

# IB IL EC AR 48/10A

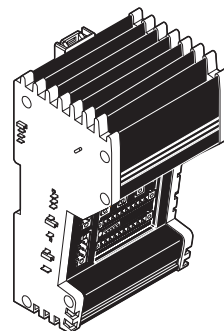
## IB IL EC AR 48/10A-PAC

### Inline Servo Amplifier for DC Motors With and Without Brushgears

Data Sheet

03/2005

6976A000



The IB IL EC AR 48/10A and IB IL EC AR 48/10A-PAC only differ in the scope of supply (see "Ordering Data" on page 13). Their function and technical data are identical.

For greater clarity, the order designation IB IL EC AR 48/10A is used throughout this document.

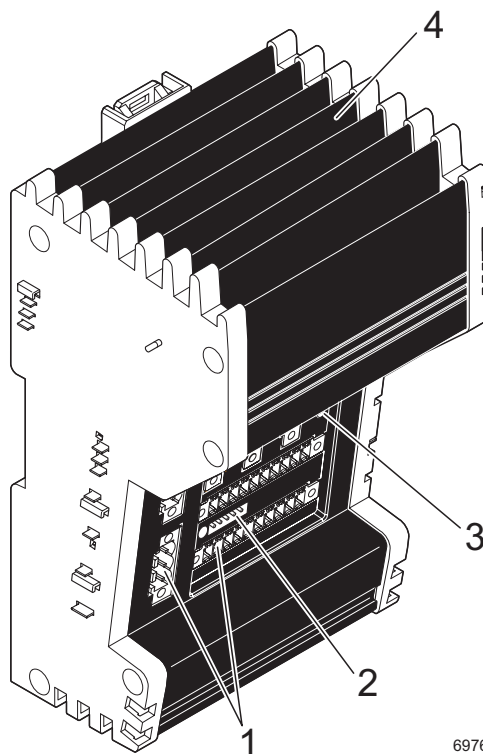


This data sheet is only valid in association with the IB IL SYS PRO UM E user manual or the Inline system manual for your bus system as well as the UM EN IB IL EC AR 48/10A user manual for the Inline servo amplifier.

## Product Description

The IB IL EC AR 48/10A Inline servo amplifier is a universal position, speed or torque controller with a power output stage for permanently excited DC motors with brushgears (DC motors) and without brushgears (EC motors) with a power consumption of up to 450 W.

The Inline servo amplifier has a 4 quadrant function, i.e., it supplies power back to the power supply unit when the brake function is used.



6976A001

Figure 1 Module view

The Inline server amplifier consists of the following components:

- 1 Connections (COMBICON connectors)
- 2 RS-232 interface
- 3 Diagnostic and status indicators
- 4 Heat sink

### Features

- Diagnostic and status indicators
- Use as position, torque or speed controller
- Inline device
- 4-quadrant function
- External brake chopper
- Short-circuit-proof motor output

### Applications

The Inline servo amplifier is used under the following conditions:

- Permanently excited DC motors with and without brushgears
- Nominal voltages from 12 V to 48 V
- Power consumption of up to 450 W
- Motor current of up to 10 A

## Typical Application of the IB IL EC AR 48/10A

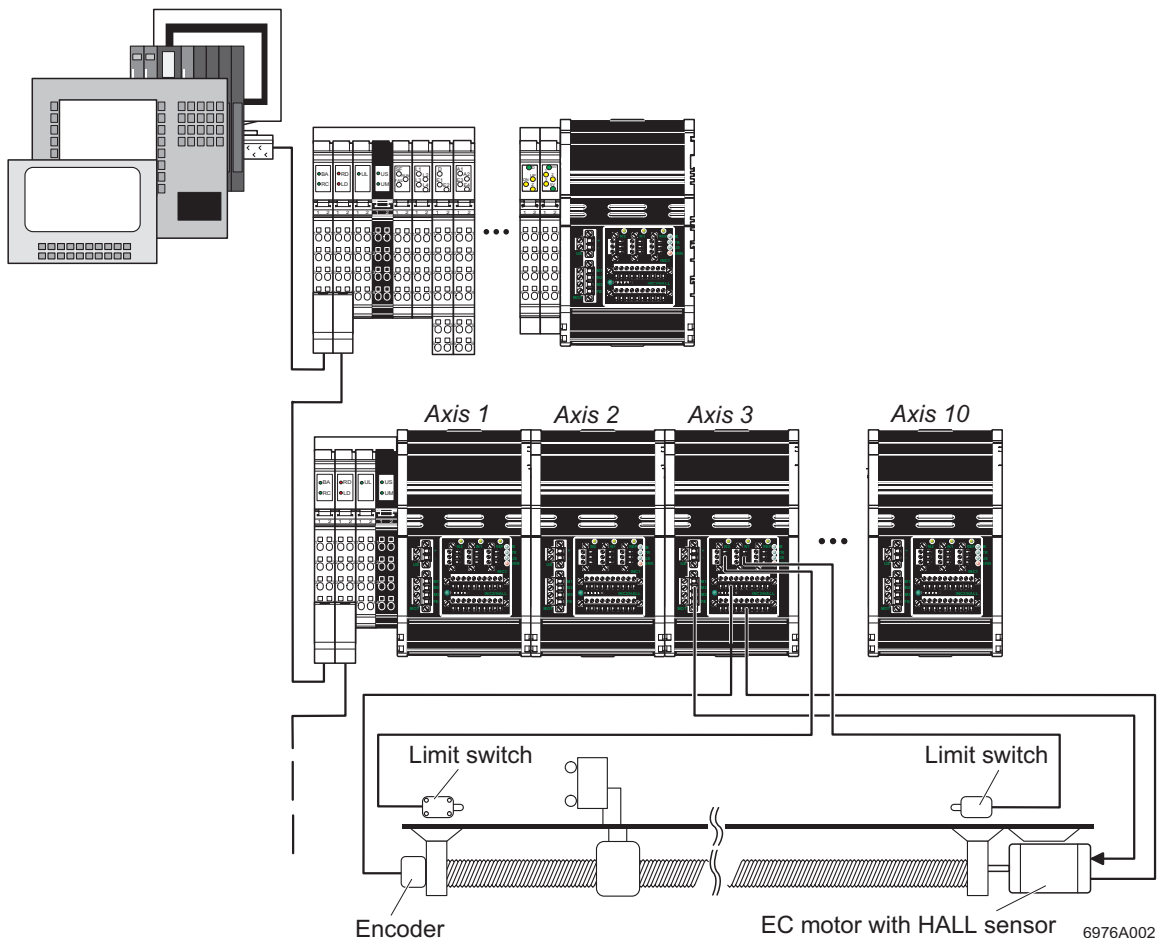
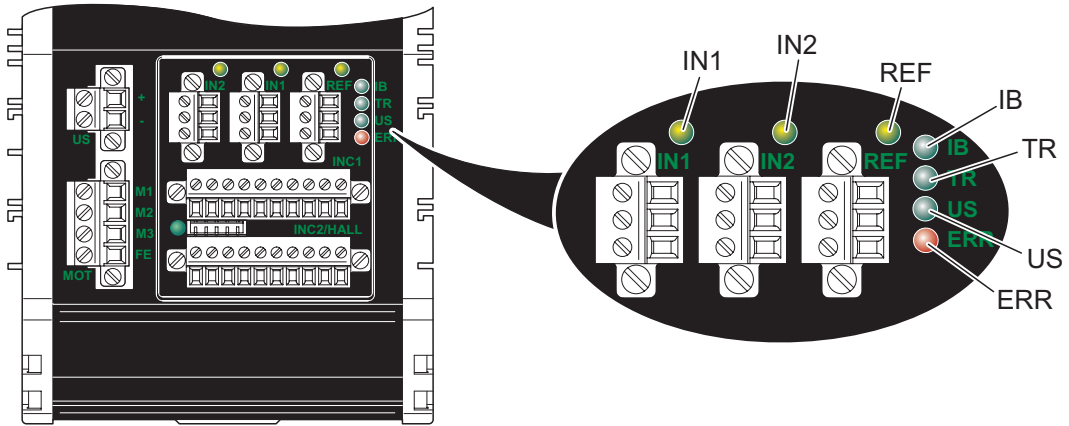


Figure 2 Typical application of the IB IL EC AR 48/10A

## Local Diagnostic and Status Indicators



6977A002

Figure 3 Local diagnostic and status indicators on the IB IL EC AR 48/10A

| Des.       | Color      | Meaning                                                                                                                                           |
|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IN1</b> | Yellow LED | Limit switch 1                                                                                                                                    |
|            | ON:        | Input set                                                                                                                                         |
|            | OFF:       | Input not set                                                                                                                                     |
| <b>IN2</b> | Yellow LED | Limit switch 2                                                                                                                                    |
|            | ON:        | Input set                                                                                                                                         |
|            | OFF:       | Input not set                                                                                                                                     |
| <b>REF</b> | Yellow LED | Home position switch                                                                                                                              |
|            | ON:        | Input set                                                                                                                                         |
|            | OFF:       | Input not set                                                                                                                                     |
| <b>IB</b>  | Green LED  | Diagnostics                                                                                                                                       |
|            | ON:        | Bus active                                                                                                                                        |
|            | Flashing:  |                                                                                                                                                   |
|            | 0.5 Hz:    | Communications power present, bus not active                                                                                                      |
|            | 2 Hz:      | Communications power present, bus active, I/O error                                                                                               |
|            | 4 Hz:      | Communications power present, terminal before the flashing module failed, terminal behind the flashing module not part of the configuration frame |
|            | OFF:       | Communications power not present, bus not active                                                                                                  |

| Des. | Color     | Meaning                                                                                                                                                           |
|------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TR   | Green LED | PCP active                                                                                                                                                        |
|      | ON:       | PCP messages being transmitted to the Inline servo amplifier                                                                                                      |
|      | OFF:      | No transmission of PCP messages                                                                                                                                   |
| US   | Green LED | Supply voltage of the power unit                                                                                                                                  |
|      | ON:       | Supply voltage for the output stage is more than 75% of the nominal voltage of the power supply                                                                   |
|      | OFF:      | Supply voltage for the output stage is lower than 75% of the nominal voltage of the power supply                                                                  |
| ERR  | Red LED   | Error                                                                                                                                                             |
|      | ON:       | An error has occurred (corresponds to bit 3 in the status word).<br>The cause of the error can be read in the "ErrorCode" parameter (index 603F <sub>hex</sub> ). |
|      | OFF:      | No error                                                                                                                                                          |

## Terminal Point Assignment

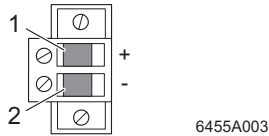


Figure 4 Terminal point assignment for power supply connection ( $U_S$ )

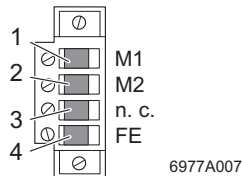


Figure 5 Terminal point assignment for DC motor connection (MOT)

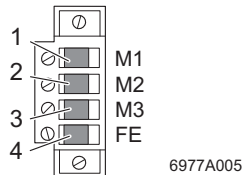


Figure 6 Terminal point assignment for EC motor connection (MOT)

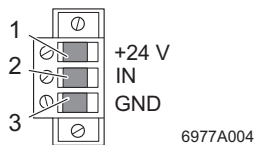


Figure 7 Terminal point assignment for limit switch and home position switch connections (IN2, IN1, REF)

### Power Supply Connection (US)

| Terminal Point | Assignment |
|----------------|------------|
| 1              | $U_S +$    |
| 2              | $U_S -$    |

### DC Motor Connection (MOT)

| Terminal Point | Assignment                   |
|----------------|------------------------------|
| 1              | M1 (Motor +)                 |
| 2              | M2 (Motor -)                 |
| 3              | Not used                     |
| 4              | Functional earth ground (FE) |

### EC Motor Connection (MOT)

| Terminal Point | Assignment                   |
|----------------|------------------------------|
| 1              | M1                           |
| 2              | M2                           |
| 3              | M3                           |
| 4              | Functional earth ground (FE) |

### Limit Switch and Home Position Switch Connections (IN2, IN1, REF)

| Terminal Point | Assignment |
|----------------|------------|
| 1              | +24 V      |
| 2              | IN         |
| 3              | GND        |

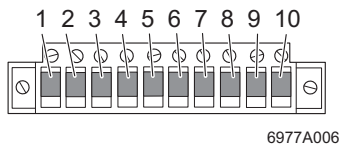


Figure 8 Terminal point assignment for incremental encoder connection (INC)

Incremental Encoder Connection (INC1)

| Terminal Point | Assignment                   |
|----------------|------------------------------|
| 1              | A                            |
| 2              | $\overline{A}$               |
| 3              | B                            |
| 4              | $\overline{B}$               |
| 5              | Z                            |
| 6              | $\overline{Z}$               |
| 7              | GND                          |
| 8              | +5 V                         |
| 9              | +24 V                        |
| 10             | Functional earth ground (FE) |

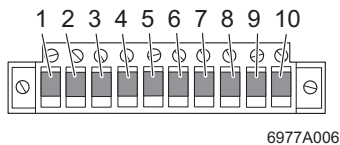


Figure 9 Terminal point assignment for Hall sensor connection (INC2/HALL)

Hall Sensor Connection (INC2/HALL)

| Terminal Point | Assignment                   |
|----------------|------------------------------|
| 1              | 1+                           |
| 2              | 1–                           |
| 3              | 2+                           |
| 4              | 2–                           |
| 5              | 3+                           |
| 6              | 3–                           |
| 7              | GND                          |
| 8              | +5 V                         |
| 9              | +24 V                        |
| 10             | Functional earth ground (FE) |

 The INC2/HALL connection can also be used to connect an incremental encoder. In this case, connect the incremental encoder using the terminal point assignment of the INC1 connection.

## Function

The Inline servo amplifier is designed as an Inline terminal. It can be easily operated in the most popular control systems and can be used to create a distributed positioning control system simply by mounting Inline positioning terminals side by side (e.g., positioning CPUs, position detection terminals, and other digital and analog output terminals).

Optical status and diagnostic indicators enable quick local error diagnostics.

The following operating modes are possible:

- Point-to-point positioning with position controller (position feedback modes using an incremental encoder or Hall sensors)
- Speed control (speed feedback using an incremental encoder, Hall sensors or the motor voltage)
- Torque control (current control)
- Homing

The IB IL EC AR 48/10A Inline servo amplifier carries out positioning with position, speed or torque control of the connected motor to the value specified as the setpoint in the form of process data.

The Inline servo amplifier can be used to create simple controlled drives using cost-effective DC motors with or without brushgears. There is also flexibility when choosing feedback for the individual control functions. For example: In the "speed control" operating mode for simple applications, there is no need for a rotary encoder system.

On the one hand, this method relies on a particular aspect of the behavior of DC motors: their speed changes in proportion to the supply voltage. In this way the speed can be indirectly controlled via the motor voltage. In addition, the Inline servo amplifier uses an IxR controller, which compensates for speed variations caused by the changing load.

Hall sensors can be used for speed and position feedback when using EC motors. This also eliminates the need for a rotary encoding system.

Operation, setting the operating mode, and parameterization should be compatible with the "DRIVECOM profile 22" protocol.

The IB IL EC AR 48/10A provides protection against:

- Overcurrent
- Surge and undervoltage
- Overtemperature
- Short circuit between motor cables
- Short circuit against the voltage supply

The IB IL EC AR 48/10A Inline servo amplifier is based on digital controllers. Its task is to provide current and voltage values, which can be used to directly operate DC motors.

The Inline servo amplifier needs to be supplied externally with 12 V up to 48 V and 0 A up to 10 A because the Inline jumpering cannot supply these high currents.

The level of the current and voltage values depends on the various functions, which the Inline servo amplifier carries out in the individual operating modes.

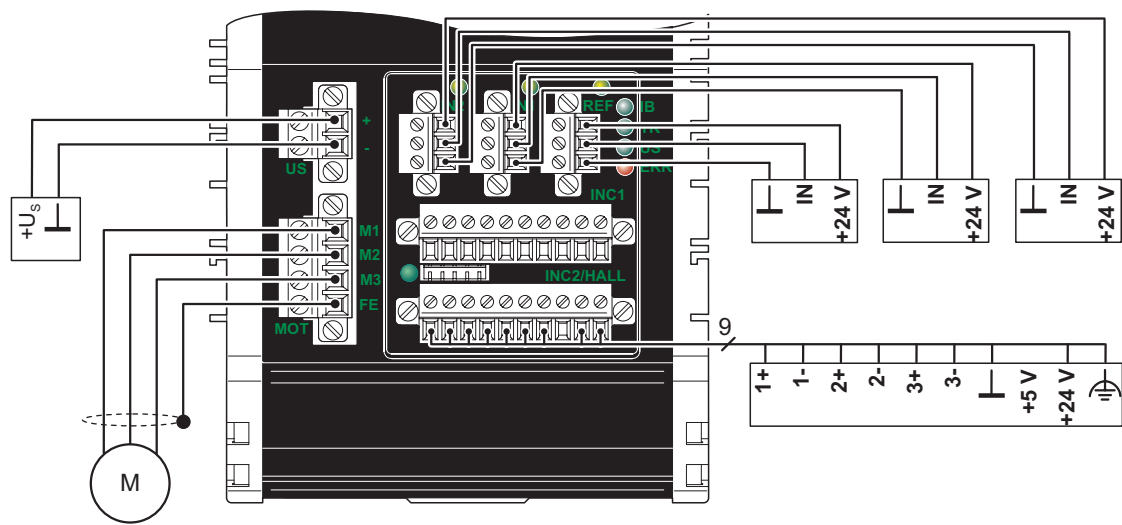


For additional information, please refer to the UM EN IB IL EC AR 48/10A user manual (Order No. 26 99 39 6).

### RS-232 Interface

The RS-232 interface can be used to connect a PC with startup and diagnostic software installed. This interface also enables access to all drive parameters and functions (see user manual).

Connection Example



6976A004

Figure 10 Connection example of EC motor with Hall sensor

Programming Data/Configuration Data

INTERBUS

|                         |                                         |
|-------------------------|-----------------------------------------|
| ID code                 | C3 <sub>hex</sub> (195 <sub>dec</sub> ) |
| Length code             | 03 <sub>hex</sub> (03 <sub>dec</sub> )  |
| Process data channel    | 48 bits                                 |
| Input address area      | 3 words                                 |
| Output address area     | 3 words                                 |
| Parameter channel (PCP) | 1 word                                  |
| Register length (bus)   | 4 words                                 |

Other Bus Systems

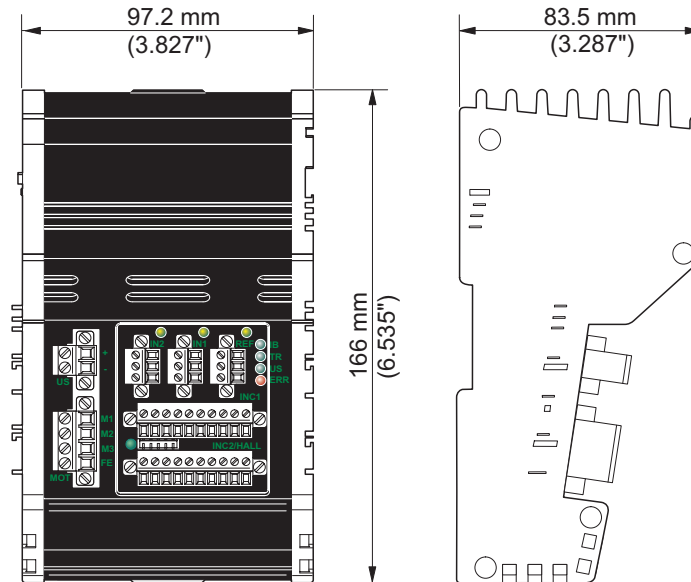


For the configuration data of other bus systems, please refer to the corresponding electronic device data sheet (GSD, EDS) at [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).



## Technical Data

### Housing Dimensions



6976A003

| General Data                                                                                                                                                                                                                                              |             |                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------|
| Order Designation                                                                                                                                                                                                                                         | (Order No.) | IB IL EC AR 48/10A (28 19 25 7)<br>IB IL EC AR 48/10A-PAC (28 19 58 7) |
| Housing dimensions (width x height x depth)                                                                                                                                                                                                               |             | 97.2 mm x 166 mm x 83.5 mm                                             |
| Housing material                                                                                                                                                                                                                                          |             | PA 6.6; black, anodized aluminum                                       |
| Heat-sink material                                                                                                                                                                                                                                        |             | Aluminum                                                               |
| Weight                                                                                                                                                                                                                                                    |             |                                                                        |
| without connectors                                                                                                                                                                                                                                        |             | 800 g                                                                  |
| with connectors                                                                                                                                                                                                                                           |             | 880 g                                                                  |
| Permissible temperature (operation)                                                                                                                                                                                                                       |             | -25°C to +55°C                                                         |
| Permissible temperature (storage/transport)                                                                                                                                                                                                               |             | -25°C to +85°C                                                         |
| Permissible humidity (operation)                                                                                                                                                                                                                          |             | 75% permanent, 85% occasionally                                        |
| Permissible humidity (storage/transport with unused interfaces [standard packaging])                                                                                                                                                                      |             | 75% permanent, 85% occasionally                                        |
| <div> For a short period, slight condensation may appear on the outside of the housing if, for example, the module is brought into a closed room from a vehicle.</div> |             |                                                                        |

| General Data (Continued)                     |                                                   |
|----------------------------------------------|---------------------------------------------------|
| Permissible air pressure (operation)         | 80 kPa to 106 kPa (up to 2,000 m above sea level) |
| Permissible air pressure (storage/transport) | 70 kPa to 106 kPa (up to 3,000 m above sea level) |
| Degree of protection                         | IP20 according to DIN 40050                       |
| Class of protection                          | Class 3 according to VDE 0106, IEC 60536          |

| Mechanical Requirements                                                             |                                                    |
|-------------------------------------------------------------------------------------|----------------------------------------------------|
| Vibration test<br>sinusoidal vibrations according to IEC 60068-2-6;<br>EN 60068-2-6 | 2g load, 2 hours in each space direction           |
| Shock test<br>according to IEC 60068-2-27, EN 60068-2-27                            | 25g for 1 ms, three shocks in each space direction |
| Free fall according to IEC 60068-2-32                                               | 1 m                                                |

| Power Supply           |                               |
|------------------------|-------------------------------|
| Status indication      | US LED                        |
| Connection method      | 2-pos. COMBICON connector     |
| Supply voltage $U_S$   | 12 V DC to 48 V DC $\pm 15\%$ |
| Supply current         | 0 A to 10 A                   |
| Surge voltage shutdown | $U_S > 60$ V DC               |

| Outputs                          |                                                                              |
|----------------------------------|------------------------------------------------------------------------------|
| Number                           | 1                                                                            |
| Connection                       | 1 permanently excited DC motor with or without brushgears                    |
| Connection method                | 4-pos. COMBICON connector<br>with shield connection clamp                    |
| Output voltage                   | $\pm$ supply voltage $U_{S, \text{maximum}}$<br>Average up to 95% of $U_S$   |
| Motor cable                      | 2-wire, shielded (DC motor)<br>3-wire, shielded (EC motor)                   |
| Continuous current               | 10 A, maximum                                                                |
| Starting current                 | 10 A, maximum                                                                |
| Motor current limiting           | 0 A to 10 A (can be set via bus)                                             |
| Maximum motor voltage (feedback) | $\pm 65$ V DC                                                                |
| Function                         | 4 quadrant servo controller                                                  |
| Braking                          | Energy fed back to the power supply unit<br>(brake chopper may be required)  |
| Minimum motor inductance         | 200 $\mu\text{H}$ at $U_S = 48$ V DC<br>100 $\mu\text{H}$ at $U_S = 24$ V DC |

| <b>Encoder Types</b>                              |                                                              |
|---------------------------------------------------|--------------------------------------------------------------|
| <b>Symmetrical Incremental Encoders</b>           |                                                              |
| Encoder supply                                    | 5 V DC or 24 V DC                                            |
| Signal connection method                          | A and $\bar{A}$ , B and $\bar{B}$ , Z and $\bar{Z}$          |
| Signal voltage level                              | 1 V <sub>PP</sub> to 6 V <sub>PP</sub>                       |
| Common mode range: signal – ground                |                                                              |
| – At 1 V <sub>PP</sub> voltage level              | ±2 V                                                         |
| – At 6 V <sub>PP</sub> voltage level              | ±4 V                                                         |
| Input frequency                                   | 1 MHz, maximum                                               |
| Cable length (for shielded cable)                 | <30 m (to ensure conformance with EMC directive 89/336/EEC)  |
| <b>Asymmetrical Incremental Encoders</b>          |                                                              |
| Encoder supply                                    | 5 V DC or 24 V DC                                            |
| Signal connection method                          | A, B, Z                                                      |
| Signal voltage level                              | Low 0 V to 2 V, high 3.5 V to 27 V                           |
| Input frequency                                   |                                                              |
| – At 4 V voltage level                            | 500 kHz, maximum                                             |
| – At 20 V voltage level                           | 100 kHz, maximum                                             |
| Cable length (for shielded cable)                 | < 30 m (to ensure conformance with EMC directive 89/336/EEC) |
| <b>Encoder Supply</b>                             |                                                              |
| <b>5 V encoder supply</b>                         |                                                              |
| Voltage range                                     | 4.75 V to 5.25 V                                             |
| Short-circuit protection                          | Electronic and thermal                                       |
| Current carrying capacity                         | 100 mA, maximum                                              |
| <b>24 V encoder supply</b>                        |                                                              |
| Voltage range                                     | 19.2 V to 30 V                                               |
| Short-circuit protection                          | Electronic and thermal                                       |
| Current carrying capacity                         | 100 mA, maximum                                              |
| <b>Cycle Time of Internal Digital Controllers</b> |                                                              |
| Position controller                               | 1 ms                                                         |
| Speed controller                                  | 500 µs                                                       |
| Torque / current controller                       | 250 µs                                                       |
| <b>Electrical Isolation</b>                       |                                                              |
| Logic U <sub>L</sub> / I/O / motor                | 500 V AC test voltage                                        |

| Pulse Wide Modulation (PWM) (In Relation to the Motor Voltage) |                  |
|----------------------------------------------------------------|------------------|
| Clock frequency                                                | 10 kHz to 50 kHz |

| Interfaces                   |                                               |
|------------------------------|-----------------------------------------------|
| Local bus                    | Inline potential distributor                  |
| Communications power $U_L$   | 7,5 V DC (via potential distributor)          |
| Current consumption at $U_L$ | 30 mA, typical; 120 mA, maximum               |
| Main voltage $U_M$           | 24 V DC (via potential distributor)           |
| Current consumption at $U_M$ | 100 mA, typical; 150 mA, maximum              |
| RS-232                       | Connection to startup and diagnostic software |

| Approvals |             |
|-----------|-------------|
| CE        | Yes         |
| UL        | Applied for |

| Conformance With EMC Directive 89/336/EEC                                         |                                                                                                                                                                  |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Conformance is only ensured if the shielded motor cable is connected to the FE terminal and the module is connected to functional earth ground via the DIN rail. |

| Noise Immunity Test According to EN 61000-6-2 |                               |                                                              |
|-----------------------------------------------|-------------------------------|--------------------------------------------------------------|
| Electrostatic discharge (ESD)                 | EN 61000-4-2<br>IEC 61000-4-2 | Criterion B<br>4 kV contact discharge<br>6 kV air discharge  |
| Fast transients (burst)                       | EN 61000-4-4<br>IEC 61000-4-4 | Criterion A<br>Supply lines: 2 kV<br>Signal/data lines: 2 kV |
| Conducted interference                        | EN 61000-4-6<br>IEC 61000-4-6 | Criterion A, test voltage 10 V                               |
| Noise Emission Test According to EN 61000-6-4 |                               |                                                              |
| Noise emission of housing                     | EN 55011                      | Class A                                                      |

Ordering Data

| Description                                                                                                                                                                           | Order Designation        | Order No.  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------|
| Inline servo amplifier for DC motors with and without brushgears; incl. COMBICON connectors and shield connection clamps                                                              | IB IL EC AR 48/10A-PAC   | 28 19 58 7 |
| Inline servo amplifier for DC motors with and without brushgears                                                                                                                      | IB IL EC AR 48/10A       | 28 19 25 7 |
| <div>The following connector set is needed for the complete fitting of the IB IL EC AR 48/10A:</div> |                          |            |
| Connector set consisting of seven COMBICON connectors and three shield connection clamps                                                                                              | IB IL ECAR-PLSET         | 28 19 56 1 |
| EC AR SW TOOL startup and diagnostic software, incl. connection cable for RS-232 interface                                                                                            | EC AR CAB SW TOOL        | 28 19 54 5 |
| Connecting cable for the RS-232 interface, for the connection of the EC AR SW TOOL startup and diagnostic software                                                                    | EC AR DIAG CAB           | 28 19 73 6 |
| "Inline Servo Amplifier for DC Motors With and Without Brushgears" user manual                                                                                                        | UM EN IB IL EC AR 48/10A | 26 99 39 6 |
| "Configuring and Installing the INTERBUS Inline Product Range" user manual                                                                                                            | IB IL SYS PRO UM E       | 27 43 04 8 |



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A conversion table is available on the Internet at [www.download.phoenixcontact.com/general/7000\\_en\\_00.pdf](http://www.download.phoenixcontact.com/general/7000_en_00.pdf).

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