

8BVI0220HCDS.000-1

1 General information

- Clearly structured, straightforward implementation via network-based safety technology
- Modular expandability through virtual wiring
- Immediate triggering of safety function thanks to short cycle times
- Easy implementation with transparent control and status information in the standard application as well
- Compact design
- Complete safety functionality in dual-axis modules as well

2 Order data


| Model number | Short description | Figure |
|--------------------|--|--|
| | Cold plate or feed-through mounting |  |
| 8BVI0220HCDS.000-1 | ACOPOSmulti inverter module, 22 A, HV, cold plate or feed-through mounting, 2 axes, SafeMC | |
| | Required accessories | |
| | Terminal block sets | |
| 8BZVI0220DS.000-1A | Screw clamp set for ACOPOSmulti 8BVI0220HxDS modules: 1x 8TB2108.2010-00, 1x 8TB2104.203L-00, 1x 8TB2104.203F-00, 1x 8TB3104.204G-11, 1x 8TB3104.204K-11 | |
| | Optional accessories | |
| | Fan modules | |
| 8BXF001.0000-00 | ACOPOSmulti fan module, replacement fan for ACOPOSmulti modules (8BVP / 8B0C / 8BVI / 8BVE / 8B0K) | |
| | POWERLINK cables | |
| X20CA0E61.00020 | POWERLINK connection cable, RJ45 to RJ45, 0.2 m | |
| X20CA0E61.00025 | POWERLINK connection cable, RJ45 to RJ45, 0.25 m | |
| X20CA0E61.00030 | POWERLINK connection cable, RJ45 to RJ45, 0.3 m | |
| X20CA0E61.00035 | POWERLINK connection cable, RJ45 to RJ45, 0.35 m | |
| X20CA0E61.00050 | POWERLINK connection cable, RJ45 to RJ45, 0.5 m | |
| X20CA0E61.00100 | POWERLINK connection cable, RJ45 to RJ45, 1 m | |
| | Shield component sets | |
| 8SCS000.0000-00 | ACOPOSmulti shielding components set: 1x shielding plate 1fold type 0; 1x hose clamp, W 9 mm, D 12-22 mm | |
| 8SCS002.0000-00 | ACOPOSmulti shield component set: 1x clamping plate; 2x clamps D 4-13.5 mm; 4x screws | |
| 8SCS009.0000-00 | ACOPOSmulti shield component set: 1x ACOPOSmulti holding plate SK8-14; 1x shield terminal SK14 | |
| | Terminal blocks | |
| 8TB2104.203F-00 | Screw clamp 4-pin, single row, spacing: 5.08 mm, label 3: T- T + B- B+, F keying: 0101 | |
| 8TB2104.203L-00 | Screw clamp 4-pin, single row, spacing: 5.08 mm, label 3: T- T + B- B+, L keying: 1010 | |
| 8TB2108.2010-00 | Screw clamp 8-pin, single row, spacing: 5.08 mm, label 1: numbered serially | |
| 8TB3104.204G-11 | Screw clamp 4-pin, single row, spacing: 7.62 mm, label 4: PE W V U, G coding: 0110 | |
| 8TB3104.204K-11 | Screw clamp 4-pin, single row, spacing: 7.62 mm, label 4: PE W V U, K keying: 1001 | |

Table 1: 8BVI0220HCDS.000-1 - Order data

Information:

Only 8BCM motor cables from B&R may be used to connect the motor interfaces.

Information:

Only 8BCF EnDat 2.2 cables from B&R may be used to connect the encoder interfaces.

3 Technical data

| Product ID | 8BVI0220HCDS.000-1 |
|--|---|
| General information | |
| B&R ID code | 0xAA1B |
| Cooling and mounting method | Cold plate or feed-through mounting |
| Slots for plug-in modules | 2 ¹⁾ |
| Certification | |
| CE | Yes |
| cULus | Yes |
| KC | Yes |
| FSC | Yes |
| DC bus connection | |
| Voltage | |
| Nominal | 750 VDC |
| Continuous power consumption ²⁾ | In preparation |
| Power loss depending on the switching frequency ³⁾ | |
| Switching frequency 5 kHz | In preparation |
| Switching frequency 10 kHz | In preparation |
| DC bus capacitance | 1320 µF |
| Design | ACOPOSmulti backplane |
| 24 VDC supply | |
| Input voltage | 25 VDC ±1.6% |
| Input capacitance | 235 µF |
| Max. power consumption | 32 W + P _{SMC1} + P _{SMC2} + P _{24 V Out} + P _{HoldingBrake(s)} + 2 * P _{Fan8BOM...} ⁴⁾ |
| Design | ACOPOSmulti backplane |
| 24 VDC output | |
| Quantity | 2 |
| Output voltage | |
| DC bus voltage (U _{DC}): 260 to 315 VDC | 25 VDC * (U _{DC} /315) |
| DC bus voltage (U _{DC}): 315 to 800 VDC | 24 VDC ±6% |
| protection | 250 mA (slow-blow) electronic, automatic reset |
| Motor connection ⁵⁾ | |
| Quantity | 2 |
| Continuous power per motor connection ²⁾ | 16 kW |
| Continuous current per motor connection ²⁾ | 22 A _{eff} |
| Reduction of continuous current depending on the switching frequency and mounting method ⁶⁾ | |
| Switching frequency 5 kHz | |
| Cold plate mounting ⁷⁾ | 0.99 A/K (from 40°C) ⁸⁾ |
| Feed-through mounting | 0.52 A/K (from 40°C) ⁸⁾ |
| Switching frequency 10 kHz | |
| Cold plate mounting ⁷⁾ | 0.29 A/K (from 10°C) ⁹⁾ |
| Feed-through mounting | 0.23 A/K (from 0°C) ¹⁰⁾ |
| Reduction of continuous current depending on the installation elevation | |
| Starting at 500 m above sea level | 2.2 A _{eff} per 1000 m |
| Peak current per motor connection | 55 A _{eff} ¹¹⁾ |
| Nominal switching frequency | 5 kHz |
| Possible switching frequencies ¹²⁾ | 5/10 kHz |
| Electrical stress of the connected motor in accordance with IEC TS 60034-25 ¹³⁾ | Limit value curve A |
| Protective measures | |
| Overload protection | Yes |
| Short circuit and ground fault protection | Yes |
| Max. output frequency | 600 Hz ¹⁴⁾ |
| Design | |
| U, V, W, PE | Male connector |
| Shield connection | Yes |
| Terminal connection cross section | |
| Flexible and fine wire lines | |
| With wire end sleeves | 0.25 to 4 mm² |
| Approbation data | |
| UL/C-UL-US | 30 to 10 |
| CSA | 28 to 10 |
| Terminal cable cross section dimension of the shield connection | 12 to 22 mm |
| Max. motor line length depending on the switching frequency | |
| Switching frequency 5 kHz | 25 m |
| Switching frequency 10 kHz | 25 m |
| Motor holding brake connection | |
| Quantity | 2 |
| Output voltage ¹⁵⁾ | 24 VDC +5.8% / -0% ¹⁶⁾ |
| Continuous current | 2.1 A |

Table 2: 8BVI0220HCDS.000-1 - Technical data

| Product ID | 8BVI0220HCDS.000-1 |
|--|--|
| Max. internal resistance | 0.3 Ω |
| Extinction potential | Approx. 30 V |
| Max. extinction energy per switching operation | 3 Ws |
| Max. switching frequency | 0.5 Hz |
| Protective measures | |
| Overload and short circuit protection | Yes |
| Open line monitoring | Yes |
| Undervoltage monitoring | Yes |
| Response threshold for open line monitoring | Approx. 0.5 A |
| Response threshold for undervoltage monitoring | 24 VDC +0% / -4% |
| Encoder interfaces ¹⁷⁾ | |
| Quantity | 2 |
| Type | EnDat 2.2 ¹⁸⁾ |
| Connections | 9-pin female DSUB connector |
| Status indicators | UP/DN LEDs |
| Electrical isolation | |
| Encoder - ACOPOSmulti | No |
| Encoder monitoring | Yes |
| Max. encoder cable length | 100 m Depends on the cross section of the encoder's supply wires ¹⁹⁾ |
| Encoder supply | |
| Output voltage | Typ. 12.5 V |
| Load capability | 350 mA |
| Protective measures | |
| Short circuit protection | Yes |
| Overload protection | Yes |
| Synchronous serial interface | |
| Signal transmission | RS485 |
| Data transfer rate | 625 Mbit/s |
| Max. power consumption per encoder interface | $P_{SMC} [W] = 19 V * I_{Encoder} [A]$ ²⁰⁾ |
| Trigger inputs | |
| Quantity | 2 |
| Wiring | Sink |
| Electrical isolation | |
| Input - Inverter module | Yes |
| Input - Input | Yes |
| Input voltage | |
| Nominal | 24 VDC |
| Maximum | 30 VDC |
| Switching threshold | |
| Low | <5 V |
| High | >15 V |
| Input current at nominal voltage | Approx. 10 mA |
| Switching delay | |
| Positive edge | 52 μs ± 0.5 μs (digitally filtered) |
| Negative edge | 53 μs ± 0.5 μs (digitally filtered) |
| Modulation compared to ground potential | Max. ±38 V |
| Electrical characteristics | |
| Discharge capacitance | 0.44 μF |
| Operating conditions | |
| Permitted mounting orientations | |
| Hanging vertically | Yes |
| Lying horizontally | Yes |
| Standing horizontally | No |
| Installation at elevations above sea level | |
| Nominal | 0 to 500 m |
| Maximum ²¹⁾ | 4000 m |
| Degree of pollution in accordance with EN 60664-1 | 2 (non-conductive pollution) |
| Overvoltage category in accordance with IEC 60364-4-443:1999 | III |
| EN 60529 protection | IP20 |
| Environmental conditions | |
| Temperature | |
| Operation | |
| Nominal | 5 to 40°C |
| Maximum ²²⁾ | 55°C |
| Storage | -25 to 55°C |
| Transport | -25 to 70°C |
| Relative humidity | |
| Operation | 5 to 85% |
| Storage | 5 to 95% |
| Transport | Max. 95% at 40°C |

Table 2: 8BVI0220HCDS.000-1 - Technical data

| Product ID | 8BVI0220HCDS.000-1 |
|----------------------------|--------------------|
| Mechanical characteristics | |
| Dimensions ²³⁾ | |
| Width | 1065 mm |
| Height | 317 mm |
| Depth | |
| Cold plate | 212 mm |
| Feed-through mounting | 209 mm |
| Weight | Approx. 4.4 kg |
| Module width | 2 |

Table 2: 8BVI0220HCDS.000-1 - Technical data

- 1) SLOT 1 and SLOT 2 of the ACOPOSmulti module are occupied by the encoder interfaces.
- 2) Valid in the following conditions: 750 VDC DC bus voltage, 5 kHz switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level, no derating due to cooling type.
- 3) I_M ... Average value of the currents on both motor connectors [A].
- 4) P_{SMC1} ... Max. power consumption P_{SMC} [W] of the SafeMC module in SLOT1 (see the "Encoder interfaces" section).
 P_{SMC2} ... Max. power consumption P_{SMC} [W] of the SafeMC module in SLOT2 (see the section "Encoder interfaces")
 $P_{24V Out}$... Power [W] that is output to the connections X2/+24 V Out 1 and X2/+24 V Out 2 on the module (max. 10 W)
 $P_{Fan8B0M...}$... Portion of the power [W] that is used by the fan modules in the mounting plate or the 8B0M0040HFF0.000-1 fan module (see the technical data for the respective 8B0M... mounting plate / 8B0M0040HFF0.000-1 fan module).
- 5) Only 8BCM motor cables from B&R may be used to connect the motor interfaces.
- 6) Valid in the following conditions: 750 VDC DC bus voltage, minimum permissible coolant flow volume (3 l/min). The temperature specifications refer to the return temperature of the cold plate mounting plate.
- 7) The temperature specifications refer to the return temperature of the cold plate mounting plate.
- 8) Value for the nominal switching frequency.
- 9) The module cannot supply the full continuous current at this switching frequency. This unusual value for the return temperature, at which a derating of the continuous current must be accounted for, ensures that the derating of the continuous current can be determined in the same manner as at other switching frequencies.
Caution! Condensation can occur at low flow temperatures and return temperatures.
- 10) The module cannot supply the full continuous current at this switching frequency. This unusual value for the ambient temperature, at which a derating of the continuous current must be accounted for, ensures that the derating of the continuous current can be determined in the same manner as at other switching frequencies.
- 11) The thermal pulse load capacity is lower than for the 8BVI0220HxS0.000-1 single-axis module. It is therefore not possible to simply replace two 8BVI0220HxS0.000-1 single-axis modules with one 8BVI0220HxD0.000-1 dual-axis module. If this is required, the load cycle must be examined in detail.
- 12) B&R recommends operating the module at its nominal switching frequency. Operating the module at a higher switching frequency for application-specific reasons reduces the continuous current and increases the CPU load. When using dual-axis modules, the increased CPU load reduces the functionality of the drive; if this is not taken into consideration, the computing time can be exceeded in extreme cases.
- 13) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
- 14) The module's electrical output frequency ($SCTRL_SPEED_ACT * MOTOR_POLEPAIRS$) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (Power element: Limit speed exceeded).
- 15) During project development, it is necessary to check if the minimum voltage can be maintained on the holding brake with the specified wiring. The operating voltage range of the holding brake can be found in the user's manual for the respective motor.
- 16) The specified values is only valid under the following conditions:
- The 24 VDC supply for the module is provided by an 8B0C auxiliary supply module installed on the same mounting plate.
If the 24 VDC supply for the module is applied to the mounting plate using an 8BVE expansion module, then the output voltage is reduced because of voltage drops on the expansion cable. In this case, undervoltage monitoring must be disabled.
- 17) Only 8BCF EnDat 2.2 cables from B&R may be used to connect the encoder interfaces.
- 18) An EnDat 2.2 functional safety encoder is required when using ACOPOSmulti with SafeMC! With standard EnDat 2.2 encoders, only the STO, SBC and SS1 functions are monitored with respect to timing!
- 19) The maximum encoder cable length l_{max} can be calculated as follows (the maximum permissible encoder cable length of 100 m must not be exceeded):

$$l_{max} = 7.9 / I_G * A * 1 / (2 * \rho)$$

I_G ... Max. current consumption of the encoder [A]

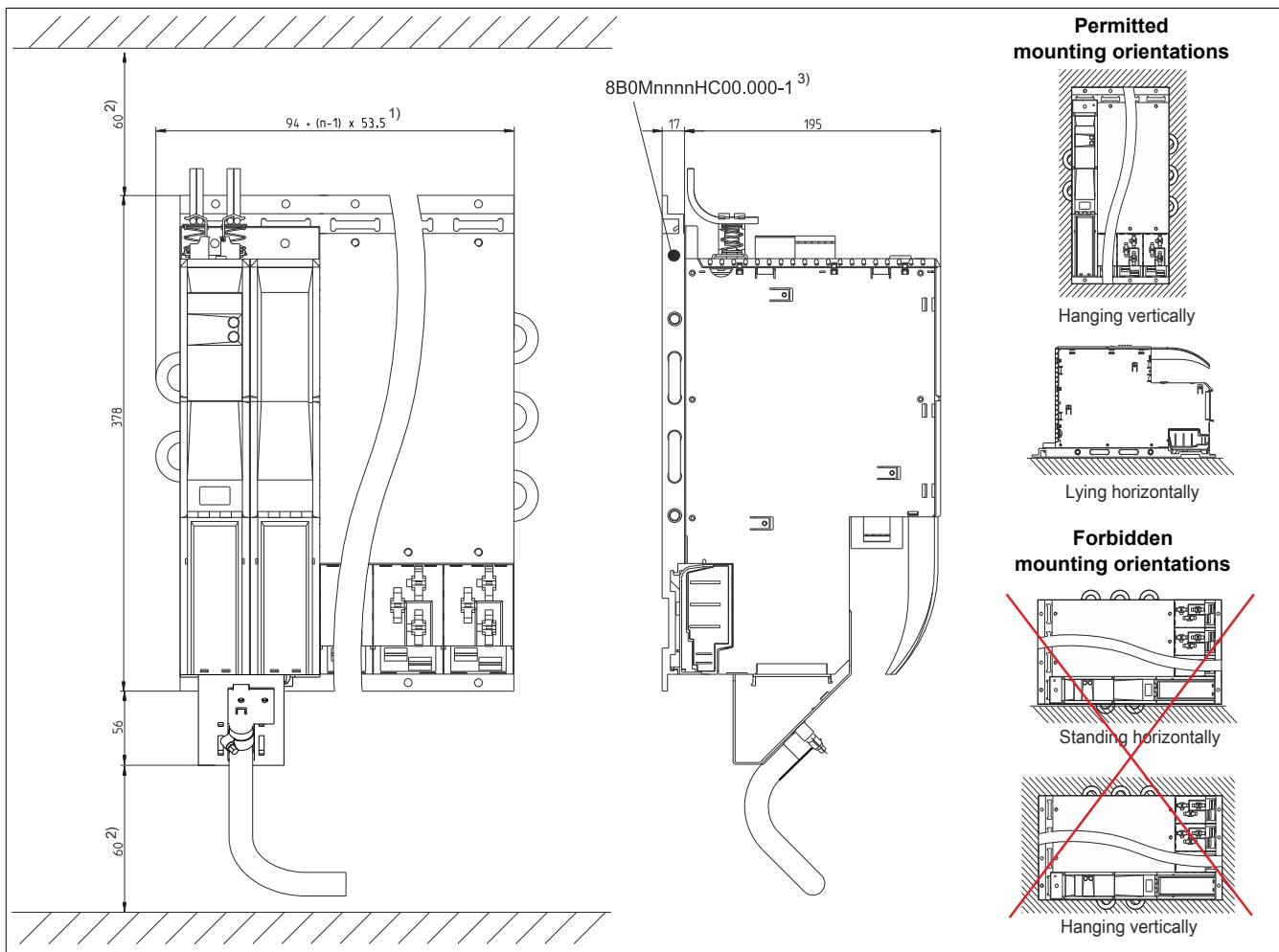
A ... Cross section of the supply wire [mm²]

ρ ... Specific resistance [Ω mm²/m] (e.g. for copper: $\rho = 0.0178$)

- 20) $I_{encoder}$... Max. power consumption of the connected encoder [A].
- 21) Continuous operation at altitudes ranging from 500 m to 4000 m above sea level is possible (taking the specified continuous current reductions into consideration).
- 22) Continuous operation at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.
- 23) These dimensions refer to the actual device dimensions including the respective mounting plate. Make sure to leave additional space above and below the devices for mounting, connections and air circulation.

4 Dimension diagram and installation dimensions

4.1 Cold plate



- 1) n... Necessary width (slots) of the mounting plate.
- 2) For proper air circulation, at least 60 mm clearance must be available above and below the module.
- 3) nnnn indicates the number of slots (e.g. 0160 refers to 16 slots).

Information:

When mounting ACOPOSmulti modules for cold-plate or feed-through mounting, be sure not to scratch the backplane. This can impair thermal dissipation to the mounting plate.

Do not set down ACOPOSmulti modules for cold-plate or feed-through mounting on their bottom side. Doing so could break the clips that hold the unit's fan. Broken clips make it more difficult to replace the fans later on.

4.2 Feed-through mounting

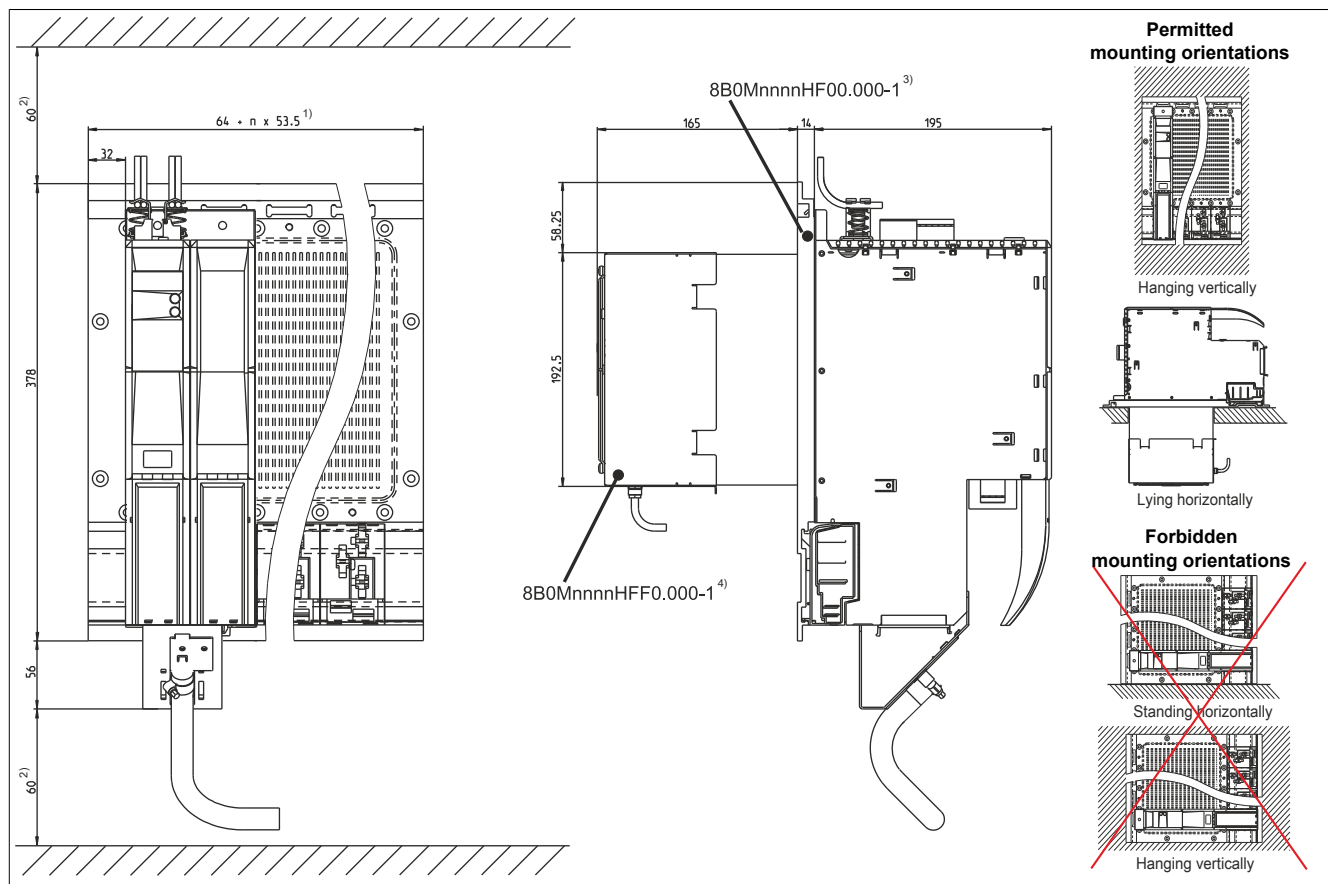


Figure 2: Dimension diagram and installation dimensions - Feed-through mounting

- 1) n... Necessary width (slots) of the mounting plate.
- 2) For proper air circulation, at least 60 mm clearance must be available above and below the module.
- 3) nnnn indicates the number of slots (e.g. 0160 refers to 16 slots).
- 4) For proper air circulation, at least 100 mm has to be left free around the fan module.

Information:

When mounting ACOPOSmulti modules for cold-plate or feed-through mounting, be sure not to scratch the backplane. This can impair thermal dissipation to the mounting plate.

Do not set down ACOPOSmulti modules for cold-plate or feed-through mounting on their bottom side. Doing so could break the clips that hold the unit's fan. Broken clips make it more difficult to replace the fans later on.

5 Wiring: Safe double-width inverter modules (dual-axis modules)

5.1 Pinout overview

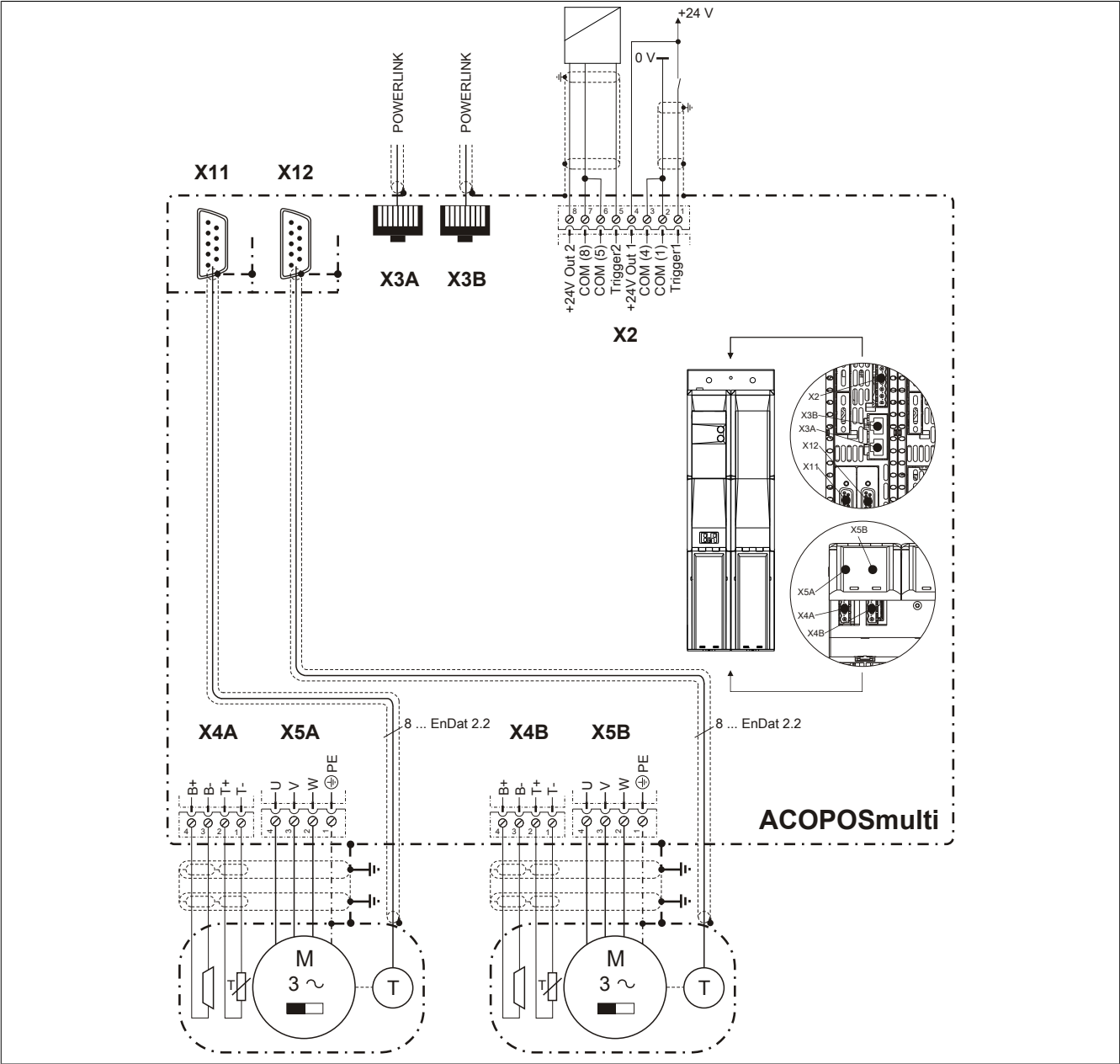


Figure 3: Pinout overview

5.2 X2 connector - Pinout

| X2 | | Pin | Name | Function |
|----|---|-----|------------|--------------------|
| | 1 | 1 | Trigger 1 | Trigger 1 |
| | 2 | 2 | COM (1) | Trigger 1 0 V |
| | 3 | 3 | COM (2) | +24 V output 1 0 V |
| | 4 | 4 | +24V Out 1 | +24 V output 1 |
| | 5 | 5 | Trigger 2 | Trigger 2 |
| | 6 | 6 | COM (5) | Trigger 2 0 V |
| | 7 | 7 | COM (8) | +24 V output 2 0 V |
| | 8 | 8 | +24V Out 2 | +24 V output 2 |

Table 3: X2 connector - Pinout

5.3 X3A, X3B connectors - Pinout

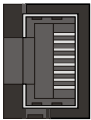
| X3A, X3B | Pin | Name | Function |
|---|-----|--------|--------------------------|
|  | 1 | RXD | Receive signal |
| | 2 | RXD\ | Receive signal inverted |
| | 3 | TXD | Transmit signal |
| | 4 | Shield | Shield |
| | 5 | Shield | Shield |
| | 6 | TXD\ | Transmit signal inverted |
| | 7 | Shield | Shield |
| | 8 | Shield | Shield |

Table 4: X3A, X3B connectors - Pinout

5.4 X4A connector - Pinout

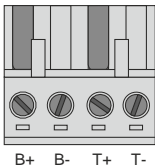
| X4A | Name | Function |
|---|------------------|------------------------------|
|  | T- | Axis 1: Temperature sensor - |
| | T+ | Axis 1: Temperature sensor + |
| | B- ¹⁾ | Axis 1: Brake - |
| | B+ ¹⁾ | Axis 1: Brake + |
| | | |

Table 5: X4A connector - Pinout

1) Wiring is not permitted to exceed a total length of 3 m.

Danger!

The functional fail safe state is enabled if the SBC output B+ is shorted to 24V (i.e. safe pulse disabling is activated). However, the brake always remains on/released because of the short circuit to 24 V!

This can lead to dangerous situations because the motor holding brake (and in the case of hanging loads, the unrestrained reduction) cannot be halted/prevented!

Appropriate wiring measures must be implemented to ensure that the SBC output B+ is not shorted to 24V!

For a double-axis module, it is therefore especially important to prevent a cross fault between the two B+ connections of the two axes!

Danger!

The SBC output

- may not be wired to multiple modules!
- may not be wired as open emitter!
- may not be wired as open collector!

Danger!

Only one output voltage of ≤ 5 V can be ensured for the safe motor holding brake output when shut off. When selecting a motor holding brake, the user has to make sure that the required braking torque is reached at a current voltage of 5 V.

Information:

The transistors of the SBC output stage are tested cyclically. When the output channels are active, this test emits low pulses on the output with a maximum length of 600 μ s.

This must be taken into consideration when choosing the motor holding brake!

Danger!

The connections for the motor temperature sensors and the motor holding brake are safely isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOSmulti inverter modules cannot determine if a holding brake is connected with reverse polarity!

Warning!

Temperature sensors are only permitted to be connected to the X4A/T+ and X4A/T- connectors on an ACOPOSmulti module under the following conditions:

- There is no ACOPOSmulti plug-in module in SLOT1 on the ACOPOSmulti module with a temperature sensor connected to T+ and T-.

Otherwise, the temperature monitoring functions on the ACOPOSmulti module may become ineffective, which in extreme cases can cause the hardware (e.g. motors) connected to the ACOPOSmulti module to be destroyed!

5.5 Pinout - X4B connector

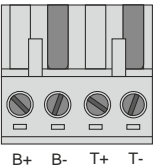
| X4B | Name | Function |
|---|------------------|------------------------------|
|  | T- | Axis 2: Temperature sensor - |
| | T+ | Axis 2: Temperature sensor + |
| | B- ¹⁾ | Axis 2: Brake - |
| | B+ ¹⁾ | Axis 2: Brake + |
| | | |

Table 6: Pinout - X4B connector

1) Wiring is not permitted to exceed a total length of 3 m.

Danger!

The functional fail safe state is enabled if the SBC output B+ is shorted to 24V (i.e. safe pulse disabling is activated). However, the brake always remains on/released because of the short circuit to 24 V!

This can lead to dangerous situations because the motor holding brake (and in the case of hanging loads, the unrestrained reduction) cannot be halted/prevented!

Appropriate wiring measures must be implemented to ensure that the SBC output B+ is not shorted to 24V!

For a double-axis module, it is therefore especially important to prevent a cross fault between the two B+ connections of the two axes!

Danger!

The SBC output

- may not be wired to multiple modules!
- may not be wired as open emitter!
- may not be wired as open collector!

Danger!

Only one output voltage of ≤ 5 V can be ensured for the safe motor holding brake output when shut off. When selecting a motor holding brake, the user has to make sure that the required braking torque is reached at a current voltage of 5 V.

Information:

The transistors of the SBC output stage are tested cyclically. When the output channels are active, this test emits low pulses on the output with a maximum length of 600 μ s.

This must be taken into consideration when choosing the motor holding brake!

Danger!

The connections for the motor temperature sensors and the motor holding brake are safely isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOSmulti inverter modules cannot determine if a holding brake is connected with reverse polarity!

Warning!

Temperature sensors are only permitted to be connected to X4B/T+ and X4B/T- on an ACOPOSmulti module under the following conditions:

- There is no ACOPOSmulti plug-in module in SLOT2 on the ACOPOSmulti module with a temperature sensor connected to T+ and T-

Otherwise, the temperature monitoring functions on the ACOPOSmulti module may become ineffective, which in extreme cases can cause the hardware (e.g. motors) connected to the ACOPOSmulti module to be destroyed!

5.6 X5A connector - Pinout

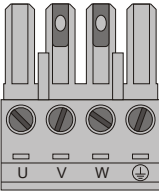
| X5A | Name | Function |
|--|------|-------------------------------------|
|  | ⊕ | Axis 1: Protective ground conductor |
| | W | Axis 1: Motor connection W |
| | V | Axis 1: Motor connection V |
| | U | Axis 1: Motor connection U |
| | | |

Table 7: X5A connector - Pinout

Information:

Only 8BCM motor cables from B&R may be used to connect the motor interfaces.

5.7 X5B connector - Pinout

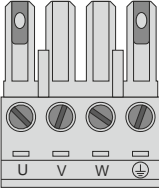

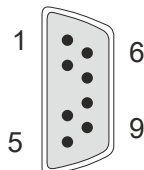
| X5B | Name | Function |
|---|------|-------------------------------------|
|  | ⊕ | Axis 2: Protective ground conductor |
| | W | Axis 2: Motor connection W |
| | V | Axis 2: Motor connection V |
| | U | Axis 2: Motor connection U |
| | | |

Table 8: X5B connector - Pinout

Information:

Only 8BCM motor cables from B&R may be used to connect the motor interfaces.

5.8 Pinout - SafeMC module

| Figure | X11 (X12) | Pin | Name | Function |
|---|---|-----|---------|-----------------------|
|  |  | 1 | U+ | Encoder supply +125 V |
| | | 2 | --- | --- |
| | | 3 | --- | --- |
| | | 4 | D | Data input |
| | | 5 | T | Clock output |
| | | 6 | COM (1) | Encoder supply 0 V |
| | | 7 | --- | --- |
| | | 8 | D\ | Data input inverted |
| | | 9 | T\ | Clock output inverted |

Information:

Only 8BCF EnDat 2.2 cables from B&R may be used to connect the encoder interfaces.

Information:

The SafeMC modules cannot be replaced! SafeMC modules and the corresponding inverter module form a single unit. In the event of an error, the entire inverter module must be replaced.