PHILIPS

Data handbook

Electronic components and materials

Components and materials

Part 18 1986

Direct current motors

PHILIPS Direct current motors C18 1986

DIRECT CURRENT MOTORS

PREFACE

New materials and manufacturing methods have enabled us to introduce motors to our range that have considerably improved characteristics and are at the same time less expensive. Some replace types that are widely used by many customers and, for this reason, are identical in fit and function to those they replace but with advantages in characteristics and price.

Notes

All mechanical drawings are in accordance with the European (third angle) projection.

Dimensions are given in mm.

Forces are given in newtons (N); 1 N = 100 g = 3,53 ounce (oz).

Torques are given in milli-newton-metres (mNm); 1 mNm = 10 gcm = 0,139 ounce inch.

Performance curves are derived from measurements made on typical motors.

The sense of rotation, clockwise (cw) or counter-clockwise (ccw), is as viewed from the spindle end of the motor.

When ordering, please use the catalogue number.

INTRODUCTION

Our direct current motors are available in two basic types:
- iron rotor motors, having high efficiency and low cost;
- ironless rotor motors, having much better speed control properties such as shorter acceleration times and lower wow and flutter levels.

APPLICATION EXAMPLES

Iron rotor motors

cassette recorders;
record players;
calculators;
dictating machines;
telephone answering equipment;
weather balloons;
rotating lights for vehicles;
car headlamp wipers.

Ironless rotor motors

hi-fi reel-to-reel recorders;
hi-fi cassette recorders;
educational recorders;
video recorders;
video long play and compact disc drives;
floppy disc and computer cassette drives;
recording measuring equipment;
computer and calculator printer drives;
ribbon transport in computer printers;
punched-card readers.

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

ELECTRON TUBES	BLUE
SEMICONDUCTORS	RED
INTEGRATED CIRCUITS	PURPLE
COMPONENTS AND MATERIALS	GREEN

The contents of each series are listed on pages iv to viii.

The data handbooks contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application information is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Electronic Components and Materials Division is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.
Product specialists are at your service and enquiries will be answered promptly.

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks comprises:

T1 **Tubes for r.f. heating**

T2a **Transmitting tubes for communications, glass types**

T2b **Transmitting tubes for communications, ceramic types**

T3 **Klystrons**

T4 **Magnetrons for microwave heating**

T5 **Cathode-ray tubes**
Instrument tubes, monitor and display tubes, C.R. tubes for special applications

T6 **Geiger-Müller tubes**

T8 **Colour display systems**
Colour TV picture tubes, colour data graphic display tube assemblies, deflection units

T9 **Photo and electron multipliers**

T10 **Plumbicon camera tubes and accessories**

T11 **Microwave semiconductors and components**

T12 **Vidicon and Newvicon camera tubes**

T13 **Image intensifiers and infrared detectors**

T15 **Dry reed switches**

T16 **Monochrome tubes and deflection units**
Black and white TV picture tubes, monochrome data graphic display tubes, deflection units

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

S1 **Diodes**
Small-signal silicon diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2a **Power diodes**

S2b **Thyristors and triacs**

S3 **Small-signal transistors**

S4a **Low-frequency power transistors and hybrid modules**

S4b **High-voltage and switching power transistors**

S5 **Field-effect transistors**

S6 **R.F. power transistors and modules**

S7 **Surface mounted semiconductors**

S8a **Light-emitting diodes**

S8b **Devices for optoelectronics**
Optocouplers, photosensitive diodes and transistors, infrared light-emitting diodes and infrared sensitive devices, laser and fibre-optic components

S9 **Power MOS transistors**

S10 **Wideband transistors and wideband hybrid IC modules**

S11 **Microwave transistors**

S12 **Surface acoustic wave devices**

S13 **Semiconductor sensors**

INTEGRATED CIRCUITS (PURPLE SERIES)

The NEW SERIES of handbooks is now completed. With effect from the publication date of this handbook the "N" in the handbook code number will be deleted.
Handbooks to be replaced during 1986 are shown below.

The purple series of handbooks comprises:

IC01	**Radio, audio and associated systems** Bipolar, MOS	new issue 1986 IC01N 1985
IC02a/b	**Video and associated systems** Bipolar, MOS	new issue 1986 IC02Na/b 1985
IC03	**Integrated circuits for telephony** Bipolar, MOS	new issue 1986 IC03N 1985
IC04	**HE4000B logic family** CMOS	new issue 1986 IC4 1983
IC05N	**HE4000B logic family – uncased ICs** CMOS	published 1984
IC06N	**High-speed CMOS; PC74HC/HCT/HCU** Logic family	published 1986
IC08	**ECL 10K and 100K logic families**	New issue 1986 IC08N 1984
IC09N	**TTL logic series**	published 1986
IC10	**Memories** MOS, TTL, ECL	new issue 1986 IC7 1982
IC11N	**Linear LSI**	published 1985
Supplement to IC11N	**Linear LSI**	published 1986
IC12	**I²C-bus compatible ICs**	not yet issued
IC13	**Semi-custom** Programmable Logic Devices (PLD)	new issue 1986 IC13N 1985
IC14N	**Microprocessors, microcontrollers and peripherals** Bipolar, MOS	published 1985
IC15	**FAST TTL logic series**	new issue 1986 IC15N 1985
IC16	**CMOS integrated circuits for clocks and watches**	first issue 1986
IC17	**Integrated Services Digital Networks (ISDN)**	not yet issued
IC18	**Microprocessors and peripherals**	new issue 1986*

* The Microprocessors were included in handbook IC14N 1985, so IC18 will replace that part of IC14N.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

C1 **Programmable controller modules**
PLC modules, PC20 modules

C2 **Television tuners, coaxial aerial input assemblies, surface acoustic wave filters**

C3 **Loudspeakers**

C4 **Ferroxcube potcores, square cores and cross cores**

C5 **Ferroxcube for power, audio/video and accelerators**

C6 **Synchronous motors and gearboxes**

C7 **Variable capacitors**

C8 **Variable mains transformers**

C9 **Piezoelectric quartz devices**

C10 **Connectors**

C11 **Varistors, thermistors and sensors**

C12 **Potentiometers, encoders and switches**

C13 **Fixed resistors**

C14 **Electrolytic and solid capacitors**

C15 **Ceramic capacitors**

C16 **Permanent magnet materials**

C17 **Stepping motors and associated electronics**

C18 **Direct current motors**

C19 **Piezoelectric ceramics**

C20 **Wire-wound components for TVs and monitors**

C21* **Assemblies for industrial use**
HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices

C22 **Film capacitors**

* To be issued shortly.

GENERAL

TYPE SELECTION

A. Iron rotor types

nominal voltage V	speed at nominal torque rev/min	nominal torque mNm	direction of rotation	remarks	dia. mm	length of housing mm	catalogue number	page
6	2400	1	c.w.		33	25	4311 105 53060	15
6	2400	1	c.c.w.		33	25	53070	15
9	2400	1	c.w.	with integrated	33	25	53090	15
9	2400	1	c.c.w.	speed governor	33	25	53100	15
12	2400	1	c.w.		33	25	53120	15
12	2400	1	c.c.w.		33	25	53130	15
5,5	2400	1	c.c.w.		27	21	4322 010 72190	21
5,5	2400	1	c.w.		27	21	72320	21
7,5	2400	1,3	c.w.		27	21	72360	21
7,5	2400	1,3	c.c.w.		27	21	72370	21
12	5900	5	reversible		□ 34	40	9904 120 09601	95
6	330	25	reversible		□ 39	64	52402	131
6	60	125	reversible		□ 39	64	52405	131
6	23	125	reversible		□ 39	64	52407	131
6	8,2	125	reversible		□ 39	64	52409	131
12	330	25	reversible		□ 39	64	52602	131
12	60	125	reversible		□ 39	64	52605	131
12	23	125	reversible		□ 39	64	52607	131
12	8,2	125	reversible		□ 39	64	52609	131
24	330	25	reversible	with reduction	□ 39	64	52702	131
24	60	125	reversible		□ 39	64	52705	131
24	23	125	reversible		□ 39	64	52707	131
24	8,2	125	reversible		□ 39	64	52709	131
13,5	50	300	reversible		54 x 38	64	52814	135
6	60	300	reversible		54 x 38	64	55406	139
12	60	300	reversible		54 x 38	64	55606	139
24	60	300	reversible		54 x 38	64	55706	139

B. Ironless rotor types

nominal voltage V	speed at nominal torque rev/min	nominal torque mNm	direction of rotation	remarks	dia. mm	length of housing mm	catalogue number	page
24	2850	10	reversible		40	40	4322 010 74080	27
12	2850	10	reversible		40	40	74090	27
15	3000	22	reversible		40	40	74190	31
24	2815	10	reversible		40	40	75060	33
12	2815	10	reversible		40	40	75110	33
15	3000	22	reversible		40	40	75130	37
30	3000	22	reversible		40	40	75300	37
24	2800	10	reversible	with tachogen.	40	50	75140	43
24	2800	10	reversible		40	40	75180	49
24	2800	10	reversible		40	40	75210	55
12	3200	5	reversible		29	40	76000	59
12	3000	5	reversible		29	40	76050	65
12	3900	5	reversible		29	40	76060	71
24	3900	5	reversible		29	40	76080	71
12	3000	5	reversible	with tachogen.	29	48	76130	77
24	3000	5	reversible		29	40	76150	65
9	3500	5	reversible		29	40	76200	83
30	2150	100	reversible		66	64	78010	89
12	1800	80	reversible		66	58	9904 120 13111	99
30	2000	120	reversible		66	58	13311	103
12	1800	80	reversible	cyl. collector	66	64	13116	107
30	2150	120	reversible	cyl. collector	66	64	13316	107
30	2150	120	reversible	with tachogen.	66	64	13352	109
30	2150	120	reversible	with tachogen.	66	64	13353	115
12	2710	10	reversible	cyl. collector	40	40	15101	119
24	2750	10	reversible	cyl. collector	40	40	15201	119
24	2750	10	reversible	cyl. collector	40	40	15211	119
12	3000	5	reversible	cyl. collector	29	40	17141	123
12	3000	5	reversible	cyl. collector	29	40	17151	123
24	3000	5	reversible	cyl. collector	29	40	17241	123
12	3000	5	reversible	cyl. collector	29	40	17801	127

DESIGN PRINCIPLES

IRON ROTOR MOTORS (Fig. 1)

These motors have a three-pole laminated iron rotor and a flat commutator. A disc varistor mounted between the commutator and coils suppresses interference and considerably increases brush life. All motors have two-leaf metal brushes except those of the 9904 120 52 . . . series which have carbon brushes. The stator consists of a Ferroxdure ring and the magnet circuit is closed by the motor housing or a steel ring.

The materials of commutator and metal brushes are chosen to ensure optimum commutation for electronic speed control. Low contact resistance ensures a problemless start, even after long rest periods. Owing to their low power consumption, these motors are suitable for operation from a battery supply. They are used as the drive in tape recorders and record players, for which speed stability, low electrical and mechanical noise and high reliability are required.
Several types have radio frequency interference suppression or magnetic shielding or both. Types with built-in integrated circuit or tachogenerator for accurate speed control are also available.

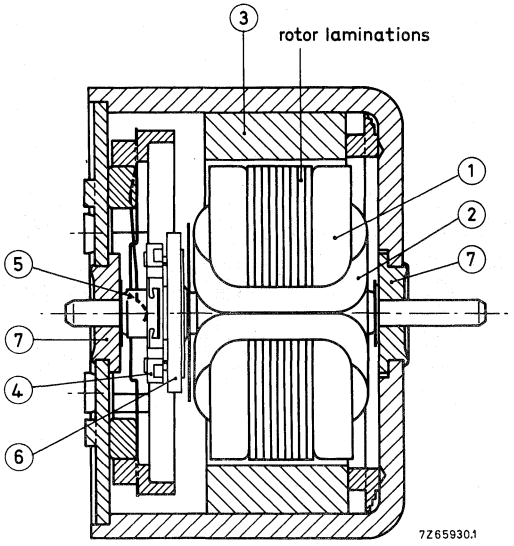


Fig. 1.
1 = rotor
2 = rotor winding
3 = stator magnet
4 = commutator
5 = brush
6 = varistor
7 = bearing

IRONLESS ROTOR MOTORS : ϕ29, ϕ40, ϕ66 mm (Figs 2a and 2b)

In these low inertia motors, the rotor comprises a coil former (cage) fixed to a spindle, upon which the coils are wound. The stator is a steel alloy cylindrical magnet, located inside the rotor for ϕ29 and ϕ40 mm motors and two magnet segments against the motor housing for the ϕ66 mm motor.

During assembly, a spigot on the housing is pressed into the stator core ring inside the rotor coil, leaving the rotor free to rotate in its bearings. The motor housing completes the magnetic circuit.

Because these motors have no rotating iron parts, they have **low inertia, low inductivity** and **no detent torque**. The precise design creates a **high efficiency**.

Another advantage of low inertia d.c. motors is that in applications which require a safety spring for zero setting in the event of an electronic failure (e.g. throttle valves in **motor vehicles**), the elasticity of the spring can be quite low. If the valve is driven by a motor reduction gear combination, the re-adjustment spring has to accelerate an inertia of $n^2 J_{motor}$, so the elasticity of the spring can be much less if a low inertia motor is used. Consequently the motor sees a smaller load and the motor and drive electronics can be lighter.

A. Ironless rotor motors with flat commutator (see Fig. 2a)

The flat commutator is plated with a precious metal. Voltage peaks during commutation are so small that, generally, **no radio interference** suppression is necessary. The brushes each have three or four leaves.

The commutators of some of these motors incorporate zener diodes or capacitors for spark suppression in heavy duty applications or for extended life.

The flat commutator has a very low voltage loss which means that these motors are very suitable for applications requiring **accurately controlled speed** (hi-fi recorders, video recorders, floppy disc and Winchester drives, card readers).

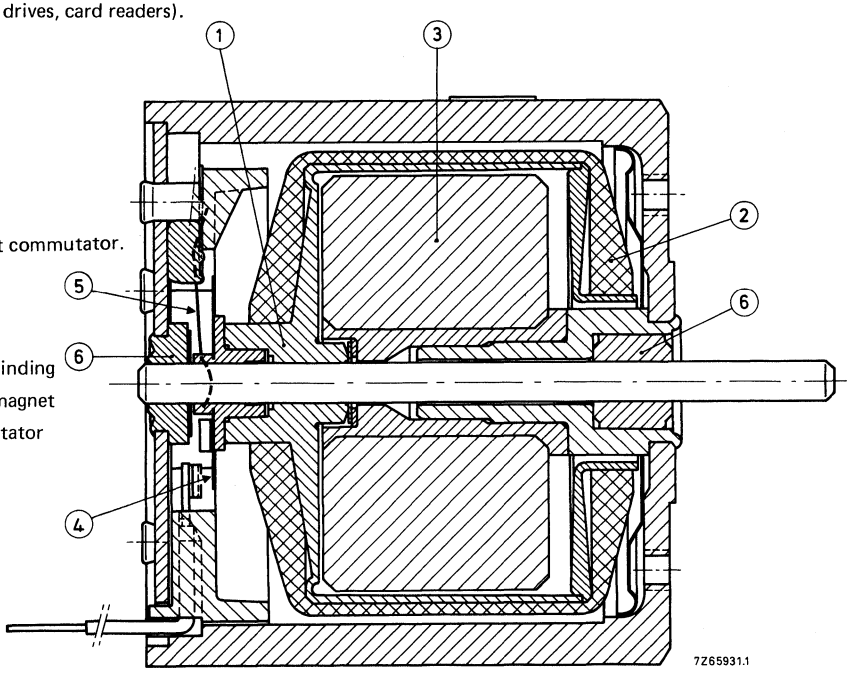


Fig. 2a Flat commutator.

1 = rotor
2 = rotor winding
3 = stator magnet
4 = commutator
5 = brush
6 = bearing

B. Ironless rotor motors with cylindrical commutator (see Fig. 2b).

The cylindrical collector with carbon metal brushes give these motors the high resistance to high peak currents, required in **accurate positioning** applications, where over powering is required for rapid acceleration and braking. An example is head positioning in printers. These motors are also ideal for high efficiency or accurate heavy duty drive applications (medical pumps or battery charged professional equipment).

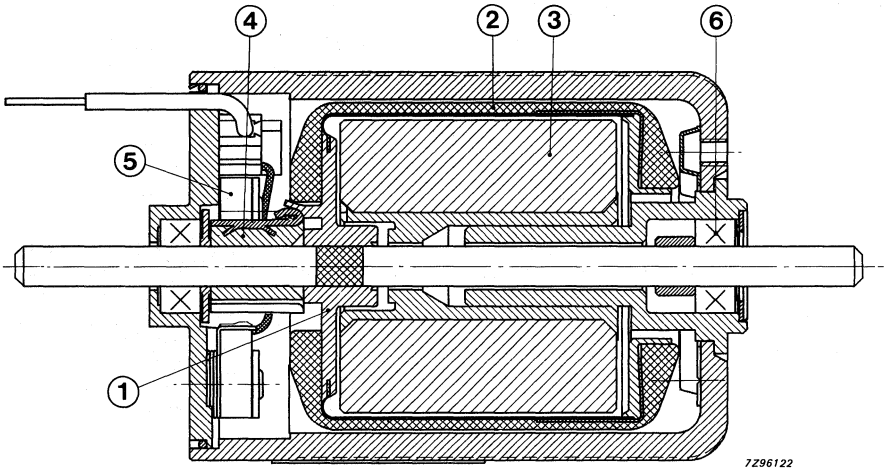


Fig. 2b Cylindrical commutator.

1 = rotor
2 = rotor winding
3 = stator magnet
4 = commutator
5 = brush
6 = bearing

TACHOGENERATOR

Several motor types are provided with a frequency tachogenerator for very accurate speed control independent of changes in motor characteristics due to ambient conditions.
The frequency tachogenerator has a toothed rotor (72 teeth) mounted on the protruding part of the motor spindle. The stator consists of a coil, a deep-drawn steel housing and a strip magnet of plastic-bonded ceramic magnetized with 72 pole pairs. The alternating flux produced as the toothed wheel rotates in the magnetic field is enclosed by the coil in which the tachogenerator voltage is generated. The frequency of the tachogenerator voltage is determined by the speed of the motor (and by the number of pole pairs of the tachogenerator).

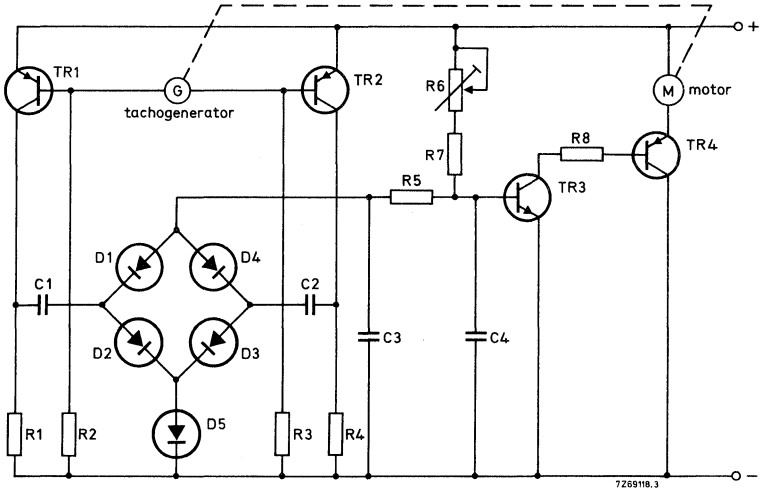


Fig. 3 Example of an electronic speed control system.
G = frequency tachogenerator, M = direct current motor.

MOUNTING

Most of the motors are front mounted using screws. Refer to the data sheets for individual details.

Mounting a pulley or pinion

This can be done in three ways:

– by *pressing* the pulley or pinion onto the motor spindle. This is only allowed if the other end of the spindle is supported so that parts inside the motor are not subjected to axial force. The required hole in the pulley or pinion is given in the table below for spindle diameters of 2 mm and 3 mm.

spindle diameter	l_{max}	hole diameter d_1	hole diameter d_2
2	2,5	2 P7	2 H7
3	3,5	3 P7	3 H7

Here, P7 denotes a tolerance –0,006 to –0,016
H7 denotes a tolerance 0 to +0,010

All dimensions in mm

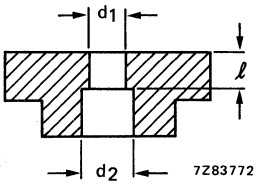


Fig. 4 d_2 is a guide hole.

– by *heating* the pulley or pinion and then sliding it onto the spindle; temperature can be calculated from the expansion coefficient of the material used. At room temperature, hole dimensions are the same as for press fitting.

– by *glueing* with a self-curing adhesive. The gap between pulley, or pinion, and spindle depends upon the glue used. Pulley eccentricity will be larger than that for the two preceding methods because of the gap.

QUALITY

Commitment to quality is an essential aspect of the entire marketing activity. To achieve the highest possible standard a Quality Assurance procedure is carried out:

* during development prior to release for pilot production,
* during pilot production to optimize conditions for mass production,
* during series production after release for production.

Development

It starts with careful drafting of the specification to meet the requirements of the application regarding performance and reliability. Development involves the choice of materials and the design of process to ensure the finished product conforms to the specification and its design is feasible for series production. Quality checks during development include:

- investigation of materials (procurement specification)
- investigation of subassemblies (process capability)
- inspection of development samples:
  - visual inspection
  - dimensional inspection
  - electrical inspection
  - tests on mechanical tolerances
  - environmental tests (based on IEC 68 publications)
  - climatic tests: humidity, dry heat, temperature cycling, functional behaviour at extreme temperatures
  - mechanical tests: simulation of transport, shock, vibration.

Pilot production

During pilot production the definitive tooling and manufacturing organization are installed. Special attention is paid to defect prevention by the investigation of process capability, feasibility and by the implementation of an adequate system of process control. The agreement for delivery and commitments to customers are based on thorough investigation of the finished products on conformance and reliability.

Series production

Quality assurance in production is based on control of incoming material, process control and 100% inspection on functional characteristics. Moreover, each production lot is submitted by the Quality Department to statistical acceptance tests based on a combined AQL of 1% for the visual, mechanical and electrical characteristics of the specification. Time-related graphs of Q-parameters and reports on reliability investigations complete the quality statement of the finished products.
The information issued by the Quality Assurance system and by the customer feedback are used for constant improvement of production.

Summary

The combination of the thorough investigation of new designs before release for production, the Quality Assurance system oriented to defect prevention and the stringest outgoing inspection guarantees the high level of performance and reliability of our products.

RELIABILITY

Apart from tests on specified zero hour properties life tests* are carried out on statistically representative samples. Life expectancy is derived from a Weibull Life Probability Chart (Fig. 5), a plot of cumulative failures as a function of time.
The cumulative failure percentage is

$$n = (i - 0{,}3)/(n + 0{,}4) \times 100$$

where i = sequence number of failure
n = number in sample

Example:

Out of a sample of 20 motors, 5 failed after respectively 1750, 2000, 2525, 2600 and 2815 hours of operation.

sequence number	failed at h	cumulative failure percentage η
1	1750	$(1 - 0{,}3)/(20 + 0{,}4) = 3{,}4\%$
2	2000	$(2 - 0{,}3)/(20 + 0{,}4) = 8{,}3\%$
3	2525	$(3 - 0{,}3)/(20 + 0{,}4) = 13{,}2\%$
4	2600	$(4 - 0{,}3)/(20 + 0{,}4) = 18{,}1\%$
5	2815	$(5 - 0{,}3)/(20 + 0{,}4) = 23{,}0\%$

Plotting these points on the graph and drawing the best straight line through them (the population line) gives a B10-life (time for 10% of the population to fail) of 2200 h. This means 90% of the population has a life longer than 2200 h.
The characteristic life is read at $\eta = 63\%$ and is here 4000 h. So the Mean Time Between Failures (MTBF) is 4000 h and the failure rate λ (= 1/MTBF) is 250×10^{-6}/h.

* Unless otherwise specified the tests are carried out with a duty cycle of 3 h on/1 h off, motor operating in preferred direction of rotation as indicated in the relevant mechanical drawing.

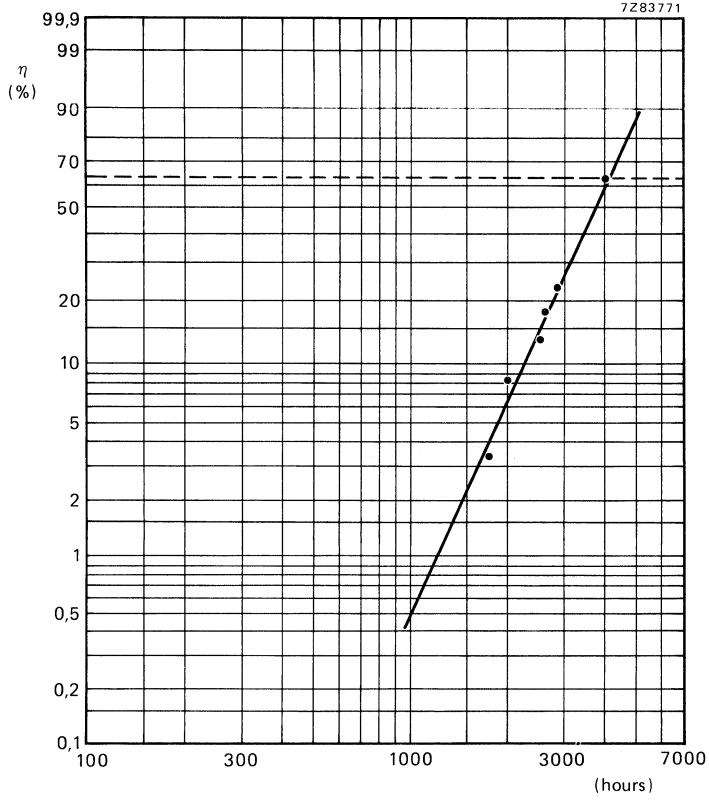


Fig. 5 Weibull Life Probability Chart.

ADDITIONAL INFORMATION TO MOTOR SPECIFICATIONS

TERMINOLOGY (in alphabetical order)

Mechanical time constant

The time the unloaded motor at a constant voltage needs, starting from rest to reach 63% of the final speed at that voltage.

Nominal speed

The speed at nominal voltage and nominal torque.

Nominal torque

The output torque of the motor without radial load, at nominal voltage and nominal speed. (With a radial load the output torque is reduced.)

Nominal voltage

The voltage at which the nominal torque and the nominal speed are specified.

Rotor inductance

The inductance measured between the terminals of the motor at 1000 Hz, motor at rest and no coils short-circuited by the brushes.

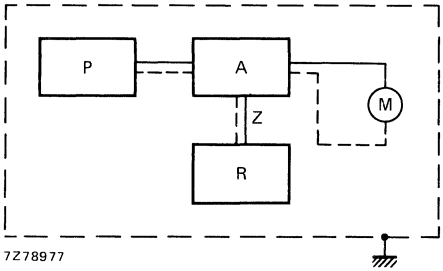
Rotor resistance

The resistance measured between the motor terminals at +22 ± 5 °C, motor at rest and no coils short-circuited by the brushes.

RADIO INTERFERENCE

In the data sheets of motors for applications requiring low interference, e.g. cassette recorders, a curve is given showing the maximum interference level with respect to 1 μV as a function of frequency. The curve is measured using the circuit shown in Fig. 6.

Fig. 6



P = interference-free power supply

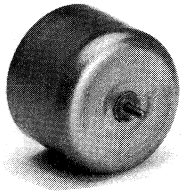
A = artificial network 50 Ω//5 μH, according to CISPR, recommendation 53 (0,1 to 100 MHz)

R = interference measuring receiver (FSME 1515 of Schwarzbeck)

M = motor, nominal torque, nominal speed

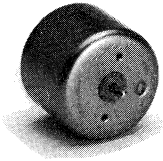
Z = 50 Ω coaxial cable

8604 11-02-01



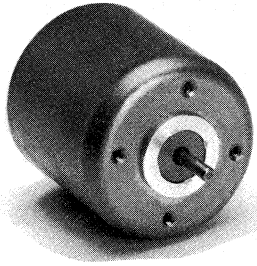
4311 105 53 . . .

8307 11-01-11



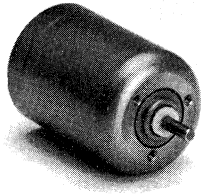
4322 010 72 . . .

8307 11-01-01



4322 010 74/75 . . .

8307 11-01-07



4322 010 76 . . .

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4322 010 77 . . .

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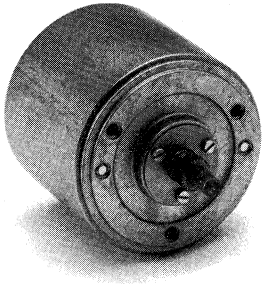


4322 010 78 . . .

DIRECT CURRENT MOTORS
iron rotor types with integrated speed governor

QUICK REFERENCE DATA

Catalogue number	CW CCW	4311 105 53060 4311 105 53070	4311 105 53090 4311 105 53100	4311 105 53120 4311 105 53130	
Nominal voltage (d.c.)		6	9	12	V
Nominal speed		2400	2400	2400	rev/min
Nominal torque		1	1	1	mNm

APPLICATIONS

These motors have been designed for applications which require low noise level, smooth running, small size and accurate constant speed. Examples:

- cassette recorders
- record players
- portable dictating machines
- telephone answering equipment
- floppy disc drive spinning motor

DESCRIPTION

A permanent magnet stator system consisting of rubber bonded ceramic material produces a very low holding torque. The silver-plated cylindrical collector and silver/palladium-plated metal brushes ensure optimum commutation suitable for the integrated electronic speed governor incorporated in the motor. This commutator brush construction and the sintered bearings ensure smooth running and long life. The built-in spark suppressor (varistor) minimizes interference and increases considerably the commutator and brush life. The speed governor uses the principle of a closed loop controlled constant back e.m.f. An in-line filter suppresses interference suppression.

The speed can be adjusted manually with an internal potentiometer. The motors have a zinc-plated deep-drawn steel housing and a tin-plated steel cover.

OPTIONS

Each type of motor can be made available – provided a sufficient quantity is involved – with:

– pulley or pinion

– two different speeds

– other spindle lengths.

TECHNICAL DATA

Outlines

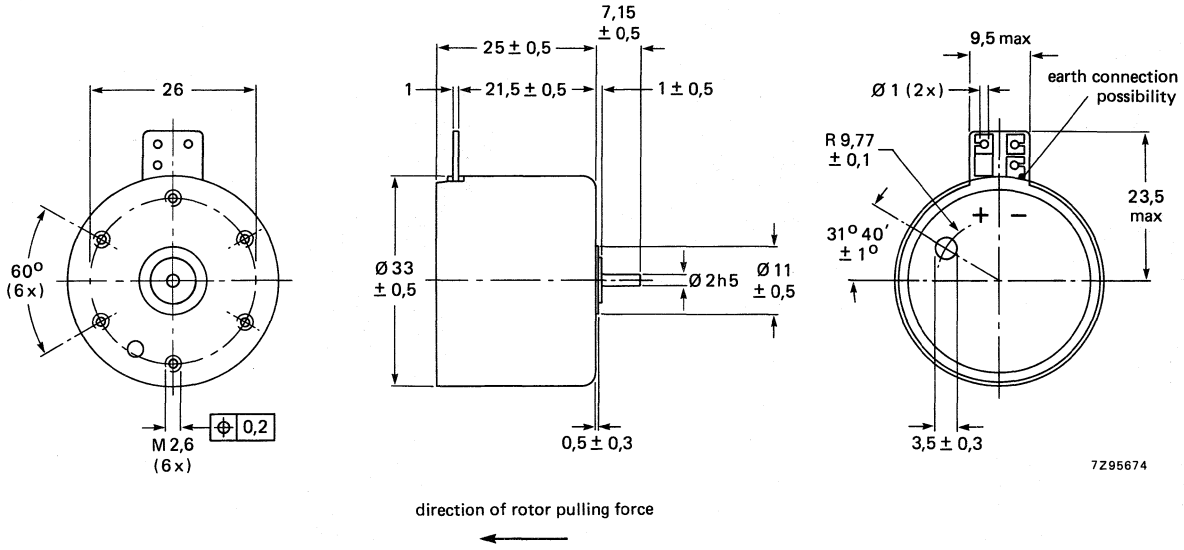


Fig. 1 Axial play of rotor min. 0,1; max. 0,7.

Mass approx. 66 g

Mounting

The motor is mounted by six M2,6 screws. Maximum screw insertion depth: 1,7 mm. Maximum tightening torque: 100 mNm.

The values given below apply at an ambient temperature of 20 ± 2 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Catalogue numbers CW / CCW	4311 105 53060 / 4311 105 53070	4311 105 53090 / 4311 105 53100	4311 105 53120 / 4311 105 53130	
Nominal voltage	6	9	12	V
Nominal torque	1	1	1	mNm
Speed	see Fig. 2	see Fig. 3	see Fig. 4	
Bearings	slide	slide	slide	
Climatic category, IEC 68	20/070/21	20/070/21	20/070/21	
Voltage range	4,2 to 10	6 to 14	8,4 to 16	V
Current at nominal voltage				
at nominal torque	135 to 205	95 to 145	66 to 100	mA
at no load	max. 90	max. 70	max. 45	mA
Speed deviation with				
load variation 0,8–1,2 mNm	max. 70	max. 60	max. 60	rev/min
voltage variation, total range	max. 30	max. 30	max. 30	rev/min
time, 5s–30 min	max. 30	max. 24	max. 24	rev/min
temperature*				
at −10 °C or + 50 °C	± 3	± 2	± 2	%
at −20 °C or + 70 °C	± 5	± 3	± 3	%
Starting torque at				
minimum voltage	4	6	6	mNm
Audio interference	see Fig. 5	see Fig. 5	see Fig. 5	mH
Ambient temperature range				
operating	−20 to + 70	−20 to + 70	−20 to + 70	°C
storage	−40 to + 90	−40 to + 90	−40 to + 90	°C

DEVELOPMENT DATA

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Catalogue number CW / CCW	4311 105 53060 / 4311 105 53070	4311 105 53090 / 4311 105 53100	4311 105 53120 / 4311 105 53130	
Voltage	10	14	16	V
Torque	2	2	2	mNm
Current	290	200	140	mA
Output power	0,5	0,5	0,5	W
Radial force	2,5	2,5	2,5	N
Axial force				
pressing	0,5	0,5	0,5	N
pulling	0,2	0,2	0,2	N

* Referenced speed at + 20 °C.

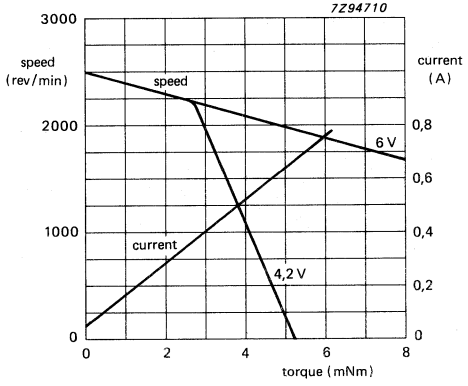


Fig. 2 Typical curves of 6 V motors, T_{amb} = 20 °C.

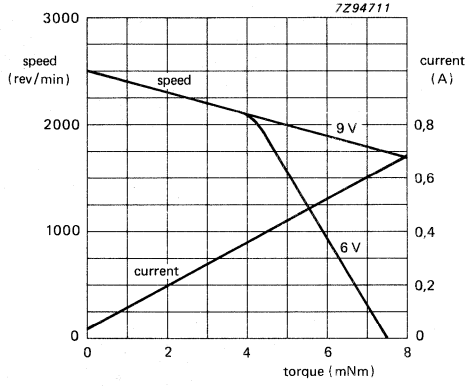


Fig. 3 Typical curves of 9 V motors, T_{amb} = 20 °C.

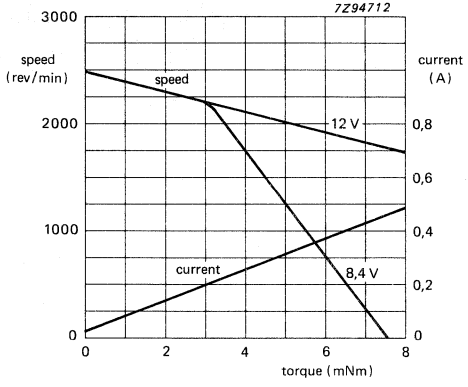


Fig. 4 Typical curves of 12 V motors, T_{amb} = 20 °C.

AUDIO INTERFERENCE

Measuring procedure

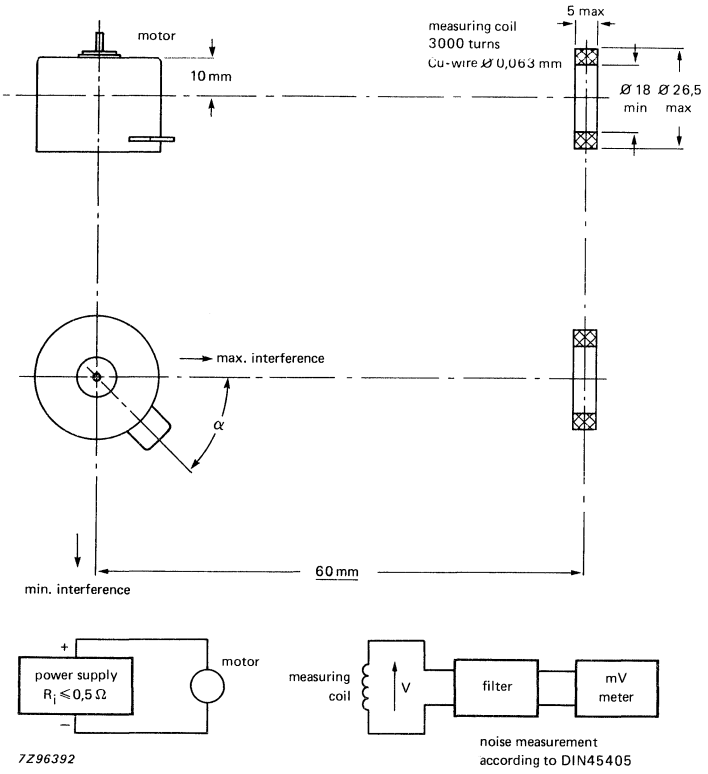


Fig. 5.

Motor speed 2400 rev/min
Nominal torque
α is varied until maximum voltage is obtained
$V_{p\text{-}p}$ = max. 28 mV (peak value)
Minimum packing quantity 320 items per cardboard box.

DIRECT CURRENT MOTOR

iron rotor type

QUICK REFERENCE DATA

Clockwise rotation Counterclockwise rotation	4322 010 72320 4322 010 72190	4322 010 72360 4322 010 72370
Nominal voltage (d.c.)	5,5 V	7,5 V
Nominal speed	2400 rev/min	2400 rev/min
Nominal torque	1 mNm	1,3 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running, small size and accurate electronic speed control.

Examples:

- cassette recorders and players
- portable dictating machines
- telephone answering equipment
- arrival and departure boards, e.g. at airports and railway stations

DESCRIPTION

The motors have a permanent magnet stator system, consisting of rubber-bonded ceramic material, with which a very low holding torque has been obtained.
The gold-plated flat commutator and silver-plated brushes ensure optimum commutation, thus making the motors suitable for accurate electronic speed control. This commutator-brush construction and the sintered bearings, ensure smooth running and long life.
The built-in spark suppressor (VDR) minimizes interference and considerably increases the commutator and brush life.
The motors have a zinc-plated, deep drawn, steel housing.

Options

Each type of motor can be made available (if a sufficient quantity is ordered) with:

- mu-metal shield (for optimum interference suppression)
- pulley or pinion
- other spindle length
- other supply voltage
- other lead length and colour
- other preferred direction of rotation

TECHNICAL DATA

Outlines

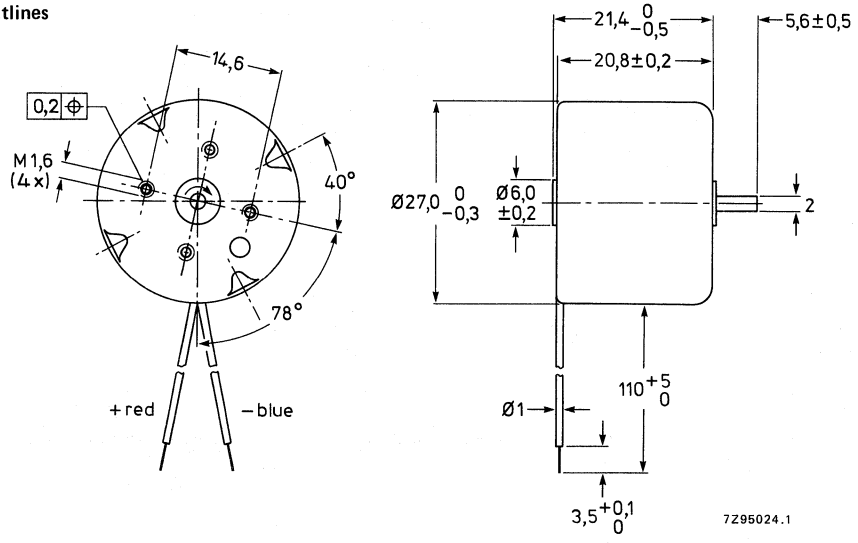


Fig. 1.

Axial play of rotor min. 0,1 mm, max. 0,7 mm

Mass 44 g approximately

Mounting

The motors are provided with two holes for front mounting by means of M1,6 screws; maximum permissible screw insertion 1,7 mm.

Maximum permissible pulling force on connecting leads 3 N.

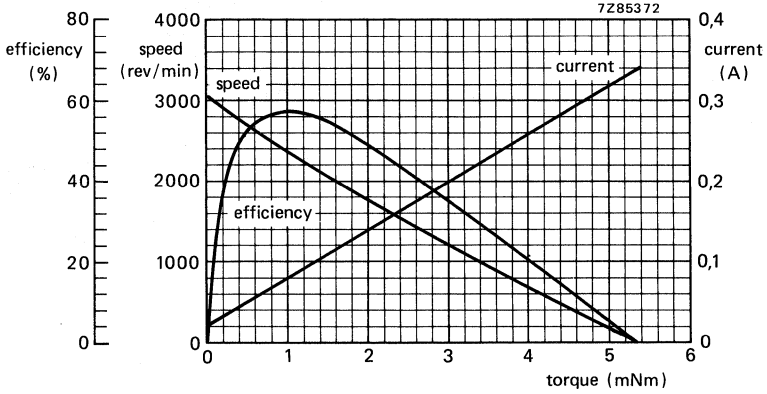


Fig. 2 Typical curves of the 5,5 V motors, T_{amb} = 22 °C.

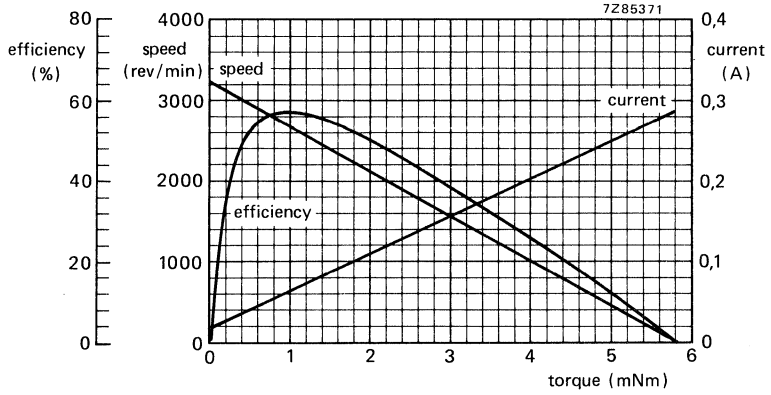


Fig. 3 Typical curves of the 7,5 V motors, T_{amb} = 22 °C.

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Catalogue numbers	4322 010 72320 4322 010 72190	4322 010 72360 4322 010 72370	
Voltage	8	14	V
Torque	2	2	mNm
Current	150	120	mA
Repetitive peak current, 10 ms, 1 Hz	600	470	mA
Speed	4200	4200	rev/min
Output power	0,5	0,65	W
Continuous blocking permitted at	3,8	5,6	V
Radial force	2,5	2,5	N
Axial force			
pressing	0,5	0,5	N
pulling	0,2	0,2	N

The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Clockwise rotation Counterclockwise rotation	4322 010 72320 4322 010 72190	4322 010 72360 4322 010 72370	
Nominal voltage (d.c.)	5,5	7,5	V
Nominal torque	1	1,3	mNm
Speed	see Fig. 2	see Fig. 3	
Bearings	slide	slide	
Climatic category (IEC 68)	20/070/21	20/070/21	
E.M.F. at 3000 rev/min	4,6 - 5,6	5,75 - 7,35	V
Rotor resistance	16 ± 10%	25,6 ± 10%	Ω
Current at nominal voltage			
at nominal torque	71 - 100	69 - 98	mA
at no load	max. 34	max. 27	mA
at a radial force of 1,5 N at 8 mm from mounting plane	max. 50	max. 40	mA
Insulation between terminals and housing	min. 2	min. 2	MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250	250	V
Torque constant	e.m.f./100π	e.m.f./100π	Nm/A
Starting torque at nominal voltage	min. 4,1	min. 4,4	mNm
Rotor inductance	16	27	mH
Rotor moment of inertia	9	9	gcm²
Mechanical time constant	34	34	ms
Audio interference	see Fig. 4	see Fig. 4	
Ambient temperature range			
operating	−20 to +70*	−20 to +70*	°C
storage	−40 to +90	−40 to +90	°C
Temperature coefficient of			
rotor resistance	0,4	0,4	%/K
e.m.f.	−0,2	−0,2	%/K

* + 85 °C for maximum 24h.

AUDIO INTERFERENCE

Measuring procedure

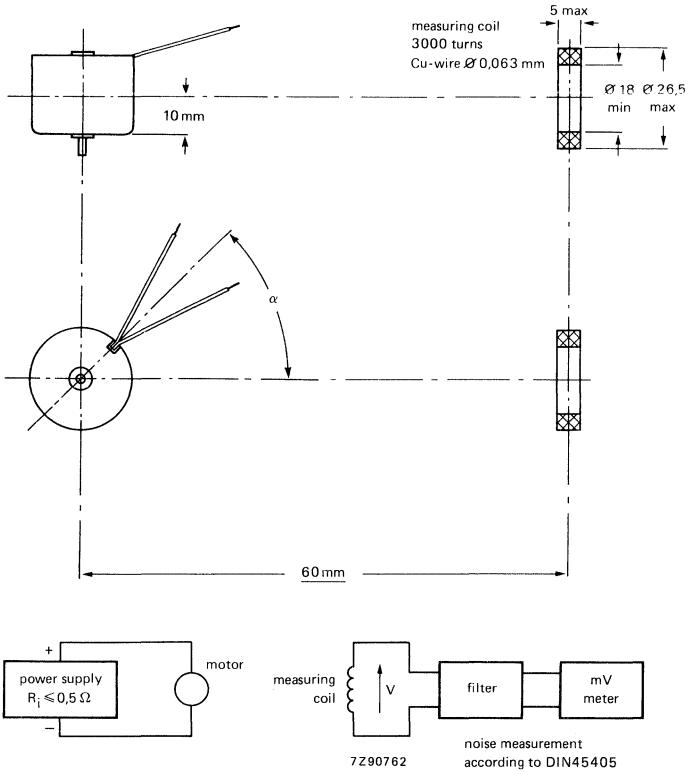


Fig. 4.

Motor speed 2400 rev/min

Nominal torque

α is varied until maximum voltage is obtained

$V_{p\text{-}p}$ = max. 28 mV (peak value)

Minimum packing quantity 432 items per cardboard box.

DIRECT CURRENT MOTORS

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 4322 010 74080	24 V
motor 4322 010 74090	12 V
Nominal speed	2850 rev/min
Nominal torque	10 mNm

APPLICATION

These motors have been designed for applications which require high acceleration, high efficiency and smooth running. No magnetic holding torque. Examples:
- digital cassette and cartridge recorders
- card readers
- printers (paper feed and head position)
- recording measuring instrument
- videorecorder

DESCRIPTION

The motors owe their special characteristics to the following design:
- Ironless rotor with oblique windings.
- Mechanical time constant of only 19,6 ms.
- High starting torque of 65 mNm.
- Precious-metal plated commutator with 9 segments and three silver-plated brushes ensure optimum commutation making the motor suitable for accurate electronic speed control or optimum functioning as a servo motor or d.c. tachogenerator.
- High efficiency due to a powerful cylindrical ticonal magnet.
- Protruding rear shaft, which can easily be supported when pinion or pulley has to be fitted on front shaft.
- The combination of the above commutator/brush construction with sintered slide bearings ensures a long life, smooth running and low noise.

TECHNICAL DATA

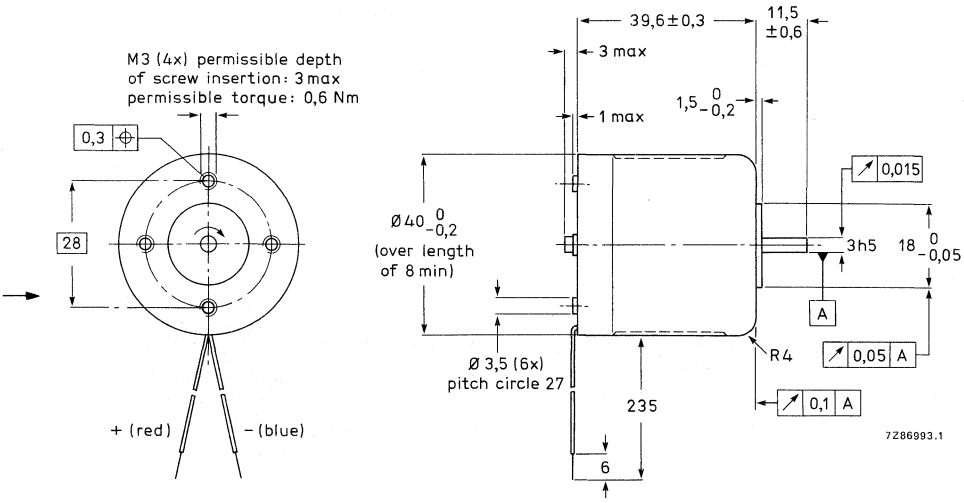


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1).
The position of the leads with respect to that of the mounting holes is arbitrary.
The motor is available with other spindle lengths.
Axial play of rotor: 0,2 + 0,4 mm.
Mass 205 g

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

	4322 010 74080	4322 010 74090	
Nominal voltage (d.c.)	24	12	V
Nominal torque	10	10	mNm
Speed	see Fig. 1	see Fig. 2	
Bearings	slide	slide	
Direction of rotation	reversible	reversible	
Climatic category (IEC 68)	05/060/21	05/060/21	
E.M.F. at 3000 rev/min	18,9 - 24,9	9,5 - 12,5	V
Rotor resistance	24,5 ± 10%	6,2 ± 10%	Ω
Current at nominal voltage			
at nominal torque	180	365	mA
at no load	max. 15	max. 30	mA
at a radial force of 5 N at 10 mm from mounting plane	max. 78	max. 156	mA

	4322 010 74080	4322 010 74090	
Insulation between terminals and housing	min. 2	min. 2	MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250	250	V
Torque constant	e.m.f./100π	e.m.f./100π	Nm/A
Starting torque at nominal voltage	min. 65	min. 65	mNm
Rotor inductance	3,3	0,8	mH
Rotor moment of inertia	$3,9 \times 10^{-6}$	$3,9 \times 10^{-6}$	kg m^2
Mechanical time constant	19,6	19,6	ms
Ambient temperature range			
operating	−10 to + 60	−10 to + 60	°C
storage	−40 to + 70	−40 to + 70	°C
Temperature coefficient of			
rotor resistance	0,4	0,4	%/K
e.m.f.	−0,02	−0,02	%/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

	4322 010 74080	4322 010 74090	
Voltage	30	15	V
Torque	20	20	mNm
Current	275	550	mA
Repetitive peak current, 10 ms, 1 Hz	1200	2400	mA
Speed	4000	4000	rev/min
Output power	5	5	W
Radial force	7	7	N
Axial force	0,5	0,5	N

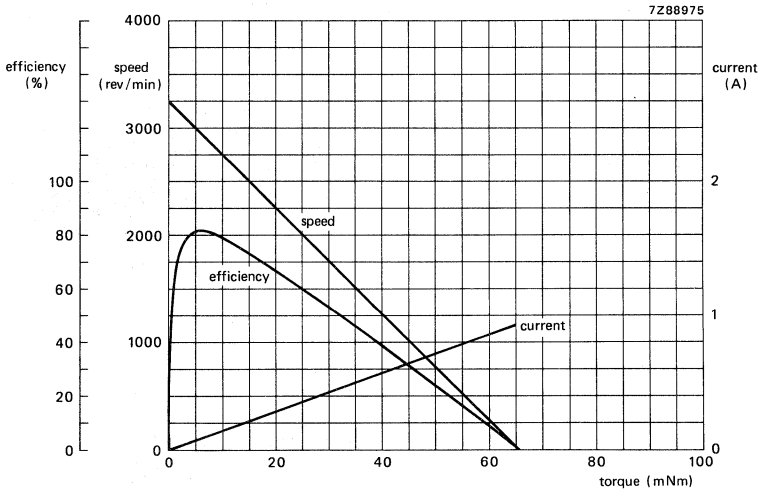


Fig. 2 Typical curves of motor 4322 010 74080 at 24 V, T_{amb} = 22 °C.

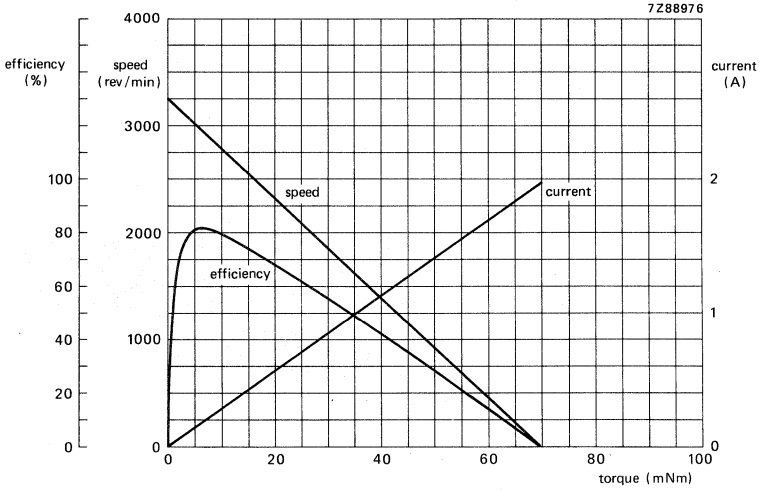


Fig. 3 Typical curves of motor 4322 010 74090 at 12 V, T_{amb} = 22 °C.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	15 V
Nominal speed	3000 rev/min
Nominal torque	22 mNm

DESCRIPTION

This motor is identical to type 4322 010 75130 but is equipped with ball bearings.

DIRECT CURRENT MOTORS

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 4322 010 75060	24 V
motor 4322 010 75110	12 V
Nominal speed	2815 rev/min
Nominal torque	10 mNm

APPLICATION

These motors have been designed for applications which require high acceleration, high efficiency and smooth running. No magnetic holding torque. Examples:

- hi-fi reel-to-reel recorders (capstan and reel drive);
- hi-fi cassette recorders (reel drive);
- video recorders (capstan, reel and drum drive);
- digital cassette and cartridge recorders;
- card readers;
- printers (paper transport and head positioner);
- recording measuring instruments.

DESCRIPTION

The motors owe their special characteristics to the following design:

- ironless rotor with oblique windings;
- mechanical time constant of only 19,6 ms;
- high starting torque of 70 mNm;
- precious-metal plated commutator with 9 segments and three silver-plated brushes ensure optimum commutation making the motor suitable for accurate electronic speed control or optimum functioning as a servo motor or d.c. tachogenerator;
- high efficiency due to a powerful cylindrical ticonal magnet;
- the combination of the above commutator/brush construction with sintered slide bearing ensures a long life, smooth running and low noise.

TECHNICAL DATA

Outlines

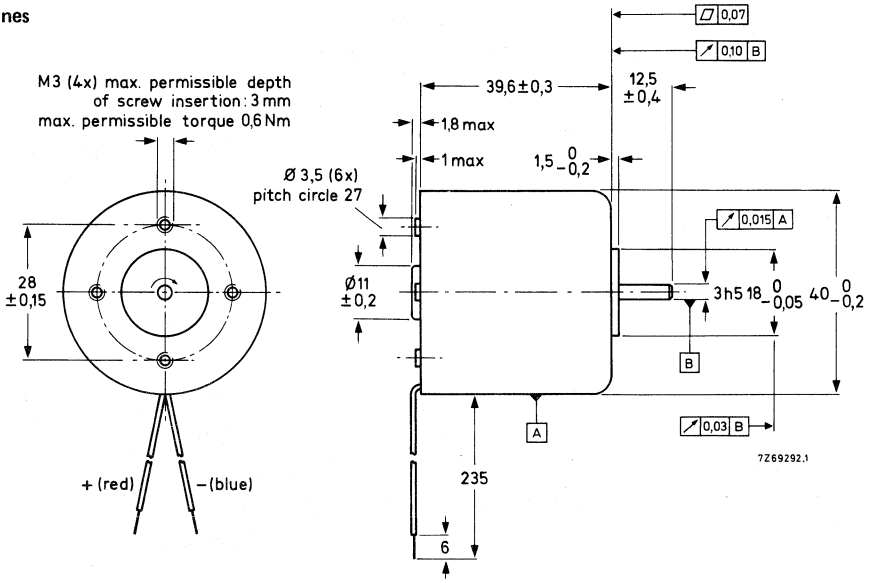


Fig. 1.

The direction of rotation is given in connection with the polarity.

Mass approx. 205 g

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

	4322 010 75110	4322 010 75060	
Nominal voltage (d.c.)	12	24	V
Nominal torque	10	10	mNm
Speed at nominal load	2815 ± 385	2815 ± 385	rev/min
at no load	3310 ± 460	3310 ± 460	rev/min
Current at nominal load	max. 365	max. 180	mA
at no load	max. 30	max. 15	mA
Starting torque	70 ± 17	70 ± 17	mNm
Input power	max. 4,3	max. 4,3	W
Specific input current	25,1 to 33,1	12,5 to 16,6	mA/mNm
Induced voltage	3,17 to 4,17	6,33 to 8,33	mV per rev/min
Rotor resistance	6,2 ± 10%	24,5 ± 10%	Ω
Direction of rotation	reversible	reversible	
Ambient temperature range	–5 to + 70	–5 to + 70	°C
Rotor moment of inertia	39,2	39,2	gcm^2
Motor constant	typ. 19,6	typ. 19,6	ms

	4322 010 75110	4322 010 75060	
Bearings	slide bearings	slide bearings	
Maximum radial force			
8 mm from mounting plane	5	5	N
Maximum axial force*	0,5	0,5	N
Maximum axial play	0,6	0,6	mm
Housing material	steel	steel	

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

	4322 010 75110	4322 010 75060	
Maximum voltage (d.c.)	15	30	V
Maximum permissible load	20	20	mNm
Maximum permissible current	550	275	mA
Maximum speed	4000	4000	rev/min
Maximum output power	5	5	W
Locked rotor	max. 2 min at 12 V	max. 2 min at 24 V	

* Directed towards the connections.

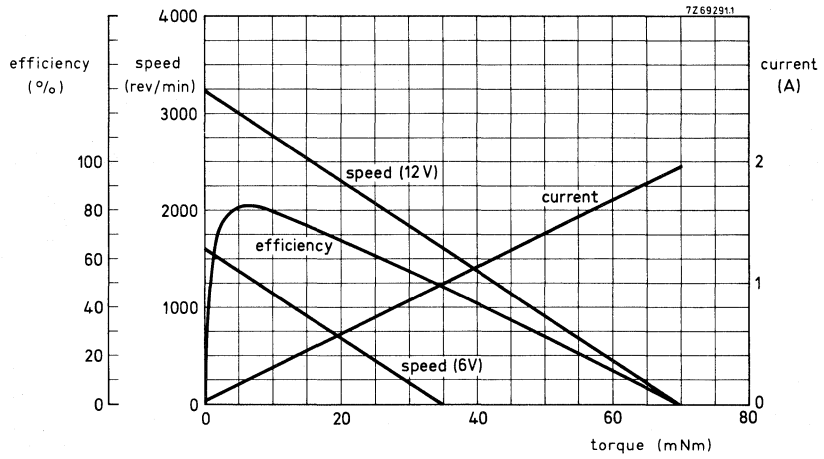


Fig. 2 Typical curves of motor 4322 010 75110 at 12 V and 6 V, T_{amb} = 20 °C.

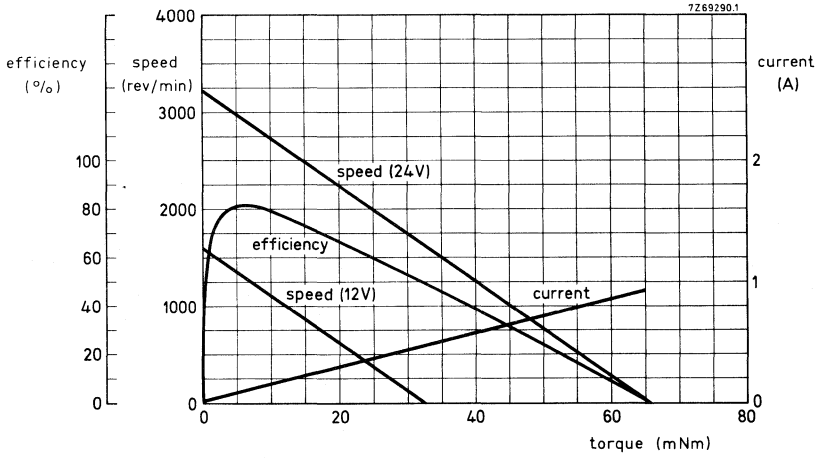


Fig. 3 Typical curves of motor 4322 010 75060 at 24 V and 12 V, T_{amb} = 20 °C.

DIRECT CURRENT MOTORS

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 4322 010 75130	15 V
motor 4322 010 75300	30 V
Nominal speed	3000 rev/min
Nominal torque	22 mNm

APPLICATION

These motors have been designed for heavy duty applications which require high acceleration and many start/stops. There is no magnetic holding torque thus the motors are extremely smooth running.

Examples:
- digital cassette and cartridge recorders;
- printers (head drive, head positioner, paper drive etc.);
- recording measuring instruments.

DESCRIPTION

The motors owe their special characteristics to the following design:

- ironless rotor with oblique winding;
- the low moment of inertia and the high starting torque yield a time constant of no more than 22 ms;
- the robust commutator/brush construction (silver-palladium-plated commutator with 9 segments and silver-plated brushes) and the built-in interference suppression system make the motor suitable for heavy duty applications;
- the commutator/brush construction together with the sintered slide bearings with extra oil reservoirs, ensure a long life, smooth running and a low audible and electrical noise level.

Motor 4322 010 75130 has a spindle at both sides.

TECHNICAL DATA

Outlines

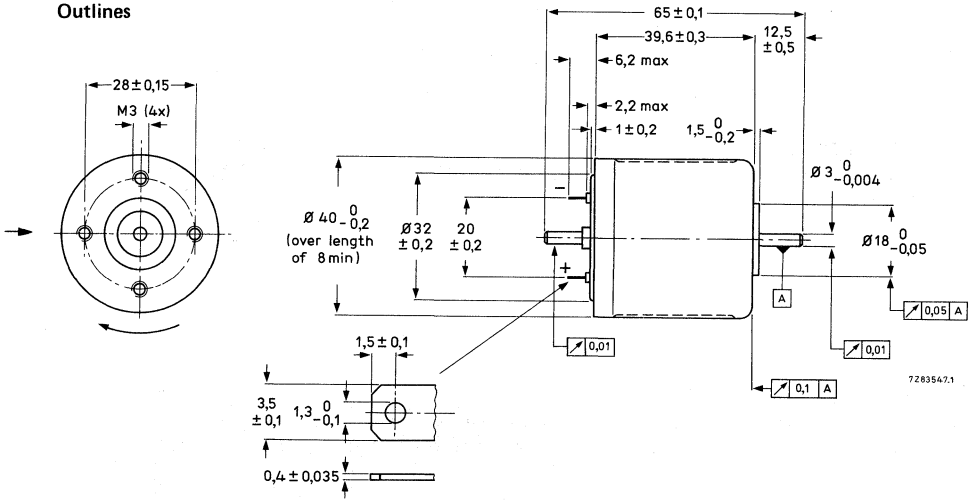


Fig. 1 Type 4322 010 75130.

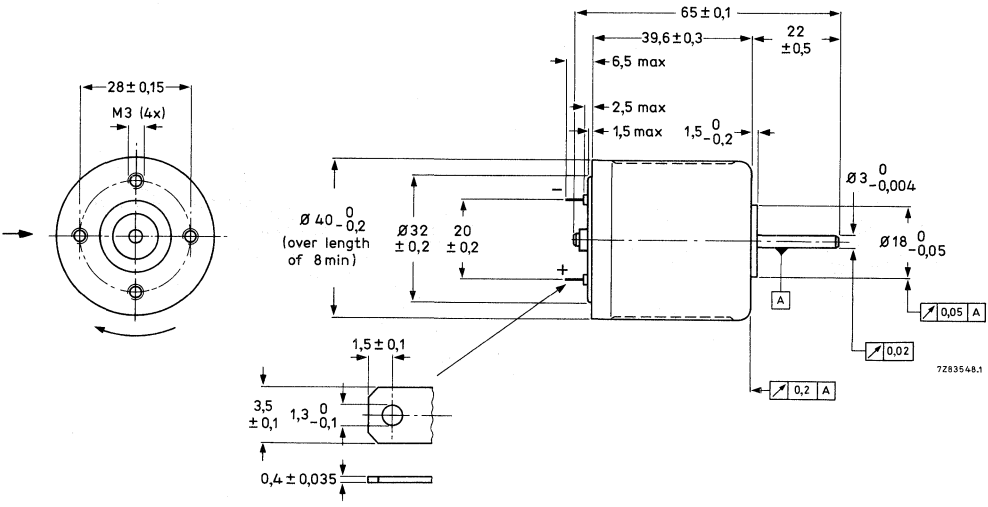


Fig. 2 Type 4322 010 75300.

The direction of rotation is given in connection with the polarity.

Mass approximately 200 g.

Mounting

The motor is front mounted by means of four M3 screws. Permissible depth of screw insertion maximum 3 mm. Maximum permissible torque 0,6 Nm.

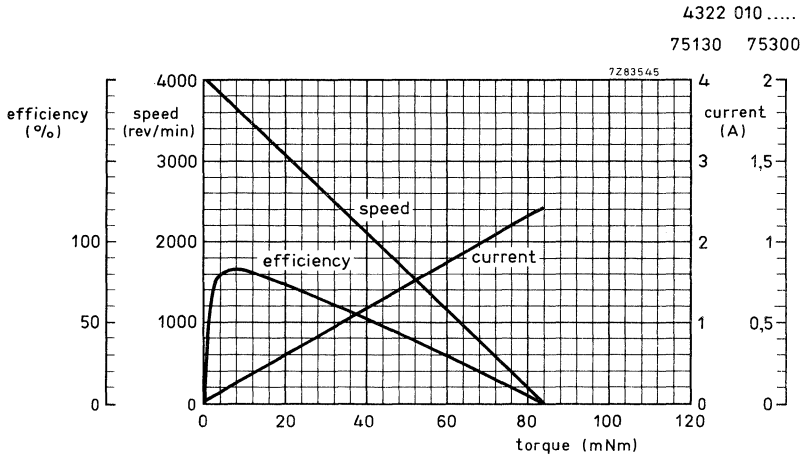


Fig. 3 Typical curves at 15 V (4322 010 75130) and 30 V (4322 010 75300), T_{amb} = 22 °C.

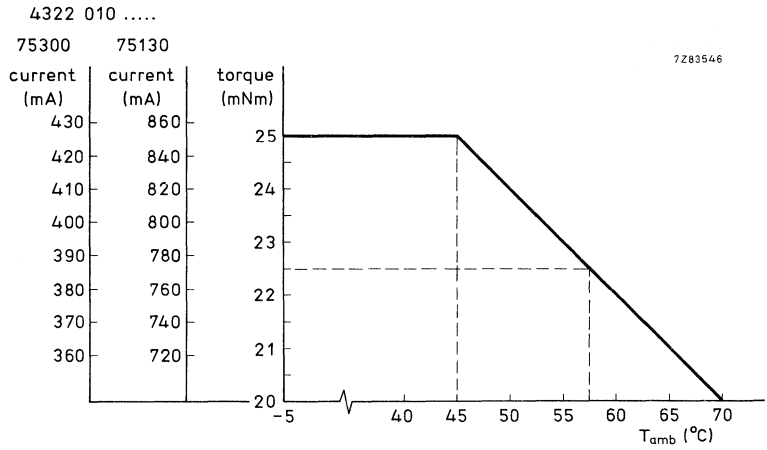


Fig. 4 Maximum permissible torque and current versus ambient temperature, motor mounted on a heatsink.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

	4322 010 75130	4322 010 75300	
Nominal voltage (d.c.)	15	30	V
Nominal torque	22	22	mNm
Speed	see Fig. 3	see Fig. 3	
Bearings	slide	slide	
Direction of rotation	reversible	reversible	
Climatic category (IEC 68)	05/060/21	05/060/21	
E.M.F. at 3000 rev/min	9,5 to 12,5	19 to 25	V
Rotor resistance	6,2 ± 10%	24,5 ± 10%	Ω
Current at nominal voltage			
at nominal torque	565-770	280-385	mA
at no load	max. 40	max. 20	mA
at a radial force of 5 N at 10 mm from mounting plane	max. 156	max. 78	mA
Insulation between terminals and housing	min. 2	min. 2	MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250	250	V
Torque constant	e.m.f./100π	e.m.f./100π	Nm/A
Starting torque at nominal voltage	min. 65	min. 65	mNm
Rotor inductance	0,8	3,3	mH
Rotor moment of inertia	$4{,}33 \times 10^{-6}$	$4{,}33 \times 10^{-6}$	kg m^2
Mechanical time constant	22	22	ms
Radio interference	see section General		
Ambient temperature range			
operating	−5 to + 60	−5 to + 60	°C
storage	−40 to + 70	−40 to + 70	°C
Temperature coefficient of			
rotor resistance	0,4	0,4	%/K
e.m.f.	−0,02	−0,02	%/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

	4322 010 75130	4322 010 75300	
Voltage	18	36	V
Torque	see Fig. 4	see Fig. 4	
Current	see Fig. 4	see Fig. 4	
Repetitive peak current, 10 ms, 1 Hz	2500	1250	mA
Speed	4000	4000	rev/min
Output power	8,5	8,5	W
Continuous blocking, mounted on heatsink of 150 x 150 x 3 mm permitted at	6,7	13,4	V
Radial force	7	7	N
Axial force (pulling only)	0,5	0,5	N

DIRECT CURRENT MOTOR

ironless rotor type with frequency tachogenerator

QUICK REFERENCE DATA

Motor		Tachogenerator	
Nominal voltage (d.c.)	24 V	Number of pole pairs	72
Nominal speed	2800 rev/min	Generated voltage at 3000 rev/min	⩾ 650 mV
Nominal torque	10 mNm	Frequency wobble at 3150 Hz	⩽ 0,11 %

APPLICATION

This motor-tachogenerator combination has been designed for applications which require a direct current drive system the speed of which can be controlled in a very accurate and reliable way, and where high acceleration, high efficiency and smooth running are preferred.

Examples:
- hi-fi reel-to-reel recorders (capstan drive);
- video recorders (capstan, reel and drum drive);
- digital cassette and cartridge recorders;
- card readers;
- recording measuring instruments.

DESCRIPTION

The motor has an ironless rotor with oblique winding. The low moment of inertia (41 gcm^2) and the high starting torque (69 mNm) yield a time constant of no more than 20 ms.

A gold-plated commutator with 9 segments and three-piece silver-plated brushes ensure optimum commutation, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency. The commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level.

The frequency tachogenerator has a gearwheel rotor (72 teeth) which is mounted on the protruding spindle of the motor. The stator consists of a deep drawn steel housing, a magnet strip of plastic-bonded ceramic material which has been magnetized with 72 pole pairs and a coil. The alternating flux, which arises by rotation of the gearwheel in the magnetic field, is enclosed by the coil in which the tacho-generator voltage is generated.The frequency of this tachogenerator voltage is determined by the speed of the motor and the number of pole pairs of the tachogenerator.

TECHNICAL DATA

Outlines

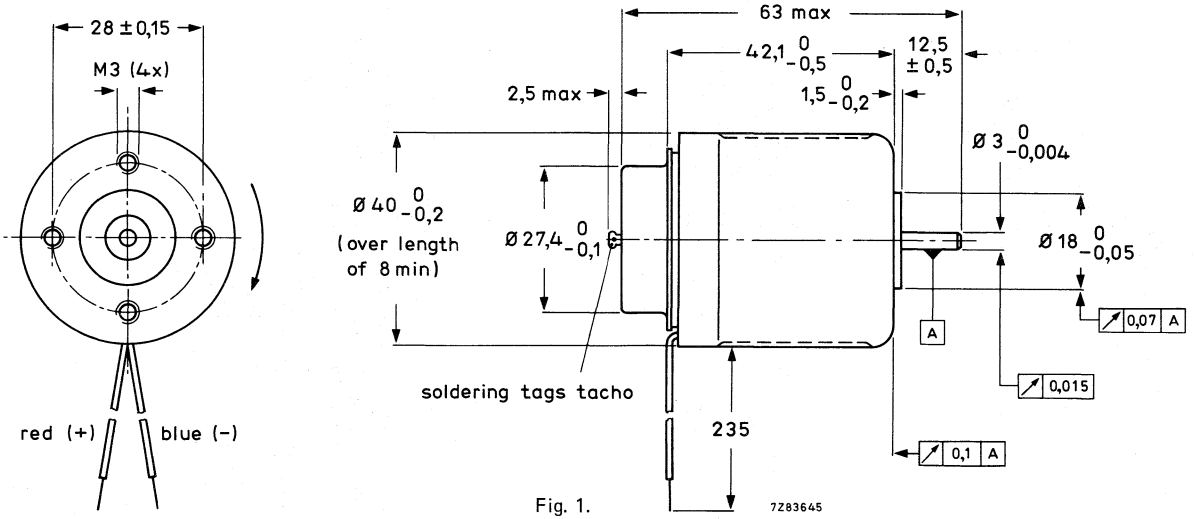


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1). Axial play is 0,2 + 0,4 mm. Position of leads/soldering tags and fixing holes is arbitrary.

The motor is available with other spindle lengths.

Mass approximately 223 g

Mounting

The motor is front mounted by means of four M3 screws. Permissible depth of screw insertion maximum 3 mm. Maximum permissible torque 0,6 Nm.

The values given below apply to an ambient temperature of +22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	24 V
Nominal torque	10 mNm
Speed	see Fig. 2
Bearings	slide
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	19 to 25 V
Rotor resistance	24,5 Ω ± 10%
Current at nominal voltage	
at nominal torque	max. 180 mA
at no load	max. 14,5 mA
at a radial force of 5 N at 8 mm from mounting plane	max. 68 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100π Nm/A
Starting torque at nominal voltage	69 mNm
Rotor inductance	3,3 mH
Rotor moment of inertia	41 gcm^2
Mechanical time constant	20 ms
Audio interference	see Fig. 5
Ambient temperature range	
operating	−10 to +60 °C
storage	−40 to +70 °C
Temperature coefficient of	
rotor resistance	0,4 %/K
e.m.f.	−0,02 %/K

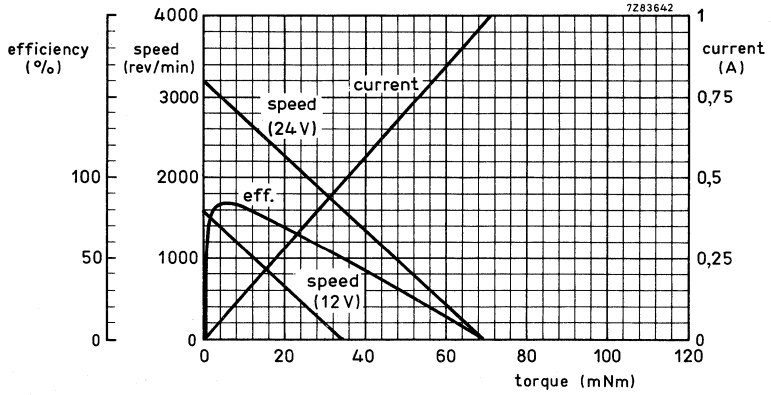


Fig. 2 Typical curves at 24 V, T_{amb} = 22 °C.

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	30 V
Torque	20 mNm
Current	275 mA
Repetitve peak current	1200 mA, 10 ms, 1 Hz
Speed	4000 rev/min
Output power	5 W
Continuous blocking permitted at	10,5 V
Radial force 8 mm from mounting plane	5 N
Axial force	
pressing	0,5 N
pulling	0,5 N

Tachogenerator

Number of pole pairs	72
Generated voltage (r.m.s.) at 3000 rev/min	min. 650 mV, see also Fig. 4
Amplitude variation for 1 revolution ($E_{l.f.}/E_p$ x 100%) (see Fig. 3)	max. 15%
Frequency	72n/60 Hz (n = number of rev/min)
Frequency wobble at 3150 Hz*	max. 0,11%
Resistance	775 Ω
Inductance	0,5 H

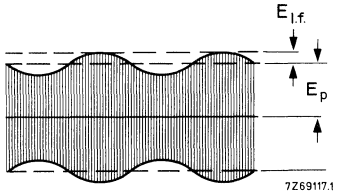


Fig. 3.

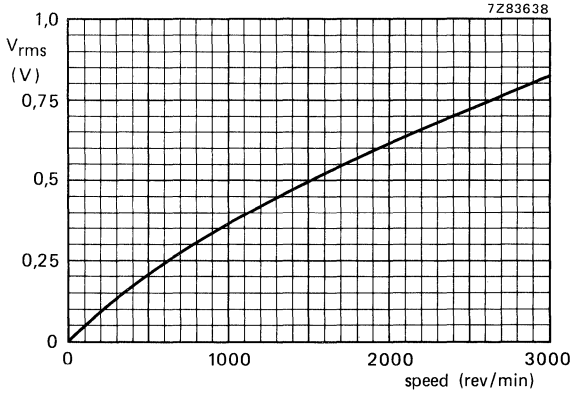


Fig. 4 Tachogenerator voltage as a function of the speed.

* Measured with EMT measuring instrument type 424 (position "linear") or equivalent. For additional information see section "General".

AUDIO INTERFERENCE

Measuring procedure

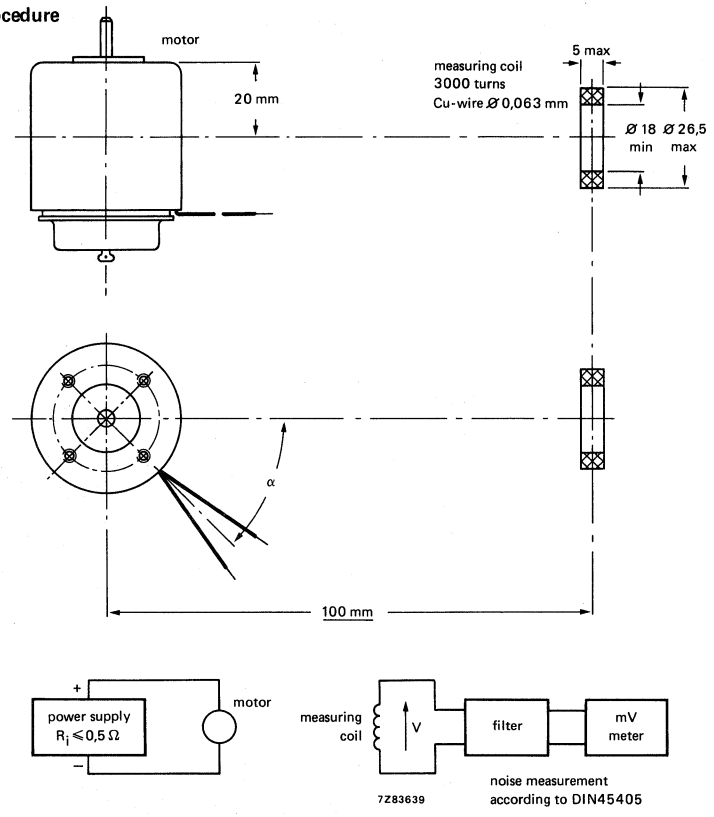


Fig. 5.

Motor voltage 24 V

Preferred direction of rotation (positive voltage to + terminal)

Torque 10 mNm

α is varied until maximum voltage is obtained

$V_{p\text{-}p}$ = max. $8 \times 2\sqrt{2}$ mV

→ Minimum packing quantity 48 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	24 V
Nominal speed	2800 rev/min
Nominal torque	10 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running and accurate speed control by an electronic speed control unit.

Examples:

- hi-fi-cassette recorders
- video cassette recorders
- digital cassette and cartridge recorders
- recording measuring instruments
- telephone answering equipment
- dictating machines
- echo sounders
- printers

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 20 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

The above mentioned commutator/brush construction together with the ball bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions and high radial load.

TECHNICAL DATA

Outlines

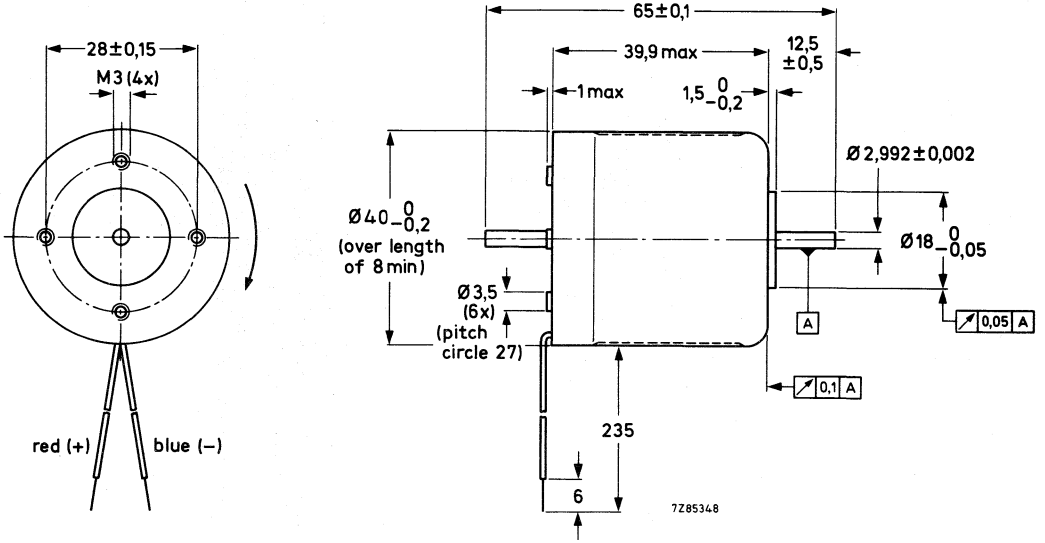


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1); Position of leads and fixing holes is arbitrary.

The motor is available with other spindle lengths.

Mass approximately 205 g

Mounting

The motor is front mounted by means of four M3 screws. Permissible depth of screw insertion maximum 3 mm. Maximum permissible torque 0,6 Nm.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	24 V
Nominal torque	10 mNm
Speed	see Fig. 2
Bearings	ball
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	19 to 25 V
Rotor resistance	24,5 Ω ± 10%
Current at nominal voltage	
at nominal torque	125-181 mA
at no load	max. 13 mA
at a radial force of 5 N at 8 mm from mounting plane	max. 50 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100π Nm/A
Starting torque at nominal voltage	68 mNm
Rotor inductance	3,3 mH
Rotor moment of inertia	39,2 gcm^2
Mechanical time constant	20 ms
Audio interference	see Fig. 5
Ambient temperature range	
operating	−10 to + 60 °C
storage	−40 to + 70 °C
Temperature coefficient of	
rotor resistance	0,4%/K
e.m.f.	−0,02%/K

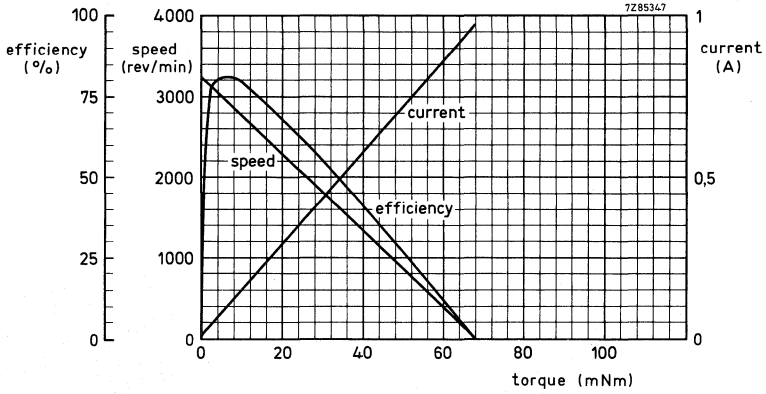


Fig. 2 Typical curves at 24 V, T_{amb} = 22 °C.

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	30 V
Torque	20 mNm
Current	275 mA
Repetitive peak current	1200 mA, 10 ms, 1 Hz
Speed	4000 rev/min
Output power	5 W
Continuous blocking permitted at	10,5 V
Radial force 8 mm from mounting plane	10 N
Axial force	
pressing	5 N
pulling	5 N

AUDIO INTERFERENCE

Measuring procedure

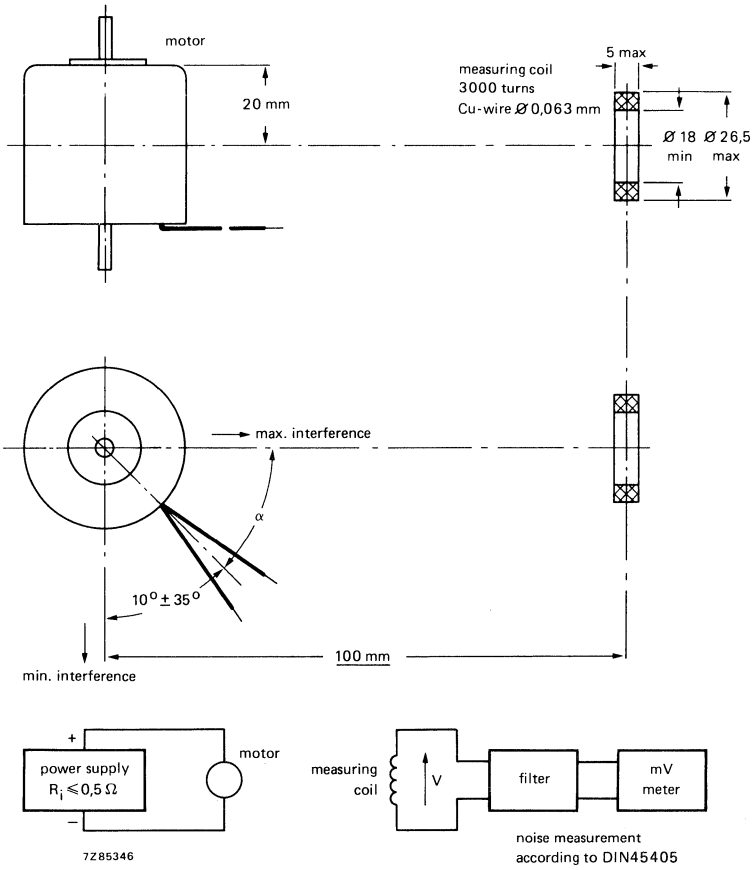


Fig. 3.

Motor speed 3000 rev/min
Preferred direction of rotation (positive voltage to + terminal)
Torque 10 mNm
α is varied until maximum voltage is obtained
$V_{p\text{-}p}$ = max. 7,0 x $2\sqrt{2}$ mV

Minimum packing quantity 48 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	24 V
Nominal speed	2800 rev/min
Nominal torque	10 mNm

APPLICATION

This motor has been designed for applications which require high acceleration, high efficiency and smooth running (no magnetic holding torque).

Examples:

- hi-fi reel-to-reel recorders (capstan and reel drive)
- hi-fi cassette recorders (reel drive)
- video recorders (capstan, reel and drum drive)
- digital cassette and cartridge recorders
- card readers
- printers (paper transport and head positioner)
- recording measuring instruments

DESCRIPTION

The motor owes its special characteristics to the following design:

- ironless rotor with oblique winding;
- the low moment of inertia and the high starting torque yield a time constant of no more than 20 ms;
- a precious-metal-plated commutator with 9 segments and three-piece silver-plated brushes ensure optimum commutation, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator;
- the powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency;
- the above-mentioned commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level.

TECHNICAL DATA

Outlines

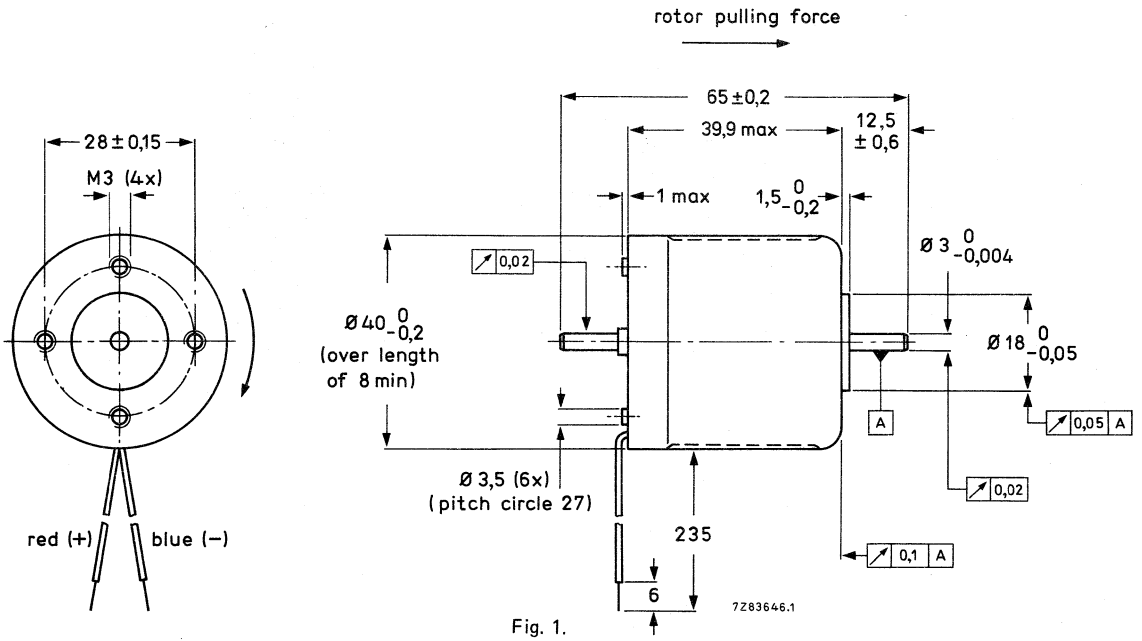


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1). Axial play is 0,2 + 0,4 mm.
Position of leads and fixing holes is arbitrary.

The motor is available with other spindle lengths.

Mass 205 g approximately.

Mounting

The motor is front mounted by means of four M3 screws. Permissible depth of screw insertion maximum 3 mm. Maximum permissible torque 0,6 Nm.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	24 V
Nominal torque	10 mNm
Speed	see Fig. 2
Bearings	slide
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	19 – 21,4 V
Rotor resistance	24,5 Ω ± 10%
Current at nominal voltage	
at nominal torque	150 – 185 mA
at no load	max. 21 mA
at a radial force of 5 N at 8 mm from mounting plane	max. 80 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100 π Nm/A
Starting torque at nominal voltage	61 mNm
Rotor inductance	3,3 mH
Rotor moment of inertia	39,2 gcm^2
Mechanical time constant	20 ms
Ambient temperature range	
operating	−10 to + 60 °C
storage	−40 to + 70 °C
Temperature coefficient of	
rotor resistance	0,4%/K
e.m.f.	−0,02 %/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	30 V
Torque	20 mNm
Current	275 mA
Repetitive peak current	1200 mA, 10 ms, 1 Hz
Speed	4000 rev/min
Output power	5 W
Continuous blocking permitted at	10 V
Radial force 8 mm from mounting plane	7 N
Axial force	0,4 N

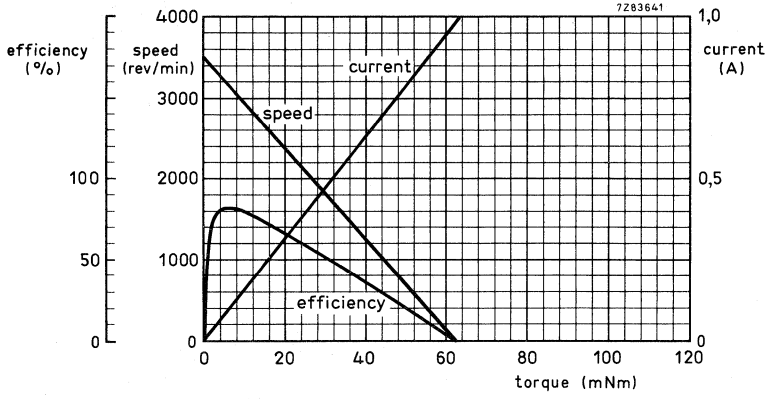


Fig. 2 Typical curves at 24 V, T_{amb} = 22 °C.

→ Minimum packing quantity 48 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	12 V
Nominal speed	3200 rev/min
Nominal torque	5 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running and accurate speed control by an electronic speed control unit.

Examples:

- hi-fi cassette recorders
- video cassette recorders
- digital cassette and cartridge recorders
- recording measuring instruments
- telephone answering equipment
- dictating machines
- echo sounders
- printers

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 12 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

The above mentioned commutator/brush construction together with the ball bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions.

TECHNICAL DATA

Outlines

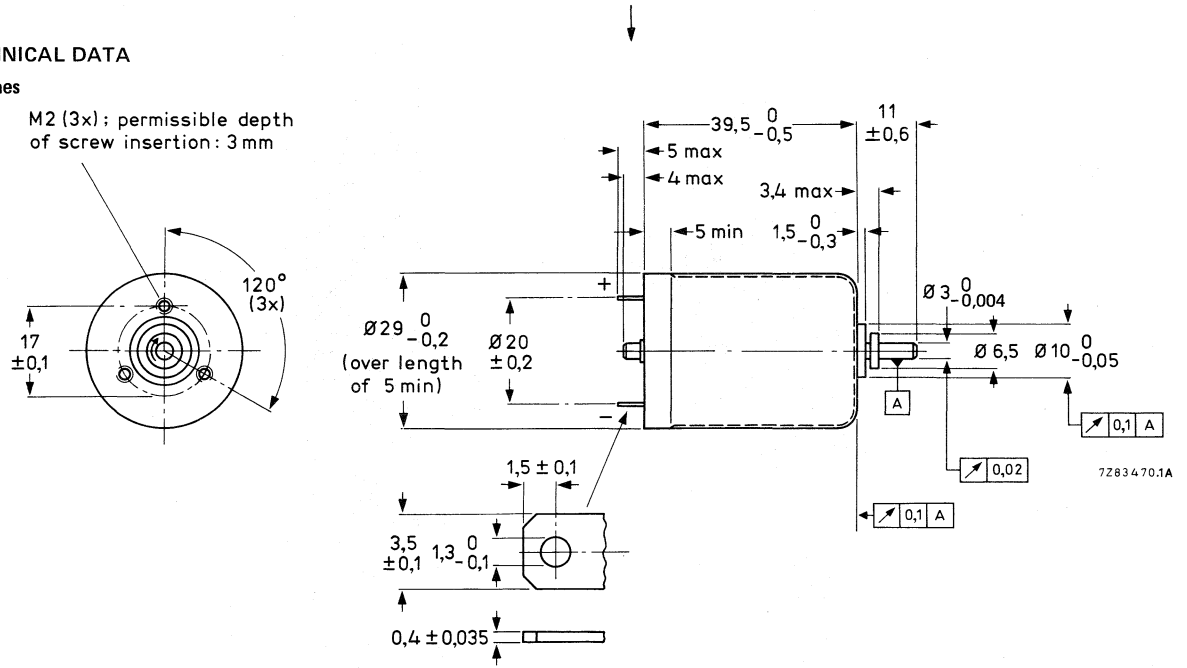


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1).
The position of the soldering tags with respect to that of the mounting holes is arbitrary.
The motor is available with other spindle lengths.

Mass approximately 120 g.

Mounting

The motor is front mounted by means of three M2 screws. Permissible depth of screw insertion maximum 3 mm.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	12 V
Nominal torque	5 mNm
Speed	see Fig. 2
Bearings	ball
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	8,1 – 10,1 V
Rotor resistance	12 Ω ± 10%
Current at nominal voltage	
at nominal torque	170 – 230 mA
at no load	max. 50 mA
at a radial force of 3,5 N at 8 mm from mounting plane	max. 70 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100 π Nm/A
Starting torque at nominal voltage	29 mNm
Rotor inductance	1 mH
Rotor moment of inertia	0,9 x 10^{-6} kgm^2
Mechanical time constant	12 ms
Audio interference	see Fig. 3
Radio interference	see section General
Ambient temperature range	
operating	−10 to + 60 °C
storage	−40 to + 70 °C
Temperature coefficient of	
rotor resistance	0,4 %/K
e.m.f.	−0,02 %/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	15 V
Torque	8 mNm
Current	325 mA
Repetitive peak current	1100 mA, 10 ms, 1 Hz
Speed	6000 rev/min
Output power	3 W
Continuous blocking permitted at	6,5 V
Radial force 8 mm from mounting plane	10 N
Axial force	5 N

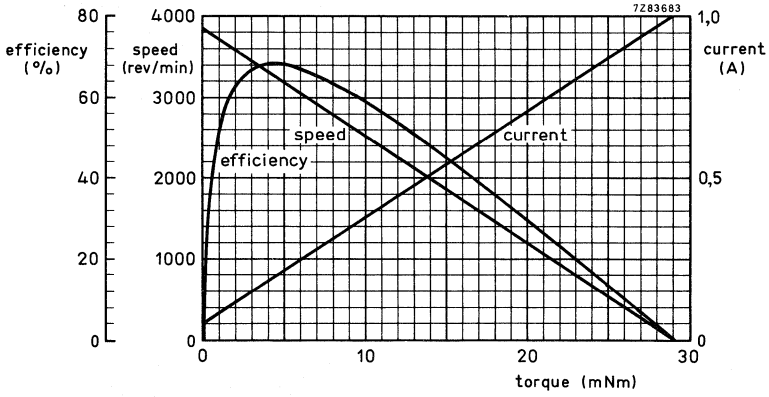


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C.

AUDIO INTERFERENCE

Measuring procedure

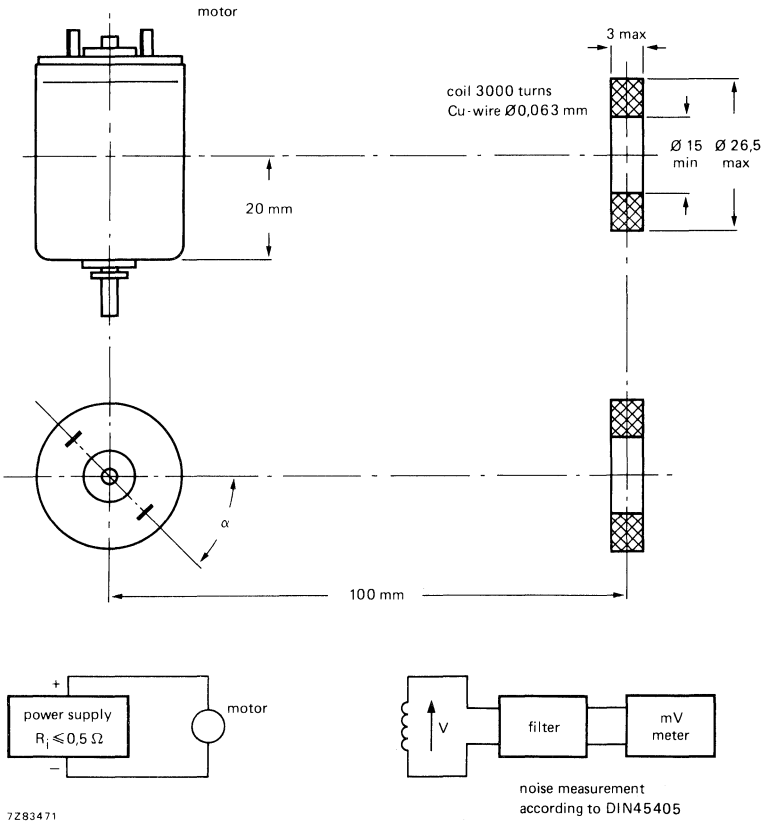


Fig. 3.

Motor speed 3000 rev/min.
Preferred direction of rotation (positive voltage to + terminal).
Current 190 mA.
α is varied until maximum voltage is obtained.
$V_{p\text{-}p}$ = max. 4,4 x $2\sqrt{2}$ mV.

Minimum packing quantity 102 items per cardboard box.

DIRECT CURRENT MOTORS

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 4322 010 76050	12 V
motor 4322 010 76150	24 V
Nominal speed	3000 rev/min
Nominal torque	5 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running and accurate speed control by an electronic speed control unit.

Examples:

- hi-fi cassette recorders
- video cassette recorders
- digital cassette and cartridge recorders
- recording measuring instruments
- telephone answering equipment
- dictating machines
- echo sounders
- printers

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 11 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

The above mentioned commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions.

TECHNICAL DATA

Outlines

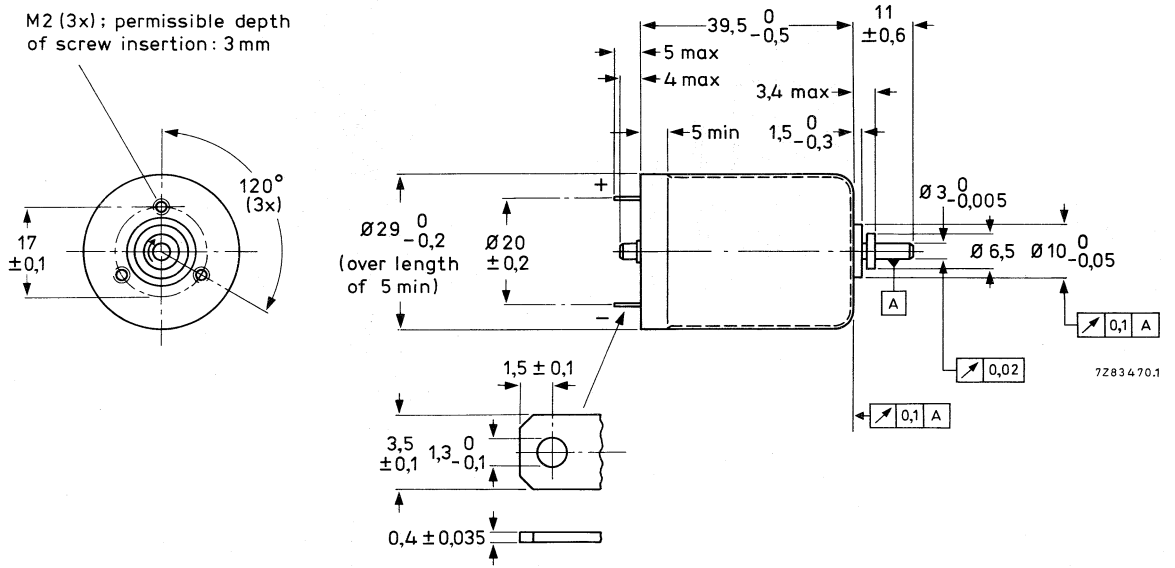


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1).
The position of the soldering tags with respect to that of the mounting holes is arbitrary.
The motor is available with other spindle lengths.

Mass approximately 120 g.

Mounting

The motor is front mounted by means of three M2 screws. Permissible depth of screw insertion maximum 3 mm.

The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

	4322 010 76050	4322 010 76150	
Nominal voltage (d.c.)	12	24	V
Nominal torque	5	5	mNm
Speed	see Fig. 2	see Fig. 2	
Bearings	slide	slide	
Direction of rotation	reversible	reversible	
Climatic category (IEC 68)	10/060/21	10/060/21	
E.M.F. at 3000 rev/min	8,4-10,8	16,8-21,6	V
Rotor resistance	12 ± 10%	47 ± 10%	Ω
Current at nominal voltage			
at nominal torque	164-238	82-119	mA
at no load	max. 56	max. 28	mA
at a radial force of 3,5 N at 8 mm from mounting plane	max. 110	max. 55	mA
Insulation between terminals and housing	min. 2	min. 2	MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250	250	V
Torque constant	e.m.f./100π	e.m.f./100π	Nm/A
Starting torque at nominal voltage	30	30	mNm
Rotor inductance	1	4,1	mH
Rotor moment of inertia	$0{,}9 \times 10^{-6}$	$0{,}9 \times 10^{-6}$	kg m^2
Mechanical time constant	11,0	11,0	ms
Audio interference	see Fig. 3	see Fig. 3	
Radio interference	see section General		
Ambient temperature range			
operating	−10 to +60	−10 to +60	°C
storage	−40 to +70	−40 to +70	°C
Temperature coefficient of			
rotor resistance	0,4	0,4	%/K
E.M.F.	−0,02	−0,02	%/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

	4322 010 76050	4322 010 76150	
Voltage	15	30	V
Torque	8	8	mNm
Current	325	162	mA
Repetitive peak current, 10 ms, 1 Hz	1100	550	mA
Speed	6000	6000	rev/min
Output power	3	3	W
Continuous blocking permitted at	6,2	12,5	V
Radial force	5	5	N
Axial force	0,5	0,5	N

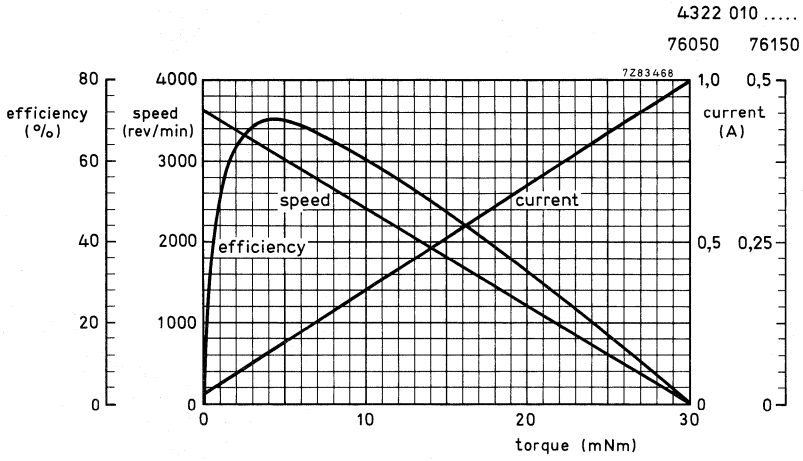


Fig. 2 Typical curves at 12 V (4322 010 76050) and 24 V (4322 010 76150), T_{amb} = 22 °C.

AUDIO INTERFERENCE

Measuring procedure

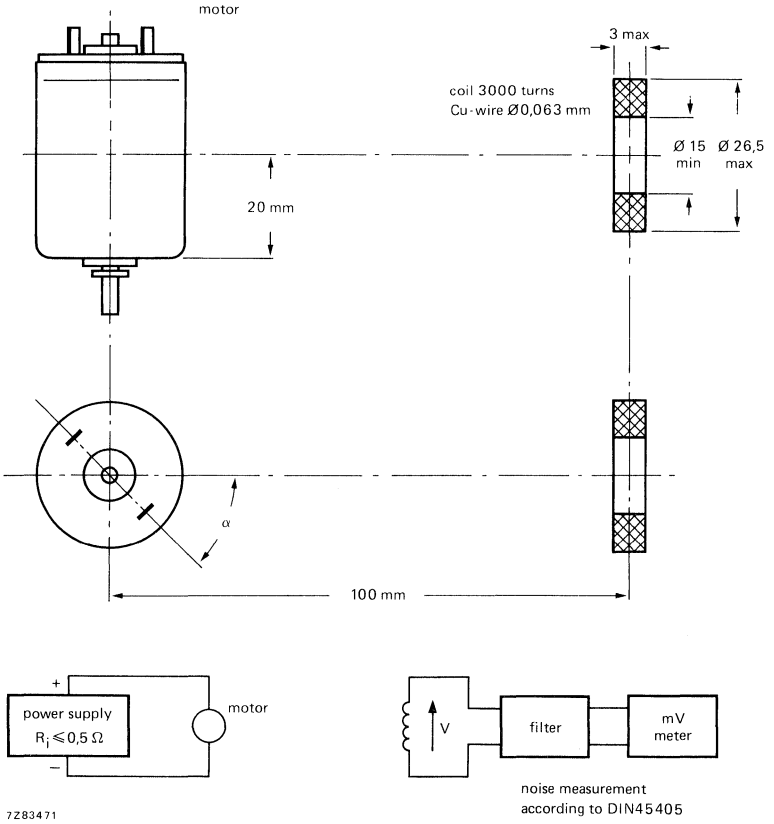


Fig. 3.

Motor speed 3000 rev/min.

Preferred direction of rotation (positive voltage to + terminal).
Current 195 mA (4322 010 76050) or 97 mA (4322 010 76150).
α is varied until maximum voltage is obtained.
$V_{p\text{-}p}$ = max. 4,4 x $2\sqrt{2}$ mV.

Minimum packing quantity 102 items per cardboard box.

DIRECT CURRENT MOTOR
ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 4322 010 76060	12 V
motor 4322 010 76080	24 V
Nominal speed	3900 rev/min
Nominal torque	5 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running and accurate speed control by an electronic speed control unit.

Examples:
- hi-fi cassette recorders
- video cassette recorders
- digital cassette and cartridge recorders
- recording measuring instruments
- telephone answering equipment
- dictating machines
- echo sounders
- printers

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 22 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

The above mentioned commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions.

TECHNICAL DATA

Outlines

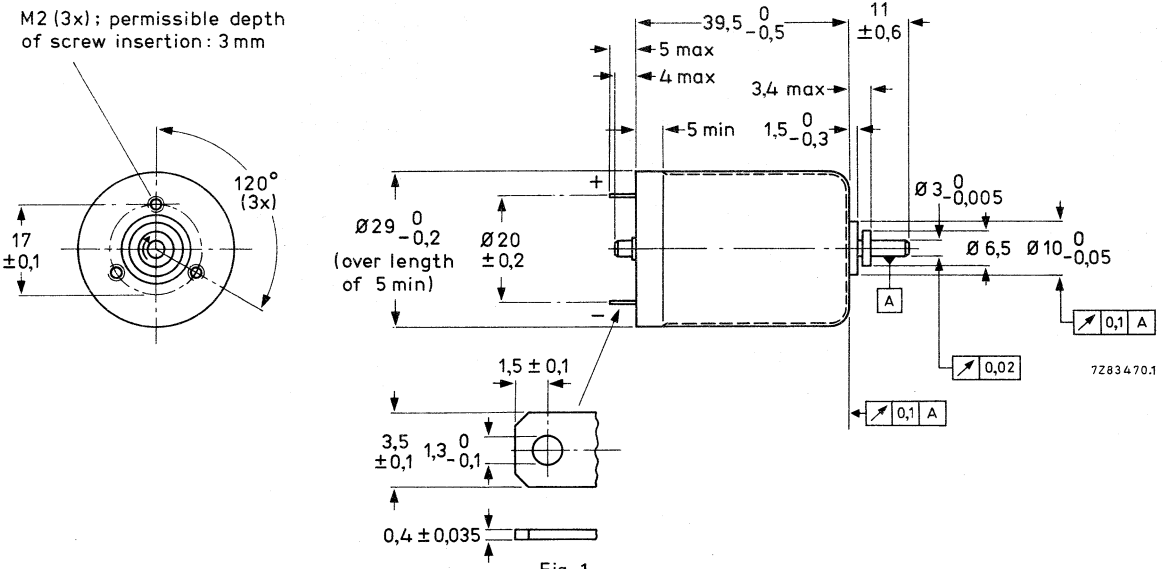


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1).
The position of the soldering tags with respect to that of the mounting holes is arbitrary.
The motor is available with other spindle lengths.

Mass approximately 120 g.

Mounting

The motor is front mounted by means of three M2 screws. Permissible depth of screw insertion maximum 3 mm.

The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

	4322 010 76060	4322 010 76080	
Nominal voltage (d.c.)	12	24	V
Nominal torque	5	5	mNm
Speed	see Fig. 2	see Fig. 2	
Bearings	slide	slide	
Direction of rotation	reversible	reversible	
Climatic category (IEC 68)	10/060/21	10/060/21	
E.M.F. at 3000 rev/min	6,0-7,85	12,0-15,7	V
Rotor resistance	12 ± 10%	47 ± 10%	Ω
Current at nominal voltage			
at nominal torque	222-326	111-163	mA
at no load	max. 74	max. 37	mA
at a radial force of 3,5 N at 8 mm from mounting plane	max. 138	max. 72	mA
Insulation between terminals and housing	min. 2	min. 2	MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250	250	V
Torque constant	e.m.f./100π	e.m.f./100π	Nm/A
Starting torque at nominal voltage	22	22	mNm
Rotor inductance	1	4,1	mH
Rotor moment of inertia	$0,9 \times 10^{-6}$	$0,9 \times 10^{-6}$	kg m^2
Mechanical time constant	22	22	ms
Audio interference	see Fig. 3	see Fig. 3	
Radio interference	see section General		
Ambient temperature range			
operating	−10 to +60	−10 to +60	°C
storage	−40 to +70	−40 to +70	°C
Temperature coefficient of			
rotor resistance	0,4	0,4	%/K
e.m.f.	−0,02	−0,02	%/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

	4322 010 76060	4322 010 76080	
Voltage	13,5	27	V
Torque	6,5	6,5	mNm
Current	375	190	mA
Repetitive peak current, 10 ms, 1 Hz	1100	570	mA
Speed	6000	6000	rev/min
Output power	2,5	2,5	W
Continuous blocking permitted at	6,2	12,5	V
Radial force	5	5	N
Axial force	0,5	0,5	N

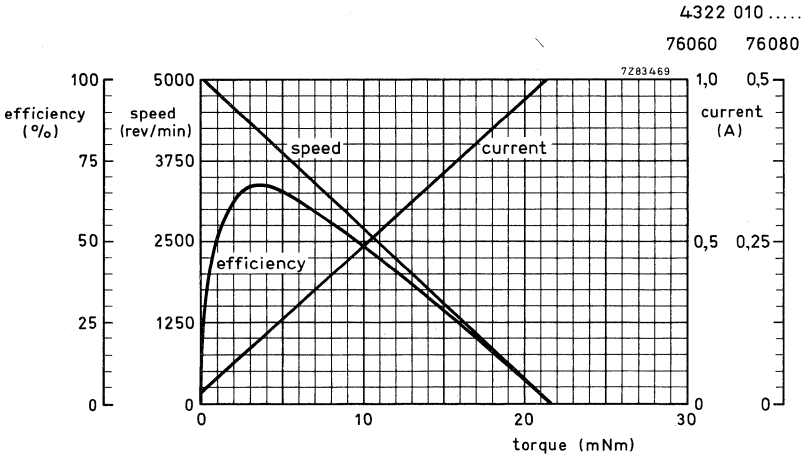
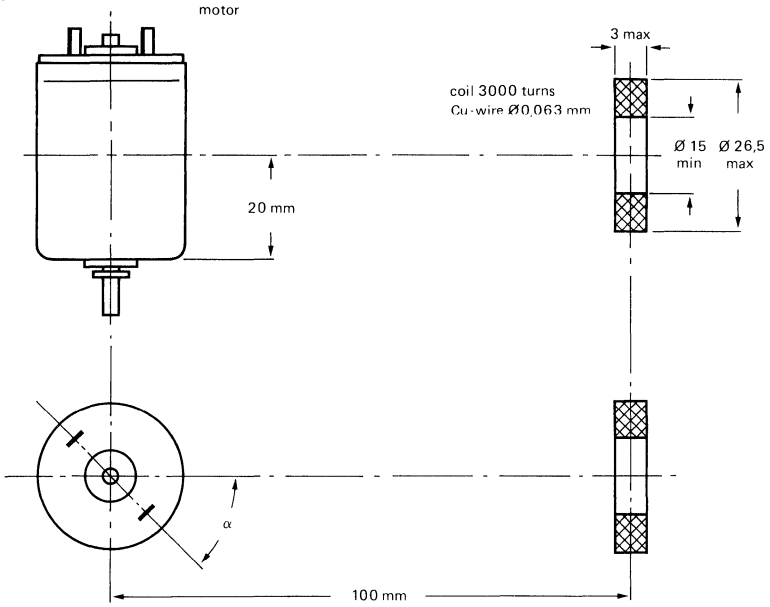
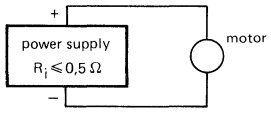


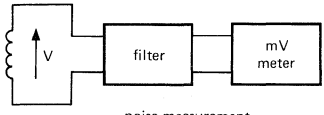
Fig. 2 Typical curves at 12 V (4322 010 76060) and 24 V (4322 010 76080), T_{amb} = 22 °C.

AUDIO INTERFERENCE

Measuring procedure







noise measurement according to DIN45405

7Z83471

Fig. 3.

Motor speed 3900 rev/min.

Preferred direction of rotation (positive voltage to + terminal).

Current 260 mA (4322 010 76060) or 130 mA (4322 010 76080).

α is varied until maximum voltage is obtained.

$V_{p\text{-}p}$ = max. 4,2 x $2\sqrt{2}$ mV.

Minimum packing quantity 102 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type, with frequency tachogenerator

QUICK REFERENCE DATA

Motor		Tachogenerator	
Nominal voltage (d.c.)	12 V	Number of pole pairs	72
Nominal speed	3000 rev/min	Generated voltage at 3000 rev/min	$\geqslant$ 650 mV
Nominal torque	5 mNm	Frequency wobble at 3150 Hz	$\leqslant$ 0,2 %

APPLICATION

This motor-tachogenerator combination has been designed for applications which require a direct current drive system the speed of which can be controlled in a very accurate and reliable way, and where high acceleration, high efficiency and smooth running are preferred.

Examples:

- hi-fi reel-to-reel recorders (capstan drive)
- video recorders (capstan, reel and drum drive)
- digital cassette and cartridge recorders
- card readers
- recording measuring instruments

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 13 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

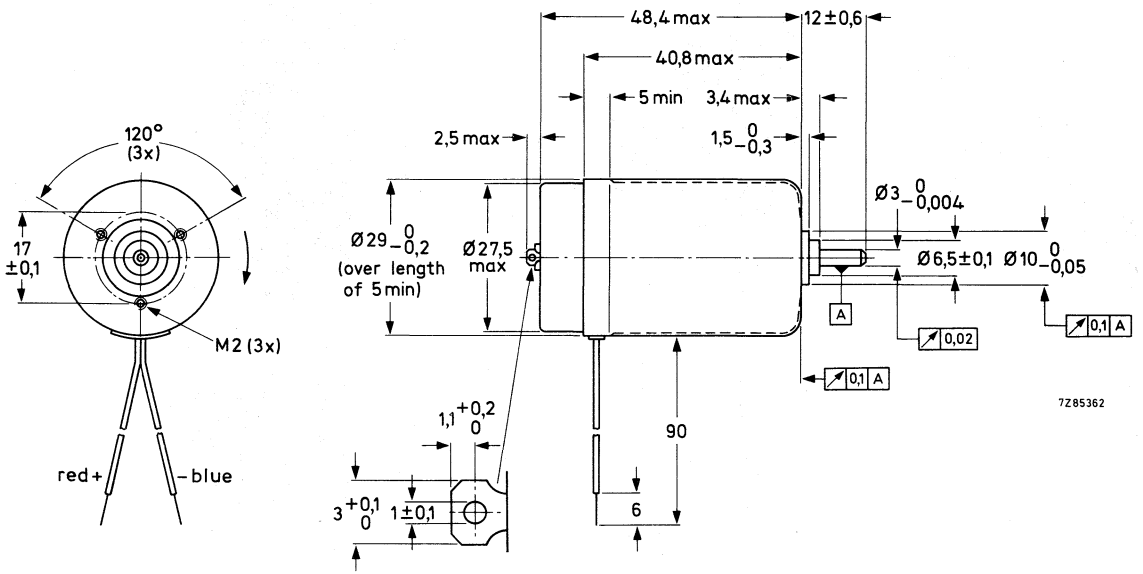
The above mentioned commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions.

The frequency tachogenerator has a gearwheel rotor (72 teeth) which is mounted on the protruding spindle of the motor. The stator consists of a deep drawn steel housing, a magnet strip of plastic-bonded ceramic material which has been magnetized with 72 pole pairs and a coil. The alternating flux, which arises by rotation of the gearwheel in the magnetic field, is enclosed by the coil in which the tacho-generator voltage is generated. The frequency of this tachogenerator voltage is determined by the speed of the motor and the number of pole pairs of the tachogenerator.

TECHNICAL DATA

Dimensions in mm

Outlines



The direction of rotation is given in connection with the polarity (clockwise in Fig. 1). Axial play is 0,2 + 0,3 mm. Position of leads, soldering tags and fixing holes is arbitrary.

The motor is available with other spindle lengths.

Mass approximately 140 g

Mounting

The motor is front mounted by means of three M2 screws. Permissible depth of screw insertion maximum 3 mm.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	12 V
Nominal torque	5 mNm
Speed	see Fig. 2
Bearings	slide
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	8,1 – 10,1 V
Rotor resistance	12 Ω ± 10%
Current at nominal voltage	
at nominal torque	175 – 250 mA
at no load	max. 58 mA
at a radial force of 5 N at 8 mm from mounting plane	max. 145 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100π Nm/A
Starting torque at nominal voltage	28 mNm
Rotor inductance	1 mH
Rotor moment of inertia	10,4 gcm^2
Mechanical time constant	13 ms
Audio interference	see Fig. 5
Ambient temperature range	
operating	–10 to + 60 °C
storage	–40 to + 70 °C
Temperature coefficient of	
rotor resistance	0,4 %/K
e.m.f.	–0,02 %/K

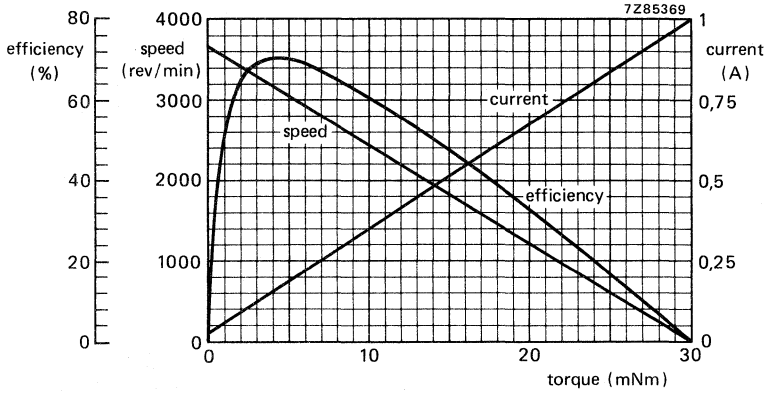


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C.

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	15 V
Torque	8 mNm
Current	325 mA
Repetitive peak current	1100 mA, 10 ms, 1 Hz
Speed	6000 rev/min
Output power	3 W
Continuous blocking permitted at	6,5 V
Radial force 8 mm from mounting plane	5 N
Axial force	
pressing	0,5 N
pulling	0,5 N

Tachogenerator

Number of pole pairs	72
Generated voltage (r.m.s.) at 3000 rev/min	min. 650 mV, see also Fig. 4
Amplitude variation for 1 revolution ($E_{l.f.}/E_p$ x 100%) (see Fig. 3)	max. 15%
Frequency	72n/60 Hz (n = number of rev/min)
Frequency wobble at 3150 Hz *	max. 0,2%
Resistance	775 Ω
Inductance	0,5 H

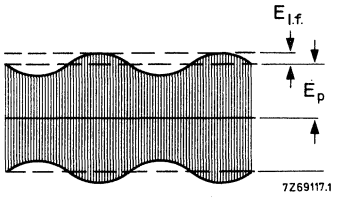


Fig. 3.

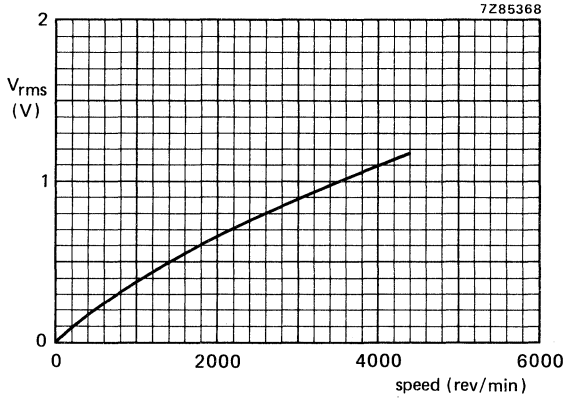


Fig. 4 Tachogenerator voltage as a function of the speed.

For additional information see general section of chapter "Direct current motors".

* Measured with EMT measuring instrument type 424 (position "linear") or equivalent.

AUDIO INTERFERENCE

Measuring procedure

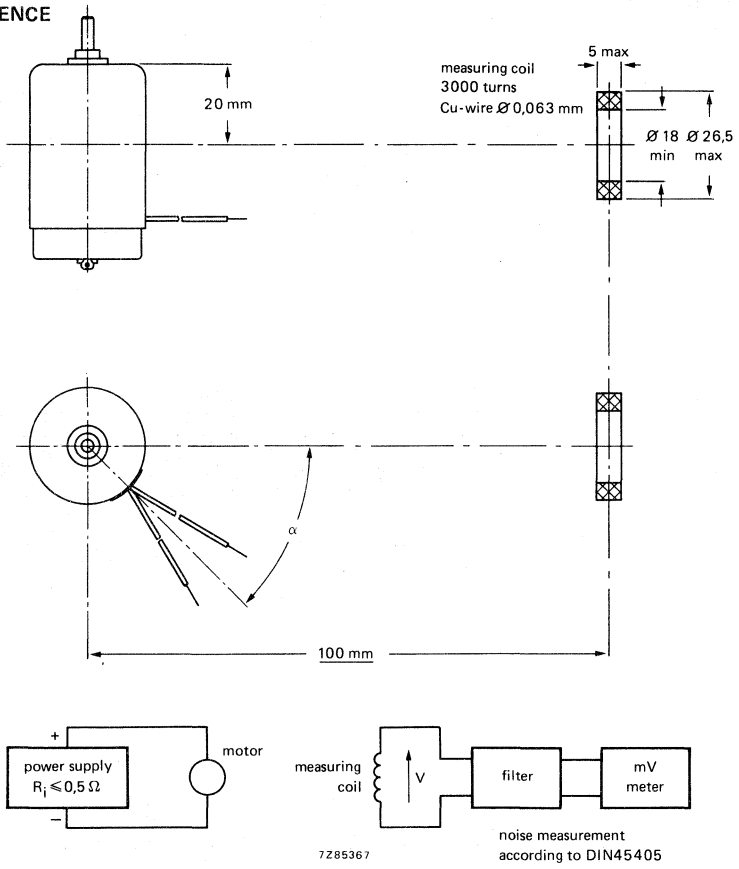


Fig. 5.

Motor speed 3000 rev/min

Preferred direction of rotation (positive voltage to + terminal)

Torque 5 mNm

α is varied until maximum voltage is obtained

$V_{p\text{-}p}$ = max. 4,4 x $2\sqrt{2}$ mV

→ Minimum packing quantity 104 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	9 V
Nominal speed	3500 rev/min
Nominal torque	5 mNm

APPLICATION

These motors have been designed for applications which require low noise level, smooth running and accurate speed control by an electronic speed control unit.

Examples:

- hi-fi cassette recorders
- video cassette recorders
- digital cassette and cartridge recorders
- recording measuring instruments
- telephone answering equipment
- dictating machines
- echo sounders
- printers

DESCRIPTION

The motors have an ironless rotor with oblique windings. The low moment of inertia and the high starting torque yield a mechanical time constant of no more than 13 ms.

A commutator with 9 segments and four-finger brushes ensure optimum commutation by applying a good combination of precious metals, thus making the motor suitable for accurate electronic control and optimum functioning as a servo motor or tachogenerator. The powerful cylindrical steel permanent magnet, around which the rotor rotates, makes for high efficiency.

The above mentioned commutator/brush construction together with the sintered slide bearings ensures a long life, smooth running and low noise level, even under severe climatic conditions.

TECHNICAL DATA

Outlines

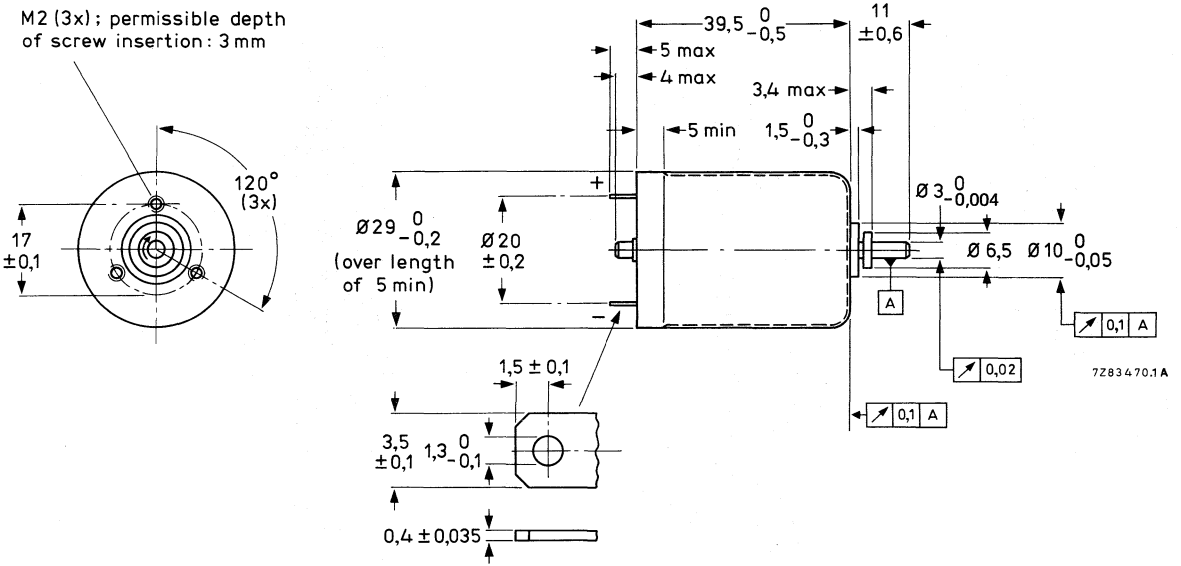


Fig. 1.

The direction of rotation is given in connection with the polarity (clockwise in Fig. 1).
The position of the soldering tags with respect to that of the mounting holes is arbitrary.
The motor is available with other spindle lengths.

Mass approximately 120 g.

Mounting

The motor is front mounted by means of three M2 screws. Permissible depth of screw insertion maximum 3 mm.

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	9 V
Nominal torque	5 mNm
Speed	see Fig. 2
Bearings	slide
Direction of rotation	reversible
Climatic category (IEC 68)	10/060/21
E.M.F. at 3000 rev/min	5,4 - 7,0 V
Rotor resistance	5,8 Ω ± 10%
Current at nominal voltage	
at nominal torque	257 - 377 mA
at no load	max. 96 mA
at a radial force of 3,5 N at 8 mm from mounting plane	max. 187 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (50 Hz) between terminals and housing, for 1 minute	250 V
Torque constant	e.m.f./100 π Nm/A
Starting torque at nominal voltage	29,5 mNm
Rotor inductance	0,5 mH
Rotor moment of inertia	9 gcm^2
Mechanical time constant	13 ms
Audio interference	see Fig. 3
Radio interference	see section General
Ambient temperature range	
operating	−10 to +60 °C
storage	−40 to +70 °C
Temperature coefficient of	
rotor resistance	0,4 %/K
e.m.f.	−0,02 %/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	10 V
Torque	8 mNm
Current	475 mA
Repetitive peak current	1600 mA, 10 ms, 1 Hz
Speed	6000 rev/min
Output power	3 W
Continuous blocking permitted at	4,5 V
Radial force 8 mm from mounting plane	5 N
Axial force	0,5 N

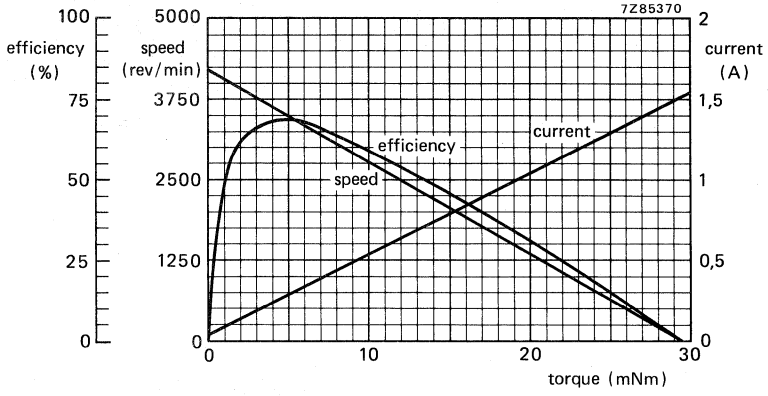


Fig. 2 Typical curves at 9 V, T_{amb} = 22 °C.

AUDIO INTERFERENCE

Measuring procedure

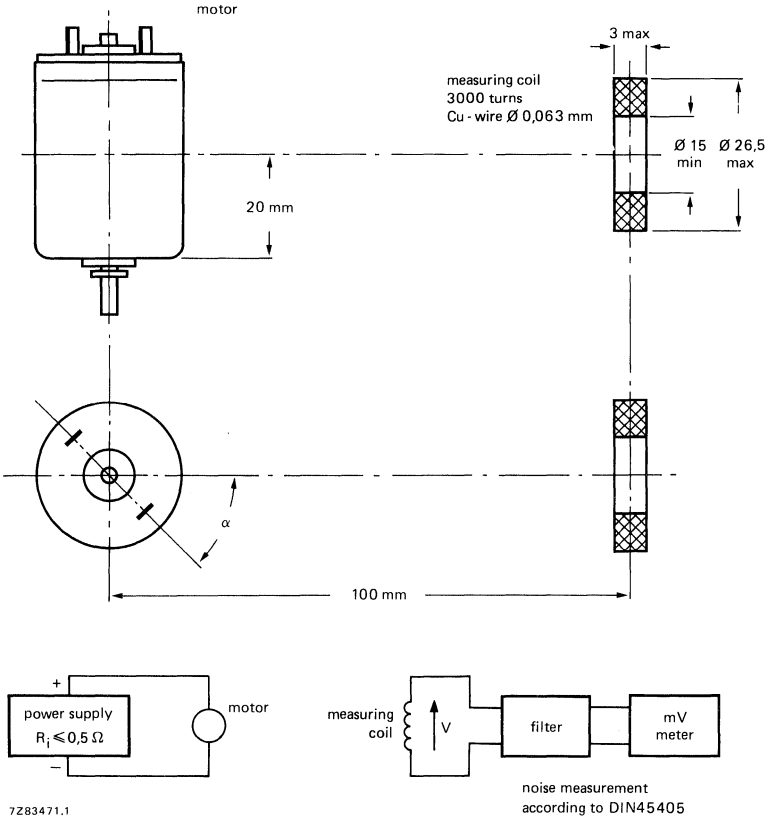


Fig. 3.

Motor speed 3500 rev/min.
Preferred direction of rotation (positive voltage to + terminal).
Torque 5 mNm
α is varied until maximum voltage is obtained.
$V_{p\text{-}p}$ = max. 4,4 x $2\sqrt{2}$ mV.

Minimum packing quantity 102 items per cardboard box.

DIRECT CURRENT MOTOR

ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	30 V
Nominal speed	2150 rev/min
Nominal torque	100 mNm
Mechanical time constant	17 ms

APPLICATION

As servomotor with high acceleration, high efficiency, long life and outstanding reliability this motor is ideal for the following applications:

- printer-carriage drives
- telex machines
- magnetic disc drive systems
- medical pumps
- instrumentation recorders
- digital/analogue recorders.

DESCRIPTION

The motor has an ironless rotor with nine oblique windings and a permanent magnet stator, implying extremely high efficiency, low mechanical time constant, high starting torque and smooth running.

The precious metal brush-commutator construction combined with nine built-in bi-polar electrolytic capacitors connected between the commutator segments for spark suppression, make the motor suitable for heavy duty applications.

Ball bearings allow for high radial and axial force on the 6 mm shaft. A second shaft at the rear side permits mounting of a d.c. or frequency tacho generator, or an optical encoder.
The motor can be supplied with a.c. or d.c. tacho on request.

TECHNICAL DATA

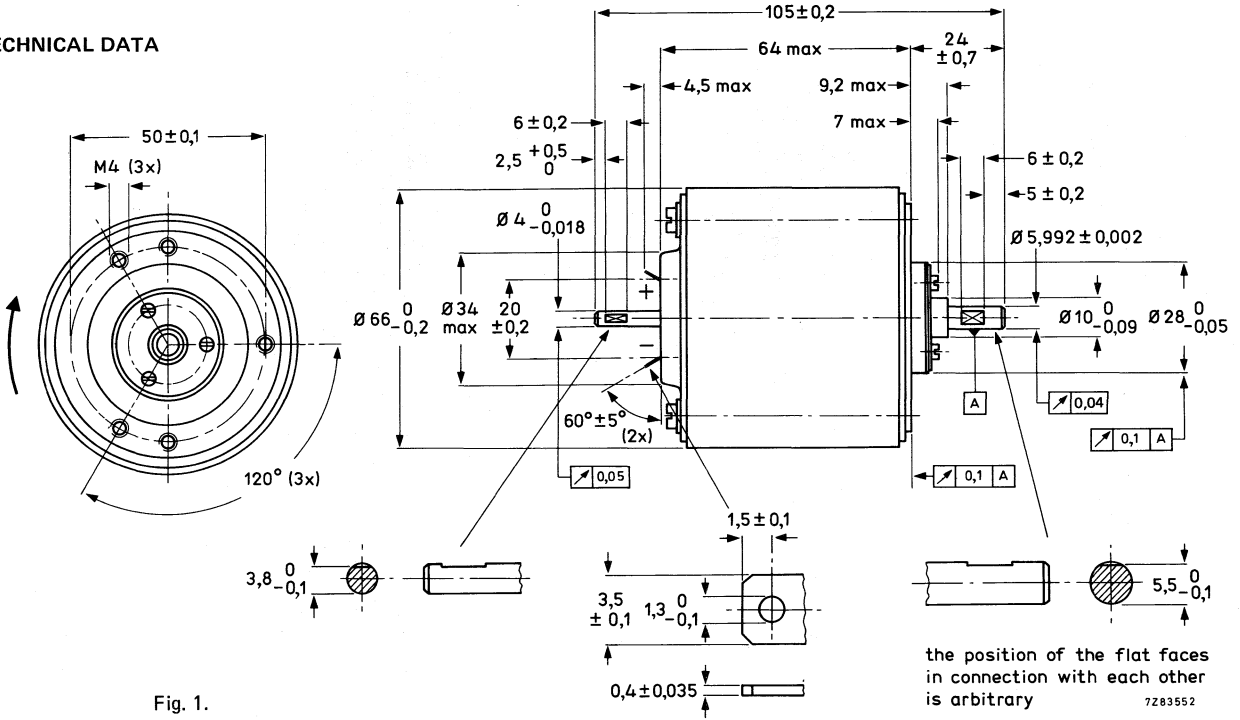


Fig. 1.

The direction of rotation is given in connection with the polarity.

Mass approximately 900 g.

Mounting The motor is front mounted by means of three M4 screws. Permissible depth of screw insertion maximum 8 mm.

Axial play at
$F_{ax} < 5$ N: none
$F_{ax} > 7$ N: max. 0,2 mm

The values given below apply to an ambient temperature of + 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

All values without further indication are approximate values.

Nominal voltage (d.c.)	30 V
Nominal torque	100 mNm
Speed	see Fig. 2
Bearings	ball
Direction of rotation	reversible
Climatic category (IEC 68)	5/060/21
E.M.F. at 3000 rev/min	28,4 – 33,2 V
Rotor resistance	7,8 Ω ± 7%
Current at nominal voltage	
at nominal torque	960 – 1180 mA
at no load	max. 65 mA
at a radial force of 20 N at 20 mm from mounting plane	typ. 75 mA
Insulation between terminals and housing	min. 2 MΩ
Test voltage (d.c.) between terminals and housing, for 1 minute	500 V
Starting torque at nominal voltage	310 mNm
Rotor inductance	5,7 mH
Rotor moment of inertia	21,4 x 10^{-6} kg m^2
Mechanical time constant	17 ms
Audio interference	see Fig. 3
Radio interference	see section General
Ambient temperature range	
operating	–5 to + 60 °C
storage	–40 to + 70 °C
Thermal resistance between winding and housing	typ. 2,6 K/W
Temperature coefficient of	
rotor resistance	+ 0,4 %/K
e.m.f.	–0,2 %/K

Limiting conditions

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	40 V
Torque	130 mNm
Current	1550 mA
Repetitive peak current	3500 mA, 10 ms, 1 Hz
Speed	3200 rev/min
Output power	25 W
Continuous blocking when mounted on heatsink (Fig. 3) permitted at	16,1 V
Radial force 20 mm from mounting plane	25 N
Axial force	
pressing	15 N
pulling	15 N

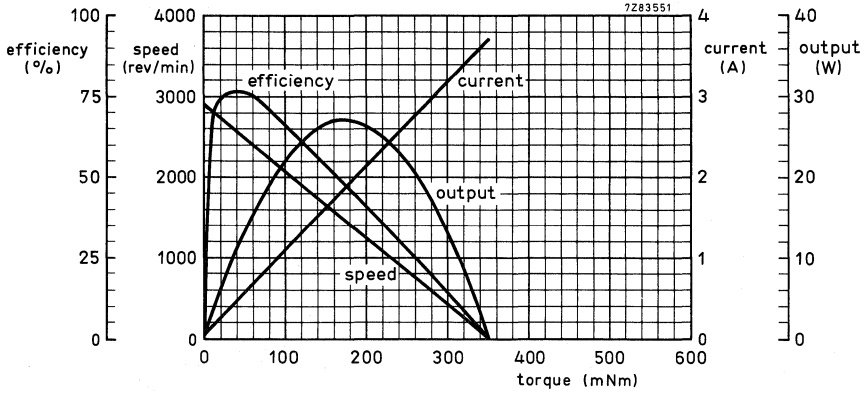
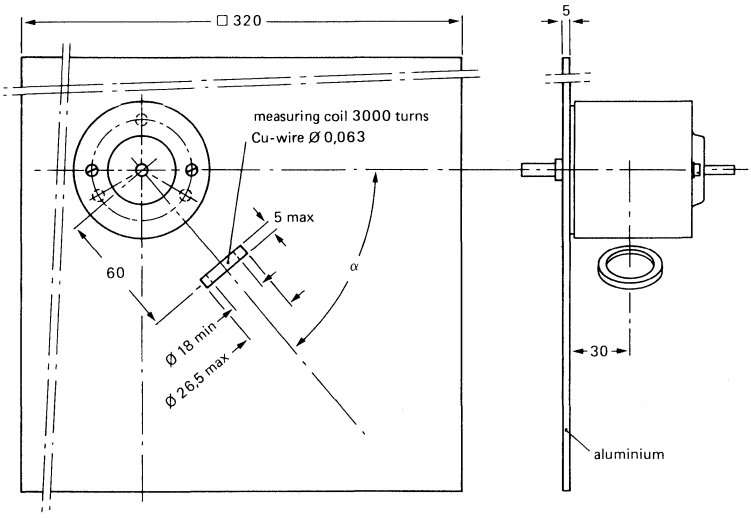


Fig. 2 Typical curves at 30 V, T_{amb} = 22 °C.

AUDIO INTERFERENCE

Measuring



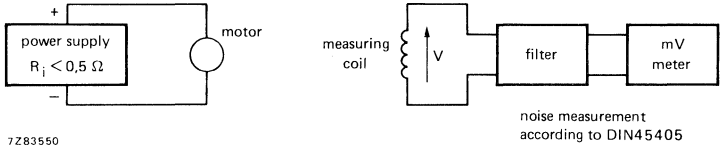


Fig. 3.

Motor unloaded at 30 V.

Preferred direction of rotation (positive voltage to + terminal).

α is varied until maximum voltage is obtained.

$V_{p\text{-}p}$ = max. $4,2 \times 2\sqrt{2}$ mV.

Minimum packing quantity 170 items per cardboard box.

DIRECT CURRENT MOTOR
iron rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	12 V
Nominal speed	5900 rev/min
Nominal torque	5 mNm

APPLICATION

This small d.c. motor has been designed for applications which require high quality, long life and high torque.
Examples:
– motor car industry: fans, car vacuum cleaners, windscreen washers and actuator systems,
– general industrial.

DESCRIPTION

The motor has been provided with a permanent-magnet system. It has a grey, injection-moulded housing of polyacetal resin, which offers an excellent resistance to chemicals and corrosion.
The application of great special brushes, a flat commutator, a new permanent magnet material and a special rotor construction guarantee a long life, high efficiency and high torque, and make the motor very suitable for applications which require low current consumption (e.g. supply from dry cells or rechargeable cells).
A voltage dependent resistor (VDR) is built in and acts as a spark suppressor. This and the fact that the commutator is flat make for a good interference suppression so that the motor can also be remotely controlled.

TECHNICAL DATA

Outlines

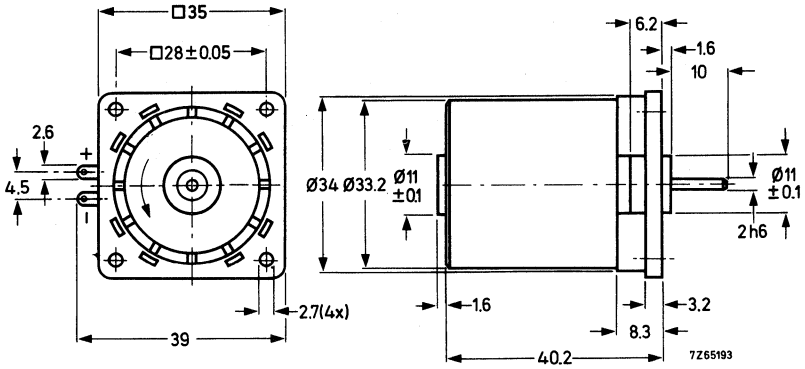


Fig. 1 The direction of rotation is given in connection with the polarity.

Mass approx. 120 g

Mounting

The motor can be fixed by means of four screws (M2,6), washers and nuts.

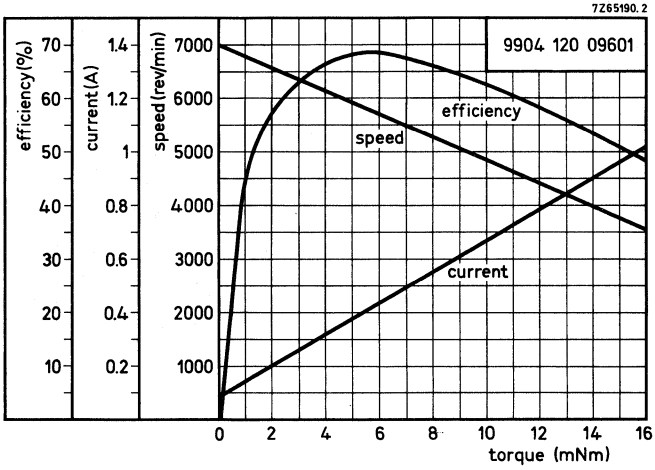


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C.

The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 - 75%.

Nominal values

Voltage (d.c.)	12 V
Torque	5 mNm
Speed at nominal load	5900 rev/min
at no load	7000 rev/min
Current at nominal load	0,55 A
at no load	0,150 A
Starting torque	⩾ 30 mNm
Input power	4,8 W
Direction of rotation	reversible, see Fig. 1
Ambient temperature range	−20 to + 60 °C
Bearings	slide bearings; self-lubricating
Maximum radial force on the bearings	2,5 N
Maximum axial force	2 N
Housing	
material	polyacetal resin
colour	grey

Limiting conditions

The following maximum values should never be exceeded.

Maximum voltage (d.c.)	15 V
Maximum permissible load	15 mNm
Maximum permissible input current	1,5 A

DIRECT CURRENT MOTOR

ironless rotor type, cylindrical collector version

QUICK REFERENCE DATA

Nominal voltage (d.c.)	12	V
Nominal speed	2000	rev/min
Nominal torque	120	mNm
Mechanical time constant	26	ms

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed stat-stop mode in the following applications:

- printer carriage drives
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- radar equipment

DESCRIPTION

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying high efficiency, low mechanical time constant, high starting torque and smooth running, no detent torque.

The carbon metal brushes with cylindrical collector make the motor suitable for high peak currents as are usual in start-stop applications. Ball bearings allow high radial and axial forces on the 6 mm shaft. A second shaft at the rear side permits mounting of a d.c. or frequency tachogenerator on request, and makes the motor suitable for mounting of an optical encoder by the customer.

TECHNICAL DATA

Outlines

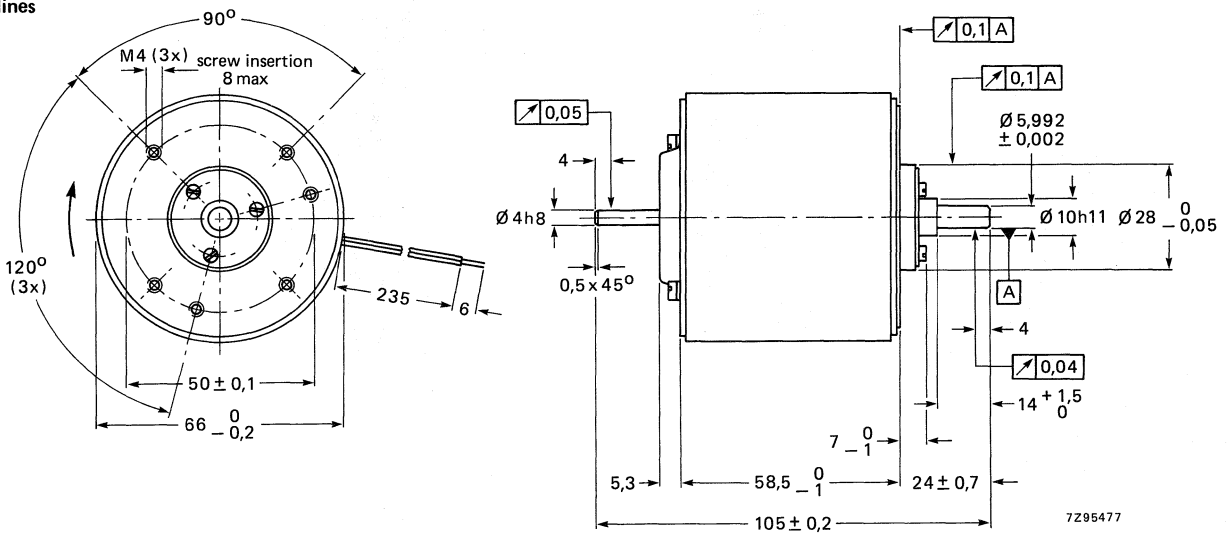


Fig. 1.

The direction of rotation is given in connection with the polarity, red = +; blue = –.

Mass: 900 g
Axial play at
$F_{ax} < 5$ N: none
$F_{ax} > 7$ N: 0,2 mm max.
Housing: steel

Operating position: any
Brushes: carbon metal
Bearings: ball bearings

Lubrication: not permitted
Friction torque at 2150 rev/min.: max. 5 mNm
Mass moment of inertia $\approx 21{,}4 \times 10^{-6}$ kgm^2

TECHNICAL DATA

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Nominal voltage		12	V
Nominal torque		80	mNm
Nominal speed		1800	rev/min
Input power	max.	27	W
Speed, no load		2500 to 2940	rev/min
Direction of rotation		reversible	
Climatic category, IEC 68		10/060/21	
E.M.F. at 3000 rev/min		11,8 to 13,8	V
Rotor resistance, measured without brushes		1,9 ± 7%	Ω
Current at nominal voltage			
at nominal torque		1840 to 2250	mA
at no load	max.	120	mA
Starting torque at nominal voltage	typ.	250	mNm
Rotor inductance		1	mH
Rotor moment of inertia		$21,4 \times 10^{-6}$	kgm^2
Mechanical time constant		26	ms
Ambient temperature range			
operating		−10 to + 60	°C
storage		−40 to + 70	°C
Thermal time constant of motor			
without heatsink		20	min
Thermal resistance			
between winding and housing	typ.	2,6	K/W
between winding and ambient, with a rectangular aluminium heatsink of 320 mm x 5 mm	typ.	3,4	K/W
Temperature coefficient of			
rotor resistance		+ 0,4	%/K
e.m.f.		−0,2	%/K

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	17	V
Load	120	mNm
Current	3250	mA
Peak current	5000	mA
Speed	3200	rev/min
Output power	32	W
Radial force	100	N
Axial force		
pressing	15	N
pulling	25	N

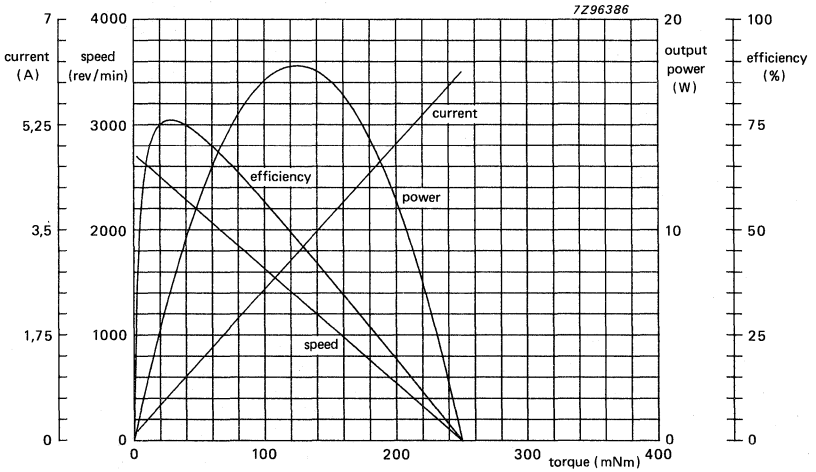


Fig. 2 Typical curves for 12 V at T_{amb} = 22 °C.

DIRECT CURRENT MOTOR
ironless rotor type

QUICK REFERENCE DATA

Nominal voltage (d.c.)	30	V
Nominal speed	2000	rev/min ←
Nominal torque	120	mNm ←
Mechanical time constant	17	ms

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed start-stop mode in the following applications:

- printer carriage drives
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- radar equipment

DESCRIPTION ←

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying high efficiency, low mechanical time constant, high starting torque and smooth running, no detent torque.

The carbon metal brushes with cylindrical collector make the motor suitable for high peak currents as are usual in start-stop applications. Ball bearings allow high radial and axial forces on the 6 mm shaft. A second shaft at the rear side permits mounting of a d.c. or frequency tacho-generator on request, and makes the motor suitable for mounting of a optical encoder by the customer.

TECHNICAL DATA

Outlines

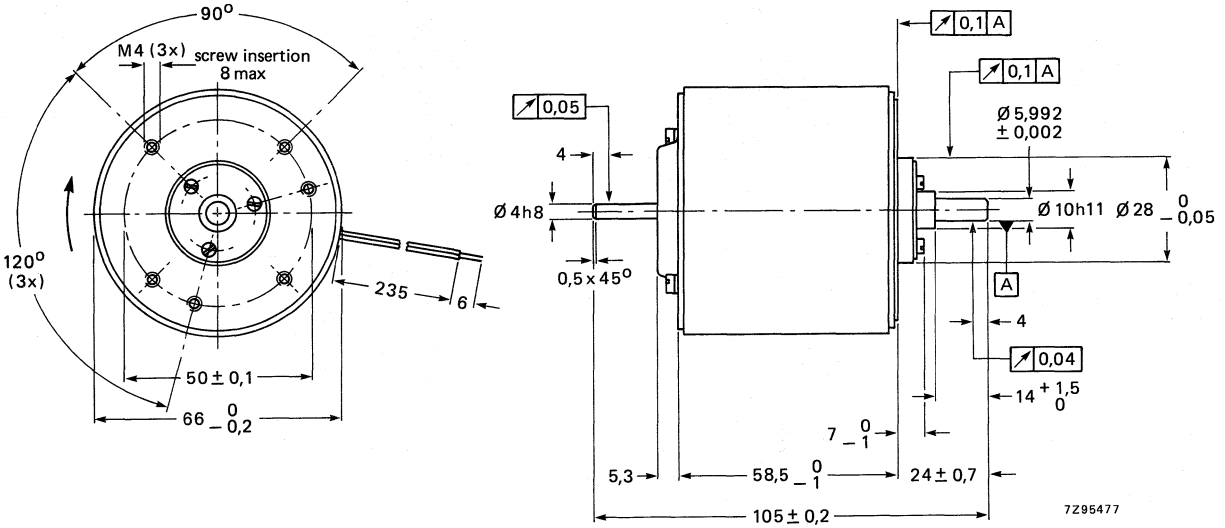


Fig. 1.

The direction of rotation is given in connection with the polarity, red = +; blue = —.

Mass: 900 g
Axial play at
$F_{ax} < 5$ N: none
$F_{ax} > 7$ N: 0,2 mm
Housing: steel

Operating position: any
Brushes: carbon metal
Bearings: ball bearings

Lubrication: not permitted
Friction torque at 2150 rev/min.: max. 5 mNm
Mass moment of inertion $\approx 21{,}4 \times 10^{-6}$ kgm^2

TECHNICAL DATA

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Nominal voltage		30	V
Nominal torque		120	mNm
Nominal speed		2000	rev/min
Input power	max.	42	W
Speed		1750-2170	rev/min
Direction of rotation		reversible	
Climatic category, IEC 68		10/060/21	
E.M.F. at 3000 rev/min		28,4 to 33,2	V
Rotor resistance, measured without brushes		7,8 ± 7%	Ω
Current at nominal voltage			
at nominal torque		1180 to 1380	mA
at no load	max.	65	mA
at a radial force of 20 N at 20 mm from mounting plate	typ.	75	mA
Test voltage (d.c.) between terminals and housing, during 1 minute		500	V
Starting torque at nominal voltage	typ.	370	mNm
Rotor inductance (measured with PM 6303)		5,0	mH
Rotor moment of inertia		$21,4 \times 10^{-6}$	kgm^2
Mechanical time constant		17	ms
Ambient temperature range			
operating		−10 to + 60	°C
storage		−40 to + 70	°C
Thermal time constant of motor without heatsink		20	min
Thermal resistance			
between winding and housing	typ.	2,6	K/W
between winding and ambient, with a rectangular aluminium heatsink of 320 mm x 5 mm	typ.	3,4	K/W
Temperature coefficient of			
rotor resistance		+ 0,4	%/K
e.m.f.		−0,2	%/K

DEVELOPMENT DATA

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	40	V
Load	140	mNm
Current	1550	mA
Peak current	4000	mA
Speed	3200	rev/min
Output power	40	W
Radial force	100	N
Axial force		
pressing	15	N
pulling	25	N

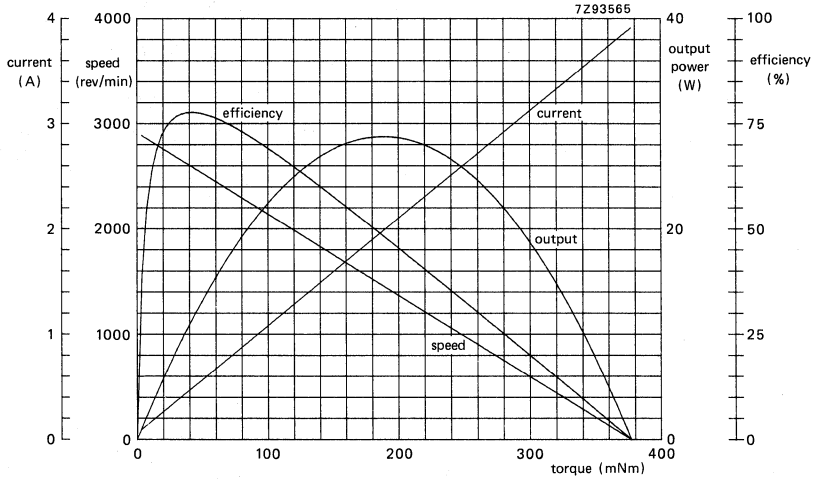


Fig. 2 Typical curves at 30 V, T_{amb} = 22 °C.

DIRECT CURRENT MOTORS

ironless rotor type, cylindrical collector version

- optical encoder flange
- cylindrical commutator

QUICK REFERENCE DATA

Catalogue number 9904 120	13116	13316	
Nominal voltage (d.c.)	12	30	V
Nominal speed	1800	2150	rev/min
Nominal torque	80	120	mNm
Mechanical time constant	17	17	mS

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed start-stop mode in the following applications:

- printer carriage drives
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- radar equipment

DESCRIPTION

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying high efficiency, low mechanical time constant, high starting torque and smooth running, no detent torque.

The precious carbon metal brushes with cylindrical collector make the motor suitable for high peak currents as are usual in start-stop applications. Ball bearings allow high radial and axial forces on the 6 mm shaft. A second shaft at the rear side and a special flange, provided with 2 x 4 fixing holes, permit the mounting of an optical encoder of Eleprint (100 series) or Hewlett Packard (HEDS 6000).

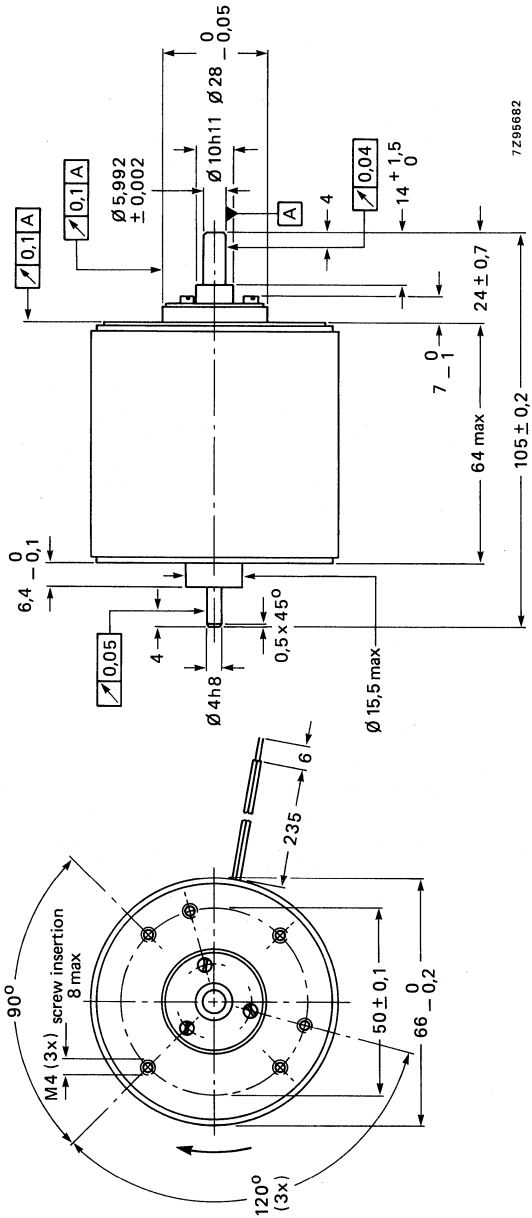
For samples the temporary catalogue numbers are:

8204 045 00647 (9904 120 13116)
8204 045 00585 (9904 120 13316)

TECHNICAL DATA

Outlines, see next page.

For all other data of 9904 120 13116 see type 9904 120 13111 and
of 9904 120 13316 see type 9904 120 13311.


7Z95682
Ø 28 0 -0,05
Ø 10h11
Ø 5,992 ± 0,002
0,1 A
0,04
14 +1,5 0
4
A
24 ± 0,7
64 max
105 ± 0,2
7 -1 0
6,4 -0,1 0
0,05
4
Ø 4h8
0,5 x 45°
Ø 15,5 max
6
235
90°
M4 (3x)
screw insertion 8 max
50 ± 0,1
66 -0,2 0
120° (3x)

Outlines

DIRECT CURRENT MOTOR

ironless rotor type, with frequency tachogenerator

QUICK REFERENCE DATA

Motor		**Tachogenerator**	
Nominal voltage (d.c.)	30 V	Number of pole pairs	72
Nominal speed	2150 rev/min	Generated voltage at 3000 rev/min	$\geqslant$ 650 mV
Nominal torque	120 mNm	Frequency wobble at 3150 Hz	$\leqslant$ 0,2 %

APPLICATION

The motor-tachogenerator combination has been designed for professional servo systems which, require in a direct current drive system, a speed that can be controlled in a very accurate and reliable way, and where high acceleration, high efficiency and smooth running are preferred. Neither the motor, nor the tachogenerator have a detent torque.

Examples:

- robotics
- instrumentation
- mechanization equipment
- remote control systems
- recording measuring instruments

DESCRIPTION

This motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator. The cylindrical collector has carbon brushes.

The frequency tachogenerator has a gearwheel rotor (72 teeth) which is mounted on the protruding spindle of the motor. The stator consists of a deep drawn steel housing, a magnet strip of plastic-bonded ceramic material which has been magnetized with 72 pole pairs and a coil. The alternating flux, which arises by rotation of the gearwheel in the magnetic field, is enclosed by the coil in which the tacho-generator voltage is generated. The frequency of this tachogenerator voltage is determined by the speed of the motor and the number of pole pairs of the tachogenerator.

For samples the temporary catalogue number is 8204 045 00616.

TECHNICAL DATA

Outlines

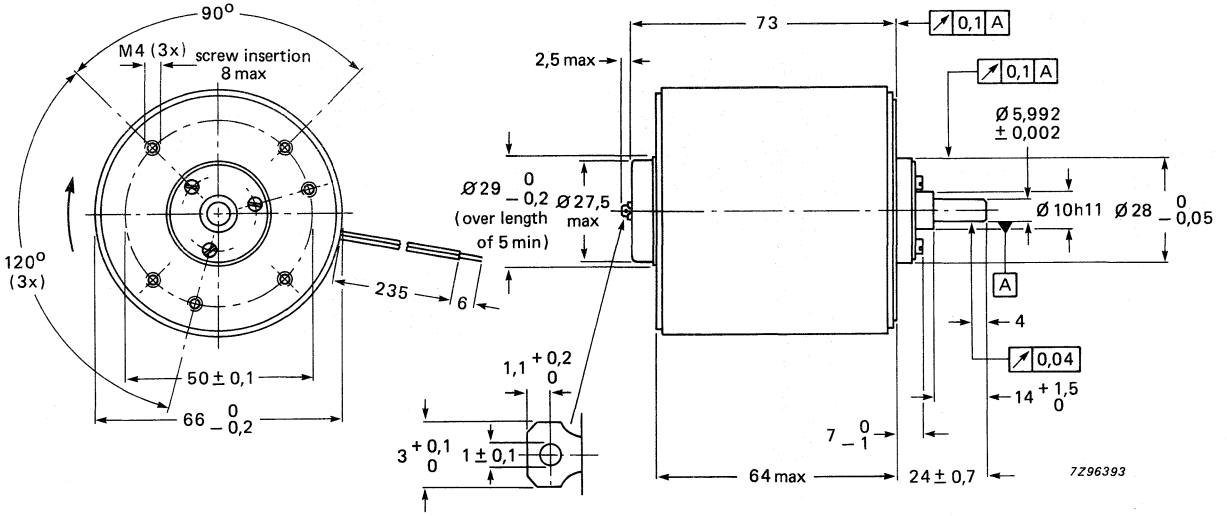


Fig. 1.

The direction of rotation is given in connection with the polarity, red = +; blue = −.

Mass: 1000 g
Axial play at
$F_{ax} < 5$ N: none
$F_{ax} > 7$ N: 0,2 mm max.
Housing: steel

Operating position: any
Brushes: carbon metal
Bearings: ball bearings

Lubrication: not permitted
Friction torque at 2150 rev/min.: max. 5 mNm
Mass moment of inertion $\approx 21{,}5 \times 10^{-6}$ kgm^2

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Nominal voltage		30	V
Nominal torque		120	mNm
Nominal speed		2000	rev/min
Input power	max.	42	W
Speed		1770 to 2170	rev/min
Direction of rotation		reversible	
Climatic category, IEC 68		10/060/21	
E.M.F. at 3000 rev/min		28,4 to 33,2	V
Rotor resistance		7,8 ± 7%	Ω
Current at nominal voltage			
at nominal torque		1180 to 1380	mA
at no load	max.	95	mA
at radial force of 20 N at 20 mm from mounting plate	typ.	75	mA
Test voltage (d.c.) between terminals and housing, during 1 minute		500	V
Starting torque at nominal voltage	typ.	370	mNm
Rotor inductance (measured with PM 6303)		5,0	mH
Rotor moment of inertia		22×10^{-6}	kgm^2
Mechanical time constant		18	ms
Ambient temperature range			
operating		−10 to +60	°C
storage		−40 to +70	°C
Thermal resistance			
between winding and housing	typ.	2,6	K/W
between winding and ambient, with a rectangular aluminium heatsink of 320 mm x 5 mm	typ.	3,4	K/W
Temperature coefficient of			
rotor resistance		+0,4	%/K
e.m.f.		−0,2	%/K

DEVELOPMENT DATA

Tachogenerator

Number of pole pairs	72
Generated voltage (r.m.s.) at 3000 rev/min	min. 650 mV, see also Fig. 3
Amplitude variation for 1 revolution ($E_{l.f.}/E_p$ x 100%) (see Fig. 2)	max. 15%
Frequency	72n/60 Hz (n = number of rev/min)
Frequency wobble at 3150 Hz *	max. 0,2%
Resistance	775 Ω
Inductance	0,5 H

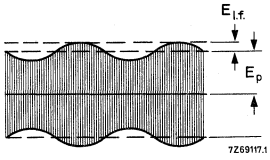


Fig. 2.

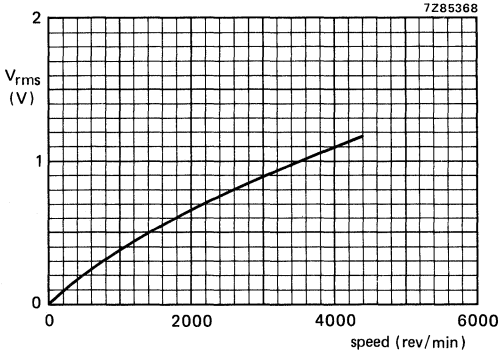


Fig. 3 Tachogenerator voltage as a function of the speed.

* Measured with EMT measuring instrument type 424 (position "linear") or equivalent.

LIMITING CONDITIONS FOR THE MOTOR

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	40	V
Load	140	mNm
Current	1550	mA
Peak current	4000	mA
Speed	3200	rev/min
Output power	40	W
Radial force	100	N
Axial force		
pressing	15	N
pulling	25	N

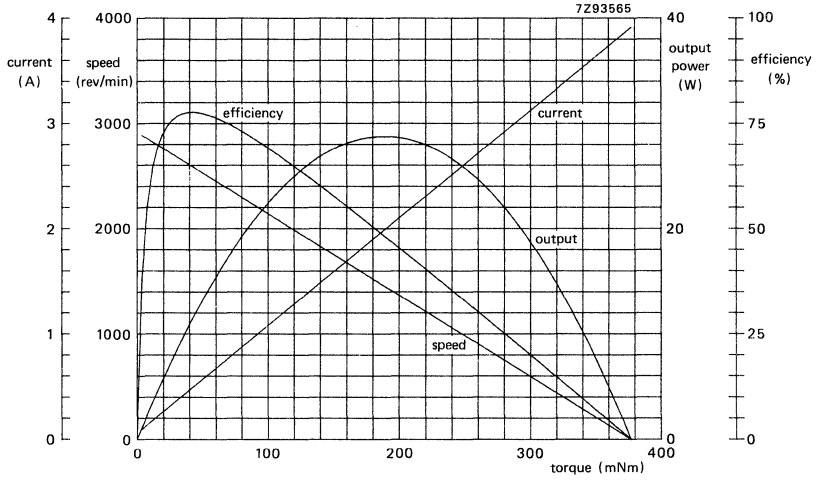


Fig. 4 Typical curves at 30 V, T_{amb} = 22 °C.

9904 120 13353
replacing 8204 045 00603

DIRECT CURRENT MOTOR

ironless rotor type, with d.c. tachogenerator

QUICK REFERENCE DATA

Motor		Tachogenerator	
Nominal voltage (d.c.)	30 V	Voltage gradient per 1000 rev/min	2,1 to 2,6 V
Nominal speed	2150 rev/min	Resistance	27 Ω ± 10%
Nominal torque	120 mNm	Generator ripple	⩽ 4%

APPLICATION

The motor-tachogenerator combination has been designed for professional servo systems which, require in a direct current drive system, a speed that can be controlled in a very accurate and reliable way, and where high acceleration, high efficiency and smooth running are preferred. Neither the motor, nor the tachogenerator have a detent torque.

Examples:

- robotics
- instrumentation
- mechanization equipment
- remote control systems
- recording measuring instruments

DESCRIPTION

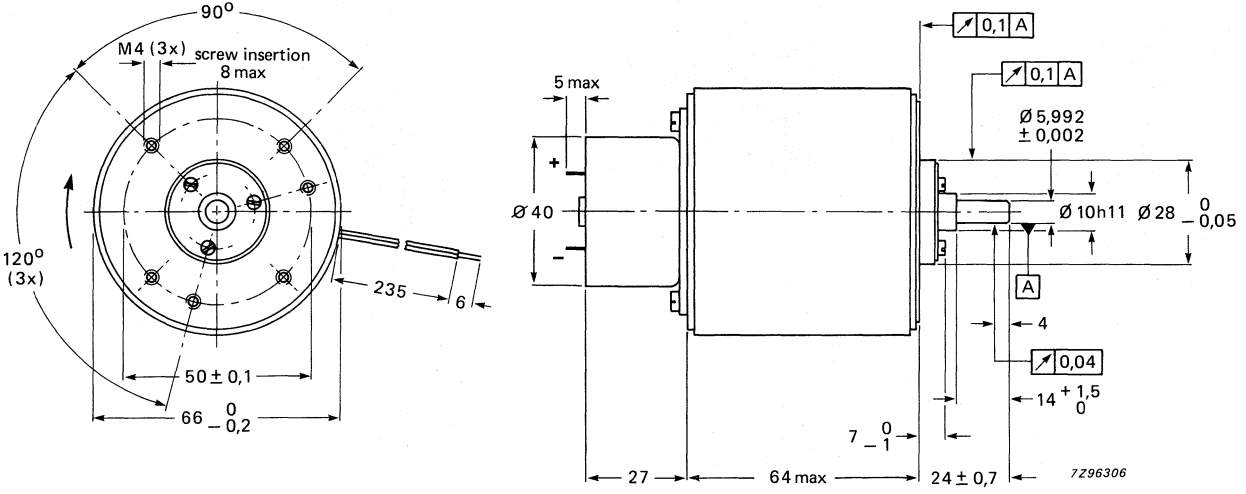
This motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator. The cylindrical collector has carbon brushes.

The d.c. tachogenerator has a metal low inertia drum rotor which is pressed directly onto the spindle of the motor, resulting in a high resonance frequency of 1200 Hz.

For samples, the temporary catalogue number is 8204 045 00603. ←

TECHNICAL DATA

Outlines



The direction of rotation is given in connection with the polarity, red = +; blue = −.

Mass: 1000 g
Axial play at
$F_{ax} < 5$ N: none
$F_{ax} > 7$ N: 0,2 mm max.
Housing: steel

Operating position: any
Brushes: carbon metal
Bearings: ball bearings

Lubrication: not permitted
Friction torque at 2150 rev/min.: max. 5 mNm
Mass moment of inertion $\approx 22 \times 10^{-6}$ kgm^2

TECHNICAL DATA

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Nominal voltage		30	V
Nominal torque		120	mNm
Nominal speed		2000	rev/min
Input power	max.	42	W
Speed		1770 to 2170	rev/min
Direction of rotation		reversible	
Climatic category, IEC 68		10/060/21	
E.M.F. at 3000 rev/min		28,4 to 33,2	V
Rotor resistance		7,8 ± 7%	Ω
Current at nominal voltage			
at nominal torque		1180 to 1380	mA
at no load	max.	85	mA
at radial force of 20 N at 20 mm from mounting plate	typ.	75	mA
Test voltage (d.c.) between terminals and housing, during 1 minute		500	V
Starting torque at nominal voltage	typ.	360	mNm
Rotor inductance (measured with PM 6303)		5,0	mH
Rotor moment of inertia		22×10^{-6}	kgm^2
Mechanical time constant		18	ms
Ambient temperature range			
operating		−10 to +60	°C
storage		−40 to +70	°C
Thermal resistance			
between winding and housing	typ.	2,6	K/W
between winding and ambient, with a rectangular aluminium heatsink of 320 mm x 5 mm	typ.	3,4	K/W
Temperature coefficient of			
rotor resistance		+0,4	%/K
e.m.f.		−0,2	%/K

Tachogenerator

Voltage gradient per 1000 rev/min		2,1 to 2,6	V
Generator ripple	typ.	4%	
Linearity	typ.	± 1%	
Resonance frequency		1200	Hz
Resistance		27 ± 10%	Ω
Inductance at 1000 Hz		4	mH

DEVELOPMENT DATA

LIMITING CONDITIONS FOR THE MOTOR

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	40	V
Load	140	mNm
Current	1550	mA
Peak current	4000	mA
Speed	3200	rev/min
Output power	40	W
Radial force	100	N
Axial force		
pressing	15	N
pulling	25	N

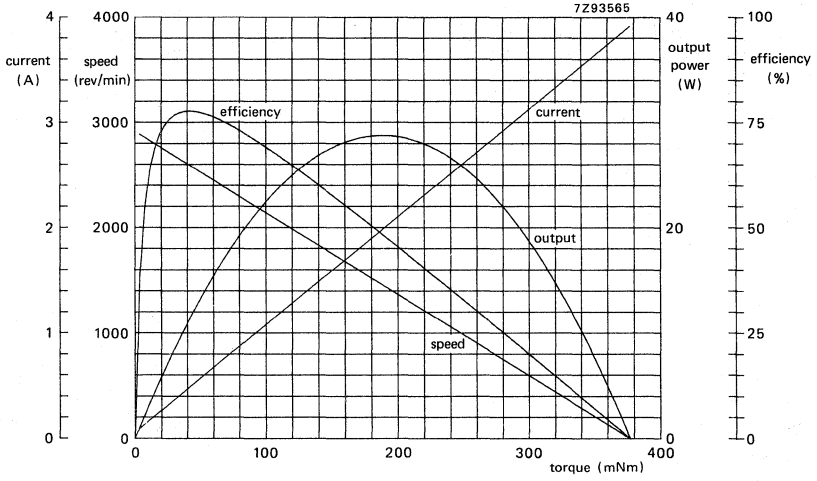


Fig. 2 Typical curves at 30 V, T_{amb} = 22 °C.

DIRECT CURRENT MOTORS

ironless rotor type, cylindrical collector version

QUICK REFERENCE DATA

Catalogue number 9904 120	15101	15201	15211	
Bearings	slide	slide	ball	
Nominal voltage (d.c.)	12	24	24	V
Nominal speed	2710	2750	2750	rev/min
Nominal torque	10	10	10	mNm
Mechanical time constant	19,6	19,6	19,6	ms

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed start-stop mode in the following applications:

- printer daisy-wheel drive
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- copiers
- card readers

DESCRIPTION

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying high efficiency, low mechanical time constant, high starting torque and smooth running.
The carbon-metal brushes with cylindrical collector make the motor suitable for high peak currents as are usual in start-stop applications. The ball bearing version allows high radial and axial forces on the 3 mm spindle.

A version with an integrated a.c. or d.c. tacho generator can be supplied on request.

TECHNICAL DATA

Outlines

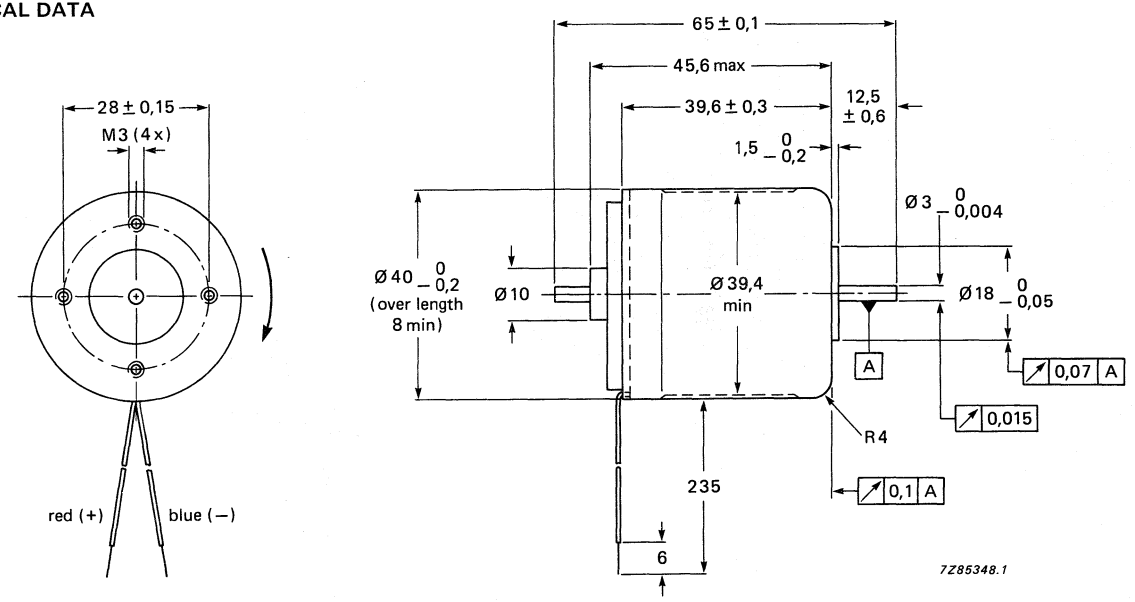


Fig. 1.

The positioning of leads and fixing holes is arbitrary.
Direction of rotation: the motor will rotate clockwise (viewed from the spindle end) when the positive voltage is connected to the red connection lead.

Mass: approx. 0,205 kg
Housing: steel
Lubrication: not permitted

Operating position: any
Brushes: metal-carbon

Mounting

The motor is mounted by four M3 screws. Maximum screw insertion depth: 3 mm. Permissible torque: max. 6 kgcm.

DEVELOPMENT DATA

TECHNICAL DATA

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Catalogue number 9904 120		15101	15201	15211	
Bearings		slide	slide	ball	
Nominal voltage		12	24	24	V
Nominal torque		10	10	10	mNm
Friction torque at 3000 rev/min.	max.	1,2	1,2	0,8	mNm
Input power	max.	4,4	4,5	4,5	W
Speed					
at nominal torque		2710	2750	2750	rev/min
at no load		3200	3240	3240	rev/min
Direction of rotation		reversible	reversible	reversible	
Climatic category, IEC 68		10/60/21	10/60/21	10/060/21	
E.M.F. at 3000 rev/min		9,5–12,5	19,0–25,0	19,0–25,0	V
Rotor resistance, measured					
without brushes		6,2 ± 8%	24,5 ± 8%	24,5 ± 8%	Ω
Current at nominal voltage					
at nominal torque		272–368	150–195	145–190	mA
at no load	max.	35	28	23	mA
Starting torque at nominal voltage		50–80	50–82	50–82	mNm
Starting voltage, no load*		0,9	1,0	0,9	V
Rotor inductance at 1000 Hz		0,8	3,3	3,3	mH
Rotor moment of inertia			$3{,}92 \times 10^{-6}$		kgm^2
Mechanical time constant	typ.		19,6		ms
Ambient temperature range					
operating			−10 to + 60		°C
storage			−10 to + 70		°C
Thermal resistance between					
winding and ambient in free air	typ.		18,5		K/W
winding and ambient, with an					
aluminium heatsink of # 150 x 3 mm	typ.		10		K/W
Temperature coefficient of					
rotor resistance			+ 0,4		%/K
e.m.f.			−0,02		%/K

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Catalogue number 9904 120	15101	15201	15211	
Voltage	15	30	30	V
Load	20	20	20	mNm
Current, without heatsink	600	320	320	mA
Peak current	4000	2000	2000	mA
Speed	4000	4000	4000	rev/min
Output power	6,5	6,5	6,5	W
Continuously stalled rotor at max.	4,9	10	10	V
Radial force, 8 mm from mounting plane	7	7	10	N
Axial force	0,5	0,5	5	N

* Measured by slowly increasing the terminal voltage.

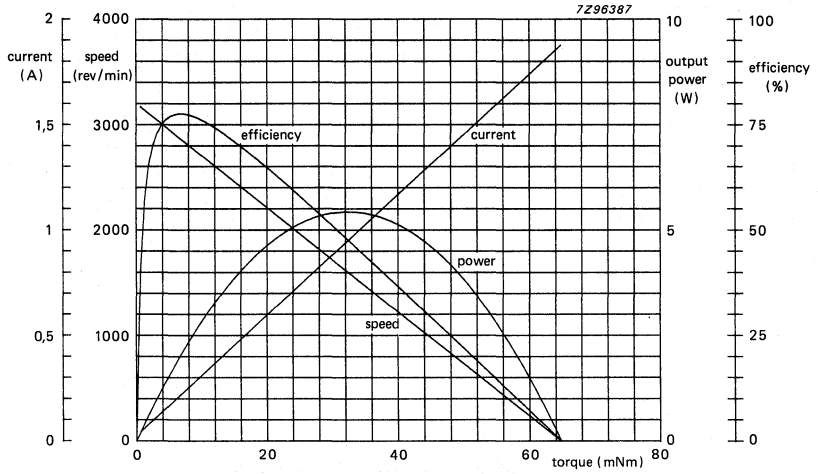


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C (type 9904 120 15101).

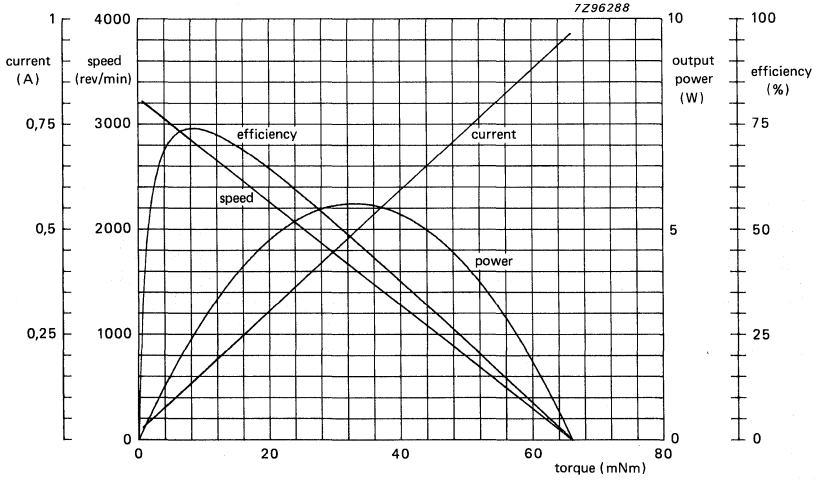


Fig. 3 Typical curves at 24 V, T_{amb} = 22 °C (types 9904 120 15201 and 9904 120 15211).

9904 120 17141
9904 120 17151
9904 120 17241

DIRECT CURRENT MOTORS

ironless rotor type, cylindrical collector version

QUICK REFERENCE DATA

Catalogue number 9904 120	17141	17151	17241	
Bearings	slide	ball	slide	
Nominal voltage (d.c.)	12	12	24	V
Nominal speed	3000	3000	3000	rev/min
Nominal torque	5	5	5	mNm
Mechanical time constant	12,5	12,5	12,5	ms

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed start-stop mode in the following applications:

- control systems
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- copiers
- card readers

DESCRIPTION

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying extremely high efficiency, low mechanical time constant, high starting torque and smooth running.

The precious carbon-metal brushes with cylindrical collector make the motor suitable for high peak currents as are usual in start-stop applications. Ball bearings of the . . . 17151 version allow high radial and axial forces on the 3 mm spindle.

A version with an integrated a.c. or d.c. tacho generator can be supplied on request.

TECHNICAL DATA

Outlines

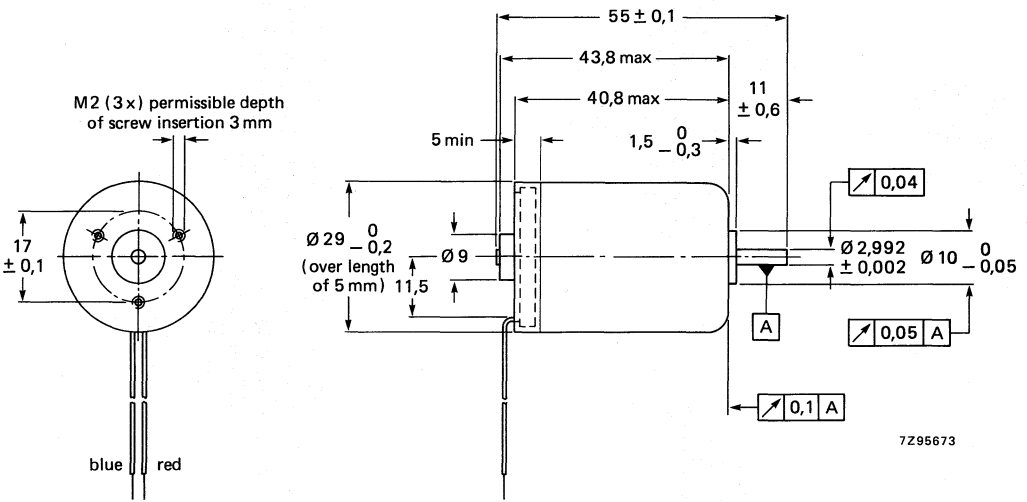


Fig. 1.

The positioning of leads and fixing holes is arbitrary.
Direction of rotation: the motor will rotate clockwise (viewed from the spindle end) when the positive voltage is connected to the red connection lead.

Mass: approx. 0,12 kg
Housing: steel
Lubrication: not permitted
Friction torque at 3000 rev/min: max. 1 mNm

Mass moment of inertia: ≈ 0,9 x 10 kgm^2
Operating position: any
Brushes: metal-carbon

Mounting

The motor is mounted by three M2 screws. Maximum screw insertion depth: 3 mm.

TECHNICAL DATA

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Catalogue number 9904 120		17141	17151	17241	
Bearings		slide	ball	slide	
Nominal voltage		12	12	24	V
Nominal torque		5	5	5	mNm
Input power	max.	3,1	3,1	3,2	W
Speed					
at nominal torque		3000	3000	3000	rev/min
at no load		3670	3670	3750	rev/min
Direction of rotation		reversible	reversible	reversible	
Climatic category, IEC 68		10/60/21	10/60/21	10/060/21	
E.M.F. at 3000 rev/min		8,2 – 10,0	8,2–10,0	16,2–20,2	V
Rotor resistance, measured					
without brushes		12 ± 10%	12 ± 10%	47 ± 10%	Ω
Current at nominal voltage					
at nominal torque		190–265	190–265	100–130	mA
at no load	max.	65	50	32	mA
Starting torque at nominal voltage		20,6–32,2	20,6–32,2	21,5–33,5	mNm
Starting voltage, no load		0,9	0,8	1,2	V
Rotor inductance at 1000 Hz		1	1	4,1	mH
Rotor moment of inertia			$0{,}9 \times 10^{-6}$		kgm^2
Mechanical time constant	typ.		12,5		ms
Ambient temperature range					
operating			–10 to + 60		°C
storage			–10 to + 70		°C
Thermal resistance between					
winding and ambient in free air			21		K/W
winding and ambient, with an aluminium heatsink of # 150 x 3 mm			11		K/W
Temperature coefficient of					
rotor resistance			+ 0,4		%/K
e.m.f.			–0,02		%/K

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Catalogue number 9904 120	17141	17151	17241	
Voltage	15	15	30	V
Load	10	10	10	mNm
Current, without heatsink	430	430	210	mA
Peak current	2000	2000	1200	mA
Speed	6000	6000	6000	rev/min
Output power	3,5	3,5	3,5	W
Continuously stalled rotor at max.	6,5	6,5	13	V
Radial force, 8 mm from mounting plane	5	10	5	N
Axial force	0,5	5	0,5	N

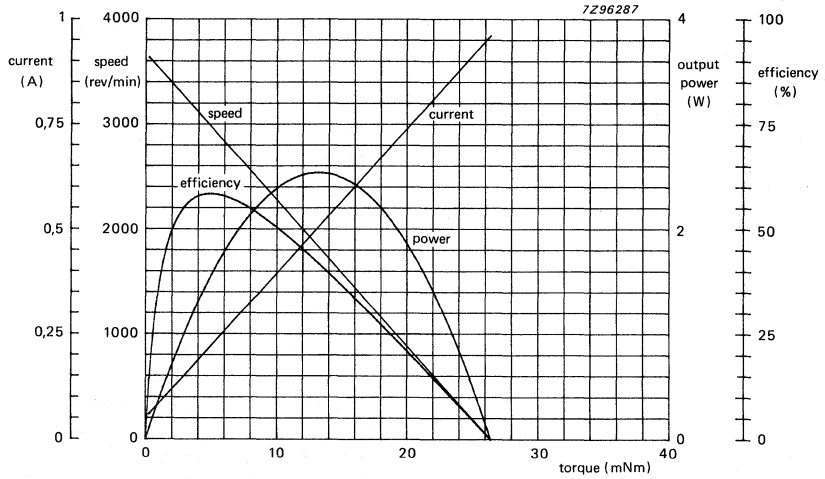


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C (types 9904 120 17141 and 9904 120 17151).

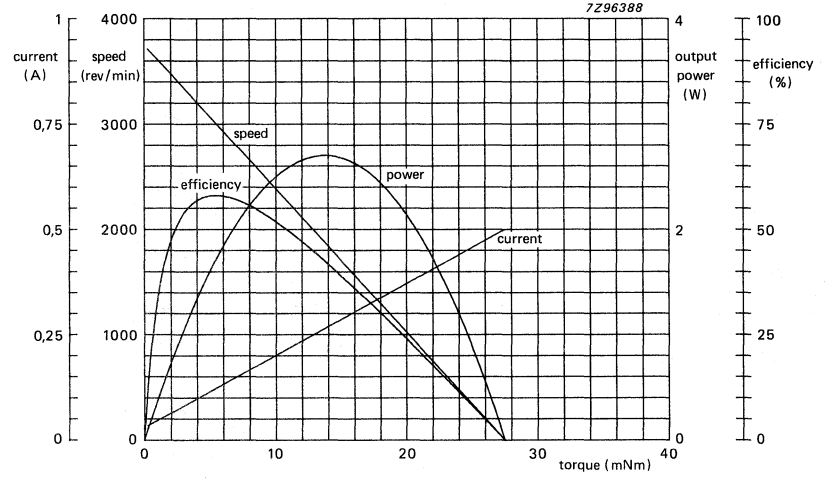


Fig. 3 Typical curves at 24 V, T_{amb} = 22 °C (type 9904 120 17241).

DIRECT CURRENT MOTOR

ironless rotor type with cylindrical collector

QUICK REFERENCE DATA

Nominal voltage (d.c.)	12 V
Nominal speed	3000 rev/min
Nominal torque	5 mNm
Mechanical time constant	12,5 ms

APPLICATIONS

As servo motor with high acceleration, high efficiency, long life and outstanding reliability, this motor is ideal for high speed start-stop mode in the following applications:

- printer daisy wheel drive
- telex machines
- small robots
- digital recorders
- medical pumps
- professional battery charged equipment
- copiers
- card readers

DESCRIPTION

The motor has an ironless rotor with nine oblique wound coils and a permanent magnet stator, implying high efficiency, low mechanical time constant, high starting torque and smooth running.

The carbon metal brushes with **cylindrical collector** make the motor suitable for high peak currents as are usual in start-stop applications. Ball bearings allow high radial and axial forces on the 3 mm shaft. A second shaft at the rear side permits the mounting of an optical encoder. ←

TECHNICAL DATA

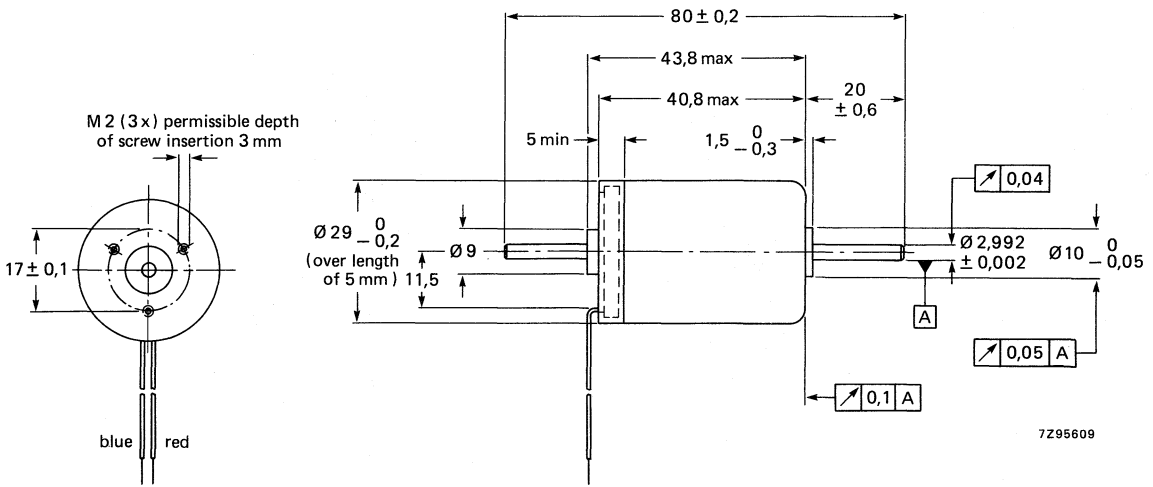


Fig. 1.

The direction of retation is given in connection with the polarity: the motor will turn clockwise if the red lead is connected to the positive supply voltage.
Positioning of leads and fixing holes is arbitrary.

Mass	approx. 0,12 kg
Housing	steel
Bearings	ball
brushes	metal-carbon

The motor can be operated in any position. Lubrication is not permitted.

The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%. All values without further indication are approximate values.

Nominal voltage		12	V
Nominal torque		5	mNm
Input power	max.	3,0	W
Speed		see Fig. 2	
Direction of rotation		reversible	
Climatic category, IEC 68		10/060/21	←
EMF at 3000 rev/min		8,2 to 10,0	V
Rotor resistance, measured in series with brushes		12 Ω ± 8%	
Current at nominal voltage			
at nominal torque		195 to 250	mA
at no load	max.	50	mA
Test voltage, (d.c.) between terminals and housing, during 1 minute		250	V
Starting torque at nominal voltage		21,5 to 31,0	mNm
Rotor inductance at 1000 Hz		1	mH
Rotor moment of inertia		$0,9 \times 10^{-6}$	kgm^2 ←
Mechanical time constant		12,5	ms
Ambient temperature range			
operating		−10 to + 60	°C
storage		−40 to + 70	°C
Thermal resistance			
between winding and ambient in free air	typ.	21	K/W
between winding and ambient, with an aluminium heatsink of # 150 x 3 mm	typ.	11	K/W
Temperature coefficient of			
rotor resistance		+ 0,4	%/K
e.m.f.		−0,02	%/K

DEVELOPMENT DATA

LIMITING CONDITIONS

The following maximum values indicate those circumstances under which the motor can run continuously without being damaged, but under these circumstances the motor life is reduced.

Voltage	15	V
Load	10	mNm
Current, without heatsink	430	mA
Peak current	2000	mA
Speed	6000	rev/min
Output power	3,5	W
Stalled rotor at max. 6,5 V	continuously	
→ Radial force, 8 mm from mounting plane	10	N
Axial force	5	N

The following maximum values should never be exceeded.

Voltage	18	V
Load	20	mNm
→ Peak current	2500	mA
Speed	7000	rev/min
Output power	6	W
Stalled rotor at 12 V	2	min
Axial force	50	N
Radial force	50	N
Winding temperature	120	°C

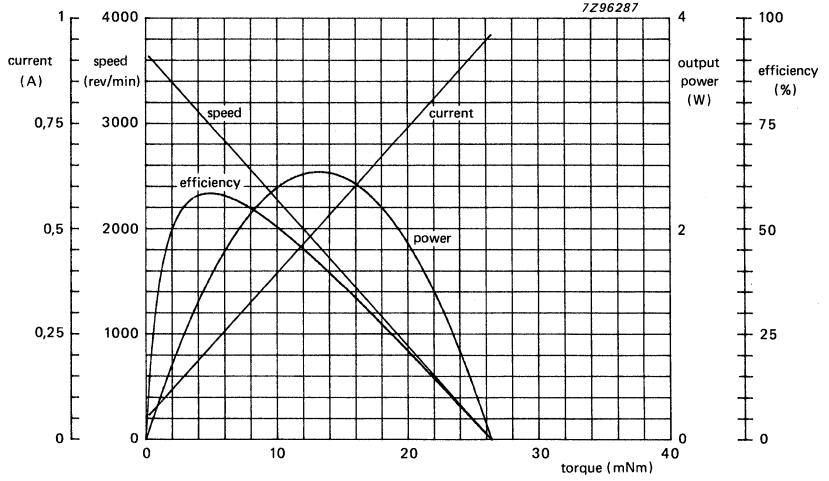


Fig. 2 Typical curves at 12 V, T_{amb} = 22 °C.

DIRECT CURRENT MOTORS

iron rotor types, with reduction

QUICK REFERENCE DATA

catalogue numbers			reduction ratio	speed rev/min	torque mNm
nominal voltage 6 V d.c.	nominal voltage 12 V d.c.	nominal voltage 24 V d.c.			
9904 120 52402	9904 120 52602	9904 120 52702	9 : 1	330	25
9904 120 52405	9904 120 52605	9904 120 52705	50 : 1	60	125
9904 120 52407	9904 120 52607	9904 120 52707	150,4 : 1	23	125
9904 120 52409	9904 120 52609	9904 120 52709	451,25 : 1	8,2	125

APPLICATION

These small d.c. motors with integrated gearboxes have been designed for applications which require a driving system of good quality and a long life.

Application examples are:
- rotating warning lights e.g. on cars
- positioning of searchlights e.g. on cars
- headlamp wipers on cars
- automation systems

DESCRIPTION

The motor has been provided with a permanent-magnet stator system. A reduction gearbox has been built in with gearwheels made of polyacetal resin; various reductions are available.

The use of special brushes, a flat commutator and built-in spark suppressor (voltage dependent resistor) guarantee a long life and a low interference level. The new stator magnet material and the special rotor construction give the motor a high efficiency. The grey injection-moulded housing of polyacetal resin is highly resistant to chemicals and corrosion.

MOUNTING

Mounting the motor is easy since it is provided with a flange having four holes. Four screws M 2,5 and washers can be used.

TECHNICAL DATA

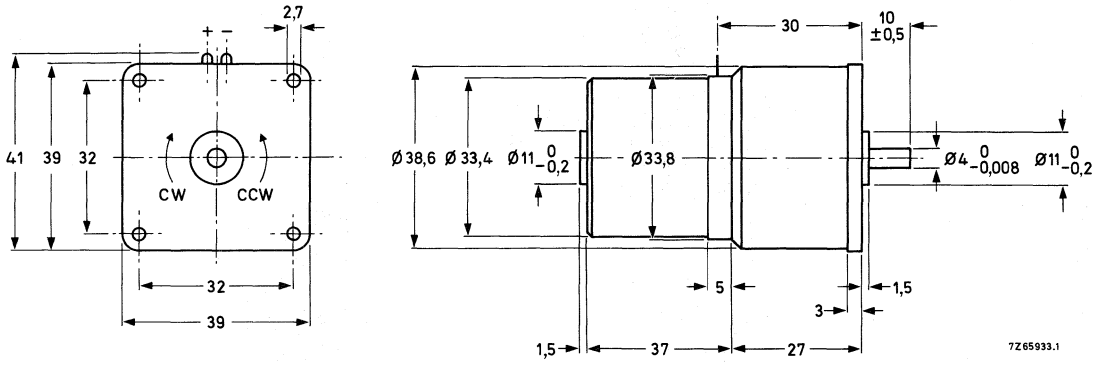


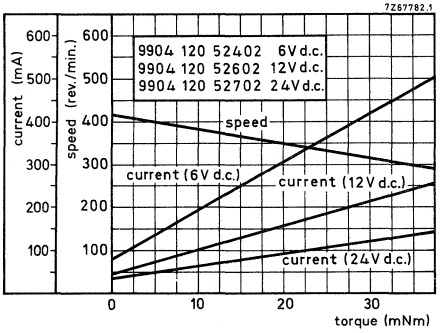
Fig. 1.

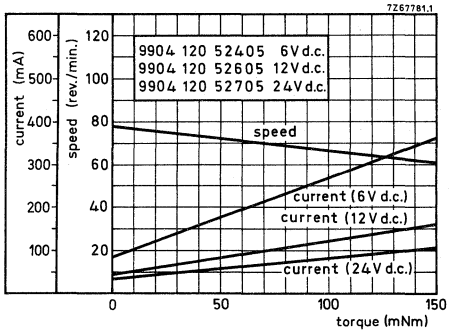
The direction of rotation is given in connection with the polarity (see table next page).

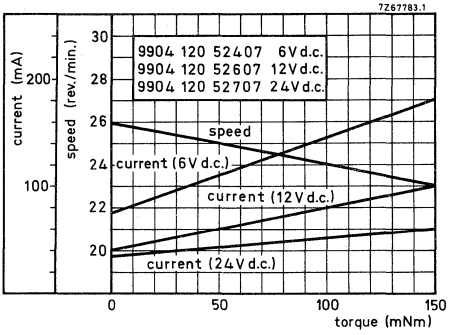
Ambient temperature range	–20 to + 60 °C
Bearings	bronze, self lubricating
Maximum axial play	0,5 mm
Housing, material colour	polyacetal resin grey
Gears, material	polyacetal resin
Mass	125 g approx.

The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

catalogue number 9904 120 52. . .	402	602	702	405	605	705	407	607	707	409	609	709	
reduction ratio	9 : 1			50 : 1			150,4 : 1			451,25 : 1			
Nominal values													
voltage (d.c.)	6	12	24	6	12	24	6	12	24	6	12	24	V
torque	25			125			125			125			mNm
speed at nom. load at no load	330 415			60 78			23 26			8,2 8,5			rev/ min
current at nom. load at no load	360 80	185 45	105 35	360 80	185 45	105 35	180 75	100 40	60 35	110 70	60 40	45 35	mA mA
input power	2,1	2,2	2,5	2,1	2,2	2,5	1,1	1,2	1,4	0,7	0,7	1,1	W
direction of rotation (see also Fig. 1)	CW			CW + CCW			CCW			CW			
max. radial force on the bearings	2			6			8			10			N
max. axial force	2			6			8			10			N
Limiting conditions													
max. voltage (d.c.)	9	18	28	9	18	28	9	18	28	9	18	28	V
max. perm. load	37,5			150			150			150			mNm







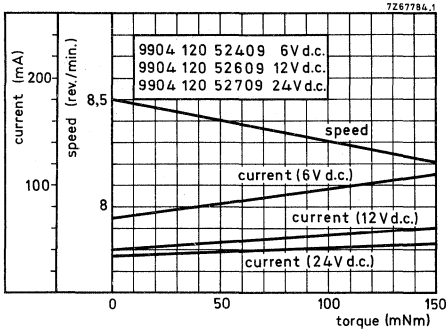


Fig. 2 Typical curves at 6, 12 and 24 V, T_{amb} = 22 °C.

DIRECT CURRENT MOTORS

iron rotortype, with reduction, special version for automotive applications

QUICK REFERENCE DATA

Nominal voltage (d.c.)	13,5 V
Nominal speed	50 rev/min
Nominal torque	300 mNm
Reduction ratio	81 : 1

APPLICATION

These small d.c. motors with integrated gearboxes have been designed for applications which require a driving system of good quality and a long life.

Application examples are:
- rotating warning lights e.g. on cars
- positioning of searchlights e.g. on cars
- headlamp wipers on cars
- automation systems
- ribbon feed in printers

DESCRIPTION

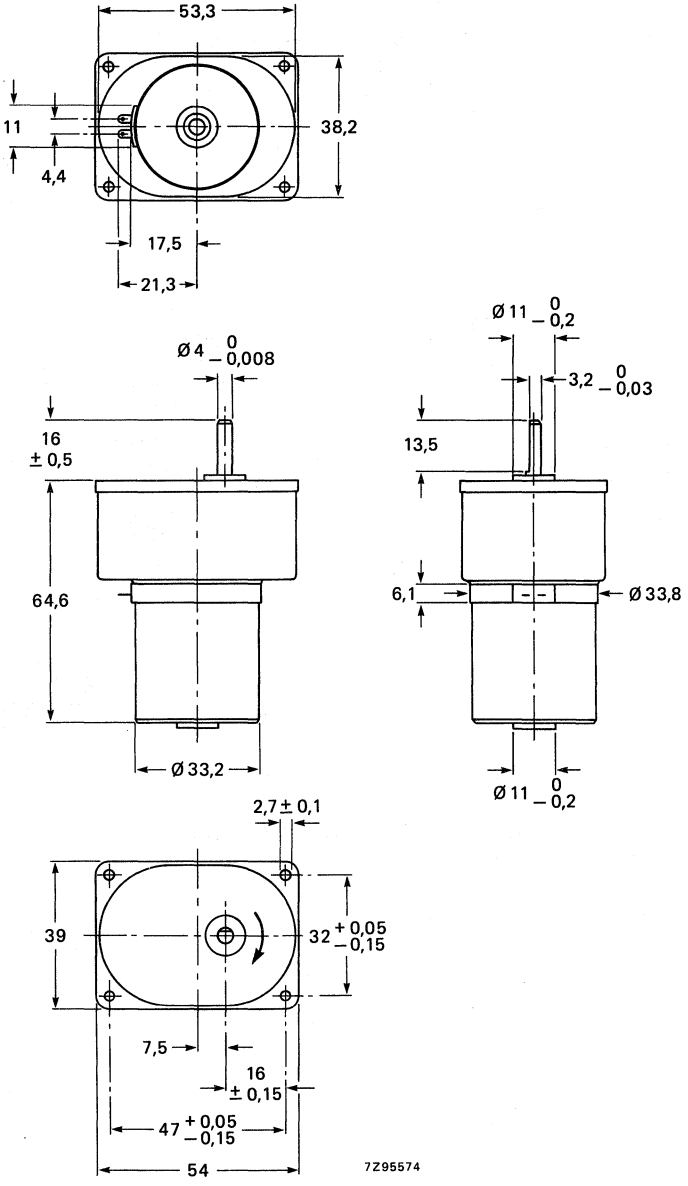
The motor has been provided with a permanent-magnet stator system. A heavy duty reduction gearbox has been built in with gearwheels made of polyacetal resin.

The use of special brushes and a flat commutator guarantees a low interference level.
Due to the special winding of the rotor the motor gear combination may be stalled up to one hour at an ambient temperature of 20 °C. The new stator magnet material and the special rotor construction give the motor a high efficiency. The grey injection-moulded housing of polyacetal resin is highly resistant to chemicals and corrosion.

MOUNTING

Mounting the motor is easy since it is provided with a flange having four holes. Four screws M 2,5 and washers can be used.

TECHNICAL DATA



The values given below apply to an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%.

Nominal voltage (d.c.)		13,5	V
Nominal torque		300	mNm
Starting torque		900	mNm
Nominal speed			
at no-load		70	rev/min
at nom. load		50	rev/min
Direction of rotation		reversible	
Rotor resistance, measured in series with brushes		15,25	Ω ± 10%
Temperature coefficient of			
rotor resistance	≈	+ 0,4	%/K
e.m.f.		−0,2	%/K
Thermal resistance between winding and housing	typ.	30	K/W
Current at nominal voltage			
at no load		80	mA
at nominal torque		300	mA
Axial play		0,1 to 0,6	mm
Mass		125	g
Housing		polyacetal resin, grey	
Ambient temperature range		−20 to + 80	°C
Brushes		carbon	
Bearings		slide	
Connections		solder tags	

Limiting conditions

The following maximum values can be applied continuously, but under these circumstances the motor life is reduced considerably.

Voltage		24	V
Torque		500	mNm
Current		0,5	A
Speed		70	rev/min
Output power		5	W
Radial force		10	N
Axial force		10	N
Winding temperature	absolute maximum	155	°C

DIRECT CURRENT MOTORS

iron rotor types, with reduction

QUICK REFERENCE DATA

Nominal voltage (d.c.)	
motor 9904 120 55406	6 V
motor 9904 120 55606	12 V
motor 9904 120 55706	24 V
Nominal speed	60 rev/min
Nominal torque	300 mNm
Reduction ratio	81 : 1

APPLICATION

These small d.c. motors with integrated gearboxes have been designed for applications which require a driving system of good quality and a long life.

Application examples are:
- rotating warning lights e.g. on cars
- positioning of searchlights e.g. on cars
- automation systems
- ribbon feed in printers
- drive systems

DESCRIPTION

The motor has been provided with a permanent-magnet stator system. A heavy duty reduction gearbox has been built in with gearwheels made of polyacetal resin.

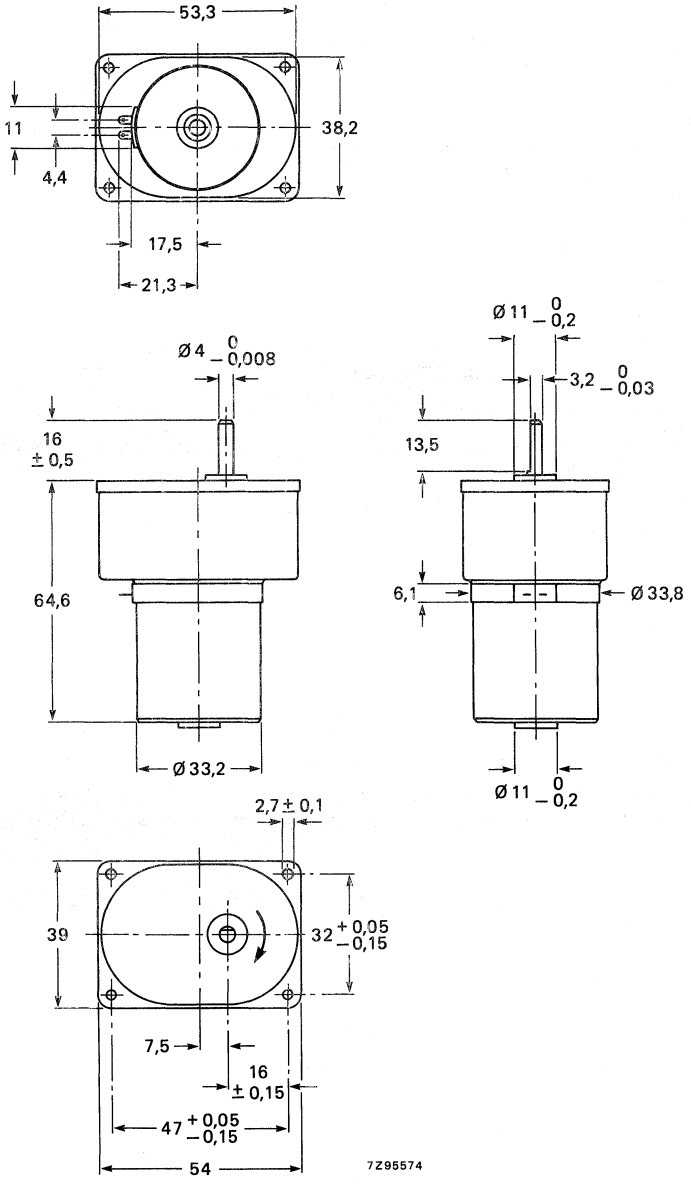
The use of special brushes, a flat commutator and a varistor guarantees a low interference level.

The stator magnet material and the special rotor construction give the motor a high efficiency. The grey injection-moulded housing of polyacetal resin is highly resistant to chemicals and corrosion.

MOUNTING

Mounting the motor is easy since it is provided with a flange having four holes. Four screws M 2,5 and washers can be used.

TECHNICAL DATA



The values given below apply at an ambient temperature of 22 ± 5 °C, an atmospheric pressure of 860 to 1060 hPa and a relative humidity of 45 to 75%.

Catalogue number 9904 120	55406	55606	55706	
Nominal voltage (d.c.)	6	12	24	V
Nominal torque	300	300	300	mNm
Starting torque	900	900	900	mNm
Nominal speed				
at no-load	70	70	70	rev/min
at nom. load	60	60	60	rev/min
Direction of rotation	reversible	reversible	reversible	
Rotor resistance, measured in series with brushes	1,5	5,5	24,75	Ω ± 10%
Temperature coefficient of				
rotor resistance	≈ + 0,4	≈ + 0,4	≈ + 0,4	%/K
e.m.f.	−0,2	−0,2	−0,2	%/K
Thermal resistance between winding and housing	typ. 30	typ. 30	typ. 30	K/W
Current at nominal voltage				
at no load	160	80	40	mA
at nominal torque	625	310	155	mA
Axial play		0,1 to 0,6		mm
Mass		125		g
Housing		polyacetal resin, grey		
Ambient temperature range		−10 to + 60		°C
Brushes		carbon		
Bearings		slide		
Connections		solder tags		

Limiting conditions

The following maximum values can be applied continuously, but under these circumstances the motor life is reduced considerably.

Catalogue number 9904 120	55406	55606	55706	
Voltage	12	24	48	V
Torque	500	500	500	mNm
Current	4,0	2,2	1,0	A
Speed		120		rev/min
Output power		5		W
Radial force		10		N
Axial force		10		N
Winding temperature, absolute maximum		120		°C

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