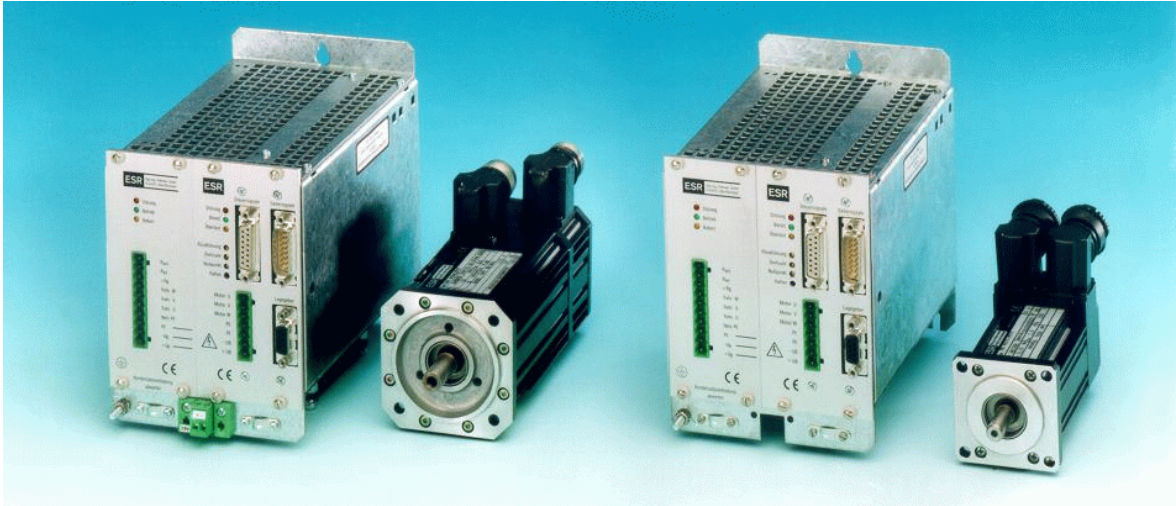
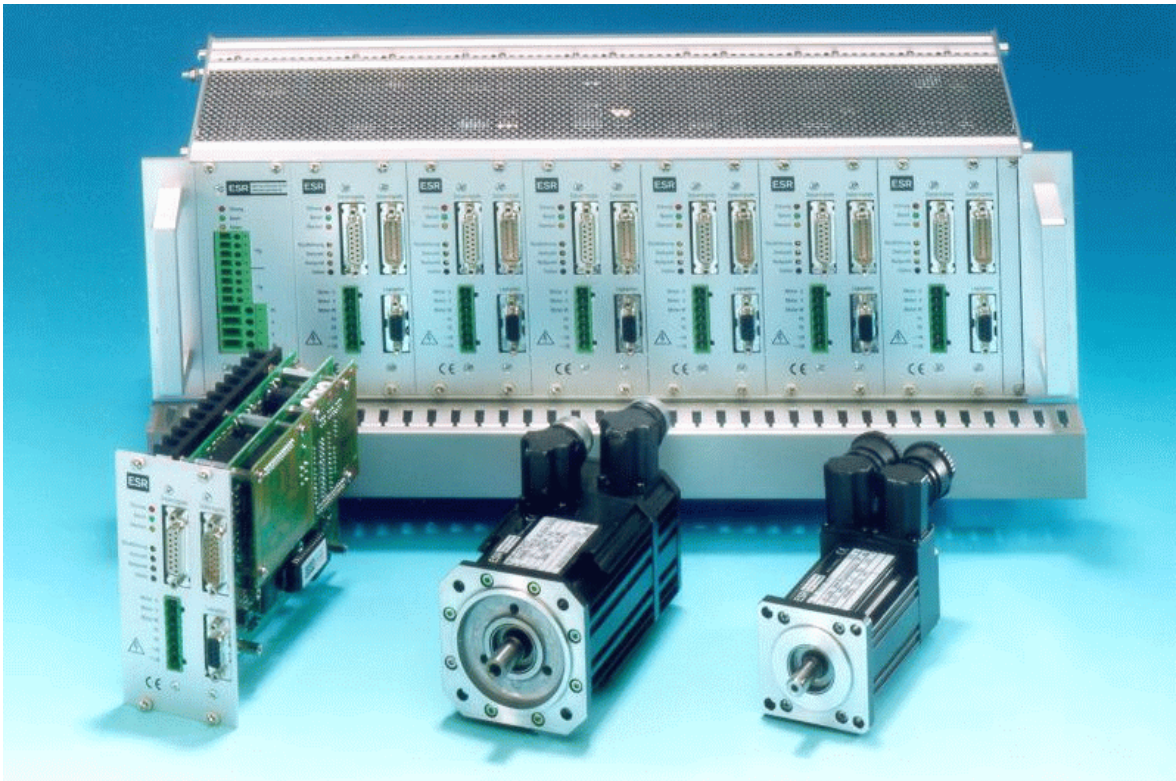


# TRIODRIVE SERVO DRIVES

Analog AC servo drives with sinusoidal commutation  
Servo amplifiers in compact or 19" design, 3 height units  
Servo motors with high power density up to 3.4 Nm / 900 W



Servo amplifiers in compact design BN 6648 (10 A) and BN 6646 (5 A), motors MR 4



Multi-axis servo amplifiers in 19" design (in this example: 6 axes, 5 .. 10 A), motors MR 4

## Products, consulting and service

ESR drive packages consist of servo amplifiers, servo motors, position sensors, gear boxes and brakes. They are supplemented by power supply units (if not already built-in in the amplifier), connectors and cables (ready-assembled on request). All parts of the package are matched and have been tested as combinations. The delivery of the complete drive system from a single source guarantees smooth installation, reliable operation and definite system responsibility on the part of one single supplier.

Our service offer includes individual drive system determination. With our long-standing experience we support you at choosing the right servo drive for your application.

## Applications

Positioning and feed movements with high dynamics and accuracy in

- Handling and assembly systems
- Optical discs production machinery
- Packaging machinery
- Textile machinery
- Plastics processing machines
- Coiling machines
- Flame cutting machinery
- Measuring and testing machinery
- Electronics production machinery
- ...

## Main characteristics

### Two power classes

Servo amplifier		Servo motor	
$I_N$	$U_{zk}$	$M_N$	$P_N$
5 A	125 V	up to 1.0 Nm	up to 500 W
10 A	125 V	up to 3.4 Nm	up to 900 W

## Characteristics of the drive packages

- High quality drive packages consisting of amplifier, motor and accessories
- High dynamics because of motors with low weight-to-power ratio and controllers with highest dynamics
- Smooth running even at low speed because of sinusoidal commutation
- Encoder emulation with 16 selectable pulse numbers: 50 to 1024 pulses per revolution
- Holding control loop can make a brake superfluous: full torque at standstill without drift (optional)
- High safety: position sensor cable break detection
- Operation monitoring by fault signal in case of motor blocking
- Integrated EMC (CE marked) and detailed operating instructions
- Options for amplifier and motor for easy adaption to different applications

## Characteristics of the servo amplifiers

- Compact or 19" design
- Easy wiring, all connections can be plugged in at the front
- High performance with compact dimensions thanks to use of surface mounting devices (SMD) and latest power transistors (MOSFET)
- Easy commissioning due to adjustable feedback, speed, offset. Current limit selectable with 16-position rotary switch.
- No re-adjustment necessary when the amplifier is replaced thanks to plug-in customer module with all setting components
- Easily adapted to non-standard applications with plug-in option modules
- Rapid acceleration, deceleration and reversing of the servo motor by momentary current increase to double the rated current
- No noise with switching frequency well above audible range
- Control supply voltage fed either by the bus voltage or by external supply, e. g. to retain position information in an emergency stop
- Safe operation thanks to monitoring and protection circuit with fault memory for short-circuit, earth leakage, amplifier or motor overheating, motor blocking, resolver error, and voltage fault
- Amplifier and motor protected by adjustable current limit

- Safety with position sensor fault and open circuit monitoring
- Easy error diagnosis with LEDs for fault, ready and overload
- Load and speed monitoring with current and speed monitor outputs
- Also available adapted to motors of other manufacturers
- Special version with rear connection via indirect connectors available (not in stock)

#### Characteristics of the MR 4 servo motors

- Maintenance-free, since brushless
- High dynamics
- Wide speed range
- Degree of protection IP 65
- Insulation according to insulation class F, DIN VDE 0530, withstanding tropical conditions
- High power density through rotor with rare earth magnets
- Ball bearings with grease filling for 20,000 operating hours
- Integrated resolver for sinusoidal commutation
- Overtemperature protection by integrated PTC resistor
- Connection via connectors for position sensor and motor
- Self-cooling
- Design with flange according to DIN 42 677, installation position as required
- Form according to DIN IEC 34 part 7, IM B 5, IM B 35
- Bearing plates and housings made of high-quality light metal alloy
- Rotor dynamically balanced according to vibration severity grade R, on request S
- Standard shaft end without groove, special version possible, e. g. with keyway
- Special motors, e. g. motors with brakes, hollow-shaft design available

#### Characteristics of the gear boxes

- Helical gears in standard design 1 : 6 to 1 : 129
- Planetary gears, one-, two or three-stage, low backlash on request, gear ratio 1 : 3 to 1 : 175
- Output torque up to 2400 Nm
- Special gears, e. g. worm gears or bevel gears, gears with hollow shafts

## Design of the servo amplifiers

### The 19" plug-in module – basis for single-axis and multi-axis applications

The TrioDrive servo amplifiers are designed in modern SM technology on two printed circuit assemblies (PCA) in euroboard format. The two PCAs are screwed together and equipped with a front panel and thus form a 19" plug-in module 3 height units high. It has slots for the customer module and for further modules which can be installed as required. Based on this plug-in module the servo amplifiers can be used in two different applications:

- 19" design for multi-axis application, 3 height units (128 mm) (4 height units with fan) for installation in control cabinets or 19" racks
- compact design for single-axis application, for installation in control cabinets, complete with power supply and integrated RFI-filter

### Multi-axis servo amplifiers, 19" design

For multi-axis applications chassis are available to accommodate several amplifier plug-in modules and the matching power supply. A multi-axis solution formed this way comprises the following components which can be supplied separately or as complete systems:

- servo amplifier as 19" plug-in module, 3 height units high, 12 units wide, front connection (also special version with rear connection via indirect connectors)
- power supply as 19" plug-in module, 3 height units high, 10 units wide, for the supply of several amplifiers
- synchronization unit as 19" plug-in module (front connection only), 3 height units high, 8 units wide, for synchronous running of two drives
- 19" chassis with fan, 4 height units high, or without fan, 3 height units high, for installation in 19" racks or for mounting on the control cabinet mounting plate, 84 units wide for up to 6 amplifier plug-in modules and 1 power supply, or 54 units wide for up to 3 amplifier plug-in modules and 1 power supply (other types on request). Mounting dimensions of the 84 units wide version see fig. 1 and fig. 2.

For applications with continuous currents of up to 3 A the devices can be used with natural convection cooling. At higher currents the devices need fans as provided by the appropriate chassis.

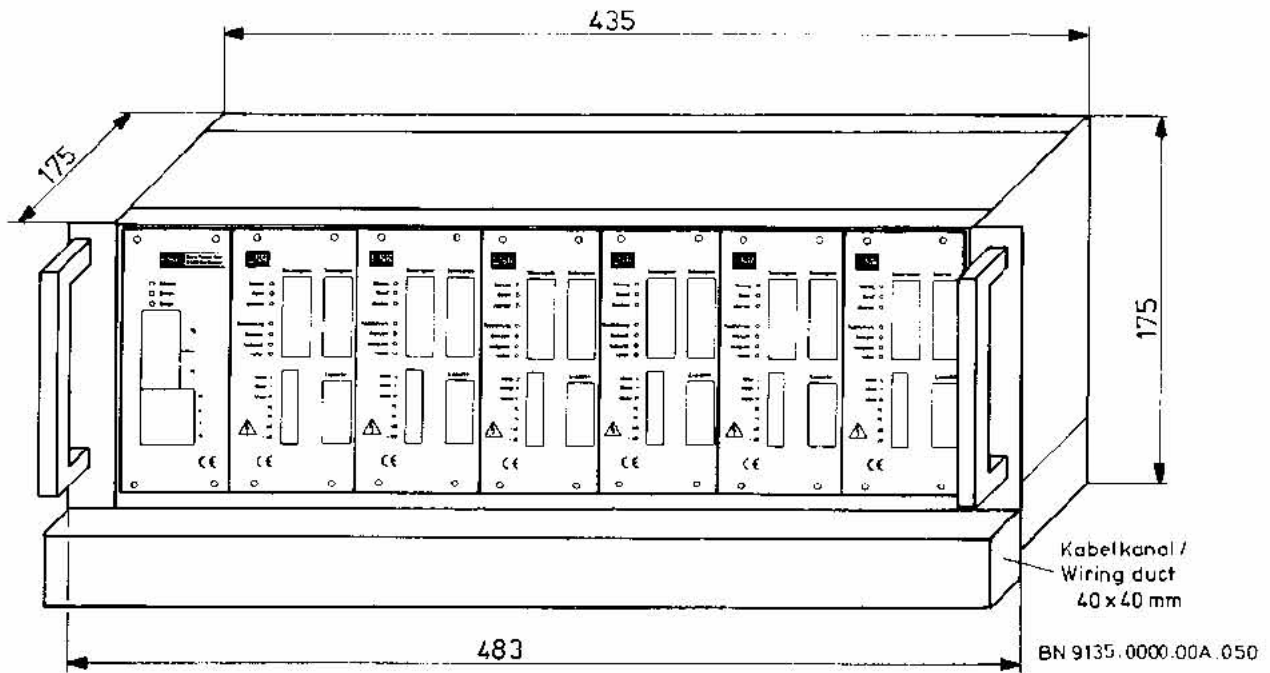


Figure 1: Multi-axis servo amplifier for installation in 19" racks; 84 units wide, 4 height units high including fan unit, dimensions (mm)

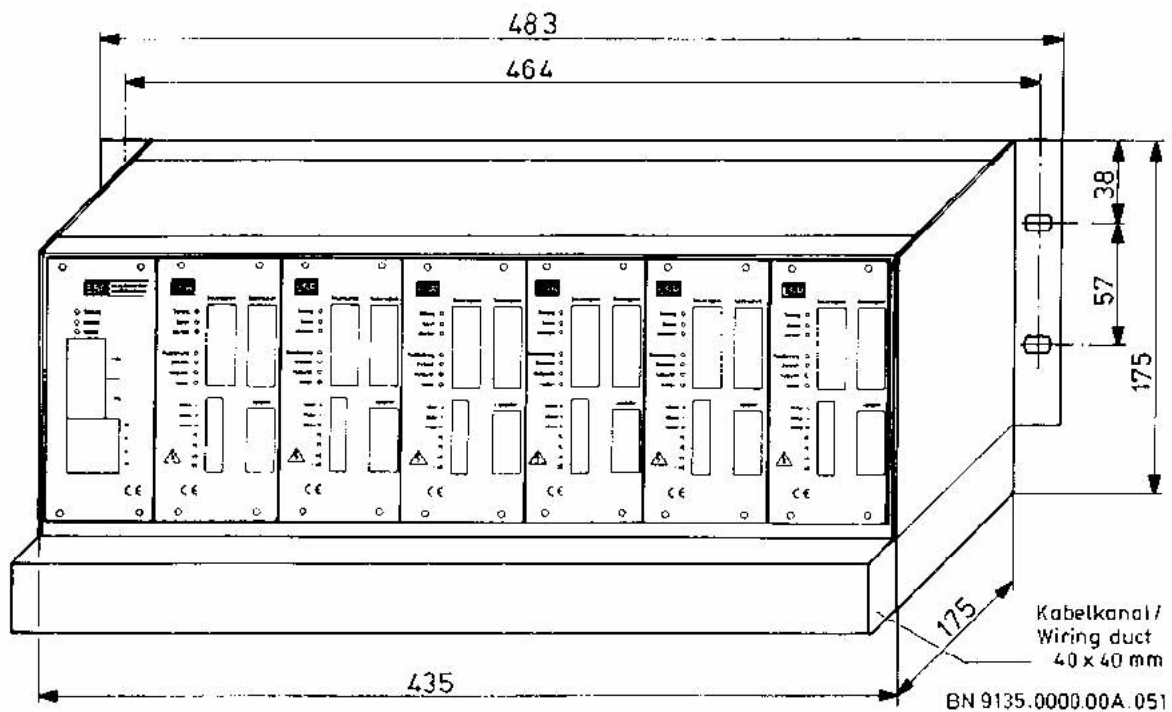


Figure 2: Multi-axis servo amplifier for mounting on the control cabinet mounting plate, 84 units wide, 4 height units high including fan unit, dimensions (mm)

### Single-axis servo amplifiers, compact design

For single-axis applications a compact enclosure with built-in power supply and integrated RFI-filter is available. The 19" servo amplifier plug-in module is fitted into this compact enclosure.

The TrioDrive servo amplifier in compact design formed this way can be mounted onto the mounting plate of a control cabinet or into the machine rack.

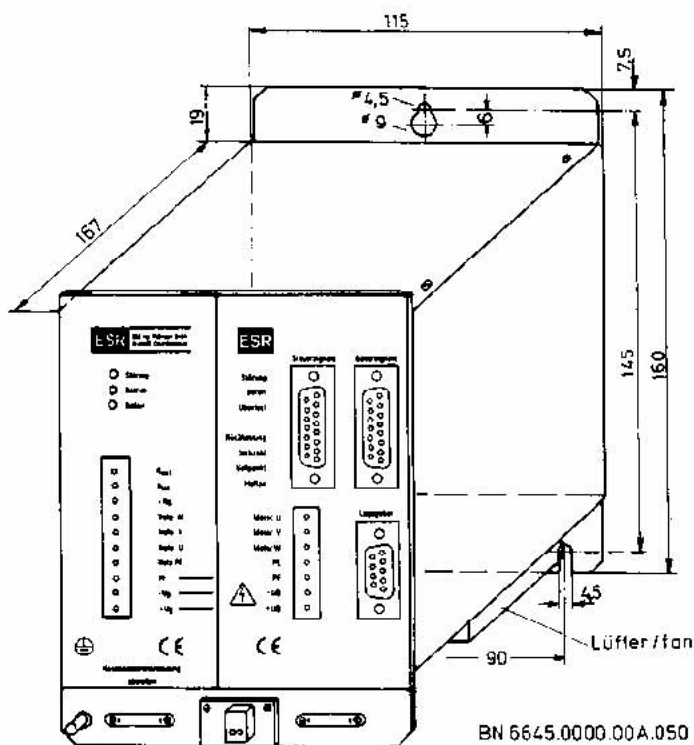


Figure 3: Servo amplifier in compact design, mounting dimensions (mm)

For applications with continuous currents of up to 3 A or with a switch-on duration of 50% or less, the compact device without fan is sufficiently cooled by natural convection cooling at an ambient temperature of up to 40 °C. At higher power the compact device with fan has to be used.

The amplifier has to be connected to mains via an isolating transformer, to 230 V single-phase mains for low power, or to 3 × 400 V or 3 × 480 V three-phase mains for higher power. The RFI-filter for compliance with EMC limits in accordance with EN 55011, classes A and B, is already integrated in the compact enclosure. The power supply of the com-

compact amplifier contains the shunt regulator with a shunt resistor which takes up the energy fed back from the motor during braking. Alternatively, an external shunt resistor can be connected.

Of the variety of possible combinations, three TrioDrive compact amplifiers are available as preferred devices. You can find them in the table "Servo amplifiers in compact design" on page 12. Figure 3 shows the mounting dimensions. We can also build other compact amplifiers from the individual components.

### Mains connection and options E0, E1

While the TrioDrive servo amplifiers in compact design have built-in power supplies, the TrioDrive servo amplifiers in 19" design require a special power supply. It can supply 2 to 4 amplifiers, depending on the power of the amplifiers.

The load factor gives the number of amplifiers that can be connected. You will find it in the technical specifications for the amplifiers, the power supplies and the mains transformers. The following applies:

- When all amplifiers are being operated simultaneously at full load, the sum of their load factors must not exceed the load factor of the power supply and the one of the mains transformer.
- When not all amplifiers are being operated simultaneously at full load, (which is frequently the case with servo drives), the total load factor is the sum of the load factors of the amplifiers being operated simultaneously.
- When amplifiers are operated under part load only, their load factors are reduced for purposes of the calculation in proportion to the part load.

Example:

- The BN 6646 TrioDrive amplifier has a load factor of 3, the BN 3246 power supply has a load factor of 12; this means that this power supply can run 4 of these amplifiers simultaneously at full load. For 4 of these amplifiers the transformer BN 3849 with a load factor of 12 has to be used as mains transformer.

The 19" plug-in module power supply BN 3246 is designed in the same way as the servo amplifiers. It contains the mains rectifier, the charging capacitors, the monitoring circuit, and the shunt regulator with a shunt resistor sufficient for common servo applications. Alternatively, an external shunt resistor can be connected.

The power supply has to be connected 3 × 400 V or 3 × 480 V three-phase mains by using an isolating



transformer. For connection to other mains voltages special transformers are available. For low power single-phase mains connection is possible.

The standard mains transformers are designed for TrioDrive servo amplifiers in compact design and 19" design. The required power is calculated according to the load factors of the servo amplifiers.

Only one servo amplifier in compact design or only one 19" power supply may be connected to one mains transformer winding.

In 19" design, a RFI-filter for compliance with EMC limits in accordance with EN 55011, classes A and B, has to be switched behind the secondary winding of the mains transformer. The compact amplifier has a built-in RFI-filter, an external RFI-filter is not necessary.

The servo amplifier generates the internal low voltage for the control circuit from the bus voltage (standard version E0). If the control circuit should be active even with the bus or mains voltage switched off (e. g. in order to keep the position measurement alive), a variant of the servo amplifier can be used which has an input for the separate feeding of a supply voltage of 24 V DC (E1 option, without extra cost).

### CE marking

The TrioDrive servo amplifiers meet the requirements of the EMC directive and the low voltage directive and thus bear the CE marking. The conformity to EMC limits according to EN 55011, class A and B, is realized through a built-in RFI-filter in case of the amplifiers in compact design and through an external RFI-filter which has to be switched before the mains transformer in case of the devices in 19" design. The operating instructions explain the installation in detail. All TrioDrive servo amplifiers comply with the high immunity requirements in accordance with EN 50082 part 1 and 2.

### Interfaces of the servo amplifiers

All connections can be plugged in at the front of the servo amplifiers in compact and 19" design. This allows a specially easy, clear, and low cost wiring. The trim potentiometers and the LEDs are also located at the front panel.

The following connectors are located at the front panel:

- motor and operating voltage (Combicon connector, 7-pin)
- control signals (SUB-D female connector, 15-pin)
- position sensor (resolver) (SUB-D female connector, 9-pin)
- encoder signals (encoder emulation, optional) (SUB-D male connector, 15-pin)

Easy controller adjustment with 3 trim potentiometers at the front panel:

- feedback
- speed
- offset

The operating mode of the servo amplifier is indicated by lighting up or blinking of 3 LEDs:

- ready
- overload
- fault

The operating mode of the power supply is indicated there by 3 LEDs:

- ready
- shunt
- fault

As special version the 19" plug-in modules are also available with rear connection via indirect connectors. This version is not meant for new developments.

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## Functions of the servo amplifiers

### Feedback control

TrioDrive servo amplifiers work with two control loops: the current control loop and the higher-level speed control loop. Since both control loops are realized in analog technology, the controller bandwidth is very high. The TrioDrive servo amplifier operates as current controller or as speed controller (with underlying current control loop) depending on the setting on the customer module (see below).

The servo amplifiers are designed for three-phase AC servo motors (permanent magnets in the rotor) with resolvers. The sinusoidal commutation provides smooth motor running even with low speeds and high dynamics.

## Customer module

The set-up elements and the components for the application-specific controller settings are located on the plug-in customer module. When an amplifier is replaced, the customer module can be transferred to the new amplifier. By this the controller settings are kept and readjustment is not necessary (except offset).

## Monitoring and protective circuits

Built-in monitoring and protective circuits protect servo amplifier and motor against damage even in extreme situations and switch off the drive in case of a fault. The circuits monitor:

- amplifier output for short circuit and earth fault
- amplifier overheating
- motor overheating
- position sensor signals for open circuit and short circuit of one or more resolver leads
- motor blocking for more than approx. 10 seconds
- faulty voltages

If one of these faults occur, the drive is stopped immediately. The fault is stored, displayed, and signalled. Missing or low operating voltage also leads to a fault. This fault is not stored, the drive will continue operation as soon as the operating voltage is sufficient again.

Speed and current can be traced and monitored using two analog outputs speed monitor and current monitor.

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## Adaptation using modules

Using pluggable modules and auxiliary units the TrioDrive servo amplifiers can be adapted to different applications. In addition to the customer module which is always fitted (see above) the following modules are available optionally:

- polarity module
- add-on module
- encoder module
- function module

See the servo amplifier type code on page 16 for an overview of the available modules.

Auxiliary units can be used for more complex applications, e. g.

- auxiliary unit for axis synchronization (only for 19" design)

The following sections describe the modules and the auxiliary unit in detail.

## Polarity modules P1, P2

The levels of the switched inputs and outputs can be adapted to different controller types using the polarity module. There are two possibilities for the signal polarity of the servo amplifier's switched inputs and outputs:

- switch to neutral or
- switch to plus

Especially programmable logic controllers (PLC) switch to plus, usually to a control voltage of +24 V, and the loads are on neutral.

The servo amplifiers described here are available for both polarities of the input and output signals. In the standard version, the output transistors switch to neutral and the input loads to plus. The PLC-compatible version (P1 or P2 option) has a plug-in polarity module which reverses the switch directions of the inputs and outputs.

## Add-on modules Z1, Z2, Z4

The standard version of the TrioDrive servo amplifier (Z0 option) has no add-on module, as it is not necessary for operation. Additional circuits for extra features, e. g.

- two direction-dependent limit switches acting like brakes
- setpoint ramp
- stall monitoring by "Motor standstill" output
- input for current reduction
- input for speed direction reversal

are integrated on a pluggable add-on module (Z1, Z2, Z4 option), see the servo amplifier type code on page 16 for further details.

## Encoder modules G1 .. G4

The encoder module can be added for generating encoder signals. It digitally analyzes the resolver signals and outputs encoder signals corresponding to the pulses of an incremental encoder (two pulses shifted by 90° and index pulse). Thus no incremental encoder is needed on the motor. Using a rotary switch, one of the following 16 pulse numbers

(incremental encoder pulses per revolution) can be selected:

- 128, 256, 512, 1024,
- 50, 100, 200, 250, 500, 1000,
- 60, 90, 180, 360, 720, 900

Other pulse numbers are also available on request. The pulses are generated by 5 volts line drivers (RS 422 compatible; G1 and G3 options). A version with 24 volts pulse output is also available (G2 and G4 options). With the G3 and G4 options the index pulse can be shifted in 256 steps within one motor revolution.

If the control circuit of the TrioDrive servo amplifier is fed by an external 24 V power supply (E1 option, details see section "Mains connection and options E0, E1", page 5), the position information is saved even when the bus voltage is switched off.

The pulse output can be used for connecting positioning controls as well as digital tachometers for monitoring the motor speed.

### Function modules

Various functions, including customer-specific functions, can be implemented on the function module. The standard function modules "Holding function" and "Field weakening mode" are described in the following.

#### Function module F1 "Holding function"

The "Holding function" module allows the motor to stop without drift at full stall torque, which is normally not feasible with common analog servo drives. When the "Hold" input is turned on, a holding control loop closed via the resolver is activated and holds the motor digitally in the position it was in at the time of the hold command. The resolution of the holding control loop is 4096 increments per revolution. If the hold command is given while the motor is still turning, the internal holding control loop stores the position of the motor at the time of the command. It returns the motor to this position as long as it has overrun the position by less than one complete revolution because of inertia. This allows easy positioning solutions.

In many cases the holding control loop can render a holding brake unnecessary, which is often used to hold the motor. A brake is only necessary where safety aspects require its use.

#### Function module F2 "Field weakening mode"

With the "Field weakening mode" module the attainable speed of the motor can be increased by some 10% beyond the rated speed at reduced torque. The increase of the speed is achieved by a phase shift of the motor current at higher speed.

#### Auxiliary unit for axis synchronization

For synchronizing two TrioDrive servo drives an auxiliary unit is available in 19" design. It measures the difference in angle between a master and a slave axis and generates a correction signal for the amplifier of the slave axis. The drives thus run at synchronized angles and hence at precisely the same speed. By continuous feedback control and adding a signal proportional to the speed of the master axis the angular accuracy is high even at high change of speed.

The synchronization unit only needs the speed setpoint as input. From this, the unit generates the signals necessary to control the two axes. It is fed by the amplifiers' power supplies.

If an adjustable warning threshold is exceeded a warning signal is set, if the maximum permissible angular error of approx. 180° is exceeded a fault signal is set and the drives are disabled in case of a fault.

For special applications up to 5 outputs are available which switch according to the position of the master axis. The standard values for the switching ranges are stored in an EPROM. Application-specific values can be programmed here as well.

The synchronization unit is available as a 19" plug-in module and is installed in a chassis together with the amplifiers in 19" design.

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## Overview on functions and characteristics

### Control

Speed control or current control (selectable on the customer module), sinusoidal commutation (resolver as motor position sensor)

- additional with Z1 option: adjustable ramps 7 msec .. 70 msec per volt setpoint step
- additional F1 option: holding control loop (stop with stall torque without drift)
- additional F2 option: field weakening mode for speed control



### Current limiting

I<sup>2</sup>t circuit, peak current approx. double the continuous current. Current limit adjustable in 16 steps with rotary switch

- additional Z2 option: current limit adjustable via analog input

### Monitoring and protecting

Safe operation thanks to monitoring and protection circuit with fault memory for short-circuit, earth leakage, amplifier or motor overheating, motor blocking, resolver error, and voltage fault

### Analog inputs

Setpoint  $\pm 10$  V (speed or current) via differential amplifier

- additional Z2 option: current limit 0 .. +10 V

### Analog outputs

Speed monitor  $\pm 7$  V for maximum speed, current monitor  $\pm 10$  V for maximum peak current

### Switching inputs

“Controller enable” (with Z1, Z2 options: braking), “Reset fault”;

- additional Z1 option: 2 limit switches (direction-dependent, acting like brakes)
- additional Z2 option: “Reverse direction of rotation”
- additional F1 option: “Hold” (stop with stall torque without drift)

### Input levels

all inputs switch to neutral

- P1, P2 options: all inputs PLC compatible, switch to +24 V

### Switching outputs

“Fault signal” (P2 option: ready), “Overload”

- additional Z1, Z2 options: “Motor standstill” or “Power circuit ready”

### Output levels

all outputs switch to neutral

- P1, P2 options: all outputs PLC compatible, switch to +24 V

### Position output

19" design: “Position” (12 bit TTL), for axis synchronization (option)

### Encoder emulation with 16 selectable pulse numbers

- G1 option: 5 V push-pull, electrically isolated, fixed index pulse
- G2 option: 24 V signals, fixed index pulse
- G3 option: 5 V push-pull, electrically isolated, adjustable index pulse
- G4 option: 24 V signals, adjustable index pulse

### Trim potentiometer

“Feedback”, “Speed”, “Offset”

- additional F1 option: “Holding control loop feedback”

### LEDs

“Ready”, “Overload”, “Fault”

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### Accessories

- Motor and resolver/encoder connection cables
  - shielded connection cables for connection of the motor and resolver, also ready-assembled cable sets on request
- Connector sets
  - comprising the matching SUB-D male or female connectors with screwable metallized housings and the Combicon female connectors
- Motor chokes
  - for motor cable lengths of more than 10 m
- Chassis for devices in 19" design
  - 84 or 54 width units wide, without fan, 3 height units high, or with fan, 4 height units high; other variants on request

Ready-assembled multi-axis servo amplifiers are available using these chassis.

ers in compact design already have built-in RFI filters.

- RFI-filter for devices in 19" design
  - for conformity to EMC limits according to EN 55011, class A and B. Note: the servo amplifi-

The tables starting from page 13 give an overview on the accessories.

### Drive packages (selection), most important technical specifications

Motor frame size DIN/IEC	Motor order number	Speed (r.p.m.)	Rated torque (Nm)	Stall torque (Nm)	Peak torque (Nm)	Shaft power (kW)	Amplifier order number
45	MR 4030-U1-N70-L0..	7000	0.3	0.4	1.0	220	BN 6645 BN 6646 BN 6647
	MR 4045-U1-N70-L0..	7000	0.4	0.6	1.4	308	
	MR 4060-U1-N45-L0..	4500	0.7	0.8	1.7	339	
	MR 4104-U1-N50-L0..	5000	0.6	0.7	1.9	314	BN 6648 BN 6649
	MR 4106-U1-N50-L0..	5000	0.8	1.0	2.0	419	
	MR 4108-U1-N50-L0..	5000	1.0	1.4	3.9	524	
63	MR 4204-U1-N35-L0..	3500	2.1	2.1	4.8	770	BN 6648 BN 6649
	MR 4208-U1-N25-L0..	2500	3.4	3.9	8.4	890	

In addition to the motors listed above, there are a number of further motors available. The rated torque refers to the rated speed given above. Higher torque is reached at a lower speed. We would be ready to assist you in choosing the most favorable combination for your particular application. We shall be pleased to calculate and configure the drive system in cooperation with the customer.

**Servo amplifiers in 19" design, most important technical specifications**

Servo amplifier order number (19" plug-in module)	BN 6646	BN 6648
Rated AC side voltage * (50 .. 60 Hz)	90 V AC (+10%)	3 x 90 V AC (+10%)
Minimum mains voltage	40 V AC	3 x 40 V AC
Bus voltage	125 V DC	
Rated current (rms value)	5 A	10 A
Maximum peak current (crest value)	15 A	30 A
Current limiting adjustable from... to...	1.25 .. 5 A	2.5 .. 10 A
Load factor (in conjunction with mains transformer)	3	6
Integration time of the I <sup>2</sup> t circuit at max. peak current	approx. 2 s	
Setpoint value	±10 V at 20 kΩ	
Operating range of speed trimmer	1 : 7	
Switching frequency / current ripple	16 kHz / 32 kHz	
Auxiliary voltage outputs	+15 V and -15 V (±10%) max. load 10 mA each	
For option E1: external control circuit supply	24 V DC -15+25%, 0.2 A	
Climatic category (DIN EN 50178) operation / storage / transport	3K3 / 1K4 / 2K3	
Permissible continuous current (rms) with convection cooling and 40 °C ambient temperature	3.0 A	3.5 A
Permissible switching duration at max. current, switch-on duration 10 min., convection cooling, 40 °C ambient temp.	50%	20%
Permissible ambient temp. in cont. operation, ventilated	50 °C	
Required minimum cooling air flow for continuous duty at 50 °C ambient temperature	0.5 m/s **	
Width	12 width units (61 mm)	
Height	3 height units (128 mm)	
Depth (without connectors)	165 mm	
Weight	0.6 kg	

\* via isolating transformer to 230 V AC, 3 x 400 V or 3 x 480 V AC, power supply BN 3246 required additionally

\*\* fulfilled by using ESR chassis or compact enclosures with fan

### Servo amplifiers in compact design, most important technical specifications

Servo amplifier order number (compact design)	BN 6645	BN 6647	BN 6649
Rated AC side voltage * (50 .. 60 Hz)	90 V AC (+10%)	3 × 90 V AC (+10%)	3 × 90 V AC (+10%)
Minimum mains voltage	40 V AC	3 × 40 V AC	3 × 40 V AC
Bus voltage	125 V DC		
Rated current (rms value)	5 A	5 A	10 A
Maximum peak current (crest value)	15 A	15 A	30 A
Current limiting adjustable from... to...	1.25 .. 5 A	1.25 .. 5 A	2.5 .. 10 A
Load factor (in conjunction with mains transformer)	3	3	6
Integration time of the I <sup>2</sup> t circuit at max. peak current	approx. 2 s		
Maximum continuous braking power	20 W	30 W	
Pulse braking power	200 W at 2% switch-on duration, 2 sec		
Setpoint value	±10 V at 20 kΩ		
Operating range of speed trimmer	1 : 7		
Switching frequency / current ripple	16 kHz / 32 kHz		
Auxiliary voltage outputs	+15 V and -15 V (±10%) max. load 10 mA each		
For option E1: external control circuit supply	24 V DC -15+25%, 0.2 A		
Built-in fan	no	yes	yes
External power supply for fan	-	24 V DC ±15%, 100 mA	
Climatic category (DIN EN 50178) operation / storage / transport	3K3 / 1K4 / 2K3		
Permissible switching duration at continuous current, switch-on duration 10 min.	100% at 3 A 50% at 5 A	100% at 5 A	100% at 10 A
Permissible ambient temperature	40 °C	50 °C	
Width	115 mm		
Height	160 mm		
Depth (without connectors)	167 mm		
Weight	1.9 kg	2.1 kg	

\* via isolating transformer to 230 V AC, 3 × 400 V or 3 × 480 V AC

**Accessories**

Description	Order number
Cable sets (ready-assembled motor and resolver/encoder connection cable)	on request
Motor connection cable, 4 cores, cross-section 1.5 mm <sup>2</sup> , shield	BN 8817
Motor connection cable, 4 cores, cross-section 2.5 mm <sup>2</sup> , shield	BN 8823
Connection cable for motor with brake, 4 × 1.5 mm <sup>2</sup> + 2 × 1 mm <sup>2</sup> , shield	BN 8820
Connection cable for motor with brake, 4 × 2.5 mm <sup>2</sup> + 2 × 1 mm <sup>2</sup> , shield	BN 8824
Resolver/Encoder connection cable, 8 cores, twisted pair, shield	BN 8818
Motor choke with terminals and enclosure, for cable length 10 to 50 m	BN 3845.2258
Motor choke with terminals and enclosure, for cable length 50 to 70 m	BN 3857.2311
Connector set for TrioDrive servo amplifier	
• in 19" design without encoder module option	ST 6646
• in 19" design with encoder module option	ST 6648
• in compact design without encoder module option	ST 6645
• in compact design with encoder module option	ST 6647
Synchronization unit (19" plug-in module)	BN 1456
Connector set for 2 TrioDrive amplifiers and one synchronization unit	EV 1456
Ferrite ring for interference suppression of supply cables	BN 3859
RFI-filter for 19" amplifiers	
• single-phase (for single-phase transformers)	BN 3862.2337
• three-phase (for three-phase transformers)	BN 3841.2302
Shield connection plate	BN 8659

**19" chassis**

Description	Order number
Chassis, empty, for installation in 19" racks, mounting flanges and handle at the front (see fig. 1, page 4)	
<ul style="list-style-type: none"> <li>• for up to 6 TrioDrive servo amplifiers and 1 power supply, 4 units high, 84 width units wide, with fans</li> </ul>	BN 8655.1587
<ul style="list-style-type: none"> <li>• for up to 6 TrioDrive servo amplifiers and 1 power supply, 3 units high, 84 width units wide, without fans</li> </ul>	BN 8655.1585
Chassis, empty, for installation on mounting plates, mounting flanges at the back, no handles (see fig. 2, page 4)	
<ul style="list-style-type: none"> <li>• for up to 6 TrioDrive servo amplifiers and 1 power supply, 4 units high, 84 width units wide, with fans</li> </ul>	BN 8655.2020
<ul style="list-style-type: none"> <li>• for up to 3 TrioDrive servo amplifiers and 1 power supply, 4 units high, 54 width units wide, with fans</li> </ul>	BN 8655.1586
<ul style="list-style-type: none"> <li>• for up to 6 TrioDrive servo amplifiers and 1 power supply, 3 units high, 84 width units wide, without fans</li> </ul>	BN 8655.2548
<ul style="list-style-type: none"> <li>• for up to 3 TrioDrive servo amplifiers and 1 power supply, 3 units high, 54 width units wide, without fans</li> </ul>	BN 8655.1624
Customer-specific chassis	on request

**Compact enclosures**

Description	Order number
Compact enclosure with power supply and RFI-filter, without amplifier	
<ul style="list-style-type: none"> <li>• for single-phase connection, without fan</li> </ul>	BN 3146.2678
<ul style="list-style-type: none"> <li>• for single-phase connection, with fan</li> </ul>	BN 3146.2682
<ul style="list-style-type: none"> <li>• for three-phase connection, without fan</li> </ul>	BN 3147.2679
<ul style="list-style-type: none"> <li>• for three-phase connection, with fan</li> </ul>	BN 3147.2683
Customer-specific compact enclosure	on request



**Power supply 19" design, technical specifications**

Power supply 19" design order number	BN 3246
Rated AC side voltage via isolating transformer	
• single-phase (for up to 0.5 W)	1 × 90 V AC +10% (min. 1 × 40 V)
• three-phase	3 × 90 V AC +10% (min. 3 × 40 V)
For bus voltage	125 V DC
Load factor in case of single-phase connection	3
Load factor in case of three-phase connection	12
Maximum continuous braking power	30 W
Peak braking power	200 W at 2% switch-on duration, 2 sec
Width	10 units (51 mm)
Height	3 height units (128 mm)
Depth (without connectors)	165 mm
Weight	0.5 kg

**Mains transformers, technical specifications**

Transformer order number	BN 3846	BN 3848	BN 3849
Mains connection (primary) *	230 V AC	3 × 400 V AC	3 × 400 V AC
Output voltage	90 V AC	3 × 90 V AC	3 × 90 V AC
Load factor (power supply dimensioning)	3	6	12
Rated output	750 VA	1.5 kVA	2.7 kVA
Line-side fuses (primary)	4 A T	3 × 4 A T	3 × 6 A T
Matching RFI-filter **	BN 3862.2337	BN 3841.2302	
Length	113 mm	225 mm	245 mm
Width	130 mm	148 mm	210 mm
Height	140 mm	195 mm	160 mm
Weight	10 kg	19 kg	24 kg

\* other voltages, e. g. 3 × 480 V AC, on request

\*\* required only with 19" design

## TrioDrive servo amplifier type code

Example ⇒ **BN 6646.1647-K2-Z1-P1-G0-F0-E0-S0**



<b>46</b>	<p><b>Connection</b></p> <p>4x front connection (standard version; Combicon, SUB-D connectors)</p> <p>5x rear connection (special version; indirect connectors)</p>	<p><b>Design, power</b></p> <p>x6 19" plug-in module, output current 5 A<sub>eff</sub></p> <p>x8 19" plug-in module, output current 10 A<sub>eff</sub></p> <p>45 compact device (without fan), output current 5 A<sub>eff</sub></p> <p>47 compact device (built-in fan), output current 5 A<sub>eff</sub></p> <p>49 compact device (built-in fan), output current 10 A<sub>eff</sub></p>
<b>1647</b>	<p><b>Assembly code (Bauvorschrift, BV)</b></p> <p>Assembly code (BV): Company-internal coding is given for various feature combinations. The BV specification need not be given if all other features are given and the customer-specific fittings are described. "BN 6646-K2-Z1-P1" would be sufficient for the above example.</p>	
<b>K2</b>	<p><b>Controller switching (customer module and jumpers)</b></p> <p>K0 none (device not ready for operation)</p> <p>K1 2-pole-pair motor, speed control 3,500 min<sup>-1</sup></p> <p>K2 2-pole-pair motor, speed control 7,000 min<sup>-1</sup></p> <p>K3 2-pole-pair motor, current control</p> <p>K4 3-pole-pair motor, speed control 3,500 min<sup>-1</sup></p>	<p>K5 3-pole-pair motor, speed control 7,000 min<sup>-1</sup></p> <p>K6 3-pole-pair motor, current control</p> <p>KA 3-pole-pair motor, speed control 10,500 min<sup>-1</sup></p> <p>KB 3-pole-pair motor, speed control 14,000 min<sup>-1</sup></p> <p>KK customer-specific</p>
<b>Z1</b>	<p><b>Additional equipment through add-on modules</b></p> <p>Z0 none (standard)</p> <p>Z1 limit switch, ramp, controller inhibit braking</p> <p>Z2 external current limiting, rotation reversal</p>	<p>Z4 limit switch, P+I/l-lim., controller inhibit braking</p> <p>ZK customer-specific</p>
<b>P1</b>	<p><b>Input/output polarity (polarity module)</b></p> <p>P0 switching towards zero (standard)</p> <p>P1 PLC-compatible, "fault" output</p>	<p>P2 PLC-compatible, "ready" output</p> <p>PK customer-specific</p>
<b>G0</b>	<p><b>Additional equipment through encoder modules (incremental encoder emulation)</b></p> <p>G0 no pulse outputs (standard)</p> <p>G1 pulse outputs, 5 V push-pull signals RS 422</p> <p>G2 pulse outputs, 24 V</p>	<p>G3 pulse outputs, with index pulse shift, 5 V push-pull signals RS 422</p> <p>G4 pulse outputs, with index pulse shift, 24 V</p> <p>GK customer-specific</p>
<b>F0</b>	<p><b>Additional equipment through function modules</b></p> <p>F0 none (standard)</p> <p>F1 holding control loop</p>	<p>F2 field weakening operation</p>
<b>E0</b>	<p><b>Supply of control circuit (cannot be refitted)</b></p> <p>E0 internal supply from DC-bus (standard)</p>	<p>E1 through external 24 V, e. g. for position retention</p>
<b>S0</b>	<p><b>Special equipment (customization)</b></p> <p>S0 none (standard)</p> <p>S1 for connection of a synchronization unit</p>	<p>SK customer-specific, explained by text</p>

The facts given in this data sheet are for information only and are no guarantee of properties. We reserve the right to make changes without notice.

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