BÜHNER SCHAIBLE
ELEKTROTECHNIK
ELEKTRONIK GmbH

Mess- und Regeltechnik
Maschinen-Steuerungen
Fördertechnik

Entwicklung - Konstruktion - Fertigung

INSTRUCTION MANUAL

Frequency control unit for circular and linearvibration feeding devices

Typ RM6
Typ RM6-10
Typ RM6PL

Bühner & Schaible GmbH
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Safety directions for the user

This description contains the required information for the use as prescribed of the described products. They are intended for qualified technical personnel.

Qualified persons are persons who on account of their training, experience and received instructions as well as their knowledge of relevant standards, regulations, rules for the prevention of accidents and operating conditions have been authorized by the responsible person in charge of the safety of the installation to execute the required work and who are able while doing so to detect and prevent all possible hazards (Definition of skilled labour, according to ICE 364).

Hazard indication

The following directions are for the safety of the service personnel as well as for the safety of the described products and the related devices and machinery.

Warning !

Hazardous voltage
Disregard may cause death, serious injury or heavy damages to the equipment.

- Isolate supply voltage before mounting- and dismounting work as well as in case of fuse replacement or modifications of the structure.
- Observe the specific safety regulations for the prevention of accidents and safety in force for the particular case.
- Check before commissioning if the nominal voltage of the device corresponds to the local mains supply.
- Emergency-Stop installations must be effective in all modes of operation. Unlocking the Emergency Stop installation must not cause an uncontrolled re-start of the device.

Use as prescribed

The devices described herein are electrical equipment for the application in industrial installations. The equipment is designed for the application in control and automation techniques.

Assembly
To assemble the equipment a snap-on mounting for 35mm top hat rails is provided. In order to avoid any overheating, the assembly direction should be selected so that the ventilation slots are directly located over each other so that there can be a through-flow of air. As heat is created when the epuipment is operating, assembling on or close to other sources of heat should be avoided. It should be ensured that an effective strain relief of the connecting leads on the plug-in terminals is achieved.

Commissioning
Before start-up, a check should be made on the power supply services that are available!

- Level of the mains voltage, (the at-system frequency is not a critical factor)

- The nominal output of the conveyor unit (Warning! It must be equipped with AC magnets)

- **NB The conveyor must not be mechanically tuned to the system frequency, (e.g. no mechanical tuning to 60 Hz in areas outside of Europe)**

Setting advice:
The following settings should be only made using the appropriate laboratory equipment (externally adjusted frequency) and the results then applied to this equipment.
Half-wave operation is also possible.

Procedural method:

Firstly, the mechanical resonant frequency is to be determined on the oscillation conveyor system using the RESOMAT. For this, the conveyor pot or the bars should only be loaded with a test part. Then using the RESOMAT, key in the operating frequency. The test part has the highest speed when there is mechanical oscillation. (WARNING! Two or more resonance points are possible). The main resonance point is where the parts are moving at the highest speed. But as the system runs very smoothly in this condition (conveyor speed dependent on attenuation), the output frequency must now be set approx. 1.5Hz higher on the RESOMAT than the mechanical resonance frequency (forced oscillation see Attachement 1). With significiant changes in weight up until discharge, an altenative operating point exists on $f_A = f_0 - \Delta 3Hz$ (Diagram 3). **In this way, the conveyor system becomes mechanically stable and the conveying speed also remains constant.** The final setting of the desired conveying speed is then made using the set-point potentiometer (vibration force) and by selecting the *current pulse wave-shape (see leaflet).

*Complete symetrical sine-wave form alternating current is an advantage for circular conveyors, as there is no magnetization effect from the solenoids and conveyor parts; also structure-borne noise is reduced to a minimum (no harmonic development).
Having something similar to delta voltage alternating current (turbo effect) is often an advantage for linear bars.
Result:
Not only does the design result in a multiplication of operational the efficiency (see Attachment 2) through energy recovery (reactive-current compensation , but it also gives a high level of stability of the conveying speed and a significant simplification of the mechanical adjustment work through the inphase operation of the oscillation conveyor system using phase resonance equipment.

The RESOMAT provides a symetrical alternating current at the outlet terminal and that is why there is no disturbing magnetization effect on the conveyor parts and no residual current on the magnets. The output frequency of the RESOMAT is absolutely stable.

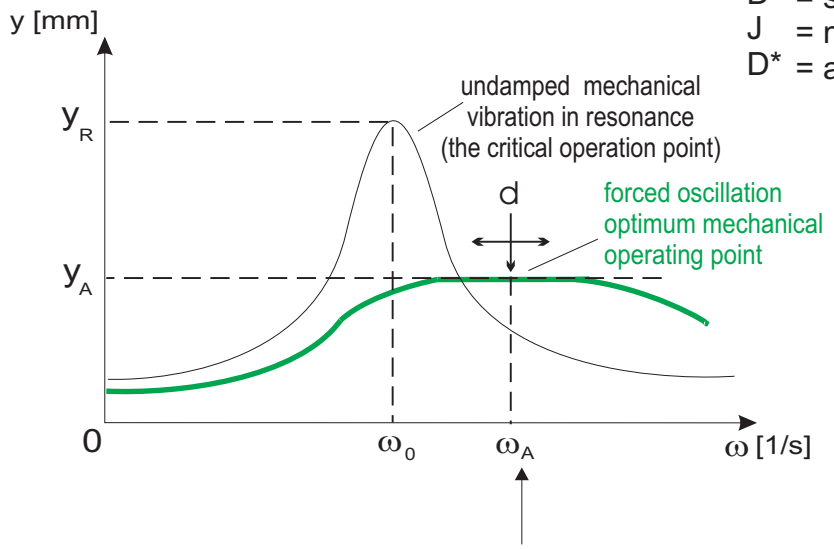
Adjustment of the operating point at vibration systems

Electrical operating frequency ω_A

$\omega_A = \omega_0 + \Delta\ 1{,}5$ Hz

Result: y_A **= constant**

y = elongation (execursion)
y^R = elongation at mech. resonance
y_A = elongation at ω_A
ω = angular frequency
ω_A = electrical drive-frequency
ω_0 = mech. resonance frequency
d = attenuation
m_0 = mass (weight)
D = spring constant (spring)
J = mass moment of inertia
D* = angular recommended dimension



over the critical operation point

$$y = f(\omega)$$

$$y_A = f(\omega_A)$$

spiral feeder $\omega_0 \approx \sqrt{\frac{D^*}{J}}$

linear feeder $\omega_0 \approx \sqrt{\frac{D}{m_0}}$

$$\beta \approx k \cdot m_0$$

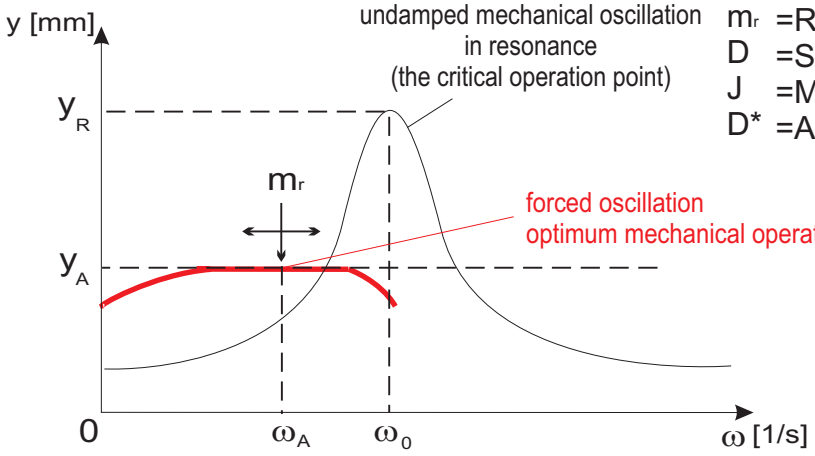
Adjustment of operating point on oscillating systems **with high changes in weight**

Diagram 3

electrical. operating frequenz ω_A

$\omega_A = \omega_0 - \Delta\ 3{,}0$ Hz

Result: y_A **= constant**



Constant feeding velocity with high changes in weight up to emptying

Pay attention to the slightly higher power input at this operating point

below the critical operation point

y =Excursion
y_R =Excursion with mechanical resonance
y_A =Excursion with ω_A
ω =Angular frequency
ω_A =Operating frequency, electrical
ω_0 =Mechanical resonance frequency
d =Attenuation
m_r =Resulting mass (weight)
D =Spring constant (spring)
J =Mass moment of inertia
D* =Angular guide value $\frac{M_d}{\varphi}$

$$y = f(\omega)$$

$$y_A = f(\omega_A)$$

spiral feeder $\omega_0 \approx \sqrt{\frac{D^*}{J}}$

linear feeder $\omega_0 \approx \sqrt{\frac{D}{m_r}}$

$$d \approx k \cdot m_r$$

Half-wave operation

Characteristic of the vibration feeding system

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{D_{ges}}{m_r} - \left(\frac{d}{2m}\right)^2}$$

d = Damping constant
D_{ges} = Total spring constant
m_r = Resulting mass of the oscillator and resulting mass moment of inertia

Attention!
Pay attention to the following items in half-wave operation!

Optimum operating point of the oscillator $f_A = f_0 \pm \Delta\ 3{,}0Hz$
As f_A can be selected with absolute stability by the Universal Resomat in the range of 4,0 – 99,9 Hz, the oscillator characteristic fo can be executed as a variable, standardized, mechanical value.

- **In this operating mode the mechanical frequency changes to half the value**
- The output current shows as pulsating direct current (d.c.)
- All other values are maintained.

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Technical data

Type	RM6, RM6/10, RM5, RM6PL,
Operating voltage	230V / 115V+10% / -15% 50 / 60Hz
drive frequency	10,0 - 99,9 Hz digitally adjustable in 0,1 Hz steps (quartz stable)
Output current (vibration intensity)	sine-wave or triangle AC-current (overload protection)
Maximum permanent current	**6A**, **10A** with heat-sink and ventilator
Soft start	0 - 5s adjustable
Optical isolator input lock / release	24 VDC 10mA (can be inverted)
Contact input	contact, contact charge 12V , 10mA (can be inverted)
Set-point value input	10K potentiometer or 0-10V (Ri approx. 10K)
Protection type	IP54
Temperature range	0 - 40° C
Dimensions RM6, RM5	aluminium housing 200 x 100 x 80 mm drill pattern 187 x 87 mm (187 x 67 mm)
Dimensions RM6PL	L x Bx H 210x 90x 65mm drill pattern 200x 50mm
Dimensions RM6/10, RM5/10	aluminium housing 200x 175x 80mm (with heat sink and ventilator) drill pattern 187x 87mm (187x 67mm)

Description of the device

Connection of the vibration feeding device
The control unit is provided with a flush-type socket-outlet. The proper mating connector is to be installed at the connection cable of the vibration feeding device.

Control input lock / release
The control input is designed for a potential-free contact or for 24VDC (connection according to connection diagram page 8). Inside the device the input can be set to "lock" or "release" by switch no.2. If the selector switch is set to "lock" and the contact is closed, the output of the control unit disconnects. If the selector switch is set to "release" the output connects when closing the contact.
If the control input is not used then the selector switch must be set to "lock".

Internal adjustment possibilities

ATTENTION! Before opening the device and when working inside unplug mains connector!!!

Selector switch 1.3 "sine-wave/rectangle-wave current"
Thus the output pulse form can be selected. Sine-wave is often more advantageous at circular devices and rectangular is preferred at linear vibration feeding devices.

Selector switch 2.3 "lock / release"
Pre-selection of the control input function.
If the control input is not used the selector switch must be set to "lock".

Selector switch 3.3 "Soft start"
The soft start becomes effective in the starting moment and it is meant to accelerate the feeding performance in due time, so that e.g. oriented material does not change ist position in the starting moment. The duration of the soft start is 3 sec. If no soft start is requested it must be switched off by actuating selector switch 3.

Frequency switch
By the frequency switches (10-1-0,1) the frequency can be adjusted in the range of 10,0 Hz and 99,9 Hz in steps of 0,1 Hz.

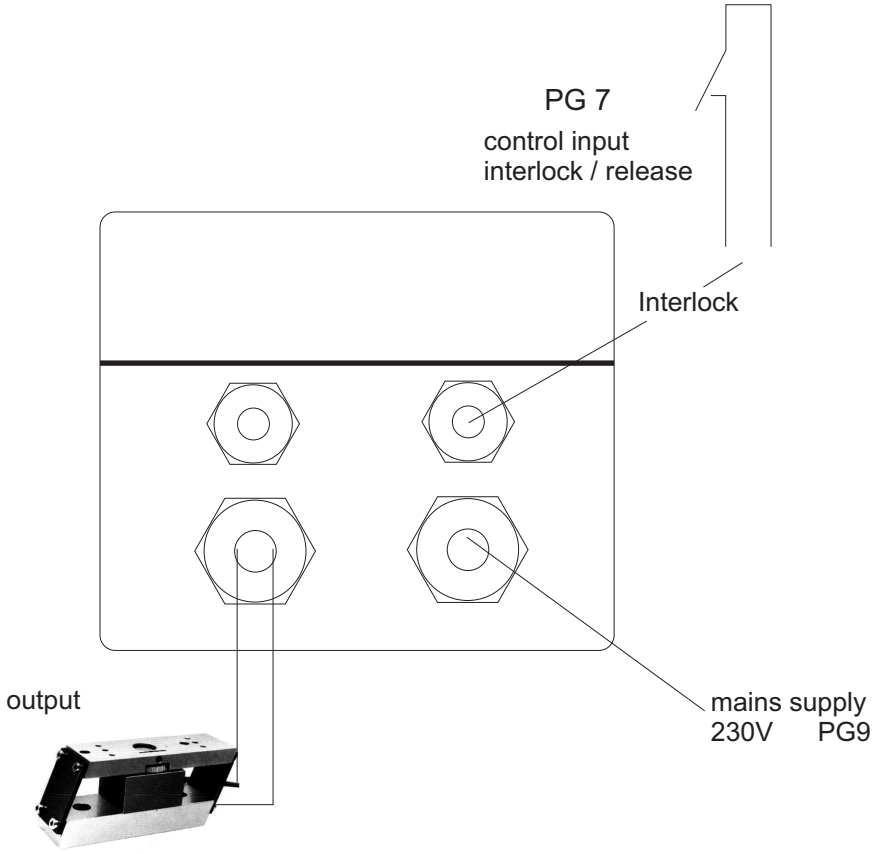
Selector switch 1.2 Set-point value input
There are two ways for the set-point value input. By means of a potentiometer which is installed as a standard in the device and is wired according to the connection diagram, or by
0 - 10 V DC. For this the plug-in jumpers must be plugged according to the connection diagram in each individual case.

Selector switch 2.2 "half-wave"
Thus the output pulse form can be selected between half-wave and full-wave.

Set-point value limiter
By means of a potentiometer which is for limiting the set-point value.

Over-current-limiter
If the over-current-limiter has turned off the device, it is possible with the RESET-Button to turn on the device again.

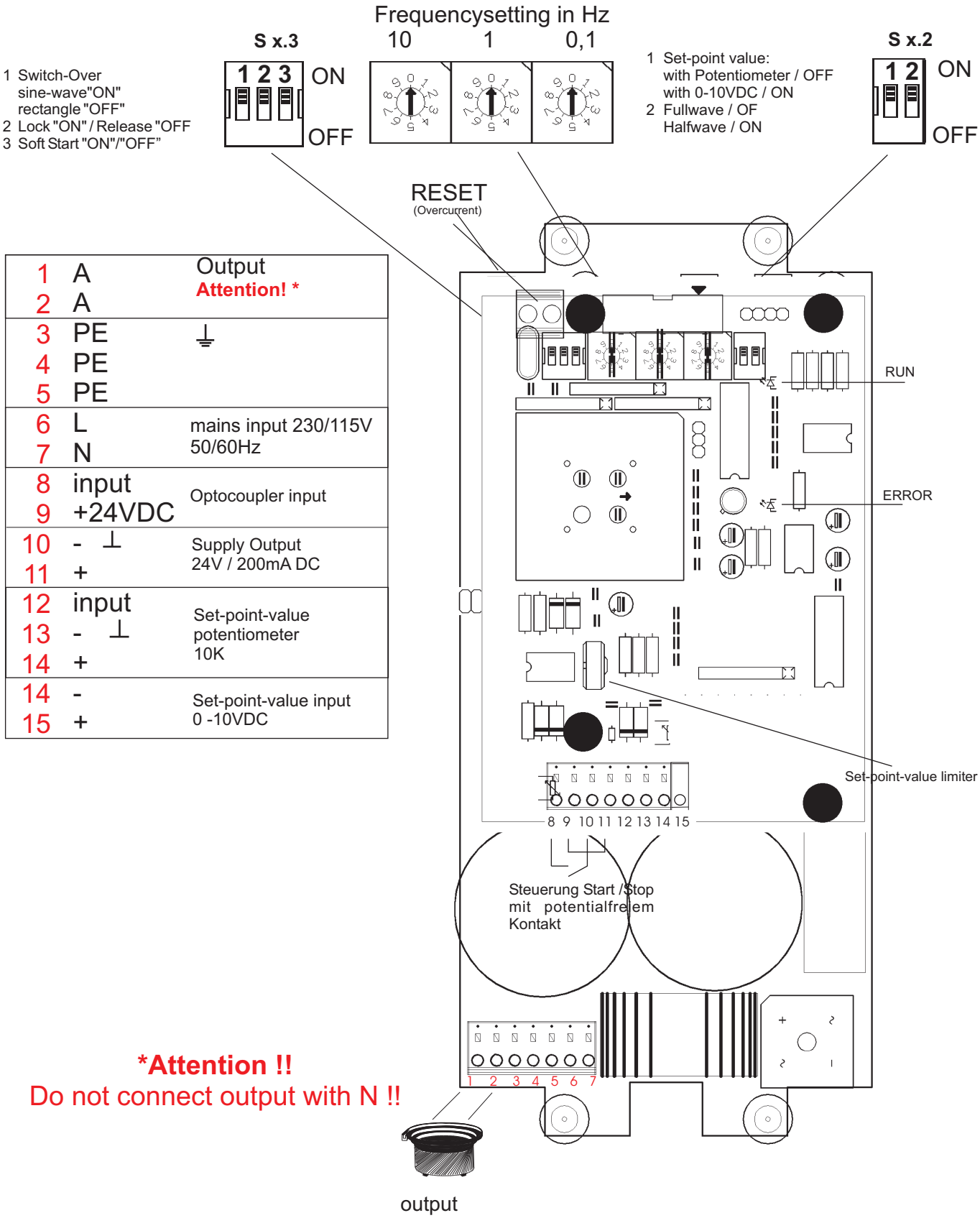
Connectors and connections



ATTENTION !!

DO NOT CONNECT OUTPUT WITH N !!

Connection diagram



1 2	A A	Output **Attention! ***
3 4 5	PE PE PE	⏚
6 7	L N	mains input 230/115V 50/60Hz
8 9	input +24VDC	Optocoupler input
10 11	- ⊥ +	Supply Output 24V / 200mA DC
12 13 14	input - ⊥ +	Set-point-value potentiometer 10K
14 15	- +	Set-point-value input 0 -10VDC

***Attention !!**
Do not connect output with N !!

Error Analysis

Equipment does not work:

- Check whether mains voltage is present.

- Set "Lock / Release" control input inversion correctly.
  If this input is not used, the selector switch must be set to "OFF".

- Red ERROR LED illuminates.
  Excess current cutout active, nominal current has been far exceeded.
  Equipment switches off automatically.
  The equipment is switched on again using the RESET button on the front panel.

- Red ERROR LED illuminates.
  If the mains voltage drops below 190V, the equipment switches off automatically. Upon mains recovery to 200V upwards, the equipment starts up again automatically and the ERROR LED goes out.

No power on conveyor:

- Check whether the correct output frequency has been set (See Pages 4/5/6 for setting instructions).
  Check reference value settings.

Conveyor vibrates depending on load:

- Check whether the correct output frequency has been set (See Pages 4/5/6 for setting instructions, operating point setting on vibrating systems).

Magnet gets hot:

- Magnet has incorrect mains voltage, check.
- The power absorption of the magnet is too high due to incorrect mains voltage or too great an air gap, check.
  The input current on the vibrating systems is measured expediently using the set of measuring instruments or current meters (moving-iron measuring instruments) of Bühner & Schaible GmbH.

- Magnetic reversal losses may be too high when using DC magnets.
  ⟶ improvement with half-wave operation

Technical Assistance:
- Application assistance, technical advice with problems on circular and linear conveyors.
  Tel: 07181-978410 see also Appendix!

EC - Conformity Statement

For the following product designated as

Frequency Control Unit type Resomat RM5, RM5-8, RM6, RM6-8 and RM6N
with vibration feeding devices

we hereby confirm that it is in accordance with the essential safety regulations which have been determined in the guidelines of the council for the adaption of the legal regulations of the member states regarding the electromagnetic compatibility, EMC (89/336/ECC).

This statement is in force for all units that are manufactured according to the enclosed drawings which are part of this statement. For the evaluation of the product relating to EMC, the following standards were applied:

EN 55011 - A	IEC 801-2
EN 50082-2	IEC 801-3
EN 60204	IEC 801-4

This statement is made in responsibility for the manufacturer/importer

Bühner & Schaible GmbH

Mr. Kurt Bühner

General Manager

Berglen, July 23, 1996

Signature: