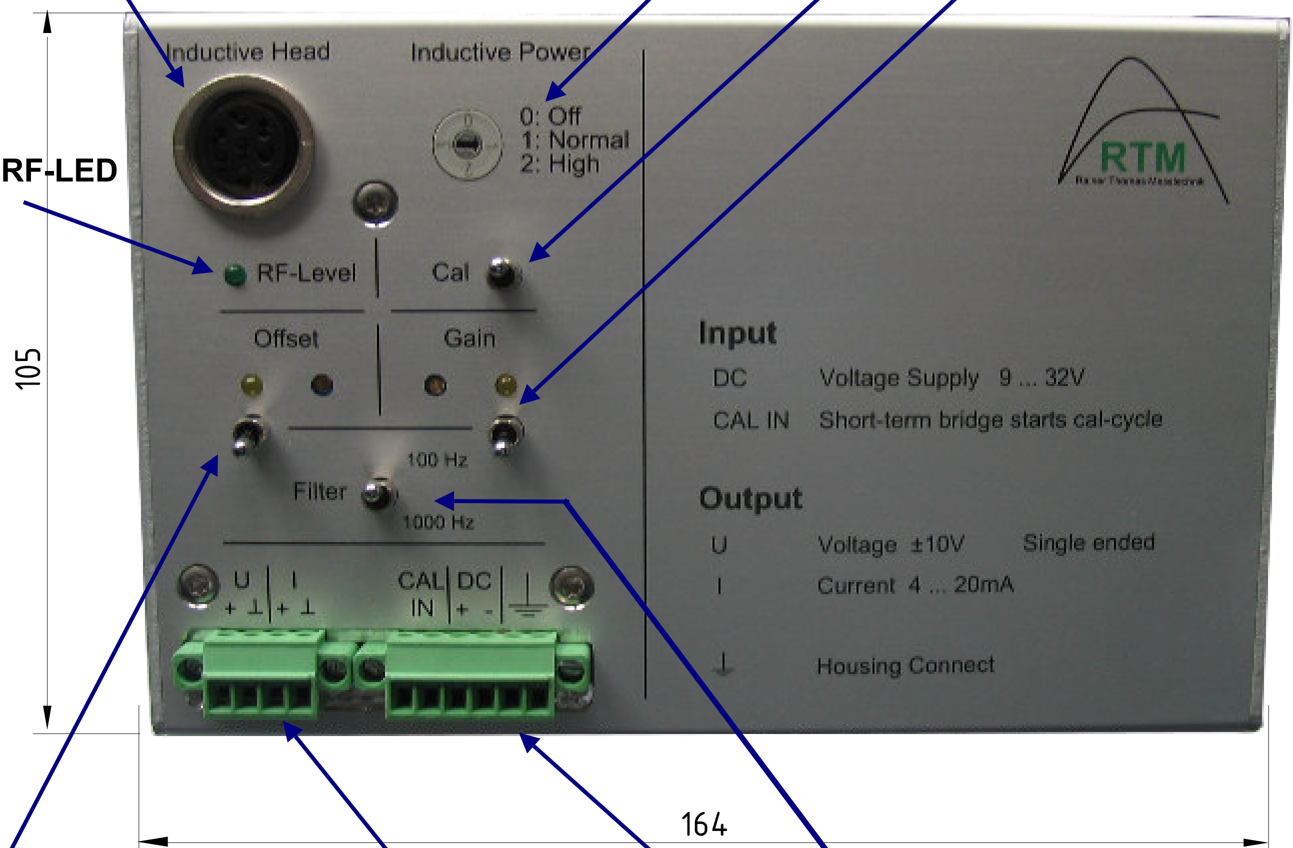
(1) Head connector
Pin 1 RF wire **Pin 2 RF Gnd**
Pin 3 Power 1 **Pin 4 Power 2**
Pin 5 Osz. ON1 **Pin 6 Osz. ON2**
(are shorted in cable connector)

(7) Inductive Power switch

(4) Calibration Switch

(5) Gain Switch
LED and Potentiometer

(2) RF-LED

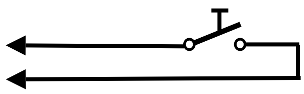


(3) Offset Switch
LED and
Potentiometer

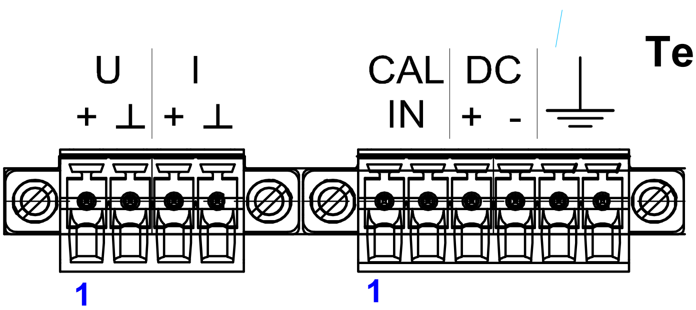
(8) Terminal 1
Outputs

(9) Terminal 2
Intputs

(6) Filter Switch
Frequency
1,000Hz / 100Hz

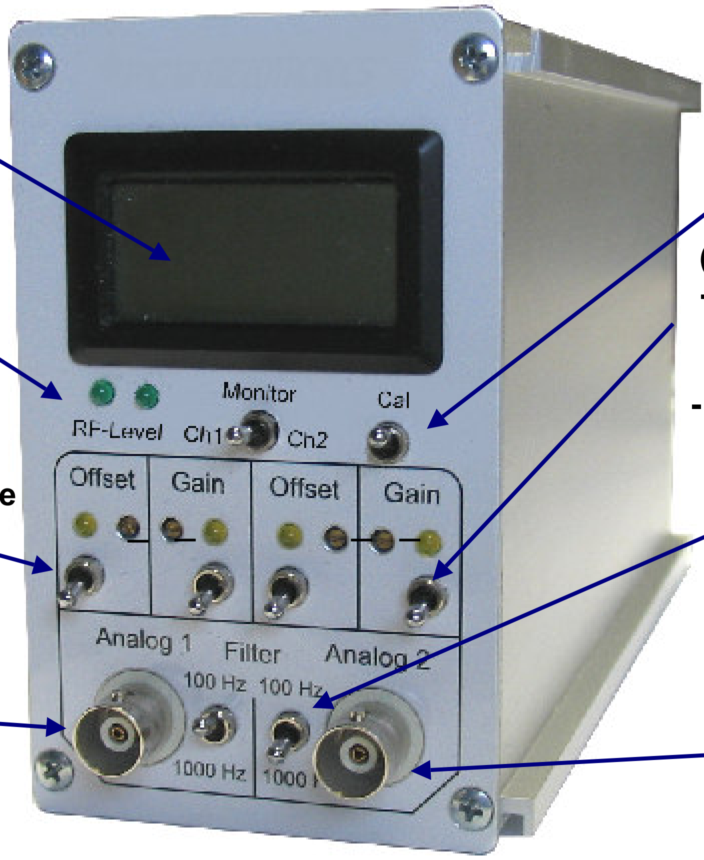
No.	Name	Short description
1	Head connector	Connection for Head SD-SHx with the telemetry cable Cab-IP or Cab-RF
2	RF-Level LED	Lit green LED indicates a good RF level. Data link is good. link is working.
3	Offset switch	lower position = factory calibration, LED off upper position = adjustable, yellow LED on Range ± 1.8V of ± 10V by potentiometer
4	Calibration switch	Initiates a shunt calibration which unbalances the bridge by x % (determined by the user installed shunt resistor)
5	Gain switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 20% by potentiometer
6	Filter switch	switches the output filter (4 pole Butterworth) to a 3dB-frequency of 100 Hz or 1 kHz
7	Ind. Power switch	Position 0 inductive power off; battery power mode Position 1 regular working conditions for all Heads SHx Position 2 raised power if this is required
8	Terminal 1 Outputs	Clamp 1 ==> Voltage Output + 10V , single ended Clamp 2 ==> Voltage Output Gnd Clamp 3 ==> Current Output 4...20mA Clamp 4 ==> Current Output Gnd
9	Terminal 2 Inputs	Short term bridge starts Calibration Cycle e.g., spring-loaded switch Clamp 1 ==> Clamp 2 ==>  Clamp 3 ==> + Power supply 9...32VDC Clamp 4 ==> Gnd Power supply Clamp 5 ==> Ground Housing Clamp 6 ==> Ground Housing

Terminal 1 **Terminal 2**



Type Double

Control unit D-CU0



(1) LCD Monitor

(2) RF-Level LED

(3) Offset Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(4) Voltage Out Channel1

(5) Calibration Switch

(6) Gain Switch
- Adjustable (LED on) Potentiometer active
- Default Setting

(7) Filter Switch Frequency 1,000Hz / 100Hz

(8) Voltage Out Channel2

(9) ON/OFF Switch

(12) Power supply
Pin 1 + supply
Pin 3 - supply/ Gnd

(11) Power switch

Position 0 off

Position 1 regular

Position 2 high power

(10) Head connector

Pin 1 RF wire	Pin 2 RF Gnd
Pin 3 Power 1	Pin 4 Power 2
Pin 5 Osz. ON1	Pin 6 Osz. ON2

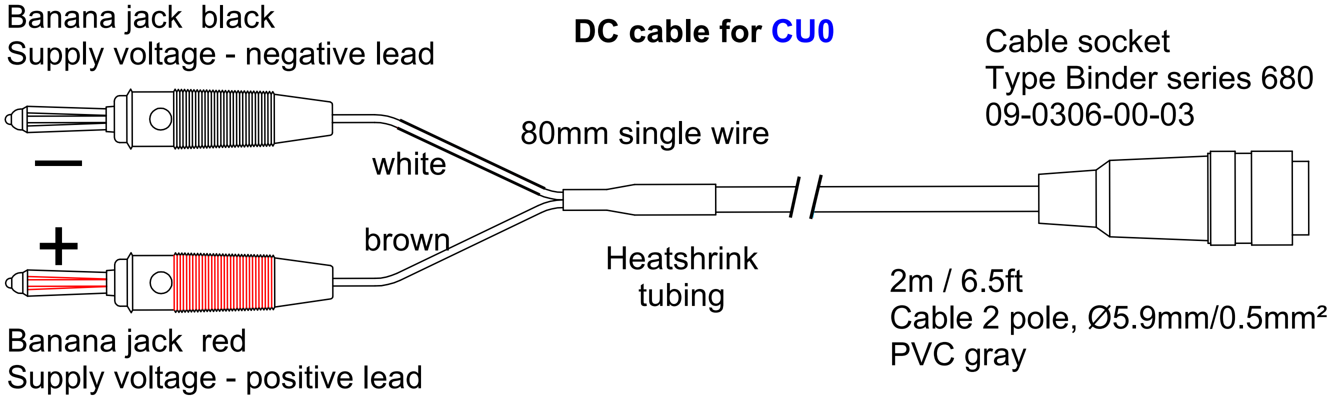
Pin 5 and Pin 6 are shorted in cable connector

Type Double

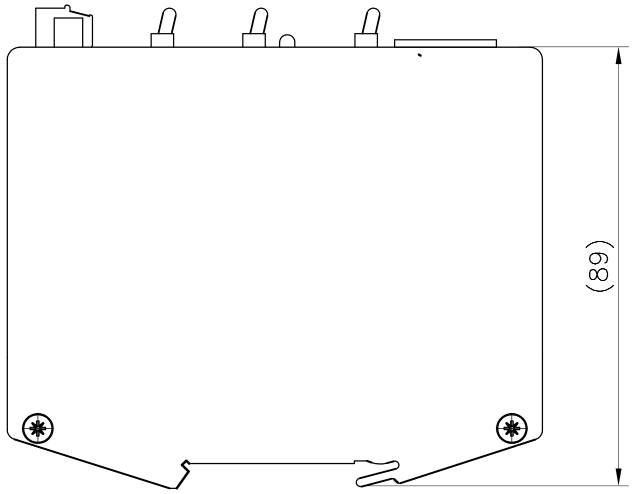
Control unit D-CU0

No.	Name	Short description
1	LCD Monitor	3.5 digit display Shows the analog output voltage, ±10V Less resolution than analog output
2	RF-Level LED	Lit green LED indicates a good RF level. Data link is good; per channel seperate.
3	Offset switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 1.8V by potentiometer; per channel seperate
4	Voltage out Channel 1	-10V...0V....+10V single ended BNC jack
5	Calibration switch	Initiates a shunt calibration which unbalances the bridge by x % (determined by the user installed shunt resistor)
6	Gain switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 20% by potentiometer; per channel seperate
7	Filter switch	switches the output filter (4 pole Butterworth) to a 3dB-frequency of 100 Hz or 1 kHz
8	Voltage out Channel 2	-10V...0V....+10V single ended BNC jack
9	ON/OFF switch	Rocker switch turns on and off the DC supply voltage to the system.
10	Head connector	Connection for SD-SHx stators with telemetry cable Cab-IP or Cab-RF
11	Power switch	Position 0 For use with SD-SH3 stator head Position 1 Normal setting for all inductive stator heads Position 2 High power for special conditions
12	Power supply connector	DC power input to power Control Unit

DC cable for CU0



Control unit D-CUH DIN Rail



(1) Head connector

Pin 1 RF wire	Pin 2 RF Gnd
Pin 3 Power 1	Pin 4 Power 2
Pin 5 Osz. ON1	Pin 6 Osz. ON2

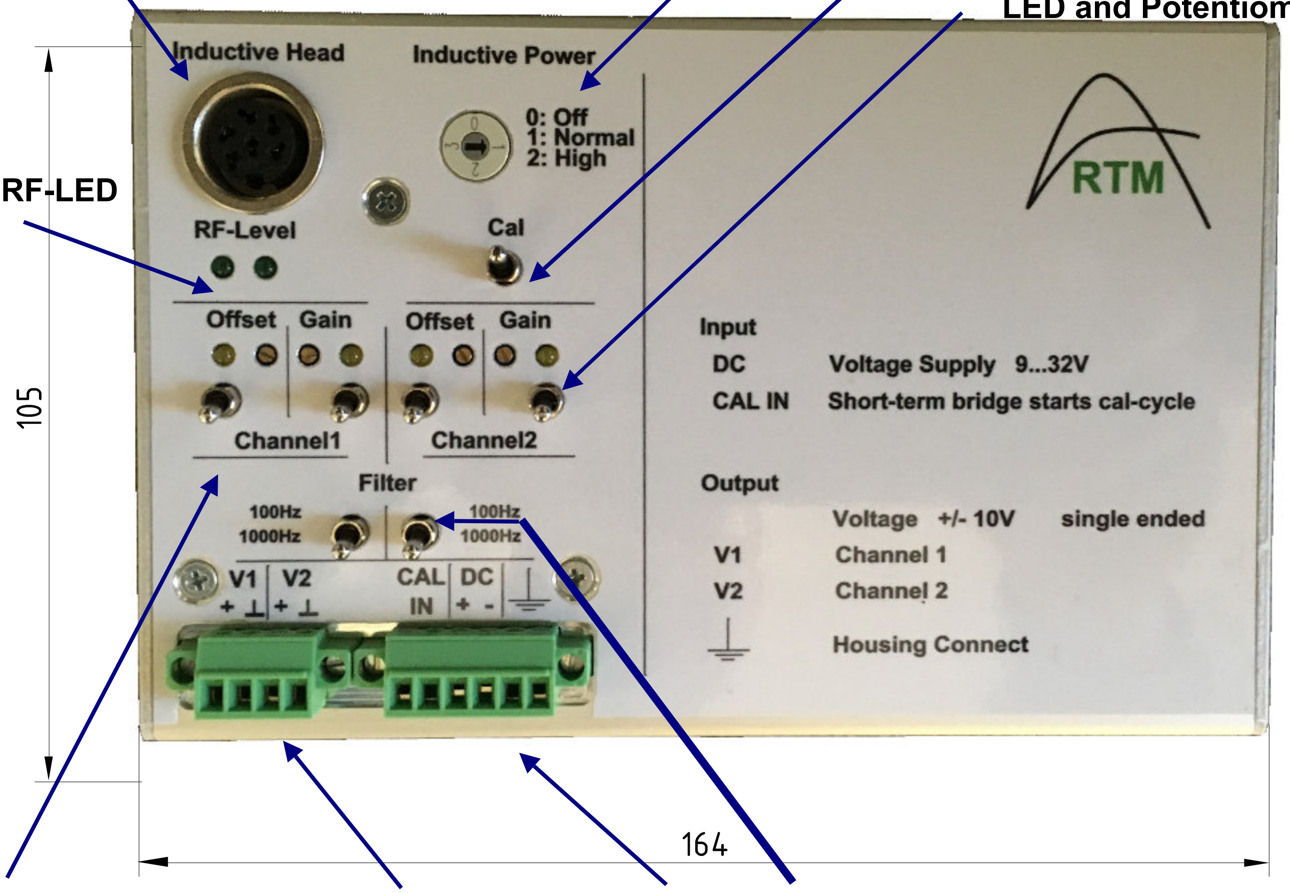
(are shorted in cable connector)

(7) Inductive Power switch

(4) Calibration Switch

(5) Gain Switch
LED and Potentiometer

(2) RF-LED



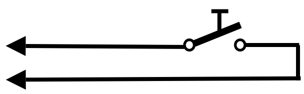
(3) Offset Switch
LED and
Potentiometer

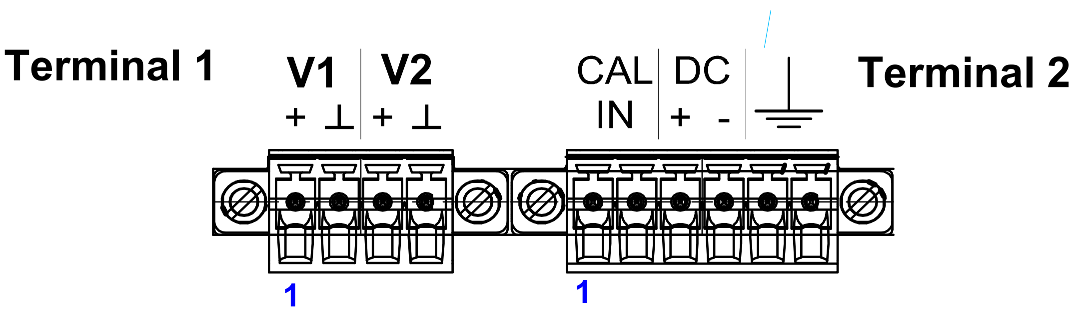
(8) Terminal 1
Outputs

(9) Terminal 2
Intputs

(6) Filter Switch
Frequency
1,000Hz / 100Hz

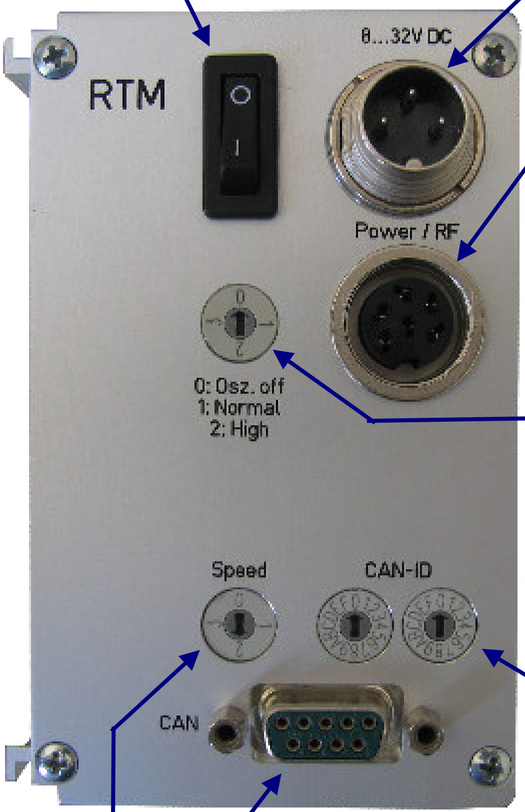
Type Double

No.	Name	Short description
1	Head connector	Connection for Head SD-SHx with the telemetry cable Cab-IP or Cab-RF
2	RF-Level LED	Lit green LED indicates a good RF level. Data link is good. link is working.
3	Offset switch	lower position = factory calibration, LED off upper position = adjustable, yellow LED on Range ± 1.8V of ± 10V by potentiometer
4	Calibration switch	Initiates a shunt calibration which unbalances the bridge by x % (determined by the user installed shunt resistor)
5	Gain switch	lower position = factory calibration, LED off upper position = user adjustable, yellow LED on Range ± 20% by potentiometer
6	Filter switch	switches the output filter (4 pole Butterworth) to a 3dB-frequency of 100 Hz or 1 kHz
7	Ind. Power switch	Position 0 inductive power off; battery power mode Position 1 regular working conditions for all Heads SHx Position 2 raised power if this is required
8	Terminal 1 Outputs	Clamp 1 ==> Voltage Output Channel 1 , single ended Clamp 2 ==> Voltage Output Gnd Clamp 3 ==> Voltage Output Channel 2 , single ended Clamp 4 ==> Current Output Gnd
9	Terminal 2 Inputs	Short term bridge starts Calibration Cycle Clamp 1 ==> Clamp 2 ==>  e.g., spring-loaded switch Clamp 3 ==> + Power supply 9...32VDC Clamp 4 ==> Gnd Power supply Clamp 5 ==> Ground Housing Clamp 6 ==> Ground Housing



Type Single / Type Double

CAN Interface SD-CAN (optional for S-CU0 and D-CU0)



(1) ON/OFF Switch

(2) Power supply
- Pin 1 + supply
- Pin 3 - supply/ Gnd

(3) Head connector

Pin 1 RF wire	Pin 2 RF Gnd
Pin 3 Power 1	Pin 4 Power 2
Pin 5 Osz. ON1	Pin 6 Osz. ON2

Pin 5 and Pin 6 are shorted in cable connector

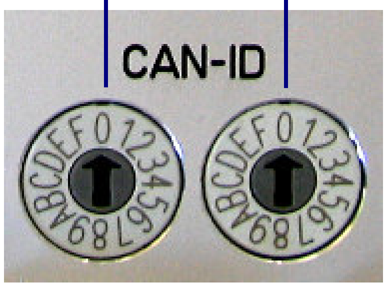
(4) Inductive Power switch

- **Position 0 Battery Operation**
- **Position 1 Regular Power**
- **Position 2 High Power**

(5) CAN Identifier

CAN ID = 2 0 0 Hex

Work setting Basic 200h



Selectable range: 200h ... 2FFh
512 ... 767 decimal
(other ranges possible)

(6) CAN
- Pin 2 CAN low
- Pin 7 CAN high

⚠ **Bus resistor has to be inserted externally**

(7) CAN Bitrate and Analog Signal Frequency

Position 0	500kbit/s	100Hz Signal frequency
Position 1	500kbit/s	1kHz Signal frequency
Position 2	1Mbit/s	100Hz Signal frequency
Position 3	1Mbit/s	1kHz Signal frequency

No.	Name	Short description
1	ON/OFF switch	Rocker switch turns on and off the DC supply voltage to the system.
2	Power supply connector	DC power input to power Control Unit
3	Head connector	Connection for Head SD-SHx with the telemetry cable Cab-IP or Cab-RF
4	Ind. Power switch	Position 0 inductive power off; battery power mode Position 1 regular working conditions for all Heads SHx Position 2 raised power if this is required
5	CAN Identifier	Selectable range 200h...2FFh (hexadecimal) equates to 512...767 (decimal)
6	CAN connector	SubD-9pin connector Pin 2 = CAN low Pin 7 = CAN high ⚠ Bus resistor has to be inserted externally
7	CAN Speed	CAN Bitrate and Analog Signal Frequency

The CAN interface occupies one CAN-ID with 4 channels:

CAN channel1 ==> **Single** channel or channel1 of a **Double** system
CAN channel2 ==> channel2 of a **Double** system
CAN channel3 ==> **Single** channel or channel1 of a **Double** system
CAN channel4 ==> channel2 of a **Double** system

Each channel is mapped twice on an identifier. The low channel is always the first sample and the next channel is the following, equidistant sample.

Examples of dbc-files for a **Double** system and a **Single** system

```
BO_ 512 Message1_1: 8 RTM
SG_ DOUBLE_1_1 :  0|16@1+ (0.0610351563,-2000.0000) [-2000.0000|2000.0000] "Nm" RTM
SG_ DOUBLE_2_1 : 16|16@1+ (0.0030517578,-100.0000) [-100.0000|100.0000] "%" RTM
SG_ DOUBLE_1_2 : 32|16@1+ (0.0610351563,-2000.0000) [-2000.0000|2000.0000] "Nm" RTM
SG_ DOUBLE_2_2 : 48|16@1+ (0.0030517578,-100.0000) [-100.0000|100.0000] "%" RTM

BO_ 529 Message1_1: 8 RTM
SG_ SINGLE_1_1 :  0|16@1+ (0.0305175781,-1000.0000) [-1000.0000|1000.0000] "Nm" RTM
SG_ SINGLE_X_1 : 16|16@1+ (0,0) [0|0] "" RTM
SG_ SINGLE_1_2 : 32|16@1+ (0.0305175781,-1000.0000) [-1000.0000|1000.0000] "Nm" RTM
SG_ SINGLE_X_2 : 48|16@1+ (0,0) [0|0] "" RTM
```

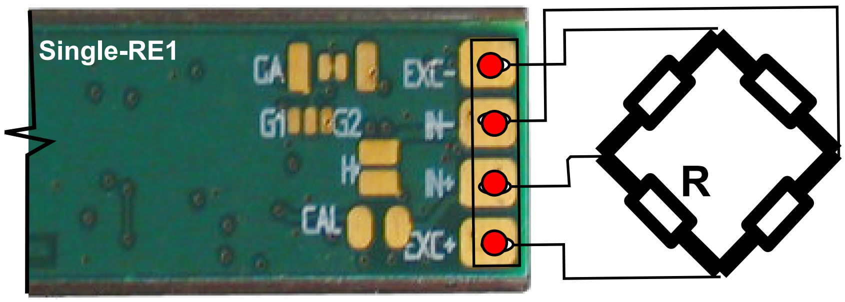
Type Single / Type Double

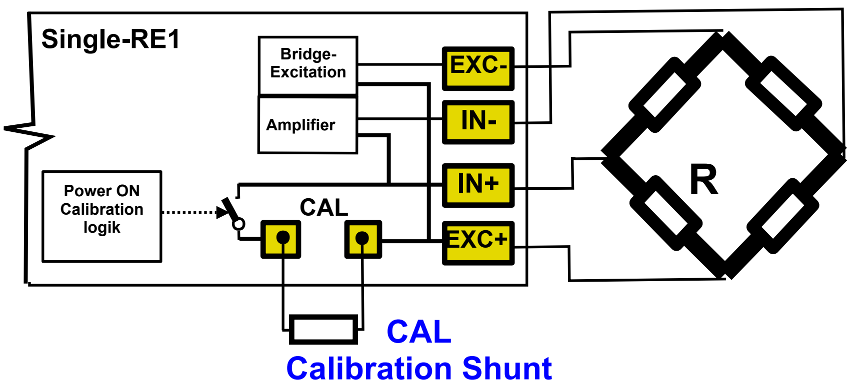
Shunt Calibration

The Shunt-Calibration is an accepted method to check the system functionality.

A resistor is placed in parallel to leg R in the picture below to unbalance the bridge to a predefined value.
This predefined value is determined by the value of resistor CAL.
To calculate the resistor CAL value please see chapter "Rotor Electronics **S-RE** respectively **D-RE**."

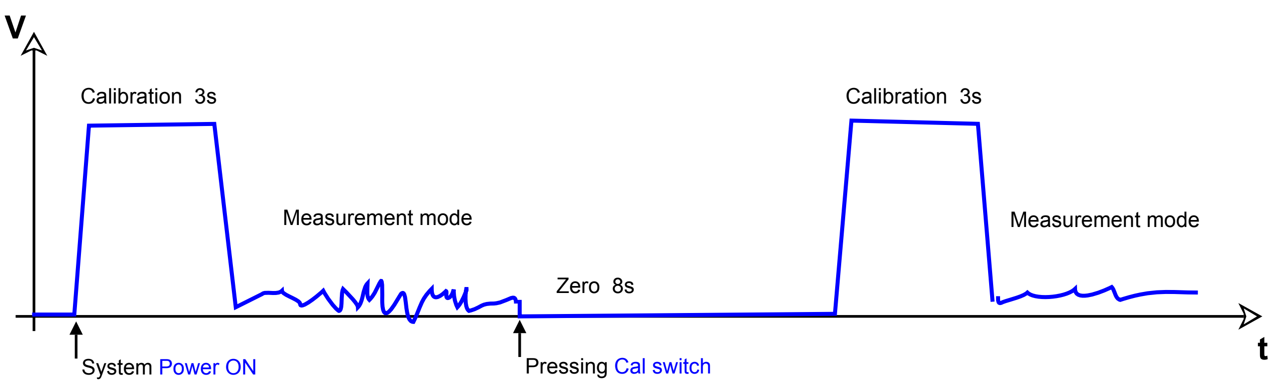
Shown is example with **S-RE**, but **D-RE** is the same two times.





A high quality resistor should be used for the Shunt resistor and can be of form factors and construction: SMD 1206; 0805; 0603 or wired components

A shunt calibration is automatically initiated when power is supplied to the system - The shunt is invoked for approximately 3 seconds and can be viewed on the Control Unit display and can be measured at the analog and frequency BNC connectors.
The shunt cal function can be triggered manually by pushing down on the cal switch located on the front panel of the Control Unit for a second. The display and output will show a zero value for approximately eigth seconds then for another three seconds the shunt value will be output and displayed. After which the system returns to normal operation. If the **D-RE** is used, both channels react of the same kind.



Note: all materials are 1m/ 3ft in length and are part of **Installation Kit SD-IK1**

The prepared area of the shaft should be wider than the width of the stator head being used. e.g.:

SD-SH1 about 75mm/2.95"
SD-SH4 about 30mm/1.18"

A Wrap a layer of insulating tape around the shaft a little wider than the width of the mu metal being used..

B Apply a layer of self-adhesive mu-metal. ⚠ Attention: Gap of 2... 6 mm! The ends must not touch.

C Completely cover this layer with insulating tape.

D Apply another layer of mu-metal. ⚠ Attention: Gap of 2... 6 mm!

The gap should offset by 90° ... 180° from the first layer.

E Apply over the last layer of mu metal an insulating layer of Kapton tape. This tape is very temperature-stable and allows soldering of the Copper band antenna.

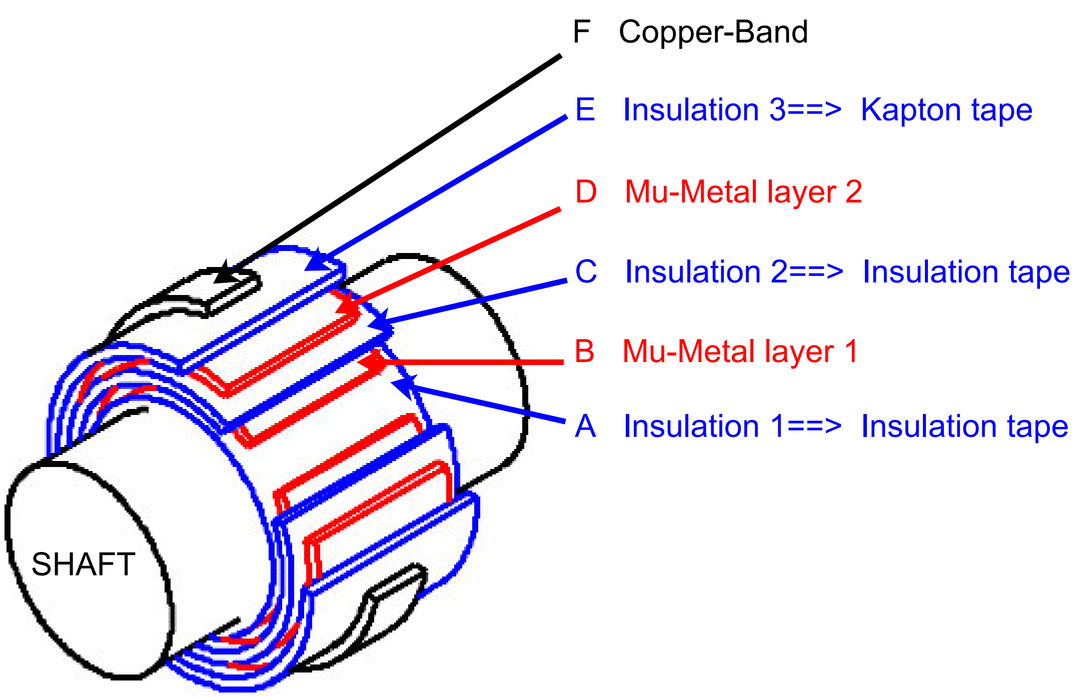
Note: A third layer of mu-metal can improve the ratios.

F Now apply the Copper band around the shaft dividing the mu metal surface in half. This Copper band has a self adhesive backing.

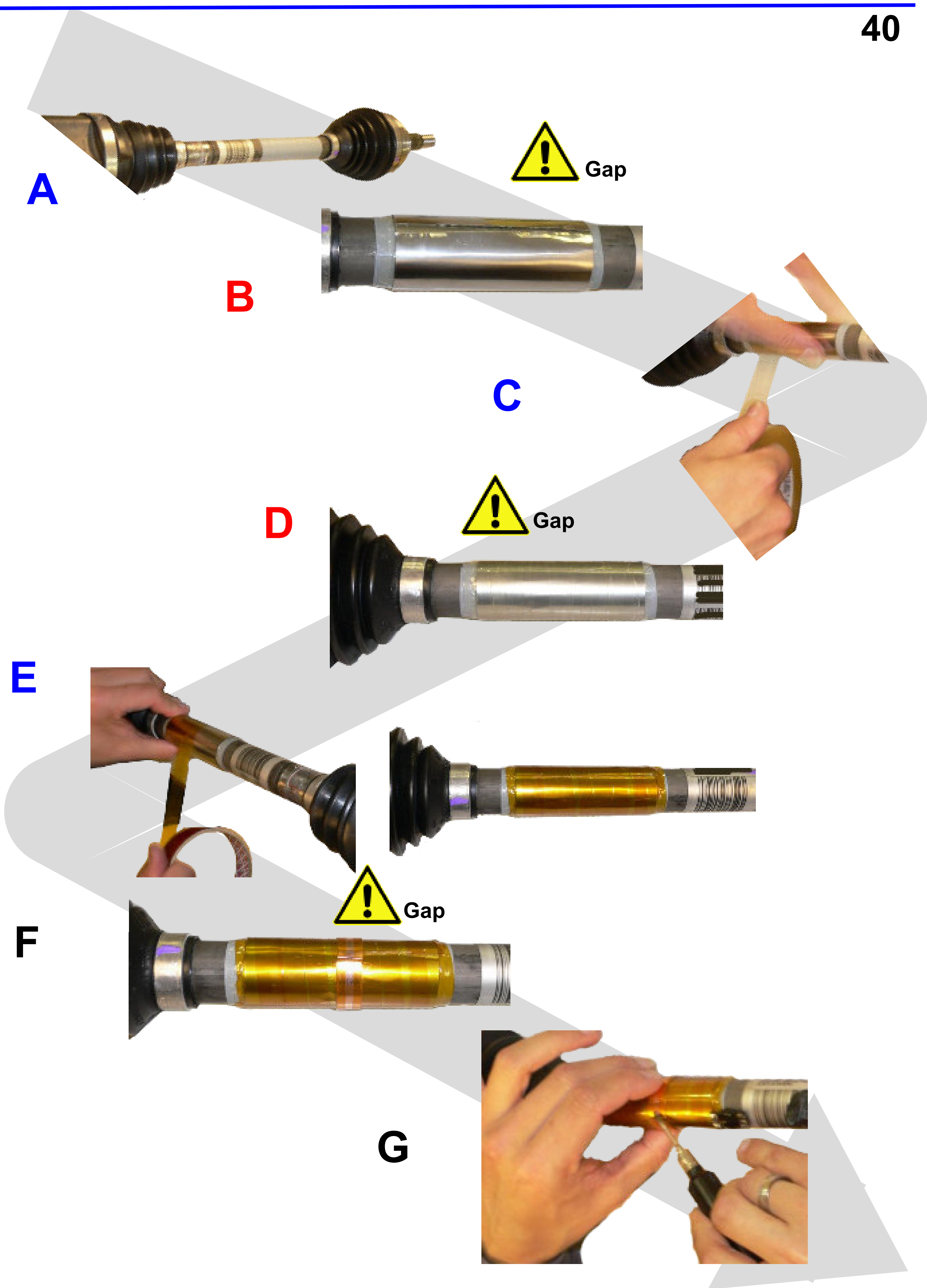
⚠ Attention: Gap of 1... 3 mm!

G Now the wires are soldered to both ends of the Copper band.

H The last step is to cover the entire installation with a layer of protective tape.



Type Single / Type Double



Installation Kit SD-IK1

1 m / 3.3ft Copper band, 0.3 mm x 10 mm; self-adhesive

1 m / 3.3ft mu metal, 0.1 mm x 155 mm; self-adhesive

1 roll of insulation tape, up to 130°C

1 roll Kapton tape, up to 260°C

1 pack 2 components epoxy

0.3 m /1ft wire AWG22 / 0.34 mm ²

1 m /3.3ft wire AWG26 / 0.14 mm ²

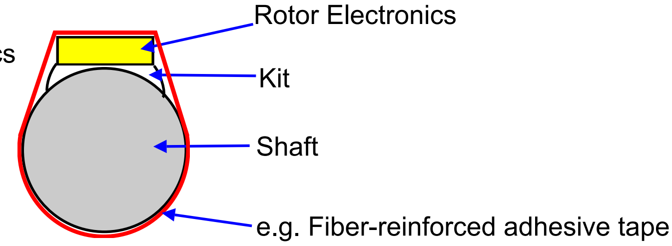
The individual components of the set may differ.
The Mu metal is possibly also in 2 pieces with half the width in the set.

The mu metal can be cut to length using everyday household scissors.

A small amount of 2 component epoxy is typically enough to bond the rotor to the shaft.
Note: it is recommended a layer of nylon reinforced tape be used to strap the rotor electronics in place in addition to the 2 component epoxy.

Depending on the application, the necessary coverage can be very different.It is the responsibility of the user to ensure the rotor electronics is properly installed on the shaft.

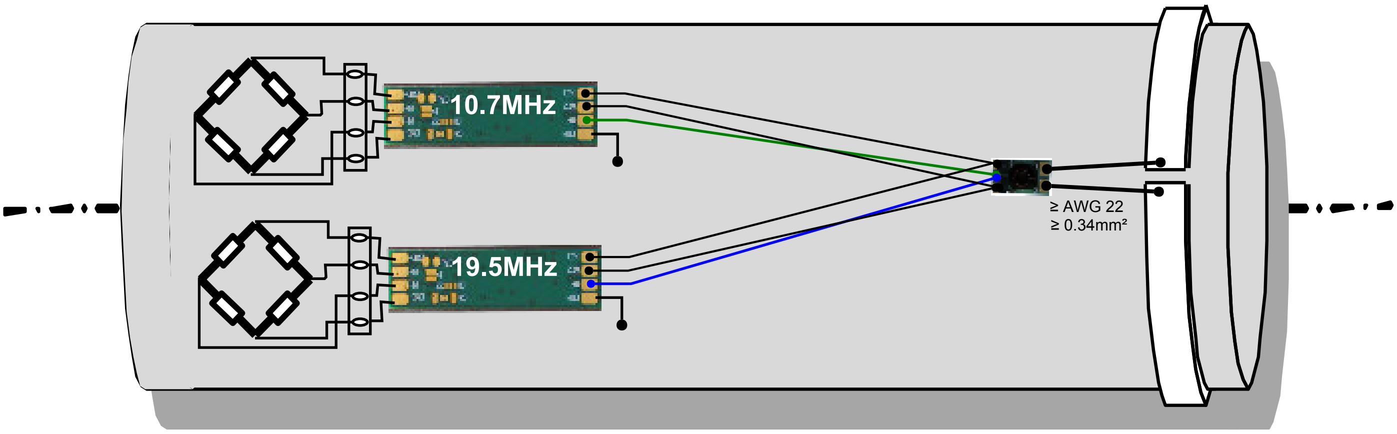
Enough 2 component epoxy should be used to create a saddle to hold the rotor electronics onto the shaft.

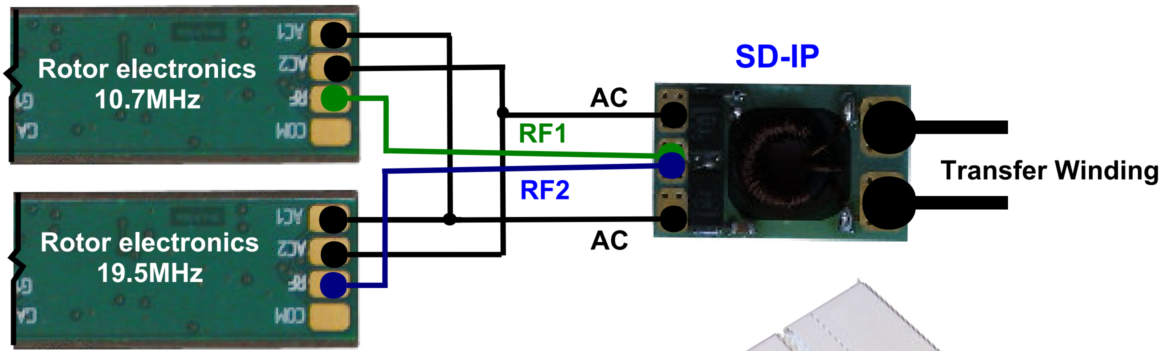


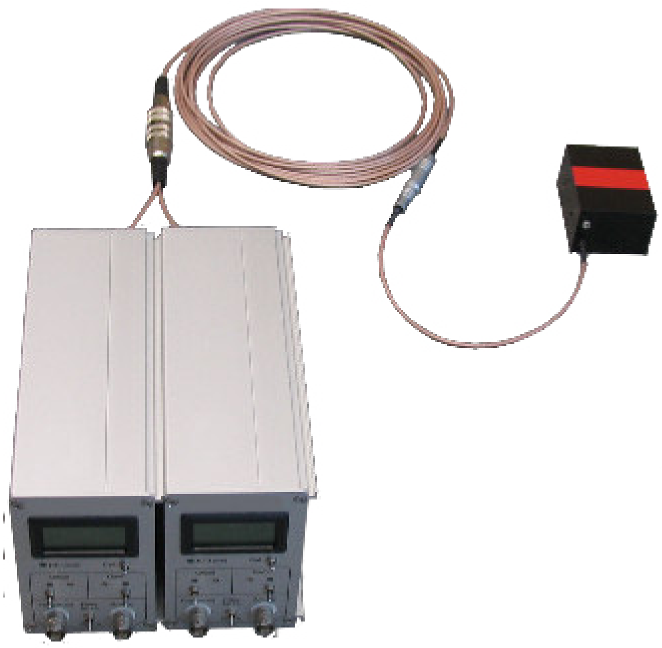
Installation of 2 Single Systems on 1 Shaft

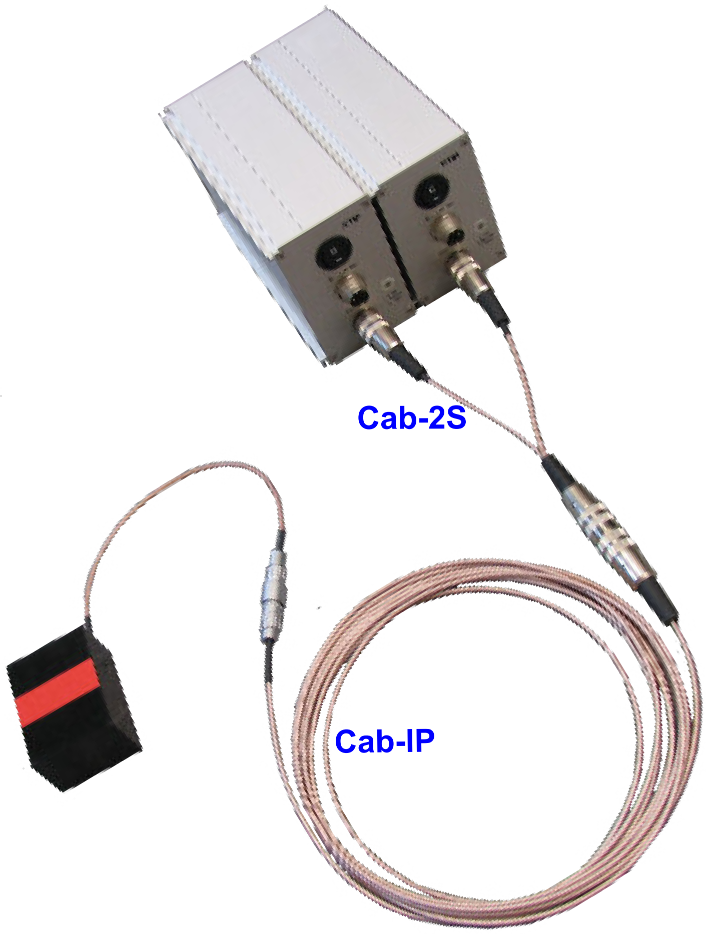
Interconnection of two Rotor Electronics S-RE with different frequencies (10.7MHz and 19.5MHz) on one shaft.

All combinations of types S-RE1, S-RE2, S-RE3 are possible.









Connection cable **Cab-2S**

Cab-2S is used with the heads: **SD-SH1 / SD-SH2 / SD-SH4 / SD-SH5 / SH3**

Cable connector

Type Binder series 680, 6pin
680-09-0321-00-06

Pinout
Pin1 RF wire
Pin2 RF sheeld
Pin3 to Pin6 n.c.

Cable connector

Type Binder series 680, 6socket
680-09-0322-00-06

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2
Pin5 n.c.
Pin6 n.c.

Cable connector

Type Binder series 680, 6pin
680-09-0321-00-06

Pinout
Pin1 RF wire
Pin2 RF shield
Pin3 Power1
Pin4 Power2
Pin5] Jumpered to turn
Pin6] power oscillator on

The cable is resistant to most oils, lubricants, water, and acids.
The bending radius of the cable should not be less than 25mm/1".
Operating temperature range:-40°F to 248°F / -40°C to 120°C

Caution!
Voltage up to 400V_{pp}, 22.5 kHz is on the cable. Only use the approved original cable.
Damaged or frayed cables must be discarded and replaced immediately.

Type Single / Type Double

EC – Certificate of Conformity

The company

Rainer Thomas Messtechnik GmbH
Wiesseer Str.1
D-83703 Gmund / Germany

herewith explains, that the telemetry devices **Type Single / Double**
in from it implementation brought in the traffic fulfils the regulations of the following appropriate harmonisation regulations of the community:

EMV-Richtlinie 2014/30/EU
DIN EN 61326-1; VDE 0843-20-1:2013-07 Elektrische Mess-, Steuer-, Regel- und Laborgeräte - EMV-Anforderungen - Teil 1:Allgemeine Anforderungen (IEC 61326-1:2012);
Deutsche Fassung EN 61326-1:2013

The protective aims of the low-voltage directive 2014 / 35 / EU are kept.

Commissioned person for the arrangement of the technical documents:

Rainer Thomas, company RTM GmbH, Wiesseer Str.1, D-83703 Gmund

Commissioned testing centre / accredited lab:
Schwille-Elektronik GmbH, Benzstr.1A, D-85551 Kirchheim, M.Schiedrich

The following basic norms were applied:

- IEC 61000-4-2
- IEC 61000-4-3

- IEC 61000-4-4
- IEC 61000-4-5
- IEC 61000-4-6
- IEC 61000-4-8
- CISPR 55011

Rainer Thomas, GF

Gmund, Apr. 9th. 2015

Type Single / Type Double

Additions to the Single / Double system

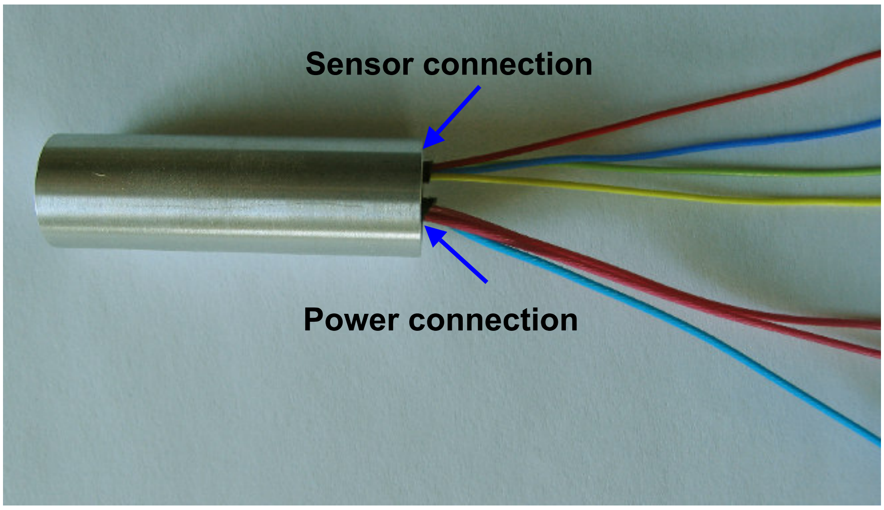
Contents

Type Single / Type Double

Rotor electronics S-RE1-cyl

A1

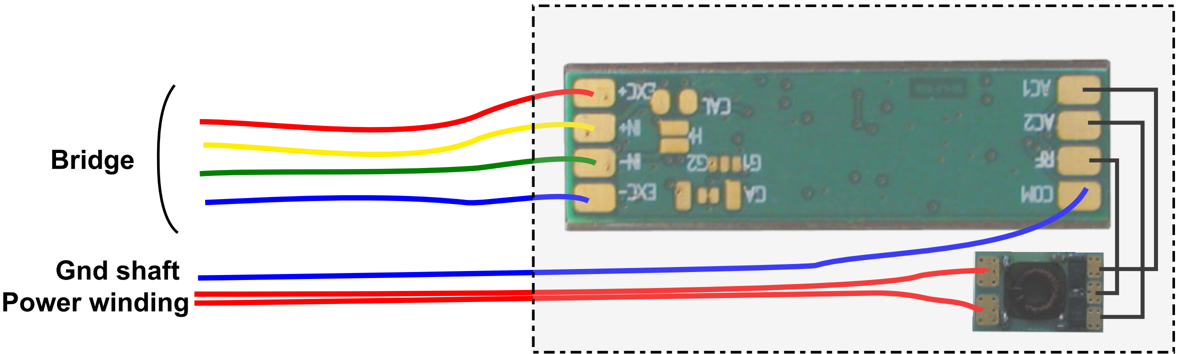
Rotary Electronics in cylindrical housing

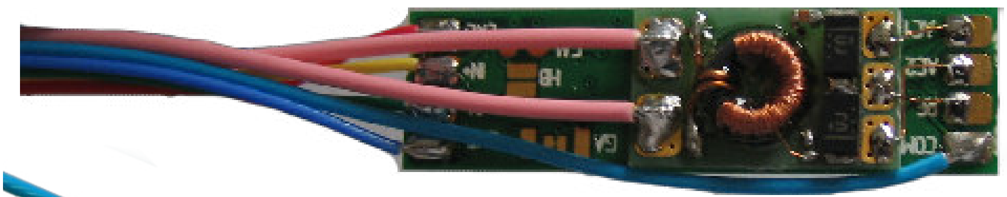


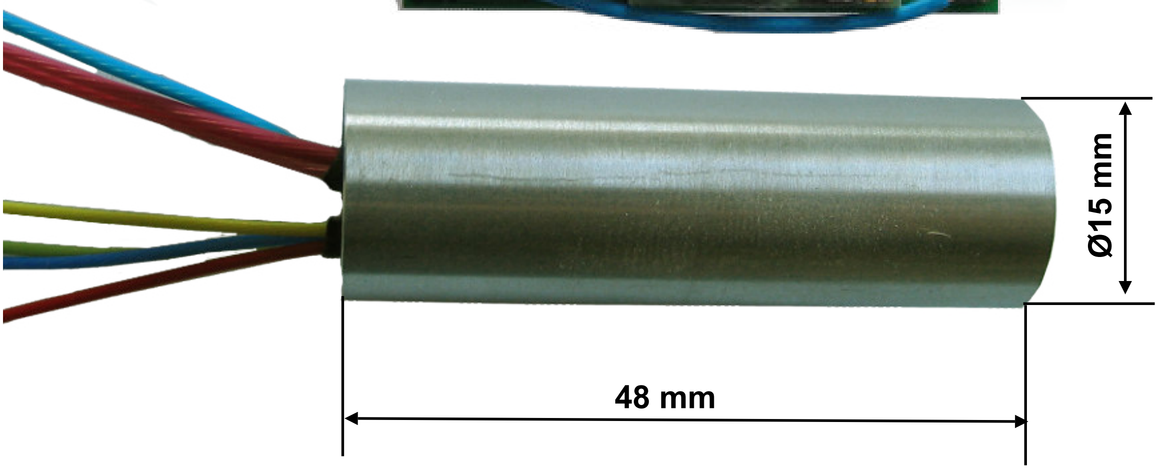
+ Bridge Excitation RED
- Bridge Excitation BLUE
- Input GREEN
+ Input YELLOW

Power winding RED

RF Ground BLUE





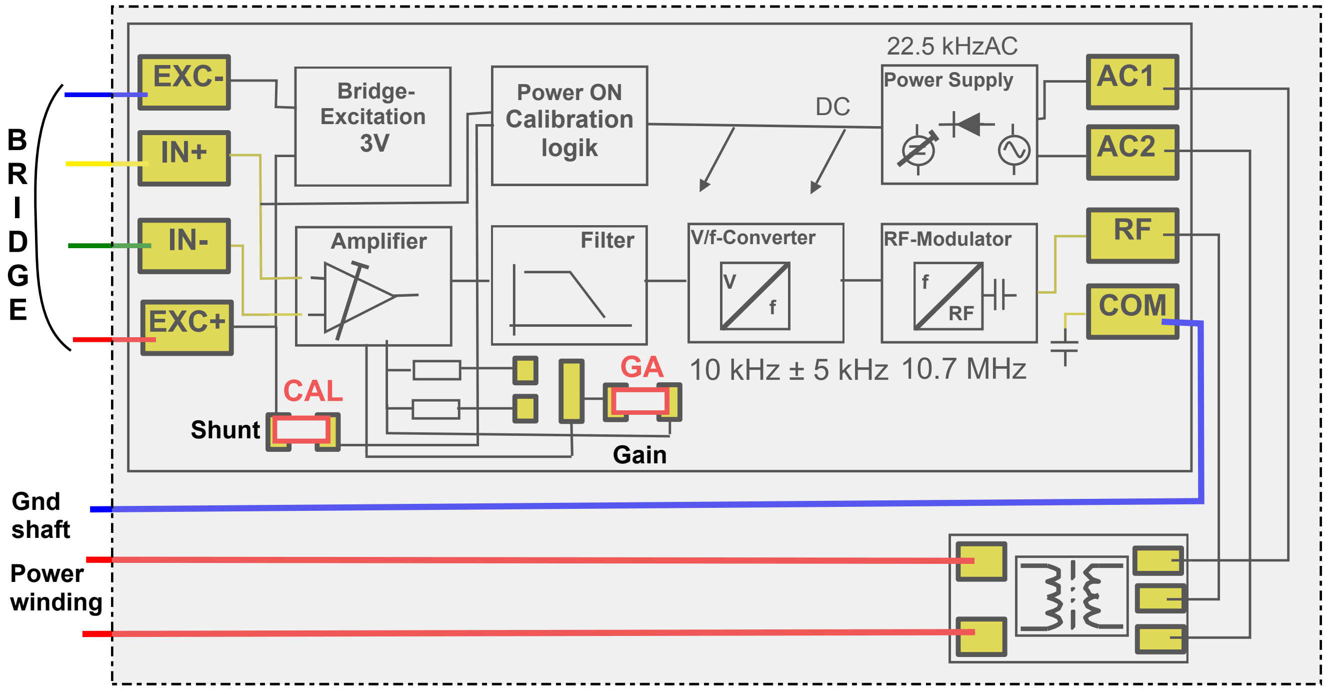


Type Single / Type Double

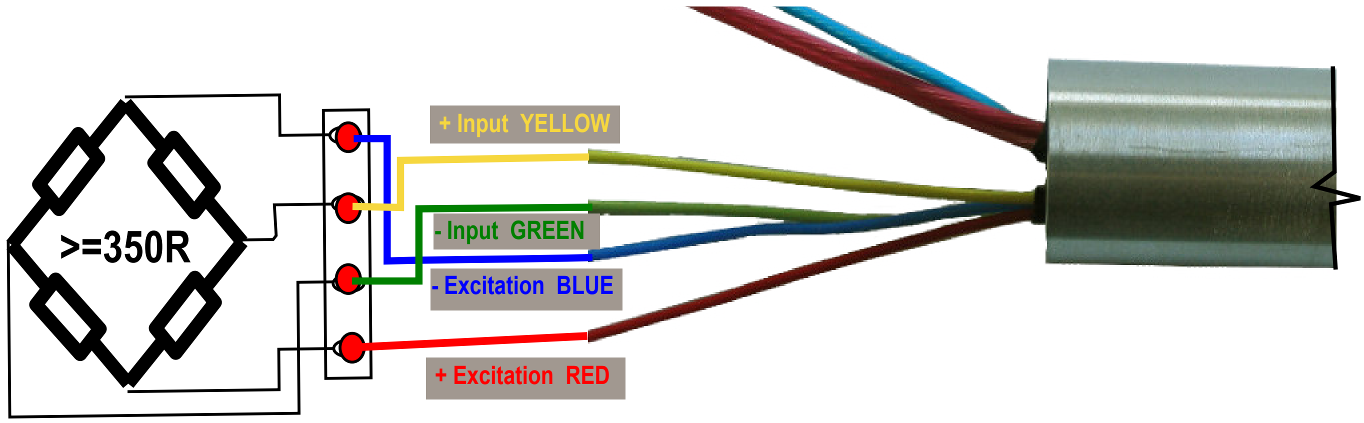
RTM
Rainer Thomas Messtechnik

A2

Rotor electronics S-RE1-cyl Overview



Rotor electronics S-RE1-cyl wiring sensor



The calculation and installation of the Gain resistor and the Shunt occurs before imbedding in the cylindrical housing.

In practice, it usually works like this:

Using the mechanical data the value of the sensitivity is calculated.
A value is installed which is more insensible, about 10% to 12%.
e.g. calculated: 0.536mV/V ==> installed: 0.6mV/V

Therefore the value can be adjusted with the potentiometer of the control unit during calibration of the shaft.

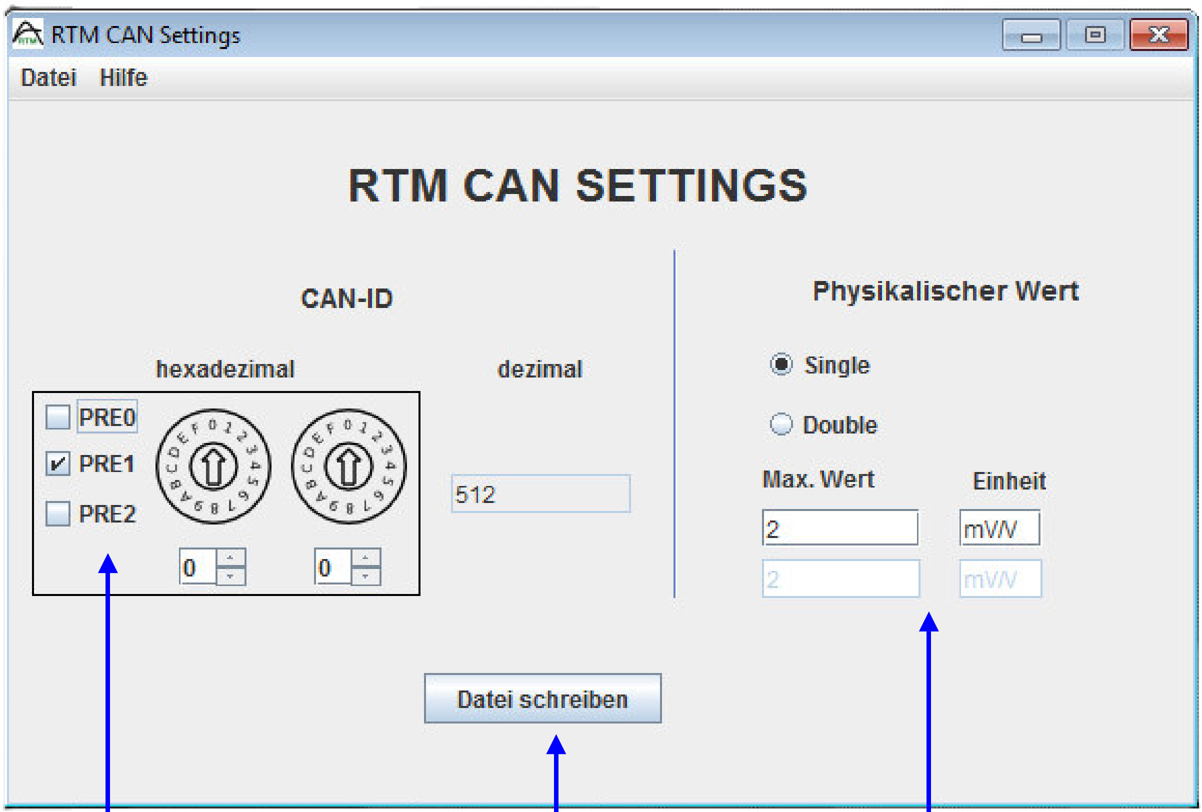
Type Single / Type Double

CAN Configuration Tool RTMCanSettings

RTMCanSettings.jar is an executable Java application.

This program makes it very easy to configure the ID-settings of the rotary switches of the CAN interface integrated in the **Single** or **Double** systems.

Together with the physical values for the full scale control of the measuring range, a dbc file is created in Intel format.



The factory default setting of the CAN identifier area.
Default value is 200 hexadecimal or 512 decimal.
The range of IDs selectable with the rotary switches is:
200h ... 2FFh
Or
512d ... 767d.

For a **Single** system or **Double** system, the physical value range can be defined here.

Specified parameters are written directly into a dbc-file in Intel format.

⚠ Depending on the installed language on the PC is switched between German and English.

Type Single / Type Double

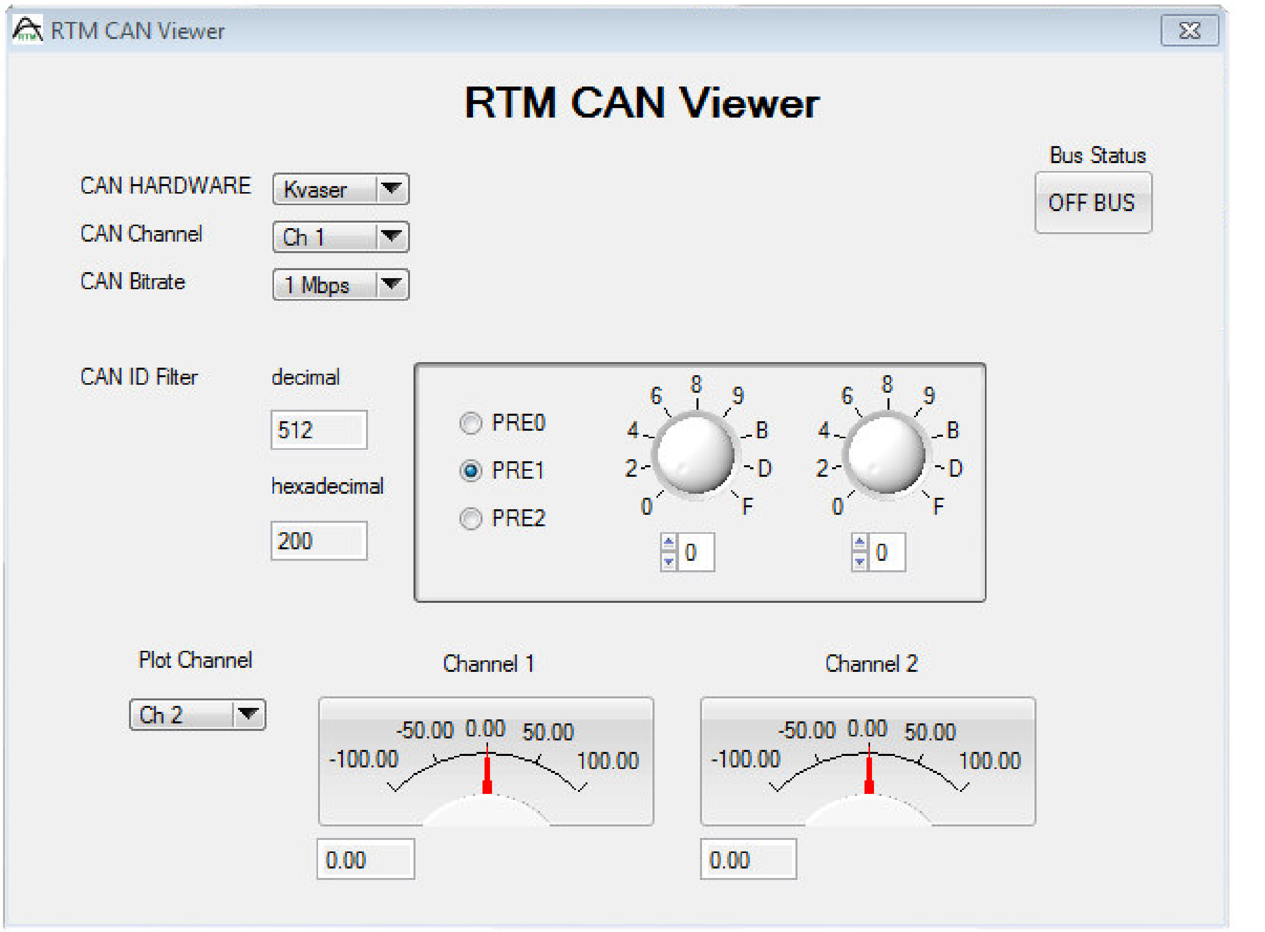
A4

CAN Test Tool RTMCANView

The program RTMCANView is a LabWindows application and has to be installed.

It serves to quickly check the CAN bus settings and allows a system quick test.

The function requires a CAN interface.
Manufacturer: Vector or Kvaser.



Type Single / Type Double

Rotor Electronics Configuration SingleCalc

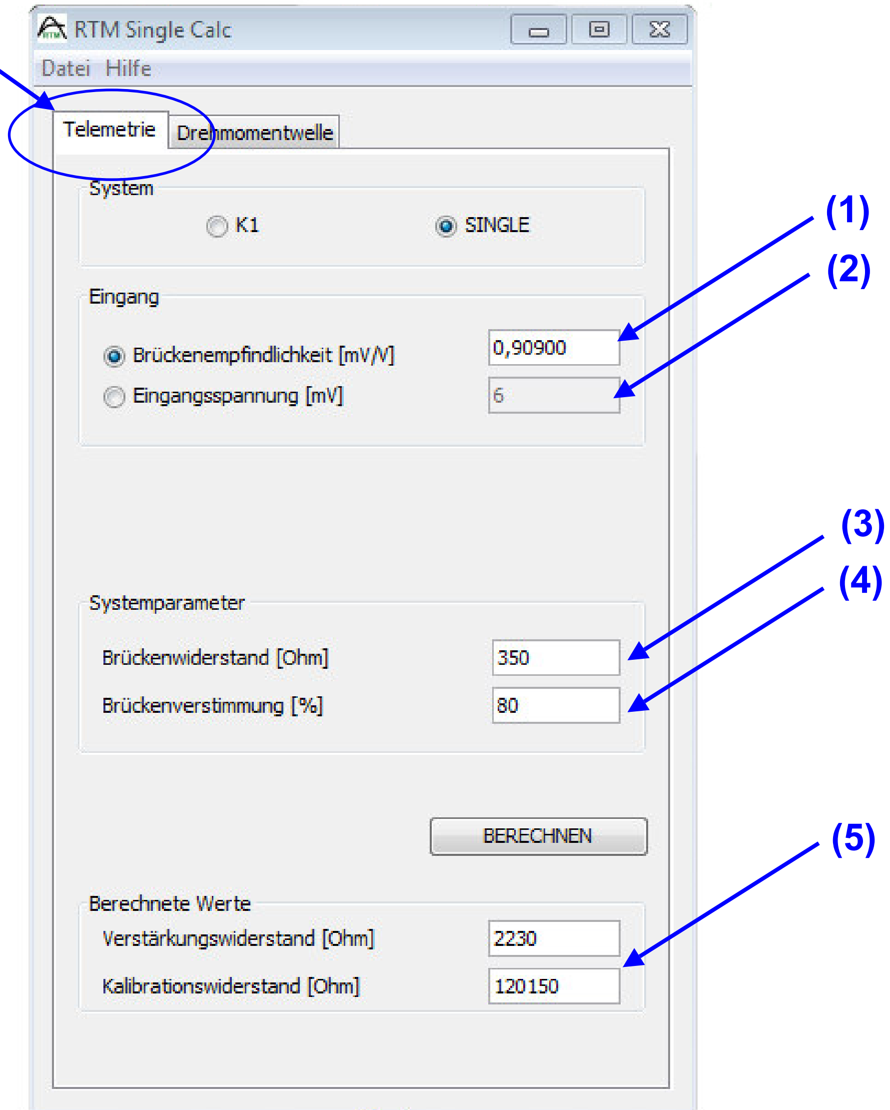
With this tool, the dimensioning of the solder resistors for the determination of the gain (GA) and the detuning (CAL) of the **Single** measuring amplifier or **Double** measuring amplifier is easily possible.

The stored mathematical formulas correspond to those named in this documentation.

The input sensitivity (1) of the connected strain gauges or the input voltage (2) must be entered. Furthermore, the resistance of the bridge (3) used should be specified.
The amount of bridge detuning when switching on the shunt (CAL) must be entered, in% of the measuring range. (4)

The program calculates the soldering resistors to be installed. (5)

Configuration Telemetry



⚠ Depending on the installed language on the PC is switched between German and English.

Type Single / Type Double

Rotor Electronics Configuration SingleCalc

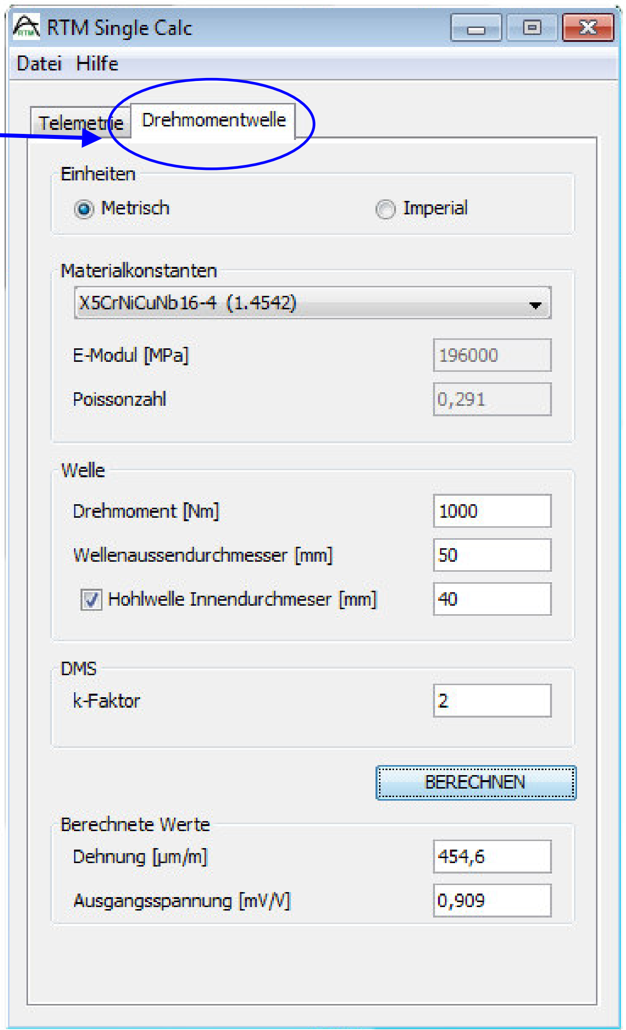
A6

Before the telemetry can be used and the dimensioning of the electronics can take place, the mechanical system must be known.
This can be done by measurement or calculation.
The second part of the program SingleCalc should support as a tool in the torque calculation.
This is not a computer program for mechanical engineering and sensor construction.

In order to finally determine the material expansion and thus the sensitivity, information on the material, the dimensions and the applied load is necessary.
In addition, the k-factor of the used strain gage bridge application is necessary for the sensitivity calculation.

The calculated value is automatically transferred to the calculation program for the dimensioning of the telemetry resistors and charged there.

Calculation
Mechanical system
of torque application



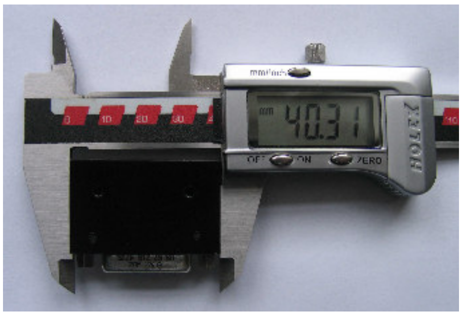
Depending on the installed language on the PC is switched between German and English.

rtmhelper.apk is an Android application with the same functionality as SingleCalc.
It can be installed on any Android tablet or phone from version Android 2.2.

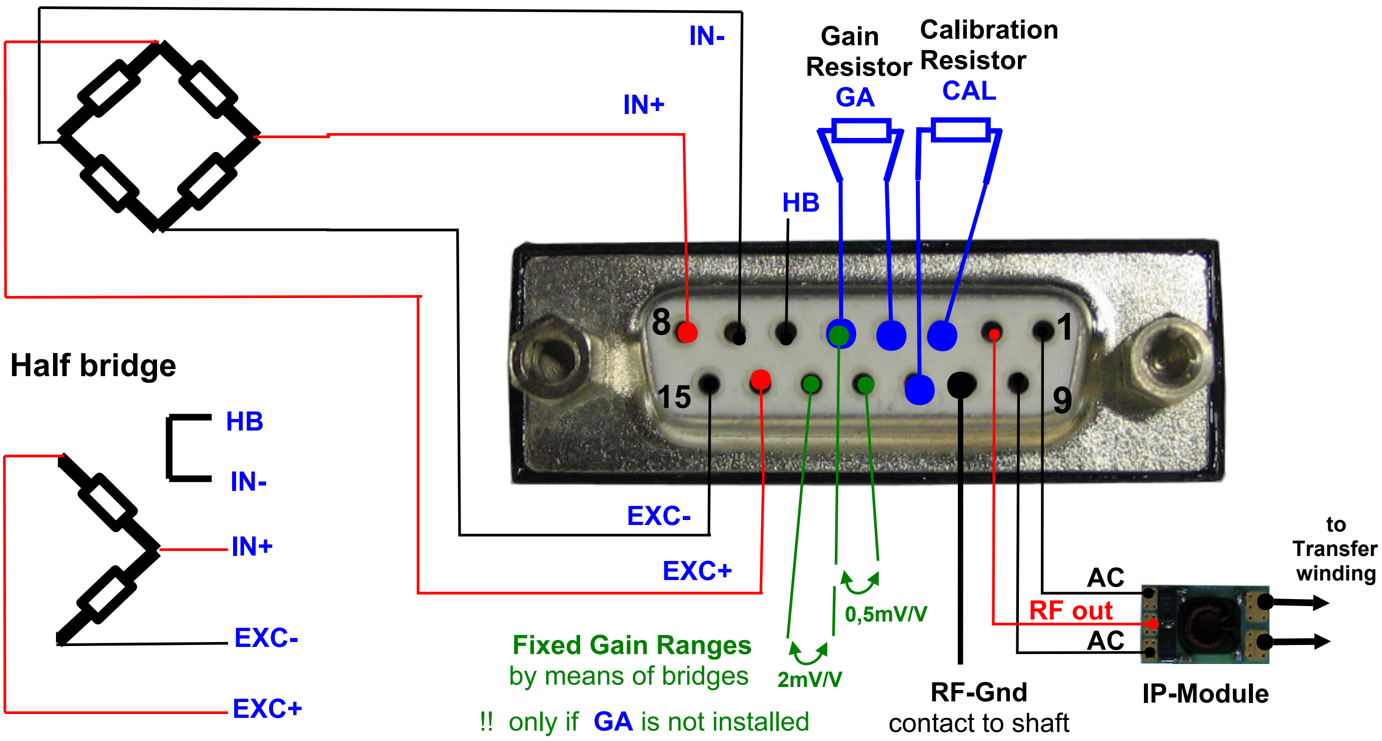
Type Single

Rotor electronics S-RE1S version SubD connector A7

Rotorelectronics for Strain gage Full or Halfbridge, ≥ 350Ω / with OffsetAdjustment



Full bridge



Calculation of the resistors to be soldered

Gain Resistor

$$GA = \frac{100}{\frac{125}{3 \times S} - 1} \quad [\,k\Omega\,]$$

Calibration Resistor

$$CAL = Rb \times \left(\frac{25000}{D \times S} - 0{,}5 \right) \quad [\,k\Omega\,]$$

Units S = Sensitivity [mV/V]; Rb = Bridge resistor [kΩ]; D = detuning [%]

Sensitivity [mV/V]	0.1	0.5	1.0	2.0	4.0	8.0
GA [kΩ]	0.241	1.215	2.459	5.042	10.619	23.762
CAL [kΩ] 80% detuning / 350Ω bridge	1,093.575	218.575	109.200	54.512	27.169	13.497

Type Single

Rotor electronics S-RE1S version SubD connector A8

Rotorelectronics for Strain gage Full or Halfbridge, ≥ 350Ω

Pinout SubD Connector			
Pin number	**Name**	**Pin Num-ber**	**Name**
1	Power AC	9	Power AC
2	RF out	10	RF Ground
3	Resistor CAL	11	Resistor CAL
4	Resistor GA	12	Range 0,5mV/V
5	Resistor GA or fix Range	13	Range 2mV/V
6	Half bridge HB	14	Positive supply EXC+
7	Negative Input IN-	15	Negative supply EXC-
8	Positive Input IN+