

HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH



**Electrical
measurement
of mechanical
quantities**

Operating manual

Force washer
KMR

B 20.KMR.10 e

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Safety instructions

Use in accordance with the regulations

The KMR are intended for the measurement of forces in test rigs / press-fit facilities / test systems / presses. Any other use is deemed to be **not** in accordance with the regulations.

In the interests of safety the transducer should be used only as specified in the mounting instructions. It is also essential to comply with the statutory and safety regulations in force for the particular application. The same applies to the use of accessories.

The transducer is not a safety device as defined for use in accordance with the regulations. Perfectly safe operation of this transducer demands appropriate transport, as well as technically correct storage, installation and mounting combined with careful operation and maintenance.

General dangers due to non-observance of the safety instructions

KMR comply with the state of the art and are fail-safe.

The transducers can give rise to residual dangers if they are inappropriately installed and operated by untrained personnel.

Any person responsible for the installation, commissioning, maintenance or repair of a force transducer must have read and understood the mounting instructions and in particular the technical safety instructions.

Residual dangers

The scope of performance and supply covers only part of measurement technology. In addition, equipment planners, installers and operators should plan, implement and be responsible for the technical safety aspects of force measurement technology in such a way as to minimise the residual dangers. Prevailing regulations must be complied with at all times. The residual dangers connected with the force measurement technology must be referred to explicitly.

Residual dangers are highlighted in these mounting instructions with the following symbols:



Symbol:

DANGER

Meaning:

Maximum danger level

Warns of an **imminently** dangerous situation in which failure to comply with safety requirements **will result in** death or serious physical injury.



Symbol:

WARNING

Meaning:

Potentially dangerous situation

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **can result in** death or serious physical injury.



Symbol:

CAUTION

Meaning:

Potentially dangerous situation

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **could result in** damage to property or some form of physical injury.



Symbol:

NOTE

Means that important information about the product or its handling is being given.



Symbol:

CE mark

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (see Declaration of Conformity at the end of this document).

Conversions and modifications

The KMR must not be modified from the design or safety-engineering point of view without our express agreement. Any modification precludes liability on our part for any damage resulting therefrom.

Qualified personnel

This instrument is to be used by qualified personnel only, in strict accordance with the safety rules and regulations. It is also essential to comply with the statutory and safety regulations in force for the particular application. The same applies to the use of accessories.

"Qualified personnel" means persons familiar with the installation, assembly, commissioning and operation of the product who possess the qualifications required for their function.

Conditions on site

Protect the transducers from moisture and atmospheric influences such as rain, snow, etc.

Maintenance

The KMR is maintenance-free.

Accident prevention

Even though the specified nominal force in the destructive range is a multiple of the full scale value, the relevant accident prevention regulations of the trade safety association must be observed.

1 Scope of supply

- KMR
- 2 hardened washers as force introduction parts
- Mounting instructions

2 Field of application and notes on use

The KMR are designed to measure static and dynamic compressive forces, and are especially suitable for the **monitoring** of forces, e.g. with production processes or bolted connections. Furthermore, they are used in the food industry, for example.

The IP67 degree of protection also permits outdoor measurements to be taken.

3 Structure and function

3.1 Measuring element

The KMR have been designed as welded construction and are completely made from corrosion-resistant, hardened steel. They can be mounted in any position.

In the measuring element, strain gauges are connected to form a Wheatstone bridge. The balancing elements are located in the cable end.

Therefore, do in no case shorten the cable.

The connection-cable sheathing is made from polyvinyl chloride (PVC).

3.2 Measurement, output signal

With axial forces, the measuring element is upset and the Wheatstone bridge detuned. With a bridge excitation voltage fed, the circuit supplies an output signal that is proportional to the change in resistance and thus proportional to the force applied.

Measurement signal conditioning requires an electronic system (e.g. an amplifier) that is part of the complete measuring chain.

3.3 Disturbance variables

Torsion, bending and side forces are disturbances that may reduce accuracy or even damage the KMR.

4 Conditions on site

4.1 Ambient temperature

To obtain optimum measuring results, the nominal temperature range of $-10\dots+70\text{ }^{\circ}\text{C}$ ($+14\dots+158\text{ }^{\circ}\text{F}$) has to be observed. Constant or, at the most, slowly changing temperatures are most suitable. The specified temperature coefficients apply to an ambient temperature changing no faster than 5K/h.

4.2 Protection against humidity

Ambient humidity and tropical climates do not impair the function of the KMR. The KMR complies with IP67 degree of protection according to EN60529. IP67 means: Protection against the penetration of dust, and protection against water, if the KMR is dived into water (test condition: 0.5h in 1m water depth). To prevent penetration of condensation water, bend the cable to form a drip loop.

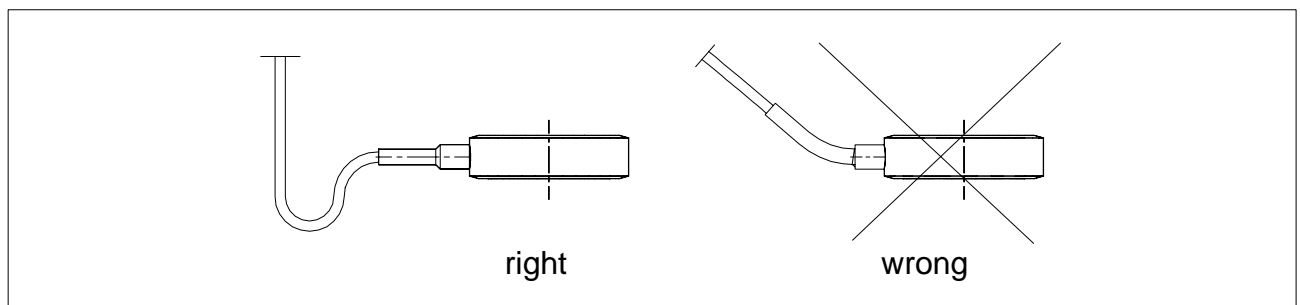


Fig. 4.1: Drip loop

4.3 External pressure

The permissible external pressure is 0...3bar.

5 Mechanical installation

5.1 Important precautions during mounting

- Handle the KMR with care.
- The KMR must lean plainly on the clean supporting surface and may not bend.
- Always use the supplied washers for force introduction (do in no case bring spring washers, tooth lock washers etc. into direct contact with the KMR).

5.2 General guide lines for installation

To determine the absolute value of the force to be monitored, you have to calibrate the KMR with a test transducer while it is in its final mounting position. Depending on the mounting position, there are significant changes in output signal. The following factors are effective:

- Friction
- Stiffness of the components
- Surface unevenness
- Asymmetric force introduction

After calibration, the mounting position may not be changed.

5.3 Examples for mounting

The following examples for installation show the various possibilities to use the KMR.

- Monitoring flange joints

With this measurement set-up, critical flange joints or the setting of screws (max. property class 14.9) can be monitored.



CAUTION

Please ensure when tightening the screws that the connecting cable is not sheared off. Slightly lubricate the supporting surface of screw head or nut to prevent the transducer from turning during fastening of the screw. You thus avoid shearing off the cable connection.

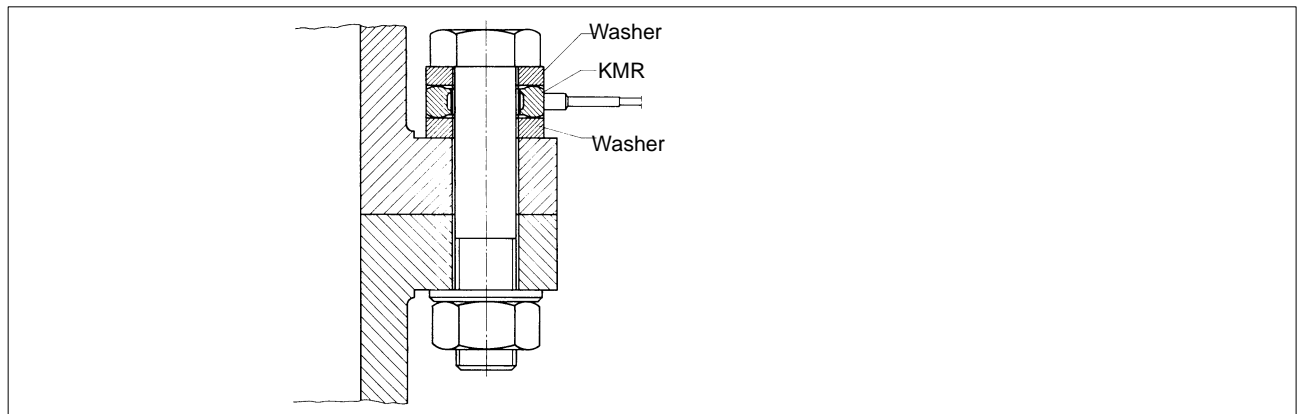


Fig. 5.1: Monitoring a screw preload

- Monitoring working loads with bolted connections

When using the KMR in a bolted connection to monitor working loads (e.g. pressure increase in a valve, press forces), you have to take into account the stress diagram for bolted connections.

The KMR measures the change in the screw preload. If you want to deduce the working load from the force F_{meas} , then the actual stiffness of the screw and of the screwed parts must be considered.

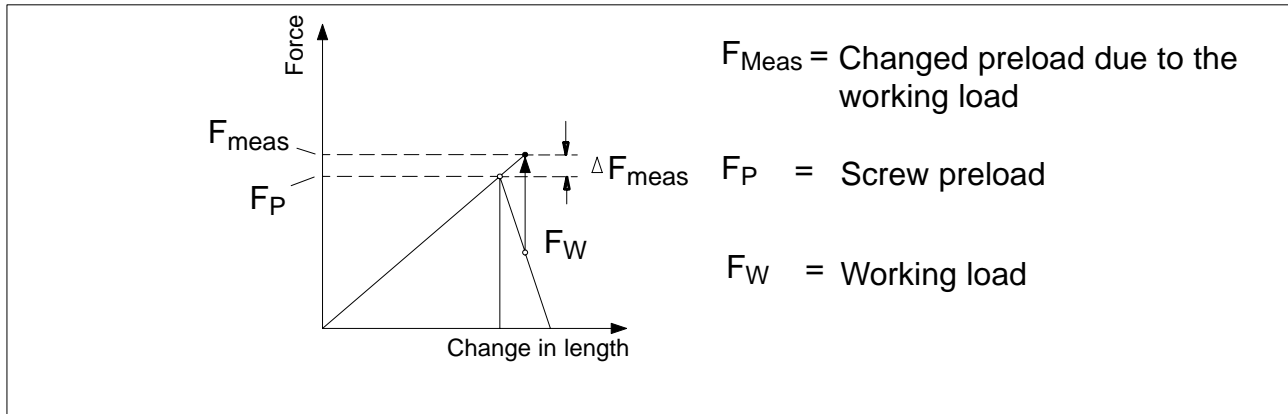


Fig. 5.2: Stress diagram

- Monitoring press forces with pressure plates

The following measurement set-up also enables you to determine press forces. The hardened washers may be omitted, if the hardness of the pressure plates is at least 43 HRC.

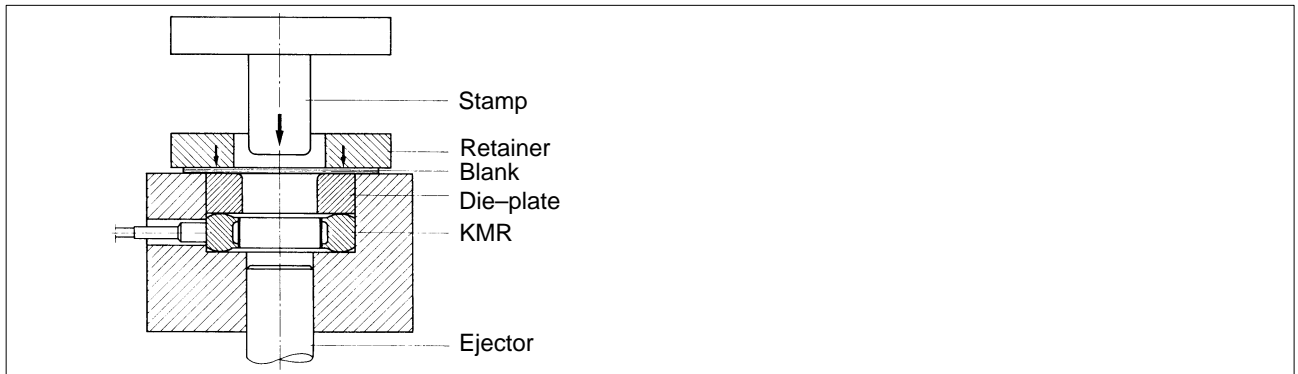


Fig. 5.3: Monitoring a pressing force

- Monitoring rope forces with tension rods

The KMR has been designed for compressive forces. Due to its internal bore hole it may also be used to monitor tensile forces. Take into account the tensile strength of the tension element in use.

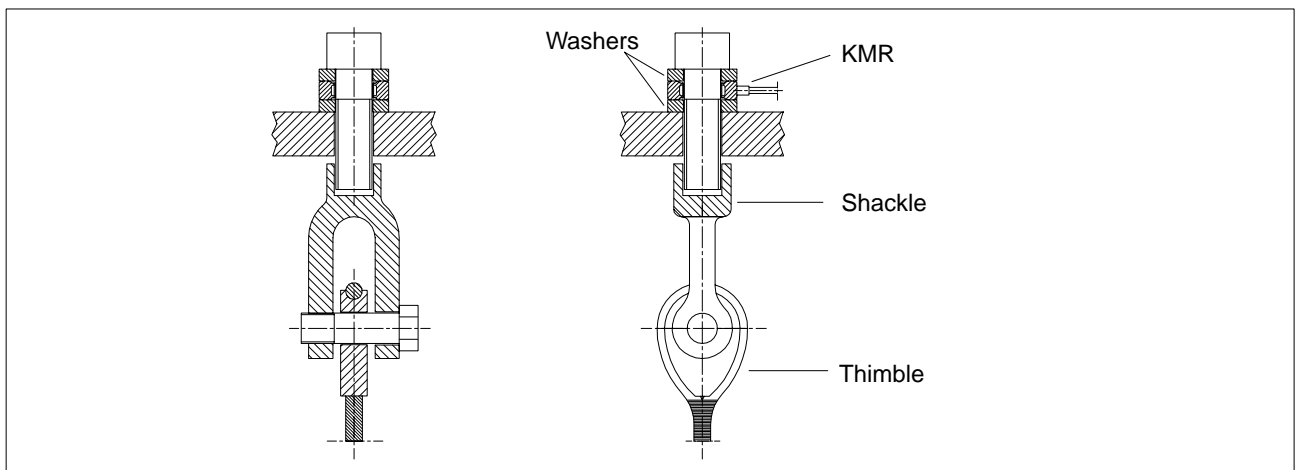


Fig. 5.4: Monitoring rope forces

6 Connection

6.1 Allocation of the cable cores

The KMR connection cable has colour-coded free ends. It is 1.5m long. With amplifiers with connection sockets, you first have to solder a plug onto the cable. The cable screen (ye) is not connected to the transducer ground. It has to be connected to the amplifier's operating voltage zero (contact 12, E, 1).

If the transducer is connected according to the indications given in the table, the output voltage at the amplifier is positive when the transducer is charged in the indicated direction of force. If with compressive transducer forces a negative output voltage at the amplifier is required, simply interchange the white and red cable cores.

The pin assignment for some of the HBM amplifiers can be taken from the following table or you can refer to the respective operating manual for your amplifier.

Connection	Core color	Connection to an amplifier with		
		Terminal or soldered connection	7-pole connection plug	15-pole D-plug
Measurement signal (+)	White	22	A	8
Bridge excitation voltage (-)	Black	21	B	5
Bridge excitation voltage (+)	Blue	20	C	6
Measurement signal (-)	Red	19	D	15
Shield to earth	Yellow	12	E	1

6.2 Connection technique

The KMR are equipped with a four-core connection cable and calibrated in four-wire technique as standard.

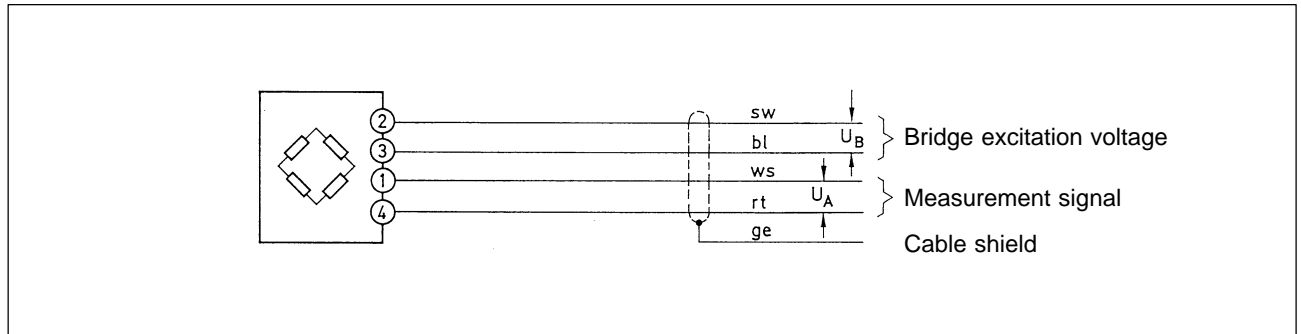


Fig. 6.1: Transducer with four-core connection cable

7 Specifications

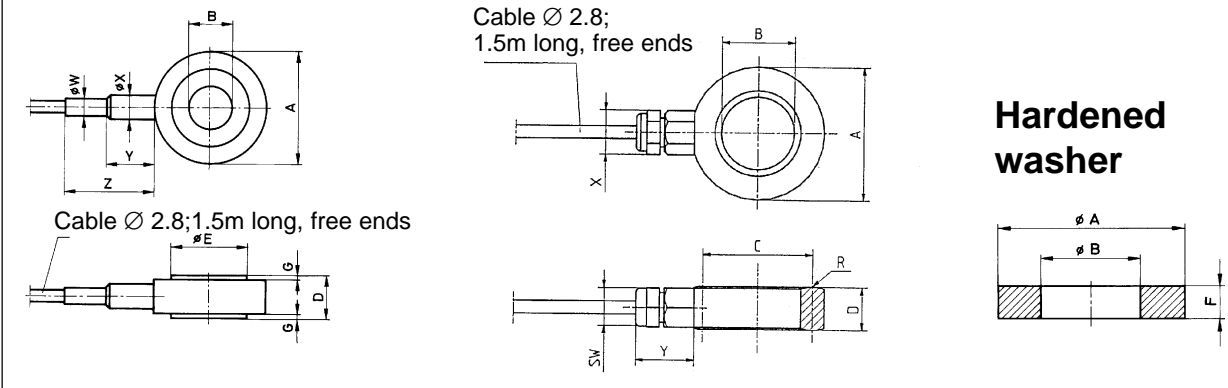
Type		KMR						
Nominal force	kN	20	40	60	100	200	300	400
Sensitivity range	mV/V	1.7...2.3 ^{*)}						
Temperature effect on the sensitivity per 10K in the nominal temperature range	%	1						
Temperature effect on the zero signal per 10K in the nominal temperature range	%	0.5						
Linearity deviation	%	10						
Hysteresis, related to the full scale value	%	10						
Repeatability with identical mounting position	%	1						
with different mounting position	%	10						
Creep over 30 min., at ambient temperature	%	2						
Input resistance at ambient temperature	Ω	> 345						
Output resistance at ambient temperature	Ω	300...400						
Insulation resistance	GΩ	> 5						
Reference excitation voltage	V	5						
Operating range of the excitation voltage	V	0.5...5			0.5...12			
Nominal temperature range	°C[°F]	-10...+70 [+14... +158]						
Operating temperature range	°C[°F]	-10...+70 [+14... +158]						
Storage temperature range	°C[°F]	-30...+85 [-22... +185]						
Limit force	%	150						
Breaking force	%	> 500						
Relative static lateral-force limit	%	20						
Nominal displacement ± 15%	mm	0.06	0.06	0.06	0.08	0.11	0.21	0.32
Natural frequency ± 15%	kHz	22	45	47	27	22	18	15
Weight, without cable	g	5	7	12	32	40	50	70
Permissible dynamic force (oscillation amplitude to DIN50100)	%	50						
Protection to EN60529		IP 67						

*) Depending on the scaled mounting position, the KMR sensitivity ranges between 1.7 ...2.3 mV/V.

8 Dimensions (Dimensional variation to DIN7168– coarse)

KMR; 20kN, 40kN, 60kN

KMR; 100kN, 200kN, 300kN and 400kN
(with PG gland and ball radius R)



KMR

Nominal force in kN	$\varnothing A_{-0.1}$	$\varnothing B^{+0.1}$	$\varnothing C$	D	$\varnothing E$	G	R	$\varnothing W$ appr.	$\varnothing X$ appr.	Y appr.	Z appr.
20	17	6.5	—	6	9	0.5	—	5.8	6	11.5	30
40	21	8	—	6	13	0.5	—	5.8	6	11.5	30
60	24	10	—	8	16	0.5	—	5.8	6	11.5	30
100	26.5	12.7	19.75	10	—	—	6	—	10.5	14.5	—
200	31	16	25.5	10	—	—	8	—	10.5	14.5	—
300	37	21	31.5	10.5	—	—	9	—	10.5	14.5	—
400	46	25	38	12.5	—	—	10	—	10.5	14.5	—

Hardened washer

Nominal force in kN	$\varnothing A_{-0.1}$	$\varnothing B^{+0.1}$	F	for screw	AF
20	17	6.5	3	M6; 1/4"	—
40	21	8	3	M8; 5/16"	—
60	24	10	4	M10; 3/8"	—
100	26.5	12.7	5	M12; 1/2"	9
200	31	16	6	M16; 5/8"	9
300	37	21	6	M20; 3/4"	9
400	46	25	8	M24; 7/8"	9

9 Declaration of Conformity



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Konformitätserklärung

Declaration of Conformity

Déclaration de Conformité

Document: 066/05.1996

Wir,

We,

Nous,

Hottinger Baldwin Messtechnik GmbH, Darmstadt

erklären in alleiniger Verantwortung, daß das Produkt

declare under our sole responsibility that the product

déclarons sous notre seule responsabilité que le produit

Kraftaufnehmer für Überwachungsaufgaben, Typenreihe KMR (Sondertypen)

auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokument(en) übereinstimmt (siehe Seite 2) gemäß den Bestimmungen der Richtlinie(n)

to which this declaration relates is in conformity with the following standard(s) or other normative document(s) (see page 2) following the provisions of Directive(s)

auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou autre(s) document(s) normatif(s) (voir page 2) conformément aux dispositions de(s) Directive(s)

89/336/EWG - Richtlinie des Rates vom 3. Mai 1989 zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit, geändert durch 91/263/EWG, 92/31/EWG und 93/68/EWG

Die Absicherung aller produkt-spezifischen Qualitätsmerkmale erfolgt auf Basis eines von der DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) seit 1986 zertifizierten Qualitätsmanagementsystems nach DIN ISO 9001 (Reg.Nr. DQS-10001).

Die Überprüfung der sicherheits-relevanten Merkmale (Elektromagnetische Verträglichkeit, Sicherheit elektrischer Betriebsmittel) führt ein von der DATech erstmals 1991 akkreditiertes Prüflaboratorium (Reg.Nr. DAT-P-006 und DAT-P-012) unabhängig im Hause HBM durch.

All product-related features are secured by a quality system in accordance with DIN ISO 9001, certified by DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) since 1986 (Reg. No. DQS-10001). The safety-relevant features (electromagnetic compatibility, safety of electrical apparatus) are verified at HBM by an independent testing laboratory which has been accredited by DATech in 1991 for the first time (Reg. Nos. DAT-P-006 and DAT-P-012).

Chez HBM, la détermination de tous les critères de qualité relatifs à un produit spécifique est faite sur la base d'un protocole DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) certifiant, depuis 1986, notre système d'assurance qualité selon DIN ISO 9001 (Reg.Nr. DQS-10001).

De même, tous les critères de protection électrique et de compatibilité électromagnétique sont certifiés par un laboratoire d'essais indépendant et accrédité depuis 1991 (Reg.Nr. DAT-P-006 et DAT-P-012).

Darmstadt, 10.05.96

01/051A1.03

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Document: **066/05.1996**

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.
Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

This declaration certifies conformity with the Directives listed above, but is no asseveration of characteristics.
Safety directions of the delivered product documentation have to be followed.

Cette déclaration atteste la conformité avec les directives citées mais n'assure pas un certain caractère.
S.v.p. observez les indications de sécurité de la documentation du produit ajoutée.

Folgende Normen werden zum Nachweis der Übereinstimmung mit den Vorschriften der Richtlinie(n) eingehalten:

The following standards are fulfilled as proof of conformity with the provisions of the Directive(s):

Pour la démonstration de la conformité aux disposition de(s) Directive(s) le produit satisfait les normes:

EN 50082-2 : 1995

Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit; Teil 2: Industriebereich; Deutsche Fassung



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