

HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH



Mounting Instructions

**Force Transducer with
S.G. Measurement System
C4**

B 20.C4.10 e

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Safety instructions

Use in accordance with the regulations

C4 type force transducers are used for high-precision force measurements and for force reference measurements (transfer standard). Use for any additional purpose shall be deemed to be **not** in accordance with the regulations.

In the interests of safety, the transducer should only be operated as described in the Mounting Instructions. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

The transducer is not a safety element within the meaning of its use as intended. Proper and safe operation of this transducer requires proper transportation, correct storage, assembly and mounting and careful operation and maintenance.

General dangers due to non-observance of the safety instructions

The C4 force transducer corresponds to the state of the art and is fail-safe. The transducers can give rise to residual dangers if they are inappropriately installed and operated by untrained personnel.

Everyone involved with 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 supply and performance of the transducer covers only a small area of force measurement technique. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of force measurement technique in such a way as to minimise residual dangers. Prevailing regulations must be complied with at all times. There must be reference to the residual dangers connected with force measurement technique.

In these mounting instructions residual dangers are pointed out using the following symbols:

Symbol:  **DANGER**

Meaning: **Highest level of danger**

Warns of a **directly** dangerous situation in which failure to comply with safety requirements **will** lead to death or serious physical injury.

Symbol:  **WARNING**


Meaning: **Possibly dangerous situation**

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

Symbol:  **ATTENTION**

Meaning: **Possibly dangerous situation**

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **could** lead to damage to property, slight or moderate physical injury.

Symbol:  **NOTE**

Refers to the fact that important information is being given about the product or its use.

Symbol:  **CE mark**

The CE mark signals a guarantee by the manufacturer that his product meets the requirements of the relevant EC directives (see Declaration of conformity at the end of this document).

Prohibition of own conversions and modifications

The transducer must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom.

Qualified personnel

This instrument is only to be installed by qualified personnel strictly in accordance with the technical data and with the safety rules and regulations which follow. It is also essential to observe the appropriate legal and safety regulations for the application concerned. The same applies to the use of accessories.

Qualified personnel means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function.

Conditions on site

Protect the transducer from damp and weather influences such as rain, snow, etc.

Maintenance

The C4 force transducer is maintenance free.

Accident prevention

Although the specified nominal force in the destructive range is several times the full scale value, the relevant accident prevention regulations from the trade associations must be taken into consideration.

1 Scope of supply

- C4 force transducer
- C4 Operating Manual

Accessories (not included in the scope of supply)

- **EPO3 thrust piece**

| | |
|-----------|-----------------------------|
| for 20kN: | Order no. EPO3/5T |
| 50kN: | Order no. EPO4/50kN |
| 100kN: | Order no. EPO4/100kN |
| 200kN: | Order no. EPO4/200kN |
| 500kN: | Order no. EPO3/250kN |

- **EDO3 thrust piece**

(recommended for precision measurements, for example, EN10002-3 calibrations)

| | |
|-----------|-----------------------------|
| for 20kN: | Order no. EDO3/20kN |
| 50kN: | Order no. EDO3/50kN |
| 100kN: | Order no. EDO3/100kN |
| 200kN: | Order no. EDO3/200kN |
| 500kN: | Order no. EDO3/500kN |

2 Application notes

Precision force transducers of the C4 type series are suitable for measuring compressive forces. They measure static and quasi-static forces with great accuracy and reproducibility and therefore require judicious handling. You must be particularly vigilant when transporting and installing the devices. If the transducers are dropped or jolted, permanent damage could be caused.

The limits for the permissible mechanical, thermal and electrical stresses are stated in the Specifications. Be sure to allow for them when planning the measuring setup, when installing and lastly, when operating.

3 Structure and mode of operation

3.1 Measuring body

The measuring body comprises a system of measuring springs with 8 applied strain gauges (S.G.). The strain gauges are arranged so that four of them are extended and the other four are upset when a force acts on the transducer.

3.2 Housing

The enclosure with the integrated system of measuring springs is hermetically sealed at the top and at the bottom by metal membranes, so that neither moisture nor aggressive chemicals can damage the sensitive application. The transducer has a crowned load button for force introduction.

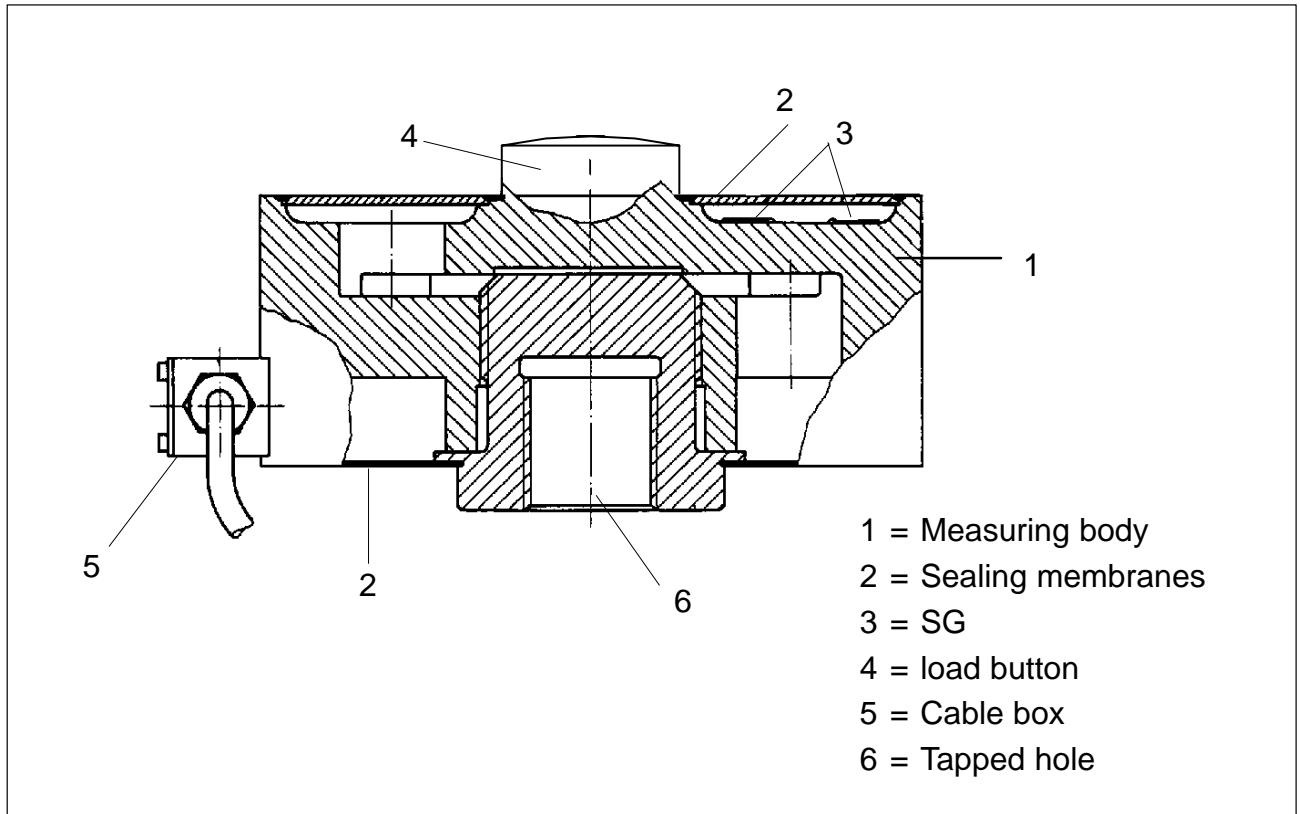


Fig.3.1 C4 (20kN...500kN)

3.3 Disturbance variables and their compensation

Torsion, bending and transverse load are disturbance variables and are therefore to be avoided. If necessary they can be remedied with HBM mounting accessories (thrust pieces, chapter 8).

The effects of temperature on the zero signal (S/G bridge and housing) and on the sensitivity are compensated.

Changes in the ambient pressure act as additive (subtractive) forces. These are scarcely of importance when compared with large nominal loads.

4 Conditions on site

4.1 Ambient temperature

The effects of temperature on the zero signal and on the sensitivity are compensated. To achieve optimal measurement results the nominal temperature range must be maintained. Temperature-induced measurement errors can be caused by heating (for example radiant heat) or cooling on one side. A radiation shield and all-round heat insulation bring about marked improvements. They must not form a force shunt.

4.2 Moisture

Extreme humidity or a tropical climate should be avoided if this means that the classified limit values are exceeded (degree of protection IP67 under DIN EN 60529).

4.3 Air pressure

Changes in air pressure affect the force transducer in the same way as a change in force. However, if the ambient pressure is 2bar or less, the effect on the measurement signal (even with the 20kN type) is negligible.

4.4 Chemical effects

The steel housing of the transducers is protected by a powder coating. If used in difficult environmental conditions (direct weather effects, contact with media which encourage corrosion) additional protective measures should be employed by the user. The unit can be painted with commercial protective paint or a tar-based coating (underseal). The sheath of the connection cable is made of silicon rubber.

5 Mechanical installation

5.1 Important measures for installation

- treat the transducer gently
- if measuring compressive forces, make sure there is a solid support structure
- the force-introduction surfaces must be scrupulously clean and carry in full
- keep to the depths of engagement for threaded rods or knuckle eyes
- do not overload the transducer.



WARNING

If there is a risk of breakage through overload on the transducer and thus a risk to persons, additional safety measures are to be taken.

5.2 General installation guidelines

The measurement direction in which forces act on the transducer must be as precise as possible.



WARNING

Torsion and bending moments, eccentric loading and transverse forces result in measurement errors and if limit values are exceeded, could destroy the transducer.

5.3 Mounting accessories

If using as a transfer standard or as a control standard, we recommend the use of force introduction parts, as suggested in DIN EN10002-3 or ISO/FDIS 376. Dimensions see chapter 8.

6 Electrical connection

6.1 Instructions for cabling

- Always use shielded, low-capacity measurement cable (HBM cables meet these requirements).
- Do not lay measurement cable parallel to high-voltage power lines or control circuits. If this is not possible (e.g. in cable ducts) protect the measurement cable, e.g. with armoured steel tube and maintain a minimum distance of 50 cm from the other cables. High-voltage power lines and control lines should be twisted (15 turns per metre).
- Avoid stray fields of transformers, motors and contactors.
- Do not earth transducer, amplifier and display device more than once. All the devices in the measuring chain are to be connected to the same earthed conductor.
- The screen of the connection cable is connected to the transducer housing.

6.2 Wiring pin assignment

The 3m long transducer connection cable has colour-coded free wire ends. The cable shielding is connected in accordance with the Greenline concept. This means that the measurement system is surrounded by a Faraday cage. Electromagnetic interference will not affect the measurement system.

Connectors to CE standard are to be fitted at the free end of the transducer.

The shielding is here to be laid over the whole area.

If a different connection technique is used then good EMC shielding is to be provided in the wiring loom, the shielding again being laid over the full area (see also HBM Greenline Information, document G36.35.0).

If the transducer is connected according to the following connection diagram then when the transducer has compressive loading the output voltage at the measuring amplifier is positive.

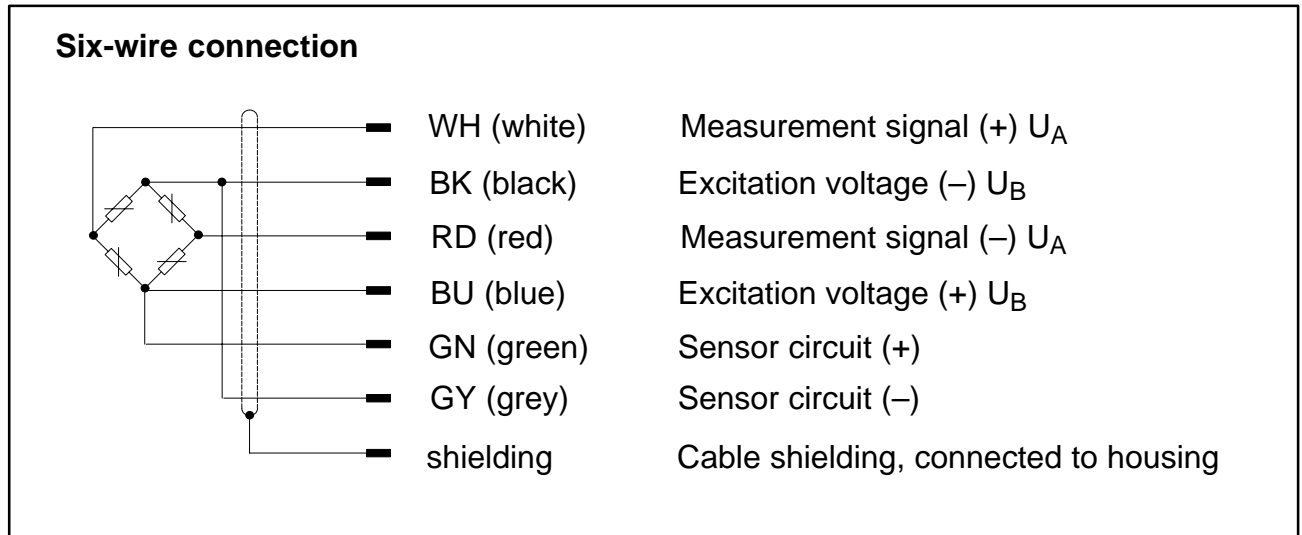
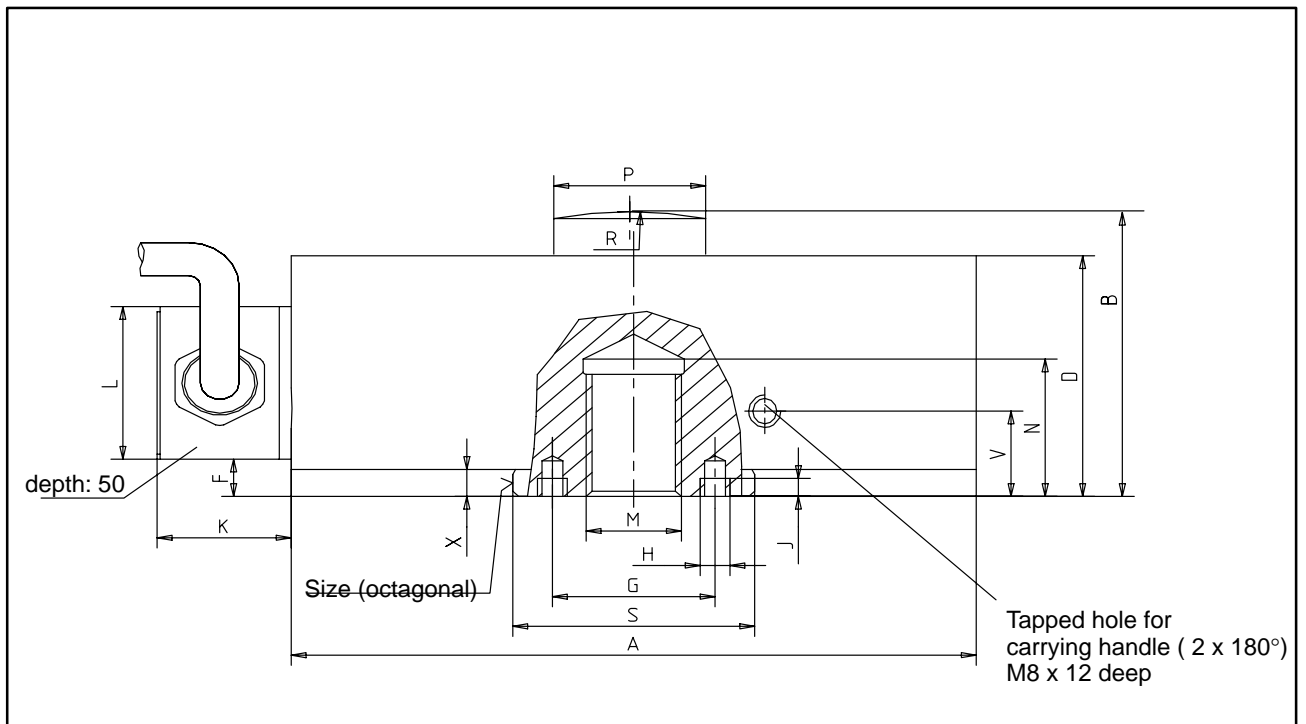


Fig. 6.1: Pin assignment for the C4

7 Specifications

| Force transducer type | C4 | | | | | | | |
|---|-------------|-------------|-----------------|-------|------|------|------|--|
| Data according to VDI standards 2638 | | | | | | | | |
| Nominal force | F_{nom} | kN | 20 | 50 | 100 | 200 | 500 | |
| Accuracy class | | | 0.02 | | | | 0.04 | |
| Nominal sensitivity | C_{nom} | mV/V | 2 | | | | | |
| rel. sensitivity deviation | d_c | % | 0.1 | | | | | |
| rel. tensile/compressive force sensitivity difference | d_{zd} | % | 0.2 | | | | | |
| Zero signal tolerance | $d_{s,0}$ | % | 0.5 | | | | | |
| rel. zero point compensation (zero signal return) | f_o | % | < ± 0.025 | | | | | |
| Rel. range (0.2 F_{nom} to F_{nom}) at: | | | | | | | | |
| unchanged mounting position, typically | b_{rg} | % | 0.02 | | | | | |
| different mounting positions, typically | b_{rv} | % | 0.03 | | | | | |
| Hysteresis (0.2 F_{nom} to F_{nom}) | u | % | 0.1 | | | | 0.3 | |
| Linearity deviation | d_{lin} | % | 0.02 | | | | 0.03 | |
| Effect of temperature on sensitivity/10K | | | | | | | | |
| by reference to sensitivity | TK_c | % | 0.01 | | | | | |
| Effect of temperature on zero signal/10K | | | | | | | | |
| by reference to sensitivity | TK_0 | % | 0.015 | | | | | |
| Effect of transverse forces (transverse force 10% F_{nom}) | d_Q | % | 0.03 | | | | | |
| Effect of eccentricity per mm | d_E | % | 0.01 | 0.005 | | | | |
| Rel. creep over 15 min | d_{crF+E} | % | 0.02 | | | | | |
| Input resistance | R_e | Ω | >345 | | | | | |
| Output resistance | R_a | Ω | 356 ± 0.3 | | | | | |
| Isolation resistance | R_{is} | Ω | $>5 \cdot 10^9$ | | | | | |
| Reference excitation voltage | U_{ref} | V | 5 | | | | | |
| Operating range of the excitation voltage | $B_{U,G}$ | V | 0.5 ... 12 | | | | | |
| Nominal temperature range | $B_{t,nom}$ | $^{\circ}C$ | +10...+40 | | | | | |
| Operating temperature range | $B_{t,G}$ | $^{\circ}C$ | -30...+85 | | | | | |
| Storage temperature range | $B_{t,S}$ | $^{\circ}C$ | -50...+85 | | | | | |
| Reference temperature | t_{ref} | $^{\circ}C$ | +23 | | | | | |
| Max. operational force | (F_G) | % | 150 | | | | | |
| Limit force | (F_L) | % | 150 | | | | | |
| Breaking force | (F_B) | % | 250 | | | | | |
| Static lateral limit force | (F_Q) | % | 30 | | | | | |
| Nominal displacement | S_{nom} | mm | 0.2 | 0.25 | 0.28 | 0.45 | | |
| Fundamental resonance frequency | F_G | kHz | 4.1 | 4.5 | 3.4 | 3.6 | 2.5 | |
| Weight | | kg | 1.8 | 2.4 | 5.5 | 11.2 | 42 | |
| Rel. permissible vibrational stress | F_{rb} | % | 70 | | | | 50 | |
| Degree of protection to DIN EN 60529 | | | IP67 | | | | | |

8 Dimensions



| Type | ∅ A | B | D | F | G | H | J | M |
|-----------|-----|------|-----|------|-----|----|---|---------|
| C4/20 kN | 115 | 54.5 | 47 | 7.3 | — | — | — | M16 |
| C4/50 kN | 120 | 60.2 | 55 | 10.2 | — | — | — | M20x1.5 |
| C4/100 kN | 146 | 74.2 | 69 | 12.2 | — | — | — | M30x2 |
| C4/200 kN | 180 | 94.2 | 89 | 13.1 | 68 | M6 | 6 | M39x2 |
| C4/500 kN | 275 | 159 | 145 | 21 | 118 | M8 | 8 | M72x4 |

| Type | N | R | ∅ S _{f7} | V | X | a.f. | K | L | ∅ P _{-0.1} |
|-----------|----|-----|-------------------|----|------|------|----|----|---------------------|
| C4/20 kN | 27 | 60 | 40 | — | 5.3 | 38 | 22 | 30 | 25 |
| C4/50 kN | 28 | 160 | 48 | — | 8.2 | 45 | | | 26 |
| C4/100 kN | 37 | 300 | 62 | — | 10.2 | 59 | | | 40 |
| C4/200 kN | 45 | 300 | 76 | — | 11.1 | 73 | | | 50 |
| C4/500 kN | 87 | 400 | 140 | 35 | 20 | 134 | 32 | 43 | 64 |

9 Declaration of conformity



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Konformitätserklärung

Declaration of Conformity

Déclaration de Conformité

Document: 140/09.1999

Wir,

We,

Nous,

HBM Mess- und Systemtechnik 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

Kraftnormal Typenreihe C4

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 91/269/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 / TTI-P-G077/91-11) 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 / TTI-P-G077/91-11).

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 / TTI-P-G077/91-11).

Darmstadt, 29.09.1999

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Document:

140/09.1999

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

Typenreihe C4:

20kN, 50kN, 100kN, 200kN, 500kN



spectris group

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IM-D 11.99-POD