

Operating manual

Force Transducer Series RF

Nominal Force
25 kN - 10 MN





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The content of these manual is intended solely for information purposes and can be changed at any time without prior notification.

With regard to the warranty and liability, we refer expressly to our 'General commercial terms and conditions' (www.gtm-gmbh.com) and the instructions and regulations contained in these installation and operating instructions.

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1. Product description

1.1 Designated use

The force transducer of the RF series is to be used for measuring static and dynamic tensile forces and compressive forces.

Any other use is not intended and is therefore prohibited. No claims may be made for damage resulting from inappropriate use.

The limit values for the total load and all other limits must be complied with.

1.2 Exempted use

The force transducer is not a safety component. You must not use it in a complete system in which its failure may lead to the life and well being of people being endangered.

The transducer is not suitable or approved for use in potentially explosive areas.

2. Safety instructions

Markings used

The following designations and symbols are used in the operating manual to identify hazards:



DANGER!

Denotes a possibly hazardous situation that can lead to physical injuries or death.



DANGER!

Denotes a hazardous situation due to electrical voltage that can lead to physical injuries or death.



NOTE!

Denotes usage tips, general information and other useful notes.



DANGER OF BURSTING!

Denotes a potentially hazardous situation that can cause physical injuries or death if ignored.

▶ Denotes handling instructions

● Denotes lists

Additional regulations

This operating manual contains the most important notes for safe operation of the transducer. Consideration must also be given to the legal and safety regulations applicable at the operating location, the accident prevention regulations applicable at the operating location and the technical data in connection with the safety regulations listed here.

Residual hazards

The transducer of series RF is state-of-the-art technology and safe to operate. Residual hazards can arise during operation if the devices are used and operated improperly by unqualified personnel.

The scope of delivery for the transducer only covers a partial area of mechatronic metrology. The safety-related criteria for using the transducer within a complete system must be taken into account by the system design engineer, the equipment manufacturer and/or the operator so that residual hazards are minimised. Reference must be made to the remaining residual hazards in the complete system.



DANGER!

In the case of a complete system, the safety-related criteria must be taken into account so that any failure of the transducer does not present a hazard to anyone.

Transducer condition and modifications

You may only operate the transducer in a perfect condition while complying with the instructions given in the operating manual.

The transducer must not be modified either in its design or safety-related features, without our express, written permission.

Overloading

All transducers of this series have already been subjected to an overload test at the manufacturer's. No additional overloads are permissible; always comply with the nominal loads of the transducer.



DANGER OF BURSTING!

Do not overload the transducer!

The attached parts must also be designed to bear the maximum load. Only use attached parts in an appropriate condition.

In case of new, untested designs, you must provide additional protective measures against bursting parts.

Personnel qualifications

The transducer and additional components must only be operated and assembled by qualified personnel. Qualified personnel are those persons who are acquainted with the assembly, commissioning and operation of the transducer and who have the appropriate qualifications for their job.



NOTE

GTM offers training courses to qualify personnel.

Ambient conditions

The transducer is intended for use in enclosed rooms while complying with the ambient conditions detailed in the technical specifications.

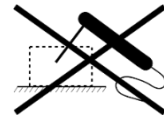
The transducer is not permitted for use in potentially explosive areas.



Protect the transducer against the influences of weather, such as rain and snow. Take appropriate measures on-site against power surges, e.g. from lightning strike.



No welding circuits may be introduced through the body of the transducer. If in doubt, you must dismantle the transducer.



DANGER!

The transducer is not suitable for:

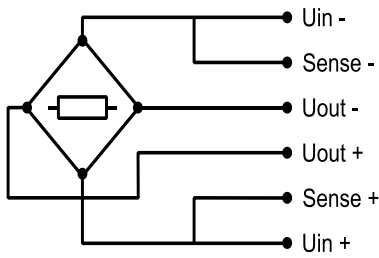
- Potentially explosive areas
- Power surges
- Welding circuits

3. Storage and transport instructions

The transducer series RF is a precision measuring device and must be handled with appropriate caution.

- ▶ If the transducer is dropped or jolted it can become damaged prohibiting any further use.
- ▶ During storage, secure rotationally symmetrical transducers and attachment parts from rolling away.
- ▶ Only use the original transport packaging and other appropriate cut-to-size packaging for storage and transport.

4. Cable connection | 25 kN - 10 MN



		configurable variants Permanent connection end not connected	all standard variants Connection pluggable ¹⁾²⁾³⁾
		SMC: grey Ø 6.5 mm twisted in pairs 3 x 2 x 0.25 mm ² -35 °C to +90 °C TMC (≥ 100 kN): red Ø 7,2 mm twisted in pairs 3 x 2 x 0.25 mm ² -50 °C to +180 °C TMC (25 - 63 kN)⁴⁾: white Ø 2 mm -196 °C to +200 °C	7-pin LEMO Series 1 Female: - Male:
Connection		Wire colour	Pin
Supply voltage (+)	U_{in+}	SMC: blue TMC (red): white TMC (white): blue	3
Supply voltage (-)	U_{in-}	SMC: black TMC (red): brown TMC (white): black	2
Measurement signal (+)	U_{out+}	SMC: white TMC (red): grey TMC (white): white	1
Measurement signal (-)	U_{out-}	SMC: red TMC (red): pink TMC (white): red	4
Sense (+)	$Sense+$	SMC: green TMC (red): green TMC (white): green	5
Sense (-)	$Sense-$	SMC: grey TMC (red): yellow TMC (white): grey	6
Shielding		SMC: yellow TMC (red): black TMC (white): yellow	Housing

1) View too weldingside

2) Female LEMO S.A. Typ: EGG.1B.307.CLL; matching socket Male: FGG.1B.307.CLA.D72

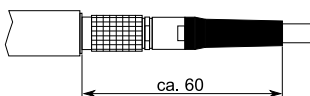
3) In the nominal force 25 - 63 kN, the connection sockets are led to the outside with a black measuring cable type FMC | 30 cm | Ø 2.9. let outwards. □

4) In the nominal force 25 - 63 kN, fixed high/low temperature measuring cables TMC = white cable with a temperature range: -196 °C to +200 °C.

► Pluggable cable connection

All standard variants of the series RF are equipped with a pluggable LEMO socket. Suitable measuring cables S-CAB / C-CAB are available as accessories.

► Plug-in cable connection with shielded measuring cable type SMC (S-CAB-L-5M-F)



► Fixed measuring cable

All configurable variants of the series RF are optionally available with fixed measuring cables, e.g. with 5 / 10 / 15 m shielded standard measuring cable type SMC or 5 / 10 m high / low temperature measuring cables TMC and open cable ends or various connectors for strain gauge measuring amplifier connections.

5. Double Bridge

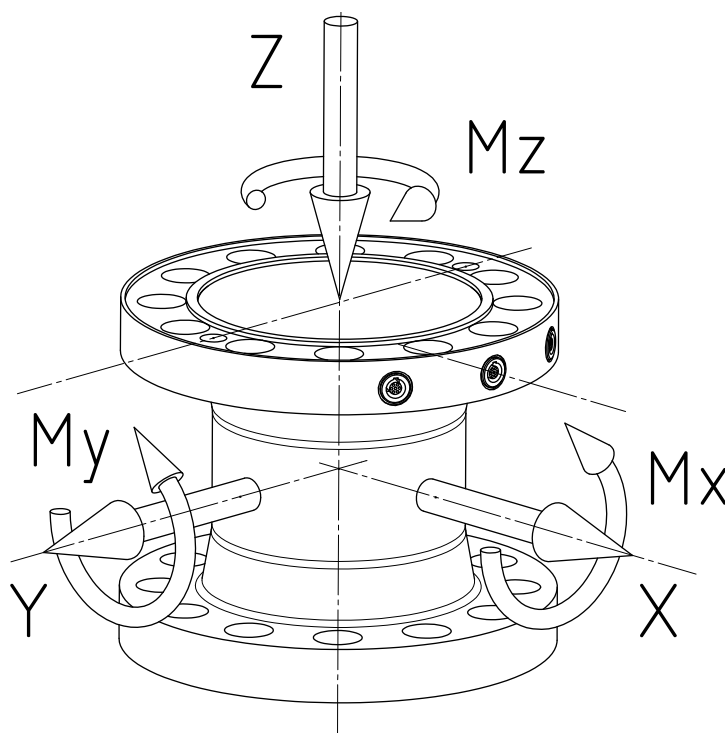
- ▶ For the double measuring bridge (available as configurable variant), the technical data apply equally to both measuring circuits.

6. Bending Moment Measuring Circuits | 25 - 500

► The bending moment measuring circuits (available as configurable variant) M_x and M_y can be used advantageously with the use of a multi-channel measuring amplifier to control the force application.

Nominal Force	F_{nom}	kN	25 - 63 (1 mV/V)	100 - 500 (2 mV/V)
Rated bending moment	Mb_{nom}	N·m	$F_{nom} \cdot 10 \text{ mm}$	
Reproducibility		%	0.01	
Temperature effect on characteristic value per 10 K	TK_C	%/10 K	0.2	
Temperature effect on zero signal per 10 K	TK_0	%/10 K	0.2	
Rated characteristic value	C_{nom}	mV/V	1)	
Input resistance	R_e	Ω	400	
Operating range of excitation voltage	$B_{U,G}$	V	12	

1) Specification shown on the label



► Position of the coordinate cross

7. Application instructions

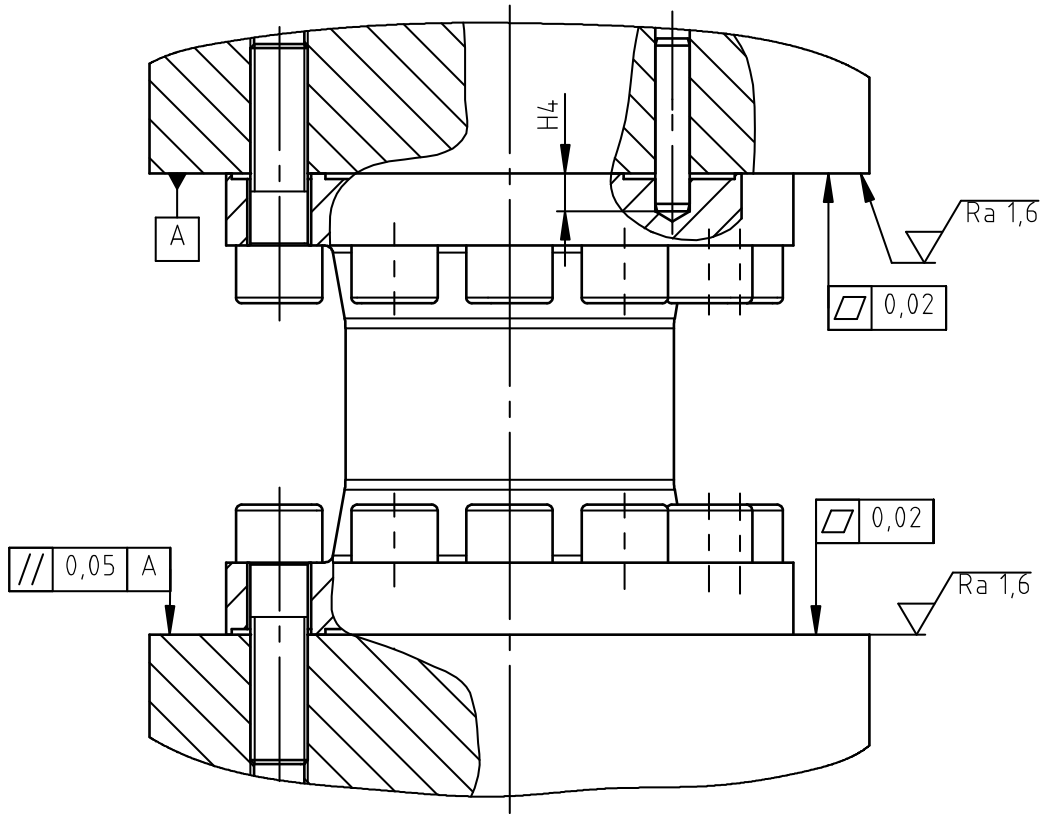
7.1 Assembly instruction | 25 kN - 10 MN

- ▶ Tighten the screws evenly and crosswise. For higher tightening torques, tighten the screws in stages.
- ▶ Avoid mechanical strain on the cable and the connector.
- ▶ Avoid a deformation of the assembly surfaces. This could affect the measurement.
- ▶ Pay attention to the cleanliness of the mounting surfaces and connections. They should be cleaned from dust and dirt before mounting and measuring, otherwise the measuring would be influenced.

Nominal force	Screw size	Screw quality	Fastening torque	Surface pressure ¹⁾
kN	-	-	N·m	N/mm ²
25, 50, 63	M8	8.8	24	920
100, 200, 250	M10	12.9	79	420
300, 400, 500, 630	M20	12.9	650	700
1000, 1200	M24	12.9	1120	630
1500, 2000, 2500	M30	12.9	1720	430
3000	M30	12.9	1720	380
4000	M30	12.9	1720	330
5000, 6000, 7500	M36	12.9	4000	490
10000	M42	10.9	5600	634

1) Surface pressure on the contact area as a result of the max. Fastening torque

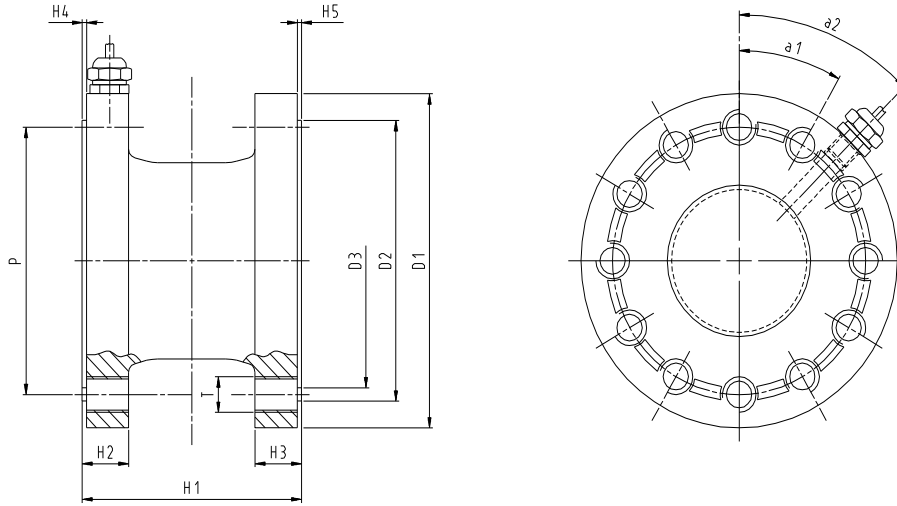
7.2 Installation instruction | 25 kN - 10 MN



Typ	H4 [mm]
25 kN - 63 kN	-
100 kN - 250 kN	14
300 kN - 2.500 kN	13
3 MN	15
4 MN	20
5 MN - 10 MN	-

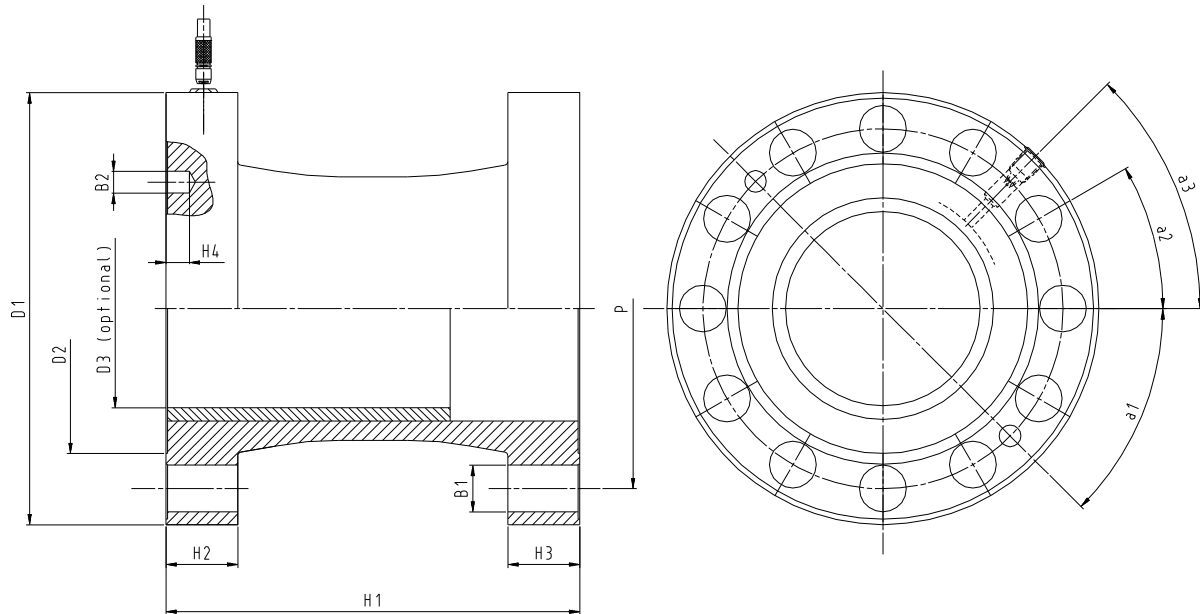
8. Mating dimensions

8.1 Mating dimensions | 25 kN - 63 kN



Nominal force compression/tension	$\pm F_{nom}$	kN	25 50 63
Diameter	$\varnothing D_1$	mm	75
Diameter	$\varnothing D_2$	mm	63-0.05
Diameter	$\varnothing D_3$	mm	57+0.01
Pitch circle diameter	$\varnothing P$	mm	60±0.1
Thread	T		M8
Height	H ₁	mm	52
Height	H ₂	mm	11
Height	H ₃	mm	11
Height	H ₄	mm	2+0.1
Height	H ₅	mm	2+0.1
Angle	a ₁		30°
Angle	a ₂		45°

8.2 Mating dimensions | 0.1 - 10 MN



Nominal force compression/tension	$\pm F_{nom}$	kN	100	300	1000	1500	3000	4000	5000	7000	10000	
			200	400		2000						6000
			250	500	1200	2500						
Bore	$\varnothing B_1$	mm	11	22	26	33			39	45	45	
Bore	$\varnothing B_2$	mm	8H7	12H7								---
Diameter	$\varnothing D_1$	mm	130	197	240	305	415	536	570	600	750	
Diameter	$\varnothing D_2$	mm	91	128	161	192	301	380	385	386	535	
Diameter	$\varnothing D_3$	mm	60	88	110	119.7	236	250	---			
Pitch circle diameter	$\varnothing P$	mm	112 \pm 0.1	160 \pm 0.1	200 \pm 0.1	250 \pm 0.1	360 \pm 0.2	480 \pm 0.2	512 \pm 0.2	512 \pm 0,2	675 \pm 0.2	
Height	H ₁	mm	112	160	230	326	358	400	580	580	650	
Height	H ₂	mm	22	25	40	57.5	69	80	130	130	140	
Height	H ₃	mm	22	25	40	57.5	69	80	130	130	140	
Height	H ₄	mm	14	13			15	20	---			
Angle	a ₁		45°				50°	7.5°	---			
Angle	a ₂		30°				20°	15°	15°	15°	11.25°	
Angle	a ₃		45°				50°	7.5°	7.5°	7,5°	5.63°	

9. Technical Data | 25 - 630 kN

Nominal force compression/tension		$\pm F_{nom}$	kN	25	50	63	100	200	250	300	400	500	630		
Metrological Data	Accuracy class			0.05											
	Force measurement range		%	1 - 100											
	Linearity error	d_{lin}	%	0.05											
	Interpolation error	f_c	%	0.4											
	Hysteresis	h	%	0.1											
	Reversibility error	v	%	0.5											
	Repeatability (f.s.)		%	0.005											
	Creep		%	0.025											
	Temperature effect on characteristic value per 10 K	TK_C	%/10 K	0.05											
	Temperature effect on zero signal per 10 K	TK_0	%/10 K	0.05											
	Eccentricity effect		%/mm	0.02											
	Lateral force effect		%/(0,1·F _{nom})	0.2											
	Torque effect		%/(mm·F _{nom})	0.005											
	Characteristic value difference, tension/compression force	d_{ZD}	%	1											
	Electrical Data	Rated characteristic value	C_{nom}	mV/V	1			2 ³⁾							
Characteristic value tolerance		d_c	%	0.4			0.2								
Zero signal deviation		$d_{S,0}$	%	1			0.5								
Input resistance		R_e	Ω	ca. 750											
Output resistance		R_a	Ω	ca. 500					ca. 750						
Insulation resistance		R_{is}	Ω	>10 ⁹											
Operating range of excitation voltage		$B_{U,G}$	V	5 - 12											
Protection (DIN EN 60529)				IP 68 ²⁾					IP 50 ¹⁾ ; IP 68 ²⁾						

Mechanical Data	Nominal force compression/tension	$\pm F_{nom}$	kN	25	50	63	100	200	250	300	400	500	630
	Rated Displacement	s_{nom}	mm	0.07			0.1			0.2			
	Spring rigidity	c_{ax}	kN/mm	350	700	900	1000	2000	2500	1500	2000	2500	3000
	Mass	m	kg	0.5			3			7.1	7.5	8	8.5
	Proportionate moving mass	m_{mess}	kg	0.25			1.5			4.5			
	Fundamental resonant frequency	f_G	kHz	>9			>5			>4			
	Permissible oscillation stress ³⁾		%	± 80									
	Force limit		%	150									
	Breaking force		%	300									
	Lateral force limit		%	60									
Limits	Permissible eccentricity	e_G	mm	30			40			50			
	Bending moment limit	M_{bzul}	kN·m	1	2	4	6	11	14	24	33	40	49
	Rated temperature range	$B_{T,nom}$	°C	10 - 60									
	Operating temperature range	$B_{T,G}$	°C	-10 - +80									

1) Plug -in connection

2) Permanent connection

3) Rated characteristic value 16mV/V with permissible oscillation stress ± 100% available on request.

Technical Data | 1 - 10 MN

Nominal force compression/tension		$\pm F_{nom}$	MN	1	1.2	1.5	2	2.5	3	4	5	6	7	8	10
Metrological Data	Accuracy class			0.05											
	Force measurement range		%	1 - 100											
	Linearity error	d_{lin}	%	0.05											
	Interpolation error	f_c	%	0.4						0.5					
	Hysteresis	h	%	0.1											
	Reversibility error	v	%	0.5											
	Repeatability (f.s.)		%	0.005											
	Creep		%	0.025											
	Temperature effect on characteristic value per 10 K	TK_c	%/10 K	0.05											
	Temperature effect on zero signal per 10 K	TK_0	%/10 K	0.05											
	Eccentricity effect		%/mm	0.02											
	Lateral force effect		%/(0,1·F _{nom})	0.2											
	Torque effect		%/(mm·F _{nom})	0.005											
	Characteristic value difference, tension/compression force	d_{zD}	%	1											
	Electrical Data	Rated characteristic value ³⁾	C_{nom}	mV/V	2										
Characteristic value tolerance		d_c	%	0.2						0.4					
Zero signal deviation		$d_{s,0}$	%	0.5						1					
Input resistance		R_e	Ω	app. 750											
Output resistance		R_o	Ω	appr. 750											
Insulation resistance		R_{is}	Ω	>10 ⁹											
Operating range of excitation voltage		$B_{U,G}$	V	5 - 12											
Protection (DIN EN 60529)				IP 50 ¹⁾ ; IP 68 ²⁾											

Mechanical Data	Nominal force compression/tension	$\pm F_{nom}$	MN	1	1.2	1.5	2	2.5	3	4	5	6	7	8	10
	Rated Displacement	s_{nom}	mm	0.2		0.3			0.4		0.6		0.7	0.8	0.7
	Spring rigidity	c_{ax}	MN/mm	5	6	5	6.7	8	7.5	10	8.3	10	10	10	14
	Mass	m	kg	19		46			81	207	285	295	291	298	490
	Proportionate moving mass	m_{mess}	kg	9.5		23			41	104	143	148	145	149	245
	Fundamental resonant frequency	f_G	kHz	>3		>2			>1		~1				
	Permissible oscillation stress ³⁾		%	± 80											
	Force limit		%	150											
	Breaking force		%	300											
	Lateral force limit		%	60											
Limits	Permissible eccentricity	e_G	mm	50					75	100					
	Bending moment limit	M_{Bzul}	kN·m	92	112	140	200	240	520	1000	1250	1500	1500	1500	3000
	Rated temperature range	$B_{T,nom}$	°C	+10 – +60											
	Operating temperature range	$B_{T,G}$	°C	- 10 – +80											

1) Plug -in connection
 2) Permanent connection
 3) Rated characteristic value 16 mV/V with permissible oscillation stress ± 100 % available on request.

10. Technical support

If problems arise while working with the product the following GTM services can be used:

E-mail support

contact@gtm-gmbh.com

Worldwide contact

GTM Testing and Metrology GmbH
Philipp-Reis-Straße 4-6
64404 Bickenbach
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Czech Republic
Tel. +420 286 891 392
info@gtm.cz
www.gtm.cz

11. Declaration of incorporation

In accordance with EC Machinery Directive 2006/42/EC from May 17, 2006,
Appendix II B

We,

**GTM Testing and Metrology GmbH
Philipp-Reis-Straße 4-6
64404 Bickenbach
Deutschland**

hereby declare that the product

Force Transducer Series RF

complies with the following basic requirement:

- ▶ 2006/42/EG, Appendix II B EC Machinery Directive
- ▶ 2004/108/EC EMC Directive

The special technical documents were created in accordance with Appendix VII, Part B of the EC Machinery Directive 2006/42/EC. Upon reasoned request we shall undertake to submit them to the market supervision authority in electronic form within an appropriate period.

The product delivered by us may only be put into operation if it has been determined that the machine into which the product is to be incorporated likewise complies with the provisions of the Machinery Directive.



Daniel Schwind, Technical Manager

Bickenbach, 30.06.2022

12. Notes



#precision wins

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Subject to change without notice. All information describes our products in general terms. They do not represent agreed quality in the sense of § 434 Para. 1 of the BGB (German Civil Code).

Illustrations may differ from originals.

