

## General

The type TDP 1,2 D.C. tachogenerators are measurement converters for measurement, control and regulation technology. The function of these permanently excited D.C. generators is to convert the speed at which they are driven into a **speed-proportional D.C. voltage**.

### Type, Information

Single and double tachogenerators

Single tachogenerator: TDP 1,2; TDPS 1,2; TDPL 1,2  
– one magnet system  
– one armature winding

Double tachogenerator: TDP 1,2 + TDP 1,2; TDPS 1,2 + TDPS 1,2  
– one magnet system  
– two galvanically separated armature windings

## Magnet system design

The magnet system of these machines consists of two permanent block magnets, developed especially for these machines and manufactured in AlNi Co alloy. The direction of magnetization is determined by the material's optimum direction of magnetization. In order to guarantee operation free of ageing problems, the permanent magnets are aged artificially until they reach optimum remanent energy density. Short circuits should be avoided because of their bad effect on the commutator; any burn marks can give rise to additional harmonics.

## Magnetization, external effects

**After magnetization, the machine's magnetic circuit must not be interrupted**, otherwise a voltage drop of approx. 25 % occurs. It is vital to follow precisely the dismantling instructions of the machine (please ask for special leaflet, see rear of cover page). Any effect on the tachogenerator voltage due to magnetic or electrical field stray is largely prevented by strongly formed machine yoke.

## Insulation

The standard insulation complies with **Insulation Class B** (VDE 0530). Special insulation types can be provided to enable the tachogenerator to operate in the following conditions:

- Insulation Class F (ambient temperature to max. 100 °C). See temperature coefficient.
- Humid and tropical condition
- Limited resistance to acid and alkaline fumes

Winding test: max. 1000 V on repeat test.

## Rated voltage tolerance

The maximum tolerance is + 5 %. A lower voltage tolerance  $\pm 1$  % can be provided.

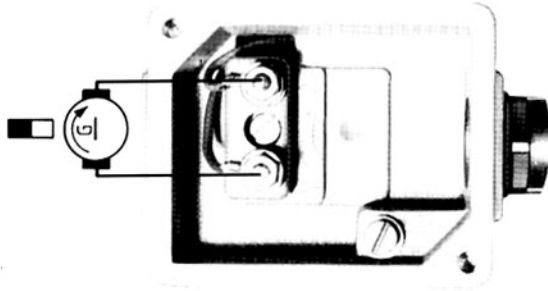
## Power available

The maximum available power given in the selection tables is always referred to the rated speed of 1000 rpm. Should this power be fully utilised, the user should note that the linearity error worsens (approx. 0,5 % at 1000 rpm). The maximum permissible current, which is given in the selection tables, should not be exceeded at maximum permissible speed.

## Connections, polarity

**Connection:** Single tachogenerator to a 2-pole terminal board. Double tachogenerator to two 2-pole terminal boards. Terminal board bolt size M 4.

When rotation is clockwise, the machine (seen from DE) has **terminal A 1 positive** and **terminal A 2 negative** polarity.



Pg 11, for cable dia 7.5 up to 9

## Terminal box

- 1 for single tachos
- 2 for double tachos (NB: double tachogenerator with tapered shaft only, 1).

## Brushes, brush-holder

The quality AG 35 (with 65 % silver content) of the silver-graphite brushes guarantees long and maintenance-free operation.

The combination of silver-graphite brushes with the commutator, which is also silver-plated, causes a patina to form which ensures that the voltage drop due to contact resistance is very low and remains nearly constant over a long period of operation. **Useful brush life is highly dependent on the ambient air conditions and the peripheral speed.** Under normal operating conditions it is approx. 20000 operating-hours.

In **aggressive ambient air conditions** the bakelite-bound brush, Quality BG 62, has proved itself. It does, however, have a higher contact resistance. If the commutator surface is smooth, the patina should not be removed during regular machine maintenance.

The **brush holders** used are standard **solid double** type with a specific brush pressure of 300 p/cm<sup>2</sup>.

If the machine is likely to be exposed to **heavy vibration** and shock loads, it is **recommended** that the **brush holder** has a relatively high **specific brush pressure of approx. 600 p/cm<sup>2</sup>**. Machines of **protection types IP 56/IP 55 spec.** generally have a higher brush pressure.

## Temperature coefficient Temperature compensation

The temperature coefficient of the permanent magnets used is dependent on the material used and is approx.  $\pm 0,1\%$  per 10 degrees K of temperature change. This value applies to a temperature range of approx.  $-40^\circ\text{C}$  to  $+100^\circ\text{C}$  and is reversible.

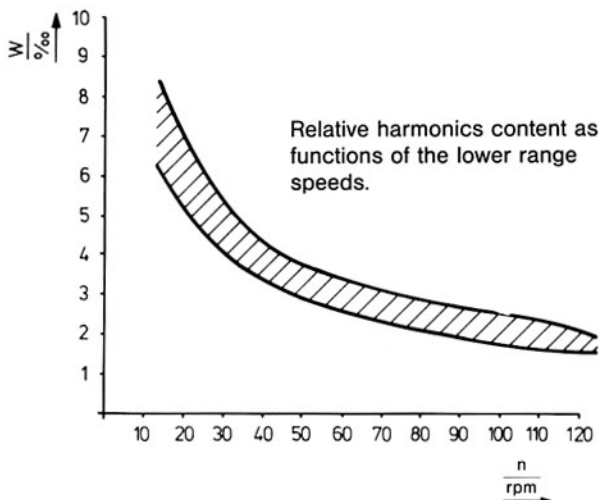
The variation can be reduced by as much as 5 times by providing temperature compensation in the form of soft magnetic material. If temperature compensation is required, this should be specified on ordering (extra cost). In the **temperature range  $0 - 100^\circ\text{C}$**  the temperature coefficient of the permanent magnets can be compensated up to a tolerance of  $\pm 0,02\%$  per 10 degrees K.

## Harmonics

An essential characteristic of a good tacho voltage is one which, over a large speed range has a low percentage harmonic content. In general, the RMS value of the total harmonic mix is measured by thermionic voltmeter and referred to the D.C. voltage value. The harmonic voltage is approx.  $0,2\%$  at speeds between 100 and 3000 rpm. Machine harmonics result from the mechanical and electrical design and the electrical utilisation, as well as production tolerances of symmetry.

Frequency analysis defines the following typical basic frequencies with their harmonics.

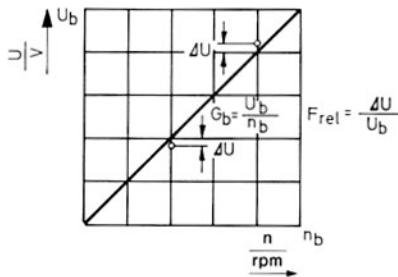
**Attachment harmonics, arising from coupling or fitting faults, influence the generator voltage because they are superimposed on the machine harmonics.** In general, two fitting faults occur: phase-angle errors and parallel misalignment. The frequency of the resulting harmonics generated corresponds to that occurring at twice a given speed (phase angle) or once that value (parallel misalignment). **By precise fitting of attachments it is possible to keep such harmonics relatively small.**



## Linearity

The usefulness of a tacho-generator in the broadest possible range of control applications is limited by the linearity of the output voltage relative to speed.

### Speed voltage curve



The maximum permissible load current is given for each machine. However, the linearity errors detailed in the selection tables refer to the current which results when the optimum load resistance is connected ( $F = 0,02\%$ ,  $0,5\%$  at maximum current).

## Disturbance variables relative to linearity

### Load current and armature reaction

If it is assumed that the speed-voltage curve at no load is a straight line at a particular angle, then when load is applied (without taking account of armature reaction) the result is a straight line at a less steep angle. The difference depends on

$$\Delta U_{Ri} = I_A \cdot R_i + U_{Brushes}$$

Since, due to the load current, the flux distorts and is weakened, the voltage curve is further altered.

## Brush contact voltage

**Silver-graphite brushes with very low contact voltage** are mainly used for D.C. tacho-generators.

The total voltage drop at the sliding contact commutator is **affected by peripheral speed, current density under the brushes, brush pressure, and the condition of the patina on the brush contact face.**

The load resistance should not be made too high. A typical value would be between 500 to 1000 Ohms/V.

The load resistance should be 200 to 10000 times the machine internal resistance in order to guarantee the specified linearity.

**Summary:** it can be said that the load resistance must not exceed or fall below a set limit value if the specified linearity error is to be maintained. If the terminal resistance is too low, then armature reaction has an adverse effect on linearity; if it is too high the effects of the commutator can increase the linearity error.

# Mechanical design

## Construction types

To DIN 42950. Modified versions have an additional letter added. (B 5 s, B 5 k, B 10 s, B 5 g . . .).

The different construction types are shown in the dimension drawings. All flange construction types can additionally be fitted with a foot (for example: B35 . . .).

The use of strengthened spheroidal graphite iron is recommended when attachments are long and heavy (specify when ordering). All tachos can have a **B 14 flange** and **2nd shaft extension** at the NDE (NDE end shield) (extra cost). Construction reference example: B 3/B 14 or B 14/B 14. The machines can also be mounted vertically, without modification. Tachos in protection type IP 55 spec. may need a change of the air vent position. Other construction types are available on request.

## Degrees of protection:

Standard versions of the units meet the requirements of IP 55 to DIN/VDE 0530 part 5 for rotating electrical machines (replaces DIN 40050 sheet 2).

**IP 55** - Fully enclosed. Protection against harmful dust deposits and against water spray from all directions.

**Special protection types – IP 56, IP 55 spec.** are used where **unfavourable environmental or ambient conditions** exist, such as: water spray, temporary flooding, oil mist, high humidity, heavy accumulations of dust (suitable for installation in open air), heavy vibration and shock loads. Additionally, the machines are suitable for use in an extended temperature range from - 40 °C to + 100 °C. The brush holders produce a relatively high brush pressure of approximately 600 p/cm<sup>2</sup>.

The **ball bearings**, which have packing washers, also have a special grease for use in a **temperature range of - 60 °C to + 120 °C**.

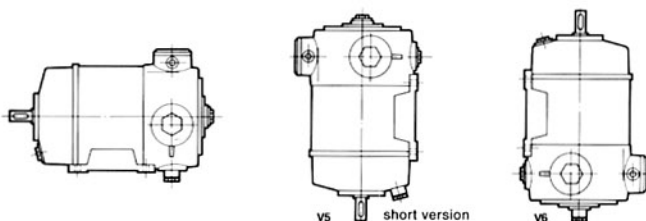
**The shaft exit at the DE is sealed with an axial shaft sealing ring.**

A **condensation water drain hole** is located at the NDE on the underside. The commutator can also be cleaned and polished through this opening.

**IP 56** – Totally enclosed, protected against damaging dust deposits and temporary flooding

**IP 55 spec.** – The special feature of this protection type is that the tacho – otherwise as **IP 56** – has a vent in **addition**.

An exchange of air between tacho interior and the environment can take place; the formation of condensation is largely prevented or can leak out through the wire grid (wire gauze filter approx. 0.2 x 0.2 mm). **Please note** that this vent on the underside of the tacho should be located **at the lowest point**. Note must also be taken of the fitting position. See below for V-construction type vertical mounting positions.



Vent plug and cover screw are interchangeable, depending on fitting position. **2nd shaft extension exit complies with IP 55; higher degrees of protection are obtained only after fitting the appropriate attachment or shaft cover.**

## Bearings

The sealed or covered deep-groove ball bearings to DIN 625 are **greased for life**. They are greased with lithium-based grease having a dropping point of 180 °C, suitable for a temperature range of - 60 °C to + 120 °C.

**Fixed Bearing DE** (drive end)

**Floating Bearing NDE** (non-drive end)

## Shaft extensions

The tacho **normally has 1 free shaft extension**, Ø 14 k 6 x 30 with closed feather keyway to DIN 6885 P 1. The feather key is also supplied.

In construction types B 10- and B 3-K 20 and . . . K 32 a tapered shaft extension (taper 1 : 20) is supplied having a fine thread. Self-locking hexagon nuts which can be used several times are supplied with the unit. A cover screw at the NDE guarantees **access to the tacho shaft** (manual speed measurement). Special shafts, of smaller diameter and different lengths can be supplied.

The 2nd shaft extension is normally Ø 12g6 x 18 (Ø 14 k 6 x 30) (specify when ordering, see page 20).

## Shaft sealing

At DE all tachos can be fitted with a **sealing ring\***.

An axial shaft seal\* is normally fitted when protection is IP 56/IP 55 spec.

We recommend not to exceed speed ranges of approx. 4000 rpm.

\*For arrangement details, see page 27.

## Mechanical balancing

The tacho armatures are dynamically balanced with the feather key fitted. Transmission components (coupling halves, pulleys, etc.) must be balanced without feather key.

The machines meet the requirements of vibration severity grade R, DIN 45665.

## Finish, surface protection

The tachos receive a **rust-proofing primer**. The cover coat is **light grey RAL 7030**. Special colours are available at extra cost.

Tachos exposed to aggressive gases and fumes receive, in addition to special insulation, an appropriate special coat of paint.

## GL – Germanischer Lloyd

The single tacho TDPS 1,2 . . . in all voltage versions, in construction types B 5 or B 3 was submitted for a model test and was found to comply with the **standards of Germanischer Lloyd**.

Certificate No 96826-87 HH. Model testing for other machines is available.

Further details are available on request.